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FINAL ENVIRONMENTAL STATEMENT AND SUPPLEMENTAL INFORMATION FOR --ETC(U)
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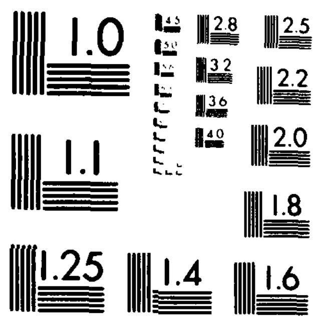
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LEVEL II

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FINAL ENVIRONMENTAL STATEMENT

AND

SUPPLEMENTAL INFORMATION

AD A089307

FOR

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SEP 8 1980
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AQUILLA LAKE, AQUILLA CREEK
HILL COUNTY, TEXAS
13 April 1976

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
FORT WORTH, TEXAS

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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Final Environmental Statement and Supplemental Information for Aquilla Lake, Aquilla Creek Hill County, Texas.

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U.S. Army Corps of Engineers
Fort Worth, Texas

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U.S. Army Corps of Engineers
Fort Worth, TX

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environment Impact Statement
Aquilla Creek, Texas
Aquilla Lake, Texas

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Engineering and economic review of the project resulted in the conclusion that the Aquilla Creek Watershed's water resources will be needed by the year 2020 to make up out-of-basin and downstream deficiencies and would be more economically feasible if it were designed and constructed to develop 9.7 million gallons per day. This supplement has been prepared to reevaluate the new or additional environmental elements impacted by the larger current project as a result of the increase in the size of the lake.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SUMMARY

AQUILLA LAKE, AQUILLA CREEK, TEXAS

( ) Supplement to Draft Environmental Statement

(X) Supplement to Final Environmental Statement

Responsible Office: U.S. ARMY ENGINEER DISTRICT, FORT WORTH, TEXAS
Colonel Joe H. Sheard
PO Box 17300
Fort Worth, Texas 76102
Telephone (817) 334-2301

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: Increase water supply yield by 4.7 million gallons per day for municipal and industrial uses.

3.a. Environmental Impacts: The increased water supply yield of 4.7 million gallons per day that will be made available by the project will help in meeting local and downstream water needs. A greater area of land and 9 additional miles of intermittent streams will be inundated as a result of the increase.

b. Adverse Environmental Effects. The conservation pool will permanently inundate about 1,992 additional acres of land (a 155 percent increase) and the new flood control pool will occasionally inundate an additional 635 acres (a 9 percent increase).

4. Additional Alternative. The alternative considered was the piping of water from nearby surface storage projects.

5. Comments Requested.

Environmental Information Center, Inc.
Institute for Environmental Studies
Brazos River Authority
City of Hillsboro
City of West
Department of Health, Education, and Welfare
Hill County Board of County Commissioners
Agriculture Research Service
Federal Power Commission
State Division of Comprehensive Planning
Hill County Board of County Commissioners
Mr. G. W. Hudson
Agricultural Stabilization and Conservation Service

Texas Committee on Natural Resources
Texas Archaeological Society
Citizens Environmental Coalition
League of Women Voters of Texas
The Nature Conservancy
National Wildlife Federation
Izaak Walton League of America, Inc.
Environmental Defense Fund
National Audubon Society
Environmental Coalition of North Central Texas
EAC of North Central Texas
Texas Archeological Survey
Coastal Ecosystems Management, Inc.
Mrs. Herbert Wincorn
Mr. William Benson
Mr. Richard Winburn
Dallas Morning News
Texas Highway Dept.
City of Aquilla
City of Whitney
Heart of Texas Council of Government
Central Texas Council of Government
Mrs. E. P. Gregory
Mr. Joe Yelderman, Jr.
B. M. and Jan J. Jean
Mr. James W. Wight
Ms. Mary Ann Sulak
Johnson County Rural Water Supply
J. R. Joplin
Mr. Loyd S. Burk
Mr. James Poehls
J. W. Morrow
Mr. H. Paul Friesema
Mr. James R. Reed
R. D. Smith

6. Draft Statement to CEQ 27 March 1974

Final Environmental Statement and Supplemental Information ____________

SUPPLEMENT TO
FINAL ENVIRONMENTAL STATEMENT FOR
AQUILLA LAKE, AQUILLA CREEK, TEXAS

CONTENTS

CONTENTS (Continued)

TABLES

PLATES

SUPPLEMENT TO
FINAL ENVIRONMENTAL STATEMENT FOR
AQUILLA LAKE, AQUILLA CREEK, TEXAS

SECTION ONE - PROJECT DESCRIPTION

1.01 Reason for Increased Water Supply Volume. Engineering and economic review of the project resulted in the conclusion that the Aquilla Creek watershed's water resources will be needed by the year 2020 to make up out-of-basin and downstream deficiencies and would be more economically feasible if it were designed and constructed to develop 9.7 million gallons per day (mgd). The local sponsor (Brazos River Authority) estimates that over the life of the project the yield of the 9.7 mgd project will be required to fulfill the municipal and industrial water needs of the Brazos River basin. Based on the foregoing conclusions the Brazos River Authority decided that is would support the larger project.

1.02 Purpose of the Supplement. This supplement has been prepared to reevaluate the new or additional environmental elements impacted by the larger current project as a result of the increase in the size of the lake. The method of analysis used in the supplement takes into consideration just the additional land areas to be inundated. In addition, the reevaluation contained herein is presented in the same detail as the indepth study in the final statement. Since the impacts expected would be extensions of those presented in the Final Environmental Statement (FES), there would be no new or unique elements adversely affected. Therefore, the primary purpose of this supplement is to explain the specific impacts expected to arise by enlarging the project's storage capacity - but is dependent on the detailed information and evaluation contained in the FES.

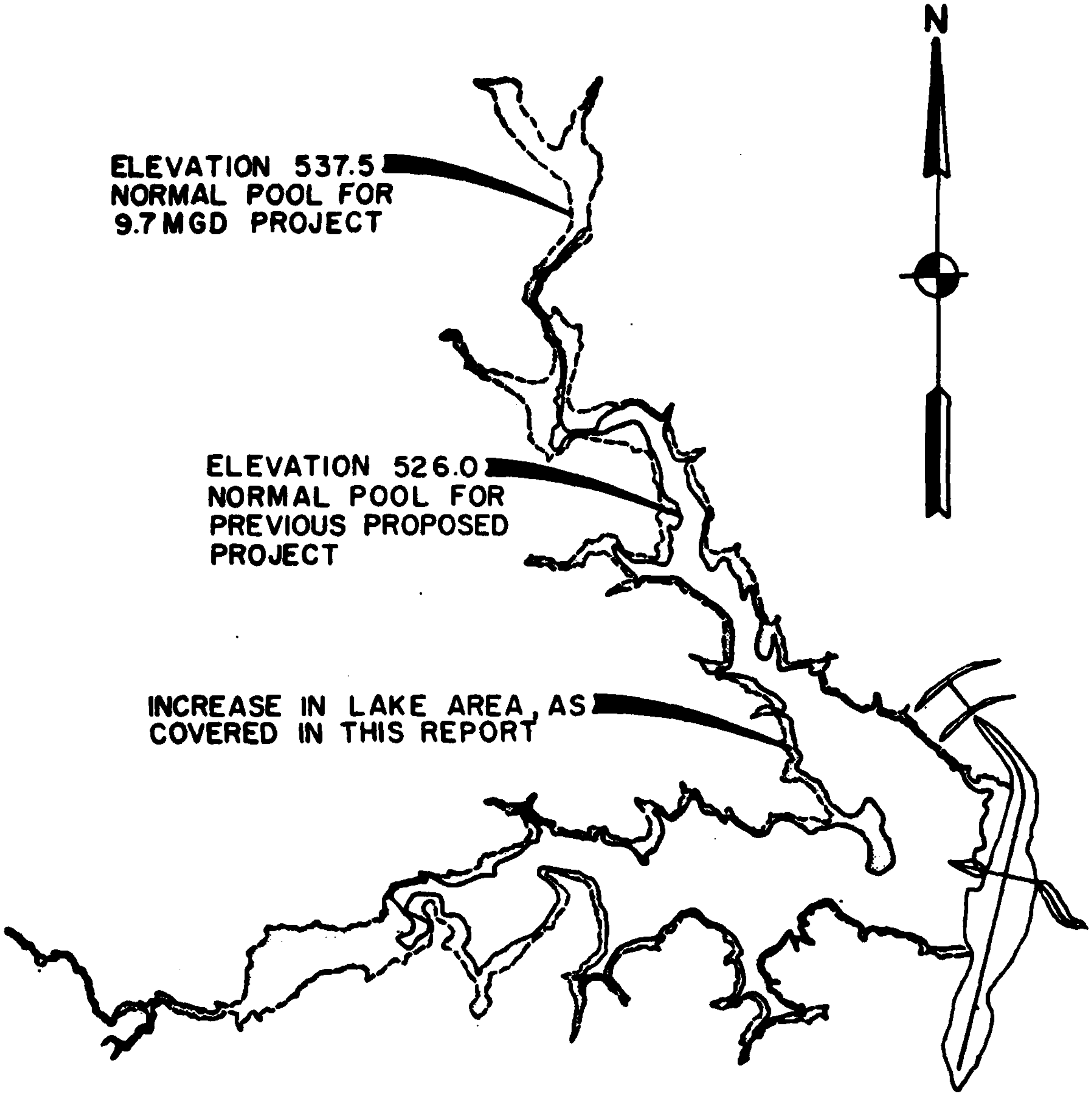
1.03 The Current Larger Project. Pertinent data on the current enlarged project are presented in table I-1, along with pertinent data on the project document plan and the previously proposed plan in the FES. Additional information about the current project includes the following: (a) The project was authorized by Public Law 483, 90th Congress, as recommended by the Chief of Engineers in Senate Document 52, 90th Congress, 1st session; (b) project purposes still include flood control, water supply, recreation, and fish and wildlife conservation; (c) the project is at the advanced engineering and design stage; (d) no additional lands are required, and (e) the shoreline will be increased by 12 miles. Plate I-1 depicts the area of change between the previously proposed project and the current enlarged project. Aquilla Lake will have a 1,992 acre increase in the surface area of the conservation pool because the pool elevation will be

TABLE I-1

COMPARISON OF THE AUTHORIZED PLAN, THE PREVIOUSLY PROPOSED PLAN, AND THE CURRENT PLAN

Feature	Project Document Plan	Previously Proposed Plan(3)	Current Plan
Mile above mouth	20.7	23.3	23.3
Drainage area, sq mi	294.0	252.0	252.0
Elevation, feet msl			
Top of dam	570.0	585.5	582.5
Maximum pool	565.2	580.5	577.5
Spillway crest	551.0	568.0	564.5
Top of flood control pool	551.0	553.0	556.0
Top of conservation pool	533.5	526.0	537.5
Storage, acre-feet			
Flood control	111,500	89,500	86,700
Conservation	59,700	10,800	33,600
Inactive or sediment	28,100	25,700	25,700
Total	199,300	126,000	146,000
Area, acres			
Top of flood control pool	9,180	6,365	7,000
Top of conservation pool	4,560	1,288 (1)	3,280
Spillway			
Location	Valley	Saddle	Saddle
Type	Broadcrested weir	Limited service	Limited service
Crest width, feet	1,200	1,200	1,200
Discharge at maximum pool, cfs	169,100	152,000	126,800 (2)
Outlet works			
Conduit size	10'	10'	10'
Gate size	2 - 5'x10' sluice gates	2 - 5'x10' sluice gates	2 - 4.5'x10' gates
Yield, mgd			
Water supply	9.7	5.0	9.7

(1) Ultimate area after 100 years sedimentation. Initial area is 1,887 acres.
(2) Based on no discharge through outlet works.
(3) This is the plan detailed in the final environmental statement.



ENLARGED AQUILLA LAKE AREA

raised 11.5 feet. This is about 155 percent increase in surface area. The flood control pool surface area will be increased by 635 acres (about 9 percent) by raising the pool elevation 3 feet. The total controlled storage at the top of the flood pool would increase 20,000 acre-feet or about 16 percent. An increased water conservation storage of 22,800 acre-feet in the lake would develop an increased total dependable water supply yield of 4.7 million gallons per day. Construction of the lake would necessitate the minor amount of additional relocations detailed in table III/IV-1, page 9.

1.04 Project Operation. The Brazos River Authority has provided assurances that water supply payments for the additional 4.7 mgd will begin when the additional water supply is needed and not later than the year 2020. They have reported that initially 1.5 mgd of water will be sold to the cities of Hillsboro and West, Texas, and that this amount will increase progressively to 5 mgd within 50 years. They have reported also that the projected demand for water by other communities in the vicinity of the project and in areas downstream in the Brazos basin is expected to utilize the remaining 4.7 mgd during the life of the project. Since the municipal and industrial water storage space in the lake is being contracted for by a basinwide authority, the water can be used to satisfy the needs over a larger area.

1.05 Project Economics. The total average annual charges for the larger Aquilla project, based on a four million dollar greater total project cost, a 100-year period of analysis and January 1973 prices, was $1,192,400, an increase of $100,600 over charges for the previously proposed smaller project. Average annual benefits accruing to the larger project increased $354,300. Based on April 1975 prices, the benefit-cost ratio for the larger project is 1.4 to 1.0, a reduction of one-tenth from the previously proposed smaller project.

The increase in cost can be accounted for in part by increased economic inflationary pressures. A breakdown of cost items shows that: (1) there was a decrease in cost of land and damages by deleting some recreational lands; (2) there was an increase in relocation costs caused by increased construction costs; (3) there was a decrease in reservoir account resulting from decreases in the unit costs of several items; (4) there was a decrease in the cost of the dam because of reduction in scope of some of the appertinent works; (5) there was a decrease in the cost of roads, railroads, and bridges by deleting some roads and reevaluating the unit cost of some items; (6) there was a cost reduction in recreational facilities resulting from the transferring of the cost of boat ramps to the reservoir account; (7) there was an increase in the cost of cultural resources preservation because of implementing archeological salvage; (8) there was an increase in the cost of buildings, grounds, and utilities resulting from refined design and cost analysis; (9) there was an increase in the cost of permanent operating equipment because of the need for additional equipment items; (10) there was an increase in the cost of engineering and design to cover additional studies and calculations in refining the project plan; and (11) there will be a decrease in the supervision and administration cost is a reflection of the direct construction cost changes previously covered.

The benefits of the current project has changed from those of the previously proposed plan in that: (1) flood control benefits have increased because of price level increases from January 1973 to April 1975; (2) water supply benefits have increased because of the additional storage capacity incorporated into the current project; (3) recreational benefits have increased as a result of reevaluation of the recreational aspects of the larger project; (4) fish and wildlife benefits have increased based on updated information from the U.S. Fish and Wildlife Service; and (5) redevelopment benefits have escalated because they are tied directly to construction costs which have increased.

The increase in benefits have not paralleled the increase in cost, resulting in the slight reduction of the benefit-to-cost ratio.

1.06 Fish and Wildlife Mitigation. To mitigate the estimated fish and wildlife losses it has been proposed that 980 acres of lands on which flowage easements would have been obtained be acquired in fee simple. This acreage is composed of several small tracts around the project where small drainage ways adjoin the project. All of these lands are within the original project boundaries.

SECTION TWO - RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

2.01 Land Use Plans. Since there will be no increase in the amount of lands needed for the current project over those needed for the project presented in the final environmental statement, there will continue to be no conflict of land use plans in the project area.

SECTION THREE AND FOUR - ENVIRONMENTAL SETTING AND IMPACTS OF THE CURRENT PROJECT

3.01 Setting. The environmental setting for the current project is the same as that for the project described in the final environmental statement which was filed with the Council on Environmental Quality. The difference between the previously proposed project and the current project is the increased pool elevation of the lake to increase the water supply volume. There are no increased land requirements.

4.01 Impacts. The additional impacts caused by the current project as presented in table III/IV-1 are caused by the increased number of acres of project lands which will be permanently inundated. The information displayed encompasses net impacts expected to arise when the current project is completed. The display is brief because a more detailed presentation of similar impacts caused by the previously proposed project is made in the final environmental statement.

TABLE III/IV-1

ENVIRONMENTAL SETTING AND IMPACTS OF THE CURRENTLY PROPOSED PROJECT

Element	Profile of Existing Conditions	Adverse Impacts	Beneficial Impacts
Biological			
Plants		There will be a loss of all terrestrial vegetation on an additional 1,992 acres which will be inundated by the conservation pool. Temporary adverse effects will occur on an additional 635 acres in the flood pool which will be flooded at varying frequencies.	
Animals		Terrestrial species will be permanently displaced from the area of the enlarged conservation pool. Some of these animals will be lost because crowding in available remaining habitat will cause stress, increased predation and a reduction in foodstuffs. Some additional losses will occur when water invades the flood pool area.	Increased inter-specific predation will cause some of the weaker members of the species to be eliminated. Increased lake volume and surface area will provide additional habitat for fish and waterfowl.
Hydrological			
Topography		The lake will cause the rolling nature of the area to become somewhat flattened to the visual sense. After the useful life of the project, the topography will be left permanently flattened out as a result of the trapping of sediment.	
Geological			
Archeological Sites			Some of those archeological sites which would have been exposed to wave wash by the conservation pool will now be protected by permanent inundations if they are not salvaged first.

TABLE III/IV-1 (continued)

Element	Profile of Existing Conditions	Adverse Impacts	Beneficial Impacts
Social, Cultural and Economic			
Transportation and Utility Networks		Approximate additional relocations or alterations required include: Roads: FM highways .08 mi State highways .29 mi County roads 1.04 mi Utilities: Electric lines 2.57 mi Telephone lines .40 mi Pipelines 1.70 mi Approximate amount of abandonments include: Roads: County roads 1.04 mi Utilities: Electric lines .10 mi Telephone lines .20 mi	This will be an opportunity to upgrade roads and utility equipment. It will also reduce the workload of the Hill County road maintenance department.
Public Health		The expanded shoreline of the project could cause an increase in disease vectors which have at least a portion of their life cycle in aquatic habitats.	

SECTION FIVE - PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

5.01 Summary of Impacts. This section addresses only those environmental effects, resulting from the enlargement of the water conservation pool volume, which are expected to occur in addition to those already addressed in the FES. Table V-1 displays the additional adverse effects.

TABLE V-1

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS OF THE CURRENTLY RECOMMENDED PROJECT WHICH CANNOT BE AVOIDED

Element	Adverse Effects	Mitigation Measures or Corrective Actions
Streams	About 8.2 miles of Aquilla Creek, 8.3 miles of Hackberry Creek, and several miles of tributary streams, all of which are intermittent, will be permanently inundated and lost upstream of the dam when the conservation pool is full. An additional 2.6 miles of Aquilla Creek, 3.2 miles of Hackberry Creek, and several more miles of tributary streams will be occasionally inundated and somewhat modified when the lake rises into the flood pool. Reduction of flows and the periodic release of large quantities of water downstream of the dam will adversely affect the aquatic and riparian ecosystems of the Aquilla Creek.	
Fish and wildlife	There will be permanent displacement and/or loss of terrestrial species which inhabit the additional areas to be inundated by the conservation pool.	It is being proposed that 980 acres of project land, to be obtained in flowage easement, be acquired in fee simple instead.
Vegetation	There will be a permanent loss of vegetation on about 1,992 additional acres which will be inundated at the conservation pool level.	

TABLE V-1 (continued)

Element	Adverse Effects	Mitigation Measures or Corrective Actions
Archeology	Unless salvaged, some of those archeological sites which were previously above the zone of wave wash by the conservation pool will now be subject to wave wash by the higher conservation pool.	Further archeological investigations will be made under the authority of Public Law 93-291 as project planning continues. Additional resources will be evaluated as to their potential for inclusion in the National Register, and if impacted by the project, section 800.4(b) will be followed for compliance with Executive Order 11593.

SECTION SIX - ALTERNATIVES TO THE PROPOSED ACTION

6.01 Introduction. This supplement does not remove from consideration and evaluation any of the alternatives discussed in the FES for Aquilla Lake. This section includes analyses of additional alternative plans for an increased water supply. Comparison of the current project to the other feasible projects can be found in table I-1.

6.02 Alternatives Considered. The alternatives considered for providing 4.7 million gallons per day of water suitable for municipal and industrial uses were limited to inter-and intra-basin transport because this volume of water is available only from surface storage sources. Further investigation revealed that although 4.7 million gallons of water per day may be available, the quality of that water, the cost of transport facilities, and energv necessary to move it made the plan less than feasible. Additionally, even though the water is available now, it will remain available only until the time it is needed by the local interest who invested in the project. This leaves unfilled the future water need to be satisified by the Aquilla project. Thus, the project developing 9.7 mgd of usable water at the Aquilla Lake site easily becomes the most desirable.

6.03 Summary. The larger current project has been selected because the increased pool volume provides for water supply development resulting in a better engineering-economic balance. The measurable environmental differences have been presented in table III/IV-1. Generally, the current project would increase the degree each element is impacted and would not cause an increased number of elements to be affected. It has been concluded that the net adverse and beneficial environmental, social, and economic effects would be relatively equal to the previously proposed project.

SECTION SEVEN - THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

7.01 General. At the present stage of history in Central Texas, the pressing need is for additional water suitable for municipal and industrial purposes. It is expected that by the time the project is no longer able to serve its intended purposes (in excess of 100 years), technology will be able to provide water from other sources and thereby eliminate many of the adverse impacts which may be associated with impoundment projects.

SECTION EIGHT - ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.01 Direct Actions. The conservation pool of the current project will permanently inundate an additional 1,992 acres, about 5.8 miles of Aquilla and Hackberry Creeks, and an estimated 74 archeological sites. These resources will never be recovered in their original state once the project begins its operational status. The archeological sites will be further evaluated and artifacts will be salvaged before the Aquilla Lake project becomes operational. In a sense, the salvaged archeological resources will be lost, since a site, once disturbed cannot be returned exactly to its previous existence. The flood pool of the current project will occasionally inundate an additional 635 acres, about 5.8 more miles of Aquilla and Hackberry Creeks, and an additional 45 archeological sites. These sites, if not salvaged, will be subject to wave wash as the water level elevation approaches them. However, they are expected to be salvaged before the project becomes operational.

SECTION NINE - COORDINATION AND COMMENTS AND RESPONSES

9.01 Coordination. Copies of the draft supplement were sent to the following listed agencies, organizations, and other publics for review and comment. The asterisk to the left indicates that the recipient commented relative to information contained in or absent from the draft supplement.

*U.S. Department of Agriculture
*U.S. Department of Transportation
*Advisory Council on Historic Preservation
*U.S. Department of Commerce
*U.S. Department of the Interior
*Dept. of Health, Education, and Welfare
Federal Power Commission
*Environmental Protection Agency, Region VI
*Department of Housing and Urban Development, Region VI
Southwestern Power Administration
Texas Highway Department
*Hill County Board of County Commissioners
City of Aquilla, Texas
City of Whitney, Texas
City of Hillsboro, Texas
City of West, Texas
Heart of Texas Council of Governments
*Office of the Governor, State of Texas
State Historic Preservation Officer
State Division of Comprehensive Planning
*Central Texas Council of Governments
*Brazos River Authority
Texas Committee on Natural Resources
Texas Archaeological Society
Citizens Environmental Coalition
*Sierra Club
League of Women Voters of Texas
The Nature Conservancy
National Wildlife Federation
Izaak Walton League of America, Inc.
Environmental Defense Fund
National Audubon Society
Environmental Coalition of North Central Texas
EAC of North Central Texas
Texas Archeological Survey
Coastal Ecosystems Management, Inc.
Sportsmen Clubs of Texas
Institute of Environmental Studies
Dallas Morning News

Mrs. Herbert Wincorn
Mr. William Benson
Mr. Richard Winburn
Mr. G. W. Hudson
Mrs. E. P. Gregory
Mr. Joe Yelderman, Jr.
B. M. and Jan J. Jean
Mr. James W. Wight
Ms. Mary Ann Sulak
Johnson County Rural Water Supply
J. R. Joplin
Mr. Loyd S. Burk
Mr. James Poehls
J. W. Morrow
Mr. H. Paul Friesema
Mr. James R. Reed
R. D. Smith

9.02 Comments and Responses. The following pages display copies of the letters of comment received and exerpted comments with responses.

BRAZOS RIVER AUTHORITY

4400 COBBS DRIVE P. O. BOX 7555 TELEPHONE AREA CODE 817 776-1441
WACO, TEXAS 76710

July 28, 1975

Mr. John Ball, Chief
Planning Branch
Fort Worth District
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

Thank you for furnishing us, with your letter of 9 July 1975, a copy of the draft supplement to the draft environmental statement regarding the proposed Aquilla Lake for our review and comment.

We have completed our review of the draft supplement and offer the following suggestions and comments:

Suggested Changes in Language

1. In Item 2 of the SUMMARY, "Description of Action," the rate of 4.7 million gallons per day is indicated to be a volume of water storage. This inconsistency might be cured by rewording this item to read, "Increase the size of the project to have an additional water supply yield of 4.7 million gallons per day."

2. It is suggested that Item 3.a. of the SUMMARY, "Environmental Impacts," be reworded to read, "The increased water supply yield of 4.7 million gallons per day that will be made available by the project will help in meeting local and downstream water needs. A greater area of land and several additional miles of intermittent streams will be inundated as a result of the increase in the project size."

3. In order to more precisely describe the anticipated use of water from the project it is suggested that the 2nd and 3rd sentences of paragraph 1.04, "Project Operation," on page 3 be changed to read, "They have reported that initially 1.5 mgd of water will be sold to the cities of Hillsboro and West, Texas, and that this amount will increase progressively to 5 mgd within 50 years. They have reported also that the projected demand for water by other communities in the vicinity of the project and in areas downstream

in the Brazos Basin is expected to utilize the remaining 4.7 mgd during the life of the project."

4. Under "Beneficial Impacts" opposite "Animals" in Table III/IV-1 on page 8, it is suggested that the following sentence be added: "The increase in lake volume and surface area will provide additional habitat for fish and waterfowl."

5. It is suggested that the first sentence opposite "Streams" under "Adverse Effects" in Table V-1 on page 12 be changed to read, "About 2.6 additional miles of Aquilla Creek, 3.2 additional miles of Hackberry Creek, and several miles of tributary streams, all of which are intermittent streams, will be permanently inundated upstream of the dam when the conservation pool is full."

Comments

1. Based upon the figures in Table I-1, we are unable to determine how the increase in the conservation pool surface area is computed to be 61 percent as stated in the first full sentence at the top of page 3 (paragraph 1.03).

2. Also based upon the figures in Table I-1, an increase of 20,000 acre-feet in total storage space would represent a percentage increase of 15.9 rather than 13.7 as shown in the third full sentence at the top of page 3 (paragraph 1.03).

3. The additional mileage which it is stated under "Adverse Effects" opposite "Streams" in Table V-1, on page 12, will be occasionally inundated in Aquilla and Hackberry Creeks by the raised flood pool seems disproportionately large in view of the moderate increase in flood pool area; the total of the mileage shown in this paragraph is also more than twice the combined total of 8.5 miles stated in paragraph 8.01, "Direct Actions," on page 19.

4. Since Aquilla Creek is an intermittent stream, subject to extended periods of no flow as well as to short periods of heavy flood flow and to all variations in between, it seems questionable that there will really be adverse effects to downstream aquatic and riparian ecosystems due to the operation of the project as stated in the last sentence under "Adverse Effects" opposite "Streams" in Table V-1, on page 12. On the other hand, it would seem that there should be beneficial ecological effects resulting from regulation of flows during periods of flooding, and, since low flows must be passed through to honor prior downstream rights, conditions should be no worse during dry periods than they are at present.

Mr. John Ball - cont'd.

July 28, 1975
Page 3

5. The protection by permanent inundation of archaeological sites that otherwise would be exposed to wave wash that is listed as an adverse effect in Table V-1 on page 13 is shown as a beneficial impact in Table III/IV-1 on page 8.

We appreciate the opportunity to review and comment on the draft supplement to the draft environmental statement. Please call on us if additional information is desired regarding the above suggestions and comments, or if we can otherwish be of additional assistance.

Sincerely,

WALTER J. WELLS
General Manager

WJW:gls

Responses to Brazos River Authority comments on Aquilla Supplement

Comment: "In Item 2 of the SUMMARY, Description of Action, the rate of 4.7 million gallons per day is indicated to be a volume of water storage. This inconsistency might be cured by rewording this item to read, 'Increase the size of the project to have an additional water supply yield of 4.7 million gallons per day'."

Response: Inconsistency noted and correction made.

Comment: "It is suggested that Item 3.a. of the SUMMARY, Environmental Impacts, be reworded to read, 'The increased water supply yield of 4.7 million gallons per day that will be made available by the project will help in meeting local and downstream water needs. A greater area of land and several additional miles of intermittent streams will be inundated as a result of the increase in the project size'."

Response: The change has been made with the exception that the word "several" has been changed to the number "9" and "in the project size" has been deleted.

Comment: In order to more precisely describe the anticipated use of water from the project it is suggested that the 2nd and 3rd sentences of paragraph 1.04, "Project Operation," on page 3 be changed to read, "They have reported that initially 1.5 mgd of water will be sold to the cites of Hillsboro and West, Texas, and that this amount will increase progressively to 5 mgd within 50 years. They have reported also that the projected demand for water by other communities in the vicinity of the project and in areas downstream in the Brazos Basin is expected to utilize the remaining 4.7 mgd during the life of the project."

Response: Concur.

Comment: "Under Beneficial Impacts opposite Animals in Table III/IV-1 on page 8, it is suggested that the following sentence be added: The increase in lake volume and surface area will provide additional habitat for fish and waterfowl."

Response: Concur

Comment: "It is suggested that the first sentence opposite Streams under Adverse Effects in Table V-1 on page 12 be changed to read, 'About 2.6 additional miles of Aquilla Creek, 3.2 additional miles of Hackberry Creek, and several miles of tributary streams, all of which are intermittent streams, will be permanently inundated upstream of the dam when the conservation pool is full'."

Response: Concur.

Comment: "Based upon the figures in Table I-1, we are unable to determine how the increase in the conservation pool surface area is computed to be 61 percent as stated in the first full sentence at the top of page 3 (paragraph 1.03)."

Response: The increase is 155%. Correction made.

Comment: "Also based upon the figures in Table I-1, an increase of 20,000 acre-feet in total storage space would represent a percentage increase of 15.9 rather than 13.7 as shown in the third full sentence at the top of page 3 (paragraph 1.03)."

Response: Concur. Correction made.

Comment: The additional mileage which it is stated under "Adverse Effects" opposite "Streams" in Table V-1, on page 12, will be occasionally inundated in Aquilla and Hackberry Creeks by the raised flood pool seems disproportionately large in view of the moderate increase in flood pool area; the total of the mileage shown in this paragraph is also more than twice the combined total of 8.5 miles stated in paragraph 8.01, "Direct Actions," on page 19.

Response: Agreed. Correction made on both pages.

Comment: Since Aquilla Creek is an intermittent stream, subject to extended periods of no flow as well as to short periods of heavy flood flow and to all variations in between, it seems questionable that there will really be adverse effects to downstream aquatic and riparian ecosystems due to the operation of the project as stated in the last sentence under "Adverse Effects" opposite "Streams" in Table V-1, on page 12. On the other hand, it would seem that there should be beneficial ecological effects resulting from regulation of flows during periods of flooding, and, since low flows must be passed through to honor prior downstream rights, conditions should be no worse during dry periods than they are at present.

Response: Most of the anticipated adverse effects will result from the prolonged high level flows from releasing the flood control pool water which will be confined to channel capacity. Under natural conditions flood flows would overbank helping to reduce the erosion and scour of the banks and bottom of the channel and simultaneously deposit a layer of enriching silt. These ameliorating actions will be eliminated. Otherwise the subject ecosystems will experience similar cycles of wetness and dryness as you point out.

Comment: The protection by permanent inundation of archaeological sites that otherwise would be exposed to wave wash that is listed as an adverse effect in Table V-1 on page 13 is shown as a beneficial impact in Table III/IV-1 on page 8.

Response: A revised explanation has been incorporated into Table V-1, page 8.

OFFICE OF THE GOVERNOR

DIVISION OF PLANNING COORDINATION

DOLPH BRISCOE
GOVERNOR

JAMES M. ROSE
DIRECTOR

October 16, 1975

Colonel Joe H. Sheard
District Engineer
Fort Worth District
Corps of Engineers
Department of the Army
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Sheard:

The draft supplement to the draft environmental impact statement (EIS), "Proposed Aquilla Lake on Aquilla Creek in Hill County, Texas," has been reviewed by the Governor's Division of Planning Coordination and by interested State agencies as required by the the National Environmental Policy Act of 1969 (NEPA).

The review participants submitted the following comments which warrant your consideration:

1. The Texas Parks and Wildlife Department (TP&WD) suggested that the Aquilla Reservoir be filled only to the level of current needs for water, thus permitting use of the area between the previously proposed normal pool and the proposed increased pool level for recreation and fish and wildlife purposes. In addition, the TP&WD proposed that a site below the dam be set aside for a future fish hatchery, and requested that facilities be provided for obtaining and conveying water from the hatchery site.

2. The Texas Water Rights Commission (TWRC) noted that the supplement fulfills the coordination requirements of NEPA. However, they reaffirmed their previous statement that the document should include a more comprehensive summary of the economic aspects of all project alternatives and a discussion of the effects of expected fluctuating reservoir levels on the proposed multiple uses of the reservoir. In addition, the TWRC stated that special consideration should be given to adopting, as an alternative, the maximized scope of the Aquilla Lake Project which was found feasible by the Commission in 1965, and approved by the U.S. Congress.

3. The Texas Water Development Board (TWDB) pointed out that if the smaller project is adopted, alterations to increase capacity at a later time could prove to be extremely costly. However, the TWDB stated that since an early need had developed for the total yield, minor modifications may be made in the final design stage to accomodate the increased storage capacity. The TWDB further noted that the elevation in water level in the upper end of the lake may possibly reach or inundate the City of Hillsboro's Sewage Treatment Plant, and suggested that the Texas Water Quality Board and the Brazos River Authority cooperate to develop an acceptable solution to this potential problem.

4. The Texas Water Quality Board (TWQB) confirmed their previous statement of concern about the water level near the City of Hillsboro's Sewage Treatment Plant. The TWQB stated that the City of Hillsboro will be required to conform to a higher level of waste treatment, but that this can be accomplished through careful planning and coordination in the development of the reservoir and the Hillsboro Wastewater Treatment Works.

The Texas Department of Agriculture, the State Department of Highways and Public Transportation, the Texas Air Control Board, the Bureau of Economic Geology, and the General Land Office also participated in the review. The comments of the review participants are enclosed to assist in your planning effort.

The Division of Planning Coordination recommends that the Corps consider the comments of the review participants in the preparation of the final EIS. We suggest, as indicated in the project description of this supplement, that the final EIS include fish and wildlife conservation as one of the purposes of this project. We also suggest that you coordinate directly with the City of Hillsboro and the TWQB to develop an acceptable solution to the potential water quality problem.

If we can be of further assistance, please let us know.

Sincerely,

James M. Rose

JAMES M. ROSE
Director

JMR:cc7/7

Enclosures

cc: The Honorable Bob Armstrong, GLO
Mr. Clayton T. Garrison, TP&WD
Mr. Robert Schneider, TWRC
Mr. Harry P. Burleigh, TWDB
Mr. Hugh C. Yantis, Jr., TWQB
Mr. Edmund L. Nichols, TDA
Mr. B.L. DeBerry, SDH&PT
Mr. Charles R. Barden, TACB
Dr. Charles G. Groat, BEG

TEXAS PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR
JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

August 26, 1975

Mr. Wayne N. Brown
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

This Department has reviewed the supplement to the draft environmental statement on proposed Aquilla Lake, Hill County, Texas. We are pleased with the proposal to purchase an additional 980 acres of fee lands as mitigation for losses to wildlife due to increasing the reservoir capacity as proposed in the subject statement.

To provide the maximum amount of recreational benefits, and for fish and wildlife, it is also suggested that Aquilla Reservoir be filled only to the level of current needs for water. During the interim the area between the previously proposed normal pool and proposed increased pool level could be used for recreation and fish and wildlife purposes.

In conjunction with considerations for fisheries, it is proposed that a site below the dam be set aside for a future fish hatchery and facilities for obtaining and conveying water from the reservoir be provided to the hatchery site.

Thank you for the opportunity to review and comment on this statement.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:WJS:pm

TEXAS WATER RIGHTS COMMISSION

STEPHEN F. AUSTIN STATE OFFICE BUILDING

August 18, 1975

Brigadier General James M. Rose
Director, Division of Planning Coordination
Office of the Governor
411 West 13th Street
Austin, Texas 78711

Attention: Mr. Wayne N. Brown

Re: U.S. Corps of Engineers, Fort Worth District -- Draft Supplement to the Draft Environmental Statement on Aquilla Lake, Aquilla Creek, Hill County, Texas, July 1975.

Dear General Rose:

In reply to your request in letter of July 24, the Commission staff has reviewed the referenced document, pursuant to the functions of the Commission as a member agency of the Interagency Council on Natural Resources and the Environment. Attached for your information and use is the Commission's Staff Analysis Report. The comments in the Report must not be misconstrued as in any way modifying previous formal actions and judgements of the Texas Water Rights Commission, relative to the Aquilla Lake project.

In essence, the staff finds that the referenced supplemental document fulfills the coordination requirement of the National Environmental Policy Act of 1969. However, the staff reaffirms its suggestion of April 8, 1974 after reviewing the March 1974 Draft Environmental Statement (DES) for the proposed Aquilla Lake project (alternate Dam Site "D"), that the DES should include a more comprehensive summary of the economic aspects of all project alternatives. In fact, in view of currently-foreseen increased water requirements for energy, agricultural, and urban growth, special reconsideration should be given to the feasibility of adopting the maximized scope of the Aquilla Lake project, as was found feasible by the Commission in 1965, and as approved by the U.S. Congress. The referenced document should include special clarification as to whether the original, larger project scope is still to be regarded as a realistic, attainable alternative or objective. In addition, the referenced document should include a discussion of the important matter of the effects of expected fluctuating reservoir water levels on the proposed multiple uses of the reservoir.

If you have any questions on the details of the attached report, please notify Dr. A. J. D'Arezzo, Special Analyst for Environment and Interagency Coordination, telephone (512) 475-2678.

Sincerely yours,

Robert E. Schneider
Executive Director

RES-AJD:ll

Attachment
As stated.

August 15, 1975

TEXAS WATER RIGHTS COMMISSION
STAFF ANALYSIS REPORT
ON
U.S. CORPS OF ENGINEERS, FORT WORTH DISTRICT
DRAFT SUPPLEMENT TO THE DRAFT ENVIRONMENTAL STATEMENT
ON
AQUILLA LAKE, AQUILLA CREEK
HILL COUNTY, TEXAS
JULY 1975

1. REQUIREMENT

By letter of July 24, 1975, the Governor's Division of Planning Coordination requested that the Texas Water Rights Commission review and submit comments on the captioned document relative to the expected environmental, economic, and social impacts of a proposed increase in the design total storage capacity of the Aquilla Lake project from 126,000 to 146,000 acre-feet -- representing an increase in surface area from 6,365 to 7,000 acres, and an increase in estimated water-supply yield capability from 5.0 to 9.7 million gallons per day.1/

2. REFERENCES

a. U.S. Office of Management and Budget Circular No. A-95.

b. National Environmental Policy Act of 1969 (Public Law 91-190).

1/ The original, authorized, multiple-purpose reservoir was larger. It provided for a total storage capacity of 199,300 acre-feet, a surface area of 9,180 acres, and an estimated dependable water-supply yield of 9.7 million gallons per day. (The project was described in the Corps of Engineers report, Interim Review of Reports on Brazos River and Tributaries, Texas, Covering Aquilla Reservoir on Aquilla Creek, December 28, 1965.

c. Ray K. Linsley and Joseph B. Franzini, Water-Resources Engineering, New York: McGraw-Hill Book Company, 1972.

d. Texas Water Rights Commission Resolution of March 30, 1965 "...designating the Brazos River Authority as the agency of the Texas Water Commission to negotiate with the Corps of Engineers of the United States Army, for acquisition of storage space in the Aquilla Creek Project and providing certain conditions."

e. Texas Water Rights Commission Order of August 2, 1966 "...approving the feasibility of the proposed Federal Project relating to flood control, water supply, recreation, and fish and wildlife enhancement as described in a report prepared by the U.S. Corps of Engineers entitled, "Aquilla Reservoir, Brazos River Basin, Texas." 1/

f. Texas Water Rights Commission letter of April 8, 1974 to the Governor's Division of Planning Coordination relative to the review of the Corps of Engineers (Fort Worth and Tulsa Districts) Draft Design Memorandum No. 3, General Design, Phase 1 -- Plan Formulation, Aquilla Lake, Aquilla Creek, Texas (March 11, 1974.) In this letter, the Commission indicated its concurrence in the Corps of Engineers' proposal to adopt a smaller reservoir. Specifically, concurrence was given to the adoption of alternate Dam Site "D" (having a total storage capacity of 126,000 acre-feet and a dependable water supply yield of 5.0 million gallons per day) in lieu of Dam Site "C" (i.e., the original, authorized project having a total storage capacity of 199,300 acre-feet and an estimated yield of 9.7 million gallons per day) which was initially recommended in the Corps of Engineers' Interim Report of December 28, 1965. Site "D" was selected with the proviso that conservation storage be expanded at a future time when economically justified.

1/ The project which was reviewed and found feasible by the Commission pursuant to Section 4 of Article 7472e, Vernon's Annotated Civil Statutes (now Section 6.073(e), Texas Water Code) was the authorized project having the capacity described in the preceding footnote.

g. Texas Water Rights Commission letter of April 8, 1974, and accompanying Memorandum of Review of April 4, 1974, to the Governor's Division of Planning Coordination relative to the review of the March 1974 Draft Environmental Statement (DES) on the proposed Dam Site "D" project alternate. The Commission recommended that the DES provide more complete and detailed cost-benefit data and analyses for all project alternatives.

3. COMMENTS

a. Analysis of Alternatives.

The Commission staff reaffirms the recommendations made in letter of April 8, 1974 (see reference 2 g, above), that a clear-cut, comparative, economic cost-benefit analysis of each major alternative should be included in the environmental statement. It is assumed that these data and the comparative assessments thereof are readily available and could be recapitulated in the environmental statement without excessive effort. These data and assessments are basic to the administrative actions taken pursuant to the National Environmental Policy Act of 1969.

The reasons why the authorized maximum project scope was not adopted at this time should be reexamined and explained carefully, if in fact the original project scope (i.e., 199,300 acre-feet of storage capacity) is still regarded as a viable alternative or objective. In the adoption of a reservoir design of suboptimum storage capacity, subject to future enlargement -- as now proposed -- planners should take cognizance of the following realistic cautions (taken from reference 2 c, above) regarding the social importance of sound economic decisions on major water projects:

> "Once they are completed, major water control structures can be altered only with difficulty, or not at all. There are only a relatively few suitable dam sites, and once they are appropriated, the possibilities for economic multiple-purpose development are very limited.... There is a sobering finality in the construction of a river basin development; and it behooves us to be sure we are right before we go ahead." (See reference 2 c, above, page 376.)

In summary, it is highly probable that when the alternatives are reexamined in the light of currently perceived state-wide or national water requirements for energy-related, agricultural, and urban developments, strong justification might be found for the construction of the Aquilla Reservoir Project on the basis of its maximum authorized scope, i.e., a total storage capacity of 199,300 acre-feet in lieu of the 146,000 acre-feet now proposed.

b. Analysis of the Ecological Impact of Fluctuating Water Levels in Aquilla Reservoir.

It is believed that a realistic evaluation should be made of the expected impacts of fluctuating water levels in the proposed reservoir in order to determine requirements for monitoring and for appropriate mitigation measures to offset any injurious effects.

Literature on fluctuating levels indicates that although there are many instances of adverse effects on fishes caused by receding water levels, there are also many cases of beneficial effects. It is generally accepted that reservoir draw down will often result in a recycling of nutrients back into the water. These nutrients may come either from aquatic plants and other organic matter on the reservoir bottom or from the release of nutrients in the bottom soil. However, with the increasing problem of eutrophication in most reservoirs, additional nutrients may be undesirable.

Water-level changes usually have some effect on the aquatic plants along the shoreline. Since some plant growth is considered desirable cover for fish and fish food organisms, as well as a spawning media, water-level changes may have a profound effect on fish population. On the other hand, aquatic plants at times become a nuisance; in which case, water-level changes may be used to control some species of plants.

In summary, it is believed that the Master Plan for the management of the reservoir and reservoir lands should reflect realistic consideration of the effects of fluctuating reservoir levels.

c. Compliance with Applicable Laws and Regulations.

The staff finds that subject to further consideration of the comments in 3 a and b, above, the captioned Draft Supplement to the Draft Environmental Statement fulfills reasonably the administrative, analytical, coordinative requirements of the U.S. Office of Management and Budget Circular No. A-95, and the National Environmental Policy Act of 1969.

4. SPECIAL REMARKS

The comments in this Staff Analysis Report must not be misconstrued as in any way modifying previous formal actions and judgments of the Texas Water Rights Commission, i.e., References 2 d, e, and f, above.

These comments are presented with constructive intent to enhance the project so as to insure the maximum, beneficial use of the natural resources in the project area within the scope of the Aquilla Lake Project as authorized originally by Congress. If there are any questions on this report, please notify the undersigned, telephone (512) 475-2678.

Alfred J. D'Arezzo
Alfred J. D'Arezzo, Ph.D., (C.E.)
Special Analyst for Environment
and Interagency Coordination

AJD:ll

NOTED:

Robert E. Schneider
Robert E. Schneider
Executive Director

TEXAS WATER DEVELOPMENT BOARD

HARRY P. BURLEIGH
EXECUTIVE DIRECTOR

P.O. BOX 13087
CAPITOL STATION
AUSTIN, TEXAS 78711

AREA CODE 512
475-3571
1700 NORTH CONGRESS AVENUE

August 7, 1975

IN REPLY REFER TO
TWDBP-O

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Jim:

Your memorandum dated July 24, 1975 transmitted for review and comments the Corps of Engineers' Draft Supplement to the Draft Environmental Statement Regarding the Proposed Aquilla Lake on Aquilla Creek in Hill County, Texas.

Increasing the capacity of the Aquilla Creek reservoir project has been under consideration for some time. Our comments relative to the original Draft Environmental Statement which were provided your office on April 24, 1974 addressed the possible enlargement feature as follows:

> "At the present time, local needs dictate that assurances can be made for use of only 5 mgd of water supply from the total potential yield of Aquilla Lake; thus, the project cost allocation is based on this criterion. The decision has been reached that this project, of smaller capacity than the authorized project, should be completed as quickly as possible, and that provisions will be made for increasing the conservation storage allocation at a later date. This can be accomplished by reallocation of flood control storage of the project without appreciably reducing the flood protection benefits."

We believe it is fortunate that an early need has developed for the total yield of Aquilla Lake. During the final design stage, minor modifications can be made which will accommodate the increased storage capacity. Such alterations to the structure at a later date could prove to be extremely expensive.

Information contained in the supplement does not show how the water surface elevation in the upper end of the lake, with the increased storage capacity, relates to the City of Hillsboro's sewage treatment plant. It is possible that back-water may reach or inundate that facility. We would suggest that the Texas Water Quality Board and the Brazos River Authority cooperate in developing a safe and acceptable solution to this potential problem.

We appreciate the opportunity to furnish these comments. We strongly endorse the plan for optimum development of the Aquilla Creek reservoir site.

Sincerely,

Harry P. Burleigh

Harry P. Burleigh

TEXAS WATER QUALITY BOARD

PH (512) 475-2651

1700 NORTH CONGRESS AVE. 78701
P.O. BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

AUG 1 1975

July 29, 1975

Re: Draft Supplement to the
Draft Environmental Statement
for Aquilla Lake

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear General Rose:

The staff of the Texas Water Quality Board has reviewed the draft supplement to the draft environmental statement regarding the proposed Aquilla Lake on Aquilla Creek in Hill County and offer the following comments on the statement.

As was stated in our comments on this project in our letters of December 5, 1972 and April 9, 1974 when the proposed reservoir is completed and the normal water level is reached, the City of Hillsboro Sewage Treatment Plant will be discharging effluent directly into the reservoir. This will present a problem to the City of Hillsboro since the Texas Water Quality Board will require a higher level of waste treatment under those conditions over what is being performed under the present conditions.

The Board's policy approved on February 26, 1975 for effluent standards for domestic wastewater treatment plants has not changed from what was cited in our previous letter. For this treatment facility, the policy would require provision of a treatment system to obtain an effluent, which on a 30-day average, would have a BOD of 10 mg/1 and TSS of 15 mg/1

plus disinfection which would limit fecal coliforms to 200. There is no incompatibility from a technical standpoint, but it will be necessary to carefully plan and coordinate development of the reservoir and the Hillsboro wastewater treatment works especially since the enlarged reservoir will be still closer to the sewage treatment plant.

We appreciate the opportunity to review this project. If we can be of further assistance, please let me know.

Very truly yours,

Emory G. Long

Emory G. Long, Director
Administrative Operations

cc: Colonel Joe H. Sheard, Corps of Engineers
TWQB District 3

EDMUND L. NICHOLS
Assistant Commissioner

July 30, 1975

Mr. Wayne N. Brown, Chief
Intergovernmental Coordination
Division of Planning Coordination
Office of the Governor
Austin, Texas 78711

Dear Wayne:

This is in response to your letter of July 24, 1975 requesting comments for the Draft Supplement to the Draft Environmental Statement Regarding the Proposed Aquilla Lake on Aquilla Creek in Hill County, Texas.

The proposed increase in the size of Aquilla Lake seems to be adequately justified and results in an acceptable environmental impact.

We appreciate the opportunity to review and comment on this statement.

Sincerely,

Ed Nichols

Edmund L. Nichols

ELN/pcf

This Paper Is Made From COTTON A Principal Crop Of Texas
Texas Department of Agriculture, John C. White, Commissioner, P.O. Box 12847, Austin, Texas 78711

COMMISSION
REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
AUSTIN, TEXAS 78701

ENGINEER-DIRECTOR
B. L. DEBERRY

August 19, 1975

IN REPLY REFER TO
FILE NO. D-5

SUBJECT: Draft Supplement to Draft Environmental Statement for Aquilla Lake, Hill County, Texas

Mr. Wayne N. Brown, Chief
Intergovernmental Coordination
Division of Planning Coordination
Office of the Governor
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Sir:

We have reviewed the draft supplement to the draft environmental statement for Aquilla Lake which accompanied your memorandum of July 24, 1975 and have nothing to add to the statements contained in our letter of April 11, 1974, same subject.

Please accept our gratitude for the opportunity of reviewing the draft supplement.

Sincerely yours

B. L. DeBerry
Engineer-Director

By: Wayne Henneberger

Wayne Henneberger
Bridge Engineer

TEXAS AIR CONTROL BOARD

PHONE 512/451-5711
8520 SHOAL CREEK BOULEVARD

CHARLES R. BARDEN, P. E.
EXECUTIVE DIRECTOR

AUSTIN, TEXAS – 78758

JOHN L. BLAIR
Chairman

HERBERT W. WHITNEY, P.E.
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JAMES D. ABRAMS, P.E.
FRED HARTMAN
WILLIE L. ULICH, Ph.D., P.E.
JOE C. BRIDGEFARMER, P.E.

July 30, 1975

Mr. Wayne N. Brown, Chief
Intergovernmental Coordination
Planning Coordination
Governor's Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Mr. Brown:

Our agency has reviewed the Draft Supplement to the Draft Environmental Statement regarding the Proposed Aquilla Lake on Aquilla Creek in Hill County, Texas. We have no comments to make concerning this document.

Thank you for the review opportunity. If we can assist you further, please contact me.

Sincerely yours,

Bill Stewart

Bill Stewart, P.E.
Director
Control and Prevention

cc: Mr. Eugene Fulton, Regional Supervisor, Waco

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION
STATE CLEARINGHOUSE
Ph. 512/475-6156

DOLPH BRISCOE
GOVERNOR

JAMES M. ROSE
DIRECTOR

COMMENTS

DRAFT SUPPLEMENT TO THE DRAFT ENVIRONMENTAL STATEMENT REGARDING THE PROPOSED AQUILLA LAKE ON AQUILLA CREEK IN HILL CO., TX

The GENERAL LAND OFFICE has no comment

Karen Alberter

Person Conducting Review (Signature) ~~Mike McKann~~
Agency General Land Office Date 7-31-75

SAI No. [illegible] Applicant [illegible]

THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY
AUSTIN, TEXAS 78712

University Station, Box X
Phone 512—471-1534

AUG 5 1975

August 4, 1975

Mr. Wayne N. Brown, Chief
Division of Planning Coordination
P. O. Box 12428
Austin, Texas 78711

Dear Mr. Brown:

The staff of the Bureau of Economic Geology has reviewed:

(1) Draft Environmental Impact Statement:
Maintenance Dredging Trinity River and Tributaries, Texas Anahuac Channel and Channel to Liberty

(2) Draft Supplement to Draft Environmental:
Statement regarding proposed Aquilla Lake on Aquilla Creek, Hill County, Texas

We have no negative comments on these projects.

Thank you for the opportunity to respond.

Sincerely,

C. G. Groat
Acting Director

CGG:wll

Responses to combined comments on Aquilla Supplement from Office of the Governor, State of Texas, Division of Planning Coordination.

Texas Parks and Wildlife Department comment:

Comment: The Texas Parks and Wildlife Department (TP&WD) suggested that the Aquilla Reservoir be filled only to the level of current needs for water, thus permitting use of the area between the previously proposed normal pool and the proposed increased pool level for recreation and fish and wildlife purposes. In addition, the TP&WD proposed that a site below the dam be set aside for a future fish hatchery, and requested that facilities be provided for obtaining and conveying water from the hatchery site.

Response: The Corps of Engineers is now investigating the feasibility of incrementally filling the impoundment. The final decision rests on the outcome of evaluations based on the desires and needs as seen by the several Federal, State, and local agencies, conservation organizations and other interested publics. Conflicts of interest among these groups must be resolved before a firm commitment to incrementally fill or not to incrementally fill can be made. Hopefully, there will be resolution before deliberate impoundment of water begins. The setting aside of a site below the dam which could be used at some time in the future for a fish hatchery can easily be accomplished since a borrow area in excess of 100 acres is proposed on lands immediately downstream of the proposed embankment. Additionally, a temporary roadway to replace Farm-to-Market Road 310 will be constructed across the northern end of this site and could be maintained, after Farm-to-Market Road 310 is relocated atop of the dam, for all weather access to the subject site. Facilities for obtaining and conveying water from the impoundment to the hatchery site will be discussed with appropriate units of the Texas Parks and Wildlife Department to determine if the facilities will need to be incorporated into the original construction or if is possible and desirable to add them on at the time of need.

Texas Water Rights Commission comment:

Comment: The Texas Water Rights Commission (TWRC) noted that the supplement fulfills the coordination requirements of NEPA. However, they reaffirmed their previous statement that the document should include a more comprehensive summary of the economic aspects of all project alternatives and a discussion of the effects of expected fluctuating reservoir levels on the proposed multiple uses of the reservoir. In addition, the TWRC stated that special consideration should be given to adopting, as an alternative, the maximized scope of the Aquilla Lake Project which was found feasible by the Commission in 1965, and approved by the U.S. Congress.

Response: The comprehensive summary of the economic aspects of all project alternatives is presented in Table 6-1 on page 6-3 of the Final Environmental Statement. An updated version of that table is shown on page 38a. Data more detailed than this is not readily available and would probably reveal little additional information. Discussion of the effects of pool elevation fluctuation are covered in Section 4 of the Final Statement. The discussion of effects in Dr. D'Arezzo's analysis report succinctly presents other effects as well as a further discussion would by the Corps. Consideration was given to the alternative of a maximized Aquilla Lake project but the study demonstrated that a greater amount of net benefits will be realized from optimizing the project which would develop 9.7 mgd. This, in effect, gives the lowest unit cost of water. This is graphically displayed in the figure on page 38a.

Texas Water Development Board comment.

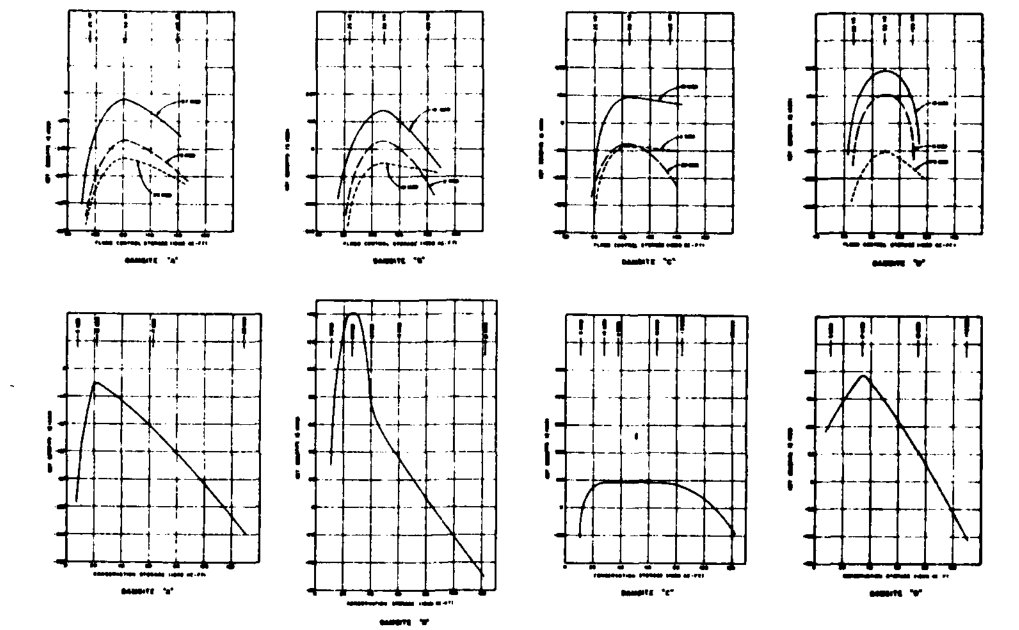
Comment: The Texas Water Development Board (TWDB) pointed out that if the smaller project is adopted, alterations to increase capacity at a later time could prove to be extremely costly. However, the TWDB stated that since an early need had developed for the total yield, minor modifications may be made in the final design stage to accommodate the increased storage capacity. The TWDB further noted that the elevation in water level in the upper end of the lake may possibly reach or inundate the City of Hillsboro's Sewage Treatment Plant, and suggested that the Texas Water Quality Board and the Brazos River Authority cooperate to develop an acceptable solution to this potential problem.

Response: The increased cost of modifying existing projects to increase storage capacity at sometime in the future are well known to the Corps. For this reason we believe it is fortunate that the local sponsor (Brazos River Authority) recognized the need for the larger project before construction was initiated or completed. This should materially reduce the overall cost per unit of municipal and industrial water. Regarding the problem of Hillsboro's Sewage Treatment Plant, see the response to the Texas Water Quality Board's comment which follows.

Texas Water Quality Board comment.

Comment: The Texas Water Quality Board (TWQB) confirmed their previous statement of concern about the water level near the City of Hillsboro's Sewage Treatment Plant. The TWQB stated that the City of Hillsboro will be required to conform to a higher level of waste treatment, but that this can be accomplished through careful planning and coordination in the development of the reservoir and the Hillsboro Wastewater Treatment Works.

Response: Mr. Joe Ward, Hillsboro City Manager, has advised the Corps of Engineers that the city government is in the process of developing a plan for sewage treatment improvement for Hillsboro which would meet Environmental Protection Agency and Texas Water Quality Board standards and result in a receipt of a joint agency permit. A schedule has been submitted to these agencies for approval, which would complete construction of the plant in 1978. This scheduled completion date would have the new treatment plant in operation well before the deliberate impounding of water in Aquilla Lake.



AQUILLA LAKE
ECONOMIC OPTIMIZATION STUDIES

PERTINENT DATA FOR ALTERNATIVES

DATA	A Alternative Site "A"	B Alternative Site "B"	C Authorized Site	D Alternative Site "D"	E [illegible]	F [illegible]	G [illegible]	H [illegible]	I [illegible]	J [illegible]	K No Action
LAND REQUIREMENTS											
Land Required (Acres)											
Fee	(1)17,100	(1)14,900	(1)13,800	(1)12,400	19,800	900	13,700	640	6,000	-	-
Easement	-	-	-	-	-	9,300	[illegible]	7,000	[illegible]	[illegible]	-
Total	17,100	14,900	13,800	12,400	19,800	10,200	[illegible]	[illegible]	[illegible]	[illegible]	-
Land Classification for Total Fee (Acres)											
Cropland	11,200	9,600	9,800	7,900	5,300	300	3,700	300	1,300	-	-
Pasture	5,100	4,500	3,500	3,400	9,300	400	7,100	300	1,400	-	-
Timberland	800	800	500	1,100	4,800	200	2,900	100	3,300	-	-
Flood Plain Acreage											
Aquilla Creek Basin below damsite	4,900	5,700	6,300	7,100	-	-	6,300	6,700	6,800	6,300	-
Brazos River Basin	958,300	958,300	958,300	958,300	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
Total	963,200	964,000	[illegible]	965,400	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
Flood Plain Land Classification (Acres)											
Cropland	430,900	431,200	431,500	432,000	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
Pasture	528,800	529,300	529,500	529,900	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
Urban or suburban	3,500	3,500	3,500	3,500	-	-	3,500	3,500	3,500	3,500	-
ECONOMICS											
Project Cost(2)	48,034,000	42,397,000	43,796,000	38,765,000	87,803,000	66,138,000	91,007,000	48,742,000	34,334,000	33,480,000	-
Benefits (Capitalized @ 3-1/4%)											
Flood Control	[illegible]	28,103,000	28,167,000	26,444,000	[illegible]	[illegible]	28,167,000	28,167,000	[illegible]	[illegible]	-
Water Supply	16,660,000	16,660,000	16,660,000	16,660,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Recreation & Fish & Wildlife	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-
Subtotal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Redevelopment Benefits	[illegible]	1,700,000	1,818,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Total Benefits	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Excess Benefits Over Cost (with redevelopment)	-83,000	4,635,000	3,336,000	5,013,000	-47,081,000	-27,077,000	-48,709,000	[illegible]	[illegible]	[illegible]	-
Benefit to Cost Ratio (with redevelopment)	0.99	1.1	1.1	1.2	0.5	0.6	0.5	1.0	1.2	1.1	-
Total Alternative D Excess Benefits Foregone (with redevelopment)	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OTHER DATA											
Drainage Area (Sq Mi)	[illegible]	[illegible]	[illegible]	[illegible]	217	217	[illegible]	[illegible]	-	-	-
Surface Acres at Top of Flood Pool	[illegible]	7,700	[illegible]	[illegible]	[illegible]	6,000	[illegible]	6,000	-	-	-
Surface Acres at Top of Conservation Pool	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	-
Volume at Top of Conservation Pool (ac ft)	[illegible]	[illegible]	(3)[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	-
Volume at Top of Flood Control Pool (ac ft)	[illegible]	[illegible]	[illegible]	[illegible]	189,700	116,700	[illegible]	-	-	-	-
Maximum Depth (feet)	46	53	[illegible]	41	60	-	60	-	-	-	-
Mean Depth (feet)	26	[illegible]	25	25	15		15	-	-	-	-
Stream Miles Inundated (excluding tributaries)											
At Top of Conservation Pool	9.4	9.4	8.7	8.3	[illegible]	-	[illegible]	-	-	-	-
At Top of Flood Pool	13.7	14.2	12.6	10.3	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-
Water Supply Yield (mgd)	9.7	9.7	9.7	9.7	[illegible]	-	[illegible]	9.7	9.7	9.7	-
Flood Control Frequency (years)	50	50	50	40	50	50	50	50	-	-	-

(1) Entire amount shown in fee pending ultimate determination of easement requirements.
(2) Includes first cost, interest during construction, and capitalized operation, maintenance, and replacement.
(3) Conservation storage reflects new hydrologic studies and is different than the project document storage.

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

July 31, 1975

OFFICE OF THE
REGIONAL ADMINISTRATOR

Mr. John C. Ball
Chief, Planning Branch
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

We have reviewed the Draft Supplement to the Draft Environmental Impact Statement on Aquilla Lake, Aquilla Creek, Hill County, Texas. We offer the following comments for your consideration in preparing the final statement.

1. According to the draft supplement, "The local sponsor (Brazos River Authority) estimates that over the life of the project the yield of the 9.7 mgd project will be required to fulfill the municipal and industrial water needs of the Brazos River Basin." This is the justification used for increasing the dependable yield water supply by 4.7 mgd. However, it is not clear what factors were considered in assessing the future municipal and industrial water needs for the area. We believe that more definitive information on estimated future area growth would provide the means for better understanding the need for a larger project. We recommend that an analysis of the growth potential for the area, including estimates of population increases, types of industries to be attracted and their potential locations be included in the final statement. Furthermore, since reservoir construction and future growth are interrelated, we recommend that the secondary impacts of project implementation be discussed. Particular emphasis should be given to discussing the potential for the degradation of air, water and noise quality resulting from future growth and construction stimulated by the availability of an additional water supply. Also, in order to minimize the adverse impacts of uncontrolled growth, local officials and the Corps of Engineers should consider formulating land use plans that would preserve the environmental integrity of the project area.

2. The final statement should consider the effects of prolonged downstream releases from the reservoir during flood stage. For instance, the potential for bank erosion and scour resulting from extended variations in flow should be discussed.

The classification of the proposed Aquilla Lake Project, as expressed in our comment letter dated May 28, 1974, remains ER-2. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the draft supplement. Please send us two (2) copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

John C. White
Regional Administrator

Responses to EPA's comments on Aquilla Draft Supplement

Comment: "...., it is not clear what factors were considered in assessing the future municipal and industrial water needs for the area.... We recommend that an analysis of the growth potential for the area, including estimates of population increases, types of industries to be attracted and their potential locations be included in the final statement."

Response: The population projections were based on two assumptions: (1) Hill County, in which Hillsboro is the primary population center, will not continue in the long-run future to decline in population. There will, in fact, be a small increase in population so that the 2080 population will be about 12,500 greater than the 1970 population; (2) Hillsboro will continue to increase as a percent of Hill County so that by 2080 some 90 percent of the county population will be in Hillsboro.

These two assumptions taken together compound the growth of Hillsboro. The assumptions appear to be reasonable even though any projection of a small area so far into the future is subject to a large error. Because of the location of Hillsboro and Hill County with regard to the rapidly expanding Dallas-Fort Worth Metroplex there will be spillover into the area. Their location near the intersection of Interstate Highway 35W and 35E will also contribute to the long-run growth. The proximity to Waco on the south will also stimulate their growth. Lake Whitney and Navarro Mills Reservoir will also stimulate growth. All of these factors combined will result in growth in Hillsboro probably at a more rapid rate than projected. Because of the uncertainties of projections over 100-years in the future, a moderate growth was projected.

The community of and around Hillsboro is presently working to attract industries which are not heavy water users or consumers. However, when Aquilla Lake becomes productive there will not be such a selective attitude about which industries locate there. There will always be a preference for industries that do not produce air, water, or noise pollution. Industrial location now is concentrated on the north side of town. It is located there because of the adequacy of utility service. It is expected that future industrial growth will continue in this area with the possibility of some spillover and development along Interstate Highway 35.

Comment: "..., since reservoir construction and future growth are interrelated, we recommend that the secondary impacts of project implementation be discussed."

Response: Little can be added to the anticipated secondary impacts as discussed in Section 3 of the Draft Environmental Statement dated March 1974 or Section 4 of the FES.

Comment: "Particular emphasis should be given to discussing the potential for the degradation of air, water, and noise quality resulting from future growth and construction stimulated by the availability of an additional water supply."

Response: The availability of an adequate water supply for municipal and industrial uses, plus the potential recreational use of the project, is expected to result in regional growth and development. This growth and development will promote higher population density which usually suffers from increased crime, congestion, noise, air, and water pollution.

Comment: "..., in order to minimize the adverse impacts of uncontrolled growth, local officials and the Corps of Engineers should consider formulating land use plans that would preserve the environmental integrity of the project area."

Response: At the present time the City of Hillsboro has a zoning plan by which it is hoped that the growth of the area can be directed. The Corps of Engineers currently has no authority to guide the type of development on lands adjacent to their projects. The Corps of Engineers will work with local, regional, and state agencies in developing land use programs when requested to.

Comment: "The final statement should consider the effects of prolonged downstream releases from the reservoir during flood state. For instance, the potential for bank erosion and scour resulting from extended variations in flow should be discussed.

Response: The effects are broadly covered in Table V-2 under the element entitled "Streams." It is realized that bank erosion and scour will occur downstream of the project because the water released will have deposited some or all of its previous sediment load in the lake. The extent of effects to be caused by the released water will be factors of the volume and speed of the releases, the sediment load of the water being released and the type of rock and soil material over which the water will flow. In any event, the scour and erosion effects of releases are not expected to be significant beyond about one mile from the outlet works.

United States Department of the Interior

OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87101

ER-75/713

SEP 2 1975

District Engineer
Corps of Engineers, U. S. Army
P. O. Box 17300
Fort Worth, Texas 76102

Dear Sir:

This responds to Mr. John C. Ball's letter of July 9, 1975, addressed to the Assistant Secretary - Program Policy, which requested review and comment on a draft supplement to the draft environmental statement for Aquilla Lake, Aquilla Creek, Hill County, Texas.

The coverage of impacts related to enlargement of the project is brief, although generally satisfactory. It is necessary to refer to the previous draft environmental statement for adequate understanding and review of the supplement, as review without benefit of the previous document would be confusing.

Comments on specific sections of the draft statement are as follows:

PROJECT DESCRIPTION

Page 1, paragraph 1.03. A 1,992 acre increase in surface area of the conservation pool from 1,288 acres to 3,280 acres would amount to a 155 percent increase rather than 61 percent. However, if the initial area of 1,887 acres for the conservation pool in the previously proposed plan is used, the increase in surface area to 3,280 acres would be 1,393 acres, or 74 percent.

Page 2, Table I-1. The elevations shown under the current plan for the top of dam, maximum pool, and spillway crest are less than those listed for the previously proposed plan. Since the current plan is larger, we wonder if these figures are correct.

ENVIRONMENTAL SETTING AND IMPACTS OF THE CURRENT PROJECT

The increased surface area of the enlarged conservation pool would lead to an increase in losses to evaporation, which should be evaluated in the environmental statement. Also, we do not note any reference in the statement to possible impacts of the project on threatened or endangered wildlife species.

A statement regarding archeological sites under the heading "beneficial impacts" on page 8 is repeated on page 13 under the heading "adverse effects." In either case, the statement seems to imply that permanent inundation would provide more protection of archeological resources within the 1,992 additional acres of land to be covered than would salvage excavation. Probably less damage will result from permanent inundation than from wave action, but to state that archeological resources will be protected by permanent inundation is incorrect. Also, there will no doubt be additional sites along the proposed lake level that will become subject to wave action. There is no indication of contacts or concurrence with the State Historic Preservation Officer.

ALTERNATIVES TO THE PROPOSED ACTION

An alternative which should be considered and discussed in this section is stage-filling of the lake in lieu of immediate full impoundment. The lack of immediate commitment for sale of the full reservoir yield of 9.7 mgd, the absence of planned recreational development other than minimum basic facilities, and the potential fish and wildlife attributes all support the alternative as being feasible and justifiable.

Reservoir construction could proceed as presently contemplated and the conservation pool level could be initially held at a maximum of about 1,890 surface-acres with a 5.0 mgd yield. At such time as future water supply requirements warrant, the conservation pool elevation could be gradually increased until the ultimate pool size of 3,280 surface-acres and associated water yield are achieved.

In terms of wildlife attributes, the action would preserve about 1,390 acres of wildlife habitat along with its public hunting and wildlife-oriented use potential for a number of years.

The operational flexibility of the project for fish and wildlife purposes also would be increased. If desired, floodwaters could be retained within the lower portion of the interim "bonus flood storage area" during appropriate fall and winter periods to augment the availability of food and cover for migrating waterfowl and water birds in general. Water levels also could be manipulated in the spring within this "bonus area" either to reduce the spawning success of undesirable non-game fish species or to foster an increase in spawning and survival of valuable game fish species, thereby having a positive impact on sport fishing success.

