TRINITY RIVER GREENWAY

A PROTOTYPE

TRINITY RIVER GREENWAY ... TYPE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A091004	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) The Trinity River Greenway : a prototype		5. TYPE OF REPORT & PERIOD COVERED Final rept.
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J.D. Mertes, A.N. Glick, R.M. Sweazy, T.T. Cheek		8. CONTRACT OR GRANT NUMBER(s) DACW63-72-C-0009
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Park Administration, Horticulture and Entomology, Texas Tech University, Lubbock, Texas 79409		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Jun 72
11. CONTROLLING OFFICE NAME AND ADDRESS Fort Worth District, Corps of Engineers, Engineering Division, Plng Br., SWFED-P, P.O. Box 17300, Ft Worth, Texas 76102		12. REPORT DATE
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) NA 190		15. SECURITY CLASS. (of this report) Unclas.
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release ; distribution unlimited.

WRC-72-3

James D. Mertes, Arthur N. Glick, Robert M. Sweazy, Terry T. Cheek

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

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

Water resources development
Trinity River watershed, Texas
Trinity River water development project
Dallas County, Texas
Tarrant County, Texas

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

The report focuses on the development of a portion of the Trinity River as a potential open space corridor or "greenway" connecting Fort Worth and Dallas with a lineal, continuous natural area parkway. The purpose is to determine through an ecological planning process the least environmental impact route for the proposed Trinity multipurpose channel, and the influence on adjacent lands resulting from the alignment, construction and operation of the channel.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

410166

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

THE TRINITY RIVER GREENWAY

A PROTOTYPE

Submitted to

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

Accession For	
NTIS GRA&I	X
DDC TAB	
Unannounced	
Justification	
By	
Distribution/	
Availability Codes	
Dist.	Avail and/or special
A	

by

J.D. Mertes
A.N. Glick
R.M. Sweazy
T.T. Cheek

June, 1972

The Department of Park Administration,
Horticulture and Entomology

and
The Water Resources Center

New

Texas Tech University

Lubbock, Texas 79409

Agricultural Sciences
Publications Number T-6-102

Publication Number WRC 72-3

Texas Tech University

College of Agricultural Sciences
Department of Park Administration, Horticulture, and Entomology
P.O. Box 4169 Lubbock, Texas 79409 Phone (806) 742-4202

June 30, 1972

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

Attention: Mr. L. E. Horsman

Dear Colonel Henk:

We are pleased to submit herewith a report entitled "The Trinity River Greenway - A Prototype", which has been completed in compliance with the provisions of Department of the Army Contract No. DACW 63-72-C-0009.

This report was prepared by an interdisciplinary team of planners and engineers at Texas Tech University. We believe this approach provided the best vehicle for analyzing the proposed Trinity River multiple purpose water development project. It is our firm conviction that the concept of a Trinity River Greenway offers an economic and environmentally feasible alternative, which could be applied to the entire river system.

We appreciate the opportunity of performing this service for you, and we look forward to working with you on similar projects in the future.

Sincerely yours,

James D. Mertes

James D. Mertes
~~Assistant Professor~~
Project Leader

JDM/cps

ACKNOWLEDGMENTS

The Trinity River Environmental Study Team wishes to extend our grateful appreciation to the private citizens and to the public officials of the local, state, and federal agencies and organizations who gave generous assistance and made significant contributions to this study.

The Fort Worth District of the U.S. Army Corps of Engineers provided funding for the study and further assisted by participating in numerous planning conferences and field trips. In addition, the Corps coordinated arrangements for the use of an Army Reserve helicopter for reconnaissance flights. Special thanks is extended to Colonel Floyd H. Henk, District Engineer, Mr. L. E. Horsman, Mr. Durwood Jones, Mr. George DeMeritt, Mr. Ronald Turner and Mr. J. E. West.

Significant contributions came from the Trinity River Authority of Texas. For their interest and assistance, we recognize Mr. David Brune, General Manager.

The following directors and their staffs of the various cities' Park and Recreation Departments greatly assisted us with their expertise, advice, and guidance.

Mr. Charles B. Campbell, Jr.	Fort Worth
Mr. Bill Enlow	Irving
Mr. L. B. Houston	Dallas
Mr. John M. Sellars	Grand Prairie
Mr. Melvin Shanks	Arlington

In addition, we acknowledge Mr. David Farrington, Director of Planning of the Fort Worth City Planning Department. Special thanks is extended to Mr. Grover Keeton of the Dallas Park and Recreation Department for his assistance in securing land ownership records of Dallas County. The staff of the Tarrant County Clerk's office cooperated in the extraction of like data for Tarrant County.

The North Central Texas Council of Governments provided a great amount of information and cooperation. The assistance of Mr. Robert L. Wegner, Director, and Mr. Joel Wooldridge of the Regional Planning Office is gratefully acknowledge.

Other organizations contributing to the study include the Bureau of Sport Fisheries and Wildlife, The Texas Parks and Wildlife Department, The Dallas Museum of Natural History, and the Soil Conservation Service. Special appreciation is extended to Mr. D. R. (Dick) Coffee, Soil Scientist of the Fort Worth SCS office, who accompanied the study team on a field trip, coordinated acquisition of soils maps and photos, and in general contributed much time and personal interest.

Warrant Officers Paul Fleming and Beauman Roberts of the 300th Aviation Company, U.S. Army Reserve, piloted our helicopter reconnaissance missions in an outstanding manner. The National Aeronautics and Space Administration Earth Resources Aircraft Program Provided excellent multispectral high-altitude imagery of the study area.

The following land owners generously cooperated in granting the study team permission to make helicopter landings on their properties:

Arlington City Sewage Treatment Plant
Mr. Charles C. Gumm, Jr., Fort Worth
Mr. W. O. Kelly, Fort Worth
Mr. J. J. Randol, Fort Worth
Texas Industries, Inc., Arlington
Trinity River Authority Regional Sewage Treatment Plant

Professor Elo J. Urbanovsky, Chairman of the Department of Park Administration, Horticulture and Entomology and Dr. Dan M. Wells, Director of the Water Resources Center provided invaluable support in the form of consultation, criticism, and editorial assistance in preparing the final report. These outstanding experts brought a wealth of knowledge and experience to the project. Their contributions are most sincerely appreciated.

Many of our graduate students made timely suggestions and comments through the media of our seminars and planning classes. We recognize their input.

Mr. F. M. Carroll, Senior Landscape Architecture Student in the Department of Park Administration, supervised the production of graphics used in this report. He was assisted by Mr. Chris Binion, Graduate Student, and Mr. Bill Orr, Senior.

Mr. Benje Daniels of the Tech Press provided invaluable technical assistance in the final preparation and printing of this study. Finally, the patience and perseverance of Mrs. Connie Spicer, Mrs. Raynell Keller and Mrs. Jan Shuler in typing our numerous draft manuscripts and final reports is most gratefully recognized and appreciated.

SUMMARY OF FINDINGS

Development of a realistic concept for the creation of a Trinity River Greenway from Fort Worth to south of Dallas presents several challenging engineering, ecological and institutional problems. There are several factors which come to bear upon the selection of feasible alternatives. Considering the objectives of the study and the number of interests involved, it is immediately obvious that simple solutions are not readily available.

Analysis of the natural features of the study area led to the following conclusions:

1. The area does not encompass any pristine natural ecological areas. Rather, much of the so-called "natural ecology" of the flood plain has been severely modified over the years by the actions of man. There are no known archelogical sites and only one historical site related to mans early attempts to navigate the Trinity.

2. Water quality in this section of the West Fork of the Trinity River has deteriorated to a level incapable of supporting game fish or any form of contact recreational use.

3. There are reforested areas along the river which provide habitat for several species of wildlife.

4. The river has numerous riffles and shelves as well as small rapids and pools which are scenic and have potential for inclusion in a urban riverway system. If channelized, many if not most of these natural resources will be destroyed. Due to the configuration and natural characteristics of the river, any plan for channelization will mean a considerable change in river alignment, land forms, vegetation and water flow.

5. Soils within the flood plain are alluvial bottom land and river terrace soils. The area has a high water table which, combined with the prospects of occasional flooding, places severe limitations on development potentials within the river bottom.

6. Unless specially modified, the majority of abandoned gravel pits will not be suitable for solid waste disposal. However, most of the abandoned pits within the levee system could be filled with the biologically and chemically inert dredge material obtained through normal maintenance of the multipurpose channel.

7. The beneficial use of water in the natural channel will be influenced greatly by the quantity and quality of water entering the channel from waste treatment plant discharges, potential up-channel releases and natural drainages. Location of discharge points and the protection of natural drainages are two important factors which will affect the water potentials of the natural channel.

8. Recreational development within the parkway will be limited by the topography, water quality, soils and vegetation of the river bottom area. Various limits on the natural carrying capacity have been identified for this area.

9. Land use adjacent to the existing natural river channel, for the most part, consists of abandoned or active sand and gravel mines, dumps, woodlands, farm or pasture lands and open fields. A good portion of this area is unusable for any purpose in its present state. The most desirable parkway lands are the forested lands immediately adjacent to the river. These lands represent only a small percentage of the area within the Greenway.

10. If proper habitat management measures are taken, the numbers of desirable native fish and wildlife species within the parkway can be increased.

11. Many communities along the river have plans for development of parks and open space lands within their jurisdiction. No comprehensive plan for the entire Greenway area has been formulated beyond the conceptual stage.*

12. Land ownership within the study area is a complex pattern of numerous small parcels. Thus, individual decision makers abound, and the number of goals and objectives of these owners are many and various, although greatly influenced by ultimate plans for development of the channel. To retain and enhance the ecological character of the river bottom environs, it is essential that these lands be acquired and administered as a single contiguous unit under one ownership rather than be fragmented into small individual tracts under a variety of ownerships.

*A general open space plan has been prepared for all drainages within the jurisdiction of the North Central Texas Council of Governments. This Environmental Corridor plan is in essence a conceptual approach to the proposal advanced in this report.

13. Recreational development should focus on land-extensive activities such as nature study, hiking, riding, fishing and picnicking. This lineal parkway offers a unique opportunity to link several communities through a large unbroken open space area.

14. Open space, on a scale such as proposed in this plan, should have a positive impact on adjacent real estate values.

15. Such a Greenway proposal cannot become a reality without a strong commitment from the State. Unless a state-federal partnership is forthcoming, the U.S. Army Corps of Engineers has neither the authority nor funds to implement a parkway plan.

16. Of all the implementation alternatives explored, the creation of a State River Parkway appears most feasible from a funding and administrative standpoint. The major limiting factor is a lack of strong state park policy with respect to the provision of such sites and facilities within urban areas.

17. The proposed open space corridor and river parkway could be developed without the stimulus of a multipurpose channel. The parkway concept encompassing the natural river channel could provide a similar package of social and economic benefits, and perhaps increased environmental benefits, if developed without a multipurpose channel. From an ecological aspect, this would certainly be more expedient. All land reclamation, revegetation and reforestation practices, water quality improvements and fish and wildlife habitat management could take place without the development of a multipurpose channel. Urban open space of this nature and magnitude could be justified on the basis of human need alone and does not need to be tied to a larger economic development package. Without the prospects for a commercial waterway, land prices would be much lower and competition for choice industrial-commercial development frontage would be virtually non-existent.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Planning for the future development and use of the Trinity River and its related land resources represents a complex and challenging multidimensional engineering and environmental planning problem. The magnitude of this problem compounds itself almost geometrically when planners come to grips with the myriad of economic, environmental, sociological, engineering and political variables which must be evaluated against the urgent needs and rising demands and expectations of all segments of the basin's growing and diversified population.

Years of planning and study have gone into the formulation of a multipurpose plan of management designed to tame the raging waters of the Trinity, subdue its flooding crests and harness this valuable water to better serve man. The Trinity has become a villain only because man has misused the lands of her watershed, built in her flood plain and thus subjected himself to those forces of nature which have operated unchained for centuries, and have through this natural process created the river and its environs as we know it today. Man has become the victim of his own ineptitudes, his disrespect for the laws of nature and his greed to consume land and resources in an unplanned fashion.

Extensive development has taken place within the flood plain and Trinity Basin for well over one hundred years. During this time, timber was harvested, fields plowed, roads built, minerals and oil extracted and homes and businesses established. As the complexion of the upper watershed changed and runoff increased, flood dangers through highly populated areas such as Fort Worth and Dallas mounted. Thus, in response to an urgent need, flood control levees were constructed by local flood control districts in Tarrant and Dallas County. Later, under direction of the Congress the Corps constructed flood control lakes on the upper tributaries of the Trinity. Eventually these lakes, in addition to reducing the potential of devastating floods, provided new recreation areas for the urban masses.

For many years the Trinity has served as an open sewer, collecting the wastes of upper basin municipalities. With the assistance of released water from upper basin lakes, better known as low flow augmentation, these wastes were flushed into Galveston Bay. This practice is, however, beginning to change as more modern and efficient regional waste treatment plants are being developed and put into operation throughout the basin.

Current plans for future development of the river system call for enlargement of upstream lakes and the eventual construction of a multiple purpose channel from Fort Worth to the bay. With the creation of this channel will come massive changes in the character of the river and its adjacent lands. Ecologically, socially and economically, the basin will experience considerable modification, much of which, with proper planning, can be an improvement over what we know as the Trinity today.

When looking at the Trinity Basin as a unique unit of diversity one inescapable fact emerges. The river and its environs are by no means pristine in any generic sense of the word. Yet, as becomes clearly evident from our close scrutiny of the basin through the use of high altitude infra-red photography, there are extensive areas of forest, wetland, reaches of open water and other natural features. Even more apparent is the number of these areas which have not been heavily invaded by man and his machines. These areas, if properly protected and enhanced, can provide immeasurable environmental, social and economic values to the region in the form of open space, recreation, fish and wildlife, and scientific resources. More important is the fact that, with the increasing rate of land conversion taking place within the basin, aggressive planning and action must ensue if we are to protect the environmental integrity of this vast area.

The reach of the Trinity under study in this project is that section from Beach Street in East Fort Worth to southeast of Dallas in the vicinity of the Club Lakes. This area has been heavily developed for well over fifty years and is an excellent example of the agricultural and urban development which has been previously described. Over the previous centuries, the river has deposited large amounts of sand and gravel which have been recently heavily mined. Forests throughout the area have been heavily cut and in some cases completely cleared. Much of the river channel has been deeply gouged by the resulting raging flood waters. Large quantities of trash and debris have been scattered throughout the area. In short it is far from a pristine ecological area.

The report contained herein focuses on the development of a portion of the river as a potential open space corridor or "greenway" connecting

Fort Worth and Dallas with a lineal, continuous natural area parkway. These greenway lands could be developed for ecological and environmental protection and enhancement, open space for outdoor recreation and areas for scientific study. The large pockets of woodland still in the area could be linked together into a massive ecological preserve.

In determining the most environmentally feasible routing for the proposed multipurpose channel, these factors constituted the guidelines for planning. As the report shows, the nature of existing land use allows for the separation of two distinct future uses, each optimizing the lands through which they pass. Thus, there can be multiple uses of the Trinity. Of course the project costs will be higher, but the benefits which more people can enjoy will be much greater.

The concept of large public open space holdings in a predominantly metropolitan region is by no means unique. As early as 1913, the State of Illinois created the Cook County Forest Preserve District. This county encompasses metropolitan Chicago and, at present, holds in public ownership thirteen percent of the county lands for nature preserves and outdoor recreation. Texas, through cooperation with the Corps of Engineers, can seize this opportunity to develop a similar resource through implementation of the concept of a state river parkway.

It is well recognized that much additional planning and coordination will be necessary to bring this plan to realization. Encouraging is the interest and spirit of cooperation demonstrated by the five cities, the Trinity River Authority and the Corps in the parkway plan. Hopefully, all citizens of the area will recognize the benefits which will accrue from such a massive public open space estate. Indeed, it is not too late for Dallas and Tarrant Counties and the State of Texas to begin preserving large tracts of natural open space of the nonmanicured city or regional park type within metropolitan areas. This is where the people are, and this is where the open space is most urgently needed. In a region containing over 20 percent of the state's population, there should be no delay in moving ahead with a large scale open space program. The Trinity River Project can be the nucleus for a future regional open space preserve system.

<u>Purpose of the Study</u> - The purpose of this study is to determine through an ecological planning process the least environmental impact route for

the proposed Trinity multipurpose channel, and the influence on adjacent lands resulting from the alignment, construction and operation of the channel.

Statement of Objectives - The objectives of this study are as follows:

1. To develop and coordinate a prototypic plan for open space development of the Trinity River flood plain corridor through the Fort Worth-Dallas area. The needs and desires of the various governmental entities within this corridor form the nucleus for the conceptual plan. This includes the following steps:

a. To coordinate within this open space systems plan all existing open space plans of the governmental entities having territorial jurisdiction within the flood plain.

b. To examine the environmental features of the area including existing parks, potential open space lands, historical sites and ecological areas and their relationship to the routing of the proposed channel.

2. To investigate the prospects for the use of existing gravel pits within the river corridor for open space and other uses after their abandonment.

3. To identify ways and means to utilize excavated material to improve the economic and aesthetic value of existing reclaimed lands within the corridor.

Nature and Scope of the Investigation - The study reported herein was conducted by an interdisciplinary team of planners and engineers working through the Department of Park Administration and the Water Resources Center at Texas Tech University. A total of six disciplines participated in the study.* Collectively, this team assembled the base data, conducted aerial and ground surveys, reviewed existing resource reports, held meetings with representatives of the various public entities, analyzed and interpreted the data, examined alternatives, participated in several in-depth planning meetings and prepared the findings presented in this

*Recognized disciplines participating in the study included Forestry, Civil Engineering, Ecology, Landscape Architecture, City and Regional Planning, and Park Administration.

report.

Some of the specific areas considered by the study team are as follows:

1. Analysis of all of the natural features and processes within the Trinity River open space corridor, delineated by the existing flood plain and its environs.

2. Determination of the least environmental impact routing for the multipurpose channel through the corridor. This was based on certain engineering constants such as radius of curve, depth, width, existing river crossings, location of locks and dams, and location of permanent structures.

3. Evaluation of additional lands within the river environs which should be included in the open space corridor to protect and enhance the river ecology and aesthetic integrity, particularly in those areas where the multipurpose channel departs from the existing river course.

4. Identification of those lands within each governmental jurisdiction throughout the study area which would fall within the corridor to determine the basis for establishing priorities for acquisition and regulation of land use within the area delineated as the Trinity River Greenway.

5. Determination of the feasibility for the use of abandoned sand and gravel mines for fill sites for excavation material and of how these sites, once filled, can be incorporated into the comprehensive land use plan for the greenway and contiguous lands.

6. Determination of those areas of the existing river course which will not be part of the multipurpose channel, but which, for purposes of ecology, aesthetics and potential recreational use, should be maintained at a natural volume of flow.

7. Suggestions of measures to be undertaken to implement the proposed plan.

AREA UNDER STUDY

General Characteristics- Located in the Trinity River Basin, as shown in Figure 1, the study area consists of approximately 70 river miles from the vicinity of Beach Street in East Fort Worth to the Club Lakes southeast of Dallas. For planning purposes, the study area was divided from west to east into seven sectors bounded by major road crossings as illustrated in Figure 2.

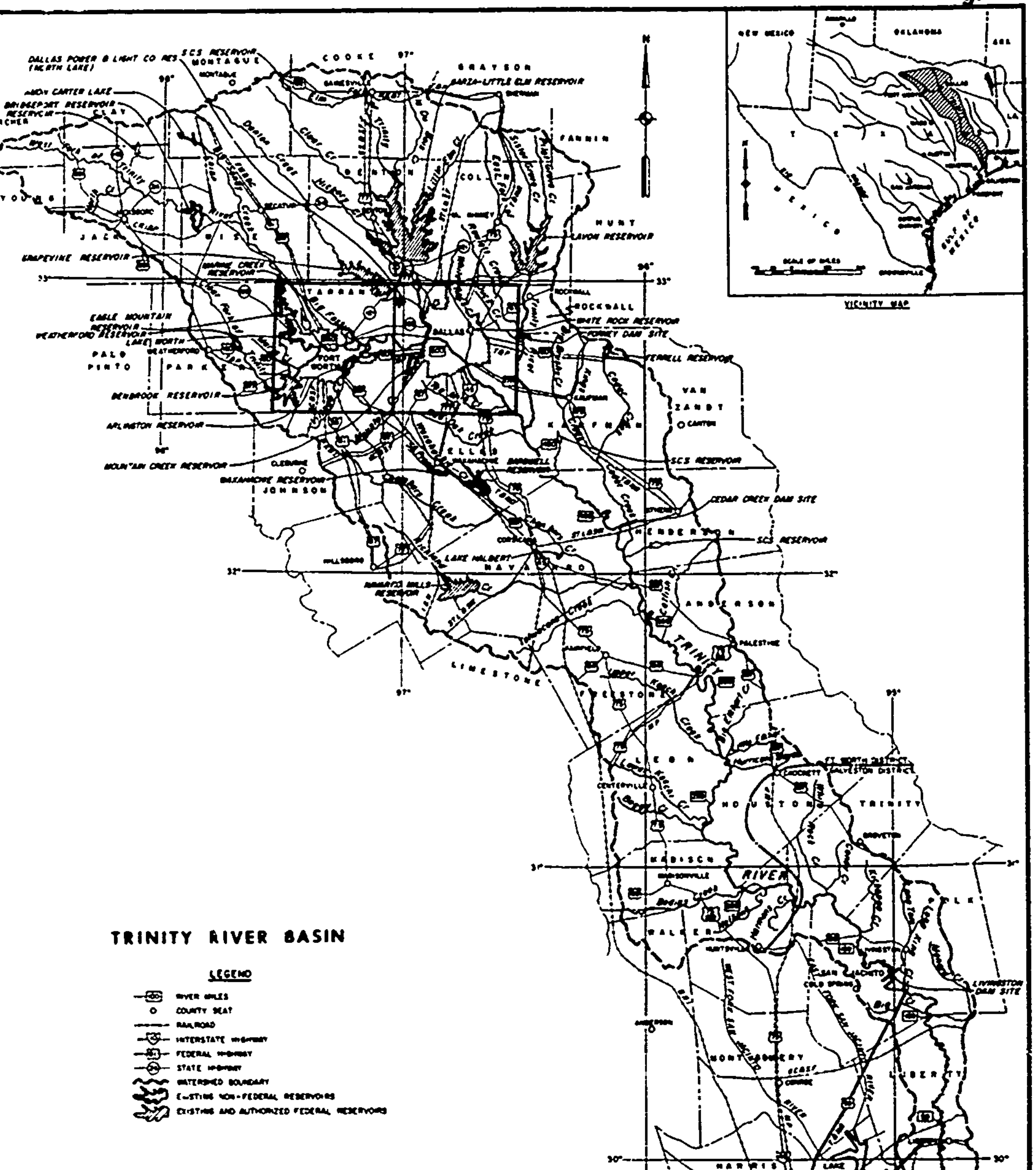
1. From Beach Street (just west of the Riverside Sewage Treatment Plant) to Loop 820 (east)
2. From Loop 820 to F.M. 157
3. From F.M. 157 to Belt Line Road
4. From Belt Line Road to Loop 12 (west)
5. From Loop 12 to the Santa Fe Railroad Bridge
6. From the Santa Fe Bridge to Loop 12 (southeast)
7. From Loop 12 to Dowdy Ferry Road (running between the two Club Lakes)

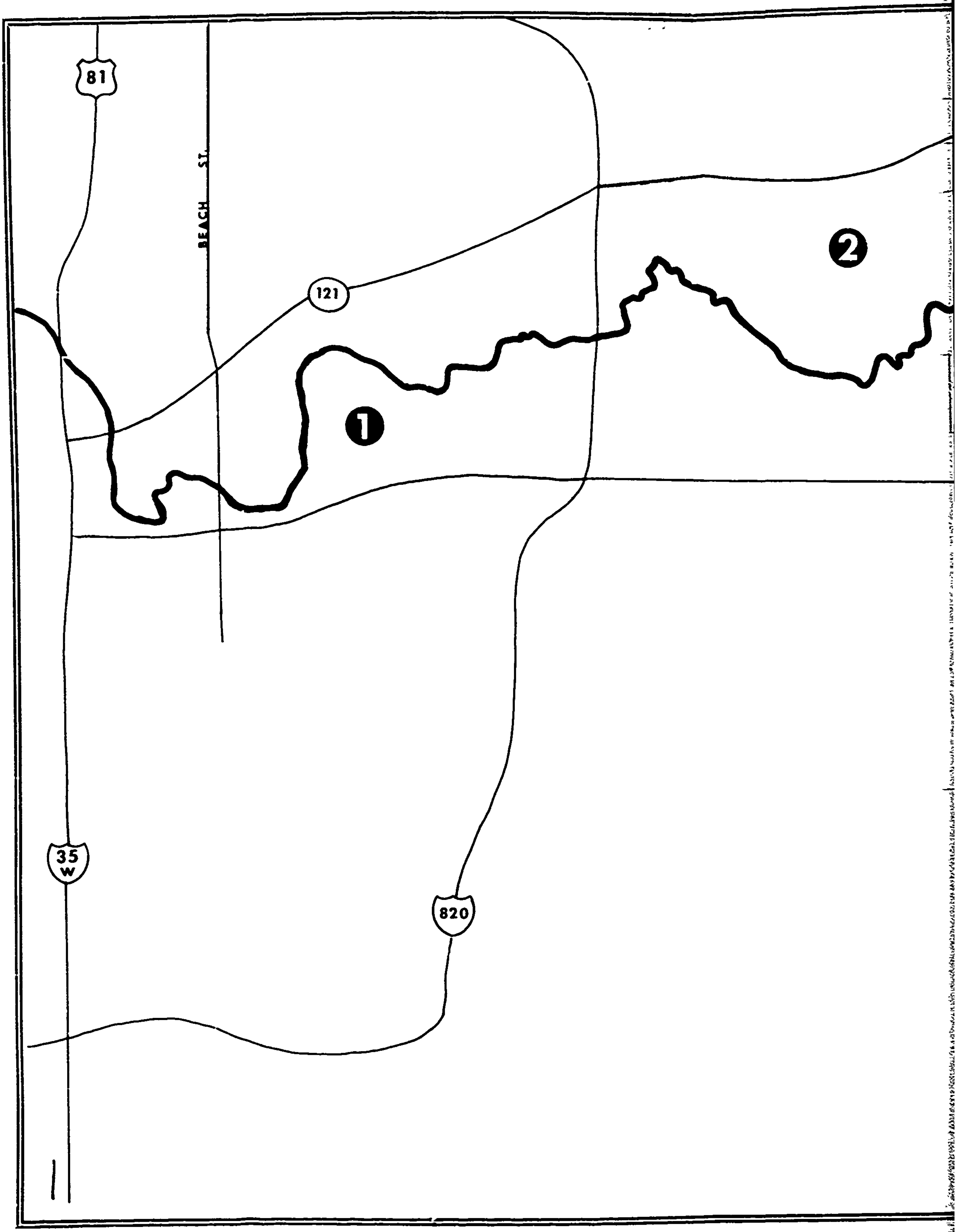
Generally, the "horizontal" limits of the study area on the West Fork are marked by Highways 121 and 183 to the north, and the Fort Worth-Dallas Turnpike to the south. Through Dallas, the sector is adjacent and parallel to the Floodway. To the southeast, it flares out to include most of the undeveloped lands between Interstate 45 to U.S. Highway 175.

Physical Description - Generally, the West Fork of the Trinity forms a relatively lineal and somewhat narrow corridor from its origins in Archer County to its junction with the main stem at the confluence of the Elm Fork in Dallas County. Topographically, the plain is gently rolling to broken between Fort Worth and Dallas and flat to gently rolling from Dallas to the area of the Club Lakes and beyond to its terminus at Galveston.

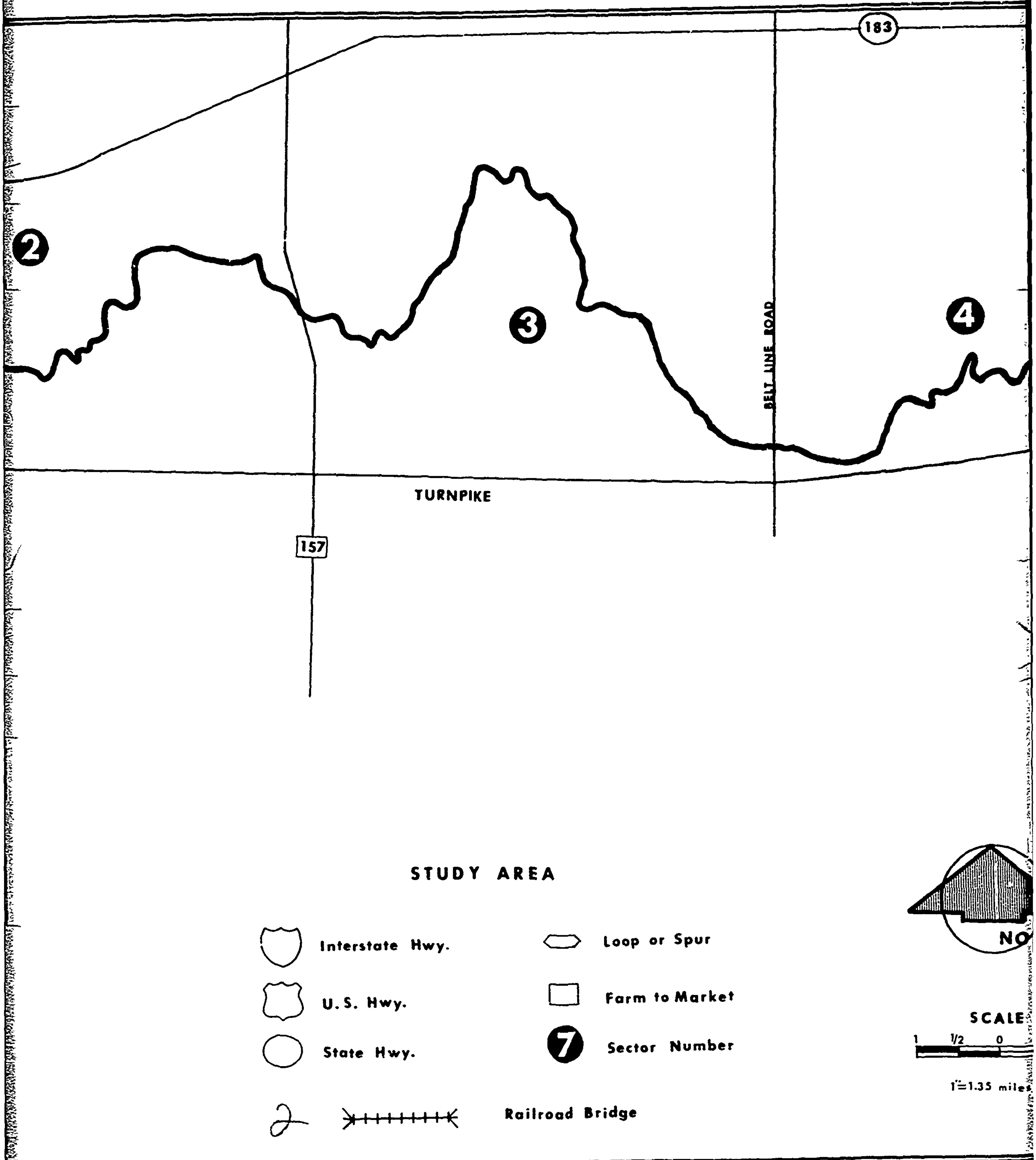
The southern most extension of the West Fork's flood plain is stabilized by the high bluffs running southeast from just east of Fort Worth to the vicinity of the western boundary of Grand Prairie. Here, the land begins to level out forming a gently rolling configuration. North of the river and extending eastward by southeastward the land form is flattened considerably with some small ridges and high points in the area just west of Dallas extending eastwardly to north of Arlington in the vicinity of Hurst. Figure 3 conceptually shows the major topographic features of the study area.

Fig. 1


TRINITY RIVER BASIN
LEGEND
RIVER MILES
COUNTY SEAT
RAILROAD
INTERSTATE HIGHWAY
FEDERAL HIGHWAY
STATE HIGHWAY
WATERSHED BOUNDARY
EXISTING NON-FEDERAL RESERVOIRS
EXISTING AND AUTHORIZED FEDERAL RESERVOIRS
VICINITY MAP
TRINITY RIVER
WATERSHED MAP
DALLAS
FORT WORTH
HOUSTON
GULF OF MEXICO
LIVINGSTON DAM SITE
CEDAR CREEK DAM SITE



81
BEACH ST.
121
2
1
35 W
820


183
2
3
4
BELT LINE ROAD
TURNPIKE
157
STUDY AREA
Interstate Hwy.
Loop or Spur
U. S. Hwy.
Farm to Market
State Hwy.
7
Sector Number
Railroad Bridge
SCALE
1
1/2
0
1"=1.35 miles

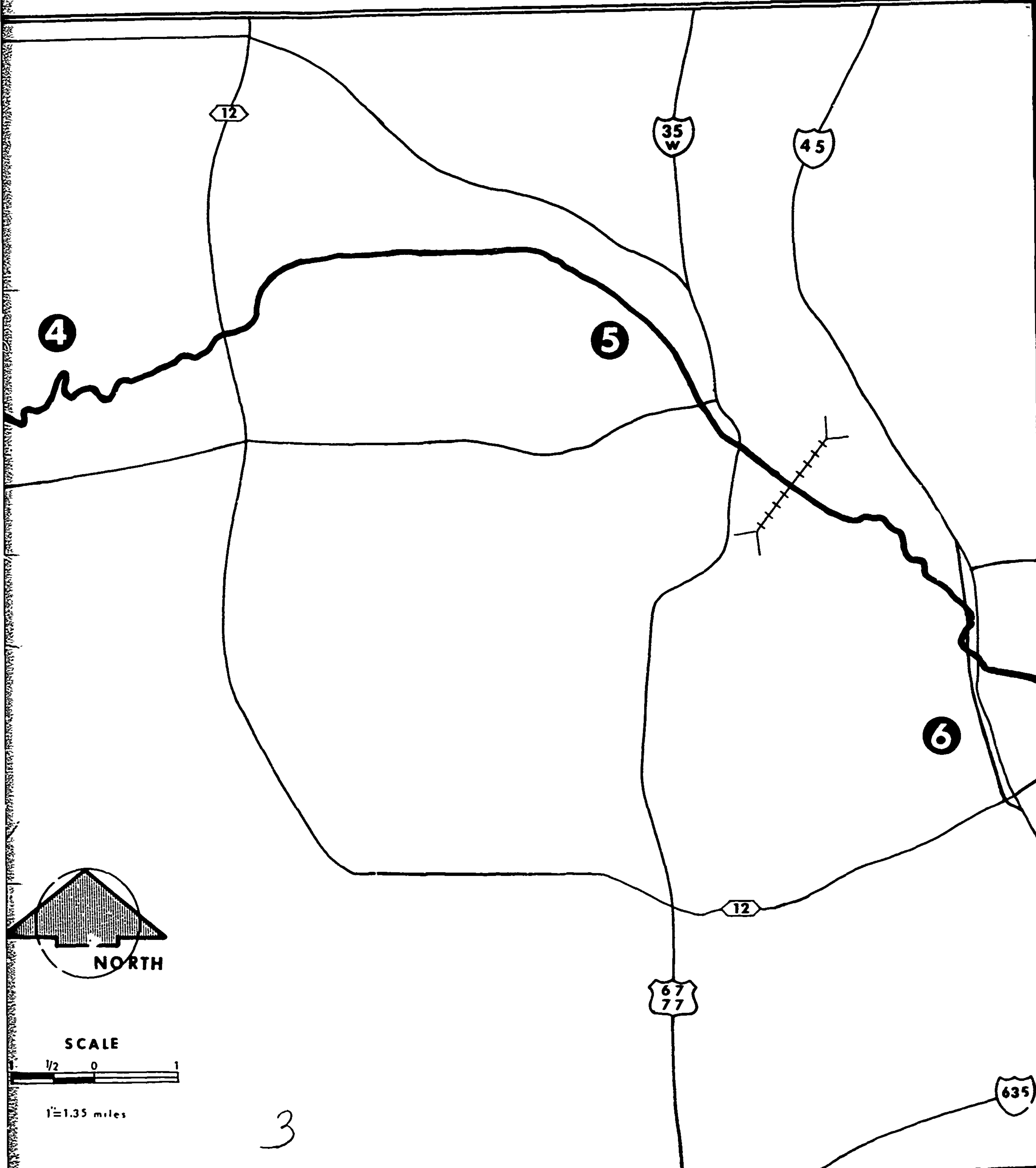
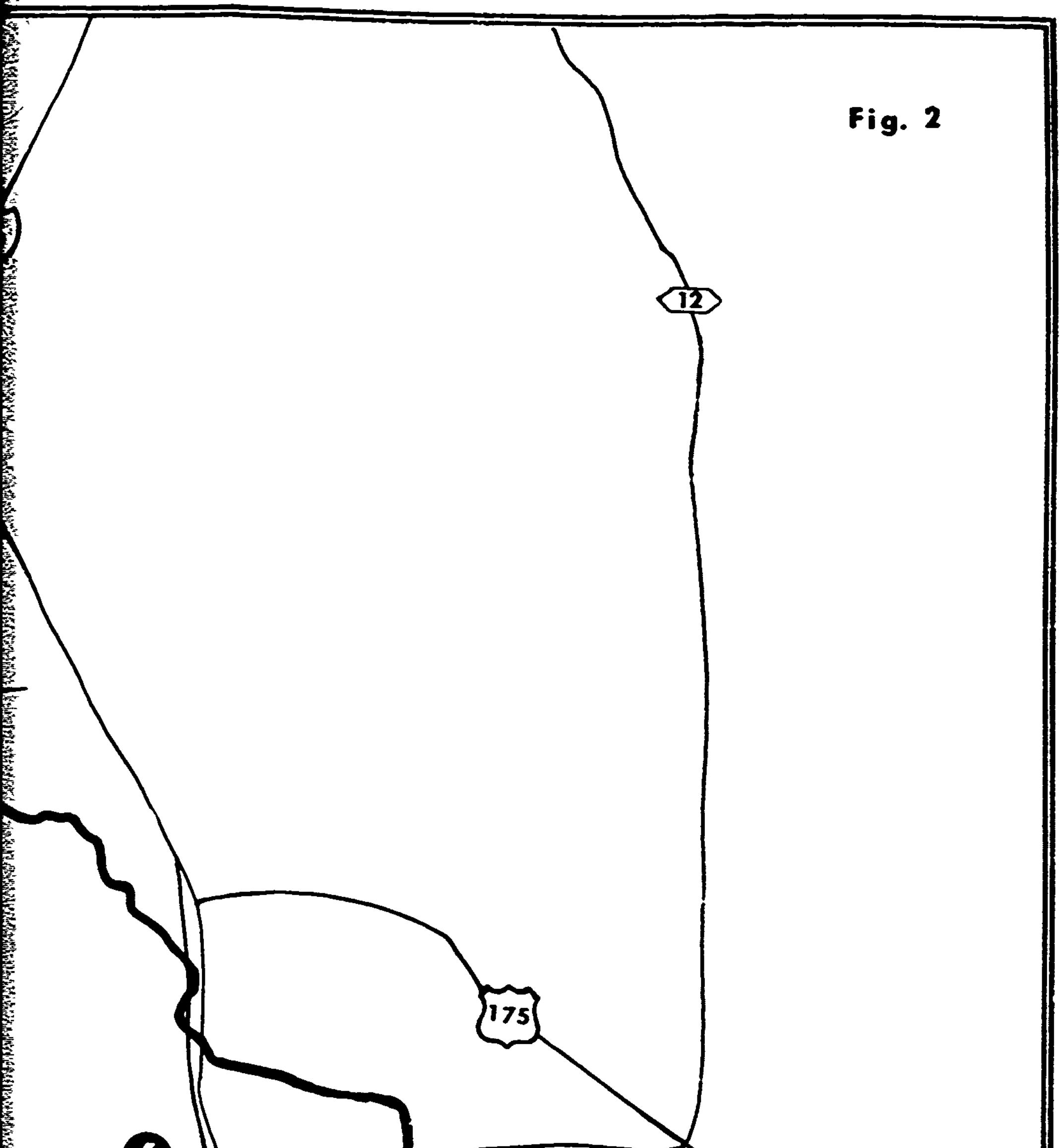
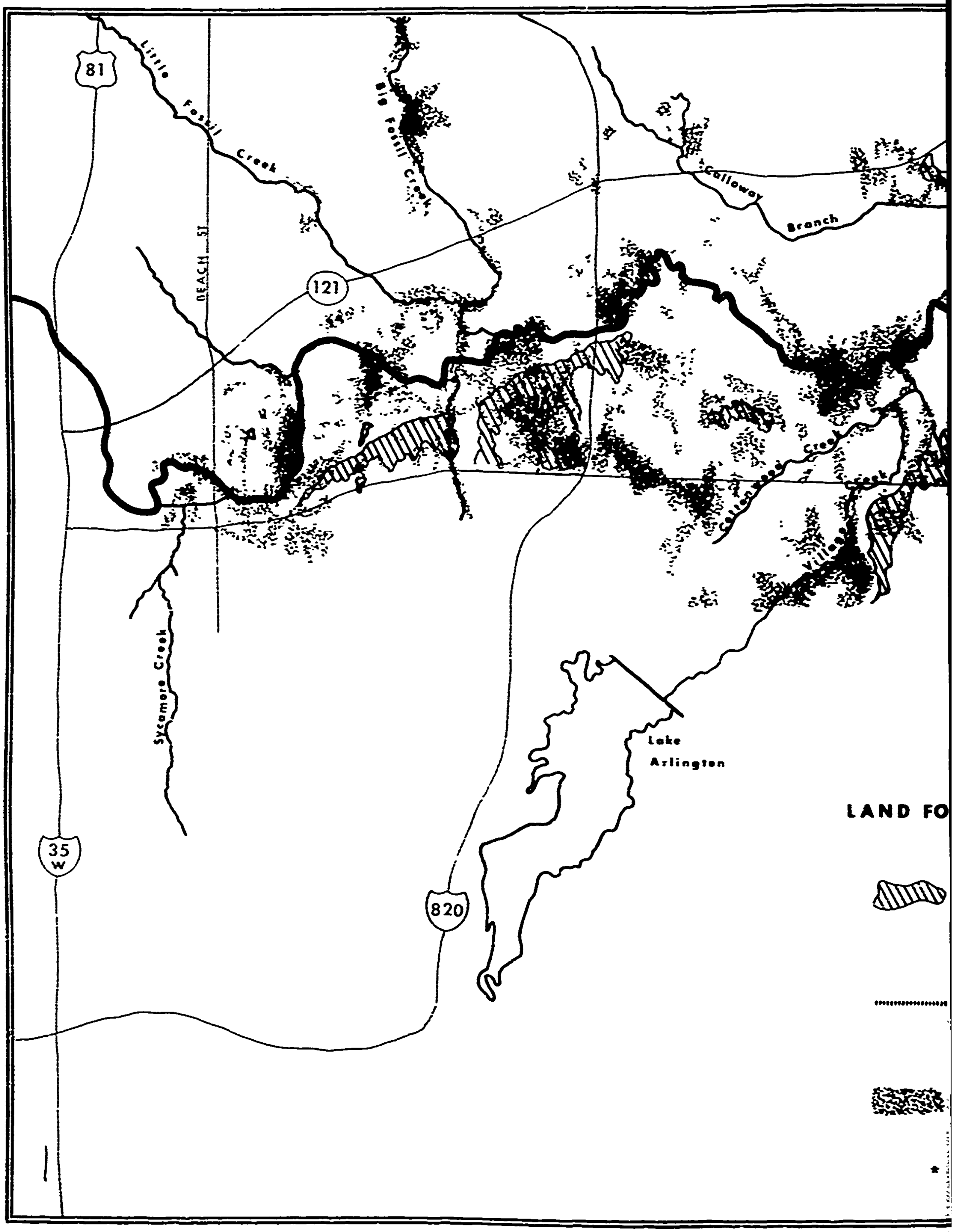
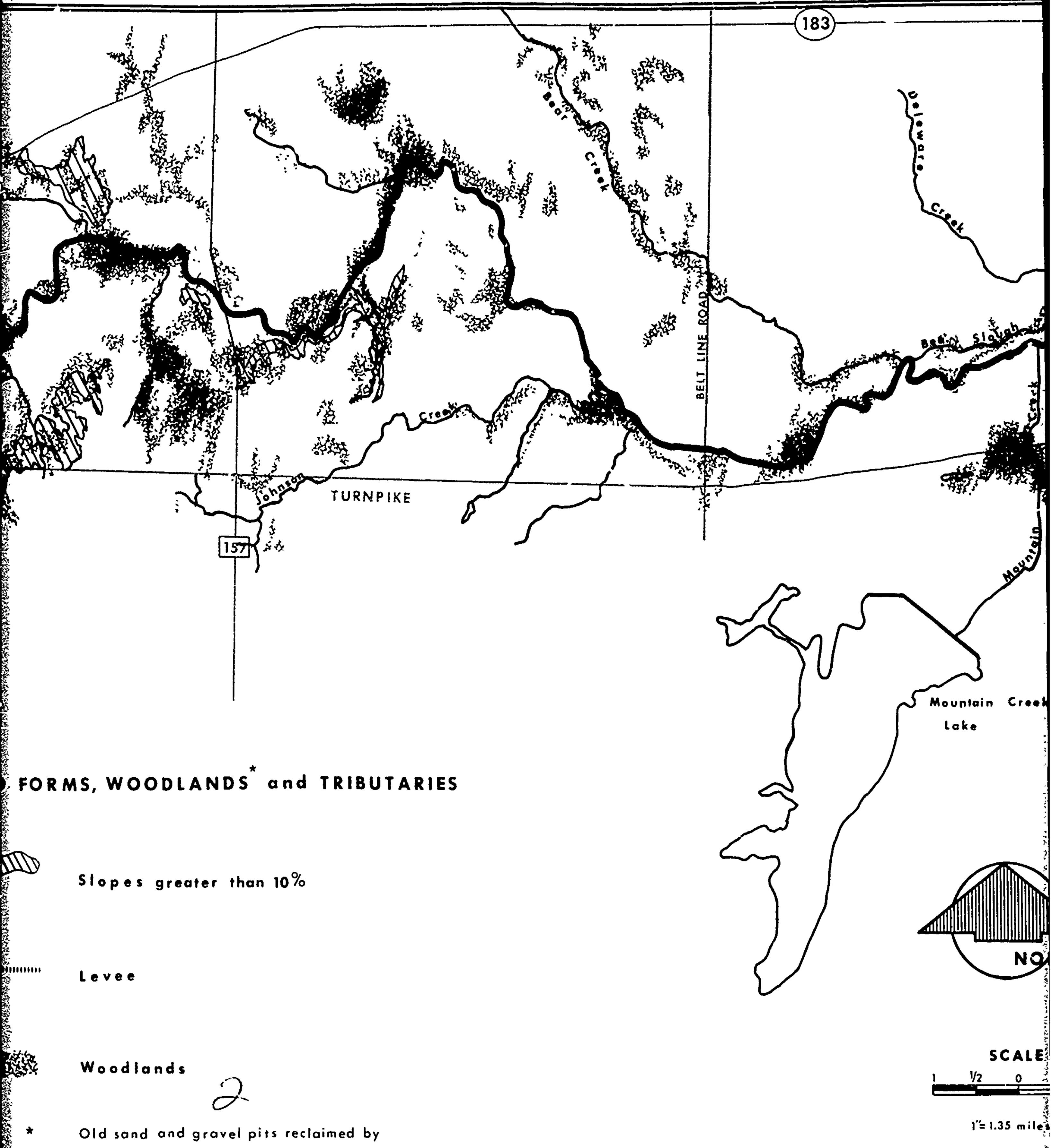

12
35 W
45
4
5
6
12
67 77
635
NORTH
SCALE
1 1/2 0 1
1"=1.35 miles
3

Fig. 2

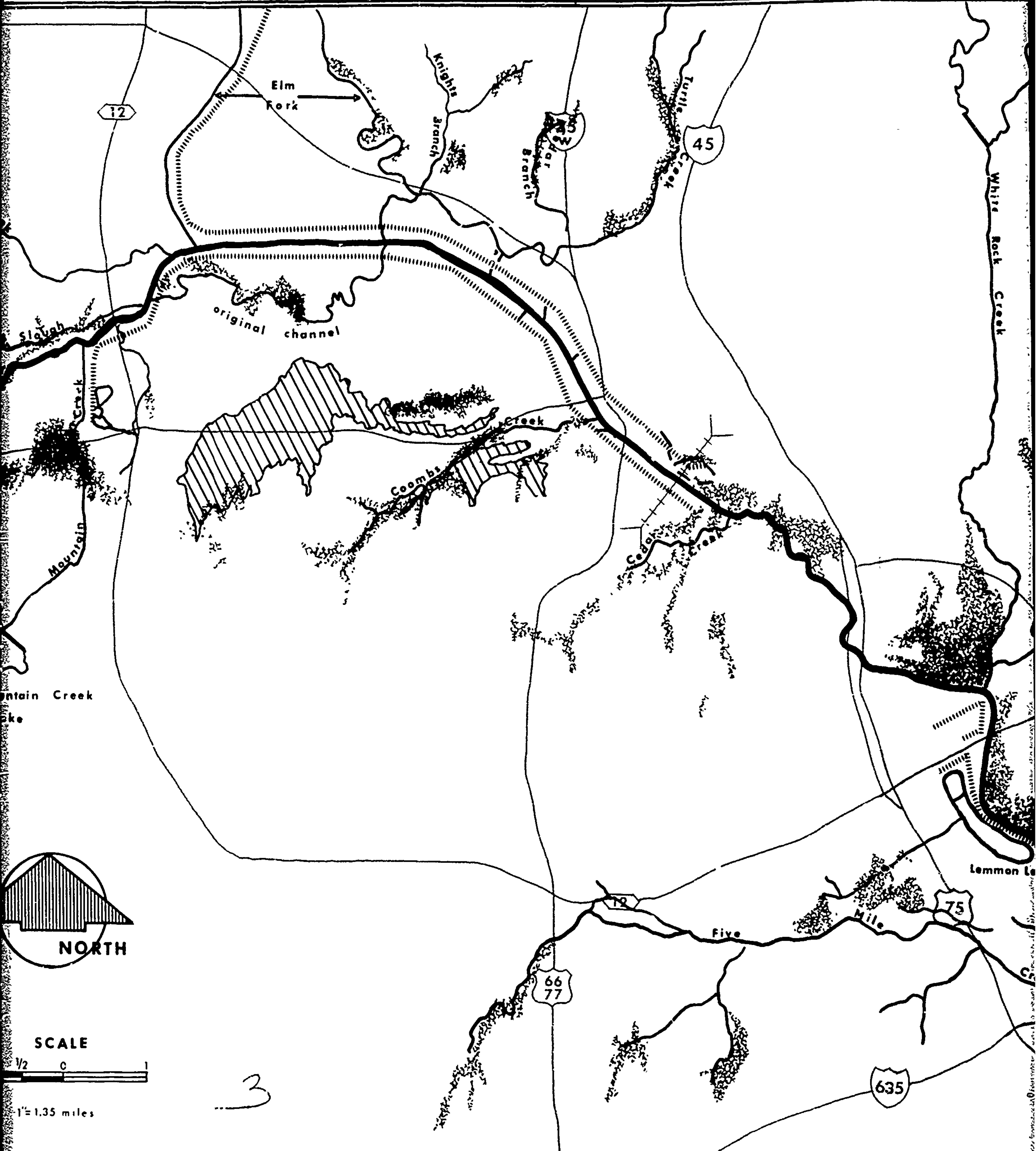



81
Little Fossil Creek
Big Fossil Creek
BEACH ST
121
Calloway Branch
Cottonwood Creek
Village Creek
Sycamore Creek
Lake Arlington
LAND FO
35 W
820



183
Bear Creek
Delaware Creek
Bear Slough
BELT LINE ROAD
Creek
Johnson
TURNPIKE
157
Mountain Creek
Mountain Creek Lake
FORMS, WOODLANDS* and TRIBUTARIES
Slopes greater than 10%
Levee
Woodlands
* Old sand and gravel pits reclaimed by vegetation are not shown as woodlands.
SCALE
1 1/2 0
1" = 1.35 miles
NO

2



Elm
Fork
12
Knights
Branch
Cedar
Branch
45
Turtle
Creek
45
White
Rock
Creek
Slough
original
channel
Creek
Mountain
Coombs
Creek
Cedar
Creek
ntain Creek
ake
NORTH
SCALE
1/2
0
1
1" = 1.35 miles
3
12
Five
Mile
75
Lemmon L
66
77
635

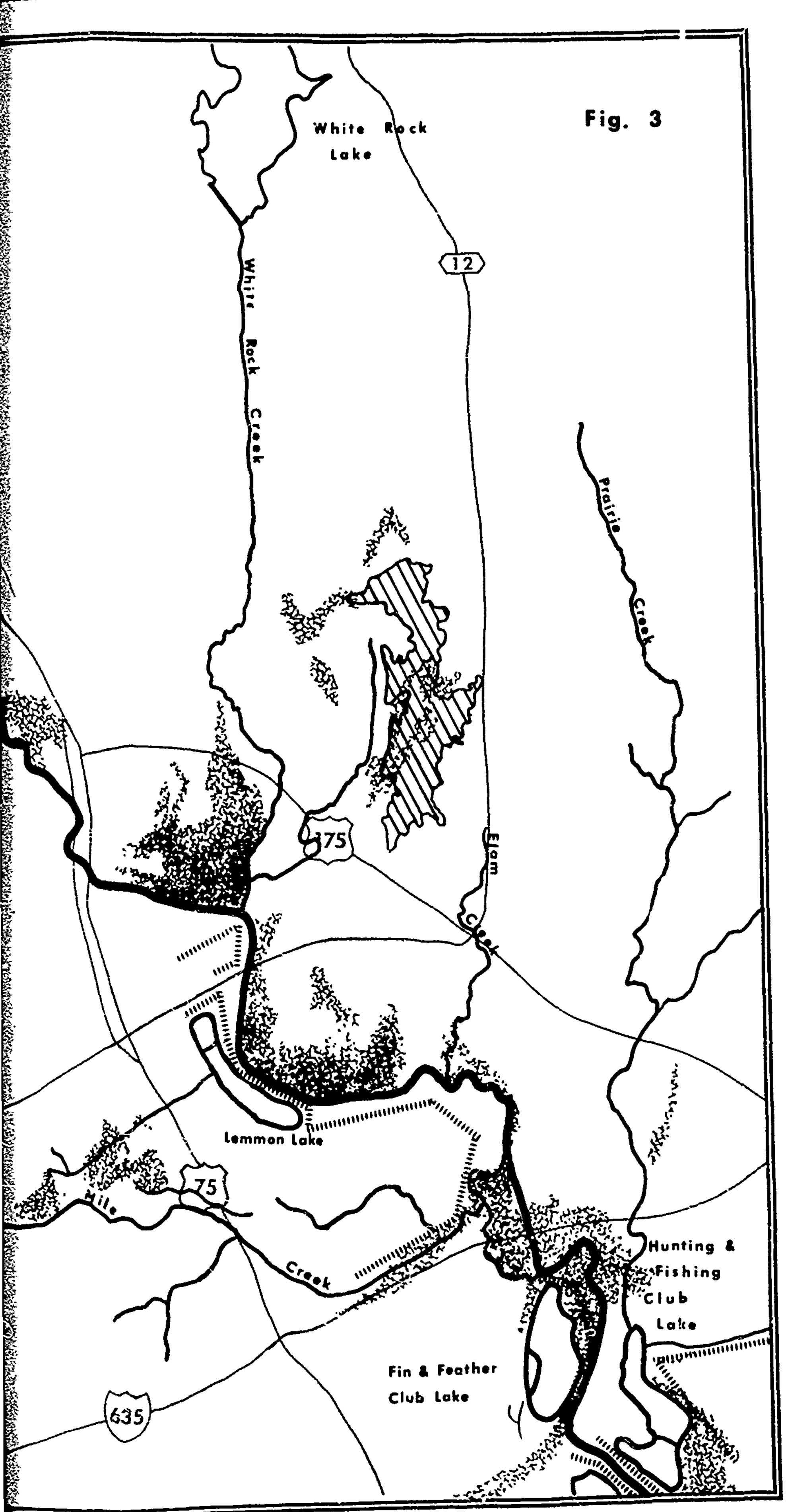


Fig. 3
White Rock Lake
12
White Rock Creek
Prairie Creek
175
Elam Creek
Lemmon Lake
75
Mile Creek
Hunting & Fishing Club Lake
Fin & Feather Club Lake
635

Nearly all of the Trinity Basin, including the study area, lies within the geologic formation known as the Coastal Plain Physiographic Province.[1] This formation, of recent origin, has weathered considerably and is characterized by meandering and generally sluggish streams. Survey data indicates the river channel has drifted considerably through the formation, accounting for the extensive sand and gravel deposits found within the alluvial plain. The massive Grand Prairie deposit to the south of the flood plain is part of this extensive formation. Frequent flooding which characterizes the Trinity River has considerably shifted the course of the river over the centuries. Thus, a broad plain and numerous old river bottom channels are found throughout the basin. A vivid example of the meandering river course is seen in Figure 4, a high-altitude view of the area approximately eight miles east of downtown Fort Worth. This natural aging process of the river partially accounts for the existing topographic configuration, soils, vegetation and other natural characteristics found within the study area.

