DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

REPLY TO
ATTENTION OF

FEASIBILITY REPORT

FLOOD CONTROL ON MC GRATH CREEK
WICHITA FALLS, TEXAS

This feasibility report is a supplement to the Survey Report on Lake Wichita, Holliday Creek, Texas, and it contains a supplement to the Final Environmental Impact Statement on Lake Wichita, Holliday Creek.

US Army Corps of Engineers
Southwestern Division
Tulsa District

FINAL

July 1985

*PROPOSED REPORT

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PM

SUBJECT: McGrath Creek, Wichita Falls, Texas

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on McGrath Creek, Wichita Falls, Texas. It is accompanied by the reports of the District and Division Engineers. The report presents the results of feasibility measures to reduce flood damages in the McGrath Creek watershed at Wichita Falls, Texas. The study was conducted to supplement the Survey Report on Lake Wichita, Holliday Creek, Texas, which was authorized by P.L. 99-662, 99th Congress, 2nd Session in accordance with the report of the Chief of Engineers dated 9 July 1979.

2. The District and Division Engineers recommend implementation of a flood control project in Wichita Falls, Texas. The project consists of a new spillway for the existing Sikes Lake and a 3,600-foot-long concrete-lined channel along McGrath Creek from the new spillway to the confluence with Holliday Creek. Total first cost of the plan, based on October 1987 price levels, is estimated to be $9,100,000. Average annual charges, based on a 100-year period for economic analysis and an interest rate of 8-5/8 percent, are $926,000. Average annual benefits are estimated to be $1,511,000, and the benefit-to-cost ratio is 1.6.

3. I note that the recommended plan maximizes net National Economic Development benefits. I likewise note that the recommended plan for McGrath Creek fully complements the proposed project for Lake Wichita, Holliday Creek, Texas, which is reported in House Document 98-219 and authorized by P.L. 99-662, 2nd Session of the 99th Congress. The McGrath Creek project is considered too large in scope and in costs to be incorporated as a modification of the Holliday Creek project and, consequently, is the subject of a separate request for authorization. The McGrath Creek project is dependent upon the Holliday Creek project in that it requires the Holliday Creek improvements to provide an adequate outlet for its flood flows.

*This report contains the proposed recommendations of the Chief of Engineers. The recommendations are subject to change to reflect substantive comments.

CECW-PM
SUBJECT: McGrath Creek, Wichita Falls, Texas

4. I concur in the findings, conclusions, and recommendations of the reporting officers and recommend implementation in accordance with cost sharing, financing, and other requirements of the Water Resources Development Act of 1986 (WRDA 86). Based on the cost sharing reflected in WRDA 86, the estimated non-Federal costs would be $2,300,000, consisting of $700,000 as a cash contribution and $1,600,000 in lands, easements, rights-of-way and relocations.

5. The recommendations contained herein reflect information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

E. R. HEIBERG III
Lieutenant General, USA
Chief of Engineers

PERMIT No. 4283

TEXAS DEPARTMENT WATER RESOURCES

APPLICATION FOR PERMIT TO APPROPRIATE PUBLIC WATER
(SECTION 11.121, TEXAS WATER CODE)

Application No.: ______ Date Received: ______
Hearing Set For: ______ Date Granted: ______

1. Personal Data of Applicant:
   - A. Name: Midwestern State University
   - B. Mailing Address: 3400 Taft Blvd., Wichita Falls, Texas 76308
   - C. Telephone No.(s): Home: N/A Office: (817) 692-6611
   - D. Social Security or Federal I.D. No.: Fed ID No. 756001738

2. Dam, Reservoir and Watercourse Data (Direct Diversion Complete 2.B.[1] & 2.E.):
   - A. Type of Storage Reservoir: ☒ on-channel ☐ off-channel Date of Construction: Prior to 1955
   - B. Structure/Direct Diversion:
     - (1) Watercourse: McGrath Creek, tributary of Holliday Creek, tributary of Big Wichita River, tributary of ______, tributary of Red River, Red River Basin
     - (2) From County Seat and nearby town: inside city limits
       - a. Location from County Seat: ~~XXXXXX~~ ______ direction from Wichita Falls, Wichita County, Texas.
       - b. Location from nearby town (if other than County Seat): N/A ______ miles in a ______ direction from ______, a nearby town shown on county highway map.
     - (3) Station (*) on the centerline of the dam is S 33 ° 18 ' 33 W (bearing) 2235 feet (distance) from the Northeast corner of J.M. English Original Survey No. ___, Abstract No. 355, in Wichita County, Texas.
     - (4) Location of Dam: J.M. English Original Survey No. ___ Abstract No. 355, in Wichita County, Texas.
       (*) Centerline of spillway
   - C. Reservoir:
     - (1) Acre-feet of water impounded by structure at normal maximum operating level: 86 (Approx.)
     - (2) Surface area in acres of reservoir at normal maximum operating level: 21.5
   - D. (1) If this is a U.S. Soil Conservation Service floodwater retarding structure, provide the Site No. N/A and watershed project name N/A.
     - (2) Do you request authorization to close the "ports" or "windows" in the service spillway? ☐ Yes ☒ No
   - E. The drainage area above the dam/diversion point is 3,420 Acres (Acres or Square Miles).

3. Appropriation Request: None
   - A. Appropriated water will be used as follows: N/A

	Purpose*	Place of Use	Acre Feet Per Annum
(1)			
(2)			
(3)			

*If irrigation, list crop(s) to be irrigated ______

   - B. Diversion: N/A
     - (1) Location of point of diversion ______ ° ______ ' ______ (bearing) ______ feet (distance) from the ______ corner of ______ Original Survey No. ______, Abstract No. ______, in ______ County, Texas.

(3) The diversion will be (check all appropriate ...) existing or proposed):

☐ a. Directly from the stream
☐ b. From an (☐ existing or ☐ proposed) on channel reservoir
☐ c. From a stream to an (☐ existing or ☐ proposed) off channel reservoir
☐ d. From an (☐ existing or ☐ proposed) off channel reservoir
☐ e. Other method (Explain fully – use additional sheets if necessary)

(4) Rate of Diversion: N/A

a. Maximum __________ gpm

b. Diversion Facility

1. If by pumping plant:
   a. Number of pumps ______
   b. Type of pump ________
   c. Pump capacity each pump ________ gpm
   d. Portable pump ☐ Yes ☐ No

2. If by gravity: (check applicable provision)
   ☐ a. Headgate
   ☐ b. Diversion dam
   ☐ c. Other method (explain fully use additional sheets if necessary)

C. Return Water or Return Flow: N/A

Water which is diverted but not consumed as a result of the above stated use will be returned to ________________, tributary of ________________, tributary of ________________, ________________ Basin, at a point which is ______° ______' ______, (bearing ________ feet (distance) from the ________________ corner of ________________, Original Survey No. ________, Abstract No. ________, in ________________ County, Texas. *Annual* amount of return flow to said stream will be ________________ acre feet.

D. Surplus Water: N/A

Water which is diverted but not used beneficially will be returned to ________________, tributary of ________________, tributary of ________________, ________________ Basin at a point which is ______° ______' ______ (bearing) __________ feet (distance) from the ________________ corner of ________________ Original Survey No. ______, Abstract No. ______, in ________________ County, Texas.

4. General Information:

A. The proposed (existing) works will be (are) located on the land of Midwestern State University, whose mailing address is 3400 Taft Blvd., Wichita Falls, Texas 76308
(If applicant does not own land and does not have the power of condemnation, a copy of the easement or option for easement must be furnished.)

B. The lands proposed to be irrigated are described in a supplement attached to this application or on the application plans and contain None acres in the ________________ Original Survey No. ______, Abstract No. ______, in ________________ County, Texas. Out of this area ________ acres will be irrigated in any one year. The applicant(s) must provide a copy of the Warranty Deed(s) describing the applicant's overall tract with the recording information from the county deed records. (In the case of individuals, *all owners* of the *land to be irrigated must join* in the application.)

C. If a permit for the appropriation is granted, either in whole or in part, construction works will be begun within N/A after such permit is issued. The proposed work will be completed within ________________ from the date of issuance of permit.

5. Maps, plats, and drawings accompany this application as required by the Board's *Rules*.
See Maps and Narrative

Witness my hand at Wichita Falls, , Texas, this the 7th day of January, 19 85.

Jim Bruijes   Louis J. Rodriguez

Subscribed and sworn to as being true and correct before me on this the 7th day of January, 19 85.

BILLIE J. BUCK
Notary Public, State of Texas
My Commission Expires May 9, 1988

Notary Public, ________________ County, Texas

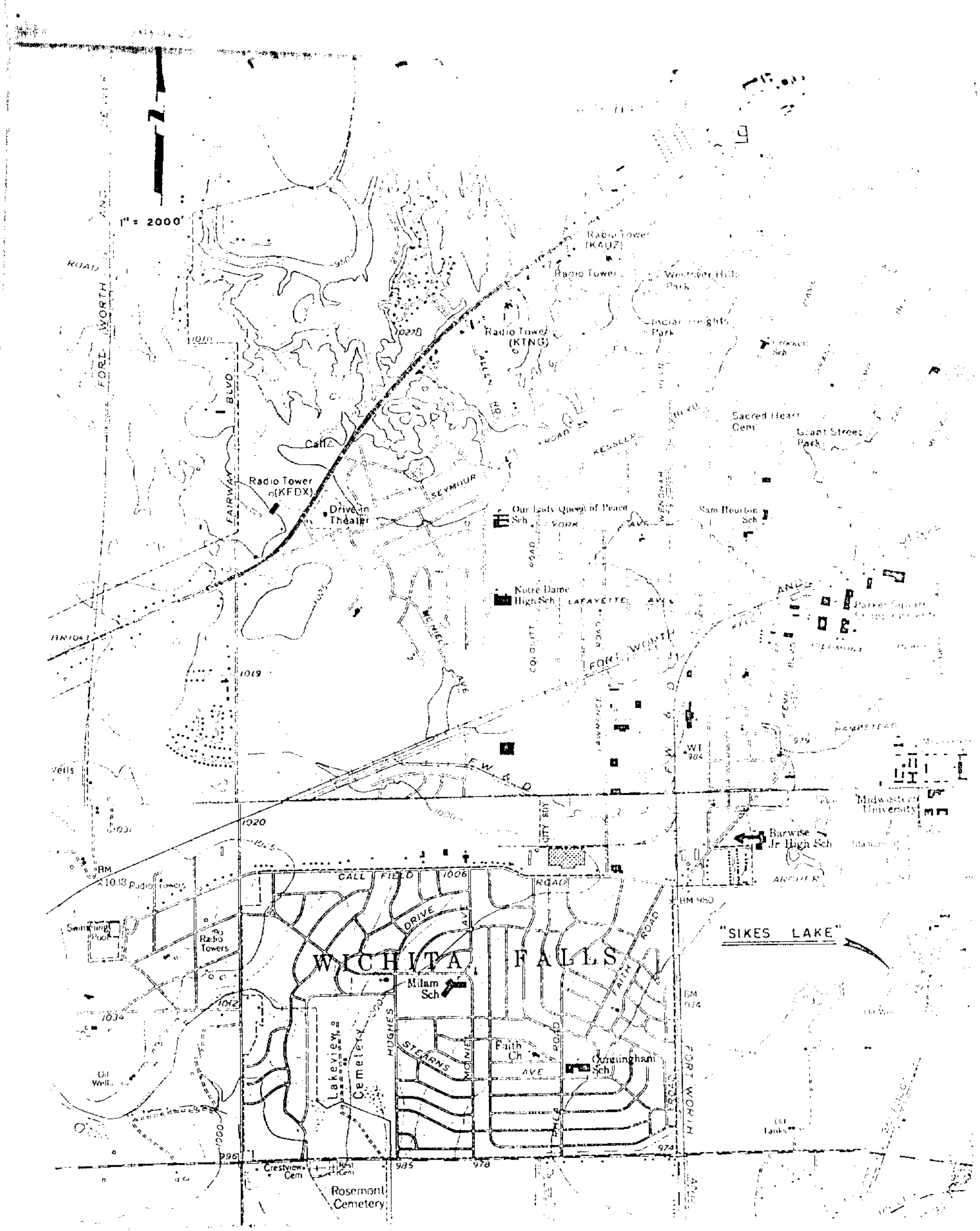
(ev. 4 19 82)

NARRATIVE:

Midwestern State University
Sikes Lake

The embankment on McGrath Creek was built by a private individual over thirty years ago using material dredged from the area upstream of the dam. McGrath Creek is a small, natural drainage channel that is dry except during excessive rainfall runoff.

Midwestern State University purchased the property about 1972 and further dredged the lake so that the facility could be used for instructional purposes for sailing and boating. The lake is presently being used for this purpose and no water is otherwise diverted or beneficially used. The dam, spillway and shoreline on MSU property is maintained by the University.



1" = 2000'
WICHITA FALLS
"SIKES LAKE"
Radio Tower (KAUZ)
Radio Tower
Radio Tower (KTNG)
Radio Tower (KFDX)
Drive-in Theater
Our Lady Queen of Peace Sch
Notre Dame High Sch
Sacred Heart Cem
Grant Street Park
Sam Houston Sch
Midwestern University
Barwise Jr High Sch
Milam Sch
Faith Ch
Cunningham Sch
Lakeview Cemetery
Crestview Cem
Rosemont Cemetery
Swimming Pool
Radio Towers
Oil Wells
Oil Tanks
FORT WORTH ROAD
FAIRWAY BLVD
SEYMOUR
KESSLER
YORK AVE
LAFAYETTE AVE
CALL FIELD ROAD
DRIVE
HUGHES
STEARNS
FAITH ROAD
ARCHER

[illegible] disposal at reduced [illegible]

26. Training Walls and Contraction Dikes. [illegible] constructed [illegible] in establishing self-maintaining sections of desired depth [illegible] channels. Training walls are constructed approximately parallel [illegible], with the wall becoming the [illegible] shoreline, whereas contraction dikes [illegible] nearly perpendicular to the existing shoreline.

The principal consideration in designing a training wall is to ensure its stability against wave attack, foundation erosion by tidal or river currents, and any possible loading behind the wall. Contraction should be used when the reduction in waterway width is relatively large, the shoal area is quite long, and foundations are not favorable to wall construction. The dikes, which usually are constructed of stone or wood or steel piling, should be permeable in some cases to produce a milder overall effect on the natural regimen of the waterway in which the harbor is located. As reliable design criteria are not available for determination of the most effective and economic system of contraction dikes, model tests should be conducted for major projects to establish the best plan of contraction works.

BREAKWATERS AND JETTIES

27. Definitions. A breakwater is defined as a structure employed to reflect and dissipate the energy of the approaching waves, thereby preventing or reducing wave action shoreward. Breakwaters for navigation purposes are constructed to create sufficiently calm waters for safe mooring, operating and handling of ships, and the protection of shipping facilities. A jetty is a structure extending into a body of water to direct or confine stream or tidal flow through selected channel limits to prevent or reduce shoaling within the channel, or to interrupt alongshore littoral drift to prevent its shoaling the channel.

28. Types. Some of the commoner types are:

Rubble Mound. This type, shown in Fig. 21, consists of an interior section, or core, of assorted sizes of stone, gravel, or other durable material, protected by one or more courses of larger, angular-shaped stone or manufactured concrete components. In areas where larger stone for the primary cover layer is not available economically, concrete tetrapods or tribars may be used, as shown in Figs. 22 and 23, respectively.

Composite. A composite structure is a combination of two or more specific types. The commonest consist of monolithic walls placed on underwater rubble mounds. The

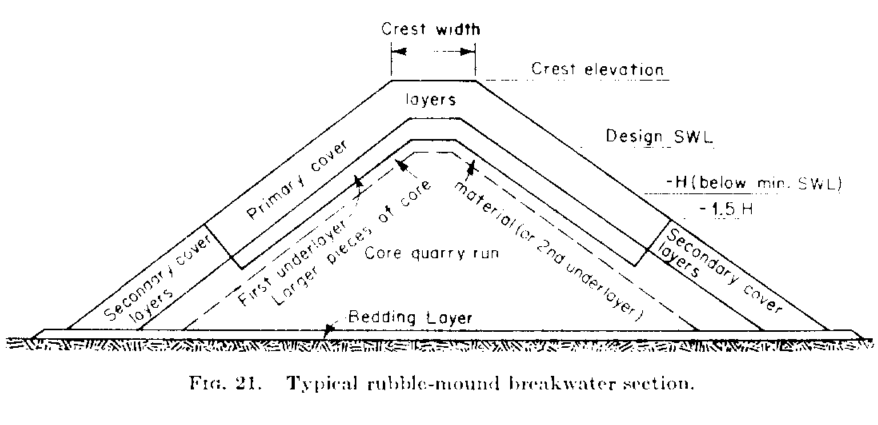


FIG. 21. Typical rubble-mound breakwater section.

SYLLABUS

This report presents the results of studies of the feasibility of measures to reduce flood damages in the McGrath Creek watershed at Wichita Falls, Texas. The study was conducted to supplement the Survey Report on Lake Wichita, Holliday Creek, Texas. The recommended plan for Lake Wichita, Holliday Creek was published as House Document 98-219 and is currently awaiting Congressional authorization for construction. The McGrath Creek study involved an analysis of the flood hazards, the development and evaluation of plans, and finally the recommendation of a plan of action which would complement the Lake Wichita, Holliday Creek project.

The 5.6-square-mile McGrath Creek watershed is a highly urbanized area within the city limits of Wichita Falls, Texas; a city with a population of 94,200 located in north-central Texas. McGrath Creek is a tributary of Holliday Creek which flows into the Wichita River. Sikes Lake, a shallow 20-acre impoundment, is located on McGrath Creek about 0.9 mile upstream of its confluence with Holliday Creek.

The flood hazards of the area are depicted through the devastation of the May 12 and 13, 1982, flood. The McGrath Creek watershed experienced an estimated $21.5 million in flood damages, $19 million of which occurred to properties downstream of Sikes Lake. Average annual damages in the McGrath Creek flood plain are estimated at $1.59 million with $1.25 million occurring to high value residential developments between Sikes Lake and the confluence with Holliday Creek.

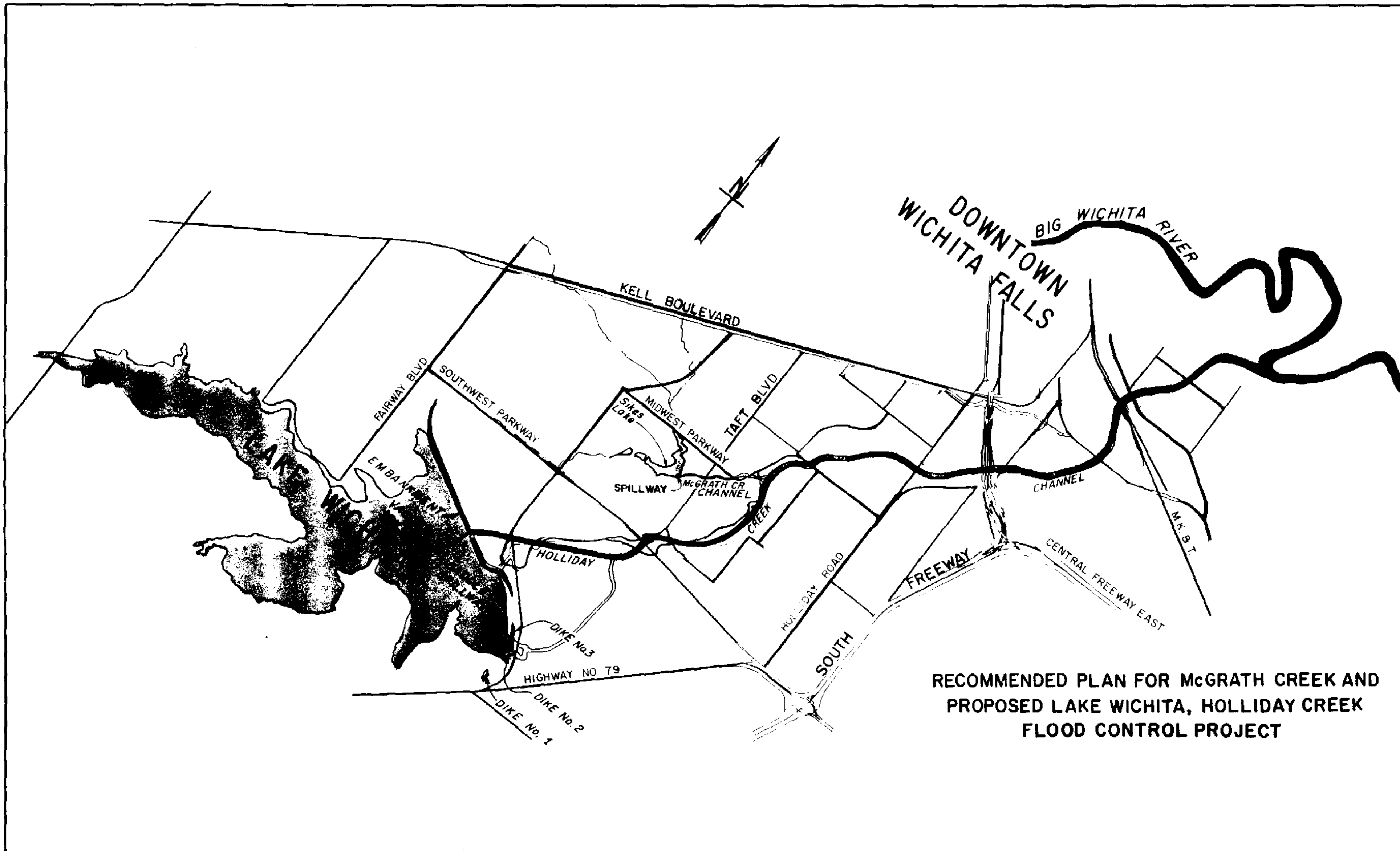
Several channelization plans for flood damage reduction were developed and analyzed during the course of this study. Various levels of flood protection were also evaluated. Plan 1A (the National Economic Development Plan) was selected as the recommended plan of action. It would provide a 100-year level of protection to properties subject to flooding along McGrath Creek between Sikes Lake and its confluence with Holliday Creek and it would also reduce flood damages to properties immediately upstream of Sikes Lake. The improvements would consist of a new 110-foot-wide spillway at Sikes Lake and a 3,600-foot-long, rectangular, concrete-lined channel with a 35-foot bottom width from the new spillway to a drop structure at the mouth of McGrath Creek. The channel would be constructed generally along the existing creek alignment.

The estimated construction cost of the selected plan is $8.46 million (April 1985 price levels). The estimated annual cost, at an 8-3/8 percent discount rate and a 100-year period of analysis, is $830,000, which includes $56,000 for annual operation and maintenance and major replacements. Under traditional cost sharing policies, the Federal construction cost would be $7.0 million and the non-Federal construction cost would be $1.46 million. The annual benefits would be $1.41 million. The benefit-to-cost ratio is 1.7 to 1.0.

The city of Wichita Falls and local residents strongly support the Lake Wichita, Holliday Creek Project which is currently before Congress, as evidenced by the city's willingness to contribute toward the cost of construction at a level greater than traditionally required. Local interests also support the plan of action for flood damage reduction on McGrath Creek. The plan recommended for McGrath Creek could be integrated with the proposed plan for Lake Wichita, Holliday Creek to achieve comprehensive flood reduction measures for a major portion of Wichita Falls, Texas.

The Tulsa District Commander finds a need to reduce flood damages along McGrath Creek and recommends that the selected plan, Plan 1A, be authorized for construction.

The following map shows an overview of the McGrath Creek and Lake Wichita, Holliday Creek project areas.



RECOMMENDED PLAN FOR McGRATH CREEK AND PROPOSED LAKE WICHITA, HOLLIDAY CREEK FLOOD CONTROL PROJECT

"Post Flood Report, Wichita Falls, Texas, Flood of May 12-14, 1982", Tulsa District, Corps of Engineers, August 1982.

Following the Wichita Falls flood of May 12-14, 1982, a post-flood evaluation report was prepared under the authority of Public Law 84-99, as amended. The report documented the storm, the water surface elevations, and the resulting flood damages on Holliday Creek, McGrath Creek, and Main Branch Plum Creek.

"Flood Insurance Study, City of Wichita Falls, Texas", US Department of Housing and Urban Development, Federal Insurance Administration, April 1979.

The study was performed by the Tulsa District Corps of Engineers and published by the Federal Insurance Administration (currently part of the Federal Emergency Management Agency). The study and report were prepared under the authority of the National Flood Insurance Act of 1968, as amended. The study included water surface profiles and flooded area maps for the Wichita River, Holliday Creek, McGrath Creek, and other significant flood sources in the city. The profiles and maps were the basis for establishing flood insurance premiums for the National Flood Insurance Program.

"Phase I Inspection Report, National Dam Safety Program, Sikes Lake, Wichita County, Texas, 1976". Inventory Number - TX01016, Fort Worth District, Corps of Engineers, April 1978.

The inspection of Sikes Lake Dam on McGrath Creek was conducted and a report of findings was prepared under the authority of the National Dam Inspection Act of 1972, Public Law 92-367. The purpose was to make a detailed, technical inspection and evaluation of the embankment and appurtenant structures and to review available engineering data to determine if the dam constitutes a danger to human life or property. The report stated that observations during the site inspection did not reveal any unsafe conditions. The report further stated that the structure did not meet recommended guidelines for spillway design flood. However, there were no problem areas requiring urgent action, and no Phase II inspection was required.

<u>"Flood Plain Information Report, Holliday and McGrath Creeks, Wichita Falls, Texas", Tulsa District, Corps of Engineers, May 1976</u>.

The report was prepared at the request of the City of Wichita Falls through the Texas Water Development Board under the authority provided by Section 206 of the Flood Control Act of 1960, as amended. The report included flood hazard information as an aid in planning for the best use of flood-prone lands and to contribute to the solution of local flood problems. The study area included 11.4 stream miles of Holliday Creek and about 2.0 miles of McGrath Creek.

<u>"Survey Report on Lake Wichita, Holliday Creek, Texas", Tulsa District, Corps of Engineers, 1976</u>.

This report was prepared under the authority of a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted February 25, 1938. The report recommended the construction of a plan for flood control on Holliday Creek which included raising and repairing the Lake Wichita Dam embankment, replacing the existing spillway, and constructing a 9.2-mile, grass-lined channel from the dam to the confluence with the Wichita River. The report was approved by the Assistant Secretary of the Army (Civil Works) and transmitted to Congress on April 25, 1984. The report, along with pertinent correspondence and supplemental information, has been published as House Document No. 98-219.

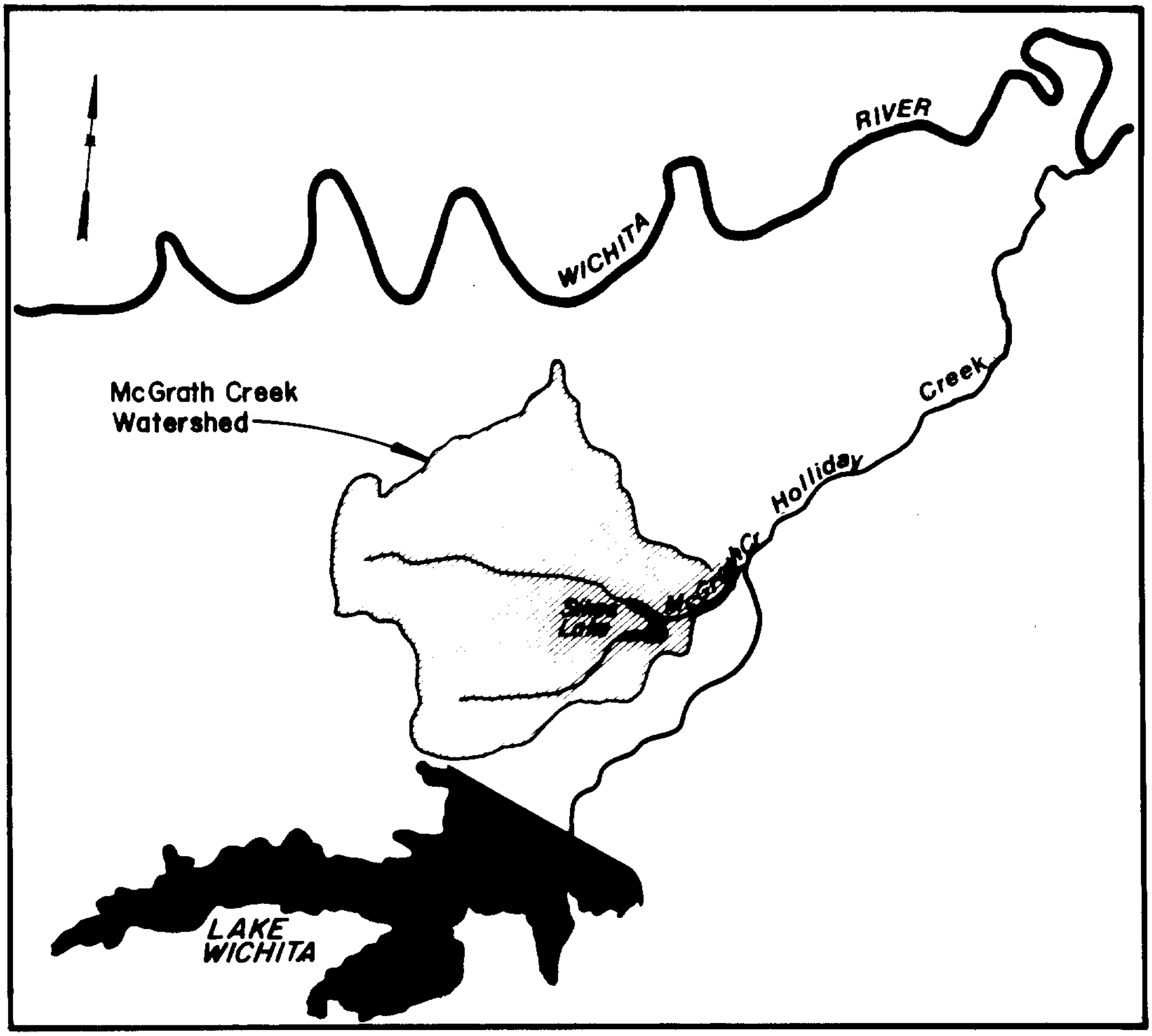
<u>"Final Environmental Impact Statement, Lake Wichita, Holliday Creek, Wichita Falls, Texas", 1979</u>.

This environmental impact statement was prepared by the US Army Engineer District, Tulsa, Oklahoma, March 1979, in accordance with the National Environmental Policy Act, as amended, 42 U.S.C. 4321, et. seq. The environmental statement was filed with the Environmental Protection Agency on March 5, 1981 and published in the <u>Federal Register</u> on March 13, 1981.

EXISTING WATER PROJECTS

Currently, no existing Federal water resource projects directly affect the McGrath Creek watershed. However, the proposed Lake Wichita, Holliday Creek project, which is in the detailed design phase of planning and engineering, would have to be constructed, or at least substantially underway, prior to initiating construction of any plan for McGrath Creek which would increase discharges or lower the channel invert at the confluence with Holliday Creek. The proposed plan for Lake Wichita, Holliday Creek would provide protection against the 100-year frequency flood below the Lake Wichita Dam.

BASE INFORMATION

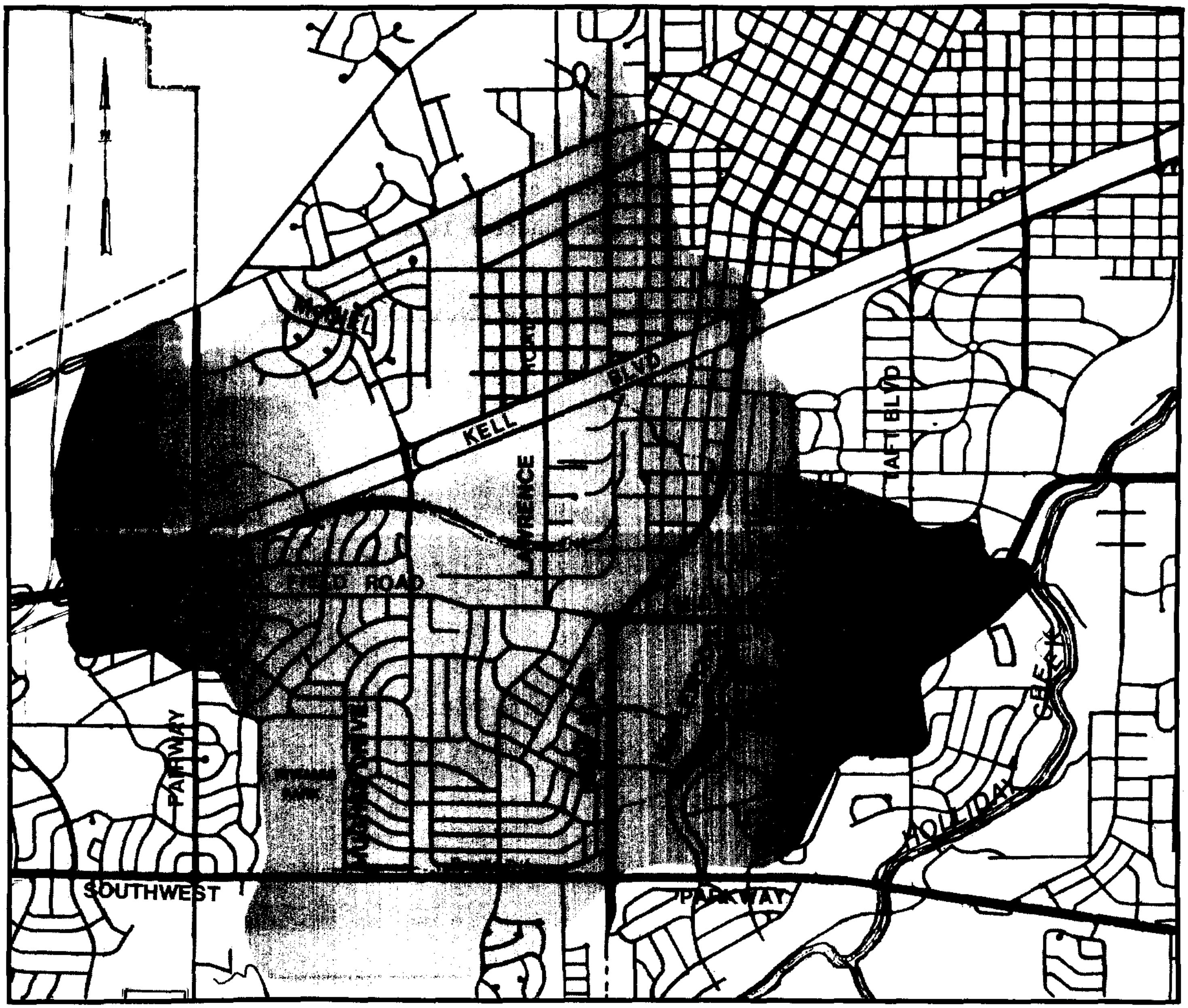


DESCRIPTION OF STUDY AREA

McGrath Creek is a tributary of Holliday Creek, a tributary of the Wichita River. The McGrath Creek watershed contains approximately 5.6 square miles and is about 90 percent urbanized, lying entirely within the corporate limits of Wichita Falls. The basin has an average slope of about 30 feet per mile. Sikes Lake is located at the confluence of two drainage courses (called the north and south tributaries in this report) of McGrath Creek about 0.9 mile upstream of the confluence with Holliday Creek (see figure 1). The northern tributary of McGrath Creek extends about 2.3 miles, and the southern tributary extends about 1.6 miles, upstream of the Sikes Lake Dam. Over 90 percent of the watershed's drainage area is upstream of the impoundment. Three-quarters of McGrath Creek and its tributaries are concrete lined.

Concrete-lined Channel on McGrath Creek

Immediately upstream of Sikes Lake is a commercial and residential area. The upper reaches of the southern tributary (west of Kemp Boulevard) are comprised of single-family residences. On the northern tributary (near Lawrence Road), the watershed opens into an industrial park. Further upstream along the northern tributary (near McNiel Boulevard) commercial and retail properties and single-family housing are predominate. Downstream of Sikes Lake, a series of low water dams form pools along McGrath Creek to create an aesthetically pleasing landscape for the single and multiple family housing developments adjacent to the streambank.



McGRATH CREEK WATERSHED

Figure 1

Apartments Located Immediately Adjacent to the McGrath Creek.

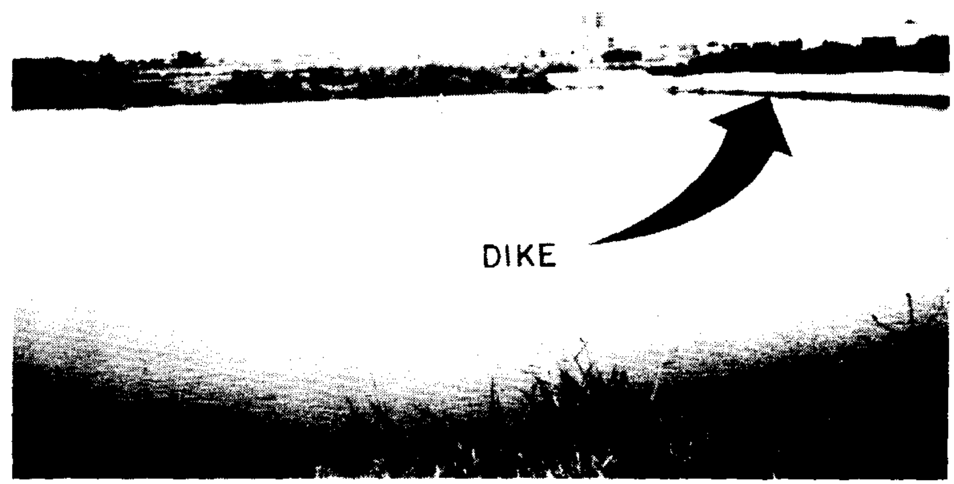
SIKES LAKE

Sikes Lake is a shallow (4 to 5 feet deep), 20-acre impoundment owned and operated by Midwestern State University. The lake is on the university campus and is used for recreational and educational purposes. The uncontrolled spillway is a 50-foot-long concrete weir with a short downstream apron, also of concrete. No stilling basins or other facilities have been constructed to dissipate the flowing water's energy; therefore, bank erosion occurs to the unimproved channel immediately downstream. A narrow paved roadway traverses the earthen side slopes of the lake and across the concrete weir of the spillway. The roadway is part of a service road/jogging trail which surrounds the main body of the lake. A 300-foot-long earthen dike across the northern arm of Sikes Lake creates a 4-acre subimpoundment. The dike is paved with concrete and is also part of the service road/jogging trail.

Sikes Lake Spillway

Sikes Lake Spillway and Concrete Apron

Bank Erosion Downstream of Sikes Lake



Dike Across Northern Arm of Sikes Lake

In 1978, Sikes Lake Dam was inspected under the authority of the National Dam Safety Inspection Act of 1972 (Public Law 92-367). The purpose of the inspection was to determine if the project constituted a danger to human life and/or property. The lake was categorized as a Class I (high hazard), project because of commercial and residential development immediately downstream. It is important to note that this classification is based solely on the dam's location with respect to local developments, not to its structural integrity.

The inspection revealed that the lake could be better described as a pool formed by a cut in natural ground rather than a body of water impounded by a typical built-up embankment. The east and south banks of the lake, usually referred to as the "embankment", are about 7 feet above the spillway crest (elevation 960.0).

Based upon the size of the lake and its high hazard classification, the spillway design flood should be the Standard Project Flood (SPF). Since it was determined through hydrologic analyses that the present embankment and spillway can only pass a flood with a magnitude of about 28 percent of the SPF without overtopping, the project is deficient from a recommended design standpoint. However, because there is no built-up embankment, a catastrophic break resulting in the release of a "wall of water" is not likely. Therefore, an inherently unsafe condition does not exist. No problem areas requiring urgent action were identified and no further inspection was recommended. The report summarized that any measures taken to reduce the design deficiency at Sikes Lake that would involve increasing the embankment height could create additional flood problems. It was therefore recommended that, if the deficiency were corrected, consideration should be given to increasing the spillway capacity.

In August 1984, the Texas Department of Water Resources (TDWR) reviewed the Sikes Lake Dam Safety Report and concurred with the view that although the structure does not meet recommended guidelines for the spillway design flood, there appears to be no significant hazard to downstream lives or property. The TDWR further stated that no corrective dam safety measures are anticipated to be required (see TDWR letter in Appendix B).

SOCIAL SETTING AND POPULATION

Wichita Falls is a city with a population of 94,201 (1980 census) in north-central Texas, approximately 12 miles south of the Texas-Oklahoma state line. Originally a trading center on the Fort Worth and Denver rail line, the city has grown to include a variety of manufacturing plants and a large military installation, Sheppard Air Force Base. The city is the major retail trade center between Dallas and Amarillo. The population has generally declined over the past 20 years. The 1970 population was 96,654 compared to the 1960 population of 101,724. A major factor in the decline is attributable to a decrease in military personnel at the Air Force base. Civilian population in the city grew by 4 percent between 1970 and 1980, from 83,570 to 86,936. Some areas in the city experienced rapid growth in the last ten years. The population in the McGrath Creek watershed immediately downstream of Sikes Lake grew by 34.8 percent between 1970 and 1980. This area is characterized by relatively high income and high-value residential properties. It is estimated by the city of Wichita Falls that 1,847 residential housing units were constructed in the area of Sikes Lake between 1970 and 1980.

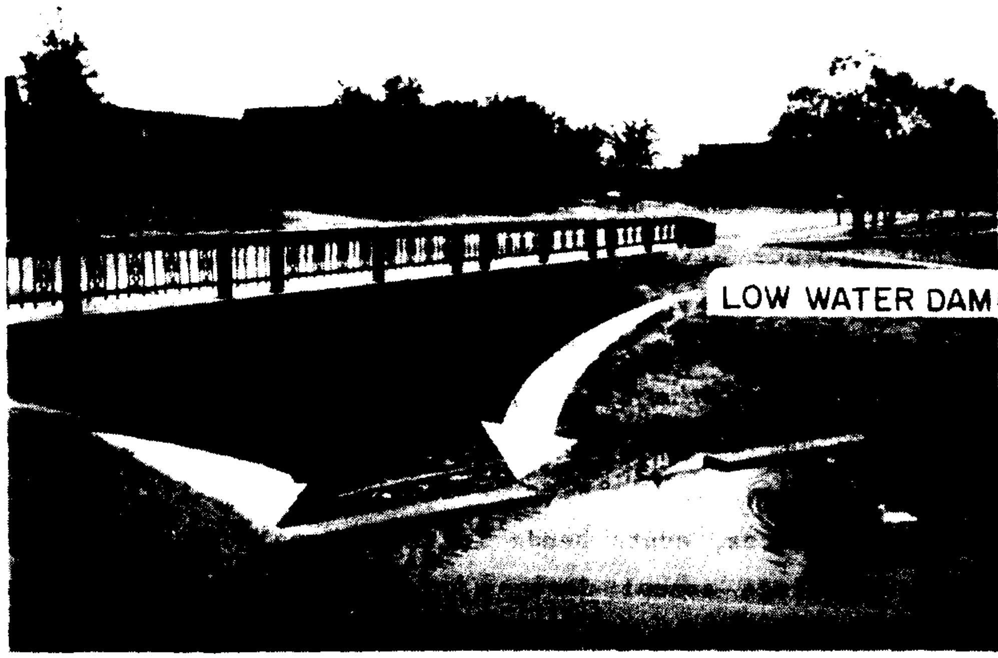
ENVIRONMENTAL SETTING

McGrath Creek and its tributaries are intermittent streams. Aquatic life in the stream is extremely limited and streambank vegetation is predominantly bermuda grass.

Sikes Lake contains several species of organisms. Siltation, shallow water, and poor water quality prohibit the development of a more diverse aquatic system. Midwestern State University (MSU) utilizes the lake for teaching biology and recreation courses.

The McGrath Creek flood plain downstream of Sikes Lake is obstructed by residential developments. This reach has several concrete-lined segments. The area from Taft Boulevard to Midwestern Parkway has a series of low water dams. Pools formed by these dams offer limited habitat for aquatic species. Primarily, the same species inhabiting Sikes Lake are found in these pools.

Only terrestrial species adaptable to an urban environment are present. Some migratory waterfowl and domestic waterfowl use Sikes Lake and the low water pools.



Cedar Elm Bridge and Low Water Dam

Waterfowl on Sikes Lake

No Federally proposed or listed threatened or endangered species inhabit the McGrath Creek watershed.

More specific information on the environmental setting is included in the Environmental Impact Statement immediately following this report.

FLOODING PROBLEM

In the Wichita Falls area, intense, localized thunderstorms may occur during any time of the year, but generally occur from May through October. Such storms may produce severe flooding on commercial, residential, industrial, and public properties located in the flood plain of McGrath Creek. The area of greatest flood damage potential is below Sikes Lake which has a channel capacity less than the discharge of the 5-year frequency flood. The Sikes Lake spillway has a discharge capacity less than the 50-year frequency flood event. Obstructions in the floodway include residential and commercial buildings, bridges, fences, acute bends in the channel alignment, debris, and low water dams. Average annual damages on McGrath Creek are estimated at $1,590,000 of which $1,250,000 are downstream of Sikes Lake (see Appendix A). Figure 2 shows the Standard Project Flood (SPF) Flood Plain in the McGrath Creek watershed.

FLOOD OF MAY 1982

On May 12 and 13, 1982, a slow-moving frontal system crossed Texas and Oklahoma. The moist, unstable air mass of this system combined with a strong upper-level disturbance to generate heavy thunderstorms over the Wichita Falls area in the afternoon and evening of the 12th and the next morning. By 7:00 a.m., May 13th, Wichita Falls had received over 5 inches of rain at the official weather station. Unofficial rain gage reports in Wichita Falls indicated that up to 10 inches of rain fell in the McGrath Creek watershed in a 12-hour period. Highwater marks indicated that the May 1982 flood was between a 50- and 100-year frequency event. On McGrath Creek, severe flooding occurred along both tributaries and below Sikes Lake. Flooding extended from immediately west of Kemp Boulevard to the mouth of McGrath Creek. However, the greatest damages were downstream of Sikes Lake. About 90 percent of the flood damages on McGrath Creek occurred there, with many single and multiple family dwellings sustaining up to 3 feet of flooding. Table 1 displays the estimated flood damages on McGrath Creek as a result of the storm. Of the $21,460,000 total damages, an estimated $19,000,000 occurred to properties below Sikes Lake. In addition to stream bank overflow, a segment of the Sikes Lake embankment was overtopped as the water surface in the lake rose from the spillway crest elevation of 960.0 feet to an elevation above the top of the embankment which is at about elevation 967.0. (All elevations in this report are based upon the National Geodetic Vertical Datum [NGVD].)

TABLE 1

ESTIMATED FLOOD DAMAGES
MC GRATH CREEK
May 12-13, 1982

Type of Property	Units	Damages (in Dollars)
Residential		
Single Family	413	13,530,000
Multiple Family	582	7,230,000
Commercial and Industrial	4	60,000
Public, Semi-Public, and Utilities	----	640,000
TOTAL	999	21,460,000

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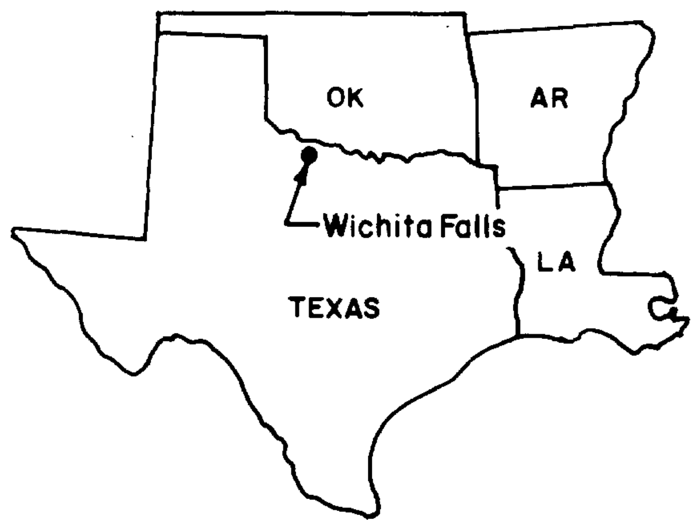
FIGURES

FLOOD CONTROL ON MCGRATH CREEK

WICHITA FALLS, TEXAS

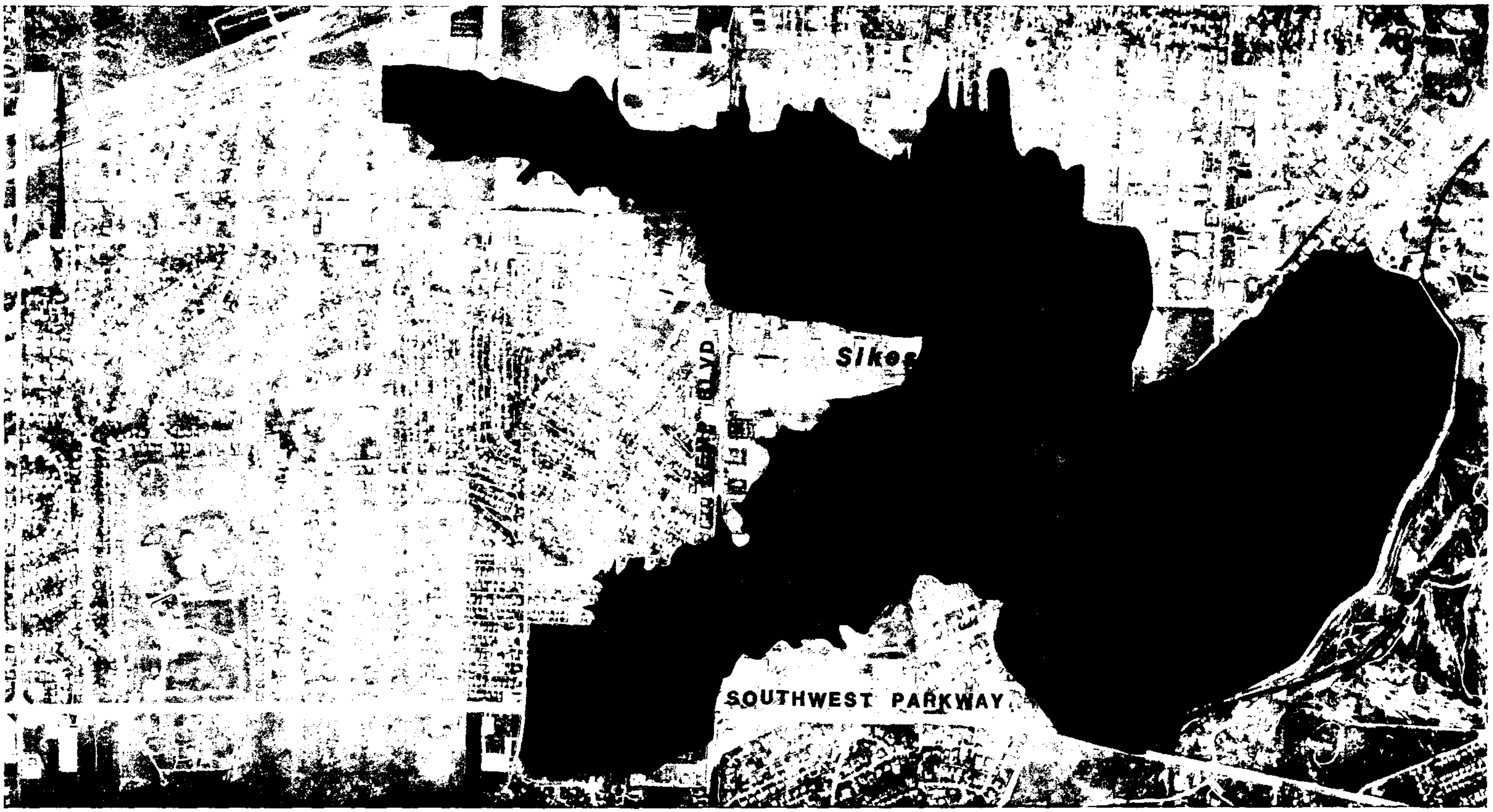
FEASIBILITY REPORT



STUDY AUTHORITY

This study of potential flood damage reduction measures on McGrath Creek in Wichita Falls, Texas, was conducted under the authority provided by a resolution of the Committee on Rivers and Harbors, US House of Representatives, adopted February 25, 1938, which reads:

> "Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on Red River, Louisiana, Arkansas, Oklahoma, and Texas, submitted in House Document Numbered 378, Seventy-fourth Congress, Second Session, and in previous documents, with a view to determining if improvement in the interest of navigation, flood control, water power, or irrigation is advisable at this time, and particularly with a view to constructing dams on the upper section of the river and the tributaries."



SPF FLOOD PLAIN
EXISTING CONDITIONS
McGRATH CREEK

Figure 2

PROBLEM AND OPPORTUNITY STATEMENTS

Problem and opportunity statements were established from public concerns to identify watershed problems, needs, and opportunities. These statements represent goals which could be achieved through implementation of various water resource management measures. The Federal concern for improving national economic development and enhancing environmental quality is also reflected. Plans were analyzed for the 1990-2090 period of study. The following paragraphs provide a discussion of the problems and needs considered in establishing problem and opportunity statements for the McGrath Creek study.

FLOOD CONTROL

The primary objective of this study is to provide flood damage reduction along McGrath Creek. The measure of this objective was the percent reduction of flood damages.

RECREATION

The city of Wichita Falls has no desire to cost share in the development of recreation facilities along McGrath Creek. Therefore, other than preserving the existing recreational value of Sikes Lake, recreation was not an objective of this study.

FISH AND WILDLIFE PRESERVATION

Preservation of fish and wildlife resources is a necessary component for any Federal project. Because of extensive urban development, only minimal fish and wildlife habitats exist in or along the McGrath Creek. Most of the habitats exist at Sikes Lake. This study considered the potential for preserving and enhancing the natural resources of the area. The measure of this objective was the number of acres of habitat preserved, created, or destroyed.

CULTURAL RESOURCES

Preservation of cultural resources was an objective of the study; however, no cultural resource sites are recorded by the State Historic Preservation Office, the Office of the State Archaeologist, or the Texas Archaeological Research Laboratory. The area has not been intensively surveyed but because the land is largely urbanized and has been disturbed by modern development the project area has little potential for undiscovered significant cultural resources.

DAM SAFETY

Although the Sikes Lake embankment and spillway are inadequate based on dam safety guidelines, no catastrophic damages would result should overtopping occur. Because the Texas Department of Water Resources concurred that no corrective dam safety measures are required, modifications to Sikes Lake embankment and spillway would be made only as required for implementation of selected plans.

SUMMARY OF PROBLEM AND OPPORTUNITY STATEMENTS

The following problem and opportunity statements were established for the formulation and evaluation of alternative plans for McGrath Creek. They were developed based on the identified problems and needs, and reflect the Federal concern for improving national economic development and preserving environmental quality.

Plans developed in the study should:

1. Contribute to improved physical, emotional, and economic health, safety, and well-being by reducing or eliminating flood damages, and

2. Contribute to environmental and life quality, and preserve fish and wildlife and cultural resources.

PLANNING CONSTRAINTS

Physical, economic, environmental, and policy constraints were identified to help formulate and evaluate alternatives. These planning constraints established the framework for the study.

PHYSICAL CONTRAINTS

The physical area for this investigation consisted of the McGrath Creek Standard Project Flood (SPF) flood plain. Areas outside the SPF flood plain were not considered in planning flood control improvements unless they had a direct bearing on the project area flood problem. Flood reduction measures formulated for McGrath Creek will be compatible with plans for Lake Wichita, Holliday Creek.

ECONOMIC CONSTRAINTS

The 1936 Flood Control Act (Public Law 49-738) established that the Federal Government could participate in flood control improvements if the benefits of the proposed action are in excess of the estimated costs. For an alternative to be recommended in this study the net economic benefits must exceed the costs. Flood damage reduction benefits cannot be claimed for future development in the flood plain, and Executive Order 11988, "Flood Plain Management," prohibits Federal agencies from promoting flood plain development. Therefore, Federal plan evaluations are based on present flood plain development and future, non-flood plain development. The local sponsor of the project, the city of Wichita Falls, has adopted zoning ordinances to regulate future development in the flood plain.

ENVIRONMENTAL CONSTRAINTS

Evaluation of alternatives shall be in accordance with all applicable environmental laws.

POLICY CONSTRAINTS

Federal policy has established criteria for distinguishing between flood control and local drainage problems. Flood control problems are defined as those problems that occur downstream of the point where the 10-year flood (a flood with a 10-percent chance of occurring in any one year) is greater than 800 cubic feet per second (cfs). The Federal Government can help solve flood control problems. Local drainage problems are considered the responsibility of local interests.

Hydrologic studies indicated that upstream of Kemp Boulevard on the southern tributary and upstream of Lawrence Road on the northern tributary the 10-year flood has a flow of less than 800 cfs. Therefore, Federal funds for the evaluation of flood control improvements were only used in the area downstream of these locations.

PRELIMINARY SOLUTIONS

Options evaluated for reducing flood damages on McGrath Creek consist of these measures:

Non Structural	Structural
No Federal Action	Levees and Flood Walls
Flood Plain Acquisition	Sikes Lake Storage
Flood Plain Management	Removal of Sikes Lake
Floodproofing	Upstream Detention
	Upstream Diversion
	Channel Modifications and Downstream Diversions

In the preliminary analysis, some of these options were judged infeasible and were eliminated while others were retained for further consideration. The following discussions present the rationale for the elimination or the continuing analyses of various options.

NON STRUCTURAL MEASURES

No Federal Action

The no-action option calls for the Federal Government to forgo participation in flood damage reduction measures for McGrath Creek. This option would be selected where an economically and environmentally feasible plan could not be identified or if local interests chose not to participate in the recommended solution. This option was used as the basis for determining the effectiveness of plans evaluated in this study.

