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FOREST

Spring Creek Forest Preserve

Master Development Plan

City of Garland, Texas

Spring Creek Forest Preserve Master Development Plan

for

The City of Garland, Texas
Park and Recreation Department

Mr. Bob Hall, Director

and

The Preservation Society for Spring Creek Forest

by

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The Texas Nature Conservancy provided a significant contribution to preserving the Forest in developing a Protection Plan for the Forest in the mid 1980s which documented the significance of the area and helped coordinate preservation activities. The Dallas County Open Space Program has played a major role in developing the Forest Preserve by acquiring three tracts of land in association with the Texas Parks and Wildlife Department. Special thanks is given to Colonel Mayer H. Halff for donating Halff Park and Halff Greenbelt to the City of Garland.

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SPRING CREEK FOREST

Executive Summary

EXECUTIVE SUMMARY

The Spring Creek Forest Preserve is a unique relict old-growth bottomland hardwood community. The Forest warrants protection and preservation, because there are very few old growth forests remaining in North Central Texas and because it contains a diverse assemblage of woody and herbaceous plant species. The mature hardwood forest and adjoining floodplain lands contain approximately 300 acres that should be designated as the Spring Creek Forest Preserve. The Forest is dominated by a variety of old trees, estimated to be 200 to 300 years old, consisting of:

- Ash,
- Sugar Hackberry,
- Boxelder,
- Slippery and Cedar Elm,
- Pecan, and
- Shumard, Bur and Chinkapin Oak.

The most notable peculiarity of the Spring Creek Forest is the presence and importance of Chinkapin Oak. A detailed vegetation survey was completed of the Forest which identified 64 species of woody plants and 96 species of herbaceous plants.

The existing and proposed site conditions around the Forest were analyzed and mapped to determine significant influences. Buffer zones and management plans have been developed to minimize detrimental impacts to the Forest Preserve.

A Master Development Plan has been created which recommends the construction of a Visitors Center, a Reforestation Interpretive Pavilion, and an Outdoor Classroom interconnected by a trail system. The Plan also calls for the reforestation of several areas and an overall interpretive system.

The Plan also recommends the implementation of reforestation/restoration activities to increase the environmental quality of peripheral lands around the Forest Preserve.

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The Forest Perspective

1. THE FOREST PERSPECTIVE

Significance of the Spring Creek Forest

At one time bottomland hardwood forests were the natural cover type of many floodplain ecosystems in the southeastern United States. Bottomland hardwood forests are dynamic, productive natural systems that depend on intermittent flooding and ground water movement to sustain their structure and condition. These forested ecosystems provide a wide range of benefits for man such as flood control, water purification and recreation. Agricultural conversion, reservoir construction, stream and river channelization, mining, timber production, and urban development have however, resulted in a substantial decline in bottomland hardwoods throughout the southeastern United States. Decisions to protect the remaining old-growth forests have been hindered by the inability to place a dollar value on the environmental functions performed by these ecosystems.

Relict tracts of bottomland hardwood forests are rare in an urbanized environment. When discovered, their protection is crucial. Relict forests represent a lifeform that has survived through the centuries. Scientists revere the opportunity to work in an outdoor laboratory where they can study biological evolution and ecological succession. Future generations will value the mature forest for it's unique illustration of life's intricate harmony and structure. Pristine open space plays an important role in the urban setting. In addition to the practical functions such as flood water conveyance and water purification, protection of natural areas provides a peaceful abode for the urban naturalist and gives inspiration to the observer.

Old-growth forests are not easily defined. Runkle (1982) indicated that they are without obvious large-scale human or natural disturbances and contain large trees. Abrell and Johnson (1977) indicate they are near virgin.

The Spring Creek Forest Preserve was established to protect such a relict forest. The old-growth forest is situated in the floodplain of Spring Creek in the City of Garland, Texas. Garland is an expanding city just northeast of Dallas in Dallas County, as illustrated in Figure 1.1.

The Spring Creek Forest Preserve is located within the Blackland Prairies vegetational area of Texas (Hatch, 1990). Dallas County is located in the transitional zone between the Subtropical Humid climatic region of eastern Texas, which is characterized by warm summers, and the Subtropical Sub-humid climatic region of central Texas, which is characterized by hot summers and dry winters. This transitional zone provides the extreme western limit of the east Texas forest species and the extreme eastern limit of the west Texas species. The forest contains a high diversity of both woody and herbaceous species.

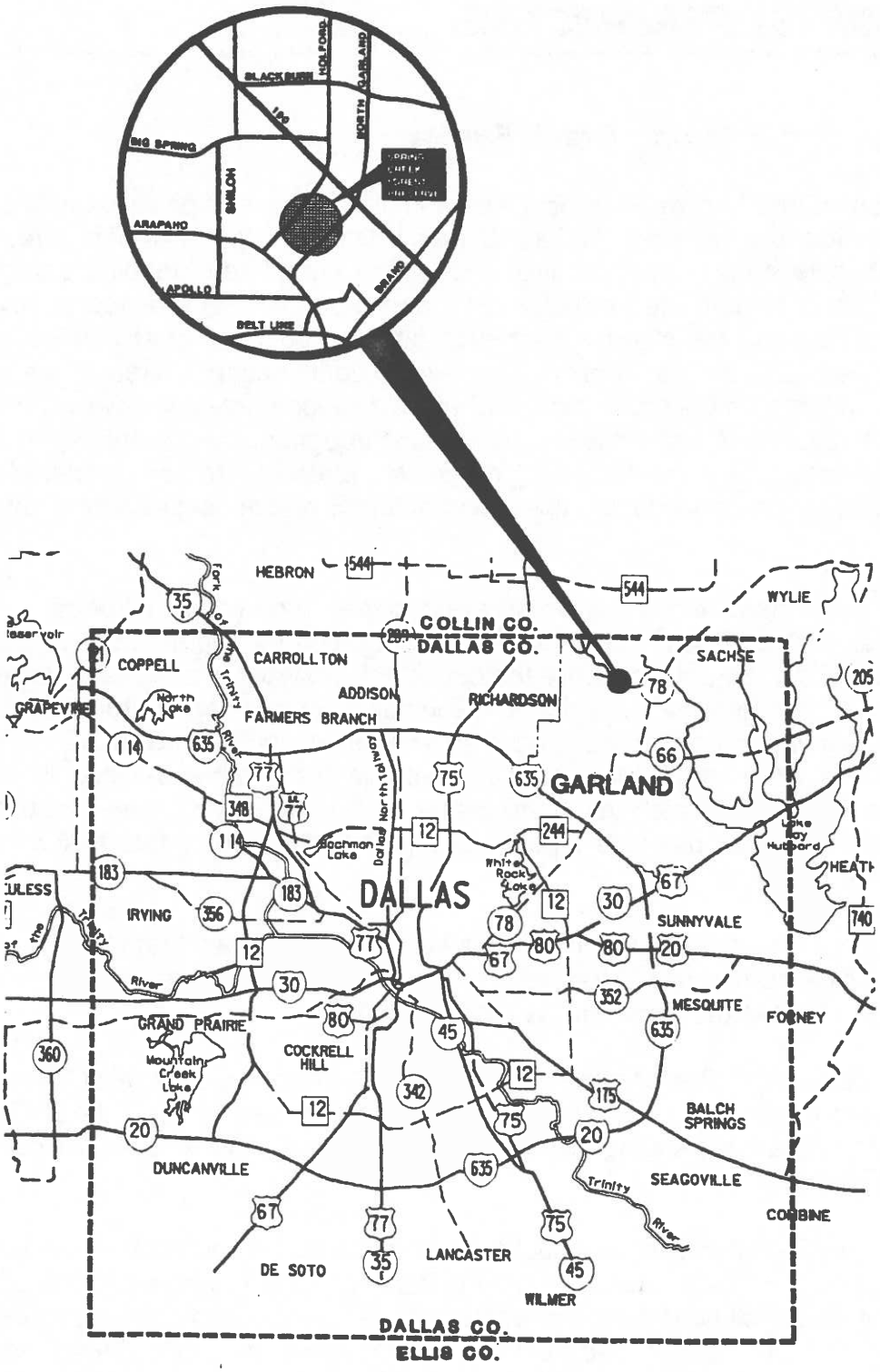

FIGURE 1.1

LOCATION MAP

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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The overall dominants in the Spring Creek Forest are:

- White Ash (*Fraxinus americana*);
- Texas Sugar Hackberry (*Celtis laevigata*);
- Boxelder (*Acer negundo*);
- Red Mulberry (*Marus rubra*);
- Slippery and Cedar Elm (*Ulmus rubra, Ulmus crassifolia*);
- Pecan (*Cara illinoensis*); and
- Shumard, Bur, and Chinkapin Oak (*Quercus Shumardi, Quercus macrocarpa,* and *Quercus muehlenbergi*).

When compared to other forest bottomland communities in north-central Texas, the Spring Creek Forest is quite similar. The most notable inconsistency of the Spring Creek Forest is the presence and importance of Chinkapin Oak. Of interest is the recent designation of a Bur Oak and Chinkapin Oak (*Quercus macrocarpa* and *Q. muehlenbergi*) forest community type, which ranges from Kansas and Nebraska into Wisconsin (Monk, et.al, 1990). Additional studies are needed to better understand the distribution of importance of Chinkapin Oak in north-central Texas. The Chinkapin Oak occurrence along with the old-growth nature of the trees, which are estimated to be 200 to 300 years old, make the Spring Creek Forest unique.

The herbaceous flora of the forest and forest margin is quite diverse and pleasing. The early flowering of the Wood Violets and Trout Lilies followed by Great Solomon's Seal, Wild Petunia, Starry Catchfly, and others, make this area very interesting. The openings along the margin of the forest contain many showy and beautiful plants which include Anemone, Winecup, Krameria, Marshallia, Evening Primrose, and Queen's Delight.

Old-growth forests need to be preserved and studied. They provide valuable information because they suggest what the structure and composition of these communities were once like. The permanent vegetation sampling plots established by this study can be very useful in determining changes and trends in the vegetation of the forest.

History of the Spring Creek Forest Preserve

In 1982, the City of Garland Parks and Recreation Department was advised about a hardwood bottomland forest in the floodplain of Spring Creek that appeared to be unique and worthy of protection. Recognizing that the City would have a difficult time restricting public access and use of the forest, the Parks and Recreation Department undertook the task of finding a group that could manage such a preservation project. On November 8, 1982, the Texas Nature Conservancy became the lead agency in the project. Within the next few years botanists and other scientists confirmed that the Spring Creek Forest is unique and appears to represent a forest assemblage that predates white man's settlement area. These biological field reports and letters supporting the findings presented in this Master Development Plan are included as Appendix A.

Once the status of the old-growth forest at Spring Creek was confirmed the City Council assigned a Task Force to work with the Texas Nature Conservancy. A Resolution was passed recommending the establishment of the Spring Creek Forest Preserve. The Resolution supported the efforts of the Texas Nature Conservancy to acquire, manage and protect the Preserve. A copy of the June 19, 1984 Resolution (No. 5240) is included as Appendix B. The Texas Nature Conservancy and City Council Task Force then prepared "A Protection Plan for Spring Creek Landowners and the Citizens of Garland", in December 1984. The report was the first to describe general site conditions and define Preserve objectives.

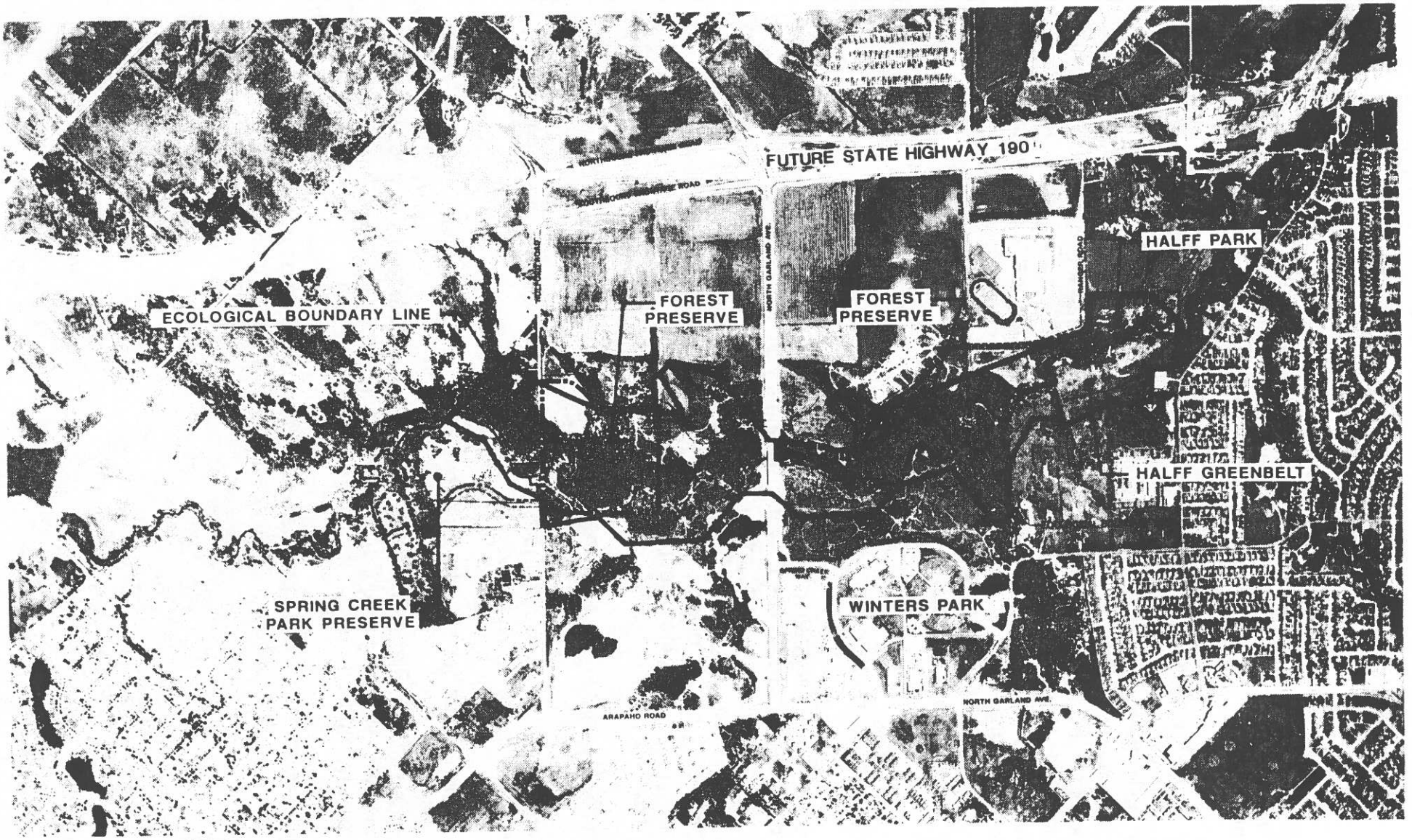
On December 14, 1988, two tracts of land were acquired through the Dallas County Open Space Program with grant assistance from the Texas Parks and Wildlife Department. Responsibility of the Preserve management was shifted to the Preservation Society for Spring Creek Forest on March 8, 1989 when the Society adopted by-laws and conducted the first election of officers and executive committee members. The organization was formed for the expressed purpose of protecting the old-growth forest, developing public educational opportunities and maintaining the general welfare of the site. The Society's goals are simple:

- promote the preservation and protection of Spring Creek Forest as a cultural and natural resource treasure; and
- facilitate scientific and educational pursuits by the public.

The Society's responsibilities are more complex:

- maintain nature trails, an interpretive center, and parking lot;
- plan activities, such as school ecology classes, ecological and plant research, and nature interpretation;
- provide guided tours; and
- guard against vandalism in the forest.

The 1984 Texas Nature Conservancy Protection Plan determined an ecological boundary, as illustrated on Figure 1.2, which defines approximate limits to the old-growth forest. As can be seen in the 1990 aerial, land immediately to the north and east of the Forest Preserve is undeveloped. However, future State Highway 190 is under construction and land adjacent to the highway is expected to develop rapidly within the next few years. Accordingly, the Master Development Plan proposes a forest preserve boundary that is broader than that proposed by the Texas Nature Conservancy in most areas, in order to encompass buffer areas that can protect the old-growth forest. Two forested areas will, however, lie outside of the Preserve, north of the planned Forest View Drive.



JRE 1.2

SITE MAP

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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Guidelines described in this Master Development Plan are intended to promote a strategy for adjacent land development that is compatible with the Forest Preserve's preservation and maintenance objectives.

Condition and quality of the old-growth forest depend upon environmental features beyond the actual preserve limits. The forest exists because of a complex relationship between the creek, soils, topography and rainfall. Forest preservation will require the protection of this physical relationship. Figure 1.3 shows the existing Preserve property and surrounding vicinity. The City of Garland has four existing parks within this area. Sections of these parks can be managed in such a way as to provide a natural buffer for the Preserve. The Master Development Plan recommends additional property be acquired so that the remaining old-growth forest is brought under the protection of the Forest Preserve. A proposed forest preserve buffer zone would also be required to protect the stability of the old-growth forest.

Master Development Plan Objectives

The City of Garland's Park and Recreation Department has initiated a work program for the Spring Creek Forest Master Development Plan. The primary goal of the Master Plan is to ensure the stability of this unique forest preserve. A detailed vegetation survey was performed as part of the work program so that the Master Plan could be designed considering sensitive ecological conditions. It is the City's goal to develop a living, outdoor museum that will provide for the preservation and appreciation of this unique part of our natural heritage.

Objectives of the Spring Creek Forest Master Development Plan include:

- perform an environmental analysis and vegetation survey to describe the condition of the relict forest and surrounding area;
- determine the composition of the Spring Creek Forest Preserve;
- develop a Master Plan that accommodates appropriate levels of public access, yet will not jeopardize the stability of this unique vegetation community; and
- perform boundary surveys, provide fencing plan construction documents, and prepare presentation material in support of this preservation project.

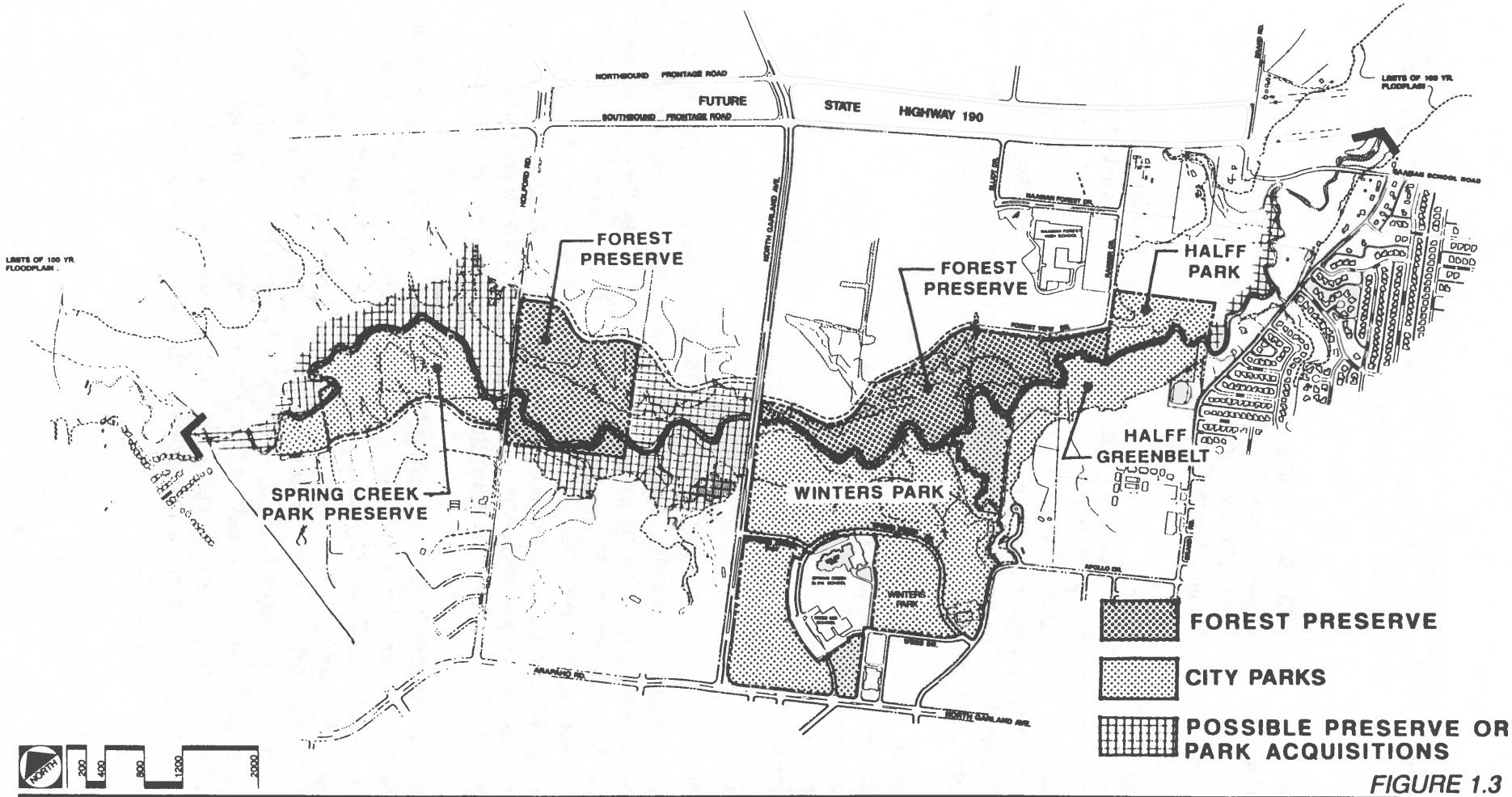

FIGURE 1.3

EXTENDED OPEN SPACE CONCEPT

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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ENGINEERS PLANNERS SCIENTISTS SURVEYORS

The Spring Creek Forest Preserve Master Development Plan presents a management plan and strategy that will preserve this relict forest while accommodating appropriate levels of public assess. The Master Development Plan is divided into the following Chapters:

Chapter 1.	The Forest Perspective
Chapter 2.	Environmental Influences
Chapter 3.	Vegetation Influences and Forest Composition
Chapter 4.	Master Development Plan

The environmental influences that affect the quality of the old-growth forest both now and in the future are discussed in Chapter 2. Preserve boundaries have been surveyed, fencing plans developed, and the fence installed. However, the condition and quality of the forest depends upon the status of land beyond the actual preserve limits. For this reason, the Master Development Plan work program included the evaluation of land adjacent to the Preserve. Natural and man-made influences that affect preservation efforts are described. Human influences that affect the Preserve include:

- existing and proposed land use,
- floodplain ordinances and other regulations,
- development trends,
- school planning,
- utilities, and
- traffic circulation.

The vegetation influences from land adjacent to the Forest Preserve and forest species composition are discussed in Chapter 3. A vegetation condition assessment was performed to better define the limits of the old-growth forest, as well as to identify additional tracts of land appropriate for Preserve status. The vegetation assessment characterizes the existing and proposed Forest Preserve and buffer zones so that management alternatives can be considered. Potential natural vegetation is compared to existing tree and grassland vegetation so that the land can be characterized as climax, successional or disturbed. Sensitivity of the natural communities are addressed.

A woody vegetation survey, directed by Dr. Elray Nixon, professor of Botany at Stephen F. Austin State University, was performed as part of the Master Plan work program. Dr. Nixon had already completed a detailed survey of the woody vegetation in part of the Spring Creek Forest Preserve. The woody vegetation survey was conducted on the Forest Preserve tracts and on the land northeast of Spring Creek between the preserve limits. Eighteen permanently-marked transects were positioned in the forest. All trees, shrubs and woody vines falling within belted transects containing a five-meter by five-meter plot were measured and recorded. This data was used to determine the composition of the forest and to denote any change attributed to creek bluff, flat floodplain bottomland or upland slope location.

The Master Development Plan is described in Chapter 4. The Master Plan identifies the proposed boundaries of the Preserve. The identification of the adjacent areas and zones within the Preserve are utilized in formulating the Master Plan. The major components of the Plan include:

- a visitors center,
- trails,
- interpretive facilities,
- fence and parking areas, and
- restoration plans.

The implementation of the Master Plan is described in Chapter 4. The priority of the components is reviewed and cost estimates for the various facilities are presented. Chapter 4 presents recommendations and guidelines for enhancing and preserving the natural resources within and adjacent to the Preserve.

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Environmental Influences

2. ENVIRONMENTAL INFLUENCES

This chapter documents the natural features, the hydrologic influences and the human influences in the vicinity of the Spring Creek Forest Preserve. The natural features which will be discussed include topography and geology, soils, microclimates, and wildlife. The hydrologic influences include stream hydrology, floodplain characteristics, erosion, and local hydrology. The human influences include land ownership, existing and future land use, thoroughfares, and utilities.

Natural Features

Topography and Geology

Spring Creek is a major tributary of Rowlett Creek which drains about 34 square miles of land within portions of Plano, Richardson and Garland, Texas. The watershed is located within Dallas and Collin Counties, and is experiencing rapid urbanization.

Gradual changes in elevation are typical of this part of Texas. Ground elevations range from about 350 to 850 feet above mean sea level (MSL) in the two-county area. In the Rowlett Creek watershed, elevations vary from approximately 780 feet above MSL in the headwater region to approximately 435 feet above MSL at the upper end of Lake Ray Hubbard.

The surface elevation in and around the Spring Creek Forest Preserve slopes from a high point of about 550 feet to a low of 490 feet above MSL. The total change in elevation is 60 feet. The area in the vicinity of the Preserve is one of the most hilly areas in Garland. Slopes range from relatively level within the creek bottom to 20 percent slopes in the adjacent uplands. This rapid change in elevation provides for a variety of pleasing views from many areas in and around the Preserve.

Dallas and Collin Counties are situated in the western part of the Gulf Coastal Plain, in the Blackland Prairie Physiographic Province, a province characterized by little relief and dark, thick, plastic, clay soils.

During the Cretaceous time period, the area was covered by a shallow sea. Sand, silt, and clay sediments deposited at that time overlie the Paleozoic rocks and form a wedge, thickening to the east, that dips east and southeast toward the East Texas Embayment. The main sources of water in the region for many years were the Woodbine, Paluxy and Trinity Sands aquifers which were deposited during the Cretaceous period.

Three geologic outcropping formations are present through Dallas County and include the:

- Eagle Ford Shale,
- Austin Chalk, and
- the Ozan (lower Taylor Marl)

The Austin Chalk Formation is the surface bedrock of the Spring Creek basin. This resistant formation provides much of the topographic relief throughout the area. Interesting geologic formations of the Austin Chalk may be viewed in Spring Creek around Holford Road.

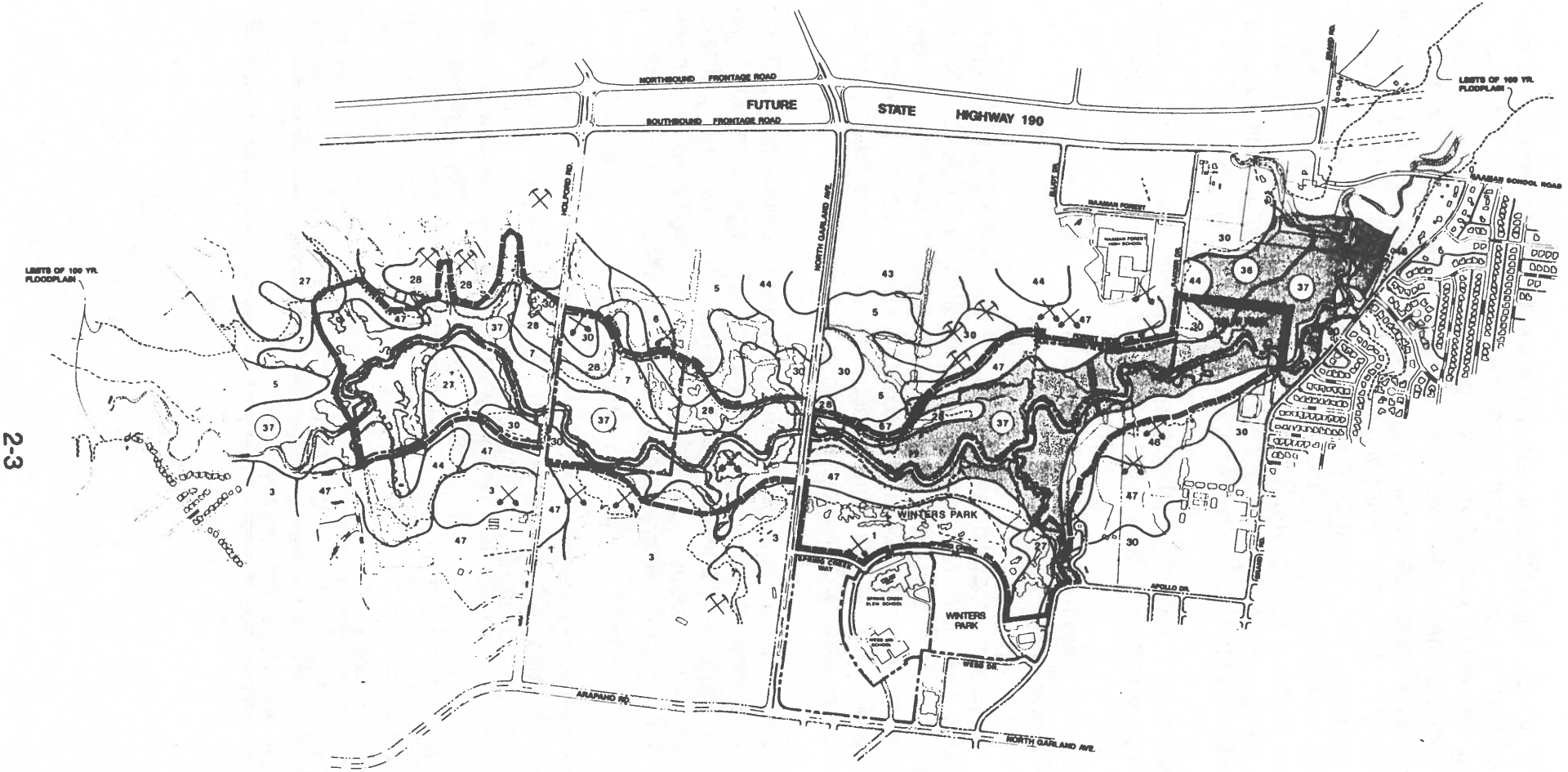
Severely eroded gullies in the Austin Chalk occur at two locations on the east side of Spring Creek north of North Garland Road and north of Holford Road, and are believed to be the result of stripping the topsoil from the area. The Chambers Brothers Construction Company operates a sand and limestone quarry on the west side of Spring Creek, between North Garland Road and Holford Road. The geologic profile of the area can be studied and viewed from the walls of the quarry pits.

Soils

Residual soils weathered from the Austin Chalk produce the dark plastic clay soils that are characteristic of the Spring Creek watershed, and typical of the Blackland Prairie Physiographic Province. These soils have been classified and mapped in detailed soil surveys for Dallas and Collin Counties prepared by the U.S. Department of Agriculture Soil Conservation Service in cooperation with the Texas Agricultural Experiment Station. Figure 2.1 illustrates the soil composition in the vicinity of the forest.

Soils within a watershed are often grouped into three broad locational categories of bottomland, transitional and upland soils. Bottomland soils are found within the normal floodplain of a stream, and are subject to flooding. Bottomland soils of the Spring Creek watershed are comprised mainly of the Frio soil series. This soil is a relatively deep sedimentary soil, laid down by repeated flood events over long periods. The Frio soil series is made up of friable, loamy, soils with slopes of less than one percent. Almost all of the mature old-growth forest along Spring Creek occurs on the Frio soil. The transitional soils are predominantly Lewisville silty clay and Austin/Lewisville complex. The transitional soils can be found between the bottomland and the upland soils on stream terraces. These soils often have greater slopes than the upland soils, and tend to be eroded and gullied. The Houston Black soil series occurs on uplands throughout the watershed and on old alluvial terraces along major streams.

In 1959, the U.S. Geological Survey published the Garland, Texas 7.5 minute Quadrangle Map which shows an abundance of gravel pits and quarries on both the north and south sides of Spring Creek around Holford Road. According to Mr. Tom Chambers, of Chambers Brothers Construction Company, the area on the north and east sides of the creek were gravel mined by his father in the late 1940's and early 1950's.



NORTH 200 400 800 1200 2000

Soil Classification information derived from Soil Survey of Dallas County, by U.S. Department of Agriculture Soil Conservation Service Issued Feb. 1980.

FIGURE 2.1

SOILS - INFLUENCES

AREA SOIL CLASSIFICATIONS

3 & 4 / 75	3 & 4 ● ARENTS - MINED AREAS 75 ● URBAN LAND - 75%+ COVERED BY DEVELOPMENT
5, 6, 7	5,6,7 AUSTIN/AUSTIN LEWISVILLE COMPLEX
27, 28, 30	27,28 ● EDDY CLAY LOAM, ● EDDY BRACKETT COMPLEX EDDY STEPHEN COMPLEX
36 & 37	FRIO SILTY CLAY 36 ● OCCASIONALLY FLOODED 37 ● FREQUENTLY FLOODED ★
46, 47, 48	46,47,48 LEWISVILLE SILTY CLAY
67	67 STEPHEN SILTY CLAY
44	44 HOUSTON BLACK CLAY
	SPRING CREEK FOREST PRESERVE BOUNDARIES
1	1 ALTOGA SILTY CLAY

★ PREDOMINANT SOIL TYPE IN PRESERVE

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

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CITY OF GARLAND, TEXAS

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Quarrying was accomplished using a dragline, and the material was not processed at all. Thus, there was no washing process involved in the work that occurred in the Preserve area. Gravel was also stripped in several areas along the east side of the creek and in an area just south of Garland Road on the west side of Spring Creek. This explains why there are eroded areas within and upslope of the Preserve. Limestone quarrying was undertaken in the extreme northeastern corner of the Preserve on the east side of Spring Creek, south of Holford Road. The mined area was subsequently filled with rubble and has recently been filled with excess concrete, rock, and dirt. Mr. Chambers indicated that there was a haul road cut across Spring Creek to connect the present quarry to the small mined area. The road is barely visible today except for a narrow path in the floodplain, and an old car body which is located along the roadway close to the creek.

Soil samples were collected in the vicinity of the vegetation transects by Dr. Elray Nixon. The 18 vegetation sampling transects were located on two soil types, which include the:

- Frio silty clay frequently flooded phase, and
- Austin-Lewisville complex.

The creekside and creek bottom vegetation stands were on the Frio silty clay. This is a deep, well-drained, nearly level soil which occurs on floodplains (U.S.D.A., 1980). It is a calcareous, moderately alkaline soil with a dark grayish color. The Austin-Lewisville complex was formed over chalky limestone, and is located on slopes up from floodplains. The slopes are usually five to eight percent and eroded. These soils are calcareous and moderately alkaline, and are usually dark grayish in color.

The soil analyses indicate that the surface soils of the study area were calcareous clays, and their general characteristics are shown in Table 1. Soil pH ranged from 7.6 to 7.7, and showed no significant difference between stands. Creekside sites had significantly less phosphorus (P = .014), and although potassium ranged from 360 ppm at creekside to 473 ppm in creek bottom sites, differences were not significant. There were no significant differences between sites in regard to sand, silt and clay content.

TABLE 1. Mean Values of the Chemical and Physical Properties of the Soil at the Spring Creek Forest Preserve.

Communities	pH	Ca	P	K	Mg	Sand	Silt	Clay	Texture
Slope [a]	7.6	>6000	30	400	>400	16	32	52	Clay
Creek bottom	7.7	>6000	31	473	>400	17	34	49	Clay
Creekside	7.7	>6000	18	360	>400	29	25	46	Clay

[a] Only one soil sample was collected from the slope site.

Climate

The climate of any specific region is considered as the average state of the earth's atmosphere over a long period of time, usually several decades. Short-term or day-to-day variation in the atmospheric condition is referred to as weather. Garland lies at the northern edge of a humid, subtropical climatic zone. The climate is generally mild, with moderate winters and hot summers. Mean annual temperature is 65.5° F, with an average temperature of 85° F in July and 46° F in January. The area has an average of 94 days with temperatures above 90° F, and 37 days with temperatures below 32° F. Mean annual rainfall is 34.5 inches, with the heaviest precipitation usually occurring in April, May, and June. Mean annual snowfall is 2.1 inches. Average relative humidity is 64 percent. Prevailing surface winds are southerly, with an average wind velocity of 10.9 miles per hour. (U.S. Department of Agriculture, 1980)

Natural variations in landform and topography alter the climatic environment characteristic of localized area, often dampening the effects of regional climatic extremes. When areas in close proximity to each other experience measurable climatic differences, the localized conditions constitute microclimates. North Central Texas creeks and their major tributaries create natural microclimates that differ somewhat from the region's overall climate. These areas typically experience lower temperatures, wind speeds, and solar-radiation intensities, and a higher relative humidity.

The primary factors that affect creek microclimates are trees, stream side slopes, and water. The orientation of a channel side slope, that is, the direction in which the slope faces has a significant effect on the microclimate. South-facing slopes which receive more sunlight experience faster evaporation rates. This results in a noticeably hotter and drier microclimate than a north facing slope which is cooler and maintains a higher relative humidity. (U.S. Army Corps of Engineers, 1978) These distinct microclimates on the north and south channel slopes may support different types of flora and fauna. The variations in the Spring Creek microclimate foster a great diversity of plant species, making the floodplain areas of special ecological value and interest.

Wildlife

The presence of wildlife is dependent on the quality and quantity of suitable habitat. Of the ten wildlife habitat categories for the Rowlett Basin, as defined by the U.S. Army Corps of Engineers, the grassland, forest land, wetlands and water bodies, fence rows, and edges contain the greatest number of animal species. (U.S. Army Corps of Engineers, 1978) Wildlife of the Garland area is presented in Appendix C. The preservation of diverse habitats adjacent to one another is the major goal in wildlife management. (Schemnitz, 1980) The Spring Creek Forest Preserve corridor provides a diverse ecosystem, consisting of water, forest, wetland and grassland, all within close proximity to one another.

The major wildlife habitat in the Preserve is forest land, with smaller areas of grassland, wetlands, and water bodies. The grassland contains a high diversity of amphibians, reptiles, birds, and mammals. The Forest Preserve is flanked by grasslands which adds a value to the wildlife diversity of the Spring Creek corridor.

The forest rivals the grassland in wildlife diversity. Amphibians are more common in the forest than on the prairie, primarily because the trees are never far from water. Nine amphibian species have been observed in this habitat.

The largest number of reptiles from any of the land-cover categories can be found in the Forest. It contains at least 31 species of reptiles, including:

- one turtle,
- nine lizards, and
- 21 snakes.

Seven of the snake species are poisonous, but the copperhead and cottonmouth are probably the most common in the region. Numerous ecological niches and the existence of rocky crevices within the floodplain terraces foster the abundance of reptiles.

Bird diversity within the forest is also very high, numbering approximately 60 species. All but nine species are considered perching birds, which is to be expected where resting areas are composed of trees rather than the bare ground of the prairie. Nearly 30 percent of this high diversity are comprised of vireos and warblers, most of which migrate through the trees in search of insects. The only game birds preferring the forests are the wood duck and the woodcock, both relatively uncommon in this area. Finches and sparrows are also seen infrequently. It is likely that the majority of the listed 60 species of birds can be observed here during migration.

A relatively large number of mammals inhabit the forest. Larger mammals are more common here than in any other part of the watershed, and include:

- opossum,
- raccoon,
- two species of skunk,
- red and gray fox,
- coyote,
- fox squirrel, and
- armadillo.

There have been no rare or endangered animals listed for this habitat.