Soils - The three major soils groups found in the study area lay in what can best be described as roughly parallel north-south bands. The Grand Prairie Soils are found from about the center of Tarrant County and westward. The East Cross Timbers Soils are found east of the Grand Prairie group up to near the Tarrant-Dallas County line. All of Dallas County falls within the Blackland Prairie Soils.[2] The soils in the study area originated from the Austin Chalk, Eagle Ford Shale, Main Street Limestone, Grayson Shale, and Woodbine geologic formations.[3,4]

Soils of the study area are, for the most part, alluvial materials deposited by waters of the river basin over the years. The three soils groups are classified into fourteen associations shown on Figure 5 and listed and described in Table 1.[5] The various soil associations are broken into three general categories: (a) flood plain soils; (b) river terrace soils, and (c) upland soils.

Each association is composed of numerous soil series. These are more detailed soil descriptions which delineate land capability and suitablilty for specific uses. Table 2 lists all of the soil series identified within the study area and indicates in which planning sector(s) they are found. Soil capabilities for various recreational uses are discussed in later sections of the report.

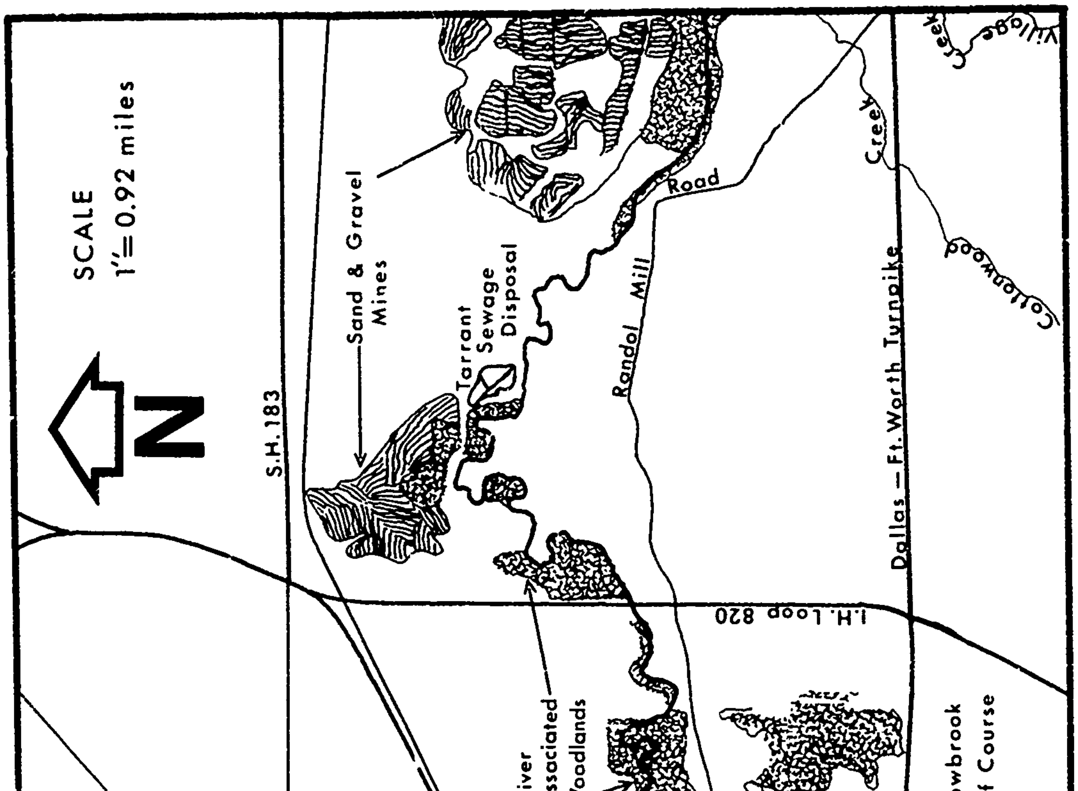


Figure 4. Section of the Study Area East of Downtown Fort Worth - High-Altitude Infrared Imagery. A Zeiss 5L sensor on a N.A.S.A. reconnaissance aircraft recorded this image in October 1969 from an altitude of approximately 59,000 feet.

TABLE 1

SOIL ASSOCIATIONS OF THE STUDY AREA

Flood Plains - associations of very deep river bottom soils:

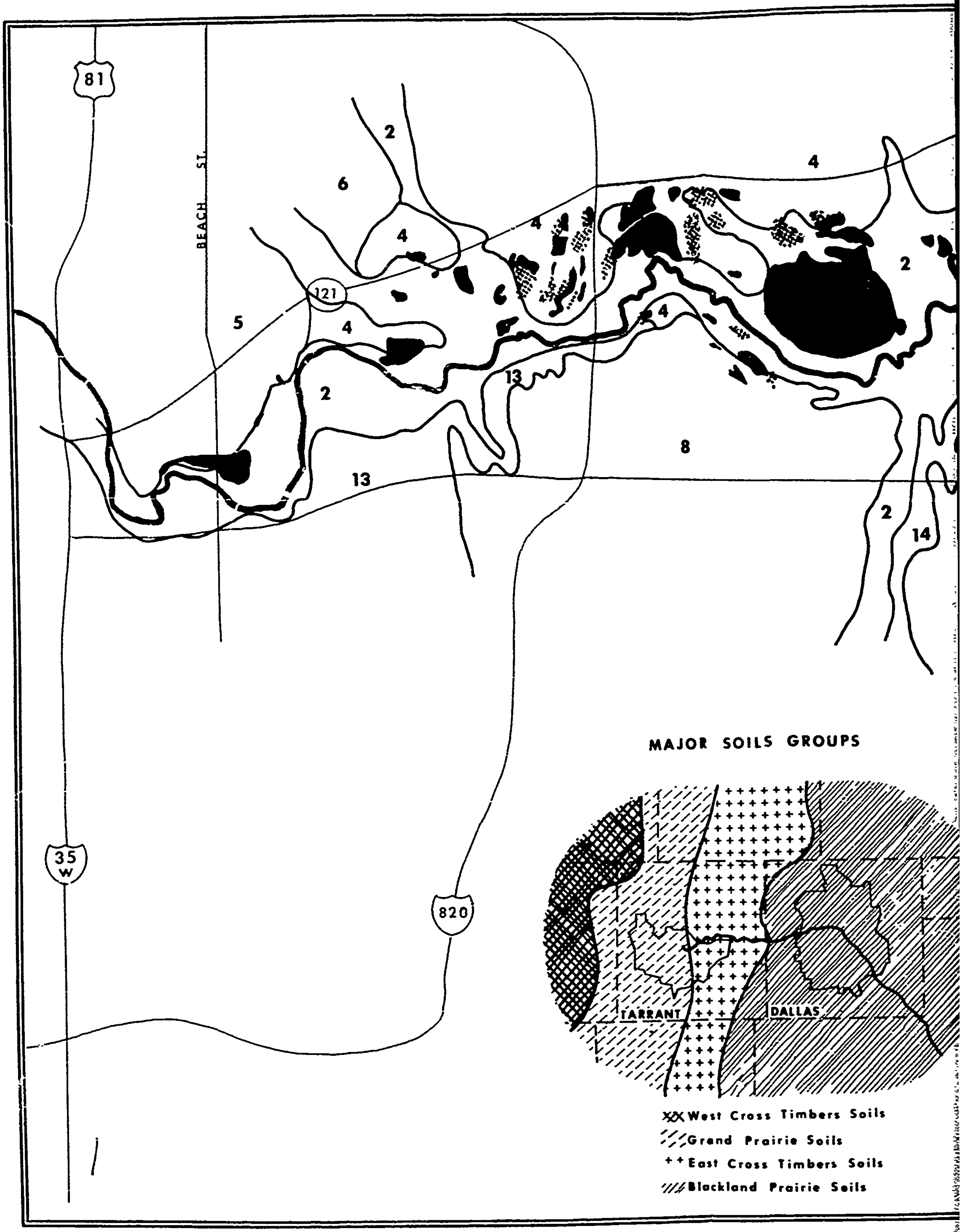
1. Trinity: nearly level bottomland soils.
2. Frio: nearly level bottomland soils.

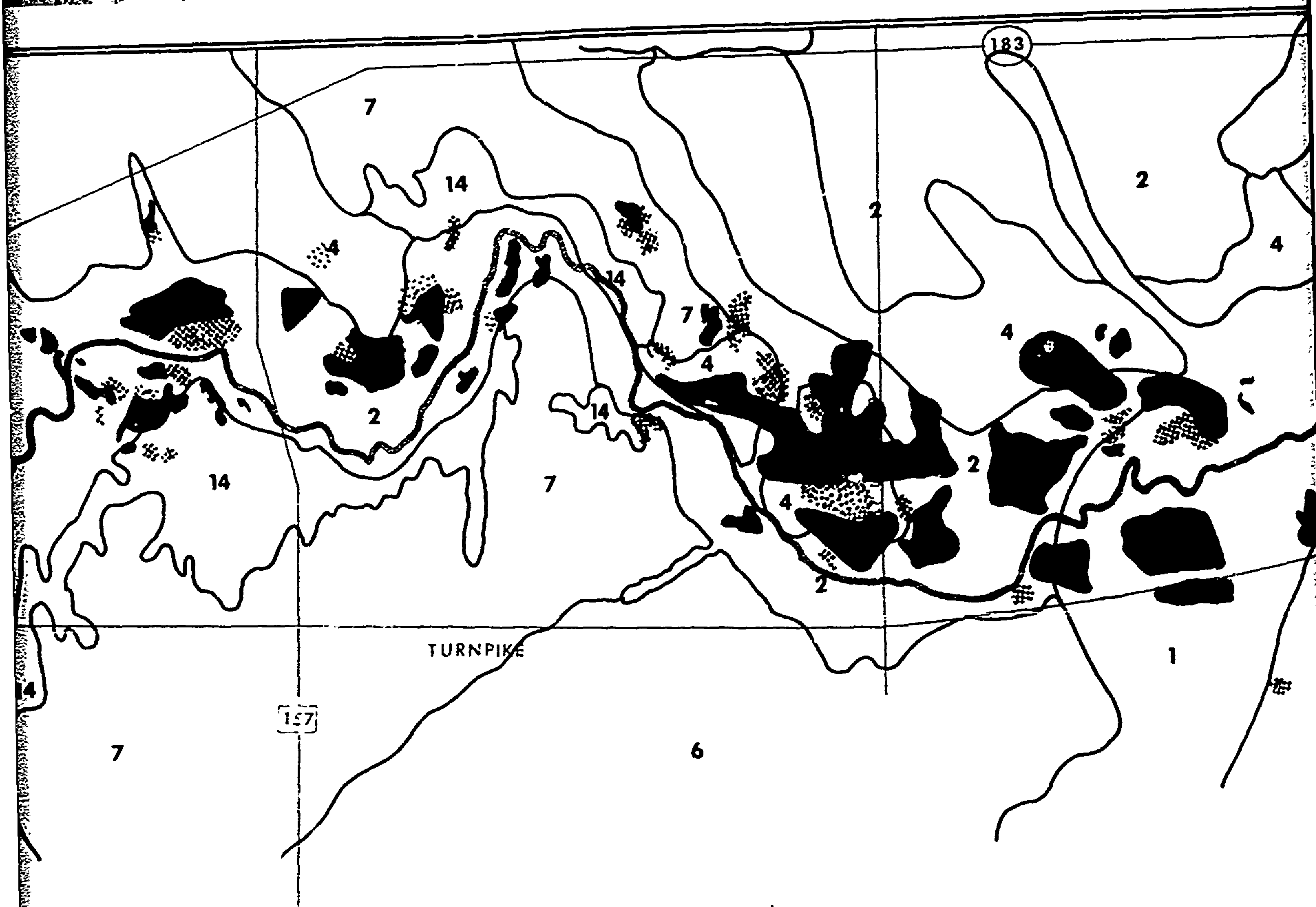
River Terraces - deep soils associations:

3. Axtell - Crockett: nearly level to sloping soils with loamy surface layers and clayey lower layers.
4. Konawa - Bastrop: nearly level to sloping loamy soils.
5. Stidham - Dougherty: nearly level to gently sloping sandy loam soils.

Uplands - deep to shallow soils associations:

6. Houston Black - Heiden: nearly level to sloping clayey soils.
7. Crockett - Konawa: nearly level to sloping loamy soils.
8. Truce - Bonti: gently sloping to hilly loamy soils.
9. Ferris - Heiden - Ellis: sloping to steeply sloping clayey soils.
10. Austin - Dalco: gently sloping calcareous clayey soils over chalk.
11. Stephen - Austin: gently sloping clayey soils over chalk.
12. Eddy - Brackett: gently to steeply sloping loamy soils.
13. Purves - Brackett: sloping to steeply sloping calcareous soils over limestone.
14. Truce - Bonti - Exray: sloping to steeply sloping loamy soils.


81
BEACH ST.
2
6
4
121
5
4
2
4
4
13
13
8
4
2
2
14
35 W
820
MAJOR SOILS GROUPS
TARRANT
DALLAS
West Cross Timbers Soils
Grand Prairie Soils
East Cross Timbers Soils
Blackland Prairie Soils



SOIL ASSOCIATIONS*

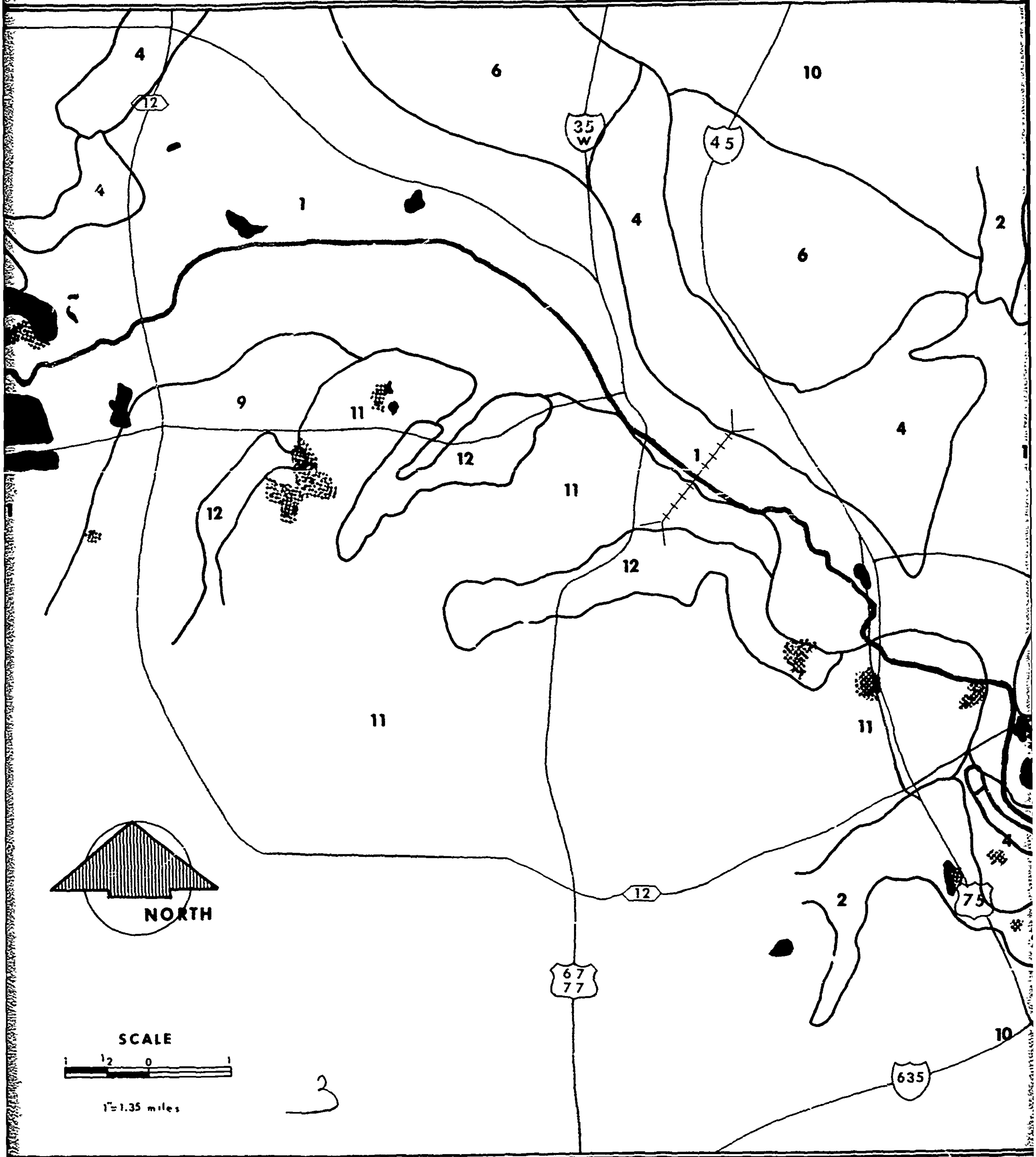
1-Trinity
2-Frio
3-Axtell-Crockett
4-Konawa-Bastrop
5-Stidham-Dougherty
6-Houston Black-Heiden
7-Crockett-Konawa
8-Truce-Bonti
9-Ferris-Heiden-Ellis
10-Austin-Dalco
11-Stephen-Austin
12-Eddy-Brackett
13-Purves-Brackett
14-Truce-Bonti-Exray

Recent or Active sand & gravel mines

Inactive sand & gravel mines

* This map is general and subject to change when the detailed soils surveys for Tarrant and Dallas County are completed and published.

2



4
12
4
1
6
35 W
45
10
4
2
6
9
11
12
1
11
4
12
12
11
11
4
2
75
67 77
12
NORTH
SCALE
1 1/2 0 1
1"=1.35 miles
10
635

3

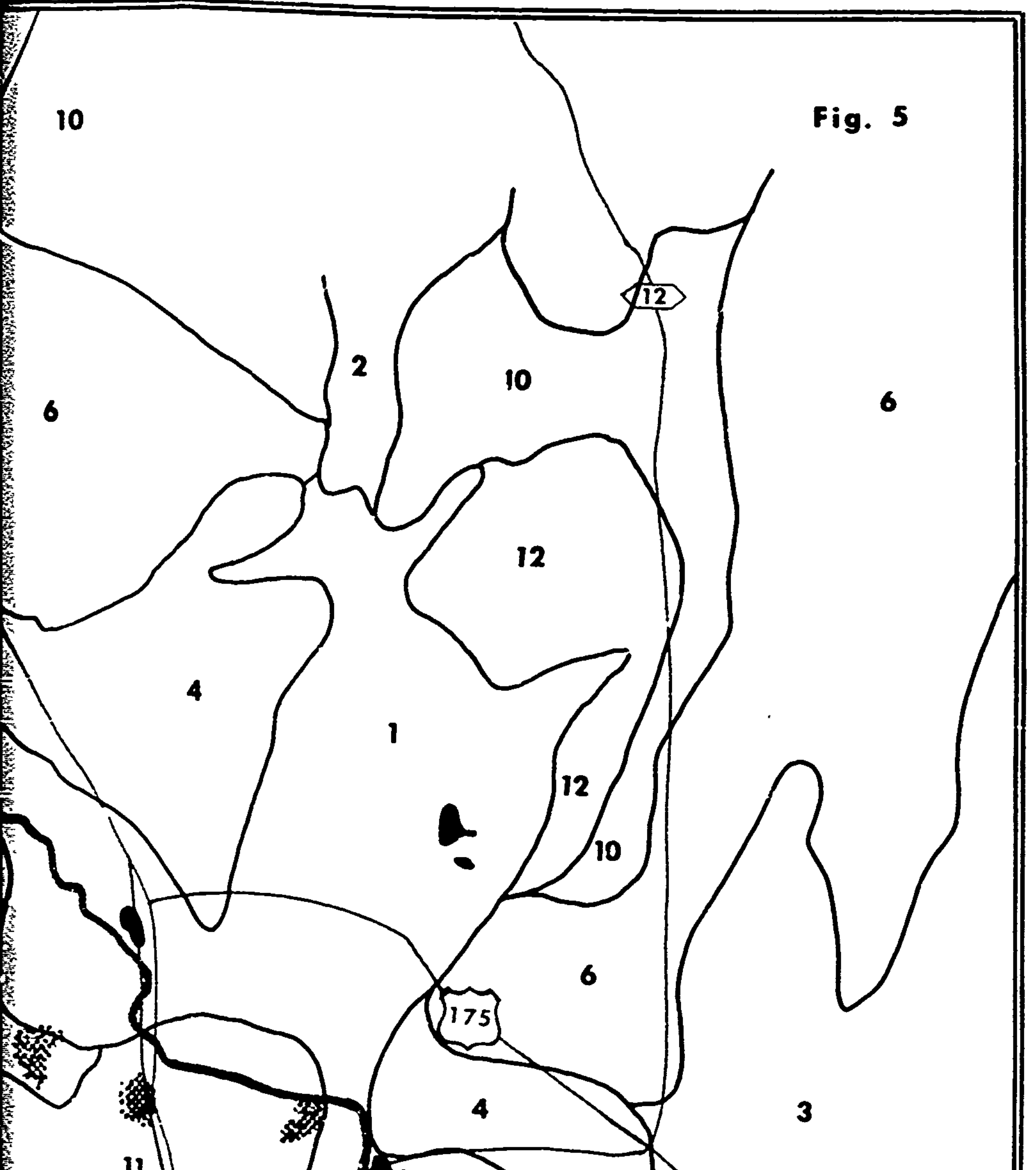


Fig. 5
10
2
10
6
6
12
4
1
12
10
6
175
4
3
11
4
4
2
75
2
10
635
6
4

TABLE 2

SOIL SERIES OF THE STUDY AREA*

Soil Mapping Code	Series name, description, and % of slope	Sector (s) 1	2	3	4	5	6	7
2A	Wilson Clay loam, 0-1%	x		x			x	x
B	" " " , 0-3%			x		x	x	x
5B	Normangee Crockett clay loam, 1-3%			x				
6A	Burleson clay, 0-1%						x	x
9A	Houston Black Clay, 0-1%							x
B	" " " , 1-3%						x	x
BC3	" " " , 2-5%, eroded			x				
12B	Heiden clay, 1-3%		x	x			x	
BC3	" " , 2-5%, eroded		x	x		x	x	
D3	" " , 5-8%, eroded				x			
14B	Bonham clay loam, 1-3%		x					
16B	Austin silty clay, 1-3%							x
BC3	" " " , 1-5%, eroded							x
D3	" " " , 5-8%, eroded							x
18B	Lewisville silty clay, 1-3%			x		x	x	x
C	" " " , 3-5%						x	x
BC3	" " " , 2-5%, eroded			x			x	
D	" " " , 5-8%							x
20	Bolar stony clay loam, 1-8%	x	x					
22	Purves stony soils, 12-20%	x						
24	Trinity clay, 0-1%	x	x	x	x	x	x	x
25	Trinity clay, 0-1%, frequently flooded	x	x	x	x	x	x	x
26	Gowen clay loam		x		x	x		
27	Gowen clay loam, frequently flooded		x					
28	Trinity clay, shallow over sand	x	x	x				
29BC3	Crockett soils, 2-5%, eroded			x				
BD4	" " , 2-7%, severely eroded			x				
31	Frio clay loam, 0-1%	x	x	x	x			
32	Frio clay loam, frequently flooded	x	x	x	x	x	x	x
36A	Wilson fine sandy loam, 0-1%		x	x	x		x	x
B	" " " " , 1-3%	x	x	x	x		x	
CB3	" " " " , 3-8%, eroded		x					
37A	Crockett fine sandy loam, 0-1%		x	x				
B	" " " " , 1-3%		x	x		x		x
C	" " " " , 3-5%			x				
BC3	" " " " , 1-5%, eroded					x		
41A	Axtell fine sandy loam, 0-1%			x	x		x	x
B	" " " " , 1-3%			x	x	x	x	x
BC3	" " " " , 1-5%, eroded			x				x
45B	Travis fine sandy loam, 1-3%		x	x	x		x	x
C	" " " " , 3-5%			x				
BC3	" " " " , 2-5%, eroded		x	x	x			x
D	" " " " , 5-8%			x				
D3	" " " " , 5-8%, eroded			x				
46B	Bonham fine sandy loam, 1-3%			x				
D3	" " " " , 5-8%, eroded			x				
48B	Freestone fine sandy loam, 1-3%		x	x				
BC	" " " " , 1-5%		x					
BC3	" " " " , 2-5%, eroded		x		x			
49A	Galey fine sandy loam, 0-1%			x	x			
B	" " " " , 1-3%		x	x	x			x
C	" " " " , 3-5%		x		x			
CD	" " " " , 3-8%			x			x	x
CD3	" " " " , 3-8%, eroded		x	x	x		x	
50A	Konawa fine sandy loam, 0-1%				x	x	x	x
B	" " " " , 1-3%	x	x	x	x	x	x	x
BC3	" " " " , 2-5%, eroded	x		x	x		x	x
CD	" " " " , 3-8%		x	x	x		x	x
D3	" " " " , 5-8%, eroded	x	x	x	x		x	x
51AB	Bastrop fine sandy loam, 0-3%		x	x	x		x	x
CD	" " " " , 3-8%	x				x		x
CD3	" " " " , 3-8%, eroded		x					

(continued on next page)

Soils Mapping Code	Series name, description, and % of slope	Sector (s) 1	2	3	4	5	6	7
60	Gowen fine sandy loam			x				x
62	Zavala fine sandy loam		x	x				x
64	Guadalupe fine sandy loam	x	x	x			x	
65	mixed alluvial land, frequently flooded		x		x		x	x
68	Tabor fine sandy loam, 0-3%		x					
70A	Bastrop loamy fine sand	x	x					
71A	Galey loamy fine sand, 1-5%	x	x	x				
D	" " " " , 5-8%	x						
73AB	Dougherty loamy fine sand, 0-3%			x	x	x	x	x
BC	" " " " , 1-5%	x	x	x	x	x	x	x
D	" " " " , 5-8%	x	x	x	x	x	x	x
76BC	Stidham loamy fine sand, 1-5%		x	x	x			x
CD	" " " ", 3-8%				x	x		x
D	" " " ",5-8%	x	x					
78	Eufaula loamy fine sand, 0-5%					x		
D	" " " " , 5-8%			x				
80BC	Konawa loamy fine sand, 1-5%		x	x				
D	" " " " , 5-8%			x				
91	Heiden Ferris clays, 5-12%, eroded	x	x	x		x		
92CD	Eddy silty clay, 3-8%							x
EF	" " " , 8-20%						x	x
94BC	Maloterre stony clay, 1-5%	x						
95FG	Brackett soils, 12-20%	x						
97	gullied land			x				
99	reclaimed gravel pits	x	x	x				
100BC	Tarrant stony clay, 1-5%	x						
101BC	Nimrod loamy fine sand, thin surface, 1-5%			x				
108CF	Brackett clay loam, 2-5%						x	
DF	" soils, 5-20%							x
110	Bonti-Exray soils, 5-15%	x	x	x				
111	Galey loamy alluvium, 2-12%		x	x				
116	Lamar soils		x	x				
118C	Venus clay loam, 3-5%		x					
146A	Tipton clay loam, 0-1%							x
B	" " " , 1-3%							x
200	Austin-Eddy silty clays							x

*Information in this table was extracted from aerial photographs marked with soil series symbols. Mapping photos were supplied by the Fort Worth office of the Soil Conservation Service, U.S. Department of Agriculture.

TABLE 3

LAND USE SUITABILITY AND DETAILED DESCRIPTIONS OF SOIL ASSOCIATIONS IN THE STUDY AREA*

1. Trinity: This is an area of nearly level, moderately well to somewhat poorly drained calcareous clayey bottomland soils of flood plains of the Trinity River and its larger tributaries. The soils in this association are used mostly for pasture and cropland with a few levee-protected areas in industrial and urban use. The Trinity soils which are calcareous make up about 95 percent of the association. They have a very dark gray clay surface layer and dark gray clayey lower layers. Some areas of these soils are underlain at 6 to 20 feet by sand or gravel. The remaining 5 percent of this association consists of crumbly soils of bottomlands and loamy and sandy soils of low terraces.

2. Frio: This is an area of nearly level, well drained, calcareous, crumbly clay loam bottomland soils. The soils in this association are used mostly for pasture. The Frio soils of the flood plains of both large and small streams make up about 60 percent of this association. They have a dark grayish brown clay loam or silty clay loam surface layer and brown silty clay or clay loam lower layer. They are crumbly and calcareous throughout. The remaining 40 percent of this association consists of soils of bottomlands that are similar but noncalcareous and loamy soils of low terraces.

3. Axtell-Crockett: This is an area of nearly level to sloping, well to moderately well drained, slightly to strongly acid soils of quaternary terrace deposits. Areas are dissected by shallow drainageways. The soils in this association are used mostly for small suburban tracts of 1 to 5 acres, and for residential urban land. A few small areas are in native post oak timber. The Axtell soils make up about 50 percent of the association. They have a brownish fine sandy loam surface layer and red acid clay lower layers mottled in the lower part with gray and yellow. The Crockett soils make up about 30 percent of the association. They have a brownish fine sandy loam surface layer and slightly acid brownish, mottled clay lower layer. About 20 percent of this association consists of soils that are similar to Crockett except they are gray throughout or clayey throughout.

4. Konawa-Bastrop: This is an area of nearly level to sloping, slightly to medium acid, well drained soils. The soils in this association are used mostly for pasture and large home sites. The Konawa soils on slopes and ridges makes up about 35 percent of the association. They have a brownish fine sandy loam surface layer and a yellowish or reddish loamy sand. The Bastrop soils on nearly level low terraces and gently sloping ridges make up about 25 percent of the association. They have a brownish fine sandy loam surface and a reddish, slightly acid, sandy clay loam lower layer several feet thick. The remaining 40 percent of the association consists of similar soils except they have more sandy surface layers or more clayey lower layers

(continued on next page)

5. Stidham-Dougherty: This is an area of nearly level to gently sloping, well drained, medium acid soils. The soils in this association are used mostly for urban development. The Stidham soils make up about 50 percent of the association. They have light colored loamy fine sand surface layers 20 to 40 inches thick and yellowish mottled sandy clay loam subsoils over sandy substratum. Dougherty soils make up about 40 percent of the association. They have brownish loamy fine sand surface soils about 30 inches thick and red sandy clay loam subsoils over sandy substratum. Common inclusions in this association are Konawa and Galey soils.

6. Houston Black-Heiden: This is an area of nearly level to sloping, moderately well to well drained, calcareous soils. The soils in this association are used mostly for cropland, pasture and urban land. The Houston Black soils of nearly level areas and gently sloping ridges make up about 50 percent of the association. They have a thick very dark gray clay surface and an olive brown and gray clay lower layer over marl or chalk. The Heiden soils on ridges and slopes make up about 20 percent of the association. They have a very dark grayish brown, calcareous clay surface and an olive, calcareous clayey lower layer underlain at about 50 inches by marl or shale. About 30 percent of the association is made up of similar soils that differ mainly in being noncalcareous in the upper part or are shallower to marl or chalk. A few areas that occupy narrow flood plains are also included.

7. Crockett-Konawa: This is an area of nearly level to sloping, well to moderately well drained, slightly to medium acid soils. The soils in this association are used mostly for urban land and pasture. The Crockett soils make up about 30 percent of the association. They have light colored loamy surface soils and mottled brownish clay subsoils several feet thick. Konawa soils make up about 25 percent of the association. They have brownish loamy surface soils and red sandy clay loam subsoils over sandy substratum. Common inclusions in this association are Galey, Axtell, Stidham and Dougherty soils.

8. Truce-Bonti: This is an area of gently sloping to hilly, well drained, slightly acid soils. The soils in this association are used mostly for urban development and pasture. The Truce soils make up about 30 percent of the association. They have brownish loamy surface soils and reddish clay subsoils underlain at 2 to 4 feet by fissle shale. Bonti soils make up about 25 percent of the association. They have brownish loamy surfaces and red clay subsoils underlain at 20 to 40 inches by sandstone. Common inclusions in this association are Crockett, Konawa and Exray soils.

9. Ferris-Heiden-Ellis: This is an area of steeply sloping and sloping, well to somewhat excessively drained, calcareous and neutral, moderately deep to deep clay soils over shales and marl. The soils in this association are used mostly for pasture and rangeland. The Ferris soils of the steep slopes make up about 35 percent of the association.

(continued on next page)

They are an olive calcareous clay throughout that grade to shale or marl at about 40 inches. The Heiden soils on ridgetops and footslopes make up about 25 percent of the association. They have a very dark grayish brown calcareous clay surface and olive calcareous clay lower layers underlain at 40 inches by shale of marl. The Ellis soils on steep slopes in the south part of the county make up about 25 percent of the association. They have thin grayish brown noncalcareous clay surfaces and olive noncalcareous clay lower layers underlain by shale. The remaining 15 percent is made up of similar soils that differ mainly in lacking high shrink-swell properties. A few areas that occupy narrow flood plains are also included.

10. Austin-Dalco: This is an area of gently sloping well drained, calcareous clayey soils. The soils of this association are used for cropland and urban land. The Austin soils make up about 60 percent of the association. They have a dark grayish brown crumbly silty clay surface and a brown silty clay lower layer underlain at about 30 inches by chalk. The Dalco soils make up about 30 percent of the association. They have a black or very dark gray sticky clay surface and dark gray clay lower layers underlain at 30 to 50 inches by chalk. The remaining 10 percent is made up of similar soils that differ mainly in being deeper. Areas that occupy narrow flood plains of local streams are also included.

11. Stephen-Austin: This is an area of gently sloping, well drained, calcareous, crumbly, shallow to moderately deep soils over chalk. The soils of this association are used mostly for cropland, pasture and urban land. The shallow Stephen soils on low ridges make up about 30 percent of the association. They are a dark brown, crumbly, calcareous silty clay throughout and are 7 to 20 inches thick over platy or massive chalk. The moderately deep Austin soils make up about 25 percent of the association. They have a dark grayish brown, crumbly, calcareous silty clay surface and brown, crumbly, calcareous, silty clay lower layers underlain by chalk at about 30 inches. The remaining 45 percent of the association consists of soils that differ mainly in being deeper. Some very shallow soils and some soils in flood plains are also included.

12. Eddy-Brackett: This is an area of gently to steeply sloping, well drained, calcareous, shallow and very shallow soils over chalk. Eddy soils which are very shallow, make up about 60 percent of the association. They are brownish gray silty clay loams about 6 inches thick over platy chalk. The Brackett soils are shallow and make up about 25 percent of the association. They have a light grayish clay loam surface and light brownish silty clay loam lower layer underlain at about 20 inches by soft platy chalk. The remaining 15 percent of the association consists of similar soils that differ mainly in being deeper and darker colored.

13. Purves-Brackett: This is an area of sloping to steeply sloping, well to excessively drained, calcareous soils over limestone. The Purves soils are found on the less sloping areas of the association. They have

(continued on next page)

brownish clay topsoil about 15 inches deep over limestone. Brackett soils occur on the steeper slopes of the association. They have light-colored limey clay loam or loam over interbedded marls and limestones. Maloterre and Tarrant soils are included in this association.

14. Truce-Bonti-Exray: This is an area of sloping to steeply sloping, excessively drained, slightly acid soils. The soils of this association are used for pasture and urban development. Truce soils make up about 40 percent of the association. They have brownish loamy surface soils and reddish clay subsoils underlain at 2 to 4 feet by fissle shale. Bonti soils make up about 30 percent of the association. They have brownish loamy surface soils and red clay subsoils underlain at 20 to 40 inches by sandstone. Exray soils make up about 15 percent of the association. They have brown loamy surface soils and reddish clayey subsoils underlain at depths of 8 to 20 inches by sandstone. Galey and Konawa soils are included in this association.

---

*Information obtained from the Fort Worth office of the Soil Conservation Service, U.S. Department of Agriculture.

The majority of soils within the study area and those of the greatest importance are the flood plain and river terrace soils. The flood plain is not generally suitable for intensive development because its clayey river bottom soils have a high shrink-swell potential. The high water table and periodic flooding are also limiting factors. Thus, the flood plain soils are mostly used for pasture, woodland and other agricultural purposes. The river terrace soils are more stable because of their higher sand-to-clay ratio. These soils are also found in pasture use but are often suitable for residential areas and other urban development. Areas disturbed by sand and gravel mining are found where deposits have occured in the alluvial bottoms.

Table 3 describes land use suitabilities and more detailed descriptions for the fourteen soil associations found in the study area.

It should be noted that the Soil Conservation Service is in the process of compiling the detailed soil surveys for Tarrant and Dallas Counties. Consequently, information in this report is general and subject to updating when the SCS reports are published.[6]

Geology - Outcrops of several distinct geological formations are found throughout the Trinity River Basin. Formations from the Pennsylvanian, Lower and Upper Cretaceous, Eocene, Miocene, Pliocene and Pleistocene have been identified by geologists. Larger streams and valleys found throughout the study area and along the West Fork contain deposits of alluvium of Quaternary age which include Pleistocene and recent deposits.

The principal geologic formations found within the study area are Austin Chalk, Eagle Ford Shale and Woodbine Sand. All of these formations were formed during the upper Cretaceous period. Austin Chalk and Eagle Ford Shale formations are subject to significant erosion. Water draining through soils within these formations is generally turbid and highly alkaline. The Woodbine sand formation, because of its high sand content, is subject to rapid erosion. Large deposits of alluvium in the river bottom account for the Grand Prairie and other rich deposits of sand and gravel which are found throughout the study area.[7]

Topography - Generally, the study area is about 410 feet above sea level at Dallas, rising to about 600 feet at Fort Worth. The study area itself is primarily a flat alluvial plain with uplifts of bluffs along the southern edge of the natural river floodplain. The river rises from 410 feet at the junction of the Elm Fork to 500 feet within the vicinity of the junction of Sycamore Creek in East Fort Worth. Ridges of 600 feet and higher are found eastward along the south boundary of the corridor in Sector 2 generally bounded by Randol Mill Road. This type of topography runs eastward to the vicinity of Highway 360 within Planning Sector 3. At this point the river widens to the south with elevations decreasing from 550 feet to 437 feet in the vicinity of the Trinity River Authority Regional Sewage Treatment Plant located in Sector 4.

North of the river the land is generally flat within the alluvial plain. Most of the major sand and gravel deposits are found north of the river where elevations range from 500 feet to 437 feet. Figure 3 shows the locations of steep slopes and high bluffs found in the western portion of the study area. The area southeast of Dallas encompassing the Club Lakes is generally flat with little significant relief. The elevation changes from 409 feet at the southeast end of the Dallas floodway to BM 389 on the river in the vicinity of the Club Lakes.

The West Fork is fed by many tributary creeks and streams (Figure 3). One of the best known of these is the Fossil Creek system which was the cause of much flood damage to Richland Hills in the late 1950's. Many of the creeks have been dammed to form flood water retention impoundments. Those nearest the study area on the West Fork are Lake Arlington on Village Creek and Mountain Creek Reservoir on Mountain Creek. The Elm Fork is the longest tributary of the main stream and is partially within the study area. Further to the southeast, in the city of Dallas, White Rock Creek has been dammed to form White Rock Lake.

Vegetation - Vegetation communities reflect strongly the edaphic characteristics of the region. For a review of these characteristics refer to the first section of the soils discussion and Figure 5.

The Blackland Prairies vegetation region is fairly congruous with the Blackland Prairie soils belt. To the west, the Cross Timbers and Prairies vegetation region takes in the East Cross Timbers and Grand Prairie Belts and other western soils. The Tarrant-Dallas County line approximates the boundary between the two regions.

The Blackland Prairie is an almost treeless rolling prairie of bunch and short grasses. However, hardwoods such as elm, hackberry, pecan, oak and bois d'arc occur along streams. Woody brush plants have invaded many sections of the grasslands.[8]

The Cross Timbers and Prairies vary widely in soils and land uses but remain fairly uniform in the climax understory vegetation. Brush species have invaded parts of the prairie proper. The East Cross Timbers ranges from open savannah to dense brush and woods largely of post and blackjack oak.[9]

Generally, the tree and shrub species of the regions are similar, particularly on the river bottom sites. Major differences appear among the native grasses on the upland sites. Because of extensive cultivation, improved pasture, timber harvesting and open surface mining operations, much of the native vegetation of the study area has been disturbed and species composition severely modified.

Species composition of the study area consists primarily of bottomland hardwoods, shrubs and understory grasses and ground plants. Table 4 lists the major tree and shrub species found within the study area. A list of the native and introduced grasses found in the study area is presented in Table 5. A more detailed and exhaustive study of flora in the region may by found in Lloyd H. Shinner's Spring Flora of the Dallas-Fort Worth Area, 1958. Benjamin Carroll Tharp's Structure of Texas Vegetation East of the 98th Meridian, 1925, may also be helpful.

It should be pointed out that plant communities vary considerably throughout the river flood plain. Land uses such as agriculture, pasture improvements, and sand and gravel mining have resulted in changes in species composition from what is normally found in relatively natural or undisturbed areas. Figure 6 shows a partially reclaimed sand and gravel mining site which is a typical example of vegetative invasion of a disturbed site. Vegetation on such sites consists primarily of elm, ash, willow and cottonwood which are quick to invade and establish themselves.

TABLE 4

TREES AND SHRUBS OF THE STUDY AREA*

Box Elder
(Acer negundo)

Wooly Pipevine
(Aristolochia tomentosa)

Rattan Vine
(Berchemia scandens)

Wooly Bumelia
(Bumelia lanuginosa)

Pecan
(Carya pecan)

Southern Hackberry
(Celtis laevigata)

Rough Leaved Hackberry
(Celtis occidentalis)

Buttonbush
(Cephalanthus occidentalis)

Redbud
(Cercis canadensis)

Cow-Itch Vine
(Cissus incisa)

Carolina Moonseed
(Cocculus carolirus)

Dwarf Dogwood
(Cornus asperifolia)

Red Haw
(Crataegus sp.)

Swamp Privet
(Forestiera acuminata)

White Ash
(Faxinus americana)

Green Ash
(Fraxinus pennsylvanica)

Honey Locust
(Gleditsia triacanthos)

Black Walnut
(Juglans nigra)

Red Cedar
(Juniperus virginiana)

Bois d'Arc or Osage Orange
(Maclura pomifera)

Chinaberry
(Melia azederach)

Red Mulberry
(Morus rubra)

Prickly Pear Cactus
(Optunia sp.)