Flood Plain Acquisition

Flood plain acquisition involves the purchasing and clearing of flood-prone structures having a first floor elevation below a selected level of flood protection thereby restoring the flood-prone land to uses more compatible with flooding, such as open space and parks. As a test of the potential costs of flood plain acquisition, the area below Sikes Lake was examined. The estimated average annual damage to all properties downstream of Sikes Lake is $1,250,000. The value of single and multiple family structures with flood elevations at or below the 10-year frequency flood is $60,000,000. Purchasing all residential structures within the 10-year frequency flood would cost $4,900,000 annually. The benefit-to-cost ratio would be 0.26 to 1.0. These facts confirmed that the costs for this type of project would greatly exceed benefits. This option was not considered further.

Flood Plain Management

Flood plain management is the process whereby city officials regulate development and growth in those areas designated as flood plains. It can be effective in preventing hazards to new construction, but alone it cannot reduce hazards or damages to existing development. The McGrath Creek flood plain is extensively developed, so flood plain management as an individual option was eliminated, but it should be considered as a part of other structural and nonstructural options.

Floodproofing

Structures in the flood plain could have temporary watertight covers placed on the openings but because of the short warning times experienced in the area (1 hour) there may not be enough time to install these fixtures. Additionally, most of the structures in the McGrath Creek flood plain could not be economically floodproofed. Therefore floodproofing as an option was eliminated.

STRUCTURAL MEASURES

Levees and Floodwalls

Costs of constructing levees or floodwalls along McGrath Creek would be prohibitive. Many buildings, bridges, and streets would have to be removed, and pumping plants and ponding areas would be needed for interior drainage. Therefore, this option was judged uneconomical.

Sikes Lake Storage

In its present condition, Sikes Lake has no appreciable storage available. Because the development surrounding Sikes Lake limits opportunities for expansion and because increasing the storage in Sikes Lake would require a higher embankment which could create a dam safety hazard, this option was not considered further.

Removal of Sikes Lake

Removal of Sikes Lake could reduce flood damages immediately upstream but would induce damages downstream because of increased discharges. For effective flood control downstream of the lake area, channelization would also be necessary. The north and south tributaries of McGrath Creek converge within the existing lake, thus for effective transition of flows into a downstream channel, construction of a 300-foot-long channel section and a control structure at the confluence would be required. Such a plan would cost more than downstream channelization and spillway modification and provide little appreciable gain in flood reduction benefits. The removal of Sikes Lake would be opposed by MSU (reference 18 January 1984 letter, page B-16) because it would destroy the recreational, educational, and aesthetic value of the resource. Residents and businesses around the lake would also oppose the removal of Sikes Lake. Additionally, the US Fish and Wildlife Service has stated it would object to any plan which includes the loss of Sikes Lake (reference 11 May 1984 letter in Appendix C) and would request mitigation by replacement in kind. For the foregoing reasons, the removal of Sikes Lake option was rejected.

Upstream Detention

The only suitable site for a detention reservoir is on the north tributary of McGrath Creek upstream of Sikes Lake between Lawrence Road and McNiel Avenue. A reservoir could be constructed to contain the 100-year frequency runoff at that location. Acreage required would be 50 to 80 acres depending upon the amount of excavation. Such a reservoir could reduce the 100-year peak discharge downstream of Sikes Lake by 1,700 cfs; however, by itself it would not significantly reduce the flood damages in the area. A reservoir in combination with downstream channel modifications, could have significant effects; however, the downstream channel costs would not be reduced enough to offset the estimated $5,000,000 cost of the detention structure. This option was eliminated from further consideration.

Upstream Diversion

Diversion of flood flows from the south tributary above Sikes Lake (no north tributary diversions were identified) could be accomplished by constructing a channel downstream of Kemp Boulevard at Southwest Parkway along Old Lake Road to Holliday Creek. The diversion channel would be about 4,400 feet long. A diversion channel sized for the 100-year frequency flood flow could reduce discharges downstream of Sikes Lake by 2,000 cfs. As with the upstream detention reservoir option, the south branch diversion alone would not significantly affect the flood damages below Sikes Lake. The reduction in costs of downstream channels would not be sufficient to offset the estimated $4,000,000 cost of the south branch diversion. Therefore, this option was eliminated from further consideration.

Spillway and Downstream Channel Modifications

Channel enlargement along the existing McGrath Creek alignment or an alternative route could provide effective flood reduction particularly in the most damage prone area of the flood plain (downstream of Sikes Lake).

Above Sikes Lake on the north and south tributary streams in the area of potential Federal involvement (reference Policy Constraints, page 22), the opportunity for significant flood damage reduction by channel modification is not major since annual damages amount to approximately $140,000. Downstream of Sikes Lake where annual flood damages are $1,250,000, substantial opportunity exists for significant flood damage reduction through channelization. To provide effective transition of flood flows into downstream channels, new spillway(s) would be required at Sikes Lake. The existing spillway has limited capacity and is not an effective control structure for downstream channelization. Additionally, a new spillway with a larger capacity could reduce some of the flood damages immediately upstream of Sikes Lake by lowering the peak water surface elevation during flood periods. Channelization below Sikes Lake and spillway modifications were identified as the most likely flood damage reduction option and were therefore carried into further analysis.

INTERMEDIATE PLANS

As was discussed in the Preliminary Solutions section of this report, the channel and spillway modification options were considered to have the best chances of providing positive net benefits to the study area. Three types of channels were examined: trape- zoidal, grass lined with 1 on 3 side slopes; trapezoidal, concrete-lined with 1 on 1-1/2 slopes; and rectangular, concrete-lined. Five levels of flood protection (10-year, 25-year, 50-year, 100-year, and SPF) were considered for each alternative channel type. Table 2 presents the approximate sizes for the different channel types and levels of flood protection.

TABLE 2

ALTERNATIVE CHANNEL DESIGNS

Frequency Protection	Trapezoidal Grass-Lined Bottom Width/ Top Width (feet)	Rectangular Concrete-Lined Bottom Width (feet)	Trapezoidal Concrete-Lined Bottom Width/ Top Width (feet)
10-year	5/80	19	5/40
25-year	15/90	25	8/45
50-year	25/100	30	15/50
100-year	40/115	35	25/60
SPF	100/185	65	N/A

Note: Channel sizes were based on hydraulic information available at the time of intermediate plan analysis - April 1984.
N/A Not Applicable

The trapezoidal channels downstream of Taft Boulevard and all channel types for SPF flood protection would require extensive relocations and would not be economically feasible. Only the rectangular, concrete-lined channels for 10-, 25-, 50-, and 100-year levels of flood protection were considered feasible in this area. Where space is available above Taft Boulevard, grass-lined channel segments were incorporated in alternative alignments. To effectively direct McGrath Creek flows into downstream channels, new spillway(s) would be required at Sikes Lake. Spillway improvements would also help reduce flood damages immediately upstream of the lake by lowering flood stages.

Figure 3 shows the various alternative channel segments. Table 3 displays pertinent information regarding the channel plans, including the alignment and type of channel considered. The table also presents the bottom width for each channel segment for 10-, 25-, 50-, and 100-year frequency flood protection. Each plan includes spillway modifications designed to keep the 100-year water surface elevation at or below the top of the Sikes Lake embankment and to effectively train flows into the channel(s). These intermediate plans were evaluated to select an array of plans for detailed analysis.

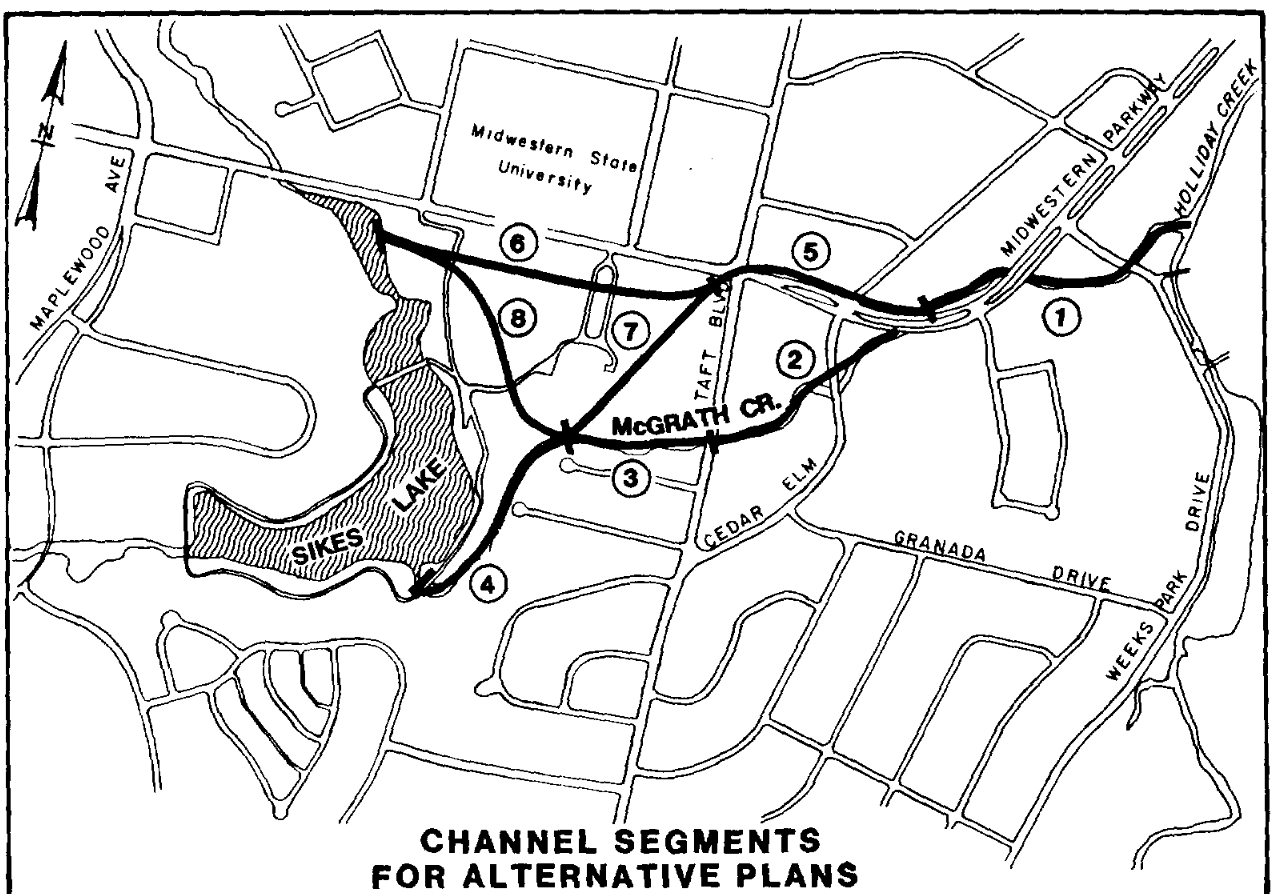


Figure 3

TABLE 3

ALTERNATIVE CHANNEL PLANS
PERTINENT INFORMATION

Plan	Channel Alignment (Segments)	Channel Type	Channel Bottom Width (Feet)			
			10-Year	25-Year	50-Year	100-Year
1	1	concrete	19	25	30	35
	2	concrete	19	25	30	35
	3	concrete	19	25	30	35
	4	concrete	19	25	30	35
2	1	concrete	18	24	30	35
	5	concrete & pipe	18	24	30	35
	7	concrete	18	24	30	35
	4	concrete	18	24	30	35
3	1	concrete	19	25	30	35
	2	concrete	19	25	30	35
	3	concrete	19	25	30	35
	4	concrete	8	10	13	15
	8	grass	10	14	17	20
4	1	concrete	18	24	30	35
	5	concrete & pipe	18	24	30	35
	7	concrete	10	14	17	20
	6	grass	10	14	17	20
	4	concrete	10	14	17	20
5	1	concrete	19	25	30	35
	2	concrete	10	13	16	20
	3	concrete	10	13	16	20
	4	concrete	10	13	16	20
	5	concrete & pipe	10	14	17	20
	6	grass	10	14	17	20
6	1	concrete	18	24	30	35
	5	concrete & pipe	18	24	30	35
	6	concrete	18	24	30	35

PLAN 1

The alignment for Plan 1 is essentially along the existing McGrath Creek channel from Holliday Creek to the spillway at Sikes Lake (channel segments 1, 2, 3, and 4 as shown in figure 3). Two bridges, one at Weeks Park Drive and one at Cedar Elm, would be replaced. At Cedar Elm, the channel would deviate slightly from the existing alignment to straighten the severe bends of the channel. One commercial office building would be removed at this location. A drop structure at the mouth of McGrath Creek would be at the same location as is included in the Holliday Creek project but at a lower crest elevation and with a width equal to the channel. The existing spillway at Sikes Lake would be replaced with a 110-foot-wide rectangular section at crest elevation 960.0. Total channel length would be 4,300 feet.

PLAN 2

The channel alignment for Plan 2 follows the existing channel below the spillway to a point about 500 feet upstream of the Taft Boulevard Bridge where a channel would be cut northeastward across Midwestern State University property to the Taft and Midwestern intersection. A channel would then be cut along the north side of Midwestern Parkway to the existing McGrath Creek channel where it would follow the existing alignment to the confluence with Holliday Creek. The channel alignment follows segments 1, 5, 7, and 4 (see figure 3). Total channel length would be 4,400 feet. Channel segments 1 and 4 would have concrete-lined rectangular cross sections. Segment 7 would have a concrete-lined rectangular section with 1 on 3 side slopes (turfed) from the top of the concrete lining to natural ground. Two large diameter pipes would extend through the Taft-Midwestern intersection to a point upstream of Cedar Elm on the north side of Midwestern Parkway (segment 5). A drop structure at the mouth of McGrath Creek would be similar to that of Plan 1. The existing Sikes Lake spillway would be replaced with a 110-foot-wide rectangular section as in Plan 1. The Weeks Park Drive Bridge would be replaced. A bridge would be constructed at Cedar Elm, and construction of a culvert would be required at the Taft and Midwestern intersection. The existing channel would be filled upstream of Taft Boulevard to prevent flood flows in the existing channel between Taft and Cedar Elm. Provisions for low flows through this channel segment for aesthetic purposes would be made with a small-diameter pipe from the lake to discharge below Taft Boulevard.

PLAN 3

The alignment for Plan 3 is the same as Plan 1 with the exception of a diversion channel from the northern portion of Sikes Lake which would provide for diversions from the north and south tributaries. Channel segments 1, 2, 3, 4 and 8 provide the alignment (see figure 3). The total length of channelization would be 5,800 feet. The existing dike across Sikes Lake would be raised 3 feet. Segments 1, 2, 3, and 4 would be rectangular concrete-lined channels. Segment 8 would have a grass-lined trapezoidal cross-section with 1 on 3 side slopes. A drop structure would be required at the end of segment 8. The drop structure at the mouth of McGrath Creek, the bridge replacements, and the removal of one commercial office building would be the same as in Plan 1. Three roads on university property would require bridges for the segment 8 portion and two university buildings would need to be removed. Two spillways at Sikes Lake would be required. The south spillway would be at the existing location as in Plan 1 but with a 50-foot wide rectangular section. The north spillway would be a 65-foot-wide rectangular section, with a crest at elevation 960. It would be located at the origin of channel segment 8.

PLAN 4

The alignment of Plan 4 is the same as Plan 2 with the exception of a diversion channel paralleling Midwestern Parkway to divert flows from the north tributary. Segments 1, 5, 7, 6, and 4 (see figure 3) provide the alignment. Total length of channelization would be 6,600 feet. As in Plan 3, the existing dike across Sikes Lake would be raised 3 feet, and the north spillway would be 65 feet wide at crest elevation 960. The south spillway would be the same as in Plan 3. The channel types for segments 1, 5, 7, and 4 would be the same as in Plan 2 and segment 6 would have a trapezoidal grass-lined cross-section with 1 on 3 side slopes. A drop structure would provide transition from segment 6 to segment 5. The drop structure at the mouth would be the same as in Plan 2. Three roads on University property would require bridges over segment 6.

PLAN 5

This plan calls for the improvement of the existing channel as in Plan 1, and diversion of flows from the north tributary of Sikes Lake along Midwestern Parkway under the Taft-Midwestern intersection to its confluence with lower McGrath Creek. Segments 1, 2, 3, 4, 5 and 6 provide the alignment which would require 6,600 feet of channelization. The channel types for the various segments are the same as in Plans 1 and 4. The plan also requires drop structures at the same locations, removal of one commercial office building, street and road bridge constructions, and intersection tunnel as in Plans 1 and 4. The two spillways would be the same as in Plans 3 and 4.

PLAN 6

This plan would divert all flood flows through a spillway and channel to the north of the existing McGrath Creek channel below Sikes Lake. The alignment follows channel segments 1, 5, and 6. The total channel length would be 4,500 feet. The existing spillway would be filled and a pipe installed in its place to allow low flows down the existing channel. A new spillway, located at the origin of channel segment 6, would have a crest width of 110 feet at elevation 960. The dike across the northern arm of Sikes Lake would be removed and some dredging in the lake would be required. The drop structure at the mouth of McGrath Creek would be the same as in Plans 2 and 4. A drop structure would also provide transition from segment 6 to segment 5. The channel types in segments 1 and 5 would be the same as Plans 2 and 4. The channel in segment 6 would have a rectangular concrete-lined cross-section with 1 on 3 side slopes from the top of the lining to natural ground. The bridge at Weeks Park Drive would be replaced and bridges would be constructed at Cedar Elm and at three roads on the university property.

PLAN SELECTION FOR DETAILED PLANNING

The six plans were evaluated for 10-, 25-, 50-, and 100-year frequency levels of protection, making a total of 24 alternatives.

To determine which of the six intermediate plans would be carried on to detailed studies, the following evaluation criteria were used.

1) The Flood Control Act of 1936 which established that benefits must exceed estimated costs,

2) The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, March 1983, which established that the National Economic Development (NED) plan should be recommended for implementation unless there are sufficient non-economic reasons to select another plan. The NED plan is defined as the plan with the highest net benefits (benefits minus costs), and

3) The effectiveness of meeting the objectives of flood damage reduction (flood control) and minimization of adverse environmental impacts (environmental quality).

Benefit-to-Cost Analyses

The economic evaluation of each of the 24 alternatives was based on April 1984 prices, an 8-3/8 percent interest rate, and a 100-year period of analysis. The construction period was assumed to be 3 years. Table 4 presents the construction costs, annual cost, annual benefits, the benefit-to-cost ratio, and the net benefits of each plan. Plans 1, 2, and 6 have the highest net benefits. Costs were not estimated for the 10-, 25-, and 50-year frequency designs for Plans 3, 4, and 5 because it was apparent the net benefits would be less than for Plans 1, 2, and 6. In each instance, the net benefits increased as the level of protection increased. It should also be noted that the annual benefits in table 4 include only flood damage reduction to existing development and excludes affluence effects and potential locational advantage benefits. These values also reflect the information available at the time of the intermediate analysis.

TABLE 4

ECONOMIC EVALUATION
(Benefits and Costs in $1,000's)

Plan	Frequency Protection (year)	Const. Cost	Annual Cost	Annual Benefits	Benefit-to Cost Ratio	Net Benefits
1	10	8,200	800	886	1.11	86
	25	8,640	950	1,142	1.20	192
	50	10,360	1,020	1,228	1.20	208
	100	11,000	1,080	1,324	1.23	244
2	10	8,750	860	886	1.03	26
	25	10,150	995	1,142	1.15	147
	50	11,100	1,090	1,228	1.13	138
	100	11,920	1,165	1,324	1.14	158
3	10	a	a	886	a	a
	25	a	a	1,142	a	a
	50	a	a	1,228	a	a
	100	12,800	1,260	1,324	1.05	64
4	10	a	a	886	a	a
	25	a	a	1,142	a	a
	50	a	a	1,228	a	a
	100	14,200	1,390	1,324	0.95	-66
5	10	a	a	886	a	a
	25	a	a	1,142	a	a
	50	a	a	1,228	a	a
	100	14,750	1,450	1,324	0.91	-126
6	10	9,340	920	886	0.96	-34
	25	10,520	1,040	1,142	1.10	102
	50	11,400	1,120	1,228	1.10	108
	100	12,200	1,200	1,324	1.10	124

NOTE: April 1984 prices, 8-3/8 percent interest and 100-year period of analysis

a Cost not estimated because net benefits would be less than for plans 1, 2, and 6.

EVALUATION OF EFFECTIVENESS

Table 5 displays a summation on how each of the plans would meet the objectives of flood damage reduction and minimization of adverse enviromental impacts.

Flood Control

The measures of effectiveness for flood control are flood damages prevented and percent of damages reduced. Table 5 displays the expected annual damages, annual damages prevented (benefits), and percent reduction in damages for the McGrath Creek watershed and for the area below Sikes Lake. Each plan/alignment would accrue the same damage values for comparable levels of flood protection. The 10-, 25-, 50-, and 100-year frequency channel designs would reduce average annual damages in the watershed by 58, 74, 80, and 86 percent, respectively. Below Sikes Lake, the reduction in annual damages to existing development would be 64, 81, 87, and 94 percent for the respective channel sizes. The 100-year channel plans would be substantially more effective in reducing damages.

Environmental Quality

Table 5 displays a preliminary assessment of the effects of the alternative plans on the environment and aesthetics of McGrath Creek. All plans considered would preserve the educational, recreational, and aquatic habitat values of Sikes Lake. No changes would occur upstream of Sikes Lake under any of the alternative plans. The losses of stream and streambank habitat downstream of Sikes Lake have not been identified as major concerns of the US Fish and Wildlife Service (see Appendix C). The aesthetic loss of the low water dams in channel segment 2 would probably be of greater environmental significance than the habitat losses that would be caused by the concrete-lined channels. It appears that Plan 6 would be the environmentally preferred plan because of the potential for improving the aquatic habitat in Sikes Lake and because it would minimize the adverse impacts on the existing

TABLE 5

PLAN EFFECTIVENESS

Plan/Protection	Flood Control: Watershed Annual Damages ($1,000's)	Watershed Damage Reduction (Percent)	Watershed Damages Prevented ($1,000's)	Below Sikes Lake Annual Damages ($1,000's)	Below Sikes Lake Damage Reduction (Percent)	Below Sikes Lake Damages Prevented ($1,000's)	Environmental Quality
No Action	1,540	NA	NA	1,360	NA	NA	No Change
Plan 1 - 10-year	654	58	886	491	64	867	Loss of stream and stream bank habitat along
- 25-year	398	74	1,140	259	81	1,100	channel segments 1, 2, 3 and 4.
- 50-year	312	80	1,230	174	87	1,180	Loss of low water dams in segment 2.
- 100-year	216	86	1,320	86	94	1,270	
Plan 2 - 10-year	654	58	886	491	64	867	Loss of stream and stream bank habitat in
- 25-year	398	74	1,140	259	81	1,100	channel segments 1 and 4.
- 50-year	312	80	1,230	174	87	1,180	
- 100-year	216	86	1,320	86	94	1,270	
Plan 3 - 10-year	654	58	886	491	64	867	Loss of stream and stream bank habitat in
- 25-year	398	74	1,140	259	81	1,100	segments 1, 2, 3 and 4.
- 50-year	312	80	1,230	174	87	1,180	Gain habitat in grass-lined channel segment 8.
- 100-year	216	86	1,320	86	94	1,270	Loss of low water dams in segment 2.
Plan 4 - 10-year	654	58	886	491	64	867	Loss of stream and stream bank habitat in
- 25-year	398	74	1,140	259	81	1,100	segments 1 and 4.
- 50-year	312	80	1,230	174	87	1,180	Gain habitat in grass-lined channel segment 6.
- 100-year	216	86	1,320	86	94	1,270	
Plan 5 - 10-year	654	58	886	491	64	867	Loss of stream and stream bank habitat in
- 25-year	398	74	1,140	259	81	1,100	channel segments 1, 2, 3 and 4.
- 50-year	312	80	1,230	174	87	1,180	Loss of low-water dams in segment 2.
- 100-year	216	86	1,320	86	94	1,270	Gain habitat in grass-lined channel segment 6.
Plan 6 - 10-year	654	58	886	491	64	867	Loss of habitat in segment 1.
- 25-year	398	74	1,140	259	81	1,100	Minor dredging in Sikes Lake could improve
- 50-year	312	80	1,230	174	87	1,180	aquatic habitat.
- 100-year	216	86	1,320	86	94	1,270	Adverse impact on Sikes Mansion property.

Figure 5

PLANS 1A, 1B, and 1C

Plan 1B

Plan 1B, shown in figure 5, would have the same channel alignment as Plan 1A. However, to reduce the adverse aesthetic, safety, and environmental impacts of the open vertical-wall concrete channel, the segment between Taft Boulevard and the upstream Midwestern Parkway Bridge would be an underground double-box culvert 17.5 feet wide and 13 feet high. All bridge replacements, commercial building relocations, and the degree of flood protection would be the same as in Plan 1A.

Plan 1C

Plan 1C, shown in figure 5, would be the same as Plan 1A with the exception of the spillway. The Plan 1C spillway would have a crest width of 140 feet to reduce the 100-year water surface elevation in Sikes Lake by an additional one foot. This would afford a slight increase in flood reduction above Sikes Lake, while still providing a 100-year level of flood protection downstream of the lake. An existing storage building located near the spillway, as well as the commercial office building on Cedar Elm Street, would have to be removed. All other features, including channel size, bridge replacements, and the drop structure at the mouth, would be the same as in Plan 1.

Plan 2A

Plan 2A, shown in figure 6, basically would be the same as Plan 2 presented in the intermediate analysis, except that the new spillway would be located about 700 feet north of the existing spillway as in Plan 1A. The existing channel segment immediately below the Sikes Lake spillway would be left intact for intervening area drainage, and the existing concrete spillway would be removed and replaced with fill to conform to the embankment. From a point about 600 feet upstream of the Taft Boulevard Bridge, a channel would be cut northeastward across MSU property to the Taft-Midwestern intersection. From this point, a double-box culvert 17.5 feet wide and 14 feet high would carry flow under the intersection and parallel the north side of Midwestern Parkway to McGrath Creek. The lower end of the channel would be the same as

PLANS 2A and 2B

Figure 6

in Plan 1A. The channel segment across MSU property would be a 35-foot rectangular concrete channel to carry design flows with 1-on-3 side slopes (turfed) from the top of the concrete to natural ground. The spillway and transition-to-channel would be the same as in Plan 1A. The Weeks Park Drive Bridge would be replaced and box culverts would be constructed under the Taft-Midwestern intersection and at Cedar Elm Street. No homes or buildings would be relocated. The existing McGrath Creek channel between Taft Boulevard and the upstream Midwestern Parkway Bridge would be left in its present condition. Flows in excess of channel design capacity would flow through this channel segment. Total length of the channel and the box culvert would be 4,000 feet.

Plan 2B

Plan 2B, shown on figure 6, would be the same as Plan 2A except that the segment across MSU property would be an underground double-box culvert 18.5 feet wide and 14 feet high. The purpose of this plan would be to diminish adverse aesthetic impacts of a large open channel through a pecan grove on MSU property. All other features of Plan 2B would be the same as in Plan 2A.

Clayton/Granada Street Diversion Plan

The Clayton/Granada Street Diversion plan, shown in figure 7, was suggested at a meeting of the City of Wichita Falls Flood Control Task Force in August 1984. It was at this meeting that the intermediate plans were presented to local interests. The plan would include a new 110-foot-wide spillway (crest elevation 960 feet) about 400 feet north of the existing spillway. The channel would be a double-box culvert 17.5 feet wide and 10 feet high beneath Clayton, Cedar Elm, and Granada Streets. The total length of the culverts would be about 3,500 feet. It would enter Holliday Creek approximately 2,100 feet upstream (south) of the mouth of McGrath Creek. Discharges in excess of the 100-year flood discharge would flow into the present McGrath Creek channel.

This plan would be the least disruptive to aesthetic and other environmental values of the present channel. No bridge replacements would be

CLAYTON—GRANADA PLAN

Figure 7

required and no residential or commercial buildings would be displaced. The streets (Clayton, Granada, and Cedar Elm), as well as utilities along them, would be relocated. Most of the construction could be completed within present street rights-of-way. However, access for residents would be restricted during construction. The level of flood protection afforded by the Clayton/Granada Street Diversion plan would be the same as the other 100-year design plans.

COMPARISON OF DETAILED PLANS

The same evaluating criteria used for the intermediate plans was used to determine which of the detailed plans should be recommended for implementation. (See Comparison of Intermediate Plans.)

Table 6 presents a comparison of the seven detailed plans. Costs and benefits presented in the table are based on April 1985 price levels, a three-year construction period, a Federal discount rate of 8-3/8 percent interest, and a 100-year period of analysis. More detailed information on the location of flood damage reduction benefits are included in Appendix A.

Each of the seven plans would provide the same level of flood protection below Sikes Lake (100-year frequency); however, benefits would vary slightly due to minor differences in Standard Project Flood (SPF) elevations. All plans except Plan 1C would reduce the 100-year flood elevation in Sikes Lake about 1.4 feet and, therefore, accrue equal flood reduction benefits upstream. Plan 1C, which has a larger spillway, would reduce the 100-year flood elevation in Sikes Lake by an additional one foot and provide an additional $5,000 in flood reduction benefits.

Plan 1A would have the greatest net benefits and demonstrates the best potential for being the NED Plan. Plan 1C is the second most cost effective plan; however, the increased flood protection upstream of Sikes Lake is not enough to offset the additional costs of the larger spillway. Plans 2A, 2B, and the Clayton-Granada Diversion Plan would have less impact on the existing McGrath Creek channel, particularly the aesthetic value of the area between channel. However, Plan 6 would involve a deep channel cut across the front lawn of the Sikes Mansion (MSU president's residence) which could be considered aesthetically unacceptable. Additionally, removal of the dike across the north tributary arm of Sikes Lake would limit access around the lake.

Plan 2 is also preferred from an environmental standpoint because the pools formed by the low water dams between Taft Boulevard and Midwestern Parkway would be preserved and the channel cut across MSU property (segment 7) would be less obtrusive.

Summary

Based on the above evaluation of the intermediate plans, Plans 1 and 2 would best meet the planning objectives and would be the most cost effective; therefore, they were examined in more detail.

DETAILED INVESTIGATIONS

Studies were made to evaluate in greater detail the two plans selected for continued study (Plans 1 and 2) and a plan identified by local interests at a city of Wichita Falls Flood Control Task Force meeting in August 1984. The detailed analysis concludes with the selection of a plan which would reduce the risk of flood damages in the most flood-prone areas of McGrath Creek.

ANALYSIS IMPROVEMENTS AND DESIGN CHANGES

The intermediate plan analysis identified several areas where more detailed and refined data were necessary. Two principal areas of concern were the height of the Sikes Lake embankment and the effects of increased runoff due to future upstream development. Field surveys were made to accurately depict the topography of the Sikes Lake embankment, spillway, and shoreline. This new information was used to revise the hydrology and hydraulic models. The hydrology and hydraulic models were also adjusted to account for future runoff conditions attributable to projected upstream development in the McGrath Creek watershed.

An analysis was made of the feasibility of constructing a new spillway about 700 feet north of the existing spillway location. The existing spillway area would be filled to become part of the embankment. The advantage of the new spillway location would be a straighter transition into the downstream channel and reduced cost.

Another design change was the use of reinforced concrete-box culverts for underground channel segments rather than the large diameter pipes considered during the intermediate plan analysis. This design change would provide for better transition to the rectangular channel segments.

Costs for the intermediate plans were based on April 1984 prices, including 25 percent for contingencies. The cost estimates for plans included in the detailed investigation were based on April 1985 prices and include 20 percent for contingencies. Annual costs and benefits for the detailed plans were computed using the Federal discount rate of 8-3/8 percent and a 100-year period of analysis.

DETAILED PLANS

Intermediate Plans 1 and 2 were modified to account for the previously discussed refinements and design changes. In addition, further plans were derived from Plans 1 and 2 to diminish adverse aesthetic, safety, and environmental impacts and to examine the feasibility of further flood reduction above Sikes Lake. To distinguish the derivative plans in the detailed analysis, an alphabetical suffix was added to the plan number (i.e., Plans 1A, 1B, 1C, 2A, and 2B). A plan suggested by local interests at the August 1984 Flood Control Task Force meeting was also analyzed in the detailed investigations. This plan is referred to as the Clayton-Granada Street Diversion Plan.

The intermediate analysis had shown that for alternative channel sizes (levels of flood protection), the relationship of cost and net benefits was similar among the different plans. The intermediate analysis also showed that for each plan considered, the 100-year frequency design provided the greatest net benefits. Therefore, for purposes of comparing the detailed plans, only the 100-year frequency designs were analyzed. Each of the following plans provides 100-year frequency flood protection to properties below Sikes Lake and reduces the 100-year water surface elevation in the lake, thus each plan has some flood reduction effect for a limited distance upstream. Once the best plan was identified, an optimization analysis was made to ascertain the most cost effective level of flood protection to determine the National Economic Development plan.

Plan 1

Plan 1, shown in figure 4, would consist of a 35-foot-wide rectangular concrete-lined channel below Sikes Lake, principally along the existing McGrath Creek alignment. Straightening of the channel at the Cedar Elm Street Bridge would be required. The total length of the improved channel would be 4,300 feet. A new spillway with vertical walls and a crest elevation of 960 feet NGVD would be constructed at the existing Sikes Lake spillway location.

PLAN 1

Figure 4

The new spillway would be 110 feet wide at the crest and would be 187.5 feet in length. The bridges at Weeks Park Drive and Cedar Elm Street would be replaced. One commercial office building at Cedar Elm Street would be removed. A drop structure at the mouth of McGrath Creek would be at the same location as is included in the proposed Holliday Creek channel project, but at a lower crest elevation and with a width equal to the channel.

Plan 1 would provide a 100-year level of flood protection to properties below Sikes Lake and would reduce the 100-year flood level in Sikes Lake by 1.4 feet, thus slightly reducing flooding upstream. The spillway would also control design flows into the channel and would eliminate the overtopping of the embankment by a 100-year frequency flood event.

Plan 1A

Plan 1A, shown in figure 5, would basically be the same as Plan 1 except that the new spillway would be constructed about 700 feet north of the existing spillway. The new spillway would have its crest at elevation 960, a crest width of 110 feet, and a length of 187.5 feet. The spillway would drop from elevation 960 to the channel invert at elevation 946.1 feet. The new spillway would be situated between two Midwestern State University (MSU) buildings on the embankment. The existing spillway would be removed and the area filled in to conform to the embankment. Material suitable for filling the existing spillway area would come from excavation of the McGrath Creek channel. The existing channel section downstream of the existing spillway runs northward and is parallel to the Sikes Lake embankment. This channel segment is already concrete lined and would be left undisturbed to capture drainage from south of Sikes Lake. A small pipe would allow discharges into the new channel. The improved channel downstream of the new spillway would follow the same alignment and would be of the same size and shape as in Plan 1. The total length of the channel would be 3,600 feet. The two bridge replacements, one commercial building relocation, and the drop structure at the mouth would be the same as in Plan 1.

TABLE 6

COMPARISON OF DETAILED PLANS (1)
(100-Year Level of Protection,
Costs and Benefits in $1,000's)

	1	1A	1B	1C	2A	2B	Clayton/ Granada
First Cost	9,590	8,460	9,550	8,700	11,620	12,430	13,300
Annual Cost	940	830	940	850	1,150	1,230	1,320
Annual Benefits	1,410	1,410	1,410	1,415	1,425	1,420	1,425
Net Benefits	470	580	470	565	275	190	105
Benefit to Cost Ratio	1.5	1.7	1.5	1.7	1.2	1.2	1.1
Commercial Buildings Displaced (Number)	1	1	1	2	-0-	-0-	-0-
Length of Existing Channel Altered (feet)	4,750	3,900	3,900	3,900	1,700	1,700	Neg.
Fish & Wildlife Habitats Modified (acres)	4.6	3.3	3.3	3.3	1.8	1.8	Neg.
Average Annual Flood Damage Reduction (Percent)							
Watershed	78	78	78	78	79	79	79
Below Sikes Lake	96	96	96	96	97	97	97

(1) April 1985 price levels; 8-3/8 percent discount rate; 100-year period of analysis.

Taft Boulevard and Midwestern Parkway. While the US Fish and Wildlife Service would prefer one of these plans (see Appendix C), they have no objection to the Plan 1A alignment. The minimal environmental differences are not considered sufficient to justify the additional costs.

PLAN OPTIMIZATION

Alternative spillway and channel sizes for the Plan 1A alignment were analyzed to determine the optimum level of flood protection which would indentify the NED Plan. All channels were designed with rectangular, concrete-lined cross sections because of right-of-way limitations and bridges which preclude channel side slopes. Pertinent hydraulic design data for alternative levels of flood protection are shown in table 7.

TABLE 7

PLAN 1A
ALTERNATIVE LEVELS OF FLOOD PROTECTION
HYDRAULIC DESIGN DATA

Frequency of Flood Protection	Design Flow (cfs)	Spillway Width (feet)	Channel Width (feet)	Crest Elevation of Drop Structure (feet NGVD)
10-year	2,170	85	17	936.75
25-year	3,180	85	23	936.75
50-year	4,110	85	28	936.75
100-year	5,470	110	35	936.75
200-year	7,550	140	43(1)	935.00

(1) Channel width narrows at three bridges.

A comparison of costs and flood reduction benefits for the alternative levels of protection for Plan 1A is displayed in table 8. A 100-year frequency level of protection for properties below Sikes Lake would provide the greatest net benefits and is therefore the NED plan.

TABLE 8

PLAN 1A
ALTERNATIVE LEVELS OF FLOOD PROTECTION
ECONOMIC ANALYSIS
(Costs and Benefits in $1,000's)

	10-Year	25-Year	50-Year	100-Year	200-Year
First Cost	6,110	6,910	7,600	8,460	9,760
Annual Cost	600	680	750	830	960
Annual Benefit	950	1,170	1,260	1,410	1,480
Net Benefit	350	490	510	580	520
B/C Ratio	1.6	1.7	1.7	1.7	1.7
Average Annual Flood Damage Reduction (Percent)					
Watershed	52	64	69	78	82
Below Sikes Lake	66	80	87	96	99

THE SELECTED PLAN (PLAN 1A)

Based on the comparison of detailed plans (see table 6) and the alternative levels of flood protection (see table 8), Plan 1A (100-year) is determined to be the NED Plan and is the alternative recommended for implementation. The following provides further description and analysis of the selected plan.

PLAN DESCRIPTION

The selected plan, Plan 1A, would provide protection against the 100-year frequency flood along McGrath Creek between Sikes Lake and its confluence with Holliday Creek. This area accounts for 79 percent of the estimated average annual flood damages in the McGrath Creek watershed. The plan would also reduce the 100-year water surface elevation in Sikes Lake by 1.4 feet (elevation 968.5 to 967.1 based on projected future built-over conditions). Figure 8 shows the existing SPF and 100-year flood plains in the project-affected area. Figure 9 shows the plan and modified 100-year and SPF flood plains.

The first cost would be $8,460,000 (April 1985 price levels). The annual cost, at an 8-3/8 percent discount rate and a 100-year period of analysis, would be $830,000. Average annual benefits would be $1,410,000. Net benefits would be $580,000 and the benefit-to-cost ratio would be 1.7 to 1.0.

The selected plan features include:

Construction of a 3,600-foot-long rectangular concrete-lined channel with a 35-foot bottom width along McGrath Creek between Sikes Lake and the confluence with Holliday Creek, and

A new spillway at Sikes Lake about 700 feet north of the existing spillway. The existing concrete spillway would be removed and the area filled to become part of the embankment.

EXISTING SPF and
100 YEAR FLOOD PLAIN
McGrath Creek

Figure 8

PLAN 1A MODIFIED SPF and 100 YEAR FLOOD PLAIN
McGrath Creek

Figure 9

The improved channel would generally follow the existing McGrath Creek alignment from a drop structure downstream of Weeks Park Drive to Sikes Lake. Figures 10, 11, and 12 show channel alignment details. A drop structure at the mouth of McGrath Creek is part of the proposed Holliday Creek channel improvement plan. The crest elevation of the drop structure would be 936.75 with a width equal to the channel (35 feet). The channel slope would be 0.00258 foot/foot from the spillway apron at elevation 946.1 to the drop structure crest.

The new spillway would be located between two MSU buildings on the Sikes Lake embankment. The spillway would be a vertical-wall concrete structure with the crest at elevation 960.0 and a crest width of 110 feet. The length of the spillway from its crest to the toe of the downstream apron would be 187.5 feet. The spillway is designed to reduce the SPF elevation in Sikes Lake from 970.6 to 969.4, and to prevent overtopping of the Sikes Lake embankment by the design flood (100-year). Access across the new spillway would be provided by a 10-foot-wide roadway located immediately upstream of the spillway crest at the same elevation (960.0). This would permit continued use of the service road/jogging trail surrounding the lake.

The existing concrete spillway would be removed and the area filled to conform to the embankment. Suitable fill material would be excavated from the new spillway site and the McGrath Creek channel. A 650-foot-long segment of existing concrete-lined channel, which runs northward parallel to the embankment downstream of the existing spillway, would be left open to collect natural drainage from south and east of Sikes Lake.

The improved channel would require the replacement of bridges at Weeks Park Drive and Cedar Elm Street. A commercial office building on Cedar Elm Street at McGrath Creek would be removed for channel straightening; however, no residential structures would be displaced. For safety, a fence would be constructed along both sides of the channel.

PLAN IA (Selected Plan)
Sikes Lake and Spillway Area

McGrath Creek

FIGURE I

PLAN IA (Selected Plan)
Upstream of Taft Blvd. to Midwestern Parkway

McGrath Creek

FIGURE 11

PLAN IA (Selected Plan)
Midwestern Parkway to Holliday Creek

McGrath Creek

FIGURE 1

The social environment of residents would be temporarily disrupted during construction because of noise level increases and traffic pattern disruptions.

Approximately 88,600 cubic yards of material would be excavated for the McGrath Creek channelization and new spillway at Sikes Lake. The embankment fill section for the old spillway would require 3,200 cubic yards of the excavated soil. Of the remaining 85,400 cubic yards of excavated material, approximately 5,000 cubic yards would be used to fill in sections of the old McGrath Creek channel and the remainder would be disposed of in fill areas associated with the proposed Lake Wichita, Holliday Creek project. The preconstruction planning studies for Lake Wichita, Holliday Creek have identifed four areas totalling 90 acres between Southwest Parkway and the Lake Wichita embankment capable of accepting over 1,600,000 cubic yards of the Holliday Creek excavation requirements. These areas could easily accommodate the additional excavation from McGrath Creek.

The selected plan would cause the loss of marginal quality terrestrial and aquatic habitat along McGrath Creek downstream from Sikes Lake. These resources have been heavily encroached upon and provide the only habitat in the immediate area. The vertical, concrete channel walls of the selected plan would be barriers to wildlife travel, would eliminate the natural habitats of the creek, and would reduce diversity. The low water dams along McGrath Creek between Taft Boulevard and Midwestern Parkway maintain pools of water most of the year providing an aesthetic quality that is attractive to residents. The replacement of these pools with the proposed concrete-lined channel would create an adverse visual impact. To soften this impact, tree and shrub plantings would be incorporated into the project design. Plant material selected would be of both indigenous and ornamental varieties, tolerant to wet conditions and useful to urban wildlife for cover and food. A list of indigenous plant species is provided in the US Fish and Wildlife Service's Coordination Report (see Appendix C). The environmental impacts of Plan 1A are discussed more fully in the Environmental Impact Statement.

RESIDUAL FLOOD DAMAGES

Plan 1A would provide a 100-year flood protection to properties below Sikes Lake and would reduce estimated average annual damages between Sikes Lake and Holliday Creek by 96 percent. Residual average annual damages would be about $50,000 in that area and about $350,000 in the total watershed. While the 100-year flood would be within the banks of the modified channel, events in excess of the design flood such as the SPF would still cause damages but to a lesser degree. Table 9 shows single event SPF damages under full built-over conditions for with- and without-project conditions.

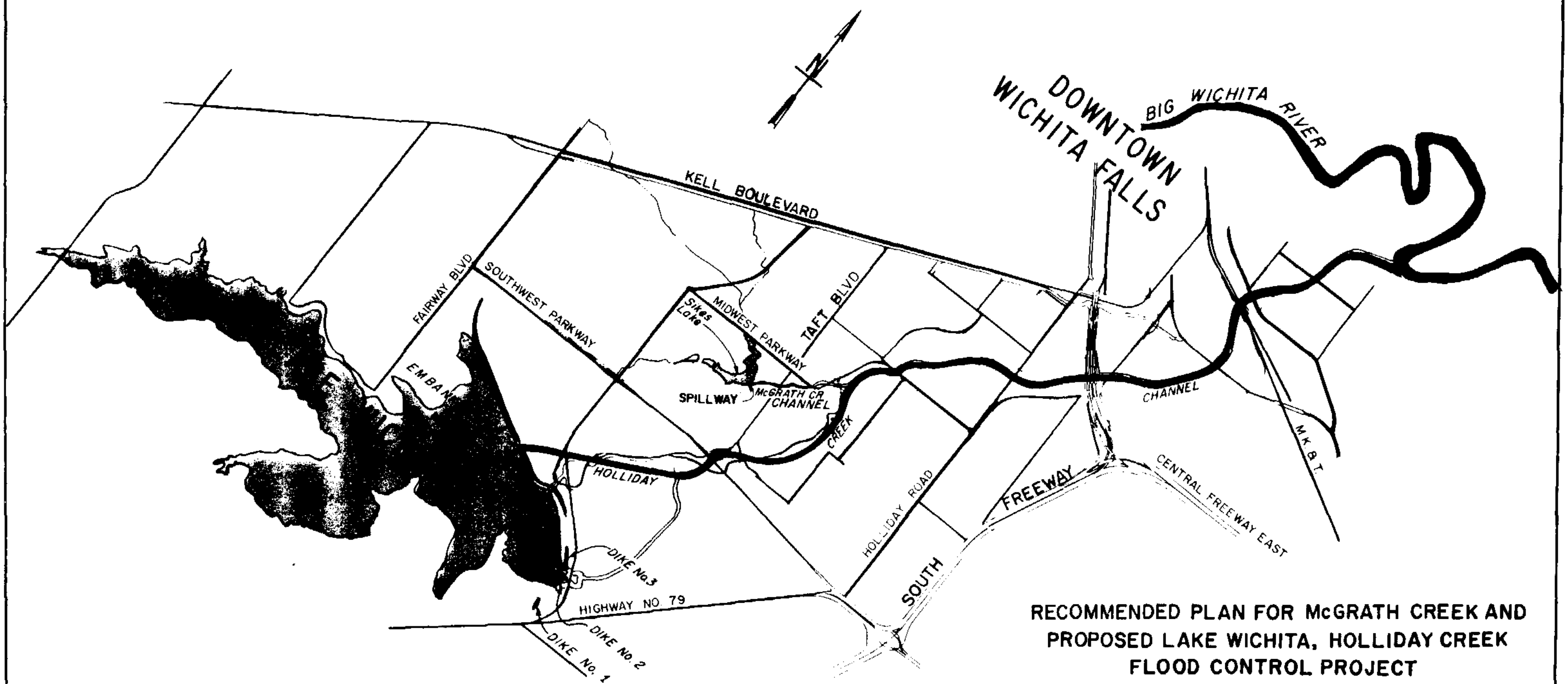
TABLE 9

STANDARD PROJECT FLOOD DAMAGES
($1,000's)

Location	Without Project	With Plan 1A
Below Sikes Lake	25,200	18,400
Above Sikes Lake	16,000	15,400
Total Watershed	41,200	33,800

EFFECTS ON HOLLIDAY CREEK

Alternatives for McGrath Creek were formulated and evaluated with the basic assumption that the proposed channel improvement for Holliday Creek is in place. The Holliday Creek channel is designed to handle increased discharges attributable to channel improvements on McGrath Creek without increasing flood stages. The selected plan for McGrath Creek (Plan 1A) would cause increases in discharges at the confluence with Holliday Creek by about 13 percent for a 100-year frequency event. However, since McGrath Creek peaks before Holliday Creek at this location (and downstream) no increases in Holliday Creek flood stages under with-project conditions would occur. Figure 13 shows the selected plan for McGrath Creek along with the plan designed for the proposed Lake Wichita, Holliday Creek flood control project.



RECOMMENDED PLAN FOR McGRATH CREEK AND PROPOSED LAKE WICHITA, HOLLIDAY CREEK FLOOD CONTROL PROJECT

FIGURE 13

PLAN IMPLEMENTATION

Legislative and administrative policies establish the Federal and non-Federal responsibilities in the construction and operation and maintenance of Federal water projects. Federal legislation authorizing implementation of water resource development projects, the most recent being the Water Resource Development Act of 1976, usually contains local cooperation requirements.

The traditional non-Federal responsibilities required for flood control projects such as McGrath Creek are based upon the Flood Control Act of 1936, as amended. The major items of non-Federal resonsibilities are:

- to provide all lands, easements, and rights-of-way,
- to perform all relocations (except railroad relocations), and
- to operate and maintain the project.

This report contains information and recommendations based upon application of these traditional requirements. Table 10 presents the apportionment of project costs for the selected plan based upon the Flood Control Act of 1936.

TABLE 10

COST APPORTIONMENT
PLAN 1A (NED PLAN)
(April 1985 Price Levels)

Item	Federal	Non-Federal	Total
First Costs	$	$	$
Lands and Damages	0	529,000	529,000
Relocations	0	800,000	800,000
Channels	5,420,000	0	5,420,000
Spillway	560,000	0	560,000
Engineering & Design	720,000	91,000	811,000
Supervision & Administration	300,000	40,000	340,000
TOTAL	7,000,000	1,460,000	8,460,000
Additional Annual Costs			
Operation & Maintenance	0	33,000	33,000
Major Replacement	0	23,000	23,000
TOTAL	0	56,000	56,000

The current Administration is reviewing project cost sharing and financing across the entire spectrum of water resources development functions. The basic principle governing the development of specific cost-sharing policies is that, whenever possible, the cost of services produced by water projects should be paid by the direct beneficiaries. It is also recognized that the Federal Government can no longer bear the major portion of financing water projects. New sources of project financing, both public and private, will have to be found. While specific financing and cost-sharing policies applicable to the McGrath Creek flood control project have not yet been established, the local sponsor(s) should anticipate its level of financial participation to be greater than traditionally required.

The current proposal for cost-sharing on flood control projects is 65 percent Federal and 35 percent non-Federal cost. The City of Wichita Falls agreed to such terms for the Lake Wichita, Holliday Creek flood control project in a resolution adopted October 16, 1984. A letter from the Mayor of Wichita Falls, dated September 24, 1984, expressed intent to cost share in the Lake Wichita, Holliday Creek project at a level of 35 percent of the first cost for flood control and was accepted by the Assistant Secretary of the Army for Civil Works. Based on the current Adminstration's proposed policies and the recently agreed upon terms for the Lake Wichita, Holliday Creek project, the sponsor(s) should anticipate financial participation for the McGrath Creek flood control improvements consistent with the 35-percent level.

Under traditional cost-sharing policies, the cost of the selected plan, identified as the NED plan, establishes the Federal extent of financial involvement. This study has identified Plan 1A as the NED plan. Plan 1A has an estimated first cost of $8,460,000, which would be divided into a Federal first cost of $7,000,000 and a non-Federal first cost of $1,460,000, based upon the cost-sharing formula of the Flood Control Act of 1936. Under the current Administration's proposed policies (65 percent Federal, 35 percent non-Federal) and consistent with the Lake Wichita, Holliday Creek cost-sharing agreement, Federal first costs would be $5,500,000 and non-Federal first costs would be $2,960,000. As costs are updated to reflect changing price levels, the local and Federal shares will change.

SUMMARY OF COORDINATION AND PUBLIC VIEWS

COORDINATION WITH SPONSOR

A meeting with Wichita Falls city officials was held September 2, 1983, to provide the city with a copy of the Section 205 Reconnaissance Report on McGrath Creek, dated January 1983, and to explain the proposed plan of action to include McGrath Creek investigations as part of the planning and engineering on the proposed Lake Wichita, Holliday Creek project. Also discussed were potential solutions to be evaluated.

On July 19, 1984, representatives from the Corps of Engineers met with Wichita Falls city officials to provide a copy of the plan formulation analysis for McGrath Creek which outlined the intermediate plans. The City of Wichita Falls agreed to set up a meeting of the Flood Control Task Force to provide a public forum for the presentation and discussion of intermediate plans.

A meeting with the Flood Control Task Force was held on August 16, 1984, to present the intermediate plan analyses. The meeting was a public forum, and representatives from other public (Federal, state, county, and local) agencies attended, as well as local citizens and the news media. About 65 people attended. At the meeting, it was proposed that Plans 1 and 2 should be carried into detailed studies. Local interests expressed an interest in analyzing a plan to carry discharges from Sikes Lake into a culvert under Clayton, Cedar Elm, and Granada Boulevards. This established the Clayton-Granada Diversion Plan which was included in the detailed investigations.

A meeting was held on October 24, 1984, with Wichita Falls city officials to present preliminary findings of the detailed investigations. The concept of the NED plan was explained and the city was informed that Plan 1A would be the tentatively recommended plan unless the City of Wichita Falls preferred another alternative and was willing to pay any additional costs. City officials expressed an interest in another meeting of the Flood Control Task Force to discuss the detailed plans before deciding their preference.

On March 5, 1985, another meeting was held with the Flood Control Task Force. About 45 people attended the public forum including local citizens, representatives from other public agencies, and the news media. The results of the detailed studies were presented. The Task Force recommended that the City Council of Wichita Falls endorse Plan 1A.

By letter dated March 11, 1985, the Mayor of Wichita Falls expressed full support by the city for participation in the implementation of Plan 1A (100-year level of protection) for McGrath Creek. A resolution accompanying the letter was adopted by the City Council on April 2, 1985 (see Appendix B).

COORDINATION WITH MSU

Coordination with MSU was predominantly by informal discussions. MSU representatives were very cooperative during the course of the study by assisting in the documentation of information on Sikes Lake, and by keeping the Corps informed of their future plans for the lake and spillway.

By letter dated January 18, 1984 (see Appendix B), MSU explained the uses of Sikes Lake and its importance to the school's educational and recreational interests. MSU has expressed interest in maintaining the lake.

On July 19, 1984, representatives from the Corps of Engineers met with MSU representatives to provide a copy of the plan formulation analysis for McGrath Creek which outlined the intermediate plans. Also discussed was the possibility of constructing a new spillway north of the existing location. MSU expressed no objections to any of the intermediate plans but preferred Plan 1 because it would cause the least disturbance to school property. They also expressed no objection to a new spillway location but were concerned about the effects on one of the two buildings on the embankment and access across the spillway. MSU mentioned that they were aware of design deficiencies in the existing spillway and that they were developing plans to enlarge the spillway to decrease flooding upstream.

By letter dated July 31, 1984, (see Appendix B) MSU further explained their intentions to enlarge the Sikes Lake spillway and to request funding from the State of Texas for the improvements. They reiterated their interest in being an active participant in the Corps study on McGrath Creek and recognized that spillway improvements would need to be made in conjunction with improvements to the downstream channel.

On October 24, 1984, a Tulsa District representative met with MSU representatives to discuss preliminary findings of the detailed plans. MSU was informed that Plan 1A which involves a new spillway to be located between two MSU buildings would be the tentatively selected plan. An access road on the upstream side of the spillway at the crest elevation would be included. MSU expressed no objection to the tentatively selected plan.

On March 5, 1985, representatives of the Corps of Engineers and Midwestern State University met to discuss the spillway design and the location of Plan 1A. MSU representatives expressed concern over the close proximity of the new spillway to one of their buildings. It was agreed that no changes would be made in the feasibility study and that future engineering and design of the proposed plan would include further analysis of the spillway design and location. By letter dated March 12, 1985, to the Mayor of Wichita Falls (see Appendix B), the president of MSU expressed support of Plan 1A and requested that the university be involved in future design studies of the spillway to minimize potential adverse impacts on existing facilities.

In summary, MSU has expressed support of Plan 1A and an interest in participating with the City of Wichita Falls and the Corps of Engineers in jointly pursuing a solution to the flood problems of McGrath Creek. MSU has tentative plans and is seeking funding to enlarge the Sikes Lake spillway. Such plans are flexible and can be adjusted to accommodate a joint Federal and non-Federal plan.

COORDINATION WITH TEXAS DEPARTMENT OF WATER RESOURCES

Need to tell them to refer to TWDB/TWC split for final rpt.

Coordination with the Texas Department of Water Resources (TDWR) focused primarily on the subject of dam safety at Sikes Lake since it is the responsible agency for safety of non-Federal dams in the state of Texas. By letter dated August 13, 1984, the TDWR responded to an inquiry regarding their views on the safety of the Sikes Lake structure and to whether corrective measures would be required (see TDWR letter in Appendix B). The TDWR concurred with the opinion that Sikes Lake represents no significant hazard to downstream lives or property and stated that no corrective measures were anticipated.

GENERAL PUBLIC VIEWS AND COMMENTS

The Flood Control Task Force meetings were the principal forums in which general public views were obtained. The task force was created by the City Council shortly after the May 1982 flood. The task force is composed of 30 individuals including some city councilmen, city staff personnel, local citizens, and developers. The task force is chaired by a city councilman, Craig Wilson. The task force was formed to be a forum for public input and discussion of storm drainage and flooding problems in the city and to be an advisory group to the city council. All task force meetings are open to the public and announcements are made in the local news media.

At the August 16, 1984 meeting, a voluntary questionnaire was distributed to each of the 65 persons present, and a total of 23 responses were received. A majority (78%) of the persons responding preferred Plan 1. (Plan 1A was not developed at the time of the meeting and, therefore was not presented.) Other plans suggested included Plan 2, upstream diversion and retention, and the Clayton/Granada Street Diversion concept. An area of concern expressed by a large number of those in attendance was that the proposed Holliday Creek project should proceed as soon as possible and that McGrath Creek plans should not delay construction of Holliday Creek flood control improvements.

At the March 5, 1985 Task Force meeting none of the 45 persons present expressed opposition to Plan 1A, and it was unanimously recommended to the City Council.

COORDINATION WITH OTHER AGENCIES AND PUBLIC ENTITIES

The US Fish and Wildlife Service was involved throughout the study process and its report is included in Appendix C. Other Federal, state, and local agencies were invited to the August 16, 1984 and March 5, 1985 Task Force meetings. Coordination with all interested parties continued through field level review of the draft report and environmental impact statement. Comments and responses to the field level review draft are included in Appendix B.