Wetlands are marshes, shorelines, swamps, and permanently damp areas where distinctive hydrophytic vegetation may occur. Typical wetlands, such as extensive marshes, low flat floodplains, or swamps, are extremely important habitats, both for wildlife and for reducing nutrients in water bodies. There are several low damp

depressions in the forest bottom that function as wetlands, as well as several man-made depressions and ponds along the perimeter of the forest.

As might be expected, amphibian diversity is high, with at least 16 species suspected to occur in local wetlands. The list includes:

- four species of salamanders,
- five small frogs,
- three toads,
- two frogs, and
- two species of narrow-mouthed toads.

Reptiles are relatively diverse, with 22 species. It is significant that all but one species (a moisture-loving skink) are snakes. Most of the lizard species prefer dryer habitats. Seven species of the snakes are poisonous, the largest number for any of the land-cover categories.

Spring Creek, with its ripples and deep pools, is an excellent stream habitat. Spring Creek was seined by the Texas Department of Water Resources in 1985, and produced a number of common fish species, such as the:

- bullhead minnow,
- black stripe topminnow,
- red mosquitofish,
- carp, and
- largemouth bass.

However, one fish collected, the dollar sunfish, was not expected since its distribution is regionally limited to East Texas, although it occurs widely in the Mississippi River drainages.

Hydrologic Influences

In undisturbed watersheds, a natural balance is developed between rainfall, runoff, and the transport of sediments and other materials naturally occurring in the watershed. This balance allows the ecosystem to achieve stability over a long period of time. Natural events, such as fire and floods, do tend to alter this stability, but the watershed responds by regrowth and channel adjustment to achieve a new stable state (ASCE, 1989).

Urbanization, the concentration of man's activities in small areas, alters stream and watershed stability. Hydrologic characteristics, such as the magnitude and frequency of flooding, are changed by watershed development. (ASCE, 1989) Urbanization may also introduce pollutants, such as oil and grease, toxic metals and phenols. (EPA, 1990) These changes can impact the existence and preservation of a floodplain forest. If the

forest is highly prized, as is the Spring Creek Forest, the urbanization changes must be mitigated as much as is practical.

Surface runoff which enters the forest from its sides has an important relationship with the soils and vegetation. Even during periods of high intensity rainfall, runoff flowing towards the forest is slowed down enough by vegetation for much of it to be absorbed by the soil. Water flowing down channels fans out on the forest floor and disappears into the ground. This process is occurring all along the edges of the forest. It is responsible for replenishing large quantities of soil moisture and for replenishing the groundwater that forms the springs along Spring Creek. This pattern of drainage (its channels, volume and velocity) is a critical component necessary to the continued survival of the forest.

Stream Hydrology

Both the upstream drainage basin and the areas adjoining the Spring Creek Forest have been affected by urbanization. The hydrologic impacts of the upstream changes were documented in Rowlett and Spring Creek Flood Plain Management Study.(Halff, 1988) The increases in peak discharge are summarized in Table 2. The study analyzed the 100 year floodplain based on a fully developed watershed so that future development is planned in conjunction with the projected fully-developed 100-year flood elevations. The floodplain width varies from about 1,400 feet around Halff Park at the southern end of the study area, to 700 feet wide south of North Garland Road, to 2,300 feet upstream of Holford Road. The average floodplain width is between 800 to 1,000 feet wide. The fully-developed 100-year flood discharge is 32,300 cubic feet per second on Spring Creek at Brand Road. This discharge produces flood elevations of about 498 feet at Halff Park, 508 at North Garland Road, and 522 at Holford Road. There would be about 12 feet of water flowing through the forest during a 100-year flood as measured at the creek bank.

TABLE 2. Spring Creek 100-Year Flood Discharge Comparison

Location	Drainage Area (mi^2)	Discharges		
		1979 FIS (cfs)	1986 FIS (cfs)	Future* (cfs)
Spring Creek below Jupiter Road	27.40	27,300	31,600	33,400
Spring Creek at Brand Road	33.75	25,500	31,000	32,300

* Future discharges are based on fully-developed land-use conditions.

Erosion

Urbanization impacts are usually manifested by increased channel erosion as the stream attempts to reach a new state of stability. Erosion was also evaluated in the Rowlett and Spring Creek Flood Plain Management Study. (Halff, 1988) In general, the study found that as the basin continues to urbanization, erosive flood flows will occur more frequently. Two reaches of Spring Creek having the highest velocities and boundary shear stress values were identified within the Spring Creek Forest Preserve limits as shown in Figure 2.2. A channel dam located about one mile downstream of Holford Road was tested in the hydraulic model to determine changes in hydraulic characteristics. It was found that the velocities and shear stresses were reduced about 40 percent and 70 percent, respectively, and these effects were extended farther upstream of the dam. Also, channel slope protection was considered which consists of 3 feet of concrete rubble or stone rip-rap. However, these erosion control measures were not recommended in the floodplain management study, due to the perceived adverse impacts on the Spring Creek Forest Preserve. The stream channel will continue to enlarge in response to increasing flood flows from upstream development within the basin, and should stabilize with minimal additional degradation. It is recommended that the City of Garland monitor Spring Creek for problem erosion areas. Severe erosion, if it occurs, can be corrected with structures and/or channel bank armor constructed from native rock.

Valley Storage

Preservation of the Forest Preserve will have a positive benefit as far as flooding along Spring Creek is concerned. Where floodplain forests are left intact, the flood peaks are not as high nor do they rise and fall as rapidly. Under natural conditions, upland runoff is released gradually to low lying areas. In the spring, when the soil is saturated and water loss through evapotranspiration is low, wetland areas release water to streams or rivers more quickly; when soils are drier and evapotranspiration is high, water is released slower. The rate of upland runoff is "dampened" by the storage capacity of land adjacent to a stream or river. Floodplains with preserved forests provide greater valley storage. Highly organic soils in these areas act as sponges, increasing water storage capacity and minimizing potential for flood peak damage. (U.S. Department of the Interior, 1987)

Local Hydrology

Some 25 small subwatersheds, ranging in size from nine acres to 729 acres, contribute stormwater runoff to Spring Creek through the Forest Preserve, as shown on Figure 2.2 and in Table 3. All but two of the watersheds have experienced or soon will experience some degree of urbanization as indicated by the future land uses shown on Figure 2.3. Some areas, such as the drainage ditch from Naaman Forest High School, are experiencing erosion. This area and other similarly damaged areas should be restored, and a more natural drainage system created. A wide grassy swale with some meanders to help reduce erosion potential can be constructed to help control erosion.

FIGURE 2.2

HYDROLOGIC INFLUENCES

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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A summary of drainage area information is shown in Table 3. This shows that 72 percent of these watersheds could experience peak discharge increases of more than ten percent. According to requirements of the State Highway 190 design guidelines, such an increase would be prohibited and must be mitigated. A copy of the pertinent sections of the State Highway 190 design guidelines that pertain to the Preserve are contained in Appendix D.

TABLE 3. Drainage Data For Local Areas

Drainage Area # (See Figure 2.2)	Gross Area (acre)	Park Area (acre)	Net Area (acre)	Percent of Net Area Currently Undeveloped (acre)	Type of Flow into Forest Preserve		Estimated Discharge Increase Greater Than Ten Percent
					Concentrated	Sheet	
1	50.0	13.8	36.2	68	√	√	Yes
2	50.7	14.4	36.3	0	NA	NA	No
3	74.4	0.0	74.4	39	√		Yes
4	84.1	18.3	65.8	100	√	√	Yes
5	14.7	11.7	3.0	100		√	Yes
6	47.3	8.5	38.8	100	√	√	Yes
7 (213)	685.0	73.0	612.0	41	√	√	Yes
8	30.4	18.7	11.7	100		√	Yes
9	34.8	34.8	0.0	0	NA	NA	No
10	20.3	12.7	7.6	0	(storm sewer)		No
11	26.9	0.0	26.9	0	(storm sewer)		No
12	33.5	2.5	31.0	100	√		Yes
13	8.9	8.9	0.0	0	NA	NA	No
14	18.0	13.6	4.4	100		√	Yes
15 (214)	729.0	10.3	718.7	16	√		No
16	19.9	5.7	14.2	100	√		Yes
17	53.2	33.0	20.2	100	√	√	Yes
18	77.9	5.2	72.7	80	√		Yes
19	19.9	15.9	4.0	100		√	Yes
20	103.0	18.1	84.9	100	√		Yes
21	21.3	3.4	17.9	100	√	√	Yes
22	56.7	25.4	31.3	100	√	√	Yes
23	156.0	12.0	144.0	100	√	√	Yes
24 (215)	276.0	11.0	265.0	70	√		Yes
25	11.4	11.4	0.0	0	NA	NA	No

Several methods of mitigating peak stormwater discharges are known, and would include detention basins, infiltration basins, porous pavements, and use of more natural drainage conveyances, such as grassy channels and swales versus concrete curb and gutter with underground drainage. The problems and proposed solutions should be evaluated for standard design flood frequencies and more frequent events such as the two-year return period flood.

Infiltration basins are a method of reducing the quantity of runoff by directing the stormwater into the soil, preferably to the same extent as nature did prior to development. By allowing stormwater to infiltrate back into the soil, it will not only reduce the quantity of runoff and recharge to water table, but the filtering properties of the soil can improve the water quality. (AISI, 1980)

The amount of runoff that cannot be infiltrated at the point of rainfall should be detained on site locations for a controlled outlet to the receiving streams, with peak discharges approaching the pre-development peak discharges. This can be accomplished with the construction of detention basins which should limit peak discharge increases to ten percent or less. Flood flows in one subarea, Number 23, are already partially controlled by a detention basin constructed within Shiloh Business Park. These basins can be combined with landscaped features to create attractive park-like areas adjacent to the Spring Creek Forest Preserve.

Roadway drainage systems in areas adjacent to the Preserve could also be designed in a manner so as to minimize the impact of urbanization. Streets could be designed without curb and gutter in a fashion more closely related to natural drainage systems. Drainage could be accomplished by roadside grassy swales which would temporarily store some flood water, in addition to conveying runoff to appropriate outfall locations. Additional right-of-way may be required to accommodate the roadside swales. Careful and detailed drainage design will be required to accomplish the goal of protecting the Spring Creek Forest Preserve.

"Low runoff" porous pavement should be taken into consideration in developed areas. Precast concrete paving blocks with perforations, precast interlocking blocks, with or without perforation, and other porous materials such as clear cut stone, clay brick chips and cinders, have successfully replaced impervious surfaces for use in parking areas, driveways, medians and boulevards. For sites with a high ratio of impervious areas, such as industrial sites, shopping centers and apartment sites, this form of paving could be most beneficial. (AISI, 1980)

Another type of porous asphalt has been developed where no fine materials are used in the mix, but slightly more asphalt is used as a binder. The omission of the fine particles does not seem to reduce the overall strength of the asphalt pavement significantly. Absence of the fine particles leaves channels for water to pass through. The base material should be composed of graded crushed stone to permit storage for the water until it percolates into the soil. The permeability of the underlying soil determines the depth of the stone base. (AISI, 1980)

Although the experience with this type of paving in frost areas is still limited, it has been indicated that ice and snow conditions, and snow removal are the same as for any other paving. No problems have been encountered with regard to heaving if the underlying soil is free-draining, but swelling-type clay soils could present difficulties. (AISI, 1980)

Methods to reduce runoff as described above, should be directed toward the natural waterways into the Preserve. Stormwater should not be concentrated and outfalls should be many and small as opposed to few and large. This should be taken into consideration during the design phase of Forest View Drive and adjacent land development. A combined effort should be made by the City of Garland and the various adjacent developers to allow the water to follow the natural drainage patterns into the Preserve. Every effort should be made to coordinate proposed drainage facilities, such as storm sewers with natural waterways, in such a way that will be aesthetically pleasing, functional, and of low impact on the Preserve.

The urbanization of local areas also results in increased pollutants from non-point sources. As previously discussed, these pollutants include elevated suspended solids, high chemical oxygen demand (COD), high fecal coliform counts, oil, grease, metals, pesticides and phenols to mention a few. Possible control and management techniques for these pollutants include detention, infiltration basins and grassy swales, some of the same techniques used to control stormwater flooding. Other water quality enhancement techniques include wetlands, oil and grease traps/separators, street sweeping, and detection and removal of illicit or non-stormwater discharges to the storm drainage system. These techniques can be applied to drainage systems constructed for the undeveloped areas adjacent to the Preserve. However, because these areas are small compared to the existing urbanized area within the basin, adoption of special measures for water quality enhancement in these areas will result in only minor improvements to water quality. Appropriate city-wide stormwater management techniques, soon to be outlined in the City of Garland NPDES Stormwater Permit Application, should be applied to these areas. A monitoring and sampling program for flows into the Preserve could be implemented, and harmful water quality problems, if detected, should be mitigated.

Human Influences

In addition to the natural and hydrologic influences on the preserve, Spring Creek Forest Preserve may also be significantly impacted by man-made conditions. Land ownership and the eventual use of those lands which bound the Preserve, as well as adjacent thoroughfares and utilities crossing through and near the Preserve, have impacted the vegetation of the Forest Preserve.

Land Ownership

Land ownership in the vicinity of the Preserve is critical, since areas owned or controlled by the City of Garland may be more responsive to the needs of the Preserve. Areas controlled by private interests will be less likely to respond primarily to the Preserve, but instead will be more interested in intensifying development and ensuring a good investment return.

Major portions of the lands around the Forest Preserve are administered by the City of Garland. West of Spring Creek, City parks front the length of Spring Creek from Mapleridge in the north to Brand Road in the south, except for the Chambers Brothers Construction Company area, located between Holford Road and North Garland Avenue, which is held in private ownership. To the southeast, Naaman Forest High School and Halff Park are the only publicly-controlled tracts which abut the Preserve. The area north of Naaman Forest High School is held by private landowners.

The existing lands controlled by the City of Garland that make up the Spring Creek Forest Preserve and Spring Creek Greenbelt as it is presently constituted include:

- The Spring Creek Park Preserve tract of 35 acres immediately to the northwest of Holford Road, lying on the creek's north-westerly bank. This tract was purchased by Dallas County Open Space funds, and is presently in County title but will be administered by the City.

- A Spring Creek Forest Preserve tract of 37 acres located south of Holford Road, lying almost entirely on the creek's east bank. This tract was purchased by Dallas County Open Space funds, and is administered by the City.

- A Spring Creek Forest Preserve tract of 44 acres, located between North Garland Road and Halff Park, lying exclusively on the creek's east bank. A portion of this tract was purchased by Dallas County Open Space funds, and the other portion was dedicated by the Garland Independent School District.

- Halff Park, a 12-acre tract in City title that was donated by the Mayer Halff family. This tract lies on the east bank of Spring Creek adjacent to the Forest Preserve and Naaman Forest High School.

- Winters Park is a major City park that contains extensive active recreational facilities, as well as providing sites for elementary and junior high schools. The park is located south of North Garland Road on the creek's western bank.

- Halff Greenbelt, a 25-acre tract in City title that was donated by the Mayer Halff family. This tract lies on the west bank of Spring Creek between Winters Park and Brand Road.

The total of City-controlled lands in and adjacent to the Preserve totals approximately 222 acres, of which 81 acres are designated as Forest Preserve property.

There are additional lands which could enlarge the Preserve, and could be acquired by the City of Garland through fee title purchase, acceptance of deed donation, and other suitable means.

City ownership of the Spring Creek Forest Preserve and adjacent areas is shown on the land use map Figure 2.3.

Adjacent Land Uses

The Preserve is located in a portion of northeast Garland that is currently in a state of transition. This transition from agricultural farmland to urban development is occurring because of the urban growth of the City of Garland and of the Dallas metroplex. It has been accelerated in this area however, by the alignment and construction of State Highway 190, which passes less than three quarters of a mile to the east of the Preserve.

The proximity of the Preserve to State Highway 190 may create significant land-use conflicts. Traditionally, tracts of land adjacent to major highways command higher prices per square foot because of the perceived ease of access and increased visibility of the parcel. These higher land costs usually push land developers to intensify the land use to recuperate their investment in the land. Higher intensity land uses may impact the Preserve and require significant mitigation efforts.

Existing land uses in the vicinity of the Preserve are based on visual observation and aerial photographs. Future anticipated land uses were taken from a 1987 study entitled *Garland Comprehensive Plan, North Area*, which looked specifically at the north sector of the City and an update of the land-use plan for that area which was revised by City staff in 1991. (City of Garland, 1991) These land-use predictions were based on both the existing zoning at the time of the comprehensive plan update and the assignment of compatible eventual land uses to tracts not carrying a highest and best use zoning category. Comprehensive plan land-use predictions are not absolutes, but do allow land uses to be steered in a desired direction based on an analysis of surrounding factors which may influence the patterns of development in that area.

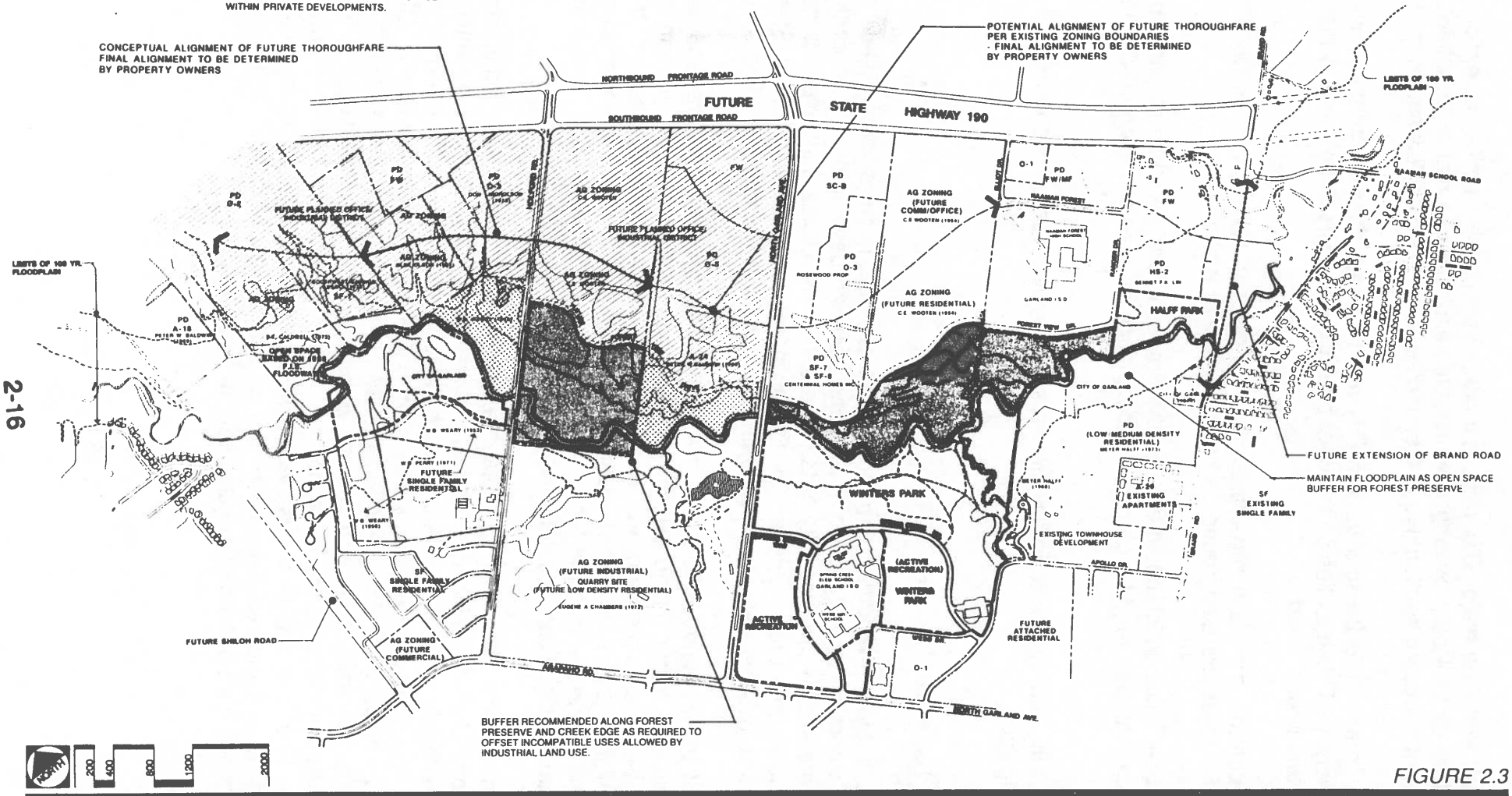

FIGURE 2.3

LAND USE & ZONING INFLUENCES

Land Use and Zoning information shown is based on Garland Comprehensive Plan, North Area by the City of Garland (1987).

- EXISTING SPRING CREEK FOREST PRESERVE.
- POTENTIAL FUTURE ADDITIONS TO FOREST PRESERVE.
- CITY OF GARLAND PARKS
- EXISTING 100 YEAR FLOODPLAIN / OPEN SPACE
- SF — RESIDENTIAL LOW AND MEDIUM DENSITY.
- A-24 — RESIDENTIAL HIGH DENSITY.
- O-1, O-2, O-3, HS-2/FW — OFFICE / COMMERCIAL / HEALTH SERVICES
- SC-B — COMMERCIAL
- FUTURE PLANNED OFFICE /INDUSTRIAL DISTRICT
- COMMUNITY FACILITIES
- PD — PLANNED DEVELOPMENT

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT H. HALFF ASSOCIATES, INC.
ENGINEERS SCIENTISTS PLANNERS SURVEYORS

Existing land uses: The majority of the existing land uses east of the Preserve are in a state of transition to more intense uses, given their proximity to future State Highway 190. Much of this area is currently cleared, and is being used as cropland or pasture. Portions of the uplands found in this area have had the topsoil layer stripped, and have been mined for gravel and limestone. An exception is the tract just north of Holford Road and east of Spring Creek which is heavily wooded with old-growth forest, and which has been targeted as a future addition to the Preserve. The only existing development east of the Preserve is Naaman Forest High School; a baseball diamond and a practice field are located due east of the future right-of-way of Forest View Drive and the Preserve boundary.

West of the Preserve and Spring Creek, the existing land uses are more stable, with one major exception being the Chambers Brothers mining operation between Holford Road and North Garland Avenue. The remaining land uses range from open pasture land at both ends of the preserve to existing single family developments east of Brand Road and west of the future extension of Shiloh Road. A significant portion of the land west of the Preserve is owned by the City of Garland as part of the Winters Park recreational complex. The Winters Park Amphitheater, a natural grassy bowl, has been developed in the west side of Spring Creek. The City has recently acquired the area contained within the 100 year floodplain west of Spring Creek between Brand Road and Winters Park, and north of Holford Road and east of the future extension of Mapleridge Drive. These areas will significantly increase the open space buffer on the western edge of the Preserve.

Future land uses: It is relatively easy to visualize the character of the Preserve when it is surrounded by undeveloped pasture land, as is now the case. However, the impact on the Preserve when adjacent tracts are developed will be enormous, and has the potential to significantly alter the character and uniqueness of the Preserve. The future land uses adjacent to the Preserve, as taken from existing zoning and the Garland Comprehensive Plan for the north sector of the City, are shown in Figure 2-3.

The final land uses east of the Preserve will have the greatest impact. Given the proximity of State Highway 190, the intensity of development in this area will probably be high to offset higher land costs. A variety of office, commercial and freeway related land uses are anticipated. A planned office industrial district is anticipated northeast of North Garland Avenue. Southeast of North Garland Avenue, commercial and office uses are forecast between State Highway 190 and Naaman Forest Boulevard, with a single family residential district being anticipated between Naaman Forest Boulevard and Forest View Drive. However, this area may also ultimately be developed as office or commercial sites, due to its proximity to State Highway 190 and the other industrial office and commercial uses planned around it.

It should be noted that the existing zoning on several of the tracts north and east of the Preserve retain the potential for high-rise office development which may be hydrologically and aesthetically incompatible with the Preserve and the surrounding residential areas. Given that these zoning categories were established during the "land development boom"

period of the mid-1980's, actual development on these tracts will probably be lower in density, and high rise development close to the Preserve should be discouraged.

West of the Spring Creek Forest Preserve, single family residential development is planned for the area north of Holford Road. The surface quarry located between Holford Road and North Garland Avenue is expected to continue to operate for a number of years; however, the North Garland Area Plan specifically recommends that industrial uses do not continue on this tract once quarry operations cease. A diverse public/private development could evolve from this tract. It is also recommended that a significant buffer adjacent to Spring Creek be maintained, consisting of, at a minimum, those areas within the 100-year floodplain. The tract located between Brand Road and the eastern boundary of Winter's Park is currently zoned for low to medium density residential development. The North Garland Area Plan recommends that a mixture of single family densities be developed on this tract.

Summary: As noted previously, the most significant land-use impact may occur on the east edge of the Preserve due to its proximity to State Highway 190. It is anticipated that the highway will produce high-impact land uses which are incompatible with the Preserve. In addition, these higher uses could create an urban environment of parking lots, extensive signage, few mature trees and large building masses which can detract from the quality of the Preserve environment.

Extensive landscape buffering, the use of design standards (some of which are already in place in the State Highway 190 Design Guidelines), and sensitive design on the part of each parcel developer should be used to offset potential land-use impacts. Additional buffer zones can be obtained by realigning portions of the planned extension of Forest View Drive, as recommended in the master plan presented in this study. Other buffer zones above and beyond those required by City landscaping standards should be implemented by adjacent developers. Most critical, however, will be an active participation on the part of the City to ensure that sensitive design is used by all adjacent developers to mitigate as much as possible the adverse effects of increased urbanization in the vicinity of the Preserve.

Thoroughfares

Major thoroughfares in Garland span the Rowlett Creek and Spring Creek channels at over 12 locations, as they connect the neighborhoods and commercial districts of the City. The existing thoroughfare system in Garland involves nine different street design classifications, from a simple two-lane undivided roadway to an eight-lane freeway system with frontage roads and controlled access. Important east-west arteries in the study area are Big Spring, Arapaho, Apollo and Belt Line Roads, and the north-south arteries include Jupiter, Shiloh, North Garland, Brand and Pleasant Valley Roads. State Highway 78 (Lavon Highway) bisects the drainage basin in a southwest to northeast direction. Constructed by the State Department of Highways and Public Transportation, this highway is currently a four-lane divided roadway within the limits of the study area.

Proposed State Highway 190 spans the study area from southeast to northwest, generally parallel to and north of Naaman School Road. Figure 2.4 illustrates the existing and proposed thoroughfares in the vicinity of the Preserve. As presently outlined, the proposed freeway will connect the Northeast Parkway extension with U.S. 75, the Dallas North Tollway and Interstate Highway 35 (Stemmons Freeway) in Carrollton. This will provide a high-speed loop across the northern suburbs of Dallas and through southern Collin County.

The network of roads that surround and bisect the Spring Creek Forest Preserve influences the Preserve in both positive and negative ways. These roads create a window of green into the preserve from adjacent urbanized areas. However, they can also allow views to developed tracts from the interior of the Forest Preserve, which may reduce the pristine quality of the forest experience.

Existing Thoroughfares: The Forest Preserve is bisected by Holford Road and North Garland Avenue which effectively divide the Preserve and adjacent parklands into three pieces. Holford Road currently consists of two lanes with an asphalt surface. The thoroughfare plan calls for it to be widened to four lanes in the future, contained within an 82-foot right-of-way.

North Garland Avenue has been widened to its final width, and consists of a six-lane, median-divided thoroughfare.

Holford Road, where it currently crosses the Preserve, offers an example of the ideal relationship of thoroughfare to Forest Preserve. The forest canopy overhangs the right-of-way, creating a feeling that the road actually is passing through a forest. Unfortunately, this character has been lost where North Garland Avenue crosses the Preserve, due to excessive clearing for the new bridge and utility crossings. Every effort should be made to maintain the existing character along Holford Road when it is widened.

New Thoroughfares: East of the Preserve, two thoroughfares are currently planned. The first is an extension of Forest View Drive which will serve as the east boundary of the Preserve. The second is an extension of Naaman Forest Drive, which will parallel State Highway 190 north and south from its current location adjacent to Naaman Forest High School. West of the preserve, the only new thoroughfare currently planned is an extension of Mapleridge Drive southeast to Holford Road and to North Garland Road.

Forest View Drive: Currently planned as a two-lane thoroughfare contained in a 50-foot right-of-way, Forest View Drive is intended to serve as a buffer between the Preserve and adjacent development. Because of its close proximity to the Preserve, the character of Forest View Drive will be especially critical to the Preserve. Where possible, existing mature vegetation should be maintained adjacent to, and if possible, within the right-of-way of Forest View Drive; guard rails can be used to protect drivers from trees in close proximity to the driving lanes. In addition, utilities should be placed within other rights-of-way, where possible, to allow the preservation of existing trees in close proximity to

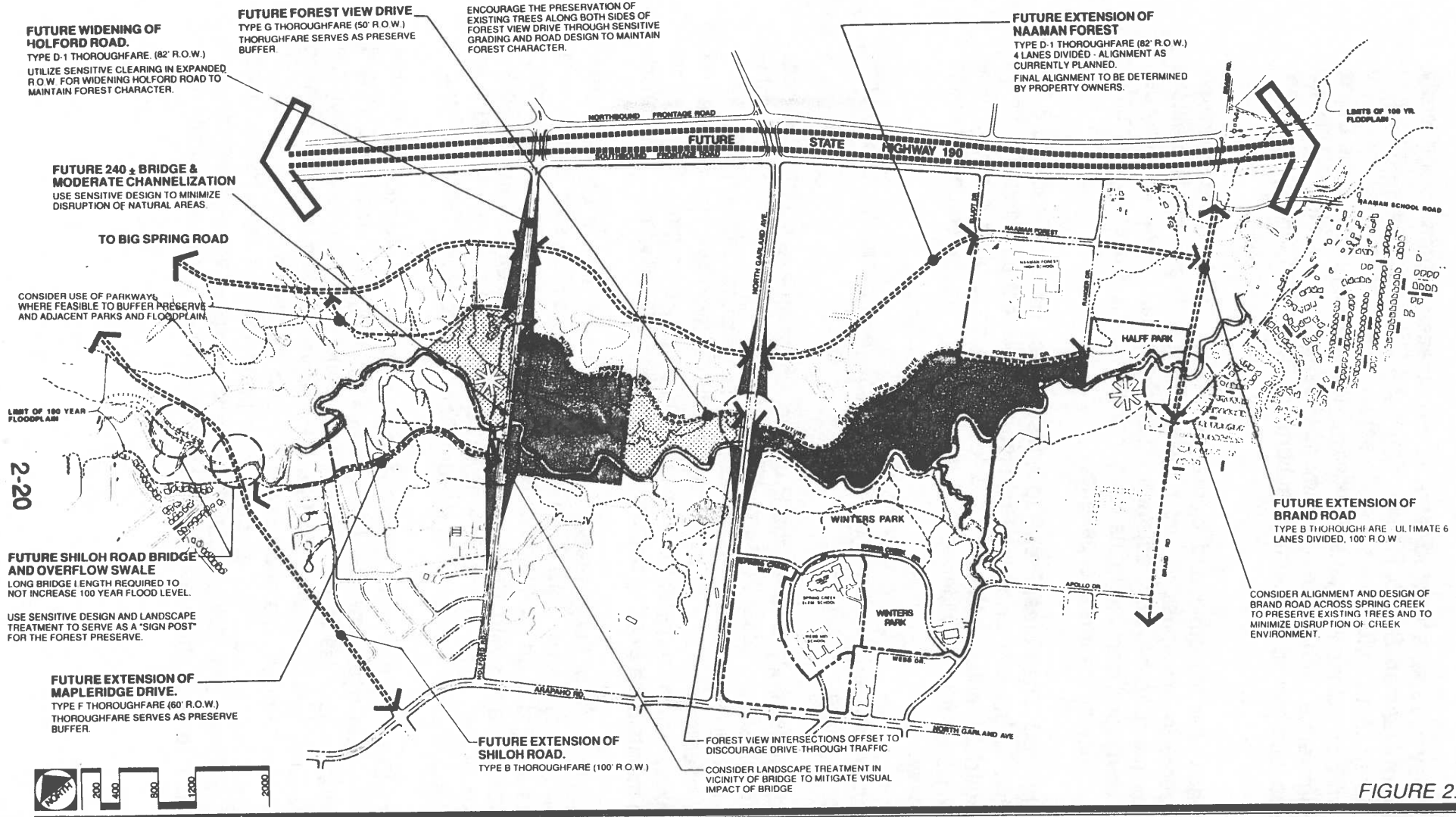

FIGURE 2.4

EXISTING & PROPOSED THOROUGHFARES

Thoroughfare information shown is based on Garland Comprehensive Plan, North Area by the City of Garland (1987).

- EXISTING SPRING CREEK FOREST PRESERVE.
- POTENTIAL FUTURE ADDITIONS TO FOREST PRESERVE.
- CITY OF GARLAND PARKS
- FUTURE THOROUGHFARES AND STREETS
- MAJOR POINTS OF INFLUENCE OF THOROUGHFARES ON SPRING CREEK FOREST PRESERVE.
- ENCOURAGE THE USE OF LANDSCAPE BUFFER ZONES BY PRIVATE DEVELOPMENT ALONG HOLFORD RD., FOREST VIEW DR. AND NORTH GARLAND AVE. TO REESTABLISH FOREST CHARACTER ALONG R.O.W.'S ADJACENT TO FOREST PRESERVE.

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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Forest View Drive. Existing tree stands should also be preserved within private development fronting on Forest View Drive.

The alignment of Forest View Drive in the vicinity of North Garland Avenue should be reviewed, and altered as shown in the Master Plan, if possible, to increase the depth of the buffer zone between the creek and the drive. Also, the extension of Forest View Drive, southeast of Holford Road, should be adjusted away from the creek if possible, to buffer future additions to the Preserve in this area.

From a negative standpoint, Forest View Drive can adversely affect the Forest Preserve in three ways:

- The new road may function as a drainage interceptor and cut the Forest Preserve off from portions of its drainage area.
- Increased noise levels within the Preserve may result if high traffic levels occur on Forest View Drive.
- The new road will allow greater access to the perimeter of the Preserve, increasing the locations where potential vandals can enter the property. This will require security measures such as fencing along Forest View Drive.

For these reasons, an extension of Forest View Drive west of Holford Road is not recommended. Maintaining natural drainage patterns from the Weary Tract and adjacent lands would be a priority objective in managing future Preserve health and restoration in this sector.

Naaman Forest Drive: The extension of Naaman Forest Drive is intended to carry the majority of the local north/south traffic generated in this area. It is currently planned as a four-lane, median-divided thoroughfare. The major impacts of this thoroughfare on the Preserve will be to potentially reduce dispersed inflow of runoff into the Preserve and to raise the ambient noise levels along the edges of the Preserve.

Naaman Forest Drive should be used as a utility corridor as much as possible, to serve development between the Preserve and State Highway 190.

The planned location of the intersection of Naaman Forest Drive with North Garland Avenue should be reviewed and, if acceptable to adjacent property owners, moved closer to State Highway 190 to provide a greater buffer zone between the thoroughfare and the Preserve.

Mapleridge Drive: A two-lane extension of Mapleridge Drive south toward Holford Road is planned to create a buffer along the west edge of the Preserve and its adjacent parklands. The principal negative effect of this extension on the Preserve will be to allow greater access to the edge of the existing park. This may require additional security measures in this area.

An extension of the parallel parkway system should be constructed between Holford Road and North Garland Avenue, across the Chambers property at the time the site is developed. This proposed roadway would provide a definite boundary for the Preserve, and provide a buffer zone to the creek.

State Highway 190: Portions of the main lanes of State Highway 190 will be elevated as they cross Spring Creek, Brand Road, North Garland Avenue, and Holford Road. Traffic noise thrown from the elevated portions of the highway may result in increased noise levels within the Preserve. A significant reforestation effort in conjunction with earthen berms and/or noise barrier walls are all possible methods of reducing noise levels generated by the highway and adjacent development.

Because of the distance between the highway and the Preserve, State Highway 190 should have minimal visual impact on the Preserve.

Existing and Proposed Utilities

Utility corridors in the vicinity of the Preserve can have a significant impact on both the physical health and the visual appeal of the forest environment. In terms of physical health, utility corridors penetrating the forest may require the removal of mature tree stands, and the machinery required to install large utility lines can damage the delicate understory growth and compact the soil, increasing runoff and erosion. From a visual standpoint, large overhead or above ground utility lines are unsightly, and the clearings for utility corridors usually appear man-made and out of context with the forest environment.

Major utilities in the vicinity of the Preserve include water, sanitary sewer, storm sewer, and electrical service provided by the City of Garland, and gas, telephone, and additional electric service provided by independent utility companies. The base utility infrastructure required to service the areas adjacent to the Preserve is in place already. New utilities would include service connections from each area parcel as it is developed to the base infrastructure. In some cases, these connections may have to cross the Preserve.

The impact of each type of utility on the Preserve will be distinct, because each utility requires a distinct method of transmission and distribution. A review of each of the area utilities follows, along with a discussion of the potential impact of each utility on the Preserve, and methods of mitigating that impact. A general view of area utilities is presented in Figure 2.5.

Water Service: Area water service is provided by the City of Garland. Main lines servicing the area include 16-inch lines along Holford Road and North Garland Avenue, and a 30-inch main running along the southwest side of State Highway 190 right-of-way. The existing water lines should provide an adequate base for development of the remaining vacant tracts in the area. Because water lines are usually placed in road

rights-of-way, providing service to area developments should have no impact on the Preserve.

Sanitary Sewer: Sanitary sewer service for the area adjacent to the Preserve consists of a sewer main placed below the creek bed of Spring Creek. The size of this main varies from 21-inches northwest of the Preserve to 42-inches as the line crosses Halff Park southeast of the Preserve. According to City of Garland engineering staff, this main is designed to accommodate the ultimate build-out of the area.

Provisions for sanitary sewer service to the areas south and west of Spring Creek should have no impact on the Forest Preserve. Existing sewer outfalls following drainage swales are already in place between Holford Road and North Garland Avenue, from Spring Creek Elementary School to the creek, from Apollo Drive to the creek, and from the Garland Trails Apartments off Brand Road to the creek. Additional sanitary sewer corridors are available along Holford Road and North Garland Avenue to the main line in Spring Creek.

Sanitary sewer service connections to the areas north and east of the Preserve will have the greatest impact on the Forest. Much depends upon the exact placement of building pads within each parcel of land, and the exact land use selected. Good individual site planning is critical to minimize penetrations through the Forest.

Naaman Forest Boulevard could serve as a potential sewer main corridor for those buildings sited above its elevation. These lines could then run to corridors along the adjacent major thoroughfares. The area between future Naaman Forest Boulevard and Forest View Drive could also be served by a line running along Forest View Drive. However, because the elevation of Forest View Drive is below adjacent thoroughfares, potential corridors at low points through the Forest may be required.

Potential sewer corridor locations are also shown on Figure 2.5. Four potential corridors have been identified. However, these corridors should be utilized only if specific site planning indicates that no other reasonable alternative is available.

Corridor A, northwest of Holford Road, and Corridor B, between Holford Road and North Garland Avenue, may be required because of sags in the elevation of Forest View Drive. Between North Garland Avenue and Naaman Forest High School, Corridor C and D (existing service to high school) could be utilized if required.