Sincerely,

Willard Lewis
Special Assistant to
the Secretary

U.S. Department of the Interior Comments on Aquilla Supplement

Comment: Page 1, paragraph 1.03. A 1,992 acre increase in surface area of the conservation pool from 1,288 acres to 3,280 acres would ammount to a 155 percent increase rather than 61 percent. However, if the initial area of 1,887 acres for the conservation pool in the previously proposed plan is used, the increase in surface area to 3,280 acres would be 1,393 acres, or 74 percent.

Response: Error noted. Correction made.

Comment: Page 2, Table I-1. The elevations shown under the current plan for the top of dam, maximum pool, and spillway crest are less than those listed for the previously proposed plan. Since the current plan is larger, we wonder if these figures are correct.

Response: The numbers as published are correct. Subject figures in the Previously Proposed Plan column were for a 5 mgd project based on preliminary hydrological data. Subsequent refinement of the data for the 9.7 mgd project caused the top of the dam to be reduced to elevation 582.5 msl (and, the other elevations were also reduced except for pool elevations).

Comment: The increased surface area of the enlarged conservation pool would lead to an increase in losses to evaporation, which should be evaluated in the environmental statement.

Response: It is recognized that the evaporation losses will be increased when the surface area of the lake is enlarged and the calculated yield takes this into account. However, the change to water quality, microclimate, relative humidy, etc. is believed to be so insignificant that it can neither be categorized as beneficial nor adverse.

Comment: We do not note any reference in the statement to possible impacts of the project on threatened or endangered wildlife species.

Response: The lack of the presence of threatened or endangered fauna in the project area is covered in the discussion of each class in Section 4 of the Final Environmental Statement.

Comment: A statement regarding archeological sites under the heading "beneficial impacts" on page 8 is repeated on page 13 under the heading "adverse effects." In either case, the statement seems to imply that permanent inundation would provide more protection of archeological resources within the 1,992 additional acres of land to be covered than would salvage excavation. Probably less damage will result from permanent inundation than from wave action, but to state that archeological resources will be protected by permanent inundation is incorrect. Also, there will no doubt be additional sites along the proposed lake level that will become subject to wave action. There is no indication of contacts or concurrence with the State Historic Preservation Officer.

Response: The apparent contradiction has been clarified by rephrasing the adverse effects on page 13. The controversy regarding the protective qualities of permanent inundation goes on and the presentation of effects evaluation in environmental statements will always be wrong to one group or another until the official organization of professional archeologists, through research, arrive at a consensus of opinion. There is little doubt that some undetected sites will be uncovered and possibly destroyed by wave wash, however, when such is noted by project personnel the proper authorities are contacted so that protection and salvage can be initiated. Mr. Truett Latimer, *the State Historic Preservation Officer*, was omitted from the coordination list on page 21 but he did receive the letter dated 9 July 1975 with a copy of the supplement inclosed. He was also furnished a copy of the draft environmental statement by letter dated 11 March 1974.

Comment: An alternative which should be considered and discussed in this section is stage-filling of the lake in lieu of immediate full impoundment. The lack of immediate commitment for sale of the full reservoir yield of 9.7 mgd, the absence of planned recreational development other than minimum basic facilities, and the potential fish and wildlife attributes all support the alternative as being *feasible and justifiable*.

Response: We recognize the possibility of stage-filling of the lake and the potential benefits to the fish and wildlife resources of the area. Furthermore, we have been in contact with appropriate Federal and State agencies to ascertain their views on the recommendation. The Ecological Services unit, U.S. Fish and Wildlife Service, Fort Worth, Texas, in a letter dated 28 July 1975, indicated that they strongly support this recommendation. The Texas Parks and Wildlife Department, by letter dated 18 September 1975, stated that they are in agreement with the proposal. The Brazos River Authority, in a letter dated 18 August 1975, urged that the lake be operated from the beginning with the conservation pool at the designed level. It was evident that there are going to be conflicts between the agencies involved. In order to resolve these conflicts and to arrive at a decision whether to incrementally fill or not, the Corps must deliberate among the diverse interests to determine which method, on balance, will produce the most benefits for the public good. To this end it is hoped that a resolution can be made before deliberate impoundment begins.

SIERRA CLUB

LONE STAR CHAPTER

August 5, 1975

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

As requested by your letter of July 9, 1975 the Sierra Club, Lone Star Chapter has reviewed the Draft Supplement to the Draft Environmental Statement regarding the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas.

In the Draft Supplement, the stated reason for increased water supply volume is, "Engineering and economic review of the project resulted in the conclusion that the Aquilla Creek watershed's water resources will be needed by the year 2020 to make up out-of-basin and downstream deficiencies and would be more economically feasible if it were designed and constructed to develop 9.7 million gallons per day (mgd)."

The Supplement also states, "It is expected that by the time the project is no longer able to serve its intended purposes (in excess of 100 years) technology will be able to provide water from other sources and thereby eliminate many of the adverse impacts which may be associated with impoundment projects."

We feel that building Aquilla 45 years in advance of need is exceedingly premature, and literally wastes almost half of the expected life of the project. And, who can predict the state of the economy 45 years into the future?

In addition, we are concerned about the Brazos River Authority proposal to build a 250 mile chain of lakes that would make the river, in effect, one great lake from Whitney Reservoir upstream to Possum Kingdom Reservoir. Aquilla, and the additional six dams proposed will have a definite effect upon the estuarine region. These projects are being evaluated piecemeal, and their combined effects, on the river, on each other, and on the estuary, are not considered. We urge that the Corps of Engineers halt such piecemeal planning, and institute studies towards river basin planning as-a-whole.

At present, we see no need for Aquilla Lake, or its increased water supply volume. Lake Whitney has already been constructed, why could not water be piped from Lake Whitney to area communities, presently dependent upon groundwater?

The Sierra Club, Lone Star Chapter is opposed to the project at this time. Thank you for the opportunity to review this statement.

Sincerely yours,
Mary Wright
Mrs. Franklyn Wright, Vice Chairman
The Sierra Club, Lone Star Chapter
9720 Wisterwood
Dallas, Texas 75238

Richard M. Evans
Chairman
815 Goodhue Bldg
Beaumont, Texas

Sierra Club comments on Aquilla Supplement

Comment: "We feel that building Aquilla 45 years in advance of need is exceedingly premature, and literally wastes almost half of the expected life of the project. And, who can predict the state of the economy 45 years into the future?"

Response: Because the state of the economy 45 years hence is unknown and based on the general trend of the economy from the past, the project formulation revealed that it will be more economical to develop the project now and pay for it with future dollars which will most likely be inflated by present standards. Regarding the lifespan of the project, the water yield of the project, as stated, takes into account that 100 years of sedimentation is contained in the lake bottom. With continually improving soil conservation practices the anticipated volume of sediment may not be accumulated within the 100 year span.

Comment: "Aquilla and the additional six dams proposed will have a definite effect upon the estuarine region."

Response: The combination of Aquilla and six other water resource projects could have a definite effect upon the estuarine region. However, the small size of the Aquilla project, when projected on to the total Brazos River basin, is exceedingly insignificant. This conclusion is based on 2,934,400 acre-feet of water for conservation purposes being contained in 30 projects in the Brazos River basin (including the Aquilla project). Aquilla will impound 52,400 of these acre-feet which is 0.18% of the total. There are no dams, existing or proposed, between the Aquilla project and the estuary region of the Brazos, therefore all flood pool water will go directly to the Gulf as fast as channel capacity will permit. Additionally, the Brazos River does not have a large bay which is generally considered necessary for significant contribution to the finfish and shellfish industry and other estuarine production. Also the Brazos estuarine region has had a history of industrial pollution which may have reduced biological production. Therefore, the significance or degree of effect of the Brazos River basin water resources system upon the estuary is a matter of conjecture.

Comment: "We urge that the Corps of Engineers halt such piece-meal planning, and institute studies toward river basin planning as-a-whole."

Response: The Corps of Engineers has been carrying out river basin planning for several years. If no formal report exists on developments planned for a river basin, the Corps of Engineers coordinates with <u>all</u> other water resource development agencies to assure that piece-meal planning is not carried out.

Comment: "Lake Whitney has already been constructed, why could not water be piped from Lake Whitney to area communities presently dependent upon groundwater?"

Response: Because of its location, Lake Whitney could be a source of water supply for the Aquilla Creek basin if it were not for poor quality water. Sources of saline water, principally of natural origin, in the upper Brazos River Basin seriously degrade the chemical quality of the water in the main stem of the river. Measures to alleviate natural salinity in the basin are being considered, but at best the impounded water in the lake would probably not be suitable for most municipal and industrial uses until after year 2000. Use of water from the lake in the near future would require demineralization by commercial process. Since other sources, either in-basin or out-of-basin, are so much cheaper, demineralization could not be considered as a suitable alternative.

BELL
CORYELL
HAMILTON
LAMPASAS
MILAM
MILLS
SAN SABA

CTCOG

CENTRAL TEXAS COUNCIL OF GOVERNMENTS

Bell County Courthouse Annex East
Telephone 817-939-1801
BELTON, TEXAS

(Mailing Address: P. O. Box 729, Belton, Texas 76513)

July 15, 1975

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

RE: Review of Draft Supplement to Draft Environmental Statement
Aquilla Lake on Aquilla Creek-Hill County, Texas

Dear Mr. Ball:

Based on a staff review of the above mentioned project, the Central Texas Council of Governments finds it unnecessary to make any formal comments in that the project does not affect the Central Texas Region.

We appreciate the opportunity to review this information.

Sincerely,

Charles A. Cass
Executive Director

CAC:jo

COMMISSIONERS
John F. Rogers, Precinct 1
Whitney, Texas—P.O. Box 97
Phone 694-2223
Field Office—Blum 874-2942

Jim Carmichall, Precinct 3
1032 E. Franklin Street
Phone 582-3782, Hillsboro, Texas
Field Office—Bynum, Texas—623-4236

GORDON R. EUBANK

BOX 497 ... 582-2871

HILL... 76645

COMMISSIONERS
A. L. Gatlin, Jr., Precinct 2
Aquilla, Texas—Ph. Whitney 694-3783
Field Office—Aquilla

Kenneth R. Davis, Precinct 4
Res. Hillsboro 582-8109
Field Office - Itasca - 687-2711

August 1, 1975

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

Attention of: SWFED-PR

The draft supplement to the draft environmental statement regarding the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas has been reviewed by the Commissioners' Court of Hill County.

The Court concurs with the draft supplement and approve the same with favorable comment.

Sincerely yours,

Gordon R. Eubank

Gordon R. Eubank
County Judge, Hill County

GRE:vfc

DEPARTMENT OF HEALTH EDUCATION AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

Our Reference: EI# 0176-553

RE: Aquilla Lake, Aquilla Creek
Hill County, Texas

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2) (c) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental laws and regulations.

We, therefore, have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

William F. Crawford

William F. Crawford
Regional Environmental Officer

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 648
Temple, Texas 76501

August 22, 1975

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

We have reviewed the draft supplement to the draft environmental statement regarding the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas.

Generally the supplement adequately describes the additional impact the project will have on the environment and contains measures to minimize adverse effects.

We appreciate the opportunity to review this supplement and make appropriate comments.

Sincerely,

L D Swenson Acting

Edward E. Thomas
State Conservationist

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

August 28, 1975

John C. Ball
Chief, Planning Branch
Department Of The Army
Fort Worth District, Corps Of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

RE: AQUILLA LAKE, AQUILLA CREEK HILL COUNTY, TEXAS.

Dear Mr. Ball:

We have no comments on the draft supplement to the draft environmental statement covering proposed Aquilla Lake or Aquilla Creek in Hill County, Texas.

Thanks for keeping us informed.

Sincerely,

ROBERT K. DODSON
Area Environmental Coordinator

Advisory Council
On Historic Preservation

July 18, 1975

Mr. John C. Ball
Chief, Planning Branch
Corps of Engineers, Fort Worth District
Department of the Army
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

This is in response to your request of July 9, 1975 for comments on the draft supplement to the draft environmental statement for the proposed Aquilla Lake, Aquilla Creek, Hill County, Texas. The Advisory Council notes in its review of the supplement that the undertaking as proposed will affect cultural resources which may be eligible for inclusion in the National Register of Historic Places, and therefore entitled to the protection afforded them by Executive Order 11593, "Protection and Enhancement of the Cultura. Environment" of May 13, 1971. However, the Council also notes that the Corps of Engineers is aware of the requirements of the Executive Order 11593 as implemented through the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800). Accordingly, the Council looks forward to working with the Corps pursuant to the procedures as appropriate.

Should you have questions or require additional assistance in this matter, please contact Michael H. Bureman of the Council staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946. Your continued cooperation is appreciated.

Sincerely yours,

Michael H. Bureman
for Louis S. Wall
Assistant Director, Office of
Review and Compliance

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
826 FEDERAL OFFICE BUILDING
AUSTIN, TEXAS 78701

July 30, 1975

IN REPLY REFER TO
06-48.108

Supplement to Draft Environmental Statement
Aquilla Lake on Aquilla Creek, Hill County

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas

Dear Mr. Ball:

We have no comments with respect to the subject supplement.

Sincerely yours,

for John J. Conrado
Division Engineer

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Duval Building
9450 Gandy Boulevard
St. Petersburg, FL 33702

August 6, 1975 FSE21/DM

District Engineer
Department of the Army
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, TX 76102

Dear Sir:

Reference is made to John C. Ball's letter of July 9, 1975, enclosing the draft environmental statement for the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas, requesting our review and comments.

The National Marine Fisheries Service is unable to adequately investigate the proposed project, and, therefore, can make no definitive recommendations.

Sincerely,

for William H. Stevenson
Regional Director

RECEIVED
8 AUG 1975
CORPS OF ENGINEERS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE Southern Region
819 Taylor Street, Room 10E09
Fort Worth, Texas 76102

July 22, 1975 WFS2x1

Mr. John C. Ball
Chief, Planning Branch
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

We appreciate the opportunity to review the draft supplement to the draft environmental statement, proposed Aquilla Lake on Aquilla Creek, Hill County, Texas.

Our River Forecast Center, Fort Worth, was asked for comments because of the proposed increase in the size of the lake. Ref: SWFED-PR, 9 July 1975.

There is nothing in the supplement that basically changes RFC involvement with the original proposal. They currently forecast for the Aquilla Creek near Aquilla gage (DA=306 $mi.^2$). This basin is estimated to be capable of generating flows of near 100,000 cfs so that it is essential that the NWS be kept informed of construction projects that affect runoff characteristics

With dam closure of Aquilla Creek as proposed, the RFC forecast procedures will have to be revised to account for stored water.

Sincerely,

R. W. Fuller
Acting Regional Hydrologist

cc: RFC Fort Worth

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
Southern Region
Blackland Conservation Research Center
P. O. Box 748
Temple, Texas 76501

September 11, 1975

Mr. John C. Ball
Chief, Planning Branch
Department of the Army
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

Reference your letter of 9 July 1975 concerning a draft environmental statement regarding the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas, we have no further comments to offer on this environmental statement.

Sincerely,

Earl Burnett

Earl Bunett
Director

cc:
J. R. Johnston

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
1100 COMMERCE STREET
DALLAS, TEXAS 75202

REGION VI

September 26, 1975

IN REPLY REFER TO:
6C

Your Reference:
SWFED-PR

Mr. John C. Ball, Chief
Planning Branch
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Ball:

The Department of Housing and Urban Development has reviewed the Supplement to the Draft Environmental Impact Statement for the proposed Aquilla Lake on Aquilla Creek in Hill County, Texas; and does not have comments on the subject document or project.

Sincerely,

Travis Wm. Miller

Travis Wm. Miller
Environmental Clearance Officer

AREA OFFICES
DALLAS, TEXAS · LITTLE ROCK, ARKANSAS · NEW ORLEANS, LOUISIANA · OKLAHOMA CITY, OKLAHOMA · SAN ANTONIO, TEXAS
Insuring Offices
Albuquerque, New Mexico · Fort Worth, Texas · Houston, Texas · Lubbock, Texas · Shreveport, Louisiana · Tulsa, Oklahoma

FINAL

ENVIRONMENTAL STATEMENT

AQUILLA LAKE

AQUILLA CREEK, TEXAS

TULSA DISTRICT CORPS OF ENGINEERS
TULSA, OKLAHOMA

SUMMARY SHEET
AQUILLA LAKE, AQUILLA CREEK, TEXAS

( ) Draft (X) Final Environmental Statement

Responsible Office. US Army Engineer District, Tulsa, Oklahoma
Colonel John G. Driskill, District Engineer
PO Box 61, Tulsa, OK 74102
Telephone - 918-581-7311

1. Name of Action. Initial construction of Aquilla Lake project.

2. Description of Action. The project is located in Hill County, Texas, due north of the city of Waco and east of Whitney Reservoir. Construction features include a reinforced concrete gate tower and outlet works, access roads, project buildings, public-use facilities, and reservoir clearing. Project purposes are flood control, water supply, recreation, and fish and wildlife enhancement.

3. a. Environmental Impacts. Damages from flooding will be reduced on Aquilla Creek and a contribution will be made to flood control on the Brazos River downstream from the Aquilla Creek confluence. The chance of flood-caused epidemics will be reduced. The high quality water supply will provide 5.0 m.g.d. toward meeting future area requirements with the capability for increase in the future when the need arises. However, recreational facilities will not be developed initially since there is no sponsor to cost share under the requirements of Public Law 89-72. About 7.6 miles of Hackberry and Aquilla Creeks will be inundated by the conservation pool. Approximately 125 archaeological sites will be affected by the impoundment.

b. Adverse Effects. The conservation pool will permanently inundate about 1,887 acres of land and an additional 4,478 acres will be inundated during flood control operations. Portions of state farm to market and county roads, pipelines, powerlines, and telephone lines will be relocated. Families living in the project area will be relocated. Plant and animal species composition will undergo some change as a result of construction of the project.

4. Alternatives. The 11 alternatives that were studied for the project are: four mainstem lakes, sites A,B,C, and D each evaluated separately; tributary multipurpose lakes evaluated as one; tributary flood control lakes with water supply import; dry lake with tributary water supply lakes; dry lake with water supply import; and three nonstructural alternatives, flood plain in fee with water supply import, flood plain in easement with water supply import, and no action.

5. Comments were requested from:

Environmental Protection Agency
US Department of Commerce
Department of Housing and Urban Development
US Public Health Service
Department of Interior
Soil Conservation Service
Federal Highway Administration

Office of the Governor of Texas
Office of Economic Opportunity
Texas State Liaison Officer
US Forest Service
Sportsmen's Clubs of Texas, Inc.
Advisory Council on Historic Preservation
Sierra Club of Texas
Izaak Walton League of America

6. Draft statement to CEQ 27 March 1974.
Final statement to CEQ ______.

TABLE OF CONTENTS

SECTION 1 - PROJECT DESCRIPTION

SECTION 2 - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

TABLE OF CONTENTS (CONT)

SECTION 2 (CONT)

SECTION 3 - RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

SECTION 4 - THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

TABLE OF CONTENTS (CONT)

SECTION 5 - ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

SECTION 6 - ALTERNATIVES TO THE PROPOSED ACTION

SECTION 7 - THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

SECTION 8 - IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

TABLE OF CONTENTS (CONT)

SECTION 9 - COORDINATION WITH OTHERS

TABLES

TABLE OF CONTENTS (CONT)

TABLES (CONT)

FIGURES

PLATE

SECTION 1

PROJECT DESCRIPTION

1.01 Project Construction. The proposed plan of improvement for the Aquilla Creek Watershed is for the construction of a multiple-purpose lake which would be constructed for flood control, water supply, and recreation and fish and wildlife. Aquilla Dam would be located on Aquilla Creek at mile 23.3 which is about 6.8 miles southwest of Hillsboro, Texas, and about 24 miles north of Waco, Texas. The location of the lake is shown on plate 1-1.

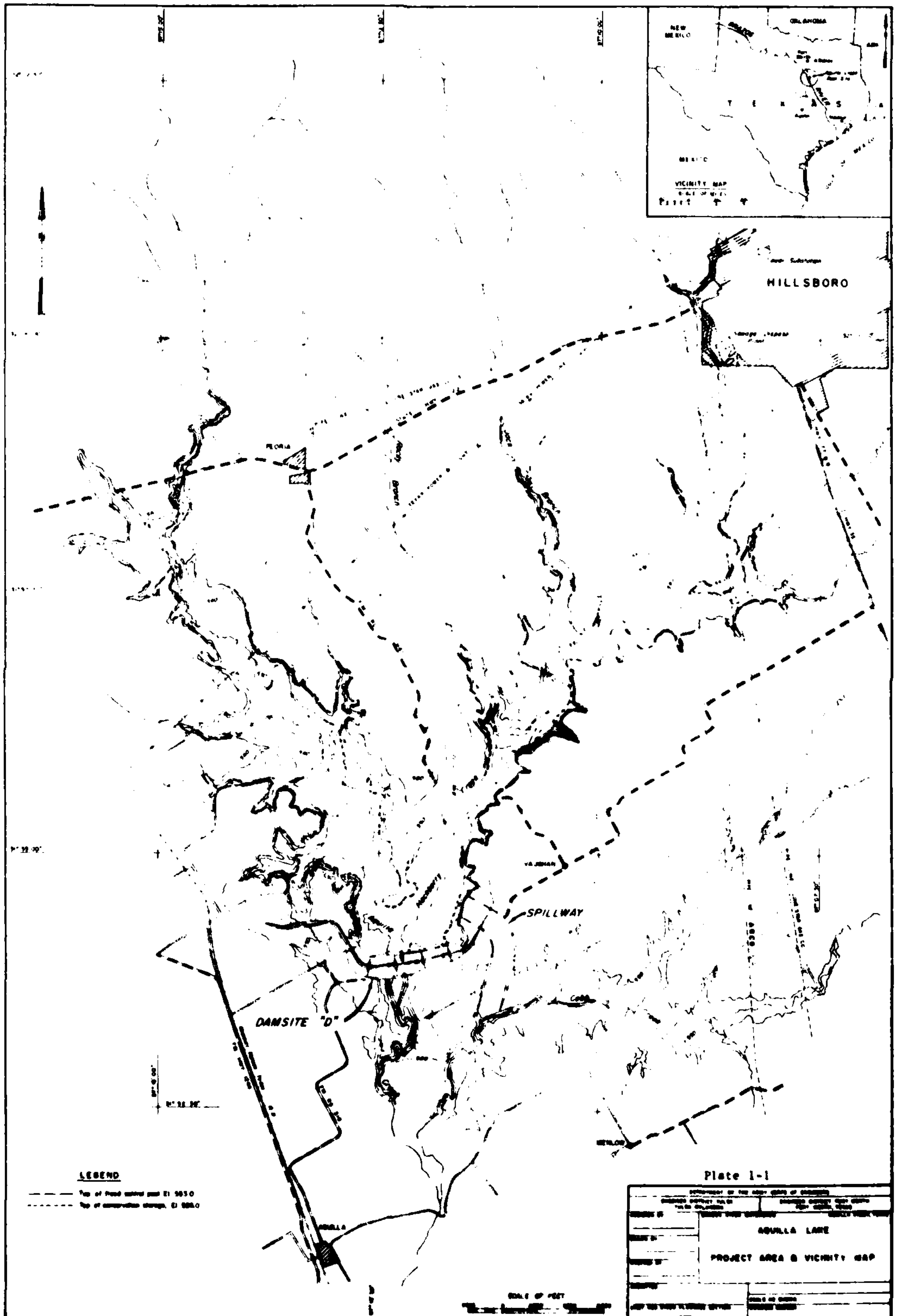
The project was authorized for construction by Public Law 483, 90th Congress as recommended by the Chief of Engineers in Senate Document 52, 90th Congress, 1st Session.

Aquilla Lake would be formed by an earth dam having a length of about 15,000 feet and a maximum height above the streambed of about 95 feet. The spillway structure would be located on the left abutment and would consist of an uncontrolled limited service spillway. The spillway crest length would be about 1,200 feet. The outlet works would consist of a gate-controlled 10-foot-diameter conduit.

Aquilla Lake would have a surface area of 1,887 acres at elevation 526.0, top of conservation pool, and an area of 6,365 acres at elevation 553.0, top of flood control pool. The lake formed by the conservation pool will provide about 18 miles of shoreline. The total controlled storage at elevation 553.0 would be 126,000 acre-feet. Land required for construction and operation of the proposed project amounts to 11,800 acres in fee simple. Of the total land required, 70 percent is classified as cropland, 29 percent as pastureland and woodland, and 1 percent homesites.

Construction of the lake would necessitate the relocation of about 4 miles of highways, (State highways, farm-market, and county roads), 6 miles of powerlines, 8.5 miles of pipelines, and 2 miles of telephone lines. Road relocation will also require nine bridges with a total of 3,375 feet. The FM1947 bridge over Hackberry Creek will be 1,500 feet long and a Hill county road bridge over Aquilla Creek will be 1,250 feet long. The protection and/or acquisiton of the mineral value (including oil and gas) is included in the contruction cost estimate.

The proposed lake would contain sufficient flood control storage to control the 50-year frequency flood at the damsite. Water conservation storage of 10,800 acre-feet in the lake would develop a total dependable water supply yield at the site of about 7.7 cubic feet per second (cfs) or 5 million gallons per day (mgd), based on maximum drought conditions (May 1953 through March 1957), and on projected conditions of watershed development by the Soil Conservation Service Sediment storage of 25,700 acre-feet would allow for deposition of sediment for a 100-year period.



NEW MEXICO
OKLAHOMA
T E X A S
MEXICO
VICINITY MAP
HILLSBORO
PEORIA
SPILLWAY
DAMSITE "D"
LEGEND
SCALE OF FEET
Plate 1-1
AQUILLA LAKE
PROJECT AREA & VICINITY MAP

TABLE 1-1

COMPARISON OF THE AUTHORIZED PLAN AND THE PROPOSED PLAN

Feature	Project Document Plan	Proposed Plan
General		
Mile above mouth	20.7	23.3
Drainage area, square miles	294	252.0
Elevations, feet, MSL		
Top of dam	570.0	585.5
Maximum pool	565.2	580.5
Spillway crest	551.0	568.0
Top of flood control pool	551.0	553.0
Top of conservation pool	533.5	526.0
Storage, acre-feet		
Flood control	111,500	89,500
Conservation	59,700	10,800
Inactive	28,100	25,700
Total	199,300	126,000
Area, Acres		
Top of flood control pool	9,180	6,365
Top of conservation pool	4,560	1,288 (1)
Spillway		
Location	Valley	Saddle
Type	Broadcrested Wier	Limited Service
Crest, width, feet	1,200	1,200
Discharge at maximum pool, cfs	169,100	152,000
Outlet Works		
Conduit size	10'	10'
Gate size	Two 5' x 10' Sluice Gates	Two 5' x 10' Sluice Gates
Yield, mgd		
Water supply	9.7	5.0

(1) Ultimate area after 100-years sedimentation. Initial area is 1,887 acres.

The proposed water supply yield of 5.0 mgd will probably be used by the cities of Hillsboro and West. The Brazos River Authority has furnished assurances of repayment. The yield of 5.0 mgd represents only a portion of the dependable yield of 17.5 mgd which could be developed at the site. However, the option for increasing the water supply storages will not be foreclosed since the project could be modified to provide a higher yield when the damand develops. The major differences between the authroized plan and the proposed plan are shown in table 1-1. Alternative studies are presented in section 6.

Departures from the authroized plan of protection reflect refinements in the economy and efficiency of the proposed project. Those refinements are considered to be within the discretionary authority of the Chief of Engineers to approve.

In the absence of a non-Federal public body to cost-share in recreation development cost, only those features set out for health and safety considerations will be constructed initially. This minimum facility procedure is provided by Public Law 89-72. However this law does not preclude a possible future cost-sharing agreement being made, at which time a more complete recreation plan could be developed. The recreation benefits are based on minimum facilties. It is expected that recreational activities at Aquilla Lake will occur mainly at points where existing roads terminate at the water's edge. Barricades, turnarounds, and some vault toilets will be constructed at these points. The cost of these health and safety features is estimated at about $42,000.

The average annula cost of the Aquilla project using a 100-year economic analysis period and an estimated first cost of $27,100,000 is $1,087,600. The total average annual benefits from the Aquilla project are $1,675,600. The benefit-cost ratio is 1.5 to 1. All costs are 1973 base. The following tabulation shows the annual cost and a breakdown of the estimated benefits.

1.01.1 Annual Costs. (Includes interest and amortization @ 3⅛ percent and operations, maintenance, replacements, and $1,800 of unmitigated fishing losses) $1,087,600. A summary of the economic data is presented in table 1-2.

TABLE 1-2

SUMMARY ECONOMIC DATA

ECONOMIC DATA, EXTRACTED FROM US ARMY CORPS OF ENGINEERS GENERAL DESIGN MEMORANDUM, PHASE I, PLAN FORMULATION, FOR AQUILLA LAKE, AQUILLA CREEK, TEXAS. COMPLETE DOCUMENT IS AVAILABLE AT US ARMY ENGINEER DISTRICT, FORT WORTH, PO BOX 17300, FORT WORTH, TEXAS 76102

Total Project Cost	$27,100,000
Average Annual Cost (1)	
Interest and amortization	944,300
Operation and Maintenance	130,400
Major Replacements	11,100
Subtotal	1,085,800
Unmitigated Fish and Wildlife Losses	1,800
Total	$ 1,087,600
Average Annual Benefits	
Flood Control	$ 1,079,000
Water Supply	472,600
Recreation and Fish and Wildlife	84,000
Redevelopment	40,000
Total	$ 1,675,600
Benefit-to-cost Ratio	1.5

Non-quantifiable environmental benefits and costs are not reflected in the benefit-to-cost determination; however, these factors were included in the comparison of the recommended plan with the alternative plans considered in section 6 of the environmental statement.

(1) The economic life of the project is estimated to be 100 years. A discount rate of $3\frac{1}{4}$ percent has been used for economic evaluation.

1.01.2 Average Annual Benefits.

Flood Control	$ 1,079,000
Water Supply	472,600
Recreation, and Fish and Wildlife	84,000
Redevelopment	40,000
	$ 1,675,600

1.01.3 Fish & Wildlife Mitigation. Fishing losses in the Aquilla Creek Basin will not be mitigated. The plan recommended for mitigation of hunting losses by the Bureau of Sport Fisheries and Wildlife does not appear to be economically justifiable. The Corps believes that the desirable way to mitigate hunting losses is to utilize project lands based on the "Joint Policies of the Department of the Interior and the Army Relative to Reservoir Projects." Under current Corps policy, resource, forestry, land and fish and wildlife management plans would be developed for Aquilla Lake. These plans would be beneficial to hunters, fishermen, and others who are interested in project resources and should essentially accomplish the objectives of the recommendations.

1.02 Project Operation.

1.02.1 Reservoir Regulation and Flood Control. Aquilla Lake will be operated for flood control, water supply, and recreation. Water supply releases will be made as demands develop. The project will be operated for maximum flood control benefits on Aquilla Creek. Releases from the lake will be determined by the amount of flood control storage used, predicted runoff from the uncontrolled areas downstream and available channel capacities, and forecasted use of flood control storage by predicted inflow volumes. The available downstream channel capacity would be used for releases of water in maintaining an approximate balance in the relative amount of flood control storage available in the lake. The limiting channel capacity in the reach below Aquilla Lake on Aquilla Creek is about 3,000 cfs. and controlled releases would exceed this amount only when the flood control storage capacity of the project is in danger of being exceeded.

1.02.2 Maintenance of Project and Its Related Structures and Facilities. Maintenance of Aquilla Lake and its related structures and facilities will be performed in accordance with a Maintenance Manual for Aquilla Lake. The manual will provide for inspection and maintenance of the earth dam, concrete spillway and outlet works, crane and hoists, buildings and grounds, water supply and sewage systems, standby generating unit, radio communication system, and various types of vehicles and equipment for administration and maintenance of the project. The manual will provide an inspection checklist, including maintenance to be performed, and supplemental information concerning principles related to maintenance practices and methods of repairing and maintaining equipment.

1.02.2.1 Disposal of Sewage and Solid Waste.

1.02.2.1.1 Disposal of Sewage. Sewage removed from vault toilets at Aquilla Lake will be disposed of by commercial contractors who will dispose of the waste in a State-approved sewage treatment facility located on project lands or in a local State-approved municipal treatment plant. Effluent from the project office buildings will flow into a septic tank and oxidation pond. Sewage generated by boats using the lake will be disposed of by individual boat owners in sanitary facilities located at marinas and on project lands.

1.02.2.1.2 Disposal of Solid Waste. Solid waste generated on project lands and waters will be disposed of by commercial contractors who will remove the waste to a State-approved landfill located off project lands.

1.02.2.2 Insect and Undesirable Vegetation Control.

1.02.2.2.1 Insect and Rodent Control. The control of pest insects and rodents at Aquilla Lake will be done through the elimination of the pests breeding habitat, i.e., refuse, sewage, stagnant water, brushy vegetation, etc. Should the need for chemical control measures arise, any chemical used will be registered and approved by the Environmental Protection Agency.

1.02.2.2.2 Control of Undesirable Vegetation. Vegetation controls used at Aquilla Lake will consist primarily of mowing grass and trimming shrubbery around project buildings and brushhog mowing along roadway shoulders. Some additional mechanical control will be accomplished by project personnel in selected areas around the lake that will benefit aesthetically by removal of the vegetation. Approved herbicides will be used to control vegetation only in areas that cannot be controlled by mowing. Only those herbicides approved by the Environmental Protection Agency will be used.

1.02.2.3 Vegetation and Wildlife Management.

1.02.2.3.1 Vegetation Management. At the present time there is no formal vegetation management program for Aquilla Lake. Guidelines have been established for the preparation of a vegetation management plan. The plan will be a multiple-use type and will provide for the most beneficial uses of the project lands for recreation, wildlife, timber, and watershed. Until the vegetation management plan is formalized and implemented, the planting of trees and shrubs for landscape purposes and cooperative efforts to control wildfire will be the only vegetative management activities undertaken.

1.02.2.3.2 Wildlife Management.

a. General. Resident fish and wildlife belongs to the State of Texas regardless of land ownership. The state, through the Texas Parks and Wildlife Department, has the authority and responsibility to preserve and manage all resident fish and wildlife. Both the US Fish and Wildlife Service and the Texas Parks and Wildlife Department are responsible for the conservation and management of all migratory animals. The Corps of Engineers, as a landowner, has the responsibility to restore and improve the fish and wildlife at Aquilla Lake through habitat development and wise use of land. Areas not managed through license or other formal agreements will be managed by the Corps of Engineers through implementation of a fish and wildlife management plan.

b. Planned Wildlife Management by the Corps of Engineers. The Corps will manage wildlife on all project lands not licensed to another wildlife agency as appropriate. Practices recommended are designed to benefit all species of wildlife. However, emphasis has been placed on game species and songbirds.

The boundary of project lands will be marked so that the public can distinguish between private and public property. Fences will be constructed on Government lands where required to regulate livestock grazing. Any grazing or agricultural use will be an interim or corallary in wildlife management to complement the objectives.

Invasion of grasslands by woody species may be controlled by mechanical means as required by individual management units to improve wildlife habitat.

Disking will be done to control woody growths and to encourage annuals utilized by quail, rabbits, and songbirds. Disking will be in strips along forest margins or in large areas of dense vegetation.

Habitat plantings will be planted in strips at preselected sites with special attention being given to field margins, fence rows, and large open fields.

Public hunting maps will be prepared for Aquilla Lake. These maps will indicate areas open to hunting and will provide general hunting information.

Recreation areas will also be managed to attract wildlife for the public to see. Mowing will be held to a minimum to permit natural cover to develop. Plantings will be in accordance with the project master plan. Nature trails will be constructed to complement recreation areas and to further encourage wildlife usage. Hunting will be prohibited in all developed recreation areas.

1.02.2.4 Public Recreation Management. The recreation benefits including those for sport fishing and hunting are based on minimum facilities. The operation and maintenance of minimum facilities consists of the removal and disposal of solid waste and sewage from the facilities, the mowing and control of undesirable vegetation, insect control through the elimination of pest breeding habitat, and judicious applications of pesticides.

1.02.2.5 Management of Land Resources and Facilities.

1.02.2.5.1 Land Management Plans. A total resource management program involving vegetation management, wildlife management (habitat manipulation and cooperative game management with the State Wildlife Agency), erosion control, management and surveillance of general outgrants and pollution control is under development and will be implemented as the project becomes operational.

1.02.2.5.2 Management of Leases, Easements, and Other Outgrants. There may be some agricultural and grazing leases at the project on an interim basis. These leases will be phased out when development and use of the project lands for the purposes zoned is accomplished. The leases will be administered by the Corps of Engineers. There may also be some mineral leases at the project. However, no drilling or excavating will be allowed on project lands.

Easements do exist for electric lines, telephone lines, county roads, waterlines, and related structures, etc., and one proposed lease for a commercial concession. Private individuals wishing boat storage facilities will be encouraged to use the facilities to be offered by the commercial concession.

1.02.2.6 Project Management and Maintenance Activities. The shoreline at the project does support some grasses and forbs which help to stabilize the slopes. However, fluctuation in the surface elevation resulting from flood control operation of Aquilla Lake will cause some shoreline erosion and possible mortality of shoreline vegetation. Another erosion problem area may be the vicinity just below the dam. If this should occur, it will be corrected by the placement of rock dikes. It is anticipated that erosion further downstream will not be extensive. Other than the measures to be taken below the dam, water-tolerant grasses and other erosion-retarding ground covers will be established to protect shorelines and roadways from erosion.

SECTION 2 - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

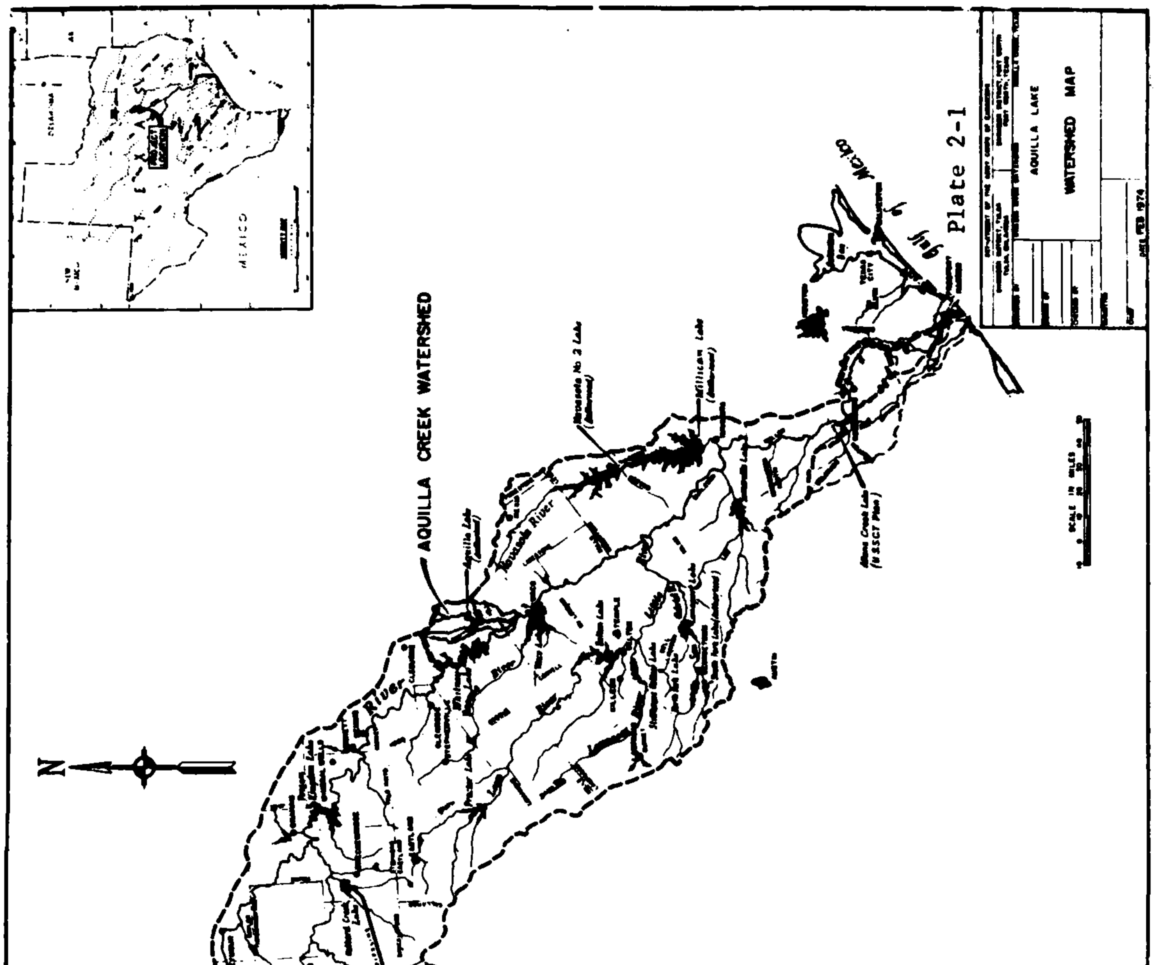
2.01 The Basin. The Aquilla Creek Watershed is located in central Texas within the southern portion of the Central Brazos River Basin (plate 2-1) in the western portion of Hill County but extending into McClennan County on the south and Johnson County on the north. The watershed has a maximum length of 41 miles and a maximum width of 16 miles. Terrain within the watershed can be described as rolling and hilly with narrow valleys and streams which are moderately entrenched. The East Cross Timbers, Blackland Prairie, and Grand Prairie physiographic areas, which occur in the basin, interlock and form transition areas between adjacent ecological communities thereby making considerable environmental variations available within short distance.

2.02 Natural Environment of the Basin. Aquilla Creek and its tributaries, Cobb Creek and Hackberry Creek, extend through a portion of the natural area which contains the east and west cross timbers as well as the grand prairie (Anon., 1945). Each of these streams is intermittent prior to the confluence of Hackberry and Aquilla Creeks. From this point toward the Brazos River there usually is a rather slow, continuous flow.

The entire watershed is subject to rather intense runoff, due to the high percentage of it that is under cultivation. This runoff causes flash flooding along Aquilla Creek and its tributaries. Moreover, runoff water in this region carries a severe silt load. This silt load dramatically increases turbidity of the streams following each rain. Usually floodwaters recede rapidly, but the turbidity persists for some time. The settling of silt and clay particles, which reflect the primary soil constituents of the watershed, leaves a silt deposit on the bottom of these streams. In certain localized portions of these streams, however, the flow is sufficient to produce clean sandy and gravelly areas. These are usually found in the form of rather slow moving riffles. The banks of these three streams are generally deep and steep, and they are covered by silt and clay particles.

An east-west transect across Aquilla and Hackberry Creeks provides a convenient means of visualizing the variation of the environment within the area. The transect has been divided into distinct zones or microenvironments (Coe and Flannery 1964). The microenvironmental zones are recognized on the basis of variations in topography, geology, vegetation, fauna, and water resources. Six zones are recognized and described below; these include: (1) flood plain, (2) the creek edge, (3) a rise or peninsula within the flood plain, (4) the edge of the flood plain and base of the upland, (5) the upland slope, and (6) the upland (figure 2-1).

2.02.1 Flood Plain. Aquilla and Hackberry Creeks are intermittent streams which drain into the Brazos River. Both creeks are entrenched into their respective flood plains. Much of the bottomland is in cultivation and pasture today. Flooding is a serious problem within the watershed and in areas where the original ground cover has been cleared erosion has become a problem.


AQUILLA CREEK WATERSHED
Watershed Boundary
Plate 2-1
AQUILLA LAKE
WATERSHED MAP
MEXICO

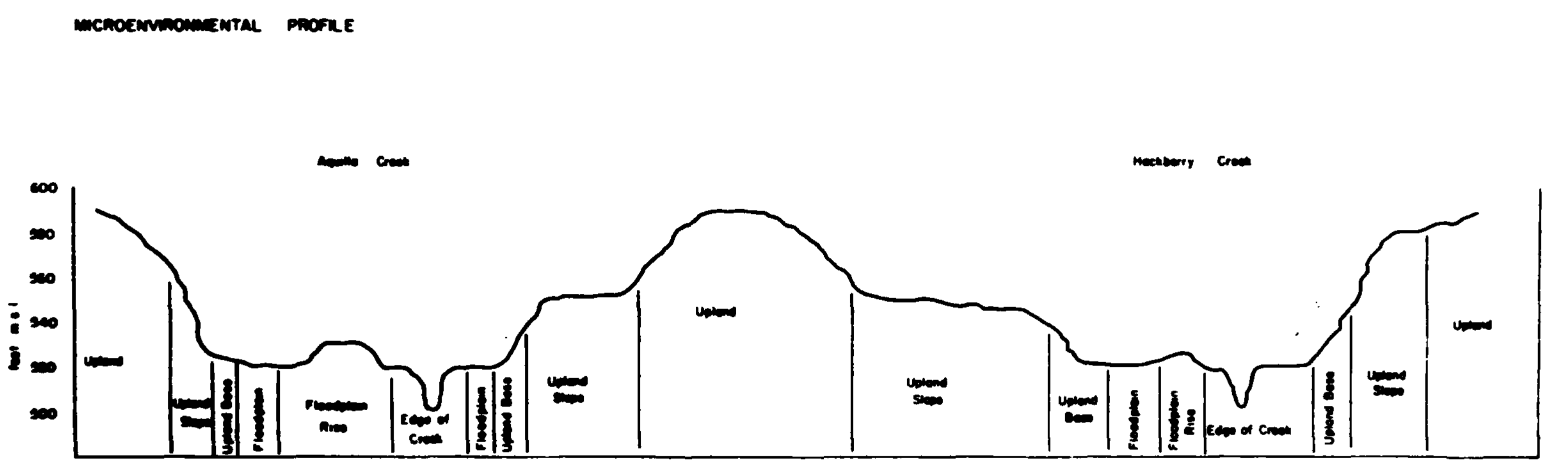


Figure 2-1 Microenvironmental Profile.

2.02.2 Creek Edge. Overbank flooding has deposited low levees along the creek banks due to the deposition of heavier silts adjacent to the creek. Upper and understory foliage is thick along the creek banks.

2.02.3 Rise or Peninsula Within the Flood Plain. Stabilized remnants of Pleistocene terraces occur throughout the watershel and appear as sandy knolls within the flood plain. They rise in elevation from 510-531 feet, mean sea level (MSL), and are isolated as islands when the bottom land is flooded. The sandy soil is covered with trees and grass if not in cultivation.

2.02.4 Flood Plain Edge/Upland Base. This zone is located throughout the reservoir between the 510-to 530-foot contour. Soils from the flood plain and the upland interdigitate at this juncture. Distance to the creek varies but water is available in the vicinity.

2.02.5 Upland Slope. Natural terracing is the most prominent feature of the upland slope. The slope is moderately rolling with few steep bluffs and many broad level areas which support a tree cover of oaks and elms. The ground has a heavy grass mat and erosion is prominent only where clearing has allowed removal of the grass. Oaks are prominent on the slopes of the watershed especially in the Eastern Cross Timbers area.

2.02.6 Upland. The upland zone is that area above 560 MSL that is gently rolling and supports a dense cover of oaks and hickories or grass. Water is unavailable in the area after rains, but the vegetation is thick.

2.03 Geology of the Basin. The Aquilla Creek drainage basin lies predominantly within the Eastern Cross Timbers subdivision of the West Gulf Coastal Plain physiographic province. The Eastern Cross Timbers is a narrow, north-south trending belt bounded on the west by the Grand Prairie subdivision and on the east by the Blackland Prairie subdivision. Generally, topography of the basin and its surrounding area reflects both the influence of bedrock composition and the regional eastward dip of the bedrock formations. Bedrock of the Grand Prairie is comprised of erosion resistant limestone beds separated by shale beds of lesser thickness. The formations involved in the area adjoining the Eastern Cross Timbers, are, in ascending order: The Georgetown Limestone, the Del Rio Shale, and isolated remnants of the Buda Limestone, all of Cretaceous Age. The Eastern Cross Timbers is formed on more erosion-prone sandstone and shale beds of the Woodbine formation, which overlies the formations of the Grand Prairie. The Woodbine and soils developed on it support a moderate growth of timber, giving rise to the name of this subdivision. The Blackland Prairie is developed largely on massive, easily eroded limy shales overlying the Woodbine formation, which along the boundary with the Cross Timber constitute the Lake Waco and South Bosque formations of the Eagle Ford groups, also of Cretaceous Age. All of these formations dip to the east-southeast at approximately 35 to 40 feet per mile.

The portion of Aquilla Creek Valley in which the dam and lake mainstream sites are located lies wholly within the outcrop belt of the Woodbine formation. The only exception occurs in the uppermost slopes of the east valley wall (left abutments) where bedrock belonging to the Eagle Ford group of formations crops out. The Woodbine formation is comprised of a basal sandstone member, a middle shale member, which is the thickest member and which contains a few scattered sandstone beds, and an upper member composed of massive sand and sandstone beds with shale interbeds. The sandstone beds are comparatively thin in the lower reaches of Aquilla Creek Valley but thicken in an upstream direction. The total thickness of the Woodbine formation is about 125 feet. The shale of the Woodbine is nonlimy in contrast to all other shales in the region. The Woodbine has been removed by erosion in the valley section of Aquilla Creek. Hackberry Creek, the longest, most extensively developed tributary of Aquilla Creek, flows over the Lake Waco and South Bosque formations of the Eagle Ford group along most of its course. Both of these formations consist of limy shale with only a few thin, marly limestone beds. Based on experience gained from two other lakes in the general area built on the Woodbine formation, no seepage problems are expected at Aquilla Lake.

Overburden soils mantling the bedrock in Aquilla Creek Valley consist of clay underlain by a few feet of sandy or gravelly clay. Usually, only a thin soil cover is present on the valley slopes, but its thickness varies from about 20 to 30 feet or more in the central part of the valley. Soils mantling the bedrock along Hackberry Creek, Alligator Creek, and Cobb Creek have not been sampled, but from surface indications they appear to be chiefly clay with a thin basal clayey, sandy gravel. Thickness of these materials probably varies from a few feet to as much as 20 feet.

Ground water is present in the overburden soils, and in the sandstone and fractures in the bedrock. The water table roughly parallels surface topography, but exhibits less relief than the ground surface. Exceptions to this relationship are limited to a few places in the uppermost slopes of the valley where discontinuous perched ground water aquifers have been encountered. The sandstones of the Woodbine formation comprise a subsurface fresh water aquifer that supplies wells to the east of Aquilla Creek Valley. The larger of these wells yields from 30 to 50 gallons per minute (gpm). Examples are the wells at the nearby town of Hillsboro, Texas. The recharge area for the Woodbine aquifer is its outcrop belt, of which Aquilla Creek Valley is a part.

The area of Aquilla Creek Valley discussed herein is located from 6 to 14 miles west of the major east-northeast trending Balcones fault system. All of the bedrock formations are displaced downward more than 100 feet on the east side of this fault. One minor displacement fault, trending north-northwest, is mapped by the Texas Bureau of Economic Geology in Aquilla Creek Valley a short distance above its confluence with the Brazos River. There is some evidence suggesting the presence of other small displacement faults approximately 3 miles southwest of river mile 16.1. The principal effect of such faulting is offsetting of the bedrock strata in a vertical sense. The depth of any particular bed is abruptly different on opposite sides of a fault. It is unlikely that fault displacements in Aquilla Creek Valley will exceed 40 feet. The possibility of fault movement was carefully investigated during reanalysis of design for Waco Dam, which lies astride part of the Balcones fault system 18 miles to the south. A positive line of evidence was developed during the investigation which indicated that no recent movement had occurred along the Balcones fault system. Additionally, Aquilla Creek Valley is located in the northern part of the portion of Texas mapped as "having no reasonable expectancy of earthquake damage" by the Environmental Science Services Administration (1969).

The only known mineral production in Aquilla Creek Valley and its tributaries is gravel and lime. Two gravel pits at about river mile 22, on the east side of Aquilla Creek, were the only sites of production found and both are abandoned. There is no known oil or gas production in Aquilla Creek Valley or in the valleys of its tributaries.

2.04 Climate of the Basin. The Aquilla Creek Watershed has a generally mild climate and a large range of annual and daily temperatures. In summer, the days are usually hot and the nights moderately warm. Generally, the winters are moderate; however, freezing temperatures and snowfall are occasionally experienced during the passage of cold high-pressure air masses from the northwestern polar regions and the continental western highlands.

The mean annual temperature for the watershed is about 66 F. Temperatures have ranged from a high of 113 F to a low of 1 F. January, the coldest month, has an average minimum daily temperature of about 34 F. August, the warmest month, has an average maximum daily temperature of about 98 F. The average length of growing season between killing frosts is about 250 days.

The mean annual precipitation over the Aquilla Creek Watershed is about 34 inches. Snowfall is an insignificant portion of the total precipitation. Although the Aquilla Creek Watershed receives a substantial amount of precipitation, the variability in rainfall and runoff have caused flood and water supply problems in the watershed.

2.05 The Creek. Aquilla Creek originates near Cleburne, Texas, and flows a distance of about 54 miles in a south to southeasterly direction to its confluence with the Brazos River. The stream valley is relatively narrow. The major tributaries, beginning at the headwaters region and proceeding toward the mouth, include Cottonwood Creek, Little Aquilla, Hackberry, Cobb, and Alligator Creeks. Pertinent data, drainage areas, lengths, and channel capacities for Aquilla Creek and its principal tributaries are presented in table 2-1.

The study area for flood control problems consist of the flood plain of Aquilla Creek downstream of stream mile 23.3 and the flood plain of the Brazos River downstream of the mouth of Aquilla Creek. The flood problems on the Aquilla Creek are the result of frequent floods caused by heavy and

TABLE 2-1

PHYSICAL CHARACTERISTICS
AQUILLA CREEK AND TRIBUTARIES

Stream	Confluence with parent Stream (miles above mouth)	Length (River miles)	Approximate Total Fall (feet)	Drainage Area (Sq Mi)
Aquilla Creek	417.1	54	470	410
Elm Creek	4.1	6	180	8
Dry Creek	5.3	7	120	8
Pattern Branch	7.9	7	140	11
Snake Creek	11.1	5	180	11
Alligator Creek	16.5	10	210	31
Dead Horse Creek	18.5	7	160	8
Cobb Creek	19.5	18	340	40
Hackberry Creek	23.5	24	320	129
Little Aquilla	31.6	10	270	25
Cottonwood Creek	39.8	10	170	22

	Average Streambed Slope (feet per mile)	Channel Capacity (c.f.s.)
Aquilla Creek		
Mile 0.0 to 13.2	3.4	3,000
Mile 13.2 to 20.6	4.7	4,000

frequent storm rainfall and inadequate channel capacities. During the period of record, 1939 to 1970, nine major floods occurred producing peak discharges at the Aquilla gage (mile 18.2) varying from 10,800 to 40,200 second-feet. The maximum flood of record in May 1968 produced a discharge of 40,200 second-feet and a stage of about 31 feet which is about 19 feet above flood stage. Prior to the period of record, the maximum known flood occurred on 31 August 1887, producing a maximum stage of 34 feet at the Aquilla Creek gaging station. Also, the flood of 27 September 1936 reached a stage of 33 feet and a peak discharge of 74,200 second-feet. The channel capacity of Aquilla Creek is insufficient to contain these floods, being about 3,000 second-feet downstream of mile 13.2 and being as low as 4,000 second-feet between miles 13.2 and 23.3. The flood plain of Aquilla Creek is an agricultural area, containing agricultural properties, transportation facilities, and utilities. There is no urban development. Within the problem area on Aquilla Creek (mile 5.0 to 23.3) the estimated value of physical property is about $4,946,000, and the estimated average annual damages are about $85,000 under present conditions of development.

The major floods that originate on the Aquilla Creek Watershed contribute appreciably to the flood problems on the lower Brazos River. Based on records during the period 1898-1971, 26 major floods have occurred on the Brazos River. These floods produced peak discharges ranging from 65,000 second-feet to 246,000 second-feet and a stage of 40.9 feet at the Waco gage. The minimum channel capacity of the Brazos River from the mouth of Aquilla Creek to the mouth of the Bosque River is 27,000 second-feet. The Brazos River flood problem area contains urban and highly developed agricultural areas as well as numerous transportation facilities, utilities, and rural nonagricultural properties. Within the investigated Brazos River problem area below the mouth of Aquilla Creek, the estimated value of physical property is about $1,384,000,000 and the estimated average annual damages are about $5,381,000 under present conditions of development, assuming the authorized system of Brazos River Basin reservoirs in operation.

2.06 Water Quality of the Streams in the Basin. Water quality data, plankton, and benthic invertebrate samples were taken from seven sites in the Aquilla Creek Basin (figure 2-2) during the summer of 1972 by personnel from Southern Methodist University, Dallas, Texas. The following discussion of water quality is based on their results; however, additional and more extensive water quality date are available from the US Geological Survey and the Brazos River Authority (appendix F). Water samples were analyzed for several parameters (table 2-2), including calcium, magnesium, iron, sodium, potassium, lead, temperature, pH, dissolved oxygen, relative transparency, conductivity, color, iron, manganese, nitrates, phosphates, sulfates, ammonium, turbidity, and alkalinity.

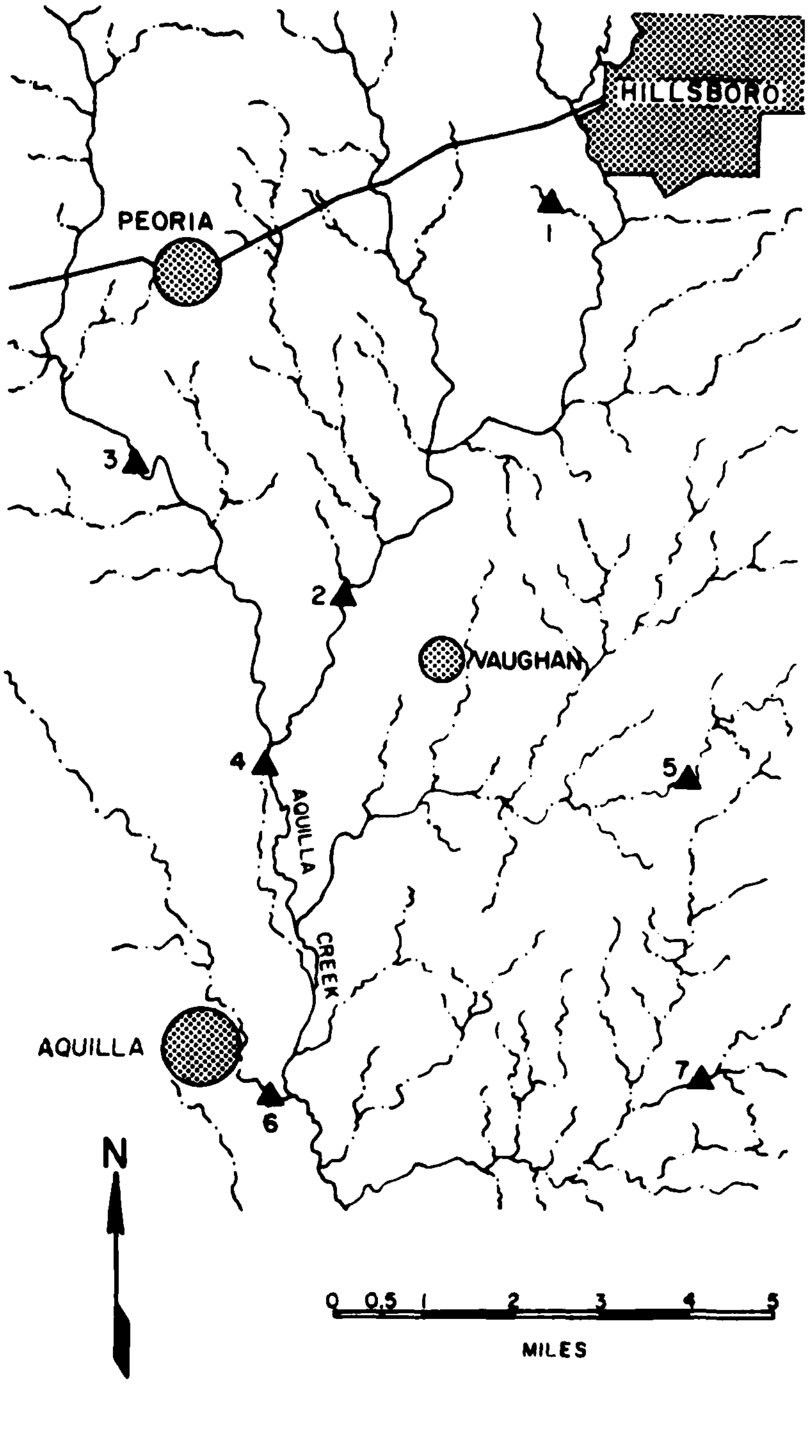


Figure 2-2 Zoologic Collection Locales.

TABLE 2-2

AQUILLA CREEK
WATER QUALITY DATA, 1972

Parameters (1)	June							July							August						
	Sites							Sites							Sites						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Temperature (°C)	27.0	23.0	24.0	25.0	25.6	25.5	24.0	29.3	26.0	26.3	26.4	26.3	26.1	24.2	28.4	25.5	25.0	25.1	26.2	25.0	24.
Dissolved Oxygen	2.4	2.1	4.1	3.1	3.2	2.5	4.2	2.0	2.9	4.7	3.0	1.0	2.4	4.1	2.2	2.5	4.1	3.2	1.3	2.5	3.
pH (units)	8.2	7.6	7.0	7.4	7.4	7.6	7.7	7.8	7.0	7.3	7.3	7.4	7.5	7.6	8.0	7.4	7.2	7.6	7.5	7.6	7.
Carbon Dioxide	88	25	25	30	80	25	4	98	30	28	26	75	35	12	80	30	26	32	80	28	16
Alkalinity (ppm $CaCO_3$)	110	120	120	100	100	135	110	100	100	130	100	100	110	130	120	80	100	125	100	130	115
Total Hardness (ppm $CaCO_3$)	380	390	350	420	450	420	370	320	420	390	410	410	450	400	420	440	430	400	460	480	420
Conductivity (ppm NaCl)	800	950	960	900	1100	980	950	920	1000	975	950	1000	950	950	850	1000	950	975	1075	1300	1000
Ammonia Nitrogen as N	1.00	0.10	0.30	0.30	1.4	0.35	0.85	1.40	0.20	0.15	0.25	1.0	0.40	0.40	1.58	0.25	0.30	0.40	1.50	0.40	1.00
Nitrate Nitrogen as N	1.40	1.20	1.00	2.40	3.00	2.80	2.00	1.00	2.20	2.00	2.00	2.90	2.90	2.20	1.50	1.00	1.30	2.20	3.30	2.90	1.90
Nitrite Nitrogen as N	0.008	0.002	0.011	0.010	0.008	0.006	0.015	0.008	0.002	0.012	0.012	0.006	0.003	0.012	0.007	0.005	0.016	0.010	0.008	0.010	0.012
Total Phosphates	0.19	0.04	0.10	0.10	0.08	0.00	0.04	0.29	0.02	1.06	0.08	0.08	0.01	0.08	0.20	0.03	0.12	0.11	0.06	0.01	0.04
Sulfates	175	120	100	125	120	115	110	160	135	120	125	140	120	135	200	130	110	130	140	140	120
Sodium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	253.0	65.2	21.2	46.8	382.0	-	17.
Potassium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	3.5	2.3	2.6	18.8	-	2.5
Calcium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62.3	74.3	75.0	74.6	373.0	-	67.7
Magnesium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.4	2.2	1.8	1.9	20.0	-	1.6
Iron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.1	< 0.1	0.4(2)	0.3	< 0.1	-	< 0.1
Lead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	-	< 0.1
Turbidity (JTU)	75(2)	110(2)	70(2)	140(2)	150(2)	100(2)	[illegible]	95(2)	120(2)	75(2)	135(2)	145(2)	[illegible]	[illegible]	135(2)	160(2)	80(2)	160(2)	120(2)	130(2)	80(2)
Relative Transparency (inches)	12	6	8	8	-	8	18	15	7	7	8	-	8	16	17	3	8	9	-	9	14

(1) All units ppm unless otherwise noted.
(2) Exceeds suggested limits of Public Health Service.

* Data Collected by SMU, June, July, August, 1972.

Collections of coliform bacteria and fecal streptococci were obtained from sites 1, 2, 3, 5, 6, and 7. Samples were obtained by transferring 1/2 liter of water from each site to a sterile container. The container was then chilled and kept in the dark until analyzed by a commercial laboratory.

Plankton were obtained by collections in number 25 plankton nets and preserved in 70 percent ethanol and glycerin. Benthic samples were taken by washing samples through sieve buckets. Macroorganisms were hand picked from the fine mesh screens and preserved in 70 percent ethanol and glycerin.

Entire zooplankton samples were examined in 1 milliliter Sedgwick-Rafter Counting Chambers. When necessary, individual specimens were mounted and cleared with lactophenol to facilitate identification. All identifications were made under 600X magnification using standard works (Pennak, 1953; Ward and Whipple, 1959).

Terrestrial invertebrates were obtained by inspection of various habitats. Soil samples were run in Berlese funnels under intense light. Insects were collected by sweep nets or collected in various traps. Nocturnal collections were obtained in illuminated sheets. All invertebrates were preserved in alcohol.

2.06.1 Temperature. The temperature ranged from 23.0 to 29.3 C. There was little variation in temperature in any stream. Lower temperatures, however, were recorded in Alligator Creek than elsewhere.

2.06.2 Dissolved Oxygen. The one most important limiting factor for aquatic life, dissolved oxygen, ranged in values from 0.2 ppm to 4.2 ppm. All streams were poor in oxygen. Only Alligator Creek with 4.2, 4.1, and 3.8 ppm (site 7) and Aquilla Creek (upper regions) with 4.1, 4.7, and 4.6 ppm of oxygen exceeded the minimum standard of 4.0 ppm as defined by the Texas Water Quality Board (Brazos River Authority, 1970). The results of a study by the Brazos River Authority (appendix F) showed that all dissolved oxygen data taken during daytime hours were always at least 6.4 mg/1.

2.06.3 pH. The pH ranged from 7.0 to 8.2. Though generally high by fresh water standards as described by Reid (1961), the values are consistent with the geology of the area and agree with values for Possum Kingdom Reservoir, Lake Whitney (Leifeste and Popkin, 1968) and the Brazos River (Rawson, 1967).

2.06.4 Nitrogen Compounds. The nitrogen compounds examined in this study include ammonium ions, nitrate ions, and nitrite. The ammonium ions ranged from 1.58 ppm in the area near the sewage treatment plant and at the stagnant pool on Cobb Creek to 0.10 ppm at site 2. These rates are not high. Nitrate values were roughly uniform ranging from 1.00 to 3.30 ppm. These levels may have been elevated from nitrates resulting from runoff of cultivated fields. Nitrate values were less than 0.016 ppm and were relatively uniform at all sites during the 3-month sampling period.

2.06.5 Phosphates. The phosphate readings include both inorganic and organic phosphates. The highest value occurred in site 1 near the sewage plant, but it is considerably lower than reported elsewhere in the state.

2.06.6 Carbon Dioxide. CO_2 is a measure of the decomposition and respiration occurring at various regions of the streams involved in this study. The levels of CO_2 were consistently higher at Cobb Creek (station 5) and beside the Hillsboro sewage plant (station 1) than elsewhere. The lowest values of 4 ppm to 16 ppm were obtained in Alligator Creek.

2.06.7 Alkalinity. Alkalinity is measured in ppm $CaCO_3$. The values obtained from this study represent both carbonate and bicarbonate alkalinity. The ranges observed are moderate for Texas waters.

2.06.8 Total Hardness. Total hardness is measured as ppm of all polyvalent metal ions, but reflect particularly calcium and magnesium. The results obtained in this study reflect that the waters are hard.

2.06.9 Conductivity. Specific conductance ranged from 850 to 1,100. Slightly higher values were obtained for Possum Kingdom Reservoir and Lake Whitney (Leifeste and Popkin, 1968). These readings reflect the high mineral content of the drainage.

2.06.10 Sulfates. The sulfates level appeared relatively uniform. If this trend is continued throughout the year, the presence of upstream gypsum formations could be expected (Rawson, 1967).

2.06.11 Sodium. High sodium values were obtained at sites 1 and 5. The high value obtained from 3 miles downstream at site 2 is significantly lower, indicating a loss either by uptake by vegetation or by dilution. The high value at site 5 may be explained by the stagnant nature of the water.

2.06.12 Potassium. The levels of potassium are all reasonable. The elevation at site 5 is representative of an evaporating pool.

2.06.13 Calcium. The calcium content of six samples was moderate with a high reading occurring at site 5.

2.06.14 Magnesium. The levels of magnesium recorded in six sites were low to moderate except site 5 where a high level was obtained.

2.06.15 Iron. Iron was found in values less than 0.4 ppm. Such low values are common in the Texas waters (Bullock and Fruh, 1972, Rawson 1968).

2.06.16 Lead. Lead was less than 0.1 ppm. The values are consistent with lead content of other similar waters in Texas.

2.06.17 Phytoplankton. Phytoplankton counts varied considerably with month and site (table 2-3). The predominant plankter was the green algae Actinastrum gracillimum. The remainder of the cells were diatoms and other phytoplankton genera. Other than the dominant plankter, the other species were not specifically identified. No linear distribution gradients could be detected. The highest counts were obtained consistently at site 5 at Cobb Creek where the water was not flowing.

2.06.18 Zooplankton. Total counts of 300 plankton for the three periods of sampling are presented in table 2-4. The zooplankton are limited primarily to a few species of rotifers and copepods. The populations are small; only in site 5 where the water was not flowing were samples obtained that indicated a relatively large population.

TABLE 2-3

PHYTOPLANKTON
(CELLS PER LITER)

Site	Date: June	July	August
1	2,801,300	1,905,411	2,050,375
2	1,450,103	1,267,443	1,431,561
3	299,500	211,480	416,960
4	1,406,844	807,610	1,315,283
5	4,800,000	6,470,000	5,489,110
6	1,060,705	1,005,699	945,566
7	580,888	470,333	250,600

TABLE 2-4

ZOOPLANKTON
(ORGANISMS PER LITER)

Site	Date: June	July	August
1	6	10	15
2	22	40	35
3	20	29	26
4	15	15	14
5	130	145	115
6	30	21	20
7	41	64	60

The dominant organisms were copepods of the genus Cyclops. Rotifers of the genera Keratella and Notholca were obtained at each site, but in reduced numbers. In a limnological survey of Lake Granbury, Mecom (1972) reported large standing crops of rotifers in the recently constructed reservoir, Lake Granbury.

2.06.19 Bacteria. Total plate counts at six sites are presented in table 2-5. Included are the numbers of coliform, *E. coli* and fecal streptococci. The highest levels of organisms were obtained at site 1, just below the Hillsboro sewage disposal plant. This reading included 11,000/ml of coliform, 460/ml *E. coli*, and 2,800/ml fecal streptococci. After roughly 3 miles, at site 2 the total count decreased by four times although *E. coli* counts increased from 460 to 1,500/ml.

Counts were equally high at site 5, Cobb Creek, in samples taken from nonflowing pools. This count is undoubtedly influenced by the cattle which use the pools for water. Levels of bacteria at all other sites indicate a reduction in numbers throughout the streams. The levels observed were all below the standard for fresh water. Bacterial counts are probably highest in the warmer months because of little or no flow in the creek and the increased amount of organic decomposition occurring in the creek. The bacterial counts at the upper sites on Hackberry Creek were also influenced by discharges from the sewage plant at Hillsboro discharging effluent into the stream, and the counts at other sites were influenced by the presence of livestock.

2.06.20 Macrobenthos. Total organism counts of macrobenthic forms are reported in table 2-6. Their distribution depends primarily on bottom sediment type. These streams are difficult to characterize by a study of macrobenthos. Silting is heavy and deep deposits of silt occur. Samples obtained from such areas, especially if the water was not running as in site 5 at Cobb Creek, had large populations of phantom midges. Snails and midges also were common. All forms are tolerant of waters with low O_2 levels. At site 3, large numbers of fingernail clams (*Sphaerium transversum*) occurred in the gravel banks of the stream. Their occurrence was limited by silt elsewhere in the streams under study. A second species of fingernail clams (*Musculium ferrisei*) occurred in mud deposits but were not as numerous. Although many invertebrates were obtained, diversity was low as many forms are not tolerant to the warm summer temperatures of these streams.