RECOMMENDATION

I recommend that the National Economic Development plan (Plan 1A), selected herein, which would provide protection against the 100-year frequency flood along McGrath Creek below Sikes Lake in Wichita Falls, Texas, be authorized for implementation as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable, in accordance with cost sharing and financing arrangements satisfactory to the President and the Congress, at a total first cost of $8.46 million with a first cost to the United States presently estimated at $7.0 million based on traditional cost sharing and April 1985 price levels.

This recommendation is made with the provision that, prior to implementation, non-Federal interests will, in addition to the general requirements of law for this type of project, agree to comply with the following requirements:

a. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for the construction, operation, and maintenance of the project;

b. Provide for the alterations and relocations of utilities, roads, bridges, buildings, storm drains, and other structures and improvements except railroad bridges and railroad bridge approaches, that are required for construction of the project;

c. Hold and save the United States free from damages due to the construction and subsequent operation and maintenance of the project, except damages due to the fault or negligence of the United States or its contractor;

e. Adopt and enforce flood plain regulations to insure an unobstructed floodway and compatability between future development and the degree of flood protection provided by the project;

f. Provide relocation assistance to persons displaced by the project in accordance with sections 210 and 305 of Public Law 91-646;

g. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army and in accordance with additional requirements as may be stipulated in the project document, in Congressional legislation, or by the Office, Chief of Engineers;

h. Prevent encroachment upon the project, channels and floodways which could interfere with the maintenance and operation of the flood control project and manage all project-related channels and floodways to preserve capacities for project functions; and

i. Publicize and notify interested parties, at least annually, that the project will not provide protection from an occurrence greater than the project design flood.

Franklin T. Tilton
Colonel, Corps of Engineers
District Engineer

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT

ON LAKE WICHITA, HOLLIDAY CREEK

MCGRATH CREEK FLOOD CONTROL REPORT

WICHITA FALLS, TEXAS

The responsible lead agency is the US Army Engineer District, Tulsa. The responsible cooperating agency is the US Fish and Wildlife Service.

ABSTRACT

The final environmental impact statement for Lake Wichita, Holliday Creek was filed with EPA on March 5, 1981, and published in the Federal Register on March 13, 1981.

The McGrath Creek project is being studied as part of the Lake Wichita, Holliday Creek Flood Control project. Several options were studied with channel modifications and downstream diversions identified as the most likely control plans for reduction of flood damages along McGrath Creek. Various channel alignments were analyzed. Plan 1A with 100-year flood protection, the National Economic Development (NED) Plan, is recommended.

Impacts include the loss of aquatic and terrestrial resources along McGrath Creek from Sikes Lake to Holliday Creek. This habitat is of marginal quality, but provides the only habitat in the immediate area for urban wildlife and provides aesthetic value for persons living nearby. Indigenous and ornamental trees and shrubs would be planted to soften the impacts of project structures. The plantings would also be useful to wildlife as food and cover.

Average annual benefits would be $1,410,000, average annual project cost is $830,000 and the benefit-to-cost ratio is 1.7 to 1.0.

For further information, contact:

Mr. Buell Atkins
US Army Corps of Engineers, Tulsa District
Post Office Box 61
Tulsa, OK 74121-0061
Commercial telephone: 918-581-7857
FTS telephone: 745-7857.

NOTE: Information displays, maps, etc., discussed in the McGrath Creek Main Report are incorporated by reference in the EIS.

SECTION 1

SUMMARY

MAJOR CONCLUSIONS AND FINDINGS

1.01 Due to intense localized thunderstorms which can cause severe flooding in the McGrath Creek Basin, a need exists to reduce or eliminate flood damages. There is also a need to contribute to environmental and life quality by preserving Sikes Lake and to minimize potential fish and wildlife losses in the McGrath Creek watershed.

1.02 Options considered included no action, flood plain acquisition and evacuation, flood plain management, floodproofing, levees and flood walls, Sikes Lake storage, removal of Sikes Lake, upstream detention, upstream diversion, channel modifications, and downstream diversions. It was determined that channel modification and downstream diversion was the most likely control plan for reduction of flood damages. Various channel alignments were analyzed. Plan 1A with 100-year protection, the National Economic Development Plan (NED), is recommended.

1.03 Impacts include the loss of aquatic and terrestrial resources along McGrath Creek from Sikes Lake to Holliday Creek. This habitat is of marginal quality but provides the only habitat in the immediate area for urban wildlife and has aesthetic value for persons living nearby.

1.04 Both native and ornamental trees and shrubs beneficial to wildlife would be planted along the channel alignment and around Sikes Lake to lessen the impact of concrete channels and fencing and make the area aesthetically pleasing.

1.05 Average annual flood control benefits would be $1,410,000 (April 1985 price levels), average annual project cost, at 8-3/8 percent discount rate and a 100-year period of analysis is $830,000 and the benefit-to-cost ratio is 1.7 to 1.0.

AREAS OF CONTROVERSY

1.06 No known opposition to the project has surfaced.

UNRESOLVED ISSUES

1.07 No unresolved issues have developed on this project.

RELATIONSHIP TO ENVIRONMENTAL PROTECTION STATUTES AND OTHER REQUIREMENTS

1.08 The relationships of each plan to the requirements of environmental laws, executive orders, and other policies; the objectives of Federal, state, and local land use plans, policies, and controls applicable to the study area, and other related state and local plans and laws; and any Federal requirements for detailed plans are shown in table EIS-1. All requirements for policies, plans, and entitlements have been met or would be met prior to the start of construction.

TABLE EIS-1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS
(The selected plan is Plan 1A)

POLICIES	COMPLIANCE Plans 1, 1A, 1C, 2A, 2B, & C/G
Archeological and Historic Preservation Act, 1974, as amended, 16 U.S.C. 469, *et seq*	FC
Clean Air Act, as amended, 42 U.S.C. 7609, *et seq*	FC
Clean Water Act, 1977, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, *et seq*	FC
Endangered Species Act, 1973, as amended, 16 U.S.C. 1531, *et seq*	FC
Estuary Protection Act, 16 U.S.C. 1221, *et seq*	NA
Federal Water Project Recreation Act, as amended, 16 U.S.C., 460-1-12, *et seq*	FC
Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 *et seq*	FC
Land and Water Conservation Fund Act, 1965, as amended, 16 U.S.C. 4601, *et seq*	FC
Marine Protection Research and Sanctuaries Act, 1972, 16 U.S.C. 1401, *et seq*	NA
National Historic Preservation Act, 1966, as amended, 16 U.S.C. 470a, *et seq*	FC
National Environmental Policy Act, as amended, 42 U.S.C. 4321, *et seq*	FC
Rivers and Harbors Act, 33 U.S.C. 401, *et seq*	FC
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, *et seq*	FC
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, *et seq*	FC
Water Resources Planning Act, 1965	FC
Floodplain Management (E.O. 11988)	FC
Protection of Wetlands (E.O. 11990)	FC
Farmland Protection Policy Act, 7 U.S.C. 4201, *et seq*	FC
Section 404 Permit	FC

NOTES: The compliance categories used in this table were assigned based on the following definitions:

FC Full compliance. Having met all requirements of the statute, E.O., or other environmental requirements for the current stage of planning (either pre- or postauthorization).

NA Not Applicable. No requirement for the statute, E.O., or other environmental requirement for the current stage of planning.

C/G - Clayton/Granada Street Diversion Plan

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SECTION 2

NEED FOR AND OBJECTIVES OF ACTION

STUDY AUTHORITY

2.01 Study of potential flood damage reduction measures on McGrath Creek in Wichita Falls, Texas, is being conducted under authority provided by a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted February 25, 1938.

PUBLIC CONCERNS

2.02 Intense, localized thunderstorms can occur in the Wichita Falls area during any time of the year, but usually occur from May through October. These storms may produce severe flooding on commercial, residential, and industrial properties in the flood plain of McGrath Creek. Obstructions in the floodway include bridges, the Sikes Lake spillway, fences, acute turns in the creek channel, waste material, and low water dams. For the May 1982 flood 90 percent of the flood damage in the McGrath Creek Basin occurred between Sikes Lake and the confluence with Holliday Creek. Average annual flood damages along McGrath Creek below Sikes Lake are over $1.25 million.

SUMMARY OF PROBLEM AND OPPORTUNITY STATEMENTS

2.03 The following problem and opportunity statements were established for the formulation and evaluation of alternative plans. They were developed based on the identified problems and needs and reflect the national concern for improving national economic development and preserving environmental quality.

Plans developed in the study should:

a. contribute to improved physical, emotional, and economic health, safety, and well-being by reducing or eliminating flood damages, and

b. contribute to environmental and life quality, and preserve fish and wildlife and cultural resources.

? The proj. is an env impact to preservation program –

SECTION 3

ALTERNATIVES

PRELIMINARY PLANS

3.01 Structural and nonstructural alternatives were evaluated. Options for reducing flooding on McGrath Creek are:

Nonstructural	Structural
No Federal Action	Levees and Flood Walls
Flood Plain Acquisition	Sikes Lake Storage
Flood Plain Management	Removal of Sikes Lake
Floodproofing	Upstream Detention
	Upstream Diversion
	Channel Modifications and Downstream Diversions

3.02 In the preliminary analysis, some options were judged infeasible due to the inability to solve the flooding problems or the cost exceeding benefits, and were eliminated. Modifications to the existing McGrath Creek channel and diversion channels below Sikes Lake were identified as the most likely control plans for reduction of flood damages. Three types of channels were examined: trapezoidal, grass lined with 1 on 3 slopes; trapezoidal, concrete lined with 1 on 1-1/2 slopes; and rectangular, concrete lined. Five levels of flood protection (10-year, 25-year, 50-year, 100-year, and SPF) were considered for each alternative channel type.

INTERMEDIATE PLANS

3.03 The intermediate plan analysis identified several areas where more detailed and refined data was necessary. Two principal areas of concern were the height of the Sikes Lake embankment and the effects of increased runoff due to future upstream development.

DETAILED PLANS

Studies were made to evaluate in greater detail two plans selected for continued study, and a plan identified by local interests at a City of Wichita Falls Flood Control Task Force meeting in August 1984.

Plan 1

3.04 Plan 1 (see figure EIS-1, segments 1, 2, 3, and 4) would consist of a 35-foot-wide vertical-wall concrete channel below Sikes Lake, principally along the existing McGrath Creek alignment. Approxmately 101,800 cubic yards of soil would be excavated for construction of the new channel and spillway. Straightening the channel at the Cedar Elm Street bridge would be required. The total length of the improved channel would be 4,300 feet. A new vertical-wall spillway with a crest elevation of 960 feet NGVD would be constructed at the existing Sikes Lake spillway location. The new spillway would be 110 feet wide at the crest and would be 187.5 feet in length. The bridges at Weeks Park Drive and Cedar Elm Street would be removed. A drop structure at the mouth of McGrath Creek would be at the same location as in the proposed Holliday Creek channel project, but at a lower crest elevation and a width equal to the channel.

3.05 Plan 1 would provide a 100-year level of flood protection to properties below Sikes Lake and would reduce the 100-year flood level in Sikes Lake by 1.4 feet, thus slightly reducing flooding upstream.

Plan 1A (Selected Plan)

3.06 The selected plan (see figure EIS-1, segments 1, 2, 3 & 4A) would basically be the same as Plan 1 except that the new spillway would be constructed about 700 feet north of the existing spillway. The new spillway would have its crest at elevation 960 feet NGVD, a crest width of 110 feet, and length of 187.5 feet. The spillway would drop from 960 feet to the channel invert of 946.1 feet. The new spillway would be situated between two Midwestern State University (MSU) buildings on the embankment. The existing

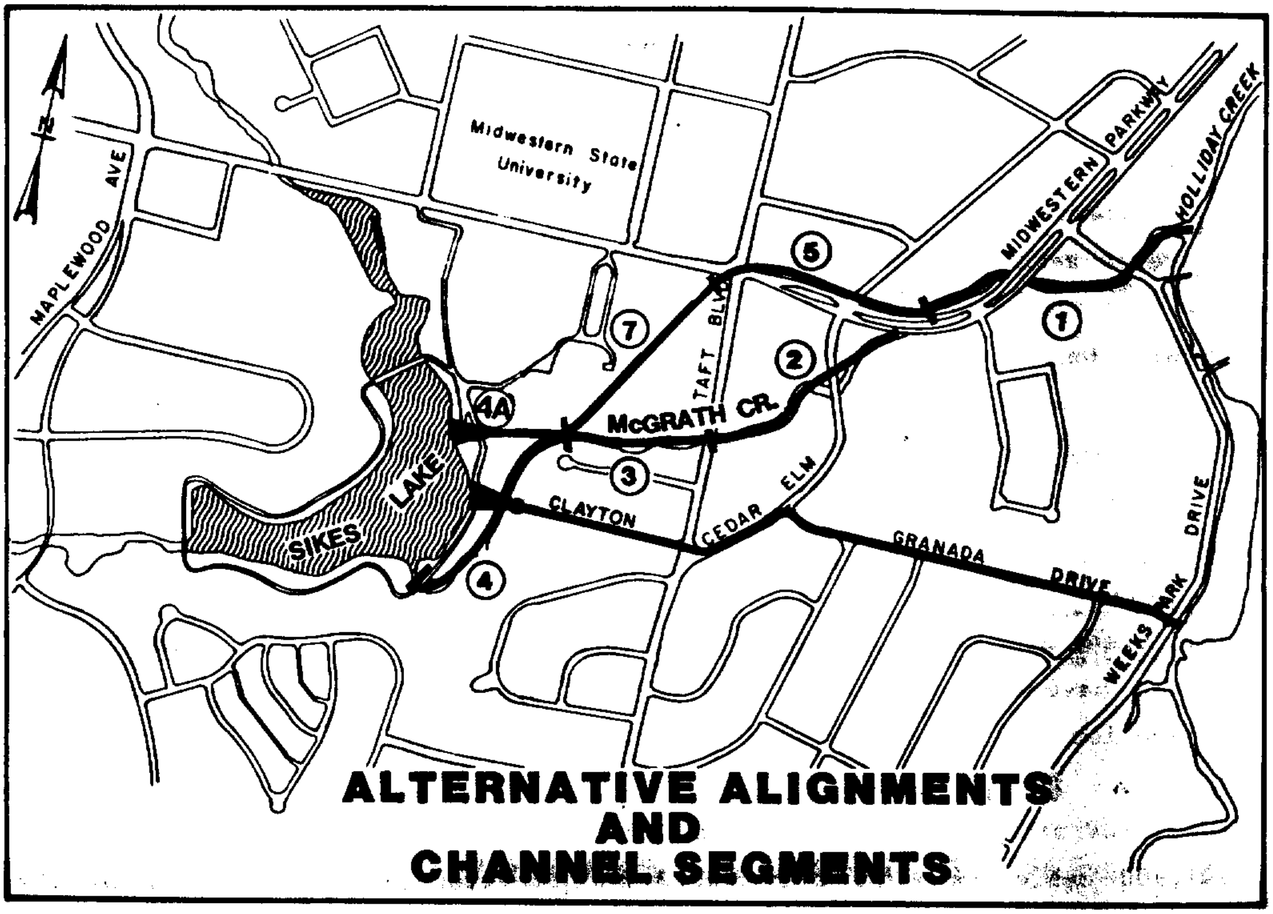

Figure EIS-1

spillway would be removed and the area filled to conform to the embankment. Approximately 88,600 cubic yards of soil would be excavated for construction of the new channel and spillway. Material suitable for filling the existing spillway area would come from excavation of the McGrath Creek channel. The channel section downstream of the existing spillway runs northward and is parallel to the Sikes Lake embankment. This channel segment is already concrete lined and would be left undisturbed to capture drainage from south of Sikes Lake. The improved channel downstream of the new spillway would follow the same alignment and be of the same size and shape as in Plan 1. The total length of the channel would be 3,600 feet. The two bridge replacements, one commercial building removal, and drop structure at the mouth would be the same as in Plan 1.

Plan 1B

3.07 Plan 1B (see figure EIS-1, segments 1, 2, 3 & 4A) would have the same channel alignment as Plan 1A. Approximately 90,100 cubic yards of soil would be excavated for construction of the new channel and spillway. To reduce adverse aesthetic, safety, and environmental impacts of the open channel, the segment between Taft Boulevard and the upstream Midwestern Parkway Bridge would be an underground box. Bridge replacements, commercial building removal, and degree of flood protection would be the same as in Plan 1A.

Plan 1C

3.08 Plan 1C (see figure EIS-1, segments 1, 2, 3 & 4A) would have the same alignment as Plan 1A with the exception of the spillway. The Plan 1C spillway would have a crest width of 140 feet to reduce the 100-year water surface elevation in Sikes Lake by an additional one foot. This would afford a slight increase in flood reduction above Sikes Lake while providing the same degree of flood protection downstream of the lake as Plans 1A and 1B. Approximately 91,900 cubic yards of soil would be excavated for construction of the new channel and spillway. All other features, including channel size, bridge replacements, the building removal, and the drop structure at the mouth, would be the same as in Plan 1.

Plan 2A

3.09 Plan 2A (see figure EIS-1, segments 1, 5, 7 & 4A) would have a new spillway as in Plan 1A. The existing channel segment immediately below the Sikes Lake spillway would be left as is for intervening area drainage, and the existing concrete spillway would be removed and replaced with fill to conform to the embankment. Approximately 132,300 cubic yards of soil would be excavated for construction of the new channel and spillway. From a point about 600 feet upstream of the Taft Boulevard Bridge, a channel would be cut northeastward across MSU property to the Taft-Midwestern intersection. From this point, an underground concrete box culvert would carry flow under the intersection and parallel the north side of Midwestern Parkway to McGrath Creek. The lower end of the channel would be the same as in Plan 1A.

The channel segment across MSU property would be a 35-foot-wide rectangular concrete channel to carry design flows with 1-on-3 side slopes (turfed) from the top of the concrete to natural ground. The spillway and transition-to-channel would be the same as in Plan 1A. The Weeks Park Drive Bridge would be replaced and box culverts would be constructed under the Taft-Midwestern intersection and at Cedar Elm Street. No homes or buildings would be relocated. The existing McGrath Creek channel between Taft Boulevard and the upstream Midwestern Parkway Bridge would be left in their existing condition. Flows in excess of channel design capacity would route through this channel segment. Total length of channel and box culvert would be 3,700 feet.

Plan 2B

3.10 Plan 2B (see figure EIS-1, segments 1, 5, 7 & 4A) would be the same as Plan 2A except that segment 7 across MSU property would be an underground double-box culvert. The purpose of this plan would be to diminish adverse impacts of a large open channel through a pecan grove on MSU property. All other features of Plan 2B would be the same as in Plan 2A. Approximately 159,700 cubic yards of soil would be excavated for construction of the new channel and spillway.

Clayton/Granada Street Diversion Plan

3.11 The Clayton/Granada Street Diversion Plan (see figure EIS-1) was suggested at a meeting of the city of Wichita Falls Flood Control Task Force in August 1984. The plan would include a new 110-foot-wide spillway (crest elevation 960 feet) about 500 feet north of the existing spillway. The channel would be an underground double-box culvert underneath Clayton, Cedar Elm, and Granada Streets. Approximately 87,500 cubic yards of soil would be excavated for construction of the new channel and spillway. The total length of the channel would be about 3,500 feet. It would enter Holliday Creek about 2,100 feet upstream (south) of the mouth of the existing McGrath Creek channel. Discharges in excess of the 100-year flood would route through the existing McGrath Creek channel.

3.12 This plan would be the least disruptive to aesthetic and other environmental values of the existing channel. No bridge replacements or residential or commercial buildings would be relocated. The streets (Clayton, Granada, and Cedar Elm), as well as utilities along these roads, would be relocated. Most of the right-of-way requirements are part of the roadways. The level of flood protection afforded by the Clayton/Granada Street Diversion plan would be the same as the other 100-year design plans.

COMPARATIVE IMPACTS OF ALTERNATIVES

3.13 The significant environmental resources of the area are aquatic resources and terrestrial resources. Table EIS-2 displays a comparison of the impacts to these significant resources by each of the detailed plans.

TABLE EIS-2

COMPARATIVE IMPACTS OF ALTERNATIVES

Base Condition, Alternatives, and Project Economics		Aquatic Resources	Terrestrial Resources
BASE CONDITION		Available:	Available:
		Sikes Lake (20 acres) & 4,750 feet along McGrath Creek below the lake.	4.6 acres of limited urban habitat along McGrath Creek below Sikes Lake
WITHOUT CONDITION		No change	No change
PLAN 1			
First Cost:	9,590	Impacts 4,750 feet of low quality habitat.	Impacts 4.6 acres of low quality habitat.
Annual Cost:	940		
Annual Benefits:	1,410		
B/C Ratio:	1.5		
PLAN 1A (Selected Plan)			
First Cost:	8,460	Impacts 3,900 feet of low quality habitat.	Impacts 3.9 acres of low quality habitat.
Annual Cost:	830		
Annual Benefits:	1,410		
B/C Ratio:	1.7		
PLAN 1B			
First Cost:	9,550	Impacts 3,900 feet of low quality habitat.	Impacts 3.9 acres of low quality habitat.
Annual Cost:	940		
Annual Benefits:	1,410		
B/C Ratio:	1.5		
Plan 1C			
First Cost:	8,700	Impacts 3,900 feet of low quality habitat.	Impacts 3.9 acres of low quality habitat.
Annual Cost:	850		
Annual Benefits:	1,415		
B/C Ratio:	1.7		

TABLE EIS-2 (Continued)

Base Condition, Alternatives, and Project Economics		Aquatic Resources	Terrestrial Resources
Plan 2A			
First Cost:	11,620	Impacts 1,700 feet of low quality habitat.	Impacts 4.1 acres of low quality habitat.
Annual Cost:	1,150		
Annual Benefits:	1,425		
B/C Ratio:	1.2		
Plan 2B			
First Cost:	12,430	Impacts 1,700 feet of low quality habitat.	Impacts 4.1 acres of low quality habitat.
Annual Cost:	1,230		
Annual Benefits:	1,420		
B/C Ratio:	1.2		
Plan Clayton/Granada			
First Cost:	13,300	No Change	No Change
Annual Cost:	1,320		
Annual Benefits:	1,425		
B/C Ratio:	1.1		

NOTE: Costs are based on April 1985 price levels; 8-3/8 percent discount rate; $1,000's; 100-year period of analysis.

SECTION 4

AFFECTED ENVIRONMENT

THE WATERSHED

4.01 McGrath Creek is a left bank tributary of Holliday Creek. It flows into Holliday Creek about six miles upstream from its confluence with the Wichita River. The McGrath Creek watershed is entirely within the corporate limits of Wichita Falls. The watershed is about 5.6 square miles and about 90 percent urbanized. Sikes Lake is located at the confluence of two drainage tributaries of McGrath Creek about 0.9 mile upstream from its confluence with Holliday Creek. The northern tributary extends about 2.3 miles and the southern tributary extends about 1.6 miles upstream from Sikes Lake Dam. The average streambed slope is 18.5 feet per mile. Three-fourths of the McGrath Creek channel is concrete lined. Sikes Lake is a shallow 20-acre recreational and educational lake owned and operated by Midwestern State University. The water surface elevation in McGrath Creek below Sikes Lake is maintained for aesthetic purposes by a series of low water dams.

CULTURAL RESOURCES

4.02 Files of the State Historic Preservation Office, the Office of the State Archaeologist, and the Texas Archaeological Research Laboratory were searched. No cultural resources sites are recorded in the project area. The area has not yet been intensively surveyed. The land is largely urbanized or at least disturbed by modern development, giving the project area a low potential for significant cultural resources. A ground survey of the selected plan area would be accomplished prior to completion of preconstruction planning.

TERRESTRIAL RESOURCES

4.03 This general area is characterized by mesquite growing in open stands among xerophytic grasses such as buffalo grass, grama, and threeawn. There is some intermingling of prairie with deciduous trees most commonly growing near streams.

4.04 Much of the area around Sikes Lake and along McGrath Creek has been developed and is in Bermuda grass lawns. On the steep banks that cannot be mowed around Sikes Lake are stands of Phragmites species, switchgrass, cocklebur, sunflower, and smartweed. Some water primrose is found along the south shoreline and near the spillway. The trees around the lake are hackberry, elm, mulberry, salt cedar, and pecan. Many have been planted in a lawn type setting, with a number of pecan trees occurring northeast of the lake on the lawn of the Midwestern State University president's residence.

4.05 Downstream of Sikes Lake, where the flood plain is obstructed by apartments and houses, lawns extend to the edge of the stream. There are also stands of switchgrass, cattails, rush, and smartweed in the channel, plus a few cottonwood, willow, hackberry, mulberry, and salt cedar trees. Where the creek runs through the Weeks Park golf course, some water primrose is found along with areas of filamentous algae.

4.06 The open area in the upstream portion of the watershed is characterized by a fairly dense stand of mesquite with good ground cover and undergrowth. Red cedar, switchgrass, yucca, curlycup gumweed, and broomweed also are found. Several wetlands, surrounded by willows, are also in this area.

4.07 Because of the developed nature of the McGrath Creek Basin, little wildlife habitat remains. Some wildlife species more tolerant of urbanization still occur. Evidence around Sikes Lake and along McGrath Creek indicates the presence of beaver, opossum, cottontail, skunk, and armadillo. Muskrat, cotton rat, and least shrew also have been reported from the basin, but because of urbanization the most abundant small mammal is probably the house mouse.

4.08 Some migratory waterfowl use Sikes Lake, primarily various dabbling ducks. Gulls, terns, and grebes also have been sighted. Great blue and little blue herons use the area and a little blue heron rookery is located just upstream of Sikes Lake. A number of resident and migratory songbirds also are found throughout this urban area.

4.09 No Federally listed or proposed threatened or endangered species are known to occur in the project area.

AQUATIC RESOURCES

4.10 Sikes Lake is a shallow 20-acre impoundment suffering from siltation. Dredging of the lake in 1976 deepened and probably improved the quality of its aquatic habitat. Numerous mayfly larvae occur in the lake along with chironomid and dragonfly larvae. Crayfish and freshwater mussels are also present in the lake. The most abundant fish are rough fish such as carp and river carpsuckers. There are some largemouth bass, channel catfish, green sunfish, and bluegill. Forage species are fathead minnows, golden shiners, red shiners, and mosquitofish. Frogs include the leopard frog, bullfrog, and cricket frog. Turtles such as sliders, snapping turtles, and soft-shelled turtles are found in the lake. Both the yellow-bellied water snake and diamond-backed water snake are also present.

4.11 McGrath Creek downstream of the lake is a series of pools formed by a number of small low water dams. Rough fish such as carp along with several forage species including fathead minnows, golden shiners, red shiners, and mosquitofish occur in the pools. Turtles are fairly abundant. In late summer these pools often dry up or have high temperatures and low dissolved oxygen.

4.12 McGrath Creek and its tributaries upstream from Sikes Lake are intermittent streams. Because the basin is almost completely developed, the streams receive urban runoff resulting in extreme fluctuations in flow and water quality. The aquatic species found in this area would be similar to those occurring in the lake and downstream.

SECTION 5

ENVIRONMENTAL EFFECTS

5.01 The project would require irreversible and irretrievable commitments of materials, energy resources, labor, and public funds for construction, operation, and maintenance of the levee and related facilities. Plans were assessed for compliance with Executive Order 11990, "Protection of Wetlands." No significant wetlands would be adversely impacted. Plans would comply with the objectives of Executive Order 11988, "Floodplain Management." Because the area has been disturbed previously and is 90 percent developed, there would be no impacts on prime farmland or cultural resources.

5.02 During project construction, activities, equipment, processes, and work operated or performed by the contractor in accomplishing the specified construction shall be in strict accordance with the State of Texas air pollution statutes, rules, and regulations, and Federal emission and performance laws and standards. Ambient air quality standards set by the Environmental Protection Agency shall be maintained during construction activities.

5.03 Minor noise pollution impacts would be associated with equipment operation during the construction phase of the project but would cease concurrent with project completion. During construction, the contractor would comply with the Occupational Safety and Health Act standards as well as the Corps of Engineers General Safety Requirements Manual (EM 385-1-1) to hold noise impacts at a safe level.

5.04 Implementation of any plan would reduce flood damages to streets, utilities, homes, commercial buildings, and lands through the elimination of inundation, scour, and silt deposition. Intangible benefits would result from the prevention of possible loss of human life due to floods and the reduction of those health hazards created as an aftermath of flooding.

5.05 Flood protection would also eliminate those inconveniences attributed to interruption of normal community activities, business operations, and vehicular travel. It would aid in the improvement of the community by protecting items of local historic and architectural interest, encourage the perpetuation of existing cultural ties, and enhance the mood and community spirit of the local citizenry.

NO ACTION PLAN

5.06 Under the No-Action Plan, the environment would remain as it currently exists.

SIGNIFICANT RESOURCES

5.07 The significant environmental resources in the project impact area are terrestrial resources and aquatic resources.

Terrestrial Resources

5.08 Plan 1 and its variations 1A, 1B, and 1C would all result in the loss of remaining terrestrial habitat in or adjacent to the stream below Sikes Lake (segments 1, 2, 3, and 4 or 4A). Plans 2A and 2B would also affect segments 1 and 4A of McGrath Creek and in segment 7 several pecan trees on the lawn of the Midwestern State University president's residence would be destroyed. The stream has been channelized in the past, encroached upon by development, and the habitat is of marginal quality, but it provides the only such habitat in the immediate area and has aesthetic value for persons living nearby. The vertical wall concrete channels would act as a barrier to movement and would prevent access and use by terrestrial wildlife. Because the Clayton/Granada Plan with underground channels would not affect the natural channel and would still carry all flows except high flood flows, this plan would not cause any change in the natural resources of McGrath Creek.

Aquatic Resources

5.09 Channelization of McGrath Creek below Sikes Lake (segments 1, 2, 3, and 4A) as in Plan 1 and its variations would result in loss of the remaining aquatic habitat in the stream. The low water dams that now maintain pools in the creek would be destroyed. Plans 2A and 2B would affect segments 1 and 4 of McGrath Creek. The stream has been channelized and the aquatic habitat is of marginal quality, but it provides the only such habitat in the immediate area. The vertical wall concrete channels would result in the complete loss of existing stream habitat, create a monotypic substrate and reduce habitat diversity in the channel for aquatic communities. The impact of the concrete channel on groundwater recharge would be minor. The streambed is composed of highly impermeable clays so groundwater recharge is insignificant even without the concrete channel. The Clayton/Granada Plan would not change the existing stream resources and would not cause any significant losses to the natural resources.

5.10 All plans would route high flows through Sikes Lake and would not affect the existing normal lake level. The spillway elevation would not be changed and only high flows would be affected. Construction activities would result in a temporary increase in turbidity and sedimentation downstream in Holliday Creek. Because the species of fish and wildlife found in and around Sikes Lake are adaptive, and are able to survive in an urban environment, they should be able to withstand the temporary disturbance of construction activities. With no change in lake elevation, the project should have little effect on the lake's fish and wildlife resources. Use of the lake by the university, fishermen, and other recreationists should be similar to what it is now.

LANDSCAPING

5.11 To lessen the impacts, ornamental and indigenous trees and shrubs would be planted along the creek. The selected species would provide food and cover for wildlife. This is in line with the US Fish and Wildlife Service recommendations to compensate for wildlife losses.

EXCAVATED MATERIAL

5.12 It is unlikely that the excavated material contains hazardous materials because McGrath Creek is located in an urban environment and there are no sources for such materials. About 3,200 cubic yards (cy) of the excavated material would be used to build the embankment closure around the old spillway of Sikes Lake, and about 5,000 cy would be used to fill sections of the old McGrath Channel. The remainder of the excavated material, about 80,400 cy, would be hauled away and put in disposal sites for the Lake Wichita, Holliday Creek Project. These sites are above the ordinary high water mark.

SECTION 404(b)(1) EVALUATION

Proposed Discharge of Fill Materials

5.13 The proposed action involves construction of 3,600 feet of vertical-wall concrete channel in the existing streambed of McGrath Creek. The channel would consist of 13,100 cubic yards of concrete and 1,752,000 pounds of reinforcing steel. About 3,200 cubic yards of material excavated from the McGrath Creek Channel would be used to create an embankment across the old spillway. An additional 5,000 cubic yards would be used to fill sections of the old channel following excavation of the new spillway channel and channel realignment at the Cedar Elm Street bridge. (See figures 10, 11, and 12 in Main Report.)

Physical Substrata and Water Circulation Effects

5.14 The physical substrata of the creek channel would be changed from impermeable clays to concrete. About 5,000 cubic yards of excavated material would be used to fill sections of the old channel. The elevation of the creek channel would be lowered an average of about four feet by excavation. The concrete channel and filled sections would remain in place indefinitely. The aquatic habitat used by bottom-dwelling invertebrates and fish would be destroyed by the concrete channel and in the filled sections. Because the habitat is of poor quality even without this project, the habitat loss is not significant. The proposed discharges would have little effect on water current patterns or circulation. Downstream flows and normal water fluctuation would only slightly be affected by the channel alignment. The water quality of the creek would not be significantly affected by the concrete channel and channel realignment. No significant changes in the hydrologic regime would occur.

Suspended Particulate/Turbidity Effects

5.15 Suspended particulate levels and turbidity would increase during the construction phase, but decrease after project completion due to erosion prevention.

Contaminant Effects

5.16 In environmental studies performed by the Tulsa District during channelization of similar small streams in urban settings, sediments have been found to be relatively free of contaminants. Because there are no industrial waste or municipal sewage discharges in the McGrath Creek watershed, the sediments should be uncontaminated. During preconstruction planning and engineering, soil tests will be conducted to determine if contaminants are present in the fill material. The concrete and reinforcing steel would not introduce contaminants into the water column.

Aquatic Ecosystem Effects

5.17 The functional aquatic ecosystem of the creek would be destroyed by the concrete channel and the filling of certain segments of the creek. The change in substrata characteristics is not conducive to aquatic life. After construction, the creek channel would have virtually no habitat for aquatic organisms. The water quality of the creek would not be significantly affected by the changes after construction.

5.18 Cumulative Effects on the Aquatic Ecosystem. The proposed action would alter all of the aquatic habitat of McGrath Creek below Sikes Lake which precludes the possibility of cumulative impacts on that stream segment. The project should not significantly affect Holliday Creek, regardless of future flood control measures.

5.19 Secondary Effects on the Aquatic Ecosystem. The concrete channel would prevent erosion which would decrease turbidity.

Status of Compliance

5.20 The proposed discharges are in compliance with the guidelines set forth in Section 404(b)(1) of the Clean Water Act of 1977.

SECTION 6

PUBLIC INVOLVEMENT

6.01 The Tulsa District, Corps of Engineers, conducted this study in coordination with Federal, state, and local agencies; local political leaders and organizations; and residents of the project area, including the Texas Department of Water Resources, the City of Wichita Falls, Midwestern State University, and the US Fish and Wildlife Service.

REQUIRED COORDINATION

6.02 Pursuant to provisions of the National Environmental Policy Act of 1969 (Public Law 91-190), coordination has been effected with agencies which are authorized to develop and/or enforce environmental standards in order to obtain a current assessment of the environmental impact of the proposed project.

6.03 The environmental statement was sent to the following government agencies and citizen organizations to request views and comments.

Center for Disease Control
Department of Commerce
Department of Housing and Urban Development
Department of Health and Human Resources
Department of the Interior
Environmental Protection Agency
Federal Emergency Management Agency
Federal Highway Administration
Forest Service
Soil Conservation Service
US Coast Guard
US Geological Survey
Department of Energy
Advisory Council on Historic Preservation
Texas State Historic Preservation Officer

Environmental Policy Center

Sportmen's Clubs of Texas, Inc.

Governor's Office of Intergovernmental Relations - Texas

National Wildlife Federation

Wildlife Management Institute

Sierra Club of Texas - Texas A&M

Sierra Club

Institute for Water Resources

Texas Department of Water Resources

Middle South Services, Inc.

City of Wichita Falls

NORTEX Regional Council of Government

Midwestern State University

Red River Authority of Texas

Red River Valley Association

Wichita County Water Improvement District No. 2

LIST OF PREPARERS

The following were primarily responsible for preparing this Environmental Impact Statement:

Name	Expertise Discipline	Experience	Role in Preparing EIS
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Mr. Steve Cone	Regional Economist	10 years with Tulsa District	Project Manager
Mr. Jim Staves	Aquatic Biologist	5 years Water Quality work with Tulsa District	Water Quality
Mr. Ken Williams	Biologist	13 years, environmental studies, Tulsa and Savannah Districts	EIS Coordinator
Mr. Jim Randolph	Biologist	13 years with Tulsa District	Fish and Wildlife Coordination, Mitigation
Mr. Michael Corkran	Anthropology/ Archeology	10 years archeological research management; 5 years archeological research, Univ. of N. Carolina.	Archeological Data Cultural Resource Impacts

TABLE EIS-3

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Social and Economic Analysis

APPENDIX A
SOCIAL AND ECONOMIC ANALYSIS

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APPENDIX A

SOCIAL AND ECONOMIC ANALYSIS

SOCIAL ASSESSMENT

The purpose of this section is to describe characteristics of the population affected by the proposed flood control alternatives on McGrath Creek and to identify potential social impacts associated with these alternatives. This section has been prepared in compliance with section 122 of Public Law 91-611 (Flood Control and Rivers and Harbor Act, 1970).

STUDY AREA

McGrath Creek is located in Wichita Falls, Texas. Two branches of the creek run primarily through four census tracts in the city (tracts 121, 125, 120, and 119). These four tracts will be referred to as the study area. The alternatives evaluated would affect specific neighborhoods within these tracts (1980 Census Neighborhood Statistics Numbers 31, 26, and 6). The affected neighborhoods will be referred to as the impact neighborhood. Figure A-1 shows the study area and the impact neighborhood.

EXISTING AND FUTURE SOCIAL CONDITIONS

Population Characteristics

The city of Wichita Falls had a 1980 population of 94,201 persons.[1] Though areas of the city have experienced population growth, the city population has generally declined over the past twenty years. The 1970 population was 96,654 compared to the 1960 population of 101,724.[2] A major factor in the decline can be attributed to a decrease in military

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[1] US Department of Commerce, Bureau of Census, County and City Data Book, 1983, Table E, US Government Printing Office, Washington, DC, 1983.

[2] US Department of Commerce, Bureau of the Census, County and City Data Book, 1972, Table B-2, US Government Printing Office, Washington, DC, 1972.

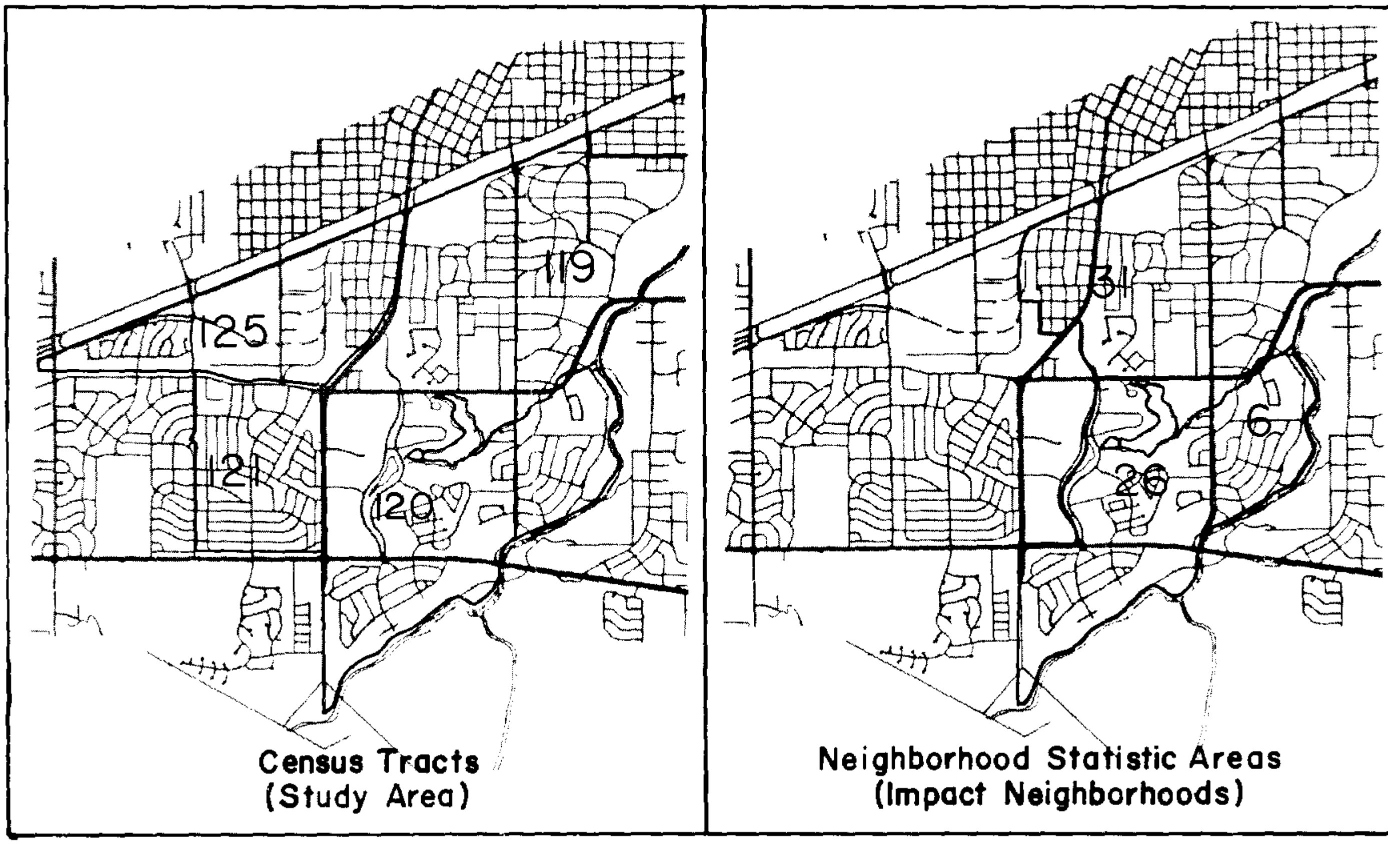

FIGURE A-1

personnel at the nearby Sheppard Air Force Base. Civilian population in the city grew by 4 percent between 1970 and 1980, from 83,570 to 86,936.[3]

Certain census tracts within Wichita Falls have had a considerably higher population growth rate than the entire city. The study area consists of a group of such tracts. Between 1970 and 1980, the study area population grew from 10,407 to 10,972, an increase of 5.4 percent.[4] Tracts of the study area containing Sikes Lake and immediately downstream of the lake

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[3] City of Wichita Falls, Planning Department, Population Trends, City of Wichita Falls, Wichita Falls, Texas, 1984. Based upon 1980 Summary Tape File 3 (STF-3), Census Data.

[4] City of Wichita Falls, Planning Department, 1980 Census Tract Data compiled from 1980 Census of Housing and Population.

(tracts 120 and 119) had a population of 5,200 in 1970 and 7,010 in 1980, respectively, an increase of 34.8 percent. This growth is due largely to the number of new housing units constructed during the 1970's.

The impact neighborhood had a population of 5,476 in 1980.[5] Most of the residents are fairly new to the area, with only 35.3 percent of the 1980 population (age 5 years and older) living in the current house for more than 5 years. More than 52 percent of the housing units in the impact neighborhood were built since 1970. In the area nearest Sikes Lake, 524 of the 976 housing units (54 percent) were built since 1979. This indicates the population growth in parts of the impact neighborhood is relatively recent.

Human Ecology

The study area provides specific activities for residents of the city of Wichita Falls. Retail trade, education, and residential living are the primary social activities within this area. Shopping centers serve both city residents and county residents surrounding the Wichita Falls Metropolitan Area. Midwestern State University is a four-year state supported school with an enrollment of approximately 5,000 students, primarily from the North Central Texas region.

The neighborhood residents are primarily upper middle income families. The median family income in the impact neighborhoods was as follows: number 6, $31,743; number 31, $17,198; and number 26, $25,912. The median family income is based upon the 1980 census of population and housing. The city of Wichita Falls Planning Department indicates that the census tracts which contain the study area will increase approximately 15.7 percent by the year 2000.

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[5] US Department of Commerce, Bureau of Census, Census of Population and Housing; Wichita Falls, Texas, Neighborhood Statistics, US Government Printing Office, Washington, DC, 1983.

Both Sikes Lake and McGrath Creek are important elements to the human ecology of the study area and the city. Sikes Lake is owned by Midwestern State University and is used for a variety of educational purposes. Students and residents in the impact neighborhood use a jogging trail around the lake for walking and running. The lake adds to the aesthetic setting of adjacent retail stores and public buildings. Below Sikes Lake, McGrath Creek provides an aesthetic environment for apartment dwellers adjacent to the creek. One apartment complex is built along both sides of the creek with ground floor apartments having door openings to within a few feet from the top of the banks of the creek. The grassy channel and low water dams have made the apartments a desirable place to live (even though the high flows of McGrath Creek have flooded these apartments.)

Future Social Conditions

Table A-1 shows historical and projected population figures for the study area and Wichita Falls. In 1970, the study area increased in population while other areas of the city decreased. The city is projected to have a 2000 population of 103,150 indicating a reversal of the historical trend of no population growth. The period of 1980 to 2000 is projected to be an era of growth. The projected growth is expected to surpass the historical growth experience in the study area as well as the projected growth that will occur city wide. The projected figures indicate that growth in the census tracts above Sikes Lake will be greater than the growth of the tract immediately below Sikes Lake (tract 119). Growth is expected to concentrate in the upper part of the McGrath Creek watershed.

TABLE A-1

HISTORICAL AND PROJECTED POPULATION OF CENSUS TRACTS
IN THE STUDY AREA

Census Tracts	Year 1960	1970	1980	1990	2000
Tract 119	1,631	2,338	2,961	3,000	2,975
Tract 120	2,426	2,862	4,049	4,600	4,800
Tract 121	5,277	4,100	2,658	3,000	3,200
Tract 125	1,092	1,107	1,304	1,500	1,500
Total	10,426	10,407	10,972	12,100	12,475
Remaining Population of Wichita Falls	91,298	85,858	83,229	86,200	90,700
Total Population of City of Wichita Falls	101,724	96,265	94,201	98,300	103,195

Source: City of Wichita Falls, Planning Department, Comprehensive Plan Population Element page 9; City of Wichita Falls, Wichita Falls, Texas; 1983. These projections are based upon a cohort survival mode using a 1 percent annual net migration rate. The military population was held constant. Projections for census tracts are based upon projected growth rate for sectors of the city which contain several tracts.

Based on housing construction trends, the vacant land within the area will continue to develop and is expected to be fully developed by 2010. The development of the area will help maintain the population growth that occurred in the 1970's.

Flooding has been a problem in the impact neighborhood and will continue to be a threat. If flooding continues to be a part of the social conditions of the impact neighborhood, the desirability of living or doing business in the impact neighborhood could diminish.

With increases in the population of the city, the study area will continue to be an important part of the retail trade, education and residential aspects of the community. Sikes Lake will increase in its importance as an educational, recreational, and aesthetic area for city residents.

SOCIAL IMPACTS OF PROPOSED ALTERNATIVES

The analysis of impacts of the proposed project alternatives was based upon existing and projected social conditions in the study area, a consideration of public views, and informal interviews with city officials and other community members.

Alternative Evaluation

Each of the detailed alternatives will be addressed including the alternative of no federal action.

No Federal action. Under this alternative, land in the the study area and impact neighborhood would become fully developed. The social character of the impact neighborhood could be altered by the occurrence of flooding which would continue to threaten the health and safety of residents. If such flooding continues to occur, the desirability of the impact area as a residential and retail trade area might diminish which could result in outmigration and devaluation of property.

Plans 1, 1A, and 1C. Each of these alternatives consists of an open channel along the existing alignment with a new spillway on Sikes Lake Dam. Under these alternatives, flooding problems for the impact neighborhood and study area would be significantly reduced. The desirability of the area for residential living would be maintained.

Construction of the open channel would temporarily disrupt traffic and increase noise for those living and doing business in the impact neighborhood. Safety problems might occur for those living adjacent to the channel (particularly children) during construction. Safety problems, however, could be diminished through proper safety procedures such as fencing. The open concrete channel would be viewed by residents living adjacent to the channel as a downgrading of aesthetics. The channel now is grass lined and has trees planted on top of the bank. This would be replaced by concrete walls and a chain link fence resulting in a permanent change in the aesthetics of areas between Taft Street and Holliday Creek. Shrub and tree plantings adjacent to the new channel for landscaping would soften the adverse aesthetic impact. Channelization would require the removal of one commercial office building. Plan 1C would also involve the removal of a storage building on Midwestern State University property.

Plan 1B. Plan 1B is the same as Plan 1A except that the channel from Taft Street to Midwestern State University would be underground. As with Plan 1A, flood protection would be provided for the study area and impact neighborhood.

Construction impacts would be similar to those under Plan 1A. Long term aesthetics of the impact neighborhood would be less adversely affected by this plan than under Plans 1, 1A, and 1C. The underground channelization between Taft and Midwestern would allow for a grass covered area in place of the old channel. Channelization would also involve removal of one commercial office building.

Plan 2A. This alternative would consist of an open channel through Midwestern State University property and an underground channel segment between the Taft-Midwestern intersection and McGrath Creek. As with the other plans, flood protection would enhance the desirability of living in the impact neighborhood. Since the existing channel on McGrath Creek between Taft Boulevard and Midwestern Parkway would be left in its present condition, the aesthetics of the area would not be diminished.

Construction impacts would be similar to the other plans. Channelization would require acquisition, division, and limitation of access to university property.

Plan 2B. Plan 2B would be the same as Plan 2A with the exception of an underground channel segment through Midwestern State University property to the Taft-Midwestern intersection. The impacts of flood protection would be similar to the other plans. The impacts of the area between Taft Boulevard and Midwestern Parkway would be the same as in Plan 2A.

Construction impacts would be similar to the other plans. The underground portion of the channel would not divide university land; however, it would require the acquisition of an easement. Such an acquisition would limit future land use.

Clayton/Granada Street Diversion Plan. This plan would consist of channelization underneath Clayton, Cedar Elm, and Granada Streets. As with the other plans, this alternative would provide flood protection for the impact neighborhood. Construction impacts would be greater than other plans because of more disruption of traffic flows and access for residents. The affect on the area between Taft Boulevard and Midwestern Parkway along the existing channel would be the same as in Plans 2A and 2B.

Conclusion

All the alternatives considered would provide flood protection for the impact neighborhood. This protection would increase the health and safety of the residents living in the area as well as provide protection to property. As a result, the desirability of living and conducting business in the area would continue to stimulate population growth and land development.

All the alternatives would have temporary construction impacts. Traffic flows would be disrupted and noise levels would be increased for those living and conducting business in the impact neighborhood. The alternatives with open channels would negatively affect the aesthetics of the area. The alternative with a channel crossing university lands would limit future development of the lands and access to the area. The alternatives with underground channel segments would have minimal impact upon the aesthetics of adjacent residences.

ECONOMIC EVALUATION

INTRODUCTION

This section provides a description of the investigations, procedures, and analyses conducted to establish the value of the property within the McGrath Creek flood plain, the average annual flood losses under existing conditions, the residual flood losses, and the average annual flood reduction benefits for Plans 1, 1A, 1B, 1C, 2A, 2B, and the Clayton/Granada Plan.

The area used in the analyses was the area within the standard project flood (SPF) plain along McGrath Creek and its northern and southern tributaries. The McGrath Creek watershed is entirely within the corporate limits of Wichita Falls, Texas. The watershed is approximately 5.6 square miles and is about 90 percent urbanized.

The flood plain of McGrath Creek was divided into ten study reaches as shown in figure A-2. Reaches were determined by considering:

1) The continuity of water surface profiles,

2) The homogeneity in the patterns of development in flood plain lands, and

3) The isolation of significant potential damage centers from areas of minimal or negligible damage potential.

The ten study reaches used in this evaluation are described in table A-2.

TABLE A-2

STUDY REACH DESCRIPTIONS
MCGRATH CREEK, WICHITA FALLS, TEXAS

NORTHERN TRIBUTARY

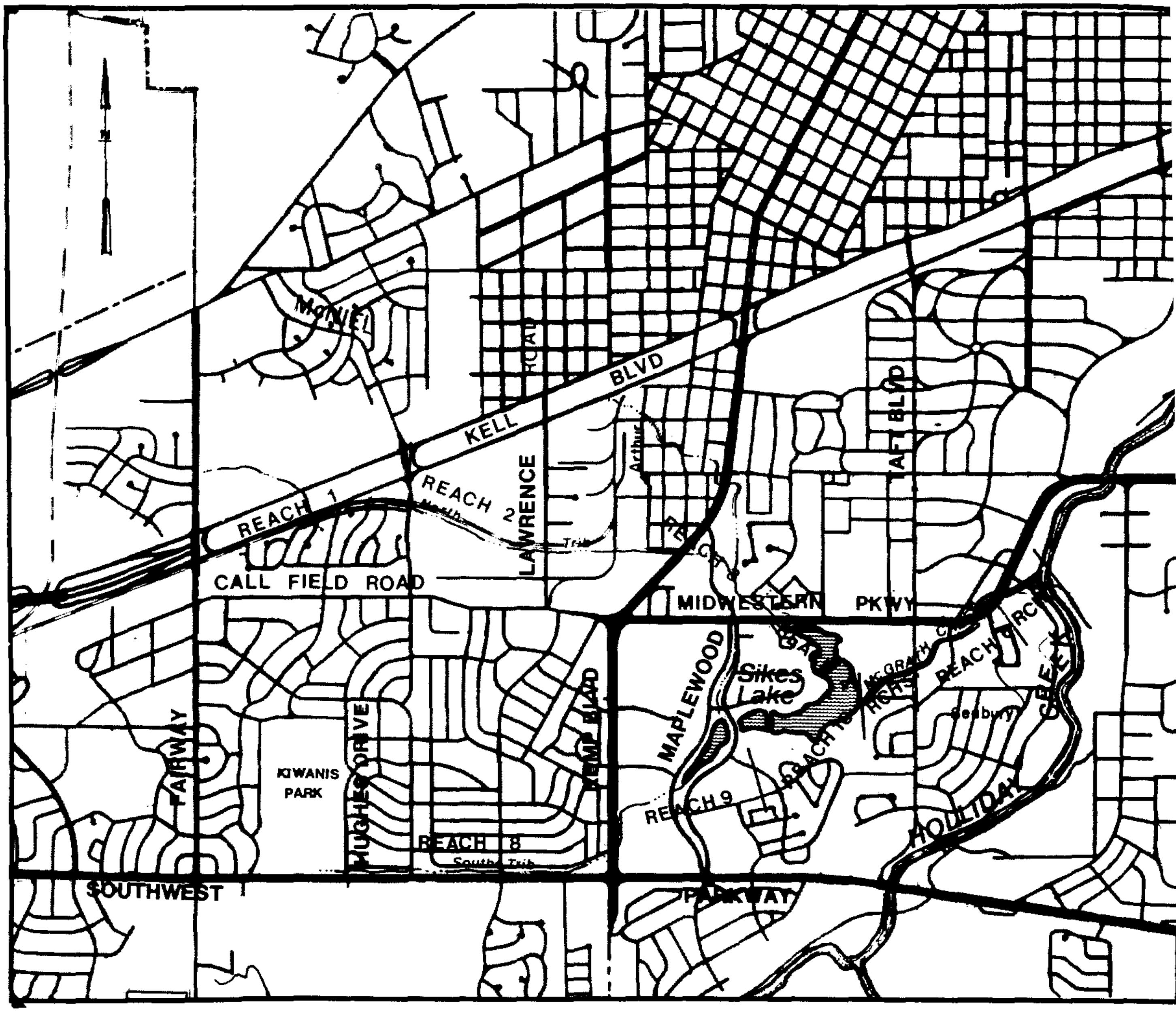
Reach 1:	Fairway Boulevard to McNiel Avenue
Reach 2:	McNiel Avenue to Arthur Street
Reach 3:	Arthur Street to Midwestern Parkway
Reach 4:	Midwestern Parkway to Sikes Lake Dam

BELOW SIKES LAKE

Reach 5:	Sikes Lake Dam to 300 feet downstream of Taft Boulevard
Reach 6:	300 feet downstream of Taft Boulevard to Seabury Drive
Reach 7:	Seabury Drive to confluence of Holliday Creek

SOUTHERN TRIBUTARY

Reach 8:	Hughes Drive to Kemp Boulevard
Reach 9:	Kemp Boulevard to 800 feet downstream of west lane of Maplewood Avenue
Reach 10:	800 feet downstream of west lane of Maplewood Avenue to Sikes Lake Dam



ECONOMIC REACHES

McGRATH CREEK WATERSHED

Figure A-2

An inspection and inventory of the flood plain was completed in October 1983 by Tulsa District, Corps of Engineers personnel. The inventory included:

1) A determination of the type, number, and level of development of flood plain property. This involved classification of property into the following damage categories:

a) Residential Structures - Single and Multiple Family
b) Residential Contents - Single and Multiple Family
c) Commercial
d) Industrial
e) Public
f) Transportation
g) Communications and Utilities
h) Public Health and Relief

2) An estimate of residential and nonresidential property values. The residential property values included both the structure and the contents. The value of existing residential contents was estimated to be 50 percent of the value of the structure. The nonresidential property values included the plant structure, inventory, and equipment.

WITHOUT PROJECT CONDITION

A description of the existing flood problem and the anticipated future conditions with no Federal action are discussed in this section. This information was gathered through field investigations and follow-up office studies conducted to ascertain the magnitude as well as the severity of the flood hazard and, subsequently, the need for flood control.

Flood History

On May 12-13, 1982, heavy thunderstorms over the Wichita Falls area dumped up to ten inches of rain in the McGrath Creek watershed during a 12-hour period. That storm caused an estimated $21,460,000 in damages.

Prior to 1982, no significant flood damage had occurred in the McGrath Creek watershed. This is largely because most of the development and channel constrictions were put in place during the late 1970's and 1980's. Hydrologic modeling of existing conditions indicates that channel capacity below Sikes Lake is less than the 5-year frequency flood.