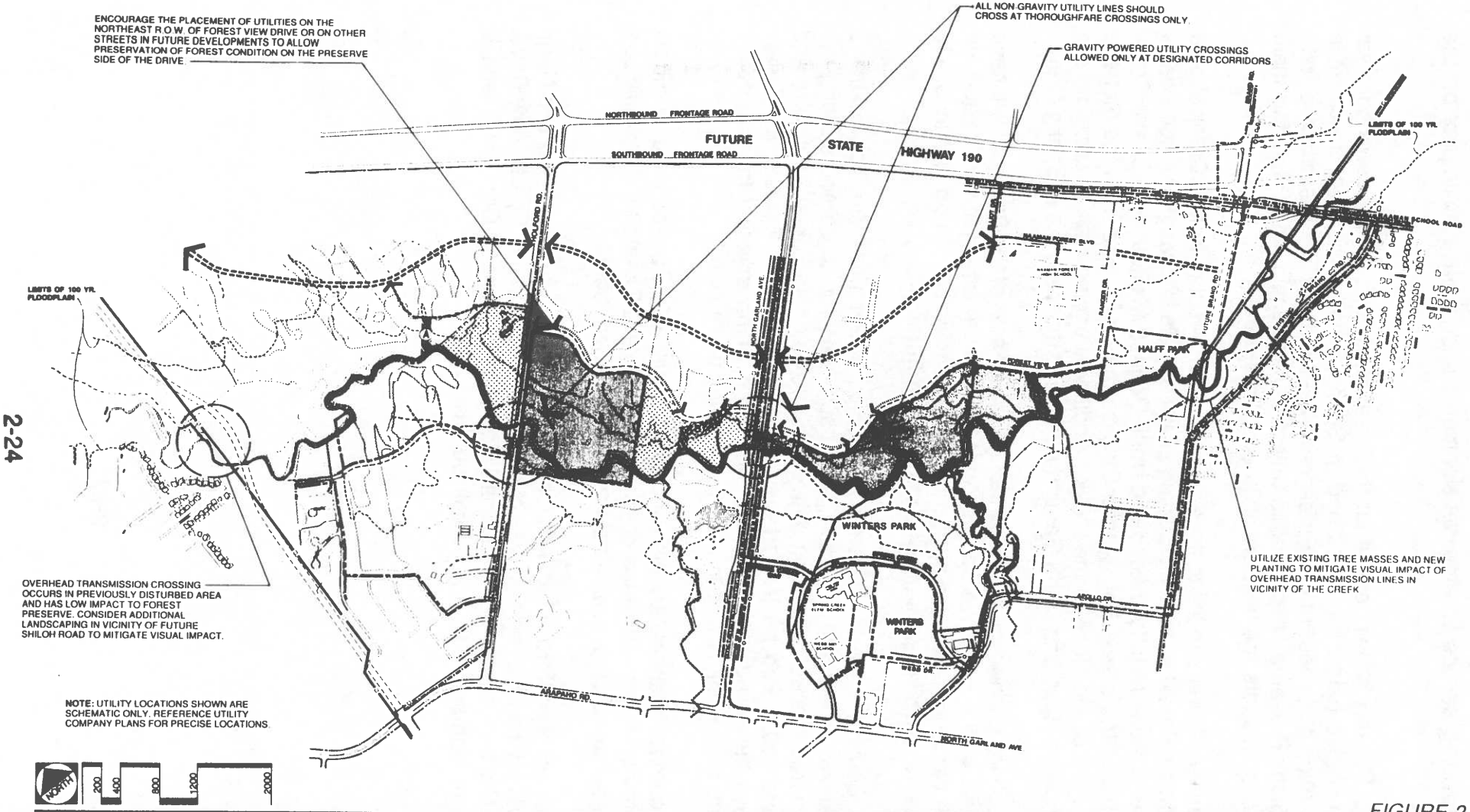

FIGURE 2.5

EXISTING & PROPOSED UTILITIES

- EXISTING SPRING CREEK FOREST PRESERVE
- POTENTIAL FUTURE ADDITIONS TO FOREST PRESERVE.
- CITY OF GARLAND PARKS
- DESIGNATED GRAVITY FLOW UTILITY CORRIDORS THROUGH PRESERVE
- LONE STAR GAS
- SANITARY SEWER (EXIST ——— PROPOSED .....)
- WATER
- GARLAND POWER AND LIGHT
- TU ELECTRIC
- FARMER'S ELECTRIC COOP
- G.T.E. (TELEPHONE)

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

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Preservation needs versus development needs must be carefully considered by City of Garland staff on a site-by-site basis. The utilization of Forest View Drive and/or Naaman Forest Boulevard as sewer corridors wherever possible is highly recommended to limit penetrations through the Forest, and should be considered early in the design process. However, this may result in longer runs of sewer pipe at deeper depths than would ordinarily be used. This may result in higher development costs. In some cases, this may make development of a particular site cost prohibitive, resulting in the loss of potential tax revenue.

City staff should also carefully monitor the use of the recommended sewer corridors to ensure that the requirements of the State Highway 190 development standards are met.

Electric Service: Electricity to properties in the vicinity of the Spring Creek Forest Preserve is provided by one of three electric utility companies. Garland Power & Light Company serves the area southwest of the creek from North Garland Avenue to Brand Road. TU Electric serves both sides of the creek northwest of North Garland Avenue, and Farmer's Electric Cooperative serves the area northeast of Spring Creek, from North Garland Avenue to Spring Creek.

The major power line corridors are, or will be, along thoroughfares, and since most of these are placed underground, they will have little impact on the Preserve. Major transmission corridors will have a far greater visual impact, since these result in the clearing of trees under the transmission lines for safety and ease of access and maintenance. Two such corridors are located in the vicinity of the Preserve. A 138 kilovolt overhead line runs east from a substation on Brand Road, forming the eastern boundaries of Halff Park and Halff Greenbelt. A second 138 kilovolt line runs north, from Arapaho Road, paralleling the right-of-way of the future extension of Shiloh Road. Reduced mowing along these two corridors should be considered, if acceptable to the utilities operating the lines. This would allow the re-establishment of native grasses and would allow smaller understory trees to grow along the edge of the clearing, softening the edge considerably.

All new electric supply lines should be placed underground, and no other overhead transmission corridors should be allowed to cross the Preserve between Shiloh Road and Brand Road. Hike and bike trails could also be constructed in the utility corridors, to connect the Rowlett and Spring Creek trail systems.

Gas and Telephone Service: Natural gas is supplied to the area by Lone Star Gas, and telephone service is provided by GTE. As with electricity, natural gas and telephone services are provided along existing or future thoroughfares, and should have no impact on the Preserve. All future lines required should also be placed within thoroughfare rights-of-way.

Utility Crossings at Bridge Locations: The forest character can be particularly appealing where thoroughfares cross Spring Creek. Care should be taken when a new and wider Holford Road bridge over Spring Creek is placed in the future, to ensure that

a minimum amount of trees are removed. Utilities that must cross the creek at the same location should utilize the minimum amount of space required, and should be routed alongside or under the bridge if possible.

History and Archaeology

The northern portion of Dallas County has a cultural heritage spanning a time period of approximately 150 years. In this section of Dallas County, several archaeological sites have been located and reported by both professional and amateur archaeologists since 1940, but an intensive archaeological investigation has never been conducted. Much of what is known about the area must be credited to R. K. Harris, Robert C. Hatsenbuehler, Vaughn McCallum, Jim Bruseth, and Bennett Kozloff of Archaeological Survey Associates of Dallas, and Carolyn Spock and Rosario Casarez of the Texas Archaeological Research Laboratory of the University of Texas at Austin.

An archaeological reconnaissance was conducted in the vicinity of the Preserve by Dr. Alan Skinner. (Skinner, 1990) Two historic sites (a dump and a house site) were recorded on the east side of the creek. Both of the sites are evidence of an early 20th century settlement system that relates to changing land use of this once rural area.

SPRING
CREEK
FOREST

Vegetation Influences and Forest Composition

3. VEGETATION INFLUENCES AND FOREST COMPOSITION

The primary goal of the Spring Creek Forest Master Development Plan is to ensure the stability of this unique old-growth forest. A detailed vegetation survey was performed as part of this study so that the Master Plan is designed considering unusual or sensitive botanical conditions.

The vegetation survey and community description were directed by Dr. Elray Nixon, professor of Botany at Stephen F. Austin State University. Dr. Nixon had already completed a detailed survey of the woody vegetation in part of the Spring Creek Forest Preserve. Results of this early work are described in The Texas Journal of Science in a paper titled, *"Woody Vegetation of an Old-Growth Creekbottom Forest in North-Central Texas"* (Nixon et al., 1991). The forest is described as an old-growth forest. The term old-growth forest is not readily defined. However, the paper cites other botanists who indicate that old-growth forests are near virgin, without obvious large-scale human or natural disturbances. Therefore, they contain stands of large, very old trees. Old-growth forests in Texas are extremely rare. It is important to characterize the Spring Creek Forest, because it reflects the past structure and composition of central Texas bottomland forests, a forest community that has received little attention.

The vegetation study presented here documents the distribution and abundance of woody species within the Preserve, as well as examines the condition of vegetation throughout an extended study area surrounding the Preserve. There are two objectives of the vegetation study:

- Determine the composition and extent of the old-growth forest community within the Spring Creek Forest Preserve, and
- Inventory the condition of woody and herbaceous vegetation communities within the Spring Creek Forest Preserve and the surrounding study area.

The vegetation condition assessment and survey were conducted in order to meet the objectives. Figure 3.1 illustrates the study area on a 1990 aerial photograph and includes adjacent areas that are part of either the hydrology or the viewshed. The vegetation condition assessment has been annotated on topographic enlargements of the study area and subdivided into four sections as shown. The ecological boundary described in the 1984 Protection Plan (TNC, 1984) was used as a guideline in conducting the survey of the study area. The assessment characterizes existing vegetation conditions for use in vegetative screening and buffering plans. A detailed vegetation survey was conducted on the Forest Preserve and on the land northeast of Spring Creek beyond the Preserve limits to quantify the composition of the old-growth forest.

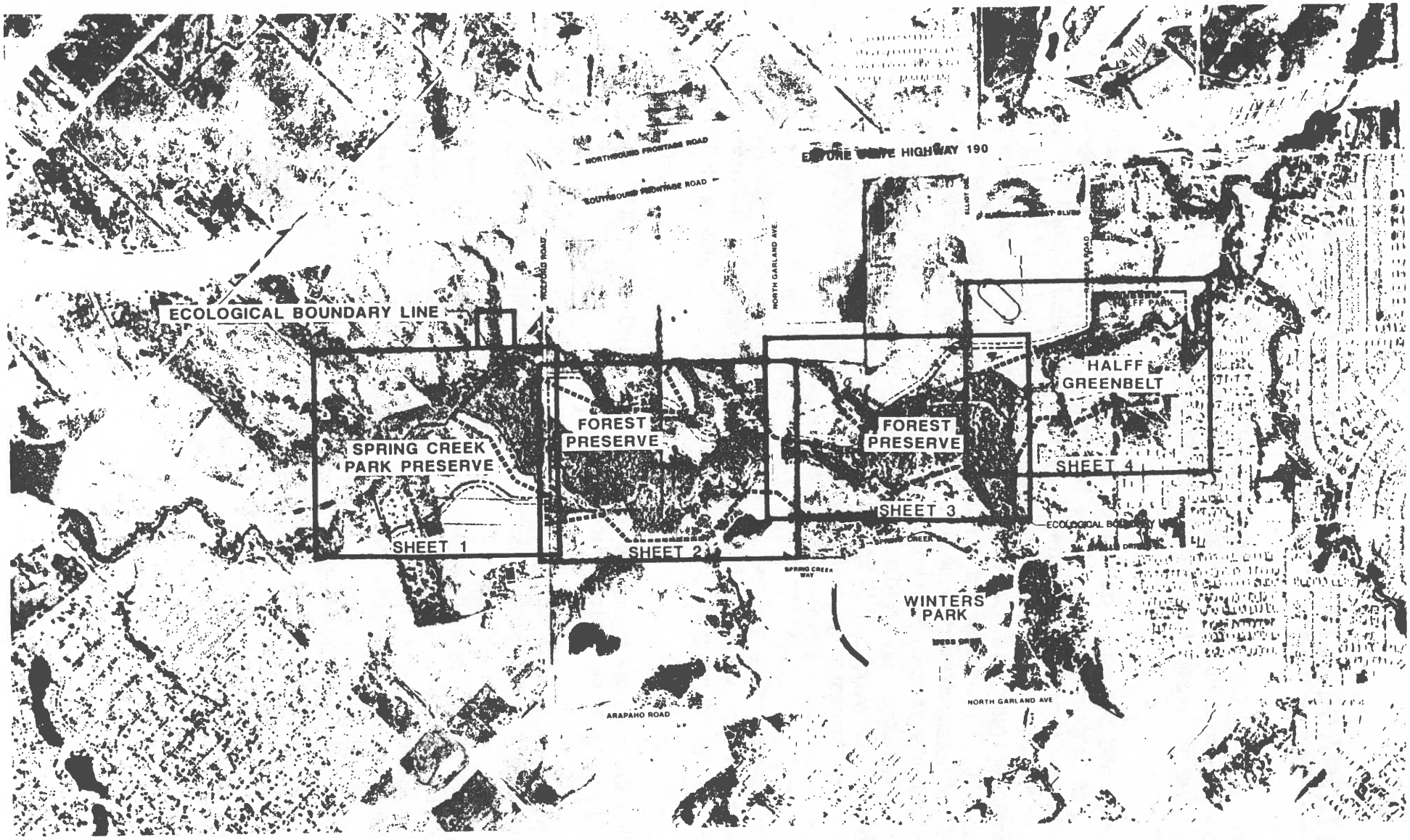

FIGURE 3.1

VEGETATION STUDY AREA INDEX

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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Vegetation Condition Assessment

In order to assess the botanical condition of the study area, it was important to document herbaceous species, such as wildflowers and native grasses, as well as significant stands of trees. The Preserve and study area were walked at appropriate times during the growing season from March through November 1990 to list the species observed and describe the existing herbaceous and woody plant condition. A list of herbaceous and woody plant species observed in the Preserve and surrounding area are included in Appendix E. A total of 96 species of herbaceous plants and a total of 65 woody plants were recorded.

As the condition assessment progressed, it became apparent that certain plants tended to be associated together, and that these plant associations had experienced varying levels of disturbance that could also be generalized. These observations lead to a pictorial representation of assessment results, where plant associations are presented as a series of irregularly-shaped groupings with a degree of disturbance noted. The lines delineating plant associations are sometimes sharp boundaries, such as a canopy meeting grassland or pasture. Other times the line is an approximate limit positioned to illustrate a gradual shift from one association into another. Figures 3.2 through 3.5 illustrate the detailed vegetation condition assessment.

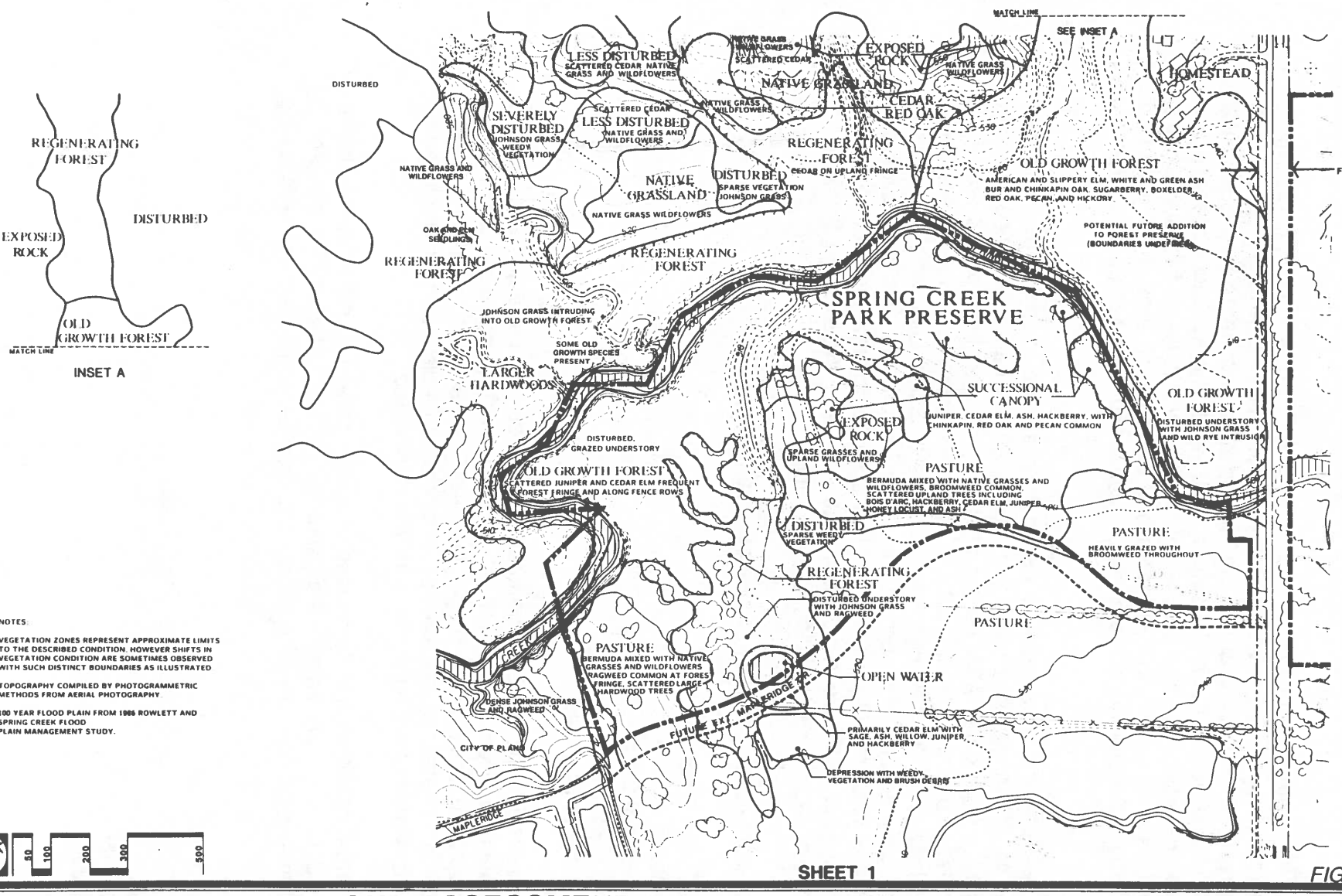
The plant associations tended to fall into one of several categories:

- Old-Growth Forest,
- Regenerating Forest,
- Successional Canopy,
- Upland Canopy, or
- Grassland or Pasture.

The following discussion provides a general description of the plant associations represented on each detailed map sheet. It should be noted that plant associations depicted in the detailed assessment maps may vary between locations with specific species composition. Therefore, tree species and noticeable disturbances are listed on the individual groups delineated on the four assessment maps.

The old-growth forest association is composed of mature trees (estimated to be greater than 100-years-old) having trunk diameters averaging 24 inches or larger. The old-growth forest typically has a high diversity of species, and may be composed of the following species:

- White and Green Ash,
- Bur, Chinkapin, and Shumard (Red) Oak,
- Pecan,
- Sugar Hackberry,
- Boxelder,



SHEET 1

FIGURE 3.2

VEGETATION CONDITION ASSESSMENT

SPRING CREEK FOREST PRESERVE
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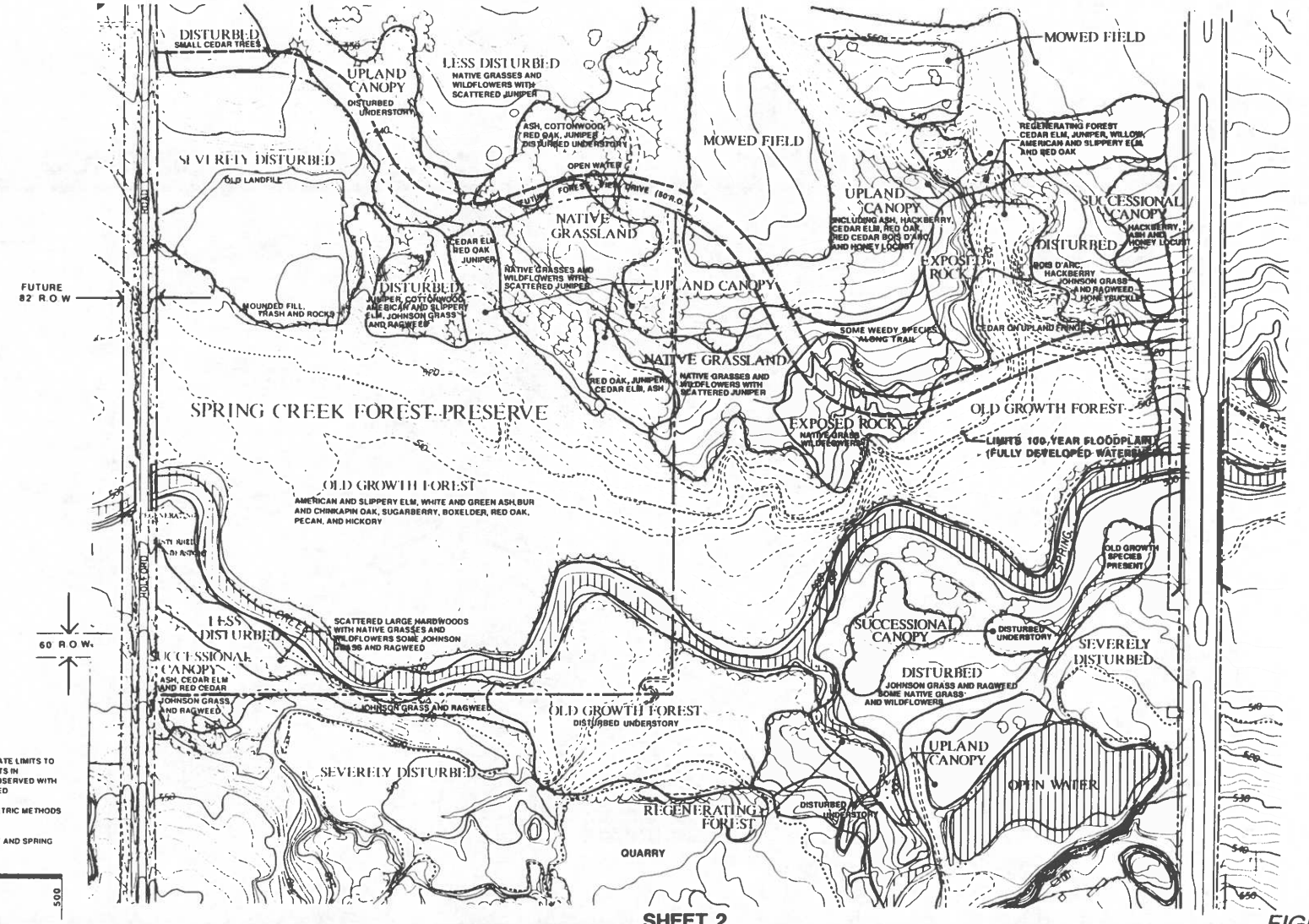

SHEET 2

FIGURE 3.3

VEGETATION CONDITION ASSESSMENT

SPRING CREEK FOREST PRESERVE
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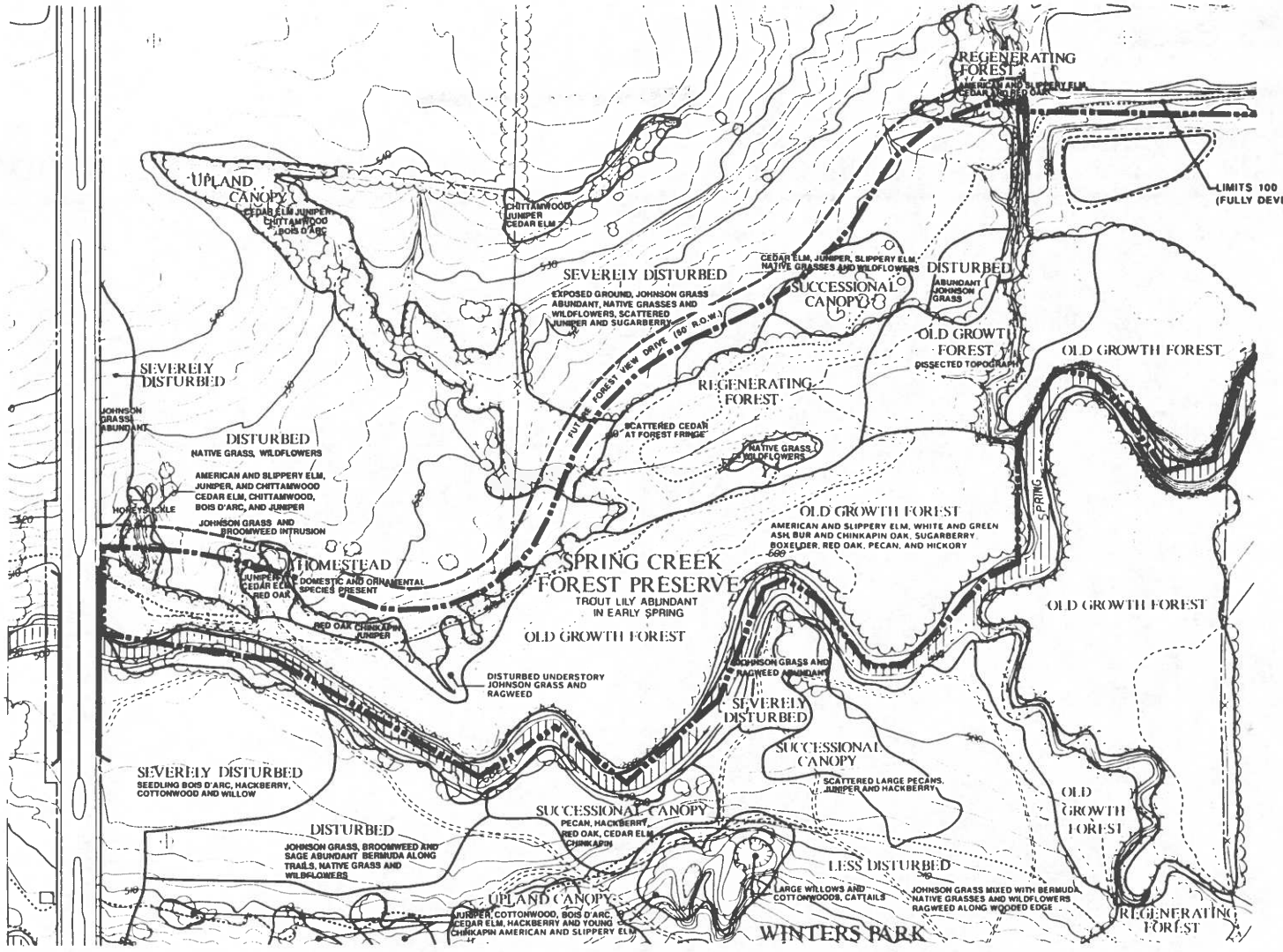

NOTES:

VEGETATION ZONES REPRESENT APPROXIMATE LIMITS TO THE DESCRIBED CONDITION. HOWEVER SHIFTS IN VEGETATION CONDITION ARE SOMETIMES OBSERVED WITH SUCH DISTINCT BOUNDARIES AS ILLUSTRATED.

TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY

100 YEAR FLOOD PLAIN FROM 1986 ROWLETT AND SPRING CREEK FLOOD PLAIN MANAGEMENT STUDY

SHEET 3

FIGURE 3.4

VEGETATION CONDITION ASSESSMENT

SPRING CREEK FOREST PRESERVE
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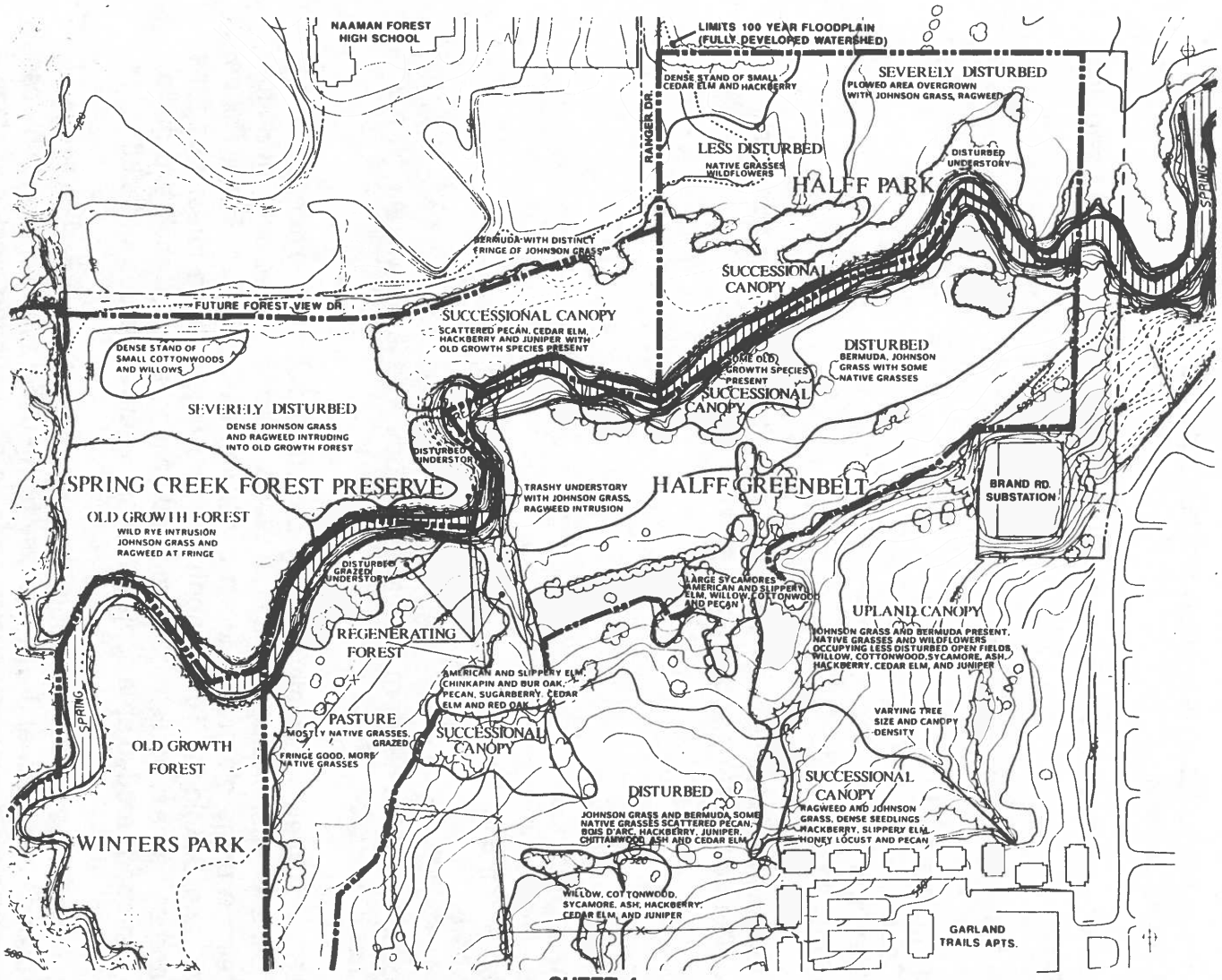

FIGURE 3.5

VEGETATION CONDITION ASSESSMENT

SPRING CREEK FOREST PRESERVE
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- Slippery, Cedar, and American Elm, and
- Red Mulberry.

The regenerating forest association is typically similar to the old-growth association, but contains smaller diameter trees.

The successional tree association contains some of the old-growth species, but also has a greater percentage of:

- Cedar Elm,
- Ash,
- Sugar Hackberry,
- Red Cedar,
- Boxelder, and
- Honey Locust.

The upland tree association is typically above the 100-year floodplain, and contains trees of smaller sizes. The dominant upland species are:

- Cedar Elm,
- Red Cedar,
- Green Ash,
- Shumard (Red) Oak,
- Sugar Hackberry,
- Chittamwood, and
- Bois d'Arc.

The vegetation condition of the northern sector of the study area is shown on Figure 3.2, and is the area north of Holford Road.

The east side of Spring Creek is currently privately-owned, and contains extensive stands of old-growth forest and regenerating forest. The Weary Tract is located north of Holford Road, and contains a prime old-growth forest consisting of Oaks, Ash, Elms, Pecan, Sugar Hackberry, and Boxelder. To the north is some regenerating forest along the creek's border and some heavily disturbed areas containing exposed rock and gullies. This particularly disturbed / eroded area contains areas of native grasses and wildflowers.

The west side of Spring Creek, north of Holford Road, is the Spring Creek Park Preserve. This area was recently acquired, and was formerly being used as a pasture for horses. The site contains some old-growth and successional forest along the creek and along a small tributary draining from the west. The majority of the site is open pasture that has been heavily grazed.

The vegetation of the central sector, Figure 3.3, contains an extensive amount of old-growth forest on the east side of the creek and severely disturbed areas along the uplands. The existing Forest Preserve tract south of Holford Road contains impressive old-growth forest along the creek and a heavily disturbed area which was a former quarry.

The quarry has been filled with dirt and rock, and will require extensive treatment to restore. The area further south has old-growth forest along the creek and exposed rock gullies on the uplands. The uplands contain extensive stands of Red Cedar, Shumard Oak, and Ash. The area on the west side of the creek is owned by the Chambers Brothers Construction Company, and has been severely disturbed by a quarry. The area does contain some old-growth forest along the creek, a quarry pond that overlooks a disturbed area, and successional growth.

The Winters Park sector, Figure 3.4, contains a large stand of old-growth and regenerating forest on the east side of the creek. Some old-growth, successional canopy, and disturbed areas occur on the west side of Spring Creek in Winters Park. The topsoil has been stripped from numerous areas within this sector, with a large impacted area located south of North Garland Road on the west side of the creek.

The South Sector, Figure 3.5, contains a relatively small amount of old-growth forest and substantial disturbed areas which are predominately Johnsongrass with some small saplings.

The Old-Growth Forest

Figure 3.6 characterizes the existing tree and grassland vegetation as climax, successional, or disturbed. The old-growth forest is most extensive on the east side of Spring Creek. A detailed woody plant survey was conducted of the old-growth forest by Dr. Elray Nixon.

A complete census of the Spring Creek Forest communities is not possible, because of limitations in resources and time. Therefore, the method for sampling the old-growth forest involved placing permanently marked transects in the field. The transects serve as primary sampling units, and are broken down into square quadrants which serve as the secondary sampling units. Quadrants were five meters by five meters, and positioned in belt transects. They occur along both sides of a transect line. Eighteen transects were positioned in the forest, as illustrated in Figure 3.7. The transect lines are permanently marked so that subsequent analyses of the quadrants can be made, and changes in the forest documented through time. Iron rods were staked at the northern end of each transect. An identifying tree was selected in close proximity to the each rod. The rod position was described by recording the compass direction and distance from the identified tree.

The transects were systematically placed, usually in the central areas of the slope and flat floodplain bottomland. Creek side transects follow the creek bluff. There are 50 plots per transect. All trees, shrubs, and woody vines falling within a quadrant and with diameters of 1/2 centimeter (cm) or greater were measured and recorded. Diameters were measured at about 1.4 meters (m) above ground.

FIGURE 3.6

VEGETATION INFLUENCES

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

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TRANSECT LOCATION NOTES

NOTE: IDENTITY TREES AND FIRST TRANSECT PIN MARKED WITH ORANGE RIBBON

#1 8' FROM LARGE LIMESTONE ROCK IN DEPRESSION AT EDGE OF LOW HILLS - IDENTITY TREE 15" DBH CHINKAPIN OAK RUNS 150 DEGREES SOUTH

#2 140' FROM #1 AT 80 DEGREES EAST - IDENTITY TREE 15" DBH WESTERN SOAPBERRY RUNS 104 DEGREES SOUTH

#3 12' FROM CREEK BANK - 5' FROM IDENTITY TREE 25" DBH CHINKAPIN OAK RUNS ALONG CREEK

#4 110' DUE NORTH OF #5, 15 SOUTH OF FOOTPATH - 30' EAST OF IDENTITY TREE 33" DBH SHUMARD RUNS SOUTHEAST

#5 15' FROM CREEK BANK - 15' NORTH OF IDENTITY TREE, TRIPLE TRUNKED CHINKAPIN OAK LARGEST DBH 23 RUNS ALONG CREEK

#6 100' NORTHEAST OF #7 SURROUNDED BY CEDARS 10' SOUTHWEST OF IDENTITY TREE 23" DBH ASH RUNS APPROX 100 DEGREES EAST

#7 70' NORTH OF CREEK BANK - 4' SOUTHWEST OF IDENTITY TREE 15" DBH CHINKAPIN OAK RUNS 140 DEGREES SOUTHEAST

#8 15' FROM CREEK BANK - 20' EAST OF IDENTITY TREE 35" DBH SYCAMORE GROWING AT ANGLE IN CREEK BANK RUNS ALONG CREEK

#9 14' SOUTH OF 7B" DBH BLACK WALNUT WHICH BENDS OVERHEAD - 8' FROM IDENTITY TREE 17" DBH ASH RUNS DUE EAST

#10 11' FROM FOOTPATH - 8' FROM IDENTITY TREE 36" DBH CHINKAPIN OAK RUNS DUE EAST

#11 16' FROM CREEK BANK - 3' NORTH OF IDENTITY TREE 8" DBH SLIPPERY ELM RUNS ALONG CREEK

#12 5' SOUTH OF STREAM BEND - 8' WEST OF IDENTITY TREE 3" DBH WESTERN SOAPBERRY "POISON IVY" RUNS ALONG CREEK

#13 200' NORTHWEST OF #14 - 8' WEST OF IDENTITY TREE 3" DBH CEDAR ELM RUNS DUE EAST

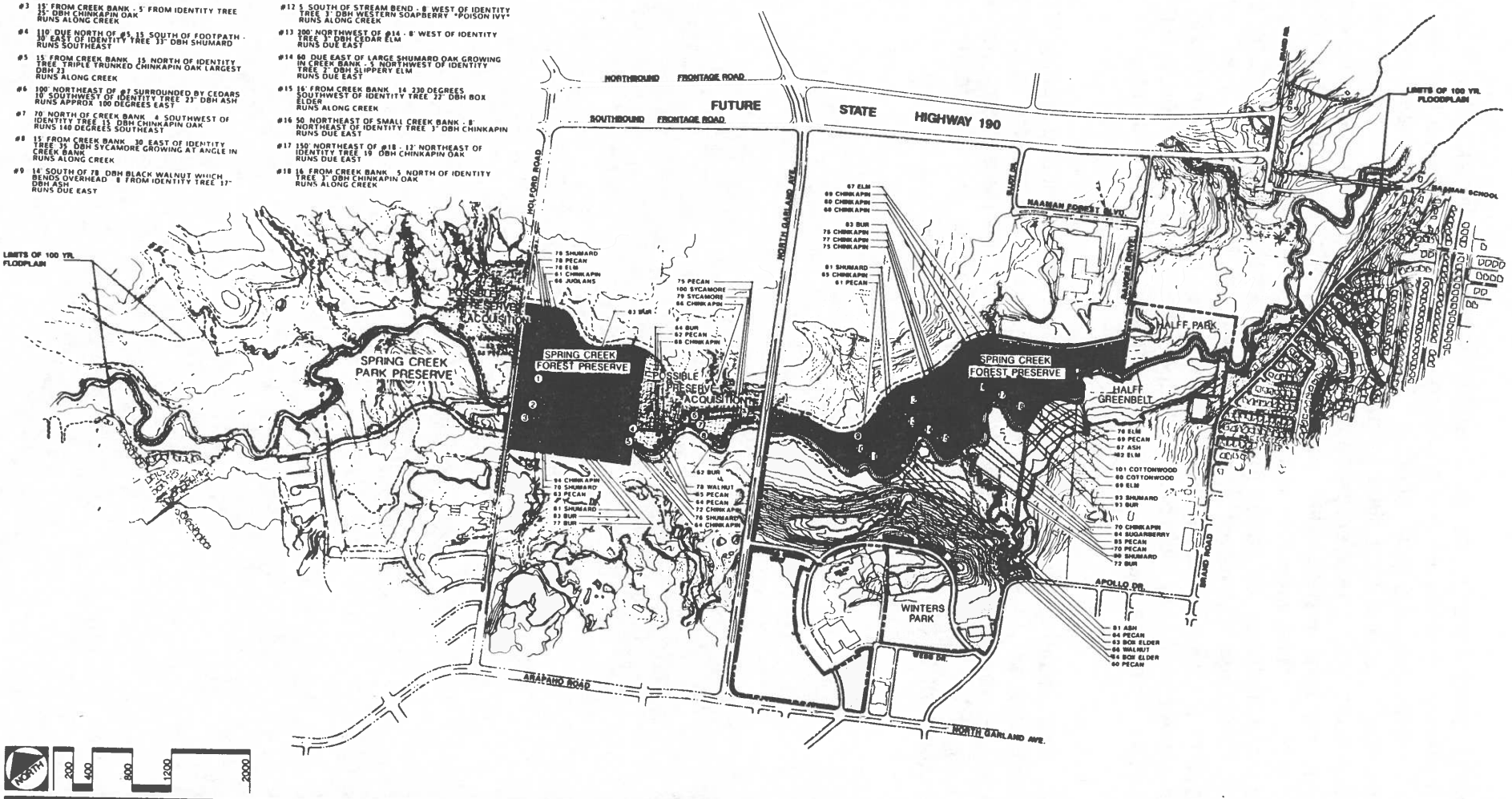
#14 60' DUE EAST OF LARGE SHUMARD OAK GROWING IN CREEK BANK - 5' NORTHWEST OF IDENTITY TREE 7" DBH SLIPPERY ELM RUNS DUE EAST

#15 16' FROM CREEK BANK - 14' 230 DEGREES SOUTHWEST OF IDENTITY TREE 22" DBH BOX ELDER RUNS ALONG CREEK

#16 50' NORTHEAST OF SMALL CREEK BANK - 8' NORTHEAST OF IDENTITY TREE 3" DBH CHINKAPIN RUNS DUE EAST

#17 150' NORTHEAST OF #18 - 12' NORTHEAST OF IDENTITY TREE 19" DBH CHINKAPIN OAK RUNS DUE EAST

#18 16' FROM CREEK BANK - 5' NORTH OF IDENTITY TREE 3" DBH CHINKAPIN OAK RUNS ALONG CREEK



VEGETATION INVENTORY
FOREST TRANSECT LAYOUT

FIGURE 3.7

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
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CITY OF GARLAND, TEXAS

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Frequency, density, dominance (basal area), and importance were calculated from the measurements collected. Frequency is the percentage of total quadrants that contains at least one rooted individual of a given species. Relative frequency is the frequency of one species as a percentage of total plant frequency. Density is the number of plants rooted within each quadrant. The average density of each species can be extrapolated to any convenient unit area. Relative density is the density of one species as a percent of total plant density. Dominance refers to those species that contribute the most cover or basal area to the community. Because forest cover is difficult to measure, basal area is generally used. Relative dominance or relative basal area is the basal area of one species as a percent of total basal area. Importance refers to the relative contribution of a species to the entire community. It is defined as the sum of relative frequency, relative density and relative dominance (basal area). Thus, importance values will range from 0 to 300.