2.06.21 Turbidity. The amount of suspended inorganic and organic material in water is an indication of the optic properties of water and greatly affects productivity. High turbidity readings effectively reduce penetration and hence reduce light available for fixations by photosynthesis in primary producers. As documented by Stevens, (1951) the Brazos River carries a heavy silt load. Turbidity readings on Hackberry Creek and on Aquilla Creek below the confluence with Hackberry were high. The readings in July and August were taken within a week after rains in the area which may have influenced these higher readings.

TABLE 2-5

BACTERIA (IN ORGANISMS/ML)

Site	Total Numbers	Coliform	E. coli	Fecal Streptococci
1	5,775,000	11,000	460	2,800
2	1,132,000	11,000	1,500	550
3	460,000	1,100	150	100
5	4,100,000	more than 1,100	1,100	600
6	1,020,000	750	150	200
7	2,216,000	1,100	150	50

TABLE 2-6

MACROBENTHOS
(ORGANSISMS PER METER^2)

Site	June	July	August
1	130	160	330
2	85	70	104
3	545	291	773
4	107	80	85
5	245	617	318
6	55	82	79
7	83	68	77

2.06.22 Relative Transparency. Relative transparency ranged from 6 to 18 inches. This examination of water quality is also a quality of the amount of silt in the streams examined. The silt levels are heavy and appear to be enhanced by considerable erosion in the bottom land. Such erosion is detrimental. It reduces water transparency, reduces photosynthesis, handicaps predators that feed on sight, and clogs the filtration apparatus of various invertebrates. Silted streams invariably result in impoverished faunas.

An examination of invertebrates from various regions of the study site show that the riparian habitat along each of the streams to be occupied by more organisms in both numbers and species than any other area in the study site. The high values obtained for numbers of individuals in the grazed fields is represented mainly by Orthroptera (grasshoppers). This is best indicated by the small number of taxa as opposed to the riparian habitat (table 2-7).

Pesticide use in the immediate area to be impounded is difficult to quantify. Discussions with local farmers and county agents indicate that pesticide use is not heavy and will probably not be of concern if erosion into the impoundment can be controlled.

In summary, the preliminary survey indicates that the streams are following a succession related to the influence of man's impact. The streams are relatively clean and generally well-oxygenated except during warm months in areas of active decomposition such as standing pools, where the oxygen falls below the minimum standard of 4.0 ppm as defined by the Texas Water Quality Board (Brazos River Authority, 1970). The pH was typical of alkaline Texas waters and did not vary significantly along the streams. Alkalinity and total hardness are moderate. Phosphates, nitrates, and ammonium ions are present in only moderate amounts.

Turbidity readings are generally high, particularly in a season of drought. This particular observation may be important in determining the productivity of the streams based upon summer planktonic populations and any speculations about the advisability of changing a water course.

TABLE 2-7

DISTRIBUTION OF INVERTEBRATES IN SECTORS OF THE STUDY SITE

Location	# Individuals	# Taxa
Mesquite Ridge	1400	78
Cultivated Field	3006	31
Grazed Field	546	18
Oak-hickory Woods (riparian)	2300	105

Siltation is responsible for the low number and limited diversity of fauna collected during the study. This condition has favored non-filter feeders and predators that rely upon senses, other than sight, for obtaining prey. Such selection eventually reduces the carrying capacity of the water.

2.07 Hillsboro Effluent Discharges. The city of Hillsboro discharges treated sewage effluent into Hackberry Creek, which will become an arm of Aquilla Lake. The Brazos River Authority and the Environmental Protection Agency concurred in the following statement.

> "....in the foreseeable future the treated sewage effluent discharged by the City of Hillsboro will not significantly affect the quality of water in Aquilla Reservoir and should not limit any of the uses for which the reservoir is intended, provided that all the wastewaters from the City of Hillsboro receive secondary treatment and disinfection and that provisions are made to maintain this treatment in the event of major power or mechanical failure."

2.08 Flora of the Basin. The Aquilla Creek study area lies mainly within the southern extremity of the Eastern Cross Timbers (as characterized by Tharp, 1926) with portions of the upper reaches of the basin extending into the Blackland Prairie on the east. See figure 2-3.

2.08.1 Eastern Cross Timbers. The belt of post-oak and blackjack oak woodland referred to as the Eastern Cross Timbers follows closely the aquiferous Woodbine sand formation from the Red River into southern McClennan County.

The characteristic vegetation of the Eastern Cross Timbers exists only in a few scattered remnants in Hill County today. Most of the woodland has been completely cleared to make way for pasture and cultivation, particularly in the areas nearer watercourses where the deeper, more moist soils are more desirable for farming. Consequently, most of the few persisting remnants of this vegetational association in Hill County are in upland, dissected areas and should therefore sustain little direct impact from reservoir construction.

Scattered stands of mesquite savannah are located throughout the study area, particularly in the western drainage of Aquilla Creek. This is, however, a weedy species and is an indicator of ecological disturbance.

2.08.2 Blackland Prairie. The upper reaches of the eastern and northern (Cobb Creek and Hackberry Creek) forks of the proposed reservoir lie within the vegetational association referred to as the Blackland Prairie. This region is typified by alkaline black clay soils with high organic content overlying the parent Cretaceous Limestone. The natural climax is grassland with little bluestem (*Andropogon scoparius*) as the dominant species (Dyksterhuis, 1946).

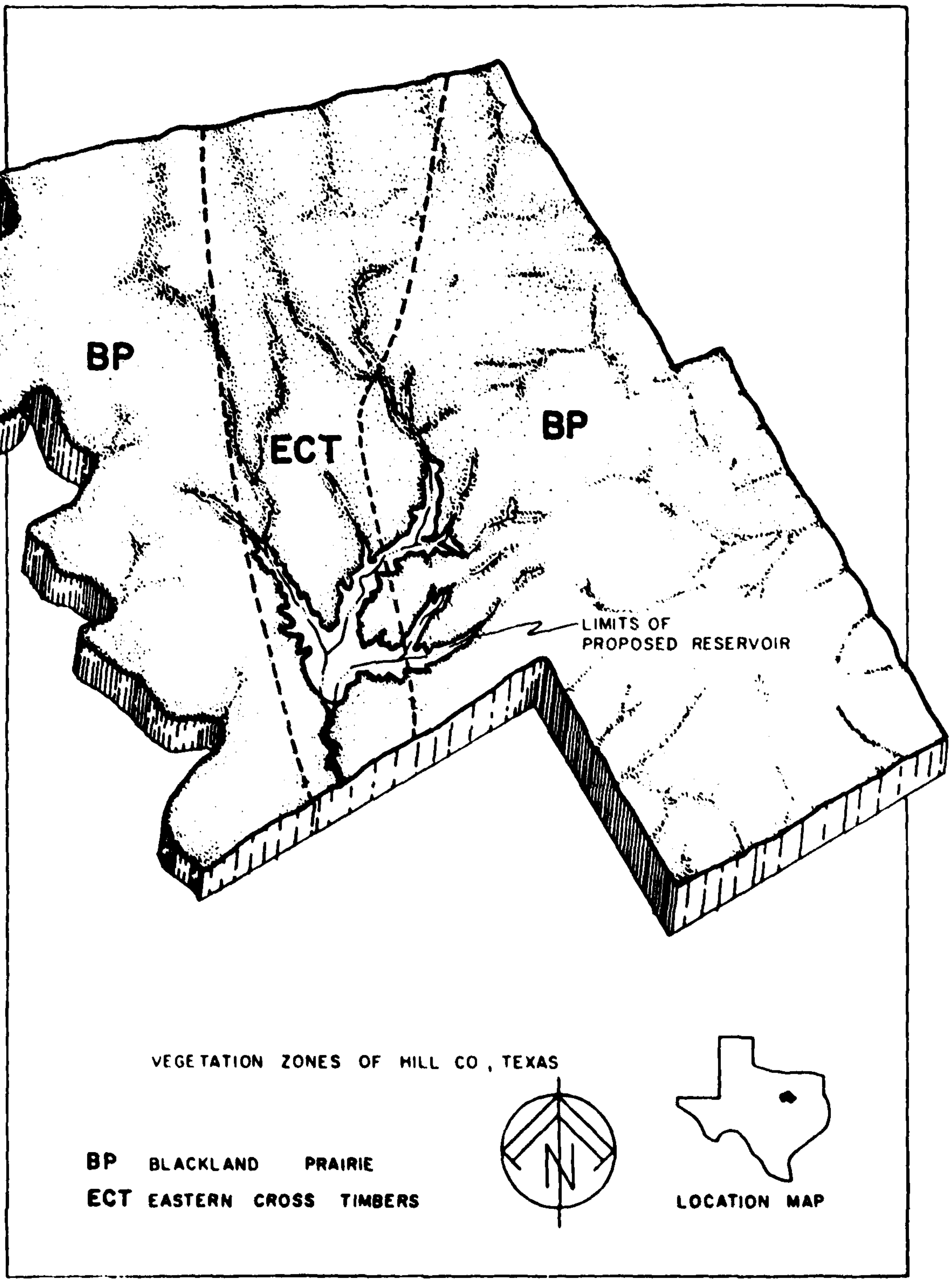


Figure 2-3 Vegetation Zones in Hill County, Texas.

Because of the desirability of the fertile soils of the Blackland Prairie for cultivation in cotton, sorghum, and other crops, very little of this grassland association has survived in Hill County. What little remains is in heavily grazed pasture and consequently retains few of its natural characteristics.

2.08.3 Bottomland Forest. The bottomland forests of the eastern half of Texas are quite different vegetationally from the prevailing plant associations in which they are located. Bray (1906) treated these bottomland associations as a distinct vegetational type, considering them to be extensions of Austroriparian forests of the south and southeast. These woodlands owe their existence to the abundance of water along the waterways. The bottomland forest is the best-preserved of the vegetational communities surviving in Hill County (figures 2-3 and 2-4) and therefore was studied in greatest detail.

The bottomland forest community in Aquilla Creek study area is primarily a red ash-cedar elm-hackberry association. Scattered large specimens of red oak, slippery elm, and pecan were also noted, but not in sufficient numbers to play an important role in community dominance.

The understory of the bottomland woods of the study area is rather sparse. In addition to the arborescent species listed in table 2-8, the limited understory consists of woody vines such as fox and mustang grapes, poison ivy, and green-brier and of frutescents including rough-leaf dogwood, downy and green haws, big-tree and hog plums, eve's necklace, black haw, and coralberry.

TABLE 2-8

TREES OF THE BOTTOMLAND FOREST

Red ash (Fraxinus pensylvanica)
Cedar Elm (Ulmus crassifolia)
Hackberry (Celtis laevigata)
Red Oak (Quercus shumardii)
Slippery Elm (Ulmus rubra)
Pecan (Carya illinoensis)
Red Mulberry (Morus rubra)
Post Oak (Quercus stellata)
Mesquite (Prosopis glandulosa)
Live Oak (Quercus virginiana)
Soapberry (Sapindus drummondii)
Chittam wood (Bumelia lanuginosa)
Deciduous Holly (Ilex decidua)
Honey Locust (Gleditsia triacanthos)

None of the dominant species of the bottomland forest of Hill County has any significant commercial value. Possible exceptions might be pecan and the oaks, but they occur in such small numbers as to be of no import in this area.

2.08.4 Endemic Species. An endemic species is one which is native to a relatively limited geographic area. Endemics are either relicts which at one time had a much wider distribution or young species which are slowly expanding their ranges.

Table 2-9 lists endemics to Texas which have been reported from Hill County either in the botanical literature or in the SMU Herbarium collection and those collected during this study.

The complete list of vascular species collected from the Aquilla Creek Wateshed in this study is presented in appendix B, table B-1. It must be kept in mind that while this inventory includes most of the woody species to be found in the study area, it shows only those herbaceous species which are part of the summer aspect. Because of the time limitations involved in this particular study, no collection data could be obtained for the spring or fall flora of the area.

Because the natural state of the vegetation of the Aquilla Creek Watershed has already been severely disrupted by agricultural activities, there is little, from the standpoint of plant ecology, that might oppose the inundation of this area by the proposed lake.

TABLE 2-9

ENDEMIC VASCULAR SPECIES PREVIOUSLY REPORTED FROM HILL COUNTY, TEXAS, OR COLLECTED DURING THIS AQUILLA CREEK AREA STUDY

Aster eulae	- Aster
Astragalus reflexus (rare)	- Milkvetch
Cirsium terrae-nigrae*	- Blackland thistle
Crataegus brazoria	- Brazos Hawthorn
Crataegus glabriuscula*	- Green Hawthorn
Indigofera miniata	- Indigo
Lesquerella recurvata	- Bladderpod
Lupinus texensis*	- Texas bluebonnet
Marshallia caespitosa	- Marshallia
Silphium albiflorum	- Rosinweed
Yucca pallida	- Yucca
Forestiera pubescens*	- Elbow-bush
Polytaenia texana*	- Texas Prairie Parseley
Pyrhopappus geiseri*	- False dandelion

***Collected during this study**

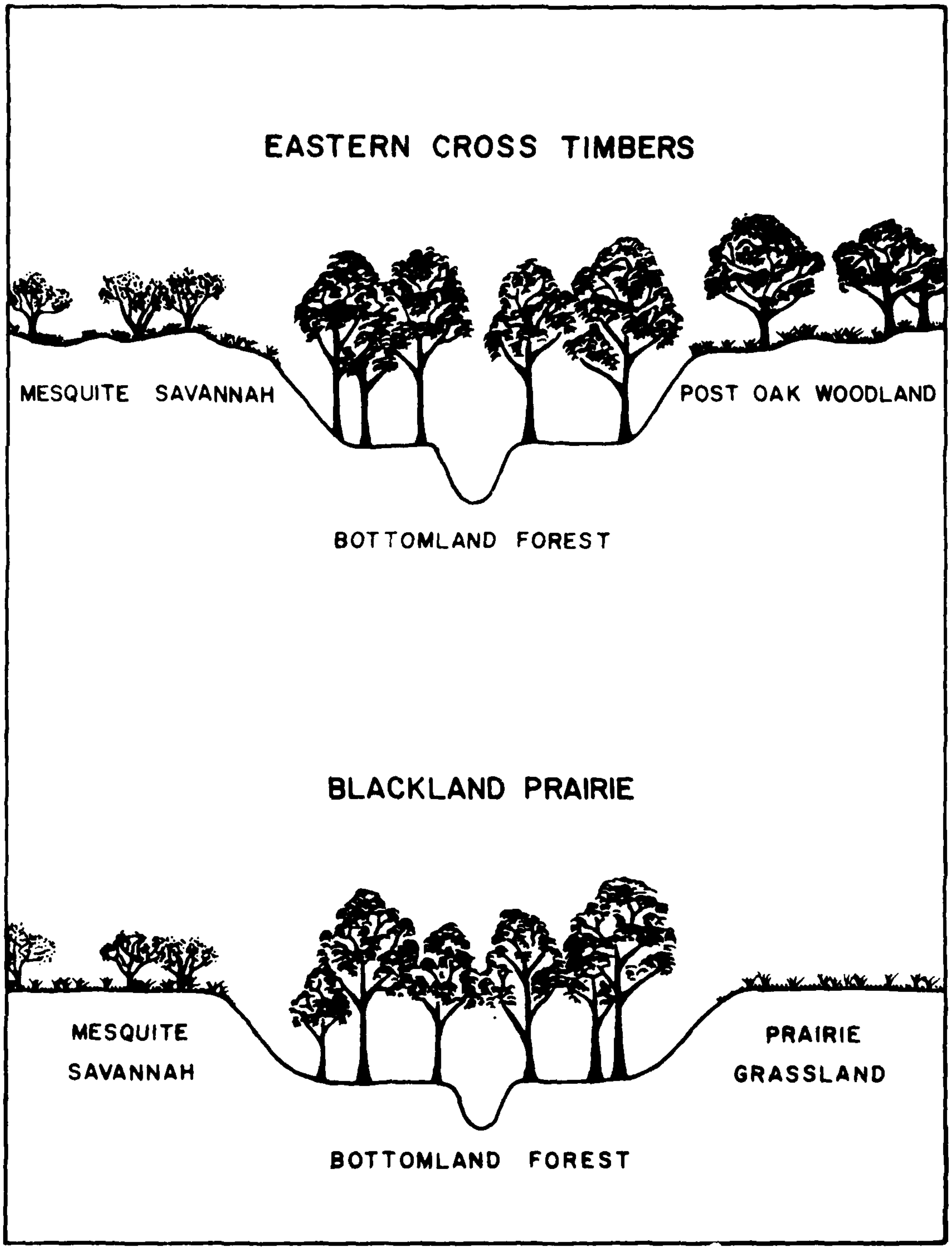


Figure 2-4 Botanical transect across watershed.

Although these species are limited in their distribution, none is considered to be endangered at this time.

Every effort should be made to preserve the woodland vegetation remaining between the flood and conservation levels of the lake. In order to maintain as much natural plant and animal habitat as possible, extensive areas should be left completely undisturbed with existing undergrowth and ground cover vegetation intact.

2.09 Fauna of the Basin. Fishes. A checklist of fish species reported from the middle Brazos River Basin, including the Aquilla Creek watershed area is presented in appendix B, table B-2. The species included on this list are taken primarily from the investigations of Hubbs (1972) and from onsite collections involving the use of both fine and large mesh seines. The onsite investigations failed to produce any species not included in Hubb's report. No endangered species have been reported from these streams.

2.09.1 Amphibians and Reptiles. A list of amphibians and reptiles whose range includes the Aquilla Creek Basin is presented in appendix B, table B-3. None of the species in the basin are rare or endangered. Poisonous reptiles in the basin include the cottonmouth, copperhead, and various species of rattlesnakes.

2.09.2 Birds. The Aquilla Creek Watershed is divided into six types of generalized habitats that influence the presence of birds, reptiles, amphibians, and mammals: (1) deciduous forests of the flood plain, (2) scrub oak of the east cross timbers on ridges and uplands, (3) mesquite-grassland in generally well-drained areas, (4) cleared pastures, (5) plowed cropland, and (6) the aquatic habitats of the creeks that run through the area.

A total of 257 species of birds are known to occur in Hill County (Kirby, 1972). The names of two of these species appear on endangered species lists: the southern bald eagle and American peregrine falcon. Other species have been recorded there in the distant past or upon very rare occasions. Table B-4 in appendix B includes only those species that can be considered to inhabit the area on a regular basis. This list was taken from one prepared by Mr. Hal P. Kirby, Director of the Dallas Museum of Natural History. Listings are in accordance with the American Ornithological Union species list.

Of 50 species of birds that are reported as abundant or common in the vicinity of the Aquilla Creek project, 46 were observed during the summer of 1972. Of these, 15 species are found primarily in heavily wooded stream bottoms. The wooded edges of Aquilla, Hackberry, and Cobb Creeks represent a substantial portion of the total of this type of habitat found in Hill County.

2.09.3 Mammals. The mammals of the Aquilla Creek (appendix B, table B-5) Basin are typical of the eastern portion of the Texan biotic province (Blair, 1950). No species in the area are endemics and none are endangered species.

Literature records are not abundant for mammals of Hill County, Texas. Therefore, records of species present were primarily based upon the investigations of Davis (1966), comparative specimens and records of the Dallas Museum of Natural History, and field investigations. Field investigations involved general reconnaissance of the area (day and night), observations of the animals present by sight, if possible, or sign, if the signs were definite enough. Personal interviews with inhabitants of the area also yielded certain pertinent data. Also included in the field investigations were 285 trap nights using medium Sherman live traps and a variety of baits. The live trapping yielded 25 animals; however, the variety taken, even from different habitats, was not great. Relative abundance figures reflect generalities, as abundance for one species may vary greatly from another depending upon secrecy, diurnal or nocturnal habits, size, range, and territory. The fox squirrel and the deer are game species found in the area. A resident of the area has seen deer very infrequently. Fox squirrels are more prevalent and hunted under rather light pressure. Raccoon hunting is unusual for the area. Cottontail rabbits have some value as food species. There is an abundance of beaver along the main artery of Aquilla Creek. In the past, this species was extensively trapped for its fur value, along with mink, raccoons, opossums, skunks, gray foxes, and more recently the nutria. However, little trapping is currently practiced in the area.

The dominant predators of the area, excepting domestic dogs and cats, are the coyotes and bobcats.

2.10 Fishing and Hunting. The study indicates that the impoundment would have little or no far reaching effect on most of the mammal species that inhabit the wooded flood plains of Aquilla Creek and its tributaries. These wildlife species include opossum, armadillo, fox squirrel, flying squirrel, beaver, whitefooted mouse, Florida woodrat, nutria, raccoon, cottontail rabbits, mink, gray fox, and whitetailed deer. Of these species, fox squirrel and deer are considered game species. Deer are infrequently seen in the area. Fox squirrels are more prevalent but are hunted under rather light pressure.

Aquilla Creek is an intermittent stream. Its principal tributaries are Hackberry, Little Aquilla, Cottonwood, Cobb, and Alligator Creeks. These streams are entrenched moderately well and have beds of mud and silt. Usually in late summer, Aquilla Creek is reduced to long, narrow pools, in its lower reaches, while upstream the stream and its tributaries are dry throughout most of their courses. This condition results in a poor quality fish habitat. The principal species of fish in the stream, at times of flow, are the flathead catfish, channel catfish, buffalo, and carp. There are a few farm ponds in the basin which provide poor to fair fish habitat. Largemouth bass and bluegill are the principal species of fish in the farm ponds. Sport fishing in the area is insignificant and there is no commercial fishing.

2.11 History of the Basin. Historical surveys and reports of Hill County are to be found in the form of several books, articles, and historical manuscripts. Bailey (1966), Reese (1961), and others provide an overview of the early settlements within the county. It is this material and reports from many Hill County residents that form the basis for this statement.

In 1849 Fort Graham was established at Jose Maria's village near the mouth of Bear Creek and the Brazos River. The Fort served as a barrier between the Indians on the west and settlers on the east (figure 2-5). The establishment of the Fort marked a turning point and made possible intensive and dispersed settlement within the Hill County area.

Hill County was established as a bona fide county in 1835 with Hillsboro (Hillsborough) as the county seat. Other towns in the county at that time were: Covington, Peoria, Union Bluff (Lexington), Woodbury, and Patton's Mill. Of these villages, Union Bluff, Peoria, Patton's Mill, and the later settlement of Aquilla are of particular interest since these historic settlements may be directly affected by construction of Aquilla Lake.

Peoria was established about 1850 on a stagecoach route. In the 1870's it was the commercial and industrial center of Hill County.

The Central Texas Railroad was probably the main reason for the demise of Peoria, as the railroad could not buy into the village, and thus founded Whitney in 1879. Most of the Peoria residents and business establishments had moved to Whitney or Hillsboro in 1881.

The settlement of Woodbury, located between Peoria and Covington, was founded about 1858.

The village of Union Bluff (Lexington) was probably settled in late 1851 or early 1852. It served as the temporary county seat until Hillsboro was chosen for the county seat in 1853.

Patton's Mill was located below Peoria on Aquilla Creek. In the 1870's it became known as Mud Town. When the Texas Central Railroad came to Hill County the people of Mud Town moved farther south along the creek and established the town of Aquilla. It was a thriving railroad center during the later 1800's and the early 1900's. Fire ravaged the town in the 1920's and the destroyed buildings were not rebuilt.

Vaughan is located 9 miles from Hillsboro, 6 miles from Aquilla, and 6 miles from Peoria. It was the first town in Hill County to start consolidated schools.

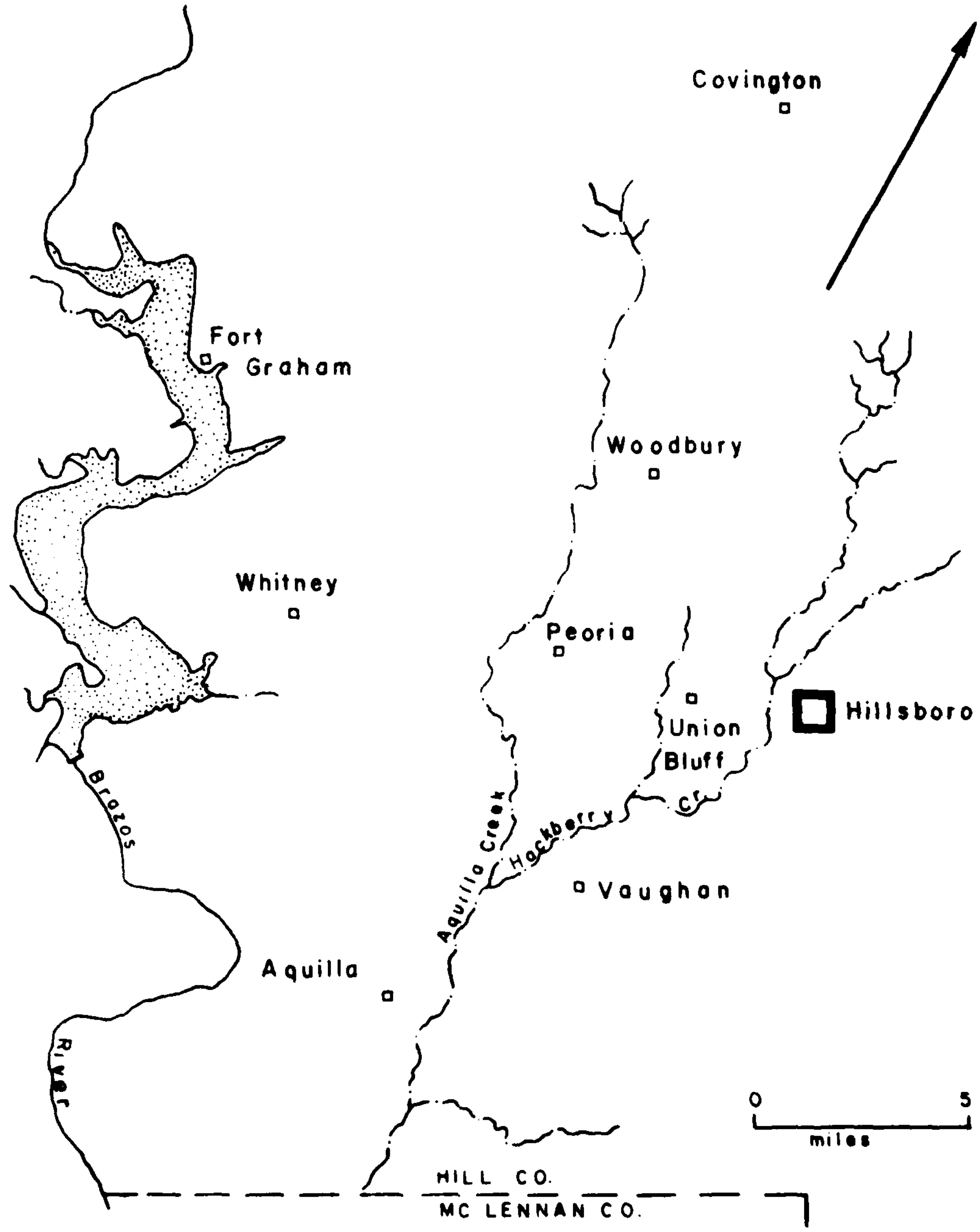


Figure 2-5 Location of historic townsites mentioned in text.

Hillsboro was founded in 1853 as the county seat of Hill County. By 1880, its reason for being was the railroad and its subsequent economic impact. In the late 1880's the railroad company, now known as the Katy, (MKT), built two branches, one from Dallas to Hillsboro, and the other from Fort Worth to Hillsboro. It was this stimulus that contributed to the tremendous growth rate between 1800 and 1900. Several hundred railway workers and their families were brought into town along with a large payroll. By 1900 the population of Hillsboro was over 5,000 people.

In summary, documentary evidence has shown the location of the important towns and population centers in the Aquilla Creek area. Each of these locations is of importance to the history of Hill County and this importance has been well recognized by the Hill County Historical Survey Committee. Consequently, State historical survey markers have been erected in Aquilla, Peoria, Hillsboro, and elsewhere throughout the county. At present we are not aware of any other important historic sites which will be affected by the planned construction. The concern of the people in Hill County for important remains of their history indicates that they will aid in the preservation of any historic structures which might be affected by lake construction.

The National Register of Historic Places has been consulted and construction of the proposed project will not affect any registered sites.

2.12 Prehistory of the Basin.

2.12.1 Previous Archaeological Investigations. Archaeological investigations within the Aquilla Creek Watershed have been conducted by amateur archaeologists who have taken the time to record and report many important sites in the area. An early description of the area was prepared by Frank Bryan and published in the Central Texas Archeologist (Bryan 1937). Bryan reports six prehistoric sites located south of Peoria. Each site is located in a sandy deposit and well above the flood plain of the creek. On the basis of the artifacts described, sinkers, projectile points and pottery, it would appear that the occupation represents about 5,500 years (4000 B.C. to A.D. 1500).

In a definitive study on "Waco Sinkers", Frank Watt (1938) describes sinkers from sites along Aquilla Creek, and it is believed that these artifacts can be attributed to the early Archaic period (prior to 4000 B.C.).

Throughout the forties and fifties, members of the Central Texas Archeological Society continued survey reconnaissance of Aquilla Creek and aided in salvage excavations at Lake Whitney. This research has yielded information about the presence of pottery-bearing sites located along the eastern edge of central Texas. The Chupek site is one of the better known "intrusive" sites within the area. The site is located on Aquilla Creek near its junction with the Brazos River. Frank Watt of Waco has studied the site and has reported that Alto Focus pottery is the only type of pottery found (Watt 1941, 1953).

On the basis of this research Krieger (1946) considers the site to be the location of a nonmound village related to the Caddoan Alto Focus of east Texas (Newell and Krieger 1949). Recent excavation by the University of Texas has attempted to determine the nature of the relationship(s) between the George C. Davis site in east Texas and the Chupek site (Dee Ann Story, personal communication). Watt (1953) also reports the presence of Frankston Focus pottery on several sites along Aquilla Creek, but this is considered to be separate from the Alto Focus materials.

Lake Whitney is located just west of the Aquilla Watershed and extensive salvage excavations were carried out there before the lake was built. This work, as reported by Stephenson and Jelks, focused upon the recording of stratigraphically useful sequences, excavation of the historic Stansbury site, and preservation of accessibility provided by the lake. A sequence extending back to 500 B.C. and possibly older was outlined and many large prehistoric sites located on the sandy river terraces were recorded. No relationship between sites along the Brazos River at Lake Whitney and sites along Aquilla Creek were formulated although there is evidence that Waco sinkers are extremely rare at Lake Whitney and that Caddoan pottery of the Alto Focus period is present in several rock shelters.

Prior to 1960 archaeological evidence for the presence of Early Man in the Aquilla area was based only upon the presence of an occasional late Paleo-Indian projectile found on the surface of a site. In 1962 the Ballew site was discovered in a peanut field near the junction of Aquilla Creek and the Brazos River. This site was tested by F. Watt and Albert Redder with the advice of Dr. George A. Agogino, then of Baylor University. Recent excavation at Horn Rock Shelter by Watt and Redder have revealed evidence to suggest that Early Man was present in the central Brazos River Valley as early as 10,800 years ago (Watt and Agogino 1968). The implication of this research is that we can expect to find evidence of Early Man throughout the study area if plowing has proceeded to a point where the recent overburden has been removed from the early archaeological deposits. Recent site survey at Lake Whitney (Skinner and Harris 1971) and information from amateur archaeologists suggest that a similar time depth is present elsewhere on the Brazos River and on tributaries such as Aquilla Creek.

Salvage excavations at Lake Waco (Story and Shafer 1965) have shown that the Brazos River has been aggrading (depositing a silt load) during the past 2,500 years (Stricklin 1961). A similar pattern of rapid deposition has been reported at Lake Granbury (Skinner 1971) and at Lake Whitney. These factors suggest that archaeological sites which predate 500 B.C. can be expected to occur buried under several feet of sediment and therefore would not be readily visible on the ground surface.

2.12.2 Recent Archaeological Investigations. To confirm and expand on prehistoric information reported in the past, an archaeological inventory of the Aquilla Creek Watershed was conducted during the summer of 1972.

A total of 125 prehistoric sites were located and evaluated during the course of this study. The major period of prehistoric occupation was during the Late Archaic although there is evidence for occupation from about 8000 B.C. to A.D. 1500. No evidence of historic Indian campsites was found.

Analysis of the settlement patterns and the artifact assemblages suggests that the sites represent short-term campsites at which similar activities were carried out. These activities include tool manufacture, mussel shell gathering, hunting, and to a lesser extend quarrying and plant food processing. A general absence of ground stone tool fragments, especially manos and metates, is interpreted as evidence that plant food processing was not an important activity. Sites along the Brazos River alluvial terrace frequently have large numbers of ground stone tools and have been interpreted as base camps (Skinner 1971). These sites also tend to be larger in area than sites along Aquilla Creek. A similar pattern of small hunting/gathering sites being located on less permanent streams occurs at the Strawn Creek site in Navarro Mills Reservoir (Duffield 1963).

On the basis of the data collected during the survey a tentative model of the prehistoric utilization of the Aquilla Creek Watershed is proposed. The general small nature of the archaeological sites and the relative scarcity of cultural remains suggest that occupation of the watershed was for short periods of time and only for part of a year. The occurrence of temporarily different projectiles at the same sites is interpreted as evidence for reoccupation of suitable camp locations. Therefore, it is suggested that prehistoric occupation of Aquilla Creek was for the purpose of specific maintenance activities carried out for short periods of time each year by small maintenance groups.

A complete maintenance cycle for the people who camped along Aquilla Creek probably involves seasonal hunting camps located on the Blackland and Grand Prairie uplands as well as more permanent base camps located within the Brazos River Valley.

2.12.3 Archaeological Site Distribution. The distribution of archaeological sites in the study area is related to the microenvironmental variation within the watershed (see figure 2-1).

It is expected that distinct artifact assemblages will be correlated with specific situations if different activities were carried out on spatially spearated areas within the study area. Moreover, if there were changes in the subsistence pattern of the prehistoric inhabitants throughout the periods represented, then we can expect to find different site distribution patterns which reflect these differences.

2.12.3.1 Flood Plain. (Eleven sites). Sites in this situation are frequently inundated by overbank flooding of Aquilla and Hackberry Creeks. Recent deposition may have covered sites in this location; however, due to the active cultivation of much of the flood plain and the resulting exposure, we expect that this area was not heavily occupied. Two date-able sites have evidence of Late Archaic occupation.

2.12.3.2 Flood Plain Rise. (Twelve sites). This zone contains both large sites showing evidence of intensive occupation and small limited occupation sites. Sites in this situation would be isolated during bottomland flooding. Seven of the sites located on rises have collections of sufficient size to be studied thus suggesting that occupation is more intense on the rises and peninsulas than on the flood plain. Evidence of occupation during Middle Archaic, Late Archaic, and Neo-American periods was found.

2.12.3.3 Creek Edge. (Twenty sites). All of these sites are located along Aquilla Creek. This may be due to the deeper entrench-ment and development of a natural levee along Aquilla Creek. The majority of these sites are small in area and several are mussel shell middens. Paleo-Indian occupation is evidenced at one site, Late Archaic occupation is represented at 10 sites, and Neo-American occupation occurs at two sites. One of the latter contains trade pottery from east Texas.

2.12.3.4 Flood Plain Edge/Upland Base. (Twenty-nine sites). Although this area has the next largest number of sites only 10 sites have adequate collections for study. This factor reflects the fact that there is variation in site size and in exposure. Nevertheless, this zone appears to have been occupied from Paleo-Indian to Neo-American times and the heaviest concentration of Neo-American sites occurs here. One of the Neo-American sites includes Caddoan ceramics from east Texas.

2.12.3.5 Upland Slope. (Thirty-six sites). Sites in this zone appear to be situated in order to exploit the resources of the upland as well as the bottomland. Although there is evidence for occupation from Paleo-Indian to Neo-American times, the heaviest occupation appears to have been during the Late Archaic. Caddoan pottery was found at one site.

2.12.3.6 Upland. (Seventeen sites). The Late Archaic is the major occupation of this zone that is reflected by the artifact assemblages collected (10 sites). Assemblage size shows that many sites in this zone have been exposed by erosion; of the 17 sites which have been exposed, collections from 11 of the sites have been studied.

The site distribution shows that site size is generally a constant, regardless of associated microenvironmental zones. Artifact collections of 29 or more specimens range from 34 percent of the upland base sites to 64 percent of the upland sites; thereby suggesting that erosion and exposure can be treated as a constant throughout the watershed. Late Archaic sites occur in all but the flood plain. Paleo-Indian occupation is represented in three zones and we expect that additional work will show that Paleo-Indian utilization occurred in all zones.

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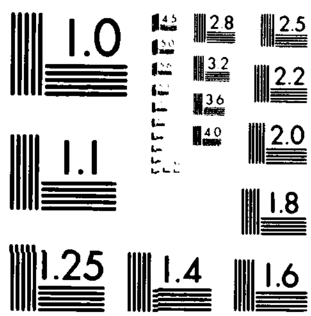

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2.13 Socioeconomic Background of Hill County.

2.13.1 Population Analysis. The population of Hill County showed a steady growth through the 1910 census when it peaked at 46,760. The 1920 census depicts the first decline when the total dropped 7.3 percent to 43,332. Each succeeding census has reflected a decline; however, a leveling off is noted in the 1970 count. Hill County population totaled 22,596 in 1970. This was only 4.5 percent short of the 1960 tabulation. According to the Texas Employment Commission's report (1971), this amounted to a loss of some 105 residents per year. In the decade of the fifties, the county's population dropped 24.4 percent, or an average of 763 residents per year.

ACTUAL AND PROJECTED POPULATION
OF HILL COUNTY 1910-2020

Year	Number	Year	Number
1910	46,760	1970	22,596
1930	43,036	1980	23,000
1950	31,282	2000	23,800
1960	23,650	2020	25,800

According to the 1970 census (7,224) 31.97 percent was listed as urban with (15,372) 68.03 percent being rural. The population count per square mile was 45.14.

The vast majority of Hill County is white. The white population in 1970 composed 86.24 percent of the total population with the largest minority population being black, 13.05 percent. These two groups compose all but .71 percent of the population of the county.

The largest percentage of the population of Hill County is between 18 to 64, 52.70 percent. The under 18 age group composes 27.88 percent and the over 65 age group make up the rest, 19.85 percent.

2.13.2 Educational Level. The average grade level for the females in Hill County is slightly higher than the male, although both groups fall below the national average. The females in the county have an average grade level of 9.5 years. The males' average grade level is 8.5. The percentage of persons 14 and 15 years of age enrolled in school is 93 percent. This figure drops to 78.5 percent in the 16 and 17 year old age group, and it is reported that 40 percent who start school will never finish.

2.13.3 Economic Analysis. According to the 1970 United States Census, there are 6,189 families in the county. From this number 48 percent of the families receive less than $3,000, and 55 percent of the housing is reported to be substandard.

2.13.4 Agriculture. The economy of Hill County is based on agriculture which consists principally of cattle production with crops being cotton and grain, particularly corn.

The Census of Agriculture shows that the value of farm products sold more than doubled between 1959 and 1964, with the rapid growth in livestock sales contributing the major portion of the gain. Between 1964 and 1969 the value of all farm products sold increased only 6 percent, but livestock sales grew 36 percent and crop sales declined significantly. In 1969 livestock products sold accounted for 76 percent of all farm products sold, 59 percent in 1964, and only 32 percent in 1959.

While the number of farms has declined since 1959, the total acreage farmed and, therefore, the average farm size has increased. According to the TEC report (1971) the area has followed the trend prevalent throughout the state; the consolidation of farms into larger units. The development and increased use of improved mechanical farm equipment enables farm operation to work additional acreage with less manual labor. These factors are reflected in farm employment in Hill County which has been gradually declining despite increased production. The April farm employment of 2,215 in 1960 dropped to 2,035 by 1965, and to 1,700 by 1971. Agricultural self-employment and unpaid family workers on the 1971 estimate numbered 1,155. The balance of 615 were seasonal wage and salary workers.

TABLE 2-10

HILL COUNTY AGRICULTURAL RESOURCES

	1969	1964	1959
Number of Farms	1,900	1,925	2,151
Acres in Farms	542,571	501,281	518,615
Average Size in Acres	285.6	260.4	241.1
Market Value of All Farm Products	$25,686,213	$24,154,841	$11,318,273
Livestock & Poultry Sales	$19,592,964	$14,335,655	$3,559,447
Crop Sales	$6,090,643	$10,287,620	$7,758,826
Average Farm Product Sales Per Farm	$13,519	$12,548	$5,262

Source: US Bureau of the Census, Census of Agriculture, 1959, 1964, and 1969.

A report of 1968, 1969, and 1970 cash receipts from the Sale of Texas Farm Commodities prepared by the Texas Crop and Livestock Reporting Service, US Department of Agriculture, reflects the following data for Hill County (tables 2-11, 2-12, and 2-13).

TABLE 2-11

CASH RECEIPTS FROM THE SALE OF TEXAS FARM COMMODITIES (Thousands of Dollars)

	1968 (Revised)	1969 (Revised)	1970 (Revised)
-Cash receipts from Farm Marketings-			
Crops	**9,844**	**7,185**	**10,528**
Livestock & Livestock Products	**10,002**	**12,140**	**14,446**
Government Payments .	**3,566**	**3,872**	**4,674**
Total Crops, Livestock & Government Payments	**23,412**	**23,197**	**26,648**
-Government Payments-			
Feed Grain Diversion & Price Support	**397**	**457**	**578**
Wheat Diversion & Marketing Cert	**31**	**41**	**33**
All Cotton Price Support	**2,779**	**3,156**	**3,922**
Cropland Adjustment & Conversion Program . .	**22**	**20**	**20**
Soil Bank & Conservation Reserve	**217**	**67**	**0**
Wool & Mohair Program	**7**	**4**	**2**
Agri. Conservation Including Emergen. Conservation Measure	**113**	**127**	**4,119**
Total Government Payments	**3,566**	**3,872**	**4,674**

TABLE 2-12

HILL COUNTY CROP
ACREAGE ESTIMATES
(PROVIDED BY THE USDA STATISTICAL REPORTING SERVICE)

	1968 Planted	1968 Harvested	1969 Plan.	1969 Harv.	1970 Plan.	1970 Harv.
Cotton	76,000	74,500	86,900	79,700	89,200	87,400
Cotton (Bales)		47,500		26,200		39,000
Peanuts		4,800		4,900		4,950
Pecans (Lbs.)		140,000*		11,000*		60,000
Corn, Field		8,400		9,700		13,000
Hay		26,130		22,170		25,045
Oats		1,250		7,600		8,300
Sorghum Grain		88,800		79,300		98,600
Wheat	8,800	7,700	15,900	7,600	4,300	3,300

TABLE 2-13

HILL COUNTY LIVESTOCK ESTIMATES
(PROVIDED BY THE USDA STATISTICAL REPORTING SERVICE)

	1 Jan 69	1 Jan 70	1 Jan 71
Dairying (Milk Cows)	2,600	2,800	2,500
Goats	1,000	1,000	1,000
Sheep	2,000	1,000	1,000
Livestock (Cattle)	65,400*	65,200*	70,500
Poultry (Chickens Only)	23,000	12,000	32,000
Swine (Hogs)	4,400*	4,800	6,200

* Revised.

2.13.5 Current Land Use. The current land use of the Aquilla Creek Watershed is broken down into 61 percent cropland, 34 percent grassland, and 5 percent miscellaneous such as roads, towns, water, and so forth.

2.13.6 Nonagriculture. Nonagriculture industries in Hill County complement the area's agricultural economic base, with diversification into manufacturing and all segments of nonmanufacturing.

According to the TEC report, nonagricultural employment at mid-April 1971 totaled 6,250 and represented 77.9 percent of total employment. This compares with 6,185 in 1970 (76.3 percent) and 4,895 in 1960 (68.8 percent). From 1960 to 1970, nonagricultural employment increased 1,290 or 26.4 percent, with an average of 129 new job holders per year. The April 1971 estimate reflected even a further increase of 65.

Wage and salary workers numbering 4,755 in 1971 comprised 76.1 percent of the nonfarm employment total. The balance were self-employed, unpaid family workers, and domestic workers in private households.

Manufacturing industries employed 1,395 of the April 1971 nonfarm wage and salary worker total. Manufacturers of apparel, for both men and women, employed the largest number of workers. Textile mill products and stone, clay, and glass products vie for second place in the number of manufacturing employees, followed by electrical machinery equipment and supplies and transportation equipment. Others are: food and kindred products, furniture and fixtures and printing and publishing.

The number of workers on manufacturing payrolls in April 1970 was more than double the 1960 figure. The numerical increase of 685 amounted to a percentage gain of 117.1 percent. From 1970 to 1971, manufacturing employment rose by 125 or 9.8 percent. In 1960 manufacturing wage and salary employment of 585 represented 18 percent of the nonfarm wage and salary total; in 1970, the 1,270 represented 27.1 percent, the 1,395 represented 29.3 percent.

Nonmanufacturing wage and salary workers numbered 2,670 in 1960. By 1970 the number had increased 745 or 27.9 percent, to 3,415. From 1970 to 1971, a slight decrease of 1.6 percent occurred as construction dropped off. Trade and Government employed the largest number, 63.9 percent of the nonmanufacturing wage and salary workers in 1960. These two groups remained in the forefront in recent estimates. Trade was up 11.7 percent from 1960. Government was off slightly as fewer workers were required in Federal units, but growth in the state and local government served to offset the loss. Services (except private households) now share the limelight, with the significant growth identified with hospital and health care services.

An analysis of nonmanufacturing wage and salary employment for April 1971 shows percentage distribution as follows: Trade, 28.4 percent, services, 28.1 percent; Government 25 percent; transportation, communications, and utilities 7.8 percent; construction 5.8 percent; finance, insurance, and real estate 3.7 percent; and other (mining and agriculture services) 1.2 percent.

The self-employed, unpaid family, and domestics (in private households) sectors are down from 1960.

The following tables, 2-14, 2-15, and 2-16 (taken from the TEC report) compare the composition of the work force in April 1960 with 1970 and 1971. The work force in counties outside Standard Metropolitan Statistical Areas is estimated annually in April. A recent monthly estimate is also provided for October 1971; however, discussion has been held to the regular estimate period for comparative purposes. The October estimate reflects normal growth or seasonal increases in all nonagricultural industries. The increase in other nonmanufacturing reflects an atypical increase in agricultural service related to peak cotton harvest activities. This industry has, in the interim, dropped back to around the April 1971 level as gains closed for the season.

TABLE 2-14

WORK FORCE ESTIMATES FOR HILL AND SURROUNDING COUNTIES

Year	County	Total Work Force	UNEMPLOYMENT Total	UNEMPLOYMENT % of Work Force	EMPLOYMENT Total	EMPLOYMENT Nonfarm Total	Nonfarm Mfg.	Nonfarm Nonmfg.	Farm
1960	Hill	7,490	380	5.1	7,110	4,895	590	4,305	2,215
	Bosque	3,920	85	2.2	3,835	2,665	205	2,460	1,170
	Limestone	6,565	415	6.3	6,150	4,800	620	4,180	1,350
	McLennan	55,260	2,725	4.9	52,535	49,515	10,310	39,205	3,020
	Navarro	12,660	700	5.5	11,960	9,960	2,100	7,860	2,000
	TOTAL	85,895	4,305		81,590	71,835	13,825	58,010	9,755
1965	Hill	8,250	380	4.6	7,870	5,835	805	8,030	2,035
	Bosque	3,935	165	4.2	3,770	2,795	350	2,445	975
	Limestone	6,265	285	4.5	5,980	4,935	600	4,335	1,045
	McLennan	58,530	2,375	4.1	56,155	53,500	11,135	42,365	2,655
	Navarro	13,355	710	5.3	12,645	11,020	2,640	8,380	1,625
	TOTAL	90,335	3,915		86,420	78,085	15,530	62,555	8,335
1971	Hill	8,285	265	3.2	8,020	6,250	1,400	4,850	1,770
	Bosque	3,835	120	3.1	3,715	2,855	630	2,225	860
	Limestone	6,600	400	6.1	6,200	5,280	550	4,730	920
	McLennan	63,750	2,975	4.7	60,775	58,335	11,370	46,965	2,440
	Navarro	14,600	600	4.1	14,000	12,600	2,950	9,650	1,400
	TOTAL	97,070	4,360		92,710	85,320	16,900	68,420	7,390

TABLE 2-15

HILL COUNTY WORK FORCE

	April 1960	April 1970	April 1971	Oct. 1971
Civilian Work Force	7,490	8,335	8,285	9,055
Unemployed	380	230	265	235
Percent of Work Force	5.1	2.8	3.2	2.5
Total Employment	7,110	8,105	8,020	8,820
Agricultural	2,215	1,920	1,770	2,120
Nonagricultural	4,895	6,185	6,250	6,700
Wage & Salary Workers	3,255	4,685	4,755	5,100
Manufacturing	585	1,270	1,395	1,435
Nonmanufacturing	2,670	3,415	3,360	3,665
Contract Construction	95	265	195	215
Transportation, Communications & Utilities	360	245	260	275
Trade	855	955	955	980
Finance, Insurance & Real Estate	100	110	125	130
Services (exc. P.H.)	390	940	945	955
Government	850	870	840	855
Other Nonmfg.	20	30	40	255
Self-employed, Unpaid Family Workers	1,240	1,135	1,130	1,210
Domestics (in private households)	400	365	365	390

TABLE 2-16

AVERAGE MONTHLY EMPLOYMENT AND TOTAL WAGES PAID BY EMPLOYERS SUBJECT TO THE TEXAS UNEMPLOYMENT COMPENSATION ACT*

HILL COUNTY

Industry	1st Quarter 1960		1st Quarter 1970		1st Quarter 1971	
	Avg. Empl.	Total Wages	Avg. Empl.	Total Wages	Avg. Empl.	Total Wages
TOTAL	1,598	$1,081,739	2,977	$3,381,949	3,604	$4,182,325
Contract Construction	51		273		168	
Manufacturing	538		1,173		1,420	
Transportation, Communications & Utilities	253		215		229	
Trade	573		701		956	
Services	111		477		694	
Other	72		138		137	

* Not edited for corrections.

SECTION 3 - RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

Aquilla Lake, as planned, does not conflict with any Federal, State, or local planning and/or regulatory agency concepts or policies.

SECTION 4 - THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

The impoundment of Aquilla Creek will have both beneficial and adverse effects on man's environment. There will be changes and alterations in the physical and social features of the area. In this section an assessment of the impacts is presented.

4.01 <u>Geological Impacts</u>. The principal environmental impacts related to geology concern slope stability, shoreline erosion, abutment and flood plain leakage, and ground water aquifers. Lake water behind the dam will come into contact principally with soft shales and sandstones of the Woodbine formation and their soil cover. At the present time all slopes along Aquilla Creek Valley appear to be stable. No abundant evidence of landsliding or mass slumping has been observed. However, minor failures may occur on the steepest slopes after encroachment of the lake and consequent saturation of slope materials. The areas most susceptible to this action are along the east side of the valley, and into the lower reach of Hackberry Creek to the point where the limy shales of the lower Eagle Ford crop out. Shoreline erosion will be minimal as most of shore area will have gentle clay slopes. A few sand beaches may develop locally if waves erode soft sandstones of the Woodbine formation. A cutoff trench is proposed through the overburden soils to preclude leakage beneath the dam. The only remaining pathway for leakage of impounded water would be through the Woodbine sands in the foundation, however, such leakage would be minimal because of the relatively low permeability of the Woodbine. It is not expected that this type seepage will present embankment instability, damage to lands downstream from the dam, or any significant loss of lake water. The Woodbine sand and sandstones which will be continuously exposed to lake water occur at or below conservation pool level. These strata include the basal Woodbine sandstones and a few thin sandstone beds in the middle shale member. The outcrops of these beds are generally covered by a natural blanket of alluvial soils, which should restrict the rate of lake water entry. The basal, somewhat shaly sandstone, which will be subjected to the largest head of the lake water, is covered by the greatest thickness of clay. Future testing of these sandstones will more directly determine their leakage potential and the possible need for protective measures. Case histories from two larger lake and dam projects, Grapevine and Garza-Little Elm, located on sandstones of the Woodbine formation confirm the low permeability concept.

Sandstones of the Woodbine formation comprise a fresh water aquifer that supplies wells to the east of Aquilla Creek. The recharge area for the aquifer is its outcrop belt, of which Aquilla Creek Valley is a part. The future effect of Aquilla Lake on the recharge of the Woodbine aquifer will depend on the same factors as those affecting leakage through the abutments of the dam. Creation of Aquilla Lake will almost certainly cause a rise in the ground water table surrounding the lake, but the practical effect of this recharge is expected to be limited to small domestic wells in the immediately peripheral area.

4.02 Impact on Streamflow. The runoff of Aquilla Creek has been gaged at river mile 18.2, 1 mile southeast of Aquilla, Texas, since January 1939. There are 306 square miles of drainage area above the gage which is about 75 percent of the Aquilla Creek drainage basin. The average annual flow for the period January 1939 to December 1971 was 83,301 acre-feet. The least flow occurred in 1963 when only 4,138 acre-feet were recorded. In this year there were five consecutive months of no flow. The greatest flow, 213,111 acre-feet was recorded in 1968 with a volume of 124,100 acre-feet occurring in the month of May.

A mean daily flow-duration computed from Aquilla gage data (1939-1971) shows that 85 percent of the time the flow is greater than zero, 50 percent of the time the flow is greater 3.5 cfs, 25 percent of the time the flow is greater than 25 cfs, and 5 percent of the time the flow is greater than 500 cfs. The average flow for the period of record is 115 cfs. An impoundment on Aquilla Creek will smooth out the wide range of flows now occurring.

The impoundment will control all floods of record to the channel capacity of Aquilla Creek below the dam and will aid in the reduction of floods in the Brazos River below the mouth of Aquilla Creek. Aquilla Lake will be operated for water supply and flood control. It will be operated for maximum flood control benefits on Aquilla Creek and the Brazos River. Releases will be coordinated with those of the other upstream lakes in the Brazos River flood control system to control floods. Releases from Aquilla Lake will be determined by (1) amount of flood control storage remaining, (2) predicted runoff from the uncontrolled areas downstream and available channel capacities, and (3) forecasted use of flood control storage in other lakes in the Brazos River system. The limiting channel capacity in the reach below Aquilla Lake is about 3,000 cfs and controlled releases would exceed this amount only when the flood control storage capacity of Aquilla Lake is in danger of being exceeded.

Streamflow immediately below the dam will be limited to releases that occur some 37 percent of the time on a monthly basis and 25 percent of the time on a daily basis, and to passage of inflows into the lake as necessary to honor prior downstream water rights during periods of low flow. The chemical quality of water of the releases will reflect impoundment mixing. The quality will be better during low flow conditions and not as good during high flow conditions. Temperatures of released water would be higher in the winter and would probably be lower in the summer although some hydrologic conditions could cause a temperature reversal of normal summer releases.

4.03 Impact on Water Quality. Continuous records of samples for chemical quality of water are available for the Aquilla Creek gage near Aquilla, Texas, from October 1967 to date. Most of the volume of the flow at the gage is composed of floodwaters from immediate runoff after rainfall. The large flows are of good quality water that deteriorate to poor quality with small flows. Dissolved solids consist mainly of inorganic salts with a small amount of organic material. The average of weighted volumes of total dissolved solids is 253 milligrams per liter (mg/l) indicating a good wuality water. Monthly concentration-duration curves for total dissolved solids indicate that the lake sould supply water with TDS concentrations of less than 500 mg/l at least 70 percent of the time. Total dissolved concentrations will be greater than 900 mg/l only about 4 percent of the time. The concentration of all chemical constituents are within criteria set by the US Public Health Service. The Texas Water Quality Board has proposed standards for the Brazos River of which Aquilla Creek is a tributary. Concentrations of constituents in samples from Aquilla Creek Watershed are well within the limits of the criteria of the Water Qualitiy Board. Aquilla water is classified as hard with about 124 mg/l carbonate hardness and 47 mg/l noncarbonate hardness. The quality is such that unusual corrosive problems are not anticipated.

Normally, during the initial impoundment in a reservoir and during the following few years water quality deteriorates. Inundation of vegetative cover and organic soils will cause an immediate increase in BOD, color, potassium, and forms of nitrogen, and decreases in DO and pH. The total effect and time required to completely neutralize this action is dependent on physical and climatological factors. If a period of very low inflow were to follow immediately after impoundment water quality would be very poor. Conversely, if, after impoundment, inflow was very high, it would mitigate the deterioration of water quality normally experienced with initial impoundment.

As indicated in section 2, turbidity readings are generally high in all streams in this area of the Brazos River Basin. Turbidity in a lake is difficult to predict because it is influenced by rate of inflow, exposure to wind, velocity of wind, depth of water, shoreline features, and other factors. The Soil Conservation Service has prepared a watershed protection and flood prevention plan for the Aquilla-Hackberry Creek Watershed. Aquilla Lake was considered during preparation of this plan. The work plan proposes land treatment measures on 23,279 acres of cropland and 24,158 acres of grassland, 27 grade stabilization structures, 23 floodwater retarding structures, and 15.6 miles of stream channel improvement. The work plan indicates that soil and water conservation plans, covering 70 percent of the land, have been developed on 721 of the 1,167 operating units in the watershed. District cooperators have applied approximately 50 percent of needed conservation practices. The work plan further states that about 80 percent of all needed land treatment practices will be applied by the end of the 7-year work plan installation period. Installation of these measures will have a net effect of decreasing turbidity in Aquilla Lake. It is estimated that the SCS program will decrease sediment deposition in Aquilla Lake by 40 percent. According to a work plan map most of the gully erosion occurs in the Hackberry Creek Watershed above the town of Hillsboro.

Normal treatment of water from this project for municipal supply will probably consist of filtration and disinfection. At times treatment for hardness may be desirable.

4.04 Impact on Vegetation. Of the 11,800 acres required for the project, approximately 7,520 acres are cropland, 3,235 acres are in pasture, and 1,045 are timberland. The use of this land will, of course, change with construction of the project. The Aquilla Lake project will inundate 1,887 acres with the conservation pool and the flood pool will periodically inundate an additional 4,478 acres. In the conservation pool, vegetation will be either cleared or inundated, and in the flood control pool, vegetation will be subjected to alternating periods of wet and dry. Observation at other projects indicates that most of the adverse effects will occur at lower elevations in the flood pool where inundation is more frequent and of longer duration. Green (1947) found that the major factor in tolerance to flooding appears to be the relationship of the root crown to normal water levels. Hall (1955) found that flooding has an adverse effect on bottom-land forests and that all woody species were killed in areas where the root crowns were periodically flooded more than 54 percent of the time during the growing season. Those species subjected to less flooding at higher elevations showed varying degrees of tolerance. The critical time is the growing season because at this time surface water exerts its major adverse effects on the woody components of bottom-land forests.

Several species of bottomland hardwoods should reestablish on the lakeshore after an interim period. While site factors (soil types, aspect, and slope) will be different, the increased moisture above the conservation pool may compensate, to some extent, for lack of some other elements. This succession can be accelerated with proper reforestation and management practices for reestablishment of the more desirable species. Herbaceous plants of the flood pool area will not be completely lost. Plant communities within the lower elevations of the flood pool, subject to frequent inundation, will be affected by the operation of Aquilla Lake. Most of the annual species and some biennial and perennial species have only mild tolerances to frequent inundations for period of more than 5 days. Other herbaceous plants have strong tolerances to flooding and will withstand inundation for periods of more than 20 consecutive days. Several summer and fall ephemeral grasses and forbs are likely to establish themselves in the lower area of fluctuation which will be divested of most other herbaceous plants.

Periphyton and rooted aquatics in the area of inundation will be destroyed, but these species should not be affected above or below the impoundment. Periphyton will rapidly establish in the littoral zone of the lake. The littoral community should be pulse stabilized in an ecologically immature but highly productive state by water level fluctuations and energy subsidies provided by gentle wave action. The phytoplankton community will be greatly expanded by the construction of the lake.

Mosses and ferns, which represent the amphibious stage of plant evolution, will be eliminated from the deeper part of the conservation pool by inundation. They probably will become reestablished around the shoreline of the lake.

Disturbances resulting from construction of the lake would provide open habitats and the number of weedy plant species might increase. As a result of these habitat changes as well as the habitat changes below the damsite, new species and types of vegetation may invade the area.

The absence of flooding in the flood plain below the dam could result in changes in the composition of the lowland forest of the area by encouraging changes in the land uses of the flood plain. It is probable that portions of the flood plain will be drained, cleared, filled, and used for urbanization, crop production, and as improved pastures.

4.05 Impact on Fishes. The proposed lake would change aquatic habitats from lotic to lentic ones. This change would most dramatically affect those fish species present that are usually confined to small streams in areas of moderate streamflow. Those species present in the regions of the Aquilla Creek Watershed that fit this category are:

Campostoma anomalum	Stoneroller
Percina shumardi	River darter
Lepomis megalotus	Longear sunfish
Lepomis punctatus	Spotted sunfish
Percina macrolepida	Big scale logperch
Notropis lutrensis	Red shiner
Notropis venustus	Blacktail shiner

Notropis lutrensis was collected in each sample taken from the three creeks studied. Studies conducted by Cross (1967) indicate that this species is indicative of habitats in which few other types of fish occur. Onsite collections during the summer of 1972 in the Hill County area tend to substantiate this view. The proposed impoundment would probably eliminate the species previously listed from the upper Aquilla Creek Watershed. Very little water is to be found in the water courses in question above the full reservoir level of the proposed impoundment. However, each of these species enjoys a rather wide distribution and seems to be in no imminent danger of extinction.

Most of the other species on the checklist should satisfactorily survive the transition to a lacustrine situation. This should result in increased populations of fishes present. Normally the ecosystem is initially conducive to the emergence of game species as dominants. Successional eutrophication, however, generally favors less desirable species, and the result is an overall increase in standing crop favoring coarse species (Jenkins, 1957).

Fish productivity in the proposed lake should be affected by the nature of the shoreline as well as the surrounding terrain. Because the lake will occupy primarily land that has been used for agricultural purposes, the shoreline will be initially rather exposed. Furthermore, a good portion of the runoff entering the impoundment will be from plowed and row-cropped land. This, considered in the light of clay and silt content of the soils of the region, should produce a high concentration of suspended particles and turbidity. This should produce two important results: (1) a slowing of the rate of eutrophication and accompanying fish productivity, and (2) an ecosystem that would tend to favor increased populations of the bottom-feeding, less desirable fish species (e. g., Cyprinus carpio, Ictiobus bubalus, Carpiodes carpio, and Pylodictus olivaris).

The turbidity conditions of the lake may also be affected by the direction in which the lake lies and the relation of this direction to prevailing winds. The proposed impoundment will offer a long reach in a generally southeast to northwest direction, particularly along the Aquilla Creek arm. This should further tend to keep the lake in a condition of rather high turbidity.

The predominate game species in the proposed impoundment would be:

Ictalurus punctatus	Channel catfish
Micropterus salmoides	Largemouth bass
Morone chrysops	White bass
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie

In addition, other species that have a rather high human food value are:

Aplodinotus grunniens	Freshwater drum
Ictalurus melas	Black bullhead
Ictalurus natalis	Yellow bullhead
Ictiobus bubalus	Smallmouth buffalo
Pylodictus olivaris	Flathead catfish

The fish population of the channel of Aquilla Creek below the proposed dam will be affected in two ways. When water entering the lake is of sufficient quantity to maintain a continuous flow below the dam, it should encourage an ecosystem favoring the presence of fishes of the Brazos River Basin that flourish in relatively clear flowing water. However, during periods of little or no inflow, that portion of the creek will return to the dry, pooled condition that now prevails during drought periods.

4.06 Impact on Amphibians and Reptiles. The tailed amphibians that inhabit the Aquilla Creek area that will be adversely affected are primarily those that are found in association with flood plains woodland. However, none of the species that fall in this category are endemics; all of them enjoy a rather wide range. The lesser siren, a flowing water species, will be removed from the inundated portion of the watershed, but its range in Texas includes most of the counties of east and southern Texas. (Raun, 1972).

Most of the tailless amphibians of Hill County would not be adversely affected with the construction of a dam on Aquilla Creek. Exceptions are the small frogs that are found as regular inhabitants of the flood plain wooded areas: green tree frogs, gray tree frogs, spotted chorus frogs, strecker chorus frogs, and western chorus frogs. One important game species, bullfrogs, would enjoy a population expansion due to an increase in favorable habitat proffered by the increased shoreline of the proposed lake.

Most of the turtles of the area would increase their populations following lake construction. Exceptions are those species that are found in flowing water: river cooter, smooth softshell turtle, and spiny softshell turtle. Most turtles enjoy a niche rather high on aquatic food chains; therefore, an increase in population of a turtle species (e.g., snapping turtles), need not indicate that this would be a favorable occurrence with reference to man's activities. Competition with more favored species would tend to make an increase in overall turtle populations a detrimental effect of an Aquilla Creek impoundment.

Lizards that would suffer eradication in the areas of inundation are: green anoles, five-lined skink, broad headed skink, prairie skink, and ground skink. None of these are endangered species. Indications are that other species of lizards would not be affected by the proposed habitat change.

No species of snake would be seriously threatened over a substantial portion of its range by the proposed lake. One species, the cottonmouth, that is dangerous to man would be encouraged along the shoreline of a proposed lake.

4.07 Impact on the Brazos River Estuary. The recommended Aquilla project features a dam at river mile 23.3 on Aquilla Creek. The Brazos River estuary is another 417 miles downstream from the mouth of Aquilla Creek. The drainage area above the recommended damsite represents about 0.7 percent of the total drainage area of the Brazos River Basin. Seven major tributaries now enter the Brazos River between the mouth of Aquilla Creek and the Brazos River estuary. Because of the small drainage area controlled, the higher rainfall in the lower Brazos River Basin, and the retention of only part of the Aquilla Creek flows, the effects of Aquilla Lake on the Brazos River estuary are expected to be insignificant. The greatest effect of the project would be to decrease the sediment load in Aquilla Creek discharges.

4.08 Impact on Birds. Those species that would suffer a serious reduction in quantity of habitat are: wood duck, red-shouldered hawk, bobwhite, yellow-billed cuckoo, great horned owl, barred owl, chuck-wills-widow, red-bellied woodpecker, downy woodpecker, eastern wood pewee, blue jay, chickadee, tufted titmouse, Carolina wren, blue-gray gnatcatcher, red-eyed vireo, parula warbler, summer tanager, and cardinal.

A dam across Aquilla Creek would provide an increase in favorable habitat for water, shore, and marsh-dwelling birds. Many of these are migratory, and another reservoir near the eastern edge of the "Central Flyway" might serve in their migratory and wintering activities. Among the birds that would benefit from such a lake are: loons, grebes, pelicans, comorants, water turkeys, herons, egrets, ibises, spoonbills, geese, ducks, mergansers, bald eagles, ospreys, coots, plovers, killdeers, sandpipers, yellowlegs, dowitchers, godwits, avocets, phalaropes, gulls, terns, and yellow-headed balckbirds. Of the species found in the area the southern bald eagle and peregrine falcon are listed as endangered, the prairie falcon is designated as threatened, and the American osprey is designated as status undetermined in the US Department of the Interior's Resource Publication 114, "Threatened Wildlife of the United States."

4.09 Impact on Mammals. The proposed impoundment would affect mostly those species that usually inhabit either the creeks or the wooded flood plains central to Aquilla Creek and its tributaries. These species include opossum, armadillo, fox squirrel, flying squirrel, beaver, whitefooted mouse, Florida woodrat, nutria, raccoon, mink, gray fox, whitetailed deer, swamp rabbit, and cottontail rabbit. The effect of the impoundment would be to move these species upstream or downstream of the lake where a habitat similar to that lost would still exist. The number of mammals in the lake area is not great enough to cause over population in the habitat remaining.

4.10 Impact on Archeological Sites. The 72 archaeological sites in the flood plain, flood plain rise, creek edge, and upland base areas of Aquilla Creek, figure 2-1, would be inundated. The 36 sites in the upland slope would be subject to wave action and fluctuations, and the 17 sites in the upland would be subject to intermittent flooding.

The sites located in the fluctuation zone of the shoreline will be those receiving the most adverse effect. Cultural materials would be removed from their archaeological context by wave action and possibly by vandalism. In the process, the sites would be destroyed. The sites which would be inundated will be affected to a lesser extent. Long-term inundation in an area not subject to mechanical action of waves or currents has been observed to have a positive rather than negative effect on preservation of archaeological sites. The sites above the conservation pool will be subjected to occasional flooding. Alternate wet-day periods increase organic decay of cultural materials. Those sites are also subject to vandalism and construction damage.

4.11 Socioeconomic Impact. A cultural survey was conducted during the summer of 1972 in the geographical area of Aquilla Lake, figure 4-1. All the area defined by this map was convassed systematically. All the small communities with population over 100 were included and all the area that will be directly or indirectly affected by the proposed Aquilla Lake. A questionnaire was especially constructed to answer the specific aims (appendix C-1) and was employed in two basic ways: by personal interview and through the mail; 329 questionnaires were completed; 233 by personal interview and 96 by mail. These questionnaires were carefully analyzed and the detailed results published in a report which is included as appendix C-2.

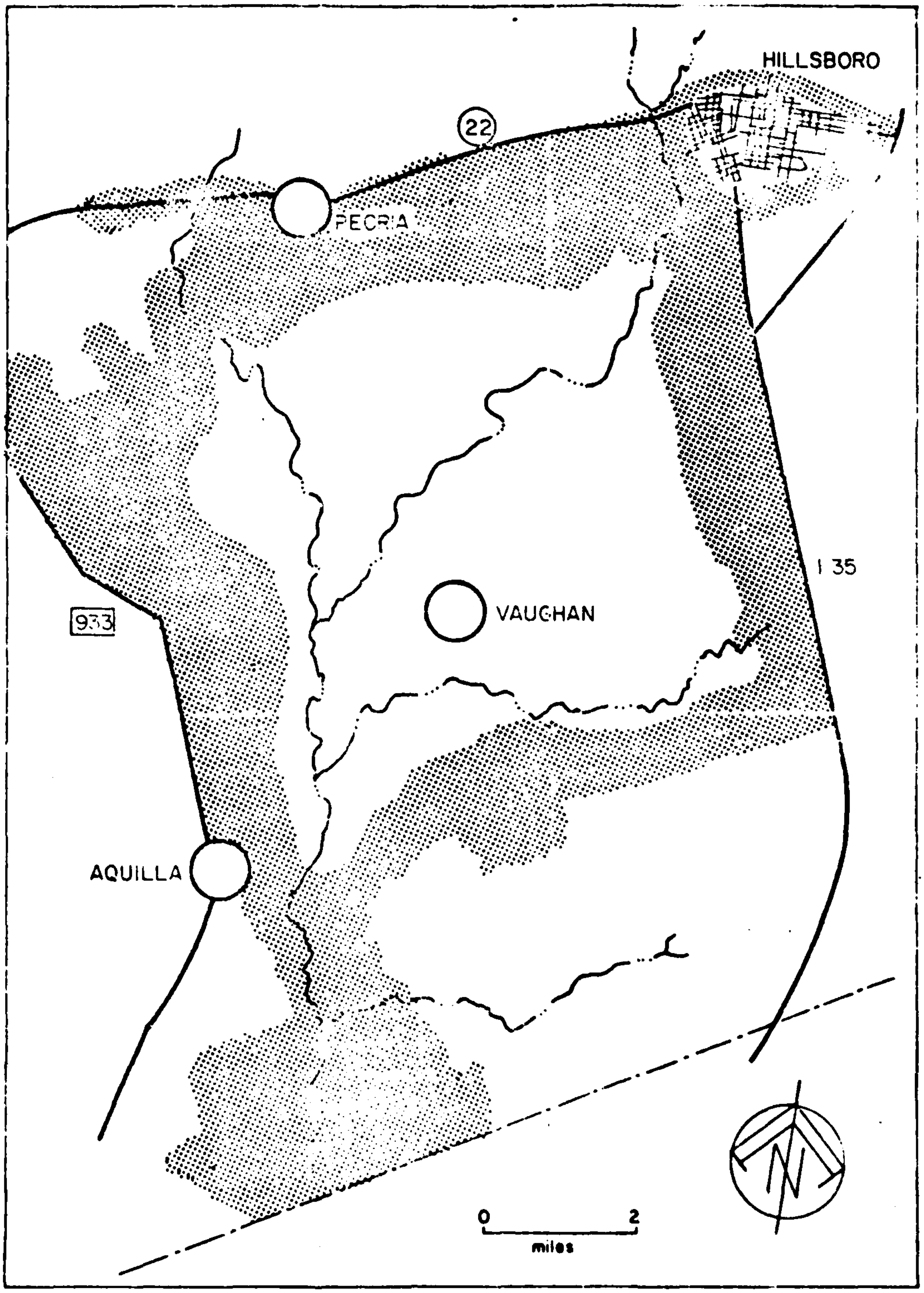

Figure 4-1. Geographic Area of Cultural Evaluation Study

This survey produced a good cross section "picture" of the people that would be affected by Aquilla Lake.