Flood Hazard

The potential for catastrophic losses in the watershed exsists in both human and economic terms. During heavy rains McGrath Creek rises rapidly with a peak time of approximately one hour. The short peaking time precludes the opportunity to move most property to a position of safety. It also puts many lives in danger. The area of McGrath Creek downstream of Sikes Lake (reaches 5, 6, and 7) is also burdened with the problem of ponding during high waters which adds to the flood damage. The water in that area has only two means of escape; by pumping the water out of the low areas by the two existing pump sites and by waiting for McGrath Creek to recede. The ponding effect increases the risk of loss of life for area residents.

Number and Value of Property

There are 1,299 structures in the standard project flood plain. The inventory of these structures is shown in table A-3. Of the 1,299 structures, 95 percent are residential (single- and multi-family buildings).

The second largest category of structures is the commercial category. The 53 total structures are divided almost evenly among the northern and southern tributaries and below Sikes Lake areas. The structures consist mainly of retail and service establishments.

The total investment in structures and property identified in the flood plain is estimated to be $253 million based on April 1985 prices and level of development. Residential structures and contents, estimated to be about $215 million, include furnishings and other household goods listed at 50 percent of the value of the structures. Other investments in the study area include commercial ($28 million), public ($9 million), industrial ($300,000), transportation ($200,000), and communications and utilities ($90,000).

Elevation-Damage Function

Damage susceptability functions (i.e., depth versus percent damage relationships) were determined from data collected during the course of field investigations and developed as part of other flood studies by the Tulsa District. These damage functions were developed and applied by property type. The development of damage coefficients considered local building characteristics and materials, as well as the nature of the contents, equipment, and inventory.

Elevation-damage relationships were developed in one foot increments beginning at the point of zero damage and continuing to the SPF water surface elevation. The point of zero damage was determined by the first instance where the water would enter a structure. The elevation-damage function was calculated by applying the appropriate damage susceptability coefficient for each foot of flooding to the value of property. Incremental losses of all activities comprising a damage category were summed to produce an elevation-damage function. An elevation damage curve for Reach 5 is shown in Plate A-1. This curve shows damages for the residential structures and contents and "other" categories. The "other" category includes transportation, such as roads; communications (telephone); utilities (gas, electric, water and sewer); and public health (relief).

TABLE A-3

NUMBER AND VALUE OF EXISTING PROPERTY
(April 1985 Level of Development and Prices. Dollar Values in $1,000's)

	Residential Structures/Contents		Commercial		Public		Industrial		Transportation		Communications & Utilities		Total	
Reach	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
1	26	2,535.0	-	-	-	-	-	-	-	-	-	-	26	2,535.0
2	-	-	3	616.0	-	-	-	-	-	-	-	-	3	616.0
3	147	17,509.5	10	1,763.0	3	3,715.0	-	-	-	-	-	-	160	22,987.5
4	-	-	3	4,880.0	1	1,310.0	-	-	1	205.0	-	-	5	6,395.0
5	88	19,125.0	-	-	-	-	-	-	-	-	-	-	88	19,125.0
6	200	29,097.0	16	5,005.0	2	3,432.0	-	-	-	-	1	91.0	219	37,625.0
7	210	31,020.0	-	-	-	-	-	-	-	-	-	-	210	31,020.0
8	308	21,487.5	3	1,346.0	-	-	1	300.0	-	-	-	-	312	23,133.5
9	61	13,440.0	18	14,457.5	-	-	-	-	-	-	-	-	79	27,897.5
10	195	80,775.0	-	-	2	804.0	-	-	-	-	-	-	197	81,579.0
TOTAL	1,235	214,989.0	53	28,067.5	8	9,261.0	1	300.0	1	205.0	1	91.0	1,299	252,913.5

Single Occurrence Flood Losses

The SPF event could potentially cause damages of $40 million. This represents a loss of about 16 percent of the total value of property in the flood plain. An examination of the data on a reach basis reveals that significant concentrations of flood losses would occur in Reaches 5, 6, 7, and 8. SPF damages in these reaches have been calculated to be about $30 million representing 76 percent of the total SPF loss. Reaches 5, 6, and 7 account for almost $25 million or approximately 63 percent of total SPF losses. Most of these losses would be sustained by residential properties. The estimated single occurrence damages of the 25-year, 50-year, 100-year, and SPF events are displayed in table A-4.

TABLE A-4

ESTIMATED SINGLE OCCURRENCE FLOOD LOSSES
EXISTING CONDITIONS
(APRIL 1985 PRICES IN $1,000's)

McGrath Creek	Flood Event			
Reach	25-Year	50-Year	100-Year	SPF
1	31	81	208	370
2	2	2	4	6
3	381	623	1,408	3,746
4	0	234	493	1,000
5	856	1,511	2,365	5,878
6	3,431	4,136	5,519	10,163
7	3,271	5,365	6,882	8,767
8	1,757	2,227	2,697	5,420
9	0	0	92	1,096
10	2	267	1,605	4,015
TOTAL	9,731	14,446	21,273	40,461

Average Annual Damages

Estimates of average annual damages under existing conditions were prepared using an integration process. This involved the multiplication of the mean damages (derived from the elevation-damage relationship) by the difference in the exceedance probabilities for the same pair of stages from the point of zero damage to the SPF. To accomplish these calculations, the Expected Annual Flood Damage (EAD) program developed by the Hydrologic Engineering Center in Davis, California was utilized. Typical elevation-frequency and damage-frequency curves are shown in Plates A-2 and A-3, respectively.

Table A-5 lists the expected annual damages (EAD) in Reach 5 that would occur in the without project condition. To obtain the EAD figures the program uses its integration process on the damage figures at determined elevations at certain frequencies of occurrences. This process is done for each category of damages and totaled.

Existing Average Annual Flood Losses

Average annual flood losses under 1985 conditions for all reaches were estimated at $1,410,000. This represents less than 1 percent of the total value of flood plain property. Approximately $1,200,000 in flood damages occur to residential property, mainly in Reaches 5, 6 and 7. The next largest category is public health with almost $77,000 in damages on an average annual basis.

Utility damages are estimated to be $50,000 yearly, most of which would occur in Reaches 6 and 7. Residential, public health, and utility flood losses represent over 96 percent of the total average annual damages. The balance of damages is comprised of commercial, public, industrial, and transportation damages.

The column labeled "Year 1985" in table A-6 shows the value of average annual losses computed as if no changes are expected to occur in the McGrath Creek flood plain. However, after considering that the watershed will develop over the years, the depth of flooding is likely to rise. Hydrologic data was developed to estimate the effects of the expected changes on the level of damages. Development was estimated to continue from 1985 to ultimate development in the year 2010. The column labeled "Year 2010" in table A-6 shows the average annual losses without the project under future built-over conditions.

TABLE A-5

EXPECTED ANNUAL DAMAGES
WITHOUT PROJECT CONDITION
REACH 5
(Values in $1,000's)

Elevation[1] Frequency[2] CATEGORY:	956.9 50.0	958.6 20.0	959.7 10.0	960.4 4.0	961.1 2.0	961.7 1.0	963.7 0.2	EAD[3]
STRUCTURES:								
Single-Family	0	20	135	287	526	866	2,364	49
Multi-Family	0	0	2	14	29	43	140	2
CONTENTS:								
Single-Family	0	28	217	441	752	1,143	2,573	68
Multi-Family	0	0	5	20	40	55	156	3
Transportation	0	1	7	15	27	42	105	2
Utilities	0	2	14	29	51	80	199	5
Public Health	0	3	23	50	87	137	340	8
TOTAL	0	54	403	856	1,512	2,366	5,877	137

(1) Elevations are feet above national Geodetic Verical Datum.
(2) Frequency shown is the exceedance probability in percent (EG. 50.0 = 2 year event).
(3) Expected Annual Damage for Reach 5.

Table A-7 displays the average annual flood losses by reach for the years 1984 and 2010. Tables A-6 and A-7 also display the estimated average annual flood losses over the life of the 100-year period of analysis by damage category and reach, respectively.

Table A-8 shows the average annual flood losses by category and reach for the without project condition totaling $1,586,000.

TABLE A-6

AVERAGE ANNUAL FLOOD LOSSES BY CATEGORY
WITHOUT PROJECT
(April 1985 Prices, in $1,000's)

	Time Period		
Category	Year 1985	Year 2010	Project Life
Residential			
Structures	494	621	556
Contents	718	902	808
Commercial	15	19	17
Public	32	42	37
Industrial	(N)	(N)	(N)
Transportation	25	31	28
Utilities	48	60	53
Public Health	77	97	87
TOTAL	1,409	1,772	1,586

(N) Negligible Annual Losses

TABLE A-7

AVERAGE ANNUAL FLOOD LOSSES BY REACHES
WITHOUT PROJECT
(April 1985 Prices, in $1,000's)

Reach No.	Time Period: Year 1985	Time Period: Year 2010	Time Period: Project Life
1	6	6	6
2	(N)	(N)	(N)
3	62	84	73
4	13	15	14
5	137	178	157
6	707	892	797
7	267	321	293
8	168	215	191
9	6	8	7
10	43	53	48
TOTAL	1,409	1,772	1,586

(N) Negligible Annual Losses

Future Conditions Without Federal Action

A forecast of anticipated future flood losses in the event of no Federal action on McGrath Creek involves the application of appropriate economic growth indices in order to measure the change in future flood damages. These changes are projected to occur over the next 50 years. Some additional development and modernization of existing plant and equipment will occur, however, these additional damages were not included since they would be restricted to above the 100-year flood plain. The additional future development above the 100-year flood plain (the McGrath Creek watershed) will increase the amount of "runoff" water thus increasing the future flood losses to existing flood plain properties. In view of the large number of residences in the planning area, changes in the damage figures would likely occur with increases in personal income due to increased stock of household goods and furnishings. The effect of affluence on residential contents is discussed in the following paragraph.

TABLE A-8

AVERAGE ANNUAL FLOOD LOSSES BY TYPE AND REACH
WITHOUT PROJECT CONDITIONS
(April 1985 Prices, $1,000's)

	Type of Development								
Reach	Residential Structures/Contents		Commercial	Public	Industrial	Public Transportation	Utility	Health	Total
1	2	3	0	0	0	(N)	(N)	1	6
2	0	0	0	0	0	(N)	(N)	(N)	(N)
3	23	33	7	3	0	1	2	4	73
4	0	0	0	12	0	(N)	(N)	2	14
5	58	82	0	0	0	3	5	9	157
6	280	409	1	20	0	14	27	46	797
7	107	155	0	0	0	5	10	16	293
8	68	98	9	0	(N)	3	7	6	191
9	2	3	1	0	0	1	(N)	(N)	7
10	16	25	0	1	0	1	2	3	48
TOTAL	556	808	18	36	(N)	28	53	87	1,586

(N) Negligible

Affluence Effects

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983, requires that the value of household contents be limited to a maximum of 75 percent of the structural value of the residences, and should not be projected beyond year 50. Projected per capita personal income for Wichita Falls was used to increase the value of household contents. Projections were based on the 1978 per capita income figure for Wichita Falls as reported by the 1980 Office of Business Economics Research Service (OBERS) Bureau of Economic Analysis (BEA) Regional Projections. The annual rate of change for per capita personal income is also based on 1980 OBERS regional projections. Estimates of future flood losses for residential contents were converted to average annual equivalent values using the applicable current Federal rate of 8-3/8 percent over a 100-year period. Table A-9 displays projected per capita income values, projected value of residential contents, and projected flood damages to residential contents without the project. The average annual affluence effect without the project is $1,122,000.

TABLE A-9

AFFLUENCE EFFECTS
WITHOUT PROJECT

Year	Projected Per Capita Personal Income (1978 Dollars)	Projected Value Of Residential Contents ($1,000's)	Projected Flood Damages To Residential Contents ($1,000's)
1978	5,503	-	-
1985	6,522	71,663	807.9
1990	7,640	83,948	946.4
2000	9,470	104,056	1,173.1
2001	9,717	106,770	1,203.7
2030-2084	16,893	185,620	2,092.6

WITH PROJECT CONDITION

Benefit Evaluations

Estimates of flood damage reduction benefits were calculated using hydrologic data developed for the various plans. This involved the integration of the elevation-frequency relationships with the previously determined elevation-damage functions resulting in damage-frequency functions with and without the project. Average annual flood losses remaining with the project were deducted from the existing condition flood losses to derive average annual flood damage reduction benefits under current conditions.

Residual Flood Losses

Residual damages are expected to continue with any plan. These losses would result from floods exceeding the design level. Table A-10 displays estimates of average annual residual flood losses from McGrath Creek by reach for each plan considered over the 100-year project life considering future hydrologic conditions. Table A-11 presents the same data by damage category.

TABLE A-10

AVERAGE ANNUAL RESIDUAL FLOOD LOSSES BY REACH
(April 1985 Prices, $1,000's)

	PLAN						
Reach	1	1A	1B	1C	2A	2B	C/G
1	6	6	6	6	6	6	6
2	(N)	(N)	(N)	(N)	(N)	(N)	(N)
3	73	73	73	73	73	73	73
4	8	8	8	8	8	8	8
5	8	8	21	8	8	11	8
6	30	30	26	30	17	17	17
7	14	14	3	14	14	14	14
8	190	190	190	190	190	190	190
9	4	4	5	4	4	4	4
10	19	19	22	15	19	19	19
TOTAL	352	352	354	348	339	342	339

(N) - Negligible
C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency protection.

TABLE A-11

AVERAGE ANNUAL RESIDUAL FLOOD
LOSSES BY CATEGORY
(April 1985 Prices, $1,000's)

Category	PLAN 1	1A	1B	1C	2A	2B	C/G
Residential:							
Structures	121	121	121	119	115	116	115
Contents	170	170	171	168	164	166	164
Commercial	16	16	16	16	16	16	16
Public	11	11	12	11	11	11	11
Industrial	(N)	(N)	(N)	(N)	(N)	(N)	(N)
Transportation	6	6	6	6	6	6	6
Utilities	12	12	12	12	12	12	12
Public Health	16	16	16	16	15	15	15
Total	352	352	354	348	339	342	339

(N) - Negligible
C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency protection.

Flood Damage Reduction Benefits

Estimates of flood damage reduction benefits presented in this report reflect a 100-year level of protection. The intermediate analysis had shown that for alternative channel sizes (levels of flood protection), the relationship of cost and net benefits were similar among the different plans. The intermediate analysis also showed that for each plan considered, the 100-year frequency design provided the highest net benefits. Therefore, for purposes of comparing the detailed plans, only the 100-year frequency designs were analyzed. Tables A-12 and A-13 show the average annual flood damage reduction benefits by reach and damage category, respectively, for the plans developed for this study.

TABLE A-12

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS BY REACH
(April 1985 Prices, 8-3/8% Interest, 100-year Project Life, $1,000's)

Reach	PLAN 1	1A	1B	1C	2A	2B	C/G
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	6	6	6	6	6	6	6
5	149	149	137	149	150	147	150
6	768	768	771	768	780	780	780
7	279	279	290	279	279	279	279
8	0	0	0	0	0	0	0
9	3	3	2	3	3	3	3
10	29	29	26	33	29	29	29
TOTAL	1,234	1,234	1,232	1,238	1,247	1,244	1,247

C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency protection.

TABLE A-13

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS BY CATEGORY
(April 1985 Prices, 8-3/8% Interest, 100-Year Project Life, $1,000's)

Category	PLAN 1	1A	1B	1C	2A	2B	C/G
Residential:							
Structures	436	436	435	437	441	440	441
Contents	637	637	636	640	643	641	643
Commercial	1	1	1	1	1	1	1
Public	26	26	26	25	26	26	26
Industrial	0	0	0	0	0	0	0
Transportation	22	22	22	22	22	22	22
Utilities	41	41	41	42	42	42	42
Public Health	71	71	71	71	72	72	72
Total	1,234	1,234	1,232	1,238	1,247	1,244	1,247

C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency protection.

Affluence Benefits

Estimates of the remaining or residual flood hazards to residential contents over the life of the project were prepared by taking into account the increase in value and, therefore, the potential damages to residential contents as per capita income rises. Benefits resulting from the affluence effect were determined by deducting the with-project residual flood damages to residential contents from the without-project flood damages to contents over the life of the project. Table A-14 shows the affluence effects projections for each of the plans.

TABLE A-14

AFFLUENCE EFFECTS
(1985 PRICES, $1,000's)

	Flood Damages To Contents							
	Without Project	Residual With Plan						
Year		1	1A	1B	1C	2A	2B	C/G
1984	808	638	638	637	639	643	642	643
1990	946	747	747	746	749	753	752	753
2000	1,173	926	926	925	928	934	932	934
2001-2084	2,093	950	950	949	952	958	956	958

C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency protection.

The affluence effects were brought to present worth and amortized at an 8-3/8 percent interest rate to obtain an average annual value. The 1985 present worth of affluence effects for Plans 1 and 1A is $814,000. The average annual effects for Plan 1B are $813,000, for Plan 1C $816,000, for Plans 2A and the Clayton/Granada Plan $821,000, and for Plan 2B $819,000. After deducting the with-project effect from the existing condition to residential contents, the affluence benefit is $176,000 for Plans 1, 1A, and 1B, $177,000 for Plans 1C and 2B, and $178,000 for Plans 2A and the Clayton/Granada Plan.

SUMMARY OF AVERAGE ANNUAL FLOOD CONTROL BENEFITS

Table A-15 presents a summary of the flood control benefits for the plans evaluated on McGrath Creek. Included in the summary is a breakdown of the current and future components of the flood damage reduction benefit.

TABLE A-15

AVERAGE ANNUAL FLOOD CONTROL BENEFITS
(April 1985 Prices at 8-3/8%, $1,000's)

	Plan						
	1	1A	1B	1C	2A	2B	C/G
Flood Damage Reduction	1,234	1,234	1,232	1,238	1,247	1,244	1,247
(Current Conditions)	(1,098)	(1,098)	(1,094)	(1,101)	(1,111)	(1,109)	(1,111)
(Future Conditions)	(136)	(136)	(138)	(137)	(136)	(135)	(136)
Affluence Effect	176	176	176	177	178	177	178
TOTAL	1,410	1,410	1,408	1,415	1,425	1,421	1,425

C/G - Clayton/Granada Plan

NOTE: All plans provide 100-year frequency flood protection.

Intangible Benefits

In addition to the tangible flood control benefits, certain nonquantifiable benefits would be realized from the project's construction. These would be:

1) Reduced hazards to life through the reduction of the fast rising flood levels;

2) reduced possibility of a health hazard caused by flood damage to sewer and water systems; and

3) reduced interruption of normal functions of the community, commerce, social activities, and the delivery of public services.

PLAN 1A OPTIMIZATION

To assist in the identification of the NED Plan (plan with highest net benefits), an economic analysis was performed on alternative levels of flood protection for the Plan 1A alignment. The same procedure used to evaluate the economic benefits of the seven detailed alternative plans was used to evaluate the beneficial effects of the 10-, 25-, 50-, 100-, and 200-year levels of flood protection for Plan 1A.

Table A-16 shows the average annual residual losses expected to occur with 10-, 25-, 50-, 100-, and 200-year levels of protection associated with Plan 1A. The values in the table represent the average annual flood losses over the life of the project. Table A-17 illustrates the damage prevention associated with the alternative levels of protection provided by Plan 1A. The values in table A-17 represent the expected average annual damages prevented over the 100-year life of the project.

In addition to flood damage reduction benefits, the alternative levels of flood protection would likewise accrue benefits attributable to the affluence effect as discussed previously. Table A-18 presents the total expected annual benefits for alternative levels of flood protection for the Plan 1A alignment. This data in conjunction with associated costs will allow the identification of the most cost effective level of flood protection (the NED plan).

TABLE A-16

AVERAGE ANNUAL RESIDUAL FLOOD LOSSES BY REACH
for Alternative Levels of Flood Protection
(April 1985 Prices, 8-3/8% Interest, ($1,000's)

	Protection Level				
Reach	10-Year	25-Year	50-Year	100-Year	200-Year
1	6	6	6	6	6
2	(N)	(N)	(N)	(N)	(N)
3	73	73	73	73	73
4	18	18	18	18	18
5	82	51	37	8	(N)
6	226	154	98	30	1
7	119	40	27	14	0
8	190	190	190	190	190
9	8	6	5	4	3
10	40	37	37	19	8
Total	762	568	484	352	288

N = Negligible

TABLE A-17

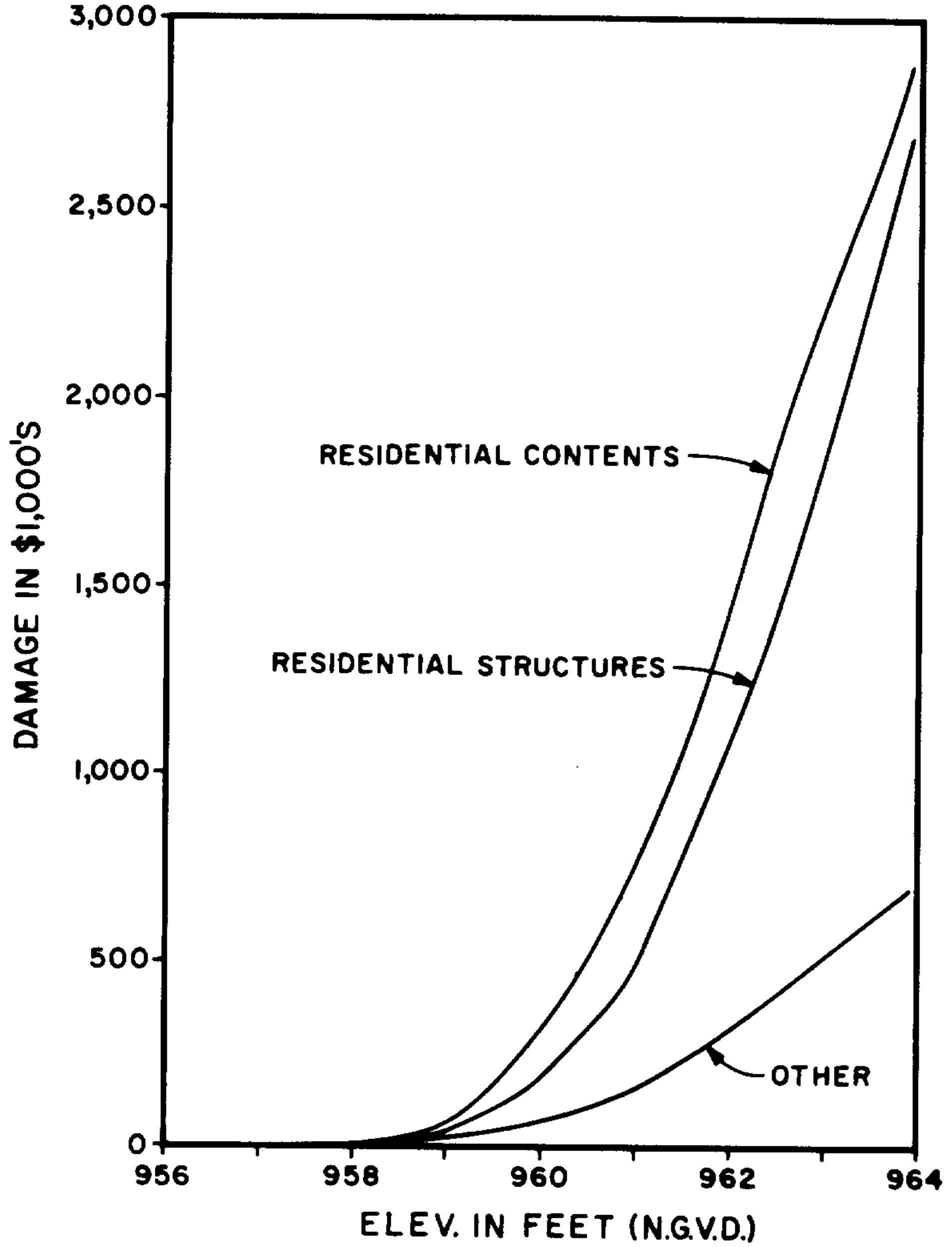
AVERAGE ANNUAL FLOOD DAMAGES PREVENTED
for Alternative Levels of Flood Protection
PLAN 1A
(April 1985 Prices, 8-3/8% Interest, ($1,000's)

Reach	Protection Level 10-Year	25-Year	50-Year	100-Year	200-Year
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	-4	3	3	6	7
5	76	106	120	149	157
6	571	643	699	768	796
7	174	254	267	279	294
8	0	0	0	0	0
9	-1	1	2	3	4
10	8	11	11	29	40
Total	824	1,018	1,102	1,234	1,298

TABLE A-18

AVERAGE ANNUAL FLOOD PROTECTION BENEFITS
For Alternative Levels of Flood Protection
(April 1985 Prices, 8-3/8% Interest, $1,000's)

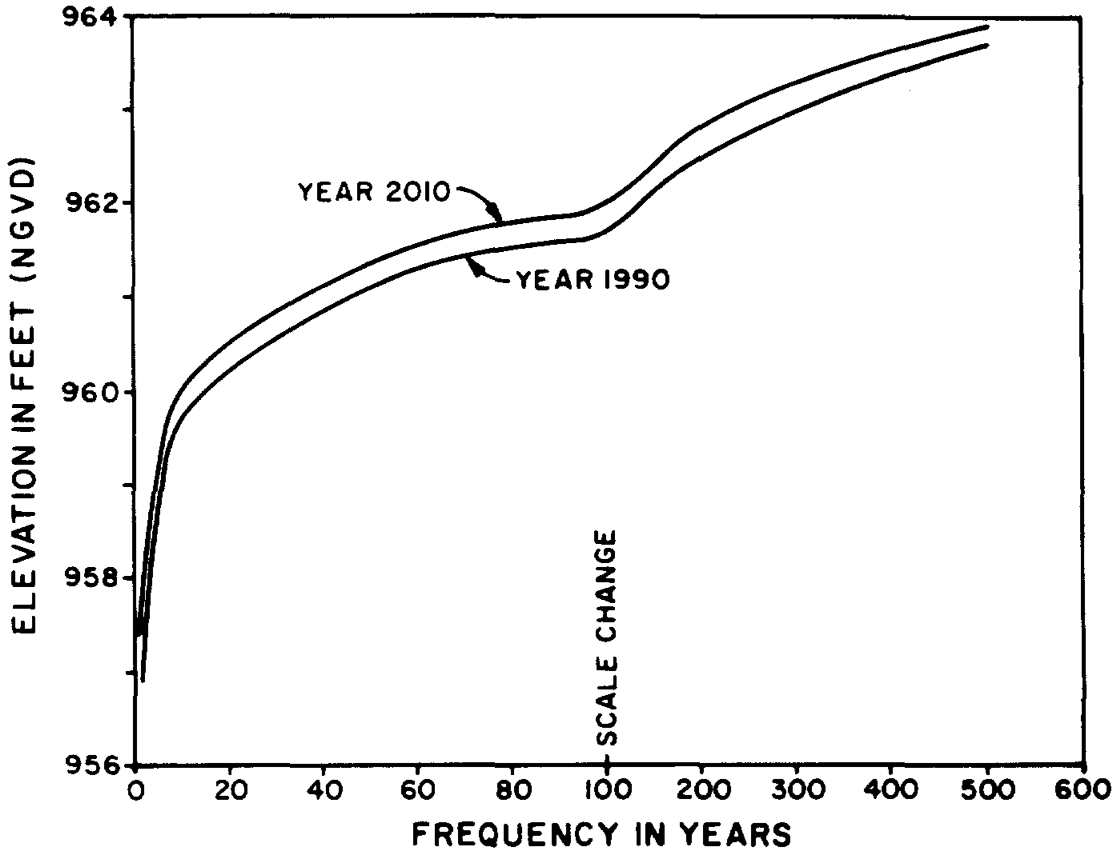
	10-Year	25-Year	50-Year	100-Year	200-Year
Flood Damage Reduction	824	1,018	1,102	1,234	1,298
Affluence Effect	126	152	158	176	182
Total Annual Benefit	950	1,170	1,260	1,410	1,480



ELEVATION - DAMAGE CURVE

REACH 5

PLATE A-1

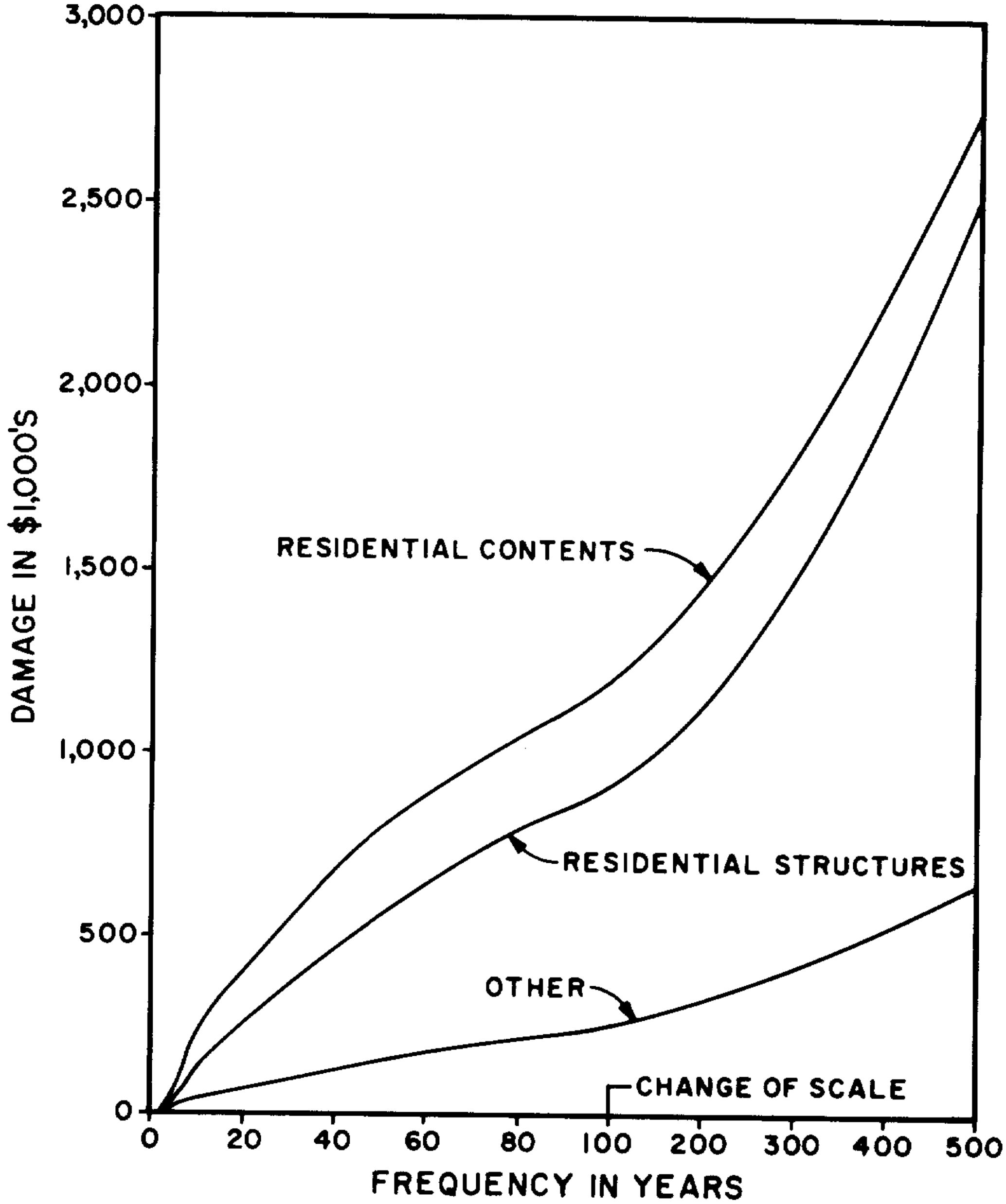


ELEVATION - FREQUENCY CURVE

REACH 5

EXISTING CONDITION

PLATE A-2



DAMAGE – FREQUENCY CURVE

REACH 5

EXISTING CONDITION

PLATE A-3

APPENDIX B

Public Views and Coordination

APPENDIX B

PUBLIC VIEWS AND COORDINATION

CONTENTS

APPENDIX B

CONTENTS
(continued)

Study Progress Correspondence

Wichita Falls

March 11, 1985

Colonel Franklin T. Tilton
District Commander, Tulsa District
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121-0061

Re: McGrath Creek Feasibility Studies,
Wichita Falls, Texas

Dear Colonel Tilton:

This letter and the attached resolution constitute an expression of intent by the City of Wichita Falls, Texas, to cooperate with the Federal Government in the implementation of the proposed plan of improvement for McGrath Creek. It is understood that Plan 1A, designed for a 100-year level of flood protection below Sikes Lake, is the proposed plan.

To facilitate construction of the proposed plan for McGrath Creek, it is the intent of the City of Wichita Falls, Texas, to provide all lands, easements, rights-of-way, and relocations, with the exception of railroads, necessary for construction during the period of project construction. The City of Wichita Falls, Texas, will bear the cost of operating and maintaining the project upon completion of construction in accordance with regulations prescribed by the Secretary of the Army.

The resolution of the Holliday Creek flooding problem remains the first priority of the community and we believe that project must move forward before we can address the McGrath Creek Watershed.

It is our understanding that Congress and the Administration are reviewing non-Federal financial participation across the entire spectrum of water resource projects and that a higher level of cost sharing may be required. The City of Wichita Falls agreed to a higher level of financial participation than required by current laws on the Lake Wichita-Holliday Creek project. This was stated in my letter to you dated September 24, 1984, and supported by a resolution adopted October 16, 1984, by the City Council of Wichita Falls, Texas. If appropriate, the City of Wichita Falls will consider a similar financial obligation on the proposed plan for McGrath Creek.

Sincerely,

Gary Cook
Mayor

Attach.

RESOLUTION NO. 45-85

RESOLUTION CONCURRING WITH THE CORPS OF ENGINEERS' FLOOD PROTECTION PLAN FOR MCGRATH CREEK, AND MAKING ASSURANCE OF LOCAL PARTICIPATION

WHEREAS, under authority of a resolution adopted February 25, 1938, by the Committee on Rivers and Harbors, House of Representativs, the Corps of Engineers, United States Army, has made an investigation of McGrath Creek to determine the feasibility of providing improvements for flood protection at Wichita Falls, Texas; and,

WHEREAS, the plan proposed by the Corps of Engineers for flood protection at Wichita Falls provides for constructing a new spillway at Sikes Lake and a concrete-lined channel along McGrath Creek from Sikes Lake to Holliday Creek; and,

WHEREAS, before proceeding with final review and the preparation of plans for the proposed flood protection project, the Corps of Engineers has requested assurance from the City of Wichita Falls, Texas, with respect to its willingness and ability to meet the requirements of local cooperation as set forth by law, to hold and save the United States free from damages due to the construction works, and to maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army; and,

WHEREAS, the non-Federal responsibilities are specified in the 1936 Flood Control Act require that local interests provide without costs to the United States all real estate interests necessary for construction of the project, all alterations and relocations to utilities, streets, bridges, buildings, storm drains and other structures and improvements except railroad bridges, with the understanding that Congressional modification to current legislation may alter the degree and/or type of local interest contribution; and, WHEREAS, it is understood that such assurances do not commit the Federal Government to construction of the proposed improvements; and,

WHEREAS, the City of Wichita Falls, Texas, is interested in the plan of improvement proposed by the Corps of Engineers, and is the legally qualified body capable, under provision of the Statutes of the State of Texas, of meeting the requirements of local cooperation:

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF WICHITA FALLS, TEXAS, THAT:

The Corps of Engineers is hereby advised that the City of Wichita Falls concurs with the plan for providing flood protection along McGrath Creek at Wichita Falls, Texas, and prior to initiation of construction will enter into a binding written agreement with the Corps of Engineers, which will address project construction and satisfy the requirements of Section 221 of Public Law 91-611, to:

a. Provide without cost to the United States, all lands, easements, and rights-of-way for the construction, operation, and maintenance of the project;

b. Provide for the alterations and relocations of utilities, roads, bridges, buildings, storm drains, and other structures and improvements except railroad bridges and railroad bridge approaches, that are required for construction of the project;

c. Hold and save the United States free from damages due to the construction and subsequent operation and maintenance of the project, except damages due to the fault of negligence of the United States or its contractor;

d. Adopt and enforce flood plain regulations to insure an unobstructed floodway and compatability between future development and the degree of flood protection provided by the project;

e. Provide relocation assistance to persons displaced by the project in accordance with sections 210 and 305 of Public Law 91-64b;

f. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army and in accordance with additional requirements as may be stipulated in the project document, in Congressional legislation, or by the Office, Chief of Engineers;

g. Prevent encroachment upon the project, channels, and floodways which could interfere with the maintenance and operation of the flood control project, and manage all project-related channels and floodways to preserve capacities for project functions; and

h. Publicize and notify interested parties, at least annually, that the project will not provide protection from an occurrence greater than the project design flood.

PASSED AND APPROVED THIS THE 2ND DAY OF APRIL, 1985.

MAYOR

ATTEST:

CITY CLERK

MIDWESTERN STATE UNIVERSITY

3400 TAFT BOULEVARD
WICHITA FALLS, TEXAS 76308

OFFICE OF THE PRESIDENT
(817) 692-6611

March 12, 1985

The Honorable Gary Cook
City of Wichita Falls
P. O. Box 1828
Wichita Falls, Texas 76307

Dear Mayor Cook:

Midwestern State University would like to express its support of Plan 1A of the McGrath Creek Flood Plan as presented by the Corps of Engineers at the March 5, 1985 meeting of the Flood Control Task Force. The University recognizes the economics of the proposed modification and relocation of the MSU (Sikes) Lake spillway. In the spirit of cooperation between the City of Wichita Falls, the Corps of Engineers, and Midwestern State University which has prevailed throughout this effort, MSU will endorse the Plan 1A.

Midwestern State University would request that as detailed plans are developed for the spillway, the University be involved in such plans. As you are aware, the substantial investment of the University in the Outdoor Education Center would be greatly impacted if the spillway were placed 15 feet from the door. Therefore, for practical and aesthetic purposes, we would request that the spillway be moved as far south as possible, even if it implies the loss of MSU's storage facility.

Thank you for your work in this endeavor. Please feel free to call on me if I can be of assistance in any way.

Best wishes for continued success.

Sincerely,

Louis J. Rodriguez
President

LJR:dlb

cc: ~~Mr.~~ Steve Cone
Corps of Engineers

Mr. Jim Brunjes, Vice President
for Business Affairs

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121

REPLY TO
ATTENTION OF

February 26, 1985

Planning
Red River Planning

Dear :

A meeting of the city of Wichita Falls Flood Control Task Force will be held at 7 p.m., March 5, 1985, in Room 500 of the Memorial Auditorium, 1300 Seventh Street, Wichita Falls, Texas. Representatives of the Tulsa District, Corps of Engineers, will present preliminary findings of feasibility studies for flood control measures on McGrath Creek and a progress report on the proposed Lake Wichita-Holliday Creek Flood Protection Project.

A draft feasibility report recommending construction of flood reduction measures on McGrath Creek is being prepared and will be available in April 1985. Engineering and design studies for the proposed Lake Wichita-Holliday Creek project are nearing completion and construction could begin in October 1985 if the project is authorized by Congress and construction funds are appropriated.

The Flood Control Task Force meeting will be open to the public and Mayor Gary Cook and City Councilman Craig Wilson, Task Force Chairman, have assured me that your attendance and participation would be most welcome. Please contact Mr. Steve Cone, Study Manager, (918) 581-7833, if you have any questions about the meeting or the subject studies.

Sincerely,

Robert D. Brown
Chief, Planning Division

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

October 23, 1984

REPLY TO
ATTENTION OF

Planning
Red River Planning

Dr. Louis Rodrigues
President, Midwestern State University
3400 Taft Boulevard
Wichita Falls, TX 76308

ATTN: Mr. Jim Brunjes, Vice President for Business Affairs

Dear Dr. Rodrigues:

It is our understanding based on your July 31, 1984, letter to Col. Tilton and recent phone conversations between Mr. Jim Brunjes of your staff and Mr. Steve Cone of my office that you are planning to make improvements to the Sikes Lake spillway on McGrath Creek. As you are well aware, the Tulsa District is conducting feasibility studies for flood damage reduction measures on McGrath Creek in Wichita Falls.

Sikes Lake, is a significant feature in the McGrath Creek watershed. Our studies indicate that both the Sikes Lake spillway and the McGrath Creek channel downstream of the lake do not have sufficient capacity to safely pass high flood flows. This inadequacy was acutely demonstrated by the flood of 12-14 May 1982, when over $20 million in flood damages occurred to properties in the McGrath Creek watershed. At this stage of our planning studies, we have not selected a specific plan for recommendation. However, we are focusing our investigation on alternative channel modifications along with modifications to the Sikes Lake spillway. The purpose of the alternatives being evaluated is to reduce flooding both upstream and downstream of Sikes Lake on McGrath Creek. We will make a tentative plan selection and recommendation in a draft report scheduled for completion in December 1984. Our final report is scheduled for May 1985.

Modification to Sikes Lake spillway, as you are considering, would reduce flooding immediately upstream of Sikes Lake. However, as you have recognized, such spillway modifications could increase flooding downstream unless appropriate channel modifications are made. It is, therefore, imperative that spillway modifications be designed and constructed in conjunction with McGrath Creek channel improvements.

We urge Midwestern State University to proceed with funds requests and develop plans to enlarge the Sikes Lake spillway. During the course of our planning and engineering studies on

McGrath Creek, we desire to continue coordination with you to ensure that your spillway modifications and any downstream channel modification plans are compatible.

I appreciate the interest and assistance you and your staff have provided us throughout our investigations and look forward to continuing that rapport as we jointly seek a solution to the severe flood problems on McGrath Creek.

Sincerely,

Robert D. Brown

Robert D. Brown, P.E.
Chief, Planning Division

TEXAS DEPARTMENT OF WATER RESOURCES

1700 N. Congress Avenue
Austin, Texas

August 13, 1984

Mr. Robert D. Brown, P.E.
Chief Planning Division
Tulsa District, Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121-0061

Dear Mr. Brown:

Re: Your recent letter concerning Sikes Lake (Inventory No. TX 1016) and its relationship to a feasibility investigations for flood control measures on McGrath Creek in Wichita Falls

In response to your request, the Department staff has reviewed the Phase I Dam Safety Inspection Report on Sikes Lake and, based on the report, we concur that although the structure does not meet recommended guidelines for spillway design flood, it appears to represent no significant hazard to downstream lives or property. At this time the staff does not anticipate that corrective dam safety measures would be required by the State. However, it appears that Sikes Lake requires a water use permit in accordance with the Texas Water Code, and Midwestern State University is being so advised by a copy of this letter. Further evaluation of the structure may be required during the permitting process.

Mr. Herman Settemeyer, Applications Unit, Permits Division, TDWR, will be the Department's Representative at the meeting of the Wichita Falls Flood Control Task Force on August 16, 1984.

Very truly yours,

Seth Burnitt

Charles E. Nemir for
Executive Director

cc: Midwestern State University, Wichita Falls, Texas 76308
Mr. Herman Settemeyer, Applications Unit, Permits Division, TDWR

City of
WICHITA FALLS
1300 7th Street P.O. Box 1431 817-322-5611 Wichita Falls, Texas 76307
OFFICE OF CITY MANAGER

August 7, 1984

Dear Task Force Member:

The next meeting of the City of Wichita Falls Flood Control Task Force will be held at 6:30 p.m., Thursday, August 16, 1984, in Room 500 of the Memorial Auditorium.

Agenda:

a. The Corps of Engineers will present preliminary findings to date on McGrath Creek for citizens' input.

b. Possible discussion of letters to be sent from Flood Control Task Force members.

c. Any other business to be considered.

Sincerely yours,

James Berzina

James Berzina
City Manager

JB/lj

cc: Honorable City Councilmen
Advisory Members
Legislative Advisors

AUG 7 1984

Planning
Red River Planning

*

The Tulsa District is conducting feasibility investigations for flood control measures on McGrath Creek in Wichita Falls, Texas. These studies are in conjunction with on-going planning and engineering for the proposed Lake Wichita-Holliday Creek project at Wichita Falls.

McGrath Creek is a left bank tributary that enters Holliday Creek about 2 miles downstream of the Lake Wichita Dam. McGrath Creek's 5.6-square-mile watershed lies entirely within the corporate limits of Wichita Falls and is highly urbanized. Officials of Wichita Falls requested that the Corps conduct the McGrath Creek studies following major flooding that occurred in the watershed in May 1982.

The McGrath Creek studies will be the subject of a meeting of the Wichita Falls Flood Control Task Force at 6:30 pm., August 16, 1984, in Room 500 of the Memorial Auditorium, 1300 Seventh Street, Wichita Falls, Texas. The meeting will be open to the public and Mayor Gary Cook and City Councilman Craig Wilson, Task Force Chairman, have assured me that your attendance and participation would be most welcome. Please contact Mr. Steve Cone, Study Manager, (918) 581-7832, regarding any questions and to notify us of your intentions to attend.

Sincerely,

Robert D. Brown, P. E.
Chief, Planning Division

August 3, 1984

Planning
Red River Planning

Mr. Charles Nemir
Executive Director, Texas
Department of Water Resources
Post Office Box 13087
Austin, TX 78711

Dear Mr. Nemir:

The Tulsa District is conducting feasibility investigations for flood control measures on McGrath Creek in Wichita Falls, Texas. Sikes Lake, owned and maintained by Midwestern State University is a significant feature in the watershed that could influence the design and selection of alternative plans for flood control. The Fort Worth District, Corps of Engineers, with the participation of your department, completed a Phase I Inspection Report on Sikes Lake under the National Dam Safety Program in April 1978. After reviewing the dam safety inspection report, it is our view that, although Sikes Lake does not meet recommended guidelines for dam safety, it is not unsafe and no corrective measures are required. This is a very important assumption in establishing the most probable without-project condition in our flood control studies.

We would appreciate your department's views concerning the safety of Sikes Lake. Specifically:

a. Do you consider Sikes Lake unsafe as it presently exists?

b. Will the owner of Sikes Lake be required to take corrective actions to meet dam safety design criteria? If so, what actions are required?

The McGrath Creek study will be the subject of a meeting of the Wichita Falls Flood Control Task Force at 6:30 pm, August 16, 1984, in Room 500 of the Memorial Auditorium, 1300 Seventh Street, Wichita Falls, Texas. At the meeting, we will be presenting alternative flood control measures for McGrath Creek, including the relationship of Sikes Lake to these measures. Your views on the safety of Sikes Lake prior to the meeting would be appreciated. Additionally, Mayor Gary Cook and City Councilman Craig Wilson, Flood Control Task Force Chairman, have assured me that your attendance and participation at the meeting would be most welcome. If you have any questions about this request or the meeting, please contact Mr. Steve Cone, Study Manager, (918) 581-7832.

Sincerely,

/s/ Robert D. Brown, P. E.
Chief, Planning Division

Copy Furnished:
Mr. John R. Clarke
Dam Safety Unit

VICE PRESIDENT FOR BUSINESS AFFAIRS

3400 TAFT BOULEVARD
WICHITA FALLS, TEXAS 76308
(817) 692 6611

MIDWESTERN STATE UNIVERSITY

July 31, 1984

Col. Frank Tilton
District Engineer
Planning Division
U. S. Army Engineer District, Tulsa
Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74121

Dear Col. Tilton:

Midwestern State University is extremely interested in being an active participant in any studies the Corps conducts regarding McGrath Creek. Sikes Lake, located on our campus, is a major component of the McGrath Creek Drainage System. During the heavy rains of 1982, a heavy amount of water drained into Sikes Lake. This caused some difficulties in the immediate area of the Lake. It appears that over the years, with the construction that has taken place in the Southwest part of Wichita Falls, the rain water run-off flow into Sikes Lake has increased substantially. The Lake is not constructed for, nor can it accommodate, such heavy flows of water. MSU has recently strengthened and widened the spillway.

In March, 1984, Biggs and Mathews, consulting engineers, completed a study for the University on the modifications required to the dam and the dike to effectively pass floodwaters through the Lake. This study has been forwarded to your office. With this study, we realize that passing floodwaters through our lake would create considerable problems downstream which would need be addressed by the City of Wichita Falls within the context of your McGrath Creek study. We have met with the city and believe with your help a solution to the drainage problems may be found.

Midwestern State University is an agency of the State of Texas and as such is funded on a biennial basis from the revenues of the State of Texas. Therefore, the University has requested funding from the State of Texas for improvements to the Sikes Lake Dam and Dike. This is attached for your information. The final disposition of this request for funds rests with the Legislature and Governor of Texas.

The University would like to request the support of the Corps of Engineers for its requested improvements to Sikes Lake. The drainage problems of McGrath Creek need to be solved jointly by the major parties involved, Midwestern State University, the City of Wichita Falls and the Corps of Engineers. I believe all parties recognize this and we all seek the ultimate control of flooding along McGrath Creek.

Col. Frank Tilton
Re: Sikes Lake
July 31, 1984
Page 2

If I or any of my staff at the University can be of assistance to your office, please advise me. I would request that the Corps of Engineers continue to keep the University informed of the study as it progresses through its various stages.

Sincerely,

J. Brunjes

Jim Brunjes
Vice President for
Business Affairs

JB:bb

Attachment

cc: Dr. Louis J. Rodriguez
Mr. R. C. Alley

MIDWESTERN STATE UNIVERSITY
3400 TAFT BOULEVARD
WICHITA FALLS, TEXAS 76308

January 18, 1984

Mr. Steve Cone
United States Corps.
of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Mr. Cone:

Mr. R. C. Alley, Director of Physical Plant at Midwestern State University, has discussed with me his conversation with you last week. Please consider this an effort to summarize the correct uses of Sikes Lake.

Several research studies have demonstrated that the most common recreational sports in the North Texas area are water related. A study of recreational activities of MSU student organizations found that water related recreational activities ranked highest. Consumer research indicates that the two most popular recreational activities in North Texas are fishing and bird hunting.

Development of the South Campus and Sikes Lake has been carefully planned to provide MSU students recreational skills and information which will be consistent with both the lifestyle and recreational opportunities and facilities of the North Texas area. Sikes Lake provides a rare and unusual opportunity that is fun, healthy, and consistent with the lifetime sports opportunities of this area.

Because Sikes Lake is on campus and so accessible its use is not limited to recreation and sports activities. Many of our academic course topics relate to the lake and immediate area. Career opportunities are expanded through practice of professional certification programs provided by the Red Cross in areas such as Sailing Instructor, Canoeing Instructor, Water Safety Instructor and Life Saving. The Physical Education Department offers several courses which take advantage of the lake including: Small Craft and Water Safety, sailing and canoeing and outdoor education. The Recreation Department similarly offers several courses that take advantage of the lake.

The Biology department has used the lake as a laboratory for more than 30 years. The flora and fauna of the lake and its immediate area provide an outstanding laboratory because of the diversity of its offerings as well as its proximity to the campus. One course, Limnology, concentrates on the aquatic biology of the lake.

Mr. Steve Cone
Re: Sikes Lake
January 18, 1984
Page 2

Sikes Lake provides many unusual educational and recreational opportunities for the university. As the university grows, as recreational space diminishes, and as environmental issues intensify, the importance and value of the lake will surely increase. It is a valuable asset to the university worth preservation and continued development.

Sikes Lake is of much importance to Midwestern State University. It is being used by a variety of constituencies within the university, as well as in our community. Our concern is to regulate water flow into this body. We very much want to continue utilizing this lake and making it available for important uses by Midwestern State University and residents of the City of Wichita Falls.

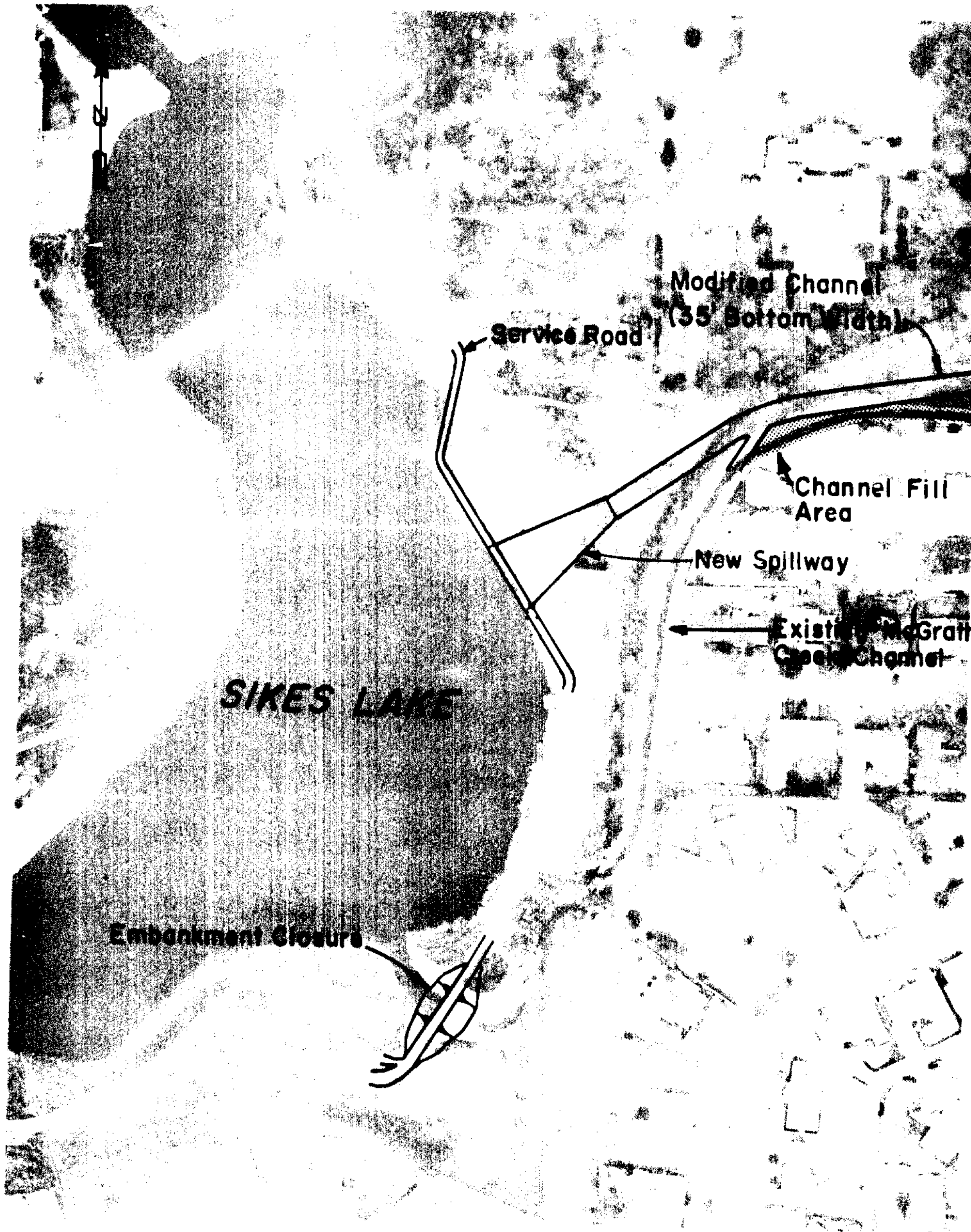
Please let me know if you need any additional information on this matter. Best wishes for continued success.