Using this information, community composition was determined for the Spring Creek Forest. Transect data summaries are included in Appendix E. The location, species and diameter of the largest trees surveyed are discussed. Table 4 lists the species observed, the number of transects a particular species was observed in, the total number of plants tallied, and the dominant species.

TABLE 4. SUMMARY OF WOODY PLANTS SURVEYED IN THE SPRING CREEK FOREST PRESERVE

Species Name	Common Name	No. of Transects Observed	Total No. of Plants in Transects	Dominant or Co-dominant Species in Transects*
Acer negundo	Boxelder	17/18	635	11
Berchemia scandens	Alabama Supplejack	4/18	28	
Bumelia lanuginosa var. oblongifolia	Chittamwood	8/18	18	
Carya illinoensis	Pecan	16/18	84	7
Celtis laevigata	Texas Sugar Hackberry	18/18	1,064	17
Cercis canadensis	Redbud	6/18	10	
Cocculus carolinus	Carolina Snailseed	2/18	5	
Cornus drummondii	Roughleaf Dogwood	15/18	175	1
Fraxinus americana	White Ash	18/18	835	17
Fraxinus texensis	Texas Ash	1/18	1	
Gleditsia triacanthos	Honey Locust	2/18	10	
Ilex decidua	Deciduous Holly	5/18	11	
Juglans nigra	Black Walnut	6/18	6	
Juniperus virginiana	Eastern Red Cedar	11/18	56	1
Ligustrum sp.	Privet	3/18	6	
Lonicera japonica	Japanese Honeysuckle	4/18	4	
Maclura pomifera	Osage Orange	10/18	29	
Melia azedarach	Chinaberry	8/18	25	
Morus rubra	Red Mulberry	17/18	140	12
Nandina domestica	Nandina	1/18	2	
Parthenocissus quinquefolia	Virginia Creeper	14/18	74	
Platanus occidentalis	Sycamore	1/18	2	1
Populus deltoides	Eastern Cottonwood	1/18	1	
Prunus mexicana	Mexican Plum	8/18	25	
Quercus macrocarpa	Bur Oak	13/18	27	3
Quercus muhlenbergii	Chinkapin Oak	17/18	79	8
Quercus Shumardii var. Shumardii	Shumard Red Oak	18/18	218	9
Rhamnus caroliniana	Carolina Buckthorn	8/18	54	
Rhus toxicodendron	Poison Ivy	12/18	34	
Sambucus canadensis	Common Elderberry	4/18	28	
Sapindus saponaria	Western Soapberry	14/18	215	4
Smilax hispida	Common Greenbrier	14/18	215	
Smilax bona-nox	Saw Greenbrier	5/18	40	
Sophora affinus	Texas Sophora	5/18	11	
Ulmus crassifolia	Cedar Elm	16/18	238	4
Ulmus rubra	Slippery Elm	18/18	673	15
Ungnadia speciosa	Mexican Buckeye	1/18	14	
Viburnum rufidulum	Rusty Blackhaw	13/18	86	1
Vitis mustangensis	Mustang Grape	1/18	4	
Vitis riparia	Riverbank Grape	13/18	137	

* 20 OR GREATER IMPORTANCE VALUE IN TRANSECT

The overall dominants in the Spring Creek forest are Ash, Slippery Elm, Cedar Elm, Boxelder, Red Mulberry, Pecan, Texas Sugar Hackberry, Shumard (Red) Oak, Bur Oak and Chinkapin Oak. This composition differs somewhat from the typical Upper Trinity River Basin forests in North-Central Texas, which are generally characterized by an abundance of Cedar Elm, Green Ash, and Texas Sugar Hackberry (Nixon and Willett, 1974). In the Spring Creek Forest, Cedar Elm is of minor importance. American Elm is consistently associated with these Trinity River bottom species, oftentimes being among the dominants (Nixon and Willett, 1974).

The association of Sugar Hackberry, Cedar Elm and Green Ash, therefore, is not uncommon. In fact, these species occur together throughout the southern deciduous forest, having been designated the Sugar Hackberry-American Elm-Green Ash Forest Cover Type (Eyre, 1980). Pecan and Red Oak are also occasionally present in bottomland forests in North-Central Texas, and they, too, may be among the dominant species (Nixon and Willett, 1974; Cox, 1983). They also occur eastward as associated species of various forest cover types (Eyre, 1980).

The notable inconsistency of the Spring Creek forest is the presence of Chinkapin Oak among the dominants. Robertson et al. (1978) found this species to be more representative of transitional sites up from bottomland. There are many more plants of Chinkapin Oak on the slope at Spring Creek, but basal area is less than that in the creek bottom. Of interest is the recent designation of a Bur Oak - Chinkapin Oak forest community type which ranges from Kansas and Nebraska into Wisconsin (Monk et al., 1990). Additional studies are needed to better understand the distribution and importance of Chinkapin Oak in North-Central Texas.

When comparing the vegetational composition of the Spring Creek Forest with bottomland vegetation of nearby regions, it was found that 18 of the 28 most common bottomland forest species of north-central Oklahoma were found at Spring Creek, including nine of the ten dominant Spring Creek species (Rice, 1965; Collins et al., 1981). American Elm is the principal tree species of Oklahoma bottomlands. Petranka and Holland (1980) found that mature stands of forest vegetation of creek bottoms in south-central Oklahoma contained Sugar Hackberry, American Elm, Western Soapberry, and Boxelder. Pecan, Bur Oak, Green Ash, and Shumard (Red) Oak in descending order of importance. These species, with the exception of American Elm, were dominants at Spring Creek. Shrub and woody vine species were also similar. Six of nine shrubs and five of nine vines mentioned by Rice (1965) also occurred at Spring Creek.

Riparian communities associated with the Guadalupe and San Antonio Rivers and with creek bottoms in the Edwards Plateau in south-central Texas display affinities to Spring Creek woody vegetation (Van Auken et al., 1979; Ford and Van Auken, 1982; Bush and Van Auken, 1984). Texas Sugar Hackberry, Pecan, Boxelder, Black Walnut, American Elm, and Western Soapberry are important components. Twenty-one of 32 species present in the Guadalupe floodplain were in common with Spring Creek communities (Ford and Van Auken, 1982). Only four of 32 species recorded in south-central Texas were not found in east Texas; however 28 appear to be at their westernmost range.

Species diversity and evenness in Spring Creek communities increased with distance from the creek (3.40 for creek side, 3.60 for creek bottom and 4.02 for slope). Bush and Van Auken (1984) also found that diversity increased as distance from the San Antonio River increased. It was obvious that the Spring Creek bottomland was subjected to flooding. Studies have shown that species diversity increases with decreasing flood stress (Bell and del Moral, 1977). It is not uncommon for species diversity to increase from dry to mesic (Cox, 1983) and from wet to mesic (Nixon et al., 1983). Stressful environments tend to reduce diversity (Barbour et al., 1980).

During the field reconnaissance phase of the study, observers found a mature Chinkapin Oak that had been felled by vandals. A section of the trunk was removed from the tree for age determination. The sample tree had an average section at "breast height" diameter (dbh) of approximately 10 to 12 inches (25 cm), and a total of approximately 106 seasonal growth rings. From survey information, it is estimated that there are numerous Chinkapin Oak trees in the Preserve that are 100-years old or older. A section of a Pecan tree was also obtained from a felled tree that measured about 17 inches in diameter and contained 55 seasonal growth rings. Figure 3.7 identifies the location and size of some of the larger trees measured as part of the vegetation survey. It should be noted that tree diameters shown on Figure 3.7 are presented as centimeters measured at breast height. From this information, it is estimated that the old-growth forest contains trees that are between 100 to 300 years old.

SPRING
CREEK
FOREST

Master Development Plan

4. MASTER DEVELOPMENT PLAN

Spring Creek Forest Preserve, 1992

Concept Overview

The nearly 300 acres of mature hardwood bottomlands and associated floodplain and slopes that are proposed as the Spring Creek Forest Preserve possess a distinctive character and ecological significance that merit both attention by the interested visitor and the fullest measure of protection by the public.

In the simplest terms, the Spring Creek Forest Preserve Master Plan can be described as a program for carefully guided and constrained visitor access through the full length of the 2.6-mile (thread of stream) Preserve. The Plan provides paths avoiding ecologically-sensitive areas. Preservation and maintenance of forest quality and ecological integrity are given the highest priorities, while providing for public access, education, and interpretation.

Any provisions for public access to and within the Spring Creek Forest Preserve (SCFP) are for enjoyment and interpretation of its unique resources and must be constrained by the Preserve's environmental sensitivities. The environmental research conducted under this master planning effort has confirmed the findings of the Texas Nature Conservancy and other earlier studies that land use changes along the Preserve's periphery and access and construction within its boundaries could alter the hydrological patterns and velocities which sustain year-round root-zone moisture. Modification of the existing hydrology of the Preserve's surface runoff and groundwater recharge could potentially lead to shortened life-spans for some of its trees and to lower capacity for self-maintenance of the Preserve as a whole.

Also, higher levels of unrestrained public access and public attention to the Preserve could result in plant removal, plant injury, littering, the spilling of damaging substances, and other forms of vandalism or abuse. They could also result in soil compaction, erosion, and other forms of environmental impact.

The City's mandate, however, is to open the Preserve to public access, for this mature hardwood bottomland is indeed a resource valuable for the aesthetic satisfactions and education it can provide the interested public, as well as for the characteristics which make it valuable for botanical history, scientific research, and general environmental study.

Determination of Preserve Components and Boundaries

Prior Recommendations: Texas Nature Conservancy

In its 1984 "Spring Creek Forest Preserve" report (Texas Nature Conservancy, 1984), the Texas Nature Conservancy (TNC) based its Preserve boundary recommendations primarily on soils, vegetation, and hydrology, noting that "the boundaries are the minimum needed to ensure maintenance of the pristine bottomland hardwood community". The high water-holding capacity characteristic of Frio Silty Clay, the most widely distributed soil type in the Preserve bottomland, was acknowledged as an important factor in supplying continuous moisture to the hardwoods. In addition, the report noted that the vegetated soils above and adjacent to the forest provide a significant amount of moisture to the mature bottomland trees for months following a rain event. "Any changes in land use in these areas", the report states, "need to have this taken into consideration to allow rainfall to soak into the ground" (and maintain moisture supply to the old-growth trees).

Another factor with an important bearing upon the question of boundary delineation is the presence of vegetation on the higher elevations adjacent to the bottomland old-growth forest. The vegetated borders slow down runoff, minimize erosion, and increase infiltration, ensuring a continuous supply of moisture to the old-growth forest, as noted above, and replenishing the springs along the creek. Again, the report notes the significance of potential land-use and control along these borders: "Any changes in land

use in the areas draining into the forest should be planned so this drainage pattern is maintained. The volume and velocity of runoff should neither increase nor decrease by more than ten percent of the current volume and velocity. There should be no change at all in the location of the channels."

The maintenance of historic runoff velocities and patterns, which have not only determined the robustness of the large trees of the bottomland but also the continuous replenishment of the area's groundwater, is therefore a significant factor in the determination of the Preserve's boundaries. As noted in Chapter 2 of this report, if sufficient buffer distances can be incorporated into the Preserve, land use and roadway development beyond the Preserve's final boundaries will be less likely to change the historic runoff velocities and patterns that have allowed the forest to become what it is. As previously noted, the public and private drainage systems of the upper watershed areas will need to be designed to ensure that runoff inflow into the Preserve does not fall below critical levels.

The TNC report goes on to note that the unforested grass/brush/saplings portion of the Forest Preserve proposed in 1984 (92 acres or 41 percent of the total of 225 acres), which is predominantly within the border areas and slopes adjacent to the mature forest, "has the capacity to become reforested if restoration measures are undertaken." In other words, the unforested area, in addition to performing essential runoff control and moisture replenishment functions on behalf of the mature forest, could in time become mature forest as well.

The Forest Preserve boundary proposed by the TNC and the boundary recommended by the Master Development Plan are delineated on Figure 4.1. The TNC boundary encompasses in excess of 95 percent of the 100-year floodplain between the two extremities of the Preserve and the unforested border areas noted above. The Master Development Plan boundary, as noted below, exceeds the TNC proposed boundary in order to further buffer and protect the Preserve.

FIGURE 4.1

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT H. HALFF ASSOCIATES, INC.
ENGINEERS PLANNERS SCIENTISTS SURVEYORS

City and County Acquisitions

As noted in Chapter 1, the City of Garland through the Dallas County Open Space Program has acquired three tracts within the recommended Preserve area. The original acquisition, to the south of Holford Road, holds the largest extent of old-growth forest within the total proposed Forest Preserve.

The latest acquisition, the new Spring Creek Park Preserve northwesterly of Holford Road, purchased by Dallas County and administered by Garland for park use, will protect the creek from development from the Creek's point of crossing of Holford Road to a point 1,950 feet due northwest of that point. Because of this, the old-growth forest within the park tract and a band 150 feet in width along the park's largely open creek edge, proposed for reforestation, could be appropriately dedicated as components of the Preserve. The dedicated areas could be protected as an overlay zone within the overall city park property, or the overall park could be regulated in a manner that would protect old-growth and regenerating forest and new reforestation areas.

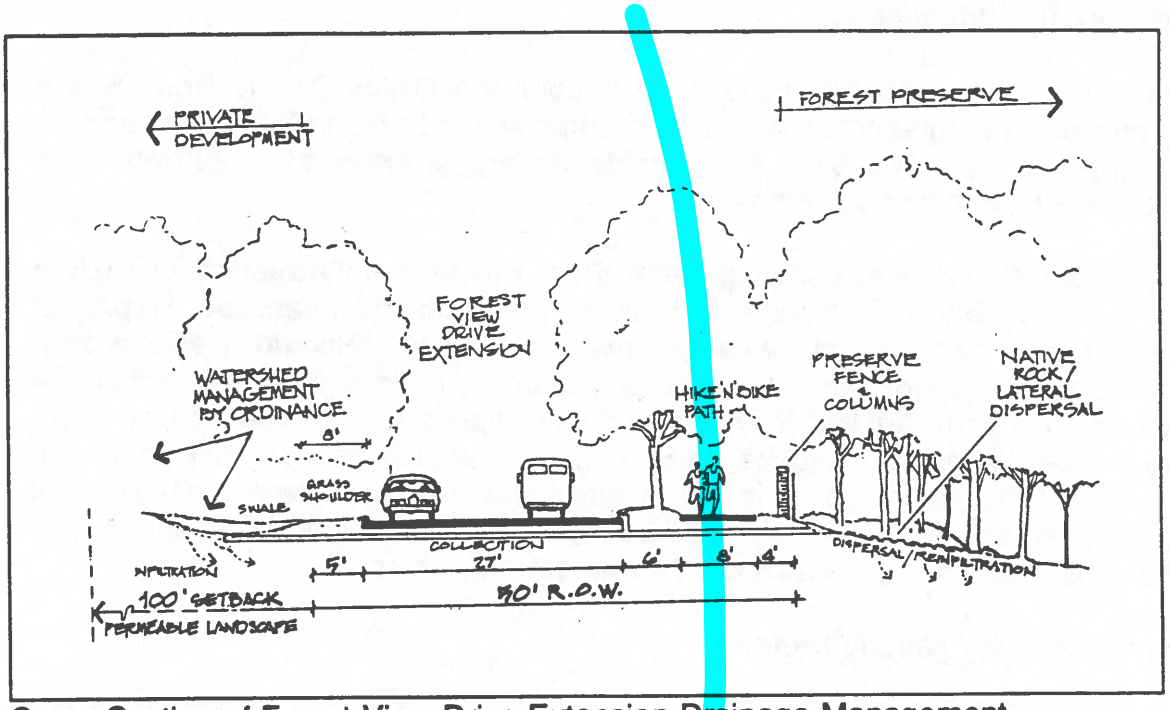
Additional Boundary Considerations

The TNC report recommended a strong boundary concept, one which would assure fair protection for the vegetational species of the Preserve. Two elements deserve further strengthening:

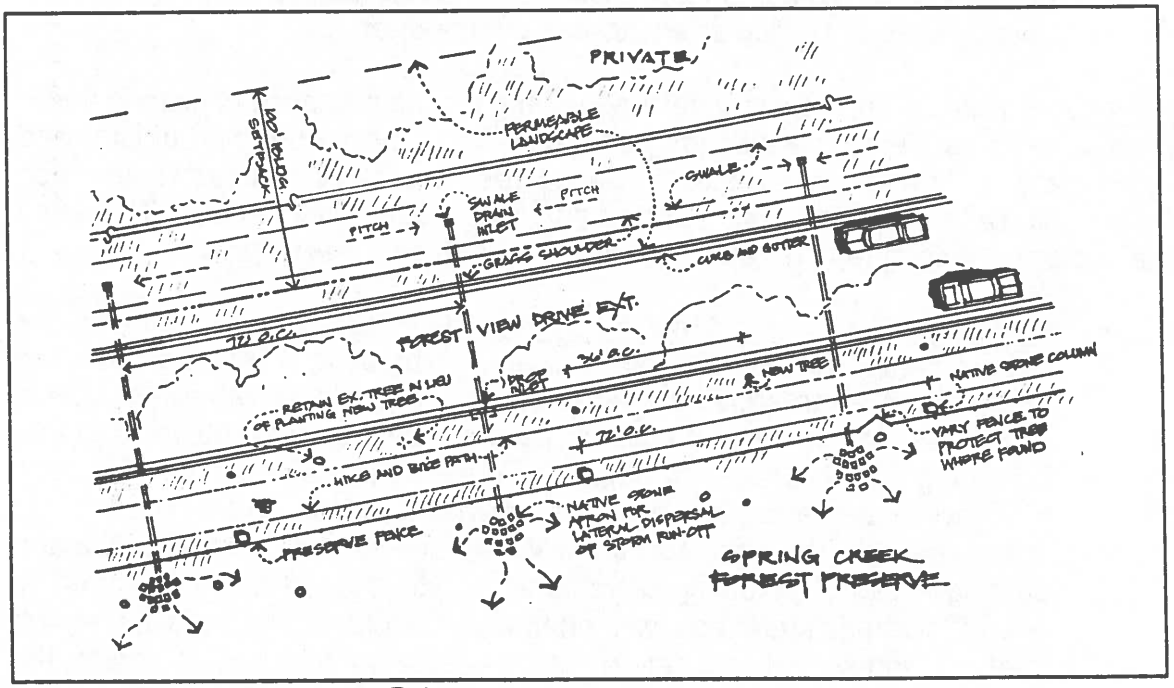
- border zones, including slopes above the floodplain, and
- special sites of particular environmental importance.

Border zones: Border zones are essential for ensuring the maintenance of historic runoff velocities and patterns. They are also important as "filters" for the trapping of litter and polluting substances. In addition, forested borders screen or buffer unwanted views, such as views of vehicular traffic and parking and of adjacent urban development. They also attenuate noise that originates on vehicular ways and adjacent development.

- Runoff infiltration and erosion control: Although quantification of this requirement is difficult and not available at present, it may be observed that a buffer width above the outer edges of the old-growth forest stands of 100 feet or more would typically be necessary on terrain similar to that bordering Spring Creek's floodplain to ensure the maintenance of historic runoff velocities and patterns. Any paved surfaces adjoining the outer edges, such as the planned Forest View Drive extensions and drives and parking areas of adjoining development, would need to be designed to special drainage standards, with stormwater discharges located at frequent intervals and with appropriate discharge dispersal features, to ensure the maintenance of historic runoff velocities and patterns and the avoidance of erosive channeling. The 100-foot buffer width would allow the full dispersion of pavement collected runoff over the buffer terrain before it reached the old-growth forest proper.



Cross Section of Forest View Drive Extension Drainage Management



Plan View of Forest View Drive

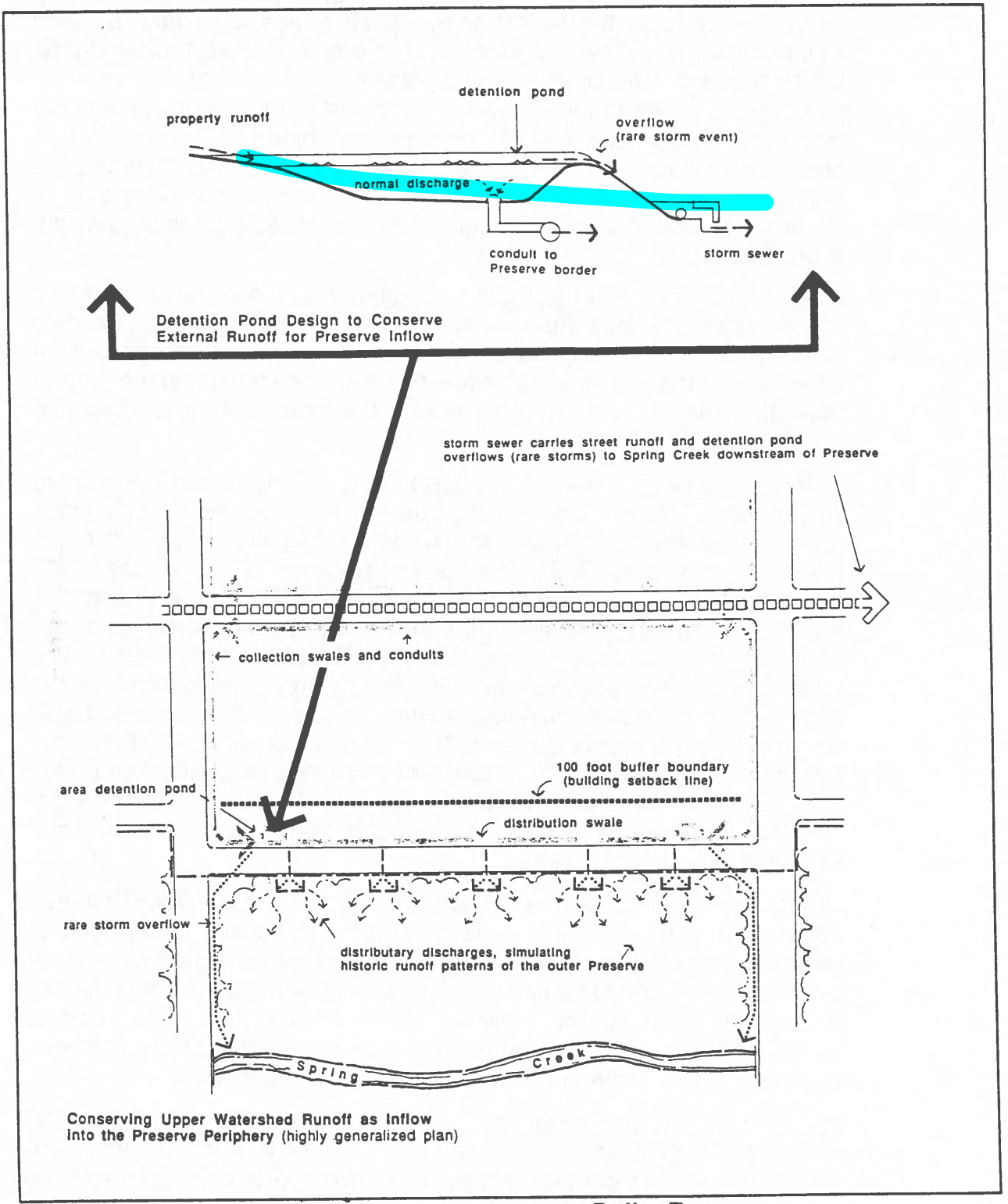
Unforested floodplain adjoining the old-growth forest, most likely having been deforested in the recent past, serves a significant role in runoff infiltration and groundwater storage. The entire floodplain along Spring Creek between the two extremities planned for the Preserve has been proposed as a part of the Preserve. Reforestation should be carried out throughout these open areas to achieve two objectives; to extend tree crown cover and reduce rain impact erosion, and to restore deforested areas and promote the other areas with tall tree potential, filling out the Preserve on both banks of Spring Creek and creating a more complete ecological setting.

- Buffers for trapping litter and polluting substances: A buffer of trees and ample understory vegetation 50 feet in width may be effective in trapping wind-borne and hand-discarded litter. No single standard can be established for polluting substances, but it can be stated that the greater the buffer width, the more likely will be the opportunity to contain and manage any spill.

- Noise attenuation: Past studies have indicated that a densely planted wooded area 300-feet wide has the potential for a ten decibel attenuation (that is, a reduction by fifty percent) of sound originating to one side of the wooded strip. (Cook, 1965) Observations revealed that a distance of 300 or more feet from an adjacent parkway across partly wooded parkland in a central urban setting was essential for the achievement of optimum user buffering from automotive noise along parkland paths and rest areas. (Mann, 1968) Field observations at the Spring Creek Forest Preserve site suggest that a roadway with light volume, low to moderate speed traffic would optimally be aligned at a minimum distance of 200 to 300 feet away from the general alignment of the major footpath paralleling the creek. With this distance, most Preserve users would find the "peace of the forest" undisturbed by vehicular sounds, other than those of car horns and exceptional brake/tire noise.

  Urban development on the far side of adjoining roads and Preserve boundaries would optimally have buildings and parking areas sited at minimum setbacks that ensure attenuation of noise generated within such developments. Adequate noise buffering is also important at the edges of the schools bordering the Preserve and at Winters Park. The 100-foot buffer proposed for ecological purposes on the outside of the Preserve perimeter would serve the noise buffering objective as well.

- Visual buffering and screening: The retaining of existing trees and understory vegetation in the setback zones of adjoining development would also provide screening with vegetative quality comparable to the old-growth forest within the Preserve and would thus prove more desirable to the general public and possibly the occupants of the development than new landscape plantings. The City of Garland should be encouraged to consider the adoption of special setback, tree protection, and landscape screening standards for urban development areas bordering the Preserve within the proposed 100-foot buffer.



Peripheral Buffer Zone / Stormwater Management Buffer Zone

Special sites of particular environmental importance: A number of sites adjacent to the existing old-growth forest along Spring Creek are also worthy of inclusion in the Spring Creek Forest Preserve. Each possesses old-growth trees:

- The Weary Tract and lands to the north: The old-growth forest in this reach of Spring Creek is at least as large as the stretch of old-growth forest between Holford Road and North Garland Avenue, and is found on the floodplain and the adjoining bluff slopes and tributaries of the creek. Many of the most impressive specimens of Garland's Spring Creek old-growth forest are here. For these reasons, placing the Preserve's boundary in the outer edge of this forest sector deserves high recommendation. With the concurrence of the Weary family, the house and outbuildings could be acquired for use as a caretaker residence and Preserve maintenance facilities.

  North of the Weary Tract and bracketed between the three draws that cut down through the bluff in this north Preserve sector are several areas of exposed rock and thin soil where topsoil extraction has evidently occurred in the past. The abundance of native grasses and wildflowers that have adapted to the rigorous conditions of these abused areas has transformed them into landscapes of exceptional beauty and testimony to the ability of prairie grasses to adapt to such conditions where man-made disturbances are limited and invasive weed grasses are not encouraged. The inclusion of these grassland/wildflowers areas in the Preserve would provide landscape diversity, allow interpretation of the abusive history of the site and of the adaptive capacity of prairie grasses, and secure the ecological relationships that presently exist between the forest and these open areas and the plant and bird species that depend on them.

- Wooded slopes south of Holford Road and west of Spring Creek: The existing Preserve tract boundary that follows the Creek's west bank lies too close to the Creek to afford it meaningful protection. For a stream distance of 600 feet, the existing boundary lies within ten to 100 feet of the Creek's edge, a setback too short to secure any effective buffering. Acquisition of the thinly wooded slopes between the 530-foot contour and the Creek, between Holford Road and the north Chambers quarry pit, will provide sufficient dimension for runoff management, visual buffer, and natural reforestation.

- Floodplain south of Holford Road, west bank: The major portion of the floodplain is recommended for inclusion in the Preserve. The only exception is an extrusion of the floodplain into the Chambers quarry measuring approximately 250 feet by 400 feet, which is unforested.

Two small areas above the floodplain are also recommended for inclusion. The first is mid-way between Holford and North Garland Avenue, consisting of a scrub-covered bluff spared from quarrying and is essential to the buffering of the old-growth forest below. The second adjoins North Garland Avenue. It would protect the pond and floodplain below from adverse runoff and other effects of future land development of this bluff.

- Forest View Drive Extension: Holford to North Garland: The southerly stretch of the drive's planned extension in this section comes within 220 feet and 260 feet of the Creek at the last two bends of the Creek, respectively. It also cuts through two draws which are important to the forest in runoff dispersal. One of these is heavily wooded. Both were recommended by the Texas Nature Conservancy for inclusion in the Preserve.

  A more environmentally-compatible alignment can be established which modifies the southerly 40 percent of the roadway, rerouting it largely above the draws and above the major trees. This alignment also shortens the route by approximately 300 feet, avoids the seven to nine percent slopes traversed by the original alignment, and may require smaller sized drainage culverts.

- Forest View Drive Extension (North Garland / Naaman Forest High School): The proposed drive extension comes within 170 feet of the Creek in this section, too close to be compatible with Garland's forest Preserve goals, since road noise and littering would adversely impact legitimate Preserve use and enjoyment.

  The large field to the northeast of the existing stock tank is also a good quality native grassland, and the inclusion of a portion of this field within the Preserve would provide valuable diversity, particularly with appropriate management of the grassland for prairie restoration and interpretation.

  Also, the present drive alignment traverses a small stock tank, which may require extensive filling and subgrade preparation. The recommended alternative alignment would avoid most large trees and the filling of the stock tank. It would also traverse easier slopes and be approximately 100 feet shorter than the original alignment.

Proposed Preserve Boundary

Based on the findings defined above, the Preserve boundaries have been designed to lie a minimum of 400 feet from Spring Creek, wherever feasible. This will help to achieve preservation of the maximum number of significant trees and associated ecological resources, and to aid in protection of runoff patterns and velocities, attenuate noise, and buffer litter and views of adjacent roads and urban land uses. The broadest distances from the creek are found within the existing Preserve (about 1,000 feet) and in portions of the Weary Tract and Winters Park. The linear extent of the proposed Preserve is approximately 9,600 feet. Measured along the thread of Spring Creek, the Preserve will run approximately 2.6 miles and contain over 300 acres.

Care has been exercised to ensure that Preserve boundaries properly encompass significant resources by locating the boundaries as follows:

- boundary beyond the Weary property east-northeast into the Nicholson tract to the upper limit of the old-growth forest along a subsidiary drainage of Spring Creek;

- upstream boundary north of the first bend of the Creek opposite of the Spring Creek Preserve, to protect tree cover from development across the creek from the Park Preserve, and to ensure view access to the bend which has the highest creek bluff in the Forest Preserve overall;

- boundary along the east slopes of the north sector sufficiently distant from Spring Creek to protect old-growth forest, regenerating forest, large hardwoods, and high quality areas of native grasses and wildflowers (Southwest Savings Association and Olson tracts);

- boundary along the Chambers property sufficiently behind bluff crests to keep future tract development at a reasonable setback from Preserve lands, thereby minimizing visual intrusion into the Preserve. The boundary is also set just beyond the outer edge of the 100-year floodplain on this property;

- areas on both sides of North Garland Avenue on the east bank of Spring Creek, to a distance of approximately 400 feet from the creek, to protect it and the Preserve visually, to fully protect the old-growth forest on the north side of the thoroughfare, and to acquire a portion of the disturbed (pasture) lands south of North Garland Avenue that were most probably a part of the Forest before the trees were cleared for agricultural use and which can be restored to forest once again; and

- boundary along Winters Park sufficiently upslope to ensure adequate room for rainfall infiltration and moisture reserves for the creek's old-growth remnants and future restored forest.

Adjacent Land Use

Presently the lands of the future Preserve are bounded for the greater part of their perimeter by woodland, old pasture, other open lands, the Spring Creek Elementary School and Naaman Forest High School, parkland, and limited areas of low and medium density housing. Only two industrial land uses adjoin the Preserve: the Chamber Brothers quarry and the Dallas Power and Light Company's Brand Road electric power substation.

Other than the quarry, present uses are compatible with the Preserve, although school construction, Spring Creek sanitary sewer line, and road and bridge construction have had prior effects on Preserve lands, including the invasion of Johnsongrass and other aggressive grasses and shrubs into the disturbed edges of the forest.

The recent abuses and vandalism of the Preserve cannot be directly linked to any existing adjacent land use, although it may be generally claimed that as the area in further urbanized, the frequency of such incidents may rise. The development of the future Forest View Drive extensions on the east and the new extension of Mapleridge Drive along the Spring Creek Park Preserve on the northwest end of the Preserve may possibly diminish such incidents, given the increased surveillance possible through the presence of the drives. On the other hand, the proximity of the drives may aggravate illicit entry and abuse. Only active Parks and Recreation Department surveillance and Police Department enforcement can bring about Preserve protection.

Future land uses are reflected in current and future zoning designations, which provide for low and medium density residential use, including planned development (PD) zoned tracts. In addition to the community development on these tracts, office, commercial, and health service uses are anticipated on others, primarily along future State Highway 190 to the northeast. The presumption can be made that the increase in population and commercial activity may present a two-edged sword: the larger urban density can either help the Preserve or damage it further.

PARD signage and surveillance, appropriate perimeter lighting, and frequent police surveillance and enforcement will be prerequisites for an effectively managed Preserve. In addition, the active participation of the schools, particularly of Naaman Forest High School in the proposed outdoor classroom instruction and experimental restoration programs described below, may help to "enlist" teenage activism and dampen the possibilities of adolescent abuse. The same potential for participation may exist within certain other new land uses in the area; perhaps an interest in "adoption" of the Preserve or any of its components by one or another new adjacent community or by one of the new large businesses in the area could help generate positive neighborly attitudes and concern and thereby diminish the occurrence of antisocial behavior within the Preserve. To these ends an active PARD outreach program could prove to be of great value.

Active recreation facilities, including a leisure pool, are planned for PARD lands at Winters Park, adjacent to the Preserve. Provided that there is sufficient buffer distance between the Preserve and those facilities, such as the leisure pool, which generate noise and crowd presence, the important aesthetic value of the Preserve as a "place apart" may be conserved. In addition, due attention should be given to the alteration of natural drainage patterns that may be created by the construction of any facility on the creek side of Spring Creek Drive. The viability of the disturbed lands along that edge as a future old-growth precinct, under the recommended restoration defined above, would be compromised if the historic rainfall runoff patterns and velocities were altered.

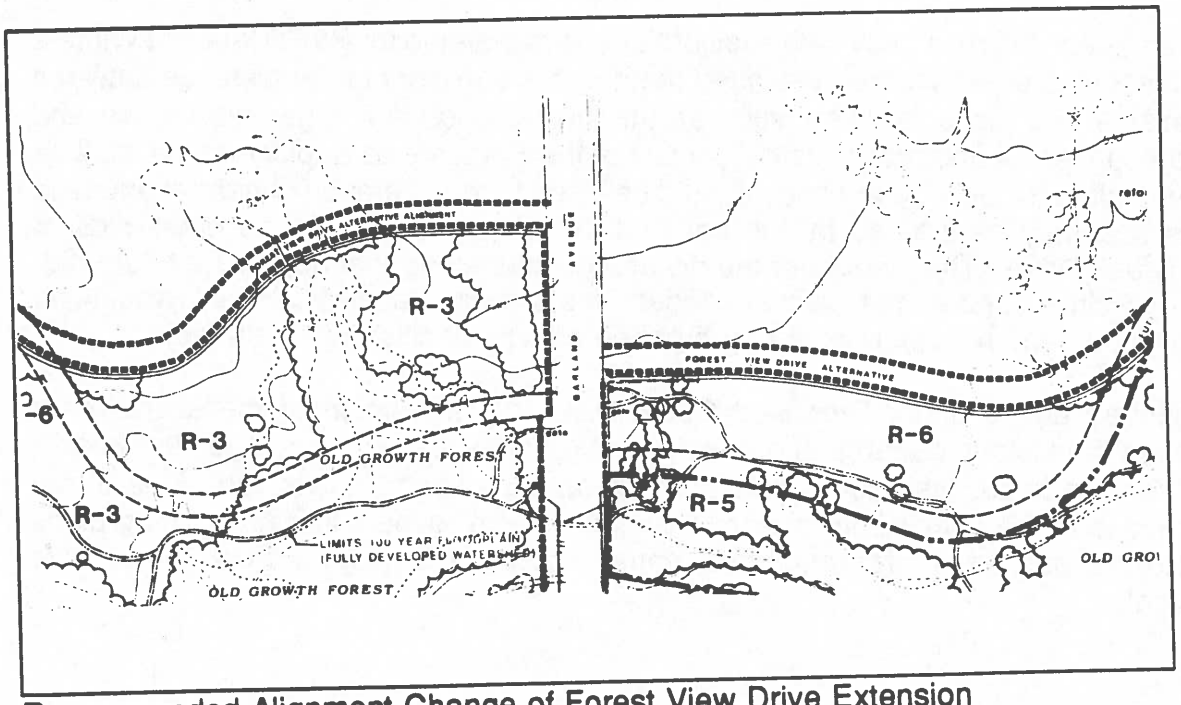
As described above under Proposed Boundaries, the prevention of the alteration of changes in the historic patterns and velocities of runoff is a crucial management need if the Preserve is to survive and its disturbed and damaged sectors restored. This is true of both sides of the Creek and must be considered with respect to both building plans (e.g., leisure pool structure) and road construction plans (e.g., Forest View Drive Extension).