There are relatively few young families in Hill County. The average age of head of household was 55 years and average family was 2.8 persons.

These people are not mobile. They have strong feelings about their residence and the region in which they live and work. They are concerned about events that affect their community.

All the people knew that a lake was planned on Aquilla Creek; 84.62 percent approved, only 14.15 percent disapproved, and 1.23 percent were neutral. Only 17 out of the 325 people questioned disapproved very strongly - their reason was one of the following: (1) they, or a friend or relative would have to sell land and/or move, (2) the lake would bring undesirable people and business into the community, (3) there are already enough lakes in the area, (4) the dam might break, and (5) no reason, just disapproved.

When 293 persons were questioned about economic growth, 230 said the lake would benefit the community economically, 37 thought there would be no economic benefit, eight thought there would be a negative economic benefit, and 18 weren't sure.

Out of 313 people, 247 wanted to see the community population increase, 64 didn't want growth, and two weren't sure.

All respondents agreed that the lake would increase the community's chance for greater recreation involvement. At present, the closest water oriented recreation area is Lake Whitney. Recreation use responses listed the following activities in this order of importance: fishing, picnicking, camping, driving or walking around the lake, swimming, boating, and water skiing.

When the respondents were asked what they thought the best justification was for construction of Aquilla Lake, 77 answered to provide more water and recreation, 186 answered to provide more drinking and industrial water for the region, 110 answered to attract more business and industry, and 58 answered to provide flood control.

An analysis of the survey responses indicates the following impacts would probably be felt in the community.

There should be no marked social changes in the area after impoundment. The only changes that should occur are those changes which normally take place with any increase in population and economic growth. If the community of Whitney is a good example of the effects of a lake on a community, then the communities affected by construction of Aquilla Lake should increase in population. The extent of this increase cannot be made known at this point. However, during the 10-year period from 1960 to 1970 Whitney's population increased 30.6 percent.

About 34 families will be displaced by construction of the project. Each displaced family is eligible for relocation under Public Law 91-646.

Temporary local adverse impacts during portions of the construction period could be noise and dust caused by heavy construction equipment, and a slight increase in turbidity in Aquilla Creek downstream of the construction area. The contract specifications will contain restrictions designed to limit or eliminate these adverse impacts.

It is felt that the largest economic boost would come to the city of Hillsboro. This fact seems to be based on the substantial labor power both in and around Hill County as reported by the Texas Employment Commission (TEC) and the proximity of three large consumer markets (Dallas, Fort Worth, and Waco) transportation facilities and access by rail and interstate highway. Other factors are the availability of accredited public schools through the Junior College level, state and local recreation opportunities, as well as public and private health facilities.

According to the TEC report (1971) the manufacturing and services growth in the past decade has significantly helped the economy. Through discussion with city officials it has also been learned that several industries have already expressed interest in locating in Hillsboro, if an adequate water supply is established. Many respondents in and around the proposed lake location have reported that they have already been approached by large real estate companies in Dallas and Fort Worth who plan development of the lake frontage. This would definitely increase the housing units in the rural areas as well as help to provide some business to the smaller communities such as Aquilla and Peoria.

One of the strongest variables of economic growth of any area is the strong desire on the part of its residents to see the area grow. According to the survey this desire is very strong in Hill County. There does appear to be potential for both economic and population growth in Hill County, and an improvement in the life style of its residents.

There will be a beneficial impact on recreation use including hunting and fishing as private land is converted to public land. In private ownership, project lands are not open to public use, therefore, recreational opportunities are limited. As public lands the recreational opportunities will be limited only by the capacity of the project to provide such use.

4.12 Impacts of Maintenance of Project.

4.12.1 Disposal of Sewage and Solid Waste.

4.12.1.1 Sewage Disposal. Disposal of sewage in a State-approved facility eliminates most environmental effects considered adverse and insures disposal in an acceptable manner. Adverse effects of a sewage disposal facility constructed on project lands would include commitment of the land for the life of the facility, and the need for continued maintenance of the facility.

4.12.1.2 Disposal of Solid Waste. Refuse disposed of in a sanitary landfill and covered with each use results in the elimination of insect and rodent infestations, blowing paper, and odors. The primary advantage of this system is that it insures the disposal of solid waste in an acceptable manner.

4.12.2 Insect and Undesirable Vegetation Control.

4.12.2.1 Insect Control. No insect control problems are anticipated at the project. Any control measures taken will result in beneficial impacts in that it will enhance visitor pleasure, however, it will reduce environmental quality in that it will reduce food for insectivores. In the event that chemical controls become necessary, all precautions will be taken in accordance with label instructions and any chemical used will be registered and approved by the Environmental Protection Agency. The problems resulting from minor usage of insecticides are considered an acceptable trade off for the increase in visitor pleasure.

4.12.2.2 Control of Undesirable Vegetation Growth. The impacts of any control measures taken will be beneficial to the aesthetic quality of the environment of the project and enhance visitor pleasure. Brush and other terrestrial vegetation is controlled by mowing and brushhogging only in areas where it is necessary to remove vegetation. The aesthetic value of a brushhogged area may be temporarily reduced. Herbicides are used in a limited amount where conventional equipment is restricted. All precautions are taken in accordance with label instructions and any chemical used must be registered by the Environmental Protection Agency.

4.12.3 Vegetation and Wildlife Management. The impacts of the project on the natural resources of the area will affect human use of vegetation and wildlife resources to a limited extent. Those resources committed for the life of the project will be lost for that period of time. The impacts on wildlife resources will result in some losses to hunters and fishermen. However, the development of the total resources management plan will make land and water available for outdoor related activities, as well as enhancing the aesthetics of the area. The preparation of a total resource management plan (which will include a vegetation management plan) is scheduled for the near future. Some tree planting and similar landscaping will be carried out in the public-use areas. The impacts of this planting will be to control when used as barriers, and certain species of trees and shrubs will provide wildlife food and habitat.

4.12.4 Public Recreation Management.

4.12.4.1 Enforcement of Regulations. As of June 1972, designated rangers and reservoir managers have citation authority as specified in the Flood Control Act of 1970, Public Law 91-611 (84 Stat 1818). Under this program individuals are cited for violations of applicable provisions of Chapter III, Title 36, Code of Federal Regulations. Maximum use of oral and written warnings are used in minor cases. Where individuals are cited, the prosecution is in the Federal Courts. The basic advantage of this system is that it gives a tool which can be used to insure compliance with the regulations. Also, it provides a method by which persistent violators may be dealt with. Other advantages of this program are cleaner and safer public-use areas, increased visitor pleasures, and a deterrent against destruction of public property (facilities and resources).

The disadvantages with this system are: that officers could easily become involved in situations where their authority is inadequate; officers implementing the program may at times be exposed to considerable danger.

4.12.4.2 Operation and Maintenance of Recreation Areas. Presently, detailed plans have not been developed for future public-use areas. In the absence of a non-Federal entity to cost-share, recreation facilities will not be provided. However, visitors will be attracted to the lake and will have access to it at road ends. Visitors attracted to the lake will cause an adverse impact on the natural environment. As they concentrate at the access points the vegetation will be depleted in quantity and quality. This will stimulate erosion and consequently will put silt into the lake at these points degrading the water quality and aquatic habitat. It will also decrease habitat for terrestrial animals and coupled with the presence of people the animal populations will decrease at these areas. Aesthetic affect will decline. Facilities for health and safety provided at the access points will be maintained. Maintenance will include minor landscaping (planting shrubs by trash cans, etc.) and maintenance measures (paint toilets and trash cans, etc.). These activities will entail some disturbance to the natural environment; however, these maintenance activities will be planned when possible to complement existing vegetation, replace lost or damaged plants, and to enhance the appearance of the related area.

4.12.5 Management of Land Resources and Facilities. Temporary adverse impacts, such as erosion and safety hazards are caused by the outgrant program. These effects primarily occur during construction phases. It is felt that the positive impacts such as rural electric service, telephone service, etc., far outweigh any adverse impacts. It should be noted that adverse impacts generated by this type of program can be mitigated by such measures as are described in the alternative section of this statement.

4.12.6 Project Management and Maintenance Activities.

4.12.6.1 Erosion Control. The impacts resulting from erosion control activities at the project will be an improved environment around the lake, both aesthetically and physically. Other beneficial impacts will be reduced turbidity of the lake water and the resulting reduced siltation.

4.12.6.2 Construction and Maintenance of Project Roads. No new roads are planned at the project, but the need for additional roads may develop in the future. The majority of the roads to serve the project will be hard-surfaced which will reduce their maintenance requirements. The surfacing of the roads reduces traffic generated dust problems in the public-use areas and will make their use by the public more pleasant.

SECTION 5 - ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

5.01 Approximately 11,800 acres of land will be required for the project. The lands consist of about 64 percent cropland, 27 percent pasture, and range land, and 9 percent timber land including bottomland forest. The conservation pool will inundate 1,887 acres. An additional 4,478 acres will be inundated by the flood pool, and the balance of the land will be in damsite and periphery areas of the lake. This inundation will result in a decrease of the total biotic diversity in the lake area. Terrestrial vegetation within the conservation pool will be cleared or killed by inundation. Terrestrial wildlife habitat in the conservation pool will be lost. Organisms adapted for living in a stream habitat will not be able to survive in the lake.

Adverse effects will occur on the land surrounding the lake and also downstream from the lake. Increases in recreational visitation as a result of improved access and the availability of lake-type recreational activities will have an adverse effect on the existing environment. Increased downstream recreational activities will also adversely affect the existing environment in that area. Increased agricultural and industrial development of the downstream reaches as a result of flood protection will adversely affect the diversity and stability of the existing environment. Because of flood control, the lake will have an adverse impact on natural terrestrial productivity in the lower reaches of the basin. In addition, during continuing construction, the stability of the Aquilla Creek Basin will be disturbed in the project vicinity.

The crop production and livestock production on these acres will stop. This change will affect the agricultural income in the area and the income of those businesses serving agricultural activity. The socioeconomic survey made in 1972 indicated that the people in the lake area are not mobile. This relocation, even though to equal or improved homes, will be a difficult experience for the people involved.

Five miles of Hill County and farm-to-market roads will be affected. There would be traffic disturbance and construction activity during the changeover and new traffic patterns will have to be established by residents.

Existing powerlines and communication lines would be relocated, altered by raising in place, or abandoned. Pipelines will be protected in place, buried at lake crossings, or relocated above the backwater effects. There would be disturbance during the construction period, but on completion, the normal service of these utilities would be resumed.

The 125 archaeological sites in the area have been located and surveyed. There is a probability that other sites may be buried in the flood plain and some could be uncovered during construction. Although salvage of a site has mitigation value, it may also be considered an adverse affect.

Visitors to the access points around the lake will decrease the quality and quantity of vegetation. This will induce erosion and degrade water quality at these points. Terrestrial habitat and wildlife will also decrease slightly with the concentrated visitation.

SECTION 6 - ALTERNATIVES TO THE PROPOSED ACTION

6.01 General. A number of alternative plans designed to solve or partially solve the water resources problems of the Aquilla Creek Basin were considered (figure 6-1). Four alternative plans studied could not be justified economically or were found to be undesirable. They were (1) levees with water supply import, (2) channel improvement with water supply import, (3) nonstructural alternatives, and (4) developing Aquilla Creek as a recreational stream. The alternatives studied in greater detail are listed below:

a. Site A

b. Site B

c. Site C

d. Site D

e. Tributary Multiple-Purpose Lakes

f. Tributary Flood Control Lakes and Water Supply Import

g. Dry Lake and Tributary Water Supply Lakes

h. Dry Lake and Water Supply Import

i. Acquire Flood Plain in Fee and Water Supply Import

j. Acquire Flood Plain in Easement and Water Supply Import

k. No Action

A comparison of the alternatives is shown in table 6-1. Listed are pertinent data for each alternative, in addition to an economic evaluation. The land requirements shown are an aid in comparing impacts of the alternative plans. Generally speaking, the projects on lower Aquilla Creek tend to have a higher percentage of cropland, whereas the ones on upper Aquilla Creek and tributaries tend to have a higher percentage of pastureland and timber. Project costs shown on the table represent the construction cost of the alternative, plus the cost (interest) of using the construction funds during the period of construction, plus operation and maintenance, and major replacement costs for the project life, all expressed in present dollar worth. Excess benefits over costs and benefit-to-cost ratios shown in the table are a means of comparing alternative project efficiency in producing economic benefits. Examination of the economics portion of the table reveals that alternative site D has a higher benefit-to-cost ratio and higher excess benefits over cost than the other alternatives considered; therefore, the excess benefits foregone for the other alternatives are measured against site D.

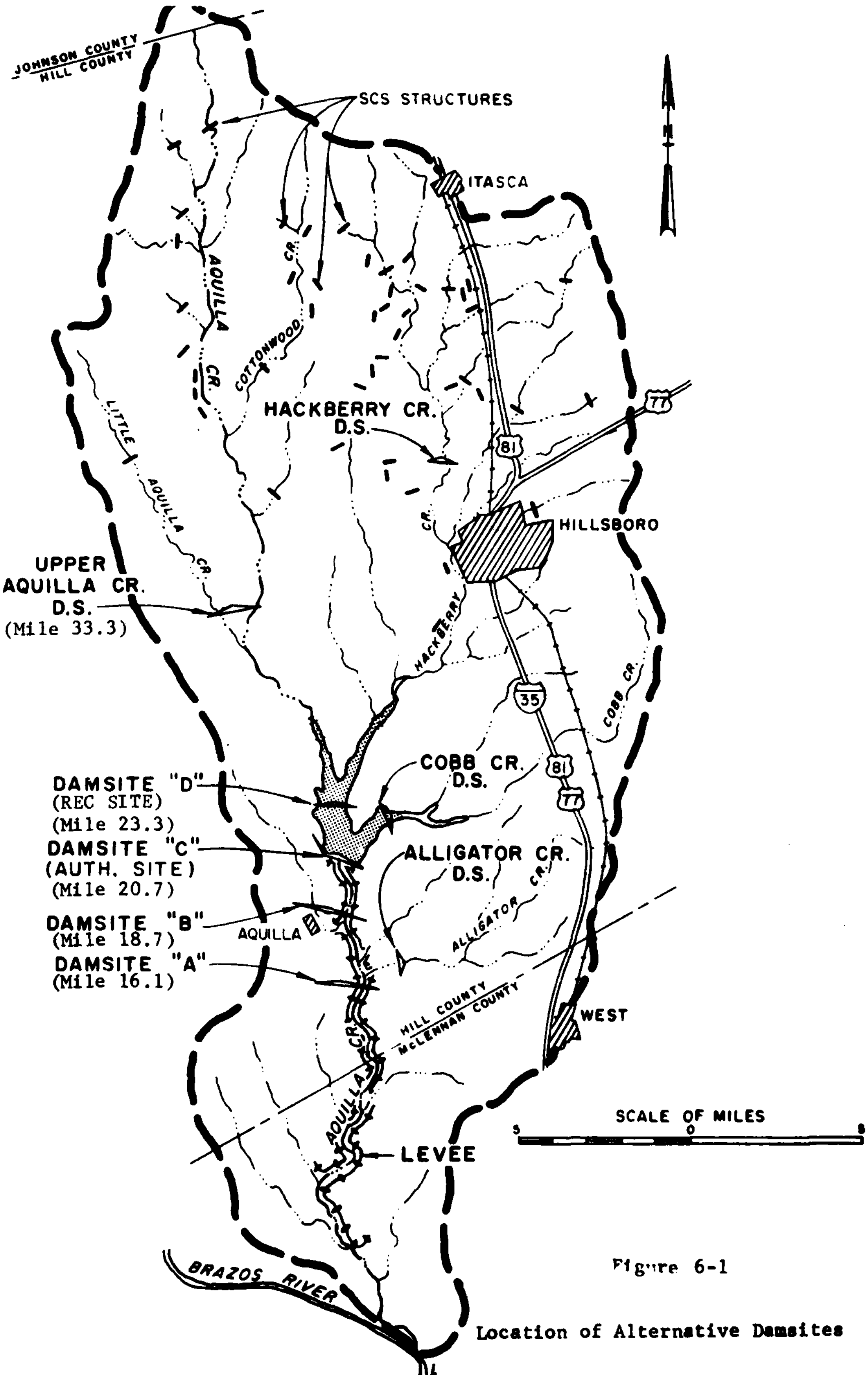

Figure 6-1

Location of Alternative Damsites

TABLE 6-1

PERTINENT DATA FOR ALTERNATIVES

	DATA	A	B	C	D	E	F	G	H	I	J	K
		ALTERNATIVE SITE "A"	ALTERNATIVE SITE "B"	AUTHORIZED SITE	ALTERNATIVE SITE "D"	TRIBUTARY MP LAKES	TRIBUTARY FC LAKES PLUS WS IMPORT	DRY LAKE PLUS TRIB WS LAKES	DRY LAKE PLUS WS IMPORT	PURCHASE FLOOD PLAIN IN FEE PLUS WS IMPORT	PURCHASE FLOOD PLAIN EASEMENTS PLUS WS IMPORT	NO ACTION
LAND REQUIREMENTS	Land Required (Acres)											
	Fee	[illegible]	14,400	13,500	12,400	[illegible]	900	13,700	600	6,200	-	-
	Easement	-	-	-	-	-	9,300	6,800	7,000	200	6,400	-
	Total	[illegible]	14,400	13,500	12,400	[illegible]	10,200	20,500	7,600	6,400	6,400	-
	Land Classification for Total Fee (Acres)											
	Cropland	[illegible]	[illegible]	[illegible]	[illegible]	5,500	300	3,700	300	1,500	-	-
	Pasture	[illegible]	[illegible]	[illegible]	[illegible]	9,500	400	7,100	200	3,400	-	-
	Timberland	[illegible]	[illegible]	[illegible]	[illegible]	4,500	200	2,900	100	1,300	-	-
	Flood Plain Acreage											
	Aquilla Creek Basin below damsite	[illegible]	[illegible]	[illegible]	[illegible]	-	-	6,200	6,200	6,200	6,200	-
	Brazos River Basin	[illegible]	[illegible]	[illegible]	[illegible]	-	-	958,300	958,300	958,300	958,300	-
	Total	[illegible]	[illegible]	[illegible]	[illegible]	-	-	964,500	964,500	964,500	964,500	-
	Flood Plain Land Classification (Acres)											
	Cropland	[illegible]	[illegible]	[illegible]	[illegible]	-	-	431,500	431,500	431,500	431,500	-
	Pasture	[illegible]	[illegible]	[illegible]	[illegible]	-	-	529,500	529,500	529,500	529,500	-
	Urban or suburban	[illegible]	[illegible]	[illegible]	[illegible]	-	-	3,500	3,500	3,500	3,500	-
ECONOMICS	Project Cost (1)	46,034,000	42,397,000	43,796,000	35,726,000	[illegible]	66,132,000	91,807,000	42,742,000	14,354,000	13,482,000	-
	Benefits (Capitalized @ 3-1/4%)											
	Flood Control	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28,167,000	28,167,000	260,000	9,000	-
	Water Supply	[illegible]	14,668,000	[illegible]	[illegible]	14,666,000	14,666,000	14,668,000	14,668,000	14,668,000	14,668,000	-
	Recreation & Fish & Wildlife	2,479,000	2,479,000	2,479,000	2,479,000	2,479,000	1,236,000	2,479,000	-	-	-	-
	Subtotal	46,156,000	45,332,000	45,314,000	[illegible]	37,709,000	36,466,000	45,314,000	42,835,000	14,928,000	14,677,000	-
	Redevelopment Benefits	[illegible]	[illegible]	[illegible]	[illegible]	3,013,000	2,639,000	3,784,000	1,948,000	558,000	558,000	-
	Total Benefits	46,011,000	47,0[illegible],000	47,132,000	44,641,000	40,722,000	39,105,000	49,098,000	44,783,000	15,486,000	15,235,000	
	Excess Benefits Over Cost (with redevelopment)	-23,000	4,[illegible],000	[illegible],336,000	5,415,000	-47,[illegible],000	-27,027,000	-42,709,000	2,041,000	1,132,000	1,753,000	-
	Benefit To Cost Ratio (with redevelopment)	0.99	1.1	1.1	1.2	0.5	0.6	0.5	1.0	1.1	1.1	-
	Total Alternative D Excess Benefit Foregone (with redevelopment)	5,938,000	1,260,000	2,579,000	-	5[illegible],996,000	32,942,000	48,624,000	3,874,000	4,783,000	4,162,000	5,915,000
OTHER DATA	Drainage Area (Sq Mi)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	217	294	294	-	-	-
	Surface Acres at Top of Flood Pool	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,260	[illegible]	[illegible]	-	-	-
	Surface Acres at Top of Conservation Pool	[illegible]	[illegible]	[illegible]	[illegible]	7,550	-	[illegible]	-	-	-	-
	Volume at Top of Conservation Pool (Ac ft)	55,800	56,200	57,[illegible] (2)	[illegible],700	[illegible],600	-	[illegible]	-	-	-	-
	Volume at Top of Flood Control Pool (Ac ft)	177,300	164,700	162,600	149,300	[illegible],700	[illegible],700	116,700	-	-	-	-
	Maximum Depth (feet)	[illegible]	[illegible]	[illegible]	41	[illegible]	-	60	-	-	-	-
	Mean Depth (feet)	[illegible]	[illegible]	[illegible]	[illegible]	15		15	-	-	-	-
	Stream Miles Inundated (excluding tributaries)											
	At Top of Conservation Pool	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	22.8	-	-	-	-
	At Top of Flood Pool	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.1	34.3	11.5	-	-	-
	Water Supply Yield (mgd)	[illegible]	[illegible]	[illegible]	[illegible]	12.4	-	12.4	9.7	9.7	9.7	-
	Flood Control Frequency (years)	50	[illegible]		[illegible]	50	50	50	50	-	-	-

(1) Includes first cost, interest during construction, and capitalized operation, maintenance, and replacement.

(2) Conservation storage reflects new hydrologic studies and is different than the project document storage.

6.02 Alternatives Considered. The 11 alternatives considered for the Aquilla project are discussed in this section:

6.02.1 Main Stem Lake at Site A. Creation of a dam and lake at this location would have an adverse effect upon the natural environment and the historical resources and is likely to find considerable adverse public reaction. The historic town of Aquilla would be inundated and before this occurred it would be necessary to carry out a detailed historical and archaeological investigation of the entire townsite. In addition, several historic log cabins would be destroyed. Inundation of Aquilla would also require the relocation of a large number of people and the disruption of an important educational complex within Hill County. About 77 families would have to be relocated. For these reasons public reaction to selection of this damsite would probably be unfavorable.

A dam placed at site A would flood almost all of the native hardwood forest belt that is found along the creek banks of Aquilla Creek. This is one of the few natural habitats available within the watershed and should be preserved as such. If site A was chosen, this would mean that no major streams within the watershed would remain in a natural or native condition. In the results of the matrix analysis this project ranked third (table 6-3).

6.02.2 Main Stem Lake at Site B. Construction of a lake at this site would require about 2,200 acres less land than site A. About 16 families would have to be relocated. The dam would be extremely close to the town of Aquilla which would possibly cause some adverse public reaction. Selection of this damsite would preserve part of the hardwood habitat and would preserve Alligator Creek in its natural condition. The matrix analysis ranks this project fourth.

6.02.3 Main Stem Lake at Site C. Site C is the damsite location of the plan authorized by Congress. The conservation storage of the alternative plan considered in this section is smaller than the authorized plan because refined hydrologic studies showed that less storage would be required to develop the authorized 9.7 m.g.d. yield. Environmentally, impoundment of Aquilla Creek by this alternative would have beneficial as well as adverse effects. Construction of a lake with flood control storage would improve the natural environment downstream due to a decrease in overbank flooding and erosion. The cleaner water that would result would help to preserve the native creek bank hardwood habitat located along the banks downstream from the confluence of Hackberry and Aquilla Creeks. On the other hand, the lake would destroy some of that habitat by inundation. The natural state of vegetation in the Aquilla Creek Watershed has already been severely disrupted by agricultural activities, and the impoundment would do little additional damage to the plant ecology other than the hardwood habitat. Archaeological sites would be adversely affected. The lake would destroy some wildlife habitat, but would also benefit some forms of wildlife such as sport fishes and water-, shore-, and marsh-dwelling birds.

No known rare or endangered species would be disturbed by construction of the lake. No important historic resources have been reported in this area.

Choice of this location would result in an adverse effect upon a section of the hardwood forest belt along Aquilla Creek and destruction of the natural environment of Cobb Creek; Alligator Creek would be preserved. No important historic resources have been reported in this area, and the majority of the public is prepared to accept this site. It would require about 1,100 acres less land than site B and about 3,300 acres less than site A. About 28 families would have to be relocated. The matrix analysis ranks this project second.

6.02.4 Main Stem Lake at Site D. Site D would have the advantage of causing the least adverse effect of any main stem site on the native hardwood habitat. In addition, choice of site D would allow Cobb and Alligator Creeks to remain in their native condition. A lake at site D, however, would have some adverse effects near the town of Hillsboro because of higher backwater in that area, and levees would have to be built around the sewage treatment plant. This site would require about 1,400 acres less land than site C. About 34 families would have to be relocated.

In the matrix analysis this site was scored the same as A, B, and C in the natural environmental parameters. It merited top score in both human life quality and economic parameters and so in the net impact of all parameters it ranks first. The advantages and disadvantages that this plan would have in comparison to the other alternatives also apply to the recommended plan as described in section 1.

6.02.5 Tributary Multiple-Purpose Lakes. A system of multiple-purpose lakes located upstream of Aquilla Lake or on other tributaries of Aquilla Creek was investigated. Four sites, upper Aquilla, Hackberry, Cobb, and Alligator Creeks, were selected to represent a scale of development that could reasonably be constructed in combination to provide approximately the same services as the authorized lake. Upper Aquilla Creek site is located near the town of Peoria, and the Hackberry Creek site is located above the town of Hillsboro. The third site, Cobb Creek, is located just above the authorized damsite, and the fourth, Alligator Creek, is on the creek with the same name which enters Aquilla Creek below the authorized damsite. The location of the four lakes is shown in figure 6-1. The conservation storage at each lake was designed to develop the maximum dependable yield, and the selected flood control storage would control the same frequency flood that would be controlled by Aquilla Lake. Because of the number of upstream dams required and the pool areas involved, the impact on the natural environment would be greater and more widely distributed than that caused by the authorized project. This alternative would require about 2,700 acres more land than the largest main stem lake located at site A. About 37 families would have to be relocated. A larger number of archaeological sites would be affected by these dams than by one large dam on the main stem. The impact of constructing water supply pipelines from the lakes to the point of use would be greater because more lines of greater length would be required. In the event that future water supply needs exceed current projections, the tributary lake system would forego the opportunity to develop a larger part of the available water resources in the basin. The tributary lakes would interfere with the SCS program in the basin as it is presently planned. Also, the degree of flood protection offered by the system of tributary multiple-purpose lakes would be less than the authorized plan. On the advantage side, this alternative would leave the main stem of Aquilla Creek free of development, thus preserving the hardwood habitat. Another advantage would be that construction of the components of the system could be staged to meet the water supply needs as they develop. This alternative ranked ninth in the matrix analysis.

6.02.6 Tributary Flood Control Lakes and Water Supply Import. This plan would consist of flood control lakes located at the same sites as the multiple-purpose projects discussed in paragraph 6.02.5. Water supply needs would be met by importation from Lake Waco and Belton Lake. This alternative would require about 10,200 acres of land which is less than any of the multiple-purpose lake alternatives. About 29 families would have to be relocated. The environmental effects of the four flood control lakes caused by pool fluctuations would be similar to the dry lake described in the following paragraph. This alternative ranked sixth in the matrix analysis.

6.02.7 Dry Lake and Tributary Water Supply Lakes. The objective of a dry lake would be to provide the same degree of flood protection as the authorized project and leave the main stem of Aquilla Creek free from a permanent impoundment. This, in combination with the water supply lakes at sites previously discussed, would provide approximately the same services as the authorized project. The water supply lakes were used in lieu of the less costly water supply import alternative to determine their effect on the natural environment and human life quality accounts in the matrix analysis to insure that the best water supply alternative had been selected. The dry lake would have no permanent pool except for water in the streambed and would impound floodwaters behind the dam and discharge the stored floodwater at a nondamaging rate not to exceed channel capacity. There would be undesirable effects on the flora and fauna and the aesthetics in the impoundment area, since this reach of stream would be subject to frequent flooding. The fluctuations in water level within the dry lake basin would prevent the establishment of a stable terrestrial or aquatic ecosystem. The fauna and flora of the system (except woody species) would consist of species which are capable of rapid invasion after a change from aquatic to terrestrial conditions (or vice versa) and a number of euryhydric species which can survive and reproduce in the fluctuating environment. The undesirable effects on the flora and fauna would be greater in the pool area of a dry lake than in the flood pool of a multiple-purpose lake or under natural conditions because of the greater degree of pool fluctuation. This alternative would require the most land of any of the alternatives studied. About 47 families would have to be relocated.

Because of the larger areas inundated and the greater fluctuations of the dry lake pool, the overall environmental impact of this plan would be greater than the authroized plan. This alternative ranked tenth in the matrix analysis.

6.02.8 Dry Lake and Water Supply Import. This alternative is similar to the previous one except that the least costly water supply alternative, import of water from Lake Waco and Belton Lake to the Aquilla Creek Basin, is used in lieu of the tributary water supply lakes. Of all the structural alternatives studies, this one ranked the lowest in requirements. About 14 families would have to be relocated. This alternative ranked fifth in the matrix analysis.

6.02.9 Flood Plain Acquisition in Fee and Water Supply Import. This alternative would consist of buying 6,200 acres of land in the Aquilla Creek flood plain between the Aquilla Damsite and the Brazos River and supplying water needs by importation from Lake Waco and Belton Lake. All privately owned structures and property in the flood plain would be removed except public and privately owned utilities such as pipelines, powerlines, telephone lines, roads, bridges, etc. Crop production in the 5-year flood palin area, except harvesting of natural hay meadows, would not be allowed. The land could be used for wildlife habitat. No families would have to relocated, however, the benefits associated with flood plain acquisition would be flood losses prevented to present and future agricultural and structural development and land rentals. Lake enhancement and recreation benefits with a lake would be foregone with this plan as well as all flood damage reduction benefits on the Brazos River. This plan would provide flood control benefits on Aquilla Creek only by removing a large portion of the flood risk. The greatest advantage to the plan would be leaving the main stem of Aquilla Creek undeveloped. Matrix ranking was seventh.

6.02.10 Flood Plain Acquisition in Easement and Water Supply Import. This alternative is identical to the preceding one except that the land acquisition would be in easement rather than fee. The flood control benefits of this plan would be limited to flood losses prevented to future agricultural expansion and structural development. Other components of the total flood control benefits associated with Aquilla Lake such as increased land utilization and flood losses prevented to present development, would be foregone. Recreation benefits would be foregone. The plan would require those people presently living within the area subject to flooding to be relocated and would restrict future construction of improvements for human habitation as well as impose a restriction on other future structural development. No families would be relocated. Matrix ranking was eighth.

6.02.11 No Action. Construction of Aquilla Lake could be postponed indefinitely. To do so would prevent the inundation of agricultural and grazing lands and natural streambeds which also provide flood and cover for wildlife. This alternative would forego meeting the established needs of the area for flood control, water supply, and recreation, and fish and wildlife.

In addition to tangible benefits, Aquilla Lake would produce intangible benefits which the no action alternative would forego. The lake would minimize the anxiety of downstream flood plain residents by reducing the dangers accompanying floods and the possibility of epidemics that follow. Other intangible benefits include elimination of pollution of wells and other water supplies; decreased interruptions of normal transportation services which can cause loss from delayed shipment of livestock, perishable fruits and vegetables, and seasonable merchandise for which the time element is important; and reduced interruptions to the normal social processes in the valley. Also, losses from erosion of land and deposition of silt would be appreciably reduced.

Because of the pressing need for a dependable source of water supply in the basin, local interests would have to find another source of supply other than Aquilla Lake if the no action alternative were adopted. The no action alternative would result in a loss to the area in terms of estimated net benefits that the authorized project would accrue.

6.03 Matrix Analysis. The next step in comparing the various alternative plans was to establish a reasonable number of parameters which are indicative of the overall impact of alternatives on the three major planning objectives of natural environmental quality, human life quality, and national and regional economics. The parameters selected for evaluating the alternatives considered in this study are presented in table 6-2. This list of factors, plus data shown in table 6-1, provide a basis for developing a matrix analysis. In the matrix analysis, shown on table 6-3, a weight is assigned to each parameter to reflect its relative importance to the region and/or nation and to express its significance in relation to other parameters in evaluating the impacts of alternatives. The weights represent the concensus of an interdisciplinary team, based on research data or on the opinion of several qualified professionals. In this instance, the disciplines were biology, economics, landscape architecture, archaeology, and civil and hydraulic engineering. Parameters within a planning objective were arranged in a hierarchy according to subject matter and relative importance (table 6-2).

In a summary analysis of the 10 alternatives shown on table 6-3, in which the national planning objectives of natural environment, human life quality, and economics were considered to be of equal importance, alternatives D, C, A, and B were found to have significantly greater beneficial net impact to man's environment.

Based on the assumption that the matrix analysis was an unbiased interdisciplinary effort and that a reasonable estimate of error was used in the statistical analysis, a determination was made that a multiple-purpose lake on the main stem of Aquilla Creek would best meet man's needs.

TABLE 6-2

FACTORS CONSIDERED IN SCORING PARAMETERS IN EXAMPLE MATRIX ANALYSIS

Natural Environment Parameters	Factors
I Unique, Rare, Endangered, or Unusually Important Species	Species present; habitat requirements; local, regional, and national abundance, distribution, and significance of species; tolerance limits of species to pertinent environmental conditions; critical coactions of species; preservation programs of other agencies: existing land use trends; land use practices on project lands.
A. Fauna	
B. Flora	
II Plant & Animal Habitat	
A. Aquatic	
1. Lotic (flowing)	
a. Quality	Present and predicted water quality and streamflow data, basic productivity; substrate type, habitat requirements of desirable species.
b. Quantity	Stream miles, mean width and flow durations with and without the project; % of riffles and pools.
2. Lentic (standing)	
a. Quality	Predicted water quality, basic productivity, mean depth, length and configuration of shoreline, substrate reservoir operational plan, habitat requirements of desirable species.
b. Quantity	Surface area, volume.
B. Terrestrial	
1. Grassland, pasture and cropland	
a. Quality	Plant community structure; successional trends with and without project; land use pattern and trends; cover and food provided by existing habitat; habitat requirements of desirable species.
b. Quantity	Acres of each habitat type.
2. Woodland	
a. Quality	Plant community structure; successional trend; timber management practices; cover and food provided by existing habitat; habitat requirements of desirable species.
b. Quantity	Acres of each habitat type.

TABLE 6-2 (CONT)

Natural Environment Parameter (cont)	Factors
III Ecosystem Diversity and Stability	Species diversity (index); habitat diversity; critical foodweb pathways; occurrence of disturbances (natural and manmade); successional state and trend predicted with and without the project.
A. Aquatic	
B. Terrestrial	
IV Ecosystem Productivity	
A. Aquatic	Present and projected total volume of water available for primary production (surface area X depth of light penetration) and secondary and tertiary produ tion (total volume of aerobic water); present and projected primary producti and fish standing crop per unit area; present nutrient concentrations; alter ations to watershed or stream that would change input of allochthonous orgar matter or nutrients, the successional state of the community, or light penetration.
B. Terrestrial	Acres of various community types; present and projected cropping practices ar land use; present successional state and trend; expected alterations in floc ing and nutrient retention by impoundments.

Human Life Quality Parameters	Factors
I Recreational Opportunities	
A. Water	
1. Sport Fishing	
a. Stream	Species composition and diversity; standing crop; habitat classification; stream miles; average stream width; flow durations; present and predicted water quality; access; regional supply and demand.
b. Lake	Predicted species composition and standing crop; surface area, mean depth and shoreline miles; water quality; access; public facilities; regional supply and demand.
2. Waterfowl hunting	Present and predicted acres of suitable resting and feeding habitat; access; regional supply and demand.

TABLE 6-2 (CONT)

Human Life Quality Parameters (cont)	Factors
3. Other Water Recreation	
a. Stream	Access and quality of swimming and canoeing; present and predicted streamflow durations and stream miles; water quality; regional supply and demand (uniqueness).
b. Lake	Surface area and number of suitable beaches; access; public facilities; clearing practices; water quality; regional supply and demand (uniqueness).
B. Land	
1. Hunting	Game species present; population dynamics; acres of habitat types; access; regional supply and demand.
2. Other Land Recreation	Acres suitable for various activities; miles of primitive roads and trails; number and size of suitable camping areas; public facilities; access; regional supply and demand (uniqueness).
II Anxiety Factors	
A. Environmental Pollution	Existing sources of pollution; projected regional industrial and population growth; recreational visitation; water quality benefits.
B. Flooding	Annual flood control benefits; population density; land use.
C. Water supply	Annual water supply benefits; regional supply and demand.
D. Nuisance, Vandalism, Pests & Parasites	Recreational visitation; population density in immediate area; existing parasitic and pestilent species and expected effect of project on their habitat, food supply, and predators.
III Other Human Life Quality Considerations	
A. Aesthetics	
1. Natural Resources	Acres of scenic area inundated or disturbed; uniqueness of the area; current and projected land use.
2. Manmade Resources	Number and type of structures; landscaping plans; relocation of roads and structures.
B. Availability of Public Facilities & Services	Diversity and magnitude of project benefits and new tax revenues created by project; relocation of roads and utilities.
C. Life-style and Community Cohesion	Diversity and magnitude of project benefits.
D. Unique Historical and Scientific Resources	Surface acres inundated or destroyed by project construction; recreational visitation; location and uniqueness of historical and archeological sites and primitive areas.

TABLE 6-2 (CONT)

Economic Parameters	Factors
I Project Efficiency	Excess benefits over cost
II Gross Local and Regional Output	
A. Income	
1. Wage and Salary	Local availability of labor and supplies, project construction cost and O&M expenditures.
2. Other Components (Welfare, rental, etc)	Recreational visitation and O&M expenditures.
3. Sales Tax Revenue	Recreational visitation, O&M expenditures, and project construction cost.
B. Employment	
1. Primary (revenue producing)	Project construction cost and any revenue stimulating units induced by the project, such as agriculture and manufacturing to the extent that the absence of the project has acted to restrain those activities.
2. Secondary (revenue circulating)	Recreational visitation, primary employment and O&M expenditures.
C. Value of Farm Products and Natural Resources	
1. Livestock	Percent of flood plain in pasture, flood control benefits, percent of livestock to total farm products sold.
2. Crops	Number of acres in flood plain being cropped, crop flood losses prevented, irrigation, type of crops, value of yields, percent of crops to total farm products.
D. Property Values	Recreational visitation, size of project and total benefits of project.
E. Displacement of people, businesses and farms	Population in project area; value and land use of acreage acquired for project; relocations.

TABLE 6-3

MATRIX ANALYSIS OF ALTERNATIVES

AGUILA

	Parameters	Method of Calculating Weighting Factors	Weighting Factors	A Mainstem Lake Site A Raw Score	A Weighted Score	B Mainstem Lake Site B Raw Score	B Weighted Score	C Mainstem Lake Site C Authorized Raw Score	C Weighted Score	D Mainstem Lake Site D Raw Score	D Weighted Score	E Tributary MF Lakes Raw Score	E Weighted Score	F Tributary PF Lakes Import Raw Score	F Weighted Score	G Dry Lake Plus Tributary WS Lakes Raw Score	G Weighted Score	H Dry Lake Plus WS Import Raw Score	H Weighted Score	I Flood Plain (+ Poe WS Import) Raw Score	I Weighted Score	J Flood Plain (- Basement WS Import) Raw Score	J Weighted Score
NATURAL ENVIRONMENT	I Unique, Rare, Endangered, or Unusually Important Species	10																					
	A Fauna	8	8.0	+5	+40.0	+5	+40.0	+5	+40.0	+5	+40.0	+4	+32.0	+2	+16.0	+3	+24.0	+1	+ 8.0	+2	+16.0	0	0
	B Flora	2	2.0	-3	- 6.0	-3	- 6.0	-3	- 6.0	-3	- 6.0	-4	6.0	-2	- 4.0	-5	-10.0	-1	- 2.0	+5	+10.0	0	[illegible]
	II Plant and Animal Habitat	50																					
	A Aquatic	4																					
	1 Lotic (Flowing)	5																					
	a Quality	7	8.4	+4	+33.6	+4	+33.6	+4	+33.6	+4	+33.6	+5	+42.0	+2	+16.8	+3	+25.2	+1	+ 8.4	-1	- 8.4	0	0
	b Quantity	3	3.6	+4	+14.4	+4	+14.4	+4	+14.4	+4	+14.4	+5	+18.0	+2	+ 7.2	+3	+10.8	+1	+ 3.6	0	0	0	
	2 Lentic (Standing)	5																					
	a Quality	7	5.6	+4	+22.4	+4	+22.4	+4	+22.4	+4	+22.4	+5	+28.0	+1	+ 5.6	+5	+28.0	+1	+ 5.6	0	0	0	0
	b Quantity	3	2.4	+4	+ 9.6	+4	+ 9.6	+4	+ 9.6	+4	+ 9.6	+5	+12.0	+1	+ 2.4	+5	+12.0	+1	+ 2.4	0	0	0	0
	B Terrestrial	6																					
	1 Grassland, Pasture, & Cropland	7																					
	a Quality	7	14.7	-3	-44.1	-3	-44.1	-3	-44.1	-3	-44.1	-5	-73.5	-2	-29.4	-4	-58.8	-2	-29.4	+1	+14.7	0	0
	b Quantity	3	6.3	-3	-18.9	-3	-18.9	-3	-18.9	-3	-18.9	-5	-31.5	-1	- 6.3	-4	-25.2	0	0	0	0	0	0
	2 Woodland	3																					
	a Quality	7	6.3	-2	-12.6	-2	-12.6	-2	-12.6	-2	-12.6	-5	-31.5		- 6.3	-4	-25.2	-1	- 6.3	+5	+31.5	0	0
	b Quantity	3	2.7	-2	- 5.4	-2	- 5.4	-2	- 5.4	-2	- 5.4	-5	-13.5	-1	- 2.7	-4	-10.8	-1	- 2.7	+5	+13.5	0	0
	III Ecosystem Diversity and Stability	20																					
	A Aquatic	4	8.0	+3	+24.0	+3	+24.0	+3	+24.0	+3	+24.0	+5	+40.0	+1	+ 8.0	+4	+32.0	+2	+16.0	0	0	0	0
	B Terrestrial	6	12.0	-3	-36.0	-3	-36.0	-3	-36.0	-3	-36.0	-3	-36.0	-2	-24.0	-5	-60.0	-2	-24.0	0	0	0	0
	IV Ecosystem Productivity	20																					
	A Aquatic	4	8.0	+4	+32.0	+4	+32.0	+4	+32.0	+4	+32.0	+5	+40.0	+1	+ 8.0	+5	+40.0	0	0	0	0	0	0
	B Terrestrial	6	12.0	-4	-48.0	-4	-48.0	-4	-48.0	-4	-48.0	-4	-48.0	+3	+36.0	-5	-60.0	-3	-36.0	0	0	0	0
	NET IMPACT ON NATURAL ENVIRONMENT				+5.0		+5.0		+5.0		+5.0		-30.0		+27.3		-16.0		-56.6		+77.3		0
HUMAN LIFE QUALITY	I Recreational Opportunities	25																					
	A Water	7																					
	1 Sport Fishing	5																					
	a Stream	55	4.8	+2	+ 9.6	+2	+ 9.6	+2	+ 9.6	+2	+ 9.6	+4	+19.2	+5	+24.0	+3	+14.4	+4	+19.2	0	0	0	0
	b Lake	45	3.9	+5	+19.5	+5	+19.5	+5	+19.5	+5	+19.5	+3	+11.7	+1	+ 3.9	+3	+11.7	0	0	0	0	0	0
	2 Waterfowl Hunting	05	.9	+4	+ 3.6	+4	+ 3.6	+4	+ 3.6	+4	+ 3.6	+5	+ 4.5	+3	+ 2.7	+5	+ 4.5	+1	+ .9	+1	+ .9	0	0
	3 Other Water Recreation	45																					
	a Stream	4	3.2	+2	+ 6.4	+2	+ 6.4	+2	+ 6.4	+2	+ 6.4	+4	+12.8	+5	+16.0	+3	+ 9.6	+4	+12.8	+1	+ 3.2	0	0
	b Lake	6	4.8	+5	+24.0	+5	+24.0	+5	+24.0	+5	+24.0	+3	+14.4	+1	+ 4.8	+3	+14.4	0	0	0	0	0	0
	B Land	3																					
	1 Hunting	3	2.2	+4	+ 8.8	+3	+ 6.6	+3	+ 6.6	+3	+ 6.6	+3	+ 6.6	0	0	+1	+ 2.2	-1	- 2.2	+5	+11.0	0	0
	2 Other Land Recreation	7	5.2	+5	+26.0	+5	+ 26.0	+5	+26.0	+5	+26.0	+5	+26.0	+1	+ 5.2	+5	+26.0	-1	- 5.2	+1	+ 5.2	0	0
	II Anxiety Factors	50																					
	A Environmental Pollution	3	15.0	-5	-75.0	-5	-75.0	-5	-75.0	-5	-75.0	-4	-60.0	-4	-60.0	-5	-75.0	-1	-15.0	-4	-60.0	-1	-15.0
	B Flooding	25	12.5	+5	+62.5	+5	+62.5	+5	+62.5	+5	+62.5	+4	+50.0	+4	+50.0	+5	+62.5	+5	+62.5	+8	+85.0	+1	+12.5
	C Water Supply	35	17.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5	+5	+87.5
	D Nuisance, Vandalism, Pests, and Mosquitos	10	5.0	-5	-25.0	-5	-25.0	-5	-25.0	-5	-25.0	-5	-25.0	-1	- 5.0	-5	-25.0	-1	- 5.0	-2	-10.0	0	0
	III Other Human Life Quality Considerations	25																					
	A Aesthetics	4																					
	1 Natural Resources	6	6.0	-2	-12.0	-2	-12.0	-2	-12.0	-2	-12.0	-5	-30.0	-1	- 6.0	-5	-30.0	-1	- 6.0	-1	- 6.0	0	0
	2 Manmade Resources	4	4.0	-5	-20.0	-5	-20.0	-2	- 8.0	-2	- 8.0	-3	-12.0	-3	-12.0	-4	-16.0	-2	- 8.0	-1	- 4.0	-1	- 4.0
	B Availability of Public Facilities and Services	35	6.3	+5	+31.5	+5	+31.5	+5	+31.5	+5	+31.5	+4	+25.2	0	0	+4	+25.2	0	0	0	0	0	0
	C Life-styles & Community Cohesion	15	3.7	+5	+18.5	+5	+18.5	+5	+18.5	+5	+18.5	+4	+14.8	0	0	+4	+14.8	0	0	0	0	0	0
	D Unique Historical and Scientific Resources	20	5.0	-5	-25.0	-5	-25.0	-4	-20.0	-3	-15.0	-3	-15.0	-3	-15.0	-5	-25.0	-3	-15.0	+2	+10.0	0	0
	NET IMPACT ON HUMAN LIFE QUALITY				+160.9		+130.7		+155.7		+158.5		+130.7		+86.1		+101.8		+120.5		+62.8		+81.0
ECONOMICS	I Project Efficiency	50	50.0	+1	+50.0	+1	+50.0	+1	+50.0	+2	+100.0	-5	-250.0	-3	-150.0	-4	-200.0	0	0	0	0	0	0
	II Gross Local and Regional Output	50																					
	A Income	3																					
	1 Wage and Salary	7	10.5	+3	+31.5	+3	+31.5	+3	+31.5	+4	+42.0	+5	+52.5	+4	+42.0	+5	+52.5	+3	+31.5	0	0	0	0
	2 Other Components (Welfare, Rental)	2	3.0	+3	+ 9.0	+3	+ 9.0	+3	+ 9.0	+2	+ 6.0	+5	+15.0	+4	+12.0	+5	+15.0	+3	+ 9.0	0	0	0	0
	3 Sales Tax Revenue	1	1.5	+3	+ 4.5	+3	+ 4.5	+3	+ 4.5	+2	+ 3.0	+5	+ 7.5	+4	+ 6.0	+5	+ 7.5	+3	+ 4.5	0	0	0	0
	B Employment	3																					
	1 Primary (Revenue Producing)	3	4.5	+3	+13.5	+2	+ 9.0	+2	+ 9.0	+2	+ 9.0	+5	+22.5	+4	+18.0	+5	+22.5	+2	+ 9.0	+1	+ 4.5	+1	+ 4.5
	2 Secondary (Revenue Circulating)	7	10.5	+5	+52.5	+5	+52.5	+5	+52.5	+5	+52.5	+4	+42.0	+2	+21.0	+5	+52.5	+4	+42.0	+1	+10.5	+1	+10.5
	C Value of Farm Products and Natural Resources	3																					
	1 Livestock	50	7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+3	+22.5	+1	+ 7.5	+5	+37.5	-5	-37.5	-4	-30.0
	2 Crops	50	7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+1	+ 7.5	+3	+22.5	+1	+ 7.5	+5	+37.5	-5	-37.5	-4	-30.0
	D Property Values	05	2.5	+5	+12.5	+5	+12.5	+5	+12.5	+5	+12.5	+5	+ 7.5	+3	+ 7.5	+1	+ 2.5	-2	- 5.0	0	0	-1	- 2.5
	E Displacement of People, Business and Farms	05	2.5	-5	-12.5	-5	-12.5	-2	- 5.0	-2	- 5.0	-4	-10.0	-2	- 5.0	-4	-10.0	-1	- 2.5	-1	- 2.5	-1	- 2.5
	NET IMPACT ON ECONOMICS				+179.0		+171.5		+179.0		+214.0		-98.0		-4.0		-42.5		+165.5		-62.5		50.0
	SUMMARY IMPACT				+521.9		+315.2		+339.5		+386.5		+ 2.7		+117.6		-18.7		+233.6		+77.6		+81.0
	RANK				3		4		2		1		9		6		10		5		7		8

In the matrix analysis site D was scored the same as A, B, and C in the natural environment parameters. This plan also merited top score in both human life quality and economic parameters and so in the net impact of all parameters it ranks first.

6.04 Recommended Plan. It should be noted that the alternative lake at site D used in the matrix analysis is not identical to the recommended project. All of the alternative plans except E and G would furnish a dependable water supply yield of 9.7 m.g.d. which is the projected 100-year municipal and industrial water supply need of the area. After the site selection, project formulation and environmental studies were essentially completed, the local water supply users determined that they could furnish assurances for repayment of only 5 m.g.d. water supply yield. Therefore, the conservation storage in the recommended plan was scaled down to yield that amount. The alternative studies were not revised to account for this design change because it would not affect the selection of the recommended plan. The economic data for the recommended plan in section I is based on detailed studies made after the alternative studies were completed. The project has better economic justification than is indicated in table 6-1 because of the preliminary economic data used for comparison of alternatives.

The recommended plan offers the following advantages:

(1) It would preserve more of the streambank hardwood habitat than any of the other main stem sites.

(2) It would preserve more of the tributary streams in their native state than any of the other main stem sites.

(3) It would disturb less land than any of the other structural alternatives except for those that include water supply import and would disturb only slightly more than those.

(4) It would inundate fewer miles of streambed than any of the other structural alternatives.

(5) No known important historic resources would be destroyed.

(6) It has a better benefit return per dollar cost than any of the other alternatives.

(7) A multiple-purpose lake at the recommended site has public acceptance.

(8) It would enhance the human life quality in the project area.

6.05 Alternatives to the Proposed Operation and Maintenance Activities. The purpose of this section of the statement is to present alternatives to the operation and maintenance activities. Alternatives considered are for operation of the project for authorized purposes and for activities which support these purposes. The intent is to describe the alternative, its desirable impacts and its undesirable impacts.

6.05.1 Reservoir Regulation and Flood Control. One alternative to the present method of reservoir regulation would be to not operate the project for flood control. The environmental gains as a result of this alternative would be small when compared to the losses from flood damage.

The faster release of flood waters from Aquilla Lake to shorten the downstream time of high flow is not possible due to the low downstream channel capacity. The proposed method of operation provides for a maximum release of 3,000 c.f.s. When releases exceed this amount downstream flooding occurs.

In addition to the above listed alternatives, Aquilla Lake could be operated solely for recreation, solely for fish and wildlife, or solely for water supply without regard for the other needs. In view of the resulting loss of benefits to man's environment by such single-purpose operation methods these alternatives are not considered viable.

The proposed course of action is to operate the project with controlled releases less than 3,000 c.f.s. since this appears to meet present downstream commitments. Within the plan of reservoir regulation there exists some latitude for modification of the plan in the interest of optimizing project operations and benefits without affecting authorized purposes. An example would be a controlled water drawdown program to improve the sport fishery by stimulating growth and survival of desirable fish. The proposed plan would be periodically examined to determine if modification is needed or warranted.

6.05.2 Alternatives to the Maintenance of the Project and Related Structures.

6.05.2.1 Disposal of Sewage and Solid Waste.

6.06.2.1.1 Alternatives for Disposal of Sewage. The first alternative would be to make no provisions for sewage disposal. If this alternative were implemented, it would result in serious health and sanitation problems as well as aesthetically displeasing conditions.

The proposed course of action consists of periodically pumping the sewage holding vaults and depositing the waste in a State-approved sewage treatment facility. The advantage of this alternative is that the sewage is dealt with in such a manner that it does not create a pollution problem.

6.05.2.1.2 Alternatives for Disposal of Solid Wastes. The first alternative is to have no solid waste disposal. If this alternative were implemented, it would result in health and sanitation problems as well as aesthetically displeasing conditions.

A second alternative would be to use high temperature incinerators. The advantage of this alternative is that they can reduce the solid waste volume by 95 percent without creating additional pollution. The primary disadvantage with this alternative is that the high temperature incinerators are very expensive, approximately 1 million dollars each. In addition to the high initial cost, incinerators require skilled employees to operate, maintain, and repair the facility. Water, power, and fuel must also be available.

A third alternative would be to burn the trash in "open pits." This type of incineration results in air contaminants which are harmful to plant and animal life. This method would also be in direct violation of the State and Federal laws and regulations which specifically prohibit this type of open burning.

The proposed system entails the operation of a sanitary landfill off of project lands. The landfill will be covered after each dumping with approximately 6 inches of soil. The sanitary landfill will be operated in accordance with the standards set forth in the State Department of Health Rules and Regulations for the Collection and Disposal of Solid Waste.

6.05.2.2 Alternatives to Insect and Undesirable Vegetation Control.

6.05.2.2.1 Alternatives to Insect Control. The most readily apparent alternative to insect control is to have no insect control program. At Aquilla Lake where mosquitoes, ticks, and flies could become a nuisance and a health hazard, to have no type of pest control program would result in a decrease in visitor usage and satisfaction. This alternative is not acceptable due to the adverse effect it would have on visitors.

A second alternative would be to develop an insect control program with major emphasis on biological pest management (encouragement of insect predators and parasites) with supplementary usage of pesticides for heavy infestations. This is a desirable alternative, but biological insect control is a relatively new field, and the technique of management has not been developed to the point of satisfactory implementation. This alternative may be the most desirable and when techniques are eventually formulated it will be considered.

The proposed program of insect control consists of elimination of pest breeding sites and limited pesticide application. This program will provide for the control of insects at an acceptable level with only a minimum amount of toxic chemicals added to the environment. Each time any pesticide is used, care is taken to insure the proper dosage and application.

6.05.2.2.2 Alternatives for Control of Undesirable Vegetation. No control of terrestrial and aquatic vegetation is an obvious alternative. The advantages of this alternative are that it would require no effort, and would permit the natural succession of growth. The disadvantage is that undesirable vegetation would soon become tall and dense, thereby reducing the aesthetic value of the lawns and recreation areas and inviting the ingression of objectionable insects and other pests. This would interfere with recreation and maintenance of project structures and improvements.

A second alternative is to use mechanical methods such as brushhogging, grass whips, etc. The advantage with this alternative is that no chemicals or the hazards associated with them are involved. The disadvantages are that it is expensive and in some cases not effective. Also, the effects of mechanical control are often less aesthetically pleasing than the chemical control.

A third alternative is chemical control of undesirable vegetation. The advantages of this alternative are that it is inexpensive, fast, and effective. The disadvantages are pollution hazards, and the possible side effects of the chemicals on desirable plant and animal life.

The present method being followed is to use a combination of mechanical and chemical control measures. This method permits each case to be considered individually and the type of control with the fewest undesirable impacts selected.

6.05.2.3 Alternatives to Vegetation and Wildlife Management. The most apparent alternative to having a vegetation management program on Corps of Engineers projects is to have no vegetation management program. The alternative to having no vegetation management, would be contrary to sound land management practices. When the influences of man and his activities are imposed upon the natural environment, some type of management is necessary to prevent the deterioration of that environment.

There are varying degrees of vegetation management from mere maintenance of existing conditions to intensive management of the total community. Alternatives involving vegetation management and the intensity would depend upon the type of activity, i.e., recreation, wilderness area (no management), etc., for which the area is most suitable and the extent of man's influence. The present course of action, is to prepare a vegetation management plan and implement the program.

A complete absence of game fish management in Aquilla Lake could be detrimental to the sport fishery of the impoundment. Rough fish may overpopulate the available habitat. Game fish progeny, faced with the task of competing for necessary food and space, may be drastically reduced. Therefore, "no" fisheries management would be adverse to the sport fishery.

A second alternative would be to have a management system controlled to some degree by the Corps of Engineers. The design could be a comprehensive wildlife management program in which the Corps would be the only agency responsible for its operation, or the plan could call for varying degrees of management between the Corps of Engineers and the various professional wildlife agencies.

A program whereby the Corps of Engineers is responsible for the entire wildlife management element has several disadvantages. Specialized personnel would be required for proper management. Farming equipment, such as tractors, plows, planters, cultivators, brushhogs, etc., would be required along with special funds to help pay for this added expense. Habitat management for wildlife would be too expensive with present personnel and funding conditions. On the other hand the State Wildlife Agencies are equipped professionally and scientifically to cope with such detailed management programs.

A management program, in which the Corps of Engineers would have the primary responsibility for certain portions of wildlife and fisheries management, would be feasible with increased personnel and funding. Management responsibilities would include habitat manipulation, vegetative plantings, sharecropping, nesting cover, grazing, mowing, and watering locations. Extra machinery for farming practices would be no problem because most of the actual cultivated food crops would be raised by sharecroppers. Extra funds required for a program of this type would be moderate because of the delegation of the physical management to separate entities.

The proposed course of action entails comprehensive management coordinated among the Corps of Engineers, the Texas Department of Wildlife Conservation, and the Fish and Wildlife Service. A more meaningful exchange of information and ideas is a beneficial aspect of this approach.

6.05.2.4 Alternatives for the Enforcement of Regulations. The following alternatives are restricted to only those that are presently possible with the existing authority of the Corps of Engineers, since with present experience and knowledge there are no known reasonable alternatives outside of the present authority to the Corps of Engineers. Also it should be noted that these alternatives are for the applicable provisions of Chapter III, Title 36, Code of Federal Regulations and not other Federal and State laws.

6.05.2.4.1 No Enforcement. This alternative is not realistic. The regulations were designed so that maximum desirable public use (recreation etc.), can be made without one individual imposing upon the rights of another. It is obvious that the impacts of this alternative are of such a significant adverse magnitude that they would outweigh any desirable impacts.

6.05.2.4.2 Requesting Compliances. This alternative is the method which was used until June 1972. The policy this method was implemented under is: Violations of Rules and Regulations. Persons who violate the rules and regulations were courteously informed that they were acting in violation thereof and requested to desist from violation. The admonition was accompanied by an explanation of the reasons for the regulation and the need for conformance in order that others having equal rights may enjoy the lake and project area. If it were a matter of applying for a permit or similar action, assistance was offered. When, in the opinion of the reservoir manager, action on the part of enforcement agencies was required, a report was made to the resident engineer giving complete information as to the nature of the violation, efforts at correction and recommendation as to continuance of action. In general, the closing procedure was for the resident engineer to send a written warning to the violator and if this was disregarded, assistance was obtained from appropriate law enforcement officers.

The advantages of this method were that most people would comply when requested to do so and none of the problems with actual enforcement were encountered. The disadvantages with this alternative were many and varied. Many of the provisions of Chapter III, Title 36, Code of Federal Regulations, are not state or local statutes, thus, can only be enforced by Federal officers. The FBI, US Marshals, etc., have a heavy workload and little time for minor cases on the project; unfortunately, this is also true of many local and state law enforcement officers. Therefore, there was often nothing that could be done except request compliance.

6.05.2.4.3 <u>Citation Authority Program</u>. This is the program which was implemented in June of 1972 and is discussed in the Impact Section of this statement.

6.05.3 <u>Alternatives to Management of Land Resources and Facilities</u>.

6.05.3.1 <u>Easements and Rights-of-way</u>. An alternative would be to not allow easements or rights-of-way. Such action would result in the cessation of water withdrawal, the abolishment of power and telephone service. This would adversely affect that segment of the regional population receiving electric, telephone, water services, etc.

Another alternative would be to allow wide, unrestricted easements to each utility. The results would be disorder and significant adverse environmental effects.

The best proposal is to require all entities seeking outgrants to restrict their alteration of the environment to a minimum, i.e., place powerlines underground and seed grass and/or plant trees after burying lines and to provide vegetative screens to obscure aesthetically displeasing structures or alterations.

6.05.3.2 <u>Commercial Concession</u>. The first alternative to a commercial concession is to prohibit the concession. This alternative is not desirable if the public demand for boat storage is such to warrant a facility.

A second alternative would be for the Corps to construct concession facilities and operate them through a second party. An advantage of this alternative is the Corps would have absolute control of the concession impacts. The disadvantage of this alternative is the high initial cost and lengthy amortization period.

The alternative selected is to lease concessions to private entrepreneurs under leases with strict controls built in to insure adequate service to the public.

SECTION 7 - THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01

The Aquilla Creek Basin is an untapped natural water resource. The proposed project will have a lasting effect on the basin, but from a human viewpoint, this effect may be either good or bad, depending upon the changing trends and needs of our society. What is good today may not necessarily be good tomorrow and vice-versa. Dr. John Zivnuska, Dean of the School of Natural Resources and Conservation at the University of California at Berkeley, has stated that "the main environment in which we spend our lives is that of our homes, offices, and factories; the cities and suburban areas in which they are concentrated; the immediate surrounding landscape; and the air and water available to them." Consequently, any decision favoring one aspect of the environment may impair an even more significant part of the environment. In regional development it is understandable from an abstract viewpoint to leave a wilderness untouched in favor of building a project that will attract industry and raise the standard of living, but will the people who enjoy scenic beauty of the wilderness be the ones who will bear the impact of not raising the standard of living in that area? Since human well-being is a significant factor of the ecology of the area, should the people in a depressed area be asked to remain poor while people in other geographical areas have increasing standards of living with time and money to enjoy the scenic beauty of the economically depressed area? Future needs for the utilization of the Aquilla's water resources are inevitable.

Once the creek is developed, potential resources will be committed, with modification being the only alternative to meet future needs that may not be apparent today. The water of central Texas is a valuable natural resource available in the area, and in the future its value will be even greater. This resource is an attraction to industry. Once industry is located there, because of the available water, the water resource will be diminished in quality and quantity. At present, the affected area is primarily used for agricultural purposes with an emphasis on livestock production.

Economic trends in Hill County have changed slowly in the past. The project would provide an impetus for growth and a higher standard of living by committing 1,887 acres of timberland, pastureland, and creek to a permanent lake which will limit the diversity of choice of long-range uses of the water recources.

In making decisions about public works projects which will alter the natural state of any ecosystem, it is imperative in today's world to be as objective and realistic as possible. The benefits of a proposed action should be carefully weighed against total costs. In addition to monetary costs which always are considered, other costs such as loss of aesthetic qualities, reduction of the stability of the ecosystem, and demands on energy resources should be considered. Necessary criteria have not been established to assign monetary worth to these presently unqualified environmental amenities. Although criteria do exist whereby the relative value of Aquilla Creek in comparison with other creeks can be assessed, this assessment at present can only be a value judgment and cannot be included in an economic benefit-cost analysis.

In evaluating the impact of a project on the environment, it is recognized that man is an integral part of the environment. The primary factor in deciding whether to preserve or alter an ecosystem should be to determine which action will provide the most ecologically stable and aesthetically pleasing environment for man on a long-term basis.

Man has artificially stimulated his food supply through technological advances in agriculture, and artificially restrained his death rate through technological advances in medicine. The net result of these actions is a continued increase in population accompanied by an increase in the demands for goods and services.

In the light of the fact that man's actions in many areas vital to ecosystem survival have irreversibly changed nature's balance, it would be disastrous to revert to a "naturalist" approach with regard to water supply, flood control, or overall biological productivity. There appears no choice but to depend on advanced technology in all areas of endeavor to maximize the quality of life during the next 100 years while man's ability to make wise decisions about population growth and industrialization has time to develop.

In evaluating the existing biological productivity of the project area and the impact of the project on the long-term biological productivity of the basin, several factors must be considered. The basis of energy flow in any ecosystem is the conversion of energy from radiant to chemical form by autotrophic primary producers. The efficiency and rate of this conversion depend on the type and quantity of plant life, adequacy of mineral cycling, and intensity and duration of radiant energy.

Direct observations of the primary productivity of the terrestrial ecosystem in the Aquilla Creek Basin have not been made. Odum (1971) indicates that grasslands, agricultural and upland forests have a gross primary production (GPP) in the range of 0.5 to 3.0 thousand kilocalories of energy per square meter per year while moist bottom-land forests are in the range of 3 to 10 thousand kcal/m^2/year. Since the Aquilla Creek Basin in the project area contains all three vegetation types, the GPP of the terrestrial community would be expected to be approximately 2 to 6 thousands kcal/m^2/year. In comparison with the productivity of shallow lakes and other creeks for which data are available, the Aquilla Creek in the project area would be classified as relatively unproductive. Water analyses for available nutrients substantiate Aquilla Creek's oligotrophic nature. Nitrate-nitrogen concentrations ranged from 1.00 to 3.30 mg N liter^{-1} and phosphate-phosphorus ranged from 0.01 to 0.19 mg P liter^{-1}.

The magnitude of aquatic productivity in the stream agrees with the expected magnitude of productivity of the surrounding terrestrial community. On superficial examination this may seem strange in light of the vast quantity of terrestrial plant biomass as compared to the smaller biomass of phytoplankton, periphyton, and rooted aquatic plants. However, it is becoming a well-established ecological principle that energy flow on a per unit area basis in aquatic systems equals or exceeds that of terrestrial systems. There has been considerable ecological data collected during the past 10 years to indicate that the lentic ecosystem created by the proposed impoundment probably will equal or exceed the existing lotic-terrestrial ecosystem in primary productivity and gas exchange.

The people living in Aquilla Creek Basin are an important part of the associated ecosystem. The addition of a water supply of sufficient quality and quantity and the regulation of erratic streamflow will unquestionably increase the stability of this ecosystem if used for the purpose of providing for the future needs of the existing populace and industry for the inevitable increase in these needs.

At the present time, none of the 125 known archaeological sites appear to warrant consideration for future development as an archaeological-educational resource. The sites located in or above the flood control pool will be protected to insure that future attempts may be made to obtain data that is presently unattainable with current excavation and test methods. Scientific techniques applied to archaeology can reasonably be expected to advance with time to take full advantages of these resources. The sites at Aquilla that appear to be insignificant today will probably increase in scientific value and significance in the future.

The eastern cross timbers exist in only a few scattered remnants in the project area. Most of the timber has been cleared to make way for pasture and cultivation, particularly in the areas near the watercourses where the deeper, more moist soils are more desirable for farming. Consequently, most of the remaining cross timbers are in upland areas and will not be affected by the lake operation. The short-term value of timber products in the basin is small and would continue to decrease in the future as more land is cleared for agricultural purposes. Benefits accrue to a lake from multiple use of water storage as well as side effects such as increased value of land around the lake and below the lake, and the opportunity to farm in the flood plain below the dam under greatly reduced chances of flooding. Hunting and fishing opportunities should be greatly improved with the lake in place.

SECTION 8 - IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The conservation pool will inundate 1,887 acres of land and about 8 miles of Aquilla and Hackberry Creeks, which will take this land out of production and be irretrievably committed for at least the life of the project. Portions or all of an additional 4,478 acres and about 11 miles of stream in the flood control pool will be committed to flooding during periods of excessive runoff. Therefore the plant and animal resources lost as a result of the impoundment would be committed for at least the life of the project. Seventy-two archaeological sites will be covered by the conservation pool and 36 are in the zone of fluctuation of the conservation pool. Seventeen additional sites will be subjected to intermittent flooding. Short-term recovery of some natural resources, archaeological sites, and agricultural products will be possible.

Just as some of the resources committed to developing the land for their agricultural use will be lost, so the labor and a majority of the material committed in the construction of the dam and its associated facilities cannot be regained. Money will have to be committed for relocations, construction, and labor. Relocation of 4 miles of public roads, 6 miles of powerlines, 2 miles of telephone lines, and about 8.5 miles of pipelines will be necessary. If the project is completed, $27,100,000 will have been used to finance the project. Operation and maintenance and replacement will require about $141,500 annually.

SECTION 9 - COORDINATION WITH OTHERS

9.01 Coordination. Coordination with various Federal and State agencies was effected during all stages of project planning.

9.02 Public Meeting. A public meeting concerning the Aquilla Lake project was held 28 January 1974 at Hill County Junior College, Hillsboro, Texas. The purpose of the meeting was to inform the public of the alternative plans and their environmental effects, and solicit constructive comments and suggestions. Statements were received from Congressmen, other public officials, boards, and authorities. Questions and comments were solicited from the floor. None of the 233 persons in attendance voiced opposition to the Aquilla project.

9.03 Coordination of Statement. The draft statement was sent to the following agencies and groups for their review and comments.

Environmental Protection Agency
Department of Housing and Urban Development
Department of Interior
Federal Highway Administration
US Forest Service
Advisory Council on Historic Preservation
US Public Health Service
Soil Conservation Service
Environmental Information Center, Inc.
Institute of Environmental Studies
Office of the Governor of Texas, Division of Planning and Coordination
State Historic Preservation Officer, Texas
Sportsmen's Clubs of Texas, Inc.
Sierra Club of Texas
Izaak Walton League of America
Brazos River Authority

9.04 Comments and Responses. The draft environmental statement was sent to the following agencies requesting their reviews and comments. Their comments are summarized in this section and copies of their original replies are in Appendix A.

9.04.1 Hillsboro Texas.

9.04.1.1 Comment: The City of Hillsboro wished to express a favorable comment of the statement and urges the construction of the Aquilla Lake Project.

9.04.2 Department of Health, Education, and Welfare.

9.04.2.1 Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations. We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

9.04.3 US Department of Transportation, Federal Highway Administration.

9.04.3.1 Comment: On page "b" of the summary sheet, mention is made of possible Interstate highway relocation. Based upon review of your environmental statement and design memorandum, it does not appear that such will be required.

Farm to Market Roads 310 and 1947 and possibly State Highway 22 will be affected b y the project. Farm to Market Road 310 and State Highway 22 are on the Federal-aid System.