Sincerely,

Louis J. Rodriguez
President

LJR:gd

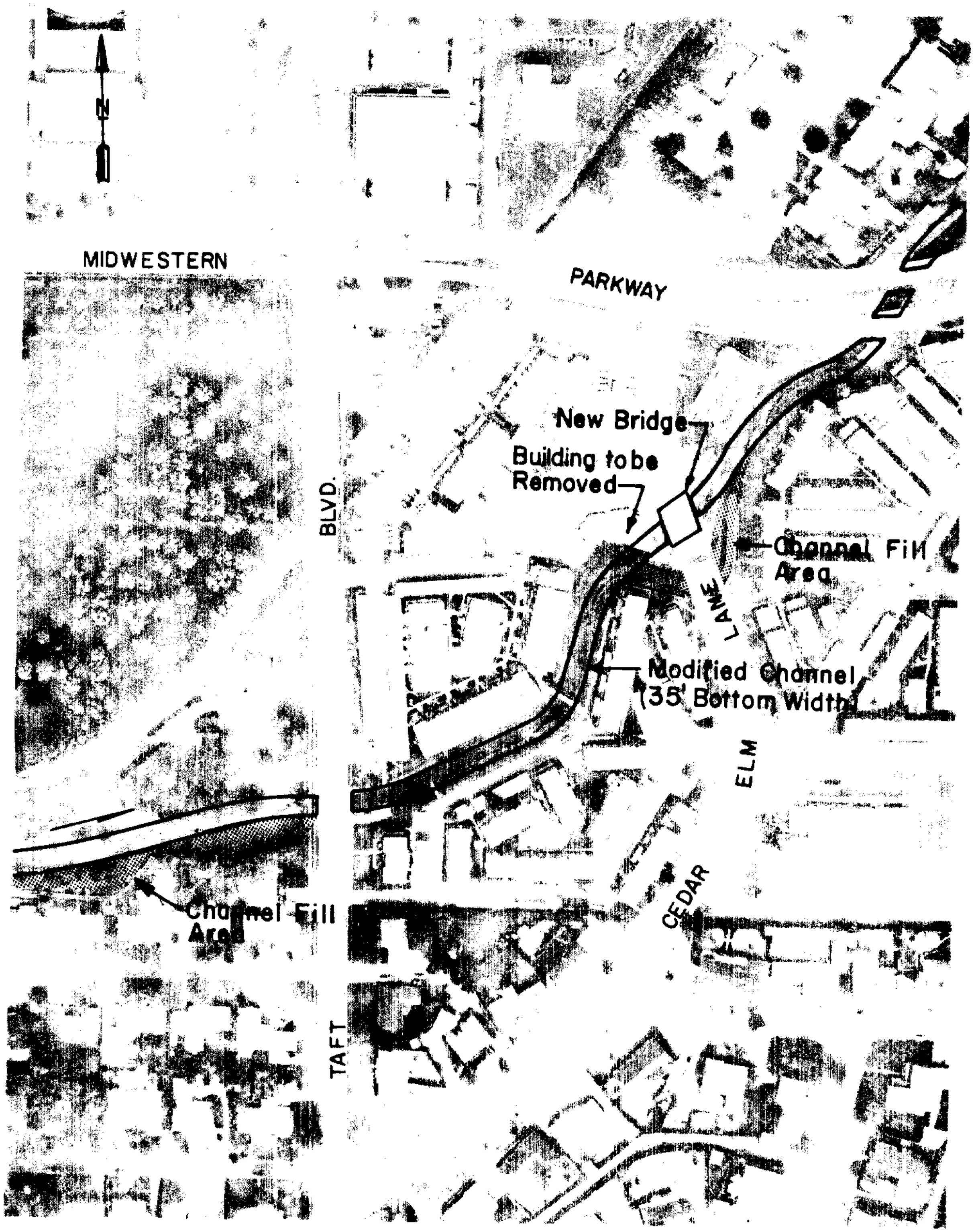
cc: Mr. Joe Hooper
Mr. R. C. Alley
Mr. Richard Inman



PLAN IA (Selected Plan)
Sikes Lake and Spillway Area

McGrath Creek

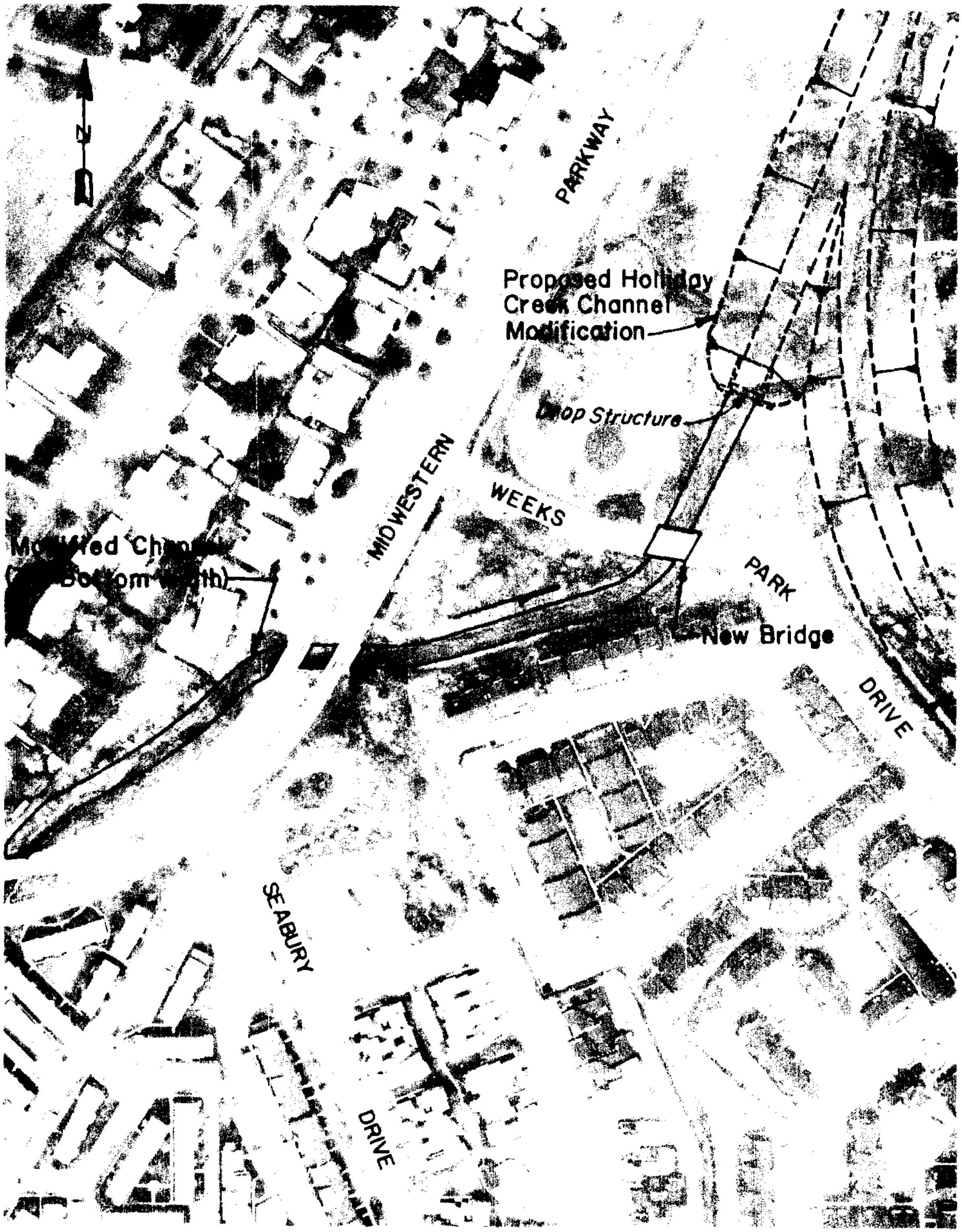
PLATE TS2-1



PLAN IA (Selected Plan)
Upstream of Taft Blvd. to Midwestern Parkway

McGrath Creek

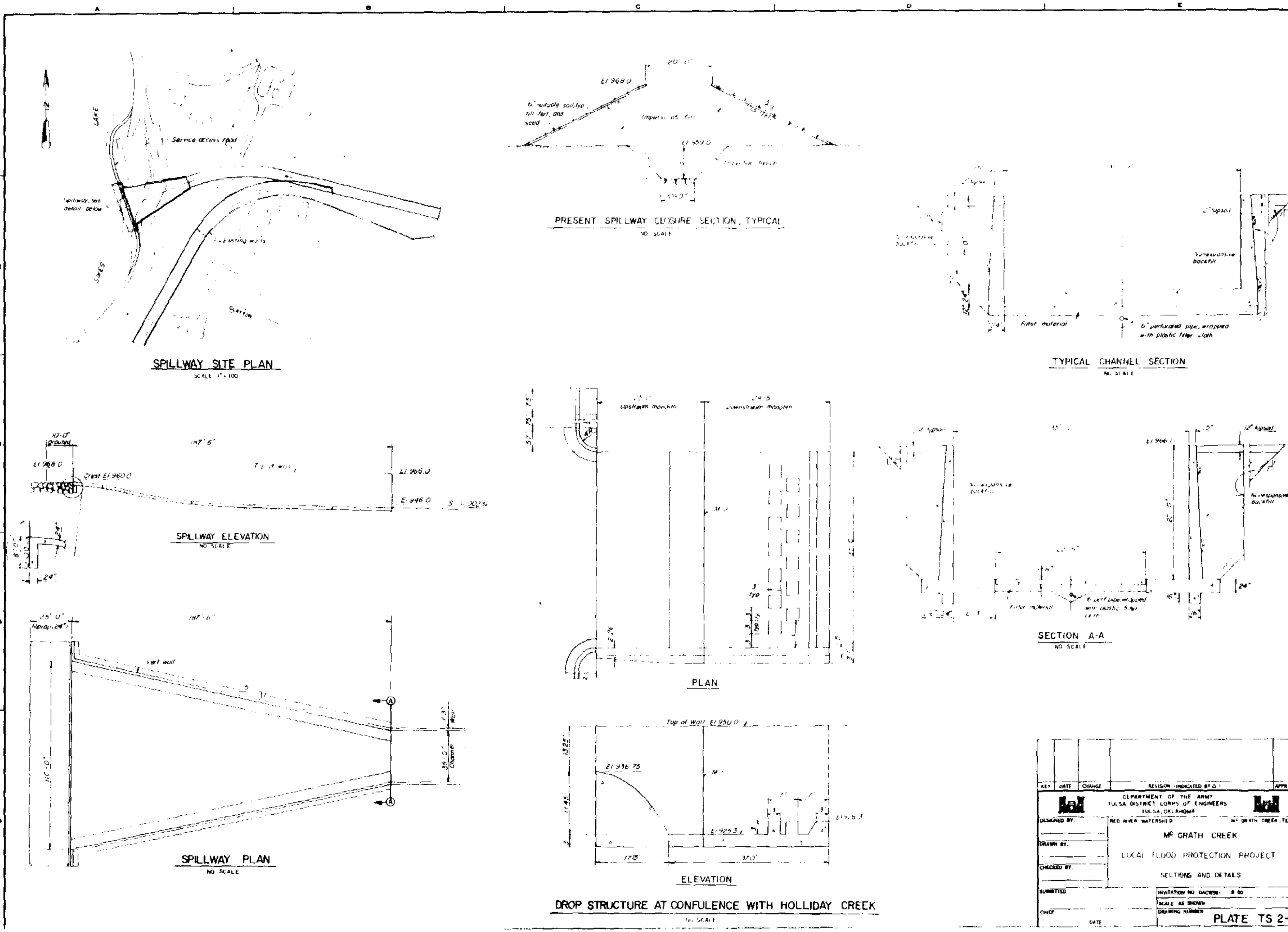
PLATE TS2-2



PLAN IA (Selected Plan)
Midwestern Parkway to Holliday Creek

McGrath Creek

PLATE TS2-



SPILLWAY SITE PLAN
SCALE 1"=100'
Service access road
Existing walls
LAKE
PRESENT SPILLWAY CLOSURE SECTION, TYPICAL
NO SCALE
El 968.0
20'-0"
TYPICAL CHANNEL SECTION
NO SCALE
Filter material
6" perforated pipe, wrapped with plastic filter cloth
SPILLWAY ELEVATION
NO SCALE
Crest El 960.0
El 966.0
El 946.0
187'-6"
SPILLWAY PLAN
NO SCALE
Vert wall
35'-0" Channel
PLAN
Upstream monolith
Downstream monolith
ELEVATION
Top of wall El 950.0
El 936.75
El 925.3
DROP STRUCTURE AT CONFULENCE WITH HOLLIDAY CREEK
NO SCALE
SECTION A-A
NO SCALE
12" topsoil
Nonexpansive backfill
KEY
DATE
CHANGE
REVISION INDICATED BY
APPR
DEPARTMENT OF THE ARMY
TULSA DISTRICT CORPS OF ENGINEERS
TULSA, OKLAHOMA
DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED
CHIEF
DATE
RED RIVER WATERSHED
MC GRATH CREEK, TEXAS
MC GRATH CREEK
LOCAL FLOOD PROTECTION PROJECT
SECTIONS AND DETAILS
INVITATION NO DACW56-
SCALE AS SHOWN
DRAWING NUMBER
PLATE TS 2-4

Review Comments and Responses

Review Comments and Responses

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

REPLY TO
ATTENTION OF

March 29, 1985

Planning
Red River Planning

Mr. Dean Blue
Regional Engineer
Department of Health and Human Services
1200 Main Tower, Room 1125
Dallas, TX 75202

Dear Mr. Blue:

I am enclosing for your review and comment our draft Feasibility Report on McGrath Creek, Wichita Falls, Texas, including a Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek. To meet established schedules for completing the final report, I would appreciate receiving your comments by May 28, 1985.

Sincerely,

Robert D. Brown
Chief, Planning Division

Enclosure

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
FEDERAL BUILDING
300 EAST 8TH STREET
AUSTIN, TEXAS 78701

April 11, 1985

Mr. Robert D. Brown
Chief, Planning Division
Tulsa District, Corps of Engineers
Post Office Box 61
Tulsa, Oklahoma 74121

Dear Mr. Brown:

The portions of the draft of the report "Flood Control in McGrath Creek, Wichita Falls, Texas" that address topics within my office's area of expertise have been examined. No records of streamflow are available for McGrath Creek. The report does not specify the procedures for determining runoff amounts and frequencies and channel capacities, other than by reference to hydrologic analyses and to hydrologic and hydraulic modeling. Assuming that standard acceptable procedures were followed in determining runoff amounts and flood frequencies, we have no adverse comment regarding the report.

My above comment should not be construed to be the official position of the Geological Survey or the Department of Interior. Policy dictates that such official response is made at the Department level when Environmental Impact Statements or related reports are submitted through the appropriate channels at the Department level.

Sincerely yours,

Charles W. Boning

Charles W. Boning
District Chief

cc: C. Haupt,
Environmental Affairs Program

CWB:bam

TULSA DISTRICT RESPONSE
TO US DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Standard acceptable procedures were followed in determining runoff amounts and flood frequencies. Those procedures are outlined in Technical Supplement No. 1, Hydrology and Hydraulics.

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

April 12, 1985

Mr. Robert D. Brown, P.E.
Chief, Planning Division
Tulsa District, Corps of Engineers
P.o. Box 61
Tulsa, Oklahoma 74121

Dear Mr. Brown:

Re: Texas Department of Water Resources (TDWR) Review of Tulsa District Corps of Engineers Draft Feasibility Report: FLOOD CONTROL ON MCGRATH CREEK, WICHITA FALLS, TEXAS (A Proposed Supplement to the Survey Report and to the Final Environmental Statement Relative to the Proposed Lake Wichita, Holliday Creek, Texas Project) (Tulsa District File Reference: PLANNING--RED RIVER PLANNING) March 1985.

In response to your letter of March 29, 1985, the Texas Department of Water Resources (TDWR) offers the following staff review comments on the referenced document:

1. TDWR concurs in the scope of the proposed project as described in the Syllabus and on pages 57-66, and in the recommendations presented on page 73 of the referenced Feasibility Report. In addition, the TDWR staff reaffirms the requirement expressed in TDWR's letter of August 13, 1984 (see pages B-9, -12, and -13 of the Feasibility Report) for non-Federal interests (i.e., Midwestern State University) to submit an application to TDWR for a State of Texas permit, pursuant to Section 11.121 of the Texas Water Code for authorization and water rights to impound and store state water in Sikes Lake.

2. We concur also in the requirement emphatically expressed in the third and fourth paragraphs of Tulsa District's letter of October 23, 1984, to Midwestern State University (see pages B-7 and B-8 of the Feasibility Report) indicating that "it is imperative, therefore, that spillway modifications (for Sikes Lake) be designed and constructed in conjunction with McGrath Creek channel improvements," and that coordination between Tulsa District and Midwestern State University will be continued "to ensure that spillway modifications and any downstream modification plans are compatible."

Mr. Robert D. Brown, P.E.
Page 2
April 12, 1985

3. We concur, in principle, with the draft supplemental environmental statement. It is our opinion that the statement adequately fulfills the essential administrative, coordinative, and analytical requirements of the National Environmental Policy Act of 1969, and related federal laws and implementing federal regulations noted in Section 1.08 (page EIS-4) and in Table EIS-1 (page EIS-5).

4. The proposed project presented in the referenced report is consistent with the policies and objectives of the Texas Water Plan.

Sincerely,

Charles E. Nemir
Executive Director

MIDWESTERN STATE UNIVERSITY

OFFICE OF THE PRESIDENT
(817) [illegible]

3400 TAFT BOULEVARD
WICHITA FALLS, TEXAS 76308

April 15, 1985

Mr. Robert D. Brown, Chief
Planning Division
Department of the Army
Tulsa District, Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Mr. Brown:

Thank you for your letter of March 29, 1985 and accompanying material dealing with flood control on McGrath Creek in Wichita Falls, Texas. I would like to call to your attention a letter contained on page 5 of Appendix B in your document. The position that was conveyed to Mayor Cook is still the one that Midwestern State University feels is most desirable from our prospective. My hope is that the appropriate bodies will involve Midwestern State University as this work develops.

Please let me know if you need any additional information.

Sincerely,

Louis J. Rodriguez
President

LJR:gd

cc: Mr. Jim Brunjes, Vice President
Business Affairs

Nortex
Regional Planning Commission

P.O. Box 5144

Wichita Falls, Texas 76307

Area 817 - 322-5281

April 19, 1985

Mr. Robert D. Brown
Chief, Planning Division
Department of the Army
Tulsa District, Corps of Engineers
Post Office Box 61
Tulsa, Oklahoma 74121

Dear Mr. Brown:

We have received your correspondence of March 29, 1985 wherein you transmitted to us for our review and comment the draft Feasibility Report on McGrawty Creek, Wichita Falls, Texas including a Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek. This information is being forwarded to the Environmental Assessment Advisory Committee for evaluation. This committee will meet on Tuesday, May 7, 1985 at 7:00 A.M. in the Conference Room of Nortex Regional Planning Commission to discuss these items. You or your authorized designate are urged to be present to discuss the material with those present.

We look forward to seeing you there.

Sincerely,

Tom Merritt

Tom Merritt
Director of Physical Planning

TM/rd

THE STATE OF TEXAS

CURTIS TUNNELL
EXECUTIVE DIRECTOR

TEXAS HISTORICAL COMMISSIO

P.O. BOX 12276 AUSTIN, TEXAS 78711 (512) 475-3

April 26, 1985

Mr. Robert D. Brown
Chief, Planning Division
Department of the Army
Tulsa District, C/E
P.O. Box 61
Tulsa, Oklahoma 74121

Re: Feasibility Report on McGrath Creek
Wichita Falls, TX
(COE, A-6, A-1)

Dear Mr. Brown:

Thank you for the opportunity to review the above referenced report. Using the information you have provided and based on our files, we find that we have no record of properties listed or eligible for listing on the National Register of Historic Places within the preferred project area described in Plan 1A.

We do note, however, that replacement of two bridges is proposed within Plan 1A (Weeks Park Drive and Cedar Elm Street). If these bridges are 50 or more years old, this office respectfully requests photographs (from several elevations) and short narratives describing the bridges. We also note that a cultural resource survey will be conducted prior to completion of detailed engineering and design. We look forward to receipt of the results of that survey, and shall provide further comments at that time.

Thank you for the opportunity to participate in the review process.

Sincerely,

LaVerne Herrington

LaVerne Herrington, Ph.D.
Deputy
State Historic Preservation
Officer

PW/LH/mes

cc: The Honorable Gary Cook,
City of Wichita Falls
P.O. Box 1828
Wichita Falls, TX 76307

TULSA DISTRICT RESPONSE
TO TEXAS HISTORICAL COMMISSION

The Engineering Department of the City of Wichita Falls has informed us that the Weeks Park Drive Bridge was constructed in 1976 and the Cedar Elm Bridge was built in 1971.

United States
Department of
Agriculture

Soil
Conservation
Service

101 South Main

Temple, Texas
76501-7682

April 30, 1985

Mr. Robert D. Brown, Chief
Planning Division
Tulsa District Corps of Engineeers
Post Office Box 61
Tulsa, Oklahoma 74121

Dear Mr. Brown:

We have reviewed your draft Feasibility Report on McGrath Creek, including the supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek, located in Wichita Falls, Texas. We have no comments at this time.

Thank you for the opportunity to review this proposal.

Sincerely,

J. C. Brown

FOR BILLY C. GRIFFIN
State Conservationist

cc: Ray L. Mott, acting Area Conservationist, SCS, Vernon, Texas

Federal Emergency Management Agency

Region VI, Federal Center, 800 North Loop 288
Denton, Texas 76201-3698

May 10, 1985

NH

Mr. Robert Brown
Chief, Planning Division
Tulsa District, COE
P. O. Box 61
Tulsa, OK 74121

Dear Mr. Brown:

Thank you for providing FEMA with an opportunity to review and comment on the Feasibility Report and Supplement to the Final Environmental Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek.

Since the stated intent of the proposed project is flood control and reduction of flood losses within the McGrath Creek area; and since the project is part of and intended as a supplement to the larger Holliday Creek flooding problem, FEMA and the COE are in accord. Our only concern would be timing. Should McGrath Creek channelizaton be funded and accomplished while the larger improvement needs are not funded we would be concerned with increased flood damage on portions of the Holliday Creek floodplain and floodway.

If I may provide additional information with regard to this or other floodplain management issues, please contact me at the above address or call 817-387-5811, extension 162.

Sincerely,

Jim LeGrotte

Jim LeGrotte
Community Planner
Natural Hazards Branch.

Federal Emergency Management Agency

Region VI, Federal Center, 800 North Loop 288
Denton, Texas 76201-3698

May 10, 1985

NH

Mr. Robert Brown
Chief, Planning Division
Tulsa District, COE
P. O. Box 61
Tulsa, OK 74121

Dear Mr. Brown:

Thank you for providing FEMA with an opportunity to review and comment on the Feasibility Report and Supplement to the Final Environmental Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek.

Since the stated intent of the proposed project is flood control and reduction of flood losses within the McGrath Creek area; and since the project is part of and intended as a supplement to the larger Holliday Creek flooding problem, FEMA and the COE are in accord. Our only concern would be timing. Should McGrath Creek channelizaton be funded and accomplished while the larger improvement needs are not funded we would be concerned with increased flood damage on portions of the Holliday Creek floodplain and floodway.

If I may provide additional information with regard to this or other floodplain management issues, please contact me at the above address or call 817-387-5811, extension 162.

Sincerely,

Jim LeGrotte
Community Planner
Natural Hazards Branch.

We appreciate the opportunity to review your Draft EIS. Please send our office one (1) copy of the Final EIS at the same time it is sent to the Office of Federal Activities, U.S. Environmental Protection Agency, Washington, D.C.

Sincerely yours,

Frances E. Phillips

Dick Whittington, P.E.
Regional Administrator

TULSA DISTRICT RESPONSE

TO US ENVIRONMENTAL PROTECTION AGENCY

Section 5.16 has been revised as recommended.

Federal Emergency Management Agency

Region VI, Federal Center, 800 North Loop 288
Denton, Texas 76201-3698

May 14, 1985

NH

Mr. Robert D. Brown
Chief, Planning Division
Corps of Engineer, Tulsa District
P. O. Box 61
Tulsa, OK 74121

Dear Mr. Brown:

This office has reviewed the draft Feasibility Report on McGrath Creek, Wichita Falls, Texas, including a Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek, and we are in general agreement with the selection of Plan 1A.

We have placed the City of Wichita Falls on our priority list for a flood insurance restudy for FY-86. At some point in the future when sufficient construction of the flood control project has been completed, the City can submit technical data and request a map revision.

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

Sincerely,

R. Dell Greer, Chief
Natural and Technical
Hazards Division

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Project Review
Post Office Box 2088
ALBUQUERQUE, NEW MEXICO 87103
May 28, 1985

ER 85/580

District Engineer
Corps of Engineers, U.S. Army
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

This responds to your request for our review and comments on the draft Feasibility Report and on Supplement to the Final Environmental Statement (FEIS) Flood Control on McGrath Creek, Wichita Falls, and Lake Wichita, Holliday Creek, Wichita County, Texas. The following comments are provided for your consideration.

As stated in the draft Feasibility Report the quality of fish and wildlife habitat affected by the proposed action is marginal because of previous channelization and urbanization, but it represents the only remaining habitat in this urban setting. The report adequately addresses the Fish and Wildlife Service's concerns and a number of their recommendations were incorporated into the project plan for implementation.

The section in the FEIS on environmental effects should address the potential for effects on groundwater recharge and levels from the construction of the 3,600 foot concrete-lined channel.

On page EIS-25, the statement is made that "The short-term impacts of construction on the natural resources would be balanced by long-term productivity of the project area through increasing property values by providing 100-year flood protection and reducing human suffering and anxiety caused by flooding." This statement seems inappropriate because loss of natural resources, including fish and wildlife resources, cannot be mitigated or offset by economic or social well-being gains.

On page EIS-28, it is indicated that about 30,000 cubic yards of excavated material would be disposed of in low areas in the Holliday Creek floodplain below Lake Wichita. The Corps of Engineers would need to comply with Section 404 of the Federal Water Pollution Control Act for the placement of this material. The next heading on the same page is "Section 404(b)(1) Evaluation," but no mention is made of this fill material. Care will need to be taken to minimize the destruction, loss, or degradation of wetlands that may result of placement of this material to assure compliance with Executive Order 11990.

In summary this Department would prefer the Clayton/Granada Street Diversion Plan. However, with the planned inclusion of plantings favorable to wildlife and improvement of aesthetics, we have no objection to the Selected plan (Plan 1A).

Sincerely,

Raymond P. Churan

Raymond P. Churan
Regional Environmental Officer

TULSA DISTRICT RESPONSE

TO US DEPARTMENT OF THE INTERIOR

Comment

The section in the FEIS on environmental effects should address the potential for effects on groundwater recharge and levels from the construction of the 3,600-foot concrete-lined channel.

Response. The streambed of McGrath Creek is composed of highly impermeable clays, so under existing conditions, it is insignificant in groundwater recharge. The addition of a concrete channel would have little effect upon groundwater recharge. This information has been added to paragraph 5.09 in the EIS.

Comment

On page EIS-25, the statement is made that "The short-term impacts of construction on the natural resources would be balanced by long-term productivity of the project area through increasing property values by providing 100-year flood protection and reducing human suffering and anxiety caused by flooding." This statement seems inappropriate because loss of natural resources, including fish and wildlife resources, cannot be mitigated or ofrset by economic or social well-being gains.

Response. This statement has been deleted from the EIS.

Comment

On page EIS-28, it is indicated that about 30,000 cubic yards of excavated material would be disposed of in low areas in the Holliday Creek floodplain below Lake Wichita. The Corps of Engineers would need to comply with Section 404 of the Federal Water Pollution Control Act for the placement of this material. The next heading on the same page is "Section 404(b)(1) Evaluation," but no mention is made of this fill material. Care will need to be taken to minimize the destruction, loss, or degradation of wetlands that may result of placement of this material to assure compliance with Executive Order 11990.

Response. The placement of excavated material in the Holliday Creek floodplain and in the McGrath Creek channel will comply with Section 404 of the Federal Water Pollution Control Act. Care will be taken to assure compliance with Executive Order 11990. More information on excavated material is found in paragraphs 5-12 and 5-13 of the EIS.

Nortex
Regional Planning Commission

P.O. Box 5144
Wichita Falls, Texas 76307
Area 817 - 322-5281

May 30, 1985

Mr. Robert D. Brown, P.E.
Chief, Planning Division
Department of the Army
Tulsa District, Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121-0061

Dear Mr. Brown:

On May 7, 1985, at 7:00 A.M. the Environmental Assessment Advisory Committee of Nortex Regional Planning Commission met to review the Draft Copy of the Feasibility Report and Supplement to the Final Environmental Statement on Lake Wichita, Holliday Creek. Mr. Steve Cone was present to discuss the matter, which was subsequently given favorable comments by the committee and recommended to the Executive Committee for their consideration. On May 30, 1985, the Executive Committee met and reviewed the recommendations of the Environmental Assessment Advisory Committee and also offered favorable comments. Consequently, a copy of the minutes have been included for your information.

In support of the professional job done by Mr. Steve Cone of your office at the Environmental Assessment Advisory Committee meeting of May 7, Dr. Arthur Beyer, Chairman, forwarded a memorandum to my office. I am taking this opportunity to forward a copy for your files.

We thank you for giving us this opportunity to work with you on the matter.

Sincerely,

Tom Merritt
Director of Physical Planning

TM/ms

Enc.

NEWSPAPER ARTICLES

Berzina says '85 important to flood plan

KAREN BALL
Record News Staff

City Manager Jim Berzina said Tuesday that 1985 will be the year that Wichita Falls either decides to forge ahead, possibly on its own, to pay for flood control along Holliday Creek or else abandons the multimillion-dollar project.

"I think that we are now ready to say (that) this is the year we decide whether we go with the project or we turn to you and say we can't do it. There's no need running into that same brick wall year after year after year," he said.

Berzina spoke at a Flood Control Task Force meeting at City Hall.

The task force Tuesday endorsed a U.S. Army Corps of Engineers recommendation for a $7.5-million plan for flood control along McGrath Creek, which begins at Sikes Lake and empties into Holliday Creek. The city's cost would be $2.6 million.

The flood that struck the city in May 1982 caused damages estimated at $35 million, including $21.5 million worth of damage that occurred in the McGrath Creek watershed.

The corps of engineers, which oversees federal water projects, plans for a new spillway at Sikes Lake and construction of 35-foot wide, concrete channel along McGrath Creek, which would be built during the last stage of Holliday Creek flood prevention measures.

Flood control measures along Holliday Creek, from Lake Wichita to to the Wichita River, would cost about $27 million and require 6½ years to complete.

"Obviously the two (projects) are related. Unless we fix Holliday Creek, we really can't fix McGrath. Truly, if we don't find the money, we can't fix either one of them," Berzina said.

"It's probably been kicked around long enough. We have said for years and years (that) we are waiting on federal funding. That may come or that may not," he said.

President Reagan's proposed budget includes $1.5 million for beginning the flood control work at Lake Wichita and Holliday Creek.

The city has agreed to fund a larger portion — 30 to 40 percent — of the project to acquire joint federal funding.

Wichita Falls Record News

Vol. LXI, No. 119 Phone 767-8341 Wichita Falls, Texas (76307) Friday Morning, August 17, 1984 38 pages 3 Sections ★ 25¢

Flood plan discussion requested

By JOE CUTBIRTH
Staff Writer

The Army Corps of Engineers should have a final plan by November for the construction of facilities to reduce flooding along McGrath Creek, a spokesman for the corps said Wednesday.

"We're already underway," Steve Cone, project manager for the McGrath Creek feasibility study, said.

"Unless somebody at the Thursday meeting, points out something we've overlooked, we should have narrowed the plans down to one by November," he said.

Cone said corps officials will meet at 6:30 p.m. Thursday in Room 500 of Memorial Auditorium with the Wichita Falls Flood Control Task Force and interested citizens to preview the 24 alternative plans proposed by the corps for the project.

Cone said the plans, which include of six proposed alignments with four sizes for each alignment, generally call for a concrete-lined channel for the creek and modifications to the Sikes Lake Spillway.

"The corps will take the information and feedback and zero in on the plan that will best serve the public," Craig Wilson, Wichita Falls City Council member and task force chairman, said.

Wilson said the meeting Thursday night will serve two functions.

"The corps is required to present its alternatives on such studies in a public meeting.

"We are giving them the chance to do that and to bring

See FLOOD, Page 2A

Flood plan discussion invited

From page one

task force members up to date on the project," Wilson said.

Although cost estimates for McGrath Creek range from $8.2 million to $14.75 million, depending on the degree of flood protection provided, Cone said the project will probably cost about $11.5 million.

He said, however, the estimates made now will need to be revised if any changes are made after citizens here offer suggestions.

Wilson said Congressman Jack Hightower will attend the meeting to report on the successes and setbacks on funding at the national level.

"As of now, funding is included in a house bill that is being held up in committee," Wilson said.

Wilson said the present benefit/cost ratio to the community must be preserved.

"But you can't just wait for the help from Washington. It may or may not come," he said.

Wilson said that extensive work done now may upset the cost/benefit ratio, thus jeopardizing federal funding of the project.

"You have to proceed with the resources you have but not close the doors on other possibilities," he said.

Although there are ways the McGrath Creek project and the Holliday Creek improvements can be implemented simultaneously, Cone said basically a large part of the Holliday creek project should be completed before the McGrath creek work gets underway.

After the draft report, available in November, is reviewed by the corps and other state, local and federal agencies, Cone said it would be April before the final report would pass review in Washington.

"Then we are looking optimisticly at two to three years — if everything goes well. We are starting out with the assumption that Holliday creek will be improved," he said.

Wichita Falls Record News

Vol. LXI, No. 110 | Phone 767-8341 | Wichita Falls, Texas (76307) Thursday Morning, August 16, 1984 | 66 pages 3 Sections | ★ 25

Corps, city officials review flood proposals

By JOE CUTBIRTH
Staff Writer

The six flood control plans proposed for McGrath Creek, southeast of Sikes Lake in Wichita Falls, were narrowed to two during a presentation Thursday night by the Army Corps of Engineers.

Each of the two plans still holds four options for various levels of flood control, making eight total options remaining before a final decision is made sometime in the next few months.

The decision as to which plan to use will be made in the next few months by the corps and the city council after those officials determine which plan is the most economically feasible, said Steve Cone, who presented the information from the corps.

"Each of the plans has essentially the same degree of flood protection and economic impact," Cone said.

However, according to the presentation, a business will have to be relocated if plan one is chosen.

Cone did not know the name of the business, but said it is located at the corner of McGrath Creek and Cedar Elm.

"Either that business or those apartments will have to be relocated under plan one," he said.

One plan generally follows the city right of way along McGrath creek. It crosses Cedar Elm and runs near French Quarter Apartments. It would require the construction of a 4,800-foot channel leading to Sikes Lake, and the doubling of the lake spillway. Both the Weeks Park bridge and the Cedar Elm bridge would have to be replaced.

The second plan calls for the channel to cross Weeks Park Drive and run along Midwestern parkway to Taft. The channel would cut south across part grounds at the Midwestern State University president's house. It would also require a 4,800-foot channel and a wider spillway for the lake. This plan also includes a tunnel underneath the intersection of Midwesatern Parkway and Taft.

Cone said the estimated construction cost for the first plan is $11 million. He estimated the construction cost for the second plan at $11.92 million.

Cone said no inflation factor

See FLOOD, Page 2A

Flood proposals studied

From page one

was included in the cost projections.

"The thing that really gets under my skin is to read about these things being characterized as 'pork-barreling,'" U.S. Rep. Jack Hightower said.

Hightower said, "This is using taxpayers' money in a wise way to prevent future loss of taxpayers' dollars."

Mayor Gary Cook praised Hightower's work in Washingtonon behalf of the project.

"We have this major accomplishment through the help of congressman Jack Hightower. Through the help of Congressman Hightower, we were able to protect our cost/benefit ratio to proceed without jeopardizing future federal funding."

Cook said, however there are still things for citizens to do in Washington.

"The problem from the beginning has been the lack of authorization," Cook said.

Cook said, "Congressman Hightower took the bull by the horns to get the bill passed in the house."

"Now it is up to a (House-Senate) conference committee," Cook said.

Reducing flooding along creek to cost millions, study says

By Pat Counsell
Staff Writer

Reducing flooding along McGrath Creek may cost as much as $14.75 million according to preliminary estimates released today by the Army Corps of Engineers.

After serious flooding in May 1982, the City of Wichita Falls asked the corps to study McGrath Creek. About 60 percent of the $34.6 million property damage caused by the May 1982 flood occurred along McGrath Creek.

Six proposals to control McGrath Creek flooding and cost estimates will be the subject of a meeting Thursday night between corps officials and the Wichita Falls Flood Control Task Force. The task force last met in February 1983.

Cost estimates for McGrath Creek range from $8.2 million to $14.75 million depending on the degree of flood protection provided, said Steve Cone of the corps.

"The low end is what we would call a 10-year level of flood protection," Cone said. "The high end is the 100-year flood level.

The six plans are similar and involve building a concrete-lined channel for the creek and modifications to the Sikes Lake spillway, Cone said. The plans differ in channel route and width, he

CRAIG WILSON

said.

"What we're going to do is la out what we've done and expla: it," he said. "We're not askin the city to commit to anything : this point."

The meeting is open to the pul

See REDUCING, Page 2A

Wichita Falls Times
Wednesday, August 15, 1984

Reducing flooding to cost $14.7 million

From page one

lic. After the presentation, the corps will ask for comments on the proposals, Cone said. Among questions for the audience will be "Do you think we're on the right track?," Cone said.

Any work on McGrath Creek must be preceded by work on Holliday Creek, he said. "They ultimately have to go together," Cone said.

The projects may be "piggybacked" in requests for federal funding, but Holliday Creek is still the first priority, said Craig Wilson, Wichita Falls City Council member and task force chairman.

"I don't necessarily understand the system, but I would think the priority should still be to get the Holliday Creek project (funding) approved," Wilson said.

"I want to inform the task force of what has been taking place," Wilson said of calling the panel's first meeting in 18 months. The task force may also want to renew its letter-writing campaign to federal officials, he said.

An earlier corps study said Holliday Creek flood control measures would have all but prevented the $12.4 million in flood damage along Holliday Creek.

But the Holliday Creek project would have a minimal effect on costlier McGrath Creek flooding, the report said.

Rep. Jack Hightower, D-Vernon, will attend the meeting to explain the status of funding requests pending before Congress.

The meeting will be at 6:30 p.m. Thursday in Room 500 of Memorial Auditorium.

APPENDIX C

Coordination with US Fish and Wildlife Service

APPENDIX C

Coordination with US Fish and Wildlife Service

APPENDIX C

COORDINATION WITH US FISH AND WILDLIFE SERVICE

CONTENTS

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

March 28, 1985

District Engineer
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

Enclosed are five copies of the Fish and Wildlife Service's report dated March 28, 1985, on Lake Wichita, Holliday Creek, McGrath Creek, Wichita Falls, Texas.

The assistance and cooperation of your staff in the development of this report are appreciated.

Sincerely yours,

Robert M. Short
Acting Field Supervisor

Enclosures (5)

cc:
Regional Director, FWS, Albuquerque, NM (AHP) w/o encl.

MARCH 1985

FISH AND WILDLIFE
RESOURCES OF

LAKE WICHITA, HOLLIDAY CREEK, McGRATH CREEK
WICHITA FALLS, TEXAS

U.S. FISH & WILDLIFE SERVICE DEPT. OF THE INTERIOR
TULSA ES FIELD OFFICE, REGION 2

THIS REPORT PREPARED IN

TULSA, OKLAHOMA

ECOLOGICAL SERVICES OFFICE

BY

STEVEN L. HENSLEY, FISH AND WILDLIFE BIOLOGIST

REVIEWED BY

SIDNEY H. WILKIRSON, SUPERVISORY FISH AND WILDLIFE BIOLOGIST

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

March 28, 1985

District Engineer
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

This report provides the U.S. Fish and Wildlife Service's evaluation of the fish and wildlife resources affected by potential flood damage reduction measures on McGrath Creek in Wichita Falls, Texas. It is intended to accompany your report on the feasibility of providing flood protection within the McGrath Creek basin. Specifically, it provides our assessment of fish and wildlife habitat and related resources under existing conditions and an evaluation of the impacts of project alternatives. This report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) in coordination with the Corps of Engineers and the Texas Parks and Wildlife Department.

The investigation is being conducted under the authority of a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted February 25, 1938. The information presented in this letter is based on data supplied by the Corps of Engineers, Texas Parks and Wildlife Department, Midwestern State University, literature surveys, and field investigations. Much of the information on fish and wildlife resources is based on personal communication with Dr. Horner and Dr. Dalquest (April 1984) of Midwestern State University. The Texas Parks and Wildlife Department has reviewed and concurred with this report as indicated by the enclosed copy of a letter from Executive Director Charles D. Travis, dated October 31, 1984.

DESCRIPTION OF THE AREA

The McGrath Creek watershed is located within the corporate limits of the City of Wichita Falls, Texas (Figure 1). Wichita Falls is in Wichita County in north-central Texas approximately 12 miles south of the Texas-Oklahoma state line. McGrath Creek is a left bank tributary of Holliday Creek. It flows into Holliday Creek approximately 6 miles upstream from its confluence with the Wichita River. The main stem of McGrath Creek is about 2.9 miles long and its northern tributary is about 2.7 miles long. Three fourths of the channel length is concrete-lined. The watershed, approximately 5.4 square miles, is 90

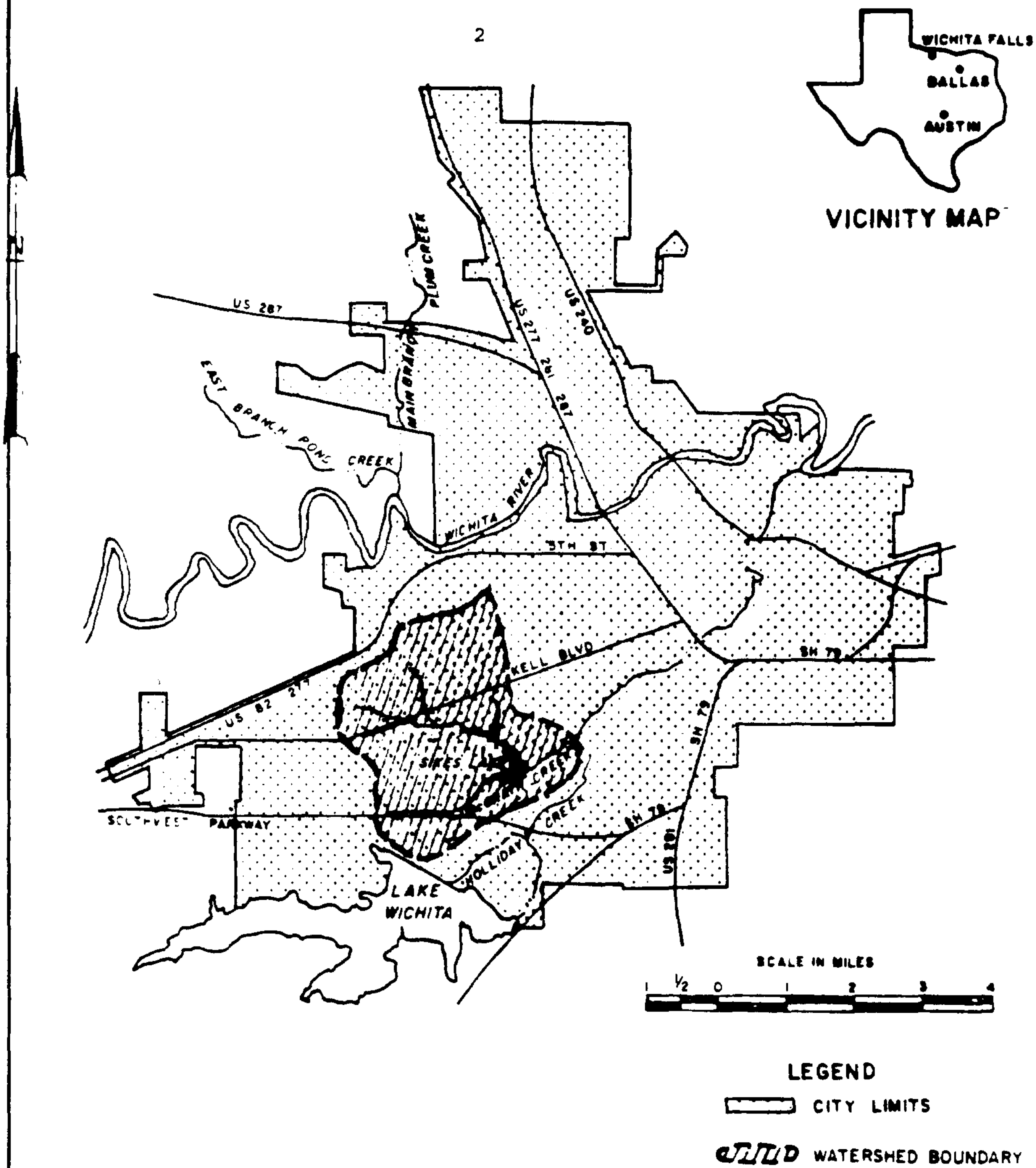


FIGURE 1

WICHITA FALLS, TEXAS
McGRATH CREEK BASIN

percent urbanized (U.S. Army Corps of Engineers 1983). The average streambed slope of McGrath Creek is 18.5 feet per mile. A shallow, 20-acre lake known as Sikes Lake is located on McGrath Creek at the confluence with its tributary from the north. The lake is owned by Midwestern State University whose campus is immediately adjacent to the north. The water surface elevation in McGrath Creek below Sikes Lake is maintained for aesthetic purposes by a series of low-water dams. Below the lake, single family and multifamily housing has developed right up to the streambank. The land along the main stem upstream of Sikes Lake is being developed into an office/commercial area. The upper reaches of the main stem are within a residential area of both single and multifamily units. The land along the tributary just above Sikes Lake is developed into small retail shops, office buildings, and residences. Further upstream, the watershed opens into an industrial park. The far upper reaches of the northern tributary watershed consist of isolated commercial and retail stores and single family housing (U.S. Army Corps of Engineers 1983).

DESCRIPTION OF PROJECT PLAN

A number of possible solutions to the flooding problems of McGrath Creek and tributaries were studied by the Corps of Engineers. They included:

non-structural	structural
no federal action	levees and flood walls
floodplain acquisition	Sikes Lake storage
floodplain management	removal of Sikes Lake
floodproofing	upstream detention
	upstream diversion
	channel modification and downstream diversion

The alternatives of floodplain acquisition, floodproofing, levees and flood walls, upstream detention, and upstream diversion were found not to be economically justifiable. The floodplain of McGrath Creek was already too developed for floodplain management; there was no room to enlarge Sikes Lake for flood storage because of development surrounding it; and the elimination of Sikes Lake would cause no appreciable gain in flood reduction benefits, whereas it provides substantial educational and recreational benefits to Midwestern State University and residents around the lake.

The only remaining possible alternatives involved channel modifications and downstream diversion. Four types of channels were examined: trapezoidal, grass-lined with 1 on 3 side slopes; rectangular, concrete-lined; and underground. Six levels of flood protection (10-year, 25-year, 50-year, 100-year, 200-year, and standard project flood [SPF]) were considered for each channel type. Table 1 presents the approximate channel sizes for channel types and levels of flood protection.

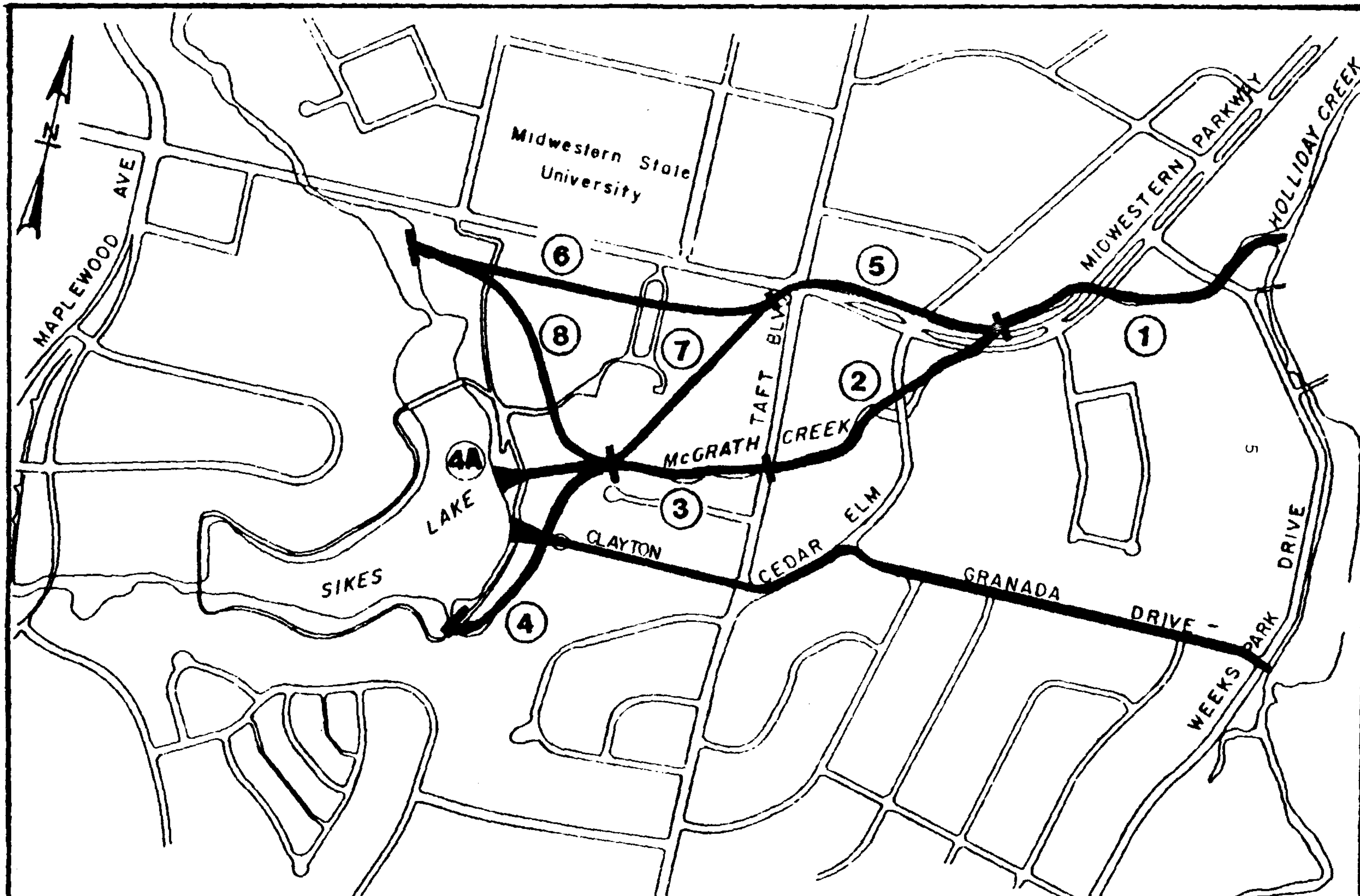
Table 1. Channel sizes for alternative type channels and levels of flood protection.

Frequency protection	Design flow (cfs)	Trapezoidal grass-lined bottom width/ top width (feet)	Rectangular concrete-lined bottom width (feet)	Trapezoidal concrete-lined bottom width/ top width (feet)
10-year	1,960	5/80	17	5/40
25-year	2,880	15/90	23	8/45
50-year	3,750	25/100	28	15/50
100-year	5,000	40/115	35	25/60
200-year	6,890	100/185	43	N/A
SPF	10,220	N/A	65	N/A

All trapezoidal channels below Taft Street would require extensive relocation of residential and commercial development and replacement of all bridges. Additionally, all channel types for SPF flood protection would require extensive relocations and would not be economically feasible. Therefore, only the rectangular, concrete-lined channels and underground channels were considered. In one alternative where space is available above Taft Street, grass-lined channel segments were incorporated into the design. The alternatives have been further narrowed down by selecting only the 100-year flood protection channels for more detailed study.

Several alternative channel alignments were considered. Figure 2 shows the various channel segments for the alternative alignments. Table 2 displays pertinent information on each alternative including alignment, type, length, relocations required, and bottom width.

The alternatives now being considered include the following:



CHANNEL SEGMENTS

Table 2. Pertinent information on alternative channel plans.

Plan	Channel alignment (segments)	Channel type	Channel bottom width (feet) 100-yr	Spillway width(ft)	Spillway length(ft)	Location	Additional information
1	1	concrete	35	110	187.5	Existing	1-business relocation
	2	concrete	35				2-bridge replacements
	3	concrete	35				1-drop structure
	4	concrete	35				1-spillway
1A	1	concrete	35	110	187.5	700 ft. north	1-business relocation
	2	concrete	35				2-bridge replacements
	3	concrete	35				1-drop structure
	4A	concrete	35				1-spillway
1B	1	concrete	35	110	187.5	700 ft. north	1-business relocation
	2	underground concrete	2-17.5w x 13h				1-bridge replacement
	3	concrete	35				1-drop structure
	4A	concrete	35				1-spillway
1C	1	concrete	35	140	187.5	700 ft. north	1-business relocation
	2	concrete	35				2-bridge replacement
	3	concrete	35				1-drop structure
	4A	concrete	35				1-spillway
2A	1	concrete	35	110	187.5	700 ft. north	1-bridge replacement
	5	underground concrete	2-17.5w x 14h				1-intersection tunnel
	7	concrete bottom, grass slope	35				1-drop structure
	4A	concrete	35				1-spillway
2B	1	concrete	35	110	187.5	700 ft. north	1-bridge replacement
	5	underground concrete	2-17.5w x 14h				1-intersection tunnel
	7	underground concrete	2-18.5w x 14h				1-drop structure
	4A	concrete	35				1-spillway
*	Granada Dr	underground concrete	2-17.5w x 10h	110	187.5	400 ft. north	no bridge replacements
	Cedar Elm	underground concrete	2-17.5w x 10h				no buildings relocated
	Clayton St.	underground concrete	2-17.5w x 10h				
	4A	underground concrete	2-17.5w x 10h				

* Clayton/Granada Diversion Plan

Plan 1

The alignment (figure 3) of this vertical-wall concrete channel follows the existing McGrath Creek channel from Holliday Creek to the spillway at Sikes Lake (channel segments 1, 2, 3, and 4). Two bridges, one at Weeks Park Drive and one at Cedar Elm, would be replaced. At Cedar Elm, the channel would deviate slightly from the existing alignment to straighten the severe bends. One commercial office building would have to be removed at this location. The spillway elevation would be the same as it is now, 960 feet National Geodetic Vertical Datum (NGVD), and it would have a width of 110 feet and length of 187.5 feet. There would be a drop structure at the mouth of McGrath Creek.

Plan 1 would provide a 100-year level of flood protection to properties below Sikes Lake and would reduce the 100-year flood level in Sikes Lake by 1.4 feet, thus slightly reducing flooding upstream. The spillway would also control design flows into the channel and would eliminate the overtopping of the embankment by a 100-year frequency flood event. Total channel length is 4,700 feet.

Plan 1A

Plan 1A, shown in figure 4, would be basically the same as Plan 1 except the new spillway would be constructed about 700 feet north of the existing spillway. The new spillway would likewise have a crest elevation of 960 feet NGVD, a crest width of 110 feet, and length of 187.5 feet. The new spillway would be situated between two Midwestern State University (MSU) buildings on the embankment. The existing spillway would be removed and the area filled in to conform to the embankment. Material suitable for filling the existing spillway area would come from excavation of the McGrath Creek channel. The existing channel section downstream of the existing spillway runs northward and is parallel to the Sikes Lake embankment. This channel segment is already concrete lined and would be left as is to capture drainage from the south of Sikes Lake. Total length of the channel would be 3,600 feet.

Plan 1B

Plan 1B, shown in figure 4, would be along the same alignment as Plan 1A. However, the segment between Taft Boulevard and the upstream Midwestern Boulevard bridge (segment 2) would be an underground double-box concrete culvert (2 - 17.5 feet wide x 13 feet high).

Plan 1C

Plan 1C, shown in figure 4, would be the same as Plan 1A with the exception of the spillway. The Plan 1C spillway would have a crest width of 140 feet to reduce the 100-year water surface elevation in Sikes Lake by an additional one foot. This would afford a slight increase in flood reduction above Sikes Lake, while providing the same degree of flood protection downstream of the lake.

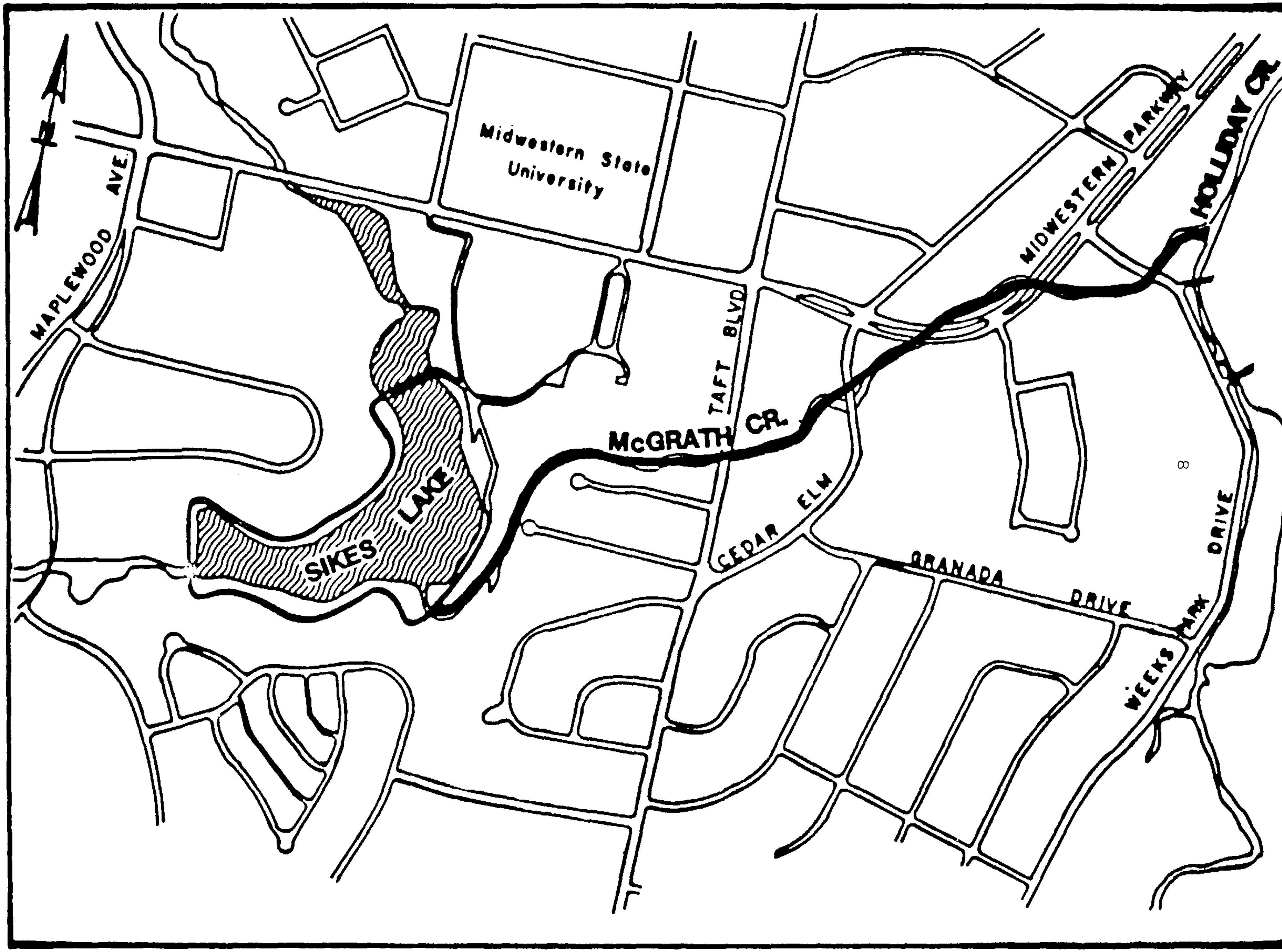
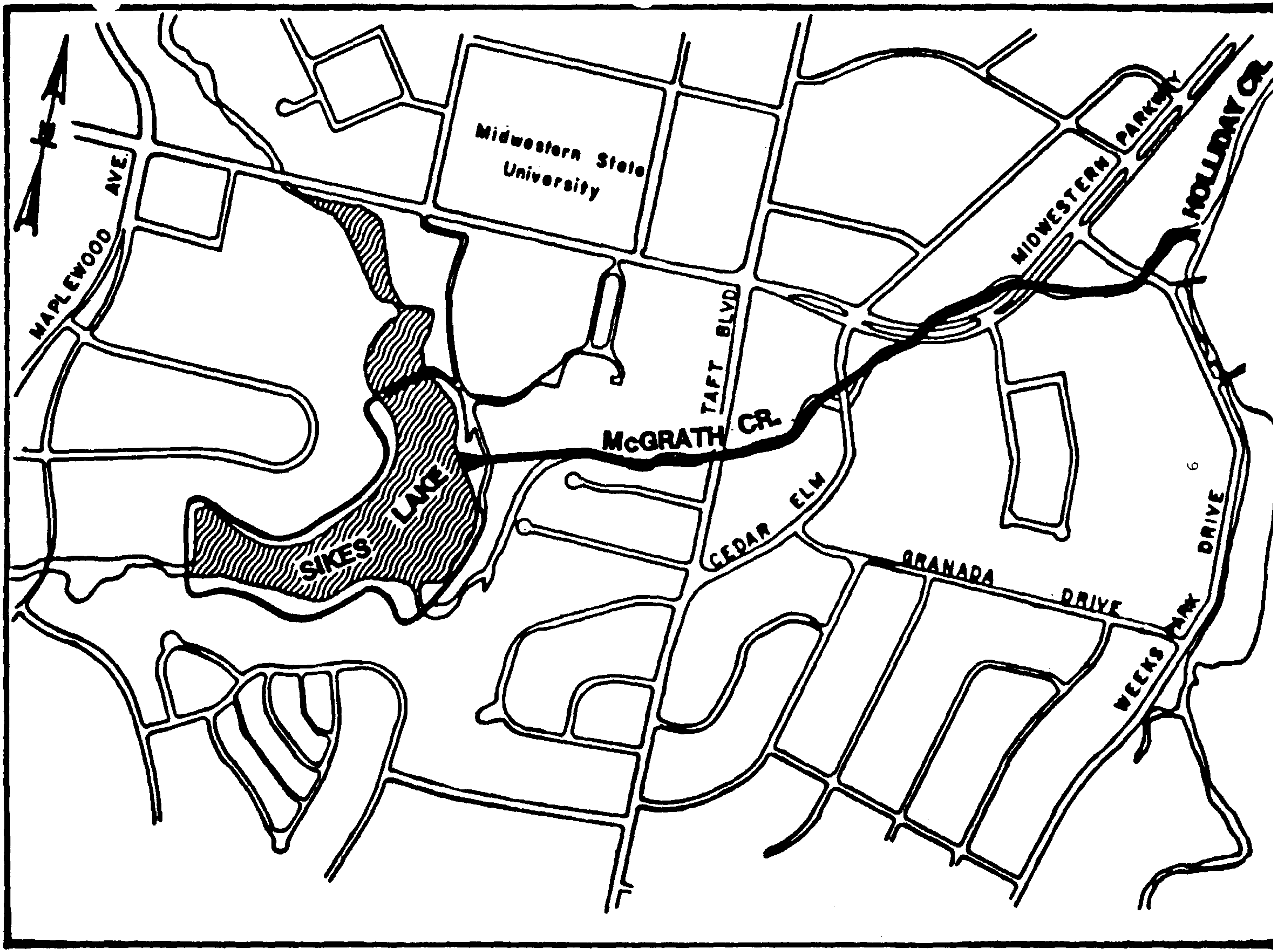


Figure 3. Channel alignment for plan 1.