Special City Actions Needed

To prevent the alteration of historic runoff patterns and velocities and consequent drying out of springs and groundwater, the following measures should be considered for adoption by City Council and the Garland Parks and Recreation Department:

- Setting the Preserve boundary along the delineations recommended in this Master Development Plan. This will secure the buffer areas which will continue historic runoff patterns and velocities in many key portions of the Preserve.

- Establishing final alignments for the Forest View Drive Extensions that approximate the realignments proposed in this Master Plan. The greater remoteness of the proposed alternate alignments from Spring Creek will aid in the dispersal of runoff to the trees on the Drive's downslope areas and help prevent decline of the Preserve's large trees.



Recommended Alignment Change of Forest View Drive Extension

- Establishing a special Zoning Ordinance regulating front yard setback requirement and maximum impervious cover limits for the properties fronting on drives or roads abutting the Preserve. The effects of these code requirements would be to increase the infiltration of rainfall into the subsoils within the upper subwatershed areas of the Preserve and minimize runoff into Forest View Drive Extension or into the detention ponds of the properties themselves, both of which rely on drainage control systems which concentrate, rather than disperse, runoff. A setback of 100 feet has been discussed, but further engineering analysis would be useful in determining the specific requirements of the proposed setback / buffer zone.

- Installation of frequently spaced culverts beneath Forest View Drive Extension, to prevent over concentration of runoff, and the installation of loose rock aprons, stone-lined distribution channels leading into grassed swales and natural terrain, and/or other devices at the culvert outfalls with the capacity to redistribute and disperse runoff as it discharges.

  - Providing a swale or broad ditch in the public right-of-way in the up-slope side of Forest View Drive Extension that would receive discharges from adjacent detention ponds, local runoff, and remote runoff detention facilities (see the following paragraph), and distribute discharged runoff to the frequent culverts beneath the Drive.

- Consider construction of a dedicated stormwater collection system for new development areas, such as those along future State Highway 190, that are within the Preserve's upper watershed areas but do not abut Forest View Drive or the Preserve proper. The dedicated system would carry detention pond discharges to the proposed swale on the upper side of the Drive, where it would discharge through the distribution system described above.

Forest Zones and Other Natural Areas of the Preserve

Old-Growth Forest

The old-growth forest is the heart of the Forest Preserve. Lying primarily at present along the east bank (northeast side) of Spring Creek but represented as well by significant stands on the west bank. These will be supplemented over time with broader expanses of old-growth forest as successional/upland canopies yield to maturing trees, particularly with the assistance of the forest restoration practices outlined below.

The largest old-growth forest stands occur in the Preserve's proposed North Sector, north of Holford Road (Weary Tract and other lands), and in the Central Sector, between Holford Road and North Garland Avenue. Other significant stands occur elsewhere in the Preserve, including areas on Spring Creek's west bank.

Given two or three decades of effective restoration management, the west bank will be easily perceived as an attractive and significant, albeit younger sibling of the east bank's old-growth forest.

For the most part, paved access paths are routed along the outer (up-slope) perimeters of old-growth forest areas. Blazed trails loop further into old-growth; these routes are unpaved and the blazing consists of small in-the-ground markers only. Sensitive areas with rare forest floor plants are generally avoided.

Regenerating Old-Growth and Successional/Upland Forest

In the regenerating old-growth forest, which lies principally along the subsidiary drainages of Spring Creek and their moisture-rich banks, Ash, Slippery Elm, Chinkapin and Bur Oak, Pecan, Sugar Hackberry, Cedar Elm, and Shumard (Red) Oak can be seen, both in larger trees and in seedling and sapling form. The Preserve paths will cross these zones at right angles, affording the visitor a view of these healing areas, but not encouraging unlimited walking and potential abuse.

Restoration measures are recommended for portions of the Regenerating Forest and Successional Forest, as a means of protecting and, in some cases, expediting their recovery from past disturbance.

Reforestation, Restoration, and Preserve Management

Preserve reforestation and management programs should initially be overseen by City staff, but may eventually be conducted by permanent staff of the Spring Creek Forest Preserve Society. The restoration programs could be conducted by various groups at different restoration areas. For example, the Naaman High School biology department could sponsor and conduct restoration activities in the vicinity of the Outdoor Classroom in Halff Park or in the vicinity of the school. The Garland PARD could manage the restoration program in Winters Park and Spring Creek Park Preserve, and the Preservation Society could work within the Preserve around the Visitors Center.

The Garland PARD can actively participate in propagation of native saplings at the greenhouse and nursery facility located in Winters Park. A sapling propagation/nursery grow-out area could be established in Winters Park just south of North Garland Road. This would be in close proximity to the Forest Restoration Interpretation Pavilion. The Texas Forest Service and urban foresters in Dallas could assist in developing specific recommendations for the various reforestation efforts. The Texas Forest Service can also supply hardwood saplings for use in developing reforested areas.

The reforestation/restoration activities will include planting, selective cutting, eradication, mowing, and reseeding. Non-native vegetation, such as Japanese Privet, Chinaberry, and Japanese Honeysuckle, should be destroyed and removed.

The reforestation activities should be carefully monitored to determine pre-existing conditions, plant types used, planting patterns and densities, and survival and growth rates.

Forest Restoration of Disturbed Areas

There are six reasons why reforestation of most of the disturbed portions of the Preserve is essential to the well-being of the Preserve's existing mature hardwoods:

- **runoff infiltration**: New trees on upper border lands will help perpetuate historic runoff patterns and velocities to the mature hardwoods in the lower bottomlands, thus helping to ensure year-round moisture in the root zone.

- **wind protection**: New trees on the Preserve periphery will buffer many mature trees from potentially damaging winds.

- **restoring the Preserve's historic environment**: The enlarging of the forest where it is presently a thin band along the Creek or otherwise poorly dimensioned will approximate the historic forest, enhancing its environmental depth.

- **aesthetic value**: The broadened forest will increase the aesthetic value of the Preserve.

- **educational value**: Reforestation will allow visitors to learn how amelioration works and to monitor its success in the Preserve, over time.

- **mitigation of damaged areas**: Reforestation, in conjunction with selected soil amelioration techniques and controlled burning where needed, will be needed to heal a number of disturbed areas which will become part of the Preserve:

  - Full Forest Restoration: Reforestation, in the tree species distribution typical of the random patterns presently found in the Preserve, would be undertaken in the areas marked as **R-1** on the Master Plan. Trees will be planted only with seed (acorns in the case of oaks) which are gathered the same season from parent trees in the immediate vicinity of the planting locations. The seeds, or acorns, will be covered with leaf litter typical of the species understory. In this manner, human intervention will be kept to a minimum and the newly reforested areas will approximate their historic antecedents to the degree possible.

  - Interpretive Forest Restoration: Several other areas will be restored to their presumed historic pattern with appropriate management techniques:

    * One **R-2** site would comprise portions of the Holford Road fill area, the site of the Visitors Center, planted with six- to ten-year-old nursery grown trees representative of the dominant canopy species of the Preserve to provide both shade and an interpretive introduction to visitors arriving in the proposed parking area. A portion of the fill area would also be preserved as it exists today, to demonstrate to future visitors the long-term effects of fill upon a forest slope.

    * A second **R-2** site would be the major portion of the severely disturbed lands on the northern end of Winters Park, adjoining North Garland Avenue. As pointed out earlier, the position of this sloping land above the Spring Creek floodplain allows it to play a crucial role in the management of runoff infiltration and consequently the potential restoration of the forest on the west

bank of the Creek. The present infestation by Johnson grass and other invasive weeds is so severe that an aggressive eradication program and the planting of native Preserve trees of sapling size are the steps most likely to remedy the problem. It is recommended that the Parks and Recreation Department propagate seedlings of Preserve species at its nearby greenhouse facilities. The seedlings could be transplanted from PARD's adjacent nursery to a nursery on a portion of the Winters Park disturbed area itself.

* The **R-3** sites are areas stripped of topsoil some years ago, to which grasses and forbs, including many attractive native wildflowers, have adapted on the thin soil cover and rock ledge niches that have offered opportunities for volunteers. A few hardy trees have also found interesting footholds. An extensive portion of these areas would be preserved intact, for both aesthetic appreciation and the chance to observe the very gradual regeneration of tree species over time.

* A selected **R-3** zone would be covered to a suitable depth with a mix of topsoil, borrowed from an area outside of the Preserve that is comparable to the Creek's Frio Silty Loam floodplain soil, and leaf litter typical of its understory; tree seeds/acorns would be planted with the technique described under **R-1**, above. The plot would afford the visitor an experimental demonstration of the restoration of topsoil-stripped forest lands.

* The **R-4** site is on the northern edge of the Chambers quarry property, in the section proposed for City acquisition. Here, too, a small area would be preserved intact to allow visitors to compare restored growth areas with the exposed rock areas of the quarry periphery and to observe volunteer or pioneer species that manage to acclimate to hospitable niches. The remainder of the area would be ameliorated with soil and leaf litter, as described above, and planted with ground cover, shrubs, and trees adaptable to thin soil conditions and found among the Preserve's native species.

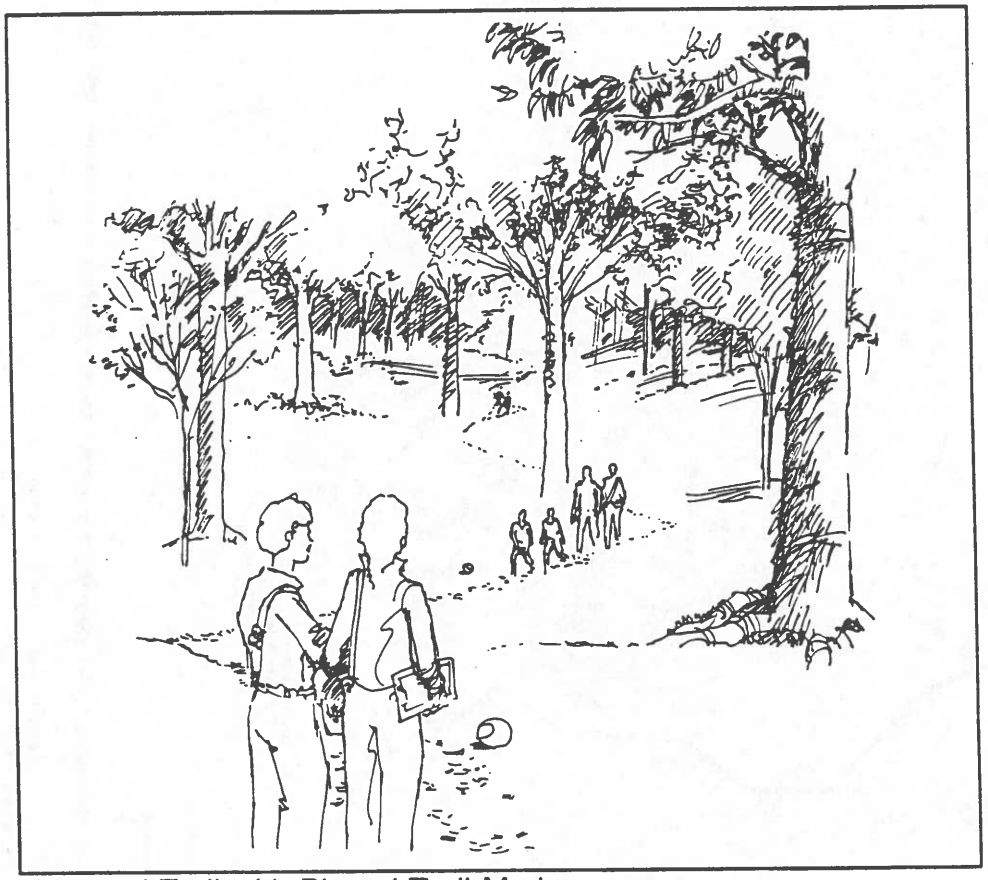
* The **R-5** sites are either lands where trees were removed in years past for pasture and cropping and which are presently in pasture or open, or are natural native grassland margins of the forest, that is, components of the historic North Texas Blackland Prairie. Where possible, where the grasslands have not been taken over entirely by non-native plants, Preserve management should be directed at methodically restoring the site to prairie conditions, as described below.

Restoration areas R-1 through R-5 are illustrated on the Site Master Plan shown in four sectors as Figures 4.2 through 4.5.

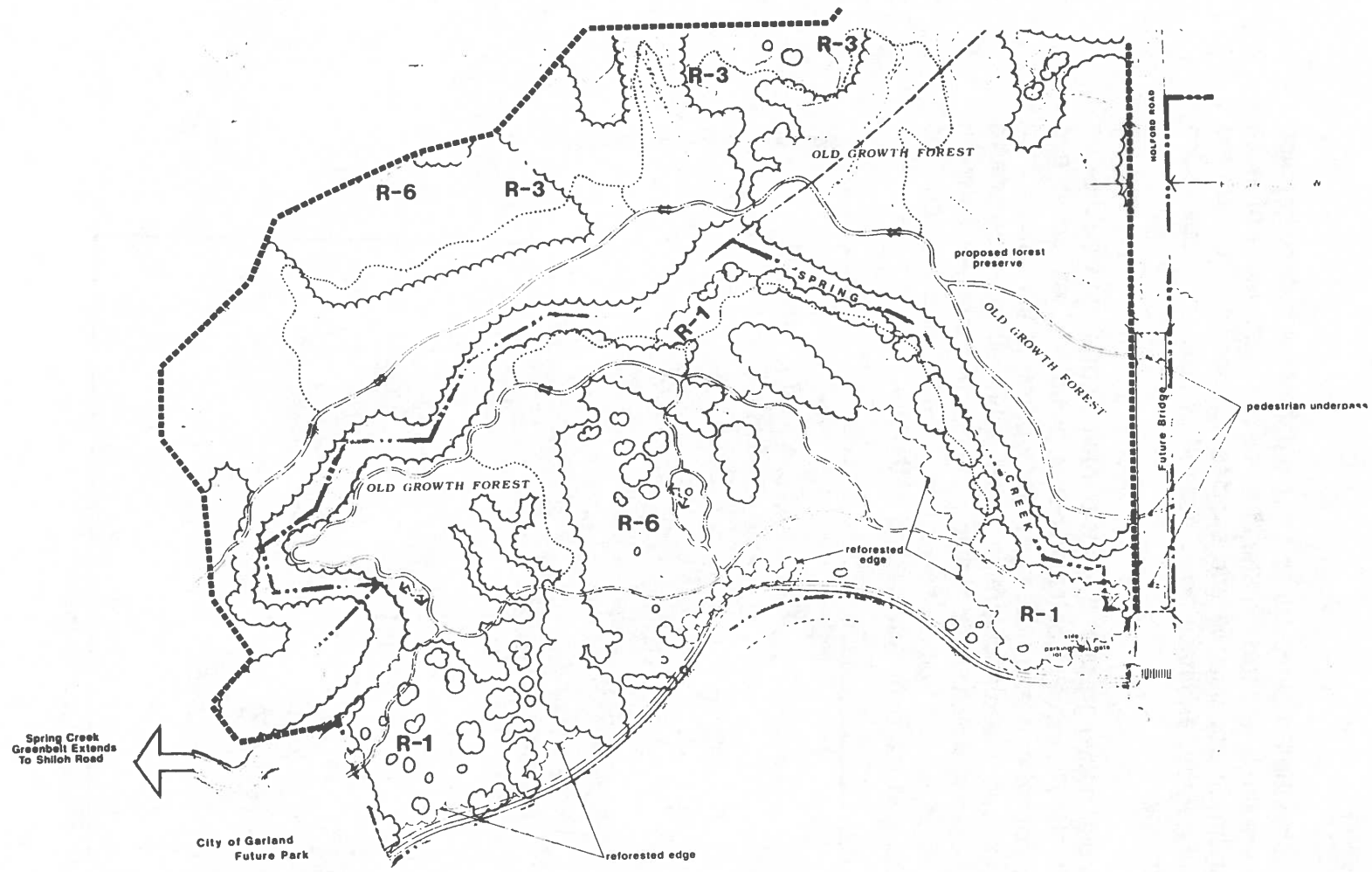
Native Grasslands Restoration

The native grassland areas within the Preserve are as much a part of the historic heritage of the creek environment as are the grand trees of the old-growth forest. Many of these grassland areas are near-prairie in appearance and species composition. Others are disturbed, in lesser or greater degree, and have been invaded by noxious species such as Johnsongrass and Ballisgrass.

Restoration of the less disturbed native grassland areas to prairie condition would be an important program mission for the Preserve. Controlled burns, ploughing, reseeding, and other techniques should be considered and utilized as appropriate to this end. Once established, the new or improved grasslands/prairie could serve as key interpretive stations on the overall Preserve tour, which would highlight the interrelationships between plant adaptation and soils, slope, and moisture, as well as the ecological relationships between grassland and forest and the birds and wildlife of the area.



Unpaved Trail with Blazed Trail Markers



Notes:

Existing tree masses shown are derived from 400 scale aerial photographs and require field verification prior to detailed design

Topography compiled by photogrammetric methods from aerial photography

100 year flood plain from 1986 Hewlett and Spring Creek Flood Plain Management Study

NORTH 50 100 200 300 500

LEGEND

City Ownership
Preserve Boundary (proposed)
Paved or Surfaced Path
Blazed Trail
Stile — Fence (typ.)
Scenic Overlook
Footbridge — Bike Rack
Pond or tank
Crosswalk — Hike & Bike Path

Restoration Areas

R-1 FULL FOREST RESTORATION
R-2 INTERPRETIVE RESTORATION/rockfill
R-3 INTERPRETIVE RESTORATION/stripped surface
R-4 INTERPRETIVE RESTORATION/quarried area
R-5 INTERPRETIVE RESTORATION/pasture/hayfield
R-6 PRESERVATION/RESTORATION/native grasses

SITE MASTER PLAN

NORTH SECTOR

FIGURE 4.2

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT H. HALFF ASSOCIATES, INC.

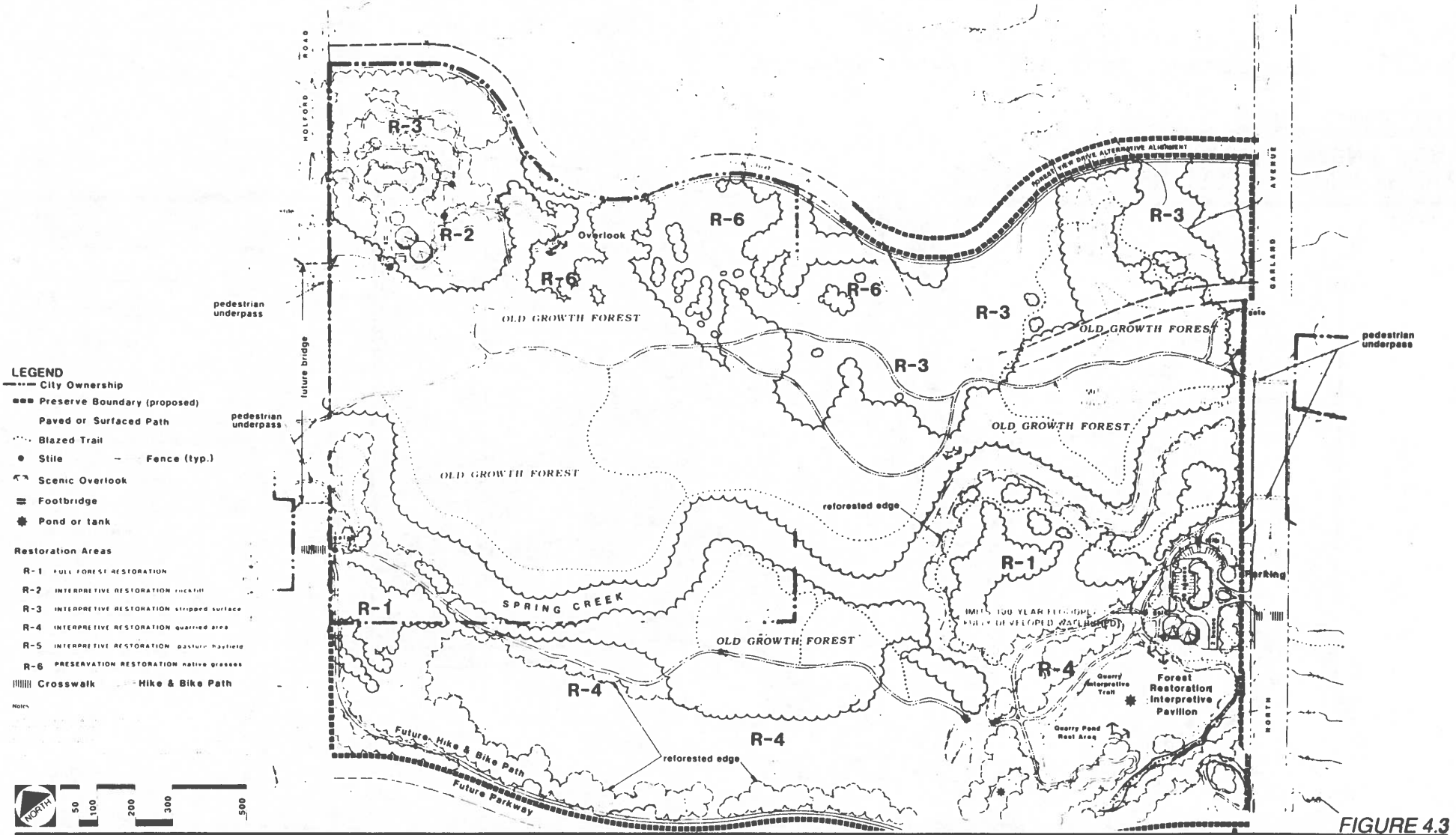


FIGURE 4.3

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

SITE MASTER PLAN

CENTRAL SECTOR

ALBERT H. HALFF ASSOCIATES, INC.

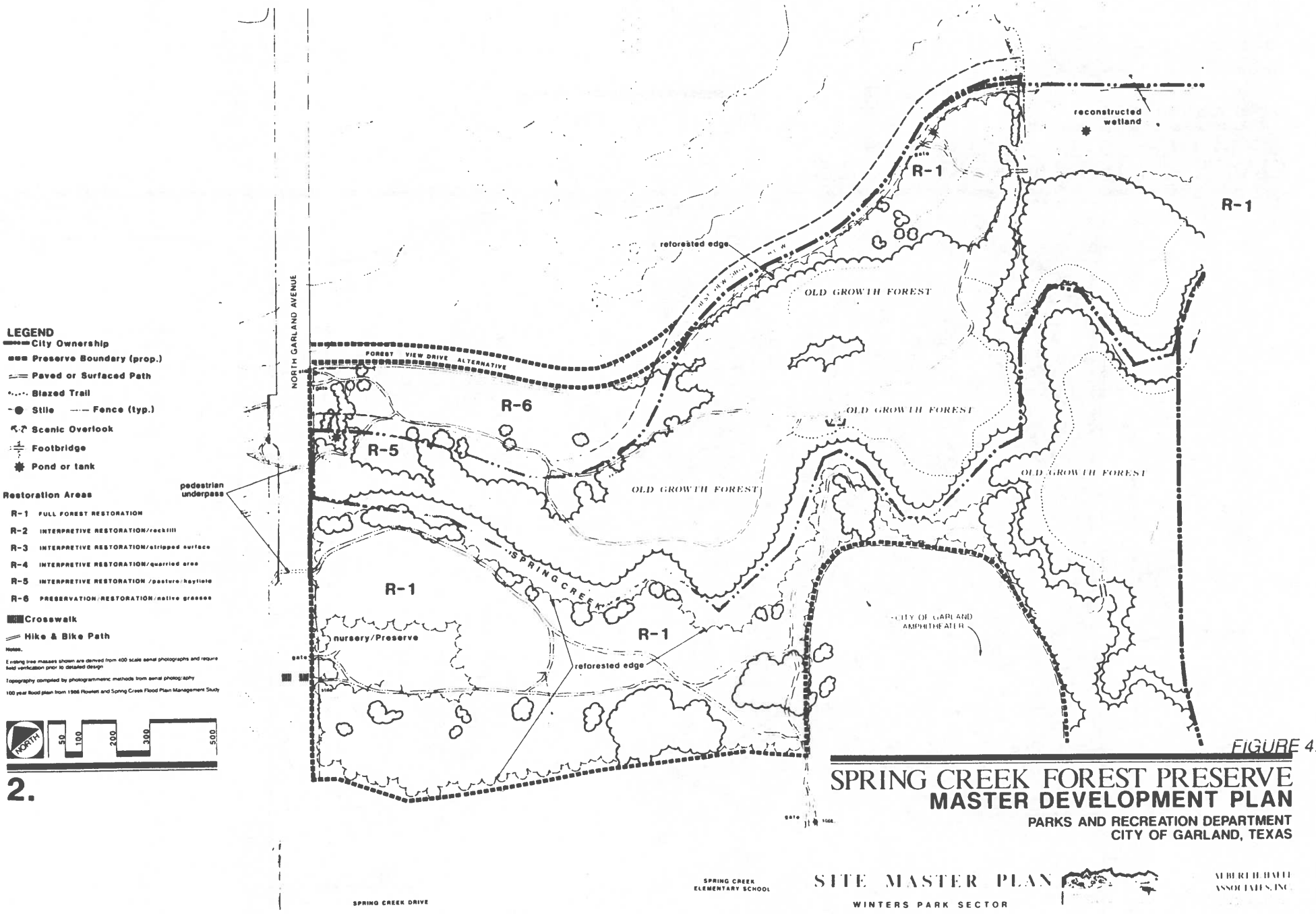


FIGURE 4.

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

SITE MASTER PLAN

WINTERS PARK SECTOR

ALBERT HALFF ASSOCIATES, INC.

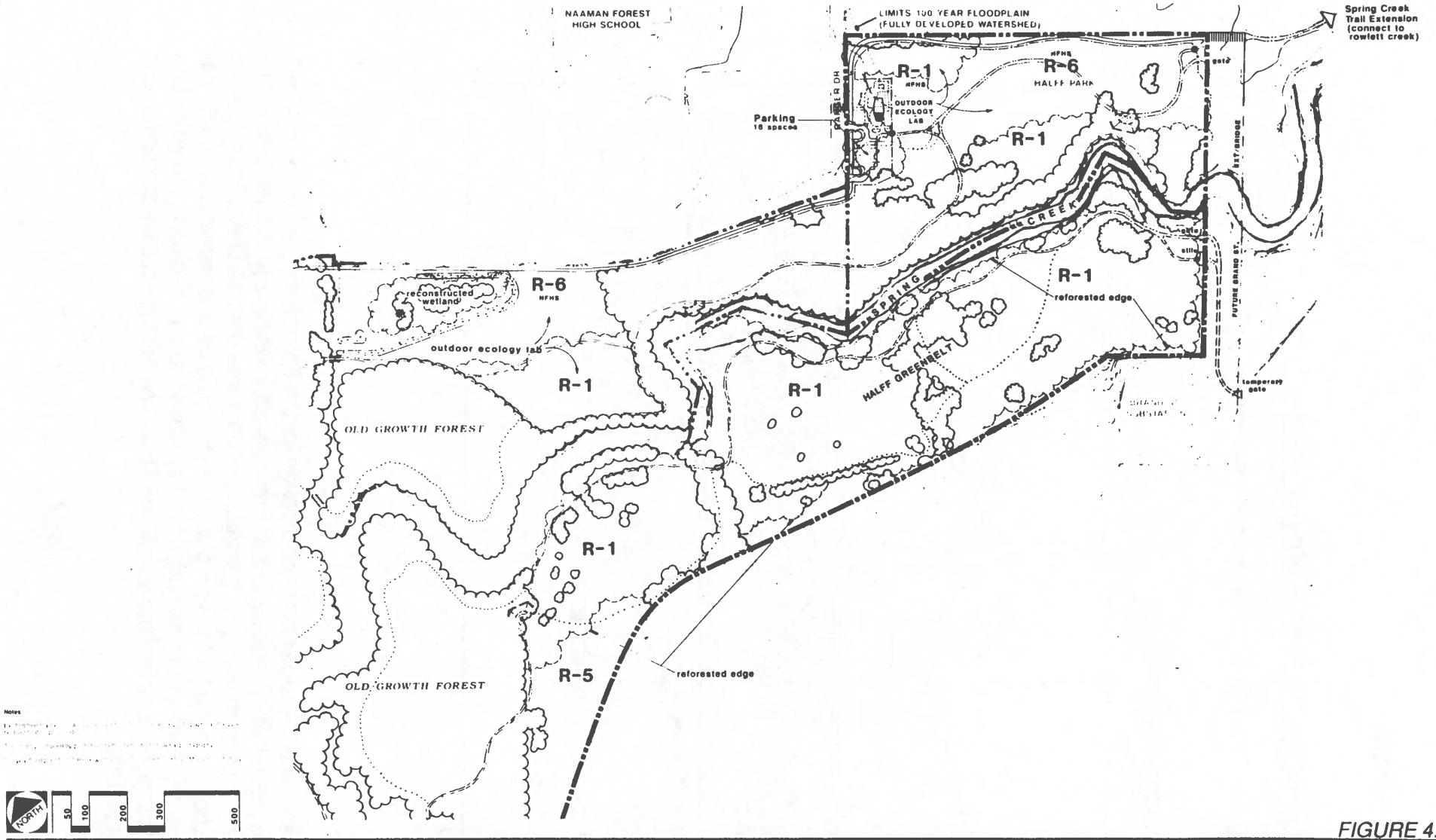


FIGURE 4.5

LEGEND

- City Ownership
- Preserve Boundary (proposed)
- Paved or Surfaced Path
- Blazed Trail
- Stile
- Scenic Overlook
- Footbridge
- Pond or tank
- Hike & Bike Path
- Crosswalk
- Fence (typ)

Restoration Areas

- R-1 FULL FOREST RESTORATION
- R-2 INTERPRETIVE RESTORATION/rockfill
- R-3 INTERPRETIVE RESTORATION/stripped surface
- R-4 INTERPRETIVE RESTORATION/quarried area
- R-5 INTERPRETIVE RESTORATION /pasture/hayfield
- R-6 PRESERVATION/RESTORATION native grasses

SITE MASTER PLAN

SOUTH SECTOR

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN

PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

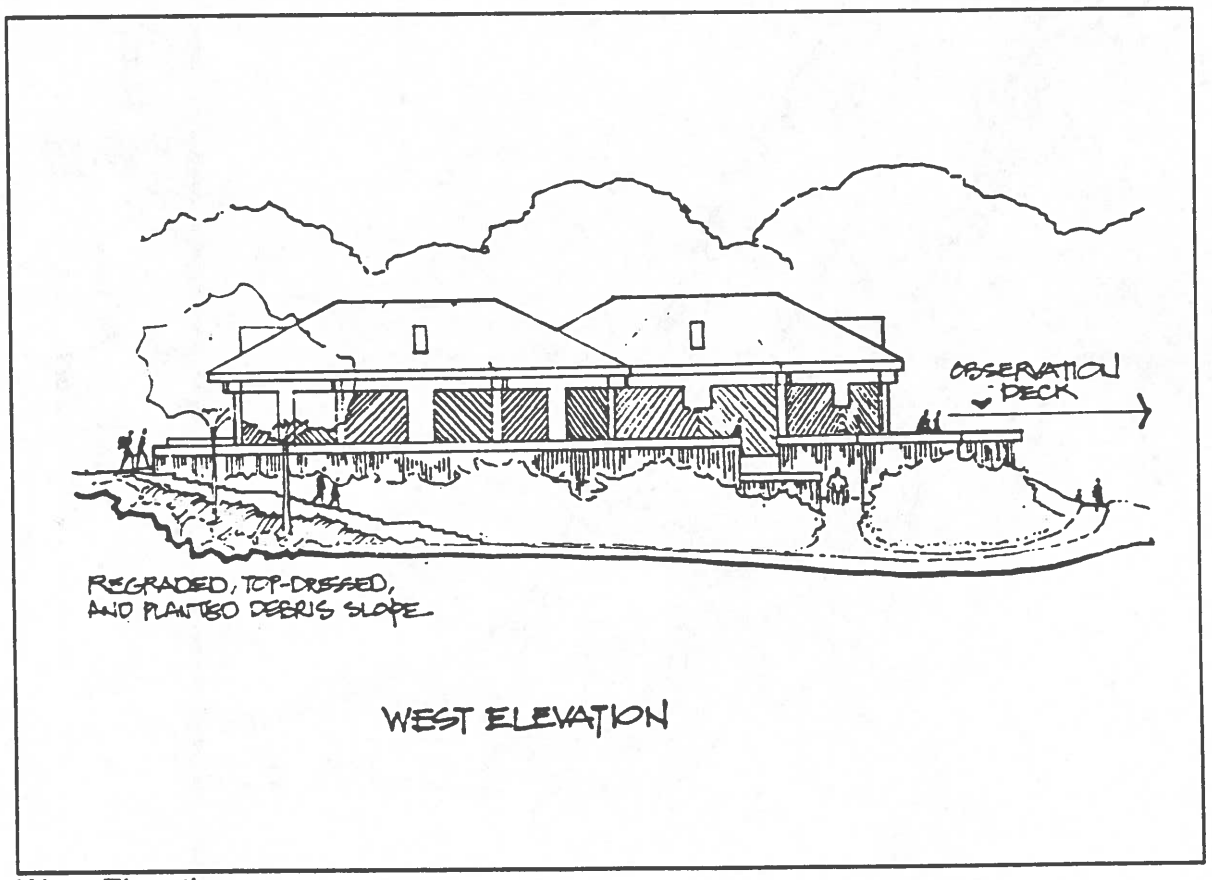
ALBERT H. HALFF ASSOCIATES, INC.

Facility Development

Major Facilities of the Preserve Master Plan

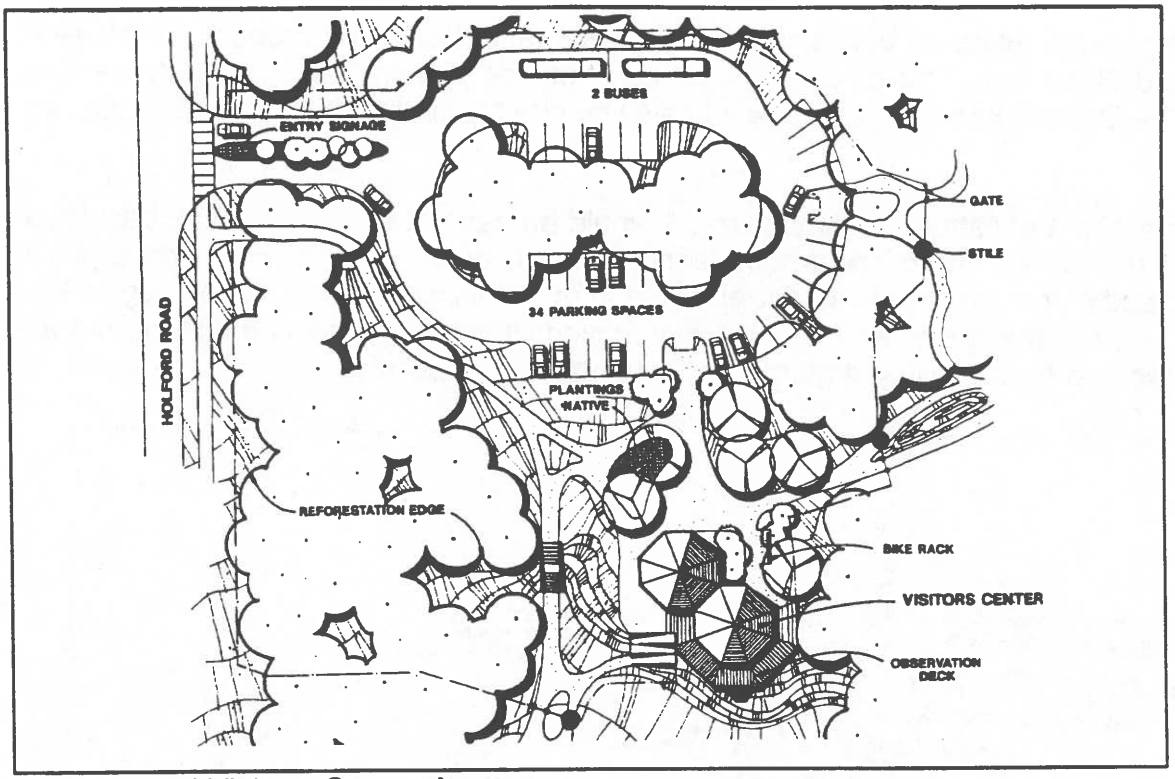
The proposed Master Development Plan facilities are shown on Figures 4.2 through 4.5.

Holford Road Visitors Center

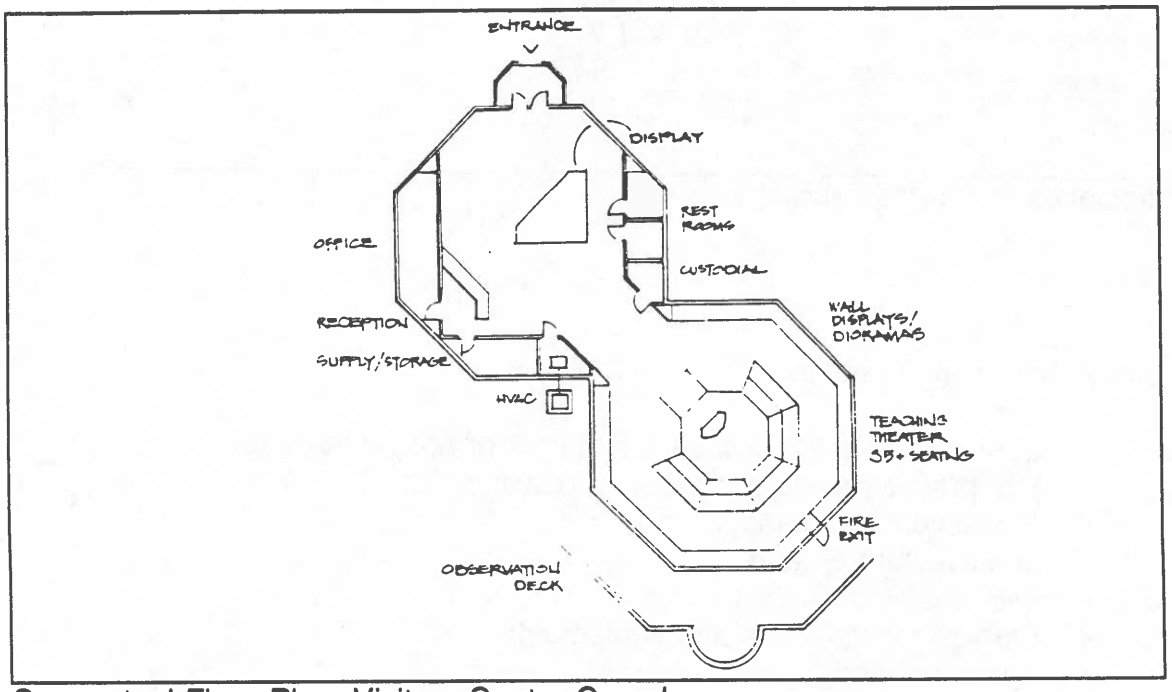


West Elevation

The Holford Road site is the recommended location for the Preserve's visitors center, with a principal interpretive facility relating to the Preserve as a whole and the tall trees of its old-growth forest. A parking area with a capacity of not more than 40 car spaces and two bus spaces is recommended for the present. Parking could be expanded to about 60 car spaces in the future. Expanding parking at the site beyond this capacity should not be undertaken without prior review of the established Preserve environmental protection and management objectives.