9.04.3.2 Response: There will be no interstate highway relocations required. Further clarification of the effects of Aquilla Lake on road relocations will be made in the Phase II General Design Memorandum and in various feature design memorandums.

9.04.4 United States Department of Agriculture, Forest Service.

9.04.4.1 Comment: Environmental impacts of Aquilla Lake extend beyond the Aquilla Creek Basin. The environmental impacts of proposed Aquilla Lake are interrelated with nearby Lakes Whitney and Waco and to a lesser extent with the total Brazos River Basin. Therefore, purported flood control, water supply, recreation, and fish and wildlife functions of Aquilla Lake cannot be properly evaluated separately as attempted in this statement.

9.04.4.2 Response: The flood control storage in Aquilla Lake would be operated in conjunction with the system of Federal lakes in the Brazos River Basin. This system operation was considered when the impacts and benefits of the Aquilla flood control storage were studied. The conservation storage will furnish water supply to the nearby towns of Hillsboro and West and will have little effect on areas outside the Aquilla Creek Basin. Because of the recommended minimum development and small anticipated visitation to the project, the recreation and fish and wildlife function are not expected to have any appreciable effect on other lakes in the area.

9.04.4.3 Comment: The cumulative acreage of bottomlands being taken for impoundments is of regional concern. The cumulative acreage of Brazos River bottomlands which is or will be lost to agricultural and forestry production in existing and proposed impoundments (like Aquilla Lake) should be evaluated as to regional impacts in this statement.

9.04.4.4 Response: The Brazos River drainage area is 44,600 square miles with about 50 percent of these lands being bottomlands. The total acreage for all Federal and non-Federal lakes in the Brazos River Basin is about 142,000 acres (Dowell and Petty, 1973) of which 4,560 is the proposed Aquilla Lake.

9.04.4.5 Comment: The Project has responsibilities to guide development and use of adjoining lands. Impoundment of Aquilla Lake will directly influence adjoining land usage. Therefore, a master land-use plan of all project lands is needed to guide compatible development spawned by the lake and to insure the maintenance and enhancement of environmental quality on project lands during the long-term investment period. This statement should contain a land-use plan for project and adjoining lands which has been closely coordinated with the North Central Texas State Planning Regions.

9.04.4.6 Response: We concur in the statement that impoundment of Aquilla Lake will directly influence adjoining land usage. A master plan for project lands will be made before the project becomes operational; however, the Federal government has no jurisdiction for land use planning outside the project boundaries.

9.04.4.7 Comment: Development of a plan of management for forest cover should receive higher priority. The proposed forest management plan (page 1-7) should be a part of the Project Lake-Use Plan and should be completed and made available for review by interested agencies prior to any clearing or cleaning operations. It may be desirable to transplant selected specimens to planned recreation administrative sites or to holding areas. The Texas Forest Service is the local authority on forest management and should be consulted for asssitance in preparation of the forest management plan.

9.04.4.8 Response: This has been changed from forest management to vegetative management because this area is out of the forest area of Texas, but lies in the Blacklands, East Cross Timbers, and Grand Prairie regions. The native vegetation is prairie and oak savannah and is primarily used for grazing except the hardwoods in bottomlands. The timber products are very limited, primarily posts and firewood, and of low value. Growth is too slow to warrant management for timber products. Therefore, no forest management plan is needed.

9.04.4.9 Comment: Irreversible and irretrievable commitments not fully evaluated. The annual production lost from inundated lands for the life of the project (plus recovery time for forested areas) is an irretrievable project commitment. Also; the labor expended, funds used, and energy consumed in project construction are irretrievably committed.

9.04.4.10 Response: This has been included in th final statement.

9.04.5 Brazos River Authority.

9.04.5.1 Comment: The draft statement appears to give balanced attention to favorable as well as possible unfavorable effects of the Aquilla Lake project and to recognize that the most important effects are those which affect the environment of man. We believe this is entirely appropriate and hope that this same approach is used when the statement is put into final form.

9.04.5.2 Comment: We note that the alternatives tabulated in Table 5-1 do not include the recommended plan, which is for a lake at site "D" designed for two-stage development of the conservation storage, with initial development sized to have a water supply yield of 5 mgd and with a potential for future increase in conservation storage to produce a yield of 17.5 mgd, without additional land requirements. The draft general design memorandum indicates that this recommended plan has a benefit to cost ratio of 1.5, better than any of the alternatives shown in Table 5-1, in addition to being better fitted to the water supply needs to be met from Aquilla Lake. It seems to us that the recommended plan should be tabulated among the alternatives shown in Table 5-1.

9.04.5.3 Response: The economic data used in Table 5-1 are preliminary, and the benefit to cost ratios shown are not comparable to the final data developed for the recommended plan. Detailed studies found the economic justification for the recommended plan to be better than previously indicated. The alternative mainstem lakes shown in Table 5-1 would meet the water supply needs equally as well or better than the recommended plan. Paragraph 5.04 explains the reasons for selecting the recommended plan.

9.04.5.4 Comment:, Section 8 of the statement discusses coordination with others; and in paragraph 8.03, the agencies and organizations to which it is reported the statement has been sent are listed. The Brazos River Authority is not named in this list of recipients. We appreciate being furnished a copy of the draft statement for review and comment, and we suggest that credit be taken for this by adding the Authority's name to the list of recipients in paragraph 8.03.

9.04.5.5 Response: The Brazos River Authority has been added to the list.

9.04.6 United States Department of Agriculture, Soil Conservation Service.

9.04.6.1 Comment: The statement adequately describes the impact of the proposed project and contains measures to minimize adverse effects.

9.04.6.2 Comment: Forest Management - This area is out of the forest area of Texas, but lies in the Blacklands, East Cross Timbers, and Grand Prairie regions. The native vegetation is prairie and oak savannah and is primarily used for grazing, except the hardwoods in bottomlands. The timber products are very limited, primarily posts and firewood, and of low value. Growth is too slow to warrant management for timber products. Therefore, no forest management plan is needed.

9.04.6.3 Land Management Plans - Same comment concerning Forest Management.

9.04.6.4 Forest Management - This is not in forested area so none is needed. Some landscaping will probably be done in public recreation areas, so maybe a landscape plan is needed, rather than forest management plan.

9.04.6.5 Section 5, 5.05.2.3 Alternatives to Forestry and Wildlife Management - Since there is no "forest," there is no forestry management plan needed.

9.04.6.6 Response: Instead of being a Forest Management Plan, this now reads a Vegetative Management Plan.

9.04.6.7 Comment: Natural Environment of the Basin - This would be much more descriptive if tied to the land resource areas.

9.04.6.8 Response: Concur; however, the intent of this section is to describe natural states of ecological development that occurred in the basin not considering human disturbances of the Aquilla Basin ecosystem.

9.06.6.9 Comment: Flora of the Basin - This shows the watershed as being in the Blacklands and Eastern Cross Timbers. This in in error, as the western portion is in the Grand Prairie rather than Blacklands.

9.04.6.10 Response: The terminology applied to the black soil prairie lying between the Eastern and Western Cross Timbers varies. Tharp (1926,1939) treated the entire north-central black prairie as a single vegetational region--the Blackland Prairie. Bray (1906) and Dyksterhuis (1946) treated the eastern (Blackland, sensu strictior) and western (Grand) prairies separately. Although there are minor differences in terrain, soil depth, and parent limestone composition, the vegetational characteristics of the two areas are very similar.

References: Bray, W.L. 1906. Distribution and Adaptation of the Vegetation of Texas. University of Texas Bulletin No. 82. 108 pp.

Dyksterhuis, E.J. 1946. The Vegetation of the Fort Worth Prairie. Ecoloigcal Monographs 16:1-29.

Tharp, B.C. 1926. Structure of Texas Vegetation East of the 98th Meridian. University of Texas Bulletin No. 2606 100 pp.

__________________, 1939. The Vegetation of Texas. Texas Acad. of Sci. Anson Jones Press, Houston.

9.04.6.12 Comment: Eastern Cross Timbers - This is described as "post-oak and blackjack oak woodland." This is more correctly described as post and blackjack oak savannah, originally a relatively open stand of trees or mottes of trees interspersed with open grasslands. Removal of grass cover and reduction of fires permitted the trees to increase where they presently form dense stands in places, an indication of ecological disturbance.

9.04.6.13 Response: Bray (1906) and Tharp (1926, 1939) both employ the term "woodland" in reference to the Cross Timbers. According to Dyksterhuis' (1948) interpretation of the Western Cross Timbers, the climax community is a post oak savannah, but the current state of the region is a disclimax in which "stands of oak woodland are more prevalent than savannah." References same as in preceding response.

9.04.6.14 Comment: Blackland Prairie - This description fits the eastern part of the watershed, but does not adequately fit the western part. The western part is Grand Prairie, which consists of mostly shallow soils with some deep spots. Vegetation is open grassland and localized savannah of live oaks-grassland on more rocky slopes and shallow soils. Mesquite is a common weedy invader. Nearly all the true Blacklands are now cultivated, but only localized areas of deeper soils on the Grand Prairie are cropped.

9.04.6.15 Response: Admittedly comments about heavy cultivation apply more closely to the eastern Blackland Prairie than the western Grand prairie. Nevertheless overgrazing of the western prairie has in similar fashion reduced that region to a state of disclimax. Only an extremely small portion of the area under consideration in this study lies in the western prairie, and consequently a minimum of space was devoted to characterization of that region.

9.04.6.16 Comment: No data regarding different land use, trends, of the watershed.

9.04.6.17 Response: This has been included in the final statement.

9.04.6.18 Comment: Section 4 - page 4-1, 2nd and 3rd line - 27 percent pasture and 9 percent timber - These are misnomers. Part of the 27 percent pasture (if not all) is rangeland and some of the 9 percent timber perhaps is also (unless it is all bottomland hardwoods).

9.04.6.19 Response: This has been corrected.

9.04.7 Office of the Governor, Division of Planning Coordination.

9.04.7.1 Comment: The Bureau of Economic Geology noted that the foundation materials at the dam site is possibly deficient, citing a publication which described the Pepper Shale member of the Woodbine Formation as being "very unstable." Potential problems may exist in the high shrink-swell characteristics, the erodability of shale substrate, and the permeability of adjacent sandstone beds.

9.04.7.2 Response: The Corps of Engineers is aware of the Pepper Shale member and further studies are currently being made to determine its extent.

9.04.7.3 Comment: The Texas Water Rights Commission recommended that the DES contain more complete and detailed cost-benefit data and analyses for all project alternatives, citing numerous legal decisions which ruled that a comprehensive cost-benefit analysis be included in environmental impact statements.

9.04.7.4 Response: This has been included in the final statement in Appendix E.

9.04.7.5 Comment: Noting that the Hillsboro Sewage Treatment Plant will be discharging effluent directly into the proposed reservoir, the Texas Water Quality Board emphasized the necessity of careful planning and coordination in the development of the reservoir with the Hillsboro water treatment facility.

9.04.7.6 Response: Tulsa District concurs that careful planning and coordination in the development of the reservoir with the Hillsboro water treatment facility is necessary. The Brazos River Authority, local sponsor for water supply storage, has studied the problem and found that the water in Aquilla Lake will be of a quality suitable for municipal and industrial use. They indicate that if secondary treatment should prove inadequate to protect the lake waters, the addition of tertiary treatment at the Hillsboro sewage treatment plant would provide a practicable solution to the problem.

9.04.7.7 Comment: The Texas Parks and Wildlife Department recommended that the DES be more specific in terms of the entities which might be involved in the management of forestry, recreation and wildlife in the proposed project area. This Department recommended further that leases for agriculture and grazing within the project area be avoided; maintenance of the natural state would provide food for wildlife while protecting the soil from overgrazing.

9.04.7.8 Response: The management plans for vegetation, recreation and wildlife are not developed in the planning stage but will be developed as the project becomes operational. Since this project is in the planning stage we do not have specific information at this time. All project lands after purchase are considered for leasing until needed for their allocated use as allocated by the Master Plan which is developed during the later phase of pre-construction planning.

9.04.7.9 Comment: The Texas Highway Department noted several inconsistencies between the DES and the design memorandum; the DES states that portions of interstate highways will be affected by the porposals, while the design memorandum indicates that State and federal highways will not be affected. Corrections recommended by the Highway Department are that no portions of an interstate highway will require relocation; however, F.M. Roads 310 and 1947 and possibly State Highway 22, which presently constitute an integral part of the State-maintained system, will in fact be affected by the project and will require relocation or adjustment.

9.04.7.10 Response: Inconsistencies between the draft Phase I General Design Memorandum and the draft environmental statement regarding road relocations have been corrected. Further clarification of the effects of Aquilla Lake on road relocations will be made in subsequent design memorandums. These road relocation plans will be fully coordinated with the Texas Highway Department.

9.04.8 Environmental Protection Agency.

9.04.8.1 Comment: Various construction features including access roads, project buildings, and reservoir clearing are mentioned in the summary. However, further information concerning these features is not included in the body of the draft statement. In order to fully assess the impacts of construction on air and water quality in the project area the inclusion of this information is necessary. We suggest that the final statement include a project map showing the location of access roads, project buildings, and areas to be cleared as well as future relocations of roads, pipelines, and telephone lines. A detailed discussion of the environmental impacts associated with these actions would strengthen the report.

9.04.8.2 Response: The project design used in the environmental statement is based on the Phase I General Design Memorandum which is basically a planning document. The purpose of the Phase I GDM is to determine the scale of development and to establish a basis for future planning, design, and construction. The exact locations of feature mentioned in this comment are not available but will be developed in future design memorandums.

9.04.8.3 Comment: The proposed project provides for the construction of a multiple-purpose reservoir. According to the draft statement the multiple uses include flood control, water supply, and recreation. However, two of these uses are not discussed adequately in the statement. For instance, the following general statement is made in relation to water use, "The proposed water supply of 5.0 MGD will probably be used by the cities of Hillsboro and West." The final statement should elaborate on the reservoirs water supply capability since this is a major justification for its construction. Detailed information addressing the necessary measures required to transfer water from the lake to the cities should be made a section of the final statement. This should include the construction of pumping stations, access roads, and delivery pipes. Possible locations for these facilities should be noted and the associated environmental impacts discussed. This information is essential in determining the overall effect of construction on the environmental integrity of the project site.

9.04.8.4 Response: Paragraph 1.01 indicates that the proposed water supply yield from Aquilla Lake is 5.0 MGD. It also states that the dependable yield at the site is 17.5 MGD. While no definite second stage development is proposed, the project design would provide some flexibility in adding conservation storage later if the need develops. At the present time it appears that the water supply users will be the cities of Hillsboro and West. The Brazos River Authority will be the contracting agency, and may sell water to other users if needed. The design and construction of water conveyance facilities will be the responsibility of local interests. Paragraph 1.01 has been revised to note this.

9.04.8.5 Comment: Recreation facilities at Lake Aquilla will be very limited due to the absence of a non-Federal public body to cost-share in development. The proposed action provides for the construction of minimum facilities including vault toilets, barricades, and turnarounds. The discussion of the recreation sites which will be placed near inundated roads should be expanded in the final statement to include possible future development sites, expected recreation pressure, and a maintenance plan for the proposed facilities. A discussion of visitor use and subsequent adverse environmental impacts would strengthen the final report. It should be noted that trash and erosion resulting from heavy visitor use and improper maintenance could detract from the general appearance and degrade water quality at the limited recreation sites. A discussion of the impacts associated with the operation of a recreation site, concession, or boat launching facilities should be included in sections 3 and 4 of the final statement.

9.04.8.6 Response: In the absence of cost sharing, no recreation facilities will be provided. The facilities provided at road ends are for health and safety. The recreation benefits are based on visitation that will occur at these sites. Discussion of impacts that visitation will have on the natural environment have been expanded in Sections 4 and 5.

9.04.8.7 Comment: In describing the sewerage disposal system (page 1-6), it is mentioned that sewage removed from vault toilets will be disposed of by contractors in a state-approved facility on project land or in a local state-approved municipal treatment plant. It is also stated that the effluent from the project office buildings will be pumped into a septic tank and oxidation pond. The final statement should give information as to the locations of these state-approved treatment plants. Information should be included identifying the location of the septic tank and oxidation pond in relation to any potable water supply and an approximation of wastes to be treated.

9.04.8.8 Response: This has been clarified in the final statement. However, the locations have not been decided yet because this project is still in the planning stage.

9.04.8.9 Comment: On page 1-9 of the draft statement, it is mentioned that agricultural, grazing, and mineral leases may be granted on project lands. The final statement should include a more complete discussion concerning the lands that will be considered for leasing, their locations, and the environmental effects that can be expected. Information should also identify the types of mineral leases that may be granted. Overgrazing, poor agriculture practices, and improper land use resulting from mineral leasing could result in an excessive amount of eroded material entering the lake resulting in degraded water quality and aquatic habitat.

9.04.8.10 Response: All project lands will be developed for their potential, and will be considered for leasing until needed by the project. As the project is constructed these leases will be phased out, starting with the lands used for the damsite. The mineral leases will probably consist of gravel and lime since these are the only minerals utilized from the lake area up to the present time. These leases will be administered by the Corps of Engineers so as to cause the least environmental affect on the environment.

9.04.8.11 Comment: Clarification of the following sentence concerning lease granting would be helpful, "These leases will be phased out when development and use of the project lands for the purposes zoned is accomplished." Project zoning is not discussed in the draft impact statement but should be made a part of the final statement. What are the ultimate uses of project lands? The final statement should be more specific concerning leases, land management, and zoning. It is difficult to determine the final disposition of project land and the ultimate environmental consequences of the proposed action from the information provided.

9.04.8.12. Response: The ultimate use of the project land is the use allocated to it by the Master Plan which is developed during the later phase of pre-construction planning. After purchase the projects lands will be considered for leasing until needed by the project.

9.04.8.13 Comment: Water quality and bacteria data are discussed in subsection 2.06 of the draft statement. We are concerned with the bacterial analyses presented in Table 2-5 (page 2-20) since the reservoir is planned to serve as a domestic water supply source for the towns of Hillsboro and West. In Table 2-5, total bacterial numbers, total coliform, E. Coli, and fecal streptococci are reported as numbers of organisms/ml. However state and Federal water quality standards for bacteria in domestic raw water supplies are reported as numbers of organisms/100 ml. This would mean that all sampling sites, if converted to number of organisms/100 ml, would exceed allowable criteria for a water supply to be utilized for domestic purposes. If in fact, the data appearing in Table 2-5 represents the number of organisms/100 ml. this change should be made in the final statement. The statement should also note sampling frequency. Do these data represent one sample and one sampling date or several? The methods used in assembling the data in Table 2-5 should be included in the final statement. This information would assist the reviewer in determining how bacteriological data were compiled and analyzed.

Texas water quality standards for potable water state that the monthly arithmetic averages should not exceed 10,000/100 ml. total coliforms or 2,000/100 ml fecal coliforms. We should point out that stations 1 and 2 exceed the recommended criteria for total coliforms in a potable water supply, while stations 2 and 5 are very close to the maximum fecal coliform standard. Other water uses, including contact recreation such as swimming or water skiing, could be hindered by high coliform bacteria levels in the reservoir. Based on the data in the statement, the possibility of high coliform bacteria levels could create a water quality problem in the proposed lake. We therefore suggest that additional information be included in the final statement to clarify the data appearing in table 2-5. This information is needed before an evaluation of the acceptability of the reservoir (bacterial quality) as a domestic water supply can be made.

9.04.8.14 Response: The information on water quality and bacteria were taken from a report on the Aquilla Basin prepared by Southern Methodist University Dallas, Texas, under contract to the Corps of Engi· ·rs, Fort Worth and Tulsa Districts, 1972. The bacterial counts presented in the report as numbers of organisms/ml at the time of sampling did exceed allowable criteria for a water supply to be used for domestic purposes. It should be pointed out that the samples were collected during the summer at a time when there was little or no flow at the sampling sites. Because of the presence of the sewage disposal plant near Site 1 and the presence of livestock at the other sites, bacterial counts, under those conditions, would be expected to be high. The data represent one sampling date and one set of data. The methods used were done by a commerical laboratory and bacteriological methods were used in determining bacterial counts. The Brazos River Authority has studied this problem and projected that the water in Aquilla Lake should be of a quality suitable for municipal and industrial use. They indicate that if secondary treatment should prove inadequate, the addition of tertiary treatment at the Hillsboro Plant would provide a practicable sollution to the problem.

9.04.8.15 Comment: High turbidity levels are reported for all sampling sites in the project area and are for the most part attributable to erosion from the surrounding farm lands. On page 3-5, the draft statement briefly mentions a watershed protection and flood prevention plan prepared by the Soil Conservation Service for the Aquilla-Hackberry Creek areas. This plan includes such measures as grade stabilization structures, floodwater retarding structures, and stream channel improvement. The draft statement concludes that there will be a net decrease in turbidity levels following implementation of the SCS plan. In order to better understand the interrelationship of the future watershed plan to the proposed Lake Aquilla Project, the final statement should include the percentage of land presently being treated and that will receive future treatment for erosion control. Severe erosion sites specified by the SCS plan should be discussed in the final statement.

9.04.8.16 Response: Additional detail of the SCS work plan has been added to Section 3.

9.04.8.17 Comment: An adverse environmental effect which would occur with the implementation of the proposed action is the shift from a lotic to a lentic environment. This would include changes in aquatic flora and fauna, water quality and sedimentation rates. Other adverse effects would be related to the decrease in flows being released downstream from the dam to Aquilla Creek and the Brazos Estuary. These adverse impacts should also be discussed in finalizing the impact statement.

9.04.8.18 Response: This has been discussed in the final statement.

9.04.9 United States Department of Interior.

9.04.9.1 Comment: The proposed project will not adversely affect any existing, proposed, or known potential unit of the National Park System or any known historic, natural, or environmental education sites eligible for the National Landmark programs. The plan of development appears compatible with any potential development of the Bureau of Reclamation.

9.04.9.2 Response: Noted.

9.04.9.3 Comment: Maps in the documents identify the authorized site. Identification of the recommended site would be helpful. We suggest a stated identification between authorized or recommended site and the respective mile location and letter designated locations.

9.04.9.4 Response: This has been done.

9.04.9.5 Comment: Both documents recognize the existence of pipelines within the project site and state that about 6 miles of pipeline would be relocated or protected. Estimated costs of relocating or protecting two pipelines 2.4 and 3.8 miles in length would be about $458,000. The maps, plate 2 of the design memorandum, and plate 1-1 of the environmental statement should be changed to show the ownership change of the Sinclair (now Arco) 10-inch pipeline in order to agree with the text on page 8-3 of the design memorandum.

9.04.9.6 Response: This has been done.

9.04.9.7 Comment: The draft report of the Bureau of Sport Fisheries and Wildlife (BSF&W) and the Corps of Engineers' comments to each of BSFW's recommendations are included in the design memorandum. The Corps has concurred or generally agreed to BSFW's recommendations, except for providing four access sites along the reservoir perimeter subject to further coordination during the advance planning of the project. Lack of public interest in cost sharing precludes anything but the development of minimum access facilities for fish and wildlife.

Subsequent to release of BSFW's report, the Texas Parks and Wildlife Department expressed an interest in the management of 8,000 acres of project lands, including the 2,000 acres developed in BSFW's draft report. The BSFW's draft report will be revised to include the Department's request.

9.04.9.8 Response: Noted.

9.04.9.9 Comment: The draft environmental statement includes little or no specific information on material to be used for construction of the earth dam. Design Memorandum No. 3 gives the volume of this material as approximately 11 million cubic yards (p. 9-4), but the source of this material does not appear to have been mentioned in the environmental statement.

9.04.9.10 Response: This has been included in the final statement.

9.04.9.11 Comment: Impacts of the project in the vicinity of the town of Hillsboro have not been adequately discussed. It has been noted early in the statement that the maximum lake level would be 580.5 feet (p. 1-3), but it is not mentioned that part of the town of Hillsboro is at a lower level. In the discussion of Hillsboro Effluent Discharges (p. 2-24), including treated sewage effluent, there should be mention that the sewage treatment plant is at a level lower than the proposed maximum lake level. Required protective measures are briefly discussed in Section 5 "Alternatives to the Proposed Action," where it is first acknowledged that the porposed lake would have some adverse effects near the town of Hillsboro because of higher backwater in that area, and states that levees would have to be built around the sewage treatment plant (p. 5-7). The accompanying Design Memorandum also mentions that protection will be required for sewage lagoon for the city of Hillsboro (p. 8-3). However, no details of the required protective levees or related measures have been found in either document. We believe that the environmental statement should include an adequate description of the location and proposed design of all such protective levees and any other existing installations in the southwestern part of Hillsboro. Environmental impacts related to intermittent lake levels above the levels of the adjoining sewage lagoon should be included in the discussion. These impacts also belong wherever environmental impacts are summarized throughout the statement.

9.04.9.12 Response: Part of the town of Hillsboro is lower than the maximum pool elevation (580.5 feet MSL) The only area seriously affected would be the sewage treatment plant which would require protective levees. During periods of high lake levels the sewage effluent would have to be pumped or additional holding ponds within the leveed area would be required. This material has been put in the final statement.

9.04.9.13 Comment: The section on Relocations in Design Memorandum No. 3 reveals that nine bridges would need to be relocated under the proposed plan, the longest two bridges being 1,250 feet and 1,500 feet long (p. 8-1). No mention of this fact appears to have been included in the environmental statement. We believe that the required construction of nine bridges up to 1,500 feet long is pertinent to the evaluation of environmental impact. The location, general design, and impact of constructing the nine bridges should be discussed and this information should be summarized in appropriate sections.

9.04.9.14 Response: The road relocations would require nine bridges with a total length of 3,375 feet. The FM 1947 bridge over Hackberry Creek would be 1,500 feet long and a Hill County road bridge over Aquilla Creek would be 1,250 feet long. This information has been included in the final statement in paragraph 1.01 on page 1-1.

9.04.9.15 Comment: Page 1-1, last paragraph, first sentence, and throughout the statement. The surface area of the conservation pool is listed as 1,288. We believe that this statement should agree with the information shown on Table 1-1; that is, initially the surface area will be 1,887. Ultimately the surface area will be 1,288.

9.04.9.16 Response: The surface area of the conservation pool has been changed to 1,887 in the final statement.

9.04.9.17 Comment: Table 1-1. Since the capacities appear to be after 100 years of sediment accumulation, this should be noted. The inactive storage should be noted as used for sediment by that time.

9.04.9.18 Response: This has been clarified in the final statement.

9.04.9.19 Comment: Paragraph 1.02.2.1.1. Provisions of the law for forcing the boat owners to dispose of sewage at marinas and sanitary facilities located on project lands should be cited.

9.04.9.20 Response: Provisions are made in Section 327.9 Chapter III, Title 36, Code of Federal Regulations for enforcing the use of sanitary facilities and practices on Federally owned and/or administered lands and waters. This has been included in the final statement.

9.04.9.21 Comment: Paragraph 1.02.2.2.1. Specifics of the insect and rodent control program sould be presented with descriptions of possible fish and wildlife habitat losses resulting from elimination of brushy vegetation and stagnant water.

9.04.9.22 Response: This has been included in the final statement.

9.04.9.23 Comment: Paragraph 1.02.2.2.2. In addition to the esthetic benefit cited, wildlife habitat preservation and enhancement also should be important considerations in the removal of vegetation.

9.04.9.24 Response: This has now been discussed in Section 1.

9.04.9.25 Comment: Paragraph 1.02.2.5.2 Is there provision for recovery of minerals if such becomes necessary?

9.04.9.26 Response: Yes, however excavating for mineral recovery will be discouraged.

9.04.9.27 Comment: Paragraph 1.02.2.6. A vegetative plan should be developed jointly by the Corps of Engineers, the Texas Parks and Wildlife Department, the Bureau of Sport Fisheries and Wildlife, and other interested agencies to select vegetation, including water-tolerant grasses and other erosion-retarding ground cover, which would meet the required criteria, plus providing wildlife benefits.

9.04.8.28 Response: In paragraph 1.02.2.5.1, Land Management Plans, reference is made to the vegetative management and wildlife management portions of the total resources management program. Both of these plans deal with selection of vegetation to provide specific benefits. These plans are developed with guidance and assistance from local, state, and Federal agencies.

9.04.9.29 Comment: Paragraph 2.03. The expectancy of a nonseeping reservoir on this geologic formation couldbe stated. Blackland Prairie is the correct title of the physiographic subdivision cited.

9.04.9.30 Response: Based on experience gained from two other lakes in the general area built on the Woodbine formation, no seepage problems are expected at Aquilla Lake. This comment has been placed in the final statement.

9.04.9.31 Comment: It is indicated that the only known mineral production in the Aquilla Creek Valley is gravel. An examination of file data indicated that during 1971 mineral facilities in Hill County yielded only lime. Only two gravel pits, both abandoned, were located within the project area.

9.04.9.32 Response: Lime has been added to the list in the final statement. It was stated that the two gravel pits were abandoned.

9.04.9.33 Comment: Paragraph 2.06.1 The temperature range should be to 29.3°C as shown in Table 2-2.

9.04.9.34 Response: This has been corrected in the final statement.

9.04.9.35 Comment: Paragraph 2.06.2 Data in Table 2-2 shows that dissolved oxygen ranged from 1.0 to 4.7 ppm. Aquilla Creek (upper region) contained 4.1, 4.7, and 4.1 ppm during the three sampling periods. It is stated that "All streams were poor in oxygen." In the summary section of 2.06.22, page 2-22, the statement is "... generally well-oxygenated..." Clarification is needed.

9.04.4.36 Response: This has been clarified in the final statement.

9.04.9.37 Comment: Paragraph 2.06.3. Hydrogen ion and pH are not sysnonymous; pH is the negative logarithm of the hydrogen ion concentration.

9.04.9.38 Response: Concur. This has been corrected in the final statement.

9.04.9.39 Comment: Paragraph 2.06.4. The "nitrate," not "nitrite," values ranged from 1.00 to 3.30 ppm.

9.04.9.40 Response: Concur. This has been corrected in the final statement.

9.04.9.41 Comment: Paragraph 2.06.8. The waters during the study were very hard, not moderately hard; however, water in the reservoir will be moderately hard or hard.

9.04.9.42 Response: Concur. This has been corrected in the final statement.

9.04.9.43 Comment: Paragraph 2.06.9 Water stored in the proposed reservoir will have a much lower specific conductance than that in Possum Kingdom Reservoir or Lake Whitney. Samples collected during the study evidently were of low flows. Samples collected during high flow would be more representative of water that will be stored in the reservoir. Specific conductance usually is reported in micromhos instead of ppm NaCl.

9.04.9.44 Response: Concur. Data for some samples collected during high flows is in Appendix F.

9.04.9.45 Comment: Page 2-10. The maximum flood of record occurred in May 1968 not 1958.

9.04.9.46 Response: Concur. This has been corrected in the final statement.

9.04.9.47 Comment: Page 2-24, first paragraph. This paragraph is somewhat confusing. A possible revised paragraph might read: "Siltation is responsible for the low number and limited diversity of fauna collected during the study. This condition has favored nonfilter feeders and predators that rely upon senses, other than sight, for obtaining prey."

9.04.9.48 Response: Corrections have been made to this effect in the final statement.

9.04.9.49 Comment: Page 2-25, figure 2-3. The limits of the proposed reservoir should be revised to correspond with plate 1-1.

9.04.9.50 Response: Figure 2-3 is a rough sketch to show the vegetation areas and not to show the limits of the reservoir.

9.04.9.51 Comment: Page 2-31, Table 2-9. Suggest adding common names to the listing of plants.

9.04.9.52 Response: This has been corrected in the final statement.

9.04.9.53 Comment: Paragraph 2.09. The first two paragraphs may be better as a part of 2.02.

9.04.9.54 Response: This has been moved to paragraph 2.02 in the final statement.

9.04.9.55 Comment: Paragraph 2.09.2. All threatened or endangered species as listed in the US Department of the Interior's Resource Publication 114, "Threatened Wildlife of the United States," and revised appendix C of that publication which occur or may occur in the project area should be noted.

9.04.9.56 Response: This has been included in the proper places in the final statement.

9.04.9.57 Comment: Paragraph 2.10. The cottontail rabbit is not officially recognized as a game animal by the Texas Parks and Wildlife Department. Also, the raccoon is considered as a fur animal.

9.04.9.58 Response: This correction has been made in the final statement.

9.04.9.59 Comment: Paragraph 2.12.3.6. The meaning of the second sentence is not clear.

9.04.9.60 Response: This sentence has been clarified in the final statement.

9.04.9.61 Comment: A description should be included of the impact of general recreation upon the flora and fauna of proposed reservoir recreation areas. Damage to the flora and fauna may result from heavy or excessive recreation use of certain areas.

Beneficial and/or adverse impacts accruing to recreationists resulting from the transfer of project lands from private to public ownership should be noted.

9.04.9.62 Response: The impact of visitation on the flora and fauna at access points has been added to the discussion in Sections 4 and 5, and the impact of converting lands from private to public ownership has been added to Section 4.

9.04.9.63 Comment: Page 3-6, second paragraph, third sentence. The impact of the conservation pool on vegetation within its limits should be further described by stating the conservation pool will initially inundate 1,887 acres.

9.04.9.64 Response: This has been corrected in the final statement.

9.04.9.65 Comment: Page 3-7, last paragraph, third sentence. The referenced sentence should be simplified or clarified to allow an understanding of its intended meaning. Does the littoral community become unstabilized during periods of rough wave action?

9.04.9.66 Response: These regular acute pertubations of the littoral community insure biotic diversity by maintaining the littoral community at some intermediate point in ecological succession. The littoral community is destroyed during times of rough wave action, but does not necessarily become unstabilized. The plant and animals that live in the littoral community are adapted to the particular intensity and frequency of the pertubation.

9.04.9.67 Comment: Page 3-12, third complete paragraph. To sufficiently evaluate the impact of Aquilla Lake on the Brazos River Estuary, the percent contribution of the Aquilla Creek drainage to the total estuary inflow should be presented in a with and without project analysis.

9.04.9.68 Response: This has been done in the final statement.

9.04.9.69 Comment: Paragraph 3.08 and table 4, page 11-42. The wood duck and great horned owl also might be included in the list of bird species which sould suffer a serious reduction in quantity of habitat.

9.04.9.70 These have been included in the final statement.

9.04.9.71 Comment: Page 3-13, first complete paragraph. To emphasize the importance of threatened and endangered species, the sentence should be revised to read, "The southern bald eagle and peregrine falcon are listed as endangered, the prairie falcon is designated as threatened, and the American osprey is designated as status undetermined in the US Department of the Interior's Resource Publication 114, "Threatened Wildlife of the United States."

9.04.9.72 Response: These corrections have been made in the final statement.

9.04.9.73 Comment: Paragraph 3.09. The swamp rabbit and eastern cottontail should be included in the list of mammals that usually inhabit either the creeks or the wooded flood plains. The effect of the impoundment would be not only to move these species upstream or downstream as described but also to areas of suitable habitat around the reservoir. Wildlife in the reservoir vicinity would be reduced by habitat losses resulting from increased clearing of flood plain vegetation. Some wildlife habitat losses also would occur in the upstream segments due to structural measures associated with the Soil Conservation Service watershed project. Therefore, any increase in the mammal population in the upstream or downstream flood plain and reservoir vicinity would temporarily overpopulate these areas, creating increased competition for food and cover and resultant loss of wildlife numbers.

9.04.9.74 Response: The swamp rabbit and eastern cottontail have been included to the list in the final statement. The rest of the paragraph has been noted.

9.04.9.75 Comment: Paragraph 3.10. Not enough research has been done on which to base the assertion that long-term inundation has a positive effect on the preservation of archeological sites. This is a controversial matter and study is needed before any positive effect can be claimed. Some archeologists have observed that the effects of inundation vary in accordance with the location of the site in relation to topography and streamflow (current). In some locations, sites will be covered by silt and relatively protected. However, even in these cases, certain components of the site will be destroyed. In other locations, scouring will completely destroy the entire site.

9.04.9.76 Response: We concur that the research is inadequate on specific case studies of the effects of inundation on archeological sites, but the preservation effects of permanent inundation, water logging and sedimentation are well known. A large percentage of Paleo-Indian sites are still preserved today because of their association with lacustrine deposits and inundations. The The Tepexpan man, so-called Minnesota Man (woman), Domebo mammoth site, Warm Mineral Springs, Florida (archaic brain preservation) Am. Antiquity Vol 26, Number 2, October 1960 are only examples of such preservation. In "Fresh Water Archeology" Donald P. Jewell, January 1961, states "the action of water is not always destructive; in fact, certain kinds of lakes act to preserve objects, either organic, or metallic, which would be destroyed out of water." The excavation of the Roman Well at Chew Stake Lake in England, (Microscope and Archeology) is a classic example of water preservation where cursive writing on a birchwood board in ink is still legible.

The logging industry has used the preservative nature of water and sedimentation by stacking logs in mill ponds to prevent decay.

Underwater examinations (with photography by a Tulsa District diver) and four years of examination of specific sites on Corps lake properties are the basis for the statement that positive effects can be claimed. It is just as erroneous to state "that inundation destroys archeological sites" as it is to state "that inundation preserves archeological sites" without qualification. The lack of mechanical action of waves or currents as pointed out in paragraph 3.10 is a qualifying statement. In essence the comment is in agreement with paragraph 3.10. No revision will be made based on this comment.

9.04.9.77 Comment: It is suggested that the sentence indicating positive effects of inundation be deleted in the final statement.

9.04.9.78 Response: An environmental statement is required to describe positive as well as adverse effects. This sentence has been deleted.

9.04.9.79 Comment: Also, the third paragraph on page 3-14 should be changed (sequence of salvage operation) so that sites above the conservation pool are last.

9.04.9.80 Response: This paragraph has been deleted. An environmental statement does not determine the sequence of implementation of the salvage program.

9.04.9.81 Comment: Paragraph 3.11 (and other places). The relocation assistance law referred to is probably PL 91-646 rather than PL 96-646.

9.04.9.82 Response: This correction has been made in the final statement.

9.04.9.83 Comment: Paragraph 3.12. There likely should be increased demands for utilities and services because of anticipated recreational use.

9.04.9.84 Response: Concur.

9.04.9.85 Comment: Paragraph 3.12.1.1. The location of the sewage disposal facility is unclear. The referenced paragraph indirectly states no such facility will be located on project lands. However, information contained on page 1-6, Disposal of Sewage, states that sewage removed from vault toilets will be disposed of in a State-approved municipal sewage treatment plant or in a State-approved sewage treatment plant located on project lands. If there is a possibility that the sewage treatment plant will be located on project lands, the potential environmental effects should be discussed.

9.04.9.86 Response: This has been clarified in the final statement.

9.04.9.87 Comment: Paragraph 3.12.3. This section is almost totally lacking in details. Impacts of the project on the natural resources of the area have been discussed in previous paragraphs, and it would seem that a followup discussion of the effects of these impacts on human use of the resources, including the management aspects of this use, would be in order.

9.04.9.88 Response: This has been discussed in the final statement.

9.04.9.89 Comment: This section should describe any recreational activities and values lost as a result of inundation of free-flowing streams. The unavoidable loss of fish and wildlife resources, their habitats, and consumptive and nonconsumptive uses by man in the reservoir site and downstream flood plain should be described. The adverse effects and unavoidable losses of wildlife habitat resulting from recreational development and use also should be identified.

9.04.9.90 Response: This has been discussed in the final statement.

9.04.9.91 Comment: Paragraph 5.01. The statement in the first paragraph indicates that alternatives E,F, and G are economically justified. Table 5-1 indicates that such an interpretation is not intended. This could be clarified.

9.04.9.92 Response: The statement in this paragraph doesn't indicate that alternatives E,F, and G are economically justified. It does indicate that four other alternatives were either not economically feasible or undesirable and were not studied in detail or included in the matrix analysis.

9.04.9.93 Comment: Paragraph 5.05. "The present course of action..." is used throughout this section. We assume this refers to present operating projects. However, this should be clarified as the present usage somewhat indicates a course of action in progress on the Aquilla Project.

9.04.9.94 Response: This comment has been corrected in the final statement.

9.04.9.95 Comment: The discussion would be helpful if it were more specific in its treatment of long- and short-term uses of the environment with and without the project. What are the long-term values of the timber products, crop yields, wildlife resources, future downstream water uses, etc., that will be foreclosed by use of the land for a reservoir and related developments?

9.04.9.96 Response: This has been discussed in Section 7.

9.04.9.97 Comment: Appendix II, Table 2. Information on the relative abundance of fishes as was given for birds on Table 4, Appendix II, would be helpful.

9.04.9.98 Response: This information is not available at the present time.

9.04.10 Office of the Governor, Division of Planning Coordination.

9.04.10.1 Comment: The Texas Department of Agriculture indicated that the estimated cost of the project did not include the loss in income from cropland; according to the DES, approximately 70 percent of the total land required is classified as cropland, and the impact of retiring this land from food or fiber production should be reflected in the cost-benefit analysis of the proposed project.

9.04.10.2 Response: The value of land, cost per acre, is based primarily on that lands ability to produce. The land the Corps of Engineers will require to build Aquilla Lake will be purchased at fair market value based on that lands productivity, therefore the income from that cropland is indirectly in the cost of the project. Also sotrage of water to considerable heights permits multiple use of the same acre of land that represents a trade-off between agriculture production for production from water supply, recreation, and flood control.

After flood protection from a project previously flooded, land in the flood plain below the reservoir can be put to its highest use without the threat of flooding.

9.04.10.3 Comment: It was recommended by the Texas Water Development Board (TWDB) that reconsideration be given to creating a multi-purpose facility, in view of the rapidly increasing recreational demands. The TWDB also noted that by including recreational uses for the proposed lake, a more favorable cost-benefit ratio would be realized.

9.04.10.4 Response: Coordination with local interests during this study indicated that no project sponsor as required by Public Law 89-72 could be found. Therefore, project formulation studies were limited to minimum facilities for public health and safety.

9.04.10.5 Comment: The Texas Historical Commission submitted extensive comments pertaining to the potential destruction of certain archeological resources within the project area, and recommended an alternative sequence of testing and mitigation measures to that stated in the DES.

9.04.10.6 Response: These comments have been answered separately.

9.04.11 Texas Historical Commission.

9.04.11.1 Comment: The DES notes that, during the archeological survey performed within the subject area, 125 archeological localities were recorded. The technical report of this survey notes, "Archaeological sites along Aquilla Creek are of a small and therefore of a fragile nature and will be easily destroyed if channelization, land clearing and flooding occur. The sites located in the Upland and Upland slope will be the first to be adversely affected by water impoundment due to wave action and the indirect action of lake utilization. Sites will be affected in all of the proposed dam sites, and therefore it is not possible to suggest that one is more favorable in terms of archeological site destruction" (Skinner 1972:58). In the DES, 3.10 Impact of Archeological Sites notes that "sites located in the fluctuation of the shoreline will be those receiving the most adverse affect," whereas the archeological survey report notes that sites will be destroyed during land clearing measures and other related activities. In addition, similar and further destruction will occur at archeological sites that lie within areas delegated for borrow. The destruction of archeological sites will occur, therefore, well in advance of controlled inundation, and proper mitigation measures should be performed to deal with the irreversible commitment of these resources.

9.04.11.2 Response: Salvage of appropriate sites will be conducted prior to construction activities.

9.04.11.3 Comment: The DES, 3.10 Impact of Archeological Sites notes that "Long-term inundation in an area not subject to mechanical action of waves or current has been ovserved to have a positive rather than negative effect on preservation of archeological sites." While this assumption is not totally unfounded, it is not presently considered to be a legitimate mitigation measure by professional archeologists (including the archeologist who performed the survey) or by the President's Advisory Council on Historic Preservation. Other federal agencies have recognized the extent to which controlled inundation alters cultural resources and do not offer controlled inundation as a preservation measure. In addition, the Corps of Engineers have failed to offer substantive data concerning the presence or absence of waves or currents within the proposed impoundment.

9.04.11.4 Response: Refer to response paragraph number 9.04.9.76 to the Department of Interior page 9-14.

9.04.11.5 Comment: The DES, 3.10 Impact of Archeological Sites notes that "The sequence of salvage operations could be, first, those sites in the "fluctuation zone, second, sites above the conservation pool, and lastly, those subject to inundation." As noted in the comments above, this sequency is unacceptable. A more rational sequence of testing, and if necessary, subsequent salvage is recommended. This sequence should include consideration of: 1) Sites destroyed as a result of clearing operations, 2) Sites destroyed as a result of their entrapment within materials selected for suitability as construction fill for the dam, 3) Sites destroyed as a result of controlled inundation as well as those subsequently destroyed by wave action within the fluctuation zone, and 4) Sites destroyed as a result of the construction of facilities necessary to operate and utilize the proposed impoundment. The sequence should include salvage of a representative portion of all significant cultural resources below 553.0 msl. Sites which lie in areas under the control or jurisdiction of the Corps but which will not sustain direct impacts as a result of the proposed impoundment should be located and protected. Protection might best be accomplished through avoidance.

9.04.11.6 Response: Refer to response paragraph number 9.04.9.80 to the Department of Interior on page 9-14.

APPENDIX A

CORRESPONDENCE WITH OTHERS

City of

HILLSBORO TEXAS

POST OFFICE BOX 568
HILLSBORO, TEXAS 76645

OFFICE OF: City Manager

March 28, 1974

Mr. Donald R. Henderson
Acting Cheif, Engineering Division
Department of the Army
Tulsa District, Corps of Engineers
Post Office Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

I acknowledge receipt of the draft copy of the Environmental Statement for Aquilla Lake.

The City of Hillsboro wishes to express a favorable comment of the statement and urges the construction of the Aquilla Lake Project.

Yours very truly,

Joe Ed Ward

Joe Ed Ward

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

April 5, 1974

OFFICE OF
THE REGIONAL DIRECTOR

Our Reference: EI # 0374-333

Donald R. Henderson
Acting Chief, Engineering Division
Dept. of the Army, COE
P. O. Box 61
Tulsa, Okla 74102

Re: Aquilla Lake, Aquilla Creek, Texas

Dear Mr. Henderson:

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2)(C) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

William F. Crawford
William F. Crawford
Environmental Impact Coordinator

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX
FORT WORTH, TEXAS 76102
819 Taylor Street

April 15, 1974

IN REPLY REFER TO 06-00.8

Mr. Donald R. Henderson, Acting Chief
Engineering Division, Tulsa District
Corps of Engineers
Post Office Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

Reference is made to your letter of March 11, 1974, transmitting copies of the draft environmental statement for Aquilla Lake, Aquilla Creek, Texas. The following comments are offered for your consideration.

On page "b" of the summary sheet, mention is made of possible Interstate highway relocation. Based upon review of your environmental statement and design memorandum, it does not appear that such will be required. Farm to Market Roads 310 and 1947 and possibly State Highway 22 will be affected by the project. Farm to Market Road 310 and State Highway 22 are on the Federal-aid System.

We appreciate having had the opportunity of reviewing this draft.

Sincerely yours,

J. W. White
Regional Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

Southeastern Area, State and Private Forestry

Atlanta, Georgia 30309

8420 April 23, 1974

Donald R. Henderson
Acting Chief, Engineering Division
Tulsa District, Corps of Engineers
Post Office Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

Here are Southeastern Area, State and Private Forestry, comments on the draft environmental statement for Aquilla Lake.

Environmental impacts of Aquilla Lake extend beyond the Aquilla Creek Basin. The environmental impacts of proposed Aquilla Lake are interrelated with nearby Lakes Whitney and Waco and to a lesser extent with the total Brazos River Basin. Therefore, purported flood control, water supply, recreation, and fish and wildlife functions of Aquilla Lake cannot be properly evaluated separately as attempted in this statement.

The cumulative acreage of bottomlands being taken for impoundments is of regional concern. The cumulative acreage of Brazos River bottomlands which is or will be lost to agricultural and forestry production in existing and proposed impoundments (like Aquilla Lake) should be evaluated as to regional impacts in this statement.

The Project has responsibilities to guide development and use of adjoining lands. Impoundment of Aquilla Lake will directly influence adjoining land usage. Therefore, a master land-use plan of all project lands is needed to guide compatible development spawned by the lake and to insure the maintenance and enhancement of environmental quality on project lands during the long-term investment period. This statement should contain a land-use plan for project and adjoining lands which has been closely coordinated with the North Central Texas and the Central Texas State Planning Regions.

Development of a plan of management for forest cover should receive higher priority. The proposed forest management plan (page 1-7) should be a part of the Project Land-Use Plan and should be completed and made available for review by interested agencies prior to any clearing or cleaning operations. It may be desirable to transplant selected specimens to planned recreation and administrative sites or to holding areas. The Texas Forest Service is the local authority on forest management and should be consulted for assistance in preparation of the forest management plan.

Irreversible and irretrievable commitments not fully evaluated. The annual production lost from inundated lands for the life of the project (plus recovery time for forested areas) is an irretrievable project commitment. Also; the labor expended, funds used, and energy consumed in project construction are irretrievably committed.

Thanks for the opportunity to review and comment on this draft statement.

Sincerely,

FREDERICK W. HONING
Area Environmental Coordinator

BRAZOS RIVER AUTHORITY

4400 COBBS DRIVE P. O. BOX 7555 TELEPHONE AREA CODE 817 776

WACO, TEXAS - 76710

April 26, 1974

Mr. Donald R. Henderson, Acting Chief
Engineering Division, Tulsa District
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

We have reviewed the draft environmental statement and the draft general design memorandum, Phase I - plan formulation for Aquilla Lake, Aquilla Creek, Texas, forwarded with your letter of 11 March 1974, and we offer the following comments.

<u>Comments on the draft general design memorandum:</u>

On page 1-3, the Aquilla Creek Basin is described as being bounded "on the northwest by Nolan Creek watershed of the Brazos River Basin." This is not correct: "Nolan Creek" should be changed to "Nolands River."

On page 5-30, it is stated that suitability of water impounded in Aquilla Lake for municipal use "is contingent on the City of Hillsboro upgrading its sewage treatment plant to provide tertiary treatment or discharging the treated wastes at some point below the Aquilla Lake impoundment." This is not consistent with the results of a study made by the Brazos River Authority in response to an inquiry by the Environmental Protection Agency. On the basis of these studies, it was concluded that treated sewage effluent discharged by the City of Hillsboro will not significantly affect the quality nor limit the use of water from Aquilla Lake, provided that all waste waters discharged by the City receive <u>secondary</u> treatment and disinfection. EPA quotes our statement to this effect and expresses agreement with our conclusion in the letter of August 2, 1972, from Mr. Thomas B. Shriver to Mr. Myron W. DeGeer, which is reprinted in Exhibit B of the general design memorandum. (A copy of our complete report to EPA is attached for your information.) Unless there have been subsequent studies unknown to us indicating otherwise, we suggest that the wording of paragraph (7) on page 5-30 be changed to read as follows:

> Studies by the Brazos River Authority indicate that the water impounded in Aquilla Lake will be of a quality suitable for municipal and industrial use. No problems are foreseen as a result of discharge

> of treated sewage effluents in the watershed by the cities of Hillsboro and Itasca provided all wastewaters from these two cities receive secondary treatment and disinfection. However, if secondary treatment should prove inadequate to protect the lake waters from pollution from these sources, the addition of tertiary treatment at the Hillsboro sewage treatment plant would provide a practicable solution to the problem.

Water will be stored in and supplied from Aquilla Lake under permits issued to Brazos River Authority by the Texas Water Rights Commission. These permits will require that the Authority pass streamflows through the lake as necessary to honor prior water rights downstream of the lake during periods of low flow. This fact is not recognized in the discussion of environmental effects in paragraph 11-04, which begins on page 11-10. In order to provide a complete statement of the facts in this regard, we suggest an addition to the end of the seventh complete sentence on page 11-11, so that it will read, "Streamflow immediately below the dam will be limited to spills that occur some 37 percent of the time on a monthly basis and 25 percent of the time on a daily basis and to passage of inflows into the lake as necessary to honor prior downstream water rights during periods of low flow."

Recommendation No. 4 by the U.S. Fish and Wildlife Service (Exhibit calls for minimum clearance of timber in the lake, and the District comments indicate that this recommendation will be given further consideration during preparation of the design memorandum for reser voir clearing. It is requested that such further consideration include a study of the effects that clearing or not clearing the reservoir will have on the color, taste and turbidity of the lake water from the standpoint of its suitability for municipal and industrial use, since this is the principal purpose and most urgent need for the conservation storage to be included in the project.

Comments on the draft environmental statement:

The draft statement appears to give balanced attention to favorable as well as possible unfavorable effects of the Aquilla Lake project and to recognize that the most important effects are those which affect the environment of man. We believe this is entirely appropriate and hope that this same approach is used when the state ment is put into final form.

We suggest that appropriate changes be made in the environmental statement to ke it consistent with the general design memorandum as it may be modified in response to the above suggestions, and we offer the following additional comments on the environmental statement:

We note that the alternatives tabulated in Table 5-1 do not include the recommended plan, which is for a lake at site "D" designed for two-stage development of the conservation storage, with initial development sized to have a water supply yield of 5 mgd and with a potential for future increase in conservation storage to produce a yield of 17.5 mgd, without additional land requirements. The draft general design memorandum indicates that this recommended plan has a benefit to cost ratio of 1.5, better than any of the alternatives shown in Table 5-1, in addition to being better fitted to the water supply needs to be met from Aquilla Lake. It seems to us that the recommended plan should be tabulated among the alternatives shown in Table 5-1.

Section 8 of the statement discusses coordination with others; and in paragraph 8.03, the agencies and organizations to which it is reported the statement has been sent are listed. The Brazos River Authority is not named in this list of recipients. We appreciate being furnished a copy of the draft statement for review and comment, and we suggest that credit be taken for this by adding the Authority's name to the list of recipients in paragraph 8.03.

The Brazos River Authority appreciates this opportunity to comment on the draft general design memorandum and the draft environmental statement, and we would like to commend the Tulsa District for the excellent job it has done, especially on the environmental statement which we feel presents a well-balanced evaluation of the environmental effects from the human perspective rather than putting the emphasis entirely on the flora and fauna as is so often done.

Please call on us if there are any questions concerning our comments or if additional information is desired.

Sincerely yours,

Walter J. Wells

WALTER J. WELLS
General Manager

WJW:gls
Encl.

United States Department of the Interior

OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87101

May 20, 1974

ER-74/384

District Engineer
U.S. Army, Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74102

Dear Sir:

This is in response to your letter of March 11, 1974, requesting review and comment of Design Memorandum No. 3 and the Draft Environmental Statement for Aquilla Lake, Aquilla Creek, Texas.

We have comments on both the design memorandum and draft environmental statement.

The proposed project will not adversely affect any existing, proposed, or known potential unit of the National Park System or any known historic, natural, or environmental education sites eligible for the National Landmark programs. The plan of development appears compatible with any potential development of the Bureau of Reclamation.

Maps in the documents identify the authorized site. Identification of the recommended site would be helpful. We suggest a stated identification between authorized or recommended site and the respective mile location and letter designated location.

Both documents recognize the existence of pipelines within the project site and state that about 6 miles of pipeline would be relocated or protected. Estimated costs of relocating or protecting two pipelines 2.4 and 3.8 miles in length would be about $458,000. The maps, plate 2 of the design memorandum, and plate 1-1 of the environmental statement should be changed to show the ownership change of the Sinclair (now Arco) 10-inch pipeline in order to agree with the text on page 8-3 of the design memorandum.

The draft report of the Bureau of Sport Fisheries and Wildlife (BSFW) and the Corps of Engineers' comments to each of BSFW's recommendations are included in the design memorandum. The Corps has concurred or generally agreed to BSFW's recommendations, except for providing four access sites along the reservoir perimeter subject to further coordination during the advance planning of the project. Lack of public interest in cost sharing precludes anything but the development of minimum access facilities for fish and wildlife.

Subsequent to release of BSFW's report, the Texas Parks and Wildlife Department expressed an interest in the management of 8,000 acres of project lands, including the 2,000 acres developed in BSFW's draft report. The BSFW's draft report will be revised to include the Department's request.

The draft environmental statement includes little or no specific information on material to be used for construction of the earth dam. Design Memorandum No. 3 gives the volume of this material as approximately 11 million cubic yards (p. 9-4), but the source of this material does not appear to have been mentioned in the environmental statement.

Impacts of the project in the vicinity of the town of Hillsboro have not been adequately discussed. It has been noted early in the statement that the maximum lake level would be 580.5 feet (p. 1-3), but it is not mentioned that part of the town of Hillsboro is at a lower level. In the discussion of Hillsboro Effluent Discharges (p. 2-24), including treated sewage effluent, there should be mention that the sewage treatment plant is at a level lower than the proposed maximum lake level. Required protective measures are briefly discussed in Section 5 "Alternatives to the Proposed Action," where it is first acknowledged that the proposed lake would have some adverse effects near the town of Hillsboro because of higher backwater in that area, and states that levees would have to be built around the sewage treatment plant (p. 5-7). The accompanying Design Memorandum also mentions that protection will be required for sewage lagoon for the city of Hillsboro (p. 8-3). However, no details of the required protective levees or related measures have been found in either document. We believe that the environmental statement should include an adequate description of the location and proposed design of all such protective levees and any other existing installations in the southwestern part of Hillsboro. Environmental impacts related to intermittent lake levels above the levels of the adjoining sewage lagoon should be included in the discussion. These impacts also belong wherever environmental impacts are summarized throughout the statement.

The section on Relocations in Design Memorandum No. 3 reveals that nine bridges would need to be relocated under the proposed plan, the longest two bridges being 1,250 feet and 1,500 feet long (p. 8-1). No mention of this fact appears to have been included in the environmental statement. We believe that the required construction of nine bridges up to 1,500 feet long is pertinent to the evaluation of environmental impact. The location, general design, and impact of constructing the nine bridges should be discussed and this information should be summarized in appropriate sections.

Specific Comments on Design Memorandum No. 3

Page B, table. The initial conservation storage appears to be 20,400 acre-feet (3,100 acre-feet are for inactive storage). The 10,800 acre-feet apply after 100 years.

Paragraph 1-05. The information concerning the recommended plan is also needed.

Paragraph 3-03. This paragraph should include estimates of recreational water surface acreage surpluses indicated in the 1968 State Comprehensive Outdoor Recreation Plan for Planning Region II. The plan indicates a recreational water acreage surplus of 276,683 acres in Planning Region II for 1975.

Paragraph 3-04. The 64,400 fishermen and hunters should be 60,400 to agree with the fishing hunting reported on page 10-11 and elsewhere in the report.

Paragraph 4-05b. The average drop of 25 feet per year seems high. This amount would seem to be either average annual variation or total known drop of the water table.

Paragraph 6-01c, and pages 11-12, 13-2, etc. The conservation pool's initial area would be 1,887 acres, and the area after 100 years would be 1,288 acres. The final controlled storage would be 100,300 acre-feet.

Paragraph 6.01c. There is a slight discrepancy. The design memorandum states (page 6-2) that the construction costs include protection and/or acquisition of mineral value in the project area, yet table 7-1 (page 7-2) indicates that it will not be necessary to purchase any known mineral deposits. It should be stated that acquisition of mineral rights would be in accordance with the February 1962 joint agreement between the Departments of the Army and of the Interior.

Page 6-3, table 6-1. Areas and capacities could be noted as initial or after 100 years.

Paragraph 11.03. The figures of 6,385 acres and 125,900 acre-feet may be slight discrepancies.

Paragraph 11.04 (and others). The relocation assistance law referred to is probably PL 91-646.

Exhibit D. Recommendation No. 5 contained in the section of comments preceding the draft report of the Bureau of Sport Fisheries and Wildlife should in part read: "...flood pool be preserved...."

Specific Comments on the Environmental Statement

SECTION 1 - PROJECT DESCRIPTION

Page 1-1, last paragraph, first sentence, and throughout the statement. The surface area of the conservation pool is listed as 1,288. We believe that this statement should agree with the information shown on table 1-1; that is, initially the surface area will be 1,887. Ultimately, the surface area will be 1,288.

Table 1-1. Since the capacities appear to be after 100 years of sediment accumulation, this should be noted. The inactive storage should be noted as used for sediment by that time.

Paragraph 1.02.2.1.1. Provisions of the law for forcing the boat owners to dispose of sewage at marinas and sanitary facilities located on project lands should be cited.

Paragraph 1.02.2.2.1. Specifics of the insect and rodent control program should be presented with descriptions of possible fish and wildlife habitat losses resulting from elimination of brushy vegetation and stagnant water.

Paragraph 1.02.2.2.2. In addition to the esthetic benefit cited, wildlife habitat preservation and enhancement also should be important considerations in the removal of vegetation.

Paragraph 1.02.2.5.2. Is there provision for recovery of minerals if such becomes necessary?

Paragraph 1.02.2.6. A vegetative plan should be developed jointly by the Corps of Engineers, the Texas Parks and Wildlife Department, the Bureau of Sport Fisheries and Wildlife, and other interested agencies to select vegetation, including water-tolerant grasses and other erosion-retarding ground cover, which would meet the required criteria, plus providing wildlife benefits.

SECTION 2 - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

Paragraph 2.03. The expectancy of a nonseeping reservoir on this geologic formation could be stated. Blackland Prairie is the correct title of the physiographic subdivision cited.

It is indicated that the only known mineral production in the Aquilla Creek Valley is gravel. An examination of file data indicates that during 1971 mineral facilities in Hill County yielded only lime. Only two gravel pits, both abandoned, were located within the project area.

Paragraph 2.06.1. The temperature range should be to 29.3°C as shown in table 2-2.

Paragraph 2.06.2. Data in table 2-2 show that dissolved oxygen ranged from 1.0 to 4.7 ppm. Aquilla Creek (upper region) contained 4.1, 4.7, and 4.1 ppm during the three sampling periods. It is stated that "All streams were poor in oxygen." In the summary section of 2.06.22, page 2-22, the statement is "...generally well-oxygenated...." Clarification is needed.

Paragraph 2.06.3. Hydrogen ion and pH are not synonymous; pH is the negative logarithm of the hydrogen ion concentration.

Paragraph 2.06.4. The "nitrate," not "nitrite," values ranged from 1.00 to 3.30 ppm.

Paragraph 2.06.8. The waters during the study were very hard, not moderately hard; however, water in the reservoir will be moderately hard or hard.

Paragraph 2.06.9. Water stored in the proposed reservoir will have a much lower specific conductance than that in Possum Kingdom Reservoir or Lake Whitney. Samples collected during the study evidently were of low flows. Samples collected during high flow would be more representative of water that will be stored in the reservoir. Specific conductance usually is reported in micromhos instead of ppm NaCl.

Page 2-10. The maximum flood of record occurred in May 1968 not 1958.

Page 2-24, first paragraph. This paragraph is somewhat confusing. A possible revised paragraph might read: "Siltation is responsible for the low number and limited diversity of fauna collected during the study. This condition has favored nonfilter feeders and predators that rely upon senses, other than sight, for obtaining prey."

Page 2-25, figure 2-3. The limits of the proposed reservoir should be revised to correspond with plate 1-1.

Page 2-31, table 2-9. Suggest adding common names to the listing of plants.

Paragraph 2.09. The first two paragraphs may be better as a part of 2.02.

Paragraph 2.09.2. All threatened or endangered species as listed in the U.S. Department of the Interior's Resource Publication 114, "Threatened Wildlife of the United States," and revised appendix C of that publication which occur or may occur in the project area should be noted.

Paragraph 2.10. The cottontail rabbit is not officially recognized as a game animal by the Texas Parks and Wildlife Department. Also, the raccoon is considered as a fur animal.

Paragraph 2.12.3.6. The meaning of the second sentence is not clear.

SECTION 3 - THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

A description should be included of the impact of general recreation upon the flora and fauna of proposed reservoir recreation areas. Damage to the flora and fauna may result from heavy or excessive recreation use of certain areas.

Beneficial and/or adverse impacts accruing to recreationists resulting from the transfer of project lands from private to public ownership should be noted.

Page 3-6, second paragraph, third sentence. The impact of the conservation pool on vegetation within its limits should be further described by stating the conservation pool will initially inundate 1,887 acres.

Page 3-7, last paragraph, third sentence. The referenced sentence should be simplified or clarified to allow an understanding of its intended meaning. Does the littoral community become unstabilized during periods of rough wave action?

Page 3-12, third complete paragraph. To sufficiently evaluate the impact of Aquilla Lake on the Brazos River Estuary, the percent contribution of the Aquilla Creek drainage to the total estuary inflow should be presented in a with and without project analysis.

Paragraph 3.08 and table 4, page 11-42. The wood duck and great horned owl also might be included in the list of bird species which would suffer a serious reduction in quantity of habitat.

Page 3-13, first complete paragraph. To emphasize the importance of threatened and endangered species, the sentence should be revised to read, "The southern bald eagle and peregrine falcon are listed as endangered, the prairie falcon is designated as threatened, and the American osprey is designated as status undetermined in the U.S. Department of the Interior's Resource Publication 114, 'Threatened Wildlife of the United States.'"

Paragraph 3.09. The swamp rabbit and eastern cottontail should be included in the list of mammals that usually inhabit either the creeks or the wooded flood plains. The effect of the impoundment would be not only to move these species upstream or downstream as described but also to areas of suitable habitat around the reservoir. Wildlife in the reservoir vicinity would be subjected to increased hunting and other types of recreation which would further reduce their numbers. Wildlife use of the downstream flood plain would be reduced by habitat losses resulting from increased clearing of flood plain vegetation. Some wildlife habitat losses also would occur in the upstream segments due to structural measures associated with the Soil Conservation Service watershed project. Therefore, any increase in the mammal population in the upstream or downstream flood plain and reservoir vicinity would temporarily overpopulate these areas, creating increased competition for food and cover and resultant loss of wildlife numbers.

Paragraph 3.10. Not enough research has been done on which to base the assertion that long-term inundation has a positive effect on the preservation of archeological sites. This is a controversial matter and more study is needed before any positive effect can be claimed. Some archeologists have observed that the effects of inundation vary in accordance with the location of the site in relation to topography and streamflow (current). In some locations, sites will be covered by silt and relatively protected. However, even in these cases, certain components of the site will be destroyed. In other locations, scouring will completely destroy the entire site.

It is suggested that the sentence indicating positive effects of inundation be deleted in the final statement. Also, the third paragraph on page 3-14 should be changed (sequence of salvage operation) so that sites above the conservation pool are last.

Paragraph 3.11 (and other places). The relocation assistance law referred to is probably PL 91-646 rather than PL 96-646.

Paragraph 3.12. There likely should be increased demands for utilities and services because of anticipated recreational use.

Paragraph 3.12.1.1. The location of the sewage disposal facility is unclear. The referenced paragraph indirectly states no such facility will be located on project lands. However, information contained on page 1-6, Disposal of Sewage, states that sewage removed from vault toilets will be disposed of in a State-approved municipal sewage treatment plant or in a State-approved sewage treatment plant located on project lands. If there is a possibility that the sewage treatment plant will be located on project lands, the potential environmental effects should be discussed.

Paragraph 3.12.3. This section is almost totally lacking in details. Impacts of the project on the natural resources of the area have been discussed in previous paragraphs, and it would seem that a followup discussion of the effects of these impacts on human use of the resources, including the management aspects of this use, would be in order.

SECTION 4 - ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This section should describe any recreational activities and values lost as a result of inundation of free-flowing streams. The unavoidable loss of fish and wildlife resources, their habitats, and consumptive and nonconsumptive uses by man in the reservoir site and downstream flood plain should be described. The adverse effects and unavoidable losses of wildlife habitat resulting from recreational development and use also should be identified.

Page 4-2. The Corps of Engineers is responsible for cultural resources under its jurisdiction (Executive Order 11593). Lack of National Park Service funding does not relieve the Corps of its responsibility.

SECTION 5 - ALTERNATIVES TO THE PROPOSED ACTION

Paragraph 5.01. The statement in the first paragraph indicates that alternatives E, F, and G are economically justified. Table 5-1 indicates that such an interpretation is not intended. This could be clarified.

Paragraph 5.05. "The present course of action...." is used throughout this section. We assume this refers to present operating projects. However, this should be clarified as the present usage somewhat indicates a course of action in progress on the Aquilla Project.

SECTION 6 - THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The discussion would be helpful if it were more specific in its treatment of long- and short-term uses of the environment with and without the project. What are the long-term values of the timber products, crop yields, wildlife resources, future downstream water uses, etc., that will be foreclosed by use of the land for a reservoir and related developments?

Appendix II, table 2. Information on the relative abundance of fishes as was given for birds on table 4, appendix II, would be helpful.

We hope these comments are useful in preparing the final documents.

Sincerely,

Raymond P. Churan

for Willard Lewis
Special Assistant to the Secretary

United States Department of the Interior
BUREAU OF RECLAMATION
SOUTHWEST REGION
HERRING PLAZA BOX H-4377
AMARILLO, TEXAS 79101

IN REPLY REFER TO: 730

125.

APR 17 1974

Colonel John G. Driskill
District Engineer
Corps of Engineers
Attention: Donald L. Henderson
Post Office Box 61
Tulsa, Oklahoma 74102

Dear Colonel Driskill:

We appreciate the opportunity to review the draft environmental impact statement and design memorandum No. 3 for Aquilla Lake, Aquilla Creek, Texas (E7-74/384).

Our comments are being forwarded to the Special Assistant to the Secretary, Department of the Interior, for coordination with comments from other bureaus within the Department. You should receive a copy of these coordinated comments soon after April 30.

Sincerely yours,

FOR
J. A. Bradley
Regional Director

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 648
Temple, Texas 76501

April 23, 1974

Mr. Donald R. Henderson
Acting Chief, Engineering Division
Department of the Army
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

We have reviewed the draft environmental statement for Aquilla Lake, Aquilla Creek, Texas.

The statement adequately describes the impact of the proposed project and contains measures to minimize adverse effects. However, we offer the following suggestions for your consideration:

102.2.3.1 Forest Management - This area is out of the forest area of Texas, but lies in the Blacklands, East Cross Timbers, and Grand Prairie regions. The native vegetation is prairie and oak savannah and is primarily used for grazing, except the hardwoods in bottomlands. The timber products are very limited, primarily posts and firewood, and of low value. Growth is too slow to warrant management for timber products. Therefore, no forest management plan is needed.

102.2.5.1 Land Management Plans - Same comment concerning Forest Management.

2.02 Natural Environment of the Basin - This would be much more descriptive if tied to the land resource areas.

2.08 Flora of the Basin - This shows the watershed as being in the Blacklands and Eastern Cross Timbers. This is in error, as the western portion is in the Grand Prairie rather than Blacklands.

2.08.1 Eastern Cross Timbers - This is described as "post-oak and blackjack oak woodland." This is more correctly described as post and blackjack oak savannah, originally a relatively open stand of trees or mottes of trees interspersed with open grasslands. Removal of grass cover and reduction of fires permitted the trees to increase where they presently form dense stands in places, an indication of ecological disturbance.

2.08.2 Blackland Prairie - This description fits the eastern part of the watershed, but does not adequately fit the western part. The western part is Grand Prairie, which consists of mostly shallow soils with some deep spots. Vegetation is open grassland and localized savannah of live oaks-grassland on more rocky slopes and shallow soils. Mesquite is a common weedy invader. Nearly all the true Blacklands are now cultivated, but only localized areas of deeper soils on the Grand Prairie are cropped.

2.48 No data regarding different land use, trends, of the watershed.

3.12.3.1 Forest Management - This is not in forested area so none is needed. Some landscaping will probably be done in public recreation areas, so maybe a landscape plan is needed, rather than forest management plan.

Section 4 - page 4-1, 2nd and 3rd line - 27 percent pasture and 9 percent timber - These are misnomers. Part of the 27 percent pasture (if not all) is rangeland and some of the 9 percent timber perhaps is also (unless it is all bottomland hardwoods).

Section 5, 5.05.2.3 Alternatives to Forestry and Wildlife Management - Since there is no "forest," there is no forestry management plan needed.

We appreciate the opportunity to review and comment on this draft statement.

Sincerely,

Edward E. Thomas
State Conservationist

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION

DOLPH BRISCOE
GOVERNOR

JAMES
DIR

May 2, 1974

Mr. Donald R. Henderson
Acting Chief, Engineering Division
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

The draft environmental statement (DES) and draft general design memorandum for the Aquilla Lake, Aquilla Creek, Texas, submitted by the Tulsa District, Corps of Engineers, have been reviewed by the Governor's Division of Planning Coordination and by other interested State agencies.