Midwestern State University
MAPLEWOOD AVE.
SIKES LAKE
McGRATH CR.
TAFT BLVD
CEDAR ELM
GRANADA DRIVE
WEEKS PARK DRIVE
MIDWESTERN PARKWAY
HOLLIDAY CR.
6

Plan 2A

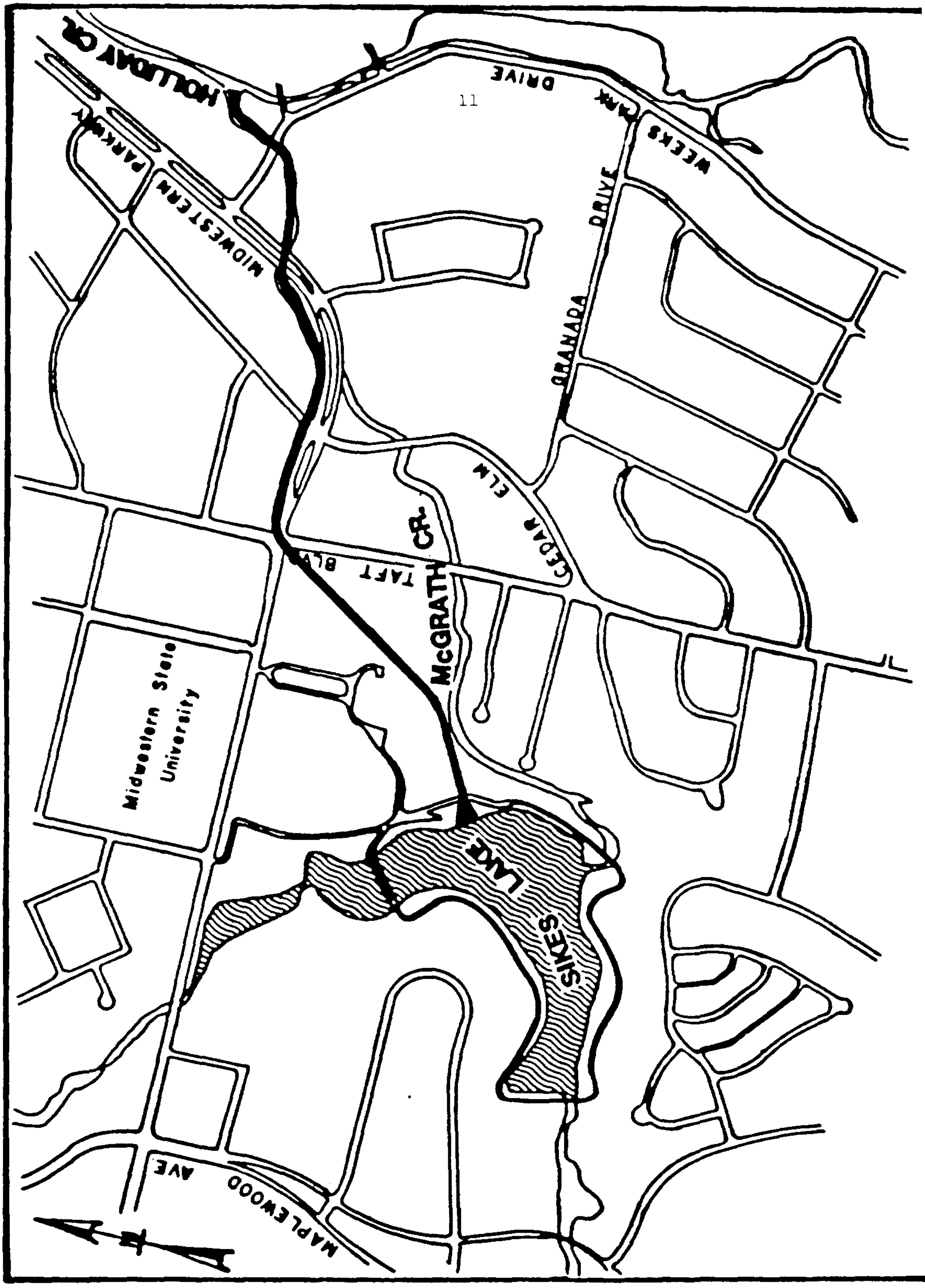
Plan 2A, shown in figure 5, would have a new spillway located about 700 feet north of the existing spillway as in Plan 1A. The existing channel segment (segment 4) immediately below the Sikes spillway would be left as is for intervening area drainage, and the existing spillway would be removed and the area filled to conform to the embankment. From a point about 600 feet upstream of the Taft Boulevard bridge, a channel would be cut northward across Midwestern State University (MSU) property to the Taft-Midwestern Parkway intersection (segment 7). From this point, an underground double-box concrete culvert (2 - 17.5 feet wide x 14 feet high) would carry flow under the intersection and parallel the north side of Midwestern Parkway to McGrath Creek (segment 5). The lower end of the channel would be the same as Plan 1A. The channel crossing MSU property would be a 35-foot wide concrete bottom channel with 3 to 1 side slopes (turfed) from the top of the concrete to natural ground level. The spillway and transition-to-channel would be the same as Plan 1A. Weeks Park Drive bridge would be replaced and box culverts would be constructed under Taft-Midwestern intersection and Cedar Elm Street. No homes or buildings would be relocated. McGrath Creek between Taft Boulevard and the upstream Midwestern Parkway bridge would be left in its existing condition. Flows in excess of channel design capacity would route through this channel segment. Low flows would be routed through the existing channel. Total length of channel and box culvert would be 4,000 feet.

Plan 2B

Plan 2B, shown on figure 5, would be the same as 2A except the segment across MSU property would be an underground double-box concrete culvert (2-18.5 feet wide and 14 feet high). All other features of Plan 2B would be the same as Plan 2A.

Clayton/Granada Drive Diversion Plan

The Clayton/Granada Drive Diversion plan concept, shown in figure 6, would include a new spillway (crest elevation 960 feet and width 110 feet) about 400 feet north of the existing spillway. The channel would be an underground double-box culvert 17.5 feet wide and 10 feet high underneath the streets of Clayton, Cedar Elm, and Granada Drive. Total length of the channel would be about 3,500 feet. It would enter Holiday Creek approximately 2,100 feet upstream (south) of the mouth of the existing McGrath Creek channel. Discharges in excess of the 100-year flood would route through the existing McGrath Creek channel. This alternative also would contain provisions for maintaining low flows through the existing channel.


HOLLIDAY CR.
MIDWESTERN PARKWAY
WEEKS PARK DRIVE
GRANADA DRIVE
ELM
CEDAR
McGRATH CR.
TAFT BLVD
Midwestern State University
LAKE SIKES
MAPLEWOOD AVE

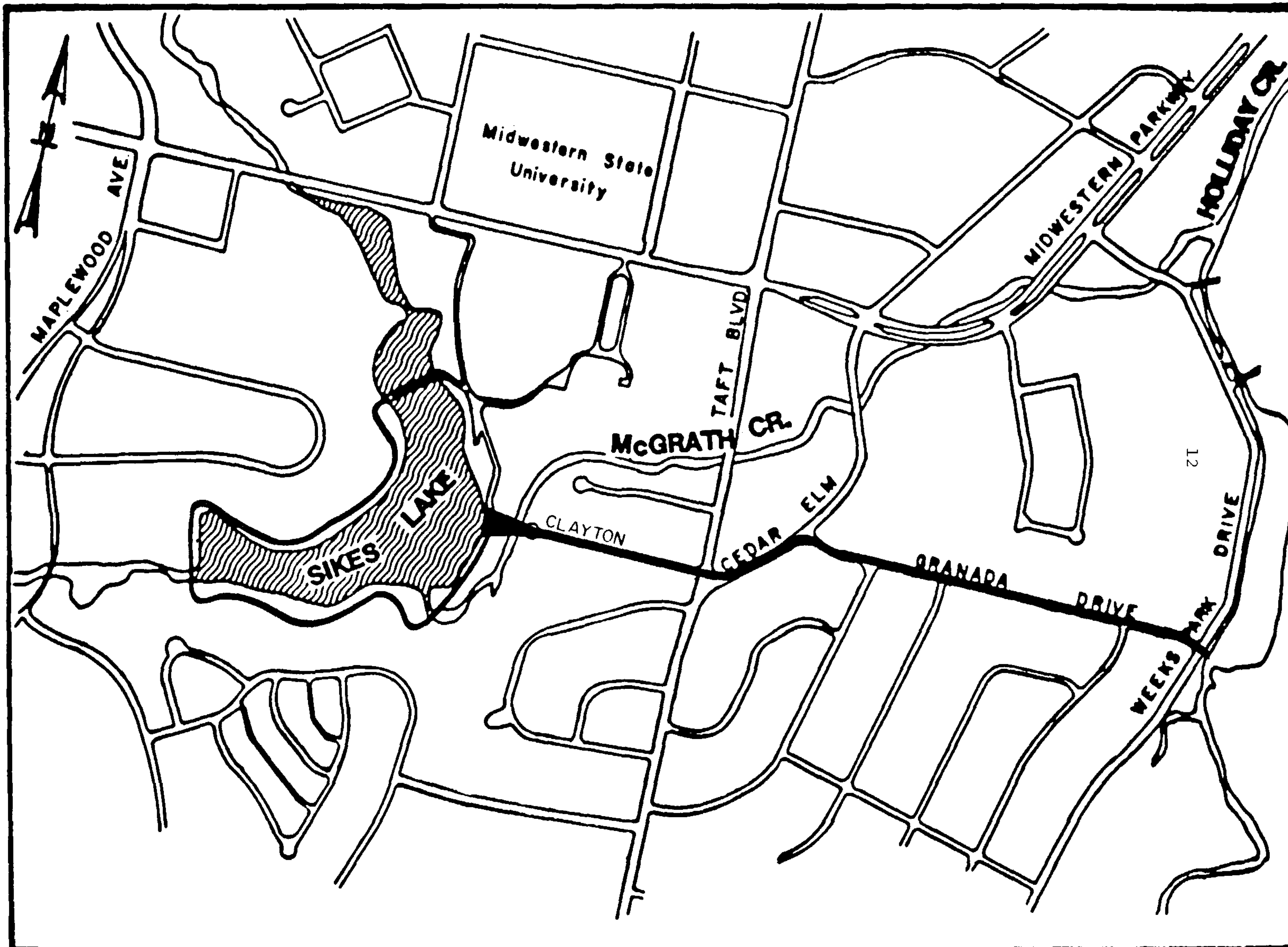


Figure 6. Channel alignment for the Clayton/Granada Diversion Plan

This plan would be the shortest route for McGrath Creek flood flows and would be the least disruptive to the aesthetic and environmental values of the existing channel. No bridge replacements or residential or commercial buildings would be relocated. The streets (Clayton, Cedar Elm, and Granada), as well as utilities along these roads, would be removed and replaced. Most of the right-of-way requirements are part of the roadways. The level of flood protection afforded by this alternative would be against the 100-year flood.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Vegetation

The project area is located in Kuchler's (1965) mesquite-buffalo grass cover type and on the border between Bailey's (1978) mesquite-buffalo grass and oak-bluestem parkland sections. This general area is characterized by mesquite growing in open stands among xerophytic grasses such as buffalo grass, grama, and threeawn. There is some intermingling of prairie with deciduous trees growing near streams.

Much of the area around Sikes Lake and along McGrath Creek has been developed and is vegetated with Bermuda grass lawns. On the steep banks around Sikes Lake that cannot be mowed are stands of *Phragmites* sp., switchgrass, cocklebur, sunflower, and smartweed. Some water primrose grows along the south shoreline and near the spillway. The trees around the lake are hackberry, elm, mulberry, salt cedar, and pecan. Many have been planted in a lawn type setting, with a number of pecan trees occurring northeast of the lake on the lawn of the residence of the president of Midwestern State University.

Downstream of Sikes Lake, McGrath Creek is constricted by apartments and houses, and lawns extend to the edge of the stream. There are some stands of switchgrass, cattails, rush, and smartweed in the channel, plus a few cottonwood, willow, hackberry, mulberry, and salt cedar trees. As the creek flows through the golf course, some water primrose is found along with filamentous algae.

The open area in the upsteam portion of the watershed just north of Call Field Road between McNiel Avenue and Lawrence Road is vegetated with a fairly dense stand of mesquite plus much ground cover and undergrowth. Red cedar, switchgrass, yucca, curlycup gumweed, and broomweed also are found. There are several wetlands surrounded by willows just north of the railroad track that crosses the area.

Aquatic Resources

Sikes Lake is a shallow 20-acre impoundment suffering from siltation. Dredging of the lake in 1976 deepened and probably improved the quality of its aquatic habitat. Quite a few mayfly larva occur in the lake along with chironomid and dragonfly larva. Crayfish and freshwater mussels are also present in the lake. The most abundant fish are rough fish such as carp and river carpsuckers. However, there are some largemouth bass along with channel catfish, green sunfish, and bluegill. Forage species are fathead minnows, golden shiners, red shiners, and mosquitofish. Frogs include the leopard frog, bullfrog, and cricket frog. Turtles such as sliders, snapping turtles, and soft-shelled turtles are found in the lake. The yellow-bellied water snake and diamond-backed water snake are present.

McGrath Creek downstream of the lake is a series of pools formed by a number of small dams. Rough fish such as carp along with several forage species including fathead minnows, golden shiners, red shiners, and mosquitofish occur in the pools. Turtles also are fairly abundant. However, in late summer these pools probably dry up or suffer from high temperature and low dissolved oxygen.

McGrath Creek and its tributary upstream from Sikes Lake are intermittent. Since the basin is mostly developed, the streams suffer from urban runoff resulting in extreme fluctuations in flow and water quality. Aquatic species found in this part of McGrath Creek are the ubiquitous species occurring in the lake and downstream.

Terrestrial Resources

Because of the developed nature of the McGrath Creek basin there is little wildlife habitat left. However, some wildlife species more tolerant of urbanization still remain. Evidence around Sikes Lake and along McGrath Creek indicates the presence of beaver, opossum, cottontail, skunk, and armadillo. Muskrat, cotton rat, and least shrew also have been reported in the basin, but because of urbanization the most abundant small mammal is probably the house mouse.

Some migratory waterfowl, primarily various dabbling ducks, frequent Sikes Lake. Gulls, terns, and grebes also have been sighted. Great blue and little blue herons inhabit the area and a little blue heron rookery is located just upstream of Sikes Lake. A number of resident and migratory songbirds also are found throughout this urban area.

Projected Changes Without the Project

Almost the entire watershed of McGrath Creek has been developed. The open area near Lawrence Road, the only remaining natural area in the basin, is owned by a development company and a railroad. This area probably will be developed in the near future. Commercial, industrial, and residential development is continuing throughout the basin on any remaining unoccupied land. At present a 50-store shopping mall is being planned west of Sikes Lake. With projected development much of the wildlife habitat remaining in the basin will be lost. Urbanization of the basin also has resulted in much of the land being in impervious parking lots, streets, and rooftops. The resulting increase in volume of stormwater runoff has increased flooding and streambed scour, and this trend is expected to continue. The change in land use from agriculture to lawns and concrete will reduce siltation, but urbanization and industrialization will degrade air and water quality.

Recreational and Educational Use

Sikes Lake is a unique resource for Midwestern State University. The university utilizes the lake in teaching a number of courses including limnology, entomology, ecology, invertebrate zoology, general botany, sailing and canoeing, outdoor education, and angling and casting. Based on class enrollment, number of days the lake is used by classes, and how often the classes are offered, the lake provides about 45,000 annual days of use to the university for instructional purposes. Since there is no dollar value readily available for an educational day, the value of $3.32 for a general recreation day as determined by the unit day method (Water Resources Council 1982) was used to arrive at a value of $149,400 annually. Based on information from university personnel the lake provided about 10,000 man-days per year of nonconsumptive recreation associated with fish and wildlife. Using the $3.32 figure this use would be valued at $33,200. A rough estimate of the fishing use of Sikes Lake is 1,000 man-days per year. The value of a general fishing day based on the unit day method is $3.64, for a value of $3,640 annually. Sikes Lake thus provides a total of 56,000 man-days of use per year with a total value of $186,240 annually. There is little or no recreational use of McGrath Creek or its tributary upstream or downstream of Sikes Lake. No hunting occurs in the urban location.

Endangered Species

No Federally listed or proposed threatened or endangered species are expected to occur in the project area .

EVALUATION OF ALTERNATIVES

Channelization of McGrath Creek below Sikes Lake (segments 1, 2, 3, and 4 or 4A) as in plans 1, 1A, 1B, and 1C would result in loss of the remaining aquatic and terrestrial habitat in or adjacent to the stream. The low water dams that now maintain pools in the creek would be lost. Plan 2A and plan 2B also would affect segment 1 of McGrath Creek, and the Clayton/Granada Diversion Plan would impact part of segment 4 of the existing stream. Even though the stream has been channelized, encroached upon by development, and habitat is of marginal quality, it provides the only remaining habitat in the immediate area and has aesthetic value for people living nearby.

New channel alignments such as segments 5 and 7 in plans 2A and 2B would be through lawn type vegetation with some ornamental trees. A number of pecan trees on the lawn of the Midwestern State University president's residence would be affected by segment 7 of plans 2A and 2B. The quality of this habitat is not high and its loss would have a greater effect on aesthetics of the area than on wildlife.

The Clayton/Granada Diversion Plan, would impact only a small area adjacent to Sikes Lake by construction of the spillway and a section of segment 4 where it crosses the existing McGrath Creek. The remainder of this alignment would be under the streets of Clayton, Cedar Elm, and Granada Drive. This alternative would have little impact on fish and wildlife resources, especially with provisions for low flow in McGrath Creek. Some temporary aesthetic impacts and inconvenience would result during construction.

All channel segments now being considered are rectangular or vertical wall concrete except segment 2 of plan 1B, segment 5 of plan 2A, segments 5 and 7 of plan 2B, and all of the Clayton/Granada Diversion Plan, which would be underground. The area affected by each alternative channel alignment is shown in Table 3. This table also presents the areas and lengths of McGrath Creek downstream of Sikes Lake that would be affected. The vertical wall concrete channels would result in complete loss of existing stream habitat and adjacent terrestrial habitat. They would create a monotypic substrate and lack of habitat diversity needed for aquatic communities. They also would act as a barrier to movement and prevent access and use by terrestrial wildlife because of their vertical side slopes. Underground channels except for those in the Clayton/Granada Diversion Plan also would destroy some habitat. They would not receive solar energy and would be more inaccessible to wildlife. However, they would present no barrier to movement of wildlife and the channel right-of-way could be developed to benefit wildlife by use of vegetative plantings. Since the underground channels in the Clayton/Granada Diversion Plan would be under existing city streets, no habitat would be lost.

Table 3. Total area, area of stream, and length of stream impacted by alternative channel alignment.

Plan	Total area impacted (acres)	Area of McGrath Creek impacted (acres)	Length of McGrath Creek impacted (feet)
1	4.6	4.6	4,750
1A	3.9	3.3	3,600
1B	3.9	3.3	3,600
1C	3.9	3.3	3,600
2A	3.9	1.8	1,700
2B	3.9	1.8	1,700
Clayton/ Granada Diversion Plan	0	0	0

The alternative that would drain Sikes Lake has been dropped, so loss of the lake is no longer a consideration. This is fortuhate because even though the quality of fish and wildlife habitat in and surrounding Sikes Lake is marginal, it is the only habitat remaining in this urban setting. Also, the lake and surrounding area are an important educational and recreational resource to Midwestern State University and residents around it.

All alternatives now being considered route high flows through Sikes Lake and would have no affect on the existing normal lake level. The spillway elevation would not be changed and only high flows would be affected. Construction activities would result in a temporary increase in turbidity. Because the species of fish and wildlife found in and around Sikes Lake are already able to survive in an urban environment, they should be able to withstand the temporary disturbance of construction activities. With no change in lake elevation the project will have no effect on the lake's fish and wildlife resources. Also, use of the lake by the university, fishermen, and other recreationists will remain as it is now.

DISCUSSION

The Service's principal fish and wildlife objectives for this study are protection of the highest valued fish and wildlife resources remaining within the McGrath Creek basin, especially those associated with Sikes Lake, and minimization of the loss of habitat values due to project construction or operation. The Service wishes to participate fully during the planning process of this project as required by the Fish and Wildlife Coordination Act.

Based on our evaluation of the different cover types during the study the value of fish and wildlife resources that potentially would be affected was categorized in accordance with the Service's Mitigation Policy (U.S. Fish and Wildlife Service 1981). Because of urbanization and related problems, the fish and wildlife habitat in the McGrath Creek basin was placed in Resource Category 4. This includes habitat of medium to low value for evaluation species. The species used for this evaluation are opossum, cottontail, beaver, waterfowl, channel catfish, bluegill, and carp. The mitigation goal for Category 4 habitat is to minimize the loss of habitat value. If losses are likely to occur, then mitigation measures may be recommended. Also, because these areas possess relatively low habitat values, they exhibit considerable potential for improvement of habitat values and enhancement measures should be considered.

Even though habitat provided by the channel of McGrath Creek downstream of Sikes Lake is of low quality it provides the only such habitat in the immediate area and is of aesthetic importance to residents of the apartments and houses along it. For this reason the Service prefers the Clayton/Granada Diversion Plan, which would route the channel under existing city streets (Clayton, Cedar Elm, and Granada Drive) resulting in little impact on McGrath Creek. If this alternative is not feasible, the Service would prefer the use of channel segments 5 and 7 as in plans 2A and 2B. With plans 2A and 2B the existing creek through segments 2 and 3 would remain in its present condition preserving the low water dams through the residential area. Also, provisions would be made to maintain low flows in the creek channel with high flows being routed through segments 5, 6, and 7. Since plans 1, 1A, 1B, and 1C would follow the existing channel of McGrath Creek downstream of Sikes Lake (segments 1, 2, 3, and 4, or 4A), this entire reach of the creek would be affected. For that reason, the Service would be less in favor of these four alternatives. However, the Service could accept any of the alternatives if habitat losses were minimized or mitigated by making recommended wildlife plantings and providing low flows in McGrath Creek downstream of Sikes Lake.

Of the vertical wall concrete channels and underground channels now being considered, the Service prefers the underground channels. Either of these channel types would destroy aquatic and terrestrial habitat. However, with an underground channel some type of terrstrial wildlife habitat could be developed over the buried channel. The underground channels of the Clayton/Granada Diversion Plan would be under city streets, preventing habitat development over them, but such alignments would result in little or no loss of existing habitat.

Construction of a vertical wall concrete channel or underground channel, regardless of size, through any portion of the existing stream would result in complete loss of habitat in that segment. To offset or mitigate these losses, the Service suggests planting native bottomland trees and shrubs beneficial to wildlife along the channel alignment, either adjacent to concrete channels or over underground channels. The area of plantings needed to minimize or mitigate the impacts should equal the area of McGrath Creek affected by each alternative as presented in Table 3. The area over underground portions of channels would be sufficient to mitigate those segments. If sufficient area is not available along the vertical wall concrete channels to equal the area lost, an area around Sikes Lake should be planted to make up the difference. In addition to offsetting habitat losses, such plantings would help lessen the aesthetic impacts of the project. Because the Clayton/Granada Diversion Plan would have so little impact, no mitigation would be required. However, some landscaping and planting around the spillway site or other areas around Sikes Lake would improve the aesthetics of the area and enhance its value to wildlife.

Species of vegetation beneficial to songbirds and other urban wildlife through provision of food and cover are presented in Table 4. It is not necessary to plant all these species, but they provide a list from which to choose. Plantings should be maintained throughout the life of the project. Such maintenance would need to include watering, fertilizing, and controlling weeds, especially during the important initial planting stage. Maintenance responsibilities should be clearly identified if a contractor or local sponsor is used. Adequate project funding should be provided for operation and maintenance of these features. Cost estimates based on $1,500 per acre for wildlife plantings plus annual operation and maintenance costs are provided in Table 5.

Table 4. Recommended species for wildlife plantings.

large trees	small trees	shrubs	vines
hackberry	red cedar	blackberry	honeysuckle
mulberry	mesquite	dogwood	morning glory
bur oak	persimmon	elderberry	trumpet vine
pecan	soapberry	pokeweed	Virginia creeper
green ash	plum	Russian olive	wild grape

Table 5. Estimated size and cost of wildlife plantings.

Plan	1	1A	1B	1C	2A	2B	*
Area (acres)	4.6	3.3	3.3	3.3	1.8	1.8	0
Initial ($)	6,900	4,950	4,950	4,950	2,700	2,700	0
O&M ($) 1/	1,500	1,000	1,000	1,000	700	700	0

1/ Annual operation and maintenance

* Clayton/Granada Diversion Plan

The alternatives being considered in the study of McGrath Creek have been ranked in order of preference by the Service. The ranking is based primarily on the degree of impact to the existing stream, the amount of habitat being affected, and the potential for minimizing or mitigating impacts. The following ranking (Table 6) is in order of increasing impact on fish and wildlife resources.

Table 6. Ranking of project alternatives.

Rank	Alternative	Segments
1	Clayton/Granada Diversion Plan	Clayton, Cedar Elm, Granada Drive, 4A
2	2A	1, 5, 7, 4A
3	2B	1, 5, 7, 4A
4	1B	1, 2, 3, 4A
5	1A	1, 2, 3, 4A
6	1C	1, 2, 3, 4A
7	1	1, 2, 3, 4

RECOMMENDATIONS

In view of the foregoing, it is recommended that:

1. The Clayton/Granada Diversion Plan be selected as the final plan to minimize the impact on existing resources of McGrath Creek downstream of Sikes Lake.

2. Low flows be maintained through the existing channel of McGrath Creek downstream of Sikes Lake as currently provided in plans 2A, 2B, and the Clayton/Granada Diversion Plan.

3. If plan 1B, 2A or 2B is selected as the final plan underground channels be chosen for segment 2 in plan 1B, segment 5 in plan 2A, or segments 5 and 7 in plan 2B, allowing the area over the channels to be planted with vegetation of benefit to terrestrial wildlife.

4. Wildlife plantings of an amount approximately equal to the area of McGrath Creek affected (Table 3) be made along channel alignments and around Sikes Lake to minimize or mitigate terrestrial habitat losses. Species of vegetation to be used are presented in Table 4 and estimated costs are shown in Table 5.

SUMMARY

Fish and wildlife habitat in the McGrath Creek basin is not high in value, but it is practically the only habitat remaining within the urbanized study area. One of the Service's major concerns with the flood control study of the basin was the potential impact on Sikes Lake. This lake provides a unique educational and recreational resource to Midwestern State University and residents around the lake. Fortunately all plans that would drain the lake now have been dropped, and all remaining plans would have no effect on the size or elevation of the existing lake because there would be no change in spillway elevation.

The Service prefers the Clayton/Granada Diversion Plan over all other alternatives because it would have little effect on the existing channel of McGrath Creek downstream of Sikes Lake. Its alignment would be under the city streets of Clayton, Cedar Elm, and Granada Drive, leaving McGrath Creek in its existing condition. Also, provisions to maintain low flow in the existing channel would be included. This alternative would require no mitigation.

With the alternatives that follow all or a portion of the existing alignment of McGrath Creek, use of any vertical wall concrete channel or underground channel would result in loss of the stream segment involved. The Service would prefer underground channels for segment 2 of plan 1B, segment 5 of plan 2A, and segments 5 and 7 of plan 2B over vertical wall concrete channels. Construction of either of these channel types would result in loss of essentially all aquatic and terrestrial habitat in the affected segments, but the channel alignment over an underground channel could be planted to develop terrestrial wildlife habitat.

The Service believes that emphasis should be placed on maintaining the existing channel of McGrath Creek downstream of Sikes Lake through the reach of low water dams within the residential area to maintain the urban wildlife resource and aesthetics of the area. This could best be accomplished by selection of the Clayton/Granada Diversion Plan, however, plan 2A or plan 2B would maintain most of the existing channel in segments 2 and 3 through the residential area. Any of the alternatives would be acceptable to the Service if habitat losses were minimized or mitigated by making recommended wildlife plantings and providing for low flows in McGrath Creek downstream of Sikes Lake.

The cooperation of your staff in providing the Service with information relative to this study is greatly appreciated.

Sincerely yours,

Robert M. Short

Robert M. Short
Acting, Field Supervisor

cc:
(3) Regional Director, FWS, Albuquerque, NM (AHR) (SE)
(5) Executive Director, Texas Parks and Wildlife Department, Austin, TX
(1) Director, FWS, Washington, D.C. (ES)
(2) Regional Administrator, EPA, Dallas, TX
(3) USDI Natural Resources Library, Washington, D.C.

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Bailey, R. G. 1978. Description of the ecoregions of the United States. Forest Service. USDA. Ogden, Utah. 77 pp. Map.

Kuchler, A. W. 1965. Potential natural vegetation. U.S. Geological Survey. Washington, D.C. Map.

U.S. Army Corps of Engineers. 1983. Reconnaissance report McGrath Creek Wichita Falls, Texas. Tulsa District Tulsa, OK.

U.S. Fish and Wildlife Service. 1981. U.S. Fish and Wildlife Service mitigation policy. Fed. Reg. 46(15). Jan. 23, 1981.

Water Resources Council. 1982. Principles and standards for planning water and related land resources. Fed. Reg. 44(242). Dec. 14, 1979.

TEXAS
PARKS AND WILDLIFE DEPARTMENT

4200 Smith School Road Austin, Texas 78744

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October 31, 1984

Mr. Sidney H. Wilkirson
Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
Ecological Services
222 South Houston
Suite A
Tulsa, Oklahoma 74127

Re: Draft Report Lake Wichita, Holiday Creek, McGrath Creek; Wichita Falls, Texas

Dear Mr. Wilkirson:

This agency has reviewed the above referenced report and offers the following comments.

While this agency is in general agreement with the report and recommendations, as written, there is one area that is of particular concern.

On page 25, paragraph 2, a statement is made that indicates that the vegetative plantings should be maintained throughout the life of the project. A second statement also indicates that operation and maintenance funding should be provided for this purpose.

Since the initial stage of planting is particularly crucial to the survival of the plantings, the party or parties responsible for this task should be specifically stated. It is presumed that watering, fertilization, and weed control will be covered by the operation and maintenance funding.

The opportunity to review this report and provide comments is appreciated.

Sincerely,

Charles D. Travis
Executive Director

CDT:RWS:wjg

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

December 21, 1984

Col. Franklin D. Tilton
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

Enclosed for your review and comment are five copies of the Fish and Wildlife Service's revised review draft report dated December 21, 1984, on the study entitled Lake Wichita, Holliday Creek, McGrath Creek, Wichita Falls, Texas. We would appreciate receipt of your comments by January 25, 1984, so the final report can be completed as soon as possible.

The cooperation and assistance of your staff in our investigation of this project are appreciated.

Sincerely yours,

Sidney H. Wilkirson

Sidney H. Wilkirson
Field Supervisor

Enclosures

cc:
Regional Director, FWS, Albuquerque, New Mexico (AHR)(SE) w/o cy encl.

The revised reviewed draft report, dated 21 December 1984 is omitted.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

September 28, 1984

Col. Franklin D. Tilton
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

Enclosed for your review and comment are five copies of the Fish and Wildlife Service's review draft report dated September 28, 1984, on the study entitled Lake Wichita, Holliday Creek, McGrath Creek, Wichita Falls, Texas. We would appreciate receipt of your comments by November 5, 1984, so the final report can be completed as soon as possible.

The cooperation and assistance of your staff in our investigation of this project are appreciated.

Sincerely yours,

Sidney H. Wilkirson

Sidney H. Wilkirson
Field Supervisor

Enclosures

cc:
Regional Director, FWS, Albuquerque, New Mexico (AHR)(SE) w/o cy encl.

The review draft report dated September 28, 1984 is omitted.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

May 11, 1984

District Engineer
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

This letter constitutes a planning assistance report of the U.S. Fish and Wildlife Service pertinent to your study of Lake Wichita (McGrath Creek), Texas. Specifically, it provides our evaluation of fish and wildlife habitat and related resources under existing conditions and a preliminary evaluation of the impacts of some of the more likely project alternatives. This report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C 661 et seq.) in coordination with the Corps of Engineers and the Texas Parks and Wildlife Department. It is not intended as the official report of the Secretary of the Interior or the Service on the proposed project within the meaning of Section 2(b) of the Act.

The purpose of the study by the Corps of Engineers is to investigate flooding problems along McGrath Creek and its tributaries. The investigation is being conducted under the authority of a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted February 25, 1938. The information presented in this letter is based on data supplied by the Corps of Engineers, Texas Parks and Wildlife Department, Midwestern State University, literature surveys, and field investigations. Much of the information on fish and wildlife resources is based on personal communication with Dr. Horner and Dr. Dalquest (April 1984) of Midwestern State University.

DESCRIPTION OF THE AREA

The McGrath Creek watershed is located within the corporate limits of the City of Wichita Falls, Texas (Figure 1). Wichita Falls is in Wichita County in north-central Texas approximately 12 miles south of the Texas-Oklahoma state line. McGrath Creek is a left bank tributary of Holliday Creek. It flows into Holliday Creek approximately 6 miles upstream from its confluence with the Wichita River. The main stem of McGrath Creek is about 2.9 miles long and its tributary, Quail Creek, is about 2.7 miles long. Three fourths of the channel length is concrete-lined. The watershed, approximately 5.4 square miles, is 90 percent urbanized (U.S. Army

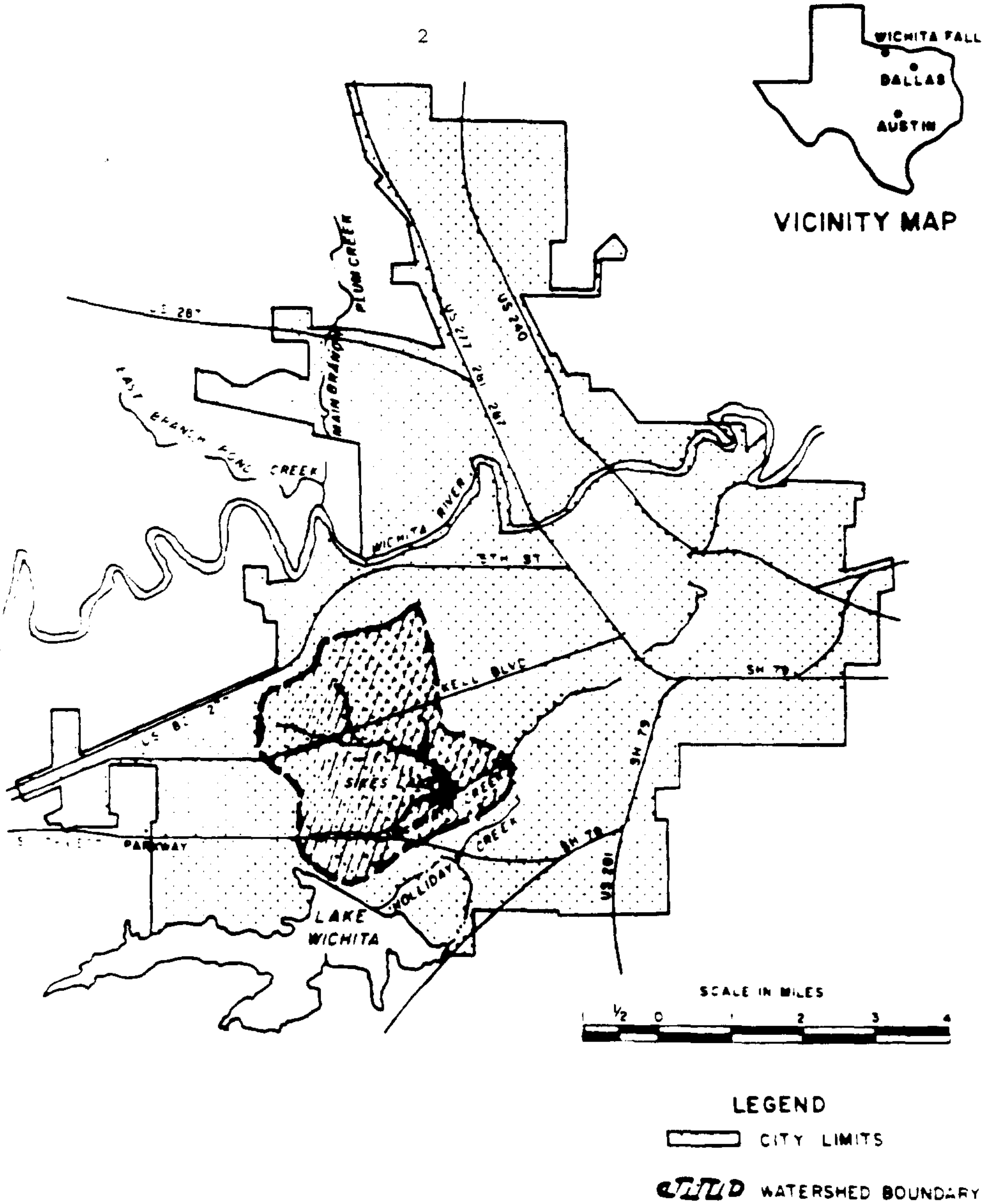


FIGURE 1

WICHITA FALLS, TEXAS
McGRATH CREEK BASIN

Corps of Engineers 1983). The average streambed slope of McGrath Creek is 18.5 feet per mile. A shallow, 20-acre lake known as Sikes Lake is located on McGrath Creek at its confluence with Quail Creek. The lake is owned by Midwestern State University whose campus is immediately adjacent to the north. The water surface elevation in McGrath Creek below Sikes Lake is maintained for aesthetic purposes by a series of low-water dams. Below the lake, single family and multifamily housing has developed right up to the streambank. The land along the main stem upstream of Sikes Lake is being developed into an office/commercial area. The upper reaches of the main stem are within a residential area of both single and multifamily units. The land along the tributary just above Sikes Lake is developed into small retail shops, office buildings, and residences. Further upstream, the watershed opens into an industrial park. The far upper reaches of the Quail Creek watershed consist of isolated commercial and retail stores and single family housing (U.S. Army Corps of Engineers 1983).

DESCRIPTION OF PROJECT PLAN

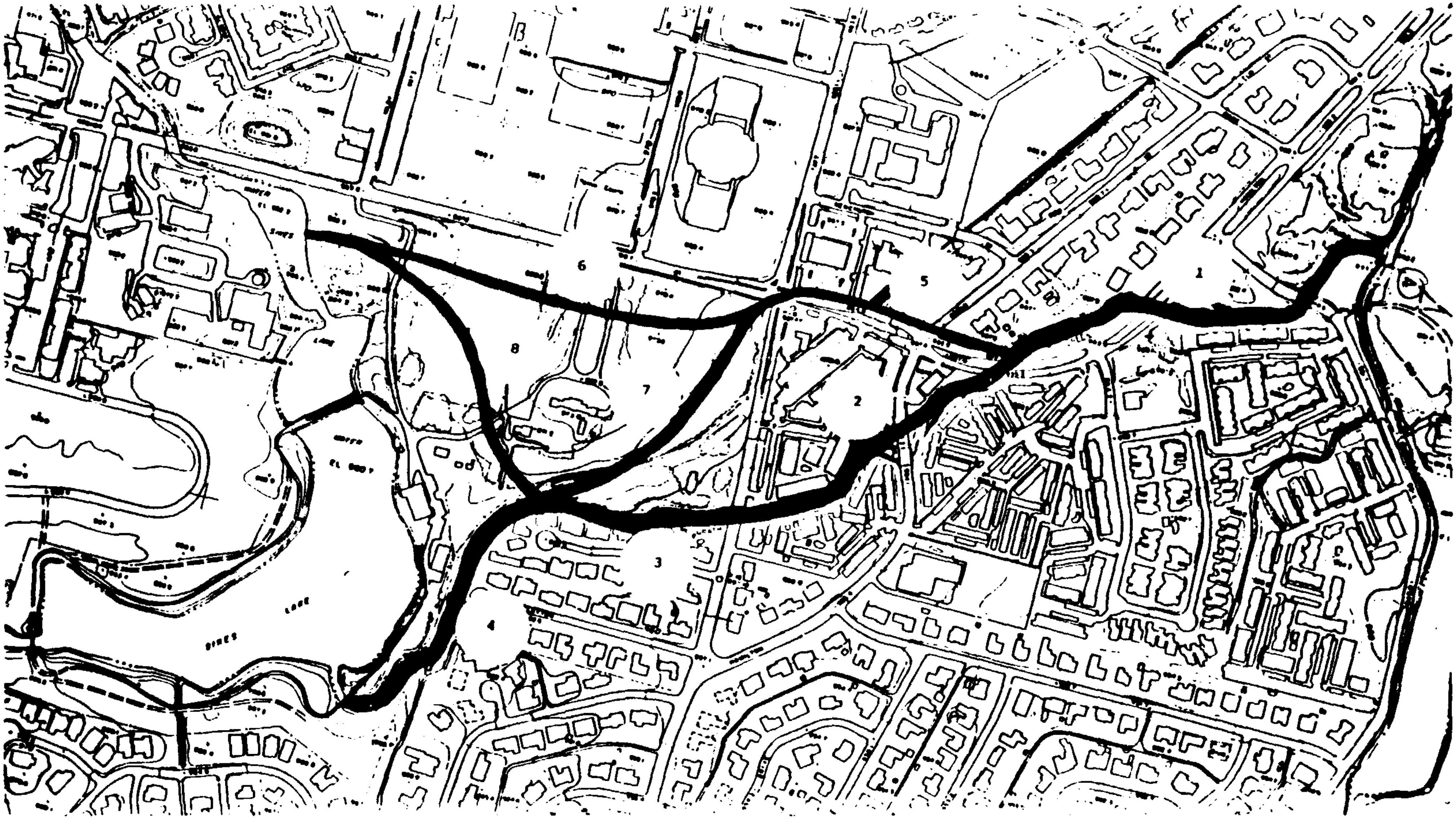
A number of possible solutions to the flood problems of McGrath Creek and tributaries are being studied by the Corps of Engineers. Various combinations of possible channel alignments and sizes are being investigated. Types of channels being considered are grass lined with one vertical to three horizontal side slopes, concrete channels with vertical sides, enclosed underground channels, or various combinations of these. Also a floodwater detention site just north of Call Field Road between McNiel Avenue and Lawrence Road and a south branch diversion at Kemp Boulevard and Southwest Parking, along Old Lake Road to Holliday Creek, were studied. Various levels of flood protection also are being investigated, including protection from the 10, 25, 50, and 100-year floods. Such levels of flood protection would require different channel sizes. For example, the bottom width of the concrete channels required to pass a 10, 25, 50, or 100-year flood would be 18, 24, 30, or 35 feet, respectively. Figure 2 shows possible alignments of several alternative channel segments. Alternatives involving various combinations of these alignments are presented in Table 1.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Vegetation

The project area is located in Kuchler's (1965) mesquite-buffalo grass cover type and on the border between Bailey's (1978) mesquite-buffalo grass and oak-bluestem parkland sections. This general area is characterized by mesquite growing in open stands among xerophytic grasses such as buffalo grass, grama, and threeawn. There is some intermingling of prairie with deciduous trees most commonly growing near streams.

Much of the area around Sikes Lake and along McGrath Creek has been developed and is in Bermuda grass lawns. On the steep banks around Sikes Lake that cannot be mowed are stands of Phragmites sp., switchgrass, cocklebur,



Figrue 2. Alternative channel alignments downstream of Sikes Lake.

Table 1. McGrath Creek Project Alternatives.

Alternative No.	Description	Length of channel (ft)
1	Alternative channel segments [1] 1, 2, 3, 4	13,100
2	" " " 1, 4, 7, 4	13,700
3	" " " 1, 2, 3, 4, 8	17,100
4	" " " 1, 5, 7, 6, 4	18,600
5	" " " 1, 2, 3, 4, 5, 6	20,900
6	" " " 1, 5, 6	12,200
7	Lawrence Road floodwater detention site	
8	South Branch Diversion at Kemp Boulevard and Southwest Parkway along Old Lake Road to Holliday Creek	900
9	Any of 1-6 above with removal of Sikes Lake Dam and channelization through the lake area	

[1] As presented in Figure 2

sunflower, and smartweed. Some water primrose is found along the south shoreline and near the spillway. The trees around the lake are hackberry, elm, mulberry, salt cedar, and pecan. Many have been planted in a lawn type setting, with a number of pecan trees occurring northeast of the lake on the lawn of the residence of the president of Midwestern State University.

Downstream of Sikes Lake where McGrath Creek is constricted by apartments and houses, lawns extend to the edge of the stream. There are some stands of switchgrass, cattails, rush, and smartweed in the channel, plus a few cottonwood, willow, hackberry, mulberry, and salt cedar trees. Where the creek runs through the golf course, some water primrose is found along with areas of filamentous algae.

The open area in the upstream portion of the watershed being considered by the Corps of Engineers for a floodwater detention area is characterized by a fairly dense stand of mesquite with good ground cover and undergrowth. Red cedar, switchgrass, yucca, curlycup gumweed, and broomweed also are found. There are several wetlands surrounded by willows just north of the railroad track that crosses the area.

Aquatic Resources

Sikes Lake is a shallow 20-acre impoundment suffering from siltation. Dredging of the lake in 1976 deepened and probably improved the quality of its aquatic habitat. Quite a few mayfly larva occur in the lake along with chironomid and dragonfly larva. Crayfish and freshwater mussels are also present in the lake. The most abundant fish are rough fish such as carp and river carpsuckers. However, there are some largemouth bass along with channel catfish, green sunfish, and bluegill. Forage species are fathead minnows, golden shiners, red shiners, and mosquitofish. Frogs include the leopard frog, bullfrog, and cricket frog. Turtles such as sliders, snapping turtles, and soft-shelled turtles are found in the lake. Both the yellow-bellied water snake and diamond-backed water snake also are present.

McGrath Creek downstream of the lake is a series of pools formed by a number of small low water dams. Rough fish such as carp along with several forage species including fathead minnows, golden shiners, red shiners, and mosquitofish occur in the pools. Turtles also are fairly abundant. However, in late summer these pools probably dry up or suffer from high temperature and low dissolved oxygen.

McGrath Creek and its tributary upstream from Sikes Lake are intermittent streams. Since the basin is practically completely developed, the streams suffer from urban runoff resulting in extreme fluctuations in flow and water quality. The aquatic species found in this area would be fairly similar to the ubiquitous species occurring in the lake and downstream.

Terrestrial Resources

Because of the developed nature of the McGrath Creek basin there is little wildlife habitat left. However, some wildlife species more tolerant of urbanization still remain. Evidence around Sikes Lake and along McGrath Creek indicates the presence of beaver, opossum, cottontail, skunk, and armadillo. Muskrat, cotton rat, and least shrew also have been reported from the basin, but because of urbanization the most abundant small mammal is probably the house mouse.

Some migratory waterfowl utilize Sikes Lake, primarily various dabbling ducks. Gulls, terns, and grebes also have been sighted. Great blue and little blue herons use the area and a little blue heron rookery is located just upstream of Sikes Lake. A number of resident and migratory songbirds also are found throughout this urban area.

Projected Changes Without the Project

Practically the entire watershed of McGrath Creek has been developed. The open area near Lawrence Road, the only remaining natural area in the basin, is owned by a development company and a railroad. This area now under consideration for a floodwater detention area by the Corps of Engineers probably will be developed in the near future without a Corps of Engineers project. Commercial, industrial, and residential development is continuing throughout the basin on any remaining unoccupied land. At present a 50-store shopping mall is being planned immediately west of Sikes Lake. With projected development much of the wildlife habitat remaining in the basin will be lost. Urbanization of the basin also has resulted in much of the land being in impervious parking lots, streets, and rooftops. The resulting increase in volume of stormwater runoff has heightened flooding and streambed scour, and this trend is expected to continue. The change in land use from agriculture to lawns and concrete should reduce future siltation, but urbanization and industrialization will adversely affect air and water quality.

Recreational and Educational Use

Sikes Lake provides a unique resource for Midwestern State University. The university utilizes the lake in teaching a number of courses including limnology, entomology, ecology, invertebrate zoology, general botany, sailing and canoeing, outdoor education, and angling and casting. Based on class enrollment, number of days the lake is specifically utilized by the class, and how often the classes are offered, the lake is estimated to provide about 45,000 annual man-days of use to the university for instructional purposes. Since there is no dollar value readily availabale for an educational day, the value of $3.32 for a general recreation day as determined by the unit day method (Water Resources Council 1982) was used to arrive at a value of $149,400 annually. Based on information from university personnel the lake provided about 10,000 man-days per year of nonconsumptive recreation associated with fish and wildlife. Using the $3.32 figure this use would be valued at $33,200. A rough estimate of the fishing use of Sikes Lake is 1,000 man-days per year. The value of a general fishing day based on the unit day method is $3.64, for a value of $3,640 annually. Sikes Lake thus provides a total of 56,000 man-days of use per year with a total value of $186,240 annually. There is little or no recreational use of McGrath Creek or its tributary upstream or downstream of Sikes Lake. No hunting occurs in the urban location.

Endangered Species

No Federally listed or proposed threatened or endangered species are expected to occur in the project area .

PRELIMINARY EVALUATION OF ALTERNATIVES

Only rough descriptions of the various alternatives being considered are available at this time. They are summarized in Table 1. As the alternatives are refined and more specific information on size and location of various components of each alternative is made available, a more indepth evaluation of impacts will be provided.

Channelization of McGrath Creek below Sikes Lake would result in loss of the remaining aquatic or terrestrial habitat in or adjacent to the stream. The low water dams that now maintain pools in the creek would be lost. Even though the stream has been channelized in the past, encroached upon by development, and habitat is of marginal quality, it provides the only such habitat in the immediate area and has aesthetic value for persons living nearby.

New channel alignments such as segments 5, 6, 7 and 8 and the south branch diversion would be through lawn type habitat with some ornamental trees. A number of pecan trees on the lawn of the Midwestern State University president's residence would be affected by segments 6, 7, and 8. The quality of this habitat is not high and its loss would have a greater effect on aesthetics of the area than on its wildlife.

With construction of any of the new channel segments, including the south branch diversion, all existing habitat would be lost. However, the value to fish and wildlife of the new channel would depend on the type of channel. A grass lined channel would be of considerably more value than either a concrete lined or underground channel because such a channel would provide some vegetative cover that would be utilized by wildlife and a substrate for the aquatic community closer to that of the existing stream. Side slopes would not be as severe resulting in the channel being less of a barrier to wildlife movement. Of course an underground channel would not receive solar energy and would not be accessible to wildlife.

Any alternative that would result in draining Sikes Lake, such as alternative 9, would cause the loss of a resource valuable to Midwestern State University and the surrounding neighborhood of Wichita Falls. As was mentioned earlier, Sikes Lake is used by Midwestern State University for instructional purposes in addition to recreation by university personnel and students. The upper ends of both the McGrath Creek arm and Quail Creek arm are open to the public and used by residents of Wichita Falls. Drainage of the lake would result in the loss of a total of 56,000 annual educational and recreational man-days valued at $186,240. The quality of fish and wildlife habitat in and surrounding Sikes Lake is marginal, but for an urban setting it represents the only habitat remaining in this urban setting.

The alternatives that route high flows around Sikes Lake would have no affect on the existing normal lake level since the spillway elevation would not be changed and only high flows would be affected. Construction activities would result in a temporary increase in turbidity. However, routing the higher silt laden flows around the lake could increase its life by reducing siltation. The species of fish and wildlife found in and around Sikes Lake are fairly adaptive, already being able to survive in an urban environment. Because of this they should be able to withstand the temporary disturbance of construction activities. With no change in lake elevation the project should have little effect on the lake's fish and wildlife resources. Also, use of the lake by the university, fishermen, and other recreationists should be similar to what it is now.

Since dimensions of the floodwater detention site north of Call Field Road between McNiel Avenue and Lawrence Road have not been provided, specific impacts can not be determined. This area has a good stand of mesquite trees with good ground cover and undergrowth. Several wetlands also are found in the area, and it probably is the best wildlife habitat left in the basin. It belongs to a development company and railroad. With present trends in development this area probably will be lost to development within the next 10 years. If a detention site were constructed on the area, it might be possible with appropriate design and management to maintain some wildlife habitat. Much of the impact of the floodwater detention site would depend on its size, design, and whether it would hold water permanently or be designed as a dry site.

DISCUSSION/CONCLUSION

The Service's principal fish and wildlife objectives for this study are protection of the remaining fish and wildlife resources within the McGrath Creek basin, especially those associated with Sikes Lake, and mitigation of habitat values unavoidably lost due to project construction or operation. The Service wishes to participate fully during the planning process of this project as required by the Fish and Wildlife Coordination Act.

Based on a preliminary evaluation of the different cover types during this early planning stage, the value of fish and wildlife resources that potentially would be affected was categorized in accordance with the Service's Mitigation Policy (U.S. Fish and Wildlife Service 1981). Because of urbanization and related problems, the fish and wildlife habitat in the McGrath Creek basin was placed in Resource Category 4. This includes habitat of medium to low value for evaluation species. The general species used for this preliminary evaluation were opossum, cottontail, beaver, waterfowl, channel catfish, bluegill, and carp. The mitigation goal of the Service for Category 4 habitat is to minimize the loss of habitat value. To accomplish this, it is the Service's responsibility to recommend ways to avoid or minimize losses. If losses are likely to occur, then other mitigation measures may be recommended. Also, because these areas possess relatively low habitat values, they exhibit considerable potential for improvement of habitat values and enhancement measures should be considered.

Since detailed information is not available at this time on each alternative, specific impacts or methods for mitigating these impacts can not be determined. However, the Service believes that because of the uniqueness of Sikes Lake in an urban environment plus the magnitude of its use by and its importance as an educational resource to Midwestern State University, every effort should be made to develop an alternative that would include maintaining this lake. Should an alternative be selected involving drainage of the lake, mitigation would be required. This possibly could be accomplished by construction of a similar 20-acre lake on other university property, if available, or on land purchased for this purpose.

Even though habitat provided by the channel of McGrath Creek downstream of Sikes Lake is of rather low quality it provides the only such habitat in the immediate area and is of aesthetic importance to residents of the apartments and houses along it. For this reason the Service would recommend channel segments 5 and 7 which would be north of the existing creek rather than segments 2 and 3 which would result in the new channel being constructed through the present alignment of McGrath Creek. With the use of segments 5 and 7 the existing creek would be left in its present condition. Also, provisions should be made for maintaining flows through the existing creek channel with only high flow being routed through segments 5 and 7.

The Service would prefer grass channels over vertical sidewall concrete channels or underground channels for all channel segments including the south branch diversion. However, we realize that in certain areas sufficient room does not exist for grass channels. If the present channel of McGrath Creek is further channelized and the existing low water dams lost, for mitigation purposes a series of small low water dams should be placed in the channels to maintain pools longer during low or no flow periods. With channelization of other segments but no loss of existing low water dams we would recommend the installation of new low water dams in affected segments to enhance aquatic resources. Consideration also should be given to planting native bottomland trees and shrubs beneficial to wildlife along channel alignments and around Sikes Lake to enhance wildlife and improve the aesthetics of the monotypic channels.