Virginia Creeper
(Parthenocissus quinquefolia)

Sycamore
(Platanus occidentalis)

Cottonwood
(Populus deltoides)

Mesquite
(Prosopis glandulosa)

Wild Plum
(Prunus mexicana)

Hoptree
(Ptelea trifoliata)

Bur Oak
(Quercus macrocarpa)

Blackjack Oak
(Quercus marilandica)

Chinkapin Oak
(Quercus muehlenberg)

Red Oak
(Quercus shumardii)

Post Oak
(Quercus stellata)

Winged or Dwarf Sumac
(Rhus copallina)

Smooth Sumac
(Rhus glabra)

Poison Ivy
(Rhus toxicodendron)

Aromatic Sumac
(Rhus trilobata)

Dewberry
(Rubus trivialis)

Sandbar Willow
(Salix interior)

Black Willow
(Salix nigra)

Elderberry
(Sambucus canadensis)

Soapberry
(Sapindus drummondii)

Greenbriar
(Smilax bona-nox)

Eve's Necklace
(Sophora affinis)

Winged Elm
(Ulmus alata)

American Elm
(Ulmus americana)

Cedar Elm
(Ulmus crassifolia)

Wild Grape
(Vitis sp.)

Prickly Ash
(Zanthoxylum clava-herculis)

---

*Most of the data in this table was taken from a species checklist prepared by the Dallas Museum of Natural History.

TABLE 5

NATIVE AND INTRODUCED GRASSES WITHIN THE STUDY AREA*

Grasses of the study area are listed herein, and the vegetative region where they occur is indicated. It should be noted that this list is general in nature and its scope is necessarily limited. There are two studies by Benjamin Carroll Tharp that are appropriate for a more in-depth study:

(1) Structure of Texas Vegetation East of the 98th Meridian, 1926.

(2) Texas Range Grasses, 1952.

An explanation of symbols used in the table follows:

REGION:

BLP - Blackland Prairies

CTP - Cross Timbers and Prairies

REMARKS:

N or I - native or introduced

A or P - annual or perennial

C or W - cool or warm season

1 - increases or invades under heavy grazing pressures

2 - deceases under heavy grazing pressures

3 - invader species

4 - seeded for pasture

REGION BLP	REGION CTP	NAME	REMARKS
x	x	Big Bluestem (Andropogon gerardi)	NPW
x		Silver Bluestem (Bothriochloa saccharoides)	NPW
x	x	Side Oats Grama (Bouteloua curtipendula)	NPW
	x	Blue Grama (Bouteloua gracilis)	NPW
x	x	Hairy Grama (Bouteloua hirsuta)	NPW
	x	Tall Grama (Bouteloua pectinata)	NPW
x	x	Texas Grama (Bouteloua rigidiseta)	NPW3
	x	Red Grama (Bouteloua trifida)	NPW3
x	x	Buffalograss (Buchaloe dactyloides)	NPW1
	x	Hooded Windmillgrass (Chloris cucullata)	NPW
	x	Tumble Windmillgrass (Chloris verticillata)	NPW3
x	x	Common Bermudagrass (Cynadon dactylon)	IPW4
	x	Canada Wildrye (Elymus canadensis)	NPC
	x	Red Lovegrass (Eragrostis oxylepis oxylepis)	NPW3
	x	Hairy Tridens (Erioneuron pilosum)	NPW3
x	x	Switchgrass (Panicum virgatum)	NPW
x		Dallisgrass (Paspalum dilatatum)	IPW4
	x	Tumblegrass (Schedonnardus paniculatus)	NPW3
	x	Little Bluestem (Schizachyrium scoparium frequens)	NPW2
x	x	Indiangrass (Sorghastrum nutans)	NPW2
x	x	Tall Dropseed (Sporobalus asper)	NPW
x		Smutgrass (Sporobalus poiretii)	IPW1
x	x	Texas Wintergrass (Stipa leucotricha)	NPC1
x	x	Other Annuals	NA3
x	x	Other Perennials	NP3

*Data taken from Texas Plants, Texas A & M University, 1969

Figure 6. Sand and Gravel Mining Site Reclaimed by a Typical Vegetative Community. Sector 3.

There are no unique "relict" vegetative communities or species found in the study area. Large wooded areas such as those adjacent to the river, contain the most diversified mixtures of plant species found throughout the study area. Even in these large forested sections, trees have been cut and other activities have taken place which have disrupted normal successional patterns within indigenous communities. In their present state, however, these areas still offer an opportunity to experience a river bottom ecosystem in a relatively natural condition. In juxtaposition to a massive urban complex, these areas provide a unique natural resource.

Figure 3 shows the remaining densely forested stands that are associated with the river environs. This map does not indicate strip mined areas that have been reclaimed by vegetation.

<u>Wildlife</u> - Similar to plant species of the flood plain, wildlife species vary considerably within the study area. Influences of man, his developments and residual wastes have brought about significant changes in habitat, food supplies and, thus, resident populations of wild creatures. Indis-

criminate hunting, predator control, use of pesticides and insecticides, and various forms of air, water and land pollution have been responsible for declines in animal numbers throughout the area. Those wild animals which remain live in a modified natural habitat within the immediate influence of an encroaching urban complex.

Wildlife population data for the study area is not readily available. The Texas Parks and Wildlife Department[10] and the Bureau of Sport Fisheries and Wildlife[11] have made various studies throughout the area. However, these are not of recent origin. At present there is no record of any rare or endangered species residing in the study area. Of course, if proper environmental management practices and safeguards which emphasize the value of the present wild creatures in the local, regional, national and world ecosystems are not implemented, they may soon find themselves endangered species, at least in the Trinity Basin.

The Dallas Museum of Natural History has prepared a check list of mammals of the upper Trinity area for which positive identification is available. This list is found in Table 6. A similar check list of common birds of the area is found in Table 8. Species of fish found in the West Fork are listed in Table 7. Poor water quality and the following related factors have led to a virtual absence of game fish species in the river.

a. The West Fork of the Trinity River from Fort Worth to Dallas and the Trinity River from Dallas to the vicinity of the proposed Tennessee Colony Reservoir are heavily polluted with municipal sewage and industrial wastes and support no significant fishing.[12]

b. Generally, streams within the Trinity Basin have poor quality habitat because of pollution, lack of water, or both.[13]

c. The quality of fresh water habitat in the Trinity River Basin will exceed that which would exist without the project. Channelization and rectification of the West Fork and the mainstem of the Trinity River and the impoundment of Tennessee Colony Reservoir will result in a complete change in the character of these streams. These changes will be beneficial, for the most part, since water depths will be increased. Instead of widely fluctuating streams subjected to alternate periods of flooding and low flows, a series of stable channel impoundments will exist. On the other hand, shoal and riffle areas favorable for the spawning of blacktail and red shiner will be eliminated. The result will be a probable loss of these species from these streams.[14]

d. Fish habitat in the cutoff sections of the West Fork of the Trinity River will be lost by the placement of spoil.[15]

e. Many of the desirable productive hardwoods, such as southern red

TABLE 6

MAMMALS OF THE STUDY AREA*

Shorttail Shrew (*Blarina brevicauda*)
Beaver (*Castor canadensis*)
Least Shrew (*Crytotis parva*)
Armadillo (*Dasypus novemcinctus*)
Virginia Opossum (*Didelphis virginiana*)
Red Bat (*Lasiurus borealis*)
Jack Rabbit (*Lepus californicus*)
Striped Skunk (*Mephitis mephitis*)
Nutria (*Myocastor coypus*)
Woodrat (*Neotoma floridana*)
Deer Mouse (*Peromyscus maniculatus*)
Raccoon (*Procyon lotor*)
Fox Squirrel (*Sciurus niger*)
Cotton Rat (*Sigmodon hispidus*)
Spotted Skunk (*Spilogale interrupta*)
Swamp Rabbit (*Sylvilagus aquaticus*)
Cottontail Rabbit (*Sylvilagus floridanus*)
Gray Fox (*Urocyon cinereoargenteus*)

*Prepared by the Dallas Museum of Natural History

TABLE 7

FISH COMMON TO THE WEST FORK

*River Carpsucker or Carp (*Carpiodes carpio*)
*Gizzard (Hickory) Shad (*Dorosoma cepedianum*)
**Mosquitofish (*Gambusia affinis*)
**Bluegill Sunfish or Bream (*Lepomis macrochirus*)
*Largemouth Bass (*Micropterus salmoides*)
**Red (Redhorse) Shiner (*Notropis lutrensis*)
*White (Striped or Sand) Bass (*Roccus chrysops*)

*Species indentified in fish-kill in the river below the West and Clear Forks, May 1971. Report of Charles T. Menn, Fisheries Biologist, Texas Parks and Wildlife Department, Letter of December 17, 1971.

**Species trapped at Station B175-4, of Fisheries Investigation conducted by Texas Game and Fish Commission, November 1, 1955 - October 31, 1957. Unpublished file copy.

TABLE 8

COMMON BIRDS OF THE STUDY AREA*

M = Migrant (fall or spring) W = Winter Resident
S = Summer Resident R = Year-round Resident
(Small letters indicate less frequency)

Mw	Horned Grebe	M	Sora
Mw	Eared Grebe	R	Common Gallinule
MWr	Pied-billed Grebe	MR	American Coot
Mr	Double-crested Cormorant	R	Killdeer
Sr	Great Blue Heron	M	Black-bellied Plover
S	Green Heron	MW	Common Snipe
S	Little Blue Heron	M	Upland Plover
S	Cattle Egret	MS	Spotted Sandpiper
S	Common Egret	M	Soitary Sandpiper
S	Snowy Egret	M	Greater Yellowlegs
Sr	Black-cr. Night Heron	M	Lesser Yellowlegs
MS	Yellow-cr. Night Heron	M	Pectoral Sandpiper
Ms	Least Bittern	M	Baird's Sandpiper
MW	Canada Goose	MWr	Least Sandpiper
M	White-fronted Goose	M	Dowitcher
M	Snow Goose	M	Stilt Sandpiper
M	Blue Goose	MW	Simipalmated Sandpiper
MWr	Mallard	M	Western Sandpiper
MW	Gadwall	Mw	American Avocet
MW	Green-winged Teal	M	Wilson's Phalarope
Mw	Blue-winged Teal	Wr	Herring Gull
MW	American Widgeon	MW	Ring-billed Gull
MW	Pintail	Mw	Franklin's Gull
MW	Shoveler	MW	Forster's Tern
R	Wood Duck	M	Black Tern
Mw	Redhead	R	Rock Dove
MW	Ring-necked Duck	R	Mourning Dove
Mw	Canvasback	S	Yellow-billed Cuckoo
MW	Lesser Scaup	R	Roadrunner
MW	Bufflehead	R	Screech Owl
MW	Ruddy Duck	R	Great Horned Owl
W	Hooded Merganser	R	Barred Owl
MR	Turkey Vulture	W	Short-eared Owl
MR	Black Vulture	MS	Chuck-Will's Widow
MWr	Red-tailed Hawk	MS	Common Nighthawk
R	Red-shouldered Hawk	MS	Chimney Swift
MS	Swainson's Hawk	MS	Ruby-thr. Hummingbird
W	Marsh Hawk	Ms	Black-chinned Hummingbird
W	Sparrow Hawk	R	Belted Kingfisher
R	Bobwhite	MW	Yellow-shafted Flicker
R	Red-bellied Woodpecker	Ms	Warbling Vireo
R	Red-headed Woodpecker	M	Black-and wh. Warbler

(continued on next page)

MW	Yellow-bellied Sapsucker
R	Hairy Woodpecker
R	Downy Woodpecker
R	Ladder-backed Woodpecker
MS	Eastern Kingbird
MS	Western Kingbird
MS	Scissor-t. Flycatcher
S	Great-crested Flycatcher
Mr	Eastern Phoebe
M	Acadian Flycatcher
M	Traill's Flycatcher
M	Least Flycatcher
M	Eastern Wood Pewee
M	Olive-sided Flycatcher
R	Horned Lark
M	Tree Swallow
MS	Bank Swallow
MS	Rough-winged Swallow
M	Barn Swallow
MS	Cliff Swallow
MS	Purple Martin
R	Blue Jay
R	Common Crow
R	Carolina Chickadee
R	Tufted Titmouse
W	Brown Creeper
MW	House Wren
R	Bewick's Wren
R	Carolina Wren
R	Mockingbird
M	Catbird
MWr	Brown Thrasher
MR	Robin
W	Hermit Thrush
M	Swainson's Thrush
R	Eastern Bluebird
MS	Blue-gray Gnatcatcher
MW	Golden-crowned Kinglet
MW	Ruby-crowned Kinglet
MW	Water Pipit
Mw	Sprague's Pipit
W	Cedar Waxwing
Wr	Loggerhead Shrike
R	Starling
S	Blacked-capped Vireo
MS	White-eyed Vireo
S	Bell's Vireo
M	Solitary Vireo
Ms	Red-eyed Vireo
M	Tennesee Warbler
M	Orange-cr. Warbler
M	Nashville Warbler
M	Parula Warbler
M	Yellow Warbler
M	Magnolia Warbler
MW	Myrtle Warbler
M	Bl.-throated Warbler
M	Blackburnian Warbler
M	Yellow-throated Warbler
M	Chestnut-sided Warbler
M	Bay-breasted Warbler
M	Louisiana Waterthrush
Mr	Yellowthroat
M	Yellow-breasted Chat
M	Wilson's Warbler
M	American Redstart
R	House Sparrow
R	Eastern Meadowlark
MR	Redwinged Blackbird
S	Orchard Oriole
Ms	Baltimore Oriole
M	Bullock's Oriole
W	Brewer's Blackbird
R	Boat-tailed Grackle
Wr	Common Grackle
MR	Brown-headed Cowbird
Ms	Summer Tanager
R	Cardinal
Ms	Blue Grosbeak
MS	Indigo Bunting
S	Painted Bunting
MS	Dickcissel
W	Purple Finch
W	American Goldfinch
W	Rufous-sided Towhee
MW	Savannah Sparrow
W	Vesper Sparrow
Sr	Lark Sparrow
W	Slate-colored Junco
Mw	Chipping Sparrow
MW	Field Sparrow
W	Harris' Sparrow
W	White-crowned Sparrow
W	White-throated Sparrow
W	Fox Sparrow
MW	Lincoln's Sparrow
Mw	Swamp Sparrow
W	Song Sparrow

*Prepared by the Dallas Museum of Natural History oak, overcup oak, bur oak and water oak have been removed. The timbered area is now dominated by ash and elm, which are of little importance to wildlife. Some desirable hardwoods persist in the flood plain at the mouths of tributaries.[16]

Further wildlife habitat losses will occur in those areas designated for water storage. Also habitat will be lost within the areas to be occupied by the multipurpose channel and its spoil areas. Species lost by river modification will be primarily those few animals residing in the river bottoms. Other habitat losses resulting from the control of natural flooding are eminent. As the Bureau of Sports Fisheries and Wildlife points out:

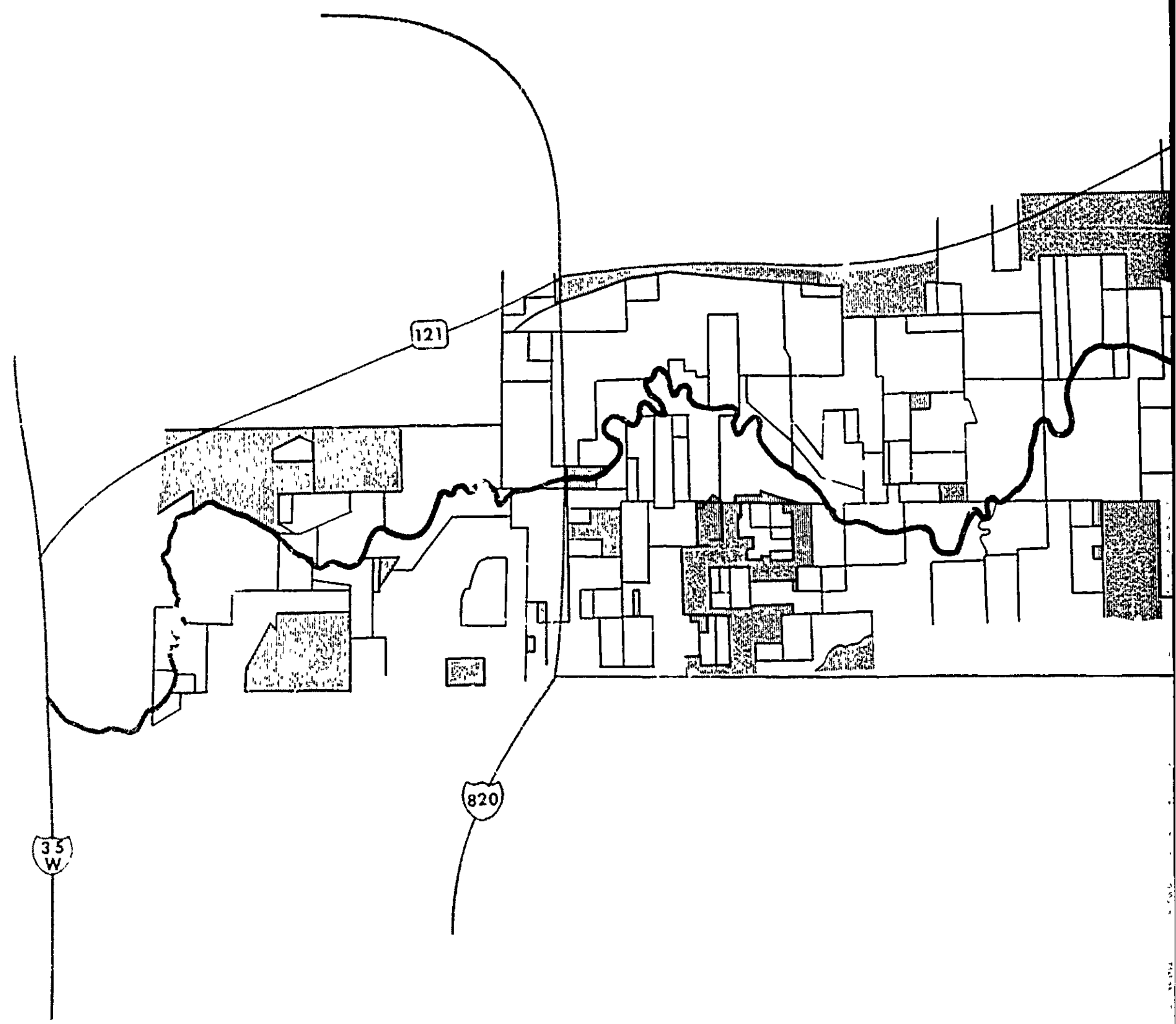
> Losses will occur to portions of habitat in the flood plain not occupied by project structures. Reduction in flooding will be deleterious to the timbered wildlife habitat vital to the winter food and cover requirements of deer, turkey, squirrel, and some species of water fowl. Moreover, reduction in flooding will result in intensive agriculture and urban or industrial developments culminating in additional clearing of timber and other wildlife food and cover plants and subsequent displacement of wildlife.[17]

Many of the habitat and species losses discussed in these early studies can be eliminated and/or substantially reduced through changes in channel location, hydraulic design, and land use management practices. Economic predicates notwithstanding, these losses can be converted to benefits through increased expenditures and more sophisticated land management for environmental protection.

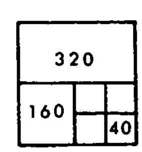
Land Ownership - The best illustration of land ownership within the study area is a patchwork quilt of 460 individual parcels. Figure 7 shows a generalized mosaic of land parcels within the study area. This land ownership map was prepared from land tract registrations and abstracts secured from the Tarrant and Dallas County tax offices. Because of the scale of this map, a certain percentage of error in transferring the data is unavoidable. The data however, delineate the complexity of ownerships within the study area although it is not a land survey document.

Public ownership now accounts for less than 5 percent of these lands. Of this public land, the major portion is owned by the cities.

The largest single landowner within the study area is the Gifford-Hill Western Company, which owns approximately 7 percent of the land.

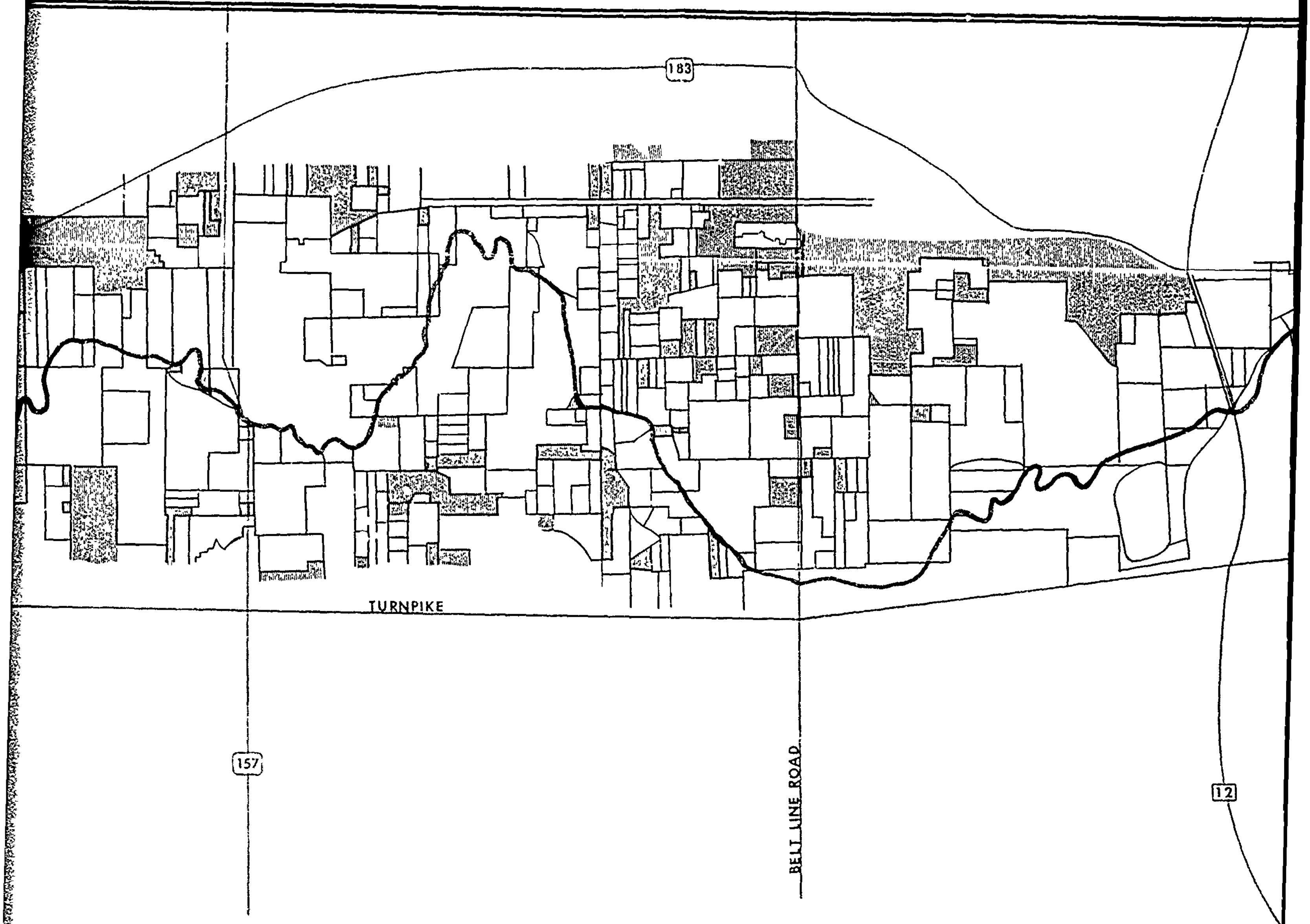


LAND



Are
One
40,

Min
par



AND OWNERSHIP

NORTH

20

40

Area measurement scale:

One square mile = 640 acres

40, 160, 320 acres

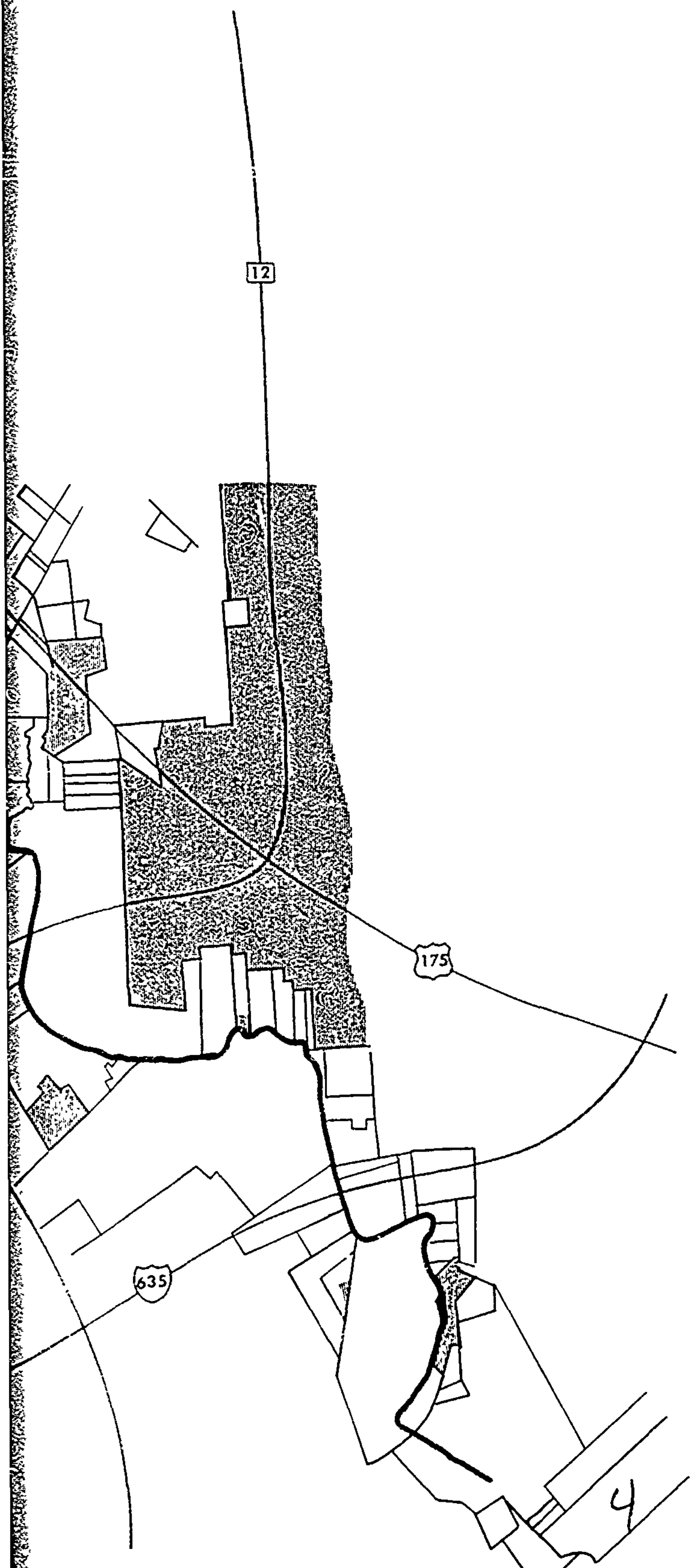
Minor tracts composed of parcels less than 10 acres

SCALE

1 ½ 0 1


45
12
75
635

Fig. 7



Most of this property is dominated by abandoned or active sand and gravel mining operations.

Land ownership data are recorded by abstract and tract in Tarrant and Dallas Counties. A summary of the land ownership data is compiled in Table 9. By examination of Figure 7, it should be obvious that, because of the number of individual tracts within the area, the task of putting together a riverway corridor will be a complex and expensive procedure.

TABLE 9

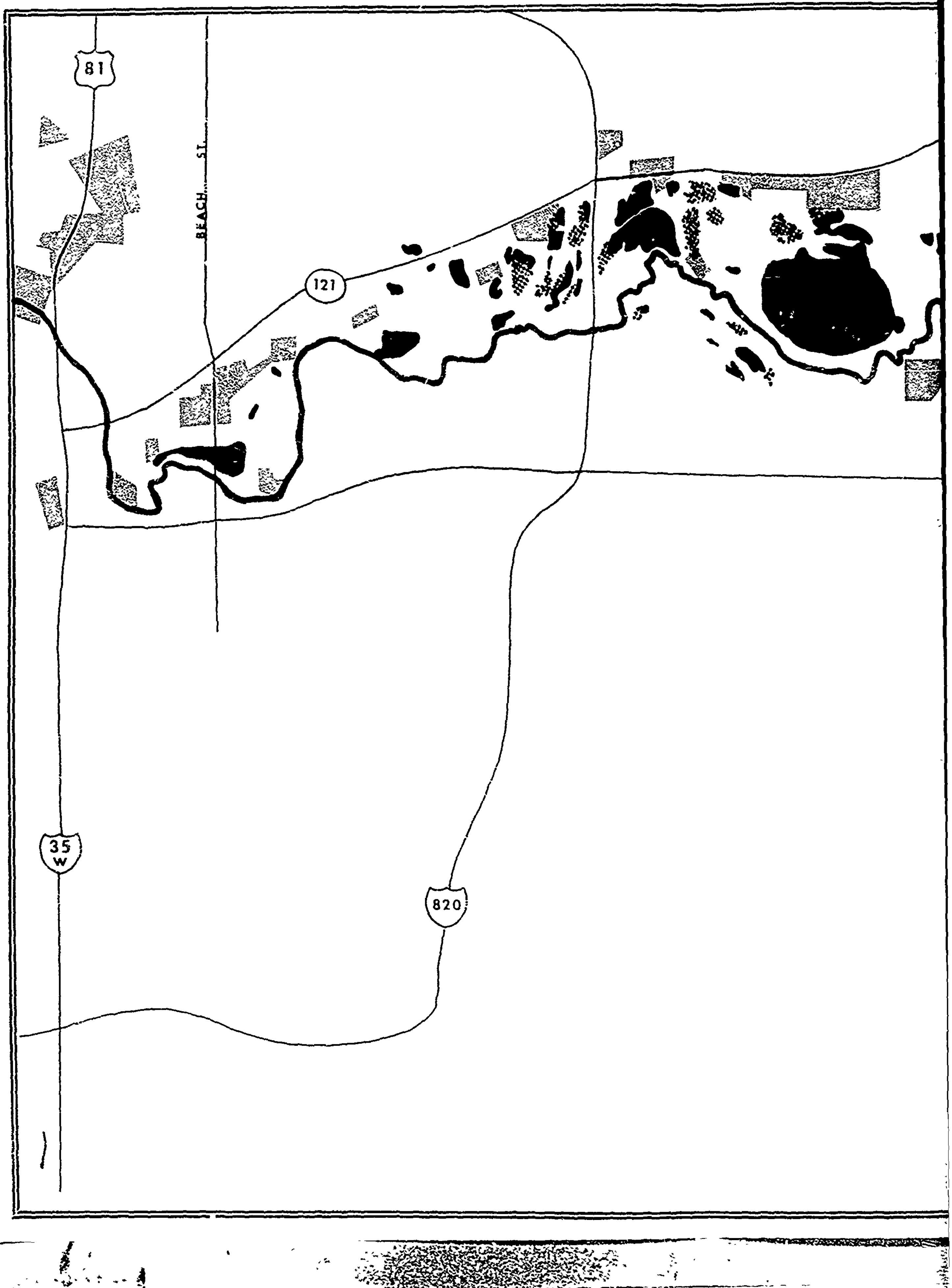
LAND OWNERSHIP DATA SUMMARY OF THE STUDY AREA

	County	
	Tarrant	Dallas
Individual Parcels of 10 acres or more	187	273
Individual Owners of 10 acres or more	141	199
Total Acres	19,130	38,910
Percent of Study Area	33	67
Acres in Public Ownership	380	2,520
Percent of County in Study Area	3.5	6.8

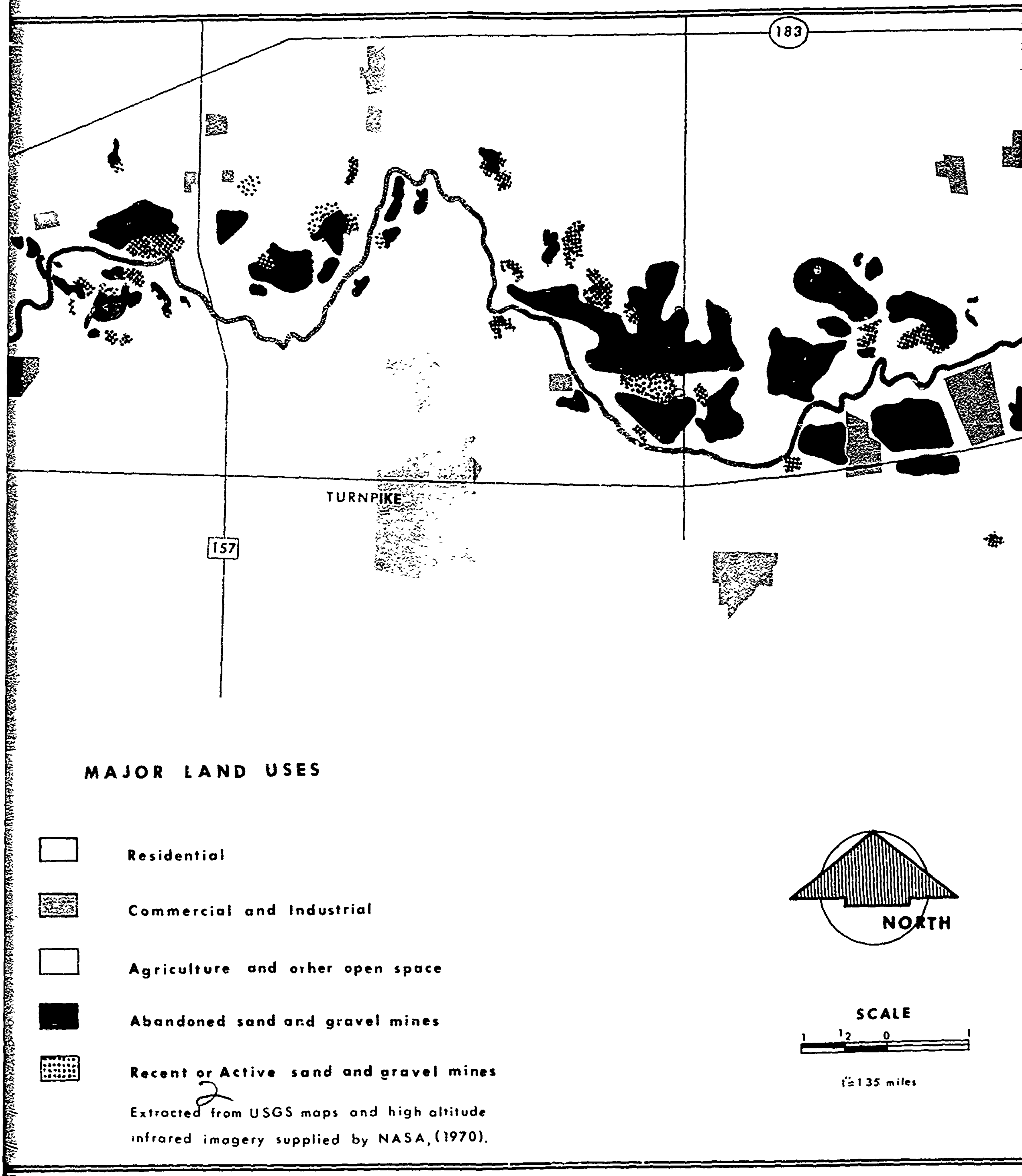
Land Use

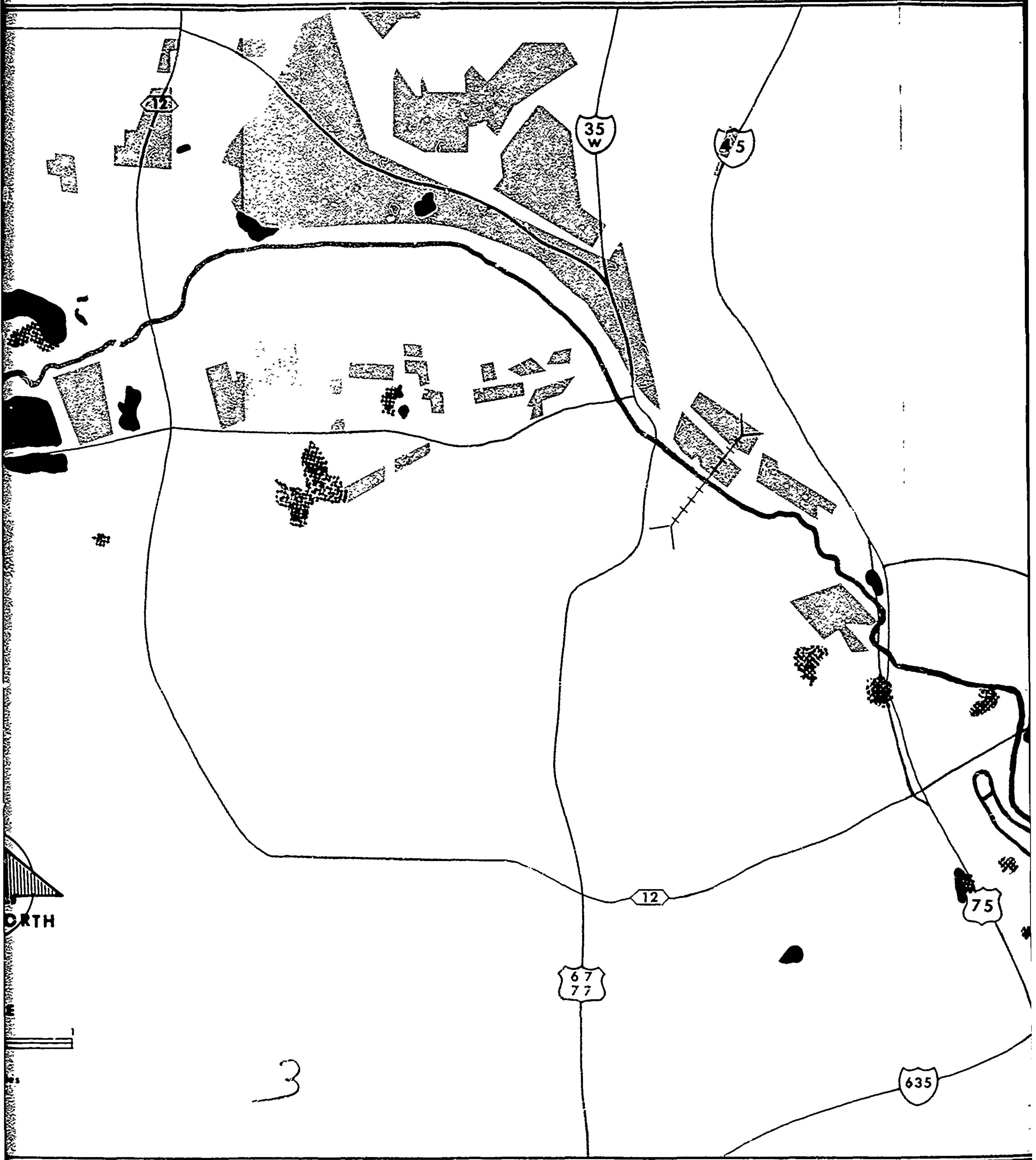
Lands within the Trinity River valley in the immediate vicinity of the river are generally vacant. The reason for this condition is that they are frequently flooded and, thus, unsuited for extensive development. The primary use of these lands is for sand and gravel mining and river bottom agriculture. Agricultural land use consists primarily of livestock grazing, improved pasture, woodlands and limited production of grain crops. In this report, land use within the study area is reported by planning sectors from west to east. Generalized major land uses are shown in Figure 8. Figure 9 shows specific land uses in these sectors as described by the following paragraphs.

Sector 1. From Beach Street to Loop 820, the principal land use is river bottom agriculture (Figure 9A). There is some commercial development and low density housing along the east side of Beach Street. Industrial land use is not found in the sector except along Highway 121. Residential use is limited to high ground above the river. In the south central portion of the sector, is White Lake Hills, a relatively recent



81
BEACH ST.
121
35 W
820


183
TURNPIKE
157
MAJOR LAND USES
Residential
Commercial and Industrial
Agriculture and other open space
Abandoned sand and gravel mines
Recent or Active sand and gravel mines
Extracted from USGS maps and high altitude
infrared imagery supplied by NASA, (1970).
NORTH
SCALE
1 1/2 0 1
1"=1.35 miles



3

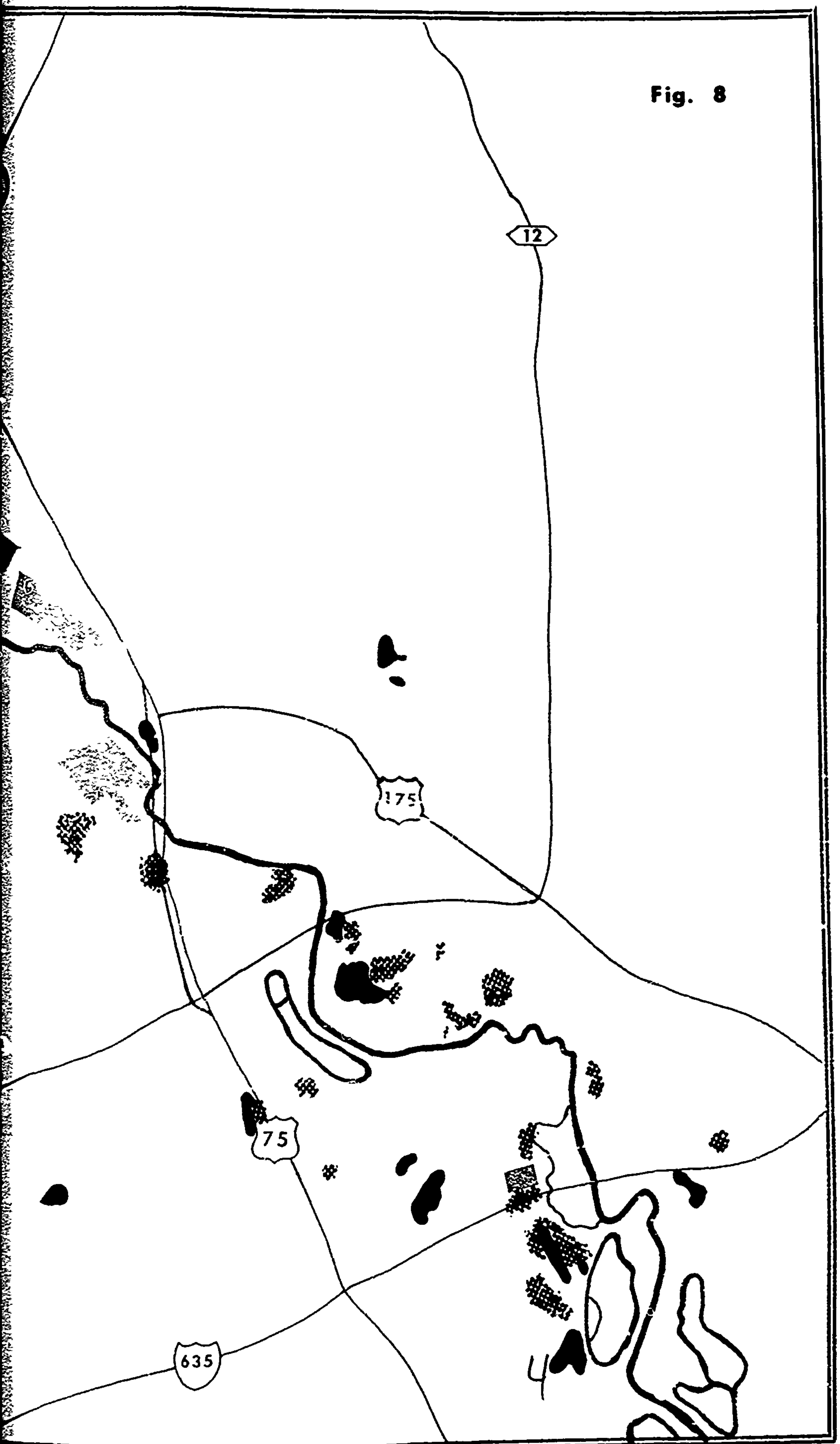


Fig. 8
12
175
75
635

FIGURE 9. SPECIFIC LAND USES DESCRIBED BY PLANNING SECTORS.

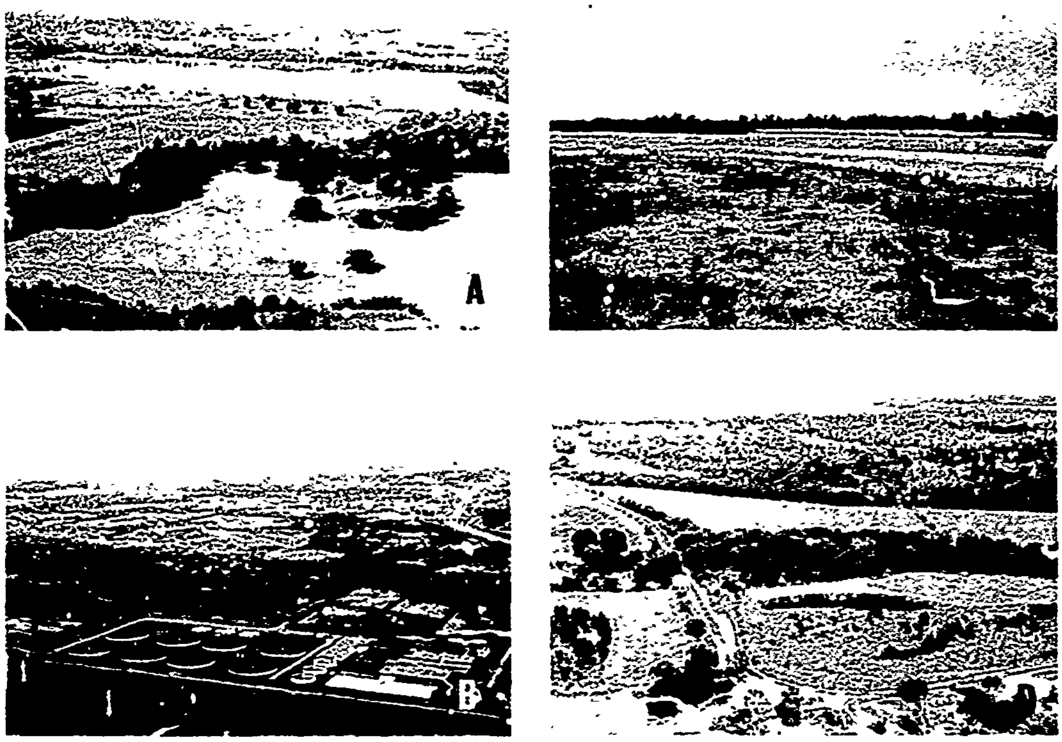


Figure 9A. Cultivated Fields Either Side of the West Fork. The scarred areas between the river and Highway 121 are reclaimed gravel pits. Looking north in Sector 1.

Figure 9B. Fort Worth Riverside Sewage Treatment Plant. The Dallas-Fort Worth Turnpike is visible to the center-right. Looking northeast down the river valley in Sector 1.

Figure 9C. Bottomland Pasture Viewed from Randol Mill Road. The West Fork runs in the treeline in the distance. Looking north in Sector 2.

Figure 9D. Secondary Road Crossing the West Fork. The road connects Randol Mill Road and Highway 183. A large oval-shaped area of depleted and grown-over gravel pits directly south of Hurst is visible to the upper-right. Looking north in Sector 2.

FIGURE 9, Continued.

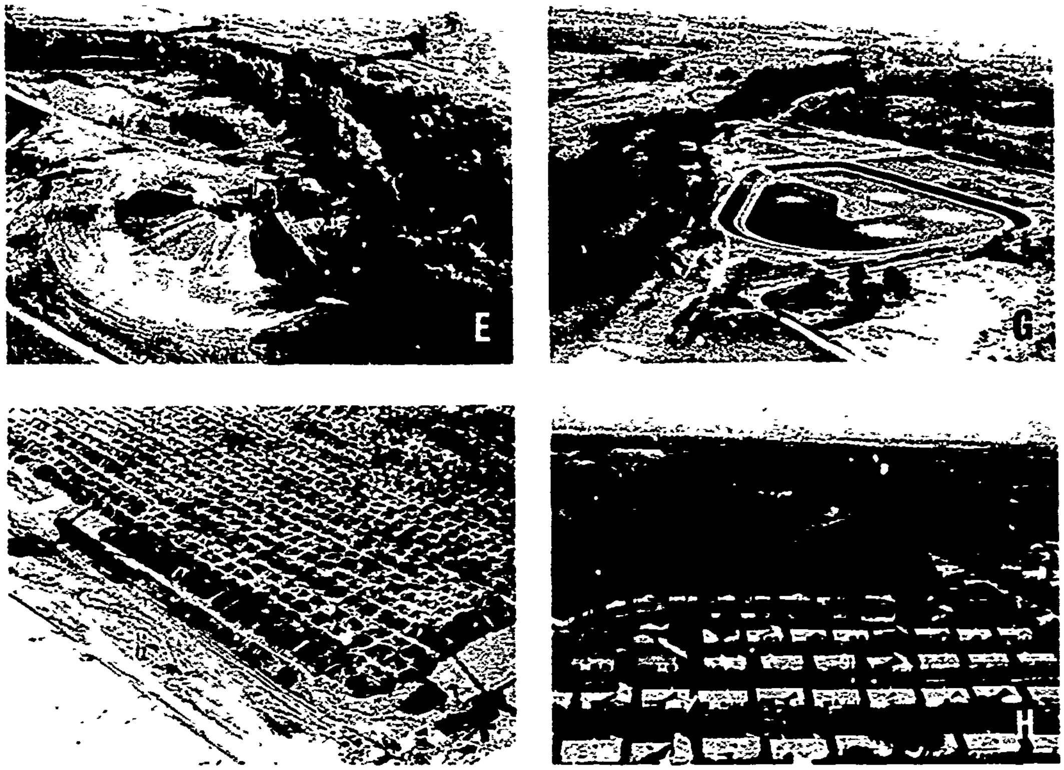


Figure 9E. Typical Sand and Gravel Mining Operation Adjacent to the West Fork. Sector 3.

Figure 9F. Typical Sand and Gravel Mining on the North Bank of the West Fork. Sector 3.

Figure 9G. Arlington Sewage Treatment Plant. Looking east in Sector 3.