Review participants have submitted the following comments that warrant your consideration:

1. The Bureau of Economic Geology noted that the foundation materials at the dam site is possibly deficient, citing a publication which described the Pepper Shale member of the Woodbine Formation as being "very unstable." Potential problems may exist in the high shrink-swell characteristics, the erodability of shale substrate, and the permeability of adjacent sandstone beds.

2. The Texas Water Rights Commission recommended that the DES contain more complete and detailed cost-benefit data and analyses for all project alternatives, citing numerous legal decisions which ruled that a comprehensive cost-benefit analysis be included in environmental impact statements.

3. Noting that the Hillsboro Sewage Treatment Plant will be discharging effluent directly into the proposed reservoir, the Texas Water Quality Board emphasized the necessity of careful planning and coordination in the development of the reservoir with the Hillsboro water treatment facility.

4. The Texas Parks and Wildlife Department recommended that the DES be more specific in terms of the entities which might be involved in the management of forestry, recreation and wildlife in the

proposed project area. This Department recommended further that leases for agriculture and grazing within the project area be avoided; maintenance of the natural state would provide food for wildlife while protecting the soil from overgrazing.

5. The Texas Highway Department noted several inconsistencies between the DES and the design memorandum; the DES states that portions of interstate highways will be affected by the proposals, while the design memorandum indicates that State and federal highways will not be affected. Corrections recommended by the Highway Department are that no portions of an interstate highway will require relocation; however, F.M. Roads 310 and 1947 and possibly State Highway 22, which presently constitute an integral part of the State-maintained system, will in fact be effected by the project and will require relocation or adjustment.

Enclosed are the comments made by the review participants. If we can be of further assistance, please let us know.

Sincerely,

James M. Rose

JAMES M. ROSE
Director

JMR/wsb
Enclosures
cc: Mr. B. L. DeBerry, Texas Highway Department
Dr. W. L. Fisher, Bureau of Economic Geology
Mr. A. E. Richardson, Texas Water Rights Commission
Mr. Hugh C. Yantis, Jr., Texas Water Quality Board
Mr. Clayton Garrison, Texas Parks and Wildlife Department
Mr. Harry Burleigh, Texas Water Development Board
Mr. Charles R. Barden, Texas Air Control Board

TEXAS AIR CONTROL BOARD

PHONE 512/451-5711
8520 SHOAL CREEK BOULEVARD
AUSTIN, TEXAS - 78758

CHARLES R. BARDEN, P. E.
EXECUTIVE DIRECTOR

April 4, 1974

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

We have received the following list of documents and a review of these indicates they will have a negligible impact on air quality.

1. Plan Formulation for Aquilla Lake, Aquilla Creek, Texas
2. Detailed Project Report for Flood Control, Zacate Creek, Laredo, Texas
3. Flood Control Project for White Oak Bayou in Houston, Texas
4. Final Environmental Impact Statement on Aubrey Lake, Elm Fork, Trinity River, Texas
5. Results of the Study of Flood Problems in the Burnett, Crystal, and Scott Bays Area in Baytown, Texas

These projects are heavily water-oriented and we found no objections to their air quality aspects. We appreciate being informed on all activities within the State having environmental consequences and will continue to offer constructive comments where appropriate. Thank you for your consideration.

Sincerely yours,

Bill Stewart, P.E.
Director
Agency Operations

COMMISSION

REAGAN HOUSTON, CHAIRMAN
DEWITT C GREER
CHARLES E SIMONS

TEXAS HIGHWAY DEPARTMENT
11TH AND BRAZOS
AUSTIN, TEXAS 78701

STATE HIGHWAY ENGINEER
B. L. DEBERRY

April 11, 1974

IN REPLY REFER TO
FILE NO. D-5

SUBJECT: Draft Design Memorandum No. 3
for Aquilla Lake, Hill County

Mr. Wayne N. Brown, Chief
State Planning and Development
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Sir:

We have reviewed the draft copy of Design Memorandum No. 3 for Aquilla Lake which accompanied your memorandum of March 21, 1974 and offer the following comments for your consideration:

1. Paragraph 8-01. GENERAL, on Page 8-1 of the Design Memorandum, indicates that no State or Federal highways will be affected by the project. In view of the fact that Farm to Market Roads 310 and 1947 and possibly State Highway 22, which presently constitute an integral part of the State-maintained system, will be significantly affected by the project and are to be relocated or adjusted at Government expense, we recommend further clarification or, if necessary, complete revision of the referenced paragraph.

2. Although we are aware of the fact that the Design Memorandum is preliminary in nature, it should be noted that the approximate bridge and roadway lengths and the estimated relocation costs indicated in Paragraphs 8-03. ROADS AND BRIDGES and 9-03. DETAILS OF ESTIMATED COSTS, on Pages 8-1 and 9-3 respectively, are subject to verification in subsequent stages of negotiation with the Corps of Engineers.

Preliminary discussions with representatives of the Corps concerning the relocation and adjustment of highways and farm to market roads in the reservoir area have been characterized by a mutual desire to provide the best possible service to the traveling public.

Please advise if we may be of further assistance in this matter.

Sincerely yours

B. L. DeBerry
State Highway Engineer

By: Marcus L. Yancey Jr.

Marcus L. Yancey, Jr.
Assistant State Highway Engineer

COMMISSION

REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

TEXAS HIGHWAY DEPARTMENT
11TH AND BRAZOS
AUSTIN, TEXAS 78701

STATE HIGHWAY ENGINEER
B. L. DEBERRY

April 11, 1974

IN REPLY REFER TO
FILE NO D-5

SUBJECT: Draft Environmental Statement
for Aquilla Lake, Hill County

Mr. Wayne N. Brown, Chief
State Planning and Development
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Sir:

We have reviewed the draft environmental statement (DES) for Aquilla Lake which accompanied your memorandum of March 21, 1974 and offer the following comments for your consideration:

1. Page b of the Summary Sheet immediately preceding the Table of Contents states that portions of interstate, state and county roads are to be relocated in connection with this project. From information made available to us by the Corps of Engineers, it does not appear that any portion of the interstate system will be affected by the project and we recommend that the referenced statement be revised accordingly.

2. Although air and noise pollution are not specifically mentioned in connection with the relocation or adjustment of highways and farm to market roads in the reservoir area, we assume that all requirements in this regard are satisfied by the DES.

Negotiations with the Corps of Engineers for the relocation or adjustment of existing highway and farm to market routes to accommodate the proposed Aquilla Lake project are progressing satisfactorily, and based on previous projects in which the State and the Corps have had a common interest, the results should prove beneficial to both parties.

Please advise if we may be of further assistance in t... matter.

Sincerely yours

B. L. DeBerry
State Highway Engineer

By: Marcus L. Yancey Jr.

Marcus L. Yancey, Jr.
Assistant State Highway Engineer

THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY
AUSTIN, TEXAS 78712

University Station, Box X
Phone 512-471-1534

April 10, 1974

Mr. Wayne N. Brown, Chief
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

The staff of the Bureau of Economic Geology has reviewed the draft environmental statement and general design memorandum for Aquilla Lake. Our comments refer chiefly to possible deficiencies of foundation materials at the dam site. The bedrock there consists mainly of a shale member (Pepper Shale) of the Woodbine Formation. This is notable in that it is the same material that failed during construction of Waco Dam.

The Pepper Shale at Aquilla damsite contains more sandstone interbeds than the substrate at Waco Dam. These sandstone beds may locally enhance foundation properties but may also provide conduits for seepage that could ultimately saturate and weaken the adjacent shales. Permeability studies of these strata should be performed on site instead of being inferred from studies at Grapevine Lake.

The Pepper Shale at Aquilla site is said to contain fewer broken and fractured zones than at Waco Dam, yet it is described (p. I-10, Design Memorandum) as containing 29 ft. of "severely oxidized, jointed, and slickensided" material (slickensides, indicators of fault displacement, are referred to again on p. I-12).

Engineering data on the Pepper Shale in the Waco vicinity have been presented by Font and Williamson (Baylor Geological Studies, Bull. 12, pt. IV). They descri[illegible] it as "very unstable," expressing a maximum natural slope angle of 10 percent (6°), and possessing high shrink-swell characteristics. Sandstone interbeds notwithstan[illegible] problems may be encountered with a proposed 1:3 cut-slope in the spillway, and wit[illegible] maintenance of a concrete spillway weir. Additionally, the erodability of shale s[illegible] and its lack of vegetative cover may pose problems in maintenance of a channelized drainage path downstream from the spillway.

Best regards.

Sincerely,

Charles M. Woodruff, Jr.

CHARLES M. WOODRUFF, JR.
Research Scientist

CMWJr:dw

TEXAS WATER RIGHTS COMMISSION

SAM HOUSTON STATE OFFICE BUILDING

COMMISSIONERS

CARTER, CHAIRMAN

[illegible]

HARDEMAN

A. E. RICHARD
EXECUTIVE DIR.
475 245?

AUDREY STRAN.
SECRETAR
475-4514

April 8, 1974

Mr. James M. Rose, Director
Governor's Division of Planning
Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Mr. Wayne N. Brown, Chief
State Planning and Development

Re: Corps of Engineers, Tulsa District, Draft Environmental Statement on Aquilla Lake, Aquilla Creek, Texas, March 1974.

Dear Mr. Rose:

In response to the request in your Memorandum of March 21, 1974, the staff of the Texas Water Rights Commission has reviewed the referenced Corps of Engineers' Draft Environmental Statement on the Aquilla Creek construction project. Attached for your information and use is a copy of our staff Memorandum of Review.

This review is made in accordance with the Commission's responsibilities as a member agency of the Interagency Council on Natural Resources and the Environment -- assisting your office, as requested, in conducting the clearinghouse review of Federal projects, pursuant to the provisions of Office of Management and Budget Circular No. A-95, Revised, dated November 13, 1973, and also the National Environmental Policy Act of 1969.

In essence, the staff finds that the environmental statement would be enhanced by including more complete and detailed cost-benefit data and analyses for all project alternatives. The staff believes that this information already has been determined and is available readily to the Corps of Engineers. These data

Mr. James M. Rose
April 8, 1974
Page 2

and analyses should demonstrate the basis of quantification adopted for the major economic, social, and environmental factors involved in each project alternative. Also, these data and analyses should demonstrate the "tradeoff" process involved in arriving at the recommended project -- as stipulated in the Court Opinion rendered in Calvert Cliffs Coordinating Committee v. AEC, 449 F.2d at 1114, 2 Environment Reporter——Cases (ERC) at 1782. This Court Opinion contains explicit guidance regarding cost-benefit data and analyses required in environmental statements prepared pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969.

The foregoing comments and those in the attached Memorandum are presented with the constructive intent of assisting staff planners concerned in developing, and expediting the vital Aquilla Lake project.

Please call Dr. Alfred J. D'Arezzo, Environmental Sciences Analy: Texas Water Rights Commission, telephone 512-475-2678, if you have any questions on this case.

Sincerely yours,

A. E. Richardson

AER-AJD:11

Attachment
As stated.

AD-A089 307 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 8/8
FINAL ENVIRONMENTAL STATEMENT AND SUPPLEMENTAL INFORMATION FOR --ETC(U)
APR 76

UNCLASSIFIED NL

3 of 4
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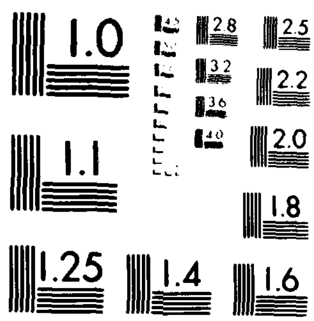

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

To: Executive Director
Texas Water Rights Commission

April 4, 1974

MEMORANDUM OF REVIEW
OF
CORPS OF ENGINEERS, TULSA DISTRICT
DRAFT ENVIRONMENTAL STATEMENT
ON
AQUILLA LAKE, AQUILLA CREEK, TEXAS
MARCH 1974.

By: Dr. Alfred J. D'Arezzo, Environmental Sciences Analyst,
Texas Water Rights Commission

1. INTRODUCTION

1.1 Basis for Review.

a. By Memorandum of March 21, 1974, the Division of Planning Coordination, Office of the Governor, transmitted to the Texas Water Rights Commission the Corps of Engineers' Draft Environmental Statement (DES) on the Aquilla Lake project, requesting the Commission's comments by April 12, 1974.

b. This review by the Texas Water Rights Commission's staff is made in accordance with the Commission's responsibilities as a member agency of the State's Interagency Council on Natural Resources and the Environment (ICNRE) -- assisting the Governor's Division of Planning Coordination in that Division's capacity as the State of Texas' Clearinghouse for the review of the Federal programs governed by the policies and regulations contained in the Office of Management and Budget (OMB) Circular No. A-95, Revised, dated November 13, 1973.

2. COMMENTS

2.1 Need to Strengthen Benefit and Cost Discussion.

The staff believes that the environmental statement would be enhanced greatly if the cost-benefit analysis were presented in a more comprehensive form as suggested by recent Court Opinions on the matter of Federal project costs and benefits.

As to the matter of benefits and costs from the Aquilla Lake project, the DES merely sets forth (on pages 1-4 and 1-5),

> "The average annual cost of the Aquilla project using a 100-year economic analysis period and an estimated first cost of $27,100,000 is $1,091,800. The total average annual benefits from the Aquilla project are $1,679,000. The benefit-cost ratio is 1.5 to 1. All costs are 1973 base. The following tabulation shows the annual cost and a breakdown of the estimated benefits.
>
> ". . . Annual Costs. (Includes interest and amortization @ 3-1/4 percent and operations, maintenance, replacements, and $6,000 of unmitigated fishing and hunting losses) $1,091,800.
>
> ". . . Average Annual Benefits.

Flood Control	$1,079,000
Water Supply	472,600
Recreation	84,000
Redevelopment	43,000
	$1,679,000 "

The staff believes that the above information is minimal. In this regard, attention is invited to the case Montgomery v. Ellis, No. CA 71-644, September 11, 1973. The full text of opinion on this case appears in 5 Environment Reporter—Cases (ERC, pages 1790 through 1802). In the cited case, exception was taken to minimal benefit and cost factors contained in an environmental impact statement. The Opinion quoted from the case of Calvert Cliffs Coordinating Committee v. AEC, 449 F.2d 1109, 2 ERC 1779 (D.C. Cir. 1971), as follows:

> "As stated in Calvert Cliffs, supra, the 'detailed statement is to cover the environmental costs which might be avoided', 449 F.2d at 1114, 2 ERC at 1782, and,
>
> > "'In each individual case, the particular economic and technical benefits of planned action must be assessed and then weighed against environmental costs; alternatives must be considered which will affect the balance of values. . .In some cases, the benefits will be great enough to justify a certain quantum of environmental costs; in other cases, they will not be so great and the proposed action may have to be abandoned or significantly altered so as to bring the benefits and costs into a proper balance. The point of the individualized balancing analysis is to ensure that, with possible alterations, the optimally beneficial action is finally taken.' (Emphasis supplied.) 449 F.2d at 1123, 2 ERC at 1788."

The cited Montgomery v. Ellis case went further, as follows:

> "In further reference to the use of conclusory figures, the following from Environmental Defense Fund v. TVA, 339 F. Supp. 806 at 809, 3 ERC 1553 at 1554-55, (E.D. Tenn. 1972), aff'd 468 F.2d 1164, 4 ERC 1850 (6th Cir. 1972), is particularly pertinent:

"'Although comprehensive in scope, the draft statement's cost-benefit analysis consists almost entirely of unsupported conclusions. As a result, a non-expert reader is denied the opportunity to intelligently evaluate TVA's conclusions. In addition, it is impossible to determine the thoroughness of the research upon which TVA based the conclusions, or their relative merit.' (Emphasis supplied.)"

In view of the above typical Court reactions to minimal cost data, the staff believes that effort should be made to include in the environmental statement all available useful cost data and analysis pertaining to all alternatives considered in the Aquilla project.

The staff recognizes that one of the most difficult problems in environmental and resource analysis is the obscurity of the definition of terms involved, and the quantitative evaluation of environmental and natural resource alternatives. In this regard, attention is invited to Technical Paper 10416 entitled, "Quantifying Impacts of Transportation Systems," by William L. Smith, in the Journal of the Urban Planning and Development Division, Proceedings of the American Society of Civil Engineers, Vol. 100, No. UP1., March 1974. The stochastic supply and demand analysis method suggested in this paper is believed to provide an excellent technique applicable to the analysis of a large number of resources. Briefly, the technique uses probability theory and common and convenient economic principles in performing quantitative environmental and resource evaluations for alternative plans of action for public works projects.

2.2 Basic Requirements of Public Law 91-190.

The staff finds that the environmental statement under review is in basic conformance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190). Revisions based upon consideration of the comments in subparagraph 2.1, above, will enhance the clarity and the justification for the vital Aquilla Lake project.

3. SPECIAL REMARKS

The comments in this review are presented with constructive intent to assist the staff planners concerned in enhancing the environmental statement and expediting necessary action on the Aquilla Lake project.

Alfred J. D'Arezzo

Alfred J. D'Arezzo

AJD:11

NOTED:

A. E. Richardson

A. E. Richardson
Executive Director

TEXAS WATER RIGHTS COMMISSION

SAM HOUSTON STATE OFFICE BUILDING

COMMISSIONERS

JOE D. CARTER, CHAIRMAN
475 2453
OTHA F. DENT
475 2451
DORSEY B. HARDEMAN
475 4325

April 8, 1974

A. E. RICHARDS
EXECUTIVE DIRE
475-2452
AUDREY STRAND
SECRETARY
475-4514

Mr. James M. Rose, Director
Governor's Division of Planning
Coordination
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Mr. Wayne N. Brown, Chief
State Planning and Development

Re: Corps of Engineers, Tulsa District and Fort Worth District -- Draft of Design Memorandum No. 3, General Design, Phase 1-Plan Formulation, Aquilla Lake, Aquilla Creek, Texas. (March 11, 1974)

Dear Mr. Rose:

In response to the request in your Memorandum of March 21, 1974, the staff of the Texas Water Rights Commission has reviewed the referenced Corps of Engineers' Draft Design Memorandum No. 3 for the Aquilla Lake, Aquilla Creek, Texas, project. The staff finds that the initial, favorable feasibility determination, made and formalized by a Commission Order, dated August 2, 1966, is still valid. The selection of Dam Site D, in lieu of Site C, which was initially recommended in the Corps of Engineers' Interim Report of December 28, 1965, does not invalidate the basic Commission feasibility determination.

Sincerely yours,

A. E. Richardson

A. E. Richardson

AER-AJD:ll

TEXAS WATER QUALITY BOARD

1700 NORTH CONGRESS AVE. 78701
P.O. BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

April 9, 1974

RE: Draft Environmental Impact
Statement - Aquilla Lake

Gen. James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Cap. Sta.
Austin, Texas 78711

Dear General Rose:

This is in response to the letter of March 21, 1974 from Mr. Wayne N. Brown transmitting the draft environmental statement and the draft general design memorandum of the Corps of Engineers on the proposed Aquilla Lake at Hillsboro, Texas.

As we stated in our letter of December 5, 1972, commenting on this project when the proposed reservoir on Aquilla Creek is completed and the normal water level is reached, the Hillsboro Sewage Treatment Plant will be discharging effluent directly into the reservoir. The present sewage treatment facilities at Hillsboro receives effluent from several industries located in the city, including a carpet textile plant. The City of Hillsboro has submitted a grant application to the Texas Water Quality Board for upgrading and expanding the existing facilities.

The Board's policy for effluent standards for domestic wastewater treatment plants dated January 22, 1974 will provide the criteria for adequate treatment at this site. For this treatment facility, the policy would require provision of a treatment system to obtain an effluent, which on a 30-day average, would have a Biochemical Oxygen Demand of 10 mg/l and Total Suspended Solids of 15 mg/l plus disinfection which would limit fecal coliforms to 200. It will still be necessary to carefully plan and coordinate development of the reservoir and the Hillsboro treatment works but there is no incompatibility from a technological standpoint.

Gen. James M. Rose, Director
Page 2
April 9, 1974

We appreciate the opportunity to make comments on this report. If we can be of further assistance, please let us know.

Very truly yours,

Emory G. Long

Emory G. Long, Director
Administrative Operations Division

PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

April 19, 1974

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Mr. Brice Barnes

Dear Mr. Brown:

The Texas Parks and Wildlife Department has reviewed the draft environmental statement and the draft design memorandum on the Aquilla Lake Project, Aquilla Creek, Texas. The following comments are offered concerning the environmental statement.

Where this environmental statement refers to recreation, the words "public recreation" should be used.

Statements about management for forestry, recreation, wildlife and for control of wildfire should suggest what entity might formalize and implement such activities, when they would be initiated, and specifically what might be done.

Provisions for fish and wildlife propagation and for fishing and hunting are reiterated briefly in several sections of the statement and are insufficiently discussed.

Contradictory to the remarks contained in this environmental impact statement, it is felt that the impact upon white-tailed deer would be significant. Despite their present low numbers, the changes which this project would bring about should influence and increase the deer population and stimulate interest in deer hunting on the project lands.

This document fails to adequately relate the effect of the project on fish and wildlife, upon stream flow below the proposed site, and upon the riparian ecosystems involved. Streambottoms are rapidly being diminished in Texas due to impoundment projects such as the proposed Aquilla Lake. We are concerned about these losses and the loss of native biota indigenous to such zones. A prime concern is the diminishing effect these projects are having collectively upon tree squirrel and swamp rabbit populations in Texas. A statement acknowledging the contribution of this project to such losses should be made, along with an indication of plans for the mitigation of these losses. Plans for offsetting the loss of bottomland habitat should be related in the statement.

Wildlife management should include treatments for waterfowl, general habitat improvement (including management to stimulate the growth of native game food plants) and management for wood ducks by protection of them and by providing nest boxes in their rearing areas along the upper creeks.

Leases for agriculture and grazing within the project lands should be avoided so that a greater amount of vegetation would develop which would provide food for wildlife and protect the soil, and so that natural plant succession could operate. Fencing should be provided to protect wildlife management areas and, in the event grazing leases are implemented, to control livestock.

The lists of animals in the appendices of this document have misspelled names and are incomplete in their listings.

We appreciate the opportunity to comment on this statement.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:WJS:ac

TEXAS WATER DEVELOPMENT BOARD

HARRY P. BURLE
EXECUTIVE DIREC

AREA CODE 512
475-3571

1700 NORTH CONGRESS AV

P. O. BOX 13087
CAPITOL STATION
AUSTIN, TEXAS 78711

April 9, 1974

IN REPLY REFER
TWDBP-O

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear General Rose:

Please refer to your memorandum dated March 21, 1974 transmitting for review and comment the Corps of Engineers Draft Environmental Statement for Aquilla Lake, Aquilla Creek Texas.

The development of one of the optional reservoir sites on Aquilla Creek is proposed in the Texas Water Plan, and has been under discussion and study for more than a quarter of a century. It is the finding of this agency's staff that Aquilla Creek is the most logical municipal water supply source for the Cities of Hillsboro, West, and probably other smaller towns within the area. Also, the development of a flood-control project on Aquilla Creek will be a major asset to the City of Waco. At this time, there is no financial sponsor for developing recreational facilities on the proposed lake, but in our view there is a definite need for flat water recreation opportunities in the area.

As is true with any reservoir development, there will be some adverse effects; the most unfortunate of which is the displacement of people who presently reside within the project area. In a rather unique approach, the Environmental Impact Statement reflects the results of a socio-economic survey for Aquilla Creek Basin in which 329 interviews with persons residing within the area were completed. Covered was a broad array of topics pertinent to the project development. It is significant to note that 84.62% of the people interviewed approved of the proposed reservoir development, and that 78.5% thought it would economically benefit the community. The greatest sentiment against building the lake was based on individuals, families, or friends having land that would be affected by the project.

An analysis of several alternatives to the proposed lake clearly shows that the most economically feasible reservoir site was selected. Two significant points should be made; first, due to depletion of groundwater reserves in the area a new source of municipal water supply must be developed for Hillsboro and West; and second, should surface water be imported from some outside source it must be stored, when available, in some local facility such as a reservoir on Aquilla Creek. The plan and project selected, while probably larger than would be required for terminal storage, has the added features of developing the water supply potential of Aquilla Creek, providing flood control, and eliminatin the cost of transporting water from an outside source.

It is our finding that the Draft Environmental Statement, Aquilla Creek Lake fulfills its intended purposes, and we are pleased to endorse it as presented.

Sincerely,

Charles S. Menifee

Harry P. Burleigh

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

May 17, 1974

Mr. Donald R. Henderson
Acting Chief
Engineering Division
Tulsa District
U.S. Army Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74102

Re: 06-4-100-TX
D-COE-34114-TX
Your Re: SWTED-PA

Dear Mr. Henderson:

We received the Draft Environmental Impact Statement and Draft General Design Memorandum for Aquilla Lake, Aquilla Creek, Texas, Phase I - Plan Formulation on March 14, 1974. Although comments are due to you by May 20, 1974, we regret that we will not be able to respond by that date. We expect to respond by May 28, 1974, and we anticipate that our comments will raise significant questions as to the environmental impact of the proposed action, especially with regard to the water quality aspects of the project's impact.

Sincerely yours,

Clinton B. Spotts

Clinton B. Spotts
Chief
Federal Assistance Branch
6AAWF

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

May 29, 1974

OFFICE OF THE
REGIONAL ADMINISTRATOR

CERTIFIED MAIL -- RETURN RECEIPT REQUESTED

Mr. Donald R. Henderson
Acting Chief, Engineering Division
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

We have reviewed your Draft Environmental Impact Statement and Design Memorandum for Aquilla Lake, Aquilla Creek, Texas. The project consists of constructing a reinforced concrete gate tower and outlet works, access roads, project buildings, public use facilities and reservoir clearing. The proposed action will utilize 11,800 acres of cropland, homesites, pastures, and woodlands to construct a reservoir with a total controlled storage capacity of 126,000 acre-feet.

The following comments on the draft statement are suggested for your consideration in preparing the Final Environmental Impact Statement:

Summary Sheet - Description of Action

1. Various construction features including access roads, project buildings, and reservoir clearing are mentioned in the summary. However, further information concerning these features is not included in the body of the draft statement. In order to fully assess the impacts of construction on air and water quality in the project area the inclusion of this information is necessary. We suggest that the final statement include a project map showing the location of access roads, project buildings, and areas to be cleared as well as future relocations of roads, pipelines, and telephone lines. A detailed discussion of the environmental impacts associated with these actions would strengthen the report.

Project Description

2. The proposed project provides for the construction of multiple-purpose reservoir. According to the draft statement the multiple uses include flood control, water supply, and recreation. However, two of these uses are not discussed adequately in the statement. For instance, the following general statement is made in relation to water use, "The proposed water supply of 5.0 MGD will probably be used by the cities of Hillsboro and West." The final statement should elaborate on the reservoirs water supply capability since this is a major justification for its construction. Detailed information addressing the necessary measures required to transfer water from the lake to the cities should be made a section of the final statement. This should include the construction of pumping stations, access roads, and delivery pipes. Possible locations for these facilities should be noted and the associated environmental impacts discussed. This information is essential in determining the overall effect of construction on the environmental integrity of the project site.

Recreation facilities at Lake Aquilla will be very limited due to the absence of a non-Federal public body to cost-share in development. The proposed action provides for the construction of minimum facilities including vault toilets, barricades, and turnarounds. The discussion of the recreation sites which will be placed near inundated roads should be expanded in the final statement to include possible future development sites, expected recreation pressure, and a maintenance plan for the proposed facilities. A discussion of visitor use and subsequent adverse environmental impacts would strengthen the final report. It should be noted that trash and erosion resulting from heavy visitor use and improper maintenance could detract from the general appearance and degrade water quality at the limited recreation sites. A discussion of the impacts associated with the operation of a recreation site, concession, or boat launching facility should be included in sections 3 and 4 of the final statement.

3. In describing the sewerage disposal system (page 1-6), it is mentioned that sewage removed from vault toilets will be disposed of by contractors in a state-approved facility on project land or in a local state-approved municipal treatment plant. It is also stated that the effluent from the project office buildings will be pumped into a septic tank and oxidation

pond. The final statement should give information as to the locations of these state approved treatment plants. Information should be included identifying the location of the septic tank and oxidation pond in relation to any potable water supply and an approximation of wastes to be treated.

4. On page 1-9 of the draft statement, it is mentioned that agricultural, grazing, and mineral leases may be granted on project lands. The final statement should include a more complete discussion concerning the lands that will be considered for leasing, their locations, and the environmental effects that can be expected. Information should also identify the types of mineral leases that may be granted. Overgrazing, poor agriculture practices, and improper land use resulting from mineral leasing could result in an excessive amount of eroded material entering the lake resulting in degraded water quality and aquatic habitat.

Clarification of the following sentence concerning lease granting would be helpful, "These leases will be phased out when development and use of the project lands for the purposes zoned is accomplished." Project zoning is not discussed in the draft impact statement but should be made a part of the final statement. What are the ultimate uses of project lands? The final statement should be more specific concerning leases, land management, and zoning. It is difficult to determine the final disposition of project land and the ultimate environmental consequences of the proposed action from the information provided.

Section 2. Environmental Setting Without the Project

5. Water quality and bacteria data are discussed in subsection 2.06 of the draft statement. We are concerned with the bacterial analyses presented in table 2-5 (page 2-20) since the reservoir is planned to serve as a domestic water supply source for the towns of Hillsboro and West. In table 2-5, total bacterial numbers, total coliform, E. coli, and fecal streptococci are reported as numbers of organisms/ml. However state and Federal water quality standards for bacteria in domestic raw water supplies are reported as numbers of organisms/100 ml. This would mean that all sampling sites, if converted to number of organisms/100 ml, would exceed allowable criteria for a water supply to be utilized for domestic purposes. If in fact, the data appearing in table 2-5 represents the number of organisms/100 ml. this change should be made in the final statement. The statement should also note sampling frequency. Do these data represent one sample and one sampling date or several? The methods used in assembling the data in table 2-5 should be included in the final statement. This information would assist the reviewer in determining how bacteriological data were compiled and analyzed.

Texas water quality standards for potable water state that the monthly arithmetic averages should not exceed 10,000/100 ml. total coliforms or 2,000/100 ml fecal coliforms. We should point out that stations 1 and 2 exceed the recommended criteria for total coliforms in a potable water supply, while stations 2 and 5 are very close to the maximum fecal coliform standard. Other water uses, including contact recreation such as swimming or water skiing, could be hindered by high coliform bacteria levels in the reservoir. Based on the data in the statement, the possibility of high coliform bacteria levels could create a water quality problem in the proposed lake. We therefore suggest that additional information be included in the final statement to clarify the data appearing in table 2-5. This information is needed before an evaluation of the acceptability of the reservoir (bacterial quality) as a domestic water supply can be made.

Section 3. Environmental Impact of the Proposed Action

6. High turbidity levels are reported for all sampling sites in the project area and are for the most part attributable to erosion from the surrounding farm lands. On page 3-5, the draft statement briefly mentions a watershed protection and flood prevention plan prepared by the Soil Conservation Service for the Aquilla-Hackberry Creek areas. This plan includes such measures as grade stabilization structures, floodwater retarding structures, and stream channel improvement. The draft statement concludes that there will be a net decrease in turbidity levels following implementation of the SCS plan. In order to better understand the interrelationship of the future watershed plan to the proposed Lake Aquilla project, the final statement should include the percentage of land presently being treated and that will receive future treatment for erosion control. Severe erosion sites specified by the SCS plan should be discussed in the final statement.

Section 4. Adverse Environmental Effect

8. An adverse environmental effect which would occur with the implementation of the proposed action is the shift from a lotic to a lentic environment. This would include changes in aquatic flora and fauna, water quality and sedimentation rates. Other adverse effects would be related to the decrease in flows being released downstream from the dam to Aquilla Creek and the Brazos Estuary. These adverse impacts should also be discussed in finalizing the impact statement.

These comments classify your Draft Environmental Impact Statement as ER-2. Specifically, we have environmental reservations concerning water quality and the acceptability of the reservoir as a domestic water supply. Additional information is needed on many aspects of the project. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement and we will be pleased to meet with you to discuss our comments. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

Arthur W. Busch
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION

JAMES M. ROSE
DIRECTOR

June 20, 1974

Mr. Donald R. Henderson
Acting Chief, Engineering Division
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74102

Dear Mr. Henderson:

In a letter from the Governor's Division of Planning Coordination dated May 2, 1974, we submitted review comments on the Draft Environmental Statement (DES), pertaining to Aquilla Lake, Aquilla Creek, Texas. Since that date, we have received additional comments from other State agencies.

Other review participants have submitted the following recommendations and comments that warrant your consideration:

1. The Texas Department of Agriculture indicated that the estimated cost of the project did not include the loss in income from cropland; according to the DES, approximately 70 percent of the total land required is classified as cropland, and the impact of retiring this land from food or fiber production should be reflected in the cost-benefit analysis of the proposed project.

2. It was recommended by the Texas Water Development Board (TWDB) that reconsideration be given to creating a multi-purpose facility, in view of the rapidly increasing recreational demands. The TWDB also noted that by including recreational uses for the proposed lake, a more favorable cost-benefit ratio would be realized.

3. The Texas Historical Commission submitted extensive comments pertaining to the potential destruction of certain archeological resources within the project area, and recommended an alternative sequence of testing and mitigation measures to that stated in the DES.

P. O. BOX 12428, CAPITOL STATION, AUSTIN, TEXAS 78711
Phone 512/475 2427 Offices Located in Sam Houston State Office Building

These additional comments are enclosed in their entirety and are designed to aid your planning efforts. If we can be of further assistance, please let us know.

Sincerely,

James M. Rose

JAMES M. ROSE
Director

JMR/wsb
Enclosures
cc: The Honorable John C. White, Texas Department of Agriculture
Mr. Harry P. Burleigh, Texas Water Development Board
Mr. Truett Latimer, Texas Historical Commission

TEXAS WATER DEVELOPMENT BOARD

HARRY P. BURLEIGH
EXECUTIVE DIRECTOR

AREA CODE 512
475 3571

1700 NORTH CONGRESS AVENUE

P O BOX 13087
CAPITOL STATION
AUSTIN TEXAS 78711

April 24, 1974

IN REPLY REFER TO
TWDBP-O

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear General Rose:

Please refer to your memorandum dated March 21, 1974 transmitting for review and comment the Corps of Engineers' General Design Memorandum Number 3, Phase 1, Plan Formulation for Aquilla Lake, Aquilla Creek, Texas.

The development of Aquilla Creek as a source of water supply and for flood control has been under study for years. The Texas Water Plan includes a multi-purpose reservoir on Aquilla Creek, and a public hearing was conducted by the Corps of Engineers in 1945 for the purpose of discussing the development of Aquilla Creek for flood control and water supply purposes. Need for this facility is now imminent, and the need will probably become critical before it can be completed as a water supply for the Cities of Hillsboro, West, and possibly other small towns. Flood control is still a feature of the proposed development.

Design Memorandum No. 3, in addition to reaching the conclusion that a need exists for municipal and industrial water supplies, finds:

(a) a need for flood protection on Aquilla Creek as well as additional protection for the Brazos River system;

(b) that a need exists for more recreational opportunities in the Aquilla Creek Basin;

(c) that the best means for satisfying the Aquilla Creek Basin needs would be a multi-purpose reservoir on the main stem of Aquilla Creek;

(d) a high-level controlled outlet works should be used; and

(e) a dam located at either site C or D would yield in the order of 14.0 to 17.5 mgd (15,700 to 19,600 acre feet per year); would be compatible with the SCS Watershed Protection Plan; and that problems relating to the City of Hillsboro's waste treatment facilities could be controlled.

At the present time, local needs dictate that assurances can be made for use of only 5 mgd of water supply from the total potential yield of Aquilla Lake; thus, the project cost allocation is based on this criterion. The decision has been reached that this project, of smaller capacity than the authorized project, should be completed as quickly as possible, and that provisions will be made for increasing the conservation storage allocation at a later date. This can be accomplished by reallocation of flood control storage of the project without appreciably reducing the flood protection benefits.

There is one area in the Corps of Engineers' Design Memorandum No. 3 on which the following comments are offered:

We would like to see reconsideration given to providing recreational facilities in Aquilla Lake. This agency has completed a study on recreational benefits to be derived from a lake of the same size and location as the Aquilla Lake Project. It is our finding that a multi-purpose lake to include water supply, flood control, and in addition recreation, as a full project purpose would be much more favorable from the standpoint of cost-benefit ratios than will be the dual-purpose facility. Recreational demands on all Texas lakes have increased at unprecedented levels, and we believe that with its proximity to Waco, Temple, and the Fort Worth - Dallas complex, Aquilla Lake would have most favorable potentials as a recreation lake.

As stated above, this agency has strongly supported the Aquilla Creek Reservoir project in the past. On October 18, 1972 in a letter to Colonel Floyd Henk, District Engineer, Corps of Engineers, Fort Worth, we urged early implementation of planning and construction of this facility. This communication is part of the supporting information included in Design Memorandum No. 3. Again, on January 28, 1974 at a public hearing conducted by the Corps of Engineers on the environmental aspects of the project, our staff presented a statement favoring construction of Aquilla Creek Lake. We now reiterate opinions expressed on those and other occasions which favor early development of this important and needed reservoir project.

The opportunity to comment on this resource development is appreciated.

Sincerely,

Harry

Harry P. Burleigh

EDMUND L. NICHOLS
Assistant Commissioner

May 1, 1974

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428
Austin, Texas 78711

Dear General Rose:

We have reviewed the Draft Environmental Statement for the Aquilla Lake, Aquilla Creek, Texas, and have the following comment for your consideration.

It is noted that the project would require 11,800 acres of land in fee simple. Of this total land required, 70 percent is classified as cropland and 30 percent as pastureland, woodland and homesites. No estimate is made in the cost of the project of the loss in income from this land for the production of food and fiber. It is also noted that the cost:benefit ratio is only 1.5 to 1, a very narrow margin when the total cost of the project is considered.

Several alternatives have been considered in developing the recommended plan. If the value of agricultural land is considered based upon present and future needs for food and fiber one of these alternatives might well have been given higher priority in deciding the final recommended plan.

Thank you for the opportunity to review this statement. We regret that situations beyond our control have caused a delay in our responding to the memo regarding this statement.

Sincerely,

Ed Nichols

Edmund L. Nichols

ELN/yv

Texas Historical Commission
Box 12276, Capitol Station
Austin, Texas 78711
Truett Latimer
Executive Director

May 14, 1974

Mr. Wayne H. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P.O. Box 12428, Capitol Station
Austin, Texas 78711

RE: Draft Environmental Statement: Aquilla Lake, Aquilla Creek, Texas.

Dear Mr. Brown:

In response to your request for review and comment on the above-referenced project, we have examined the documents and our records and offer the following comments:

1) The DES notes that, during the archeological survey performed within the subject area, 125 archeological localities were recorded. The technical report of this survey notes, "Archaeological sites along Aquilla Creek are of a small and therefore of a fragile nature and will be easily destroyed if channelization, land clearing and flooding occur. The sites located in the Upland and Upland slope will be the first to be adversely affected by water impoundment due to wave action and the indirect action of lake utilization. Sites will be affected in all of the proposed dam sites, and therefore it is not possible to suggest that one is more favorable in terms of archeological site destruction" (Skinner 1972:58). In the DES, 3.10 Impact of Archeological Sites notes that "sites located in the fluctuation of the shoreline will be those receiving the most adverse affect," whereas the archeological survey report notes that sites will be destroyed during land clearing measures and other related activities. In addition, similar and further destruction will occur at archeological sites that lie within areas delegated for borrow. The destruction of archeological sites will occur, therefore, well in advance of controlled inundation, and proper mitigation measures should be performed to deal with the irreversible commitment of these resources.

2) The DES, 3.10 Impact of Archeological Sites notes that "Long-term inundation in an area not subject to mechanical action of waves or currents has been observed to have a positive rather than negative effect on preservation of archeological sites." While this assumption is not totally unfounded, it is not presently considered to be a legitimate mitigation measure by professional archeologists (including the archeologist who performed the survey) or by the President's Advisory Council on Historic Preservation. Other federal agencies have recognized the extent to which controlled inundation alters cultural resources and do

not offer controlled inundation as a preservation measure. In addition, the Corps of Engineers have failed to offer substantive data concerning the presence or absence of waves or currents within the proposed impoundment.

3) The DES, 3.10 Impact of Archeological Sites notes that "The sequence of salvage operations could be, first, those sites in the fluctuation zone, second, sites above the conservation pool, and lastly, those subject to inundation." As noted in the comments above, this sequence is unacceptable. A more rational sequence of testing, and if necessary, subsequent salvage is recommended. This sequence should include consideration of: 1) Sites destroyed as a result of clearing operations, 2) Sites destroyed as a result of their entrapment within materials selected for suitability as construction fill for the dam, 3) Sites destroyed as a result of controlled inundation as well as those subsequently destroyed by wave action within the fluctuation zone, and 4) Sites destroyed as a result of the construction of facilities necessary to operate and utilize the proposed impoundment. The sequence should include salvage of a representative portion of all significant cultural resources below 553.0 msl. Sites which lie in areas under the control or jurisdiction of the Corps but which will not sustain direct impacts as a result of the proposed impoundment should be located and protected. Protection might best be accomplished through avoidance.

Thank you for the opportunity to review and comment on this project in our joint effort to provide the future with a past. If we may be of further service, please advise.

Sincerely,

Truett Latimer
Executive Director

By

Alton K. Briggs
Archeologist

AKB:pc

APPENDIX B

BIOLOGICAL INVENTORIES

APPENDIX B

TABLE B-1

Inventory of vascular plant species of the Aquilla Creek Watershed (summer aspect only).

Scientific Name	Common Name
Acer negundo L.	Boxelder
Ambrosia artemisifolia L.	Common Ragweed
Ambrosia trifida L.	Giant Ragweed
Amorpha fruticosa L.	Bastard Indigo
Argemone polyanthemos (Fedde) G. Ownbey	Prickly Poppy
Aristida wrightii Nash	Wright's Three-awn
Asclepias viridiflora Raf.	Green-flowered Milkweed
Aster subulatus Michx. var. ligulatus Shinners	Annual Aster
Aster texanus Burgess	Texas Aster
Avena sativa L.	Oats
Andropogon saccharoides (Sw.) Rydb. var. longipaniculata (Gould) Gould	Silver Bluestem
Andropogon saccharoides (Sw.) Rydb. var. torreyana (Steud.) Gould	Silver Bluestem
Bromus japonicus L.	Japanese Chess
Bromus racemosus L.	Field Chess
Buchloe dactyloides (Nutt.) Engelm.	Buffalo Grass
Bumelia lanuginosa (Michx.) Pers. var. oblongifolia (Nutt.) Clark	Chittamwood
Carya illinoensis (Wang.) K. Koch	Pecan
Cassia fasciculata Michx. var. fasciculata	Partridge-pea
Castilleja indivisa Engelm.	Texas Paintbrush
Celtis laevigata Willd. var. laevigata	Texas Sugarberry (Hackberry)
Chaerophyllum tainturieri Hook. var. tainturieri	Chervil
Unijola latifoliam (Michx.) Yates	Inland Sea Oats
Cirsium terrae-nigrae Shinners	Blackland Thistle

Cirsium texanum Buckl.	Texas Thistle
Cissus incisa (Nutt.) Des Moul.	Cow-itch
Cocculus carolinus (L.) DC.	Snailseed (Coralbead)
Commelina erecta L. var. angustifolia (Michx.) Fern.	Narrow-leaf Day-flower
Commelina erecta L. var. erecta	Erect Day-flower
Convolvulus equitans Benth.	Bindweed
Erigeron Canadensis (L.) Cronq. var. glabrata (Engelm. & Gray) Cronq.	Horse-weed
Cornus drummondi C.A. Mey.	Rough-leaf Dogwood
Crataegus mollis Scheele	Downy Hawthorn (Red Haw)
Crataegus viridis L. (incl. C. glabriuscula)	Green Hawthorn
Cuscuta cuspidata Engelm.	Dodder
Cynodon dactylon (L.) Pers.	Bermuda Grass
Daucus pusillus Michx.	Rattlesnake-weed
Desmanthus illinoensis (Michx.) MacM.	Shame-weed
Dicliptera brachiata (Pursh.) Spreng.	--
Rudbeckia amplexicaulis (Vahl) Cass.	Yellow Cone-flower
Elymus canadensis L.	Canada Wild-rye
Elymus virginicus L.	Virginia Wild-rye
Erigeron annuus (L.) Pers.	Daisy Fleabane
Eryngium leavenworthii T. & G.	Purple Eryngo
Euphorbia dentata Michx.	Toothed Poinsettia
Forestiera pubescens Nutt.	Elbow-bush (Spring Herald)
Fraxinus pennsylvanica Marsh.	Green Ash
Gaillardia pulchella Foug.	Indian Blanket (Fire-wheel)
Gaura brachycarpa Small	--
Geranium carolinianum L.	Carolina Cranesbill
Geum canadense Jacq.	White Avens
Gleditsia triacanthos L.	Honey Locust
Grindelia squarrosa (Pursh) Dun.	Gumweed (Tarweed)
Helenium amarum (Raf.) Rock	Bitterweed
Helenium microcephalum DC.	Sneezeweed
Helianthus annuus L.	Common Sunflower
Hordeum pusillum Nutt.	Little Barley
Hymenopappus scabiosaeus L'Her. var. corymbosus (T. & G.) B. L. Turner	Old Plainsman

Ilex decidua Walt.	Deciduous Holly (Possum Haw)
Ipomoea trichocarpa Ell. var. torreyana (Gray) Shinners	Purple Morning-glory
Ipomoea trichocarpa Ell. var. trichocarpa	Purple Morning-glory
Gilia rubra (L.) Wherry	Standing Cypress (Texas Plume)
Juncus torreyi Cov.	Torrey's Rush
Juniperus virginiana L.	Virginia Juniper (Red Cedar)
Kallstroemia parviflora Nort.	--
Lactuca canadensis Jacq.	Wild Lettuce
Lactuca serriola L.	Prickly Lettuce
Lepidium austrinum Small	Southern Peppergrass
Lepidium virginicum L. var. medium (Greene) C.L. Hitchc.	Virginia Peppergrass
Lindheimera texana Gray & Engelm.	Texas Yellow Star Daisy
Lolium perenne L.	Ryegrass
Lupinus texensis Hook.	Texas Bluebonnet
Maclura pomifera (Raf.) Schneid	Bois D'Arc (Horse-apple)
Matelea gonocarpa (Walt.) Shinners	Milk-vine
Medicago lupulina L.	Black Medick
Melia azedarach L.	Chinaberry
Melilotus albas Lam.	White Sweet Clover
Melothria pendula L.	Melonette
Monarda citriodora Cerv.	Lemon Horsemint (Beebalm)
Morus rubra L.	Red Mulberry
Neptunia lutea (Leavenw.) Benth.	Yellow-puff
Oenothera speciosa Nutt.	Showy Primrose
Opuntia leptocaulis DC.	Desert Christmas Cactus
Oxalis dillenii Jacq.	Yellow Wood-sorrel (Sheep Sours)
Panicum fasciculatum Swartz var. reticulatum (Torr.) Beal	Browntop Panic Grass
Panicum obtusum H.B.K.	Vine-mesquite
Parietaria pennsylvanica Muhl.	Hammerwort (Pellitory)
Passiflora incarnata L.	Passion-flower (Maypop)
Phoradendron tomentosum (DC.) Gray subsp. tomentosum	Mistletoe
Lippia incisa Small	Texas Frog-fruit
Plantago aristata Michx.	Buckthorn Plantain
Plantago rhodosperma Dcne.	Red-seeded Plantain

Polytaenia nuttallii DC.	Prairie Parsley
Polytaenia texana (Coult. & Rose) Math. & Const.	Texas Prairie Parsley
Populus deltoides L.	Cottonwood
Prosopis glandulosa Torr. var. glandulosa	Mesquite
Prunus mexicana Wats.	Big-tree Plum
Prunus persica (L.) Batsch.	Peach
Prunus rivularis Scheele	Hog Plum (Creek Plum)
Pyrrhopappus carolinianus (Walt.) DC.	False Dandelion
Pyrrhopappus multicaulis DC. (incl. P. geiseri)	False Dandelion
Quercus shumardii Buckl.	Shumard's Red Oak
Quercus stellata Wang.	Post Oak
Quercus virginiana Mill.	Live Oak
Rapistrum rugosum (L.) Allioni	--
Rhus glabra L.	Smooth Sumac
Rhus toxicodendron L. var. vulgaris Michx.	Poison Ivy
Rivina humilis L.	Pigeonberry
Rubus trivialis Michx.	Dewberry
Rudbeckia hirta L. var. pulcherrima Farw.	Black-eyed Susan
Ruellia nudiflora (Gray) Urban	Wild Petunia
Rumex crispus L.	Curly Dock
Salix nigra Marsh. var. nigra	Black Willow
Sambucus canadensis L.	Elderberry
Sapindus drummondi (H. & A.) L. Benson	Soapberry
Sesbania vesicaria (Jacq.) Ell.	Bag-pod
Setaria viridis (L.) Beauv.	Bristlegrass (Foxtail)
Sisyrinchium pruinosum Bickn.	Blue-eyed Grass
Smilax bona-nox L.	Stretch-berry (Cat-brier)
Smilax hispida Muhl.	China-root (Bristly Brier)
Solanum dimidiatum Raf.	Western Horse-nettle
Solanum elaeagnifolium Cav.	Silver-leaf Nightshade
Solanum rostratum Dun.	Buffalo-bur Nettle
Solidago altissima L.	Goldenrod
Solidago gigantea Ait.	Giant Goldenrod
Sonchus asper (L.) Hill	Sow Thistle
Sophora affinis T. & G.	Eve's Necklace

Sorghum halapense (L.) Pers.	Johnson Grass
Stipa leucotricha Trin. & Rupr.	Texas Speargrass
Symphoricarpos orbiculatus Moench.	Coral-berry (Buck-bush)
Torilis arvensis (Huds.) Link	Hedge-parsley
Triodanis perfoliata (L.) Nieuw.	Venus' Looking-glass
Ulmus crassifolia Nutt.	Cedar Elm
Ulmus rubra Muhl.	Slippery Elm (Red Elm)
Verbena bipinnatifida Nutt.	Prairie Verbena
Verbena halei Small	Texas Vervain
Vernonia baldwinii Torr.	Western Ironweed
Viburnum rufidulum Raf.	Black Haw
Vicia dasycarpa Ten.	Winter (Wooly-pod) Vetch
Vitex agnus-castus L.	Chaste-tree
Vitis mustangensis Buckl.	Mustang Grape
Vitis vulpina L.	Fox Grape
Xanthisma texanum DC. var. drummondii (T. & G.) Gray	Sleepy Daisy
Xanthium strumarium L.	Spiny Cocklebur
Xanthocephalum texanum (DC.) Shinners	Texas Broomweed
Zanthoxylem clava-herculis L.	Prickly Ash (Tickle-tongue)

APPENDIX B

TABLE B-2
FISHES OF THE AQUILLA CREEK BASIN

Scientific Name	Common Name
Lepisosteidae	
Lepisosteus oculatus	Spotted gar
Lepisosteus osseus	Longnose gar
Clupeidae	
Dorosoma cepedianum	Gizzard shad
Cyprinidae	
Cyprinus carpio	Carp
Carassius auratus	Goldfish
Notemigonus crysoleucas	Golden shiner
Notropis emiliae	Pugnose minnow
Hybopsis aestivalis	Speckled chub
Phenocobius mirabilis	Suckermouth minnow
Notropis atherinoides	Emerald Shiner
Notropis oxyrhynchus	Sharpnose shiner
Notropis shumardi	Silverband shiner
Notropis potteri	Chub shiner
Notropis buccula	Smalleye shiner
Notropis venustus	Spottail shiner
Notropis lutrensis	Red shiner
Notropis volucellus	Mimic shiner
Notropis buchanani	Ghost shiner
Hybognathus nuchalis	Silvery minnow
Hybognathus placitus	Plains minnow
Pimephales vigilax	Bullhead minnow
Pimephales promelas	Fathead minnow
Campostoma anomalum	Stoneroller
Catastomidae	
Cycleptus elongatus	Blue sucker
Ictiobus bubalus	Smallmouth buffalo
Carpiodes carpio	River carpsucker
Moxostoma congestum	Gray redhourse
Ameiuridae	
Ictalurus punctatus	Channel catfish
Ictalurus furcatus	Blue catfish
Ictalurus melas	Black bullhead
Ictalurus natalis	Yellow bullhead

Pylodictis olivaris	Flathead catfish
Noturus gyrinus	Tadpole madtom

Anguillidae

Anguilla rostrata	American eel

Cyprinodontidae

Fundulus kansae	Plains killifish
Fundulus notatus	Blackstripe topminnow

Poeciliidae

Gambusia affinis	Mosquitofish

Percichthyidae

Morone chrysops	White bass

Centrarchidae

Micropterus punctulatus	Spotted bass
Micropterus salmoides	Largemouth bass
Chaenobryttus gulosus	Warmouth
Lepomis punctatus	Spotted sunfish
Lepomis microlophus	Redear sunfish
Lepomis macrochirus	Bluegill
Lepomis humilis	Orangespotted sunfish
Lepomis megalotis	Longear sunfish
Lepomis marginatus	Dollar sunfish
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie

Percidae

Percina sciera	Dusky darter
Percina shumardi	River darter
Percina caprodes	Logperch
Percina macrolepala	Longhead logperch
Etheostoma spectabile	Orangethroat darter

Sciaenidae

Aplodinotus grunniens	Freshwater drum

APPENDIX B

TABLE B-3

REPTILES AND AMPHIBIANS OF THE AQUILLA CREEK BASIN

Amphibia

Species	Common Name	Preferred Habitat[a]	Effect on Population[b]
Order Caudata			
Sirenidae			
Siren intermedia	Lesser Siren	FW	-
Ambystomatidae			
Ambystoma texanum	Small-mouthed Salamander	Wd	-
Ambystoma tigrinum	Tiger Salamander	Wd	-
Salamandridae			
Diemictylus viridescens	Common Newt	Wd	-
Order Aniina			
Pelobatidae			
Scaphiopus couchi	Couch's Spadefoot	V	0
Scaphiopus holbrooki	Eastern Spadefoot	V	0
Hylidae			
Acris crepitans	Cricket Frog	Sh	+
Hyla cinerea	Green Tree Frog	Wd	-
Hyla versicolor	Gray Tree Frog	Wd	-
Pseudacris clarki	Spotted Chorus Frog	Wd	-
Pseudacris streckeri	Strecker Chorus Frog	Wd	-
Pseudacris triseriata	Western Chorus Frog	Wd	-

Bufonidae			
Bufo debilis	Green Toad	V	0
Bufo punctatus	Red-spotted Toad	V	0
Bufo compactilis	Texas Toad	V	0
Bufo valliceps	Gulf Coast Toad	V	0
Bufo woodhousei	Woodhouse Toad	V	0
Ranidae			
Rana catesbeiana	Bullfrog	Sh	+
Rana pipiens	Grass Frog	V	0
Microhylidae			
Gastrophryne carolinensis	Eastern Narrow-mouthed Toad	V	0
Gastrophryne olivacea	Great Plains Narrow-mouthed Toad	V	0

Reptilia

Order Testudinata

Chelydridae			
Chelydra serpentina	Snapping Turtle	Sh	+
Kinosternidae			
Kinosternon flavescens	Yellow Mud Turtle	Sh	+
Stenothaerus odoratus	Stinkpot	Sh	+
Emydidae			
Chrysemys concinna	River Cooter	FW	-
Chrysemys scripta:	Pond Slider	Sh	+
Deirochelys reticulata	Chicken Turtle	Sh	+
Graptemys pseudogeographica	False Map Turtle	Sh	+
Terrapene carolina	Eastern Box Turtle	V	0
Terrapene ornata	Ornate Box Turtle	V	0

Trionychidae			
Trionyx muticus	Smooth Softshell	FW	-
Trionyx spinifer	Spiny Softshell	FW	-
Order Squamata			
Iguanidae			
Anolis carolinensis	Green Anole	Wd	-
Holbrookia texanas	Greater Earless Lizard	V	0
Crotaphytus collaris	Collared Lizard	V	0
Holbrookia maculata	Lesser Earless Lizard	V	0
Phrynosoma cornutum	Texas Horned Lizard	V	0
Sceloporus olivaceous	Texas Spiny Lizard	V	0
Scelopous undulatus	Fence Lizard	V	0
Scincidae			
Eumeces fasciatus	Five-lined Skink	Wd	-
Eumeces latriceps	Broad-headed Skink	Wd	-
Eumeces obsoletus	Great Plains Skink	V	0
Eumeces septentrionalis	Prairie Skink	Wd	-
Lygosoma laterale	Ground Skink	Wd	-
Teiidae			
Cnemidophorus gularis	Texas Spotted Whiptail	V	0
Cnemidophorus sexlineatus	Six-lined Racerunner	V	0
Anguidae			
Ophisaurus attenuatus	Slender Glass Lizard	V	0

Colubridae

Coluber constrictor	Racer		
Diadophis punctatus	Ringneck Snake	Wd	-
Elaphe guttata	Corn Snake	V	0
Elaphe obsoleta	Common Rat Snake	V	0
Heterodon platyrhinos	Eastern Hognose Snake	V	0
Hypsiglena torquata	Night Snake	V	0
Lampropeltis calligaster	Prairie Kingsnake	V	0
Lampropeltis getulus	Common Kingsnake	V	0
Masticophis flagellum	Coachwhip	Wd	-
Natrix erythrogaster	Plain-bellied Water Snake	Sh	+
Natrix fasciata	Broad-banded Water Snake	Sh	+
Natrix grahami	Graham Water Snake	Sh	+
Natrix rhombifera	Diamond-backed Water Snake	Sh	+
Opheodrys aestivus	Rough Green Snake	Wd	-
Pithuophis melanoleucus	Bullsnake	V	0
Sonora episcopa	Great Plains Ground Snake	V	0
Storeria dekayi	Brown Snake	Wd	-
Tantilla gracialis	Flat-headed Snake	Wd	-
Thamnophis marcianus	Checkered Garter Snake	Sh	+
Thamnophis proximus	Western Ribbon Snake	V	0
Thamnophis sirtalis	Common Garter Snake	Sh	+
Tropidoclonion lineatum	Lined Snake	V	0
Virginia striatula	Rough Earth Snake	V	0

Elapidae			
Micrurus fulvius	Coral Snake	Wd	-
Viperidae			
Agkistrodon contortrix	Copperhead	Wd	-
Agkistrodon piscivorus	Cottonmouth	Sh	+
Sistrurus catenatus	Massasauga	Sh	+
Crotalus atrox	Western Diamondback Rattlesnake	V	0
Crotalus horridus	Timber Rattlesnake	Wd	-

a: Preferred Habitat
- Wd - bottomland forest floor
- FW - flowing water
- Sh - shore and shallow water
- V - variety of habitats or upland

b: Effect of impoundment on population
- \+ population increase
- \- population decrease
- 0 no change predicted

APPENDIX B

TABLE B-4
BIRDS OF THE AQUILLA CREEK BASIN

Species*	Relative Abundance[a] Sp.	Su.	F.	W.	Preferred Habitat[b]	Predicted Population Change[c]
Gaviidae						
<u>Gavia immer</u>: Common Loon	R		R	R	W	+
<u>Gavia stellata</u>: Red-throated Loon	R		R	R	W	+
Podicipedidae						
<u>Podiceps auritus</u>: Horned Grebe	R		R	R	W	+
<u>Podiceps caspicus</u>: Eared Grebe	U		U	U	W	+
<u>Podilymbus podiceps</u>: Pied-billed Grebe*	C	U	C	C	W,M	+
Pelecanidae						
<u>Pelecanus erythrorhynchos</u>: White Pelican	C		C		W	+
Phalacrocoracidae						
<u>Phalacrocorax auritus</u>: Doublecrested Cormorant	U	R	U	R	W,M	+
<u>Phalacrocorax olivaceus</u>: Mexican Cormorant	U	R	U	R	W,M	+
Anhingidae						
<u>Anhinga anhinga</u>*: Anhinga	U	U	U		W,M	+
Ardeidae						

Hydranassa tricolor: Louisiana Heron			U		Sh,M	+
Florida caerulea: Little Blue Heron*	C	C	U		Sh,M	+
Bubulcus ibis: Cattle Egret^	C	C	C	R	O,M	+
Nycticorax nycticorax: Black-crowned Night Heron*	U	U	U	R	Sh,M	+
Nyctanassa violacea: Yellow-crowned Night Heron*	U	U	U		Sh,M	+
Botaurus lentiginosus: American Bittern	U		U	R	M	O
Ciconiidae						
Mycteria americana: Wood Ibis		U	U		Sh,M	+
Threskiornithidae						
Eudocimus albus: White Ibis		R	R		Sh,M	+
Ajaia ajaja: Roseate Spoonbill		R	R		Sh,M	+
Anatidae						
Olor columbianus: Whistling Swan				R	W	O
Branta canadensis: Canada Goose	C		C		W,O	+

Ardea herodias: Great Blue Heron*	C	C	C	U	Sh,M	+
Casmerodius albus: Great Egret*	A	A	A	U	Sh,M	+
Leucophoyx thula: Snowy Egret*	U	U	U		Sh,M	+
Anser albifrons: White-fronted Goose	R		R		W,O	+
Chen hyper-borea: Snow Goose	C		C	U	W,O	+
Anas platyrhyn-chos: Common Mallard*	C	R	C	C	W,M	+
Anas rubripes: Black Duck				R	W	+
Anas strepera: Gadwell	A		A	C	W,M	+
Mareca americana: American wideon	A		A	C	W,M	+
Anas acuta: Pintail	A		A	C	W,M	+
Anas carol-inensis: Green-winged Teal	A		A	C	W,M	+
Anas discors: Blue-winged Teal*	A	R	A		W,M	+
Spatula clypeata: Shoveler	C		C	U	W,M	+
Aix sponsa: Wood Duck*	C	U	C	C	W,M	+
Aythya americana Redhead	U		U	U	W	+
Aythya collaris: Ring-necked Duck	A		A	C	W	+

Aythya valisineria: Canvasback	U		U	U	W	+
Aythya marila: Greater Scaup	R		R		W	0
Aythya affinis: Lesser Scaup	A		A	C	W	+
Bucephala clangula: Common Goldeneye	R		R	R	W	+
Bucephala albeola: Bufflehead	U		U	R	W	+
Clangula hyemalis: Oldsquaw				R	W	+
Oxyura jamaicensis: Ruddy Duck	C		C	U	W	+
Lophodytes cucullatus: Hooded Merganser	U		U	U	W	+
Mergus merganser: Common Merganser	R		R		W	+
Mergus serrator: Red-breasted Merganser	R		R		W	+

Catharlidae

Cathartes aura: Turkey Vulture*	A	A	A	A	O,Wd	0
Coragyps atratus: Black Vulture*	C	C	C	C	O,Wd	0

Accipitridae

Ictinia Misisippiensis: Mississippi Kite	U		U		O	0
Accipiter striatus: Sharp-shinned Hawk	U		U	R	Wd,F	-
Accipiter cooperii: Cooper Hawk	U	R	U	R	Wd,F	-
Buteo jamaicensis: Red-tailed Hawk*	U	U	U	C	O,Wd	0
Buteo lineatus: Red-shouldered Hawk*	C	C	C	C	Wd, F	-
Buteo platypterus: Broad-winged Hawk*	C	U	C		O,Wd	0
Buteo swainsoni: Swainson Hawk			R		O	0
Buteo lagopus: Rough-legged Hawk				R	O	0
Buteo regalis: Ferruginous Hawk				R	O	0
Parabuteo unicinctus: Harris Hawk		R	U		O	0
Aquila chrysaetos: Golden Eagle	R		R	R	O	0
Haliaeetus leucocephalus: Southern Bald Eagle	R		R	R	Sh,W	+
Circus cyaneus: Marsh Hawk	U		U	U	O,M	0

Pandionidae						
Pandion haliaetus: Osprey	R		R		Sh,W	+
Falconidae						
Polyborus cheriway: Audubon Caracara	R	R	R	R	O	0
Falco mexicanus: Prairie Falcon	R	R	R	R	O	0
Falco peregrinus: American Peregrine Falcon	R		R		Sh,O	0
Falco columbarius: Merlin	R		R		Sh,O	0
Falco sparverius American Kestrel*	C	U	C	C	O	0
Phasianidae						
Colinus virginianus: Bobwhite*	C	C	C	C	Th,Wd	-
Gruidae						
Grus canadensis: Sandhill Crane	R		R		O	0
Rallidae						
Rallus elegans: King Rail	R	R	R	R	M	0
Rallus limicola: Virginia Rail	R		R		M	0
Porzana carolina: Sora	U		U	R	M	0

Coturnicops noveboracensis: Yellow Rail				R	M,O	0
Laterallus jamaicensis: Black Rail	R		R		M,O	0
Porphyrula martinica: Purple Gallinule*		R			M	-
Gallinula chloropus: Common Gallinule*		R			M	0
Fulica americana: American Coot	A	U	A	C	M,W	+
Charadriidae						
Charadrius semipalmatus: Semipalmated Plover	U		U		Sh	+
Charadrius vociferus: Killdeer*	C	C	C	A	O,Sh	+
Pluvialis dominica: American Golden Plover	U		R		O	0
Squatarola squatarola: Black-bellied Plover	U		U		Sh	+
Arenaria interpres: Ruddy Turnstone	R		R		Sh	0
Scolopacidae						
Philohela minor: American Woodcock			U	U	F,M	-
Capella gallinago: Common Wilson Snipe	C		C	U	Sh,M	0

Bartramia longicauda: Upland Plover	U	U		O	O
Actitis macularia: Spotted Sandpiper	C	C	U	Sh,M	+
Tringa solitaria: Solitary Sandpiper	U	U		Sh,M	O
Catoptrophorus semipalmatus: Willet	R	R		Sh	+
Totanus melanoleucus: Greater Yellowlegs	C	C		Sh	+
Totanus flavipes: Lesser Yellowlegs	C	C		Sh	+
Erolia melanotos: Pectoral Sandpiper	C	C		O,Sh	+
Erolia fuscicollis: White-rumped Sandpiper	R	R		Sh	+
Erolia bairdii: Baird Sandpiper	R	R		Sh	+
Erolia minutilla: Least Sandpiper	C	C	R	Sh	+
Limnodromus griseus: Short-billed Dowitcher	R	R		Sh	+
Limnodromus scolopaceus: Long-billed Dowitcher	U	U		Sh	+

Micropalama himantopus: Stilt Sandpiper	U	U		Sh	+
Ereunetes pusillus: Semipalmated Sandpiper	C	C		Sh	+
Ereunetes mauri: Western Sandpiper	U	U		Sh	+
Tryngites subruficollis: Buff-breasted Sandpiper	R	R		O	O
Limosa fedoa: Marbled Godwit	R			Sh	+
Limosa haemastica: Hudsonian Godwit	R	R		M,Sh	+
Crocethia alba: Sanderling	R	R		Sh	+
Recurvirostridaae					
Recurvirostra americana: Avocet	R	R		Sh	+
Phalaropodidae					
Steganopus tricolor: Wilson Phalarope	U	R		Sh	+
Laridae					
Larus argentatus: Herring Gull	U	U	R	W	+
Larus delawarensis: Ring-billed Gull	C	C	U	W	+

Larus atricilla: Laughing Gull	R		R	R	W	+
Larus pipixcan: Franklin Gull	C		A		W	+
Larus philadelphia: Bonaparte Gull	U		U	R	W	+
Sterna forsteri: Forster Tern	U		C		W	+
Sterna hirundo: Common Tern	R		R		W	+
Sterna albifrons: Least Tern		R			W	+
Chlidonias niger: Black Tern	U		U		W	+
Columbidae						
Zenaidura macroura: Mourning Dove*	A	A	A	A	O,Th	0
Cuculidae						
Coccyzus americanus: Yellow-billed Cuckoo*	C	C	U		Wd,F	-
Coccyzus erythropthalmus: Black-billed Cuckoo	R	R	R		Wd,F	-
Geococcyx californianus: Roadrunner*	U	U	U	U	Wd,Th	-

Strigidae						
Tyto alba: Barn Owl*	R	R	R	R	Wd,O	0
Otus asio: Screech Owl*	C	C	C	C	Wd,F	-
Bubo virginianus: Great Horned Owl*	U	U	U	U	Wd,F	-
Speotyto cunicularia: Burrowing Owl				R	O	0
Strix varia: Barred Owl*	C	C	C	C	Wd,F	-
Asio flammeus: Short-eared Owl				R	O,M	0
Caprimulgidae						
Caprimulgus carolinensis: Chuck-wills-widow*	U	C	U		F,Wd	-
Caprimulgus vociferus: Whip-poor-will	R		R		F,Wd	-
Chordeiles minor: Common Nighthawk*	U	U			O	0
Apodidae						
Chaetura pelagica: Chimney Swift*	A	A	C		O	0
Trochilidae						
Archilochus colubris: Ruby-throated Hummingbird*	C	U	U		Wd,T	0

Archilochus alexandri: Black-chinned Hummingbird*	U	U	U		Sh,T	O
Alcedinidae						
Megaceryle alcyon: Eastern Belted Kingfisher*	C	C	C	C	Sh,W	O
Picidae						
Colaptes auratus: Yellow-shafted Flicker*	C	U	C	C	Wd,T	-
Colaptes cafer: Red-shafted Flicker				U	F,Wd	-
Dryocopus pileatus: Pileated Woodpecker*	U	U	U	U	F,Wd	-
Centurus carolinus: Red-bellied Woodpecker*	C	C	C	C	F,Wd	-
Centurus aurifrons: Golden-fronted Woodpecker*	U	U	U	U	F,Wd	-
Melanerpes erythrocephalus: Red-headed Woodpecker*	C	C	C	C	Wd,T	O
Sphyrapicus varius: Yellow-bellied Sapsucker	C		C	C	F,Wd	-
Dendrocopos villosus: Hairy Woodpecker*	U	U	U	U	F,Wd	-

Dendrocopos pubescens: Downy Woodpecker*	C	C	C	C	F,Wd	-
Tyrannidae						
Tyrannus tyrranus: Eastern Kingbird*	C	C	U		O,T	0
Tyrannus verticalis: Western Kingbird*	U	U	C		O	0
Muscivora forficata: Scissor-tailed Flycatcher*	C	C	A		O	0
Myiarchus crinitus: Great Crested Flycatcher*	C	U	U		F,Wd	-
Myiarchus cinerascens: Ash-throated Flycatcher		R			O,Sh	0
Sayornis phoebe: Eastern Phoebe*	C	R	C	C	Wd,Sh	0
Sayornis saya: Say Phoebe	R		R		Wd,F	-
Empidonax flaviventris: Yellow-bellied Flycatcher	R		R		Wd,F	-
Empidonax minimus: Least Flycatcher	R		R		Th	-
Contopus virens: Eastern Wood Pewee*	C	C	C		Wd,F	-
Nuttallornis borealis: Olive-sided Flycatcher	R		R		Wd,F	-

Alaudidae						
Eremophila alpestris: Horned Lark	R		R	R	O	O
Hirundinidae						
Iridoprocne bicolor: Tree Swallow	R		R		W,Wd	-
Riparia riparia: Bank Swallow	U	R	U		O,W	O
Stelgidopteryx ruficollis: Rough-winged Swallow*	C	U	C		O,W	O
Hirundo rustica: Barn Swallow*	A	U	A		O,W	O
Petrochelidon pyrrhonota: Cliff Swallow	R	R	R		O,W	O
Progne subis: Purple Martin*	A	A	C		O,W	O
Corvidae						
Cyanocitta cristata: Blue Jay*	C	C	C	C	F,Wd,T	-
Corvus brachyrhynchos: Crow*	A	A	A	A	F,Wd,O	-
Paridae						
Parus carolinensis: Carolina Chickadee*	C	C	C	C	F,Wd	-
Parus bicolor: Tufted Titmouse*	C	C	C	C	F,Wd	-