Construction of the Lawrence Road floodwater detention site would provide an opportunity to maintain some fish and wildlife habitat in the basin. It is estimated that the natural area now existing at the site will be lost to development within 10 years. If a floodwater detention site is constructed, it would be possible to design and maintain the site in such a manner as to benefit fish and wildlife. The Service would recommend that as much natural vegetation as possible be left undisturbed. Where the area is disturbed by construction, it should be replanted with trees, shrubs, and grasses beneficial to wildlife. The site also should be designed with a permanent pool of about 2 or 3 acres with sufficient depth to maintain an urban type fishery.

This project, without disturbance of Sikes Lake, would have only minor adverse effect on fish and wildlife resources of the McGrath Creek basin. The impacts would be mostly aesthetic in nature. However, if appropriate consideration is given during design and operation of the project these impacts could be reduced. Also, there would be an opportunity to enhance fish and wildlife resources.

The Service wishes to participate fully throughout the planning process of this project to assist the Corps of Engineers in fulfilling its responsibilities as governed by public laws, executive orders, and other planning regulations. The consideration of fish and wildlife resources in the design and selection of alternatives will help avoid adverse impacts and reduce mitigation requirements.

The cooperation of your staff in providing the Service with information relative to this study is greatly appreciated.

Sincerely yours,

cc:
Regional Director, FWS, Albuquerque, NM (AHR)
Director, ODWC, Oklahoma City, OK

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U.S. Fish and Wildlife Service. 1981. U.S. Fish and Wildlife Service mitigation policy. Fed. Reg. 46(15). Jan. 23, 1981.

Water Resources Council. 1982. Principles and standards for planning water and related land resources. Fed. Reg. 44(242). Dec. 14, 1979.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Ecological Services
222 S. Houston, Suite A
Tulsa, Oklahoma 74127

February 23, 1984

2-14-84-I-32

District Engineer
Attn: Environmental Resources
U.S. Army Corps of Engineers
P.O. Box 61
Tulsa, Oklahoma 74121

Dear Sir:

This is in reply to your letter of February 13, 1984, which requested information about species that are listed or proposed to be listed as threatened or endangered. Your area of interest is McGrath Creek, Wichita County, Texas, a local flood protection project for Wichita Falls, Texas.

As provided by the Endangered Species Act, the Fish and Wildlife Service furnishes, upon request, a list of those species, both proposed and listed, which may be impacted by Federal actions.

Our data indicate no listed or proposed species would be affected by the proposed action in your area of interest. Although the project area occurs within the migration corridor of the endangered whooping crane, Grus americana, the urban location of the project essentially would preclude its use by the crane during migration. If we may be of further assistance, do not hesitate to contact this office.

Sincerely yours,

Sidney H. Wilkirson

Sidney H. Wilkirson
Field Supervisor

cc:
Regional Director, FWS, Albuquerque, New Mexico (AHR)(SE)

February 13, 1984

Planning
Environmental Resources

Mr. Sidney H. Wilkirson
Field Supervisor
U. S. Fish and Wildlife Service
222 South Houston, Suite A
Tulsa, OK 74127

Dear Mr. Wilkirson:

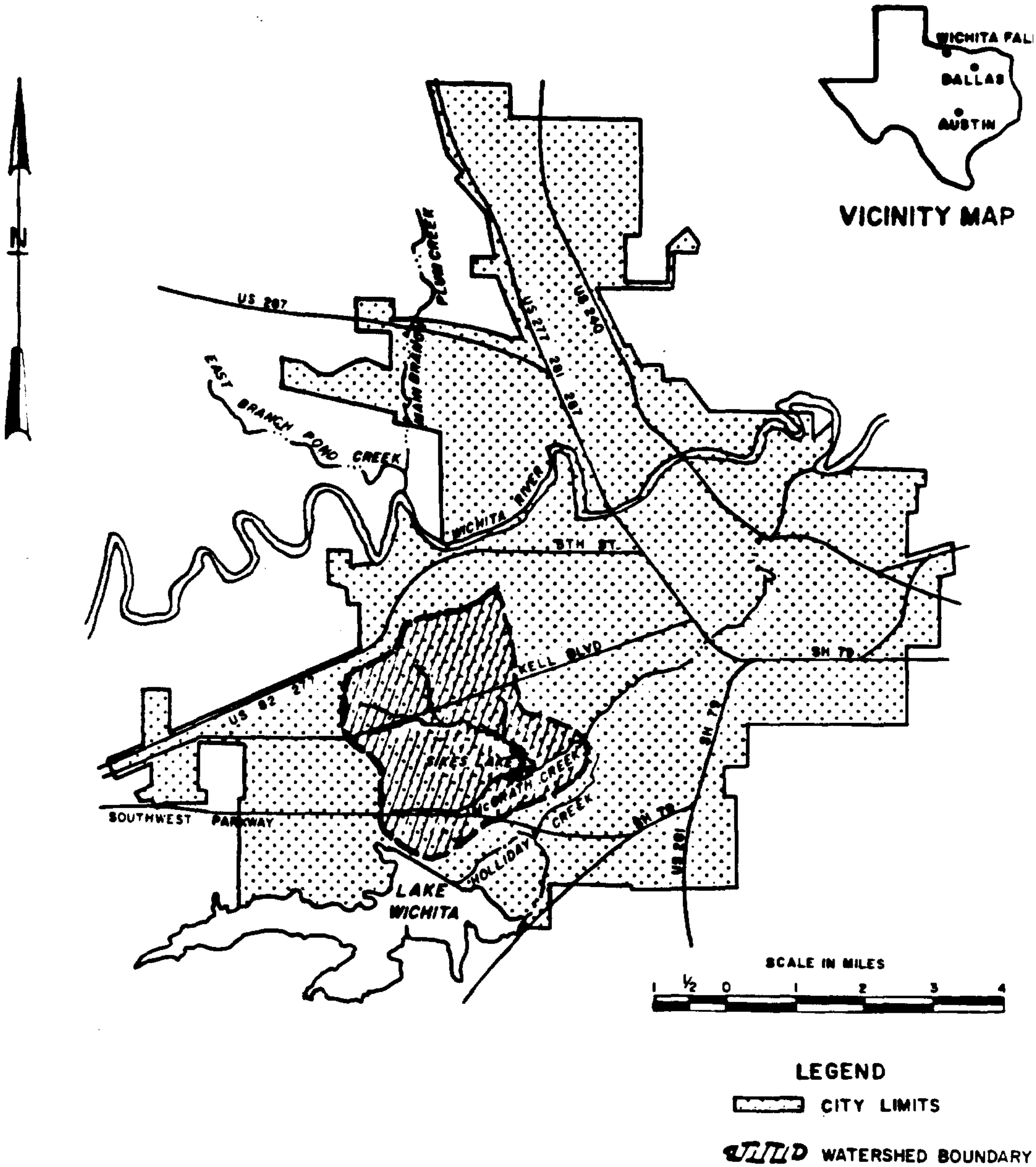
In accordance with Section 7(c) of the 1978 amendments to the Endangered Species Act of 1973, the Tulsa District is requesting a list of endangered species for McGrath Creek, Wichita County, Texas. Enclosed is a map which includes the project area. This is a local flood protection project for Wichita Falls, Texas.

Sincerely,

Robert D. Brown, P.E.
Chief, Planning Division

Enclosure

CF:
Red Riv Plng Br
ER Br (Y)



WICHITA FALLS, TEXAS
McGRATH CREEK BASIN

TECHNICAL SUPPLEMENT

SECTION 1

Hydrology and Hydraulics

SECTION 1
HYDROLOGY AND HYDRAULICS

CONTENTS

CONTENTS
(Continued)

TABLES

FIGURES

PLATES
(Water Surface Profiles)

SECTION 1

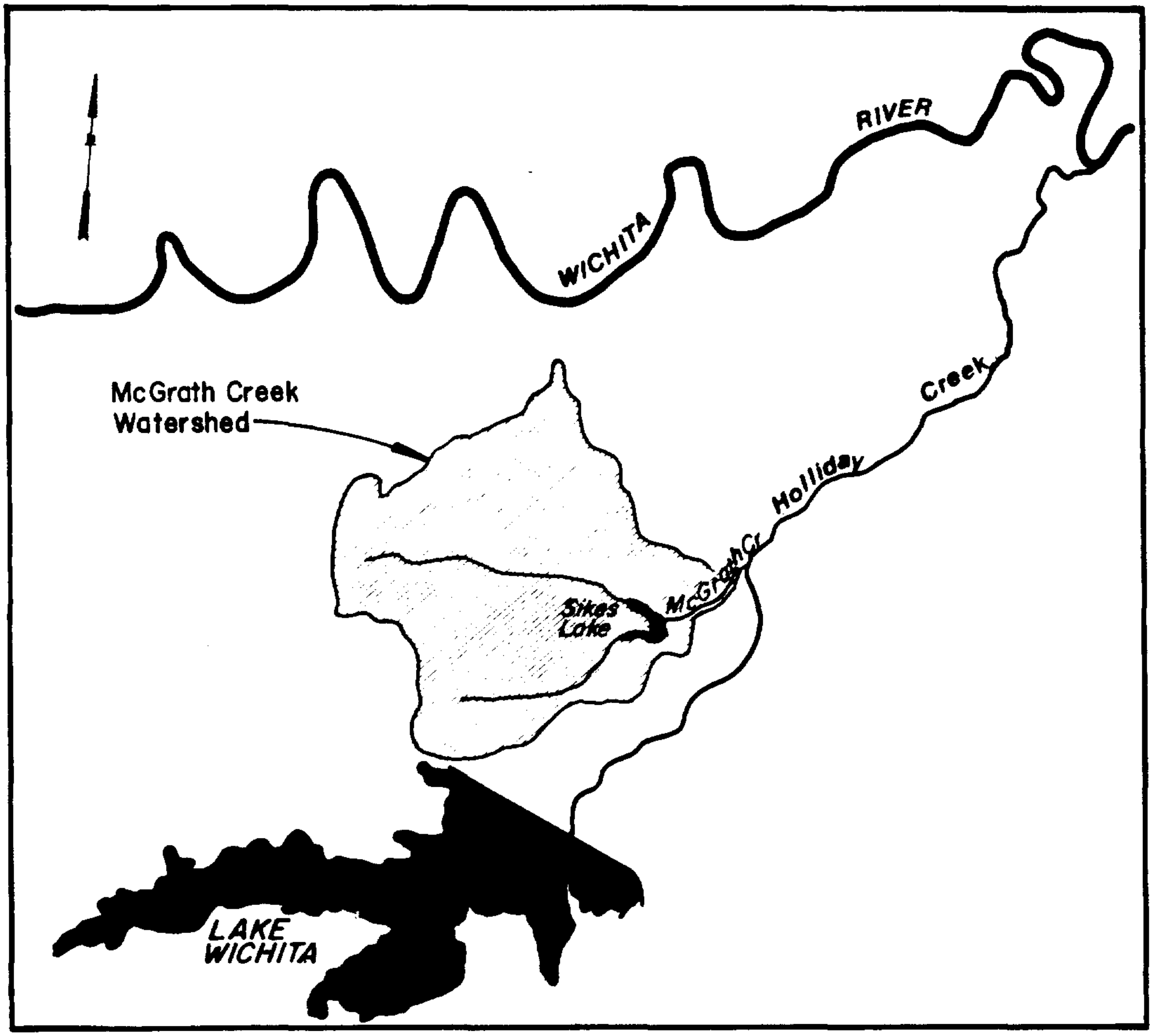
MCGRATH CREEK HYDROLOGY

BASIN DESCRIPTION

The McGrath Creek Basin lies north of Lake Wichita and flows in an easterly direction into Holliday Creek about 3.75 miles downstream of Lake Wichita. The entire basin is in an area of dense development in the southwest portion of Wichita Falls, Texas. The basin has 5.55 square miles of drainage area at the mouth with about 5.1 square miles of the basin lying above the small uncontrolled Sikes Lake. The basin has an average slope of about 30 feet to the mile and, for hydrologic conditions, is considered to be about 25 percent builtover. Sikes Lake has about 18 surface acres at the spillway crest, limited flood storage capacity, and has minor effect during floods. Figure TS 1-1 shows the general location of the study area.

HISTORICAL FLOODS

There are no stream gage records in the McGrath Creek Basin; therefore, historical flooding information is limited. The flood of May 1982 is the maximum historical flood and because of the severity of this flood, several high water marks along McGrath Creek were established by field interviews with area residents and from evidence remaining after the floodwaters receded. Figure TS 1-2A shows the model reproduction of Sikes Lake operation during this flood. The maximum pool elevation reached is 966.1 which is close to the nearest high water mark (HWM), elevation 967.5. This HWM is also displayed on Plate TS 1-1, falling between the 50- and 100-year profiles. The peak inflow from this part of the drainage area was estimated to be 2012 cubic feet per second (cfs) in the May 1982 flood, which also falls between the 50- and 100-year peak flows of 1630 and 2175 cfs estimated for the same location. These comparisons confirm the accuracy of both the hydrologic model and the hydraulic model that produced the water surface profiles.



McGRATH CREEK WATERSHED AREA

Figure TS 1-1

ASSESSMENT OF AVAILABLE DATA

Topographic Maps

USGS 7.5 minute topographic maps, having a scale of 1:24,000 and a contour interval of 5 feet; and topographic maps dated 1 December 83 having a scale of 1:4,800 and a contour interval of 2 feet were used for this study.

Cross Section

Surveyed cross sections and detailed bridge descriptions taken in 1982 were used in water surface profile studies. Cross sections taken from the topographic maps were also used.

Precipitation Stations

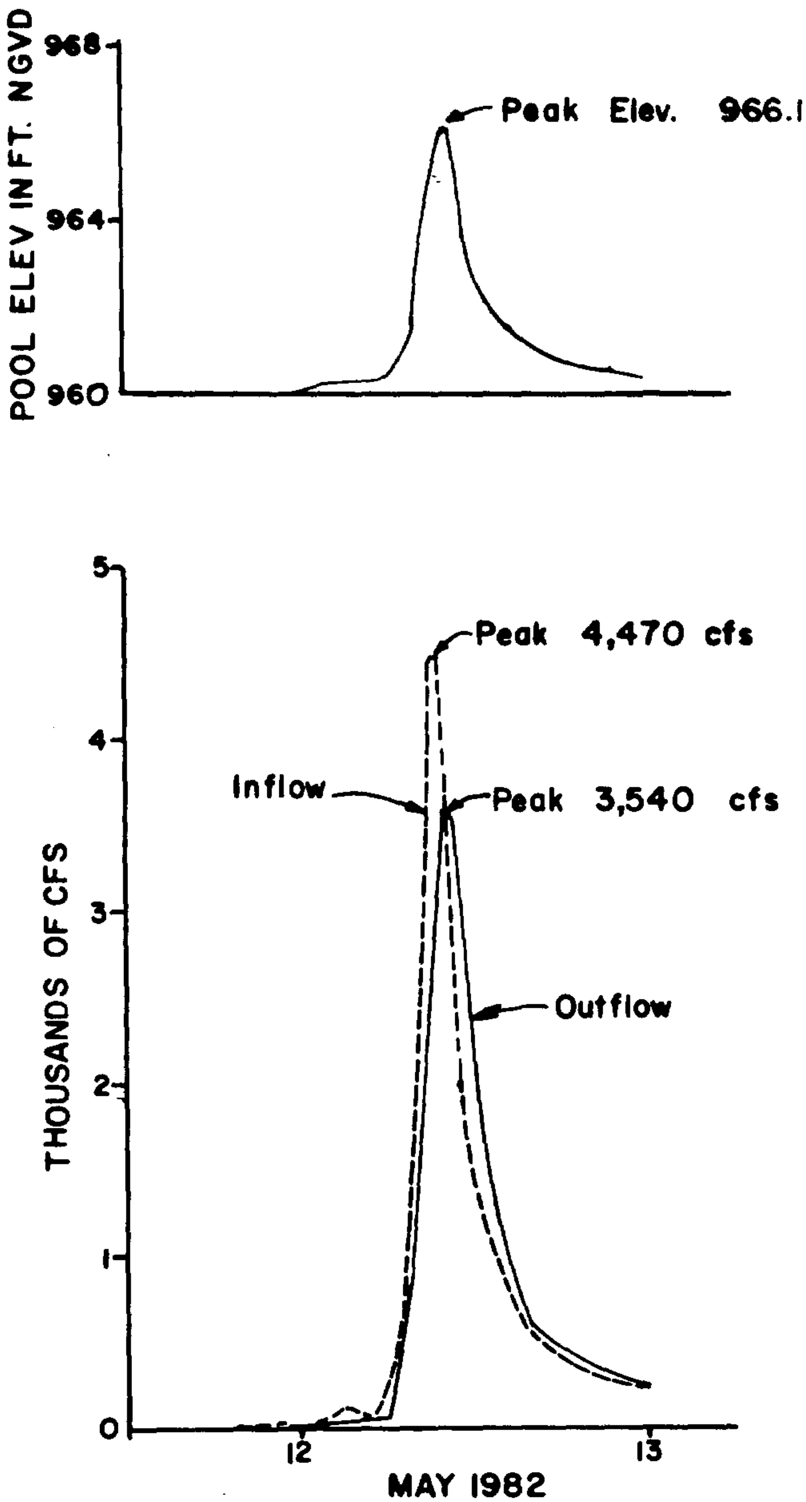
One official hourly recording rainfall gage was in operation in the Wichita Falls area during the May 1982 flood of record. Numerous unofficial rainfall amounts were obtained in the city area and were used to develop an isohyetal pattern for the storm. Locations of the rainfall gages and the totals of the May 1982 flood along with isohyetal pattern for the McGrath Creek and adjacent basins are also shown in figure TS 1-2B. The isohyets for the May 1982 storm over the McGrath Creek Basin are shown in figure TS 1-3.

Highwater Marks

High water mark locations for the May 1982 flood were established by field interviews with area residents and from evidence remaining after the floodwaters receded. Because of the severity of this flood and the detailed information available it was used to calibrate the HEC models.

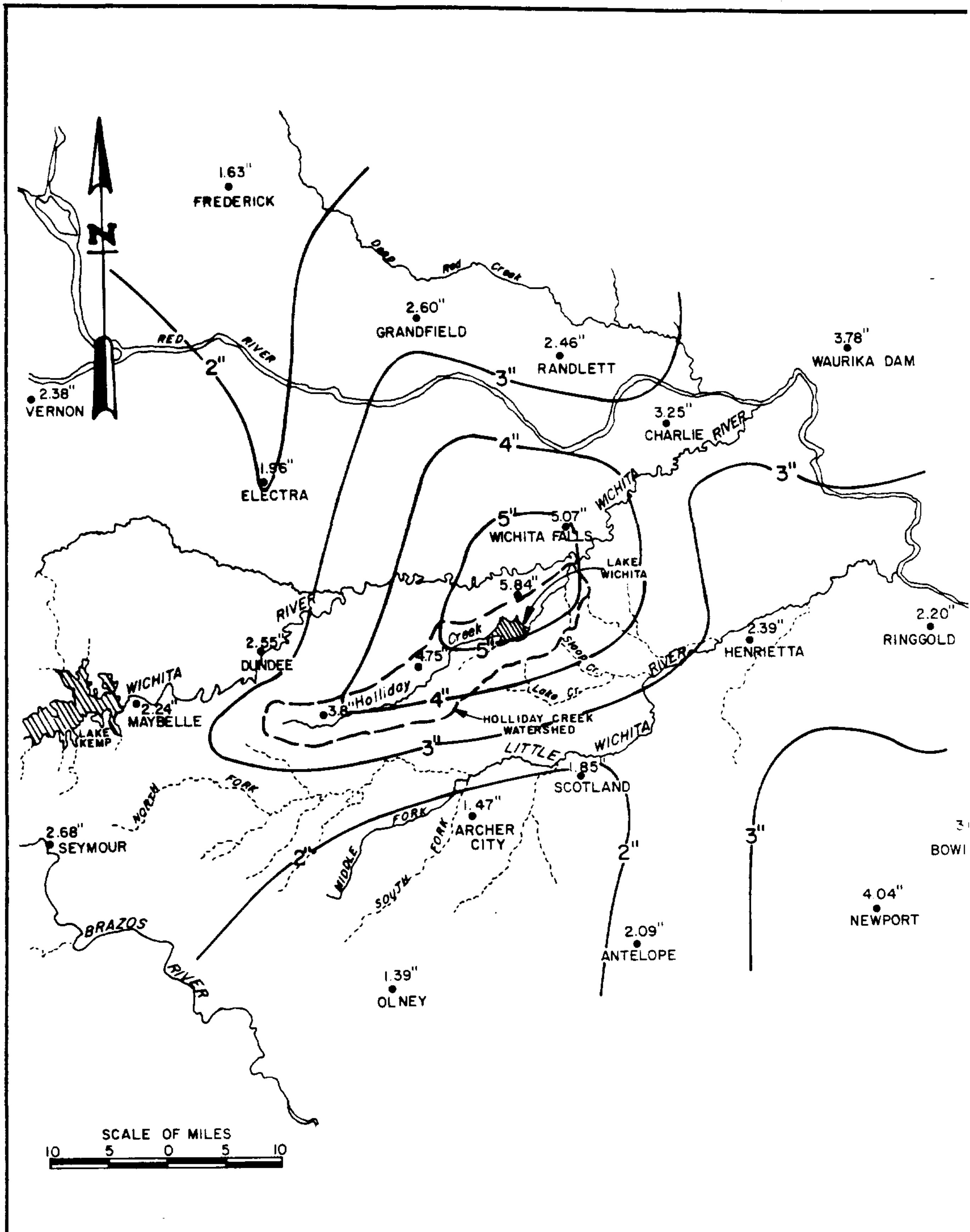
Sedimentation

No recorded data on sedimentation or degradation in the McGrath Creek watershed of Sikes Lake are available. The flood controlling volume of Sikes Lake is quite small and inconsequential in the determination of flood discharges. Further reduction by sedimentation would cause no important change in peak flows since outflows are nearly equal to inflows.



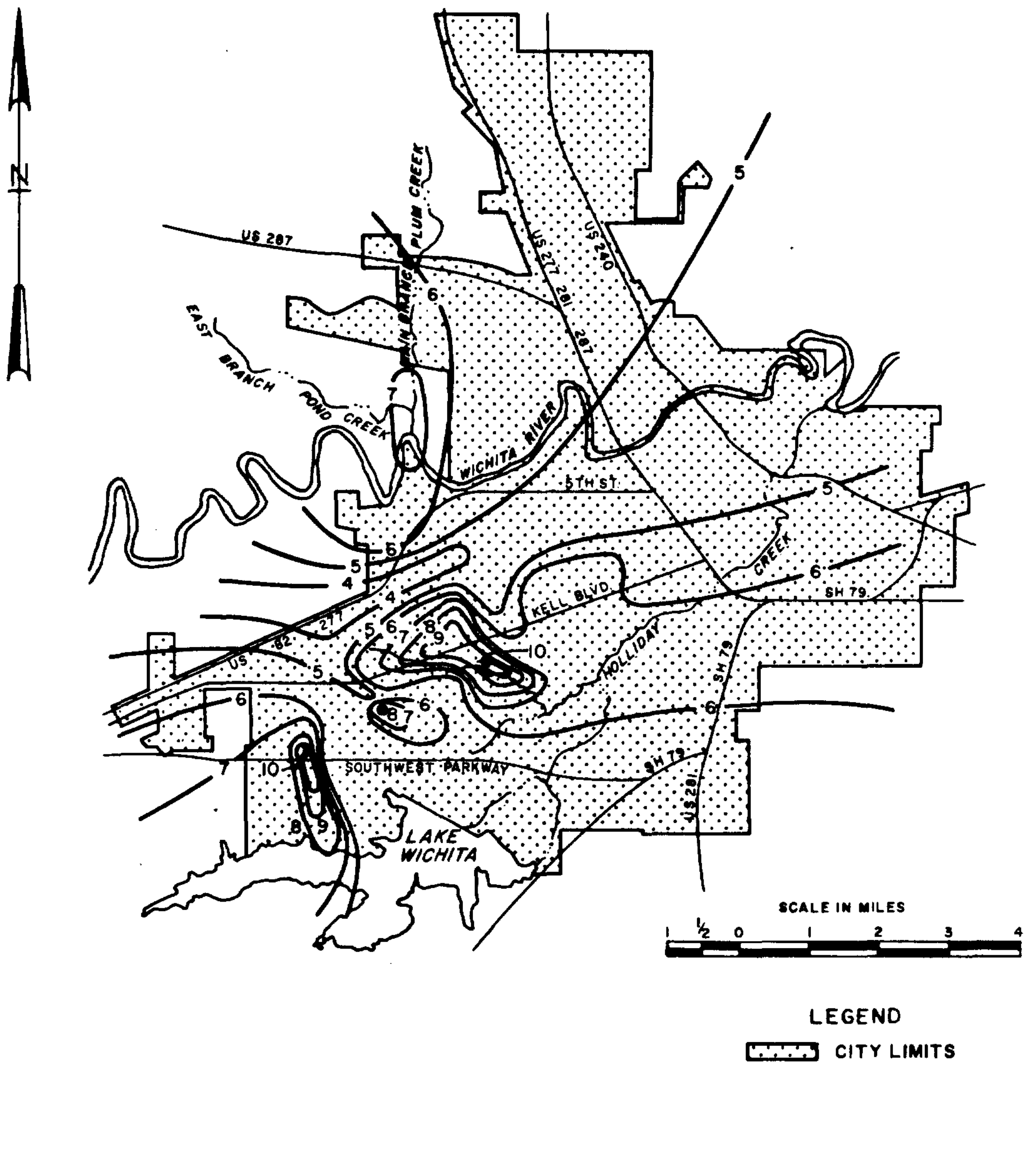
HEC-1 MODEL
MAY 12 FLOOD HYDROGRAPHS AT SIKES LAKE

FIGURE TS1-2A



REGIONAL ISOHYETAL
STORM OF MAY 12-13, 1982

Figure TS 1-2B



LOCAL ISOHYETAL
UNOFFICIAL RAINFALL AMOUNTS
MAY 12-13, 1982 STORM

Figure TS 1-3

RAINFALL - RUNOFF PROCEDURES

Model Development (HEC-1) - Model Subdivisions

The McGrath Creek Basin was divided into 19 subareas. These subareas range in size from .03 to .68 square miles. The HEC-1 model they form is described in the following paragraphs. Figure TS 1-4 shows the HEC-1 subarea divisions on McGrath Creek.

Unit Hydrographs

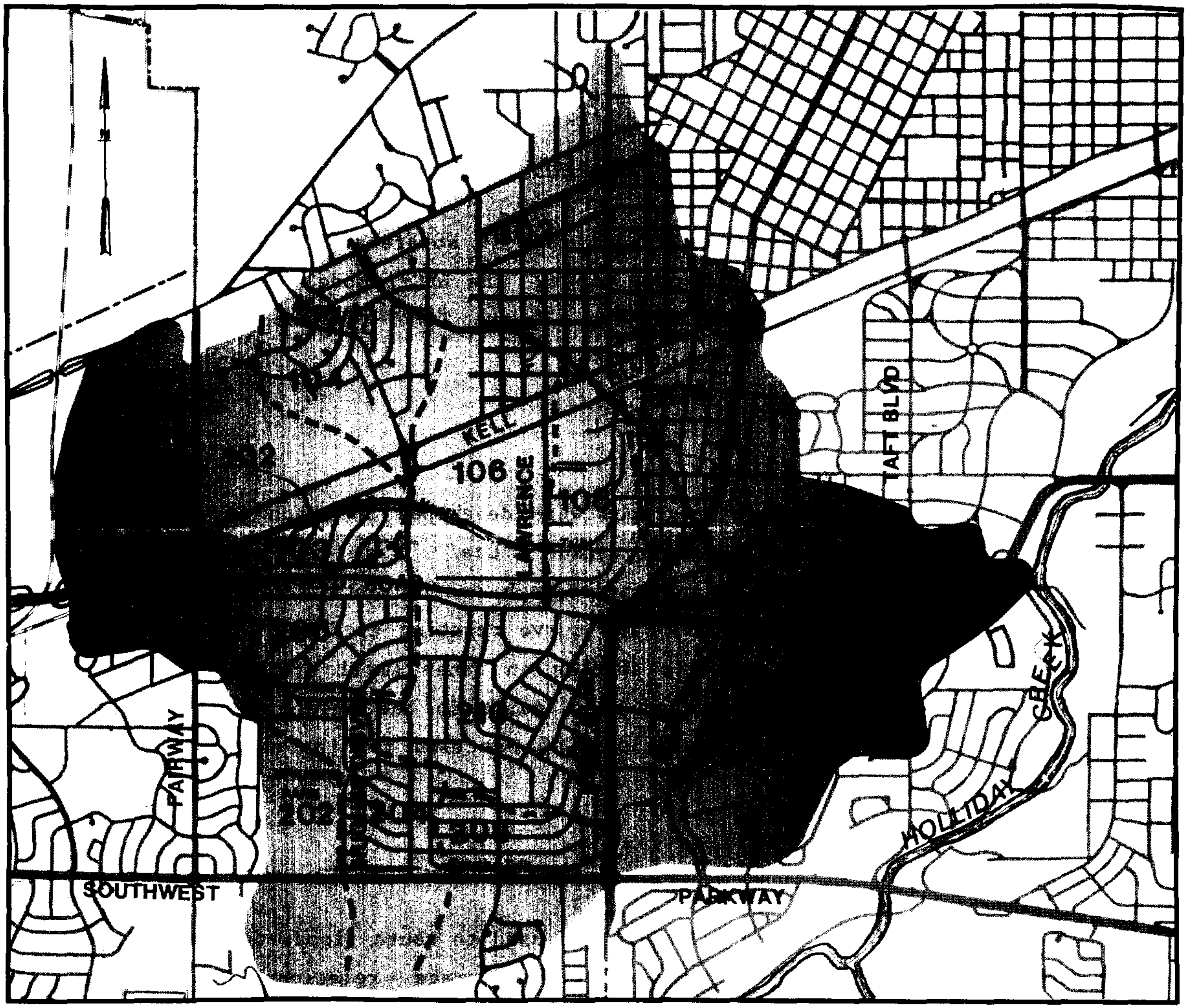
Snyder's synthetic unit hydrographs were developed for each of the 19 subareas using a curve relating tp versus $L'Lca/\sqrt{s}$ (figure TS 1-5). Shown on table TS 1-1 are the unit hydrograph coefficients and parameters developed for existing conditions. The curve relating tp $L'Lca/\sqrt{s}$ was developed from regression analysis studies on other small streams in the general area. This curve was used as a guide in the selection of unit hydrograph coefficients. A Cp value of 0.45 was used for the entire basin under existing conditions.

Routing Criteria

The Modified Puls routing procedure was used to route floods through the McGrath Creek Basin. The outflow-versus-storage relationships were determined by using cross sections to compute storages for given discharges.

Loss Rates

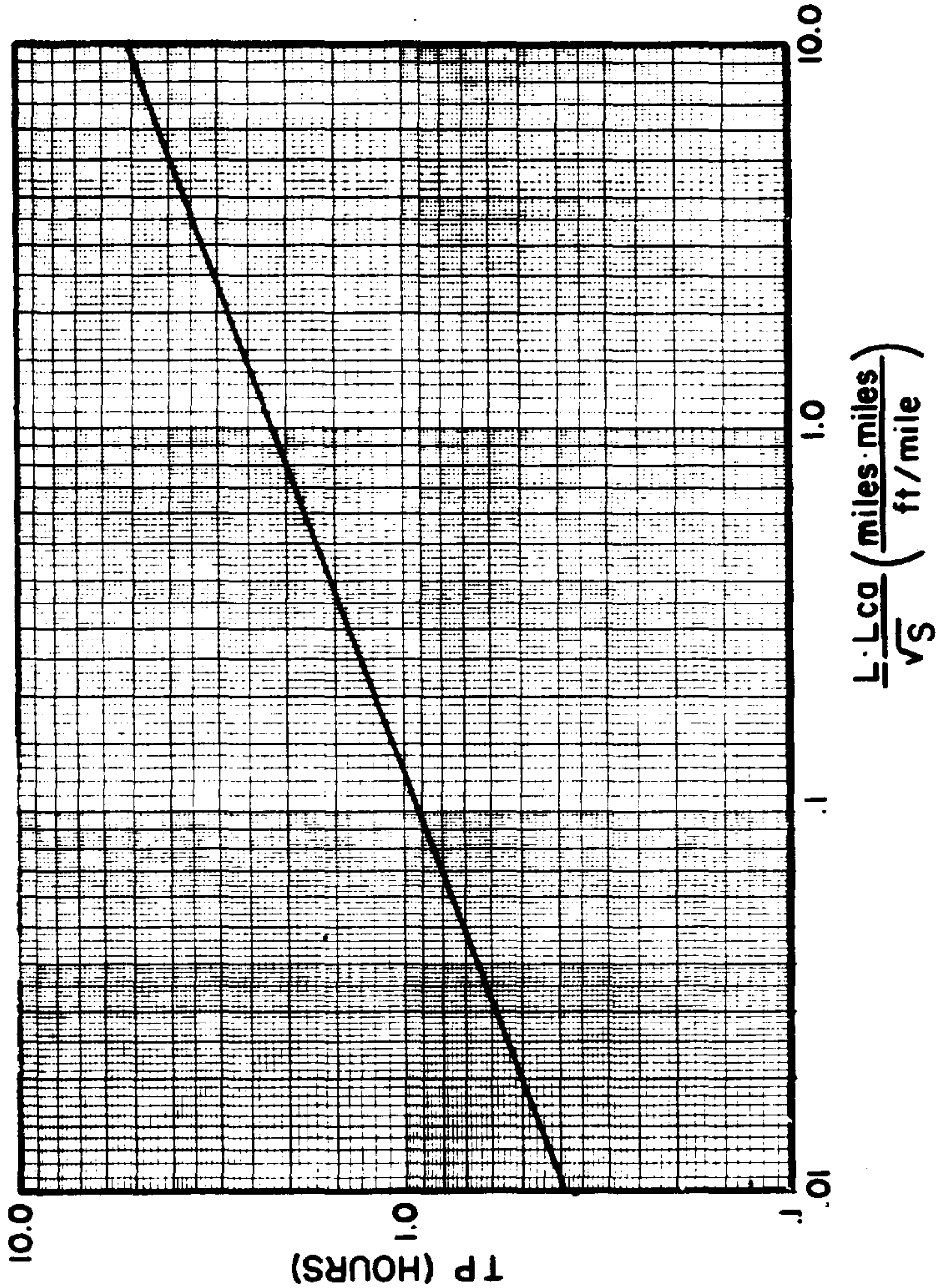
Loss rates selected were based on a review of studies of comparable areas in the general vicinity as developed in the Lake Wichita study. An infiltration loss rate of 0.05 inches per hour was selected for all subareas for current conditions. Initial losses used in the hypothetical storm models were 1.20 inch.



HEC-1 SUBAREA DIVISIONS

McGRATH CREEK WATERSHED

Figure TS I-4



UNIT HYDROGRAPH COEFFICIENTS

SNYDER'S tp vs L·Lca/$\sqrt{s}$

McGRATH CREEK

WICHITA FALLS, TEXAS

Figure TS I-5

TABLE TS 1-1
UNIT HYDROGRAPH DATA

Subarea	Drainage Area (miles)	L (mi)	Lca (mi)	Sst (ft mi)	$L \cdot Lca^{0.5}$	tp	Impervious Drainage Factor
102	0.64	0.90	0.46	54.65	0.056	0.73	0.15
103	0.17	0.48	0.40	153.44	0.0155	0.45	0.20
104	0.31	0.98	0.56	32.68	0.096	0.89	0.15
106	0.45	0.49	0.28	2.043	0.096	0.89	0.20
108	0.20	0.53	0.22	29.41	0.0215	0.51	0.25
110	0.12	0.303	0.20	2.834	0.036	0.62	0.30
112	0.07	0.36	0.18	6.3718	0.025	0.54	0.25
114	0.16	0.45	0.25	3.292	0.062	0.76	0.25
116	0.03	(SIKES LAKE)					
118	0.09	0.35	0.14	58.828	0.0065	0.33	0.50
120	0.36	0.848	0.32	7.364	0.10	0.90	0.40
202	0.15	0.39	0.19	33.513	0.0128	0.42	0.10
204	0.30	0.40	0.20	30.440	0.0145	0.44	0.20
206	0.31	0.98	0.34	22.416	0.072	0.80	0.30
208	0.22	0.64	0.36	10.24	0.072	0.80	0.25
210	0.56	0.98	0.46	13.006	0.125	0.98	0.30
212	0.48	0.91	0.45	4.645	0.19	1.14	0.25
302	0.68	1.33	0.44	40.461	0.092	0.88	0.35
304	0.27	0.87	0.56	28.044	0.092	0.88	0.30

12-14 May 1982 Flood

The 12-14 May 1982 flood was used to calibrate the HEC-1 rainfall-runoff model. One recording rainfall gage was in operation during the storm. This rainfall gage, in conjunction with several total storm amounts, was used to draw an isohyetal pattern for the total storm rainfall. The recording rainfall station was used to distribute the total storm rainfall for each subarea. The total rainfall for each subarea is shown in table TS 1-2.

TABLE TS 1-2
TOTAL RAINFALL - MAY 1982 STORM

Subarea	Total Rainfall (inches)
102	5.2
103	6.9
104	5.7
106	6.0
108	5.8
110	6.9
112	8.5
114	7.8
116	7.9
118	7.5
120	6.9
202	5.3
204	7.0
206	6.5
208	7.6
210	6.5
212	8.8
302	5.3
304	5.8

Built-over Conditions

The McGrath Creek Basin is highly developed at the present but has future development potential in the upper reaches of the watershed (above Sikes Lake). A modified HEC-1 model was developed to reflect ultimate development conditions. Based on future growth projections discussed in Appendix A (Social and Economic Analysis), the impervious area was increased an average of about 20 percent. Distribution of the increases by subarea was done in cooperation with an economist familiar with the growth projections for the study area. Field surveys of the watershed by the economist and hydrologists were conducted to identify potential development sites. City officials were consulted to verify anticipated locations, type, and timing of new development. The Cp 640 values were also increased by about 20 percent to account for expected straightening and channelization of small streams due to increased waterway development. Based on the projected growth rates and discussions with city officials, ultimate builtover conditions were expected to occur by 2010.

FLOOD PROBABILITY

Hypothetical Storm Rainfall and Runoff

To develop flows for various frequencies at selected points in the study area, the HEC-1 model was used with rainfall from US Weather Bureau Technical Paper No. 40. Rainfall amounts for the 2-, 5-, 10-, 25-, 50-, and 100-year storms were arranged in a critical pattern. Regional adjustments based on USGS publication WRI 77-110 were made to the rainfall to reproduce the basic frequency curve. Peak discharge frequency studies performed on records for Beaver Creek near Electra, Texas, were used to adjust this basic curve for partial duration. Expected probability was applied to the basic frequency discharge curve as shown in CW-151 "Statistical Methods in Hydrology" by Leo R. Beard, dated January 1962. Adjustments in the frequency rainfall were made in the HEC-1 model to reproduce the discharge frequency curve. Frequency rainfall is shown on table TS 1-3. The 100-year, 24-hour rainfall distribution factors are shown on table TS 1-4. Peak discharges under existing and future builtover conditions at key locations for each rainfall event are shown on table TS 1-5. Figure TS 1-6 shows the discharge frequency curves at Sikes Lake for original and adjusted conditions along with the USGS regional data.

TABLE TS 1-3
FREQUENCY RAINFALL (24 HOUR) WITH REGIONAL
AND PARTIAL DURATION FACTORS
RAINFALL IN INCHES

Frequency Years	T.P. 40(1) Rainfall (inches)	Regional ADJ Factor	Partial Duration Factor	Adjusted Rainfall	Design Rainfall(2)
200	-	-	-	-	12.81
100	8.53	1.00	-	8.53	9.65
50	7.55	.90	-	6.80	7.29
25	6.67	.80	-	5.33	5.59
10	5.59	.69	1.01	3.90	4.06
5	4.51	.64	1.02	2.94	3.21
2	3.58	.58	1.15	2.39	2.44

(1) Adjusted for Depth Area
(2) Expected Probability Rainfall Included

TABLE TS 1-4
RAINFALL DISTRIBUTION FACTORS
100-Year T.P. 40, 24-Hour Point Rainfall

Time (15-Minute Ordinates)	Rainfall (1)
1-13	0.02
14-25	0.03
26-28	0.04
29-31	0.05
32-36	0.06
37-38	0.07
39-40	0.08
41-42	0.10
43	0.11
44	0.13
45	0.15
46	0.30
47	0.45
48	0.80
49	1.85
50	0.65
51	0.38
52	0.22
53	0.14
54	0.12
55-56	0.10
57-59	0.08
60-61	0.07
62-65	0.06
66-68	0.05
69-71	0.04
72-83	0.03
84-96	0.02
	8.70

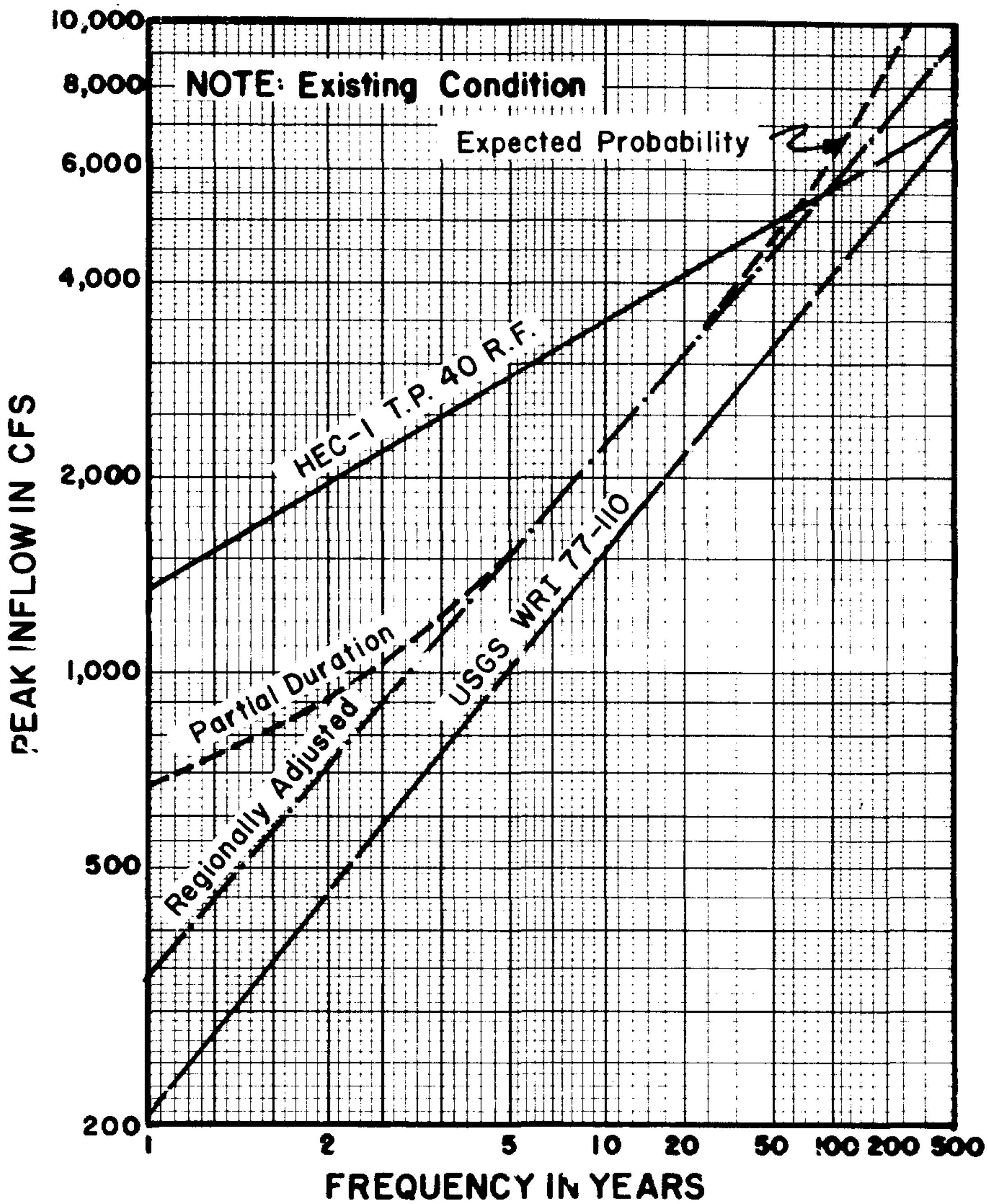
1 Critical Arrangement

TABLE TS 1-5

MCGRATH CREEK PEAK DISCHARGES
(cfs)

Frequency Event	Kemp Blvd (Above Sikes Lake)		Midwestern Blvd (Above Sikes Lake)		Sikes Lake (inflow)		Taft Street Below Sikes Lake		Confluence with Holliday	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
2 Year	330	380	510	620	910	1,080	850	990	860	1,000
5 Year	570	660	870	1,030	1,550	1,810	1,420	1,600	1,430	1,610
10 Year	820	930	1,270	1,460	2,250	2,590	1,960	2,170	1,970	2,170
25 Year	1,220	1,390	1,950	2,200	3,460	3,910	2,880	3,140	2,890	3,180
50 Year	1,630	1,840	2,650	2,970	4,700	5,250	3,780	4,100	3,790	4,110
100 Year	2,175	2,450	3,580	4,000	6,340	7,060	5,000	5,460	5,010	5,470
200 Year	2,900	3,260	4,800	5,370	8,500	9,480	6,890	7,490	6,880	7,550
SPF	4,100	4,550	6,770	7,520	12,230	13,640	10,220	11,150	10,390	11,270
PMF	8,280	9,190	13,650	15,280	24,790	27,600	20,890	22,880	21,430	23,200

(1) existing conditions
(2) future built-over conditions



McGRATH CREEK
WICHITA FALLS, TEXAS

PEAK INFLOW FREQUENCY CURVES
AT SIKES LAKE

Figure TS 1-6

Design Discharges

In the HEC-1 model, the ultimate builtover conditions for the McGrath Creek Basin were found by making adjustments for peaking and runoff effects resulting from continued urbanization. Table TS 1-6 shows the frequency discharges resulting from ultimate builtover conditions, modification of Sikes Lake spillway, and improvement of the channel above and below Sikes Lake.

TABLE TS 1-6
MCGRATH CREEK BASIN
DESIGN DISCHARGE
MODIFIED CONDITIONS
(cfs)

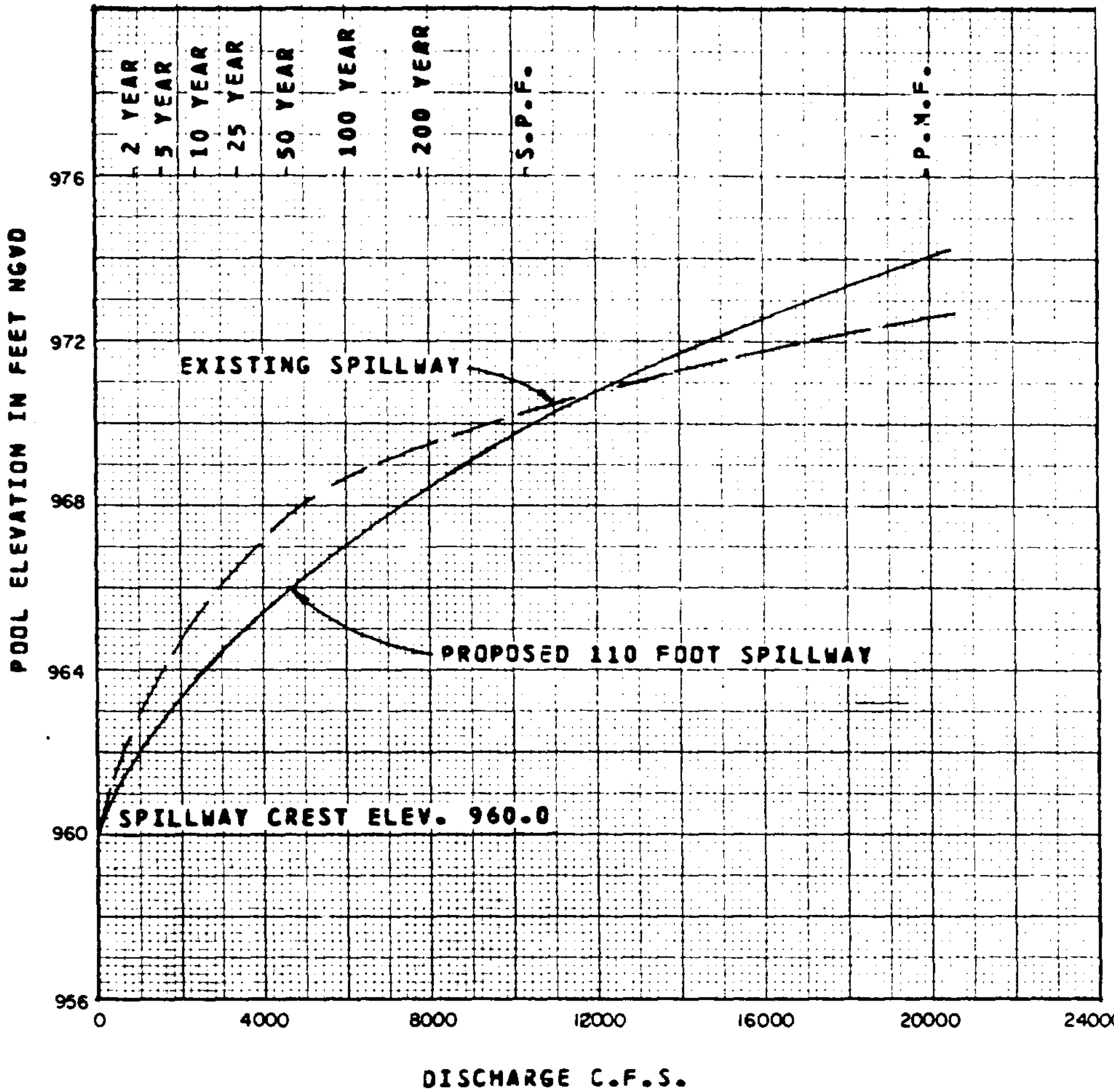
Frequency Years	Sikes Lake Inflow	Sikes Lake Outflow	Taft Street (below Sikes)	Confluence With Holliday Creek
2	1,080	970	990	1,000
5	1,810	1,620	1,640	1,670
10	2,590	2,320	2,340	2,380
25	3,910	3,470	3,510	3,570
50	5,250	4,560	4,610	4,690
100	7,060	5,980	6,050	6,160
200	9,480	7,790	7,870	8,000
SPF	13,640	10,310	10,430	10,580
PMF	27,600	19,230	19,410	19,730

Standard Project Storm

One probable maximum storm rainfall transposition was made in accordance with the procedures set forth in HMR-52. The flows produced from one half of the probable maximum rainfall applied to the adopted HEC-1 model were used as the standard project flood discharges. The preferred orientation of the storm, taken from figure 8 of HMR-52, was used to produce the standard project flood. Due to the small drainage area of McGrath Creek only one storm transposition was necessary. Tables TS 1-5 and TS 1-6 show the maximum discharges of the SPF storm at various locations in the study basin. Table TS 1-7 shows the maximum 6-hour SPF rainfall for the McGrath Creek storm centering and table TS 1-8 shows the distribution.

TABLE TS 1-7
SPF RAINFALL
MAXIMUM 6 HOUR

Subarea	SPF Rainfall (Inches)
102	11.44
103	14.16
104	13.00
106	14.32
108	14.32
110	14.32
112	14.32
114	14.32
116	14.32
118	13.70
120	13.85
202	14.32
204	14.32
206	14.16
208	14.32
210	14.32
212	14.32
302	14.02
304	14.32



McGRATH CREEK

SIKES LAKE

DISCHARGE RATING

Figure TS I-7

DRAWN BY: RLB

DATE: NOV.

TABLE TS 1-8
TYPICAL SPF DISTRIBUTION

Time (15-minute ordinates)	Rainfall
1	0.15
2	0.15
3	0.28
4	0.28
5	0.29
6	0.29
7	0.29
8	0.43
9	0.57
10	0.72
11	1.15
12	1.58
13	3.15
14	1.29
15	0.86
16	0.57
17	0.43
18	0.43
19	0.29
20	0.28
21	0.28
22	0.28
23	0.14
24	.14
Total	14.32

EXISTING WATER SURFACE PROFILES

Water surface profiles for the existing conditions were computed using the computer program, HEC-2. Cross-sections were taken from 2-foot topographic maps, dated December 1983, with additional bridge survey information provided by the city of Wichita Falls. Highwater marks from the flood of May 1982 were used to calibrate the model. Manning roughness coefficient ("n" value) varied between 0.04 to 0.06 in the channel and 0.10 to 0.15 in the overbanks. Starting water surface elevations were based on slope-area adjusted to the 1982 highwater marks (Q=3,600 cfs). Highwater marks and water surface profiles are shown on plates TS 1-1 and TS 1-2 for McGrath Creek and the North Branch above Sikes Lake for existing conditions. Plates TS 1-3 and TS 1-4 show water surface profiles based on existing channels and spillway with ultimate builtover conditions in the watershed.

MODIFIED CONDITIONS

The selected plan (Plan 1A) would have a vertical wall, concrete channel with a 35-foot bottom width. The channel would have a drop structure downstream of Weeks Park Drive to transition into the proposed Holliday Creek channel. The channel would have a slope of 0.00258 feet/feet from the drop structure at crest elevation 936.75 to the spillway apron at elevation 946.10. The design channel velocity would be about 17 feet per second. The 110-foot-wide spillway would have a crest elevation of 960.0. The spillway drop would have a parabolic trajectory from the crest to the channel invert at 946.1. Downstream, the channel width would transition from 110 feet to 35 feet in a distance of 187.5 feet. Spillway rating curves for the existing and proposed spillway are shown on figure TS 1-7. Water surface profiles for the modified conditions are shown on plates TS 1-5 and TS 1-6.

Degree of Protection

The channel is designed for the 100-year flood. The spillway is sized so that the standard project flood is less than the existing standard project flood. The spillway is also sized to prevent overtopping the Sikes Lake dam (approximate elevation 968) by the design flood (100-year).

Freeboard

Channel freeboard varies from zero to two feet. The spillway provides zero freeboard at the 100-year flood frequency.

Channel Stability

The channel would be fully concrete-lined to withstand the maximum channel velocity of 17 feet per second.

Sedimentation

The highly urbanized drainage basin is not expected to contribute a large sediment inflow. Sikes Lake should trap a major portion of the transported sediment, while the high velocities of the channel are expected to pass the remaining sediment through McGrath Creek without disposition in the channel.

DETAILED PLANS

Plan 1

Plan 1 consists of a 35-foot-wide, vertical wall, concrete channel extending from Holliday Creek to the existing spillway location of Sikes Lake. The existing Sikes Lake spillway would be replaced with a 110-foot, vertical wall spillway. Below the spillway, the channel would have a sharp bend to the north and follow the existing McGrath Creek alignment to Holliday Creek.

Plan 1A (Selected Plan)

Plan 1A is identical to Plan 1 except the spillway would be located approximately 700 feet north of the existing spillway. This location shortens the improved channel length and provides a straighter channel below the spillway to McGrath Creek.

Plan 1B

Plan 1B would have the same channel alignment as Plan 1A. The segment of the channel between Midwestern and Taft would be an underground double box culvert, 17.5 feet wide by 13 feet high. Flow through the box would be open channel. The drop structure at Holliday Creek would have a crest elevation of 934.5. An invert change of 1.5 feet at the entrance to the box would be required to provide 1 foot of freeboard between the design water surface and the roof of the box.

Plan 1C

Plan 1C would be the same as Plan 1A except the spillway width would be increased to 140 feet in order to lower the 100-year pool elevation of Sikes Lake to elevation 966.0.

Plan 2A

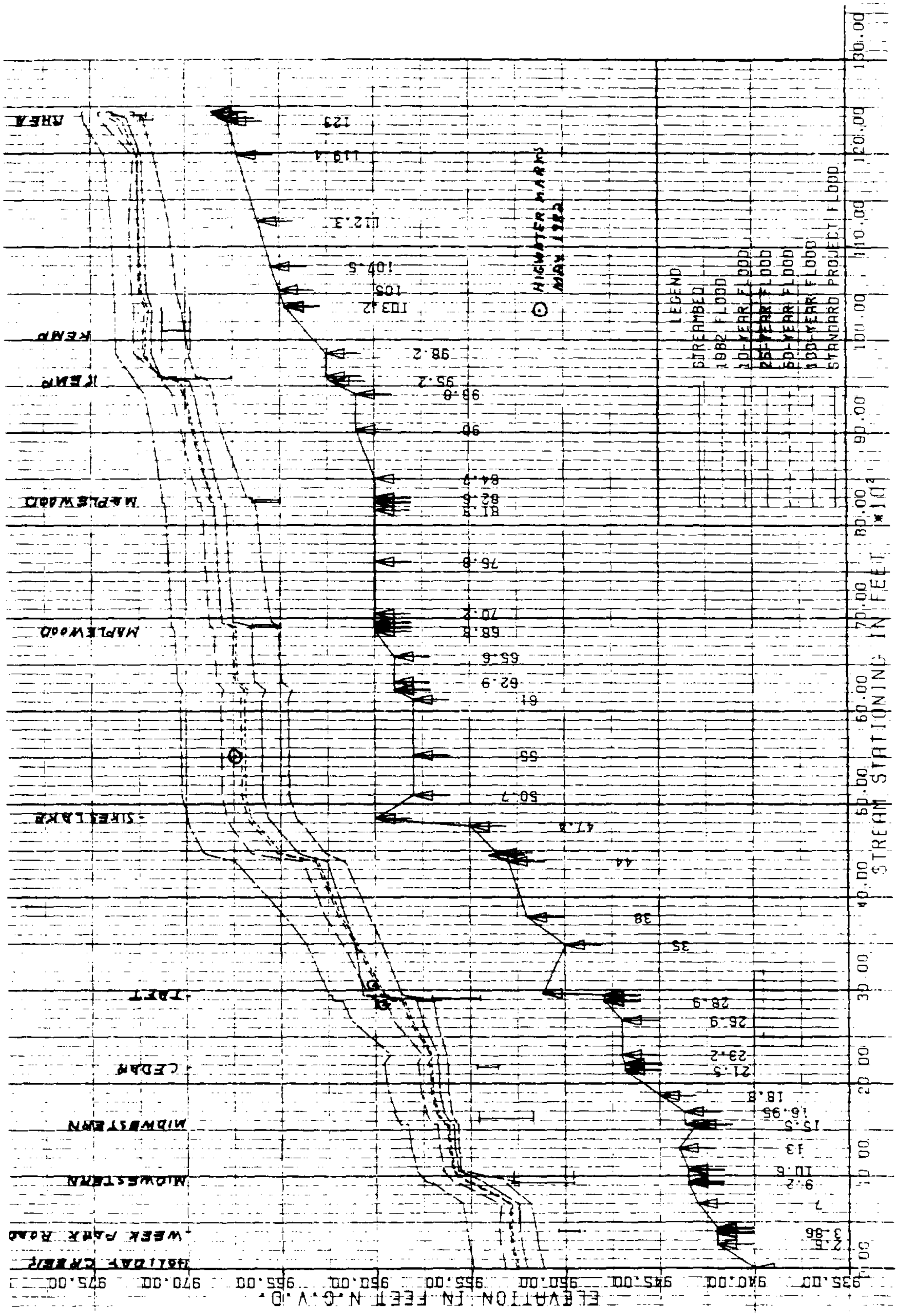
Plan 2 would be an overland diversion alignment which would divert the design flow away from the existing channel alignment. The spillway would be in the same location and of the same size as Plan 1A. The channel would have a 35-foot bottom width with vertical walls except for a segment from Taft to Midwestern. This segment would consist of a double box culvert, 17.5 feet wide by 14.0 feet high. Flows in excess of the design capacity of the box culvert would flow down the existing McGrath Creek channel. The 100-year flood would be open channel flow through the culvert.