Figure 9H. Subdivision Extending Southward from Irving. The lakes were created from abandoned sand and gravel pits. Note the Dallas skyline in the distance. Looking east in Sector 4.

residential development of high-quality homes. Nolan High School and some small businesses are also near the subdivision. Another subdivision is developing south of the river. Between it and the river is a private golf course. The only commercial developments within the river bottom lands are a few liquor stores. The Riverside Sewage Treatment Plant is located in the southwest corner of the Sector (Figure 9B). Depleted gravel pits dot the sector north of the river, many reclaimed by vegetation. River associated forest lines most of the West Fork's banks and remains elsewhere in a few isolated dense clumps.

Sector 2. From Loop 820 to Highway 157 the character of the flood plain is largely the same as in the previous Sector (Figure 9C). However, again to the north, abandoned gravel pits occur more frequently and are usually of greater size. On top of the bluffs in the southwest portion, scattered low-density housing can be found. About the only significant land use south of the river is the Fort Worth Village Creek Sewage Treatment Plant. The Tarrant Sewage Treatment Plant is located north of the river. Physical development is much in evidence north of the river. Much industrial activity is found near and adjacent to the south side of Highway 183. Some low-density housing is interspersed between industrial areas. This region is also laced with secondary roads (Figure 9D), and railroad main lines and spurs which service industry, manufacturing, and sand and gravel mining operations.

Sector 3. From Highway 157 to Belt Line Road, the river bottom is much the same. Sand and gravel operations have taken much of the area north and adjacent to the river (Figure 9E and 9F). In the eastern end of the sector, scattered single-family units have been built close to the flood plain, both north and south of the river. More recently, low-density residential areas have developed south of the river in the southeast corner of the Sector. Greater Southwest International Airport occupies the north-central portion of the Sector directly above the West Fork's northernmost bend. The Arlington Sewage Treatment Plant is in the southeast portion of the sector (Figure 9G). Lion Country Amusement Park is being developed immediately west of Belt Line Road and north of the West Fork.

Sector 4. From Belt Line Road to Loop 12, urbanization has developed up to the flood plain; Irving to the north (Figure 9H) and Grand Prairie to

FIGURE 9, Continued.

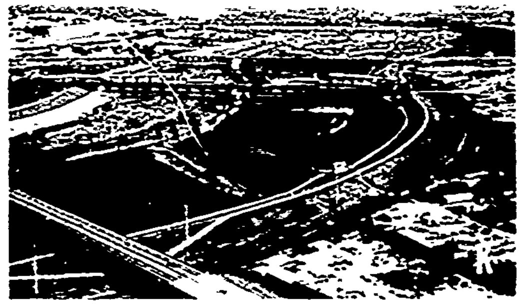


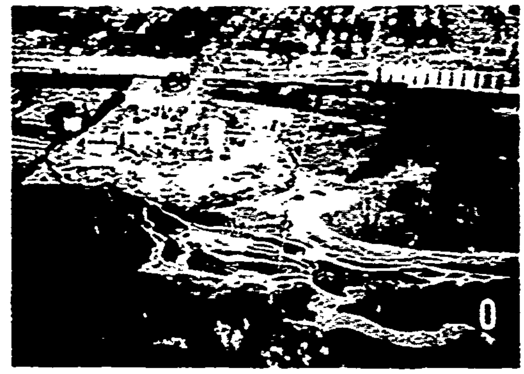
Figure 9I. Sand and Gravel Mining and Trinity River Authority Sewage Treatment Plant in Background. The West Fork runs between the two. Looking south in Sector 4.

Figure 9J. Dumpground Near the West Fork. Sector 4.

Figure 9K. Downstream Terminus of the Dallas Floodway. The Turnpike connection and the Houston Street Viaduct are the two nearest crossings. The diversion channel and levees end approximately 10,000 feet in the distance. Looking southeast in Sector 5.

Figure 9L. Dallas Floodway. Residential sections have built up to the south levee, while primarily industrial and commercial land uses have developed on the north side. The two crossings are the Lamar Street Viaduct and the Texas and Pacific Railroad Bridge. Looking east in Sector 5.

FIGURE 9, Continued.



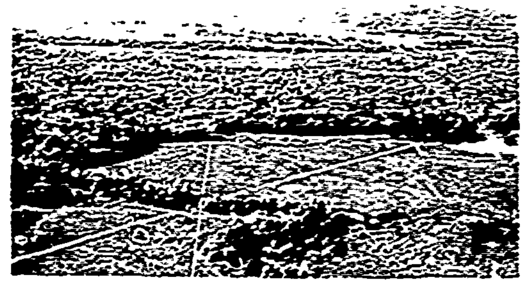


Figure 9M. Portion of the Dallas White Rock Sewage Treatment Plant. The new Interstate 45 connection is being constructed in the background. Looking east in Sector 6.

Figure 9N. Chemical Plant Adjacent to the Flood Plain below the Floodway. The crossing is the Missouri-Kansas-Texas Railroad. Looking east in Sector 6.

Figure 9O. Pollution in the Flood Plain The run-off discharges are from the plant shown in Figure 9N. Sector 6.

Figure 9P. Rochester Park/Roosevelt Heights Area. White Rock Creek runs along the treeline across the center. Note the Dallas skyline. Looking northwest in Sector 6.

the south. The land in between is mostly vacant and scarred by gravel pits. The Trinity River Authority Sewage Treatment Plant occupies most of the southeast corner of this sector (Figure 9I). Here, the levee system that extends through Dallas has its beginning. Lands throughout this sector have been used extensively as dumping grounds for abandoned autos and other trash. Figure 9J illustrates a scene common to this sector.

Sector 5. The river is channelized from the TRA plant, past the Santa Fe Railroad bridge to the southeast of Downtown Dallas. The 3000-foot wide Dallas Floodway levee and channel system starts at the confluence of the Elm Fork and the West Fork and extends nearly to the railroad bridge (Figure 9K). This area of 2420 acres is totally void of development except for the many highway and rail crossings, a few service roads inside the floodway, and utility crossings. Its only use, when not carrying floodwaters, is for open pasture.

Development such as that shown in Figure 9L has extended to both sides of the Floodway. On the north, this is primarily industrial and commercial; to the south, it is, for the most part, single-family residences. There are no wooded sections and very few trees within the floodway. The old river channel meanders outside the levee system and serves to carry surplus runoff.

Sector 6. The river meanders along its natural course southeast of the Santa Fe railroad bridge to where Loop 12 again crosses it. Gravel mines begin to reappear and the flood plain is more densely forested than in any of the previous sectors of the West Fork. A private country club, its golf course, and the Dallas White Rock Sewage Treatment Plant (Figure 9M), are the only man-made developments adjacent to the river, but industrial sites are located on the northern edge of the flood plain. (Figure 9N and 9O) Residential development continues to the south. However, to the north, all development terminates abruptly where a large egg-shaped parcel of mostly vacant land extends from the river northeastward to include Rochester Park and the Roosevelt Heights section of Dallas. White Rock Creek runs through the center of this large open area shown in Figure 9P. In times of heavy runoff flood waters back up White Rock Creek and pose a serious threat to the Roosevelt Heights Community. The area is bordered by a mixture of residential and city park land.

FIGURE 9, Continued.

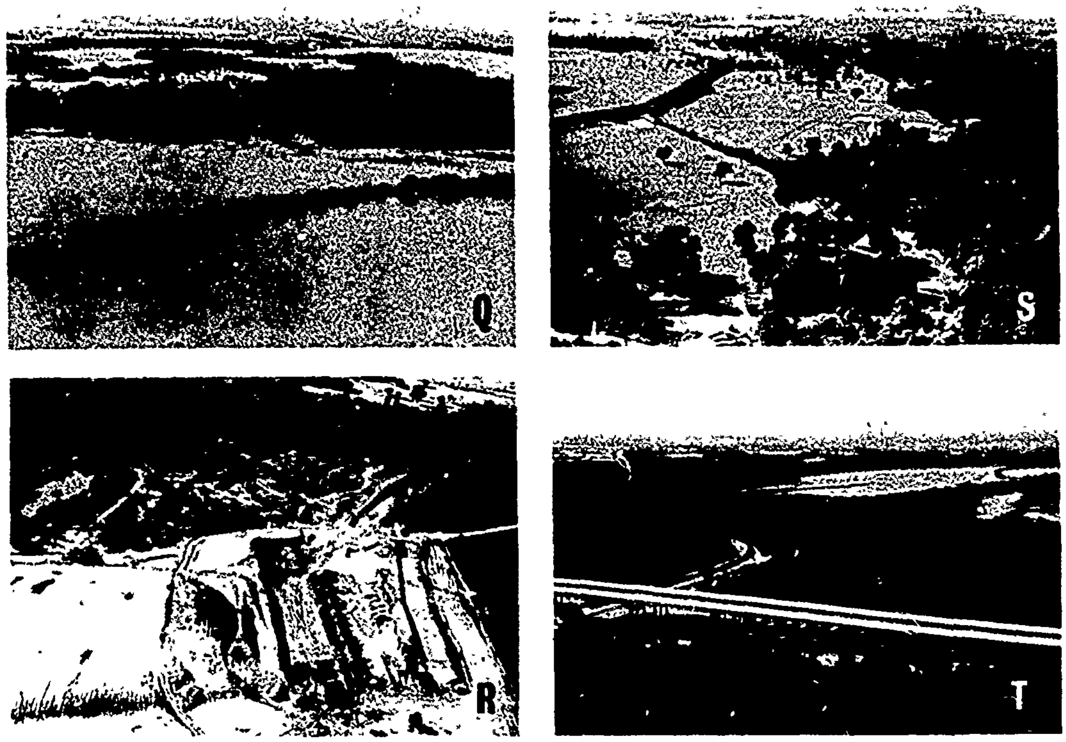


Figure 9Q. Fin and Feather Club Lake. The river is leveed to run between Fin and Feather and the Dallas Hunting and Fishing Club Lake in the background. Looking southeast in Sector 7.

Figure 9R. Landfill Site for Refuse Disposal Near the River. Sector 7.

Figure 9S. Portion of the River Environment Between Lemmon Lake and the Club Lakes. A small levee to the center-left runs up to Lemmon Lake visible approximately 9000 feet in the distance. Looking northwest in Sector 7.

Figure 9T. Interstate Highway Loop 635 and Fin and Feather Club Lake. At this crossing the river has been channeled and the bridge built to navigation standards. Looking south in Sector 7.

The only development, Roosevelt Heights, is located in the very center of the tract and consists of a mixture of housing and industrial uses. Other land uses include highway and utility line crossings.

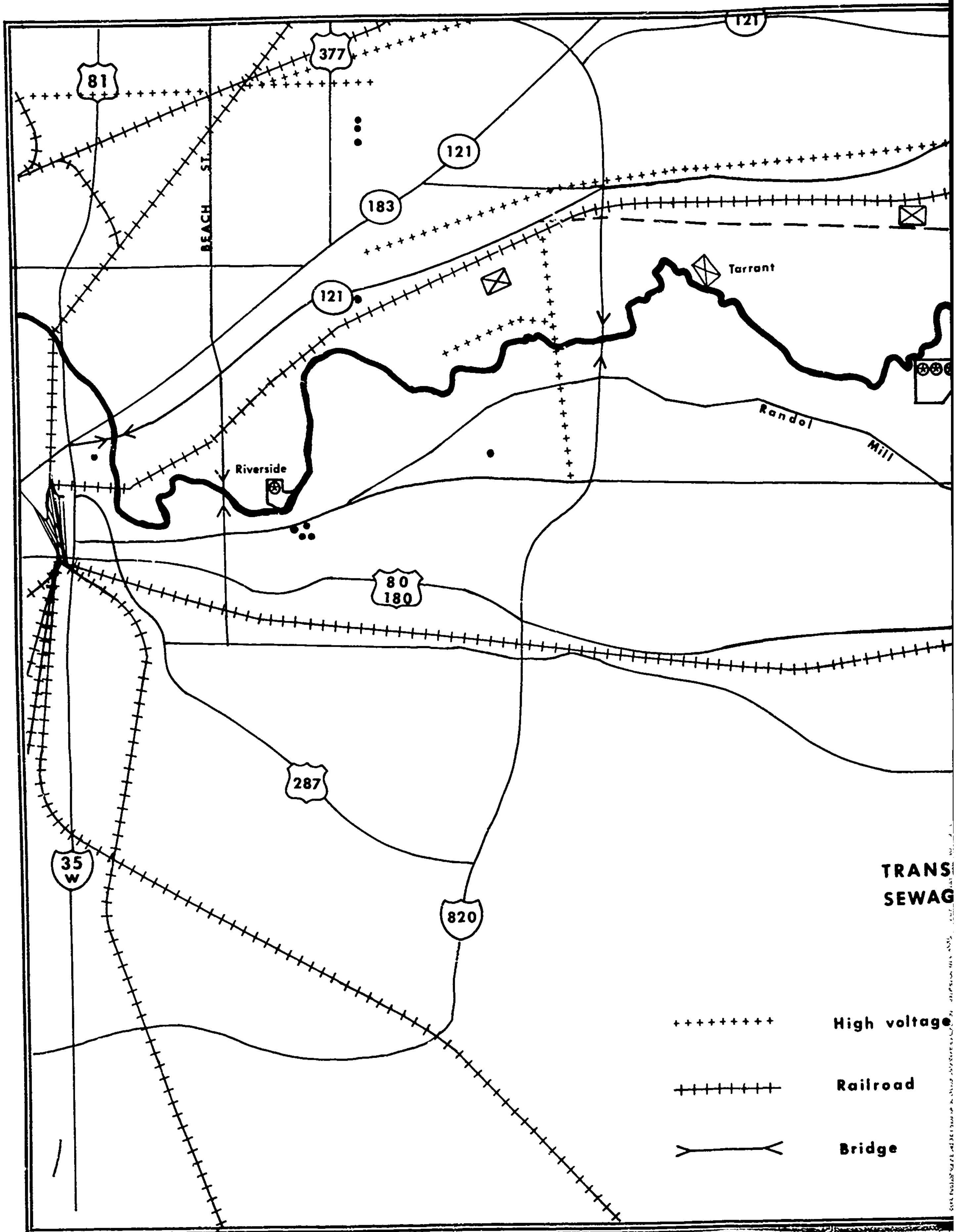
Sector 7. The last sector in the study area is that reach of the river between Loop 12 and Dowdy Ferry Road, which runs between the Club Lakes. Lemmon Lake is located just south of Loop 12 and the river channel. Land in this sector is, for the most part, heavily forested with little development. Dense woodlands entirely cover the north bank of the river except where it approaches Fin and Feather Club Lake (Figure 9Q). Marsh lands surround the lake. About the only use of land in this sector other than agriculture and woodland, is gravel mining. A spent gravel pit north of the river and adjacent to Loop 12 is currently being used as a sanitary landfill (Figure 9R).

Between Lemmon Lake and the Club Lakes, the land is nearly vacant. A levee runs along the north side of Five Mile Creek and up to Lemmon Lake (Figure 9S), and a few strip mines dot the area. Low-density residential development has occured north and east of the river. I.H. Loop 635 crosses the sector north of the Club Lakes (Figure 9T). Here, the river has been channelized and the bridge crossing has been built to navigation standards.

Major transportation routes, utility lines and sewage treatment plants within the corridor area are shown in Figure 10. Most of the bridges cross the river over the Dallas Floodway. From west of Dallas to east of Fort Worth, several major north-south arteries as well as several secondary roads cross the river. These established crossings also provide access to areas indicated for development along the multipurpose channel. A list of river crossings in the study area is presented in Table 10.

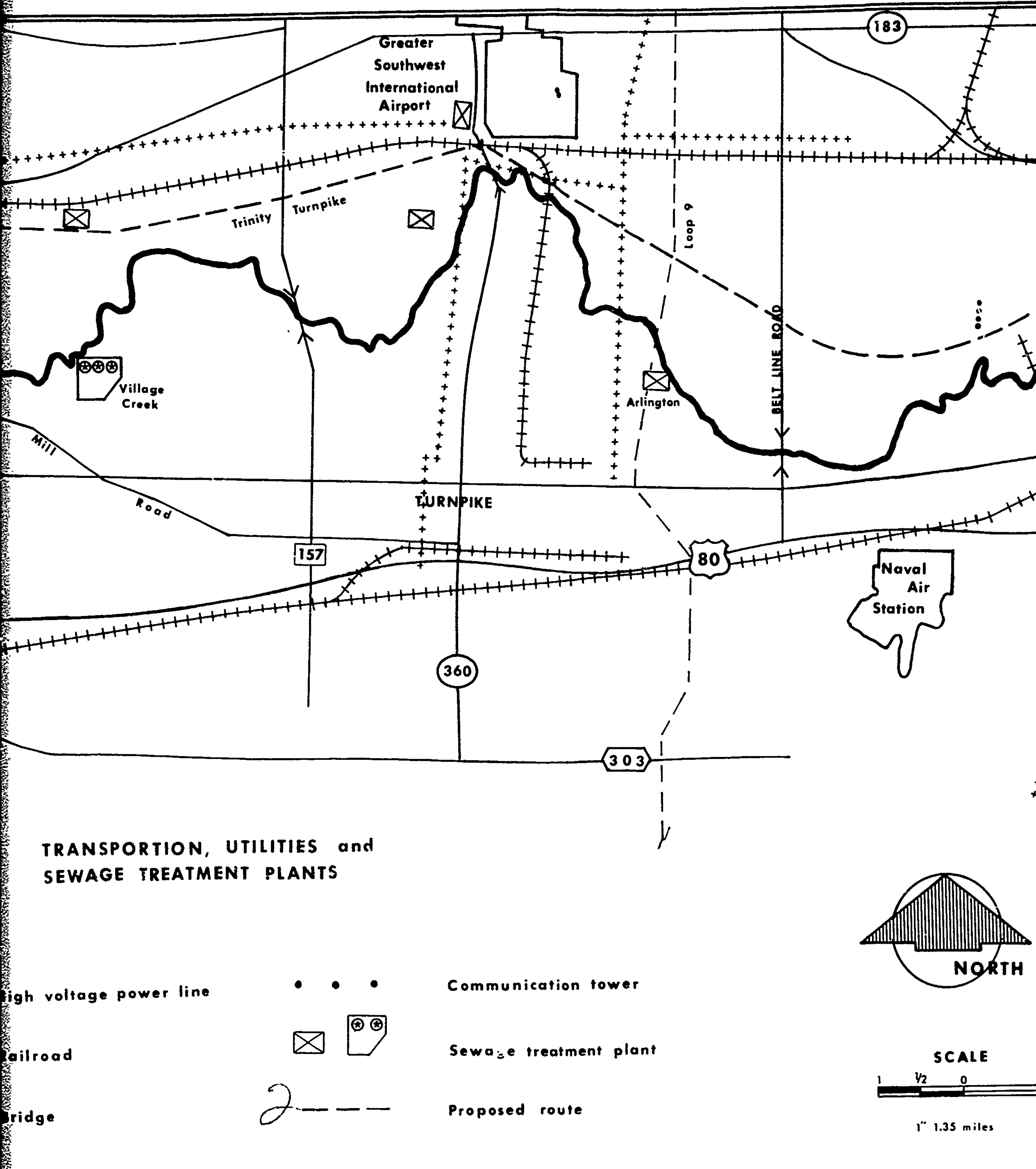
Not shown on the map but very much in presence is a maze of sewer and water lines that parallel most of the West Fork in the study area. Figure 11 is a composite of land uses depicted by Figures 3, 8, and 10 with sand and gravel mining areas shaded. The river corridor is clearly framed by the adjacent land uses.

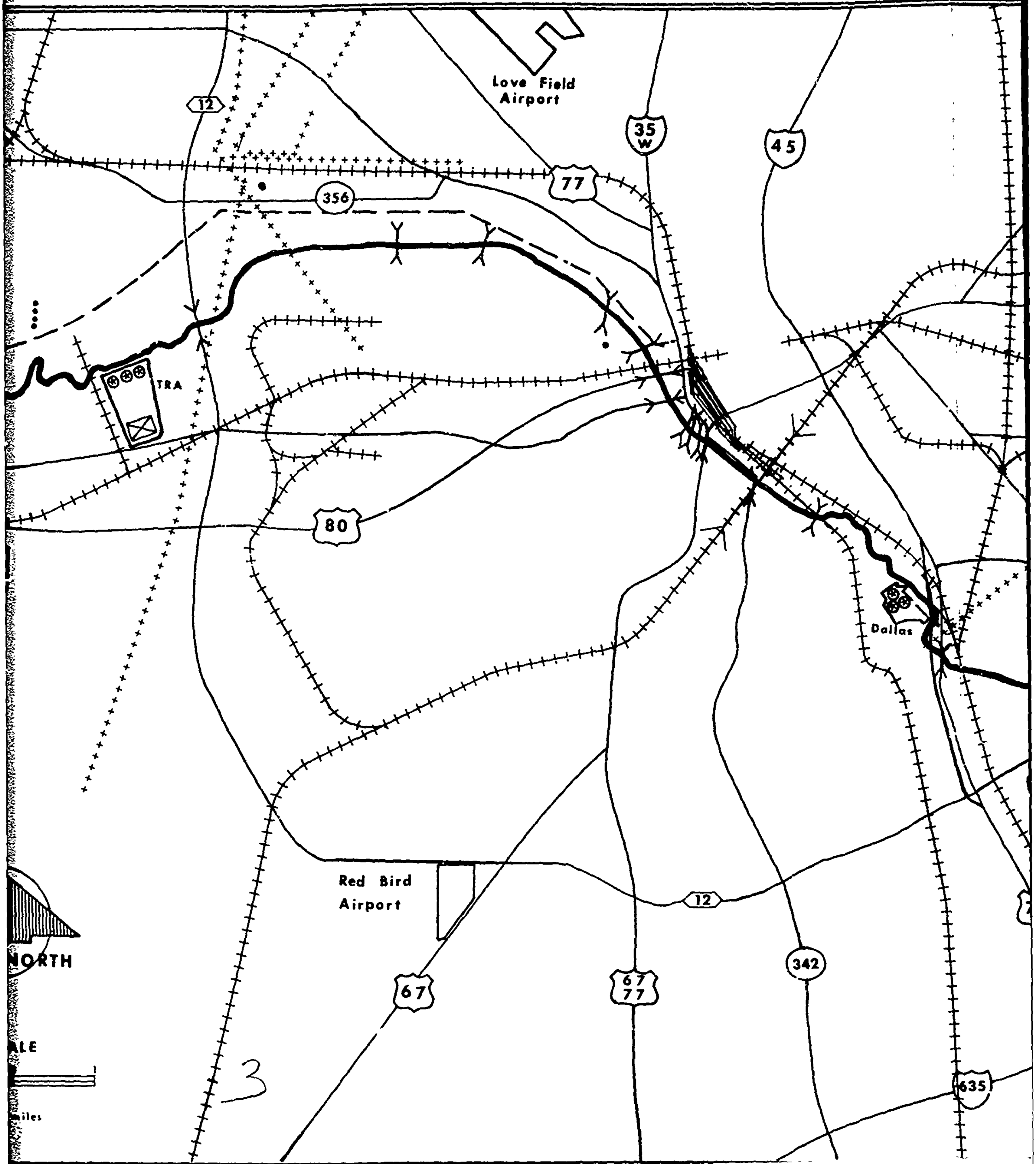
Designated park and open space areas are shown in Figure 12. As can be seen, there are a variety of recreational developments located in rather close proximity to the river corridor. A municipal golf course in Arlington will, for example, adjoin the existing river flood plain. Golf



81
377
121
121
183
121
BEACH ST.
Tarrant
Riverside
Randol Mill
80
180
287
35
W
820
TRANS
SEWAG
High voltage
Railroad
Bridge

TRANSPORTION, UTILITIES and SEWAGE TREATMENT PLANTS





Love Field
Airport
12
35
W
45
77
356
TRA
80
Dallas
Red Bird
Airport
12
NORTH
LE
miles
67
67
77
342
635
3

Fig. 10

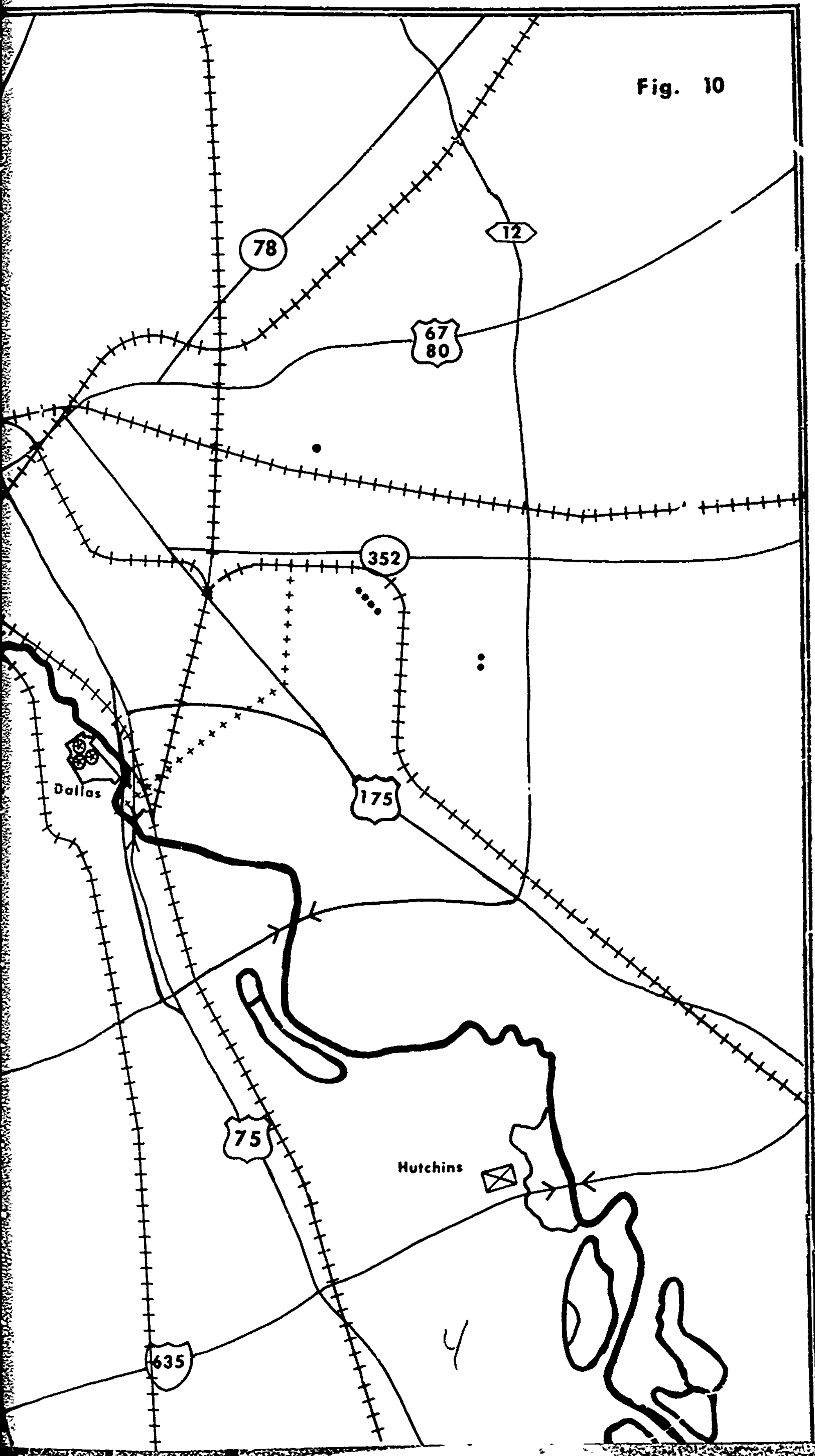


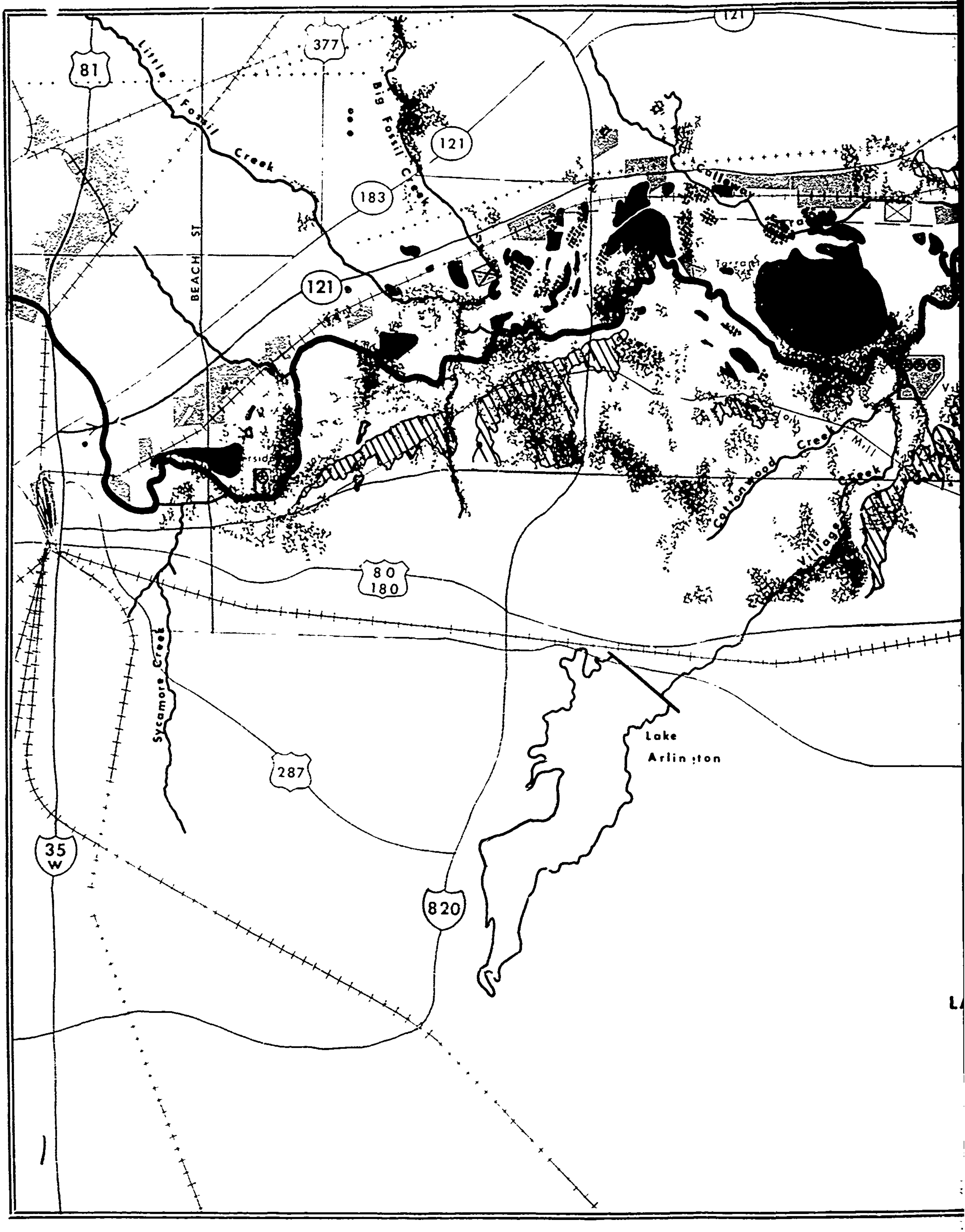
TABLE 10

RIVER CROSSINGS

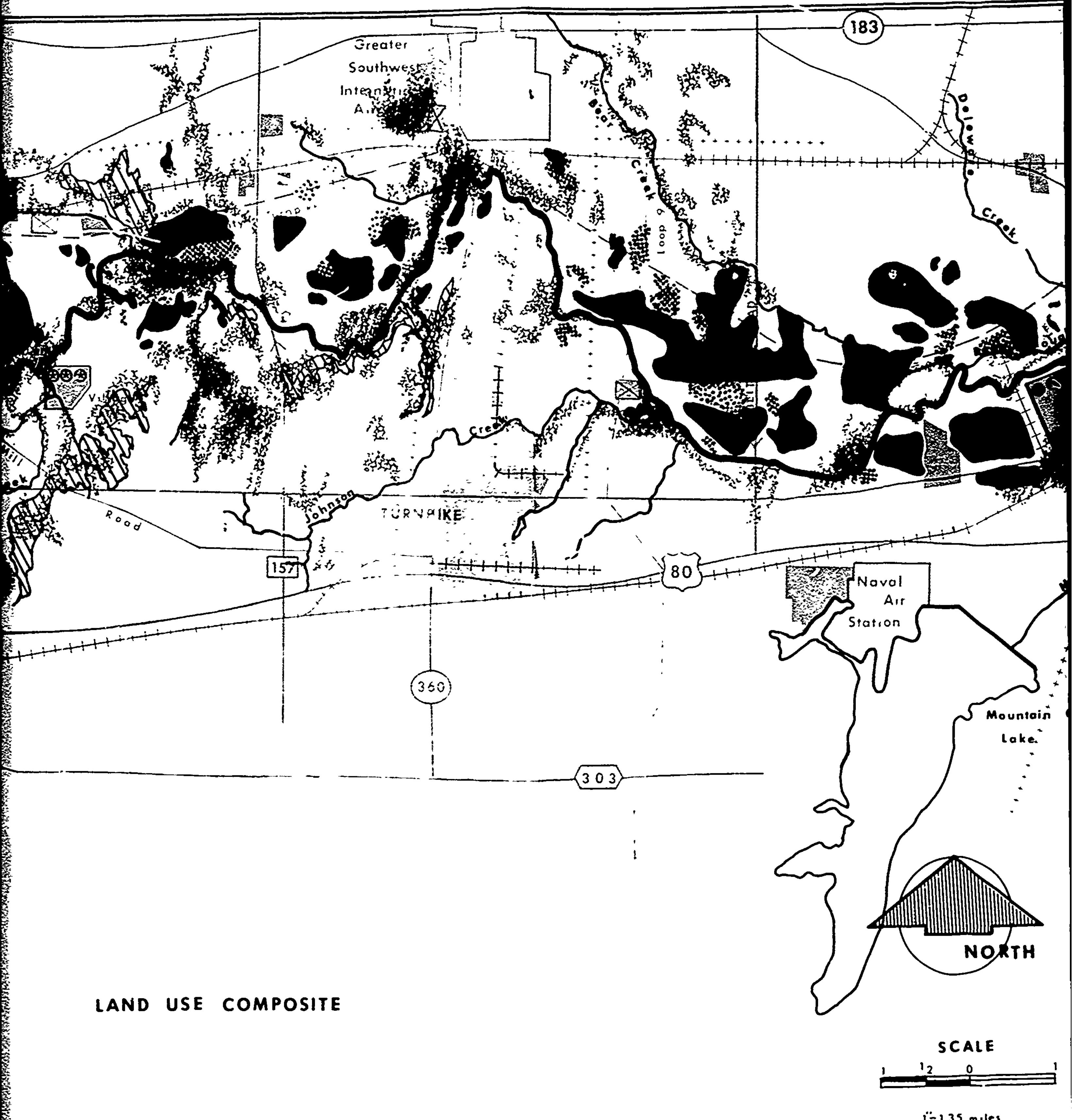
*Indicates a crossing not shown on Figure 11

(S) Secondary route (F) Subject to Flooding (C) Under Construction

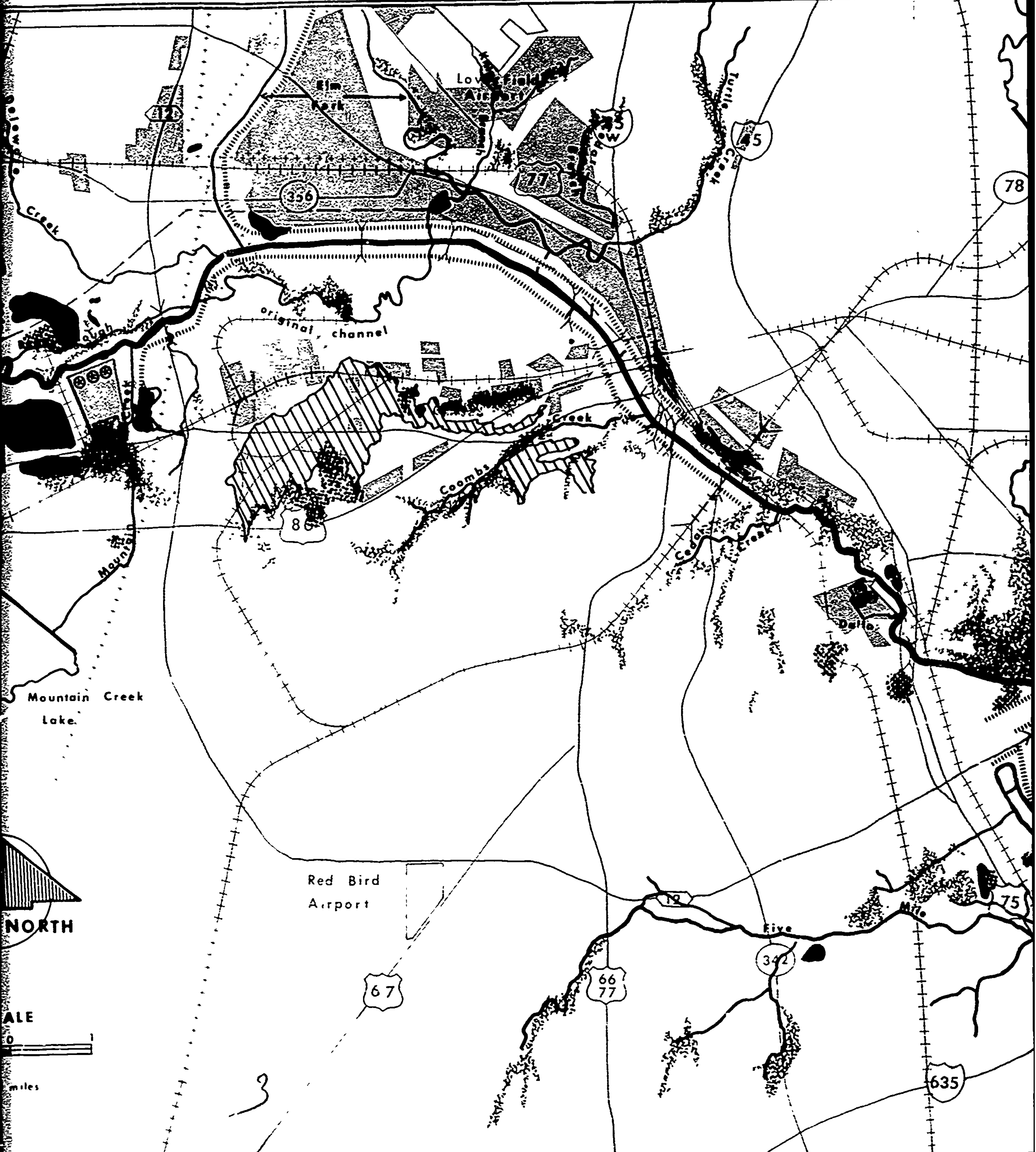
1.	S. H. 121	
2.	*East Fourth Street	(S)
3.	Chicago, Rock Island & Pacific Railroad	
4.	*Riverside Drive	
5.	Beach Street	
6	*East First Street	(S) (F)
7.	*Handley-Ederville Road	(S) (F)
8.	Loop 820 (east)	
9.	*Precinct Line Road	(S) (F)
10.	*Bedford-Arlington Road	(S) (F)
11.	F.M. 157	
12.	S.H. 360	
13.	Greater Southwest Industrial District Railroad Spur	(S) (F)
14.	Belt Line Road	(F)
15.	*Meyers Road	(S)
16.	Loop 12 (west)	
17.	Westmoreland Avenue	(F)
18.	Hampton Road	
19.	Sylvan Avenue	(F)
20.	Lamar Street Viaduct	
21.	Texas & Pacific Railroad	
22.	Commerce Street Viaduct	
23.	Dallas-Fort Worth Turnpike	
24.	Houston Street Viaduct	
25.	Jefferson Avenue	(C)
26.	I.H. 35	
27.	Cadiz Street Viaduct	
28.	Cornith Street Viaduct	
29.	Santa Fe Railroad	
30.	Cedar Crest Boulevard Viaduct	
31.	Missouri-Kansas-Texas Railroad	(F)
32.	I.H. 45	(C)
33.	Central Expressway	
34.	Southern Pacific Railroad	(F)
35.	Loop 12 (south)	
36.	I.H. 635	
37.	*Dowdy Ferry Road	(S)



81
Little Fossil Creek
377
Big Fossil Creek
121
183
121
BEACH ST
121
Calloway
80
180
Cottonwood Creek
Mill Creek
Village Creek
Sycamore Creek
287
Lake
Arlington
35
W
820



LAND USE COMPOSITE



Elm
Fork
Love Field
Airport
Turtle Creek
original channel
Creek
Coombs
Creek
Cedar
Creek
Mountain
Creek
Mountain Creek
Lake
Red Bird
Airport
Five
Mile
NORTH
ALE
0
1
miles
12
356
77
45
78
80
67
66
77
342
635
75

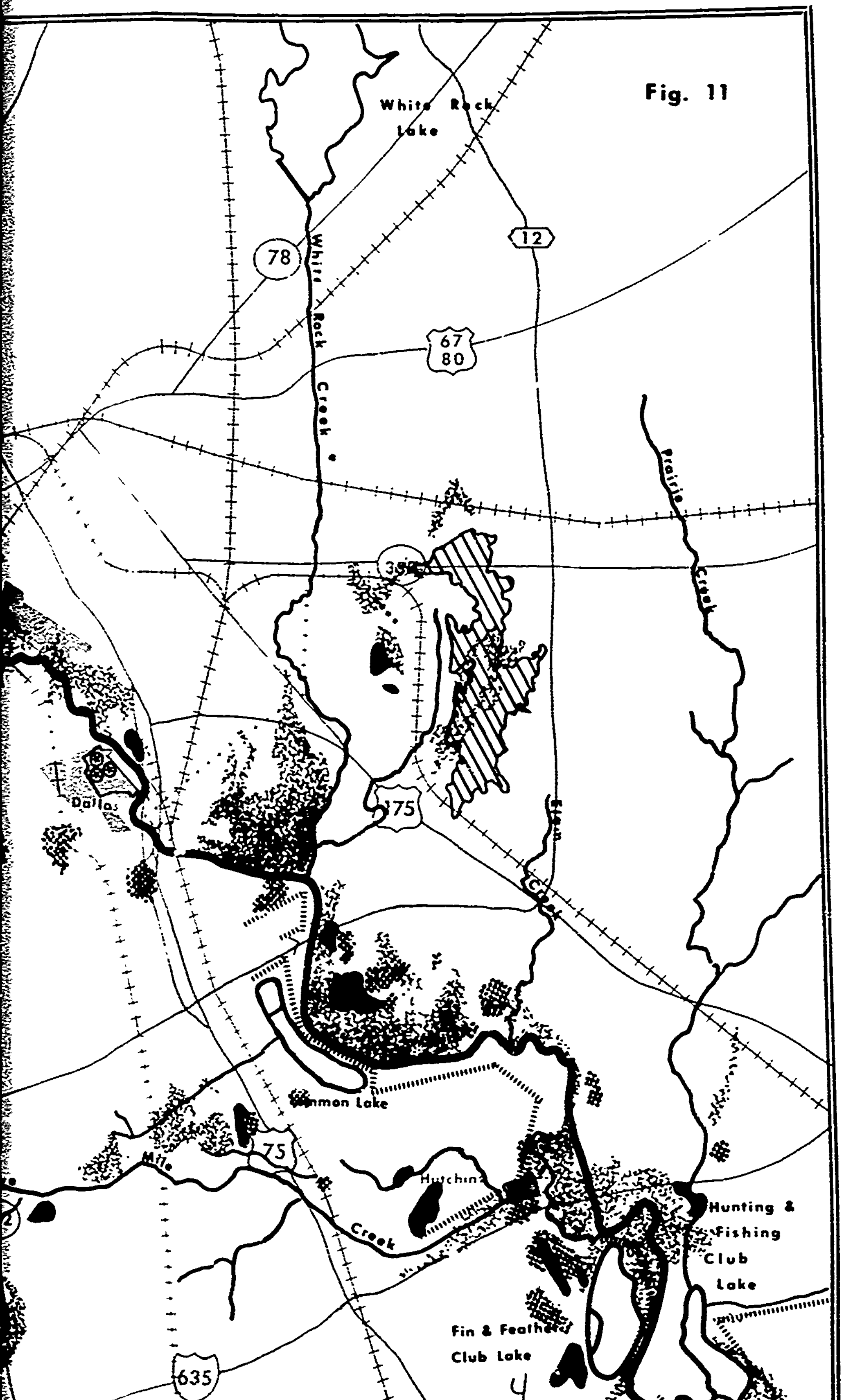
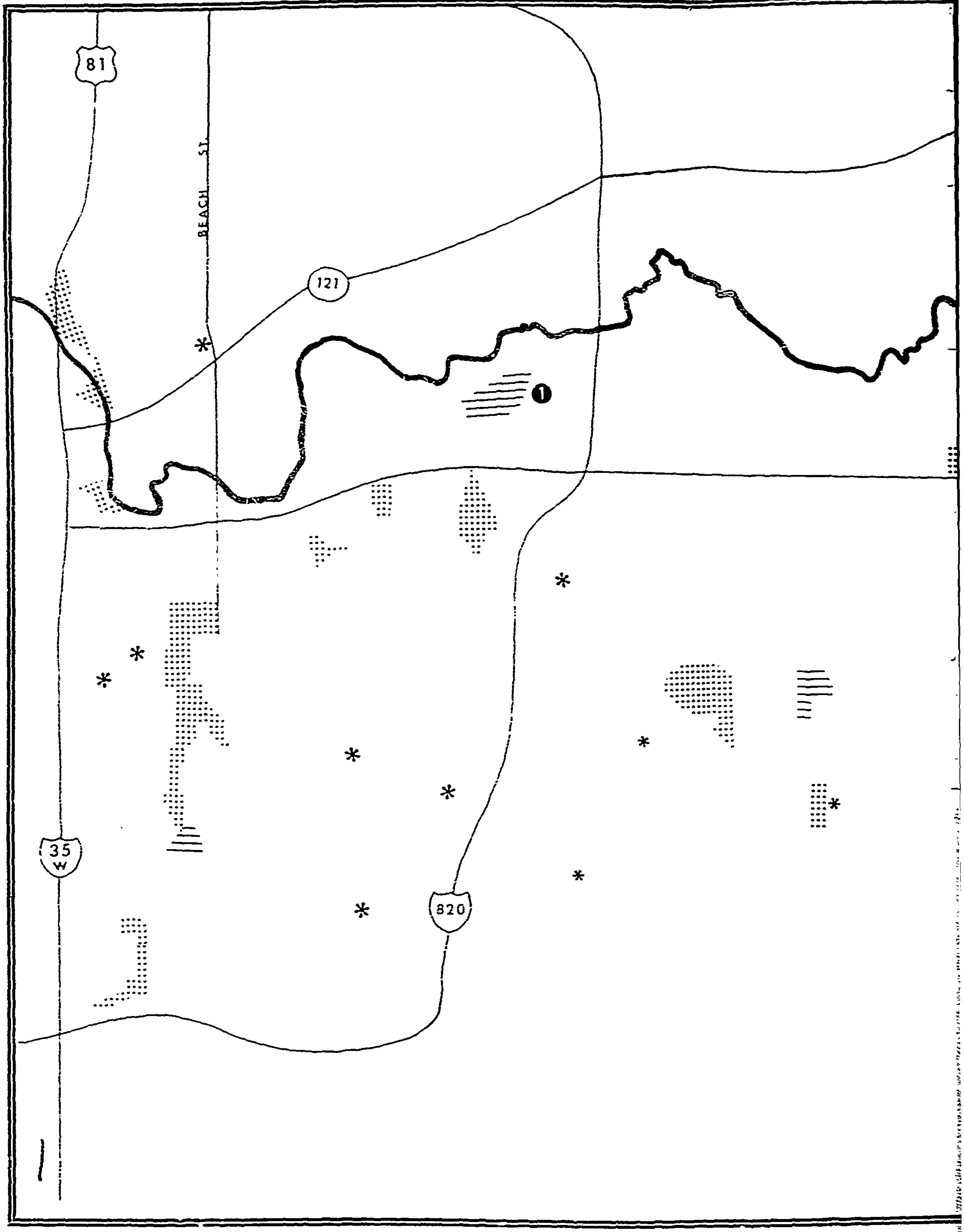
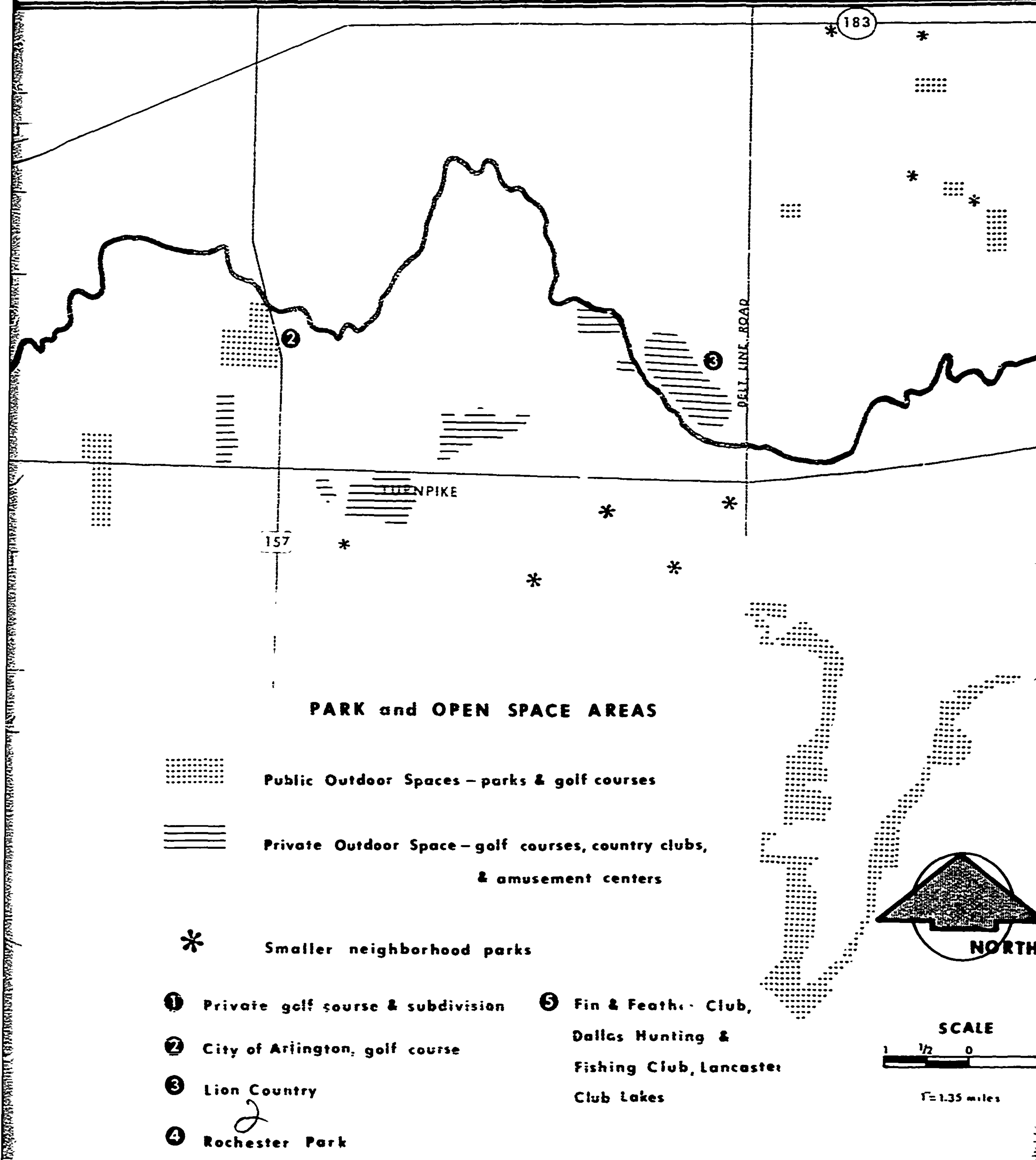