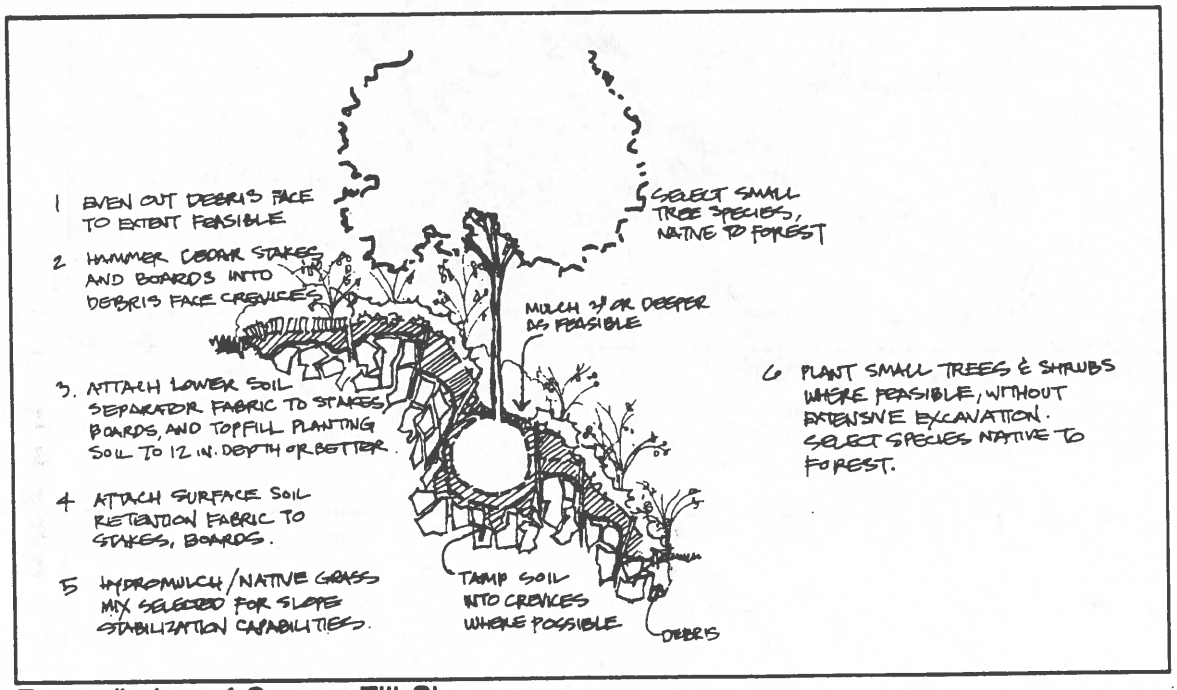
Plan View of Visitors Center Area



Conceptual Floor Plan, Visitors Center Complex

The old-growth forests on both banks of the Creek and the Weary property to the west of Holford Road would be directly accessible from the Visitors Center and its parking area. The Observation Promontory would also be directly approachable from the Visitors Center.

The edge of the construction debris landfill would be partly dismantled; reset; backfilled with suitable layers of soil separator fabric, subsoil, general fill, topsoil, and organic matter; and planted with native species capable of stabilizing the new slopes edging the debris. Where the rocky landfill is not dismantled or covered, planting pits should be excavated into the rockfill and planted with suitable tree species.



Remediation of Coarse Fill Slope

The Visitors Center would have:

- approximately 4,000 square feet of floor area (enclosed);
- interpretive panels and other displays;
- Preserve management office;
- small lecture theater;
- two unisex restrooms;
- storage for materials and equipment;
- public phones;
- drinking fountains;
- four trash receptacles; and
- bike rack.

Observation Promontory

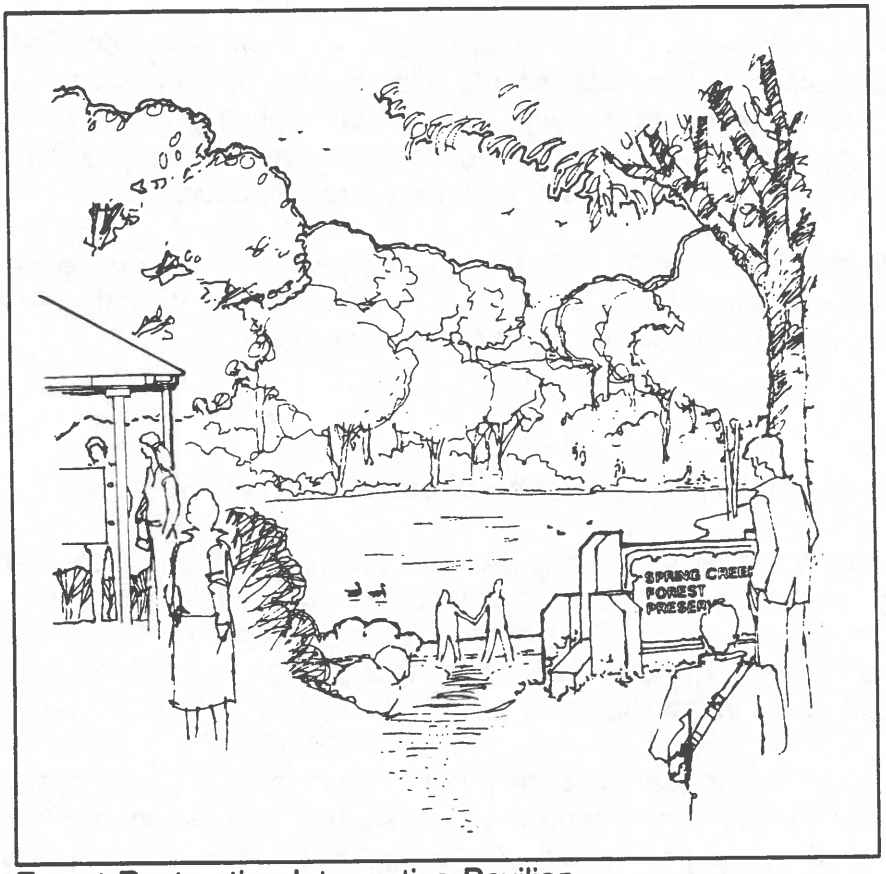
A spur path to a nearby existing high earthen hill in an area to the southeast of the visitors center would provide visual access into and above a portion of the high canopy of the old-growth forest, the high point being about 30 feet above grade on its down side. It would be easily accessible by a wheelchair-compatible path on its up-slope side, with an appropriately designed ramp of natural materials and a suitable surface.

A newly-built deck, platform, or observation tower would be unnecessary because of the prominence and accessibility of this landform. The absence of an intrusive structure would also be compatible with the character of the Preserve.

North Garland Avenue Forest Restoration Interpretive Pavilion

A site on the Chambers Brothers' property is the recommended location for a secondary interpretive facility, whose principal function would be to guide visitors on the Preserve's forest restoration program, important elements of which would be in evidence in the facility's immediate vicinity. The structure would ideally be a roofed, open-wall pavilion, and the general site could be considered an "outdoor classroom".

The visual restoration of the scarred quarry landscape could be best seen from the pavilion and the trails which would lead along the creek and its upper shores. The general restoration of the upper slopes would minimize future erosion and help to conserve both groundwater supply and surface water quality. Both processes could be readily interpreted on durable displays at and near the structure.

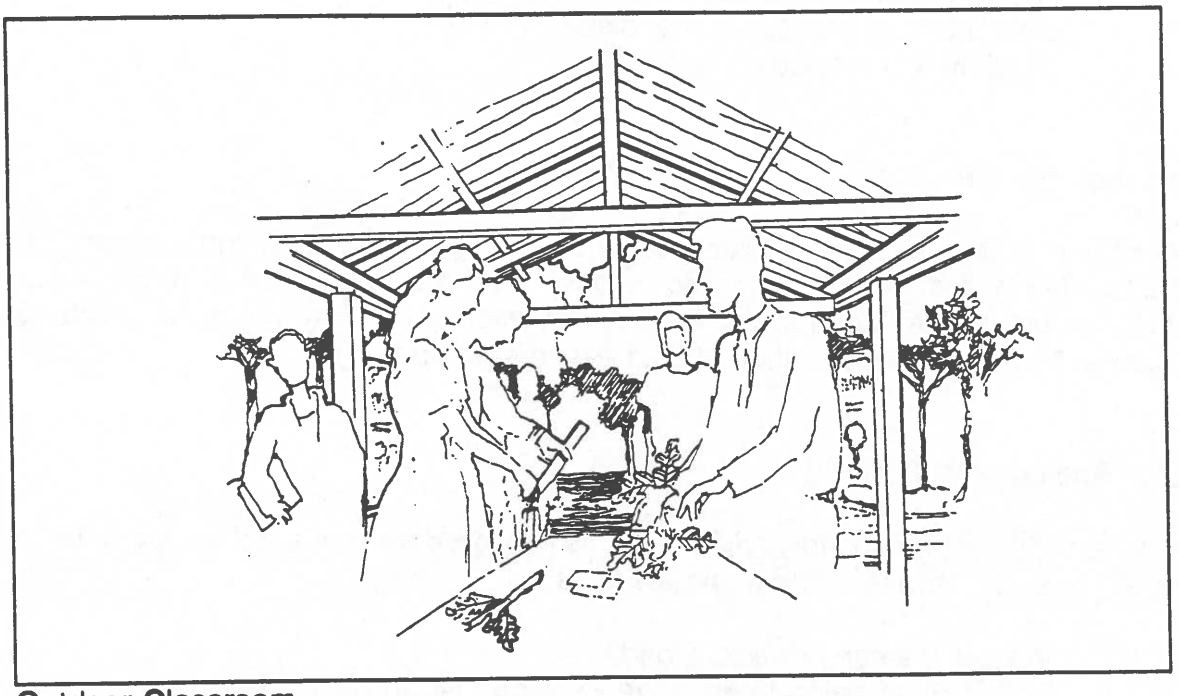


Forest Restoration Interpretive Pavilion

The pavilion would have:

- approximately 1,000 square feet of floor area;
- enameled steel interpretive panels and other displays, in the public, open-wall area;
- small office/Preserve rangers (enclosed area);
- two unisex restrooms (enclosed area);
- emergency phone;
- drinking fountain; and
- two trash receptacles.

Naaman Forest High School Outdoor Classroom



Outdoor Classroom

A similar outdoor "ecological laboratory" could be established in the vicinity of the small pond / wetland area, which lies close to the high school property line. This thematic element could encompass prairie grass and forest restoration.

There is an absence of old-growth forest in Halff Park, a presence of diverse disturbed lands and successional canopy, and proximity to Naaman Forest High School. The presence of the disturbed lands suggests that reforestation should have a high priority at this location, while the close location of the high school suggest that the process and progress of reforestation could have considerable teaching value for classes in biology, botany, and related subjects or special programs. It is hoped that the Garland Independent School District would consider participation in such an outdoor classroom framework and agree on appropriate joint management of such a facility with the Garland Parks and Recreation Department.

A small shelter without walls is the only proposed structure for the classroom. It would shelter tools and materials brought out from the high school during the day. A small number of interpretive display panels, relating to forest restoration and the sciences of forestry and ecology, would be integrated with the shelter's roof supports. The Shelter would be sited within the loose Cedar Elm-Hackberry-Johnsongrass stand at the northern corner of the park; clearing out the Johnsongrass and otherwise managing the stand itself would be one of the lessons taught in the "laboratory".

The Naaman Forest High School outdoor classroom would have:

- approximately 400 square feet of floor area;
- steel interpretive/educational displays; and
- possibly two restroom units.

Spring Creek Park Preserve

The role of the "preserve park" will necessarily be heavy on preserve, light on park. A small picnic area and adjacent open field frisbee / free play area, with a 10 to 14 car parking lot, should be the extent of passive park development. Elsewhere, as indicated on the Master Plan, forest restoration should assume first priority.

Vehicular Access and Parking

The five sites within or immediately adjacent to the Preserve which are potentially suitable as general vehicular access and parking areas are:

- Visitors Center / Holford Road,
- Forest Restoration Interpretive Pavilion / North Garland Avenue,
- Spring Creek Drive and Winters Park,
- Naaman Forest High School Outdoor Classroom,
- Spring Creek Park Preserve.

Visitors Center / Holford Road: The Holford Road site is publicly owned, has already been disturbed, and stands close to a significant stand of large, mature Preserve trees. The site also has little direct visual access to either the understory of the Preserve or Spring Creek, which, while making the site somewhat detached from the Preserve proper, will beneficially insulate the Preserve from the intrusion of vehicular sights and sounds.

Since the site is distant from a majority of the Preserve, an additional parking site or sites closer to the central and southern sectors would also be desirable. The Holford site is located on Holford Road, which for the present at least is a two-lane, no-shoulder facility, and which runs at a slope of greater than 15 percent. A parking capacity of about 30 to 40 cars would be appropriate until future road improvements allowed better left-turn storage and traffic safety, at which point the capacity could be increased.

Forest Restoration Interpretive Center / North Garland Avenue: The southeast corner of the Chambers Brothers' property site is advantageous. It is located close to the center of the Preserve, is situated on North Garland Road, (which has good traffic carrying capacity, good sight lines, and a break in the road median at an appropriate location), and can be easily accessed from Spring Creek Elementary School and Webb Middle School. This latter factor could allow ease of periodic visits by school classes to an interpretive facility situated at this parking location.

Although the potential parking area at this site would not be immediately adjacent to the Preserve's major reaches of big trees, it does offer access to the large trees along the Creek both upstream (Chambers property) and downstream (Winters Park) of the North Garland Avenue Bridge (beneath the bridge span). Visitors can also cross the bridge to access the principal big tree reaches on the east bank of Spring Creek.

The Chambers Brothers' property site could provide parking for about 30 to 40 vehicles. Most of these could be sited in the 100-year floodplain (above the 25-year floodplain) without physically or visually encroaching upon the Creek banks or any existing trees. The site is an existing quarry hauling access point.

Spring Creek Drive and Winters Park: The school properties could potentially provide parking spaces on a shared parking/after school hours and weekends basis, if agreeable to both the City and the Garland Independent School District. Parking on or along Spring Creek Drive on a routine basis, however, would probably create conflicts with both school and parks management. Thus, Preserve parking could be allowed on Spring Creek Drive, but the provision of a dedicated Preserve parking area on the Drive and the "advertising" of the Drive as a place to park for Preserve access should be avoided.

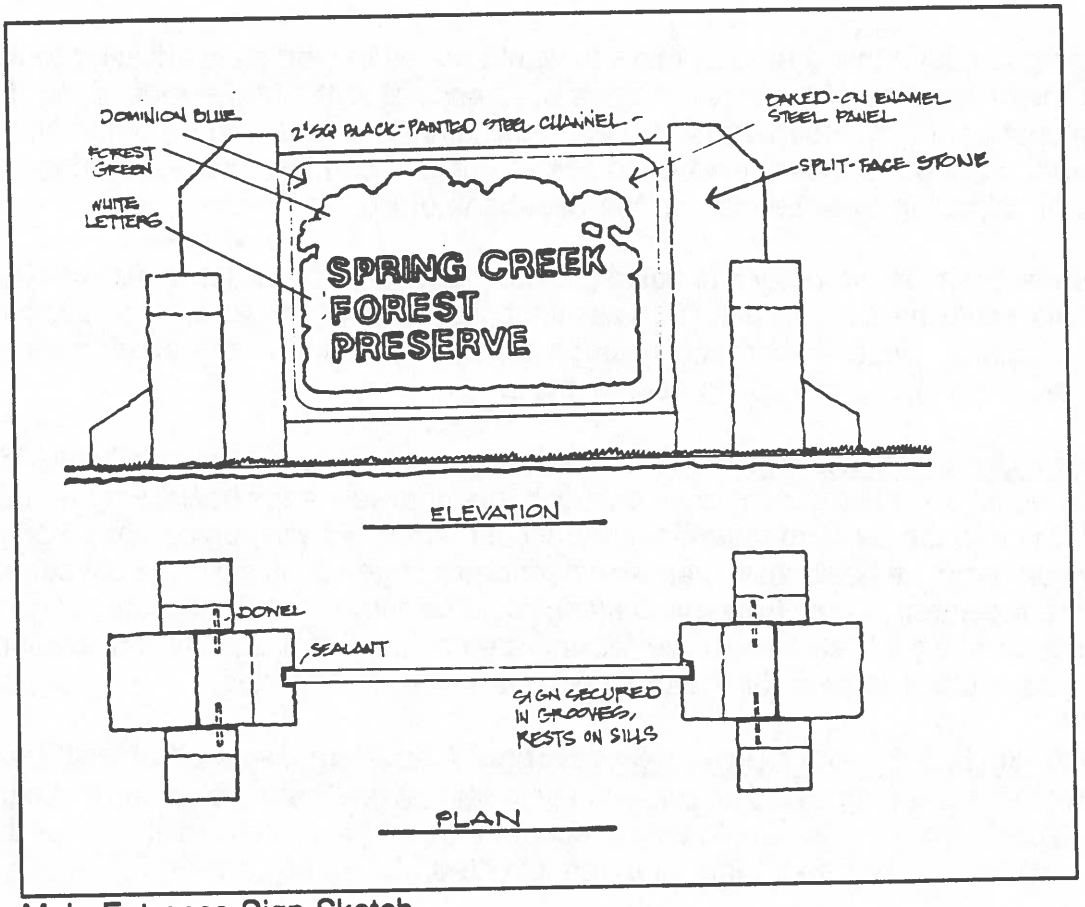
Naaman Forest High School Outdoor Classroom: A small parking area at Halff Park would be desirable to afford users an opportunity to park at the Preserve's southern end. A parking capacity of 16 to 24 would be suitable and could serve as a trailhead for the Spring Creek hike and bike trail that will be constructed along Forest View Drive.

Spring Creek Park Preserve: A small parking lot in this park is desirable, and would provide access to a picnic area and a looped trail system within the park.

Path and Trail System

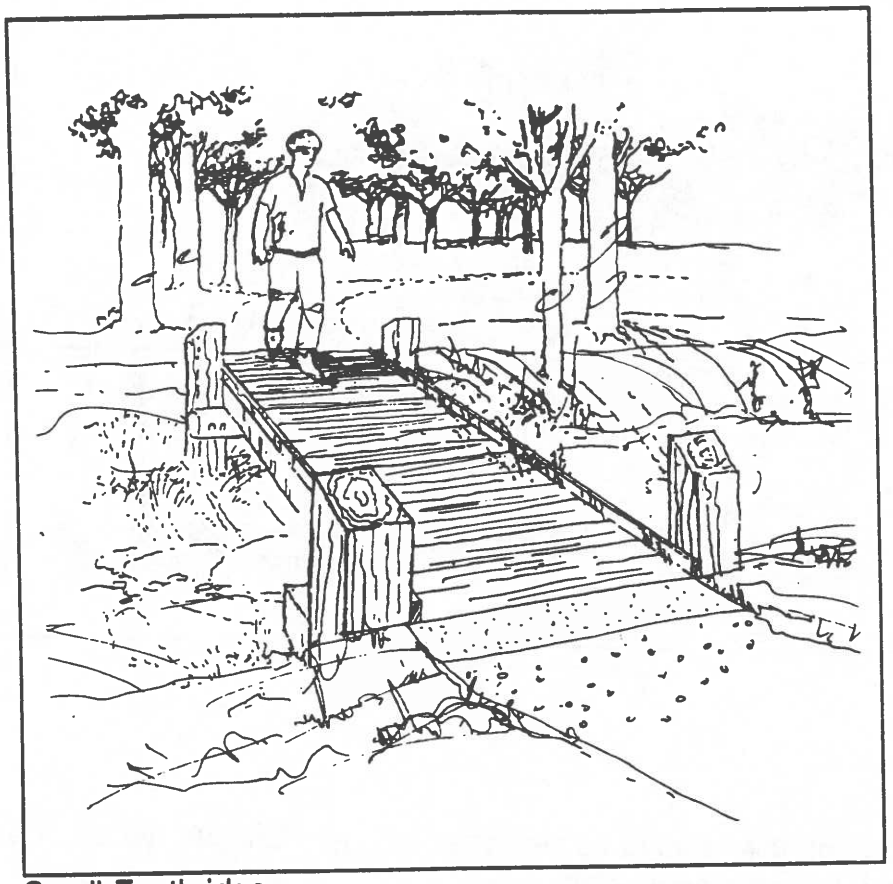
Paved hike and bike trails are proposed within the rights-of-way of Forest View Drive and Mapleridge Drive, which would provide pedestrian and bicycle access along the Spring Creek corridor and eventually connect to Rowlett Creek.

One main Preserve path is planned for each side of the Creek, aligned near the outer perimeter of the old-growth forest. In this location, the path affords access to the heart of the Preserve, yet keeps the burden of visitation to the higher elevations of the floodplain and away from some of the wetter soils and from many sensitive areas, such as hazardous bluff slopes and rare plant habitat. Its relative proximity to the future Forest View Drive extensions may also provide a certain level of either actual or perceived security.



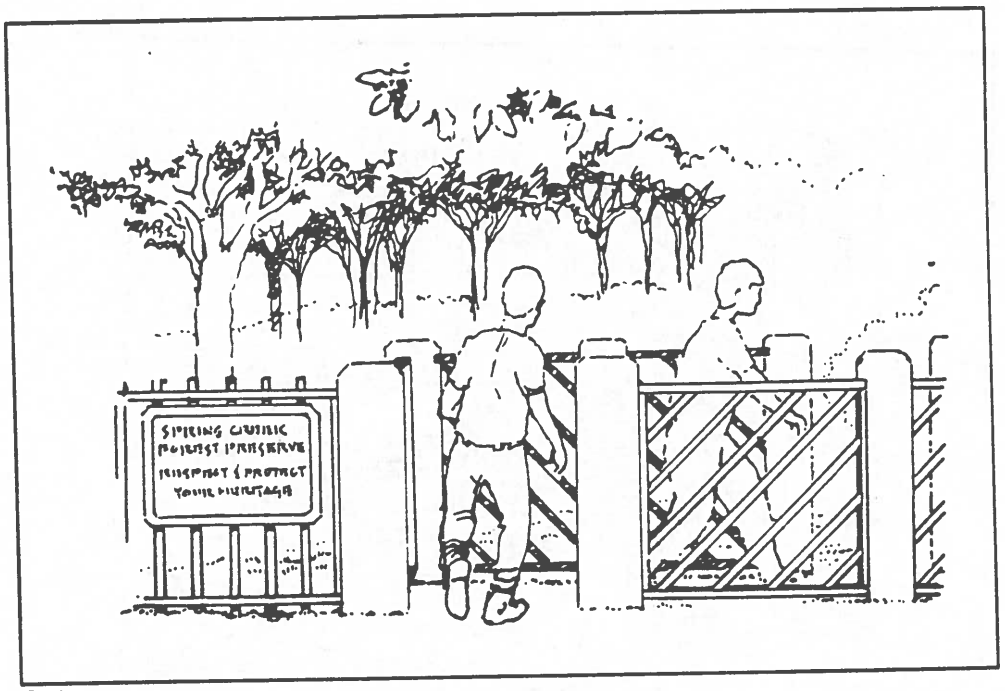
Main Entrance Sign Sketch

The material used for surfacing the main path should be processed bark chips, tamped into a caleche base. This selection would be highly consistent with Preserve character. An alternative selection would be porous bituminous concrete ("popcorn paving"). The recommended path width is five feet. Suitable and unobtrusive sub-drainage will be provided where needed. Where cross-drainage cannot be accommodated in an unobvious manner, small footbridges (adzed logs or planks cut in 19th century style) are recommended.



Small Footbridge
(supplement to standard footbridges with deck spans and safety railings)

The main path will be continuously accessible by the handicapped. Access into the Preserve by wheelchairs will be by gate adjacent to the stile at the head of the main path. The stile is essential in order to exclude bicycles, trail bikes, and other unauthorized vehicles. The gate will stay locked at all times other than for the admittance of wheelchair visitors, and for PARD, police, ambulance, and other authorized vehicles.

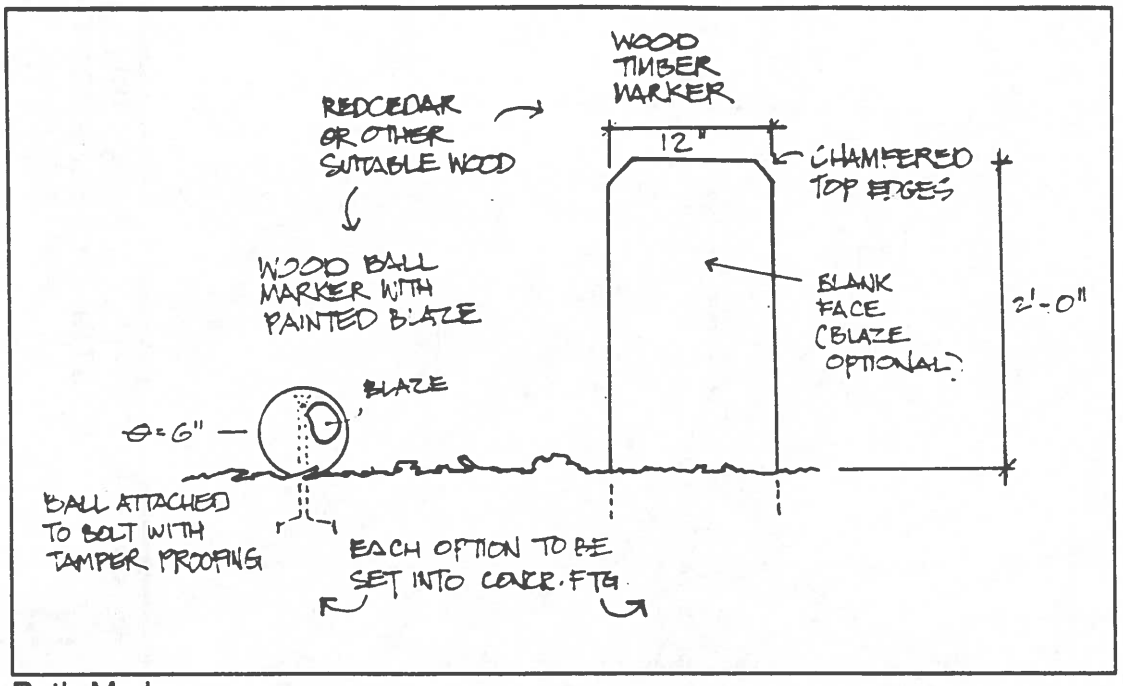


Stile

Footbridges, although they should be designed as rustic bridges typical of early North Texas, will be handicapped accessible.

Blazed trails, marked by numbered spherical markers set close to the ground on single stalks, will loop away from and return to the main path at the points shown in the Master Plan. No signs will be provided other than these markers, which will be set approximately 100 feet apart to minimize visual disturbance. In the flatter areas of the forest, surfacing of the blazed trails should not be undertaken. Where slopes occur, however, tamping of chipped wood, shredded bark, or other suitable natural forest materials into the earth will serve as an appropriate surface.

The blazed trails can easily be relocated, simply by shifting the movable markers. In this manner, users can be diverted away from any sensitive area of the Preserve, and allow for the restoration of impacted areas.



Path Markers

Fence and Gate Development

A five-foot-high black-coated chain link fence and stone columns are recommended for the perimeter of the Preserve. The boundary of the existing Preserve property was surveyed and the chain link fence has been installed. The stiles, gates, and stone columns will be added with future phases of site development. Figures 4.6 and 4.9 illustrate the location and style of the fence.

Where the fence flanks the road bridges, six-foot-high black-coated steel grill fencing will be substituted for chain link. The greater height, greater durability, and finer quality of the grill fence will present a more respectable authority to passerby and hopefully improve public respect for the Preserve along its more accessible edges.

Stiles are installed within the grill fence sections, near the bridges and at the heads of the main paths in each section of the Preserve. The stiles will admit people on foot, but not bikes and other vehicles.

Lockable gates for authorized access should be installed in the perimeter fence in each reach of the Preserve, on both sides of the Creek. As noted above, wheelchair access to the main paths is to be provided through these gates, as well as access to authorized vehicles.

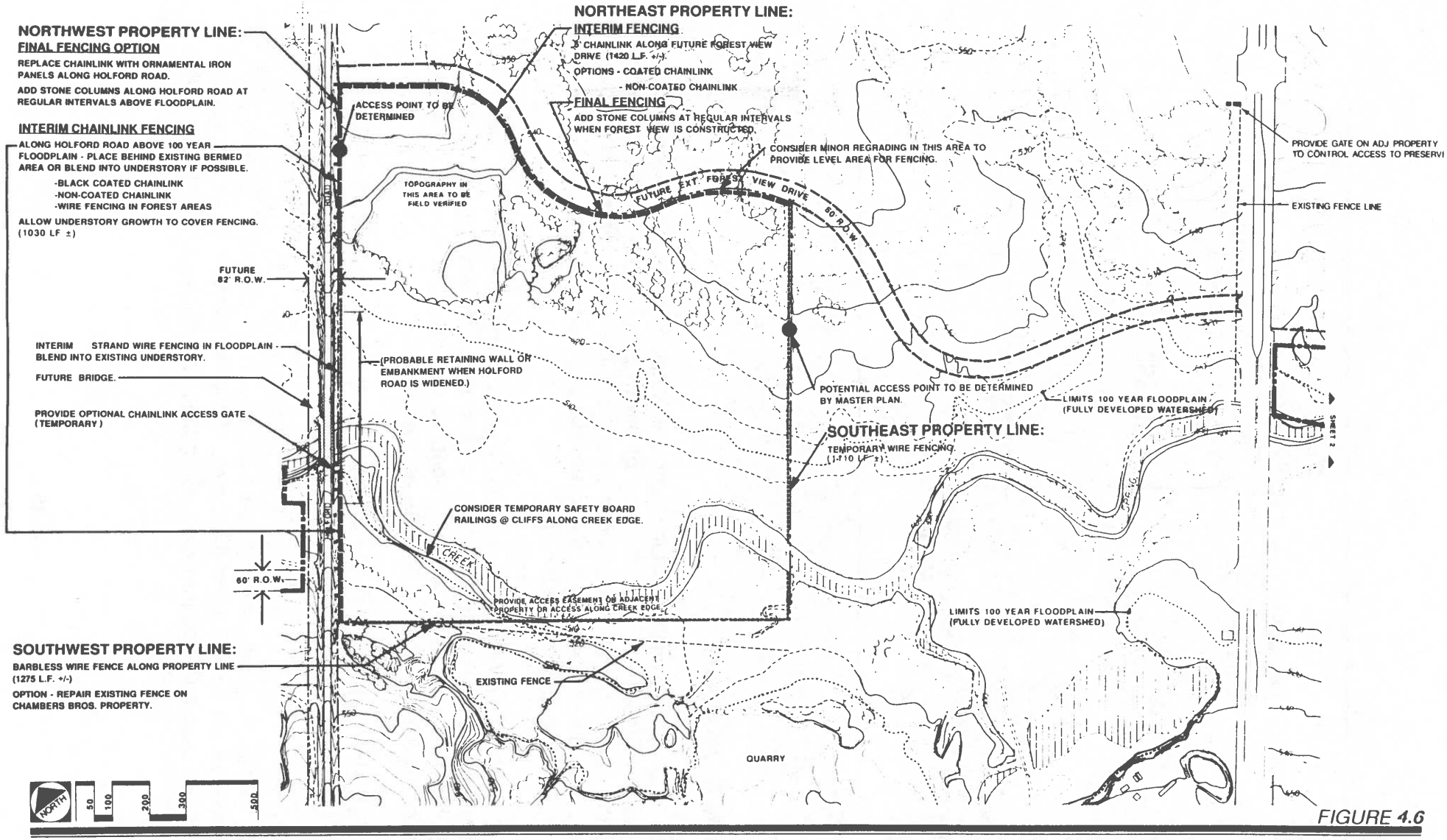
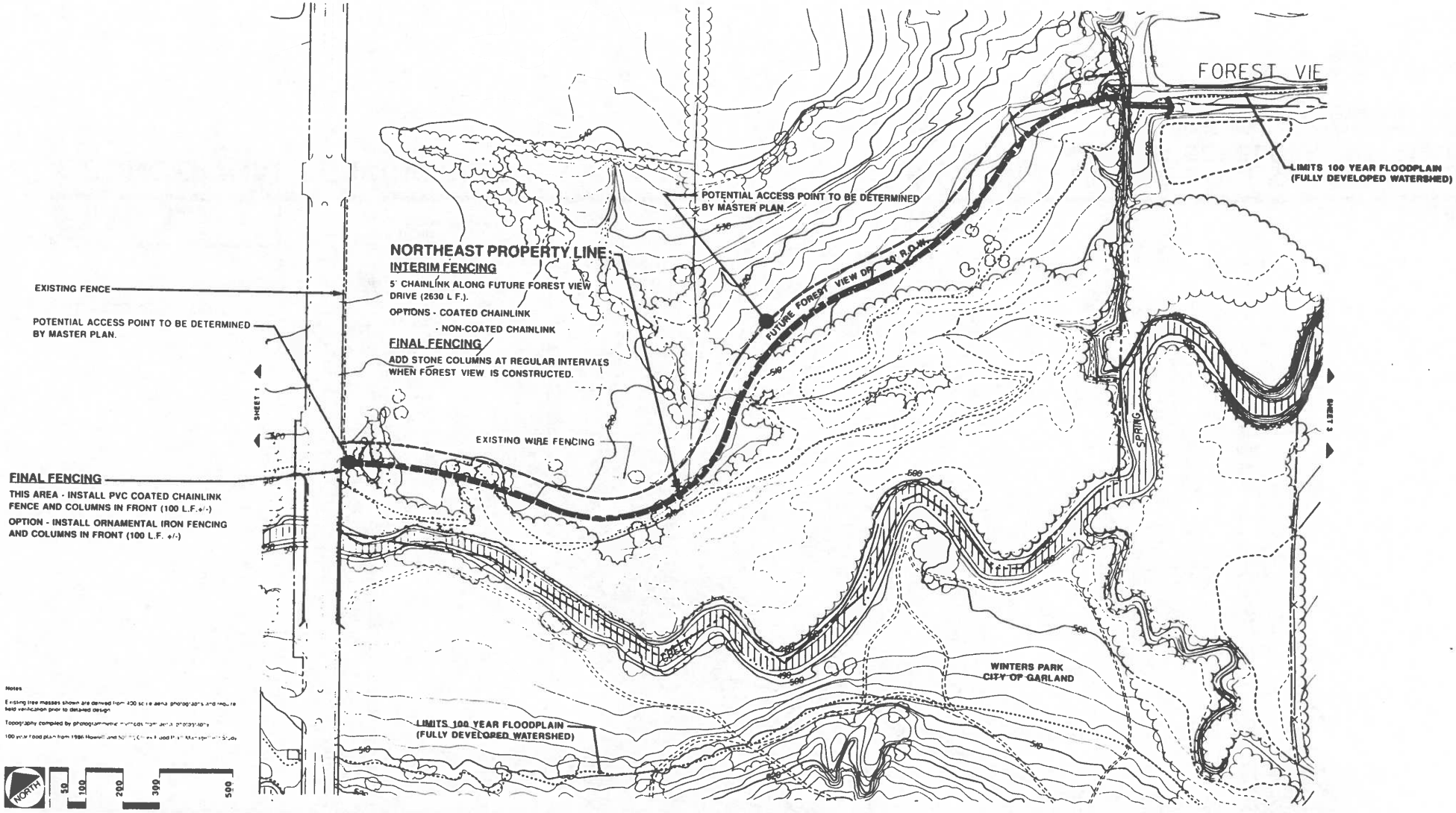


FIGURE 4.6

1. CONCEPTUAL FENCING PLAN

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT H. HALFF ASSOCIATES, INC.



Notes

Existing tree masses shown are derived from 400 scale aerial photographs and require field verification prior to detailed design.

Topography compiled by photogrammetric methods from aerial photographs.

100 year flood plain from 1986 Howell and Spring Creek Flood Plain Management Study.

FIGURE 4.7

2. CONCEPTUAL FENCING PLAN

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

RMW/Beck
Landscape Architects and Planners, Inc

ALBERT H. HALFF ASSOCIATES, INC.
ENGINEERS SCIENTISTS
PLANNERS SURVEYORS

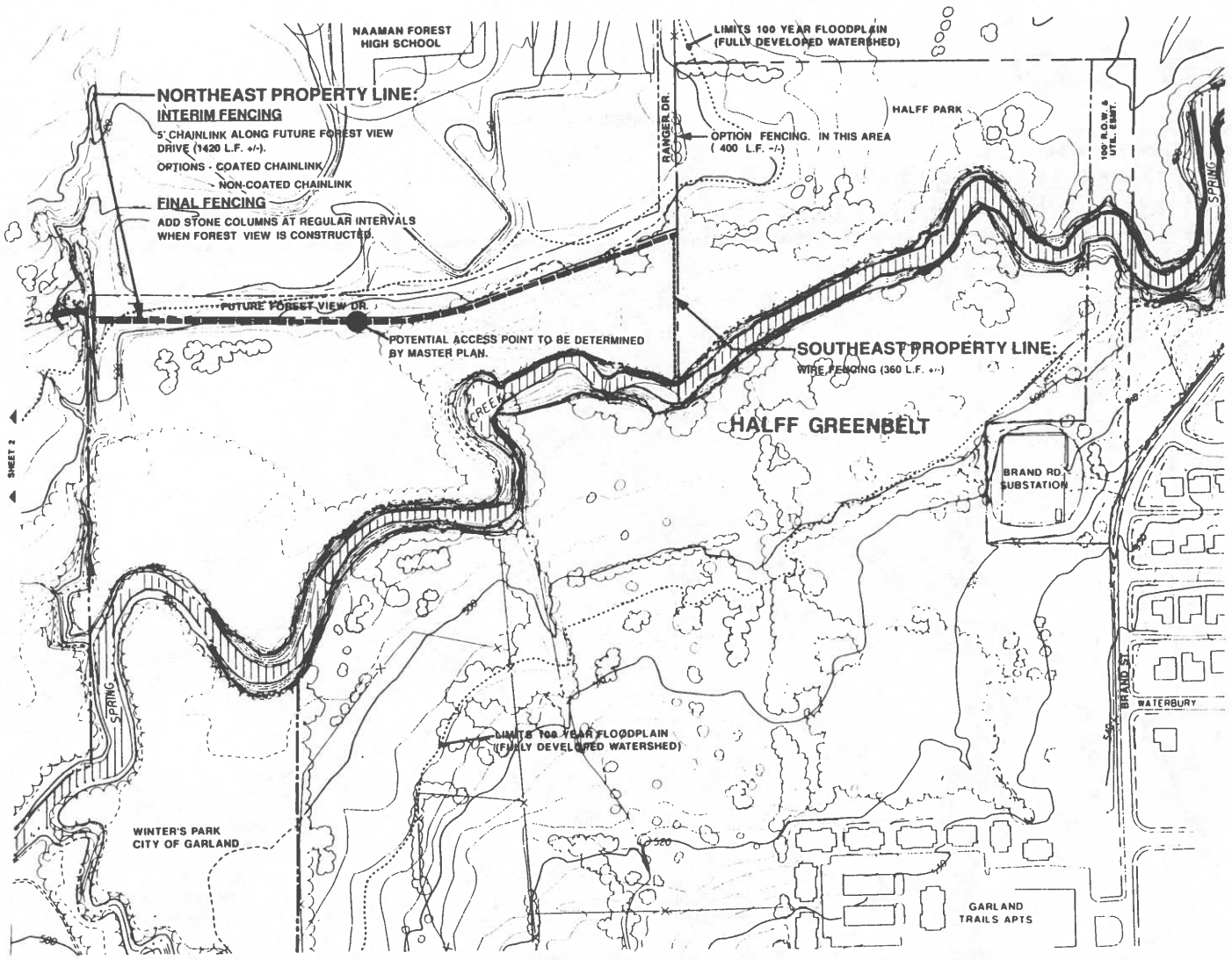


FIGURE 4.8

3. CONCEPTUAL FENCING PLAN

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT B. HALFF ASSOCIATES, INC.