Sittidae						
Sitta carolinensis: White-breasted Nuthatch*	U	U	U	U	F,Wd	-
Sitta canadensis: Red-breasted Nuthatch				R	Wd	0
Certhiidae						
Certhia familiaris: Brown Creeper	U		U	U	F,Wd	-
Troglodytidae						
Troglodytes aedon: House Wren	U		C	R	Th	0
Troglodytes troglodytes: Winter Wren	R		R	R	F,Th	-
Thryomanes bewicki: Bewick Wren	U	R	U	U	Th,Wd	-
Thryothorus ludovicianus: Carolina Wren*	C	C	C	C	F,Th	-
Telmatodytes palustris: Long-billed Marsh Wren	U		R		M	0
Mimidae						
Mimus polyglottos: Mockingbird*	C	C	C	C	Th,T	0
Dumetella carolinensis: Catbird*	U	R	R		Th,T	0
Toxostoma rufum: Brown Thrasher*	C	U	C	C	Th,T	0

Turdidae

Turdus migratorius: Robin*	C	U	C	A	T,O	0
Hylocichla mustelina: Wood Thrush*	U	U	R		F,Wd	-
Hylocichla guttata: Hermit Thrush	C		U	U	F,Wd	-
Hylocichla ustulata: Swainson Thrush	U		R		F,Wd	-
Hylocichla minima: Gray-cheeked Thrush	U		R		F,Wd	-
Sialia sialis: Eastern Bluebird*	C	C	C	A	T,O	0

Sylviidae

Polioptila caerulea: Blue-gray Gnatcatcher*	C	C	C		F,Wd	-
Regulus satrapa: Golden-crowned Kinglet	C		C	C	F,Wd	-
Regulus calendula: Ruby-crowned Kinglet	C		C	C	F,Wd	-

Motacillidae

Anthus spinoletta: Water Pipit	U		C	U	O,Sh	0
Anthus spraguei: Sprague Pipit	R		R	R	O	0

Bombycillidae						
Bombycilla cedrorum: Cedar Waxwing	A		C	A	T,F	0
Laniidae						
Lanius ludovicianus: Loggerhead Shrike*	C	U	C	C	O	0
Sturnidae						
Sturnus vulgaris: Starling*	A	A	A	A	T,O	0
Vireonidae						
Vireo griseus: White-eyed Vireo*	C	C	U		Th	0
Vireo bellii: Bell Vireo	R	R			Th	0
Vireo solitarius: Solitary Vireo	U		U		F,Wd	-
Vireo flavifrons: Yellow-throated Vireo	R		R		F,Wd	-
Vireo olivaceus: Red-eyed Vireo*	C	C	U		F,Wd	-
Vireo philadelphicus: Philadelphia Vireo	U		R		F,Wd	-
Vireo gilvus: Warbling Vireo	U	R	R		F,Sh	-

Parulidae

Mniotilta varia: Black-and-white Warbler*	C	U	C		F,Wd	-
Protonotaria citrea: Prothonotary Warbler*	U	U	R		F,Sh	-
Vermivora peregrina: Tennessee Warbler	R		R		F,Sh	-
Vermivora celata: Orange-crowned Warbler	U	U	U	R	Sh	-
Vermivora ruficapilla: Nashville Warbler	C		U		F,Wd	-
Parula americana: Parula Warbler*	C	C	U		F	-
Dendroica petechia: Yellow Warbler	U		R		Th,M	0
Dendroica magnolia: Magnolia Warbler	C		R		F,Wd	-
Dendroica tigrina: Cape May Warbler	R		R		Sh	0
Dendroica coronata: Myrtle Warbler	U		U	C	F,Wd	-
Dendroica Virens: Black-throated Green Warbler	U		R		F,Wd	-

Dendroica cerulea: Cerulean Warbler	R				F,Wd	-
Dendroica fusca: Blackburnian Warbler	U		R		F,Wd	-
Dendroica dominica: Yellow-throated Warbler*	U	R			F,Wd	-
Dendroica pensylvanica: Chestnut-sided Warbler	C		R		F,Th	-
Dendroica castanea: Bay-breasted Warbler	U		R		F,Wd	-
Seiurus autocapillus: Ovenbird	R		R		Wd,F	-
Seiurus noveboracensis: Northern Water-Thrush	R		R		Sh,M	0
Oporornis formosus: Kentucky Warbler*	U	U			F,Wd	-
Oporornis agilis: Connecticut Warbler	R				F,Th	-
Oporornis philadelphia: Mourning Warbler	R		R		F,Th	-
Geothlypis trichas: Yellowthroat*	C	C	U	R	M,Th	0
Icteria virens: Yellow-breasted Chat*	C	C	U		Th	0

Wilsonia pusilla: Wilson Warbler*	R	R			F	-
Wilsonia canadensis: Canada Warbler	U		R		F	-
Setophaga ruticilla: Redstart	U		R		F,Wd	-
Ploceidae						
Passer domesticus: English Sparrow	A	A	A	A	T,O	0
Icteridae						
Dolichonyx oryzivorus: Bobolink	U		U		O,M	0
Sturnella magna: Eastern Meadowlark*	A	A	A	A	O	0
Xanthocephalus xanthocephalus: Yellow-headed Blackbird	R		R		M,O	+
Agelaius phoeniceus: Redwing Blackbird*	A	A	A	A	M,O	0
Icterus spurius: Orchard Oriole*	C	C	R		Th	0
Icterus galbula: Northern Oriole*	U	R	R		T	0

Euphagus carolinus: Rusty Blackbird	U			C	F,T,O	-
Euphagus cyanocephalus: Brewer Blackbird				A	O	0
Quiscalus quiscula: Common Grackle *	A	U	C	A	T,Th	0
Molothrus ater: Brown headed Cowbird *	A	A	A	A	O,T	0
Thraupidae						
Piranga olivacea: Scarlet Tanager	R				F,Wd	-
Piranga rubra: Summer Tanager*	C	C	U		F,Wd	-
Fringillidae						
Richmondena cardinalis: Cardinal*	A	A	A	A	Wd,Th	-
Pheucticus ludovicianus: Rose-breasted Grosbeak	U		R		F,T	-
Guiraca caerulea: Blue Grosbeak*	C	C	U		Th	-
Passerina cyanea: Indigo Bunting*	C	C	C		Th	0
Passerina ciris: Painted Bunting*	C	C	U		Th	0
Spiza americana: Dickcissel*	C	C	U		O	0

Carpodacus purpureus: Purple Finch	C			C	F,Wd	-
Spinus pinus: Northern Pine Siskin	C			C	Wd,Th	0
Spinus tristis: Goldfinch	A		C	A	Wd,Th	0
Pipilo erythrophthalmus Rufous-sided Towhee	U		U	U	F,Wd,Th	-
Passerculus sandwichensis: Savannah Sparrow	C		C	C	O,Th	0
Ammodramus savannarum: Grasshopper Sparrow*	U	R	R		O	0
Ammodramus bairdii: Baird Sparrow				U	O	0
Passerherbulus caudacutus: Leconte Sparrow	U		U	U	Th,O	0
Passerherbulus henslowi: Henslow Sparrow				U	O	0
Pooecetes gramineus: Vesper Sparrow	C		U	C	Th,O	0
Chondestes grammacus: Lark Sparrow*	C	C	C	C	O,Th	0
Aimophila aestivalis: Bachman Sparrow	U	U	U	U	Wd,Th	-
Junco hyemalis: Slate-colored Junco	C		C	A	Th,Wd	0
Spizella arborea: Tree Sparrow				R	O	0

Spizella passerina: Chipping Sparrow*	U	R	U	R	Wd,Th	0
Spizella pallida: Clay-colored Sparrow	R				Th,T	0
Spizella pusilla: Field Sparrow*	C	C	C	C	Th	0
Zonotrichia querula: Harris Sparrow	U			C	Th	0
Zonotrichia leucophrys: White-crowned Sparrow	U		U	C	Th	0
Zonotrichia albicollis: White-throated Sparrow	C		C	A	F,Wd,Th	-
Passerella iliaca: Fox Sparrow	U		U	U	F,Th	-
Melospiza lincolnii: Lincoln Sparrow	C		C	U	Th	0
Melospiza georgiana: Swamp Sparrow	U		U	U	M,Th	0
Melospiza melodia: Song Sparrow	U		U	C	Th,M	0

*Species known to breed in the area

a: Occurrence classifications:
- A - abundant
- C - common
- U - uncommon
- R - rare

b: Preferred habitat classifications:

F - bottomland hardwood forest
M - marshes and swamps
O - fields, pastures, croplands
Sh - lake and stream shores
T - towns, parks, dwellings and scattered trees
Th - thickets and scrubby woodland edges
W - open water
Wd - dry woodland

c: Predicted short-term changes:

\+ population increase
\- population decrease
0 no change predicted

APPENDIX B

TABLE 5

MAMMALS OF THE AQUILLA CREEK BASIN

Species	Relative Abundance[a]	Preferred Habitat[b]	Predicted Population Change[c]
Didelphis marsupialis: Opossum	C	F,W,O	-
Scalopus aquaticus: Eastern Mole	U	Wd,O	0
Cryoptotis parva: Little Short-tailed Shrew	U	Gr	0
Eptesicus fuscus: Big Brown Bat	U	F,H	0
Lasiurus cinereus: Hoary Bat	R	W	0
Lasiurus borealis: Red Bat	U	W	0
Tadarida brasiliensis Mexican Freetail Bat	C	H,Wd,O	0
Dasypus novenicinctus: Armadillo	A	F,W,O	-
Lepus californicus: Black-tailed Jackrabbit	C	Gr	0
Sylvilagus floridanus: Eastern Cottontail	C	Th,Gr.	0
Citellus tridecemlineatus: 13-lined Ground Squirrel	R	O,Gr	0
Sciurus niger: Fox Squirrel	C	Wd,F	-
Sciurus carolinensis Eastern Gray Squirrel	U	Wd,F	-
Sylvilagus aquaticus Swamp Rabbit	R	F,M	-

Glaucomys volans:			
Southern Flying Squirrel	R	Wd,F	-
Geomys bursarius:			
Plains Pocket Gopher	A	O,G	0
Perognathus hispidus:			
Hispid Pocket Mouse	C	Th,G	0
Castor canadensis:			
Beaver	C	R,M	-
Reithrodontomys fulvescens:			
Long-tailed Harvest Mouse	R	Th,G	0
Reithrodontomys montanus:			
Plains Harvest Mouse	U	Th,G	0
Baiomys taylori:			
Pigmy Mouse	R	Gr,Th	0
Peromyscus maniculatus:			
Deer Mouse	C	Gr,Th	0
Peromyscus leucopus:			
White-footed Mouse	A	F,R	-
Peromyscus boylei:			
Brush Mouse	R	Gr,Th	0
Sigmodon hispidus:			
Hispid Cotton Rat	C	Gr,Th	0
Neotoma floridana:			
Florida Wood Rat	U	F	-
Mus musculus:			
House Mouse	A	H,G	-
Rattus rattus:			
Black Rat	A	H	0
Rattus norvegicus:			
Norway Rat	C	H,Th	0
Myocastor coypus:			
Nutria	U	R	-
Procyon lotor:			
Raccoon	C	R,F	-
Bassariscus astutus:			
Ringtail	R	Rk,Th,Wd	0
Mustela frenata:			
Longtail Weasel	R	Gr,O	0
Mustela vison:			
Mink	R	R,F	-
Spilogale putorius:			
Spotted Skunk	U	Wd,G,O	0

Mephitis mephitis:			
Striped Skunk	C	Wd,Th	0
Urocyon cinereoargenteus:			
Gray fox	C	F,W,Th	-
Canis latrans:			
Coyote	C	Gr,O,Wd	0
Lynx rufus:			
Bobcat	U	Rk,Th,Wd	0
Odocoileus virginianus:			
White tail Deer	R	F,W,O	+

a: Relative abundance
- A - abundant
- C - common
- U - uncommon
- R - Rare

b: Habitat preferred
- F - forrested bottomland
- Gr - grasslands, meadows, old fields
- H - human habitations
- M - marshes, swamps, sloughs, ponds
- O - open farmland, scattered trees
- R - stream, stream shores
- Rk - rocky areas
- Th - thickets, brush piles
- Wd - dry, upland woods

c: Population change
- \+ increase
- \- decrease
- 0 no predictable change

APPENDIX C

WATER RESOURCE AND SOCIO ECONOMIC
SURVEYS FOR AQUILLA BASIN

APPENDIX III - 1
QUESTIONNAIRE

Hill County Water Resource Survey

DIRECTIONS: Answer as accurately as you can by printing your reply where blanks are provided or by entering an "X" in the small enclosure to the right of the appropriate reply. If you find that there is not enough space to answer a certain question, simply write the question number on the back of this questionnaire and answer accordingly. After completing the questionnaire, any further comments or questions will be greatly appreciated and can be placed on the back.

1. Your name ______________________________.

2. Present address (street or highway) ______________________.
   (town or nearest town) ______________________.

3. Today's date: day__________month__________year________.

4. Sex: male ( ) female ( ).

5. Race: Caucasian ( ) Negro ( ) Mexican Amer. ( ) Other ( ).

6. Age in years: under 21 ( ) 21-35 ( ) 35-55 ( ) 55-65 ( ) over 65 ( ).

7. Number of years of schooling completed ______________.

8. Highest school degree held ________________(B.A., M.A., etc).

9. What is your occupation? ______________________.

10. Are you presently employed in this occupation?
    Yes ( ) How long? ____________. No ( ) If no, what is your recent occupation? ________________ How long? ________.

11. How long have you lived in: Texas __________ Hill Co. ______.

12. Do you own this home? Own ( ) Rent ( ).

13. Did you own or rent your former dwelling? Own ( ) Rent ( ).

14. Why did you move here? ______________________.

15. If you had to leave here for some reason and live somewhere else, would you miss this place?
    Very much ( ) Some ( ) Not at all ( ).

16. Do you ever wish you did not live here?
    Often ( ) Sometimes ( ) Seldom ( ) Never ( ).

17. How many other people live with you at this present address? _____.

18. How long did you live at your last previous address? __________.
    (give in nearest months or years)

SECTION II

The following section is composed of questions dealing with Water Resource Development and the proposed Aquilla Reservoir.

1. As far as you know, what is the source of your drinking water?
   Lake ( ) River ( ) Well ( ).

2. About how far away from your residence is this source of water located? ______________________________.

3. What lake in Texas do you most often visit? ________________.

4. About how many times a year do you visit this lake?____________.

5. Why do you visit this lake? (rank in order of importance 1,2,3, etc.)
   To fish ( ) To ski ( ) To boat ( ) To camp ( ) To picnic ( )
   Other ______________________________________.

6. What other lakes in Texas do you frequently visit?
   (give number of times per year for each) ________________.
   ________________. ________________. ________________.

7. Why do you usually go to these other lakes? (rank in order)
   To fish ( ) To ski ( ) To boat ( ) To camp ( ) To picnic ( )
   Other ______________________________________.

8. Did you know that a lake on Aquilla Creek was being planned before you received this questionnaire? No ( ) Yes ( ).
   How long have you known? ____________________________.

9. How did you first learn about the project?
   Another person ( ) The newspaper ( ) The radio ( )
   Television ( ) Other ______________________________.

10. Why do you think they have proposed to put another lake in this region? (check one or more)
    A. To provide more water and camping recreation outlets for this region. ( )
    B. To provide a greater source of drinking and industrial water for this region. ( )
    C. To help bring more business and industries into the area. ( )
    D. Other ______________________________________.

11. If the Aquilla Reservoir is built, how many times a year do you think you would visit it? ____________________________.

12. What would be your main uses of the Aquilla Reservoir?
    To fish ( ) To ski ( ) To boat ( ) To camp ( ) To picnic ( )
    Other ______________________________________.

13. Is there any other person at this address whom you feel would use the Aquilla Reservoir more than yourself? No ( ) Yes ( ) If yes, give relationship to you ________________________ and age ______________.

14. Do you own land that would be covered or bordered by the Aquilla Reservoir? (If yes, state quantity to nearest acre)

WOULD BE COVERED	WOULD BE BORDERED
Yes ( ) quantity owned _________.	Yes ( ) quantity owned ______.
No ( )	No ( )
Not sure ( )	Not sure ( )

15. DO YOU APPROVE OR DISAPPROVE of the newly proposed reservoir? (check one under A or B)

A

1. I approve, but it does not make much difference to me ( ).
2. I approve, but would not fight for it in the light of strong opposition ( ).

B

1. I disapprove, but it does not make much difference to me ( ).
2. I disapprove, but would not fight against it in the light of strong opposition ( ).
3. I strongly disapprove, and would fight against it no matter how strong the opposition ( ).

16. IF YOU APPROVE OF THE PROPOSED RESERVOIR what are the reasons?

1. It would increase my and my family's chance for greater water recreation involvement ( ).
2. It would increase the community's chance for greater water recreation involvement ( ).

17. 1. Do you think that the Reservoir would
   (a) benefit you or the community economically.
   (b) have no economic effect on you personally.
   (c) have a negative economic effect.
   (d) other: ______________________________________.

2. Can you think of any disadvantages that would be brought about by the creation of the Aquilla Reservoir? No ( ) Yes ( ) (If yes, for what reasons) ____________________
____.

18. IF YOU DISAPPROVE what are the reasons? (check one or more)

1. It would bring in:
   - undesirable people ( )
   - undesirable businesses ( )
   - There are already enough lakes in this region ( )
   - Other ____________________

   It would cause:
   - me to sell my land ( ).
   - me to move ( ).
   - a friend or relative to move ( )
   - a friend or relative to sell land ( ).

2. Can you think of any advantages that would be brought about by the building of the Aquilla Reservoir?
No ( ) Yes ( ) (If yes, give reasons) ______________________
____.

19. Would you like to see Hillsboro increase in population?
Yes ( ) No ( )

20. How large would you personally like to see it? ______________________
____.

21. How much can you do to influence political decisions affecting your neighborhood?
I can do a very great deal ( )
I can do quite a bit ( )
I can do something ( )
I can't do much ( )
I can't do anything ( )

22. Would you prefer to see the natural environment of Aquilla Creek remain unchanged? Yes ( ) No ( )

23. Is there anyone else at this address who would express an opposite opinion from the one you hold?
No ( ) Yes ( ) (If yes, give name and relationship to you)

____

*If you own a farm in Hill Co., please fill out Form B on next page.

LAND UTILIZATION ANALYSIS

FORM B

1. Total number of acres of this farm ____________________.

2. Total number of acres per year put into cash crops ____________.

3. What is the number one cash crop put into cultivation each year? ____________________ How many acres? ____________.

4. How much livestock is raised for market sell each year?

   Number of cattle ____________.

   Number of hogs ____________.

   Number of chickens ____________.

   Other ____________________.

5. How many people are employed on a yearly full time basis? ________.

6. How many people are employed on a half-time basis? ____________.

7. How many weeks or months of the year are they employed? __________.

8. How much of this farm makes up your source of income?
   1/4 ( )   3/4 ( )   1/2 ( )   All ( )

9. If this farm is not your total source of income, please give other sources?

   ____

   ____

   ____

APPENDIX III - 2
SOCIO ECONOMICS

GENERAL SURVEY ANALYSIS

Introduction

This section is comprised of an analysis of the cultural survey conducted during the summer of 1972. It is an analysis of all the completed questionnaires combined, not individual sample comparisons. They will be discussed later in the report. It must be remembered that the response to each individual question many times varied. Therefore, each percentage is based on the number of responses to each individual question rather than the total sample size.

During the duration of this survey 956 potential respondents were contacted either through personal interview or through the mail. There were 600 contact attempts made through the mail in Hillsboro and 356 contacts (mainly personal) were attempted outside of the Hillsboro area. The number of completed questionnaires was 329 (34.41%); refusals 528 (55.23%); no contact 99 (10.36%). The phrase "no contact" means that the household was contacted personally, but no one was at home at the time the contact was attempted. The high percentage of refusals can be attributed to the low response of the mailed-out questionnaires in Hillsboro which will be discussed in the section dealing with Hillsboro. The large majority of the completed questionnaires was conducted through personal interview, 233 (70.82%); as compared to 96 (29.18%) through mail-out.

Evaluation

The average interview time for the personal interviews was 19.6 minutes. Because of the short time duration for the completion of the questionnaire (12 min.), much of the interview time was spent in discussing questions and problems which went beyond the scope of the short answer questionnaire.

Each questionnaire was evaluated by the following questions:

1. Under what conditions was this interview conducted?

	No	Percentage
A. Very relaxed, no interruptions	210	90.13%
B. Relaxed with a few interruptions	16	6.87%
C. Slight stress	7	3.00%
D. Great stress with many interruptions	0	.00%
	233	100.00%

2. Did you feel that the person was sincerely interested?

	No	Percentage
A. Yes	217	93.13%
B. No	16	6.87%
	233	100.00%

Socio-Demographic Analysis

This section of the questionnaire was completed in order to give substance to the rest of the questionnaire. It is interesting to note that the data on race, age, and education in this sample survey correlate very closely with the 1970 U.S. Census findings.

1. Sex:	No.	Percentage
Male	184	55.93%
Female	145	44.07%
	329	100.00%

2. Race	No.	Percentage
Caucasian	300	91.19%
Negro	27	8.21%
Mexican American	2	.60%
Other	0	.00%
	329	100.00%

There are relatively few young families in Hill County. Although the questionnaire was directed at the head of the household, the average age of the respondents appears to be unusually old, 55-65 years of age. If this is the case, it would then appear that the average household size would also be small. The survey does not argue with this point. The average household size was found to be 2.8 persons.

The following table is a breakdown of the respondents' ages into various categories.

3. Ages	No.	Percentages
-21	7	2.15%
21-35	40	12.27%
36-55	89	27.30%
46-65	84	25.77%
65+	106	32.52%
	326	100.00%

Education Analysis

The 1970 U.S. Census reported that the average level of education in Hill County is 9.0 years. This correlates closely with the survey average of 10.53 years of schooling. This slightly higher percentage is probably explained by the fact that people with very low educational levels are more apprehensive about completing a questionnaire.

Closely connected to the educational factor is the labor level. The number of Blue Collar respondents was 175 (73.84%) compared to 62 (26.16%) White Collar. Blue Collar is defined here as unskilled labor. White Collar is defined here as professional people, highly-trained technical labor, and anyone who owns his own business and whose total income is derived from this business (farms not included).

1. Number of years of schooling completed

	No.	Percentages
0-6	36	11.32%
7-12	216	67.93%
13-16	54	16.98%
16+	12	3.77%
	318	100.00%

Mobility and Sentiment Analysis

It was found that there was very little mobility among the respondents to the questionnaire. This means that the people have very strong feelings about their residence and the region in which they live and work; therefore, the people have very strong opinions about things that affect their community. The respondents to the questionnaire had lived in Texas for an average of 52.87 years, and in Hill County 39.86 years. The number of respondents owning their home was 258 (79.88%), as compared to 65 (20.12%) that rented. The average length for living in their present place of residence was 14.94 years.

1. Length of years in present place of residence

Years	No.	Percentage
0-2	42	19.72%
3-10	72	33.80%
11-20	36	16.90%
21-30	33	15.49%
31+	30	14.09%
	213	100.00%

2. If you had to leave here for some reason and live somewhere else, would you miss this place?

	No.	Percentage
Very much	263	82.44%
Some	45	14.11%
Not at all	11	3.45%
	319	100.00%

3. Do you ever wish you did not live here?

	No.	Percentage
Often	5	1.56%
Sometimes	31	9.66%
Seldom	28	8.72%
Never	257	80.06%
	321	100.00%

Project Awareness Analysis

The cognizance level plays a very important part in attitude formation. Also, the medium by which the person first learns about an innovation often affects opinion formation. Three questions were specifically constructed for this purpose: "Did you know that a lake on Aquilla Creek was being planned before you received this questionnaire?" "How long have you known?" "How did you first learn about the proposed reservoir?" In response to the first question 291 (98.23%) said that they had known before they received this questionnaire compared to 5 (1.72%) who responded that they did not know before now. The response average to the length of awareness was 4.81 years.

1. How long have you known about the proposed reservoir?

Years	No.	Percentage
0-1	32	11.00%
2-3	94	32.30%

Years	No.	Percentage
4-6	112	38.49%
7-10	41	14.09%
11+	12	4.12%
	291	100.00%

2. First learned about project from what source?

	No.	Percentage
Another person	128	44.14%
The newspaper	126	43.45%
The radio	27	9.31%
The television	1	.34%
Not sure	8	2.76%
	*290	100.00%

*The reason for this rather low sample response is that many of the respondents marked more than one source; therefore making the response invalid. However, the majority of the respondents that marked more than one source checked both newspaper and radio.

Reservoir Attitude Analysis

Of the 329 respondents 257 (78.12%) would be indirectly affected by the proposed Aquilla reservoir based on dam site "C", compared to 72 (21.88%) directly affected. "Indirectly affected" is defined here as anyone in the sample area that would not be forced to move or one that does not own or utilize land that would be covered or bordered by the reservoir. "Directly affected" is defined as anyone that owns or utilizes land that would be covered or bordered by the reservoir or would be forced to move because of inundation by the reservoir.

The vast majority of the respondents approved of the proposed reservoir, 275 (84.62%) approved, 46 (14.15%) disapproved, and 4 (1.23%) were neutral.

1. Degree of approval and disapproval

	No.	Percentage of Respondents Who Approve
A. Approve, but it does not make that much difference to me.	41	14.91%
B. Approve	81	29.45%
C. Very greatly approve	153	55.64%
	275	100.00%

(84.62% of total sample approve)

	No.	Percentage of Respondents Who Disapprove
A. Disapprove, but it does not make that much difference to me	14	30.43%
B. Disapprove	15	32.61%
C. Very strongly disapprove	17	36.96%
	46	100.00%

(14.15% of total sample disapproved)

Neutral (did not register an opinion)	4	1.23% of total sample
	325	Total sample number

The 46 respondents that disapproved did so for various reasons: 22 of the 46 said that it would cause them to sell all or part of their land or cause them to move; 10 said it would cause a friend or relative to sell or move; 3 said it would bring in undesirable people or businesses; 2 said the dam might break; 1 said there were enough lakes in the area; and 8 gave no reason.

The attitude of the respondent toward himself was elicited. The following question was asked in order to determine how much influence each individual felt he had in the community.

2. How much can you do to influence political decision affecting your neighborhood?	No.	Percentage
A. A very great deal	16	5.10%
B. Quite a bit	22	7.01%
C. Something	98	31.21%
D. Can't do much	155	49.36%
E. Can't do anything	23	7.32%
	314	100.00%

In the attitude analysis it was also important to determine if the respondent felt that his attitude toward the proposed Aquilla Creek Reservoir represented the attitude of his entire household. Each respondent was asked the question: "Is there anyone else at this address who would express an opposite opinion from the one you hold?" The response was that 296 (97.69%) said that there was no one who would express an opposite opinion, compared to 7 (2.31%) who responded that there was someone in the household that would express an opposite opinion. Therefore this survey represents the attitudes of 595 people toward the proposed Aquilla Creek Reservoir.

Economic and Recreational Analysis

The term "economic" is used here only in relation to the proposed reservoir. Each respondent was asked:

1. Do you think that the Reservoir would:	No.	Percentage
A. Benefit the community economically	230	78.50%
B. Have no economic effect	37	12.63%
C. Have a negative economic effect	8	2.73%
D. Not sure	18	6.14%
	293	100.00%

It is often felt that population growth is associated with economic growth; therefore, the respondents were asked if they would like to see their community increase in population. Some 313 people responded to this question, 247 (78.91%) said yes and 64 (20.48%) said no, with 2 (.61%) saying they were not sure.

In the municipal areas of Hillsboro, Peoria, and Aquilla, the respondents were asked if they felt the proposed reservoir would increase their or their family's chance for greater recreation involvement or if it would increase the community's chance for greater water recreation involvement? This question became invalid in the sampled rural area because of the nearness to the reservoir. Most people responded that they would be living next to the reservoir, or they felt they could not give a meaningful quantifiable answer. The results from the municipalities were that 26 (20.16%) said that it would increase their or their family's chance for greater recreation involvement, as compared to 103 (79.84%) who responded that it would increase the community's chance for greater recreation involvement.

In response to the question: "What lake do you most often visit in Texas?" 201 (62.04%) said Lake Whitney, 117 (36.11%) said none, and 6 (1.85%) said some other lake. The frequency was based on 2 or more visits per year. Of the respondents that stated that they visited Lake Whitney the most frequently, 42 (20.9%) also responded that they visited one or more other lakes in Texas more than twice a year. This figure (42) also represents 12.96% of all the 324 respondents to the question. The average number of visits to Lake Whitney for the 201 respondents was 16.22 times per year.

2. Number of visits per year to Lake Whitney	No.	Percentage
2-10	107	57.22%
11-20	38	20.32%
21-30	11	5.88%
31-50	25	13.37%
51+	6	3.21%
	187	100.00%

The reasons for visiting the lakes are ranked in order according to importance: to fish 114, to picnic 97, to camp 33, to swim 31, to drive or walk around 30, to boat 26, to water ski 14. The respondents could give more than one reason. The response to "swimming" probably would have been much higher if it had been listed as an official reason in the questionnaire.

The proposed recreational usage of the Aquilla Reservoir is based entirely on the Hillsboro sample. The tabulations for this area appear low, because many responses had to be disallowed, since they did not give quantifiable numbers. Out of 36 responses, the projected average number of times to visit the proposed Aquilla Creek Reservoir per year was 31.19. Again the main reasons for visiting the proposed reservoir are similar to those reasons for visiting other lakes. Thirty respondents stated that they would go there to fish; 30 also to picnic; 14 to boat; 11 to camp, 7 to water ski, 3 to drive or walk around.

3. Projected number of visits per year to the proposed Aquilla Creek Reservoir	No. of Respondents	Percentage
2-10	19	52.78%
11-20	4	11.11%
21-30	5	13.89%
31-50	2	5.56%
51+	6	16.67%
	36	100.00%

The survey shows that the respondents are very much aware of their water resources and the need for water. Only one respondent in the entire sample of 329 respondents was not aware of where his source of drinking water originated. The respondents were also asked why they thought another reservoir had been proposed for this region. Only 25 of the respondents said that they were not sure. The other respondents usually stated one or more reasons. Seventy-seven respondents [illegible]sed that they thought the proposed reservoir was [illegible] water and camping recreation outlets for the region. One hundred and eighty-six respondents stated that it was to provide a greater source of drinking and industrial water for this region, and one hundred and ten said that it was to help bring more business and industry into the area. Fifty-eight respondents gave flood control as a reason, with two stating that it was only to allow the soil conservation service to make money.

Land Utilization Analysis

The land utilization analysis for this survey very closely correlates to the findings already given in this study as reported by the TEC (1971). Some 42.25% of all the respondents in this survey owned or leased five or more acres of land. The total number of acreage of farm land for the 139 respondents that owned or leased five or more acres was 31,499 acres. This means that the average farm of the respondents was 226.61 acres. This compares to the TEC's report of 268.8 acres average per farm in Hill County.

1. Number of acres owned or leased

Acres	No. of Respondents	Percentage
5-50	21	15.11%
51-100	37	26.62%
101-200	41	29.50%
201-500	25	17.99%
501+	15	10.78%
	139	100.00%

The amount of land leased to someone else is 3,585 acres (11.38%) of the total amount of land. The respondents were asked to state their main cash crop or crops (if the acreage for each was evenly split). In the survey region cotton was still the main producer, 5672 acres (18.01%). Maize was second with 3761 acres (11.94%). Peanuts accounted for 198 acres (.6[illegible]). This means that 29.95% of the land is planted in either cotton or maize. Some 21 cattle were sold per year per farm. In the survey region there were four dairy farms.

2. What percentage of your total income is derived from your farm?

	No. of Respondents	Percentage
Less than 1/4	41	32.54%
1/4	30	23.81%
1/2	14	11.11%
3/4	8	6.35%
All	33	26.19%
	126	100.00%

INDIRECTLY AND DIRECTLY AFFECTED SURVEY ANALYSIS

Introduction*

In this section of the report the directly affected respondents have been compared with the indirectly affected respondents in relation to dam site "C". As previously stated, "directly affected" is defined here as anyone who owns or leases land that would be covered or bordered by the reservoir, or anyone who would be forced to move because of inudation by the reservoir. "Indirectly affected" is defined here as anyone who does not own or lease land that would be covered or bordered by the reservoir and would not be forced to move because of inudation by the reservoir.

There were 257 (78.12%) of the respondents that will be indirectly effected based on dam site "C". One hundred and sixty-three (63.42%) of the questionnaires were completed through personal interview as compared to 94 (36.58%) completed by mail.

There were 72 (21.88%) of the respondents who will be directly affected by the proposed reservoir. Of these, 70 (97.22%) were interviewed personally, compared to 2 (2.28%) who were interviewed by mail.

Evaluation**

1. Under what conditions was this interview conducted?

	Directly Affected No.	Directly Affected %	Indirectly Affected No.	Indirectly Affected %
Very relaxed, no interruptions	64	91.43	146	89.57%
Relaxed with a few interruptions	4	5.71	12	7.36%
Slight stress	2	2.86	5	3.07%
Great stress with many interruptions	0	.00	0	.00%
	70	100.00%	163	100.00%

*The percentages in this section are based on the number of responses to each question rather than the entire sample universe.

**For explanations of individual questions see relevant topic under the General Survey section in this report.

2. Did you feel that the respondent was sincerely interested?

	Directly		Indirectly	
	No.	%	No.	%
Yes	148	90.80%	69	98.57%
No	15	9.20%	1	1.43%
	163	100.00%	70	100.00%

	Directly	Indirectly
3. Average interview time	21.86 min.	18.63 min.

Socio-Demographic Analysis

1. Sex:

	Directly		Indirectly	
	No.	%	No.	%
Male	52	58.33%	142	55.25%
Female	20	41.67%	115	44.75%
	72	100.00%	257	100.00%

2. Race:

Caucasian	52	77.22%	248	96.50%
Negro	20	27.78%	7	2.72%
Mexican American	0	.00%	2	.78%
Other	0	.00%	0	.00%
	72	100.00%	257	100.00%

Note the very high percentage of Negros that will be directly affected in comparison to the indirectly affected.

The average age of the respondents for the two groups is roughly the same: 55.79 years for the directly affected group, and 55.61 years for the indirectly affected group. The average number of residence per household among the respondents was 2.69 persons for the directly affected broup and 2.83 for the indirectly affected group.

3. Ages in years

-21	2	2.78%	5	1.97%
21-35	7	9.72%	33	12.99%

	Directly		Indirectly	
	No.	%	No.	%
36-55	23	31.94%	66	25.98%
56-65	20	27.78%	64	25.20%
65+	20	27.78%	86	33.86%
	72	100.00%	254	100.00%

Education Analysis

The average level of schooling for the directly affected area is 10.4 years of schooling compared to 10.57 years of schooling for the indirectly affected group.

1. Educational level by number of years of schooling

	Directly Affected		Indirectly Affected	
Years	No.	%	No.	%
0-6	6	8.57%	30	12.10%
7-12	54	77.14%	162	65.32%
13-15	10	14.29%	44	17.74%
16+	0	.00%	12	4.84%
	70	100.00%	248	100.00%

2. Labor:

Blue Collar	46	82.14%	129	71.27%
White Collar	10	17.86%	52	28.73%
	56	100.00%	181	100.00%

Mobility and Settlement Analysis

The residential stability factor for both groups appears to be about the same. Both groups place high sentimental value on their place of residence. The average length of time lived in Texas for the directly affected group was found to be 5[illegible].96 years compared to [illegible] for the indirectly affected group. The average length of time spent in Hill County for the indirectly affected group was 40.4[illegible] years. For the directly affected group this was slightly lower 38 years.

Although both groups seem to express high sentiment values toward their place of residence, there does appear to be some difference between the two groups, as indicated by the figures. Some 63 (87.5%) of the respondents in the directly affected groups owned their own homes compared to 195 (77.69%) of the respondents in the indirectly affected area that own their homes. Nine (12.5%) of the directly affected group rent compared to 56 (22.31%) of the indirectly group that rent their homes. The average length of time spent in their present place of residence was 14.49 years for the directly affected group and 15.13 years for the indirectly affected group.

1. Length of years in present place of residence

	Directly		Indirectly	
	No.	%	No.	%
Years				
0-2	9	13.85%	33	22.30%
3-10	24	36.92%	48	32.43%
11-20	16	24.62%	20	13.51%
21-30	8	12.31%	25	16.89%
31+	8	12.31%	22	14.87%
	65	100.00%	148	100.00%

2. If you had to leave here for some reason and live somewhere else would you miss this place?

	Directly		Indirectly	
Very much	68	94.44%	195	78.95%
Some	3	4.17%	42	17.00%
Not at all	1	1.39%	10	[illegible].05%
	72	100.00%	247	100.00%

3. Do you ever wish you did not live here?

	Directly		Indirectly	
Often	0	.00%	5	2.01%
Sometimes	3	4.17%	28	11.25%
Seldom	1	1.39%	27	10.84%
Never	68	94.44%	189	75.90%
	72	100.00%	249	100.00%

This difference in sentimental values can only be conjectured. The higher feeling of sentiment toward the place of residence among the directly affected group might be attributed to the fact that this group felt a higher sentiment rating would cause them to receive a higher price for their land.

Project Awareness Analysis

All 72 (100%) of the directly affected respondents said that they had known about the proposed Aquilla Creek Reservoir before now. This compares to 5 (2.19%) of the indirectly affected respondents who stated that they did not know about the proposed reservoir before now. The directly affected group also responded that they had known about the project for an average of 6.32 years. This average was close to two years longer than the indirectly affected group whose average length of awareness was 4.35 years.

1. How long have you known about the proposed reservoir?	Directly		Indirectly	
	No.	%	No.	%
Years				
0-1	1	1.47%	31	13.90%
2-3	14	20.59%	80	35.87%
4-6	34	50.00%	78	34.98%
7-10	12	17.65%	29	13.01%
11+	7	10.29%	5	2.24%
	68	100.00%	223	100.00%

2. First learned about reservoir from what source?	Directly No.	Directly %	Indirectly No.	Indirectly %
Another person	28	42.42%	100	44.64%
The newspaper	34	51.52%	92	41.07%
The radio	4	6.06%	23	10.27%
The television	0	.00%	1	.45%
Not sure	0	.00%	8	3.57%
	66	100.00%	224	100.00%

Reservoir Attitude Analysis

In the directly affected group 44 (61.11%) approved, 27 (37.50%) disapproved of the proposed reservoir, and 1 (1.39%) remained neutral. The approval rate among the indirectly affected group was much higher as would be expected: 231 (91.30%) approved of the proposed reservoir; 19 (7.50%) disapproved, and 3 (1.20%) were neutral.

1. Degree of approval and disapproval

	Directly		Indirectly	
	No.	%	No.	%
(Approve)				
Approve, but it does not make that much difference to me.	4	9.09%	37	16.02%
Approve	14	31.82%	67	29.00%
Very greatly approve	26	59.09%	127	54.98%
	44	100.00%	231	100.00%
(Disapprove)				
Disapprove, but it does not make that much difference to me.	4	14.81%	10	52.63%
Disapprove	8	29.63%	7	36.84%
Very strongly disapprove	15	55.56%	2	10.53%
	27	100.00%	19	100.00%

Among the respondents that disapproved in the directly affected group, 22 of the 27 disapproved because it would cause them to move or sell their land. Three said it would cause a friend to sell land, and three said that they disapproved because the reservoir would bring in undesirable people and businesses. One said that there were enough lakes in the region.

Among the indirectly affected group, seven disapproved because it would cause a friend or relative to move or sell land; one responded that it would bring in undesirable people and businesses, and that there were already enough lakes in the region. Another respondent said that the reservoir would create more tornados.

2. How much can you do to influence political decisions affecting your neighborhood?

	Directly		Indirectly	
	No.	%	No.	%
A very great deal	3	4.29%	13	16.02%
Quite a bit	9	12.86%	13	16.02%
Something	22	31.42%	76	31.15%
Can't do much	34	48.56%	121	49.59%
Can't do anything	2	2.86%	21	8.60%
	70	100.00%	244	100.00%

3. Is there anyone else at this address who would express an opposite opinion from the one you hold?

	Directly		Indirectly	
	No.	%	No.	%
Yes	1	1.47%	6	2.55%
No.	67	98.53%	229	97.45%
	68	100.00%	235	100.00%

Economic and Recreational Analysis

1. Do you think that the Reservoir would-

Benefit the community economically	50	73.53%	180	80.00%
Have no economic effect	13	19.12%	24	10.66%
Have a negative economic effect	2	2.94%	6	2.67%
Not sure	3	4.41%	15	6.67%
	68	100.00%	225	100.00%

2. Would you like to see this community increase in population?

	Directly		Indirectly	
	No.	%	No.	%
Yes	50	72.46%	197	80.47%
No	19	27.54%	45	18.44%
	69	100.00%	244	100.00%

3. What lake in Texas do you most often visit?

	Directly		Indirectly	
	No.	%	No.	%
Whitney	40	56.00%	161	63.88%
Other	0	00.00%	6	2.38%
None	32	44.00%	85	33.73%
	72	100.00%	252	100.00%

The above Table is based on two or more visits per year. Among those respondents directly affected, 7 (17.5%) of those respondents that visit Whitney also visit some other lake in Texas as well. This compares to 35 (21.74%) of the indirectly affected group that also visit some other lake in Texas as well as Whitney.

4. Number of visits per year to Lake Whitney

	Directly		Indirectly	
	No.	%	No.	%
2-10	23	57.50%	84	57.14%
11-20	12	30.00%	26	17.69%
21-30	1	2.50%	10	6.80%
31-50	3	7.50%	22	14.97%
51+	1	2.50%	5	3.40%
	40	100.00%	147	100.00%

All of the directly affected group knew where their source of drinking water originated and only one respondent in the indirectly affected said he did not know. Both groups visited the lakes for the same main reason. These reasons rank in the same order as they do in the General Survey Analysis section of this report.

The two groups both responded that the main reason another reservoir had been proposed for this region was to provide a greater source of drinking and industrial water. The second most important reason was to help bring more business and industries into the area. The directly affected group felt that flood control was the third most important reason whereas the indirectly affected group felt that to provide more water and camping recreation outlets was the third most important reason. The directly affected group ranked water and camping recreation fourth and the indirectly affected group gave flood control as the fourth largest reason.

Inundation Land Analysis

This part of the Analysis involves only the directly affected respondents in this report.

Of the 72 respondents classified as directly affected, 51 respondents said that they owned land that would be covered by the proposed Aquilla Creek Reservoir. However, 9 of the respondents in this group gave no quantifiable amount of land that would be covered by the proposed reservoir. Fifty of the 72 respondents stated that they had land that would be bordered by the reservoir, but 13 of the 50 respondents in this group gave no quantifiable amount to be bordered. The term "bordered" is defined here, as any land that is owned or leased that would directly join the lake front.

The total amount of land to be covered by the proposed reservoir is [illegible] acres. This is an average of 100.24 acres per respondent who stated that he had land that would be covered. The average amount bordered would be 94.7[illegible] per respondent or a total of 3504 acres. (The above figures in this section are based entirely on the figures reported by each respondent. There was no effort made to validate any of the figures. Most of the respondents stated that these were the figures given to them by the surveyors at the time they were surveying their land).

1. The amount of land directly affected (Directly affected group only)

Acres	Covered No.	Covered %	Bordered No.	Bordered %
1-10	4	9.52%	2	5.41%
11-50	16	38.10%	15	40.54%
51-100	9	21.43%	12	32.43%
101-200	8	19.05%	4	10.81%
201-500	3	7.14%	3	8.11%
501+	2	4.76%	1	2.70%
	42	100.00%	37	100.00%
Not Sure	9		13	
Total	51		50	

Land Utilization Analysis

Among the directly affected group 87.5% stated in a quantifiable amount that they owned or leased five or more acres. This compares to 29.57% for the indirectly affected group. The difference in figures can be attributed to the number of "urban" dwellers in the indirectly affected group. The average amount of acreage owned between the two groups can also be attributed to this factor. The average amount of land owned or leased by the directly affected group was 268.81 acres per respondent; compared to 191.63 acres per respondent in the indirectly affected group.

1. Number of acres owned or leased

Acres	Directly No.	Directly %	Indirectly No.	Indirectly %
5-50	7	11.11%	14	18.42%
51-100	16	25.40%	21	27.63%
101-200	18	28.57%	23	30.26%
201-500	14	22.22%	11	14.48%
501+	8	12.70%	7	9.21%
	63	100.00%	76	100.00%

Among the directly affected group 2398 acres (14.16%) of the land is leased to someone else; compared to 1187 (8.15%) for the indirectly affected group. The major crops grown among both groups are maize and cotton.

(The following figures are based on the question: What major crop or crops are put into cultivation? Give amount cultivated in Acres.). The average amount of land cultivated in maize and cotton among the directly affected group is 13.11% of a total of 2221 acres for maize and 20.12% of a total of 3408 acres in cotton. This means that 5629 acres (33.24%) of the land is cultivated in cotton and maize. The indirectly affected group put 1[illegible]40 (10.58%) of its land in maize and 2264 (15.55%) of the land into cotton; or 26.13% of the land into maize and cotton. The directly affected group sells an average of 1231 head of cattle per year or 19.54 head per farm. The indirectly affected group sells 876 head of cattle a year or 11.53 head per farm per year. There are four dairy farms in the directly affected group.

2. What % of your total income is derived from your farm?

	Directly		Indirectly	
	No.	%	No.	%
Less than 1/4	19	31.15%	22	33.85%
1/4	14	22.95%	16	24.62%
1/2	7	11.48%	7	10.77%
3/4	2	3.28%	6	9.23%
All	19	31.15%	14	21.54%
	61	100.00%	65	100.00%

AD-A089 307 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 8/8
FINAL ENVIRONMENTAL STATEMENT AND SUPPLEMENTAL INFORMATION FOR --ETC(U)
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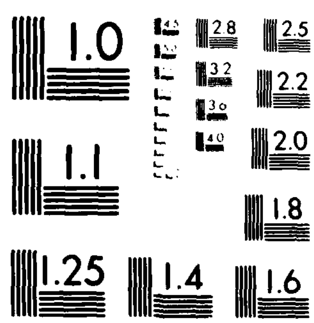

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AQUILLA, PEORIA, AND HILLSBORO SURVEY ANALYSIS

Introduction

This section is a comparison of the three closest communities to the proposed Aquilla Creek Reservoir, with populations exceeding 100 persons, Aquilla, Peoria, and Hillsboro, Texas. The location and relationship to the proposed reservoir was based on dam site "C" can be seen on Figure 5-1 of the statement.

AQUILLA

Description

Aquilla is a small community consisting of about 200 people. The town of Aquilla can best be described as a town of the aged. Only five of the thirty-eight heads of the households interviewed were under forty-five. The youngest couple in the town are in their early twenties. The majority of the people in Aquilla are retired. Everyone that lives in the town was either born or reared in or near Aquilla, or married someone who had the preceding characteristics. All but one family in Aquilla was Caucasian. This family was a Negro family.

Outside of government paychecks, the economics of the town is composed of two food stores, two gasoline stations, and one cotton gin. Ever since the early thirties the town has slowly decreased in size. The town attributes this to fires, the loss of train service, a decrease in interest in cotton, and to the fact that it is no longer on a main highway. They all talk of times past when Aquilla was a boom town. However the majority of the people state that they would like to see the town grow in population. They feel that the proposed Aquilla Creek Reservoir will help achieve this aim.

The Aquilla High School in Aquilla serves the educational needs of the people within the community and the surrounding area. There are three active churches in the town to care for the spiritual needs of the people.

History

The history of the three communities is taken from the book written by Ellis Bailey entitled A History of Hill County, Texas 1839-1965.

According to Mr. Bailey the town of Aquilla was first called Patton Mill, and it was organized before Hill County became an official county. After the Civil War, the name Patton Mill was dropped and the place was called Mud Town, probably in jest of the always muddy streets. Mr. Bailey says that this name stuck until the Texas Central Railroad built in the county. Whitney became the first railroad town and Mud Town was the first town to change its name when it moved. It was changed to its still present name of Aquilla. The townsite was purchased from H.P. Harris. One of the first businessmen to move to Aquilla was E.R. Boyd, who with his brother-in-law, J.E. Ballard, owned a grocery store.

There was much sickness in Aquilla because of the water supply. Water had to be hauled from Harris Spring or from Aquilla Creek in barrels. In 1897 an artesian well was dug, and because of its perpetual motion flow, water could be piped into the homes and businesses.

About 1890 a Masonic Lodge was organized at Aquilla, and at one time the town was incorporated with a mayor and several aldermen. However, after six years the corporation was voted out. Also in 1890, the first church was organized in Aquilla. It was a Baptist Church, which was closely followed by a Methodist and Christian Church.

In 1904 the Aquilla State Bank was organized. The bank was later sold to Citizens National Bank of Hillsboro and was liquidated during the late 1920's.

From 1905 until about 1909 Aquilla had no brick buildings, but at one time the town of Aquilla is said to have boasted 750 people. (Bailey 1966, pp. 44-46).

Method

There was an attempt to contact all households in Aquilla, 36 (83.72%) of the respondents completed the questionaire with only 7 (16.28%) being classified as no contact. Thirty-five of the 36 completed questionaires through personal interview or (79.22%). One (2.78%) was completed by mail. Thirty-four (94.44%) of the respondents fell into the indirectly affected classification with only 2 (5.56%) being classed as directly affected.

PEORIA

Introduction

Peoria is a small community located between Hillsboro and Whitney, Texas on Highway 22. Its population is even smaller than that of Aquilla, and over the past couple of decades it too, has been slowly losing population. However the majority of the people feel that the proposed Aquilla Creek Reservoir would reverse this trend.

The economics of the town consist of two food-gasoline station stores; one small auto mechanic shop; and a stock car race track which is located just outside of town on Highway 22.

History

According to Mr. Bailey, Peoria was started about 1850 when a stagecoach route was formed in the western part of the county. Peoria had its greatest economic boom during the 1870's when there were ten stores, a saloon, and a blind tiger. It became the commercial and industrial center of Hill County with a brick yard that had a capacity of 30,000 bricks per day and a factory that manufactured saddles.

Peoria had the honor of having the first churches organized in Hill County. The Cumberland Presbyterian Church was the first organized church in the county, with the Methodist being second. Both were organized in 1855.

Peoria was incorporated in 1874 for school purposes. At one time in the 1870's Peoria was larger than Hillsboro, and because of this an election was held about moving the courthouse to Peoria from Hillsboro; however it was defeated by a few votes. Prior to this Peoria had invested in 240 acres of land in preparation of the courthouse change.

However the prosperity of Peoria did not last long because in 1879 the railroad was built through Hill County by-passing Peoria. When the railroad was built through Hillsboro in 1881, most of the remaining businesses and residences moved to Hillsboro (Bailey pp. 37-39).

Method

All twenty-two completed questionnaires in Peoria can be attributed to the personal interview method. Each household in Peoria was contacted and 22 (75.87%) were completed; there were 3 (10.34%) no contacts, and 4 (13.79%) that refused to complete the questionnaire. Twenty-one (95.45%) were classed as indirectly affected and 1 (4.55%) was classed as being directly affected.

HILLSBORO

Introduction

Hillsboro is a centrally located community off interstate 35 between Dallas and Waco. The city of Fort Worth also lies just fifty miles to the north. Hillsboro is a community of approximately 9,900, although the 1970 U.S. Census has it estimated at 7,224. It is the county seat of Hill County and derives most of its income from agricultural products and light industry which has increased steadily in the past decade. In the ninteen fifties the population dropped 11.4%, or an average loss of 95 persons per year. The recent 1970 census places Hillsboro's population at 7,224, only a slight 2.4% under the 1960 count. However the city estimates the present population at 9,650 which would mean a growth rather than a loss over the past decade.

Hillsboro receives two local newspapers, the "Daily Mirror" and the "Reporter." It has adequate fire and police service for its size. The educational facilities on both the secondary and junior college level are good, and the banking system in Hillsboro is large for its size. It has a progressive Chamber of Commerce, city management, and other service organizations.

History

The town of Hillsboro was started in 1853, as the county seat of Hill County on a donation of land by Thomas M. Steiner. Hillsboro obtained a town charter in 1883, and from 1880 until 1897 the population of Hillsboro grew extensively. The 1880 census showed that 1,125 people lived in Hillsboro. The greatest one thing contributing to the growth was the railroad and the railroad shops located at Hillsboro. The population by 1890 had grown to 5,346.

On June 6, 1883 the first fire company was organized at Hillsboro, the hock and ladder company. On Sept. 17, 1885 the engine company was formed and on Oct. 24, 1885 the fire department was organized. A house was built on South Waco Street where the post office now stands. In 1909 the fire department moved to its present location and in 1913 the department bought a truck and became the first motorized fire department in Texas.

The first public school was built in 1886 at a cost of $12,000. The junior college was started in 1923, and in 1925 it was admitted to the Association of Texas Colleges and in 1927 to the American Association of Junior Colleges.

Method

Six-hundred standard questionnaire forms were mailed in Hillsboro. This was based on a sample drawn from the Hillsboro City Telephone Directory of every fourth person. All of the respondents considered in this sample completed the questionnaire by mail. Although several extensive interviews were conducted with city officials, they were not considered part of the sample unless they appeared as a selected respondent in the Directory. Only 93 (15.5%) of the 600 mailed questionnaires were completed. Ninety-one (97.85%) fell into the indirectly affected category with 2 (2.15%) falling into the directly affected category.

Evaluation*

1. Under what conditions was this interview conducted?

	Aquilla		Peoria	
	No.	%	No.	%
Very relaxed, no interruptions	28	80.00%	21	95.45%
Relaxed with a few interruptions	5	14.29%	1	4.55%
Slight Stress	2	5.71%	0	0.00%
Great stress with many interruptions	0	.00%	0	.00%
	35	100.00%	22	100.00%

* The percentages in this section are based on the number of responses to each individual question rather than the entire sample universe. The town of Hillsboro is not considered in the evaluation section because all questionnaires were completed by mail; therefore there could be no personal evaluation by the interviewer.
For explanations of individual questions see relevant topic under the General Survey section in this report.

2. Did you feel that the respondent was sincerely interested?

Yes	30	85.71%	19	86.36%
No	5	14.29%	3	13.64%
	35	100.00%	22	100.00%

3. Average interview time: 23.77 min. 17.50 min.

Socio-Demographic Analysis

	Hillsboro		Aquilla		Peoria	
1. Sex	No.	%	No.	%	No.	%
Male	53	56.99	12	33.33	13	59.09%
Female	40	43.01	24	66.67	9	40.91%
	93	100.00	36	100.00	22	100.00%
2. Race:						
Caucasian	88	94.62	35	97.22	22	100.00%
Negro	4	4.30	1	2.78	0	.00%
Mex.Amer.	1	1.08	0	.00	0	.00%
Other	0	.00	0	.00	0	.00%
	93	100.00	36	100.00	22	100.00%

In Aquilla the majority of the respondents were female and in the other two communities the majority of respondents were male.

In the second Table it is interesting to see that the highest percentage of Negro respondents were from the much larger community of Hillsboro.

Aquilla had the oldest average age per respondent, 59.14 years; Hillsboro was second, 57.88 years and Peoria was the youngest 55.55 years. The average number of persons per household for the three groups was 2.56 for Hillsboro, 2.58 for Aquilla and 2.59 for Peoria.

3. Ages in years

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
-21	1	1.10	0	.00	0	.00%
21-35	7	7.69	4	11.00	5	22.73%
36-55	28	30.77	8	22.22	5	22.73%
56-65	21	23.08	9	25.00	5	22.73%
65+	34	37.36	15	41.67	7	31.81%
	91	100.00	36	100.00%	22	100.00%

Education Analysis

The respondents in Hillsboro had a much higher average in the number of years of schooling completed. The average respondent in Hillsboro had completed an average of 12.55 years of schooling. This compares to Aquilla's average of 9.36 and Peoria's average of 9.18 years of schooling. However the higher educational level of Hillsboro might be attributed to the fact that only those respondents with a higher level of formal education completed the questionnaire.

1. Educational level by number of years of schooling.

Years	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
0-6	2	2.27	6	16.67	5	22.73%
7-12	50	56.82	25	69.44	16	72.73%
13 16	27	30.68	5	13.89	1	4.54%
16+	9	10.23	0	.00	0	.00%
	88	100.00	36	100.00	22	100.00

2. Labor:

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Blue Collar	24	39.34	29	80.56	13	81.25%
White Collar	37	60.66	7	19.94	3	18.75%
	61	100.00	36	100.00	16	100.00%

As would be expected the largest percentage of white collar workers can be found in Hillsboro.

Mobility and Sentiment Analysis

The average length of time lived in Texas by the Hillsboro respondents was 53.7 years; 57.44 years for the Aquilla respondents, and 53.77 years for the Peoria group. The average length of time spent in Hill County per respondent was 42.43 years for Hillsboro, 44.64 years for Aquilla, and 44.36 years for Peoria.

In Hillsboro 77 (84.61%) of the respondents who completed the questionnaire owned their own homes compared to 14 (15.39%) who rented. In Aquilla 30 (83.33%) of the respondents owned their homes compared to 6 (16.67%) that rented. In Peoria 22 (100%) of the respondents that completed the questionnaire owned their own homes. The average respondent in Aquilla had lived in his present place of residence for 14.72 years; for Peoria this figure was 12.55 years. Since this question was not asked to the Hillsboro sample, no figures can be given on this topic.

1. Length of years in present place of residence:

Years	Aquilla No.	Aquilla %	Peoria No.	Peoria %
0-2	5	15.63	5	25.00%
3-10	12	37.50	7	30.00%
11-20	8	25.00	4	20.00%
21-30	3	9.37	1	5.00%
31+	4	12.50	3	15.00%
	32	100.00	20	100.00%

2. If you had to leave here for some reason and live somewhere else would you miss this place?

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Very much	67	74.44	29	80.56	20	90.90%
Some	20	22.22	7	19.44	1	4.55%
Not at all	3	3.34	0	.00	1	4.55%
	90	100.00	36	100.00	22	100.00%

3. Do you ever wish you did not live here?

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Often	4	4.44	0	.00	0	.00%
Sometimes	15	16.67	6	16.67	1	4.55%
Seldom	16	17.78	2	5.56	2	9.09%
Never	55	61.11	28	77.87	19	86.36%
	90	100.00	36	100.00	22	100.00%

There appears to be more discontent with place of residence among the Hillsboro respondents than among either the Aquilla or Peoria respondents.

Project Awareness Analysis

Hundred percent of the Aquilla and Peoria respondents said that they had known about the project before they received this questionnaire; however there were 3 respondents out of 73 persons that responded to the question in Hillsboro that were not aware of the proposed Aquilla Creek Reservoir before now. The Hillsboro respondents had known about the proposed reservoir for an average of 3.06 years. This average was higher for both Aquilla and Peoria. The Aquilla respondents said that they had known about the proposed reservoir for an average of 5.71 years and the Peoria respondents said they had known for an average of 5.19 years. This is more than an average of two years longer for the two smaller communities.

1. How long have you known about the proposed reservoir?

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Years						
0-1	16	22.86	3	8.82	1	4.55%
2-3	34	48.57	12	35.29	4	18.18%
4-6	17	24.28	12	35.29	11	50.00%
7-10	2	2.86	5	14.71	5	22.73%
11+	1	1.43	2	5.88	1	4.55%
	70	100.00	34	100.00	22	100.00%

2. First learned about reservoir from what source?

Another	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
Person	32	49.23	16	47.06	10	45.45%
Newspaper	24	36.92	17	50.00	7	31.82%
Radio	7	10.77	1	2.94	4	18.18%
Television	0	.00	0	.00	0	.00%
Not sure	2	3.08	0	.00	1	4.55%
	65	100.00	34	100.00	22	100.00%

Reservoir Attitude Analysis

Among the Hillsboro respondents 85 (93.41%) approved of the proposed Aquilla Creek Reservoir; 5 (5.49%) disapproved; and 1 (1.10%) remained neutral on the subject. Among the Aquilla respondents 28 (77.80%) approved of the proposed reservoir and 8 (22.20%) disapproved. In Peoria the approval rate was 20 (90.91%) among the respondents and 2 (9.09%) that disapproved of the proposed reservoir.

1. Degree of approval and disapproval

	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
(Approve)						
Approve, but it does not make that much difference to me.	11	12.94	8	28.57	3	15.00%
Approve	22	25.88	7	25.00	7	35.00%
Very greatly approve	52	61.18	13	46.43	10	50.00%
	85	100.00	28	100.00	20	100.00%
(Disapprove)						
Disapprove, but it does not make that much difference to me	4	80.00	3	37.50	2	100.00%

	Hillsboro		Aquilla		Peoria	
	No.	%	No.	%	No.	%
Disapprove	0	.00	3	37.50	0	.00%
Very greatly disapprove	1	20.00	2	25.00	0	.00%
	5	100.00	8	100.00	2	100.00%

2. How much can you do to influence political decisions affecting your neighborhood?

	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
A very great deal	7	8.24	1	2.78	2	9.09%
Quite a bit	8	9.41	2	5.56	1	4.55%
Something	37	43.54	11	30.56	4	18.18%
Can't do much	25	29.41	18	50.00	14	4.55%
Can't do anything	8	9.41	4	11.11	1	4.55%
	85	100.00	36	100.00	22	100.00%

3. Is there any one else at this address who would express an opposite opinion from the one you hold?

	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
Yes	3	3.75	1	2.78	0	.00%
No	77	96.25	35	97.22	21	100.00%
	80	100.00	36	100.00	21	100.00%

<u>Economic and Recreational Analysis</u>

1. Do you think that the Reservoir would:

	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
Benefit the community economically	62	84.93	19	67.86	17	80.96%
Ha[illegible] economic effect	9	12.33	7	25.00	1	4.76%

Have a negative economic effect

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
	1	1.37	2	7.14	1	4.76%
Not sure	1	1.37	0	.00	2	9.52%
	73	100.00	28	100.00	21	100.00%

2. Would you like to see this community increase in population?

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Yes	84	95.45	35	97.22	14	66.67%
No	4	4.55	1	2.78	7	33.33%
	88	100.00	36	100.00	21	100.00%

Each group was asked, "How large would you like to see this community?" In Hillsboro the optimum population size was reported to be 25,700.

3. Population preference for Hillsboro

Thousands	Hillsboro No.	Hillsboro %
10-20	32	64.00%
21-50	15	30.00%
51-100	3	6.00%
	50	100.00%

Among the Aquilla respondents the average optimum population size was reported to be 3,235 with five respondents saying they would like to see it get just as large as it could.

4. Population preference for Aquilla

Hundreds	Aquilla No.	Aquilla %
200-500	3	12.00%
501-1,000	8	32.00%
1001-3,000	7	28.00%
3001+	7	28.00%
	25	100.00%

Among the Peoria respondents the average optimum population size was reported to be 3,370.

5. Population preference for Peoria

Hundreds	Peoria No.	%
150-200	1	10.00%
201-500	1	10.00%
501-1,000	3	30.00%
1001-2,000	3	30.00%
2001+	2	20.00%
	10	100.00%

6. What lake in Texas do you most often visit?

	Hillsboro No.	%	Aquilla No.	%	Peoria No.	%
Whitney	66	74.16	26	72.22	12	54.55%
Other	2	23.59	1	2.78	0	.00%
None	21	2.25	9	25.00	10	45.45%
	89	100.00	36	100.00	22	100.00%

The above Table is based on two or more visits per year. Among the Hillsboro respondents that visit Lake Whitney two or more times a year, 17 (25.76%) stated that they also visit some other lake in Texas two or more times a year. In Aquilla 6 (23.08%) of the respondents that visit Lake Whitney visit some other lake also, and in Peoria this figure is 4 (33.33%).

7. Number of visits per year to Lake Whitney

2-10	38	62.30	14	70.00	1	8.33%
11-20	11	18.03	3	15.00	6	50.00%
21-30	3	4.92	2	10.00	1	8.33%
31-50	8	13.11	1	5.00	4	33.34%
51+	1	1.64	0	.00	0	.00%
	61	100.00	20	100.00	12	100.00%

All three groups knew where their source of drinking water originated and the respondents in each group visited the lakes for the same main reason. These reasons rank in the same order as they do in the General Survey Analysis section of this report.

All three communities responded that the main resson another reservoir had been proposed for the region was to provide a greater source of drinking and industrial water. The second most important reason for all three groups of respondents was to help bring more business and industries into the area. However the Hillsboro group felt that the third most important reason was to provide more water and camping recreation outlets for the region; whereas Aquilla and Peoria felt that the third most important reason was to provide flood control on Aquilla Creek.

The following two questions were only recorded for the Hillsboro respondents because it was felt that the questions became invalid for the Aquilla and Peoria group for reasons already stated in the "Directly and Indirectly Affected Survey" section of this report.

8. Projected number of visits per year to the Aquilla Creek Reservoir

	Hillsboro No.	Hillsboro %
2-10	2	51.35%
11-20	4	10.81%
21-30	5	13.51%
31-50	2	5.41%
51+	7	18.92%
	37	100.00%

9. Do you think that the proposed reservoir would:

Increase families chance for greater recreation involvement	18	19.35%

Increase communities chance for greater recreation involvement

	75	80.65%
	93	100.00%

The main reasons given for visiting the proposed Aquilla Creek Reservoir is for fishing and picnicing.

Land Utilization Analysis

Among the Hillsboro respondents 14 (16.13%) owned or leased five or more acres of land, and in Aquilla this figure was 5 (13.89%) compared to Peoria's 5 (22.73%). However Aquilla had the largest average farm acreage per respondent that owned or leased five or more acres. The average farm in Aquilla was 402.2 acres per respondent compared to 141 acres for Peoria and 275.93 acres for Hillsboro. In Aquilla 650 acres (32.32%) of the farm land was leased to someone else. In Peoria 160 acres (22.77%) was leased and in Hillsboro 471 acres (12.19%) of the farm land was leased based on the quantifiable responses given by the respondents.

1. Number of acres owned or leased

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Acres						
5-50	3	21.43	1	20.00	1	20.00%
51-100	2	14.29	0	.00	0	.00%
101-200	3	21.43	1	20.00	4	80.00%
201-500	4	28.56	2	40.00	0	.00%
501+	2	14.29	1	20.00	0	.00%
	14	100.00	5	100.00	5	100.00%

2. % of total income derived from farm:

	Hillsboro No.	Hillsboro %	Aquilla No.	Aquilla %	Peoria No.	Peoria %
Less than 1/4	4	30.77	1	33.33	1	25.00%
1/4	5	38.47	0	.00	2	50.00%
1/2	2	15.38	2	66.67	1	25.00%
3/4	2	15.38	0	.00	0	.00%
All	0	.00	0	.00	0	.00%
	13	100.00	3	100.00	4	100.00%

URBAN AND RURAL SURVEY ANALYSIS

Introduction

This section of the report compares the urban respondents that completed the questionnaire with the rural respondents. The term "urban" is defined here as all respondents that completed the questionnaire and live either in the community of Hillsboro, Aquilla, or Peoria. The term "rural" is defined here as all other respondents that did not fall into the above category.*

In the rural area 178 (62.68%) of the people contacted completed the questionnaire; 89 (31.34%) were listed as "no contact;" and 17 (5.98%) were listed as refusals. Of the completed questionnaires 176 (98.88%) were completed by personal interview and 2 (1.12%) were completed by mail.

Among the urban group 151 (22.47%) of the people contacted completed the questionnaire. This seemingly low percentage can be attributed to the low return of the 600 mailed questionnaires in the Hillsboro region. Of the 151 completed questionnaires in this group, 57 (37.75%) were completed through personal interview and 94 (62.25%) were completed by mail. From the total contacts of 672, 10 (1.49%) were listed as "no contact;" and 511 (76.04%) were listed as refusals.

One-hundred fifty-one (45.9%) of the sample respondents were urban and 178 (54.1%) of the sample were rural.

*These defined areas can be seen on the map in the appendix section.

Evaluation*

1. Under what conditions was this interview conducted?

	Urban No.	Urban %	Rural No.	Rural %
Very relaxed, no interruptions	49	85.96	161	91.48%
Relaxed with a few interruptions	6	10.53	10	5.68%
Slight Stress	2	3.51	5	2.84%
Great stress with many interruptions	0	.00	0	.00%
	57	100.00	176	100.00%

2. Did you feel that the respondent was sincerely interested?

	Urban No.	Urban %	Rural No.	Rural %
Yes	49	85.96	168	95.45%
No	8	14.04	8	4.55%
	57	100.00	176	100.00%

3. Average interview time: 21.35 min. 19.03 min.

Socio-Demographic Analysis

1. Sex:

	Urban No.	Urban %	Rural No.	Rural %
Male	78	51.66	106	59.55%
Female	73	48.34	72	40.45%
	151	100.00	178	100.00%

2. Race:

	Urban No.	Urban %	Rural No.	Rural %
Caucasian	145	96.03	174	97.75%
Negro	5	3.31	3	1.69%
Mex. Amer.	1	.66	1	.56%
Other	0	.00	0	.00%
	151	100.00	178	100.00%

*The percentages in this section are based on the number of responses to each individual question rather than the entire sample universe. For explanations of individual questions see relevant topic under the General Survey section in this report.

The average age of the urban respondents was 57.84 years and the rural respondents was 53.81 years.

3. Ages in years

	Urban		Rural	
	No.	%	No.	%
-21	1	.66	6	3.39%
21-35	16	10.74	24	13.56%
36-55	41	27.52	48	27.12%
56-65	35	23.49	49	27.68%
65+	56	37.59	50	28.25%
	149	100.00	177	100.00%

The average number of persons per household for the urban respondents was 2.57 and 3.22 for the rural respondents.

4. Education Analysis

As would be expected the average number of years of schooling for the urban respondents was much higher than among the rural respondents. The average number of years of schooling for the urban respondents was 11.25 years. The average number of years of schooling for the rural group was 9.22.

1. Educational level by number of years of schooling

	Urban		Rural	
	No.	%	No.	%
Years				
0-6	13	8.91	23	13.38%
7-12	91	62.33	125	72.67%
13-16	33	22.60	21	12.21%
16-	9	6.16	3	1.74%
	146	100.00	172	100.00%

2. Labor:

	Urban No.	Urban %	Rural No.	Rural %
Blue Collar	66	58.41	109	87.90%
White Collar	47	41.59	15	12.10%
	113	100.00	124	100.00%

Mobility and Sentiment Analysis

The average length of time lived in Texas by the urban respondents was 54.61 years compared to 51.39 years for the rural group. For the average time spent in Hill County the statistics did not vary. The rural respondents had lived in Hill County an average of 37.01 years and the urban respondents had lived in the county an average of 43.26 years.

Some 129 (74.14%) of the rural respondents said that they owned their own home, whereas 45 (25.86%) rented. For the urban group the percentage was even higher for those respondents that owned their own home, 129 (86.58%) compared to 20 (13.42%) that rented.

1. Length of years in present place of residence:

Years	Urban* No.	Urban* %	Rural No.	Rural %
0-2	10	19.23	32	19.88%
3-10	19	36.54	53	32.92%
11-20	12	23.08	24	14.91%
21-30	4	7.69	29	18.00%
31+	7	13.46	23	14.29%
	52	100.00	161	100.00%

2. If you had to leave here for some reason and live somewhere else would you miss this place?

	Urban No.	Urban %	Rural No.	Rural %
Very much	116	78.38	147	85.97%
Some	28	18.92	17	9.94%
Not at all	4	2.70	7	4.09%
	148	100.00	171	100.00%

*The percentages in Table number one does not include the Hillsboro respondents.

3. Do you ever wish you did not live here?

	Urban No.	Urban %	Rural No.	Rural %
Often	4	2.70	2	.58%
Sometimes	22	14.87	9	5.20%
Seldom	20	13.51	8	4.62%
Never	102	68.92	155	89.60%
	148	100.00	173	100.00%

The percentages for these two groups in the preceding section seem to be typical of most urban-rural situations.

Project Awareness Analysis

Only one of 172 rural respondents was not cognizant of the proposed Aquilla Creek Reservoir, and only 3 (2.33%) of the urban respondents were not aware of the proposed reservoir before they received the questionnaire.

The urban respondents had known about the proposed reservoir for an average of 4.07 years. This average was higher for the rural respondents with an average of 4.98 years.