White Rock Lake
78
White Rock Creek
12
67
80
Prairie Creek
175
75
Mile
Creek
Hunting & Fishing Club Lake
Club Lake
635

Fig. 11


81
BEACH ST
121
35 W
820


183
BELT LINE ROAD
TURNPIKE
157
PARK and OPEN SPACE AREAS
Public Outdoor Spaces – parks & golf courses
Private Outdoor Space – golf courses, country clubs,
& amusement centers
Smaller neighborhood parks
1 Private golf sourse & subdivision
2 City of Arlington, golf course
3 Lion Country
4 Rochester Park
5 Fin & Feath Club,
Dallas Hunting &
Fishing Club, Lancaste
Club Lakes
NORTH
SCALE
1 1/2 0
1"=1.35 miles

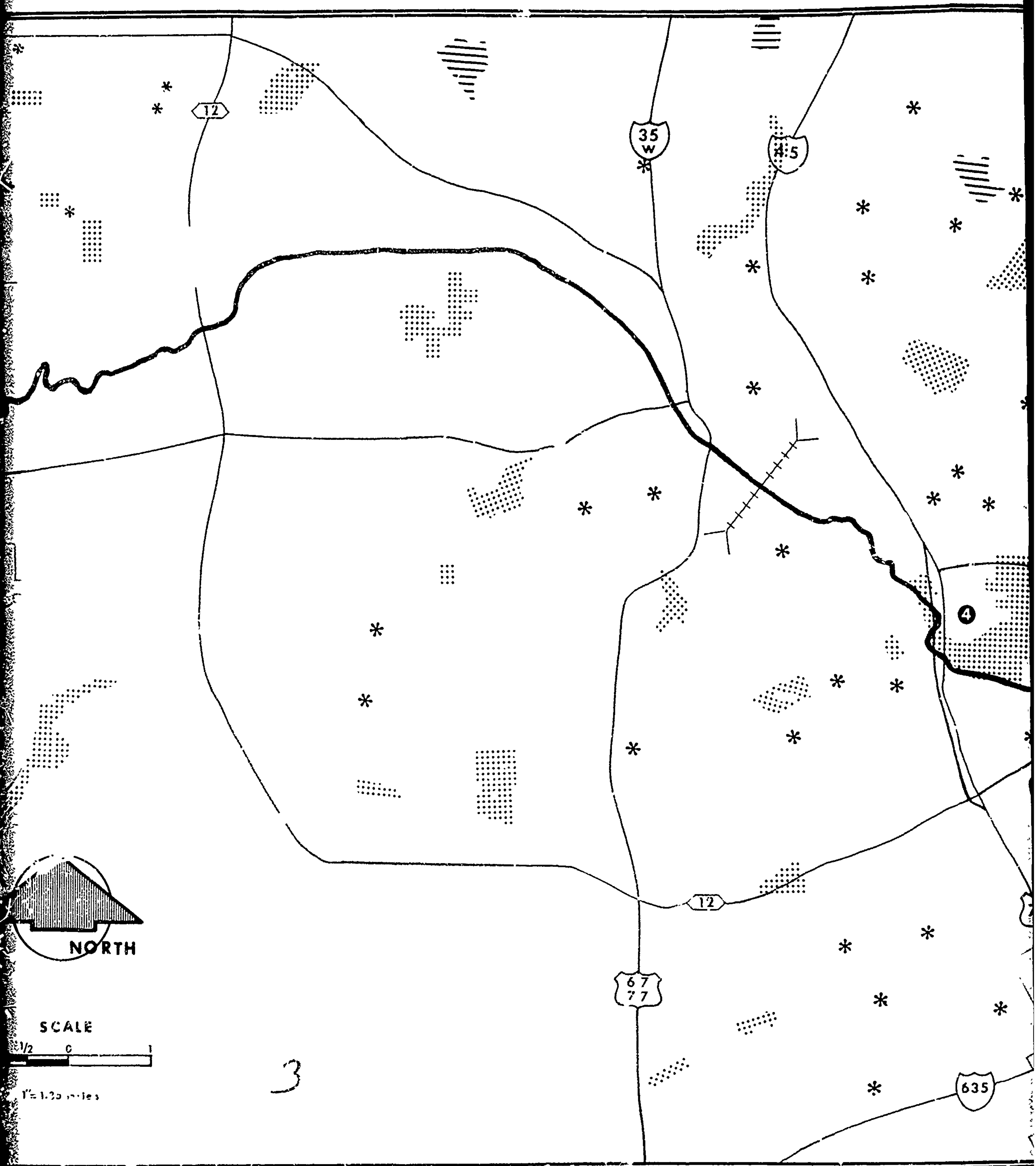
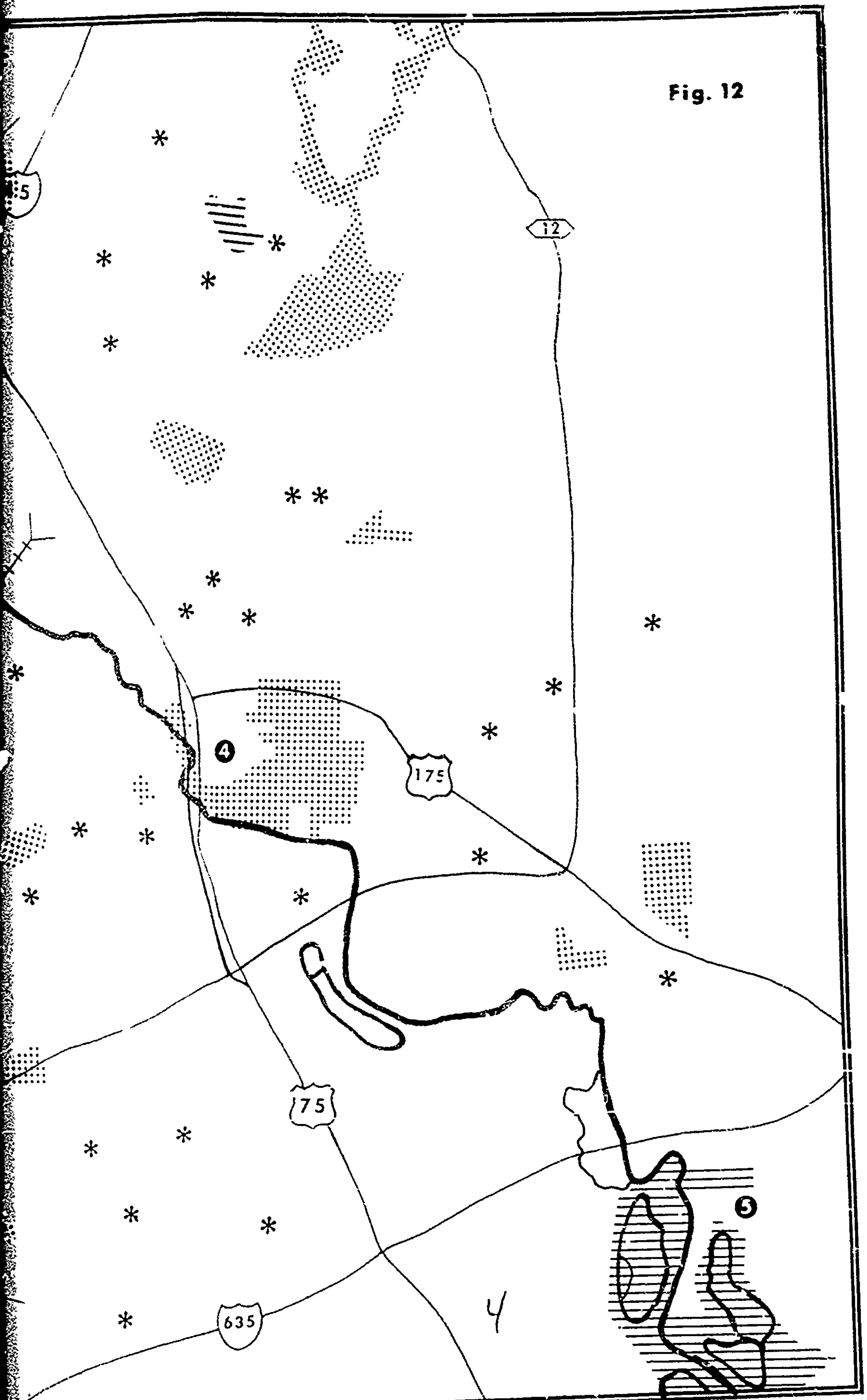

12
35
W
45
4
12
67
77
635
NORTH
SCALE
1/2
0
1
3

Fig. 12



courses and country clubs comprise the major recreational developments near the river.

History - Prior to the arrival of the Europeans in the early 1500's, the Caddo Indian tribes inhabited much of Texas. Of this tribe, the Wichita group lived in the lands of the Trinity River headwaters.[18]

A long period of conquest and colonization of Texas was initiated with the coming of the Spanish conquistadores and missionaries. Throughout this period Texas was claimed and fought over by many nations. In 1690 Captain Alonso de Leon, Governor of Coahuila, came to Texas to eradicate traces of French occupation. He named a major river La Santisima Trinidad (Most Holy Trinity), and it became known as the Three Forks of the Trinity by early Anglo settlers (it actually has four forks: Clear, East, Elm, and West).[19]

Mexico gained her independence from Spain, and under her rule, Texas was colonized by Anglo-American settlers from 1821 to 1835. In the years 1835-1836 the Texas Revolution was fought, and the independant Republic of Texas came to exist from 1836 to 1845.[20] During this period most Texans had settled on the coast or in the south-central regions of the Republic. Indians and great herds of buffalo occupied most of the remainder of the state.[21]

In the 1840's, the Republic began to allow settlements in the Upper Trinity River Basin area under the empressario system. Heads of household were allowed 640 acres, and single men could claim 320 acres. For each section taken, one was reserved for the land settlement company and another for the Republic. In this way, most of what are now Tarrant and Dallas Counties was settled by colonists of the Peters Company.[22] In 1845 the Republic applied for and was granted statehood.

Although Dallas and Fort Worth came to grow in close proximity, their development patterns of land use were quite different. Because of distinct physiographic differences, the rancher became predominant to the west and the farmer settled to the east.[23]

In 1841, John Neely Bryan claimed a parcel of land under the Peters grant and promoted a townsite that was later incorporated as Dallas. Dallas County was named for a Vice-President of the United States and was organized in 1846.[24]

The La Reunion Colony had been formed by French settlers in 1854 near the bluffs on the West Fork of the Trinity. But it failed, and many of its highly skilled and cosmopolitan members moved to Dallas and contributed greatly to the city's early development.[25]

In 1868 a steamboat actually navigated the Trinity River as far as Dallas rekindling hopes that the city was in fact at the head of a navigable river. But similar later efforts met with less success. The coming of the railroads in the 1870's greatly increased Dallas' growth. Since then, as Texas' second largest city, it has become a center of economic activity.[26]

A U.S Army post was built in 1849 and was named Fort Worth for General William J. Worth, commander of troops in Texas at that time. The post was abandoned in 1853, but a village had grown around it. Tarrant County was also established in 1849 and named for General Edward H. Tarrant. He was so honored for his attack on an Indian village along Village Creek (a tributary of the West Fork and the present boundary between Fort Worth and Arlington) where he and his 70 men dispersed the Indians and "recovered many stolen horses and much stolen plunder". Thus, did the Battle of Village Creek in 1841 make the area safe for settlement.[27]

Fort Worth developed in a colorful western tradition that still remains imbedded in its culture. After the Civil War, it became a major point of origin for the great cattle drives northward on the Chisolm Trail. In the 1870's, the advent of the railroads and building of the stockyards led to Fort Worth's fame as "Cowtown". The mansions of many wealthy cattlemen such as Burk Burnett, W. L. Waggoner, and Winfield Scott still stand within the city. Fort Worth continued to develop through meat packing and aircraft industries. It exists today as one of Texas' major metropolitan centers.

Important historic sites in and near the study area are listed below:

(1) Bird's Fort site. An inscribed granite marker stands on the site seven miles north of Arlington. In 1840, seven miles north of Arlington, Jonathan Bird established the fort on the military road from the Red River to Austin. An important Indian treaty was signed near the site on September 29, 1843. Remnants of the Snively Expedition sought

refuge there on August 6, 1843.

(2) Cedar Springs. An inscribed granite marker stands in Dallas on the earliest known historic site in Dallas County. The area was visited in 1840 by Colonel W. G. Cooke's exploration party. A community established in 1848 was annexed to Dallas in 1929.

(3) Battle of Village Creek. An inscribed granite marker stands three miles east of Handley on Highway 80. On May 24, 1841 General Tarrant and 70 men attacked an Indian Village situated along Village Creek.

(4) La Reunion. A granite marker and a park are located near the Trinity Portland Cement Plant in Dallas on Highway 80. This is the site of the old French colony of the same name.

There are no known historical or archeological sites within this area that would be adversely affected by the development of a multipurpose channel.

No discussion of the history of the study area would be complete without at least a brief look at the flood history of the Trinity River. Most of the forks of the Trinity that pass through Fort Worth have been modified by channelization and leveed to contain flood waters. However, the Fort Worth levee system ends just upstream from the study area on the West Fork. From there to the beginnings of the levee system in Dallas County, the West Fork and some of its major tributaries continue to periodically flood the lowlands. Fairly recent and notable examples are the great flood of 1949 and the floods of the late 1950's when Big Fossil Creek inundated large residential sections in Richland Hills. The creek system has since been modified to minimize flood hazards.

Downtown Dallas also developed very close to the river's flood plain, and in 1908, a large portion of the downtown area was flooded. In 1926, the City and County of Dallas Levee Improvement District was created to build the Dallas Floodway. By 1930, the Trinity River through Dallas was substantially channelized and leveed to form the floodway. Major supplemental improvements were accomplished by the Corps of Engineers in 1953.[28]

Political Jurisdictions - The central business districts of the cities of Fort Worth and Dallas are centrally located within their respective counties. Surrounding both cities and forming a virtual continuum between them are a number of satellite communities. The lands within the study area are nearly totally incorporated by local units of government. Municipal jurisdictions immediately within the study area are listed as they occur from Planning Sector 1 to Sector 7. Accompanying each city is its 1970 Census of population.*

Fort Worth	393,476
Haltom City	28,127
Richland Hills	8,865
Hurst	27,215
Euless	19,316
Arlington	90,643
Grand Prairie	50,904
Irving	97,260
Dallas	844,401
Hutchins	1,755
Kleberg	4,768

Other census data of interest:

Fort Worth SMSA	762,086
Tarrant County	716,317
Dallas SMSA	1,555,950
Dallas County	1,327,321
State of Texas	11,196,730

These jurisdictions and their boundaries are shown in Figure 13. Also within the study area are several special districts with functions that affect land use. Such decisions are made by the following public authorities:

The Trinity River Authority of Texas

The Texas Turnpike Authority

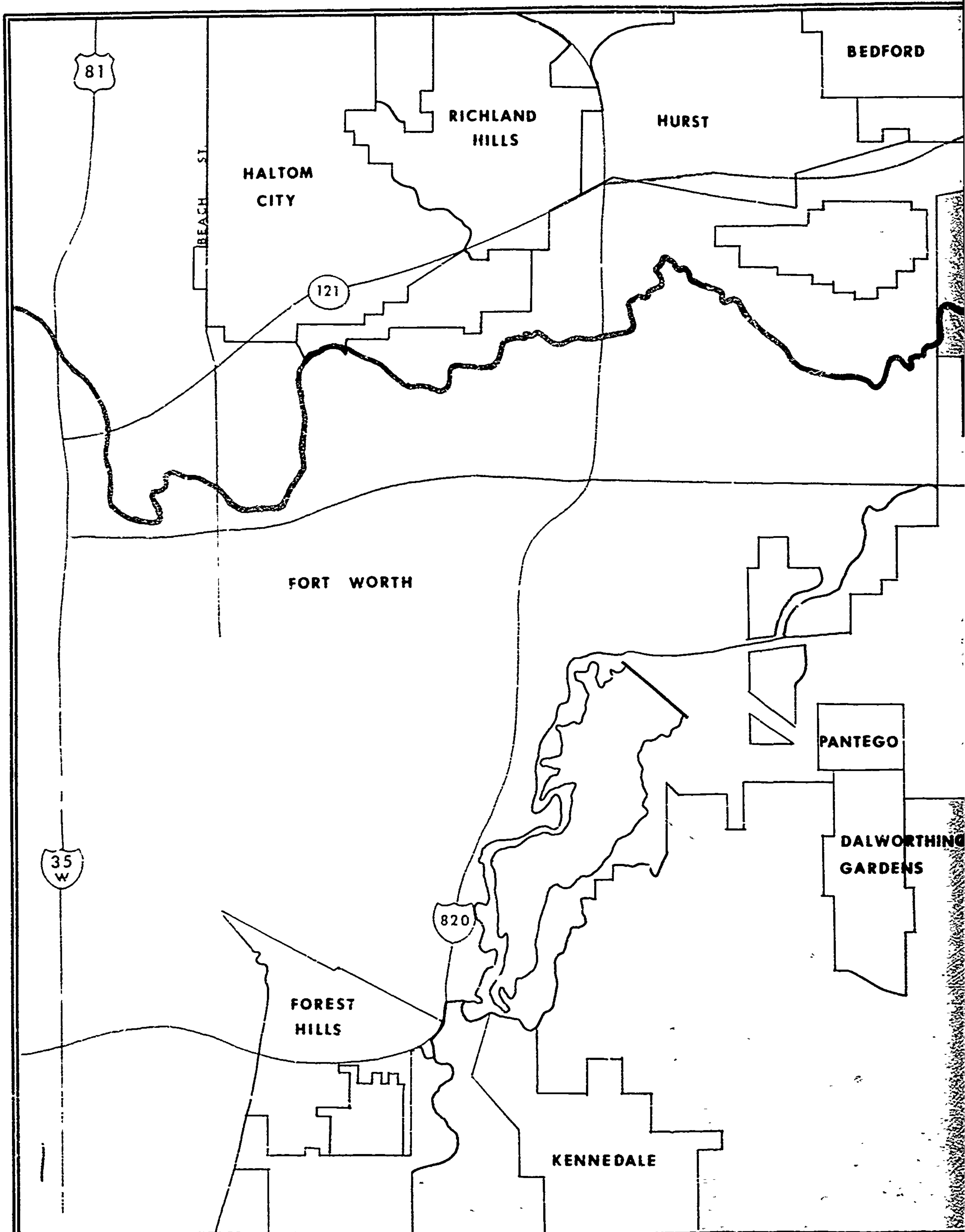
The Tarrant County Water Control and Improvement District

Area Planning - There are a number of plans and studies written for varying purposes which involve lands within the defined study area. Each of them is listed below, and their purposes are briefly explained.

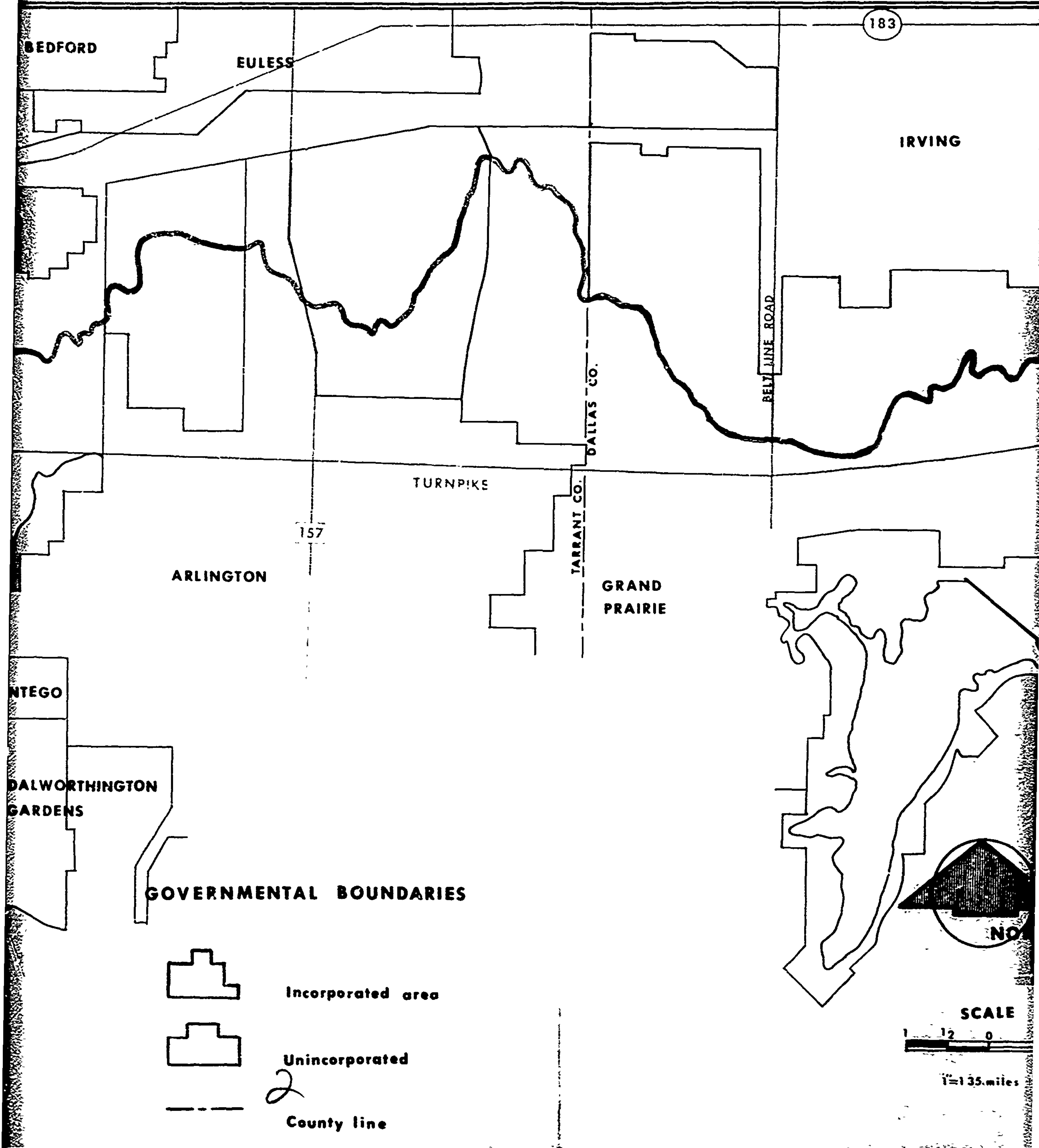
1. Dallas-Fort Worth Regional Transportation Study, 1967. This study was prepared by the Texas Highway Department in cooperation with the U.S. Department of Transportation and local governments to study

---

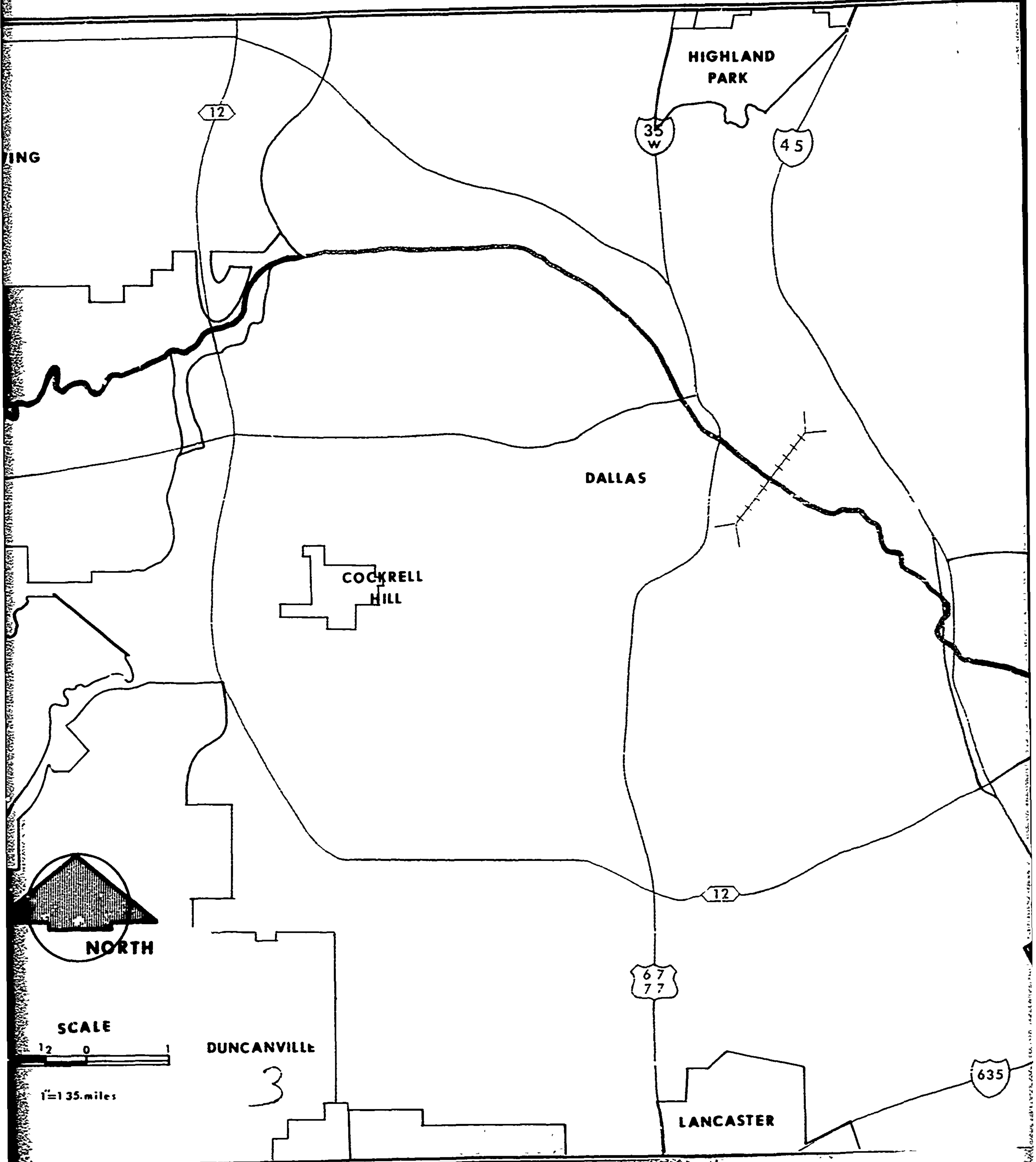
*1970 Census Fact Book, North Central Texas Council of Governments, Arlington, Texas.



81
BEDFORD
RICHLAND
HILLS
HURST
HALTOM
CITY
BEACH ST.
121
FORT WORTH
PANTEGO
DALWORTHING
GARDENS
35
W
820
FOREST
HILLS
KENNEDALE



BEDFORD
EULESS
183
IRVING
BELT LINE ROAD
DALLAS CO.
TURNPIKE
TARRANT CO.
157
ARLINGTON
GRAND PRAIRIE
NTEGO
DALWORTHINGTON GARDENS
GOVERNMENTAL BOUNDARIES
Incorporated area
Unincorporated
County line
SCALE
1"=1.35 miles



HIGHLAND
PARK
12
35
W
45
ING
DALLAS
COCKRELL
HILL
12
NORTH
67
77
SCALE
1/2
0
1
1"=1.35 miles
DUNCANVILLE
3
635
LANCASTER

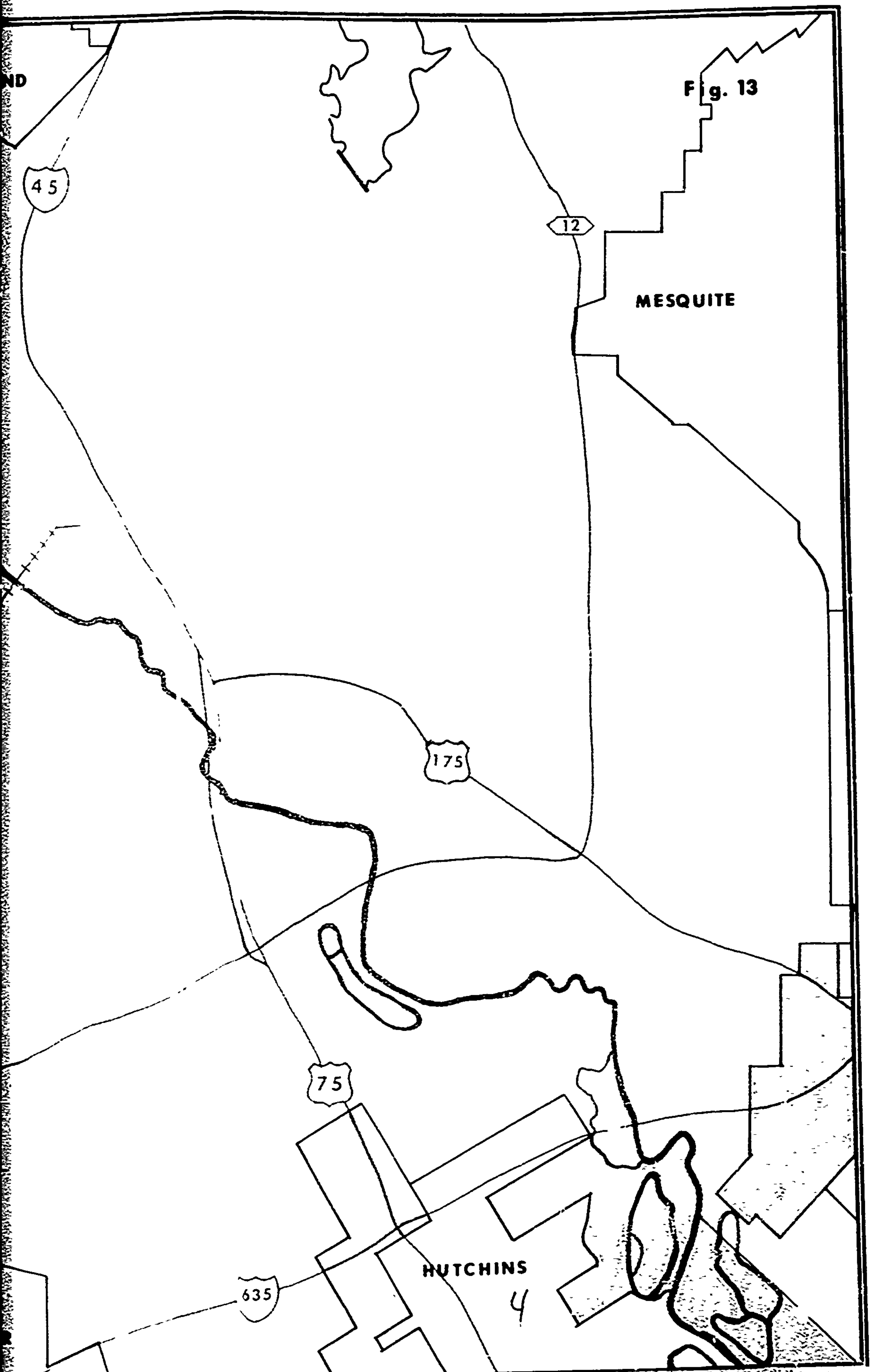


Fig. 13
ND
45
12
MESQUITE
175
75
HUTCHINS
635
4

public and private transportation facilities within the metropolitan region and to make recommendations for future transportation systems. The plan proposes additional crossings of the Trinity, considers existing bridges, and recommends further routes which would parallel the river.

2. Trinity River and Tributaries, Texas, 1965. The Corps of Engineers has compiled this comprehensive development plan for the Trinity River Basin. The central feature of the plan is the proposed multipurpose channel from Fort Worth to Galveston Bay. Four of the proposed 21 locks and dams fall within the study area. The plan calls for multipurpose development of the Trinity River to include navigation, flood control, recreation, and water resource development.

3. Open Space Development Trinity River System in Dallas, Texas 1969. This plan is also known as the "Springer Plan" for its author, Marvin Springer. It is a comprehensive plan for open space development along the portion of the River proper and the Elm Fork that runs through Dallas and adjacent communities.

4. Dallas Parks and Open Space Plan, 1959. This plan proposes the acquistion of several large tracts of land within and near the study area.

5. Fort Worth General Plan. Volume IV of this plan, "Meadowbrook Sector", is dated 1970 and Volume VI, "District C", is dated August, 1971. Together these plans cover the area within Fort Worth from the western terminus of the study area to the Tarrant-Dallas County Line. Both plans cover open space, transportation, housing, commercial and/or industrial development.

6. Future Structure of the North Central Texas Region, 1970. This study is focused on the fact that the Dallas-Fort Worth Regional Airport is expected to become operational by 1974. The North Central Texas Council of Governments prepared an outline of the expected impact of the airport in terms of population growth, development and employment. A great deal of growth is expected adjacent to the regional airport and along the primary travel routes connecting it to the metropolitan complex it will serve.

7. Arlington, Texas - Urban Development Framework, 1971. This comprehensive plan was written by Marvin Springer and Associates for the City of Arlington.

8. Comprehensive Plan Report - City of Grand Prairie, 1966. This comprehensive plan was prepared by Marvin Springer and Associates for the City of Grand Prairie.

9 Master Thoroughfare Plan for the City of Irving. This plan is in the process of being completed. The City also has a general land use plan with primary emphasis on utilities and roads, and which reflects the Corps' channelization and levee improvement plans for the West Fork of the Trinity.

10. Open Space Plan/Report for North Central Texas, 1971. This plan is in draft form and was written by the North Central Texas Council of Governments. It describes and studies potential sites and demands for open space within the NCTCOG Region.

11. Upper Trinity River Comprehensive Sewerage Plan, 1970. Volume I. This plan was prepared for the NCTCOG by three consulting firms. It sets forth the goals for regional waste treatment.

THE PROBLEM

Water resources of the Trinity River have been viewed over the years with mixed emotions by basin residents. Negative reactions to the river have come as man has been confronted with the consequences of his misunderstanding of river basin environmental systems and his unwise and, oftentimes, robber baron approach to uses of the lands which constitute the vast watershed of the Trinity River. Floods and other natural hydrologic functions of the river became a problem only after man had arrived in the basin in large numbers, settled in its flood plains, cleared its land, built roads and cities, and developed its resources. He significantly changed major characteristics of the hydrologic regime in a relatively short period of history, thereby quickly disrupting an ecosystem which had developed and evolved slowly through geologic time.

Early residents of the basin had little impact on the land and, therefore, caused only minor changes in the basin hydrologic system. These early settlers knew the characteristics of the river and respected them. They lived in relative harmony with the Trinity. As urbanization, the clearing of forests and grasslands for agricultural and other developments grew throughout the basin, human settlements found themselves in close proximity to the river. In fact, they were often established within the flood plains of the river and its various tributaries. When the floods came, great loss of life and property resulted. The Trinity became an enemy, a raging torrent to be tamed and eventually subdued.

Meanwhile, thoughful men began to realize that these raging waters, if properly harnessed and conserved, could serve man in many productive ways. Unfortunately, in his haste to make use of this vast water system, man failed to come to grips with the real complexities of the river, its vast watershed lands, its flood plains and, more importantly, its future role in the environmental and economic system of the region. It is a fact beyond dispute, if man is to continue to live and prosper in the Trinity Basin, he must use the land and water resources of the basin wisely.

Development of structures to control floods and conserve water began in the Trinity Basin over thirty years ago. In the aggregate, the numerous lakes, diversion channels and other works comprise a total land and water management system designed to safeguard communities and agricultural land, provide additional sources of municipal and industrial water, improve water quality, and increase opportunities for fish, wildlife, and outdoor recreation. The ultimate goal of the Trinity development plan is the construction of a multiple purpose channel from Galveston Bay to Fort Worth.

The Trinity Basin is by no means virgin. The almost constant presence of man in large numbers for over fifty years has altered drastically the face of the land throughout the region. The negative impacts of the past have been far greater than any likely impact resulting directly from the future alteration of the river and its ecosystems to accomodate the proposed channel. Through wise resource development and management, man can direct future changes of the river basin environment to repair much of the past abuse, quantitatively and qualitatively, and can provide basin residents, the State, and the Nation with a healthy and pleasant environment.

For over twenty years, federal, state and local agencies and private concerns have been at work studying various aspects of the Trinity Basin. Many of these efforts have been single-purpose in nature and/or restricted in scope and scale to local effectuation. Only recently has the concept of a truly interdisciplinary and comprehensive approach to the study and analysis of the basin-wide environment been recognized and implemented.

The major charge of this study is to examine a portion of the basin and develop a model for environmental protection, consonant with multiple purpose water development, which has basin-wide application. The most important aspect of the study centers around the ultimate location of the multipurpose channel and its supporting structures. All other events which will result in varying degrees of environmental impact will relate to this decision. The future of the river-oriented environs will be determined by the course of action taken with respect to those lands which now constitute the floodplain. It is the use and management of these lands to which this report is primarily addressed. This study is one of several plans addressed to the ultimate future of lands within the floodplain. Its challenge is the full consideration of the river system as a complex unit and the proposal of an ecological, engineering, social and institutional framework whereby the goals of open space, environmental integrity, economic enhancement, social well-being and political equity may be realized, each in harmony with the other. Differing from other studies, this report deals principally with ecological, rather than institutional, parameters. The latter, it is hoped, will be circumscribed by the boundaries of an environmentally defined, economically feasible and socially acceptable resource unit. As a point of departure, we have delineated this unit as the Trinity River Greenway - a prototype for the eventual development of the entire river system.

One inescapable fact permeates and dominates this undertaking. The study area is by no means a stable ecological community. It has been heavily developed in the past and is experiencing drastic land use changes at the present. Human settlement has been held back only by the threat of substantial loss to life and property from the ever possible flood waters. Even the vast upstream reservoirs have not been able to guarantee complete security and thus give the green light to urban invasion of one of the last remnants of natural open space within the Dallas-Fort Worth Metropolitan Region. Roads, subdivisions, abandoned mineral pits, dumps and many forms of blight frequent the area. In many respects, this area has become a defacto dump for many waste products and residuals of the region. Water quality has long since deteriorated and has hardly been improved by token institutional regulations and less-than-adequate waste treatment facilities. Only the hardiest species of wildlife reside in the area, living in constant danger of eventual elimination. Thus, the present environment within the study area can be classified as natural only in a contemporary time perspective.

The future ecosystem within this area will be natural only to the extent that internal and external influences allow natural processes to continue to evolve toward ecological communities resembling an ultimate associational climax. It has been pointed out, what now appears "natural" is in a sense a perceptual phenomena on the part of those urbanites who crave trees, grass, plants, animals and flowers as a contrast to their predominately concrete and steel environs. Thus, fields of weeds and brush, revegetated mine areas and the river bottom woodlands are "natural" habitats which, although not virgin in composition, offer a sense of "naturalness" in contrast to synthetic urbanity. These areas must be identified, assessed, linked together, protected and enhanced if they are to be preserved for future generations.

The problem is to blend multipurpose development and desired environmental objectives into a plan which provides for each to be accomplished, for each to be realized as having significant value to all the people of the region and for each to compliment the other in the total scheme of things. The vehicle to be used is open space, developed by the communities, agencies and individuals having ownership of, and therefore, mutual responsibility for the ultimate future of the lands within the area. The impacts resulting from improper land use are of as much concern as the unwise development of a massive water resource project. The challenge then, is to devise a framework for implementation of qualitative environmental objectives and then to evaluate the area as it would be with and without the proposed channel. Through such a plan, the stage can be set for future river environments that will reverse the course of organic events which have taken place in the region for well over one hundred years.

METHODOLOGY

Prior to begining the study, several preliminary planning sessions were held with staff from the Environmental Resources Section of the Fort Worth District, Corps of Engineers. These meetings served to:

(a) outline and clarify the purpose and objectives of the study.

(b) determine the range of disciplines needed to be represented on the study team,

(c) establish a framework for the study and,

(d) develop workable channels of communication between the study team, the Corps of Engineers and the cities and other units of government having jurisdiction over lands within the study area.

Upon notification of the study contract, a preliminary briefing meeting was held in Arlington, Texas to outline the objectives of the study. Present at the meeting were representatives of the Corps, the Trinity River Authority of Texas, Texas Parks and Wildlife Department, North Central Texas Council of Governments and the Park Directors of the Cities of Dallas, Irving, Arlington, Grand Prairie and Fort Worth. Working with these public agencies and various interest groups throughout the study area, a primary goal of providing maximum allowable opportunity for including these groups in the study was provided. To this end a series of newsletters providing periodic progress reports were sent to each of the above mentioned agencies. Each of these letters can be found in Appendix A. Inputs from personnel in all of these agencies proved extremely valuable to the study team throughout the project.

Field work was conducted by individual specialists to obtain specific data not found in previously published documents. In general, field trips included studies of water quality, vegetation, land forms, fish and wildlife populations and habitat, soils and geology, access, existing land use and development, scenic vistas, historical, archaeological and cultural sites, solid waste disposal areas, mined-out as well as currently operational sand and gravel sites, and additional environmental features which would be influenced by the proposed project.

In addition to the field investigations and library research, soil survey reports, high-altitude color infrared imagery *(see Figure 4),

---

*High-altitude color photography and infrared imagery of the Trinity Basin has been made available to the Department of Park Administration by the National Aeronautics and Space Administration.

area plans, topographic maps, special reports, and interviews with agency personnel and knowledgable citizens were used by the investigators. Personnel from the Soil Conservation Service, Texas Parks and Wildlife Department, Bureau of Sports Fisheries and Wildlife, Tarrant County and Dallas County cooperated with the study team when called upon for assistance.

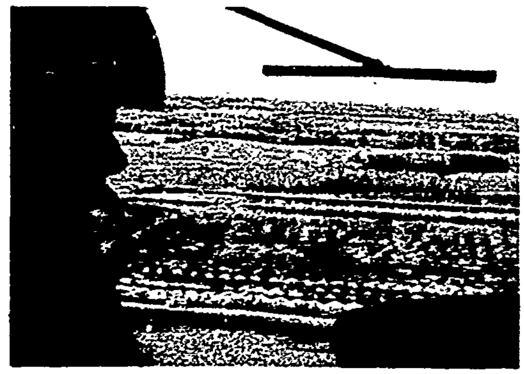


Figure 14:

Left. UH-1H "Huey" Helicopter. The 300th Aviation Company, U.S. Army Reserve in Fort Worth supplied the reconnaissance aircraft.

Right. Helicopter Reconnaissance. Observing an active sand and gravel mining operation in Sector 3.

Concurrent with the initial ground surveys, arrangements were made through the Corps to secure the services of military aircraft for reconnaissance surveys of the study area. Through the cooperation of the U.S. Army Reserve, aircraft and support services from nearby Oak Grove Airport were made available to the Tech study team. Figure 14 shows the helicopter aircraft used by the study team.

Upon completion of the first draft of the report, meetings were held with personnel from the Corps of Engineers to solicit their views on the proposed open space corridor and those lands within the corridor over which they would have responsibility. Various revisions were made to arrive at a solution acceptable to all involved.

Upon completion of all data gathering, analysis and synthesis, field investigations and public meetings, the final report was prepared. This report was presented to the Corps and followed by an informal review session after which the final report was printed.

PROPOSED SOLUTIONS AND RECOMMENDATIONS

Water Quality - Water quality is without a doubt of paramount importance to the successful planning, construction, and utilization of the Trinity River multipurpose project. A dilemma which has survived the struggles that codified and institutionalized our concepts of water quantity lies in the definition of the word "quality". The dictionary may suggest that quality implies some sort of positive attribute or virture in water, but the fact remains that one water's virtue is anothers vice. That is, after all the impurities in water have been cataloged and quantified, their significance can be interpreted in reference to quality only relative to the needs or tolerances of each benefical use to which the water is to be put. While the quality of the project water will have little if any effect on navigation, other beneficial uses associated with the project will depend heavily upon water quality. The presence and abundance of the desirable aquatic or terrestrial flora and fauna, aesthetic acceptance, recreational potential, and other beneficial uses intended for the project will depend almost exclusively upon water quality. For this reason, efforts to establish and maintain the quality of the water at a desirable level are as essential to the success of the project as is the acquisition and maintenance of a sufficient volume of flow.

In order to provide sufficient quantities of water for navigation purposes, utilization of treated wastewater effluents is essential. There are data to indicate that there have been may years when low flow volumes of the river in and around Dallas and Fort Worth were less than the total quantities of wastewater effluents discharged from their respective sewage treatment plants.[29] For this reason, the quality of effluents from the treatment plants is especially critical to the water quality of the project. In addition to sewage treatment effluents, sources of water for the project will include augmentation from various lakes, tributary inputs, rainfall and runoff from urban and rural watersheds. Of these sources, only the quality of the rainfall and reservoir contributions are sufficiently good to meet the multipurpose objectives of the project. During low-flow conditions which occur for extensive periods of time in the study area, the water quality in the Trinity River and its tributaries is generally unsatisfactory.[30]

The poor water quality of the Trinity River is not entirely dependent upon municipal and industrial effluent and surface runoff. Dumps and landfills located along the river contribute significantly to pollution and the impairment of aesthetic quality. Floating materials of all kinds as well as junk and debris are found in and along the river. It is known that inhabitants occasionally use the river and its tributaries as dump sites.

The quality of the water from Fort Worth to Dallas is as poor as in any other reach of the river. Water quality data included in the Comprehensive Sewerage Plan for the Upper Trinity River Basin indicate that dissolved oxygen levels approach zero at every sampling station in the Dallas-Fort Worth area at some time during the year and most commonly during low-flow, high-temperature conditions. The plan also concluded that, exclusive of reaches immediately upstream from Dallas, dissolved oxygen levels under representative summer conditions do not meet minimum state requirements, i.e. 4 mg/l. The study further indicates that the maximum BOD (biochemical oxygen demand) limit of 15.0 mg/l is exceeded in major portions of this reach of the river, and concentrations of phosphates and nitrates increase greatly between Fort Worth and Arlington. This effect, according to the Comprehensive Sewerage Plan Study, can be attributed primarily to the effluents from the Fort Worth and Arlington sewage treatment plants. Even the comparatively low concentrations of nitrogen and phosphorus contributed by other threatment plants in the area are sufficiently high to pose eutrophication problems. It is recognized that allowable BOD alluded to in many water quality criteria reports is often expressed in terms of an annual average and that the conditions in this reach of the Trinity River may satisfy the requirements. However, the annual average measurement is not considered meaningful for critical summer conditions when dissolved oxygen concentrations are lower, metabolic oxygen requirements are higher and recreational use is at its peak.

Although bacteriological data are not readily available for the particular reach of the river under study, data collected at lower reaches by the Texas State Department of Health indicate that the river is heavily contaminated with fecal coliform bacteria.[31] Counts as high as 160 to 900 fecal coliform per 100 ml were recorded about seventy miles below the confluence of the Trinity River with the East Fork. While these data do not in themselves indicate fecal contamination of the West Fork of the Trinity River between Dallas and Fort Worth, studies by Silvey, et. al. indicate that concentrations of fecal coliforms in excess of a log mean of 200 per 100 ml, the maximum allowable limit for primary contact recreation, are often found.[32] The particular section of the Trinity River which was surveyed during their investigation included the proposed project area and was found to be highly contaminated with respect to compiled bacteriological data. They further found that chlorination, although quite effective in reducing the coliform density at stations where the chlorine was applied, did not effectively improve the pre-existing bacteriological conditions of the river.[33] These results suggest that the bacteriological quality of the waters in the Trinity will not be improved significantly in the near future even though sewage effluents may be heavily chlorinated. If, however, chlorination continues over an extended period of time, its effect coupled with the dilution effect contributed by additional high quality flows, may combine to render the bacterial quality of the water suitable for recreational purposes.

At this time, however, a heavy pollution load in the river resulting from the discharge of effluents from sewage treatment plants and various industries, septic tank discharges, raw sewage discharges from homes, leachates from refuse disposal dumps, and sanitary landfills and surface runoff from urban and rural areas combine to constitute a severely polluted and contaminated river. Thus, the Upper Trinity River now poses a potential health hazard, does not satisfy aesthetic conditions and is not suitable for many of the beneficial uses that could result from multipurpose development.