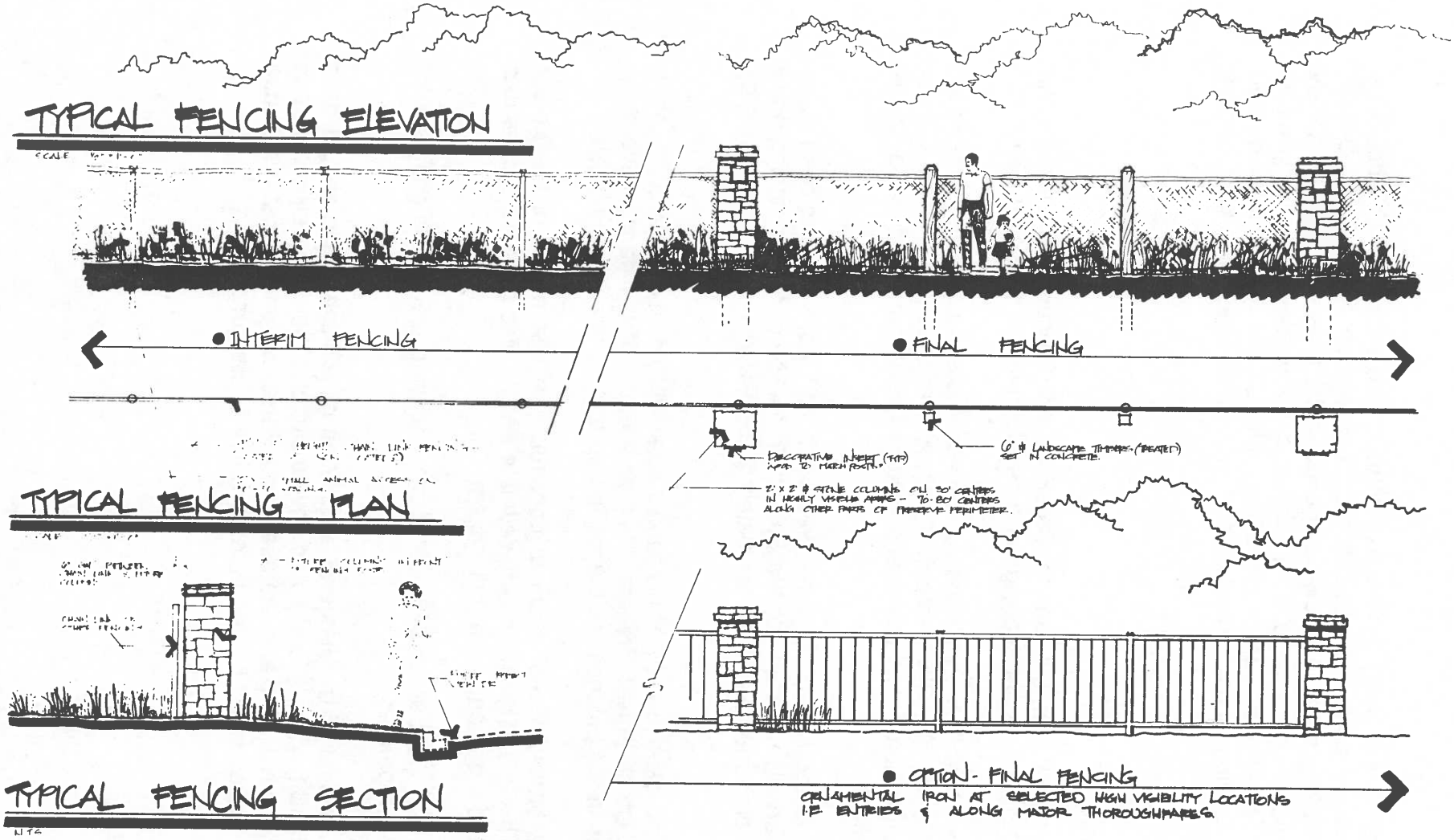


FIGURE **4.9**

CONCEPTUAL FENCING PLAN

SPRING CREEK FOREST PRESERVE
MASTER DEVELOPMENT PLAN
PARKS AND RECREATION DEPARTMENT
CITY OF GARLAND, TEXAS

ALBERT H. HALFF ASSOCIATES, INC.
ENGINEERS PLANNERS SCIENTISTS SURVEYORS

Lighting

Lighting is not recommended for the Preserve interior and paths, which should be experienced only under natural light conditions. Lighting for the Visitors Center, Interpretive Pavilion, parking areas, and any other ancillary facilities should be judiciously selected, providing minimally acceptable illumination at low intensities. All lighting fixtures should be shielded in all directions to prevent light scatter and minimize their intrusiveness. Site lighting should be designed with luminaires that face directly downward.

Implementation

The continued development of the Spring Creek Forest Preserve will require the acquisition of additional lands and the design and development of needed facilities.

The acquisition of additional Preserve lands can be accomplished by several methods, such as direct purchase by the City, through matching grants from the Dallas County Open Space Bond funds and Texas Parks and Wildlife Department, and by donations from the property owners.

The City of Garland has about $53,000 from a previous bond fund, which has been made available to the Preservation Society for the Spring Creek Forest as a matching grant fund. To date, the Society has raised approximately $7,500, which could be matched by the City.

The City passed a bond issue in 1991 which contained an allocation of $434,000 in bond funds for the Spring Creek Forest Preserve. To date, none of the bonds have been issued, but the City is in the process of determining an appropriate funding level.

Table 5 illustrates a breakdown of costs to construct the first phase of the Forest Preserve facilities. This is a very preliminary estimate which could be used to construct the Visitors Center and a portion of the trail system.

The City of Garland has spent about $48,000 to install fencing around the perimeter of the existing Preserve property.

The continued development of facilities and acquisition of additional land should be a combined effort by the City, county, state, and private sector. The cooperative efforts of everyone involved with developing and overseeing the Forest will ensure that this unique Forest survives and thrives so that it can be enjoyed by future generations.

Table 5. Cost Estimate for First Phase Spring Creek Forest Preserve
(prepared by City of Garland staff)

Parking and Drives	
• 40-space parking lot (concrete)	$ 40,000
• Bus parking (15' x 110', concrete)	4,000
• Driveways and approach	13,000
• Signage, fencing, gates, and stiles	25,000
Utilities	
• 250 linear foot water line at $20/linear foot	$ 5,000
• 900 linear foot sewer line at $20/linear foot	18,000
• 250 linear foot underground electrical line at $10/linear foot	2,500
• Fire hydrants	2,000
Visitors Center	
• Site preparation	$25,000
• 3,840 square foot shelter with lecture, display, and restroom areas at $50/square foot	$192,000
• 1.430 square foot paved observation deck and display area	28,000
Trails	
• 400 linear foot of handicapped accessible trail at $16/linear foot	$ 6,400
• Trail development (clearing, signage, minor grading, and low-water crossings on Weary Tract, Centennial Tract, and Naamen Forest School Tract); 10,000 linear feet at $2.85/linear foot	28,500
Design and Administration	$ 44,600
TOTAL (1990)	**$434,000**

References

Allen, Peter M. and William D. Flanigan. Geology of Dallas, Texas, United States of America. Bulletin of the Association of Engineering Geologist, Vol. XXXIII, No. 4, 1986, p. 369.

American Iron and Steel Institute. Modern Sewer Design. First Edition, Washington, D.C., 1980.

American Society of Civil Engineers. "Design of Urban Runoff Quality Controls". New York, New York, 1989.

Cook. "Effect of Vegetation on Noise Attenuation". University of Nebraska Agricultural Experiment Station, c. 1965.

Garland, City Council Task Force. Spring Creek Forest Preserve, Garland, Texas.

Garland, City of. North Area Land Use Plan Update. City of Garland, Texas, Planning Department, December 1990.

Halff, Albert H. Associates, Inc. and RMA/Texas. Dallas County Open Space Plan. Prepared for the Dallas County Commissioners Court, 1991.

Halff, Albert H. Associates, Inc. Linear Greenbelt Park Study. Prepared for the City of Allen, Texas, October 1986, p. III-5.

Halff, Albert H. Associates, Inc. Floodplain Management Study on Rowlett and Spring Creeks. Prepared for the City of Garland, Texas, November 1988.

Larkin, T.J. and G. W. Bomar. Climatic Atlas Of Texas. Texas Department of Water Resources, Austin, Texas, 1983, 151 pp.

Mann, Roy Associates, Inc. An Open Space Plan For Collin County (Texas). Collin County Open Space Board, 1986.

Mann, Roy B. Rehabilitation Plan for the Charles River Basin and Muddy River Parklands. Boston Redevelopment Authority, 1968.

McMahan, Craig A. and Roy G. Frye. Bottomland Hardwood in Texas. Wildlife Division, Texas Parks and Wildlife Department, March 1987.

Monk, C.D., Donald W. Imm, and R.L. Potter. Oak Forests Of Eastern North America. Castanea, 1990, 55:77-96.

Nixon, E.S., et al. Woody Vegetation Of An American Beech (*Fagus gradifolia*) Community in Eastern Texas. Castanea, 19__, 45:171-180.

Nixon, E.S., R.L. Willett, and P.W. Cox. Woody Vegetation Of A Virgin Forest In An Eastern Texas River Bottom. Castanea, 1977, 42:227-236.

Nixon, E.S. and R.L. Willett. Vegetational Analysis Of The Floodplain Of The Trinity River, Texas. U.S. Army Corps of Engineers, Fort Worth District, Fort Worth, Texas, 1974, 267 pp.

Odum, Eugene P. Fundamentals of Ecology. 3rd Edition. W.B. Saunders Co., 1971, p. 137-138.

Petranka, J.W. and R. Holland. A Quantitative Analysis Of Bottomland Communities In South-Central Oklahoma. Southwest. Nat., 1980, 24:207-214.

Rice, E.L. Bottomland Forests Of North-Central Oklahoma. Ecology, 1965, 46:708-713.

Robertson, P.A., G.T. Weaver, and J.A. Cavanaugh. Vegetation And Tree Species Patterns Near The Northern Terminus Of The Southern Floodplain Forest. Ecology Monogr., 1978, 48:249-267.

Schemnitz, Sanford D. Wildlife Management Techniques Manual, 4th Edition. Wildlife Society, 1980, p. 330.

Shannon, C.E. and W. Weaver. The Mathematical Theory Of Communication. The University of Illinois Press, Urbana, 1949, 117 pp.

Skinner, Alan S. Ph.D. Cultural Resource Survey of the Spring Creek Forest Preserve. Texas Antiquities Permit No. 868, Cultural Resources Report 90-2, January 25, 1990.

Texas Nature Conservancy. A Protection Plan for Spring Creek Landowners and the Citizens of Garland. The Nature Conservancy, December 1984.

U.S. Environmental Protection Agency. "National Pollutant Discharge Elimination System Permit Application Regulations for Stormwater Discharges; Final Rule". Published in the Federal Register, November 16, 1990.

U.S. Department of the Interior, Fish and Wildlife Service. "Synopsis of Wetland Functions and Values: Bottomland Hardwoods with Special Emphasis on Eastern Texas and Oklahoma". Washington, D.C., September 1987

U.S. Army Corps of Engineers. Regional Environmental Impact Statement Trinity River and Tributaries Dallas, Denton, and Tarrant Counties, Texas, Draft Copy. Prepared by the Fort Worth District of the U.S. Army Corps of Engineers, 1986, pp. 32-33.

U.S. Department of Agriculture, Soil Conservation Service, in cooperation with Texas Agricultural Experiment Station. Soil Survey of Dallas County, Texas. Washington, D.C., February 1980, p. 70.

Van Auken, A.L. Ford, and A. Stein. A Comparison Of Some Woody Upland Riparian Plant Communities Of The Southern Edwards Plateau. Southwest. Nat., 1979, 24:165-180.

Appendix A

HERBARIUM
SOUTHERN METHODIST UNIVERSITY
DALLAS, TEXAS 75275

Aug 26, 1981

James A. Neal
The Nature Conservancy
503-B E. 6th Street/old Pecan Street
Austin, TX 78701

Dear Mr. Neal:

This letter is being written as a result of the recent visit to the hardwood bottomland in Northeastern Dallas County.

The area is most impressive and unlike any other bottomland forest that I am aware of in the Blackland Prairie. The area is unique in that 1) the tree size for the various arborescent taxa is larger in diameter than usual for this particular geographic area, and 2) the presence of two species, chinkapin (Quercus muehlenbergii) and bur oak (Q. macrocarpa) among the dominant trees along with Shumard oak (Q. shumardii), pecan (Carya illinoenensis), and black walnut (Juglans nigra) is unexpected. On climax or virgin bottomland in the Blackland Prairie, I would have expected elm (Ulmus americana) and hackberry (Celtis reticulata) to have been the dominant taxa along with cottonwood (Populus deltoides), willow (Salix nigra), and pecan. Thus, the presence of chinkapin and bur oak among the dominants was unexpected. 3) The presence of large trees of ash (Fraxinus sp) and occassional honey locust (Gleditsia triacanthos) scattered among the dominants of the overstory indicated an old growth forest potentially referable to a virgin or climax vegetation type.

Since this community type apparently has never been described for the Blackland Prairie, additional studies are needed. Perhaps aerial, infra-red photography would enable this particular community type to be distinct enough so as to locate others that are unknown within the Blackland Prairie, if others similar to this one exist.

In summary, this particular hardwood bottomland forest community type is apparently unique to the Blackland Prairie and additional studies would be most desirable.

Sincerely,

Wm. F. Mahler

cc. Bobby Scott
Dr. Elray Nixon

STEPHEN F. AUSTIN STATE UNIVERSITY
NACOGDOCHES, TEXAS 75962

DEPARTMENT OF BIOLOGY

September 2, 1981

Mr. James A. Neal
The Nature Conservancy
503-B E. 6th Street/Old Pecan Street
Austin, Texas 78701

Dear Jim:

Following are my impressions concerning the creek bottom forest in Dallas County.

The forest contains an interesting assemblage of plant species. The overstory dominance of Shumard oak (Quercus shumardii), chinkapin oak Q. muehlenbergii), bur oak (Q. macrocarpa), pecan (Carya illinoinensis) and black walnut (Juglans nigra) is somewhat unique. I don't recall seeing a community anywhere else with this mixture of dominants.

The most impressive aspect of the community is the size of the trees. It is certainly an old-growth community and thus could be called a virgin forest. Whether it is climax vegetation or not is difficult to determine. Most ecologists, from what I can gather, feel that these westward extentions of forest along rivers and streams would be dominated by oaks and hickories (which probably includes pecan and black walnut) in the climax state. So the Dallas County community could be climax based on this characteristic. A climax community is defined as one which appears to have permanent possession of the habitat. Therefore the dominant species should be reproducing and represented by a good size class distribution. The Dallas County community needs to be analyzed to determine if this is the case. The species present also need to be looked at in regard to shade and water tolerance.

I should also mention that old-growth forest communities are a rarity in central and eastern Texas. Therefore, they deserve special attention.

Sincerely,

Elray

Elray S. Nixon
Professor of Botany

A partial listing by Bobby Scott of the tree species populating the virgin stream forest adjacent to Spring Creek

1. Eastern Black Walnut (Juglans nigra)
2. Pecan (Carya illinoensis)
3. Chinquapin Oak (Quercus muhlenbergii)
4. Burr Oak (Quercus macrocarpa)
5. Shumard Oak (Quercus shumardii)
6. American Elm (Ulmus americana)
7. Slippery Elm (Ulmus rubra)
8. Red Mulberry (Morus rubra)
9. Ash Leaf Maple (Acer negundo)
10. White Ash (Fraxinus americana)
11. Green Ash (Fraxinus pennsylvanica var. lanceolata)
12. Sugar Hackberry (Celtis laevigata)
13. Wooly Bucket Bumelia
14. Bitternut Hickory (Carya cordiformis)
15. Cedar Elm (Ulmus crassifolia)
16. Carolina Buckthorn (Rhamnus caroliniana) - Some are of tree size.
17. Wild Plum - Some are of tree size.
18. Western Soapberry (Sapindus drummondii) - Some are of fairly large tree size.
19. Honey Locust - Only a handful to be found in the forest and these are very widely separated.
20. Osage Orange (Maclura pomifera) - Number and distaribution same as above.
21. Eastern Red Juniper (Juniperus silicicola) - This species comprises less than one percent of the total forest tree population and, moreover, it is typically no more than three or four feet in height, save for a few instances, in which case it may be several times taller; but never within this forest does this species even begin to approach the height and overall size of the surrounding and dominating hardwoods. In disturbed places, it becomes much larger than it grows in the forest.
22. Eastern Cottonwood (Populus deltoides) - Only three or more can be found within the entire forest and these are on a bank of the creek. All are on the same side of the creek, incidentally.
23. Sycamore or American Plane Tree (Platanus occidentalis) - The relatively few that are here are confined to the banks of the creek.
24. Hercules Club Prickly Ash (Zanthoxylum clava-herculis) - Only a few to be found on the forest periphery.
25. Persimmon (Diospyros virginiana)
26. Texas Sophora (Sophoro affinis) - Some are nearly 30 feet tall.
27. Eastern Redbud

Texas Department of Water Resources

INTEROFFICE MEMORANDUM

TO : Assistant Executive Director DATE: September 30, 1981

THRU : Director, Division of Planning and Development;
Chief, Engineering and Environmental Systems Section;
Unit Head, Environmental Studies Unit;

FROM : Gary Powell and David Brock, Environmental Studies Unit

SUBJECT: Field Sampling and Reconnaissance of Big Spring Creek Environments

A field survey of the Big Spring Creek environments (Dallas County, Texas) was performed as a result of inquiries made by Mr. Robert (Bobby) Scott of Garland, Texas to Herb Grubb (Director, Planning and Development Division) at the annual meeting of the Texas Organization for Endangered Species (September 12, 1981). Bobby Scott's questions concerned the conservation of high quality stream environments, particularly water quality aspects, and an invitation was issued to Gary Powell (Engineering and Environmental Systems Section) for appropriately trained TDWR staff to visit an unspecified riparian forest area near Garland. It is noted that Bobby Scott works closely with the landowners to prohibit trespassing and protect the area. Major landowners in the area are the Weary family, including the elder Doctor Weary who resides at a country mansion built by the President of Proctor and Gamble, Inc. several decades ago. This house stands at the margin of the area's unique riparian forest adjacent to Big Spring Creek about two miles north of Garland, Texas.

TDWR staff ecologists David Brock (limnology) and Gary Powell (ichthyology) visited the site during September 22-23, 1981 in the company of Bobby Scott, who provided an extensive walking tour of the area. Apparently Scott's interests are in strict preservation of about 1.75 miles of the riparian bottomland forest system that exists there, since it is a probable relic from at least many centuries ago, and potentially represents a biological assemblage or forest community type that was once present over wide areas of North America during the last few thousand years, but which has now almost disappeared. Trees are among the largest and oldest living organisms on earth. Many mature trees in this forest are estimated to be 300-500 years old, with trunks up to 4 feet thick and total heights approaching 100 feet. Many plants known from eastern deciduous forests of the Mississippi River drainage and beyond occur here, including large specimens of such trees as the Carolina Buckthorn (Rhamnus caroliniana), eastern Black Walnut (Juglans nigra), Bitternut Hickory (Carya cordiformis), Bur Oak (Quercus macrocarpa), Chinkapin Oak (Q. muehlenbergii), and the Shumard Oak (Q. shumardii). In this sense, some plants here could be considered a population disjunct from its current species range. Indeed, some plants in this unique forest were not even known to occur in Texas.

A major feature of the riparian forest under investigation is Big Spring Creek. The creek is fed by numerous springs and seeps from the Austin Chalk beds through which it cuts its course. Since there was little or no precipitation in the area for many days before the TDWR survey, the measured flow of 2.06 cfs probably represents the base spring flow of the creek under late

summer seasonal conditions. On site analyses indicated good water quality, with dissolved oxygen concentrations near saturation (9.8 - 10.2 parts per million at 22°C) and conductivity observed at 420 micro-mhos. Additional water samples were taken for laboratory nutrient analyses and results should be available in a few weeks, but eutrophication was not evident.

The presence of flood debris and woody wrack in the trees, on the forest floor, and along the creek testifies to the heavy surface runoff carried at times by the drainage system (Scott reports near annual flooding in the forest). Most of the surrounding drainage areas are pastoral or agricultural, but an increasing amount is being converted to urban use categories. This suggests a prognosis for increases in runoff velocity and flood frequency with area development. Although the power of normal flooding is evident in several morphological characteristics of the raparian habitats, the resistence and resilience of the rare biota in this small forest system is equally impressive. Clearly, this forest has special relationships to creek flooding. First, the forest vegetation appears to greatly stabilize the creek channel. Second, large amounts of flood debris were observed to be in various states of decay, indicating the forest traps organic materials and recycles the nutrients, which provides an excellent basis for sustained plant growth and vitality. Lastly, tree stature and species composition at different locations within the riparian forest seemed to be determined, at least in part, by the pattern of flood water drainage.

Benthic organisms were not observed to be very abundant in the creek, a probable result of flushing and bottom scour by floods. Benthic primary production was represented mostly by diatoms. In addition, there was some growth of filamentous algae (Cladophera glomerata and Compsopogon sp.) observed in the creek, but not enough to indicate eutrophic conditions. Macrophyte genera such as Anacharis (Elodea) and Chara were of very limited distribution in the creek.

Creek seining produced a number of common fish species such as the bullhead minnow (Pimephales vigilax), black stripe topminnow (Zygonectes notatus), red shiner (Notropis lutrensis), yellow bullhead catfish (Ictaluris natalis), mosquitofish (Gambusia affinis), carp (Cyprinus carpio), and largemouth bass (Micropterus salmoides). However, one fish collected, the dollar sunfish (Lepomis marginatus), was not expected since its distribution is regionally limited to East Texas, although it occurs widely in the Mississippi River drainages.

Species diversity within the riparian, bottomland hardwood forest appeared to be very high. Virtually no introduced species or "weeds", which were common along the roads and in fields nearby, were found to occur in the forest. However, the diversity of native vegetation was found to include Eastern Black Walnut, Carolina Buckthorn, Bur Oak, Shumard Oak, Chinkapin Oak, Bitternut Hickory, Honeylocust (Gleditsia triacanthos), Red Mulberry (Morus rubra), Pecan (Carya illinoensis), Slippery Elm (Ulmus rubra), American Plum (Prunus americana), White Ash (Praxinus americana), and other trees, as well as Virginia Wild Rye, Elderberry, wild petunias, and white, yellow, and blue flowered violets. This relic virgin forest is probably representative of timber stands common before human settlement, clearing, and overgrazing of livestock. Several lines of evidence can be used to establish the age of the forest in its uncut state. We were shown several letters by Texas botanists

which supported claims to the area's uniqueness and efforts to preserve it. In addition, Garland City Councilman, Gary McVay, has expressed interest in the area because an adjacent field is already planned as a park. There are some people, particularly landowners farther downstream, who have called for the channelization of Big Springs Creek to reduce the extent of intermittant flooding along the creek's narrow floodplain.

Obviously, the forest is of considerable value for both economic and ecological reasons, but even greater values may still be hidden. Almost half of our modern drugs have their natural origin in plants, yet only a tiny percentage of plants have been scientifically screened for biochemicals important to man. For example, people with leukemia in 1960 had an 80 percent rate of death; today, people have a four in five chance for survival because a tropical forest plant, the rosy periwinkle, was found to contain an alkaloid chemistry with powerful anti-leukemia properties. It is possible that several plants in this relic Texas forest, such as the rare Solomon's Seal, may also contain biochemicals or other characteristics important to man.

GLP

Gary L. Powell

David A. Brock

RECEIVED 1983

J.N.T/28

STEPHEN F. AUSTIN STATE UNIVERSITY
NACOGDOCHES, TEXAS 75962

PARTMENT OF BIOLOGY

February 25, 1983

Jim Neal
Texas Nature Conservancy
503-B East 6th Street
Austin, TX 78701

Dear Jim:

Following are comments concerning the old-growth forest situated along Spring Creek in Dallas County, Texas. The woodland within the Weary and Wooten properties was studied using the plot method. Each plot was 5 meters square with plots being positioned within belt transects. Communities were studied within three habitat types; a gradual sloping site away from the creek bottom, the creek bottom itself and immediately along the creek (creekside). There were two slope communities studied (52 plots in each community), five creek bottom communities (50 plots each) and three creekside communities (50 plots each) giving a total of 504 plots analyzed. Only woody species with diameters at breast height (about 1.4 m) equal to or greater than .5 cm were measured in each plot. From data collected concerning species present and their size; we were able to determine the frequency, density and basal area of each species and to construct size class distribution tables. Size class tables provide information concerning reproduction.

A total of 41 woody species was recorded in plots in the study area. These were variously distributed with some being more restricted in their distribution. Dominant overstory species on the slope were shumard oak (Quercus shumardii), pecan (Carya illinoinensis), chinkapin oak (Quercus muhlenbergii), black walnut (Juglans nigra) and ash (Fraxinus american and F. pensylvanica). The more common shrubs were roughleaf dogwood (Cornus drummondii), deciduous holly (Ilex decidua), elderberry (Sambucus canadensis) and eastern wahoo (Euonymous atropurpureus). Prevalent vine species were grape (Vitis sp.), Virginia creeper (Parthenocissus quinquefolia), poison ivy (Rhus toxicodendron) and Alabama supplejack (Berchemia scandens).

Overstory dominants on the flat creek bottom sites were pecan, chinkapin oak, elm (Ulmus americana and U. rubra), ash, Texas sugarberry (Celtis laevigata), black walnut and Shumard oak. The shrub layer was composed mainly of deciduous holly, elderberry, eastern wahoo and roughleaf dogwood. Common vines were grape, Virginia creeper, poison ivy and Alabama supplejack.

The more open creekside communities contained Shumard oak, ash, bur oak (Quercus macrocarpa), black walnut, chinkapin oak and pecan in the upper canopy and roughleaf dogwood in the shrub layer. Principal vine species were Virginia creeper, poison ivy and Alabama supplejack.

Although the recorded species are components of central and east Texas forest communities, there is some degree of uniqueness to the Spring Creek community. In our brief search of the literature the uniqueness of the community appears to center on the combination of oak species present. We have found bur oak to be a common component of bottomlands in the Dallas area. Paul Cox, in his thesis project at the Heard Museum at McKinney, TX found bur oak and Shumard oak to be associated in creek bottom communities. We have not, however, found a community containing these oak species plus chinkapin oak.

Of course the size of the trees in the Spring Creek community and the general undisturbed condition make this a relict community. It certainly should be protected and preserved through time. These old growth undisturbed communities are becoming very rare and thus are needed as reference communities to be able to say that this is what the vegetation used to be like. This is especially helpful in regard to plant succession studies where a community such as the one in Spring Creek could be the ultimate climax stage.

We hope to be able to provide more detailed information by the middle of May when we plan to have a manuscript ready to be submitted for publication. If, in the meantime, you need more information, we will be happy to do what we can.

Sincerely,

Elray

Elray S. Nixon
Professor of Botany

cc

The Nature Conservancy

1800 North Kent Street, Arlington, Virginia 22209
(703) 841-5300

July 11, 1983

Andrew Sansom
Texas Field Office
The Nature Conservancy
503-B East Sixth Street
Austin, TX 78701

RECEIVED JUL 13 1983

Dear Andy:

I would like to make some observations about the significance of the forest along Spring Creek near Dallas. I spent part of two days last year studying the site with Bobby Scott.

The forest is outstanding, for the reasons in the following paragraphs.

The area shows very little evidence of human disturbance. Except for edges that are recovering from past grazing, much of the forest probably appears the same as it did when the region was settled over a century ago. If there is evidence of past disturbance, I cannot see it--and I spend much of my time concerned with deciphering such matters.

This is a large tract. Such an extensive, continuously forested stand is highly unusual--especially in a region where forests on deep, productive soil are prone to heavy development pressure.

The forest along Spring Creek has an unusually strong development of climax eastern deciduous forest species (trees, shrubs, and ground flora). The community is much like what develops hundreds of miles eastward. I have seen several bottomland forests in this part of Texas (from Dallas to Austin and San Antonio) and none approach the mature development of the Spring Creek forest, both in terms of species composition and community structure (age, size, and arrangement of vegetation layers).

Large, undisturbed, maturely developed forest stands are rare everywhere in the eastern United States. It is very unlikely that any other forest like the one along Spring Creek exists in the nation. In terms of its unusual species composition and geographic location, the Spring Creek forest is quite different from any other forested natural area with which I am familiar.

Sincerely,

John White

John White
Science Department

THE UNIVERSITY OF TEXAS AT AUSTIN
LYNDON B. JOHNSON SCHOOL OF PUBLIC AFFAIRS
AUSTIN, TEXAS 78712-7450

(512) 471-4962

July 26, 1983

Mr. James A. Neal
The Nature Conservancy
503-B E. 6th Street/Old Pecan Street
Austin, Texas 78701

Dear Jim:

I was much interested to hear of the Spring Creek forest near Garland. The data gathered from vegetational surveys by Elray S. Nixon of Stephen F. Austin State University, and William F. Mahler of Southern Methodist University, and the field sampling and reconnaissance by Gary Powell and David Brock of the Texas Department of Water Resources provide an objective and convincing picture of the composition and structure of this impressive old growth forest. While I have not visited the stand, the data are more than sufficient to convince me of the ecological value of this relict part of Texas' virgin forest.

My conclusions are essentially identical to those of John White of the Science Department of The Nature Conservancy. Namely, the forest is outstanding because it is a unique example of old growth in a large, undisturbed tract. It should be preserved if at all possible.

Sincerely,

Stephen H. Spurr

Stephen H. Spurr
Professor

SHS/td

TEXAS NATURAL HERITAGE PROGRAM

THE TEXAS NATURE CONSERVANCY

Garry Mauro
Commissioner
General Land Office

July 17, 1984

Mr. James W. Stone
Design and Development Division
Recreation and Parks Department
City of Garland
P. O. Box 469002
Garland, Texas 75046

Dear Jim:

It was a pleasure to visit with you during our trip to Garland last week. We thoroughly enjoyed our visit to Spring Creek and the discussions with you and Luke Thompson concerning future preservation of the area.

Shortly, Luke will be bringing you a map of the ecological "take line" or preserve boundaries that we developed during our visit to the preserve site. These represent "surveyable" lines which correspond closely to the ecological boundaries which we delineated on the aerial photos. The boundaries are the minimum needed to ensure maintenance of the pristine bottomland hardwood community now gracing the floodplain of Spring Creek.

The boundaries are based primarily on soils. The soil is the basic resource that determines the kind of ecological community that occupies a site and it will also determine the distribution of that community. As you may notice, the boundaries that we drew include soils which are topographically above the flat floodplain of the creek itself. Nonetheless, these make a significant contribution to the hydrological regime that supports the bottomland hardwood communities. In time, they will support transitional woody communities with many of the same bottomland species found in the floodplain. Although some of these transitional soils have been badly eroded (or otherwise removed), we feel that most of this area has the potential to succeed to climax communities. This area must be preserved in order to protect the integrity of the pristine bottomlands.

(512) 475-0660

The northern and southern boundaries of the communities are based on clear "breaks" in the continuity of the bottomland forest and associated slopes. These breaks are the result of differences in land use history in the areas north and south of the woodland remnant and represent the boundaries of the high quality wooded areas.

Again, we enjoyed working with you and we certainly wish to endorse the foresight of the City Council in their efforts to preserve the ecological diversity of Spring Creek. If you or your coworkers have any further questions, please do not hesitate to contact us.

Sincerely,

Ben Brown
Coordinator

BB/dd

TEXAS NATURAL HERITAGE PROGRAM

THE TEXAS NATURE CONSERVANCY

RECEIVED NOV 0 1 1984

October 29, 1984

Mr. Luke Thompson
The Nature Conservancy
321 Alamo Plaza, Suite 240
San Antonio, TX 78205

Dear Luke:

This letter is in reply to your query concerning the projected effects of a single, well-designed trail or footpath through the Spring Creek Forest in Garland. David Diamond and I have discussed this and we agree that the idea is a good one.

Basically, if the trail is well-designed and located so as not to interfere with natural drainage patterns, there should be little, if any, noticeable effect on the woodland community. In fact, such a trail would certainly be preferable to none at all--a circumstance which would permit diffused and undirected public use. Such use is much more likely to cause damage to sensitive areas and microsites. In addition, the use of well thought out interpretive aids will further encourage users to remain on the trail and out of the more sensitive areas.

The trail should not be concreted, but rather graveled to allow some percolation and evaporation of soil moisture. Graveling will also make the trail usable in all kinds of weather and discourage "shortcuts" and detours through unpaved areas in inclement weather when vegetation and soils are more susceptible to damage from foot traffic. Hopefully, it would also localize litter problems and make them more manageable.

If you have any more questions concerning the advisability of trail construction and use, please do not hesitate to get in touch.

Sincerely,

Ben Brown, Ph.D.
Coordinator

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
9A33 Fritz Lanham Building
819 Taylor Street
Fort Worth, Texas 76102

November 1, 1984

Luke Thompson
The Nature Conservancy
321 Alamo Plaza, Suite 240
San Antonio, Texas 78205

Dear Mr. Thompson

Thank you for your telephone call yesterday concerning the Spring Creek natural area near Garland, Texas. I was happy to hear that the Nature Conservancy is actively pursuing that acquisition of this important site.

Enclosed is a copy of a September 5, 1984, field trip report that describes the Spring Creek site based on a visit to the area by Tom Cloud of our staff. You requested a copy of his report during our telephone conversation.

It was a pleasure to hear from you and we would appreciate your keeping us advised of your progress. If there is anything we can do to assist your efforts, please let us know.

Sincerely,

Jerome L. Johnson

Jerome L. Johnson
Field Supervisor

cc: Regional Director, FWS, Albuquerque, NM (ARD-HR)

TEXAS NATURAL HERITAGE PROGRAM

THE TEXAS NATURE CONSERVANCY

RECEIVED NOV 0 1 1984

October 29, 1984

Mr. Luke Thompson
The Nature Conservancy
321 Alamo Plaza, Suite 240
San Antonio, TX 78205

Dear Luke:

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Jerome L. Johnson
Field Supervisor

cc: Regional Director, FWS, Albuquerque, NM (ARD-HR)

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

U.S. FISH & WILDLIFE SERVICE

Memorandum

TO : Field Supervisor, FWS, Fort Worth, TX (ES)

DATE: September 5, 1984

FROM : Senior Staff Biologist, FWS, Fort Worth, TX (ES)

SUBJECT: Spring Creek, Garland, Texas

On August 29, 1984, Joe Johnston and I inspected Spring Creek in Garland, Dallas County, Texas. Our site visit was prompted by a telephone conversation with Ms. Linda McKee from Senator Bentsen's office, who indicated they have received inquiries from The Nature Conservancy and Mr. Bobby Scott of Garland concerning conservation of the area's forest community. We were guided during the field inspection by Mr. Scott.

Spring Creek is a bottomland hardwood forest community within the Blackland Prairies ecological region of Texas. The forest is atypical of bottomlands commonly occurring in this portion of Texas in both structure and age of the vegetative community. The bottomland is characterized by eastern deciduous forest species of the oak-hickory association. Predominant overstory tree species include the chinkapin, bur and shumard oaks, black walnut, and pecan. A number of these specimens reach 3-4 feet in diameter and 75+ feet high. The forest occupies an area of approximately 500-800 acres.

Common understory woody species are American beautyberry, coralberry, possumhaw, and small saplings of sugarberry, cedar and American elm, Eastern redcedar, red mulberry, green and white ash, and redbud. Several species of forbs and flowering plants rare to north Texas also occur in this bottomland forest. The heavy overstory canopy cover (90-95%), size of the trees, and composition of the plant community generally indicate an undisturbed, climax condition which is highly unusual for the Dallas-Fort Worth metropolitan area, if not Texas.

A number of plant taxonomists including John White (The Nature Conservancy), Bill Mahler (SMU), Elray Nixon (Stephen F. Austin State University), and Fred Smeins (Texas A&M) have visited the site and commented on its unique nature. A letter from John White to the Texas Nature Conservancy attesting to the ecological significance of Spring Creek is attached for your reference.

I believe the Spring Creek forest represents a unique ecosystem with respect to its rare plant composition, age, and geographic location. Further, the forest is extremely vulnerable to future development, since it is located in a rapidly expanding urban environment.

I recommend that the Regional Director be informed of the status of this natural area and request Realty to investigate potential alternatives for protection of the site.

Attachment

Jon Claud

Appendix B

CERTIFIED COPY OF RECORD

STATE OF TEXAS I

COUNTY OF DALLAS I

I, the undersigned, City Secretary of the City of Garland, Texas, a governmental subdivision of the State of Texas, in the performance of the functions of my office, hereby certify that the attached record is a full, true and correct copy of Resolution No. 5240 as the same appears of record in my office, and that I am the lawful possessor and have legal custody of said record.

WITNESS my hand and Seal of said City of Garland, Texas, at my office in said City, County and State aforesaid, this the 22nd day of June A. D., 1984.

Alta Watson
City Secretary
City of Garland, Texas

RESOLUTION NO. 5240

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF GARLAND, TEXAS, RECOMMENDING THE ESTABLISHMENT OF A FOREST PRESERVE ALONG CERTAIN PORTIONS OF SPRING CREEK AND SUPPORTING THE EFFORTS OF THE TEXAS NATURE CONSERVANCY TO ACQUIRE, MANAGE AND PROTECT THIS FOREST PRESERVE.

WHEREAS, the Parks and Recreation Board has visited and inspected a state and nationally significant unique, "relic" bottomland forest situated along Spring Creek in the area of Holford, North Star and Brand Roads and has adopted a Resolution supporting this action; and

WHEREAS, the Development Guidelines for Parks and Recreation 1980 to 1990, as approved by the Park Board, identifies the creek corridor of Spring Creek as one of Garland's significant natural features and encourages the preservation of significant plant and tree communities; and

WHEREAS, the Council has been presented letters from recognized authorities in the field of ecology who have made on-site surveys of the forest area and have noted the rare significance of the plant community of the forest and its need to be preserved and protected in perpetuity; and

WHEREAS, the Spring Creek forest area has been included in the 1985 Texas Outdoor Recreation Plan as a potential preservation area because of its unique natural features; and

WHEREAS, representatives of the Texas Nature Conservancy, as the state chapter of a national non-profit conservation group whose goal is preservation of outstanding examples of our natural heritage, have appeared before the Council and expressed their ability and willingness to acquire and manage the forest lands; and

WHEREAS, the Council recognized the need to preserve and protect the forest area and believes that the Texas Nature Conservancy is the instrument by which this unique natural resource can best be safeguarded in perpetuity;

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF GARLAND, TEXAS,

Section 1

That the City Council of the City of Garland recommend the establishment of a Spring Creek forest perserve within the general area.

Section 2

That the City Council of the City of Garland hereby encourages the Texas Nature Conservancy to establish, within the next four weeks, an exact boundary of the General site shown on Exhibit A.

Section 3

The City Council of the City of Garland further encourages that the Task Force which has been appointed and the Texas Nature Conservancy establish a statement of policies regarding this site as soon as practical and upon the establishment of an exact boundary.

Section 4

That this Resolution shall take effect immediately from and after its passage.

Section 5

That the City Secretary is hereby authorized to furnish copies of this Resolution to all interested parties.