1. How long have you known about the proposed reservoir?

Years	Urban No.	Urban %	Rural No.	Rural %
0-1	20	15.87	12	8.45%
2-3	50	39.68	41	28.87%
4-6	40	31.75	61	42.96%
7-10	12	9.52	23	16.20%
11+	4	3.18	5	3.52%
	126	100.00	139	100.00%

2. First learned about reservoir from what source?

	Urban		Rural	
	No.	%	No.	%
Another person	58	47.93	70	40.68%
The newspaper	48	39.67	78	45.35%
The radio	12	9.92	15	8.35%
The television	0	.00	1	.60%
Not sure	3	2.48	8	4.65%
	121	100.00	172	100.00%

Reservoir Attitude Analysis

Among the urban respondents 133 (89.26%) approved of the proposed reservoir; 15 (10.07%) disapproved and 1 (.67%) remained neutral on the subject. Of the rural respondents 142 (79.78%) approved while 33 (18.54%) disapproved and 3 (1.68%) remained neutral.

1. Degree of approval and disapproval

	Urban		Rural	
	No.	%	No.	%
(Approve)				
Approve, but it does not make that much difference to me.	22	16.54%	19	13.38%
Approve	36	27.07%	45	31.69%
Very greatly approve	75	56.39%	78	54.93%
	133	100.00%	142	100.00%
(Disapprove)				
Disapprove, but it does not make that much difference to me.	9	60.00%	5	15.15%
Disapprove	3	20.00%	12	36.36%

	Urban		Rural	
	No.	%	No.	%
Very greatly disapprove	3	20.00%	16	48.49%
	15	100.00%	33	100.00%

2. How much can you do to influence political decisions affecting your neighborhood?

	Urban No.	Urban %	Rural No.	Rural %
A very great deal	10	6.99%	6	3.51%
Quite a bit	11	7.69%	11	6.43%
Something	52	36.36%	46	26.90%
Can't do much	57	39.86%	98	57.31%
Can't do anything	13	9.10%	10	5.85%
	143	100.00%	171	100.00%

3. Is there anyone else at this address who would express an opposite opinion from the one you hold?

	Urban		Rural	
	No.	%	No.	%
Yes	4	2.92%	3	1.78%
No	133	97.08%	166	98.22%
	137	100.00%	169	100.00%

Economic and Recreational Analysis

1. Do you think the Reservoir would:

	Urban No.	Urban %	Rural No.	Rural %
Benefit the community economically	98	80.33%	132	77.19%
Have no economic effect	17	13.93%	20	11.70%

	Urban No.	Urban %	Rural No.	Rural %
Have a negative economic effect	4	3.28%	4	2.34%
Not sure	3	2.46%	15	8.77%
	122	100.00%	171	100.00%
2. Would you like to see this community increase in population?				
Yes	133	91.72%	114	68.67%
No	12	8.28%	52	31.33%
	145	100.00%	166	100.00%
3. What lake in Texas do you most often visit?				
Whitney	104	70.75%	97	54.80%
Other	3	2.04%	3	1.70%
None	40	27.21%	77	43.50%
	147	100.00%	177	100.00%

The above Table is based on two or more visits per year. Among the urban respondents that visit lake Whitney two or more times a year 27 (25.96%) stated that they also visit some other lake in Texas two or more times a year. Of the rural respondents that visit lake Whitney two or more times a year 15 (15.46%) said that they visit some other lake in Texas as well. The average number of visits per respondent for the rural group to Lake Whitney is 15.40 times per year and 17.04 for the urban respondents.

4. Number of visits per year to lake Whitney	Urban No.	Urban %	Rural No.	Rural %
2-10	53	56.99%	54	57.45%

	Urban No.	Urban %	Rural No.	Rural %
11-20	20	21.51%	18	19.15%
21-30	6	6.45%	5	5.32%
31-50	13	13.98%	12	12.76%
51+	1	1.07%	5	5.32%
	93	100.00%	94	100.00%

One hundred percent of the urban respondents knew where their source of water originated, and only 1 (.56%) of the rural respondents was not aware where his source of water originated.

Both groups felt that the most important reason the Aquilla Reservoir had been proposed was to provide a greater source of drinking and industrial water for the region. The second most important reason the reservoir had been proposed was to bring more business and industry into the area. The third most important reason was for more water and camping recreation outlets and the fourth reason was for flood control.

Land Inundation Analysis

Of the rural respondents 50 (28.09%) have land that will be inundated by the reservoir and 46 (25.84%) own or lease land that will be bordered. Only 1.32% of the urban respondents own or lease land that will be inundated by the reservoir and only 3.31% have land that will be bordered by the proposed reservoir, based on dam site "C." The average amount of land that would be covered by the proposed reservoir of the rural group that will be directly affected is 117.14 acres covered and 97.74 acres bordered.

1. Amount to be covered or bordered (assessment of rural respondents only)

Acres	Covered No.	Covered %	Uncovered No.	Uncovered %
0-10	4	9.52%	2	5.71%
11-50	16	38.10%	14	40.00%
51-100	9	21.43%	11	31.43%

Acres	Covered No.	Covered %	Uncovered No.	Uncovered %
101-200	8	19.05%	4	11.43%
201-500	3	7.14%	3	8.57%
501+	2	4.76%	1	2.86%
	42	100.00%	35	100.00%

Land Utilization Analysis

Among the urban respondents 24 (15.90%) owned or leased five or more acres. This compared to 116 (64.78%) of the respondents in the rural group that owned or leased more than 5 acres. However the average size farm owned by the urban respondent was larger than that of the rural respondent; 274.13 acres average for the urban respondent, and 219.31 acres average for the rural respondent.

1. Number of acres owned or leased

Acres	Urban No.	Urban %	Rural No.	Rural %
5-50	5	20.84%	16	13.79%
51-100	2	8.33%	35	30.17%
101-200	8	33.33%	33	28.45%
201-500	6	25.00%	20	17.24%
501+	3	12.50%	12	10.35%
	24	100.00%	116	100.00%

The rural respondent leased an average of 21.59 acres of land to someone else. This was 9.84% of the total land. As would be expected the urban respondent leased a larger proportion of his land to someone else. The average amount of acreage leased per urban respondent was 62.54 acres or seen in another way 22.82% of the land is leased to someone else.

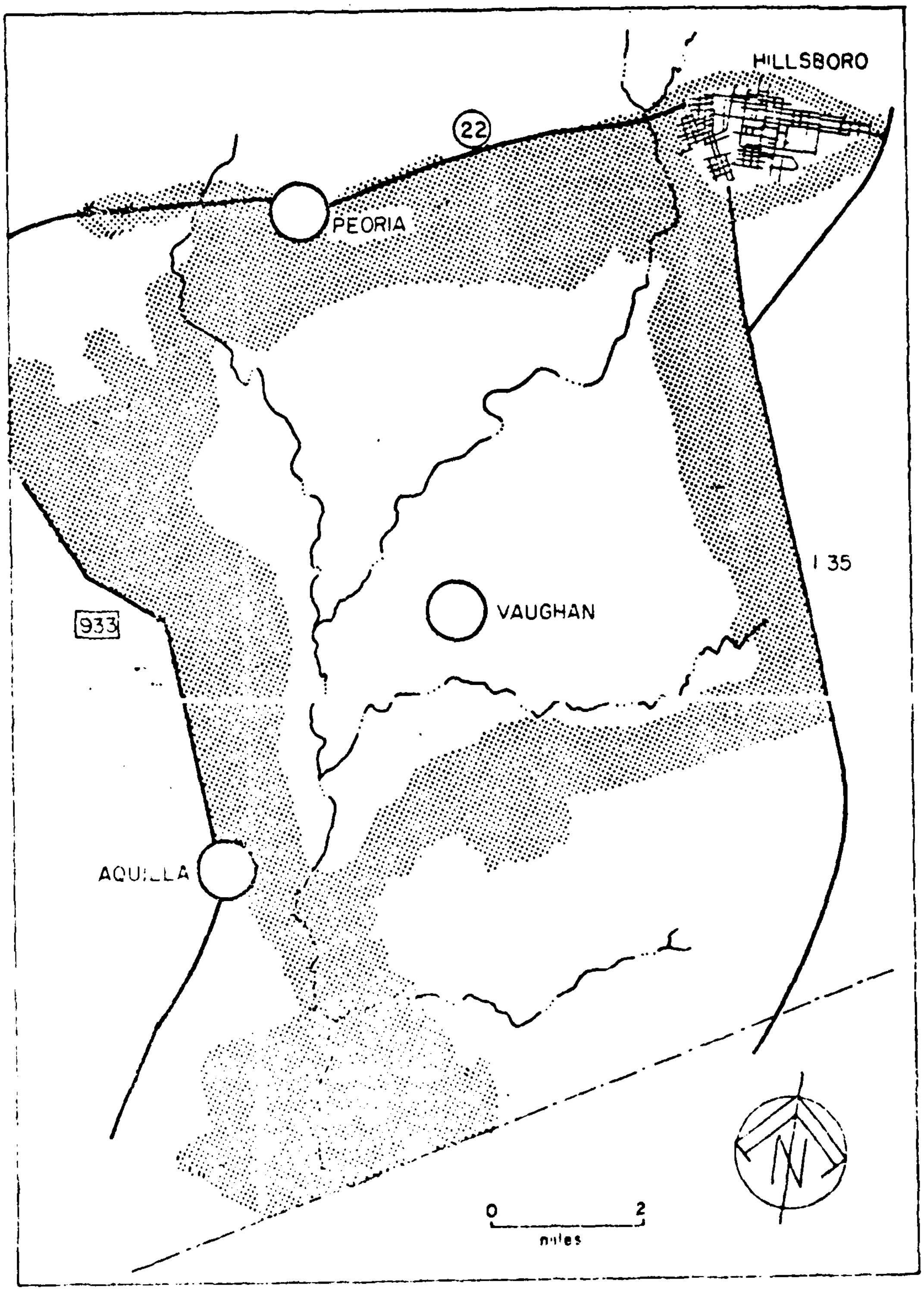
The average rural respondent that owned or leased five or more acres of land planted 14.45% of the land in maize and 19.41% of the land in cotton, and sold an average of 15.28 head of cattle per year. This compares to the average urban respondents utilization of 10.24% of his land cultivated in maize, 14.21 in cotton, and an average of 12.67 head of cattle sold per year per respondent. The total amount of land that was owned or leased by the rural respondents of five or more acres was 25,440 with the urban respondents' total being 6579 acres.

2. % of total income derived from farm:

	Urban No.	Urban %	Rural No.	Rural %
Less than ¼	6	30.00%	35	33.01%
¼	7	35.00%	23	21.07%
½	5	25.00%	9	8.50%
3/4	2	10.00%	6	5.66%
All	0	.00%	33	31.13%
	20	100.00%	106	100.00%

Analysis of West, Texas

Only one day was spent in West, Texas because of the poor response of the people to the survey. Most of the people contacted were either too suspicious of the questionnaire to complete it, or felt that the government was wasting money since they felt that everybody in the community was in favor of the proposed reservoir. However from talking to several people informally, including the mayor's wife, it does appear that West, Texas does want the proposed Aquilla Creek Reservoir very much and there appears to be very little opposition, if any. The respondents interviewed felt that the proposed reservoir was very important for the economic growth of West, and a necessity for drinking water in the future.



Figur 9 Geographic Area of Cultural Evaluation Study.

APPENDIX D

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LITERATURE CITED

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APPENDIX E

SUMMARY OF COSTS AND BENEFITS
USED FOR COMPARING ALTERNATIVES
TO THE PROPOSED ACTION

TABLE E-1

SUMMARY OF COST DATA USED FOR
ALTERNATIVES TO THE PROPOSED ACTION

	A	B	C	D	E	F	G	H	I	J
	Alternative Site A	Alternative Site B	Authorized Site	Alternative Site D	Tributary MP Lakes	Tributary FC Lakes Plus WS Import	Dry Lake plus trib WS Lakes	Dry Lake Plus WS Import	Purchase Fld Pln in Fee Plus WS Import	Purchase Fld Pln Easements Plus WS Import
	$	$	$	$	$	$	$	$	$	$
01 Lands & Damages	9,720,000	6,300,000	6,620,000	5,660,000	27,520,000	2,130,000	6,900,000	1,890,000	1,454,000	582,000
02 Relocations	8,010,000	4,400,000	6,819,000	6,027,000	9,420,000	7,210,000	12,341,000	5,428,000	-	-
03 Reservoir	915,000	920,000	884,000	845,000	1,948,000	1,833,000	2,041,000	93,000	-	-
04 Dam	15,237,000	16,694,000	15,945,000	11,336,000	23,343,000	18,620,000	36,846,000	13,634,000	-	-
08 Roads, Railroads & Bridges	112,000	112,000	112,000	112,000	448,000	448,000	560,000	112,000	-	-
14 Recreation	950,000	950,000	950,000	950,000	6,000,000	-	-	-	-	-
19 Buildings, Grounds & Utilities	300,000	300,000	300,000	300,000	1,000,000	1,000,000	1,180,000	180,000	-	-
20 Permanent Operating Equipment	200,000	200,000	200,000	200,000	700,000	700,000	806,000	106,000	-	-
30 Engineering & Design	2,670,000	2,475,000	2,617,000	2,123,000	4,984,000	3,742,000	6,224,000	2,053,000	-	-
31 Supervision & Administration	1,986,000	1,849,000	1,953,000	1,547,000	3,427,000	2,217,000	4,202,000	1,504,000	-	-
Water Supply Import	-	-	-	-	-	7,800,000	-	7.800.000	7,800,000	7,800,000
Total First Cost	40,100,000	34,200,000	36,400,000	29,100,000	58,800,000	45,700,000	71,100,000	32,800,000	9,254,000	8,382,000
Investment (1)	42,632,000	36,348,000	38,691,000	30,917,000	62,067,000	48,164,000	75,722,000	34,425,000	9,254,000	8,382,000
Capitalized Cost (2)	48,034,000	42,397,000	43,796,000	38,726,000	87,803,000	66,132,000	91,807,000	42,742,000	14,354,000	13,482,000

(1) Includes interest at 3¼ percent during the construction period for the project.

(2) Includes the investment cost plus the capitalized annual operation, maintenance, and major replacement costs. For those plans with water supply import it also includes capitalized annual repayment costs for water supply storage in lakes outside the basin and pumping costs.

APPENDIX E

SUMMARY OF COSTS AND BENEFITS
USED FOR COMPARING ALTERNATIVES
TO THE PROPOSED ACTION

1. General. The purpose of this appendix is to provide background data for costs and benefits used for comparing alternatives in Section 5 of the environmental statement. These data are preliminary. Subsequent to the alternative studies, the costs and benefits for the recommended plan were refined and updated for price level changes. Therefore, the values shown in this appendix are not readily compared to the economic data shown in other parts of the environmental statement although the methodology is similar.

2. Costs. A summary of cost data used in the alternative studies is presented in Table E-1.

3. Benefits.

a. Flood Control. Flood control benefits for Aquilla Lake and alternatives were computed incremental to the system of existing and authorized lakes in the Brazos River system. Under this arrangement a project would be credited with the difference in system benefits when computed with and without the project operating in the system. The average annual loss expectancy for the Aquilla Creek and Brazos River flood plains below Aquilla Lake exceeds $5,000,000. A detailed benefit analysis was applied to alternative C, the authorized site, and benefits for the other alternatives were estimated by comparing their controlled drainage areas with the alternative C drainage area. The flood control benefits include losses prevented on present and future development and benefits from increased land utilization. The annual benefits for alternative C are summarized as follows:

Flood losses prevented on present development	$353,500
Flood losses prevented on future development	208,100
Increase land utilization	392,800
Total	$954,400

These benefits capitalized over a 100-year period at 3-1/4 percent equal $28,167,000. Capitalized benefits for the other alternatives are listed in table 5-1 of the environmental statement. Benefits for purchasing the flood plain in fee (alternative I) would be limited to flood losses prevented to existing and future agricultural and structural development and land rentals on Aquilla Creek. Benefits for acquisition of this area by easements (alternative J) would be limited to flood losses prevented to future agricultural expansion and structural development.

b. Water Supply. Water supply benefits were assumed to be the annual cost of the best method available to local interests to obtain 9.7 million gallons of water per day (mgd) in the absence of the Federal project. It was assumed that water would be pumped from Lake Waco on the Bosque River and Belton Lake on the Leon River to the Hillsboro and west areas for about a 40-year period until a dependable in-basin source of supply would be needed to meet the growing water supply needs. At that time a water supply lake would be built on Aquilla Creek to provide the projected need of 9.7 mgd. The total first cost of this project would be about $24,600,000. The average annual equivalent cost of this project with all future costs discounted and using a 3-3/4 percent non-Federal and a 3-1/4 percent Federal interest rate would be $497,000. This includes all operation, maintenance, major replacement, and pumping costs. Capitalized over a 100-year period at 3-1/4 percent, this cost, used as a benefit, would have a value equal to $14,668,000. The same value was used for all of the alternatives considered.

c. Recreation. A local sponsor to share the costs of recreational development at Aquilla Lake in accordance with Public Law 89-72 was not found; therefore, benefits were based on the estimated visitation to the project assuming that facilities would be limited to those necessary for public health and safety. Average annual benefits were computed as follows:

General recreation	- 46,400	man-days @ $0.50 =	$23,200
Fisherman	- 60,000	man-days @ $1.00 =	60,000
Hunters	- 400	man-days @ $2.00 =	800
Total	106,800	man-days	$84,000

These benefits capitalized over a 100-year period at 3-1/4 percent equal $2,479,000 and were used for all alternatives with recreation potential except alternative F where they were reduced by 50 percent.

d. Redevelopment. Redevelopment benefits were quantified on the basis of dollar expenditures made into the redevelopment area as a result of constructing each alternative. These expenditures contribute to the alleviation of unemployment and underemployment and thus serve a national efficiency objective. For alternative C, the authorized site, the average annual redevelopment benefits were estimated as follows:

Construction component	- $47,500
Supervision and administration	- 9,300
Operation and maintenance	- 4,800
Total	$61,600

The capitalized value of these benefits would be $1,818,000.

APPENDIX F

BRAZOS RIVER AUTHORITY'S REPORT

APPENDIX F

Quality of Water in Proposed Aquilla Reservoir:

Sources and Effects of Pollution

and

Comments on Effect of Hillsboro

Wastewater Treatment Plant

Brazos River Authority

July 1972

Quality of Water in Proposed Aquilla Reservoir:
Sources and Effects of Pollution
and
Comments on Effect of Hillsboro
Wastewater Treatment Plant

TABLE OF CONTENTS

I - Proposed Aquilla Reservoir

I-01. Location. Aquilla Reservoir is a proposed multiple-purpose reservoir for flood control, water supply, and recreation and fish and wildlife enhancement at mile 20.7 on Aquilla Creek. (1) The damsite is 2.6 miles downstream of the confluence of Hackberry Creek with Aquilla Creek. The major urban areas on the reservoir watershed are Hillsboro and Itasca.

I-02. Size of Proposed Aquilla Reservoir. The Aquilla Reservoir will have a surface area of 4,560 acres at elevation 533.5, top of the conservation pool, and an area of 9,180 acres at elevation 555.0, top of the flood control pool. The water conservation storage will be 59,700 acre-feet, developing a total dependable water supply yield of about 15 cubic feet per second or 9.7 million gallons per day. The maximum design water surface, expected at intervals greater than 100 years, is 565.2. The average runoff into the reservoir is expected to be 70,870 acre-feet per year. (1)

I-03. Construction Schedule. It is anticipated that increased Federal funding will enable preconstruction planning to be expedited to permit the start of construction in Fiscal Year 1975. Even under such an accelerated schedule, it will take at least five years (1979) to complete the project. (2)

II - Quality of Water

II-01. Historical Water Quality Records. U. S. G. S. chemical composition of streamflow records for Aquilla Creek near Aquilla are available on a periodic basis during water year 1962 (Table I) and on a daily basis since water year 1965, except water year 1967 (Table II). Table III presents biochemical analyses for the water years 1968 through 1971.

II-02. Interpretation of Historical Water Quality Records.

A. Flow. The flow in Aquilla Creek near Aquilla varies from zero discharge to over 10,000 cubic feet per second (cfs). The average flow for 31 years of record is 114 cfs.

B. Dissolved Solids. The average dissolved solids concentration for water years 1966, 1968, and 1969 is 252 milligrams per liter (mg/l). In general, waters with a dissolved solids content less than 500 mg/l are considered fresh by the U. S. Public Health Service (PHS) and are suitable for domestic use. (3)

C. Hardness. The average calcium-magnesium hardness, the average non-carbonate hardness, and the average total hardness for water years 1966, 1968, and 1969 are 169, 48, and 217 mg/l, respectively. The hardness falls in the "very hard" range. (4)

D. Other Inorganic Constituents. The bicarbonate concentration averages 169 mg/l; the sulfate concentration, 105 mg/l. Although these concentrations are high, probably due to underlying geologic formation which will be discussed later, they are within the PHS recommendations for public water supply. Chloride concentration averages 12 mg/l for the above period and is considered very good.

Quality of Water in Proposed Aquilla Reservoir:
Sources and Effects of Pollution
and
Comments on Effect of Hillsboro
Wastewater Treatment Plant

TABLE OF CONTENTS

E. Nutrients. Nitrate concentrations for the water years 1966, 1968, and 1969 average 5.8 mg/l or 1.3 mg/l as nitrogen. This is well below the 45 mg/l limit for nitrate imposed on drinking waters by the PHS. (5) Phosphate determinations have been made periodically since water years 1968 and average approximately 0.27 mg/l or 0.09 mg/l as phosphorus. The ratio of these average concentrations for nitrogen and phosphorus is 14:1, indicating that the ratio falls within the range of 10-15 parts of nitrogen to each part phosphorus which is considered optimal for algal utilization. (6) The phosphorus concentration of 0.09 mg/l exceeds the often cited concentration of 0.01 mg/l considered to be the minimum value capable of supporting any algal growth (7) but is not considered adequate to support extensive algal blooms.

F. Dissolved Oxygen. Biochemical analyses for water years 1968 through 1971 indicate high dissolved oxygen concentrations, 25 percent of which were supersaturated. Algae are often the cause of supersaturated dissolved oxygen levels, and their respiratory requirements can cause low dissolved oxygen concentrations at night. All dissolved oxygen data was taken during the day, and none of the dissolved oxygen concentrations dropped below 6.4 mg/l.

G. Biochemical Oxygen Demand. Twenty-four samples were analyzed to determine biochemical oxygen demand (BOD) during water years 1968 through 1971. The average BOD was found to be 3.0 mg/l.

TABLE I

Periodic Sampling Data

Aquilla Creek near Aquilla
(TWDB, Report 55)

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3) (a)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated) Parts per million	Dissolved solids (calculated) Tons per acre-foot	Dissolved solids (calculated) Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Hardness as $CaCO_3$ Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
66. AQUILLA CREEK NEAR AQUILLA																					
Dec. 4, 1961	35.0	9.9		93	6.8	58		187	173	34	0.6	5.4		c473	0.64		260	107	1.6	727	7 [illegible]
Jan. 8, 1962	28.1	5.1		104	9.4	75		192	222	49	.5	4.0		c580	.79		298	140	1.9	876	7.[illegible]
Feb. 12	19.1	1.8		138	12	101		264	289	63	.7	4.8		c760	1.03		394	178	2.2	1,120	7 [illegible]
Mar. 19	17.0	--		--	--	--		176	--	66	.7	--		--	--		328	--	--	1,030	7.[illegible]
Apr. 24	28.6	8.6		135	15	139		295	321	85	.9	3.8		c903	1.23		398	156	3.0	1,260	7.[illegible]
June 4	3.53	8.7		108	9.1	72		199	210	54	.7	4.0		c583	.79		307	144	1.8	895	7 [illegible]
July 18	4.08	12		130	9.7	76		299	210	45	.8	2.0		c640	.87		364	120	1.7	966	7.[illegible]

TABLE II

Daily Sampling Data
Aquilla Creek near Aquilla
(U.S.G.S. Water Quality Papers)

-4- 137

BRAZOS RIVER BASIN—Continued

8-930. AQUILLA CREEK NEAR AQUILLA, TEX.

LOCATION.—At gaging station at bridge on Farm Road 1304, 0.8 mile upstream from Hollo Branch, and 1 mile southeast of Aquilla, Hill County.
DRAINAGE AREA.—306 square miles.
RECORDS AVAILABLE.—Chemical analyses: May to September 1965.
Water temperatures: May to September 1965.
REMARKS.—Where no potassium (K) is reported, sodium and potassium are calculated as sodium (Na). No flow Aug. 22, Sept. 17-20.

Chemical analyses, in parts per million, May to September 1965

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated): Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$: Calcium, Magnesium	Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
May 1-8, 1965	23.4	9.6		87	6.8	70	--	304	0	166	37	0.8	4.8		517	0.70	33.5	[illegible]	103	1.9	782	7.8
May 9-11	3527	9.6		40	1.5	12	--	174	0	37	6.6	--	3.0		170	.24	1700	[illegible]	22	.5	[illegible]	7.8
May 12-13	318	11		71	3.1	22	--	154	0	83	12	--	13		288	.39	390	[illegible]	64	.7	471	7.8
May 14-17	3630	10		46	1.5	6.7	2.7	124	0	71	4.3	--	2.8		[illegible]	.23	2950	121	19	.3	274	7.7
May 18-21	500	12		63	3.1	20	--	161	0	57	12	.8	4.2		251	.34	339	170	38	.7	410	7.8
May 22-31	50.2	16		92	9.8	63	--	164	0	160	64	.7	6.5		503	.68	68.2	270	135	1.6	792	7.8
June 1-12	21.6	11		115	13	78	--	198	0	251	88	.6	4.2		628	.85	36.6	340	178	1.8	980	7.8
June 13-30	10.0	11		163	18	109	--	315	0	334	78	.7	1.5		870	1.18	37.6	480	222	2.2	1320	7.7
July 1-31, Aug. 1-21, 23-31, Sept. 1-16	.6	10		72	6.6	44	3.8	130	0	184	30	.6	1.8		387	.53	.53	206	99	1.3	634	7.8
Sept. 21-23	30.0	7.8		52	3.6	39	--	160	0	101	23	.5	4.0		330	.45	35.9	144	13	1.1	540	7.8
Sept. 24-30	1.0	9.0		64	7.9	70	--	156	0	167	58	--	3.5		420	.58	1.15	183	64	2.2	670	7.8

-5- 180

BRAZOS RIVER BASIN—Continued

8-0935. AQUILLA CREEK NEAR AQUILLA, TEX.

LOCATION.—Lat 31°50'40", long 97°12'00", at gaging station at bridge on Farm Road 1304, 0.8 mile upstream from Hollo Branch, and 1 mile southeast of Aquilla, Hill County.
DRAINAGE AREA.—306 square miles.
RECORDS AVAILABLE.—Chemical analyses: May 1965 to June 1966 (discontinued).
Water temperatures: May 1965 to June 1966 (discontinued).
EXTREMES, October 1965 to June 1966.—Dissolved solids: Maximum, 737 ppm June 1-18; minimum, 186 ppm May 1-2.
Hardness: Maximum 403 ppm June 1-18; minimum 134 ppm Oct. 1-11, 19-22.
Specific conductance: Maximum daily, [illegible] micromhos June 17; minimum daily, 310 micromhos Apr. 30.
Water temperatures: Maximum [illegible]°F May 2[illegible], June 10, 14, 25, 27; minimum, 33°F Jan. 30.
REMARKS.—Where no potassium (K) is reported, sodium and potassium are calculated as sodium (Na).

Chemical analyses, in parts per million, October 1965 to June 1966

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated): Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$: Calcium, Magnesium	Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
Oct. 1-11, 19-22, 1965	2.8	10		46	4.6	175	6.0	370	0	160	82	1.1	5.6		620	0.84	4.76	134	0	6.6	1000	7.8
Oct. 12-18, 23-31	3.0	--		87	8.2	--	--	344	0	320	39	--	--		--	--	--	[illegible]	[illegible]	--	[illegible]	7.6
Nov. 1-4	177	8.8		61	3.9	20	--	124	0	83	12	.6	13		[illegible]	.30	134	166	62	1.0	[illegible]	7.8
Nov. 5-10	32.8	8.5		80	3.3	38	--	134	0	167	16	--	13		373	.51	33.0	213	104	1.1	[illegible]	7.8
Nov. 11-22	2.2	9.4		88	6.7	61	--	164	0	205	27	--	4.7		473	.64	2.76	233	102	1.7	720	7.8
Nov. 23-30	1.3	8.1		110	8.1	70	--	216	0	262	38	--	.5		594	.81	1.91	312	[illegible]	1.6	[illegible]	7.7
Dec. 1-17	2.1	10		120	8.4	124	--	250	0	344	80	.6	.8		749	1.02	4.33	[illegible]	[illegible]	[illegible]	1190	8.1
Dec. 18-19	31.5	12		65	7.3	106	--	250	0	140	61	--	10		368	[illegible]	43.1	[illegible]	[illegible]	[illegible]	[illegible]	8.0
Dec. 20-31	7.0	8.6		102	7.2	85	--	[illegible]	0	135	36	--	6.3		449	.61	9.56	[illegible]	[illegible]	[illegible]	702	7.8
Jan. 1-31, 1966	6.6	7.7		117	7.0	100	4.1	[illegible]	0	262	44	[illegible]	8.7		645	.80	9.80	[illegible]	[illegible]	[illegible]	1000	8.0
Feb. 1-8	6.0	7.6		100	5.6	132	6.7	312	16	210	67	.6	10		711	.97	9.36	[illegible]	13	3.2	1000	8.0
Feb. 9-11	77.7	7.9		78	2.8	38	8.2	[illegible]	0	155	13	--	1.6		351	.48	76.5	210	100	1.0	535	7.8
Feb. 12-28	10.7	7.0		107	3.8	64	5.6	316	0	100	30	--	13		523	.71	15.2	[illegible]	[illegible]	1.7	812	7.9
Mar. 1-27	11.0	6.2		90	4.5	67	4.3	314	0	100	32	.6	7.3		540	.69	15.0	[illegible]	[illegible]	1.8	[illegible]	7.8
Mar. 28-31	34.5	7.4		72	3.1	41	3.0	141	0	130	20	.6	6.6		353	.48	33.0	[illegible]	77	1.2	600	7.9
Apr. 1-13, 20-23	8.3	8.3		90	4.9	50	3.6	183	0	173	30	.7	2.6		459	.62	[illegible]	244	[illegible]	[illegible]	[illegible]	7.8
Apr. 14-19	15.7	8.8		[illegible]	8.1	83	6.7	[illegible]	0	229	37	.6	3.3		[illegible]	.79	24.6	[illegible]	[illegible]	2.1	[illegible]	7.8
Apr. 24-27	[illegible]	9.6		60	1.7	17	3.0	139	0	88	6.1	.5	6.4		246	.34	6030	157	41	.6	390	7.3
Apr. 28	205	--		--	--	--	--	[illegible]	0	--	16				--	--	--	[illegible]	[illegible]	--	[illegible]	7.8
Apr. 29-30	[illegible]	10		50	1.2	[illegible]	5.6	142	0	44	3.2	.2	8.2		186	[illegible]	1100	135	18	.2	301	7.8
May 1-2	4875	10		53	2.0	6.1	2.6	167	0	35	5.3	.1	3.5		186	.25	2530	140	24	.2	313	7.8
May 3-5	217	[illegible]		80	2.0	30	2.7	186	0	117	26	.3	[illegible]		336	.46	209	[illegible]	[illegible]	.9	[illegible]	7.7
May 6-19, 24-28	40.4	11		104	[illegible]	57	2.7	176	0	204	60	.3	3.3		524	.71	65.6	[illegible]	[illegible]	1.6	[illegible]	7.8
May 20-23	196	10		60	3.5	32	2.5	123	0	114	27	.6	2.3		341	.46	170	180	82	1.0	511	7.9
June 1-18	3.0	8.8		[illegible]	17	85	3.0	316	0	374	75	.6	6.6		737	[illegible]	[illegible]	[illegible]	[illegible]	2.1	1160	7.8
June 19-23	37.1	9.7		[illegible]	5.6	63	3.0	150	0	164	36	.6	7.4		[illegible]	.56	38.6	[illegible]	[illegible]	1.8	[illegible]	7.8
June 24-30	2.3	10		110	8.4	50	3.1	[illegible]	0	167	35	.1	2.0		[illegible]	.76	[illegible]	[illegible]	[illegible]	1.6	[illegible]	7.3
Weighted average	--	8.9		[illegible]	2.3	30	--	144	0	96	[illegible]	--	[illegible]		[illegible]	[illegible]	[illegible]	162	45	[illegible]	[illegible]	[illegible]
Time-weighted average	[illegible]	8.3		104	6.0	70	--	220	0	[illegible]	30	--	6.6		540	--	--	297	80	1.1	[illegible]	7.8
Tons per day	--	6.8		31	1.1	8.1	--	[illegible]	0	38	6.6	--	3.7		--	--	--	--	--	--	--	--

a Mean discharge for 273 days of chemical analyses.

BRAZOS RIVER BASIN

8-0935. AQUILLA CREEK NEAR AQUILLA, TEX.

LOCATION.--Lat 31°55'00", long 97°13'00", Hill County, at gaging station at bridge on Farm Road 1304, 0.8 mile downstream from Pitts Branch, and 1 mile southeast of Aquilla.
DRAINAGE AREA.--308 sq mi.
RECORDS AVAILABLE.--Chemical analyses: May 1965 to June 1966, October 1967 to September 1968.
Biochemical analyses: January to September 1968.
Water temperatures: May 1965 to June 1966, October 1967 to September 1968.
EXTREMES, 1967-68.--Dissolved solids: Maximum, 819 mg/l Sept. 1-24, 26-30; minimum, 148 mg/l Mar. 21.
Hardness: Maximum, 396 mg/l Aug. 1-31; minimum, 69 mg/l Mar. 21.
Specific conductance: Maximum daily, 1,250 micromhos Aug. 30; minimum daily, 288 micromhos Apr. 27.

CHEMICAL ANALYSES IN MILLIGRAMS PER LITER, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DATE	MEAN DIS-CHARGE (CFS)	SILICA (SIO2)	CAL-CIUM (CA)	MAG-NE-SIUM (MG)	SODIUM (NA)	PO-TAS-SIUM (K)	BICAR-BONATE (HCO3)	CAR-BONATE (CO3)	SULFATE (SO4)
OCT.									
01-14	.20	9.9	80	6.5	40	6.2	190	0	150
15-16	2002	9.2	32	1.2	8.9	2.7	136	0	19
17-21	35	9.9	80	6.9	40	6.2	190	0	150
22-28	6.1	10	100	6.6	57	6.6	240	0	171
29-31	2208	9.2	32	1.2	8.5	2.7	136	0	19
NOV.									
01-09	61	9.6	90	3.6	35	3.6	209	0	116
10...	1000	9.0	60	1.0	12	2.0	167	0	40
11-30	60	7.3	90	3.6	36	3.3	231	0	113
DEC.									
01-14	62	6.9	112	5.9	44	5.1	290	0	136
15-16	504	8.1	69	2.1	21	3.2	162	0	69
17-19	171	9.6	90	3.1	28	3.3	206	0	109
20-31	90	6.9	112	5.9	40	3.1	290	0	136
JAN.									
01-18	80	7.6	—	3.9	46	2.5	—	—	160
19-21	1040	10	75	2.7	25	3.1	161	0	90
22...	5630	11	35	1.8	11	3.0	146	0	41
23-31	469	10	80	3.2	20	2.0	191	0	101
FEB.									
01-26	367	11	80	3.3	20	--	200	0	69
27-29	80	7.0	120	6.0	42	—	265	0	150
MAR.									
01-10	72	8.0	—	5.2	—	--	--	--	109
11-12	1060	7.0	97	1.8	16	--	130	0	46
13-20	105	10	—	6.0	—	—	—	--	161
21...	2403	1.9	25	1.0	27	--	90	0	19
22-31	96	10	—	6.0	—	—	—	—	176
APR.									
01-02	1390	9.3	50	2.1	11	--	0	0	52
03-19	110	9.6	—	5.0	40	3.5	--	--	150
20-22	123	9.5	96	5.0	40	--	192	0	149
23...	682	10	72	3.0	21	--	161	0	77
24-26	65	9.5	--	5.3	40	--	—	—	142
27...	246	6.7	64	2.0	9.6	—	119	0	31
28-30	120	8.0	--	6.3	44	--	--	--	130
MAY									
01-03	49	9.5	105	6.3	40	--	229	0	162
04...	1616	8.4	50	2.7	9.9	--	137	0	32
05-07	72	10	90	5.5	16	--	187	0	121
08-12	4934	7.9	55	1.3	5.0	--	146	0	73
13-17	929	11	70	5.6	31	--	107	0	110
18...	3900	8.2	55	1.6	9.1	--	146	0	33
19-25	109	10	170	8.1	63	--	265	0	160
26-27	676	9.7	85	6.6	27	--	107	0	98
28-31	62	10	170	8.1	63	--	265	0	160
JUNE									
01-07	900	11	76	6.7	37	--	179	0	129
08-30	83	11	112	8.7	50	—	210	0	107
JULY									
01-02	17	7.0	70	6.1	49	2.7	129	0	166
03-19	11	7.5	126	9.6	64	--	250	0	208
20-21	27	7.0	70	6.1	49	2.7	129	0	166
22-31	6.9	7.5	120	9.6	64	--	250	0	208
AUG.									
01-31	1.3	6.9	126	19	106	—	200	0	319
SEPT.									
01-24	2.8	8.6	80	18	190	—	240	16	310
25...	95	7.6	63	8.0	67	—	172	0	133
26-30	2.0	8.6	80	18	100	—	240	16	310
WTD. AVG. TIME	—	8.6	63	2.6	16	--	191	0	60
WTD. AVG. TONS	396	8.9	100	6.9	61	—	219	2	172
PER DAY	—	7.9	66	2.2	19	—	156	0	96

-7-

BRAZOS RIVER BASIN

8-0935. AQUILLA CREEK NEAR AQUILLA, TEX.--Continued

EXTREMES, 1967-68.--Continued.
Water temperatures: Maximum, 30°C Aug. 18; minimum, 1°C Jan. 8.
EXTREMES, October 1965 to June 1966, 1967-68.--Dissolved solids: Maximum, 819 mg/l Sept. 1-24, 26-30, 1968; minimum, 148 mg/l Mar. 21, 1968.
Hardness: Minimum, 403 mg/l June 1-18, 1965; minimum, 69 mg/l Mar. 21, 1968.
Specific conductance: Maximum daily, 1,990 micromhos Aug. 30, 1968; minimum daily, 270 micromhos Apr. 30, 1968.
Water temperatures: Maximum, 30°C Aug. 18, 1968; minimum, 1°C Jan. 30, 1966 and Jan. 8, 1968.
REMARKS.--Where no potassium (K) is reported, sodium and potassium are calculated as sodium (Na). See Part I this report for remarks on diversions and return flows.

CHEMICAL ANALYSES IN MILLIGRAMS PER LITER, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DATE	CHLO-RIDE (CL)	FLUO-RIDE (F)	NITRATE (NO3)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	HARD-NESS (CA,MG)	NON-CAR-BONATE HARD-NESS	SPECI-FIC CONDUCTANCE (MICRO-MHOS)	PH
OCT.								
01-14	19	.6	1.0	426	218	62	666	7.8
15-16	3.0	.3	.8	186	135	25	300	8.1
17-21	19	.6	1.0	426	238	82	666	7.6
22-28	26	.5	3.0	537	288	85	766	7.3
29-31	3.0	.3	.8	186	135	25	300	8.1
NOV.								
01-09	20	.6	5.2	390	230	70	649	7.0
10...	7.7	.6	.0	228	171	30	388	7.8
11-30	20	.6	3.5	490	262	73	640	8.0
DEC.								
01-14	27	.8	4.5	459	296	91	726	7.9
15-16	15	.6	2.5	270	181	48	444	8.0
17-19	19	.5	2.5	376	252	85	509	8.1
20-31	27	.5	4.5	459	296	91	726	7.9
JAN.								
01-18	30	.3	7.0	—	--	—	760	—
19-21	15	—	6.7	307	198	66	495	7.8
22...	5.0	—	6.6	206	149	25	300	7.9
23-31	10	—	7.6	353	232	75	506	7.8
FEB.								
01-26	37	.6	8.6	361	229	64	569	7.6
27-29	32	—	7.0	483	310	117	802	7.9
MAR.								
01-10	39	.9	6.4	—	--	—	671	7.0
11-12	8.0	—	3.8	195	157	38	356	8.1
13-20	28	—	7.5	--	--	—	566	7.9
21...	10	—	.4	168	69	0	299	7.8
22-31	30	—	5.5	--	--	—	610	8.0
APR.								
01-02	10	—	9.4	211	153	153	376	7.9
03-19	35	.5	9.3	--	--	—	776	—
20-22	36	—	9.2	461	268	102	707	8.0
23...	19	—	6.9	248	192	88	406	7.7
24-26	32	—	5.1	--	--	—	706	—
27...	6.9	—	.1	159	118	20	288	7.6
28-30	20	—	4.0	--	--	—	650	—
MAY								
01-03	27	.9	3.3	403	288	100	756	8.0
04...	9.6	—	.2	197	136	26	356	7.8
05-07	20	—	3.0	196	247	96	549	8.0
08-12	3.6	—	2.2	167	138	10	290	8.0
13-17	20	—	3.2	369	242	90	622	7.9
18...	6.0	—	.0	186	144	26	277	8.1
19-25	40	—	4.1	509	317	132	817	7.9
26-27	25	—	2.0	361	230	81	572	7.6
28-31	40	—	4.1	505	333	132	817	7.9
JUNE								
01-07	26	.9	7.6	352	206	90	556	8.2
08-30	62	—	9.1	562	316	146	802	8.0
JULY								
01-02	30	.6	5.0	381	200	96	611	8.0
03-19	43	—	6.0	590	353	142	909	7.9
20-21	30	.6	5.0	381	200	96	611	8.0
22-31	43	—	6.0	590	353	142	909	7.9
AUG.								
01-31	60	.7	5.6	731	366	196	1110	7.7
SEPT.								
01-24	73	1.3	5.9	819	396	76	1250	8.9
25...	26	—	6.1	306	182	41	610	7.7
26-30	73	1.3	5.9	819	396	76	1250	8.9
WTD. AVG. TIME	11	—	3.6	293	166	46	460	7.8
WTD. AVG. TONS	39	—	9.1	503	279	90	773	7.0
PER DAY	30	—	3.0	—	—	—	—	—

-8-

406

BRAZOS RIVER BASIN

08093500 AQUILLA CREEK NEAR AQUILLA, TEX.

LOCATION.--Lat 31°50'00", long 97°12'00", Hill County, at gaging station at bridge on Farm Road 1304, 0.8 mile upstream from Pelts Branch, 1 mile southeast of Aquilla, and 1.2 miles downstream from Cobb Creek.
DRAINAGE AREA.--300 sq mi.
PERIOD OF RECORD.--Chemical analyses: May 1965 to June 1966, October 1967 to September 1969.
Biochemical analyses: January 1968 to September 1969.
Water temperatures: May 1965 to June 1966, October 1967 to September 1969.
EXTREMES, 1968-69.--Dissolved solids: Maximum, 853 mg/l Sept. 1-17; minimum, 180 mg/l Oct. 9-10.
Hardness: Maximum, 440 mg/l Sept. 1-17; minimum, 106 mg/l Oct. 9-10.
Specific conductance: Maximum daily, 1,770 micromhos Sept. 6; minimum daily, 219 micromhos Oct. 9.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DATE	MEAN DIS-CHARGE (CFS)	SILICA (SIO2) (MG/L)	CAL-CIUM (CA) (MG/L)	MAG-NE-SIUM (MG) (MG/L)	SODIUM (NA) (MG/L)	PO-TAS-SIUM (K) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	SULFATE (SO4) (MG/L)	CHLO-RIDE (CL) (MG/L)
OCT.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
NOV.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
DEC.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
JAN.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FEB.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
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APR.										
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MAY										
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JUNE										
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JULY										
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AUG.										
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SEPT.										
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WTD. AVG. TIME	--	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
WTD. AVG. TONS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
PER DAY	--	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]

BRAZOS RIVER BASIN

08093500 AQUILLA CREEK NEAR AQUILLA, TEX.--Continued

EXTREMES, 1968-69.--Continued.
Water temperatures: Maximum, 30.0°C July 23; minimum, 3.0°C Jan. 4, 5, 10, 11.
EXTREMES, October 1965 to June 1966, 1967-69.--Dissolved solids: Maximum, 853 mg/l Sept. 1-17, 1969; minimum, 140 mg/l Mar. 21, 1968.
Hardness: Maximum, 440 mg/l Sept. 1-17, 1969; minimum, 69 mg/l Mar. 21, 1968.
Specific conductance: Maximum daily, 1,990 micromhos Aug. 30, 1968; minimum daily, 219 micromhos Oct. 9, 1968.
Water temperatures: Maximum, 30.0°C Aug. 18, 1968, July 23, 1969; minimum, 1.0°C Jan. 30, 1966, Jan. 8, 1968.
REMARKS.--There no potassium (K) is reported, sodium and potassium are calculated as sodium (Na).

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DATE	FLUO-RIDE (F) (MG/L)	NITRATE (NO3) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	DIS-SOLVED SOLIDS (TONS PER AC-FT)	DIS-SOLVED SOLIDS (TONS PER DAY)	HARD-NESS (CA,MG) (MG/L)	NON-CAR-BONATE HARD-NESS (MG/L)	SODIUM AD-SORP-TION RATIO	SPECI-FIC CON-DUCTANCE (MICRO-MHOS)	PH (UNITS)
OCT.										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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NOV.										
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DEC.										
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JAN.										
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FEB.										
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MAR.										
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APR.										
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JUNE										
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JULY										
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AUG.										
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SEPT.										
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WTD. AVG. TIME	--	[illegible]	[illegible]	--	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WTD. AVG. TONS	--	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PER DAY	--	[illegible]	[illegible]	--	--	--	--	--	--	--

F-11

~~Table 1.—Biochemical oxygen demand and selected nutrients records of Texas surface waters~~

(Results in milligrams per liter except as indicated)

Date	Time (24 hour)	Discharge (cfs)	Ammonia nitrogen (N)	Nitrate nitrogen (N)	Nitrite nitrogen (N)	Total phosphorus (P)	Specific conductance (micromhos at 25°C)	pH (field)	Temperature (°C)	Dissolved oxygen (DO) mg/l	Dissolved oxygen (DO) Percent saturation	Biochemical oxygen demand (BOD)
8-0935. AQUILLA CREEK NEAR AQUILLA, TEXAS (31°50'40", 97°12'06")												
Jan 18, 1968		142		0.05		0.12	760	7.2	10	10.0	96	1.5
Feb 16		96		1.26		0.15	775	7.3	6	10.0	88	2.0
Mar. 21,		2,400		0.68		0.10	250	7.9	10	11.0	103	3.0
Apr. 15		55		1.74		0.07	750	7.7	20	8.4	95	1.8
May 13		633		1.13		0.02	638	7.9	22	7.8	91	1.8
June 10		41		1.76		0.07	971	7.7	28	7.0	90	1.0
July 18		4.2		0.59		0.03	959	7.4	27	6.9	87	.6
Aug 14		3.8		1.67		0.02	1210	7.5	27	7.8	99	1.1
Oct. 9	1600	465		0.18		0.09	119	7.5	20	7.6	84	6.0
Dec. 9	1040	10		1.38		0.25	798	7.7	6	11.0	91	1.9
Feb. 5, 1969	1750	6.3				0.27	1090	7.7	11	12.2	114	21.0
Feb 18	1145	21		2.48		0.49	876	7.8	8	11.2	97	4.1
Apr 10	1610	30		1.38		0.33	810	7.9	24	6.4	78	1.2
June 3	1750	19		0.88		0.06	1080	7.7	22	7.7	87	2.0
July 9	1540	0.05		0.43		0.06	1380	7.4	32	9.7	131	2.6
Aug 11	1320	0.46		0.09		0.03	1240	7.6	32	12.0	162	1.5
Oct 8	1305	0.27	--	0.0	--	0.09	929	7.4	20.0	6.4	70	3.2
Dec 2	1230	2.0	0.38	.5	0.01	.77	1400	7.5	10.5	7.4	66	3.1
Feb 12, 1970	0915	3.5	.00	2.7	.05	.57	923	7.8	9.0	10.2	88	6.3
Oct 22	1330	UNK	0.00	1.1	.02	.11				7.3	79	2.7
Dec 11	1120	UNK	0.03	0.3	.02	.27				8.4	79	5.3
Jan 30, 1971	1650	UNK	0.14	1.9	.06	3.2				11.8	116	2.1
Apr 24	1807	UNK	0.16	.0	.11	.19				7.6	85	2.3
June 24	1355	UNK	0.00	0.5	.02	.11				7.4	97	4.2

II 05. Sources, Effects, and Control of Pollution.

A. Inorganic Material. The geology of the Aquilla Reservoir Watershed is a significant source of inorganic material. The drainage area of Aquilla Creek is underlain by the Woodbine Formation of Late Cretaceous Age, which consists of crossbedded ferrunginous sandstone, clay, shale, and sandy clay interbedded with lignite and gypsiferous clay. Water issuing from or traversing these formations generally is fresh (1,000 mg/1 dissolved solids) but very hard (181 mg/1 hardness). The dissolved solids loading to Aquilla Reservoir, as determined from the monitoring station near Aquilla, will average 2,990 lbs./day. During the low flow, the principal chemical constituents are calcium, sulfate and bicarbonate. (4)

B. Organic Material. The principal sources are overland runoff and municipal wastewater treatment plant effluents. Except for lakeshore systems, septic tanks probably contribute very little because of long periods of time involved before reaching surface waters. (8) Organic material in rural runoff originates from crops and livestock. Table IV (9) shows that beef cattle have a population equivalent of 10. This means that each beef animal contributes as much BOD waste as 10 humans. The Texas County Statistics, by the Texas Department of Agriculture, indicates a beef cattle population of approximately 68,000 in Hill County. The portion of these in the Aquilla Reservoir watershed is nearly 20,000 cattle, producing approximately 34,000 lb. BOD/day. This waste is probably greatly reduced in strength before reaching the stream system.

TABLE IV

BOD Population Equivalents for Typical Animal Wastes

Animal	BOD Population Equivalent
Hogs	2
Beef	10
Dairy Cows	15
Chickens	0.1

Tables V (10) and VI (11) indicate the quality of urban runoff. Applying the Cincinnati, Ohio data to the Aquilla Reservoir watershed, the BOD from urban areas is calculated to be approximately 200 lb/day.*

* Use average runoff of 70,870 AF/YR (63.4 MGD) and 2% urban area.

BOD = (0.02) (19 mg/1) (63.4 MGD) (8.34) = 200 lbs./day

TABLE V

Quality of Urban Runoff

LOCATION	BOD (mg/l)	S.S. (mg/l)	TOTAL N (mg/l)	TOTAL P (mg/l)
Cincinnati, Ohio	19.00	227.00	3.10	.35
Seattle, Wash.	10.00	—	To 9.00	To .78
Detroit, Mich.	96.00 to 234.00	102.00 to 213.00	—	—
Madison, Wis.	—	—	1.74	.25
Ann Arbor, Mich.	28.00	2080.00	—	3.20
Houston, Texas*	20.00	—	3.80	.30

*Data from one flood - More detailed information to be published by the USGS at a later date.

TABLE VI

CONCENTRATIONS OF POLLUTANTS IN URBAN STORM RUNOFF
(PREVIOUS STUDIES)

	BOD mg/l	TS mg/l	SS mg/l	COD mg/l
1. Tulsa (1)				
Minimum	2	na	na	39
Maximum	26	na	na	199
Average	13	336	161	86
2. Oxney (2)				
Maximum	100	2,045	na	na
3. Detroit (2)				
Minimum	90	310	na	na
Maximum	234	914	na	na
Average	na	na	158	na
4. Washington (2)				
Minimum	6	na	26	na
Maximum	625	na	36,250	na
Average	na	na	2,100	na
5. Stockholm (2)				
Minimum	na	na	na	na
Maximum	80	3,000	na	3,100
Average	17	300	na	183
6. Moscow (2)				
Minimum	186	1,000	na	na
Maximum	285	3,500	na	na
Average	na	na	na	na
7. Leningrad (2)				
Average	36	14,541	na	na
8. Pretoria (2)				
Average	30	na	na	29
9. Los Angeles (2)				
Average	161	2,909	na	na
10. Cincinnati (4)				
Minimum	2	na	5	20
Maximum	84	na	1,200	610
Average	19	263	210	99

There are two municipal wastewater treatment plants in the Aquilla Reservoir watershed, at Hillsboro and at Itasca. The Texas Water Quality Board Permits for the cities are enclosed. Table VII (10)(12) indicates the organic material (BOD) in the effluents from various stages of treatment.

TABLE VII

BOD in Treated Domestic Wastewaters

Degree of Treatment	BOD (mg/1)
Untreated	250
Primary	200
Secondary	20
Tertiary with Lime Addition	9

NO. 10630

PAGE NO. 1 - This page supersedes and replaces page 1 of 1 of permit issued June 19, 1964.

TEXAS WATER QUALITY BOARD

1108 LAVACA STREET
AUSTIN, TEXAS 78701

PERMIT to dispose of wastes under provisions of Article 7621d-1, Vernon's Texas Civil Statutes

I. Name of Permittee
1. Name
2. Address
3. City

City of Hillsboro
P. O. Box 568
Hillsboro, Texas 76645

II. Type of Permit: Regular ______ Amended XXX

III. Nature of Business Producing Waste

Municipal Sewerage System

IV. General Description and Location of Waste Disposal System

Description: Bar screen, grit chamber, Parshall flume, primary clarifier, five stabilization ponds in series with the first three provided with mechanical aeration, sludge thickener, anaerobic digester, and sludge drying beds.

Location: Located on the west bank of Hackberry Creek approximately one mile south of State Highway 22 due west of the City of Hillsboro in Hill County, Texas.

V. Conditions of the Permit

1. Character, volume and disposal area(s) or point(s) of discharge authorized under this Permit. The conditions on the reverse side are a part of this Permit and apply for all purposes.

Character: Treated municipal sewage effluent

Volume: Not to exceed an average of 1,500,000 gallons per day; not to exceed a maximum of 3,000,000 gallons per day; not to exceed a maximum of 2100 gallons per minute.

Quality:

	NOT TO EXCEED		
Item	Monthly Average	24 Hr. Daily Composite	Individual Sample
B. O. D.	20 mg/l	25 mg/l	30 mg/l

Point of Discharge: A discharge by pipeline from the treatment plant to Hackberry Creek, thence to Aquilla Creek, thence to the Brazos River in the Brazos River Basin and as shown on the map submitted with the application.

2. Special Provisions

Area-wide Clause and Certified Operator's Clause Applicable and Attached.

3. This permit becomes effective September 11, 1969 and is valid until amended or revoked by the Board

ISSUED this 23rd day of September, 19 69.

Executive Director

For the Board

WQ87 WJ

PAGE NO 1 This page supersedes and replaces Page 1 of 1 of Permit issued July 22, 1963.

TEXAS WATER QUALITY BOARD

1108 LAVACA STREET
AUSTIN, TEXAS 78701

PERMIT to dispose of wastes under provisions of Article 7621d-1, Vernon's Texas Civil Statutes

I. Name of Permittee

1. Name
2. Address
3. City

City of Itasca
P. O. Box 686
Itasca, Texas 76055

II Type of Permit: Regular _____ Amended xxx

III Nature of Business Producing Waste

Municipal Sewerage System

IV. General Description and Location of Waste Disposal System

Description: Oxidation ditch with Parshall flume, bar screen and 2 oxidation lagoons.

Location: One mile south of Itasca between old and new U.S. Highway 81 on Coleman Creek in Hill County, Texas.

V. Conditions of the Permit

1. Character, volume and disposal area(s) or point(s) of discharge authorized under this Permit. The conditions on the reverse side are a part of this Permit and apply for all purposes.

Character: Treated municipal sewage effluent

Volume: Not to exceed an average of 200,000 gallons per day; not to exceed a maximum of 400,000 gallons per day; not to exceed an average of 140 gallons per minute.

Quality:

	NOT TO EXCEED		
Item	Monthly Average	24 Hr. Daily Composite	Individual Sample
B.O.D.	20 mg/l	25 mg/l	30 mg/l

Point of Discharge: Into Coleman Creek adjacent to plant in Hill County, Texas; thence into Hackberry Creek; thence to Aquilla Creek; thence to the Brazos River in the Brazos River Basin.

2. Special Provisions

Area-wide clause and certified operator's clause applicable and attached.

3. This permit becomes effective July 25, 1968 and is valid until amended or revoked by the Board.

ISSUED this 14th day of August, 1968

Executive Director
Deputy

For the Board

WO87
js

The calculated loadings to Aquilla Reservoir due to the municipal wastewater treatment plant effluents are shown below at the maximum permitted BOD, 20 mg/l.

TABLE VIII

LOADINGS FROM MUNICIPAL EFFLUENTS

Degree of Treatment	City	Avg. Permitted Flow (MGD)	BOD (lbs./day)
Secondary	Hillsboro	1.5	250
	Itasca	0.2	33
	Total	1.7	283
Tertiary with Lime Addition	Hillsboro	1.5	113
	Itasca	0.2	15
	Total	1.7	128

The effect of BOD is to exert a demand on the dissolved oxygen of the receiving water in order to oxidize biochemically the organic material. If the demand is very great, the dissolved oxygen content may be depleted and anoxic conditions may result. The previous calculations indicate the amount of organic material produced at various sources but do not indicate the amount of organic material actually reaching the stream system. Hence, comparison of Aquilla watershed with similar ones in the area may be the best way to predict future water quality. Neither Waco nor Whitney Reservoirs have water quality problems associated with organics. In both cases, the organic concentrations are low and the dissolved oxygen levels are high. Therefore, organics are not expected to have a significant effect on the water quality in Aquilla Reservoir as long as the municipal wastewaters receive secondary treatment. Should additional control of organic loading be necessary, then consideration should be given to septic tank licensing in developments around the reservoir, storm water treatment, and additional treatment of the municipal wastewaters.

C. Nutrients. Common sources of nutrients are septic tanks, overland runoff, and municipal wastewater treatment plant effluents. An average septic tank effluent contains significant concentrations of nutrients as shown below in Table IX. (8)

Tables V (10), VI (10), and XI (11) indicate nutrient loadings in agricultural and urban runoff. Assuming the rural area is 98% of the watershed and using the average runoff of 70,870 AF/YR (1), the estimated nutrient contribution from rural and urban runoff is calculated below.

TABLE IX

NUTRIENTS IN SEPTIC TANK EFFLUENTS

Parameter	(mg/l)
Organic Nitrogen	10
Nitrite (as Nitrogen)	0
Nitrate (as Nitrogen)	0
Ammonia (as Nitrogen)	25
Phosphate (as Phosphorus)	6.5

ing these concentrations, assuming no losses until they reach the servoir, and assuming a total septic effluent of 0.1 MGD in the watered, the following are estimates of the nitrogen and phosphorus originting from septic tanks.

TABLE X

NUTRIENT LOADS FROM SEPTIC TANKS

Parameter	Stream Loading lb/day
N	29
P	5

bles V (10), VI (10), and XI (11) indicate nutrient loadings in agriltural and urban runoff. Assuming the rural area is 98% of the watered and using the average runoff of 70,870 AF/YR (1), the estimated trient contribution from rural and urban runoff is calculated below.

ral Runoff

(a) Nitrogen

(0.98) (294 mi^2) (640 ac/mi^2) (3 lb/ac/yr) =1516 lb/day

(b) Phosphorus

(p.98) (294mi^2) (640 ac/mi^2) (0.3lb/ac/yr) = 152 lb/day

ban Runoff

(a) Nitrogen

(0.02) (3.10 mg/l) (i.34)(70,870AF/YR) (8.93X10^{-4}mgd/AF/YR)=32lb/dy

(b) Phosphorus

(0.02)(0.35 mg/l)(8.34)(70,870AF/YR)(8.93X10^{-4}mgd/AF/YR)= 3.7 lb/dy

TABLE XI

Nutrients in Agricultural Runoff

LOCATION	N Lb./Acre/Yr.	P Lb./Acre/Yr.
Madison, Wisconsin	5.93 – 8.13	.36 – .40
Kaskaskia R., Ill.	–	.35
Yakima Valley, Wash. (Agricultural)	2.45 – 24.00	.92 – 3.88
Yakima Valley, Wash. (Forest)	1.30 – 3.00	.30 – .80

Table XII (10)(12) gives the nutrients in wastewater treatment plant effluent following various degrees of treatment.

TABLE XII

NUTRIENTS IN MUNICIPAL WASTEWATER TREATMENT PLANT EFFLUENTS

Treatment	N (mg/1)	P (mg/1)
Untreated	25	10
Primary	21	9
Secondary	15	6
Tertiary with Lime Addition	15	1

TABLE XIII

NUTRIENTS LOADS FROM MUNICIPAL WASTEWATER TREATMENT PLANTS

Degree of Treatment	City	Avg. Permitted Flow (mgd)	N (lbs./day)	P (lbs./day)
Secondary	Hillsboro	1.5	188	75
	Itasca	0.2	25	10
	Total	1.7	213	85
Tertiary with Lime Addition	Hillsboro	1.5	188	13
	Itasca	0.2	25	2
	Total	1.7	213	15

The nutrient loading estimates indicate that rural runoff contributes over 7 times as much nitrogen and 1.8 times as much phosphorus as the secondary effluent. Since many soils are capable of fixing large quantities of phosphorus and thereby making it unavailable to plants as a nutrient, the fixation capacity having been reported as high as 8,000 lbs P/acre to a depth of 6 inches (8), it is difficult to predict precisely the amounts or the effects of nutrients flowing into Aquilla Reservoir. If only the treated municipal wastewaters are considered a source of phosphorus, the concentration will be approximately 0.16 mg/1 as P. This concentration is in excess of the amount required to sustain any algal growth. Laboratory studies (13) to determine the effect of phosphorus on algal growth have shown that:

1. Some algae growth occurred at phosphorus concentrations as low as 0.02 mg/1.
2. Phosphorus concentrations of 0.03 to 0.1 mg/1 significantly inhibited the rate and density of algal growth.
3. Phosphorus concentrations below 0.2 mg/1 inhibited alga growth.
4. Any concentration above 0.33 mg/1 supports abundant algal growth.

5. To inhibit algal growth entirely would probably require removal of phosphorus to concentrations well below 0.02 mg/l.

Hence, it appears that the phosphorus concentration of 0.16 mg/l in Aquilla Creek will support algal growth but at an inhibited rate. Assuming no major changes in domestic use of phosphorus, the concentration of phosphorus in Aquilla Creek due to municipal effluents is not expected to increase since no significant population increases are anticipated for Hill County during the period 1975-90. (14)

The actual phosphorus loading to Aquilla Reservoir is likely to be greater than that of the municipal wastewater treatment plants alone. A comparison of Aquilla with Waco Reservoir where ortho-phosphate concentrations have been observed since 1965 and generally range below 0.4 mg/l (0.13 mg/l as P) without algae problems (24) indicate that nuisance algae problems in Aquilla Reservoir are not anticipated. Should nuisance algae problems arise and the source be identified as municipal wastewater treatment plant effluent, then steps should be taken to reduce the amount of phosphorus from that source. Two possible alternatives for the treatment facilities are tertiary treatment of the wastewaters and diversion of the treated effluent from the Aquilla Reservoir watershed.

Tertiary treatment by lime addition may be expected to reduce the reservoir influent phosphorus concentration to 0.04 mg/l. The cost of lime addition and clarification is estimated in Table XIV. (15)

TABLE XIV

ESTIMATED COSTS OF PHOSPHORUS

REMOVAL BY LIME ADDITION*

City	Capacity (MGD)	Lime Addition before Primary Settler Capital	Operating, ¢/1,000 gal.
Hillsboro	1.5	$ 54,000	3¢/1000 gal.
Itasca	0.2	14,000	4¢/1000 gal.

*Estimated costs for rapid mix facilities include new concrete basins, having a detention time of 1 minute at the design flow, and new mixers, with shafts and impellers constructed of stainless steel. Flocculation facilities consist of the addition of the necessary baffle walls and mixers to provide a flocculation chamber, having a detention time of 30 minutes, within existing circular settling basins. Estimated costs of these additions include an allowance for the Contractor's installation, overhead, and profit, plus an additional allowance of 20% of the construction cost for engineering and contingencies.

The cost per thousand gallons for adding single-stage lime treatment to an existing plant was determined by amortizing the capital cost at 6% over 25 years and adding the cost of chemicals. Operational expenses such as labor and power are not included. Investment figures for the lime storage and feed systems are not included. Lime costs per 1,000 gal. are based on a chemical cost of $20/ton with 90% available CaO at a dosage of 150 mg/l as CaO.

These costs do not include an allowance for additional equipment for sludge handling and disposal and corresponding operating costs. Since a considerable quantity of additional sludge is produced, this expense is likely to be substantial.

Another alternative would be diversion of the effluent outside the Aquilla Reservoir watershed. In the Synopsis of Hearing Report, Texas Water Quality Board, August 15, 1969, for the City of Hillsboro Application for a waste discharge permit, the applicant stated that diversion to a point below the reservoir would cost $400,000 (approximately $40,000 a mile) and pumping the effluent to the next drainage basin would cost $200,000. At the same cost per mile, it is estimated that the City of Itasca could divert their wastewater from the watershed by pumping less than 8,000 feet at a cost of approximately $60,000.

D. Coliforms and Viruses. Enteric Coliforms and viruses are introduced into the stream system by septic tank effluents, overland runoff, and wastewater treatment plant effluents.

The bacterial content in septic tank effluents is comparable to that of untreated domestic wastewater, approximately 10^6 organisms per milliliter. (16) Most of these are detained long enough in the soil adsorption fields to allow very high die-offs, making septic tank effluents a minor, almost negligible, source of coliforms to the stream system, with the possible exception of those systems in lakeshore developments.

Overland runoff contains numerous coliforms. Generally, these are harmless soil bacteria but sometimes include fecal organisms, possibly indicating the presence of sewage.

The greatest source of coliforms and viruses is wastewater. Huge numbers of coliforms, 10^5 to 10^8 bacteria per milliliter, are present in untreated sewage. (17) Of the total coliforms in untreated sewage, most will be fecal and as many as 25 percent may be fecal streptococci. (18) Average virus concentrations have been cited as 7 organisms per milliliter. (18) Wastewater treatment plants remove large percentages of these organisms by the various physical and biological treatment processes and by disinfection. The dieoff of coliforms and viruses has been studied in various streams and appears to depend on water quality and temperature. One study of lagoons demonstrated that 99.999 percent of the organisms were dead after 16 days (19); however, other studies have shown much longer dieoff periods. Viruses are able to survive in wastewater, natural water, and water supplies long enough to allow transmission to a human population. (20) Still another source (21) concluded that different types of enteric viruses vary widely in their resistance to chlorine and that at least some types of poliovirus, Coxsackie viruses, or ECHO viruses are more resistant to chlorine than are coliform or enteric pathogenic bacteria. Although some of these viruses are markedly more resistant to chlorine than coliform bacteria, it has been concluded that any enteric virus would be effectively destroyed by a free chlorine residual of 1.0 ppm, provided it could be maintained for about 30 minutes and the virus particles were not embedded in particulate material. (22)

Hence, the transmission of pathogenic organisms via water is a potential threat to human health wherever a natural water supply exists. Wastewater treatment plants must effectively disinfect their effluents to kill or inactivate these organisms, and water treatment plants must effectively disinfect their finished water to minimize this threat.

A study on coliform bacteria in 168 sewage treatment plant chlorinated effluents has indicated that 55.6 percent of the effluents contain 5 or less bacteria per milliliter. Nearly all effluents contained 50 or less bacteria per milliliter. (18)

The Texas State Department of Health requirements state that the desirable average number of fecal coliforms not exceed 2 per milliliter for water contact sports and that the desirable number of total coliforms not exceed 1 per milliliter for raw water supplies. (23)

Since the dieoff of these bacteria in the stream system is difficult to determine precisely, an estimate of the concentration of bacteria in the Aquilla Reservoir conservation pool (59,700 AF) after a period of 100 days assuming no dieoff and assuming uniform dispersion of the bacteria throughout the reservoir is

$$\frac{(50\ \text{bacteria/ml})\ (1.7 \times 10^{6}\ \text{gal/day})(100\ \text{day})}{(7.48\ \text{gal/cf})(59{,}700\ \text{AF})(43{,}560\ \text{cf/AF})} = 0.5\ \text{coliforms/ml}$$

and is 0.1 fecal coliforms/ml assuming 25% of the total coliforms are fecal.

These estimates are conservative in that some dieoff is expected during the period; yet, the estimated concentrations fall within the TSDH requirements.

E. Other Considerations. All estimates of organic, nutrient, and coliform loadings to Aquilla Reservoir are predicated on a well-treated secondary effluent from the wastewater treatment plants at Hillsboro and Itasca. To attain this standard, the plants should be operated effectively, and a continuous maintenance program should be carried on. To assure that all wastewaters are adequately treated, it is suggested that some alternative means of treatment be available at each stage of the treatment process in the event of a major breakdown. It is recommended that planning and construction schedules precede expected demands placed on the system by increasing wastewater flows, if and when they occur.

III - Conclusions

III-01. General. Aquilla Reservoir is intended to be a multi-purpose reservoir, two of its uses being water supply and recreation. Although no problems are anticipated in the foreseeable future, these uses are sensitive to pollution. Based on continuing testing of the reservoir, should water quality problems arise, it may be necessary to reevaluate the effects on the reservoir from the various sources of pollution. Significant control of organics, nutrients, and enteric organisms may be achieved through efficient agricultural management, through proper design and operation of wastewater treatment plants, through proper construction and operation and licensing of septic tank systems, especially in lakeshore developments, and through storm water treatment.

III-02. Hillsboro Wastewater Treatment Plant. No eutrophication problems in Aquilla Reservoir due to well-treated secondary effluents from the Hillsboro and Itasca wastewater treatment plants are anticipated in the foreseeable future; however, should any arise, the alternatives of advanced treatment for phosphate removal or diversion from the watershed may alleviate the problem. The plants are not expected to have a significant effect on the organic content of the reservoir nor the coliform and virus concentrations. Nevertheless, all use of the water from Aquilla Reservoir for human consumption should be given normal treatment and disinfection before distribution.

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SUMMARY ECONOMIC INFORMATION

ECONOMIC DATA EXTRACTED FROM US ARMY CORPS OF ENGINEERS GENERAL DESIGN MEMORANDUM "AQUILLA LAKE" COMPLETE DOCUMENT IS AVAILABLE AT US ARMY ENGINEER DISTRICT, TULSA, OK

PROPOSED AQUILLA LAKE DATA

SUMMARY OF TANGIBLE BENEFITS

(Jan 1973 prices)

Flood Control	$1,079,000
Water Supply	472,600
Recreation	84,000
Redevelopment	40,000
Total	$1,675,600
TOTAL FIRST COST	$27,100,000
ANNUAL FIRST COST (Includes interest and amortization @ 3¼% and operation and maintenance and replacements)	1,087,600
BENEFIT TO COST RATIO	1.5

ECONOMIC DATA 1/

Element	*Previously Proposed Plan 2/	*Previously Rejected Plan 3/	**Current Plan 4/
Total project costs	$27,100,000	$31,100,000	$44,900,000
Annual benefits			
Flood control	1,079,000	1,079,000	1,218,400
Water supply	472,600	822,200	968,900
Recreation	23,200	23,200	98,700
Fish and Wildlife	60,800	60,800	71,600
Redevelopment	43,400	48,100	62,200
Total	$ 1,679,000	$ 2,033,300	$ 2,419,800
Total annual charges	$ 1,091,800	$ 1,192,400	$ 1,710,700
Benefit-Cost Ratio	1.5	1.7	1.4

* January 1973 price base.
** April 1975 price base.

1/ Complete documents are available at U.S. Army Engineer District, Fort Worth, Texas.

2/ 5 mgd project. Nonquantifiable environmental benefits and costs are not reflected in this benefit-cost ratio. (Source: Draft Environmental Statement, Aquilla Lake, March 1974).

3/ 9.7 mgd project. Nonquantifiable environmental benefits and costs are not reflected in this benefit-cost. (Source: Design Memorandum No. 3, Phase I, Aquilla Lake, June 1974).

4/ 9.7 mgd project. Nonquantifiable environmental benefits and costs are not reflected in this benefit-cost ratio. (Source: GDM No. 3 - Phase II, Aquilla Lake, July 1975).

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10