Of the various pollution sources, effluents from industry and municipal sewage treatment plants constitute the greatest threat to water quality. Fortunately, however, these two pollution sources are also probably the easiest to contend with. It is anticipated that enforcement of the 1899 Refuse Act which requires industries to obtain a discharge permit will greatly curtail the discharge of large quantities of untreated industrial waste into the Trinity River or its tributaries. A recent federal district court decision ruled that all discharges into non-navigable waterways are illegal, and that the government may not issue a permit for a discharge to a navigable waterway until it has prepared a full statement on the effect each permit would have on the environment. If this decision is upheld, more stringent interpretation of the 1899 Refuse Act, possibly outlawing all waste discharges, will result, and the quality of Trinity River water may be further improved. Realistically, however, industrial discharges into the Trinity River will probably be allowed, but current and future legislation will undoubtedly force industries to discharge effluents of considerably higher quality than is presently practiced.

Detailed descriptions and locations of 31 of the existing 132 sewage treatment plants in the Upper Trinity River Basin are provided in the previously cited Comprehensive Sewerage Plan for the Upper Trinity River Basin. Locations of plants in the study area are shown on Figure 10. According to the report, most of the existing major plants provide secondary treatment by activated sludge or trickling filter processes with subsequent sludge digestion and dewatering on drying beds being common practices. In addition, the study points out that many of the plants are located in river flood plain areas and experience operational difficulities during peak flow periods, and that effluents from the majority of all plants in the area are not of sufficiently good quality to meet proposed future needs.

In view of this, recommendations made in the Comprehensive Sewage Plan provide for six large joint-use treatment plants in the metropolitan area of Dallas and Fort Worth. At present, each of these plants exists or is under construction. Although only three of these plants, Village Creek, TRA (Figure 9I), and Dallas White Rock (Figure 9M), are situated in the study area, adoption of and compliance with the plan will have a profound advantageous effect on the quality of water in the Upper Trinity River.

While the proposed secondary treatment facilities should be very effective in removing organic and bacterial contamination, previous experiences with the utilization of secondarily treated effluents such as in Santee, California, indicate that coliform bacterial concentrations may prohibit primary contact recreational activities in the waters, and that eutrophication and subsequent algae growth problems may be encountered. Only by incorporation of advanced or tertiary treatment into the overall process can nutrient concentrations in treated effluent be reduced to levels low enough to prohibit extensive algae growth.

Residual BOD and tributary-contributed organic materials will provide enough nourishment to sustain fairly high heterotrophic bacterial concentrations. Though most may not be coliforms, numbers in excess of recreational quality standards are likely to be present. Tertiary treatment would be required to remove the trace organic materials from the secondarily treated effluent to levels which would limit bacterial growth. Stabilization of residual BOD in the multipurpose channel as a result to stream self purification will more than likely be minimal because the retarded velocities of flow necessary to accomodate navigation will in turn reduce the turbulence and subsequent reaeration from the atmosphere. The value of the self purification constant, f, which is the ratio of the reaeration constant divided by the deoxygenation constant, is expected to range from one to two at 20 degrees Centigrade.[34] To some extent, however, increased surface area may offset the detrimental effects of reduced velocity. The above value for the self purification constant may be exceeded under moderate flow conditions in steeper reaches of the existing river channel due to increased current velocity. In any case, it is difficult to assume that the bacterial quality of either the multipurpose channel or the preserved reaches of the natural channel will meet primary recreation standards. Even with efficient sewage treatment, the channels are accessible to bacteria through runoff, and residual organics will allow them to propogate at fairly rapid rates.

The deleterious effects of untreated or poorly treated domestic and industrial waste discharges on the quality of receiving waterways has long been recognized, but the relative importance of stormwater runoff as a source of pollutants has only recently been emphasized.[35]

Surface runoff from both urban and rural areas often contributes large amounts of bacteria, viruses and organic and inorganic chemical pollutants which may limit the usefulness of streams.

Investigations by researchers in Cincinnati, Ohio,[36] Tulsa, Oklahoma[37] and Lubbock, Texas[38] have conclusively shown that surface runoff from urban areas constitutes a significant source of pollution. These studies show that the pollution load discharged to receiving water by urban runoff is approximately equal in BOD concentration to the effluent from a secondary sewage treatment plant. The chemical oxygen demand (COD) and suspended solids concentrations in urban runoff more nearly approximate the quantities of these pollutants found in raw domestic sewage. Because of the high COD concentrations but relatively low BOD concentrations, conventional secondary (biological) treatment would be ineffective. The Lubbock study has further shown that chemical treatment is at this time infeasible because of the high coagulant dosages which would be required. Therefore, the maintenance of a suitable quality of water in rivers or lakes receiving urban runoff discharges depends heavily upon sizable quantities of good quality water to dilute the various pollutant concentrations to acceptable levels. Greater emphasis must, therefore, be placed upon restoring the quality of those polluted waters which are amenable to conventional treatment and which may eventually serve as dilution water.

Rural or agricultural runoff at times contains toxic concentrations of pesticides and eutrifying concentrations of nitrogen and phosphorus as a result of pest-control operations and fertilization of crop lands. Unlike urban runoff and feedlot runoff which are relatively localized in occurrence, rural runoff is diffuse in nature, and extends over much of the study area. Nevertheless, there are some control measures applicable to reducing pollution from rural runoff. These include better farm management practices such as terracing and irrigation tailwater recovery, balancing fertilizer application with crop requirements and more stringent controls on the use and handling of pesticides. Here again, however, agricultural runoff, with the exception of concentrated animal feeding operations whose pollution control facitities must be in accordance with the regulations of the Texas Water Quality Board, must be diluted by receiving water to lessen their pollutional impact.

Other deterrents to water quality in the study area include sanitary landfill sites, dump grounds and septic tanks. In order to avoid future pollution from septic tanks, all existing tanks situated between the proposed levees should be phased out of operation and removed. Stringent control measures governing septic tank design, construction, location and use should be enacted and enforced.

No additional sanitary landfill sites should be allowed within the proposed levee system. Existing landfill operations in the flood plain should be immediately phased out of operation and, depending upon the nature of the deposited waste material, consideration should be given to relocating the sites' contents in a licensed landfill outside the flood plain. Closed landfills within the study area will hopefully have undergone sufficient degradation so as to be of little concern at the time of project implementation. If, however, it is estimated that seepage from the closed fills will have a detrimental impact on the surrounding water quality, remedial measures should be taken. Such measures include the removal and transfer of non-degraded material from the pit or lining the pit with an impervious material, the latter measure being infeasible for existing fills.

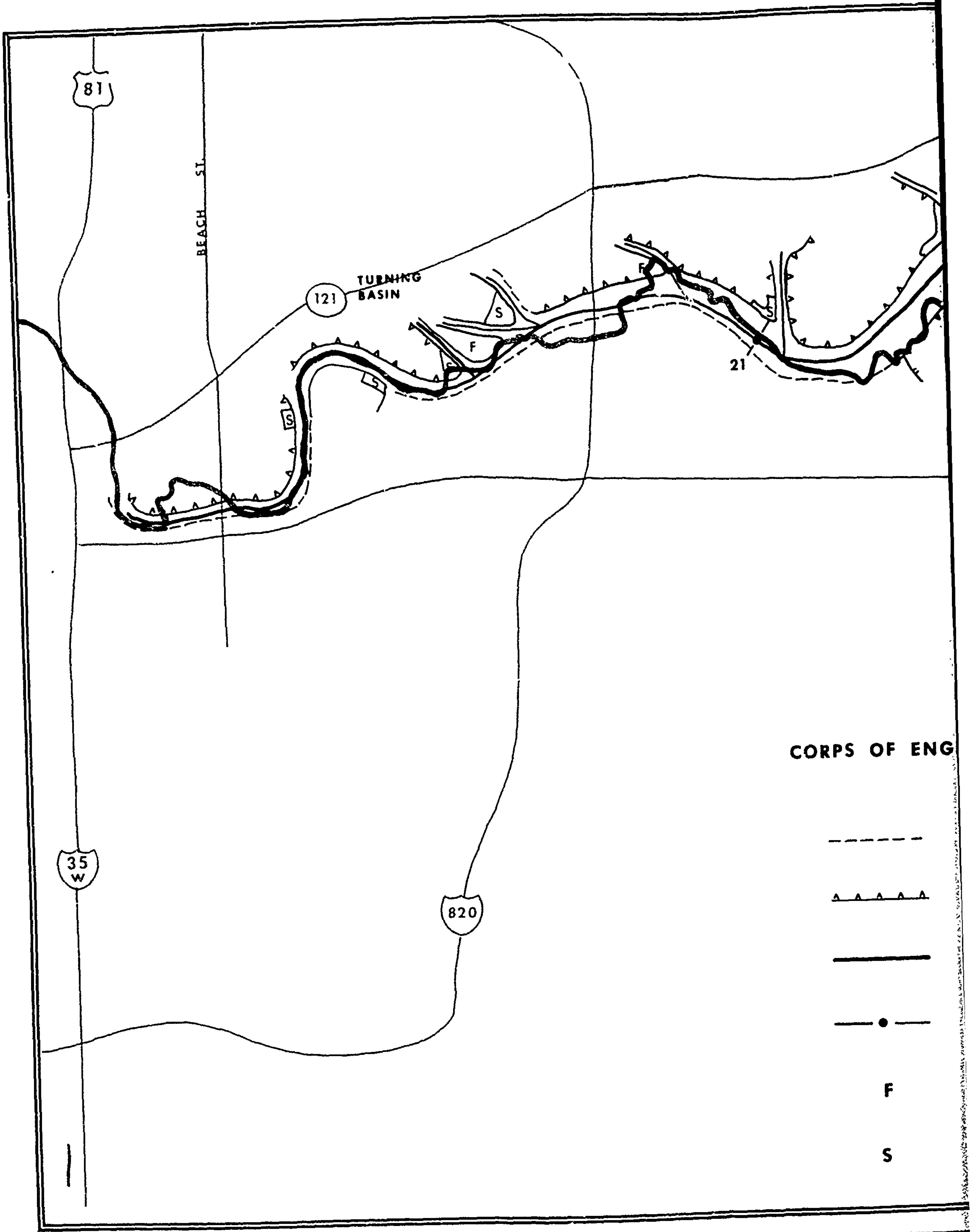
As is true in any water resources project, the degree of treatment provided is dependent on water quality objectives. In order to supply water to the project which will support abundant species of aquatic life and will be aesthetically pleasing and receationally safe, a high degree of treatment will be necessary. Conventional secondary treatment alone will not meet the water quality objectives. Additional treatment in the form of bacterial control and nutrient removal will be necessary. Induced aeration at the point of sewage treatment plant effluent discharge and/or at lock and dam sites may be necessary to sustain dissolved oxygen concentrations at acceptable levels. Low flow augmentation stands to enhance significantly the quality of the project water through dilution, <u>but should not preclude the incorporation of advanced waste treatment into project planning</u>. Advanced waste treatment is especially essential to the success of severed portions of the natural river channel which will be supplied with little if any augmentation water from up stream lakes.

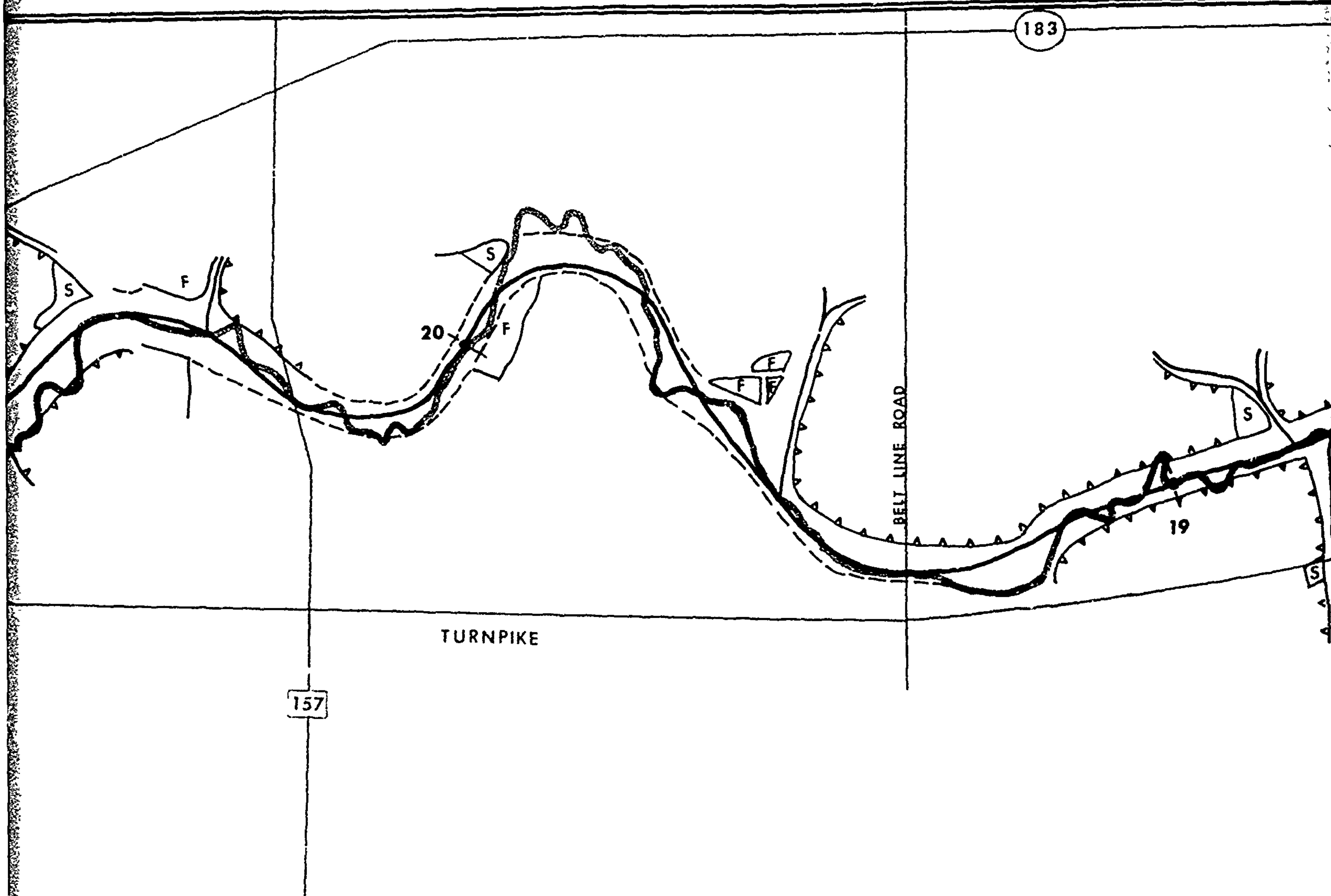
The Upper Trinity River Comprehensive Sewage Plan presents detailed recommendations concerning practically every facet of water quality management of importance to the project. Concurrence with these recommendations is advised in the planning and development stages of this project.

<u>Least-Impact Channel Alignment</u> - Examination of the physical configuration of the river, existing land use, hydrologic data and the preliminary channel alignment brought to light several potentials for developing a plan to accomplish the multiple development objectives for the Trinity River. While questions of cost and benefit are not subject to treatment in this study, they are certainly critical factors to be dealt with in the final decision making arena. Many of the benefits derived from environmental protection are not precisely quantifiable. Therefore, the allocation of resources must be based on other factors, for the most part subjective in nature. It should be pointed out, however, that the increased costs associated with the proposed alignment largely represent the extra value placed on protecting and enhancing the river environs through the provision of additional open space.

The key factor dictating the level of development of the river and its adjacent lands is the location or alignment of the multipurpose channel. Perhaps the greatest single consideration with respect to the channel alignment is the resulting change in flow patterns of the natural river. Because the Trinity is a narrow, shallow, and extremely winding river, a channel two hundred feet wide and twelve feet deep would obviously leave little natural river. Add the protective levee system and other structures required for such a channel and virtually a whole new river profile emerges. Normally, small ox bow cut-offs would be filled in, and only those longer stretches of natural river not used for channel left unchanged. However, if no surplus water is available, diminished flows in severed sections of the river sharply curtail their capability to sustain fish, wildlife and recreation. River bottom plant communities are endangered and oftentimes die, leaving a muddy, empty cavity that once was a natural stream.

These factors, coupled with the study of the natural processes within the river corridor, led to the evaluation of the preliminary channel


81
BEACH ST.
TURNING BASIN
121
S
F
21
CORPS OF ENG
35
W
820
F
S



ENGINEERS ALIGNMENT

Floodway Limits

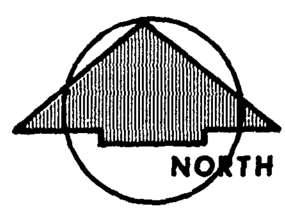
Levee

Channel

Lock & Dam

Fill

Sump



SCALE

1 ½ 0 1

1"=1.35 miles

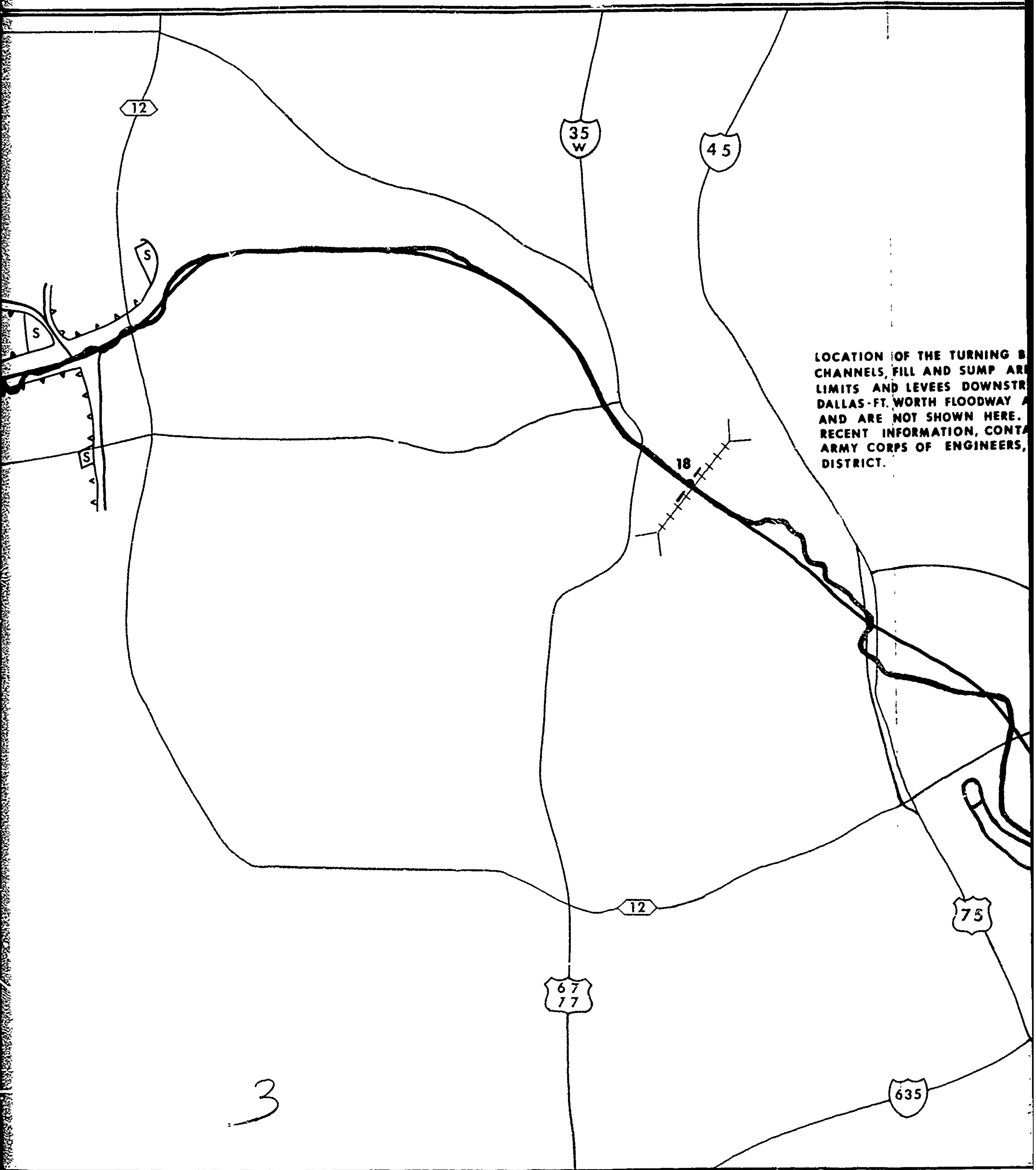
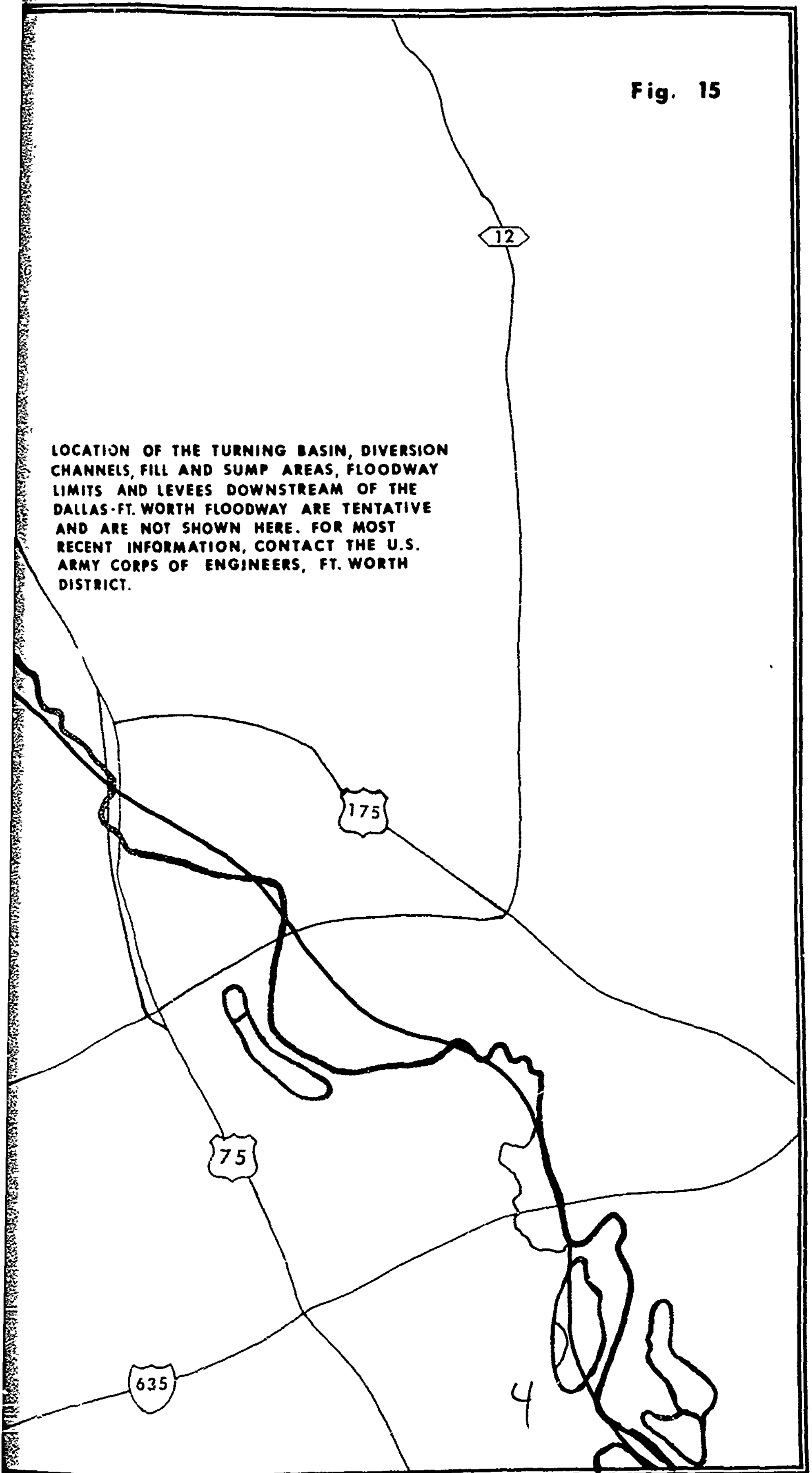
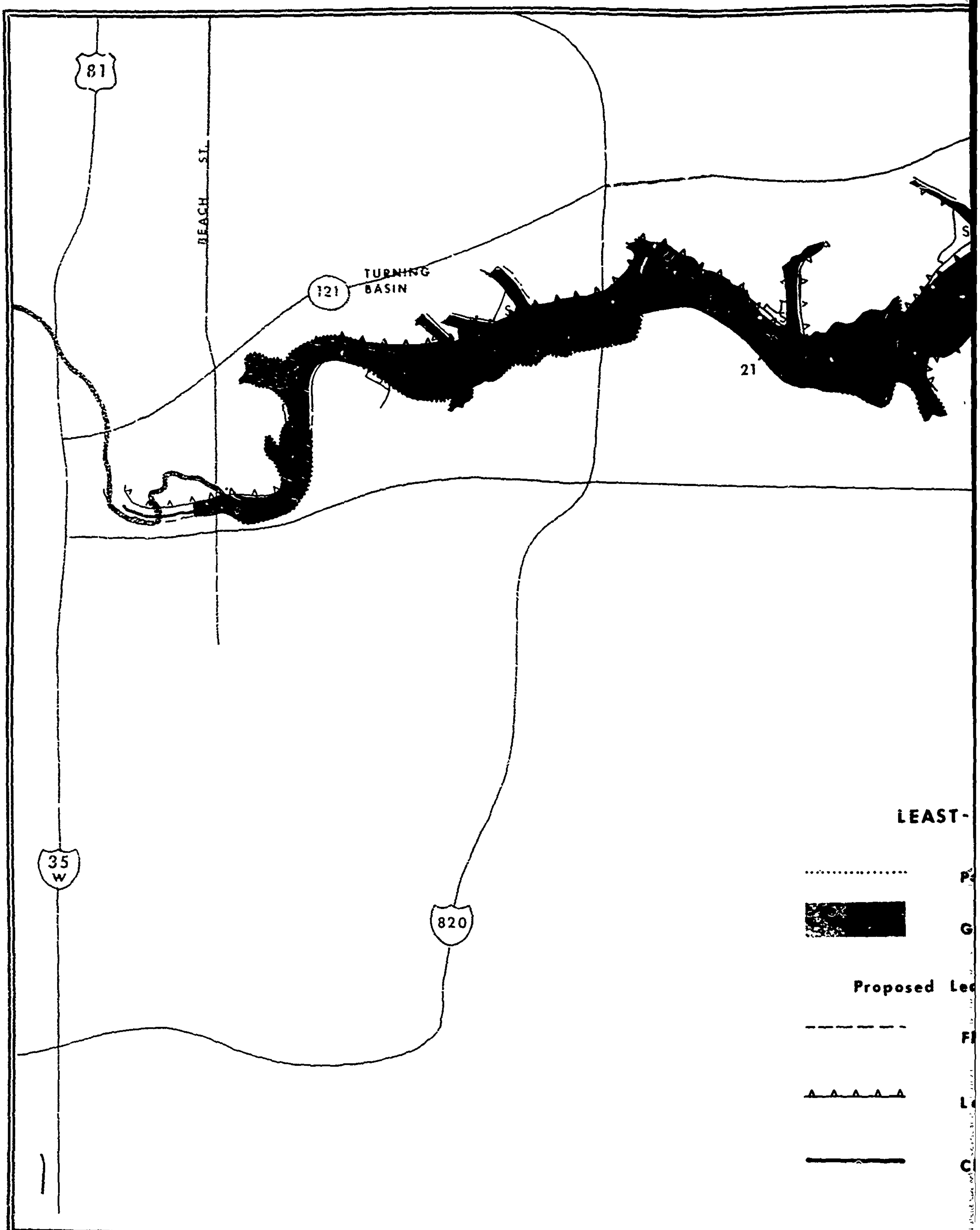
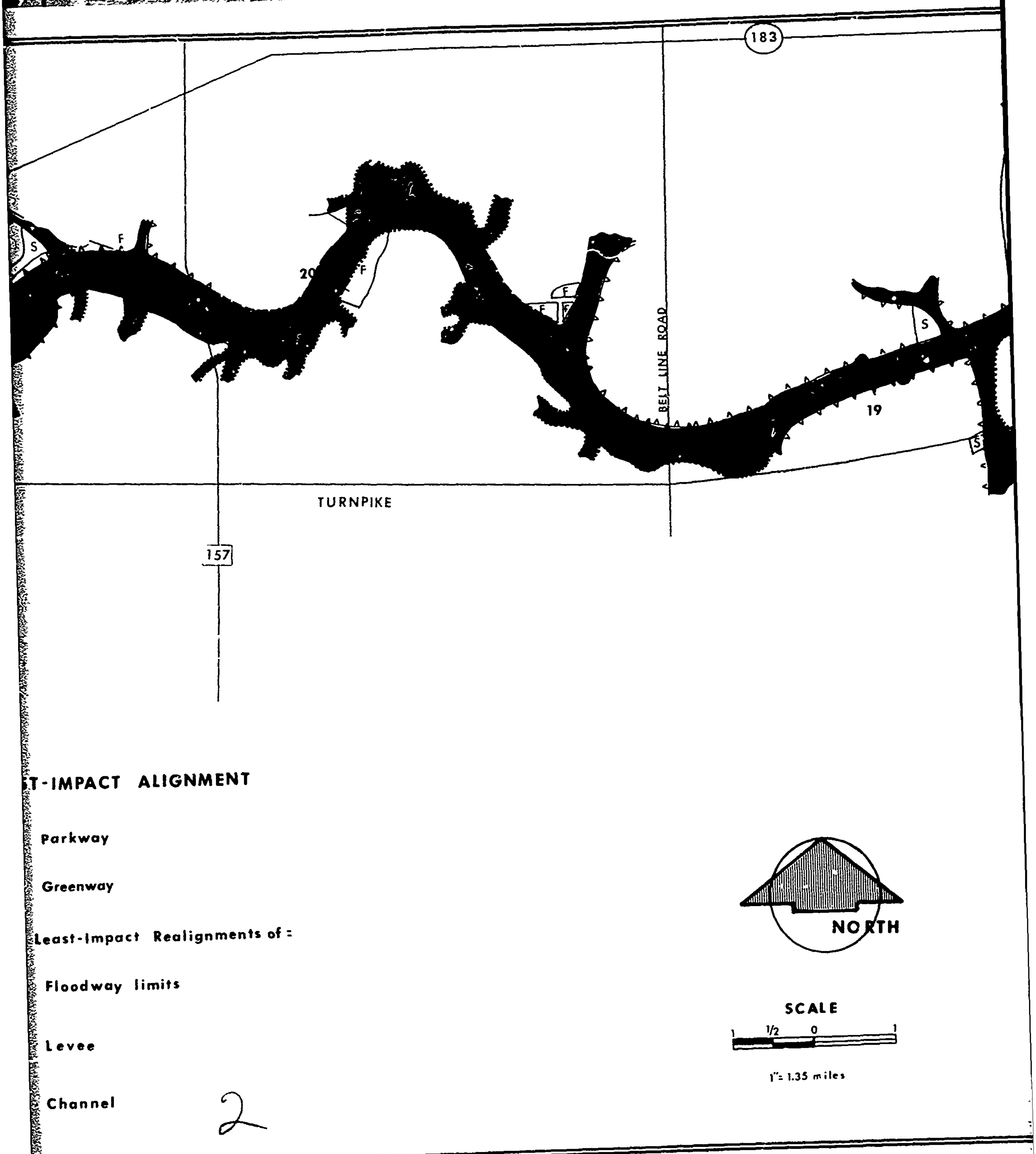
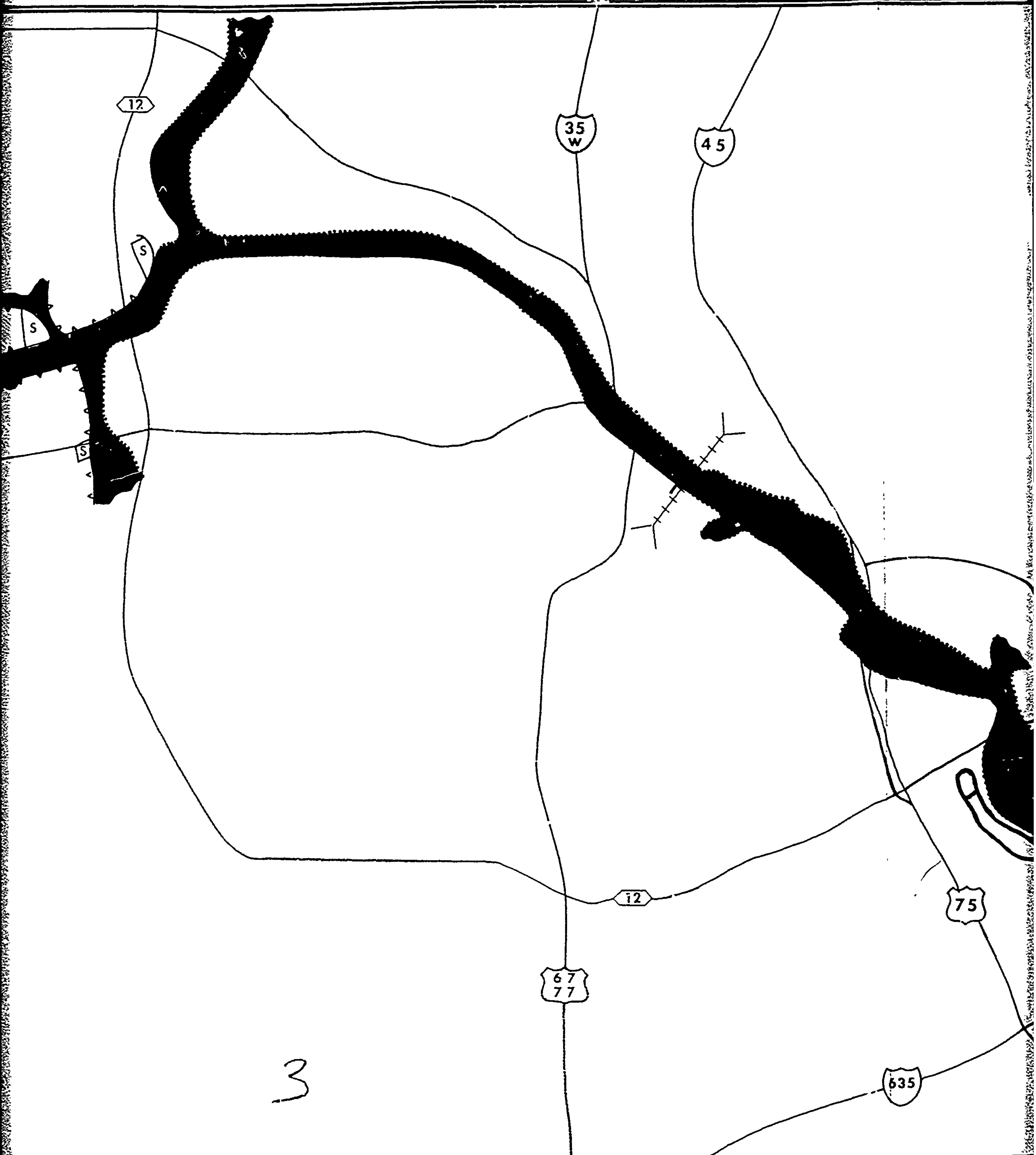

12
35 W
45
S
S
S
LOCATION OF THE TURNING B
CHANNELS, FILL AND SUMP AR
LIMITS AND LEVEES DOWNSTR
DALLAS-FT. WORTH FLOODWAY A
AND ARE NOT SHOWN HERE.
RECENT INFORMATION, CONTA
ARMY CORPS OF ENGINEERS,
DISTRICT.
18
12
75
67 77
635
3

Fig. 15


LOCATION OF THE TURNING BASIN, DIVERSION CHANNELS, FILL AND SUMP AREAS, FLOODWAY LIMITS AND LEVEES DOWNSTREAM OF THE DALLAS-FT. WORTH FLOODWAY ARE TENTATIVE AND ARE NOT SHOWN HERE. FOR MOST RECENT INFORMATION, CONTACT THE U.S. ARMY CORPS OF ENGINEERS, FT. WORTH DISTRICT.
12
175
75
635
4


81
BEACH ST.
TURNING BASIN
121
21
35 W
820
LEAST-
Proposed


183
S
F
20
F
BELT LINE ROAD
S
19
S
TURNPIKE
157
T-IMPACT ALIGNMENT
Parkway
Greenway
Least-Impact Realignments of :
Floodway limits
Levee
Channel
NORTH
SCALE
1 1/2 0 1
1"= 1.35 miles



12
35 W
45
S
S
S
12
75
67 77
635
3

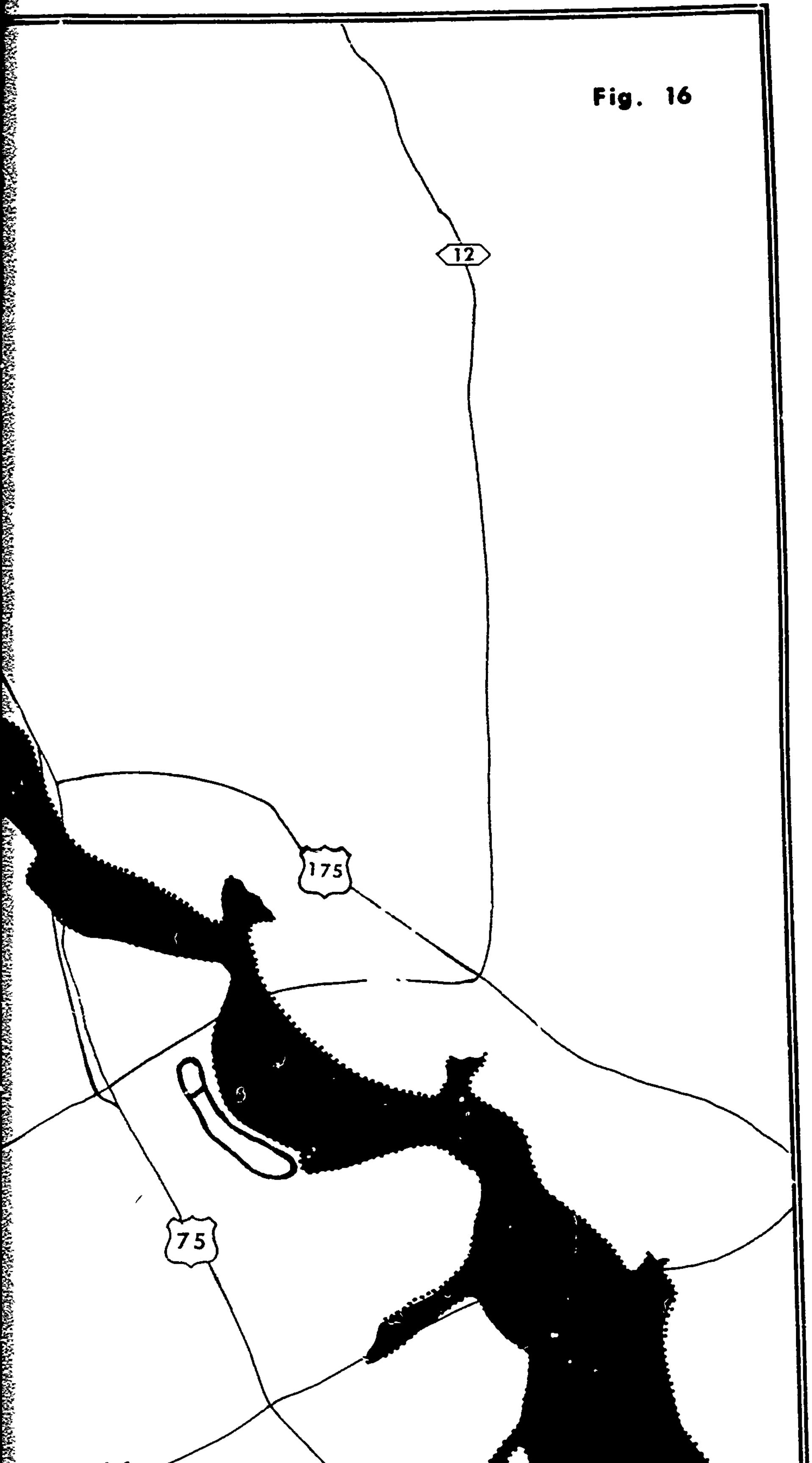


Fig. 16

aligment initially proposed by the Corps, as shown in Figure 15. Careful analysis of the corridor brought forth the conclusion that several adjustments in the channel alignment, (Figure 16) could preserve the environmental integrity of the natural river and its adjacent lands, shorten the multipurpose channel, straighten several bends in the channel, provide additional area for spoil disposal, and provide more desirable areas for docks, wharves, marinas, locks, dams and other types of related structures.

Essentially, this least-impact alignment moves the channel to the north and out of the natural river bottom. Except in those areas where topography, existing river alignment or land use make it infeasible to depart from the Corps alignment, the proposed routing creates an entirely new channel in many stretches. This new channel location, in addition to providing longer unbroken stretches of natural river, also takes advantage of the fact that most of the land through which it passes is abandoned mine land, such as that shown in Figure 17, where additional excavation and fill can hardly be construed as a serious adverse environmental impact.

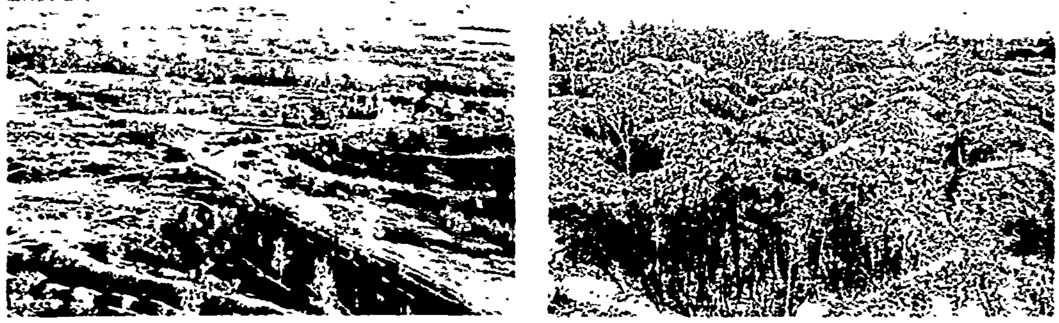


Figure 17:

Left. Abandoned Mine Land. Directly over the river looking northeast in Sector 4.

Right. Abandoned Mine Land. North of the West Fork in Sector 1.

Three factors were used to compare the Corps alignment with the proposed least-impact alignment. These factors, channel distance, natural river distance and acres of open space, are contrasted in Table 11. Note that the definition of the area delineated as open space includes those lands within the levees. As will be pointed out in a later section, while these lands are, for the most part, open in character, not

TABLE 11

CANAL ALIGNMENT DATA

LIA - Least-Impact Alignment
CA - Corps Alignment

	CHANNEL MILES		PRESERVED NATURAL RIVER MILES		OPEN SPACE ACREAGE	
	LIA	CA	LIA	CA	LIA*	CA**
Beach St. to L & D #21	7.7	8.0	8.4	6.1	165	119
L & D #21 to L & D #20	7.1	7.4	9.8	8.0	156	110
L & D #20 to L & D #19	8.1	8.3	9.5	7.2	184	202
L & D #19 to A.T. & S.F. R.R.	11.1	11.1	0	0	496	496
A.T. & S.F. R.R. to Club Lakes	12.0	12.0	12.9	12.9	542	3,127
TOTALS	46.0	46.8	40.6	34.2	2,291	4,054

*Land within the Proposed Parkway

**Land between the designated levees, (Only the floodway west of the turning basin has 1000 foot levees. All multipurpose levees are 1500 to 2000 feet apart).

all would be included within the parkway system. In fact, the land between the natural river and the multipurpose channel would best s·rve as a buffer or transition between the two watercourses. Several lan. uses could be found within this broad corridor and land ownership could conceivably be held by several interests. However, unanimous voluntary and/or statutory subscription to the criteria for the development of lands within the corridor, perhaps as administered by a regional, state or federal agency; would insure the maximum degree of compatible land use and environmental protection and enhancement within the river corridor.

The proposed greenway extends for a minumum distance of 500 feet from either side of the natural river channel. In many places, depending on the characteristics of the vegetation, slope and distance from the suggested routing for the multipurpose channel, the greenway may extend more than 500 feet from the river. Careful attention was given to the configuration of the remaining pockets of woodland as well as to the flood plains of the numerous tributary streams draining into the Trinity. Acreage calculations were based on those lands included within the greenway as delineated on the greenway plan.

Changes in the location of the multipurpose channel suggested in this plan ameliorate the need for an extensive protective levee system. Only a minor westward extension of the south channel levee beyond the Trinity River Authority Regional Sewage Plant is foreseen. North of the multipurpose channel, the protective levee has been set at 500 feet from the north bank of the channel. All sumps and diversion channel locations have been relocated to conform to the general alignment plan determined in the original engineering survey.[39] Adjustments in major highway crossing plans are left to the Army engineers who will adapt these generalized plans to their guidelines for specific engineering plans, specifications and costings.

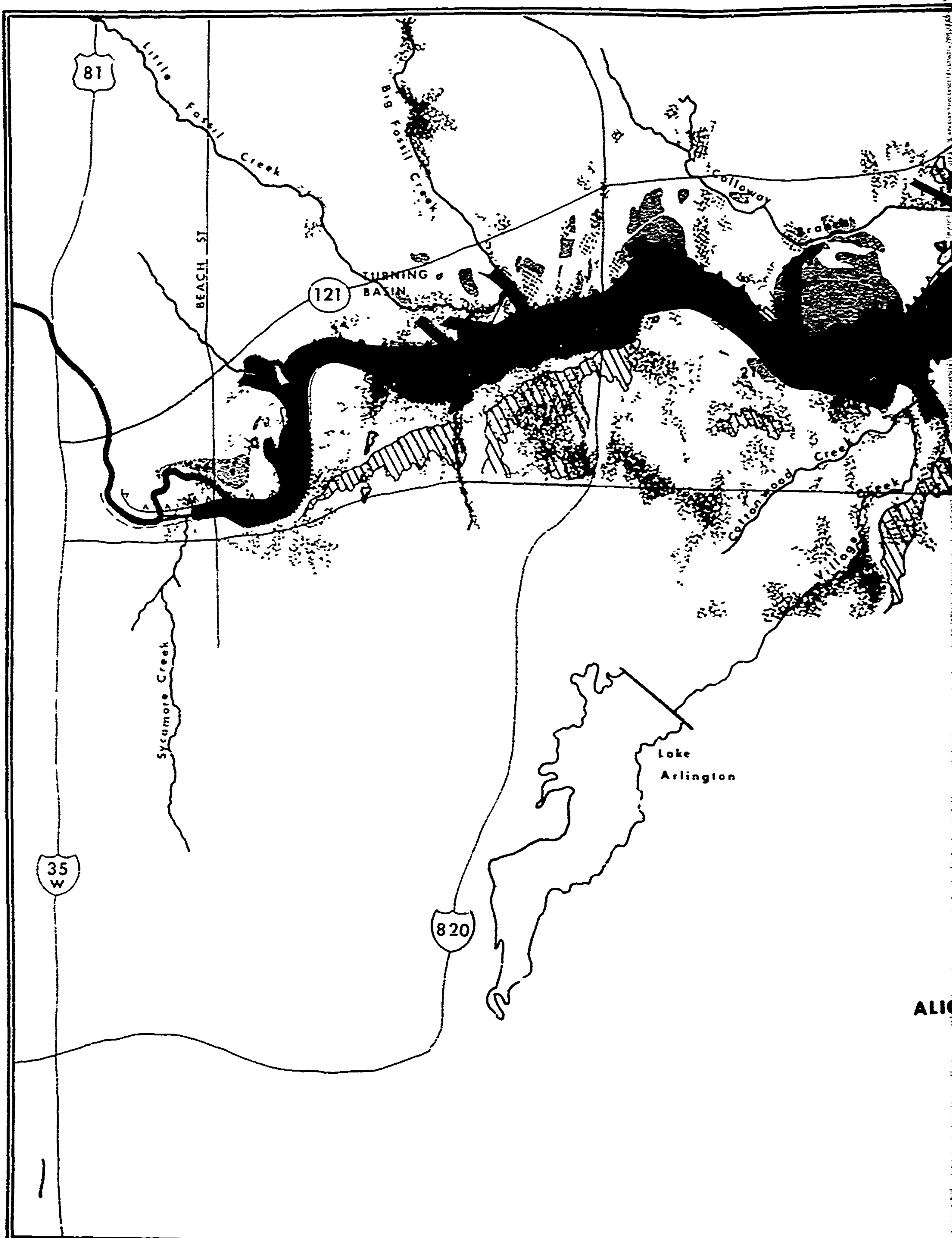
The proposed alignment was discussed in detail with hydraulic engineers from the Fort Worth District during the early stages of planning. All components of the proposed alignment have been ruled feasible from an engineering point of view. The additional construction costs, however, are subject to consideration by those who must participate in funding the project.