Plan 2B

Plan 2B would be the same as Plan 2A except the segment across the Midwestern State University would be an underground double box culvert 18.5-feet wide by 14 feet high.

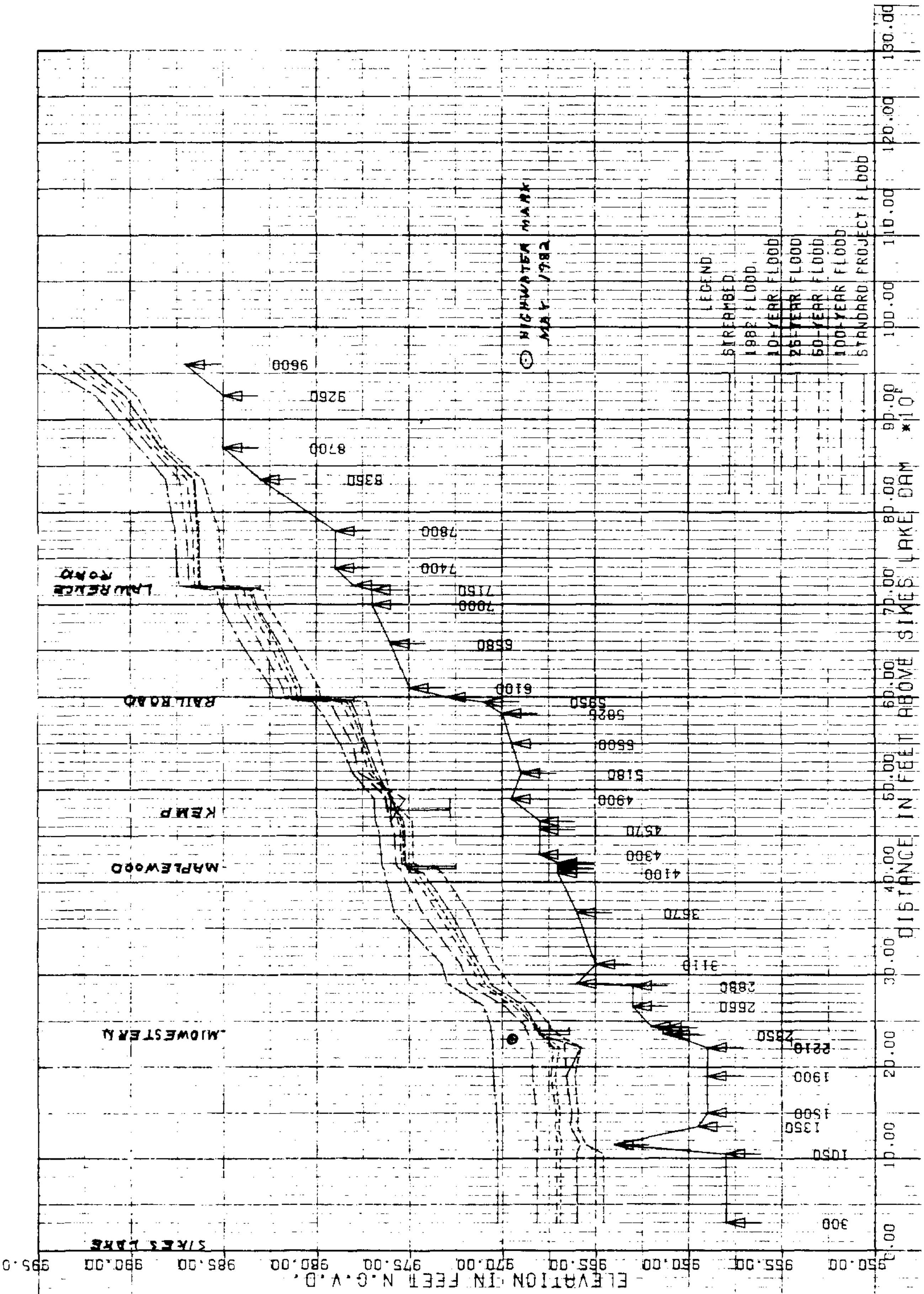
Clayton/Granada Plan

The Clayton/Granada plan would consist of an underground double box culvert, 17.5 feet wide by 10.0 feet high with an RCB spillway, extending east under Clayton and Granada Streets to Holliday Creek. The channel would enter Holliday Creek approximately 2,100 feet south (upstream) of the mouth of the existing McGrath Creek. The 100-year flood would be open channel flow through the culvert. Discharges in excess of the 100-year discharge would flow down the existing McGrath Creek channel.



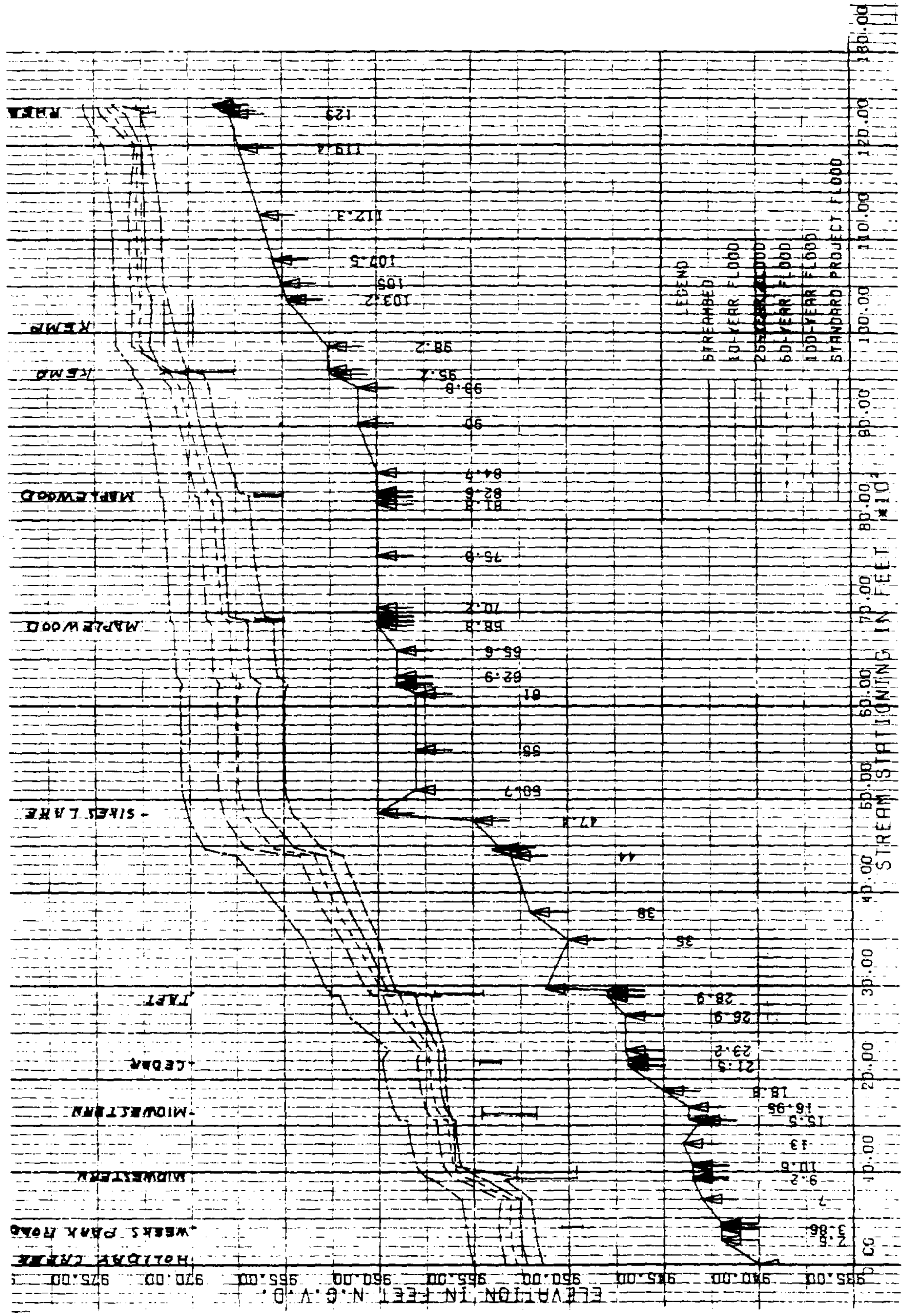
Natural Channel with 1984 Flows
McGrath Creek

Plate TS 1-1



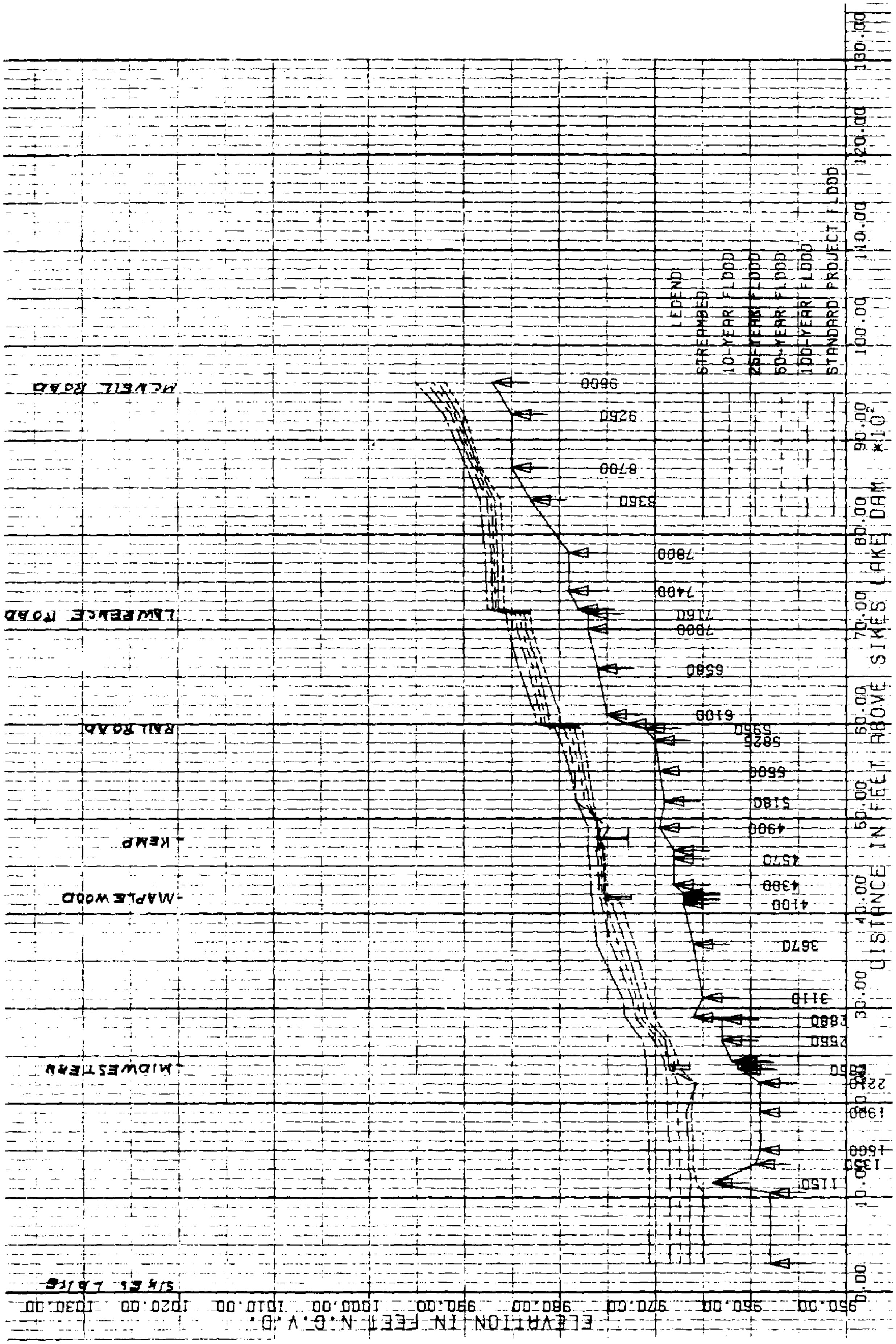
Natural Channel with 1984 Flows
North Branch Above Sikes Lake

Plate TS 1-2



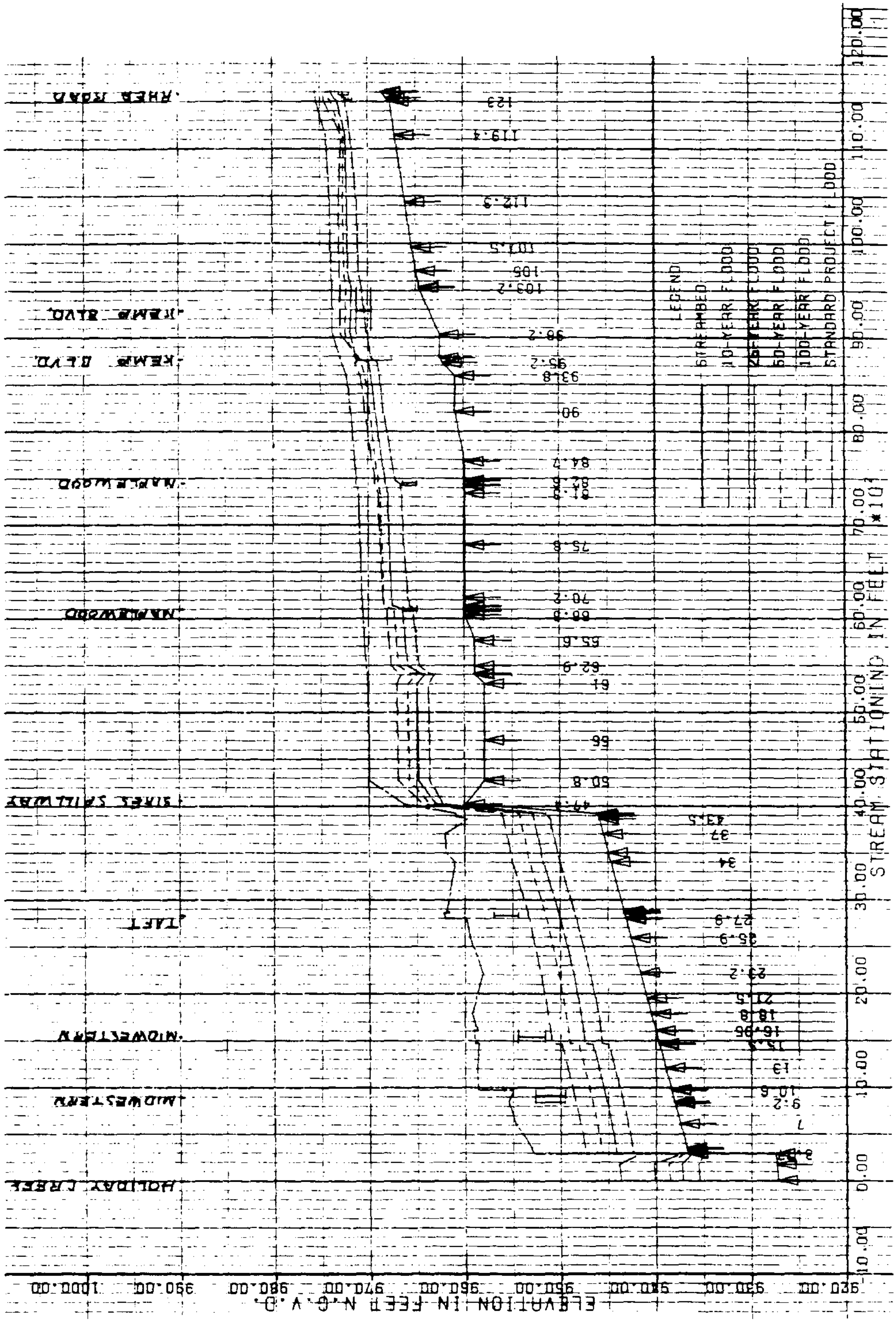
Natural Channel with Ultimate Flows
McCrath Creek

Plate TS 1-3

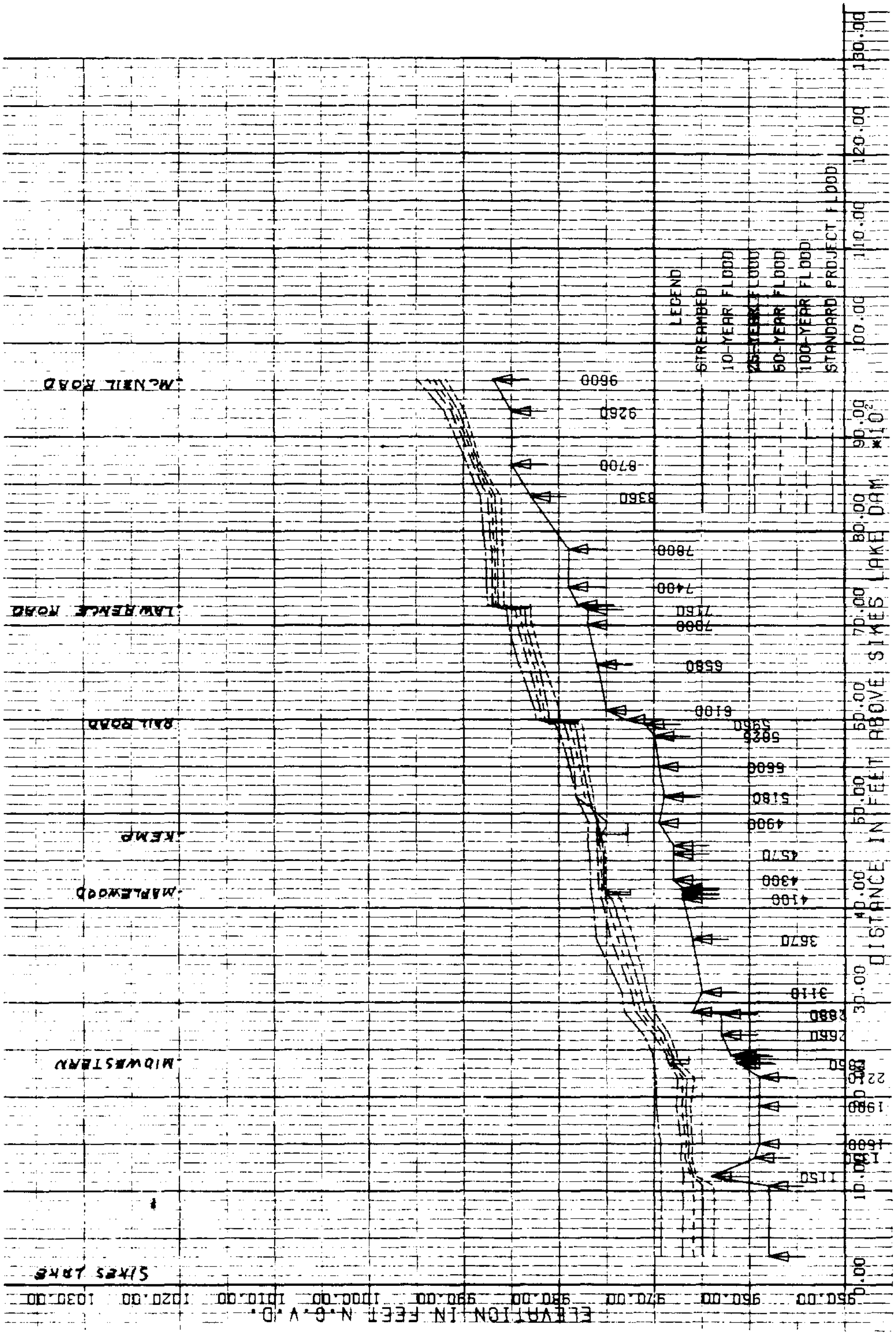


Natural Channel with Ultimate Flows
North Branch Above Sikes Lake

Plate TS 1-4



Selected Plan
Plan 1A - 100-year Channel
McGrath Creek
Plate TS 1-5



Selected Plan
Plan 1A - 100-year Channel
North Branch Above Sikes Lake

Plate TS 1-6

TECHNICAL SUPPLEMENT

SECTION 2

Designs, Cost Estimates, and Geotechnical Investigations

TABLE TS 2-3

DETAILED COST ESTIMATE
PLAN 1B

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Perpetual Easements	LS			112,000
	Severance	LS			45,000
	Improvements	LS			202,000
	Relocation Assistance	LS			8,000
	Subtotal				367,000
	Administrative				70,000
	Contingencies 25% ±				92,000
	TOTAL LANDS & DAMAGES				529,000
001	RELOCATIONS				
.1	Bridges				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			75,000
	Subtotal, Bridges				150,000
.3	Utilities				
	Sewer Lines	LS			218,000
	Water Lines	LS			212,500
	Gas Lines	LS			33,500
	Power Lines	LS			27,000
	Telephone Lines	LS			23,000
	Subtotal, Utilities				514,000
	Subtotal, Relocations				664,000
	Contingencies, 20%±				136,000
	TOTAL, RELOCATIONS				800,000
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	81,400	6.00	488,400
	Sand Backfill	CY	45,000	8.00	360,000
	Topsoil	CY	4,000	4.00	16,000
	Concrete	CY	8,600	175.00	1,505,000
	Reinforcing Steel	LB	1,734,000	0.50	867,000

TABLE TS 2-3
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
009 (Cont)					
	Filter Material	CY	5,390	12.00	64,680
	6-inch Perf Pipe w/Filter Cloth	LF	3,470	7.00	24,290
	Subdrain Manhole	EA	6	3,800.00	22,800
	Fence, 4-foot Chainlink	LF	4,140	6.50	26,910
	Modify Drop Structure				10,000
	Sheet Piling		625	124.00	77,500
	Concrete (dbl RCB 17.5 by 13.5 feet)	CY	7,150	250.00	1,787,500
	Remove Old Channel	SY	620	65.00	40,300
	Subtotal				5,290,380
	Contingencies, 20%±				1,059,620
	TOTAL CHANNELS AND CANALS				6,350,000
015	SPILLWAY				
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	470	175.00	82,250
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforced Steel	LB	212,000	0.50	106,000
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate & Waste	CY	8,730	6.00	52,380
	Sand Backfill	CY	2,450	8.00	19,600
	Topsoil	CY	50	4.00	200
	Sheet Piling, 25 feet	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				465,900
	Contingencies, 20%±				94,100
	TOTAL SPILLWAY				560,000
030	ENGINEERING AND DESIGN				926,000
031	SUPERVISION AND ADMINISTRATION				390,000
	TOTAL ESTIMATED PROJECT COST				9,550,000

TABLE TS 2-4

DETAILED COST ESTIMATE
PLAN 1C

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Perpetual Easements	LS			112,000
	Severance	LS			45,000
	Improvements	LS			300,000
	Relocation Assistance	LS			8,000
	Subtotal				465,000
	Administrative				70,000
	Contingencies, 25%±				120,000
	TOTAL LANDS & DAMAGES				655,000
002	RELOCATIONS				
.1	Bridges				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			75,000
	Subtotal, Bridges				150,000
.3	Utilities				
	Sewer Lines	LS			218,000
	Water Lines	LS			212,500
	Gas Lines	LS			33,500
	Power Lines	LS			27,000
	Telephone Lines	LS			23,000
	Subtotal, Utilities				514,000
	Subtotal, Relocations				664,000
	Contingencies, 20%±				136,000
	TOTAL, RELOCATIONS				800,000
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	78,600	6.00	471,600
	Topsoil	CY	4,000	4.00	16,000
	Sand Backfill	CY	47,000	8.00	376,000
	Concrete	CY	13,970	175.00	2,444,750
	Reinforcing Steel	LB	1,676,000	0.50	838,000
	Filter Material	CY	4,370	12.00	52,440
	6-inch Perf Pipe w/filter cloth	LF	3,420	7.00	23,940
	Subdrain Manhole	EA	6	3,800.00	22,800

TABLE TS 2-4
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
009 (Cont)					
	Fence, 4-foot Chainlink	LF	6,830	6.50	44,395
	Modify Drop Structure	LS			10,000
	Sheet Piling	LF	625	124.00	77,500
	Remove Old Channel	SY	620	65.00	40,300
	Subtotal				4,417,725
	Contingencies, 20%±				882,275
	TOTAL CHANNELS AND CANALS				5,300,000
015	SPILLWAY				
	Fence	LF	500	6.50	3,250
	Concrete, Formed	CY	580	175.00	101,500
	Concrete, Unformed	CY	2,100	85.00	178,500
	Reinforced Steel	LB	322,000	0.50	161,000
	Rip Rap 24-inch	CY	730	35.00	25,550
	Rip Rap Backing 12-inch	CY	370	35.00	12,950
	Excavate & Waste	CY	13,270	6.00	79,620
	Sand Backfill	CY	3,125	8.00	25,000
	Topsoil	CY	50	4.00	200
	Sheet Piling, 25-feet	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				644,370
	Contingencies, 20%±				125,630
	TOTAL SPILLWAY				770,000
030	ENGINEERING AND DESIGN				825,000
031	SUPERVISION AND ADMINISTRATION				350,000
	TOTAL ESTIMATED PROJECT COST				8,700,000

TABLE TS 2-5

DETAILED COST ESTIMATE
PLAN 2A

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Perpetual Easements	LS			501,000
	Severance	LS			135,000
	Improvements	LS			12,000
	Relocation Assistance	LS			5,000
	Subtotal				653,000
	Administrative				63,000
	Contingencies, 25%±				163,000
	TOTAL LANDS & DAMAGES				879,000
002	RELOCATIONS				
.1	Bridges & Streets				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			20,000
	Taft Boulevard	LS			55,000
	Subtotal, Bridges & Streets				150,000
.3	Utilities				
	Sewer Lines	LS			242,000
	Water Lines	LS			221,000
	Gas Lines	LS			16,000
	Power Lines	LS			20,700
	Telephone Lines	LS			11,300
	Subtotal, Utilities				511,000
	Subtotal, Relocations				661,000
	Contingencies, 20%±				129,000
	TOTAL, RELOCATIONS				790,000
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	123,600	6.00	741,600
	Topsoil	CY	4,000	4.00	16,000
	Sand Backfill	CY	25,100	8.00	200,800
	Concrete	CY	13,200	175.00	2,310,000
	Reinforcing Steel	LB	2,336,000	0.50	1,168,000
	Filter Material	CY	5,390	12.00	64,680
	6-inch Perf Pipe w/filter cloth	LF	3,610	7.00	25,270
	Subdrain Manhole	EA	6	3,800.00	22,800

TABLE TS 2-5
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
009 (Cont)					
	Fence, 4-foot Chainlink	LF	5,040	6.50	32,760
	Modify Drop Structure	LS			10,000
	Sheet Piling	LF	1,940	170.00	329,800
	Concrete (dbl RCB 17.5 by 14 feet)	CY	6,240	250.00	1,560,000
	Remove Old Channel	SY	620	65.00	40,300
	Subtotal				6,522,010
	Contingencies, 20%±				1,307,990
	TOTAL CHANNELS AND CANALS				7,830,000
015	SPILLWAY				
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	470	175.00	82,250
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforced Steel	LB	212,000	0.50	106,000
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate & Waste	CY	8,680	6.00	52,080
	Sand Backfill	CY	2,400	8.00	19,200
	Topsoil	CY	50	4.00	200
	Sheet Piling, 25 feet	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				465,200
	Contingencies, 20% ±				94,800
	TOTAL SPILLWAY				560,000
030	ENGINEERING AND DESIGN				1,101,000
031	SUPERVISION AND ADMINISTRATION				460,000
	TOTAL ESTIMATED PROJECT COST				11,620,000

TABLE TS 2-6

DETAILED COST ESTIMATE
PLAN 2B

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Perpetual Easements	LS			501,000
	Severance	LS			85,000
	Improvements	LS			12,000
	Relocation Assistance	LS			5,000
	Subtotal				603,000
	Administrative				63,000
	Contingencies, 25%±				151,000
	TOTAL LANDS & DAMAGES				817,000
002	RELOCATIONS				
.1	Bridges & Streets				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			20,000
	Taft Boulevard	LS			55,000
	Subtotal, Bridges & Streets				150,000
.3	Utilities				
	Sewer Lines	LS			242,000
	Water Lines	LS			221,000
	Gas Lines	LS			16,000
	Power Lines	LS			20,700
	Telephone Lines	LS			11,300
	Subtotal, Utilities				511,000
	Subtotal, Relocations				661,000
	Contingencies, 20%±				129,000
	TOTAL, RELOCATIONS				790,000
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	151,000	6.00	906,000
	Topsoil	CY	4,000	4.00	16,000
	Sand Backfill	CY	30,000	8.00	240,000
	Concrete	CY	5,770	175.00	1,009,750
	Reinforcing Steel	LB	2,342,000	0.50	1,171,000
	Filter Material	CY	5,390	12.00	64,680
	6-inch Perf Pipe w/filter cloth	LF	3,610	7.00	25,270
	Subdrain Manhole	EA	6	3,800.00	22,800

TABLE TS 2-6
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
009 (Cont)					
	Fence, 4-foot Chainlink	LF	2,820	6.50	18,330
	Modify Drop Structure	LS			10,000
	Sheet Piling	LF	1,940	170.00	329,800
	Concrete (dbl RCB 17.5 by 14 feet)	CY	13,200	250.00	3,300,000
	Remove Old Channel	SY	620	65.00	40,300
	Subtotal				7,153,930
	Contingencies, 20%±				1,426,070
	TOTAL CHANNELS AND CANALS				8,580,000
015	SPILLWAY				
	Topsoil	CY	50	4.00	200
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	470	175.00	82,250
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforced Steel	LB	212,000	0.50	106,000
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate & Waste	CY	8,680	6.00	52,080
	Sand Backfill	CY	2,400	8.00	19,200
	Sheet Piling 25 feet	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				465,200
	Contingencies, 20%±				94,800
	TOTAL SPILLWAY				560,000
030	ENGINEERING AND DESIGN				1,188,000
031	SUPERVISION AND ADMINISTRATION				495,000
	TOTAL ESTIMATED PROJECT COST				12,430,000

TABLE TS 2-7

DETAILED COST ESTIMATE
CLAYTON/GRANADA DIVERSION PLAN

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Relocation Assistance	LS			133,000
	Subtotal				133,000
	Administrative				34,000
	Contingencies, 25%±				33,000
	TOTAL LANDS & DAMAGES				200,000
002	RELOCATIONS				
.2	Roads				
	Clayton Lane & Granada Drive Paving	LS			240,000
	Subtotal, Roads				240,000
.3	Utilities				
	Gas, Water, Sewer Power & Telephone	LS			529,000
	Subtotal, Utilities				529,000
	Subtotal, Relocations				769,000
	Contingencies, 20%±				151,000
	TOTAL, RELOCATIONS				920,000
009	CHANNELS AND CANALS				
	Remove Existing Paving	SY	12,330	12.50	154,125
	Excavate & Waste	CY	78,800	6.00	472,800
	Sand Backfill	CY	11,900	4.00	95,000
	Concrete (Dbl RCB 17.5 by 10 feet)	CY	19,750	250.00	4,937,500
	Reinforcing Steel	LB	2,370,000	0.50	1,185,000
	Sheet Piling	LF	7,400	170.00	1,258,000
	Subtotal				8,102,625
	Contingencies, 20%±				1,617,375
	TOTAL CHANNELS AND CANALS				9,720,000

TABLE TS 2-7
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
015	SPILLWAY				
	Topsoil	CY	50	4.00	200
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	470	175.00	82,250
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforced Steel	LB	212,000	0.50	106,000
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate & Waste	CY	8,680	6.00	52,080
	Sand Backfill	CY	2,400	4.00	19,200
	Topsoil	CY	50	4.00	200
	Sheet Piling 25 feet	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				465,200
	Contingencies, 20% ±				94,800
	TOTAL SPILLWAY				560,000
030	ENGINEERING AND DESIGN				1,340,000
031	SUPERVISION AND ADMINISTRATION				560,000
	TOTAL ESTIMATED PROJECT COST				13,300,000

TABLE TS 2-8

SUMMARY COST ESTIMATES
100-YEAR LEVEL OF PROTECTION
APRIL 1985 PRICES
($1,000's)

Cost Acct No.		Plan 1			Plan 1A			Plan 1B			Plan 1C		
		Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total
001	Lands and Damages	-	453	453	-	529	529	-	529	529	-	655	655
002	Relocations	-	800	800	-	800	800	-	800	800	-	800	800
003	Channels and Canals	6,580	-	6,580	5,420	-	5,420	6,350	-	6,350	5,300	-	5,300
015	Floodway Control & Diversion Structures	430	-	430	560	-	560	560	-	560	770	-	770
030	Engineering and Design	840	97	937	720	91	811	830	91	926	730	95	825
031	Supervision Administration	350	40	390	300	40	340	350	40	390	310	40	350
TOTAL PROJECT COST		8,200	1,390	9,590	7,000	1,460	8,460	8,090	1,460	9,550	7,110	1,590	8,700

TABLE TS 2-9

SUMMARY COST ESTIMATES
100-YEAR LEVEL OF PROTECTION
APRIL 1985 PRICES
($1,000's)

Cost Acct No.		Plan 2A Federal	Plan 2A Non-Fed	Plan 2A Total	Plan 2B Federal	Plan 2B Non-Fed	Plan 2B Total	Plan Clayton/Granada Federal	Plan Clayton/Granada Non-Fed	Plan Clayton/Granada Total
001	Lands and Damages	-	879	879	-	817	817	-	200	200
002	Relocations	-	790	790	-	790	790	-	920	920
003	Channels and Canals	7,830	-	7,830	8,580	-	8,580	9,720	-	9,720
015	Floodway Control & Diversion Structures	560	-	560	560	-	560	560	-	560
030	Engineering and Design	1,010	91	1,101	1,095	93	1,188	1,235	105	1,340
031	Supervision Administration	420	40	460	455	40	495	515	45	560
TOTAL PROJECT COST		9,820	1,800	11,620	10,690	1,740	12,430	12,030	1,270	13,300

TABLE TS 2-10

INVESTMENT AND ANNUAL CHARGES
APRIL 1985 PRICES
($1,000's)

	Plan 1			Plan 1A			Plan 1B			Plan 1C		
Item	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total
Construction Cost	8,200	1,390	9,590	7,000	1,460	8,460	8,090	1,460	9,550	7,110	1,590	8,700
Interest During Construction 3 yrs. @ 8-3/8%	780	130	910	670	140	810	780	140	920	680	150	830
Total Gross Investment	8,980	1,520	10,500	7,670	1,600	9,270	8,870	1,600	10,470	7,790	1,740	9,530
Annual Charges												
Interest and Amortization (100 years) @ 8-3/8%	750	125	875	640	134	774	740	135	875	650	145	795
Maintenance and Operations	-	38	38	-	33	33	-	38	38	-	33	33
Major Replacement	-	27	27	-	23	23	-	27	27	-	22	22
TOTAL ANNUAL COSTS	750	190	940	640	190	830	740	200	940	650	200	850

TABLE TS 2-11

INVESTMENT AND ANNUAL CHARGES
APRIL 1985 PRICES
($1,000's)

Item	Plan 2A			Plan 2B			Clayton/Granada		
	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total
Construction Cost	9,820	1,800	11,620	10,690	1,740	12,430	12,030	1,270	13,300
Interest During Construction 3 yrs. @ 8-3/8%	940	170	1,110	1,025	165	1,190	1,155	125	1,280
Total Gross Investment	10,760	1,970	12,730	11,715	1,905	13,620	13,185	1,395	14,580
Annual Charges									
Interest and Amortization (100 years) @ 8-3/8%	900	165	1,065	980	160	1,140	1,105	115	1,220
Maintenance and Operations	-	50	50	-	53	53	-	60	60
Major Replacement	-	35	35	-	37	37	-	40	40
TOTAL ANNUAL CHARGES	900	250	1,150	980	250	1,230	1,105	215	1,320

TABLE TS 2-12

SUMMARY COST ESTIMATES
PLAN 1A ALTERNATIVE LEVELS OF PROTECTION
APRIL 1985 PRICES
($1,000's)

Cost Acct No.		10 Year Federal	10 Year Non-Fed	10 Year Total	25 Year Federal	25 Year Non-Fed	25 Year Total	50 Year Federal	50 Year Non-Fed	50 Year Total	200 Year Federal	200 Year Non-Fed	200 Year Total
001	Lands and Damages	-	448	448	-	474	474	-	493	493	-	589	589
002	Relocations	-	740	740	-	760	760	-	780	780	-	820	820
003	Channels and Canals	3,700	-	3,700	4,360	-	4,360	4,880	-	4,880	6,270	-	6,270
015	Floodway Control & Diversion Structures	400	-	400	380	-	380	410	-	410	750	-	750
030	Engineering and Design	495	85	580	570	90	660	640	92	732	844	96	940
031	Supervision Administration	205	37	242	240	36	276	265	40	305	351	40	391
TOTAL PROJECT COST		4,800	1,310	6,110	5,550	1,360	6,190	6,195	1,405	7,600	8,215	1,545	9,760

TABLE TS 2-13

INVESTMENT AND ANNUAL CHARGES
PLAN 1A ALTERNATIVE LEVELS OF PROTECTION
APRIL 1985 PRICES
($1,000's)

Item	10 Year			25 Year			50 Year			200 Year		
	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total	Federal	Non-Fed	Total
Construction Cost	4,800	1,310	6,110	5,550	1,360	6,910	6,195	1,405	7,600	8,215	1,545	9,760
Interest During Construction 3 yrs. @ 8-3/8%	460	130	590	530	130	660	595	135	730	795	145	940
Total Gross Investment	5,260	1,440	6,700	6,080	1,490	7,570	6,790	1,540	8,330	9,010	1,090	10,700
Annual Charges												
Interest and Amortization (100 years) @ 8-3/8%	435	123	558	510	125	635	570	130	700	760	138	898
Maintenance and Operations	-	25	25	-	27	27	-	30	30	-	37	37
Major Replacement	-	17	17	-	18	18	-	20	20	-	25	25
TOTAL ANNUAL COSTS	435	165	600	510	170	680	570	180	750	760	200	960

GEOTECHNICAL INVESTIGATIONS

GENERAL

This report contains geologic and soil information relative to the detailed alternatives being studied for reducing flood damages in the city of Wichita Falls, Texas, due to flooding of McGrath Creek. The alternative plans include modifications such as open channelization, underground channelization and spillway alterations on Sikes Lake at the head of the proposed project. The information presented in this report is based on general data used to describe the subsurface conditions of Wichita County and limited bridge boring data at two McGrath Creek crossings. Geotechnical explorations at the site are necessary to determine specific subsurface information.

GEOLOGY

Regional

The project is located in the Osage Plains section of the Central Lowlands physiographic province. The rock strata is part of the upper Wichita Group, mid-Permian age. The Wichita Group consists of shales and interbedded sandstones that in the Wichita Falls area, originated from continental sediments. The regional dip of the beds is about 1 degree west-northwest. No major structures or unusual conditions are known to exist at the site.

Site

The project lies southwest of downtown Wichita Falls along McGrath Creek. McGrath Creek is an intermittent stream that flows northeast into Holliday Creek. The soil above rock is expected to be shallow, generally less than 20 feet deep. The rock will generally be shale, but sandstone may be encountered. Both the shale and sandstone should be weak enough to excavate by conventional ripping. However, the rock strengthens with depth so that deep excavations may be difficult to rip.

Scope of Explorations

No field explorations have been accomplished to date. Core drilling was done along nearby Holliday Creek and at Lake Wichita. Data presented in this report is from interpretations from other investigations in the area, and from library research.

TYPICAL SUBSURFACE CONDITIONS

The alluvial deposits in the McGrath Creek flood plain consist of 5 to 10 feet of lean sandy clay above 10 to 15 feet of high plasticity clays that grade into soft shaley sandstones at approximately 15 to 25 feet below the surface. The near surface soils are classified as CL by the Unified Soil Classification System (USCS), while the deeper soils encountered down to the soil-rock interface are classified as CH. The upper soils have an average liquid limit of 35 and the percentage passing the No. 200 sieve averages 85 percent. The fat clays have liquid limits ranging from 50 to 70 and percentages passing the No. 200 sieve ranging from 90 to 100. The typical subsurface profile of the upland soil deposits that developed from old stream alluvium and red-bed clays and shales vary from clayey silts at the surface to firm clays at 4 to 6 feet to sandy clayey silts down to depths exceeding 10 feet below the surface. The depth to rock could not be determined from available information but the depth is greater than 10 feet. The upland soils range in classification from CL-ML at the surface grading to CL. Available data reveals liquid limits ranging 20 to 45, plasticity indices ranging from 10 to 30 percentages passing the No. 200 sieve ranging from 60 to 80.

GROUNDWATER CONDITIONS

The alluvial soils adjacent to McGrath Creek are frequently flooded. During periods of low flow, the water table may be encountered at the surface. The upland soils may experience perched water tables during wet months but the water table is encountered 15 feet below the surface.

DISCUSSION OF ALTERNATIVES

The various alternative plans involve three different channel alignments and two spillway locations. The geotechnical considerations for each alignment and spillway location is discussed below.

Channels

Plan 1 Alignment. The existing channel alignment of McGrath Creek is the alignment for Plans 1, 1A, 1B, and 1C. Excavation for channel modifications down to depths of 15 feet would involve only the removal of clay overburden near Sikes Lake with overburden depths increasing to 25 feet at the confluence of McGrath Creek with Holliday Creek. Deeper excavations would require the removal of soft shaley sandstones. Due to the potentially expansive nature of the high plasticity clays encountered in excavations over 5 feet deep, it would be necessary to provide drainage systems for the concrete lined channels. A typical drainage system would include a 6-inch sand blanket with a perforated pipe collection system along the invert of the channel. Any backfill placed behind and beneath the concrete channel and drainage system should be nonexpansive ($PI \leq 12$) to further reduce the potential for heave. Groundwater control would be a concern during construction and operation because the water table has been encountered at the ground surface along McGrath Creek.

Plan 2 Alignment. Plans 2A and 2B involve the construction of diversion channels north of the existing McGrath Creek. These channels would be cut through the upland soil deposits of McGrath Creek. The depth of the silty clay overburden cannot be determined from the available information but it exceeds 10 feet. Local experience indicates that ground water can be anticipated at depths greater than 15 feet. The soils encountered in the upper 10 feet exhibit low to moderate swell potential. A drainage system would be required beneath the underground concrete channels and both beneath and behind the open concrete channels to reduce the swell potential caused by fluctuating water tables.

Clayton/Granada Alignment. The geotechnical considerations for this plan would be the same as those for the Plan 2 alternatives. This plan involves constructing underground channels in the upland deposits east of McGrath Creek.

Spillway

All of the alternatives involve modifications to the Sikes Lake spillway. The proposals involve widening of the existing spillway or relocation of the spillway and filling in the old spillway. The existing spillway is cut into the natural ground that serves as the "embankment" for the shallow lake. The relocated spillway would also be cut into this natural "embankment." The new spillway would serve to decrease the length of the channel improvements. Excavation for a new spillway or widening of the old spillway would require the removal of medium to high plasticity clay overburden. To prevent erosion it would be necessary to line the spillway with concrete and the approach slopes of the embankment with riprap. A drainage system would be required both beneath and behind the concrete spillway to reduce the potential for expansion of the clay soils that the spillway would be founded on. The old spillway could be filled in with properly compacted clay materials excavated from the new spillway. The typical section required to fill in the old spillway is shown on Plate TS 2-4. It would have a 5-foot inspection trench and 1V on 3H side slopes for stability. No additional slope protection would be required due to the shallow depth of the lake and the type of material used to construct the section. Underseepage would be insignificant due to the low water heights and low permeability of the clay foundation materials.

ADDITIONAL EXPLORATIONS

Additional explorations are required at 500- to 1,000-foot intervals along the final channel alignment and at the new spillway location. The explorations are necessary in order to confirm the types of materials to be excavated, the depth to rock and ground water, and the suitability of materials for construction.

SECTION 2
DESIGN, COST, AND GEOTECHNICAL DATA

CONTENTS

TABLES

CONTENTS
(continued)

PLATES

DESIGN AND COST DATA

Design and cost data are presented in this section for the seven plans evaluated in the detailed analysis. The following design and cost items are covered.

1) Lands and damages
2) Relocations
3) Channels and spillway

DESIGN DESCRIPTION

PLAN 1

Lands and Damages

The channel is located in a highly developed area with apartments and other buildings located adjacent to the channel. Approximately 28 ownerships would be affected and one office building would be acquired. Approximately 6.9 acres of land would be required for the project, 4.6 acres for the channel and 2.3 acres for maintenance easements.

Relocations

New bridges would be required at Cedar Elm Lane and Weeks Park Drive. Two footbridges could be salvaged and reused. Water lines which would be relocated include one 8-inch line, one 12-inch line, and one 48-inch line. Sewer lines affected include one 18-inch line and one 33-inch line. Natural gas lines crossing the channel would be relocated as required. Four underground power lines would require relocation. Five overhead power lines cross the channel and would also require some relocations. Telephone lines requiring some relocations include five underground cables and one aerial line.

Channel and Spillway

The plan would consist of an improved channel and a new spillway. The channel would be a rectangular, concrete-lined channel, beginning at the drop structure at the confluence with Holliday Creek along the present channel alignment up to the spillway. Total length of the concrete lined channel would be about 4,300 feet. The drop structure, as presently planned as a part of the Lake Wichita, Holliday Creek project, would be modified and the crest lowered 3.25 feet. Existing storm drainage pipes would be extended or cut off as necessary to drain into the the new channel. Ground water pressure under the concrete lining would be relieved by a subdrainage system. A 4-foot chain link fence would be installed along either side of the channel.

The spillway would be 110 feet wide with a 187.5-foot-long transition to the rectangular channel cross section. It would be located at the present spillway site. Service access to the south side of the lake would be provided by a 10-foot wide road crossing the spillway immediately upstream from its crest.

PLAN 1A (SELECTED PLAN)

Lands and Damages

The channel would be located in a highly developed area with apartments and other buildings located adjacent to the channel. Approximately 28 ownerships would be affected and one office building would be acquired. Approximately 5.9 acres of land would be required for the project, 3.9 acres for the channel and 2.0 acres for maintenance easements.

Relocations

New bridges would be required at Cedar Elm Lane and Weeks Park Drive. Two footbridges could be salvaged and reused. Water lines which would be relocated include one 8-inch line, one 12-inch line, and one 48-inch line. Sewer lines affected include one 18-inch line and one 33-inch line. Natural gas lines crossing the channel would be relocated as required. Four underground power lines would require relocation. Five overhead power lines cross the channel and would also require some relocations. Telephone lines requiring some relocations include five underground cables and one aerial line.

Channel and Spillway

The plan would consist of an improved channel and a relocated spillway. The channel would be a rectangular, concrete-lined channel beginning at the drop structure at the confluence with Holliday Creek along the present channel alignment to the spillway. The total length of the concrete-lined channel would be about 3,600 feet. The drop structure, as presently planned as a part of the Lake Wichita, Holliday Creek project, would be modified and the crest lowered 3.25 feet. Existing storm drainage pipes would be extended or cut off as necessary to drain into the the new channel. Ground water pressure under the concrete lining would be relieved by a subdrainage system. A 4-foot chain link fence would be installed along either side of the channel.

The spillway would be 110 feet wide with a 187.5-foot-long transition to the channel cross section. It would be located about 750 feet north of the present spillway. Service access to the south side of the lake would be provided by a 10-foot-wide road crossing the spillway immediately upstream from its crest. The present spillway would be removed and the opening filled to elevation 968.0. Material for the embankment fill would be from the channel and new spillway excavation. The channel alignment and spillway location are shown on plates TS 2-1 through TS 2-3. Details of the spillway channels and other data are shown on plate TS 2-4.

PLAN 1B

Channel and Spillway

This plan would be the same as Plan 1A except that the reach from Midwestern Parkway up to Taft Boulevard would be underground and would consist of a double 17.5-foot by 13.5-foot reinforced concrete box culvert about 1,350 feet long.

PLAN 1C

This plan would be the same as Plan 1A except that the spillway would be about 140 foot wide. The wider spillway would require the removal of the steel frame building located on the right side of the spillway.

PLAN 2A

Lands and Damages

The channel would be located in a highly developed area with a commercial office building and two single-family homes located adjacent to the channel. Approximately 25 ownerships would be affected and 6.1 acres of land would be required for the project, 4.1 acres for the channel and 2.0 acres for maintenance easements.

Relocations

A new bridge would be required at Weeks Park Drive. One footbridge could be salvaged and reused. Water lines which would be relocated include one 6-inch line, one 12-inch line, and one 48-inch line. Sewer lines affected include one 6-inch line, one 18-inch line, and one 33-inch line. Natural gas lines crossing the channel would be relocated as required. Four underground power lines would require relocation. Five overhead power lines cross the channel and would also require relocation. Telephone lines requiring some relocations include five underground cables and one aerial line.

Channel and Spillway

Plan 2A would be the same as Plan 1A except that a segment of the channel would extend from a point about 600 feet downstream of the relocated spillway northeastward to the north side of Midwestern Parkway at Taft Boulevard, then eastward to the mouth of McGrath Creek, a distance of about 2,200 feet. This alignment would include approximately 1,100 feet of underground, double 17.5-foot by 14-foot reinforced concrete box culvert from the creek to Taft Boulevard. This segment would cross under an office parking lot and the intersection of Midwestern Parkway and Taft Boulevard. The remaining improvement would be a rectangular concrete-lined channel. The total length of the improved channel would be about 3,700 feet.

PLAN 2B

This plan is the same as Plan 2A except that the entire length of the 2,200-foot diversion segment would be underground and would be a double 18.5-foot by 14-foot concrete box culvert.

CLAYTON/GRANADA DIVERSION PLAN

Lands and Damages

The channel would be constructed beneath Clayton Lane and Granada Drive. A major problem would be the inconvenience to 34 homeowners who would be unable to reach their homes when the channel was under construction. They would have to move to temporary residences for a short period of time or be provided temporary vehicle access across front lawns.

Relocations

The project would affect nine water lines varying from 6 to 48 inches. Sewer lines affected would include one 6-inch line, one 8-inch line, one 15-inch line, and one 33-inch line.

Channel and Spillway

This plan would provide a conduit under Granada Drive and Clayton Lane from Holliday Creek to Sikes Lake. The conduit would be a double 17.5-foot by 10-foot concrete box culvert, about 3,700 feet long. A 6-foot high concrete drop structure would be required at the confluence with Holliday Creek. The spillway would be constructed about 500 feet north of the present spillway. It would be 110 feet wide as in Plan 1A.

COST DATA

All costs presented in this section are based on April 1985 price levels. Detailed cost estimates for each plan are presented in tables TS 2-1 through TS 2-7.

Tables TS 2-8 and TS 2-9 present summary cost estimates including Federal and non-Federal costs. The estimated investment and annual charges, including Federal and non-Federal costs, are presented in tables TS 2-10 and TS 2-11. Estimated annual costs include interest and amortization (at 8-3/8 percent interest over a 100-year project life). Estimated construction period for the project is three years.

OPTIMIZATION

To assist in the optimization of the Plan 1A alignment, cost estimates were made for alternative levels of flood protection (10-, 25-, 50-, and 200-yr). The size of channels and spillways for the alternative levels of flood protection are presented in table 6 of the main report. Table TS 2-12 presents summary cost estimates for 10-, 25-, 50-, and 200-year levels of flood protection for the Plan 1A alignment. Table TS 2-13 presents the investments and annual charges associated with the respective levels of flood protection.

TABLE TS 2-1

DETAILED COST ESTIMATE
PLAN 1

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS & DAMAGES				
	Perpetual Easements	LS			85,000
	Severance	LS			18,000
	Improvements	LS			200,000
	Relocation Assistance	LS			3,000
	Subtotal				306,000
	Administrative				70,000
	Contingencies 25%±				77,000
	TOTAL LANDS & DAMAGES				453,000
002	RELOCATIONS				
.1	Bridges				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			75,000
	Subtotal, Bridges				150,000
.3	Utilities				
	Sewer Lines	LS			218,000
	Water Lines	LS			212,500
	Gas Lines	LS			33,500
	Power Lines	LS			27,000
	Telephone Lines	LS			23,000
	Subtotal, Utilities				514,000
	Subtotal, Relocations				664,000
	Contingencies, 20%±				136,000
	TOTAL, RELOCATIONS				800,000

TABLE TS 2-1
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	95,560	6.00	573,360
	Sand Backfill	CY	53,300	8.00	426,400
	Topsoil	CY	4,600	4.00	18,400
	Concrete	CY	17,040	175.00	2,982,000
	Reinforcing Steel	LB	2,045,000	.50	1,022,500
	Filter Material	CY	5,390	12.00	64,680
	6 inch Perf Pipe w/Filter Cloth	LF	4,160	7.00	29,120
	Subdrain Manhole	EA	6	3,800.00	22,800
	Fence, 4-foot Chain-Link	LF	8,320	6.50	54,080
	Modify Drop Structure	LS			10,000
	Sheet Piling	LF	625	124.00	77,500
	Remove Old Channel	SY	3,080	65.00	200,200
	Subtotal				5,481,040
	Contingincies 20%±				1,098,960
	TOTAL CHANNELS AND CANALS				6,580,000
015	SPILLWAY				
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	320	175.00	56,000
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforcing Steel	LB	194,000	.50	97,000
	Topsoil	CY	130	4.00	520
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate & Waste	CY	6,240	6.00	37,440
	Sand Backfill	CY	870	8.00	7,000
	Remove Old Spillway	LS	Job		10,000
	Subtotal				356,630
	Contingincies 20%±				73,370
	TOTAL SPILLWAY				430,000
030	ENGINEERING AND DESIGN				937,000
031	SUPERVISION AND ADMINISTRATION				390,000
	TOTAL ESTIMATED PROJECT COST				9,590,000

TABLE TS 2-2

DETAILED COST ESTIMATE
PLAN 1A (Selected Plan)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
001	LANDS AND DAMAGES				
	Perpetual Easements	LS			112,000
	Severance	LS			45,000
	Improvements	LS			202,000
	Relocation Assistance	LS			8,000
	Subtotal				367,000
	Administrative				70,000
	Contingencies 25%±				92,000
	TOTAL LANDS & DAMAGES				529,000
002	RELOCATIONS				
.1	Bridges				
	Weeks Park Drive	LS			75,000
	Cedar Elm	LS			75,000
	Subtotal, Bridges				150,000
.3	Utilities				
	Sewer Lines	LS			218,000
	Water Lines	LS			212,500
	Gas Lines	LS			33,500
	Power Lines	LS			27,000
	Telephone Lines	LS			23,000
	Subtotal, Utilities				514,000
	Subtotal, Relocations				664,000
	Contingencies, 20%±				136,000
	TOTAL RELOCATIONS				800,000
009	CHANNELS AND CANALS				
	Excavate and Waste	CY	79,900	6.00	479,400
	Sand Backfill	CY	51,600	8.00	412,800
	Concrete	CY	14,200	175.00	2,485,000
	Reinforcing Steel	LB	1,704,000	0.50	852,000
	Topsoil	CY	4,100	4.00	16,400

TABLE TS 2-2
(Continued)

Cost Acct No.	Item	Unit	Quantity	Unit Price $	Amount $
	Filter Material	CY	4,390	12.00	52,680
	6-inch Perforated w/filter cloth	LF	3,470	7.00	24,290
	Subdrain Manhole	EA	6	3,800.00	22,800
	Fence, 4-foot Chainlink	LF	6,940	6.50	45,110
	Modify Drop Structure	LS			10,000
	Sheet Piling	LF	625	124.00	77,500
	Remove Old Channel	SY	620	65.00	40,300
	Subtotal				4,518,280
	Contingencies 20%±				901,720
	TOTAL CHANNELS AND CANALS				5,420,000
015	SPILLWAY				
	Fence	LF	380	6.50	2,470
	Concrete, Formed	CY	470	175.00	82,250
	Concrete, Unformed	CY	1,300	85.00	110,500
	Reinforcing Steel	LB	212,000	0.50	106,000
	Rip Rap 24-inch	CY	680	35.00	23,800
	Rip Rap Backing 12-inch	CY	340	35.00	11,900
	Excavate and Waste	CY	8,730	6.00	52,380
	Topsoil	CY	50	4.00	200
	Sand Backfill	CY	2,450	8.00	19,600
	Sheet Piling, 25-foot	LF	200	170.00	34,000
	Remove Old Spillway	LS	Job		10,000
	Embankment	CY	3,200	4.00	12,800
	Subtotal				465,900
	Contingencies 20%±				94,100
	TOTAL SPILLWAY				560,000
030	ENGINEERING AND DESIGN				811,000
031	SUPERVISION AND ADMINISTRATION				340,000
	TOTAL ESTIMATED PROJECT COST				8,460,000