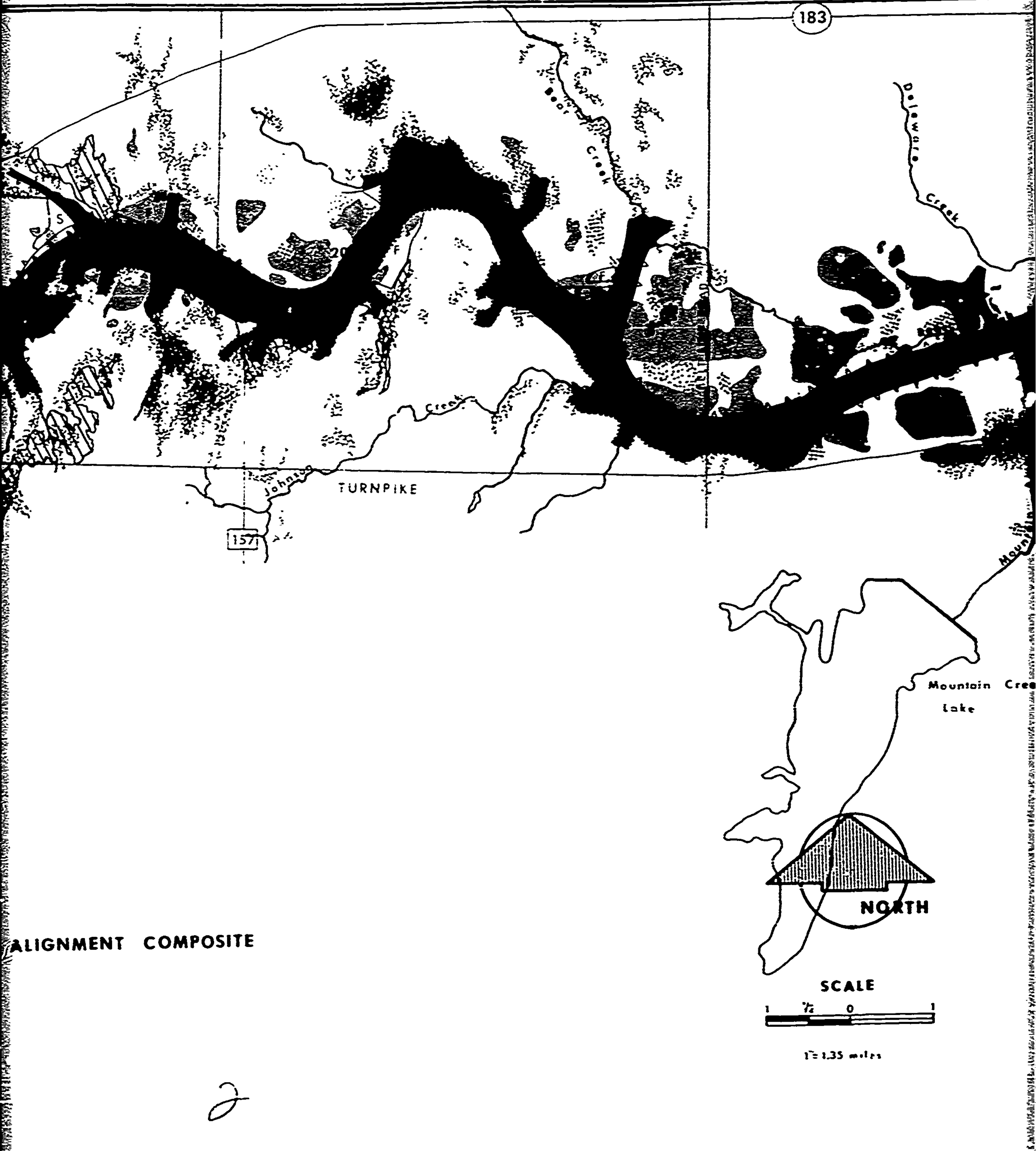
It is also important to note, in calculating the acreages required for the revised plan, only those lands within the parkway were considered; not those associated with the originally proposed channel. It is assumed that those acres between the levee and the multipurpose channel and between the south channel bank and the parkway will be in some form of public ownership or otherwise regulated to blend their use into the open space character of the parkway system. As is suggested throughout the plan, these lands form a buffer between two distinctly separate waterway systems, the channel and the natural stream bed.

The least environmental impact alignment for the proposed multipurpose channel is shown in Figure 18. This composite of Figures 3, 15 and 16, plus the locations of sand and gravel mines, illustrates much of the rationale presented in the following sections. The channel has been moved away from the natural river, straightened considerably and reduced in distance. A brief explanation of the resulting modifications to the original Corps proposal follows for river segments between each lock and dam, proceeding east from Beach Street. Reference to U.S. Geologic Survey 7.5 minute series maps of the study area may aid in locating described reference points.

1. Beach Street to Lock and Dam 21. - The channel runs in a northeasterly direction connecting with the Corps alignment approximately 2500 feet from the proposed site of Lock and Dam 21. The proposed Fort Worth turning basin will be located within the area west of Fossil Creek as shown on Figure 18. By following this alignment, approximately 2.3 additional miles of natural river channel would be saved for the river parkway. Also, all of the forested lands along the river, such as those shown in Figure 19, are reserved for inclusion in the parkway.

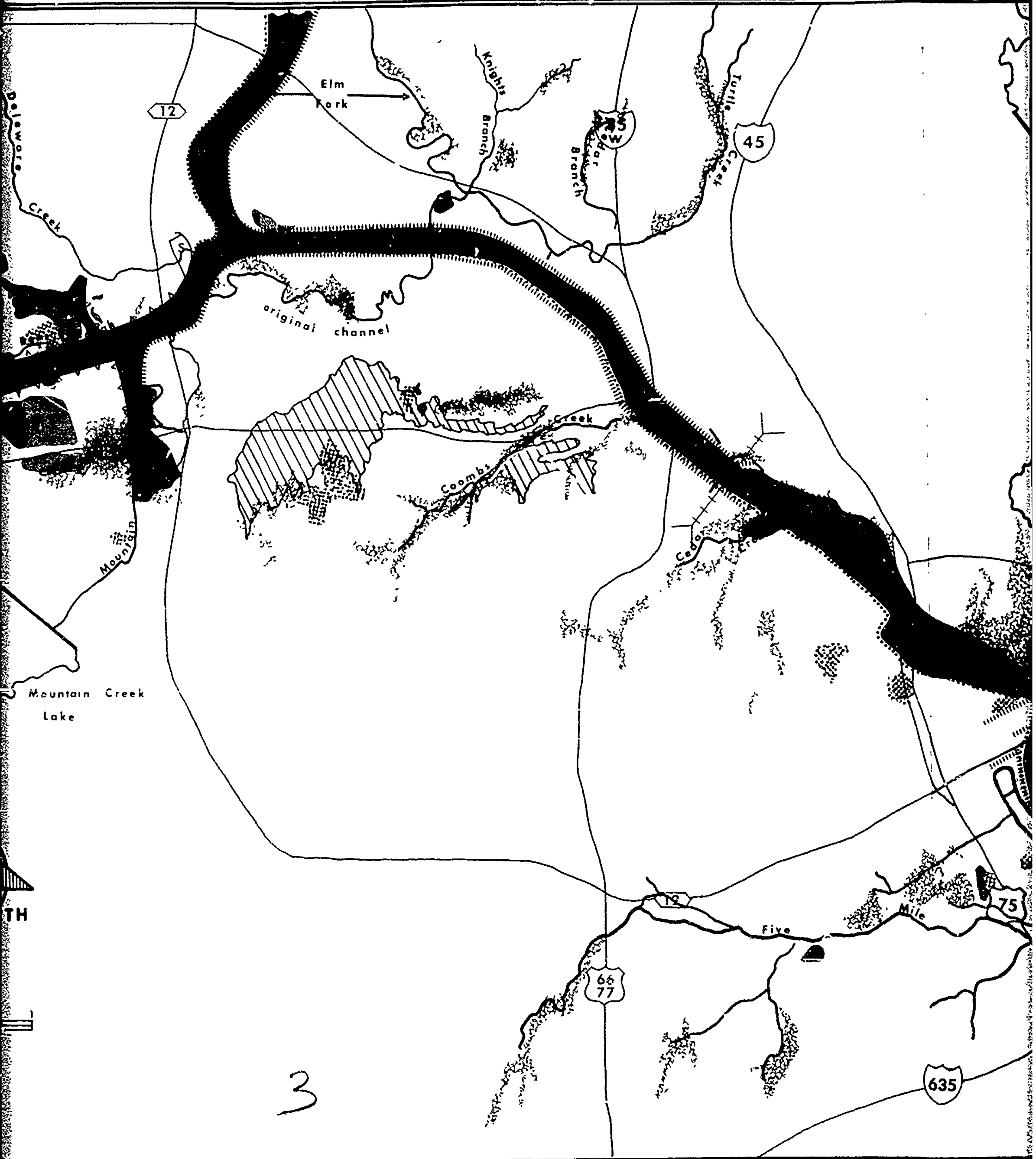
The north levee follows the Corps location to just south of Elliott-Reeder road in the vicinity of Valley Chapel. The new levee alignment is located on a line approximately 500 feet north of the multipurpose channel and follows this route throughout the remainder of the alignment. This plan adds about 46 acres to the land inside the levee. However, it decreases the multipurpose channel distance by about 0.3 river miles. A small portion of the natural channel southwest of the Tarrant Sewage Treatment Plant will be lost to storage pool behind the dam. Much of the new channel alignment passes through abandoned mine sites. It is also interesting to note that the new channel is located less than a mile


81
Little Fossil Creek
Big Fossil Creek
BEACH ST
TURNING BASIN
121
Calloway
Cottonwood Creek
Village Creek
Sycamore Creek
Lake Arlington
35 W
820
ALIG



ALIGNMENT COMPOSITE

2



Elm
Fork
Knights
Branch
Cedar
Branch
Turtle Creek
45
Delaware
Creek
12
original channel
Creek
Coombs
Cedar
Mountain
Mountain Creek
Lake
TH
12
Five
Mile
75
66
77
635
3

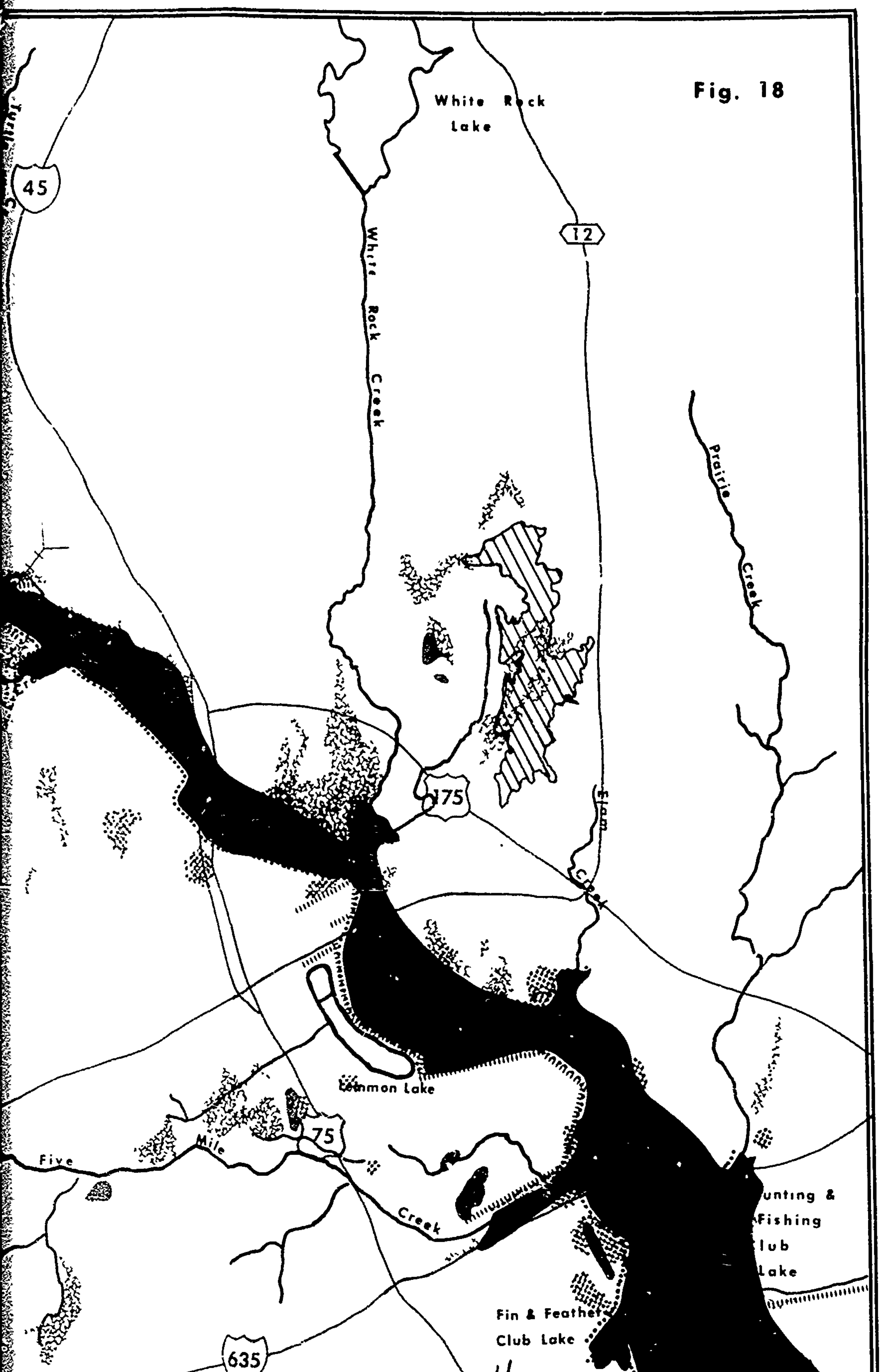


Fig. 18
White Rock
Lake
45
12
White Rock Creek
Prairie Creek
175
Elam Creek
Lemmon Lake
75
Five Mile Creek
Hunting &
Fishing
Club
Lake
Fin & Feather
Club Lake
635

4

from rail and highway locations. These sites could become industrial parks and port sites. The scenic section of the Trinity north of the bluffs of Meadowbrook would be unspoiled and available for public acquisition for parkway purposes. This accomplishes one of the primary objectives of the Meadowbrook Plan.

Figure 19. Forested River Bank. Sector 1.

2. From Lock and Dam 21 to Lock and Dam 20.- Leaving Lock and Dam 21, the proposed channel departs slightly north from the Corps alignment to save the forested tract just south of the large gravel pit which lies south of Trammell-Davis Road. The alignment follows the Corps channel to just northeast of the confluence of the Walker branch of Fossil Creek. From this point the alignment straightens, and the turning radius smooths out to about 4000 feet and ties into the Corps alignment approximately 3000 feet east of the proposed site of Lock and Dam 20. In both areas where the proposed alignment departs from the Corps alignment, the new channel passes through abandoned gravel pits where any adverse environmental impact would be negligible. Also, the plan relocates Lock and Dam 20 north of the natural river. Since the existing Highway 157 crossing has not been constructed to navigation specifications, realignment will not pose unusual problems. However, it will increase considerably the cost of the crossing as a consequence of having to bridge two channels. This

relocation in addition to preserving approximately 1.8 miles of natural river channel and about 46 acres of open space, will shorten the multi-purpose channel by about 0.3 miles. Lands on both sides of the channel are predominantly mined-out gravel pits which can be used for deposit of dredge spoil. Soils data suggest that it is feasible to locate the multi-purpose channel through these abandoned mine areas.[40] By following this alignment, a total of about 9.8 miles of natural river and environs are preserved.

3. Lock and Dam 20 to Lock and Dam 19. - Proposed changes in channel alignment within this section of the system are similar to those recommended for the channel between Lock and Dam 21 and Lock and Dam 20. Beginning about 3000 feet east of Lock and Dam 20, the channel follows the Corps alignment across Highway 360 to a point approximately 1000 feet from the Tarrant-Dallas County Line. Here the proposed alignment crosses the natural river channel and continues in a southeasterly direction to the Belt Line Road crossing. The channel is a considerable distance from the natural river and its environs, as can be seen from Figure 17, and it again passes through a considerable area of abandoned mines. This includes a relatively small portion of the proposed Lion Country Amusement Park. From Belt Line Road the channel heads in a northeasterly direction and ties in with the Corps alignment approximately 5000 feet from the proposed site of Lock and Dam 19. Again, the channel passes through predominately abandoned mine areas. The short portion of the natural river severed by the channel will be part of the storage pool backed up behind Dam 19.

The north floodway limit begins with the sump above Lock and Dam 20 and follows the 450 foot contour to near the county line. From there, it parallels the channel to the north and joins the Corps levee southeast of Hunter-Farrell Road in Dallas County. This alignment decreases the multi-purpose channel length by about 0.2 mile and in so doing preserves nearly 2.3 miles of natural river channel. Perhaps the most significant feature of this alignment change is the preservation and protection of lengthy stretches of old river channel in their natural condition.

4. Lock and Dam 19 to the Atchison, Topeka and Santa Fe Railroad Crossing. - From this point to the termination of the Dallas floodway, the proposed Corps alignment represents the best and least-impact alignment

for the multipurpose channel. Approximately 3000 feet east of the proposed site for Lock and Dam 19 the river channel has been straightened for a distance of about 2.75 miles near the Loop 12 crossing. This area is shown in Figure 20. This straightened stretch is typicial of how the multipurpose channel would appear although a channel designed to accomodate navigation would be much wider and deeper. Beyond this point the channel makes only a slight bend before connecting with the floodway at

Figure 20. Straight River Channel at the TRA Sewage Treatment Plant Outfall. Looking east in Sector 4.

the Elm Fork junction. There are no significant natural features within this sector of the river deemed worthy of special attention. On the contrary, those lands inside the south levee and north of the river have been used extensively for borrow, dumping and other undesirable uses. Figure 21 shows the lands near the confluence of the Elm Fork and West

Fork. If the lands between the existing and proposed levees were in public ownership, the concept of a floodplain parkway such as developed by the City of Dallas for the Elm Fork and the river proper[41] could be extended westward to Lock and Dam 19 where the corridor would then widen to include both natural and channelized Trinity River. Undesirable land uses could be terminated, and an aesthetically pleasing river parkway could be developed.

Figure 21. Confluence of the West and Elm Forks. The nearest crossing is Highway 356 over the Elm Fork. Looking north toward Texas Stadium in Sector 5.

Through Dallas to the terminus of the floodway the multipurpose channel will simply follow the existing flood control channel. Plans have been developed for this area which include public acquisition and imaginative park and open space development.[42]

5. <u>Atchinson, Topeka and Santa Fe Railroad Crossing to South of Fin and Feather Club Lake</u>. - As the channel leads southeast out of Dallas, it passes through a heavily wooded area with extensive urban development to the south and west. Based on topography, existing public and private installations and the options for adding significant stretches of natural river to the greenway, it was decided that the alignment proposed by the Corps was the most feasible routing. As shown in Figure 18 the major wooded areas have been included within the greenway borders. In addition

to recognizing the environmental, open space and recreational potential, this area forms the beginnings of what could be a Trinity River Greenway extending to the mouth of the river at Galveston Bay. This section of the parkway provides approximately 12.9 miles of natural river. The river then winds southeasterly out of the Dallas Floodway. However, this reach is contained within a relatively narrow corridor delineated by existing developments such as the Dallas White Rock Sewage Treatment Plant, abandoned gravel mines and the St. Louis and Southwestern Railroad. All wooded lands within this area are included in the greenway. From this area to the Club Lakes, the multipurpose channel follows a course which departs from the natural river and traverses lands least susceptible to adverse environmental impact. From Interstate Highway 45 to the Dallas City Limits at Five-Mile Creek, a considerable amount of open space, as shown in Figures 18 and CS, is available for inclusion in the parkway. Throughout this section which includes the Club Lakes, the greenway boundary meanders to incorporate all sizable wooded tracts which are important elements of the river environs. In total, this area includes 542 acres of open space within the greenway. Although this is less than that within the Corps' proposed levee, its character is much different.

Of immediate environmental concern is the impact of channelization on the Club Lakes ecosystem. This area is used extensively for hunting and fishing. As can be seen, the multipurpose channel will pass through Fin and Feather Lake (Figure 9Q), cut off part of Lancaster Lake and skirt the Dallas Hunting and Fishing Lake. It is reasonable to intuitively observe that construction of the proposed multipurpose channel and its subsequent operation for commercial navigation will have a severe adverse environmental impact not only on the ecological relationships in this area, but also on continued use of these lakes for their present purpose. More specific data concerning this impact will be furnished to the Corps in other studies.*

The least-impact alignment attempts to accomplish several objectives in the eventual development of an amenable Trinity River system.

*Other agencies and universities are studying the environmental impact of navigational use of the multipurpose channel.

In overview, the suggested least-impact alignment shortens the multipurpose channel by two river miles. While this may not appear significant at first, closer inspection and analysis reveals several advantages associated with the change. The perceptive reviewer will be quick to note the smoother turning radii, the flatter topography with respect to possible location of industrial ports north of the channel and the proximity of large abandoned mine sites which can be converted easily into pleasure craft marinas just off the main channel.

From an environmental perspective, the advantages are even more readily apparent. First and foremost, the proposed plan serves to accomplish the inexorable goal of preserving the integrity of the natural river by adding about 6.4 miles of natural channel over what would not be channelized under the existing engineering plan. Of the 40.6 miles of natural channel to be preserved under the proposed plan, approximately 27.7 miles lie between Beach Street in Fort Worth and the beginning of the Dallas Floodway at the confluence of the Elm Fork. This is a major environmental benefit when one fully considers the options for open space benefits, outdoor recreation, scientific, and fish and wildlife opportunities.

A contiguous, lineal open space corridor encompassing the natural river and the multipurpose channel emerges as an obvious advantage of the proposed greenway plan. As delineated, the greenway plan calls for about 2,291 acres of open space, some 176.3 acres less than would fall within the standard levee system proposed in the original engineering plan. There are, however, more important factors than total acreage to consider when assessing the benefits of the proposed greenway. First, and indeed foremost, is the <u>character</u>, <u>quality</u> and <u>ecological</u> composition of the open space acres under consideration. The area included in the greenway not only includes most of the remaining river-bottom forest but also considerable acreage of river terrace lands. These acres form the protective cover for the natural channel, fish and wildlife habitat and watershed protection against severe runoff and soil erosion. Secondly, these forested lands (a good portion of which would certainly be obliterated should channel construction follow the existing engineering route) form an aesthetic resource which can add considerable value to residential properties along both flanks of the corridor. Rather than a virtually barren, straight channel like the existing Dallas Floodway, (see Figure 9K and 9L) the greenway provides an opportunity for a natural buffer between the natural river channel and the noise, fumes and other disagreeable characteristics frequently associated with a heavily used commercial waterway. This feature alone should suggest significant economic benefits to the local public as well as private decision makers. Thirdly, the greenway increases the outdoor recreation opportunities afforded by the Trinity project beyond those provided in the original engineering plan. In addition to providing an inter-city riverway, and walking and riding trails, the greenway connects to numerous small flood plains of tributaries flowing into the Trinity from the south, as well as to several proposed city park areas. Thus, a unique resource-based recreation system is created to compliment the massive recreation and tourism system already forming within the Dallas-Fort Worth region. Fourthy, in an area of growing population and resultant air pollution problems, any effort to save the remaining forest communities has environmental merit. This vast metro-forest system can serve as a valuable natural air filtering and cleaning plant. While this may not appear consequential to many people, we are living in an age of massive urban development which has witnessed the clearing of vast tracts of forest and natural vegetative cover which are significant sources of oxygen. Such an argument in behalf of these woodlands certainly does not lack merit.

No attempt has been made to compute changes in construction costs, for this would be a monumental effort best left to the engineers in the employ of the Corps. Land acquisition costs can only be averaged. Past experience with other public works developments such as highways, man-made lakes and airports indicates that land prices within the proposed corridor will escalate rapidly once a definite route is announced. Without the tools of immediate appropriation for advanced acquisition and excess condemnation, it is obvious that land prices for these acres of open space will run high. Highway departments have long recognized that the construction of highways frequently adds to the locational value and, thus, the market value of adjoining land.

Values lost and values added are important considerations that must be assessed as accurately as possible. There are several factors, however, which must be considered when analyzing the package of amenities resulting from the proposed least-impact channel alignment.

1. A large section of the natural river and its adjoining lands will be avilable for inclusion into a natural, contiguous river parkway. This accomplishes, in a single action, the objectives of numerous independent planning units within the study area. Questions of land ownership, control and administration will be discussed in following sections. From an ecological point of view, this allows for a much larger area to serve as habitat and buffer, and at the same time increases the options for resource based recreational use within the heart of a metropolitan complex.

2. The plan allows for separation of uses of the riverway system; that is, recreation and commerce, while juxtapositioned, will both have adequate space.

3. The plan calls for the increased use of lands whose character has already been altered significantly as the result of a single resource extration activity, sand and gravel mining. Development of a multipurpose channel through such areas will cause little ecological damage and can serve to shift these presently idle acres into more productive uses. Also, the excavated material can be used to construct levees and fill open pit lands adjacent to the multipurpose channel. Many of the pits inside the corridor can be used for deposit of dredge material removed through normal maintenance of the multipurpose channel. As these lands are reclaimed, filled and leveled, they can be put to many uses, all of which can be complimentary and can serve to increase the economic and social utility associated with a multipurpose river development project.

4. Providing open space of the magnitude suggested in this plan requires commitment to public use and loss to local tax rolls of considerable acreages of land. This may be a valid argument for reappraisal of current thinking regarding continued reliance on the ad-valorem tax as a primary source of revenue for local governments. Past experience in a host of cases suggests that open space, particularly lands in a natural or semi-natural state, tends to increase the value of adjacent lands, particulary in situations where open space lands are scarce.[43] It has been the practice of tax assessors to be slow in recognizing the economic lever at work as the result of public investments in open space. Lands adjacent to a riverway corridor, particularly those on higher ground, will enjoy several advantages of location, view and buffer which will increase

considerably their value for choice real estate developments. Industrial and commercial lands adjacent to the channel will come into being only because of a public investment in a public waterway. As has been previously pointed out, public utility corridors tend to increase considerably land values adjacent to the public artery.[44] This concept is made explicit by a recent Arizona court ruling on a highway condemnation case. Referring to property values, the Arizona court ruled, "It is abundantly clear in cases such as this, that a substantial portion of the value of the property in question arises by reason of its right of access to the public road upon which it fronts".[45] Other factors such as air, light, view and the nature of adjacent properties influence substantially the value of real estate along a public corridor.[46] Marion Clawson of Resources for the Future describes the creation of these economic externalities in his book, Suburban Land Conversion in the United States. Thus, if the lands influenced by this value escalation are taxed equitably, the tax value added should more than offset the minimal revenues lost from those relatively few acres reserved for the parkway. The social values of aesthetics and outdoor recreation should also be estimated in these calculations. For without these lands, very few of the regional citizenry, particularly many inner-city residents, would be able to share directly in the package of social and economic benefits attributed to the waterway development.[47]

5. The proposed least environmental impact alignment has reduced the length of the multipurpose channel by a few miles while elongating several turning radi. This shortening and straightening should reduce operational costs of barge tows and could possibly provide more sites for riverway ports. No data to support these claims have been gathered. Thus, these observations in defense of the plan are intuitive. Again, more precise planning is left to the engineers as they move into the advanced design stage.

Obviously, the alignment of the multipurpose channel advanced in this plan will result is some degree of environmental impact on the river and its environs. This impact can be minimized through the steps proposed in this plan. It is recognized that the costs will be greater than for the existing engineering alignment. However, it is felt that these additional costs will be justified in the long run. Problems encountered in land acquisition, exact location of the structures and hydraulic design and operation are challenges which can be surmounted. The key question of available water of the proper quality is the most critical and limiting factor with respect to the natural river environment and the extent of its use as an urban river parkway. Water quality will be a serious concern in the multipurpose channel. But, if the proper criteria are adopted and enforced, this problem can be minimized. What is important, from this point on, is the recognition of the full range of possibilities offered by the proposed project and a willingness and determination on the part of the people of the area to take those steps necessary to insure the realization of all the benefits the project can offer. Once the trees, the river and the wildlife are gone, there can be no turning back.

Dredge or Excavation Spoil Disposal - Construction of the Trinity River multipurpose channel will produce several million tons of excavated or dredged material which must subsequently be handled and disposed of. The two most logical disposal alternatives appear to be: utilization in the construction of the proposed levees and as fill material for the spent gravel pits situated between the levees.

No estimate of the amount of material necessary to construct the levees and fill the abandoned gravel pits is available at this time, but it is assumed that sufficient material to construct the levee system and at least partially fill the gravel pits will be produced. If a deficiency exists, the remaining gravel pits would serve as navigation maintenance dredge spoil disposal sites.

According to soil surveys and profiles, much of the excavated or dredged material will be of a sandy nature amenable to use as a construction material.[48] A portion of the material, specifically the spoil from portions of the natural river bottom, will be susceptible to further degradation because of its organic content. It should not be employed for levee construction purposes. The amount and subsequent importance of this bottom spoil or sludge is questionable. In some reaches of the river, sludge banks have been deposited, and these deposits should not be utilized for construction purposes unless they are combined with sufficient quantities of higher quality materials or are allowed to stabilize. Sizable sludge deposits will probably be encountered only along river bends downstream from sewage treatment facility discharges. Other reaches of the stream are devoid of sludge banks and thick bottom deposits. Throughout much of the river's course between South Dallas and Fort Worth, it has cut through the alluvium to underlying rock strata. In these areas, scour associated with peak flows and steeper gradients has prevented large accumulations of sludge or silt. Depending upon the type of excavation or dredging employed, spoil disposal problems associated with such areas may not be encountered. That is, if sizable quantities of earthen material and sludge are removed simultaneously, as opposed to hydraulic dredging of thin layers of bottom deposits, the combined material could be effectively used as fill.

If larger quantities of sludge are revealed by field examinations to be more extensive than the cursory observations made during the course of this study, more severe disposal measures may be necessary. Diked sludge drying beds lined with an impervious material could be constructed in the flood plain. Spreading the sludge from twelve to eighteen inches deep in these beds will allow it to dry and stabilize in a matter of weeks. The dried, stabilized sludge would then be suitable as fill material. Such stringent measures are not at this time considered essential to the success of the project.

The quality of the water contained in the spoil and its effects on the quality of the groundwater will probably be negligible. There is considerable interchange between the surface and ground waters in the flood plain. Therefore, the qualities of these waters, except for suspended material concentrations, are virtually the same. No deleterious effects from seepage of water associated with the sludge into groundwater reserves are anticipated. As the quality of the water serving the proposed multipurpose channel is improved, the groundwater quality in the flood plain will also improve.

In the event some pockets of high quality sand or gravel are encountered in the construction of the channel, the possibility of selling the material to a local manufacturer of concrete products should be explored.

In order to maintain the proper channel depth, some maintenance dredging will doubtless be required. The spoil resulting from such dredging should be of sufficiently good quality to negate stringent handling or disposal procedures. Adjacent gravel pits could easily be employed for disposal purposes, depending upon the method used for dredging. Spoil derived from suction or hydraulic dredging is probably more amenable to gravel pit disposal than is spoil resulting from dipper or ladder dredging.

Dipper and ladder dredges are not acceptable for use when the spoil must be discharged at a considerable distance from the dredge and, in addition, hydraulic dredging preserves water quality to a much greater extent than do other methods.

The ecological character between the levees will be altered significantly by channel construction and fill operations. Few favorable species presently reside within the banks of the existing river because of the poor water quality. Improved water quality in the multipurpose channel will provide suitable habitat for numerous desirable aquatic and terrestrial organisms.

Habitat currently provided by abandoned gravel pits will be obliterated. However, as previously pointed out, because of the recent radical changes in the area brought about by gravel mining operations as well as fluctuating periods of flood and drought, these habitats are currently of a temporary nature and few static ecological equilibria exist. Surveys by other researchers indicate there are no endangered species in the area. Therefore, it is assumed that most of the present desirable inhabitants will be capable of adapting to the improved environment that implementation of this plan would provide.[49]

Solid Waste Disposal - Many agencies have suggested the possibility of converting some of the larger spent gravel pits into sanitary landfill sites for solid waste disposal purposes. According to this theory, a significant portion of the mined area could be put to immediate beneficial use, and this land could be reclaimed or restored later to provide attractive and usable flood plain. However, this does not appear to be a workable solution for reclamation of gravel pits for this area.

Sanitary landfill is considered to be the most desirable method for disposal of refuse in this area. The procedure is defined as a method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary. The proper location of a sanitary landfill is a function of the geology, soil conditions, land use, adequate access roads and highways, economic haul distances and other considerations. Few of these criteria are met by lands within the study area.

Several of the regulations governing land disposal sites, including access and water pollution regulations adopted by the Texas State Department of Health, would be violated if some of the existing gravel pits were converted into landfill sites. The Municipal Soild Waste-Rules, Standards and Regulations adopted by the Texas State Board of Health on September 13, 1970, state that, "In the interest of both safety and operational efficiency, proper access to and within the land disposal sites shall be provided". The meeting of the following requirements shall constitute compliance with this item:[50]

a. Public roads and highways providing access to the area shall be of sufficient design capacity to accommodate additional traffic engendered by the installation of the facility.

b. Provision shall be made for all-weather access of the entrance of the site to the unloading area, or

c. Wet weather access shall be provided to an alternate treatment area.

Existing Texas State Board of Health guidelines governing landfill-associated water pollution which are pertinent to the study area state the following:[51]

1. "Solid waste shall be deposited in such a manner that the possibility of leachate percolating into the groundwater is minimized. An impervious barrier may be either naturally occurring or artificially placed."

The following procedures are acceptable:

a. Placement of three feet of clay

b. Placement and compaction of one foot of selected clayey material under optimum moisture conditions.

c. Placement of an impervious membrane of asphaltic, plastic, or other approved material.

d. Any procedure other than a, b, or c above, if approved by the Texas State Department of Health.

2. The surface drainage on a land disposal site shall be controlled to minimize surface water runoff onto, into and off of the treatment area.

The meeting of the following requirements shall constitute compliance with this item:

3. Dikes, embankments or diversion channels of adequate size and grade shall be constructed when necessary to control surface water.

4. The surface of the completed area shall be smooth and graded for adequate drainage and the slopes and the sides and toe shall be graded in such a manner as to minimize the possibility of erosion.

5. All accumulations of standing water on the site shall be eliminated promptly.

6. The rules and regulations of the Texas Water Quality Board shall be followed at all times. The Texas Water Quality Board will be consulted on all matters related to water pollution.

7. If deemed necessary by the department, monitor wells will be drilled by the operating agency in the configuration and number set by the Texas Water Quality Board to observe changes in the quality of groundwater. To ensure that these regulations are complied with, no new solid waste disposal facility can be operated without approval by local authorities and by the Texas State Department of Health prior to being placed into operation.

Generally, the abandoned gravel pits along the Trinity River do not meet the regulations of the Texas State Department of Health. For any gravel pits situated between the proposed levees, it would be virtually impossible to provide sufficient access to and within the land disposal site. Soil and geologic conditions as well as the shallow water table would prohibit the use of the gravel pits for waste disposal sites. In most instances, approximately 25 feet of sandy overburden overlies an impervious shale formation, and the water table is generally situated between 10 and 15 feet below the surface of this overburden. Channel construction will in some instances raise the water table. As a result, employing adjacent gravel pits for refuse disposal is undesirable. In order to prevent the possibility of leachate percolating into the groundwater, impervious barriers would be required for all gravel pits. A great deal of effort and expense would be required to install such barriers or to insure proper access, drainage, protection and operation of the site.

The aforementioned problems would be lessened if the gravel pits in question were situated outside the levee. Even then, the possibility of pollution from the landfill leachates would be great, and measures to prevent leachate percolation would still be required. For these reasons, it is recommended that the abandoned gravel pits not be used for the disposal of refuse.

Areas which have already been used for sanitary landfills should be used for those types of development which do not require a stable foundation. Such sites are sometimes unstable and are usually subject to shifting and settling. Noxious and potentially dangerous gases are oftentimes produced by decaying material and find their way to the surface through structures as well as natural pores.

Recreation Potential of Abandoned Mine Pits- Abandoned mine pits can be used for several types of recreational development. The limiting factors with respect to the range of recreational uses include: location, soil, water table and construction procedures if permanent structures are to be placed on the sites.

Open pits can be sealed, filled with water and used for small fishing lakes, and swimming ponds. Small sites can be used for active recreational developments such as motorcycle hill climbs and four-wheel drive cross-country areas which require sites that can withstand considerable disturbance. These types of activities, however, are not compatible with the major theme of development and use of lands proposed for inclusion in the river corridor. Also, areas which are located close to the multipurpose channel could be eventually filled with hydraulic spoil material. When filled and leveled, these areas can be revegetated and used as newly created riparian open space lands.

Several of the larger abandoned mine areas outside the proposed north levee could be excavated and developed as large pleasure craft marinas. It is reasonable to assume if navigation is eventually developed linking the Trinity to the entire inland waterway system of the nation, such facilities would be an integral component of the river system. Where such marinas would be located off the main channel, the protective levee would have to be constructed around the entire marina complex. These types of development could be a joint public-private venture. The State of Michigan uses such a system for the operation of its small boat harbors around the Great Lakes.

There are several parks, sunken gardens and other open space sites throughout the area developed on abandoned mine or landfill sites. In each instance the development was based on what the particular site could support. The Oriental Gardens, developed by the City of Fort Worth, are an excellent example of what can be done with such areas. Many Dallas parks are also located on filled and leveled mine sites.

Trinity River Greenway - The concept of a Trinity River open space corridor nas been in the minds of planners in one form of another for several years. Because no definite plans for the proposed multipurpose channel were available, past planning efforts have tended to be broadly conceptual, vague and related to specific localized segments of the river. No definitive open space plan for the entire riverway from Fort Worth to Galveston has yet been advanced.*

To preserve the maximum amount of natural river channel and associated land resources, as well as to enhance the environmental character of the lands adjacent to the multipurpose channel, an open space river parkway linking Fort Worth to Dallas is herein proposed. This river parkway would be a continuous stretch of land in public ownership encompassing the natural river and its immediate environs as well as those portions of the proposed multipurpose channel where the two join. All of the land within this river parkway would be available for specific open space uses compatible with the overall resource protection objectives set forth for the parkway.

At this point, it is necessary to distinguish between the "greenway" and "parkway" since these terms are used throughout the remainder of the report. The greenway consists of all lands within the open space corridor, largely determined by the floodway limits established by the hydraulic engineers of the Corps. Greenway is the more general of the two terms, and the land area so described can be comprised of both public and private parcels managed to stabilize the flood plain of the river. Among the most obvious and important of the potential greenway functions are:

a. A buffer to separate the natural river and the multipurpose channel.

b. Access to both river channels

c. Flood plain preserved, for periods of extremely high water.

These lands can be used in several ways, all of which serve to maintain the open space character of the greenway. Recreation, grazing and certain agricultural crops all would be compatible. All land uses within the greenway would be required to conform to the overall open space plan.

*Such a plan is underway in the Department of Park Administration, Horticulture and Entomology, Texas Tech University and will be available by June, 1972.

The parkway specifically consists of those lands within the greenway which are to be afforded special protection and management as a river bottom open space corridor. Development criteria for parkway lands will differ from, and be more specific than, those suggested for the more broadly defined greenway. Parkway lands should be largely or entirely held in public ownership for management purposes. The proposed parkway, as shown in Figure 18 encompasses a zone extending from 500 to 1,000 feet from the center of the natural river channel. This land, for the most part, consists of forest and dense understory vegetation with scattered small clearings. Except for construction sites, pipeline crossings and excavations, the river bottom forest is virtually unbroken along the channel. Areas such as shown in Figure 22 are typical of the natural river channel.

Figure 22. River Associated Forest on the Banks of the West Fork. Sector 1.

Most heavy development, such as wharves and loading and unloading facilities for warehousing associated with the commercial uses of the multipurpose channel, would best be located to the north of the channel, and outside the greenway, on those lands which are primarily abandoned mine sites. A similar pattern has developed to the north of the Dallas Floodway.

From an ecological perspective it is important to emphasize that the lands within the Greenway Corridor are by no means pristine or unique habitat areas. Evidence uncovered in this study, both from published data and field investigations, suggests that the river bottom has been heavily used over the years for a variety of purposes. Timber has been cut, vegetation communities altered, wildlife hunted and trash dumped into and along the river. In general the area has taken on the appearance of a open-air dump. Figure 23 shows vivid examples of the area as it exists today.


Figure 23:

Left. Interstate Highway Loop 820 (east) Crossing the West Fork. Note the cleared, cultivated and mined lands west of the Loop and the dense woodlands to the east. Looking north between Sectors 1 and 2.

Right. Wrecking Yard. This salvage site is located on the north bank of the river at its northernmost bend in Sector 1. Looking southeast.

Thus, from a scientific, planning, economic, sociological or purely common sense point of view, any comprehensive multipurpose development program which calls for management of these related lands for open space and outdoor recreation should indeed have a positive impact on the river bottom ecology of the Trinity between Fort Worth and Dallas, and beyond. Projecting the current rate of land clearing and development without the benefit of comprehensive planning, within five years there will be little "natural" environment left to protect. Thus, open space planning and management on the scale called for in this report is, perhaps, the only means of protecting and enhancing these environmental resources for use and enjoyment by the public. Without this protection, these resources will no doubt vanish from the landscape. Total and comprehensive environmental planning can delineate a multitude of objectives not usually considered in past single purpose planning, and generally not attributed to water development in the generic context.

Availability of water and the quality of water within the natural river channel will be critical factors dictating alternatives for open space and recreational uses of the parkway. There are several reasons for this assertion.

1. The vegetation within the river bottom is largely hydrophytic, depending on seasonal flooding and a high water table caused in part by the river water. Loss of this water table or significant reduction in flow would cause changes in the vegetative communities immediately adjacent to the river.

2. Flowing water creates the principal recreation attraction of a river parkway. A dry or muddy river bottom is hardly considered as a desirable aesthetic feature. If only a limited amount of water is available in the natural channel, a good portion of the recreation potential will be effectively eliminated.

3. Water for a recreational river way should be clear, clean and free of offensive odor. Such is not the case in the Trinity River today, as previously described and as illustrated in Figure 24. This is a regretful but all too common scene along the river between Fort Worth and Dallas. In its present condition, the river does not support game fish and is not recommended for any type of human contact. While it is recognized that a regional sewage treatment system is being developed, it cannot be stressed strongly enough that further stringent water quality standards commensuate with existing wastewater treatment technology must be applied and strictly enforced, not only along this section of the Trinity but throughout the entire river system. This includes management of municipal and industrial discharges, subsurface seepage, surface runoff from adjacent lands, drainage from tributary streams and releases from commercial and pleasure craft.

Figure 24. Sewage Treatment Plant Outfall on the West Fork.

Regional waste treatment planning should carefully consider the location of discharge outlets to coincide with the water needs of the recreational river, as well as the water needs of the multipurpose channel. Proper flood plain regulation on the numerous tributary streams draining from the south into the natural river will help assure flowing water through most of a normal rainfall year. Location of small low-flow dams at strategic points along the natural river would create pools which could be used for fishing and non-power boating. In addition, this would help conserve water during the dry season. Also, it would keep the water moving, even if slowly, thereby reducing considerably the prospects for stagnation. In the best interests of the system, some optional provision should be made to maintain minimum flow, by providing a diversion outlet from the multipurpose channel.

4. In order to supply the water volume needed to operate the multipurpose channel, no surplus water is presently available for diversion into the natural river channel. At the time the upstream man-made lakes were planned, no need had been visualized for additional storage to augment flow in a separate recreational and scenic riverway system. Thus, in order to realize the full recreation potential suggested in this plan, a complete restudy of the hydrologic regime of the upper Trinity system would be desirable. The Texas Water Development Board and the Trinity River Authority should be active partners with the Corps in this important phase of the final project planning.

5. Flood plain zoning and/or valley bottom easements along tributary drainage ways can help shape urban development in areas south of the river. Those scenic green valleys would provide choice development frontage which would be reflected in premium land values. Comprehensive planning throughout the entire south river area can organize area drainage patterns into a network designed to capture maximum urban runoff and, subsequently, feed this directly into the natural river channel. Thus, cities south of the river, through wise land use planning and regulation, can play an important role in the water supply picture for the recreational waterway. Sediment ordinances and other erosion controls placed on development can reduce considerably the volume of silt and other undesirable materials washing off these urban watersheds, particularly during large tract development.

<u>Recreation Development of the Greenway</u> - The proposed Trinity River Greenway can provide a unique open space and recreational linkage between the Fort Worth and Dallas metropolitan areas. In addition to an open space corridor, the area provides protection to the flora and fauna of the river bottom.

Within the greenway, various communities could extend their park systems to adjoin the parkway lands, thus linking a vast system of multiuse park areas. This has been proposed by one community already.*

Through land use controls such as flood plain zoning and open space easements, lands along the numerous drainages flowing into the Trinity

*The City of Arlington has proposed a golf course which would adjoin parkway lands. See Figure 12.

from the south can be protected. This will be essential if updrainage watersheds are to supply adequate water for the severed sections of the natural river channel. Herein lies another source of open space within the rapidly developing suburban areas south of the river. All of the region's open space plans point out the urgent need to protect the environmental character of these drainages.

Perhaps the most important benefit of the parkway will be the extensive natural area for day use recreation that will become available to the urban populations, particularly central city residents. In an area where adequate hiking and riding trails, wooded picnic areas along streams, and similar kinds of resource-based activity are limited, this concept offers a unique opportunity. Figure 25 conceptually depicts this type of recreational use. To the urbanite living in predominately high density environments, such an extensive parkway can provide a momentary escape from conurbation through visual relief. Although the skyscrapers of Dallas and Fort Worth are visible at many places along the river, once inside the heavily wooded areas one can feel a touch of nature and sense an escape from the compressing urban environment. Such a situation is depicted in Figure 26.

The present rate of urban land conversion in the vicinity of the Trinity River is explosive. Thus, the availability of this vast park and open space resource is certainly temporal. Decisions must be made in the immediate future to move ahead with the parkway acquisition as a part of the total river development project.

Lands within the proposed parkway are for the most part within the Trinity bottoms as shown in Figure 27. They are primarily in forest cover, with a scattering of old fields consisting of grasses and low shrubs. However, there are several limiting factors to be considered in developing a greenway recreation plan. Soils within the bottom land are clays, clay loams, sands and sandy loams. Drainage in many areas is poor and the soils are wet a good portion of the year. Continual flooding has cut and deepened the slopes along the river as shown in Figure 28. Such river bluffs are hazardous for recreational use. At other locations along the parkway, as shown in Figure 29, the banks are gentle and firm, and could withstand limited recreational development.

Fig. 25

Conceptual Greenway Development

Day-Use Parkway Recreation Potential

Fig. 26

FIGURE 27. CHARACTERISTIC TRINITY BOTTOMLANDS

Figure 27A. Bottomland Fields and Woodland Pockets.

Figure 27B. Pasture and Woodland.

Figure 27C. Poorly Drained Flood plain.

Figure 27D. Pasture and Woodland.

Figure 28. Steeply Eroded River Bank. Sector 2.

Figure 29. Gently Sloping River Bank. Sector 1.

Soils, slopes and vegetation place severe constraints on the recreational carrying capacity of the parkway. As planning continues, additional in-depth study and analysis will be needed to ascertain the carrying capacity of individual areas within the parkway. Such studies should precede any specific site planning.

The most obvious use of the lands within the parkway is for hiking and riding trails through the woods along the river. Throughout the parkway where site conditions are appropriate, small rest areas in the form of picnic sites and trail shelters could be developed. Trail facilities such as those shown in Figure 30 have been developed by the Cook County Forest Preserve District of Illinois within its lineal forest preserve tract along the Des Plains River.

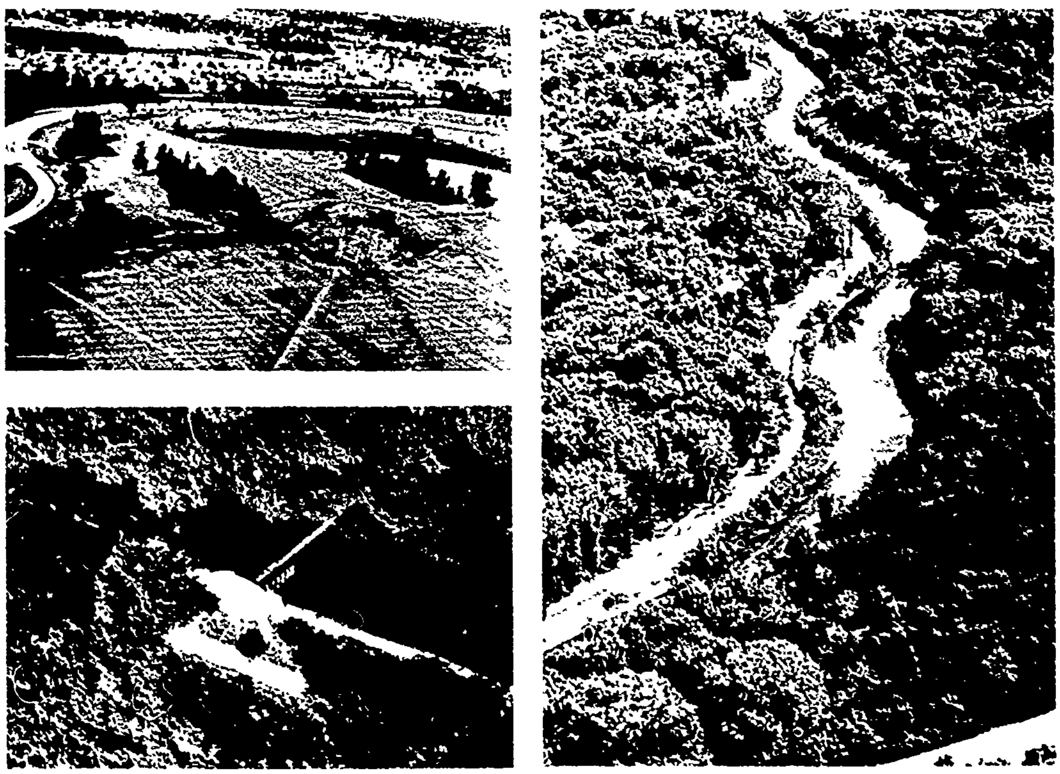


Figure 30. Portions of the Cook County, Illinois Forest Preserve District along the Des Plains River. Note the remarkable similarity of the land forms, woodlands and river to the study area in Texas.

An important role for private concessions will be present within the parkway concept. Riding horses and food services could be provided by concessionaires along the parkway. Plans for these developments can be incorporated into the overall development plan. Natural and historical interpretation and environmental communication should be one of the paramount elements in the parkway recreation development plan. Small nature centers should be designed and built to blend with the natural river bottom landscape.

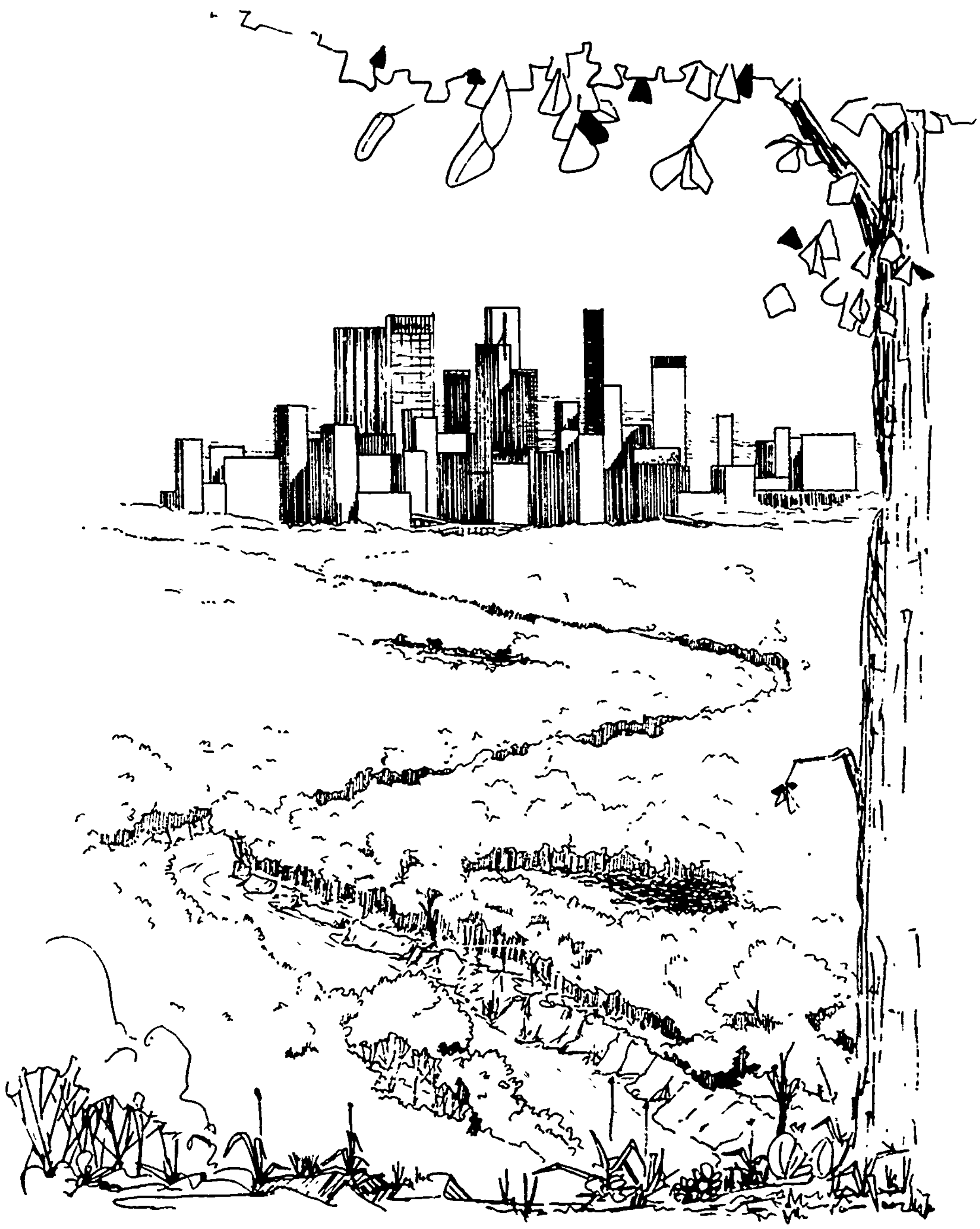
Trees, plants and animal habitats should be identified, and features of local geology, archaeology and history and the characterictics of the river should be pointed out. For example, in one stretch of the old channel between Loop 635 and the Club Lakes is found the remains of an old river lock. This was constructed in a day when men first proposed commercial navigation of the Trinity.

Within the forest openings which dot the riverway, more intensive recreation development may be compatible in limited areas. These developments would include picnic groves, play fields, sports fields and ornamental gardens. Where topography allows safe access to the water, small fishing sites are potential developments.

In addition to the river parkway, recreation facilities will be developed by the Corps at each lock and dam and at selected points along the multipurpose channel. Interpretation of the canal operation and associated commercial activity, picnicing and other day-use facilities will be part of the overall recreation development of the multipurpose channel.

Access to these park facilities should be by means of existing low level roads and bridges now crossing the natural river channel. Automobile traffic should be highly controlled and restricted to designated areas. The river parkway should be first and foremost a pedestrian, bicycling and equestrian facility and should not attempt to exceed its capacity to accomodate autos. Staging areas for horse trailers can be properly placed. However, throughout the major portion of the parkway, the private auto should be looked upon as an unwelcome and incompatible intruder. Forms of public transportation should be expanded to connect with entry points to the parkway to put this recreation resource within easy reach of all urban residents who desire to enjoy the area. A conceptual approach to the suggested parkway development is shown in Figure 31.

Fig. 31



Greenway - Urban Interface

Planning, Development and Management of the Greenway- A comprehensive open space and recreation plan for the greenway should be prepared jointly by the Texas Parks and Wildlife Department, the Trinity River Authority, the U.S. Army Corps of Engineers, the North Central Texas Council of Governments and the local communities adjacent to the river. Any planning, acquisition and development scheme should respond to the ecological characteristics of the riverway rather than institutional boundaries. Any development by local governmental units within the greenway should concurr with the guidelines set forth in such cooperative planning.

Because of the metropolitan character of this portion of the Trinity Basin, the need for additional natural open space lands is greater than in many other areas. Although each city provides excellent park and recreation facilities, there is a recognized shortage of resource-based lands for land-extensive recreation areas. With the emergence of the mid-cities area as a state and national recreation and tourism center, such an extensive greenway will serve a vast number of people who are not local residents. The proposed greenway will provide a type of recreational opportunity not generally found in city parks within the region.

In its 30 mile stretch from Fort Worth to the south of Dallas, the greenway passes through six incorporated municipalities, two counties, five special districts and a plethora of private land holdings. Consequently, welding the parkway together as a contiguous land resource unit poses a monumental coordination problem. Each property owner whose land falls within the prescribed greenway plays an important role as a land use decision maker and will have a most significant impact on the eventual composition and configuration of the parkway. As vividly portrayed in Figure 7, the natural continuity of the river and adjacent lands is partitioned in a jigsaw configuration by the various properties. However, it is interesting to observe the large tracts in single ownership which fall within the corridor. In cases where these tracts can be acquired in total, the greenway boundary should be flexible toward expansion, in many instances adding sizable areas to the edges of the greenway.

Coordination of land management and water release management for the natural river and parkway in conjunction with the operation of the multipurpose channel and its associated land uses will require an intricate framework for planning and close interagency communication. Negotiation, alternative selection and conflict resolution will be less complex by minimizing the number of governmental units involved in day to day administration of the greenway. A frequent suggestion of land use economists is to internalize the externalities in dealing with resource areas. This can be accomplished to a degree by enlarging the area under single ownership or management.[52] This has been a basic tenet in park and recreation administrative theory for years and has been strongly advocated by recognized leaders in the field.

A corollary application of this concept is presently emerging in the regional plan for water quality management. Through facilities of the Trinity River Authority and four municipal treatment plants, coordinated waste treatment will be handled on a regional basis. This system will replace a large number of smaller outdated and overloaded plants, thereby increasing operational efficiency, reducing operational costs, and improving considerably the quality of wastewater discharged into the river. Coordination and development within a similar framework is an important consideration in developing the greenway.

In initiating such a program, it is important to clearly establish the responsibility and authority of the lead agency as well as the framework for integration of associated agencies in the planning, development and management of facilities and programs. In addition, financing such an extensive project becomes a paramount consideration in establishing the appropriate administrative framework. It is critical that the lead agency have adequate financial resources and administrative flexibility to administer a variety of open space preservation and land acquisition techniques simultaneously. Many of the large forested open space units of the greenway consist of numerous ownerships, as shown in Figure 7. If acquired piecemeal, many of the larger and more critical tracts could be segmented to the point of losing their ecological character and consequently, their contribution to the continuity of the greenway and/or parkway.

With the pressures on local governments to allocate already limited capital budgets for a host of local neighborhood park and recreation areas, it is difficult to foresee massive local expenditures for open space lands to be used by a high percentage of people from outside the local communities. Outside assistance beyond that provided through open space grant-in-aid programs is critical to the development of the greenway. It is concluded that the most feasible approach to the development of the Trinity River Greenway at the present time, is to designate the area as a State River Parkway. Land acquisition and overall planning would be the responsibility of the State Parks and Wildlife Department working cooperatively with the Corps of Engineers, the Trinity River Authority, the North Central Texas Council of Governments and the local units of government. The primary land acquisition agency would be the State, augmented by TRA funds and Corps matching funds as provided in Public Law 89-72 for the development of public recreational facilities at civil works projects.[53]

There are several reasons for selecting the State as lead agency for developing the Trinity River Parkway. These are enumerated as follows:

1. The State is in a position to provide an outdoor recreation resource of a magnitude which cannot be effectively developed by any one local unit of government. Thus, the principle of ecological continuity of the river ecosystem would be best maintained through one administrative unit.

2. The State Parks and Wildlife Department is currently involved with the operation of land-extensive open space programs. Comprehensive planning for the entire parkway could thus be accomplished by a single agency already experienced in park resource planning. Because of the close coordination required with the Corps and The Trinity River Authority, it is best to keep the number of administering units small, thereby providing for expedient coordination among the key agencies involved in the project. It would be imperative that the State work closely with the local communities on matters concerning local development within the parkway and land use controls required to protect the integrity of the greenway from undesirable encroachments on its perimeter.

3. The present shortage of resource-oriented recreation lands in an area that contains nearly 20 percent of the state population, calls for the development of this type of facility by an appropriate State agency. Other similar riverway developments have recently been proposed by the Parks and Wildlife Department.[54] Although Texas has not previously had a policy of developing state park facilities within or immediately adjacent

to urban areas, there is no reason not to adapt such a policy. This is particularly appropriate since the State's urban populations are growing at an unprecedented rate, increasing the need for such resource based facilities within close proximity to metropolitan centers. This is by no means a novel idea for state involvement in outdoor recreation. The history of state park development policy is replete with examples of states such as New York, Michigan, Wisconsin, Minnesota and California which have provided state recreation facilities close to or within their urban areas.

4. The State is in the immediate position to muster the machinery and revenues required to move ahead with land acquisition on a scale necessary to develop the parkway. At present there are several sources of revenue available to the State for land acquisition:

a. Monies from the 75 million dollar bond issue passed in 1967.[55]

b. Monies from the one cent tax on tobacco passed by the legislature in 1971.[56]

c. Matching funds from the Land and Water Conservation Fund program.[57]

d. Cost sharing with the Corps of Engineers for land acquisition under the Federal Water Recreation Act or P.L. 89-72.[58]

e. Assistance from Trinity River Authority, assuming the successfull passage of a revenue measure under powers granted by the legislature.[59]

f. Cooperation with the local units of government to secure HUD open space matching funds. One suggestion here might be the declaration of the area as a Model River Parkway. Due to the rapid urbanization and commercial development on both sides of the corridor, it is conceivable that, in the not too distant future, the parkway could become a unique national model of green open space in an urban sea of asphalt and concrete. This unique form of urban open space should fall within the purview of the Department of Housing and Urban Development Open Space Program. Prompt action is suggested to bring this plan before the appropriate HUD officials. It is conceivable, in view of the rapid urbanization taking place throughout the basin, that the entire course of the Trinity River could be appropriately designated as a Model Riverway.

In addition to outright fee acquisition of lands within the parkway, other avenues are open. Considerable tax advantages are to be realized for private lands donated in perpetuity for park and open space purposes.

Several of the wooded tracts within and adjacent to the proposed parkway would be ideal for potential donation or dedication as honorary or memorial parkway units. What greater contribution to the regional environment could be made than to honor a family with a memorial tract within the Trinity River Parkway dedicated to the State? In many past instances, entire memorial open space belts have been assembled through the generous contributions of public spirited citizens.[60]

Lands within the parkway will serve as an urban forest and wildlife conservancy. The professional resources and technical skills of the state fisheries and wildlife managers will be an essential element in the overall recreation and resource management plan developed for the parkway. Assisted by federal and local experts, this pool of talent should insure the highest level of scientific guidlines required for such a unique area.

In summary, all lands exclusively within the parkway should be acquired in fee and held by the State. Assistance with acquisition of these and other greenway lands should come from the coordinating agencies. Lands outside the parkway would be held in both public and private ownership consistant with the open space objectives of the greenway plan. Lands outside the greenway would be the responsibility of adjacent local governmental units through the customary local zoning, land acquisition, and subdivision regulations procedures.

Major land-extensive facilities of the parkway would be held in fee by the State. Corps lands will be maintained by that agency. Since a major portion of the total usage of the greenway will come from local residents, it is only reasonable to expect the local governments to share in the maintenance and operation costs. It is suggested that a maintenance formula based on parkway acreage within each jurisdiction and population be developed to determine the local share. Development of the parkway will not be of the intensive nature characteristic of city parks, gardens and playfields. Therefore, maintenance costs will not be nearly as high on an acreage basis. In those areas where more intensive development may be located, adjustments in the maintenance formula would be necessary.

The proposed State River Parkway as an integral part of the Trinity multipurpose project offers the people of Fort Worth, Arlington, Grand Prairie, Irving, Dallas, Hutchins and nearby communities an opportunity to realize a vast package of recreation and environmental benefits. Only a small addition in land acqusition over the original project requirements will be needed. As a consequence, some 28 miles of natural river channel will be saved for development as a river parkway. Land adjacent to, or in view of, the greenway will appreciate greatly in value as the aesthetic character of this resource becomes more apparent. The majority of lands within the greenway are either far enough removed from the multipurpose channel so as not to preempt prime industrial or port facilities, or have natural soil and ground water limitations which excluded them from these purposes. In actuality, the proposed plan permits more of the flat land north of the levee to be available for port sites, pleasure boat marinas and industrial staging areas than the original proposal. This concept is in full accord with land use delineations found in each city plan for the communities within or near the parkway. Increased land acquisition and construction costs must be off-set by a much broadened base for calculating the benefits generated by the open space lands, escalated land values and increased outdoor recreation opportunities.

Also, a sense of civic pride must enter into the decision matrix. The cities of Fort Worth and Dallas have demonstrated this in their dynamic plans to realize the open space benefits of the Trinity flood plains within their communites and in their ability to build a regional airport second to none. Other units of government including the State of Texas must enter into this spirit if the full potential of the Trinity River project is to be realized.

Economic Relationships - With increased acreage over the original proposal, the cost of the proposed greenway might at first appear unreasonable and the project infeasible. Upon closer study, however, several factors surface which, in addition to enhancing the regional environment, make solid economic and planning sense. The Trinity multipurpose project is to be a publicly financed development. Among the many beneficiaries of such a project are those whose land adjoins the waterway. Even though transferral of benefits through the industrial and service sectors of the regional economy is a recognized contribution of the project, such benefits by no means represent the total package of economic, environmental and social returns the project is capable of producing.

Appreciated land values for residential and commercial developments are another part of the package. The phenomenon of rapidly appreciating real estate values for lands adjacent to certain types of public development is often realized only by those directly involved in reaping the harvest spurred by public investment. Location decisions for highways, airports, ports and public office buildings often trigger powerful market mechanisms stimulating land conversions and raising price levels.

Although little empirical data are available to confirm these assertions, implications of such trends are apparent in the body of case law evolved from a long history of litigating eminent domain actions. Aesthetic factors affect the market value of property, especially residential property. The alert entrepreneur recognizes that aesthetic characteristics can raise property values quickly when such characteristics influence the highest and best uses of the property in question.[61] Even though beauty and other environmental amenities cannot be accurately measured, such factors have significance, and handsome awards have been made to compensate for them. An interesting example of the inverse of this phenomenon is contained in a New York State highway condemnation case. The state constructed a highway along a beautiful lake, cutting off access to the lake by upland owners in the City of Geneva. The claimant's property contained professional offices and living quarters and a large porch which overlooked Seneca Lake. The court considered that prior to the construction of the highway, the property commanded a desirable view of the lake (contrast this with those properties along the Trinity corridor, which now enjoy the economic and aesthetic amenities of a commanding view of the wooded river bottom). However, because of the loss of view and the deprivation of access to the lake, the court awarded substantial compensation to the claimant.[62]

Although little research has been carried out on the economic impact of park and open space lands on adjacent property valuation, available data suggest that properties located near well-kept parks are valued higher than those even one block away.[63] Just as easy access to major transportation arteries is a positive factor in land development decisions, frontage on lakes, river and large public parks is a definite positive aesthetic factor in pricing residential properties. There is far from complete agreement among planners as to what constitutes good design and limited empirical evidence that well designed park and open space areas increase present satisfactions of users and viewers. However, parks, under certain conditions, have been shown to account for discernable increases in property values. It is apparent that good design is frequently valuable beyond its additional cost, and its values to endure. Thus, when developing a plan for recreational use of the parkway, these factors must be paramount considerations if the area is to provide the greatest possible package of social, environmental and economic benefits.

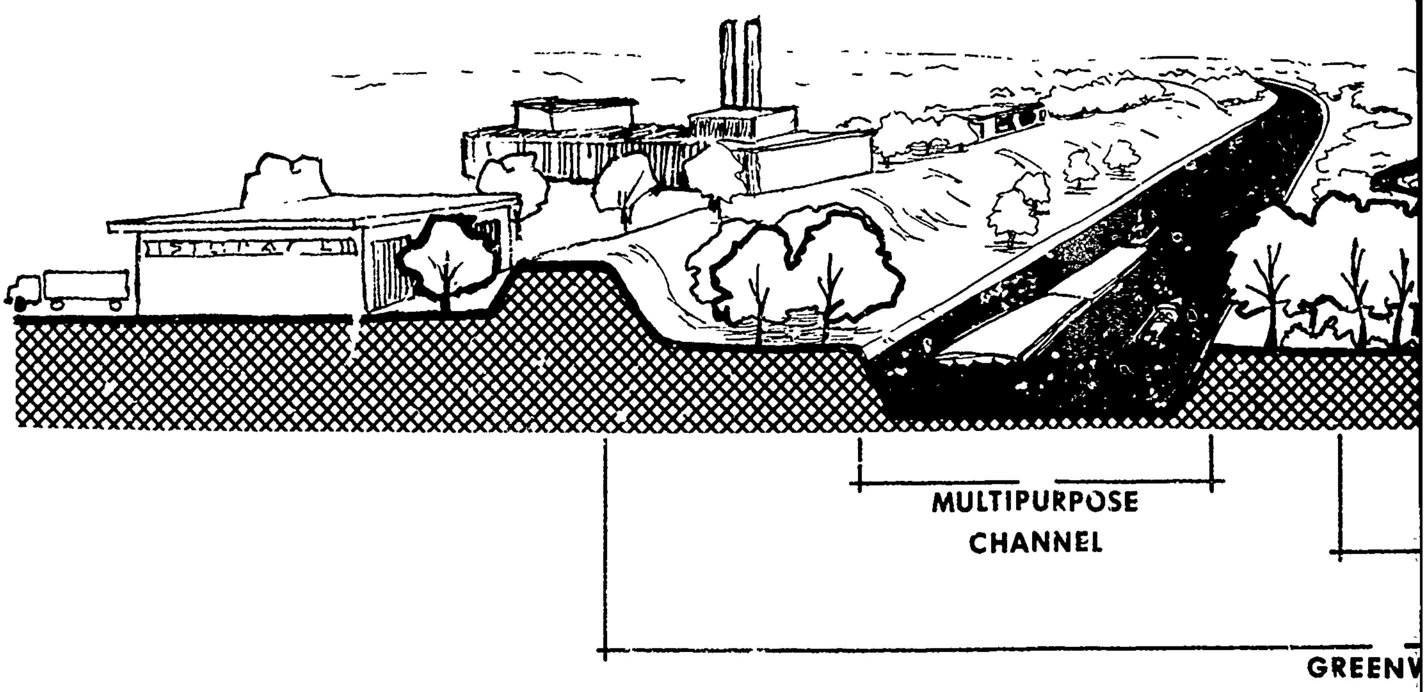
The economic externalities of open space, while being difficult to determine precisely, can best be discussed in terms of a flow of values which accrue to individuals, communities and regions, over time. Within a complex area such as that encompassed by the greenway, the use and valuation of tracts of land depends more upon what is done on other tracts within the same complex than upon anything which can be done on any particular tract. It is important to emphasize the positive externalities that a vast open space corridor can generate. No individual can provide such amenities at the scale proposed, yet each individual will experience considerable social and economic benefit. Increased land values, pleasant living conditions, good recreation areas and room to roam are a part of the complex flow of values which can be attributed to the open space benefit system. Reduced crime and vandalism, increased worker productivity, and attraction of new business and commerce resulting from the publicly financed institutional arrangement for the creation, maximization and management of these externalities in land use values is indeed a worthy justification for the additional effort to be incurred.[64]

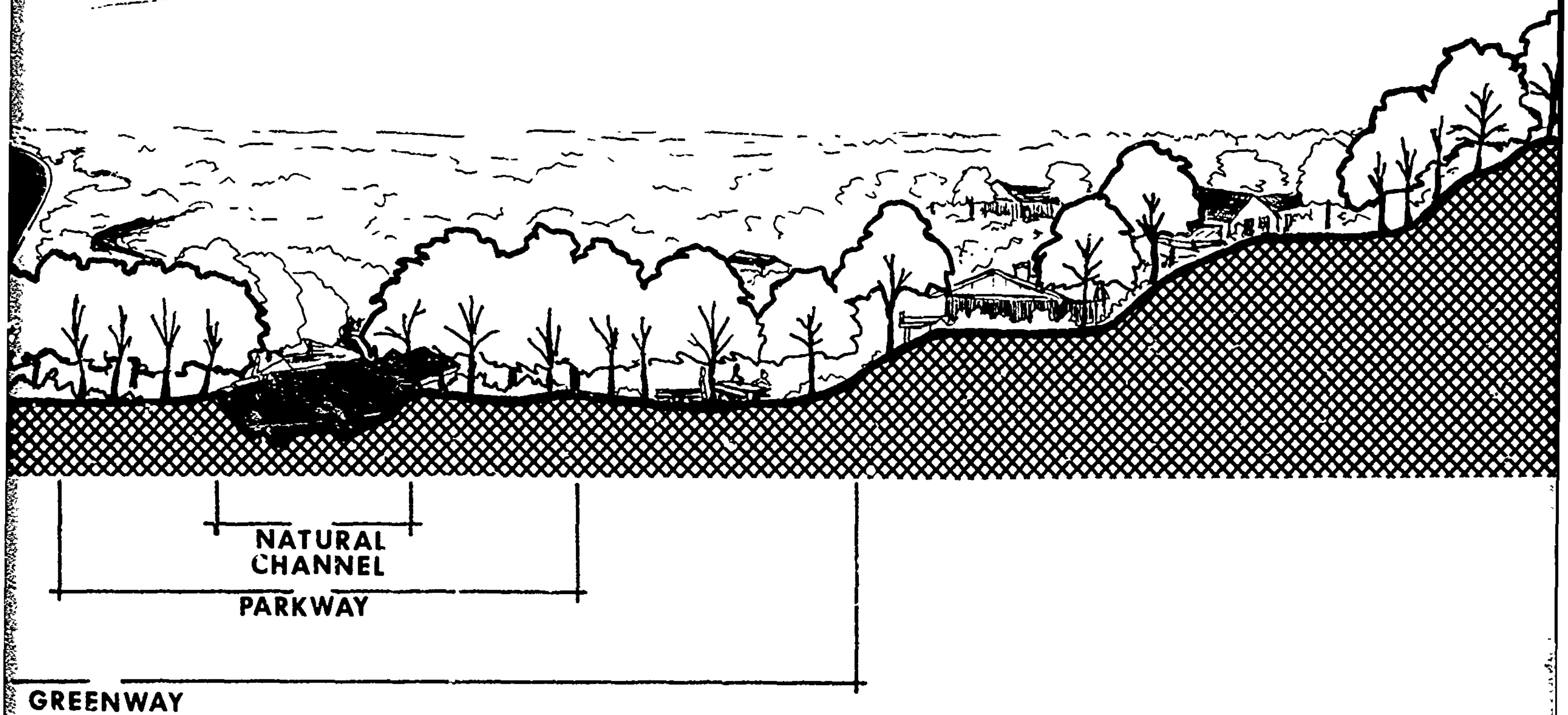
Almost immediately the age-old question arises of decreased tax revenue through the loss of potentially prime high-valued development land as the result of extensive public open space dedication. It is well known that local units of government garnish a large percentage of their general revenue from real and personal property taxation. They are reluctant to favor prospects of decreases in revenue unless feasible substitutes are provided.

Dedication of open space land on the scale proposed for the Trinity parkway should be a significant land value escalator. Existing studies point to a considerable escalation in value of properties coterminous to dedicated open space.[65] A corollary exists in the design and marketing of lots in private land development operations.[66] Choice lots abutting golf course greens and fairways, small lakes, public lands or other aesthetic features command much higher prices by virtue of location.[67]

A related market adjustment is already underway within the study area as landowners anxiously await word on the final alignment of the multi-purpose channel and specific locations of locks, dams, turning basins and prospective port sites. Land speculation fever runs high. However, as the market begins to stabilize, realistic values based on expected future development will be established. Because most of the present excitement is focused on commercial aspects of the waterway, little thought has been given to the economic benefits of a broadened concept public open space land within the river corridor.

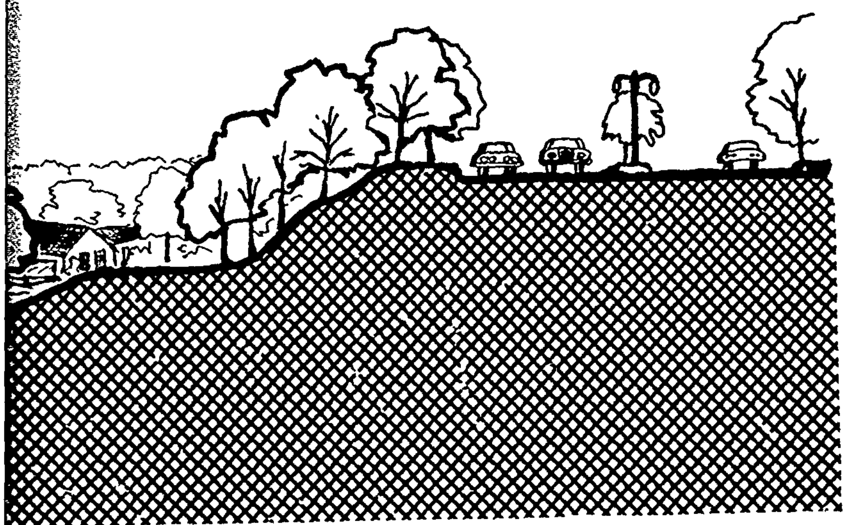
Perhaps the greatest presently unanticipated economic impact to be realized from the proposed river parkway will accrue to those lands at higher elevations south of the river. Vista and proximity are important aesthetic locational amenities that will accrue to these lands. As shown in Figure 32, several critical view lines will be protected and enhanced by the presence of the open space corridor. Similar lands adjacent to the greenways proposed for the tributary drainages should also experience considerable appreciation in real value. This anticipation is based on several reasonable assumptions, concerning the location of residential properties. Choice lands on the higher bluffs from Meadowbrook eastward to the vicinity of West Grand Prairie will enjoy a commanding vista over a forested river bottom. This green belt will partially screen out industrial installations which are likely to develop north of the multipurpose channel. It would be desirable for the local communties to acquire public park lands on the high bluffs. This same experience of view would then be available to many more people throughout the area. As the south elevation begins to drop, lands in proximity to the parkway such as those between Highway 360 and Belt Line Road could also develop as choice residential properties. The City of Arlington has recognized these land use characteristics and has designated land use in this area of the community for residential development.[68] Also, the parkway concept can have considerable bearing on the location of new parks in communities such as Arlington and Grand Prairie where intensive urban development is still a considerable distance from the river.[69] Because most of the land north


MULTIPURPOSE
CHANNEL
GREENV



Greenway

Fig. 32



Greenway Profile

3

of the channel appears to be best suited for industrial development, the parkway will be of less importance in influencing the valuation of these lands.

Reasonable expectations of increased land values generated by the parkway and multipurpose channel should more than offset the taxable value of the primarily vacant lands included in the parkway. In order to economically justify parkway open space in public ownership, the resulting increased value of adjacent lands must be taxed to reflect this higher value. In one sense, this is a form of income redistribution in that the public is recovering its fair share of the income accruing from prior investments of public funds. It will be up to the individual taxing jurisdictions to monitor escalated real estate values and adjust real property taxation rates accordingly. Premature reevaluation must be avoided. Taxation that anticipates future land use changes and taxes on the basis of anticipated rather than existing use has, in the past, forced the premature sale of countless acres of farm, ranch and woodland to land speculators because corn, grain, cattle and timber could not produce adequate earnings to meet increased costs of ownership. The resulting disorderly change in use of such lands contributes to the increased rate of uncontrolled and uneconomic suburban land conversion and the loss of valuable open space resources. Continual study and evaluation will be necessary to develop the proper policies and procedures to allow local units of government to cope with these changes.

IMPLEMENTATION FRAMEWORK

The principal characters in this play have already been identified and to a certain extent their roles have been delineated. Interest in the greenway project has been amply demonstrated by the extent of cooperation shown by all parties contacted during this study. It is recognized that time simply did not allow the project team to consult with all agencies, groups, and individuals who have an interest in plans for future development of the Trinity River. The research team did work with the key federal agencies and state agencies, as well as the Council of Governments which represents the local units of government within the study area. Our charge was to develop a prototype, determine its feasibility, examine its environmental magnitude and suggest an implementation vehicle for bringing the prototype from plan to full scale development. Those who are responsible for implementing the plan must resolve conflicts among the various interests who will be cost-sharing partners in the development and administration of the parkway.

Much has been said and written concerning the positive and negative aspects of the proposed Trinity River project. Unfortunately, a great deal of this has been purely speculative and hypothetical. Now that detailed analysis, planning and evaluation is underway, it is time for responsible involvement and decision making on the part of those who have offered much criticism but little positive solution. The Corps of Engineers and associated research teams have expored a multitude of alternatives with respect to project development. For each alternative the social, economic, and environmental costs and benefits have been evaluated. Each alternative involves certain comprimises on the part of all groups having direct or indirect interest in the project. What is more important is that as the project moves into the advanced planning and analysis stage, certain design decisions involving concepts such as the proposed greenway and parkway must soon be made if they are to be incorporated into the final plan. Costs and benefits obviously must be reassessed, and recalculated.

The Corps, by nature of its policies and operational procedures, is flexible in its planning and design and seeks to entertain sound proposals and include them into its engineering plans. It is however, limited by previous commitment as well as regulations established by the Congress as to the expenditure of federal funds for more encompassing development such as that proposed in this plan. Additional construction costs must be offset by demonstrable economic benefits, and no massive change in federal cost accounting is likely to occur fast enough to alter the present direction of the project. What is possible and can change the course of previous plans is the extent of non-federal participation in cost-sharing for those additional social, economic and environmental amenities which would be provided by the greenway plan. Thus, if local interests and the State are willing to cost-share, the Corps can incorporate this more comprehensive plan into the overall design of the Trinity project. In simple terms, it is now up to those who want an open space parkway to come forth with funds and enter actively into the planning, design and development program.

No final decison on the project can be made until the complete environmental impact statement is accepted and approved. Meanwhile, as time passes, planning continues and decisions are made which can have drastic impacts on the fate of many areas along the river proposed for inclusion in the greenway and parkway.

The greenway plan incorporates the thinking expressed in numerous other open space plans for various portions of the Trinity River between Fort Worth and Dallas. This report outlines the general steps that must be taken if a greenway is to become a reality. The time for pouring forth pious environmental platitudes has passed. A firm commitment by those who must join hands with the Corps is now necessary.

Within a reasonable time after this report is accepted by the Corps the following steps should be taken:

1. Formation of a Trinity River Greenway Advisory Committee which includes the following members:

Director, Texas Parks and Wildlife Department

District Engineer, Fort Worth District of the U.S. Army Corps of Engineers

General Manager, Trinity River Authority

Executive Director, North Central Texas Council of Governments

Mayors of the Cities of Fort Worth, Arlington, Grand Prairie, Irving, Dallas and Hutchins.

County Judges of Tarrant and Dallas Counties.

2. The operational relationships of the responsible agencies should be established. The responsibility and authority of the lead agency should be clearly delineated as well as the supporting roles for each cooperating agency.

3. Either under the auspices of the proposed lead agency or the Advisory Committee, education and information concerning the project should be undertaken through public media and appropriate public hearings held concerning the formal institutionalization of the greenway program. At this time detailed site plans should be developed which would more accurately stipulate specific acreage and project costs. We recommend that leadership in this planning should come from the Texas Parks and Wildlife Department.

4. Meetings should be held with representatives of the Department of Housing and Urban Development and Bureau of Outdoor Recreation to explore the prospects for designating the Trinity as a "Model River". The concept falls within the scope of the Legacy of Parks Program and is definitely a move to "bring parks to people".

5. Efforts should then get underway to seek those landowners who would be willing to sell options on their property or donate memorial tracts for inclusion in the Trinity River Greenway System. Action beyond this point will be to a large extent, dependent on the outcome of all environmental studies throughout the entire basin, and the eventual decision regarding construction of the multipurpose channel. It is recognized that during this time land prices will continue to soar and that changes in the character of the land will continue. Since Texas counties lack zoning power, it can only be hoped that private inertia coupled with available local regulatory powers will hold the line on development within those lands designated for the greenway. Obviously, if a commitment is made to move ahead with the plan, land prices will escalate rapidly. Thus, early decisions on the project will provide a vehicle for obtaining property options in advance of actual need for the land. It is essential that the lead agency be prepared to move into immediate action at such time as the project is approved for construction.

As this report is being written, plans are being made for use of lands in proximity to the expected location of the multipurpose channel.

Land speculation similar to that occurring around the regional airport is beginning, and it can be expected that real estate values will increase threefold or more as developers opt for key locations. Without decisive, expeditious public action, there can be relatively little hope of preserving any of the natural features of the river. This is the time for public agencies, developers and landowners to begin working together in the comprehensive planning of the river corridor. Once the last tree is cut, the animals driven off and the once flowing river reduced to a mere trickle or muddy bog, it will be too late to wish there was a Trinity River Greenway.

REFERENCES

1. U.S. Congress. Trinity River and Tributaries, Texas. Vol. I: Main Report (Washington, D.C.: Government Printing Office, 1965), 89th Congress, 1st Session, House Document No. 276, pp. 43-46.

2. Soil Conservation Districts of the Trinity Watershed. Soil Conservation and Upstream Flood Prevention of the Trinity River and Tributaries, Texas. Texas State Soil Conservation Board, January 1959, p. 3.

3. Marvin Springer and Associates. Open Space Development, Trinity River System in Dallas, Texas December 1969. p. 24.

4. Fort Worth General Plan. Volume IV: Meadowbrook Sector Plan, July 1970, p. 80.

5. General soils associations maps and soil series photomaps supplied by the Soil Conservation Service, Fort Worth office.

6. Letter, D. R. Coffee, Soil Scientist. Soil Conservation Service, Fort Worth, Texas; February 1972.

7. U. S. Congress. Trinity River and Tributaries, Texas. Vol. IV: Cost Estimates, Geology, and Design Information (Washington, D.C.: Government Printing Office, 1965), 89th Congress, 1st Session, House Document No. 276, pp. 6-7.

8. Texas Almanac, 1970-1971. Dallas: A. H. Belo Corporation, 1969, p. 130.

9. F. W. Gould. Texas Plants, A Checklist and Ecological Summary. Texas A & M University, April 1969, pp. 11-12.

10. Letter, Charles T. Menn, Fisheries Biologist. Texas Parks and Wildlife Department, Fort Worth, Texas; December 17, 1971.

11. Letter, John G. Deganti, Field Supervisor. Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior, Fort Worth, Texas; December 20, 1971.

12. U.S. Congress. Trinity River and Tributaries, Texas. Vol. V: Recreation and Fish and Wildlife (Washington, D. C.: U.S. Government Printing Office, 1965), 89th Congress, 1st Session, House Document No. 276, p. 53.

13. Ibid., p. 52.

14. Ibid., p.55.

15. Ibid., p. 57.

16. Ibid., p. 61.

17. Ibid., p. 66

18. Almanac, p. 76.

19. Dallas-Fort Worth Regional Transportation Study. Volume 2, Texas Highway Department, July 1967, p. 9.

20. Almanac, p. 84.

21. Transportation Study, p. 11.

22. Ibid.

23. Ibid, p. 14.

24. Ibid.

25. Ibid.

26. Ibid., p. 15.

27. Ibid., p. 16.

28. Springer, Open Space, pp. 3-5.

29. Upper Trinity River Basin Comprehensive Sewerage Plan. Prepared by Camp, Dresser & McKee, Consulting Engineers, et. al. Volume I, July 1970, pp. III-11.

30. Ibid., pp. III-16.

31. Ibid., pp. III-14.

32. J. K. G. Silvey, William J. Nunez, III, and R. L. Abshire. The Trinity River Project - A Bacteriological Study on the Effect of Chlorination on Sewage Effluents and a Receiving Stream. North Texas State University, December 1970, p. 30.

33. Ibid., p. 61.

34. G. M. Fair, and J. C. Geyer. Water Supply and Waste-Water Disposal. New York: John Wiley and Sons, Inc., 1966, p. 847.

35. American Public Works Association. "Water Pollution Aspects of Urban Runoff." Final Project Report No. WA66-73. Federal Water Quality Administration, Department of the Interior, January 1969.

36. S. R. Weibil, et. al. "Characterization, Treatment, and Disposal of Urban Stormwater." Advances in Water Pollution Research. Volume I, Washington, D.C.: W. P. C. F., 1967.

37. AVCO Economic Systems Corporation. "Storm Water Pollution from Urban Land Activity." Final Project Report No. 14-12-187. Federal Water Quality Administration, Department of the Interior, July 1970.

38. D. M. Wells, T. A. Austin and B. C. Cook. Variation of Urban Runoff with Duration and Intensity of Storms. Texas Tech University, Water Resources Center Publication No. 71-5, August 1971.

39. U. S. Congress. Trinity River and Tributaries, Texas. Vol. III: Hydrology, Hydraulic Design, and Water Resources (Washington, D.C.: U.S. Government Printing Office, 1965), 89th Congress, 1st Session, House Document No. 276.

40. Notes, Field trip of February 11, 1972. D. R. Coffee, Soil Conservation Service, Fort Worth, Texas.

41. Springer, Open Space.

42. Ibid., p. 41.

43. E. J. Urbanovsky, et. al. Sociological and Economic Impact of Parks in Dallas, Texas. Department of Park Administration, Texas Tech University, 1968.

44. "Joint Development and Multiple Use" Catholic University Law Review, Vol. 20, Fall 1970, p. 1.

45. 178. Kan. 26, 283 p. 2d 392 (1955).

46. S. Z. Searles. "Adventures in Condemnation: Aesthetic Considerations and Unusual Elements of Value." Alabama Lawyer, Vol. 32, October 1971, p. 392.

47. Marion Clawon. Suburban Land Conversion in the United States. Baltimore: John Hopkins Press, 1971, p. 184.

48. Coffee, Field Notes.

49. Deganti, Letter.

50. Municipal Solid Waste Rules, Standards and Regulations. Texas State Department of Health; November 5, 1970.

51. Ibid.

52. Suburban Land Conversion, p. 367.

53. Public Law 89-72 (79 Stat. 213); Federal Water Project Recreation Act. July 9, 1965.

54. W. D. Oliver, et. al. Pathways and Paddleways. Texas Parks and Wildlife Department; Austin, Texas; August 1971.

55. Texas, Special Referendum Election, November 1967.

56. Texas, Texas Park Fund, Statutes (1971).

57. Public Law 88-578; (78 Stat. 897) Land and Water Conservation Fund Act, July 15, 1968.

58. Suburban Land Conversion, p. 367.

59. Ibid.

60. R. H. Pratt. Open Land in Urban Illinois. Dekalb: Northern Illinois University Press, 1971.

61. Alabama Lawyer, p. 392.

62. Crance v. State 205 Misc. 590 128 NYS. 2d. 479 Rev'd 136 NYS, 2d. 156. 284 A.D. 750 Rev'd. 309 N.Y. 680 (1955).

63. Impact of Parks in Dallas.

64. Suburban Land Conversion, pp. 367-370.

65. Law Review.

66. Discussion with William Sims, Lawyer and Owner of the Moore Brokerage Company, Land Holding Company. Breckrenridge, Colorado; January 1972.

67. Discussion with Richard Buck, Chief Landscape Architect of the Cook County Forest Preserve District. River Forest, Illinois; February 25, 1972.

68. Marvin Springer and Associates. Arlington, Texas Urban Development Framework, May 1971.

69. Ibid.

OTHER REFERENCES

1. Elm Fork Nature Area. Dallas Museum of Natural History, n.d., 24 pp.

2. Fort Worth General Plan. Volume VI. "District C General Plan," August 1971, 109 pp.

3. "Second Dallas - FW Tollway Backed," Fort Worth Star Telegram. November 14, 1971; pp. 1 and 20A.

4. Marvin Springer and Associates. Comprehensive Plan Report, City of Grand Prairie. January 1966, 142 pp.

5. Regional Science Research Institute. Future Structure of the North Central Texas Region. Arlington, Texas: North Central Texas Council of Governments (NCTCOG), November 1970, 19 pp.

6. NCTCOG. 1970 Census Fact Book. Arlington, Texas: NCTCOG, June 1971, 290 pp.

7. NCTCOG. Open Space Plan/Report for North Central Texas (Draft); December 15, 1971.

8. Maps for NCTCOG by:
Schrickel, Rollins and Associates-
Map 1. Existing Parks and Open Space
Map 2. Proposed Parks and Open Space
Map 3. Environmental Corridors
Marvin Springer and Associates-
Incorporated Areas and Population Distribution
Terrain Map

9. National Aeronautics and Space Administration. Earth Observations Aircraft Program Screening and Indexing Reports. Houston: Manned Spacecraft Center. Missions 106 and 145.

10. U.S. Department of Agriculture, Soil Conservation Service. General Soil Map of Dallas County, Texas. Temple, Texas: Texas Agriculture and Experiment Station.

11. U.S. Department of Agriculture, Soil Conservation Service. Indexes to Aerial Photographs. Temple, Texas:

Flight DJY-1951	Tarrant County
Flight DJU-1964	Dallas County

12. U.S. Geologic Survey 7.5 Minute Series (Topographic) Maps. Series V882; Tarrant and Dallas Counties, Texas; Photo revised 1968. AMS Numbers and Quadrangle Sheets:

6549 IV SE	Haltom City
6549 III NE	Fort Worth
6549 I SW	Hurst
6549 II NW	Kennedale
6549 I SE	Euless
6549 II NE	Arlington
6649 IV SW	Irving
6649 III NW	Duncanville
6649 IV SE	Dallas
6649 III NE	Oak Cliff
6649 I SW	White Rock Lake
6649 II NW	Hutchins

APPENDIX A

TRINITY RIVER GREENWAY PROJECT

Newsletter No. 1
October 18, 1971

PAST RELATED EVENTS

On Friday morning October 8, the first formal meeting for the Trinity River Greenway Planning project was held in the Trinity River Authority Office in Arlington, Texas. Those in attendance were:

Mr. David H. Brune	Trinity River Authority
Mr. W. Dickens III	TRA/TIA
Mr. L. B. Houston	City of Dallas
Mr. Charles Campbell	City of Fort Worth
Mr. Bill Enlow	City of Irving
Mr. Melvin Shanks	City of Arlington
Mr. John M. Sellars	City of Grand Prairie
Mr. L. E. Horsman	U.S. Corps of Engineers
Mr. Derwood Jones	U.S. Corps of Engineers
Mr. Joel C. Wooldridge	North Central Texas Council of Governments
Professor E. J. Urbanovsky	Texas Tech University
Mr. Terry T. Cheek	Texas Tech University
Dr. James D. Mertes	Texas Tech University

Dr. Mertes led off the discussion by explaining his concept of the proposed greenway. During his talk, portions of high-altitude remote-sensing imagery of the greenway planning region were shown. Also, slides of the of the Trinity in its present state were contrasted with those of the recently completed Arkansas River inland waterway project. In general, all the attendants at the meeting provided meaningful input and demonstrated a keen interest in the project.

Following the meeting, the planning team collected data from the Corps of Engineers and Soil Conservation Service offices in Fort Worth.

PLANNING TEAM'S ACTIVITIES

At the present, most of the team's work is being devoted to preparation for the project. We have been granted final funding approval from the Corps and we are officially known as the Trinity River Environmental Study. In addition to the three members in attendance at the meeting, we also have on the Texas Tech team: Dr. Robert Sweazy, Civil Engineer and Water Ecologist in the Department of Civil Engineering and Water Resources; Mr. Arthur Glick, Professor of Landscape Architecture in the Department of Park Administration; and several part-time senior landscape design students to accomplish our graphics for the final publication.

We are presently preparing a study laboratory in the Plant Science Building on the Tech campus. In it we have developed an improved over-head projection system to better utilized the high-altitude NASA color and infrared imagery mentioned earlier.

This is the first of a series of newsletters on the Trinity River Greenway Planning Project. We wish to take this opportunity to thank those in attendance at our first meeting for their interest and support.

We may be calling upon some of you to assist us in the next task. We are also assembling base data for the project: U.S.G.S. Maps, NCTCOG open space and parks maps, area sewerage studies, geological maps, soil surveys, Corps of Engineers canal alignment maps, zoning plans, park plans, boundary maps, and anything else we can get our hands on.

FUTURE PLANS

Courtesy of the Corps, we have arranged a helicopter flight for an aerial reconnaissance of the complete planning area later this month. We plan to fly down both sides of the river, taking continuous sequential low-oblique color slides of each opposite bank and its adjacent lands. These will be most valuable as a supplement to the vertical photography we now have, and will also serve to assist us in detailed planning.

Our other most important plans for the near future are to visit with each of the municipal governments that will be affected and concerned in the project. We highly value your input, your existing plans, and your concepts. We hope you will be able to help us when in the near future we begin to contact your various departments.

James D. Mertes
Principal Investigator

JDM/cs

TRINITY RIVER GREENWAY PROJECT

Newsletter No. 2
November 29, 1971

PAST RELATED EVENTS

The last two months have been extremely busy ones as we move ahead on our environmental corridor study. Terry Cheek, assisted by two senior landscape architects is finishing our base maps which include: land ownership, soils, geology, vegetation, topography, transportation and other major categories of land use. Much of this data is being taken from our 1970 high-altitude infra-red photographs of the river, provided by the National Aeronautics and Space Administration. Our soils survey data includes the most recent association and series interpretations provided by the Soil Conservation Service. We are awaiting statements from the Texas Parks and Wildlife Department and the Bureau of Sports Fisheries and Wildlife as to the wildlife populations habitat conditions and related factors within the study area. This phase of the work should be completed by the end of December.

On November 3, Durwood Jones of the Fort Worth Engineer District spent the day at Texas Tech consulting with the study team on various aspects of the project. Durwood, Bud Horsman and other members of the Corps Environmental Planning team are working closely with the Tech team throughout the study.

On November 11, Professors Mertes Sweazy and Glick, accompanied by student assistants Cheek and Freeman, joined with Durwood Jones of the Environmental Resources Section of the Fort Worth Engineer District on an aerial reconnaissance of the study area. Flight services were provided by the U.S. Army Air Reserve Unit stationed at Oak Grove Airport. Our special thanks to J. B. West, Paul Fleming and Beauman Roberts of the U. S. Army for an outstanding job. The photographs and notes secured from this flight are already proving extremely valuable as we move into the evaluative phase of the study.

Professor Sweazy has done considerable work evaluating the potential of played-out sand and gravel mines for dredge fill and solid, waste disposal. Bob is also looking at various aspects of the river systems hydraulic design and water quality as they relate to the ultimate open space plan and environmental alignment recommendations.

Professor Glick and his team of Landscape Architects are beginning work on our graphics and conceptual schematics depicting various aspects of the greenway and related lands.

Professor Mertes has given several talks on the project to various interested groups. Among these were the Board of Directors of the Trinity River Authority of Texas and the Dallas Park Board. We are attempting to meet concerned groups whenever called upon.

FUTURE ACTIVITIES

Through December and January, we will be completing our base maps, field surveys and preparing the initial draft of our report. In early February we will circulate copies of the plan to each participant in advance of scheduling some planning meetings with the various agencies involved. Further information on this phase of the project will be forthcoming at a later date.

James D. Mertes
Principal Investigator

JDM/cs

TRINITY RIVER GREENWAY PROJECT

Newsletter No. 3
May 25, 1972

PAST RELATED EVENTS

Since the first of the year, our research team has been working to complete the analysis and publication of the Trinity River Environmental Study. During that time we have conducted several field trips through the area and have met with many officials of the various communities and agencies directly or indirectly involved in the project. Our preliminary draft was presented to the Corps in late March. A meeting was held in Lubbbock in mid-April to review the draft and summarize the final report. The report will go to press in late May and will be delivered to the Corps by the end of June.

Much of the natural processes analysis carried out as part of the study was accomplished through the use of high-altitude infrared imagery coverage of the basin. Texas Tech, through cooperation with the National Aeronautics and Space Administration, has available excellent air reconnaissance coverage of the study area. Many of the base maps in the report were prepared from this imagery. This technology has considerably advanced the process of environmental analysis and planning.

For the study team, this has been a most challenging planning project. Highlights of the study were the opportunities we had to work with the many interested individuals and organizations throughout the area. We hope this interest, enthusiasm and spirit of cooperation will continue to prevail and strengthen during the implementation programs of the future. To you and the people of the area, we present a plan for a Trinity River Greenway. This Greenway can be a natural tie that binds these great communities together in a union destined to be a model for others to emulate. Indeed, the proposed Trinity River Greenway can be a model riverway for the State and Nation.

To the Corps of Engineers we offer our special thanks for providing the opportunity to undertake this study. The level of environmental planning being carried out by the Engineers will lead to an ecologically sound water resource development program. Together we have learned a little more about a large and complex ecological, social and economic system.

Our sincere thanks again to all who contributed to this study. It has been a pleasure working with you.

James D. Mertes
Project Leader

Robert M. Sweazy

Arthur N. Glick

F. M. Carroll

Terry T. Cheek