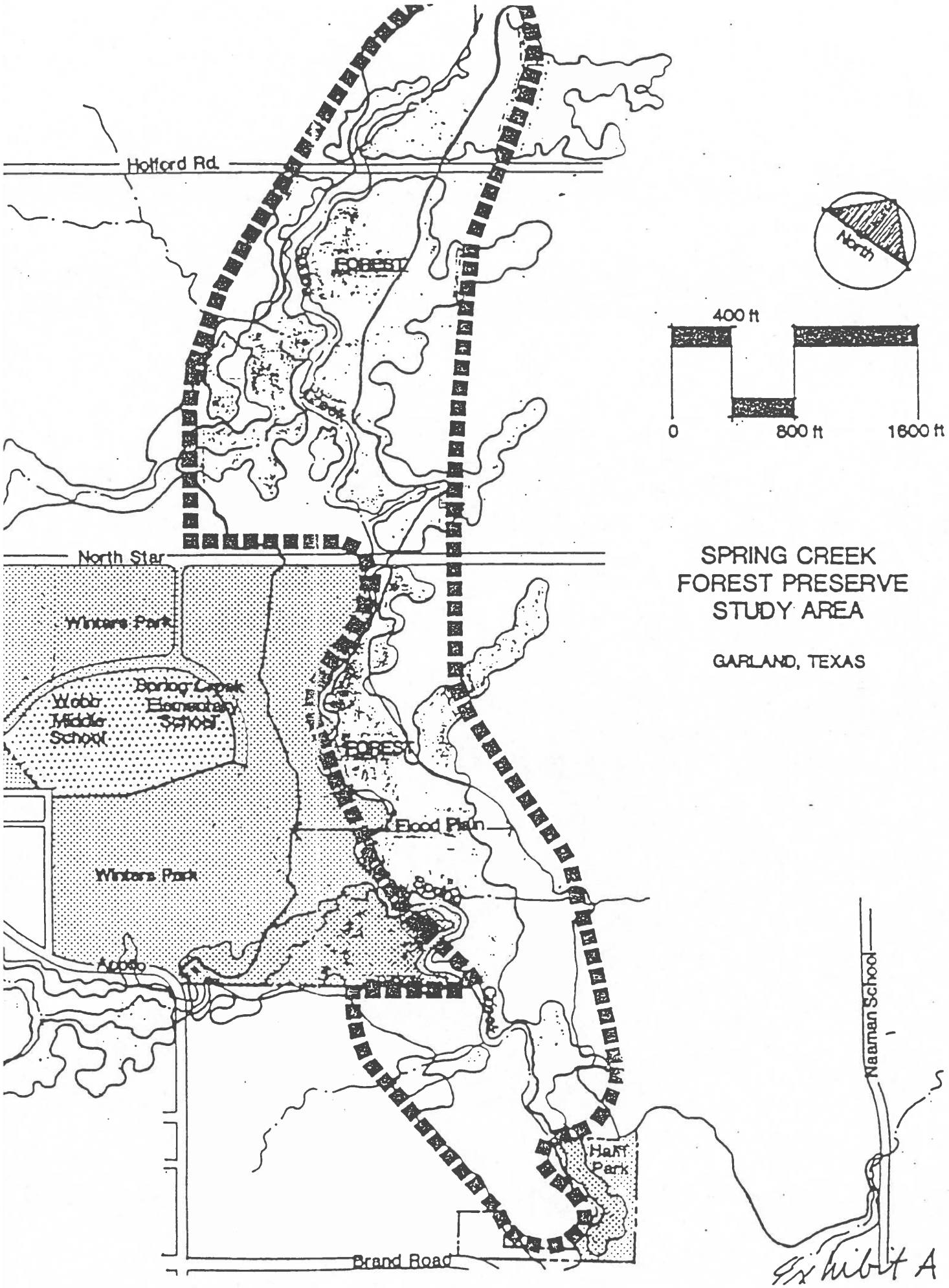
PASSED & APPROVED this 19th day of June, 1984.

THE CITY OF GARLAND, TEXAS

By: _____
Mayor

ATTEST:

_____
City Secretary



SPRING CREEK
FOREST PRESERVE
STUDY AREA

GARLAND, TEXAS

Exhibit A

Appendix C

WILDLIFE OF
ROWLETT AND SPRING CREEKS
FISH
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Dorosoma petenense	* Threadfin shad	W
Cyprinus carpio	* Carp	W
Notemigonus crysoleucas	Golden shiner	W
Notropis lutrensis	* Red shiner	W
Pimephales vigilax	* Bullhead minnow	W
Pimephales promelas	* Fathead minnow	W
Zygonectes notatus	* Blackstripe topminnow	W
Campostoma anomalum	Stoneroller	W
Pylodictus olivaris	Flathead catfish	W
Ictaluris nactalis	* Yellow bullhead catfish	W
Noturus gyrinus	Tadpole madtom	W
Gambusia affinis	* Mosquitofish	W
Micropterus salmoides	* Largemouth bass	W
Lepomis cyanellus	* Green sunfish	W
Lepomis megalotis	Longear sunfish	W
Lepomis marginatus	* Dollar Sunfish	W
Lepomis macrochirus	* Bluegill	W
Percina sciera	Dusky darter	W
Etheostoma chlorosomum	Bluntnose darter	W

F = Forestland Biota
G = Grassland Biota
W = Water Bodies
WL = Wetlands Biota
* = Observed in Garland

WILDLIFE OF
ROWLETT AND SPRING CREEKS
REPTILES
GARLAND, TEXAS

SCIENTIFIC NAME		COMMON NAME	PREFERRED HABITAT
Terrapene ornata		Western box turtle	F
Terrapene carolina	*	Eastern box turtle	G
Chelydra serpentina	*	Common snapping turtle	W
Kinosternon flavescens		Yellow mud turtle	W
Kinosternon subrubrum		Mississippi mud turtle	W
Sternothaerus carinatus		Razor-backed musk turtle	W
Dierochelys reticularia		Chicken turtle	W
Graptemys pseudogeographica		False map turtle	W
Sternothaerus odoratus		Stinkpot	W
Chrysemys concinna		River Cooter	W
Chrysemys scripta	*	Red-eared slider	W
Trionyx muticus		Smooth softshell	W
Trionyx spiniferus		Spiny softshell	W
Anolis carolinensis		Green anole	F
Phrynosoma cornutum		Texas horned lizard	G
Sceloporus olivaceus		Texas spiny lizard	F
Sceloporus undulatus		Eastern fence lizard	F
Ophisaurus attenuatus	*	Slender glass lizard	G, F
Eumeces septentrionalis		Prairie skink	G
Eumeces fasciatus	*	Five-lined skink	F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
REPTILES
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Eumeces laticeps	Broad-headed skink	F, WL
Lygosoma laterale	* Ground skink	F
Natrix erythrogaster	Blotched water snake	W, WL
Natrix fascinati	Broad-banded water snake	W, (SL) ←
Natrix grahami	Graham's water snake	W, WL
Natrix rhombifera	* Diamond-backed water snake	W, WL
Cnemidophorus gularis	Texas spotted whiptail	G
Cnemidophorus sexlineatus	* Six-lined racerunner	G, F
Coluber constrictor	Blue racer	G, F
Elaphe guttata	Great Plains rat snake	G, F
Elaphe obsoleta	Texas rat snake	F, WL
Lampropeltis calligaster	Prairie kingsnake	G, F
Lampropeltis getulus	* Common kingsnake	G, F, WL
Lampropeltis triangulum	Louisiana milk snake	G, F, WL
Masticophis flagellum	Coachwhip	G, F, WL
Pituophis melanoleucus	Bullsnake	G, F
Sonora episcopa	Great Plains ground snake	G
Tropidoclonion lineatum	Lined snake	G
Diadophis punctatus	* Ringneck snake	F, WL
Hetrodon platyrhinos	* Eastern hognose snake	F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
REPTILES
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Opheodrys aestivus	* Rough green snake	F
Storeria dekayi	Brown snake	WL
Tantilla gracilis	Flat-headed snake	F, WL
Tantilla nigriceps	Plains black-headed snake	F, WL
Thamnophis proximus	Western ribbon snake	F, WL
Thamnophis sirtalis	Common garter snake	F, WL
Virginia stratula	Rough earth snake	F, WL
Agkistrodon piscivorus leucostoma	* Western cottonmouth	W, WL
Sistrurus catenatus tergeminus	Western massasauga	G, WL
Crotalus atrox	* Western diamondback rattlesnake	G
Sistrurus miliarius streckeri	Western Pygmy rattlesnake	F, WL
Crotalus horridus	Canebrake rattlesnake	F, WL
Agkistrodon contortrix contortrix	* Copperhead	F, WL
Micrurus fulvius	Coral snake	F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
AMPHIBIANS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Pseudacris clarki	Spotted chorus frog	G
Pseudacris streckeri	Strecker's chorus frog	G, F, W, WL
Pseudacris triseriata feriarum	Upland chorus frog	F, WL
Pseudacris triseriata triseriata	Western chorus frog	W
Acris crepitans	Blanchard's cricket frog	W, WL
Hyla cinerea	* Green treefrog	W, WL
Hyla versicolor	Northern gray treefrog	F, W, WL
Rana catesbeiana	* Bullfrog	W, WL
Rana pipiens	* Leopard frog	W, WL
Bufo punctatus	* Red-spotted toad	G, WL
Bufo speciosus	Texas toad	G, F
Bufo valliceps	Gulf Coast toad	G, WL
Bufo woodhousei	Rocky Mountain toad	F, W, WL
Gastrophryne olivacea	Great Plans narrow-mouthed toad	G, F, WL
Gastrophryne carolinensis	Eastern narrow-mouthed toad	F, WL
Siren intermedia	Lesser siren	W, WL
Ambystoma texanum	Small-mouthed salamander	F, W, WL
Ambystoma tigrinum	* Tiger salamander	W, WL
Notophthalmus viridescens	Common Newt	W, WL
Scaphiopus holbrooki	Eastern spadefoot	F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
MAMMALS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Peromyscus maniculatus	Deer mouse	G, F
Peromyscus leucopus	White-footed mouse	G
Baiomys taylori	Pygmy mouse	G
Reithrodontomys fulvescens	Fulvous harvest mouse	G
Perognathus hispidus	Hispid pocket mouse	G
Sigmodon hispidus	Hispid cotton rat	G, F, WL
Neotoma floridana	Florida wood rat	F
Geomys bursarius	Plains pocket gopher	G
Scalopus aquaticus	Eastern mole	G
Blarina brevicauda	Short-tailed shrew	F
Cryptotis parva	Least shrew	G
Sciurus niger	Fox squirrel	F
Glaucomys volans	Eastern flying squirrel	F
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel	G
Sylvilagus floridanus	Eastern cottontail	G, F
Sylvilagus aquaticus	Swamp rabbit	F, WL
Lepus californicus	California jackrabbit	G
Castor canadensis	* Beaver	W, WL
Myocastor coypus	Nutria	W, WL
Lasiurus borealis	* Red bat	F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
MAMMALS
GARLAND, TEXAS

SCIENTIFIC NAME		COMMON NAME	PREFERRED HABITAT
Tadarida mexicana		Guano bat	F
Eptesicus fuscus		Big brown bat	F
Pipistrellus subflavus		Georgia bat	F
Mustela vison		Mink	F, WL
Mustela frenata		Long-tailed weasel	G, F, WL
Dasypus novemcinctus	*	Nine-banded armadillo	G, F, WL
Mephitis mephitis	*	Striped skunk	F
Spilogale putorius	*	Eastern spotted skunk	G, F, WL
Procyon lotor	*	Raccoon	F, WL
Didelphis virginiana	*	Opossum	F, WL
Urocyon cinereoargenteus		Gray fox	F
Vulpes fulva		Red fox	F
Canis latrans		Coyote	G, F

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Gavia immer	Common loon	W
Podiceps caspicus	Eared grebe	W
Podilymbus podiceps	* Pied-billed grebe	W
Pelecanus erythrorhynchos	* White pelican	W
Phalacrocorax auritus	* Double-crested cormorant	W, WL
Ardea herodias	* Great blue heron	W, WL
Butorides virescens	* Green heron	WL
Florida caerulea	* Little blue heron	W, WL
Nycticorax nyctiocorax	* Black-crowned night heron	WL
Nyctanassa violacea	* Yellow-crowned night heron	WL
Bulbulcus ibis	* Cattle egret	G
Leucophoyx thula	* Snowy egret	W, WL
Casmerodius albus	Common egret	W, WL
Olor columbianus	Whistling swan	W
Branta canadensis	* Canada goose	G, WL
Anser albifrons	White-fronted goose	G, WL
Chen hyperborea	Snow goose	C, WL
Chen caerulescens	Blue goose	G, WL
Anas platyrhynchos	* Mallard	W
Anas rubripes	Black duck	W

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Anas acuta	* Pintail	W
Anas carolinensis	* Green-winged teal	W
Anas cyanoptera	Cinnamon teal	W
Anas discors	* Blue-winged teal	W
Mareca americana	* American widgeon	
Spatula clypeata	* Shoveler	W
Aix Sponsa	* Wood duck	F, W, WL
Aythya americana	* Redhead	W
Aythya collaris	Ring-necked duck	W
Aythya valisinera	* Canvasback	W
Aythya marila	Greater scaup	
Aythya affinis	* Lesser scaup	W
Bucephala clangula	* Common goldeneye	
Bucephala albeola	* Bufflehead	
Clangula hyemalis	Oldsquaw	W
Melanitta deglandi	White-winged scooter	W
Oxyura jamaicensis	* Ruddy duck	W
Mergus serrator	Red-breasted merganser	W
Lophodytes cucullatus	Hooded merganser	W
Anas strepera	Gadwall	W

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Mycteria americana	Wood ibis	W
Plegadis chihi	White-faced ibis	WL
Coturnicops noveboracensis	Yellow rail	WL
Porzana carolina	Sora rail	WL
Gallinula chloropus	Common gallinule	WL
Fulica americana	* American coot	W, WL
Charadrius vociferus	* Killdeer	G
Pluvialis dominica	American golden plover	G
Bartramia longicauda	* Upland plover	G
Squatarola squatarola	Black-bellied plover	G
Philohela minor	American woodcock	F
Gapella gallinago	* Common snipe	WL
Actitis macularia	* Spotted sandpiper	WL
Tringa solitaria	* Solitary sandpiper	WL
Erolia melanotos	* Pectoral sandpiper	WL
Erolia bairdii	Baird's sandpiper	W
Erolia minutilla	Least sandpiper	W
Micropalama himantopus	Stilt sandpiper	W

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Ereunetes mauri	Western sandpiper	W
Ereunetes pusillus	* Semipalmated sandpiper	WL
Totanus melanoleucus	* Greater yellowlegs	WL
Totanus flavipes	Lesser yellowlegs	WL
Ixobrychus exilis	Least bittern	WL
Botaurus letiginosus	American bittern	WL
Larus argentatus	Herring gull	G, W, WL
Larus delawarensis	* Ring-billed gull	G, W, WL
Larus pipixcan	* Franklin's gull	G, W, WL
Sterna albifrons	Least tern	W
Chlidonias niger	Black tern	W
Sterna forsteri	Forster's tern	W
Limnodromus scolopaceus	Long-billed dowitcher	W
Cathartes aura	* Turkey vulture	G
Coragyps atratus	* Black vulture	G
Falco peregrinus	Peregrine falcon	G
Buteo jamaicensis	* Red-tailed hawk	G
Buteo swainsoni	* Swainson's hawk	G
Circus cyaneus	* Marsh hawk	G
Buteo lineatus	Red-shouldered hawk	G
Falco sparverius	* American kestrel	G

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Accipiter Striatus	Sharp-shinned hawk	F
Accipiter cooperii	* Cooper's hawk	F
Buteo harlani	* Harlan's hawk	G
Buteo lagopus	Rough-legged hawk	G
Falco columbarius	Pigeon hawk	G
Otus asio	* Screech owl	F
Bubo virginianus	* Great horned owl	F
Strix varia	Barred owl	F
Asio flameus	Short-eared owl	G
Colinus virginianus	* Bobwhite	G
Zenaidura macroura	* Mourning dove	G
Columba livia	* Rock dove	G
Coccyzus americanus	* Yellow-billed cuckoo	G
Geococcyx californianus	* Roadrunner	G
Caprimulgus carolinesis	* Chuck-will's-widow	F
Chordeiles minor	* Common nighthawk	G
Chaetura pelagica	Chimney swift	G
Archilochus colubris	Ruby-throated hummingbird	G
Archilochus alexandri	Black-chinned hummingbird	G

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Megaceryl alcyon	* Belted kingfisher	W, WL
Centurus carolinus	* Red-bellied woodpecker	F
Melanepes erythrocephalus	Red-headed woodpecker	F
Dendrocopos villosus	* Hairy woodpecker	F
Dendrocopos pubescens	* Downy woodpecker	F
Dendrocopos scalaris	Ladder-backed woodpecker	F
Colaptes auratus	Yellow-shafted flicker	F
Colaptes cafer	* Red-shafted flicker	G
Sphyrapicus varius	* Yellow-bellied sapsucker	F
Muscivora forficata	* Scissor-tailed flycatcher	G
Myiarchus crinitus	Great-crested flycatcher	G
Empidonax virescens	Acadian flycatcher	G
Empidonax traillii	Traill's flycatcher	G
Empidonax minimus	Least flycatcher	G
Nuttallornis borealis	Olive-sided flycatcher	G
Tyrannus tyrannus	* Eastern kingbird	G
Tyrannus verticalis	* Western kingbird	G
Sayornis phoebe	Eastern phoebe	F
Contopus virens	* Eastern wood pewee	F
Eremophila alpestris	* Horned lark	G

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Hirundo rustica	* Barn swallow	G
Iridoprocne bicolor	Tree swallow	F
Riparia riparia	Bank swallow	W, WL
Stelgidopteryx ruficollis	Rough-winged swallow	W, WL
Petrochelidon pyrrhonota	Cliff swallow	G
Progne subis	* Purple martin	G
Cynocitta cristata	* Blue Jay	F
Corvus brachyrhynchos	* Common crow	G
Parus carolinensis	* Carolina chickadee	F
Parus bicolor	* Tufted titmouse	F
Sitta canadensis	Red-breasted nuthatch	F
Certhia familiaris	* Brown creeper	F
Thrynomanes bewickii	* Bewick's wren	F
Thryothorus ludovicianus	* Carolina wren	F
Troglodytes aedon	House wren	G
Telmatodytes palustris	Long-billed marsh wren	WL
Troglodytes troglodytes	Winter wren	F
Mimus polyglottos	* Mockingbird	G
Dumetella carolinensis	Catbird	F

F = Forestland Biota
G = Grassland Biota
W = Water Bodies
WL = Wetlands Biota
* = Observed in Garland

WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Toxostoma rufum	* Brown thrasher	F
Turdus migratorius	* Robin	F
Hylocichla guttata	* Hermit thrush	F
Hylochichla ustulata	* Swainson's thrush	F
Sialia sialis	* Eastern bluebird	F
Polioptila caerula	* Blue-gray gnatcatcher	F
Regulus satrapa	* Golden-crowned kinglet	F
Regulus calendula	* Ruby-crowned kinglet	F
Anthus spinoletta	* Water pipit	W, WL
Anthus spragueii	Sprague's pipit	G
Bombycilla cedrorum	Cedar waxwing	G, F
Lanius ludovicianus	* Loggerhead shrike	G
Sturnus vulgaris	* Starling	G
Vireo atricapilla	Black-capped vireo	F
Vireo griseus	* White-eyed vireo	F
Vireo bellii	Bell's vireo	F
Vireo solitarius	* Solitary vireo	F
Vireo olivaceus	* Red-eyed vireo	F
Vireo gilvus	Warbling vireo	F
Vireo flavifrons	Yellow-throated vireo	F

F = Forestland Biota

G = Grassland Biota

W = Water Bodies

WL = Wetlands Biota

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PRLFERRED HABITAT
Vireo philadelphicus	Philadelphia vireo	F
Miniotilta varia	Black-and-white warbler	F
Parula americana	Parula warbler	F
Dendroica petechia	* Yellow warbler	F
Dendroica magnolia	Magnolia warbler	F
Dendroica virens	* Black-throated green warbler	F
Dendroica coronata	Myrtle warbler	F
Dendroica fusca	Blackburnian warbler	F
Dendroica dominica	Yellow-throated warbler	F
Dendroica pensylvanica	Chestnut-sided warbler	F
Dendroica castanea	Bay-breasted warbler	F
Wilsonia pusilla	Wilson's warbler	F
Vermivora peregrina	Tennessee warbler	F
Vermivora celata	Orange-crowned warbler	F
Vermivora ruficapilla	Nashville warbler	F
Oporornis philadelphia	* Mourning Warbler	F
Wilsonia canadensis	Canada warbler	F
Selurus motacilla	Louisiana waterthrush	W, WL
Seiurus noveboracensis	* Northern waterthrush	W, WL

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Geothlypis trichas	* Yellowthroat	F
Icteria virens	Yellow-breasted chat	F
Setophaga ruticilla	* America redstart	F
Sturnella neglecta	Western meadowlark	G
Sturnella magna	* Eastern meadowlark	G
Xanthocephalus xanthocephalus	Yellow-headed blackbird	G
Agelaius phoeniceus	* Red-winged blackbird	G, WL
Euphagus cyanocephalus	Brewer's blackbird	G
Cassidix mexicanus	* Great-tailed grackle	G
Quiscalus quiscula	* Common grackle	G
Molothrus ater	* Brown-headed cowbird	G
Icterus galbula	Baltimore oriole	F
Icterus spurius	Orcharg oriole	F
Icterus bullockii	Bullock's oriole	F
Piranga rubra	* Summer tanager	F
Richmondena cardinalis	* Cardinal	F
Pheucticus ludovicianus	* Rose-breasted grosbeak	F
Guiraca aerulea	Blue grosbeak	F, G

F = Forestland Biota

G = Grassland Biota

W = Water Bodies

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* = Observed in Garland

WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
	BIRDS	
Spinus pinus	Pine siskin	F
Posserina cyanea	Indigo bunting	F
Linaria ciris	* Painted bunting	F
Carpodacus purpureus	* Purple Finch	F
Spinus tristis	* American goldfinch	G
Spiza americana	* Dickcissel	G
Pipilo erythroph thalmus	Rufour-sided towhee	F
Passer domesticus	* House sparrow	G
Spizella passerina	Chipping sparrow	G
Zonotrichia querula	Harris sparrow	F
Zonotrichia leucophrys	White-crowned sparrow	F
Zonotrichia albicollis	White-throated sparrow	F
Passerculus sandwichensis	* Savannah sparrow	G
Pooecetes gramineus	* Vesper sparrow	G
Chondestes grammacus	* Lark sparrow	G
Spizella pusilla	* Field sparrow	G
Passerella iliaca	* Fox sparrow	F
Melospiza lincolnii	* Lincoln's sparrow	G
Melospiza georgiana	Swamp sparrow	F, WL
Melospiza melodia	* Song sparrow	G

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G = Grassland Biota

W = Water Bodies

WL = Wetlands Biota

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WILDLIFE OF
ROWLETT AND SPRING CREEKS
BIRDS
GARLAND, TEXAS

SCIENTIFIC NAME	COMMON NAME	PREFERRED HABITAT
Ammodramus savannarum	* Grasshopper sparrow	G
Spizella pallida	* Clay-colored sparrow	G
Junco hyemalis	Slate-colored junco	F, G

F = Forestland Biota

G = Grassland Biota

W = Water Bodies

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* = Observed in Garland

Appendix D

DEVELOPMENT STANDARDS FOR THE STATE HIGHWAY 190 CORRIDOR

GARLAND, TEXAS

DEVELOPMENT STANDARDS
FOR THE STATE HIGHWAY 190 CORRIDOR

GARLAND, TEXAS

ADOPTED BY THE GARLAND CITY COUNCIL
FEBRUARY 18, 1986

ACKNOWLEDGMENTS

Creation of **Development Standards for the State Highway 190 Corridor** has been possible only with the cooperation and efforts of the many individuals listed below. Special recognition goes to the members of the Development Standards Committee for their dedication to this project.

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INTRODUCTION

INTENT

State Highway 190 offers a wealth of opportunity to Garland and its citizens. As illustrated by Figure 1, the thoroughfare will provide a critical regional linkage to the other communities in the metroplex, making Garland a more desirable place to live and conduct business and improving access for Garland citizens and businesses. S.H. 190 will be a catalyst for economic development and long-term fiscal stability; creating jobs, strengthening the tax base, improving property values and opening up business, shopping, and entertainment opportunities within the city.

No matter how the S.H. 190 corridor develops it will, by virtue of its location and function, play a major role in how others view Garland and, consequently, in Garland's ability to attract future residents and desired businesses. This image could be negative - another indistinguishable freeway corridor characterized by strip development and billboards - or, through careful planning and foresight, it can be very positive. The intent of the Development Standards is to ensure that the S.H. 190 corridor is developed and maintained in a manner that is attractive, safe, compatible and harmonious, according to consistent design guidelines. The standards are also intended to achieve development that is sensitive to and protective of the Spring Creek Forest Preserve. It should be noted that the Development Standards are separate from the Zoning Ordinance, Building Code, and other existing development-related ordinances and policies. **The standards set forth herein are in addition to, and do not take the place of, existing ordinances; compliance with all applicable ordinances remains essential.**

Through the Development Standards, Garland has the opportunity to shape the S.H. 190 corridor and, to a great extent, the future of a large portion of the city. The opportunity and the challenge at hand is to bring to reality the tremendous asset, to Garland and the region as a whole, that S.H. 190 has the potential to be. Given the natural beauty that characterizes much of the development corridor, the potential and the challenge is enhanced.

CORRIDOR BOUNDARIES

The State Highway 190 development corridor traverses North Garland, as delineated on Figure 2. The highway's official State designation extends from the northern city limits at Shiloh Road southeast to State Highway 78. The City of Garland Thoroughfare Plan shows a major (Type A) thoroughfare continuing southeast from S.H. 78 to the eastern city limits along Rowlett Road. Spring Creek and Rowlett Creek form the southern and northern corridor boundaries to a large extent. The Development Standards shall apply within this entire corridor, including the Rowlett Road extension.

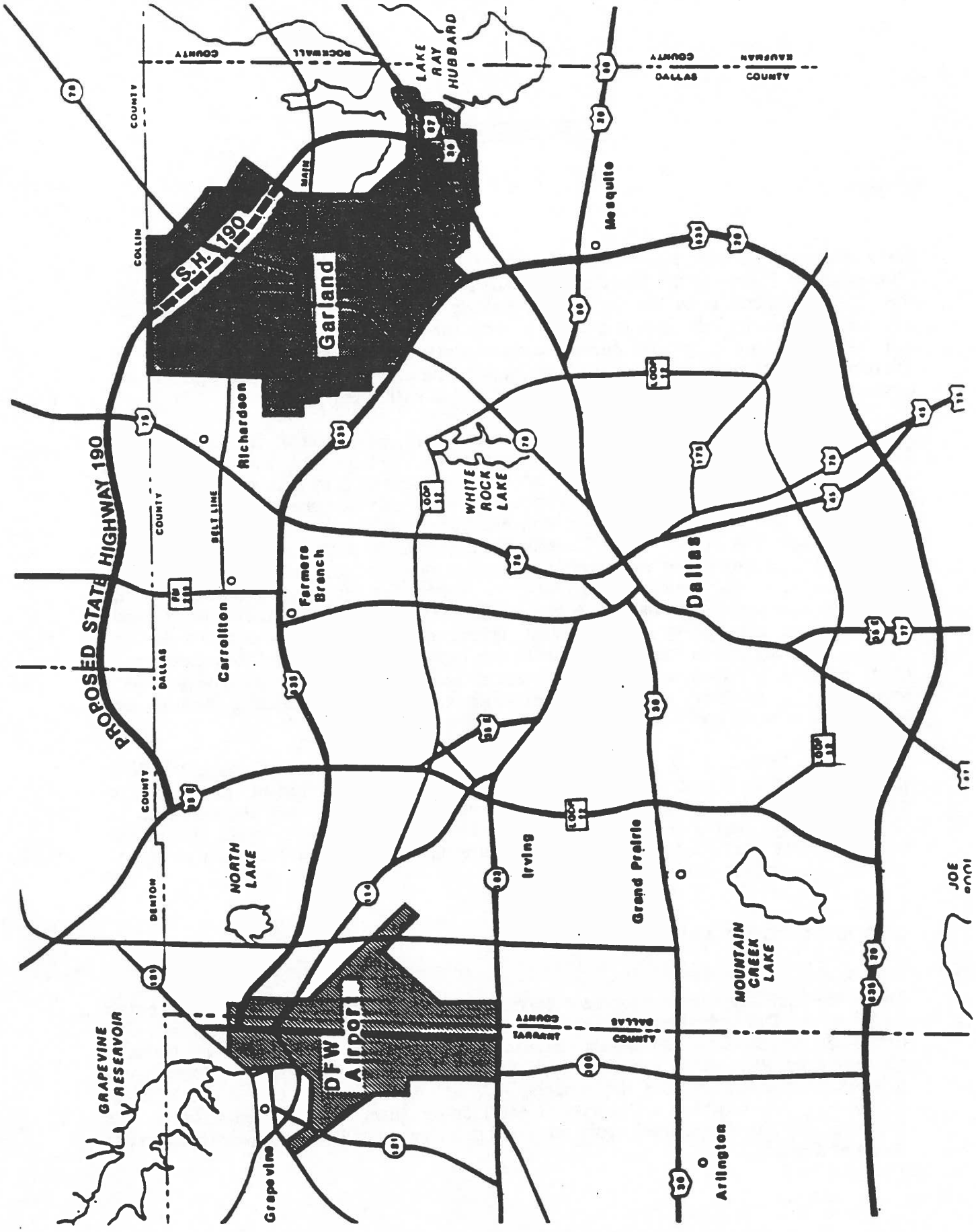


FIGURE 1: REGIONAL LOCATION OF STATE HIGHWAY 190

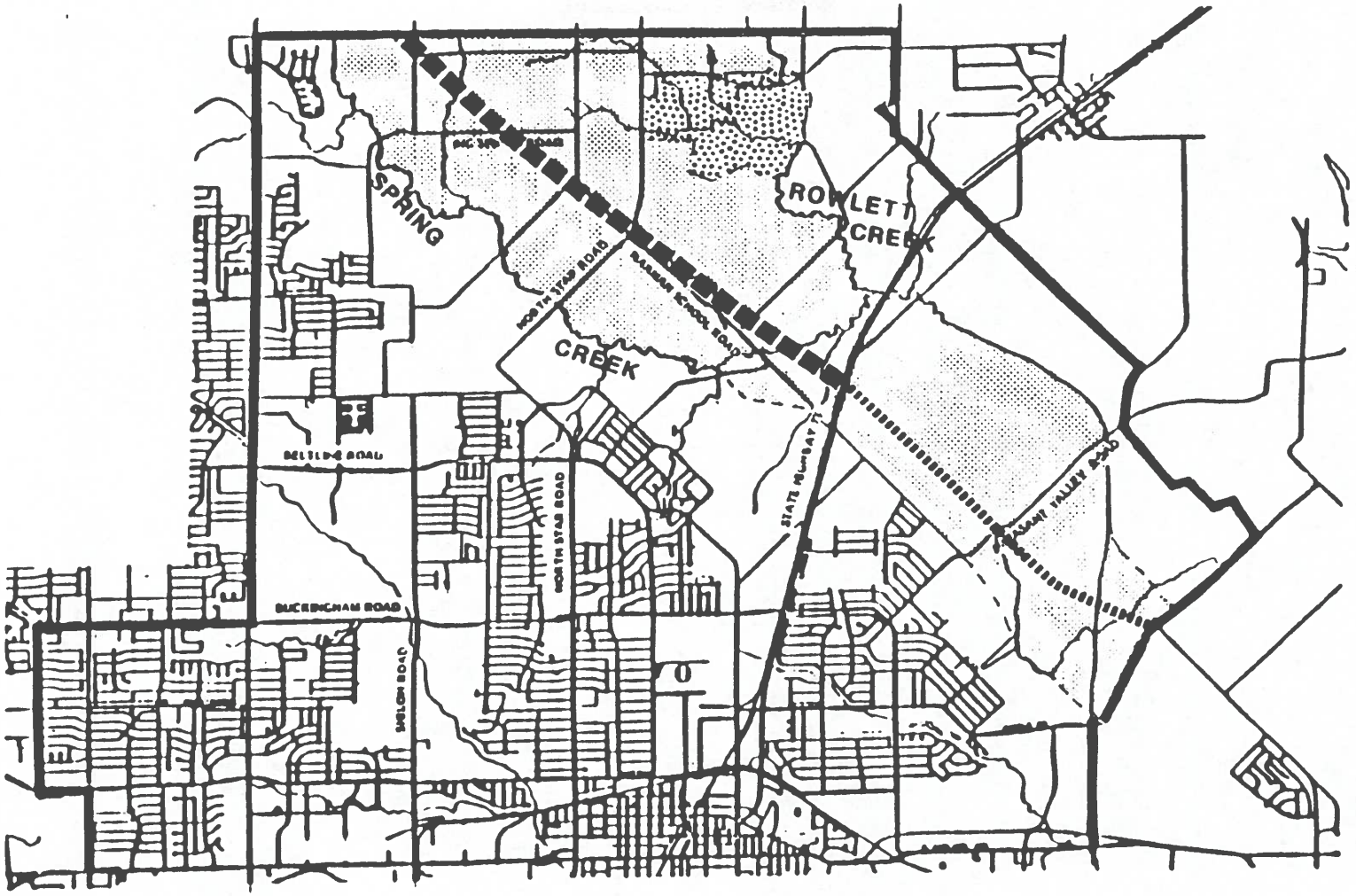


FIGURE 2: STATE HIGHWAY 190 DEVELOPMENT CORRIDOR

DESIGN ELEMENTS

Regulation of land use patterns has traditionally been the major tool used by cities to shape the urban environment. Of equal if not more importance than the particular use that takes place at a certain location is the design and specific development of land uses: their appearance, the impacts (noise, traffic, glare, safety hazards, etc.) they generate, and how the site on which they are located functions with regard to circulation, parking, ingress/egress, and adjacent activities. In many cases a particular use can be incompatible and offensive to its neighbors and the city as a whole or, if carefully and properly designed, that same use can be an attractive and welcome activity. This emphasis on how uses are designed and developed is the focus of the S.H. 190 Development Standards. The following design elements are addressed by the standards. A statement of intent accompanies each element.

Building Design: Non-Residential

Design standards for non-residential buildings shall ensure that the design, color, materials, and basic proportion of structures within the S.H. 190 development corridor are harmonious with and compliment the character and design of existing buildings.

Building Placement: Non-Residential

Visual continuity and compatibility shall be achieved through the appropriate placement of buildings and related site features such as parking and loading areas.

Landscaping

The landscaping standards promote a flexible framework of planting and "green areas" that enhance and safeguard property values while aiding in erosion control, noise abatement, glare and reflection control, buffering between land uses of different character and atmospheric purification.

Screening

Required screening shall accomplish visual screening of the site, noise attenuation, prohibition of vehicular traffic between non-residential and residential uses by means of adjoining easements and alleys and a psychological separation between uses which encourages the peace and repose of residents. Toward this goal, landscaping shall be used to break up the view of continuous barriers and to aesthetically enhance screening devices.

Signs

Sign standards shall promote effective and efficient communication in a manner which does not visually detract from buildings, vistas and other site features in the S.H. 190 corridor. In addition, regulation of signs promotes traffic and pedestrian safety.

Glare And Illumination

The purpose of site lighting is to provide safety and security and enhance the architectural and natural features of the site. Glare and illumination standards shall ensure that the mechanisms providing light do not negatively impact the appearance of the site and ensure that light is contained to the extent that adjacent uses are not detrimentally affected.

Traffic Management

Safe and efficient circulation shall be provided for vehicles and pedestrians both on-site and within the street system.

Utilities

Utilities serving development within the S.H. 190 corridor shall be placed underground where feasible to achieve a positive overall appearance, minimizing the visual clutter and confusion associated with overhead lines. Utilities which cross the Spring Creek Forest Preserve shall be located and constructed in a manner which is sensitive to the forest environment and minimizes its disturbance.

Watershed Management

Development within the Spring Creek and Rowlett Creek watersheds shall occur in a manner which is sensitive to the creek environment and minimizes any negative impacts as a result of site drainage, alteration of the floodplain, or activities associated with nearby land uses. The uniqueness of the Spring Creek Forest Preserve is recognized as a valuable and irreplaceable community resource. It is imperative that special precautions be taken when developing in the drainage area abutting the Spring Creek Forest Preserve to prevent any degradation of this area.

Water Quality Protection

Protection of water quality shall be achieved through the implementation of spill prevention and control measures designed to minimize contamination of stormwater and wastewater. These measures shall address outside storage of chemicals, railroad and tank car loading/unloading facilities and disposal of impounded stormwater from spill containment areas.

REVIEW PROCESS

Upon receipt of a request for approval of a building permit, zoning change, or subdivision plat within the designated S.H. 190 development corridor, the applicant will receive a copy of the Development Standards and counseling as to their applicability and the review process. Staff will review the plans for compliance with the Development Standards, as they do for compliance with the Building Code, Zoning Ordinance, and various other development-related codes and policies. It should be emphasized that **the review process for the S.H. 190 Development Standards is concurrent with the other development-related permitting and plan review processes** such as zoning, platting, and construction permitting, thereby minimizing additional delay.

In those instances where the standards call for special review, or where the applicant feels that, due to unique characteristics of the site or other special circumstances, strict compliance with the standards is not feasible or desirable, the Plan Commission will be called upon to make a judgement concerning appropriate regulation of the site element in question. Should the Commission deny a request for a variation or exception to the Development Standards, an appeal can be made to the City Council.

I. BUILDING DESIGN: NON-RESIDENTIAL

1.0 GENERAL PROVISIONS

All non-residential buildings shall be designed by an architect registered in the State of Texas and shall comply with the Zoning Ordinance, Building Code and related construction codes of the City of Garland.

2.0 EXTERIOR WALLS

2.1 No more than two basic materials in addition to glass may be used on any single building, and one of these must be masonry as defined in I-2.4.

2.2 Masonry shall constitute 80 percent of the total exterior wall area excluding doors, windows or window walls and a minimum of 20 percent of the total wall area including doors, windows or window walls as measured per each expanse of exterior wall between corners of 15 degrees or more. Atrium window walls shall be excluded from the minimum 20 percent masonry requirement.

2.3 The dominant exterior wall material shall be used on all parking structures and accessory buildings to the same extent as or greater than that used on the major building for which the structure is an accessory. At least 12 percent of each side of the parking structure facade (including openings, if any) must be covered with the same material used predominantly on the first 24 feet of height of the main building. Openings in each side of the parking structure facade may not exceed 52 percent of the total facade area of that side.

2.4 Masonry shall be defined as an exterior facade material consisting of brick, stone, rock, marble and other built-up panels of these materials designed for exterior use.

2.5 Use of other exterior building materials such as wood, concrete and concrete block, stucco, glass (other than windows and doors) and metal panels shall be permitted only upon approval by the Plan Commission where such materials are determined to be of high quality and consistent with the intent of these standards.

3.0 WINDOWS

3.1 Highly reflective glass may not be used as an exterior building material on any building or structure.

3.2 Highly reflective glass is defined as glass with an exterior reflectance percentage in excess of 27 percent. Visible reflectance is the percentage of available visible light energy reflected away from the exterior surface of the glass.

3.3 Windows and window walls shall not be glazed or reglazed with mirrored glass except upon approval by the Plan Commission.

3.4 When approving the use of mirrored glass windows or glass exterior facades, orientation of the structure relative to streets and sun angle must be considered to prevent reflective blind spots, particularly along S.H. 190.

4.0 FIRE ESCAPES

4.1 Exterior fire escapes shall not be permitted.

II. BUILDING PLACEMENT: NON-RESIDENTIAL

1.0 SETBACKS

1.1 Setbacks From Property Lines Adjacent To Streets:

1.1.1 No structure of any kind and no part thereof shall be placed within the following setback lines except with approval of the Plan Commission where parcels are of an irregular shape such that development in accordance with these setbacks is not feasible:

1.1.1.1 Minimum 50 feet from S.H. 190 right-of-way (including service road right-of-way).

1.1.1.2 Minimum 30 feet from right-of-way of all other streets.

1.2 Setbacks From Property Lines Not Adjacent To Streets:

1.2.1 No structure of any kind and no part thereof shall be placed within the following setback lines:

1.2.1.1 Minimum 15 feet from rear and side property lines; or 10 feet with additional screening as approved by the Plan Commission. (See Figure II-1).

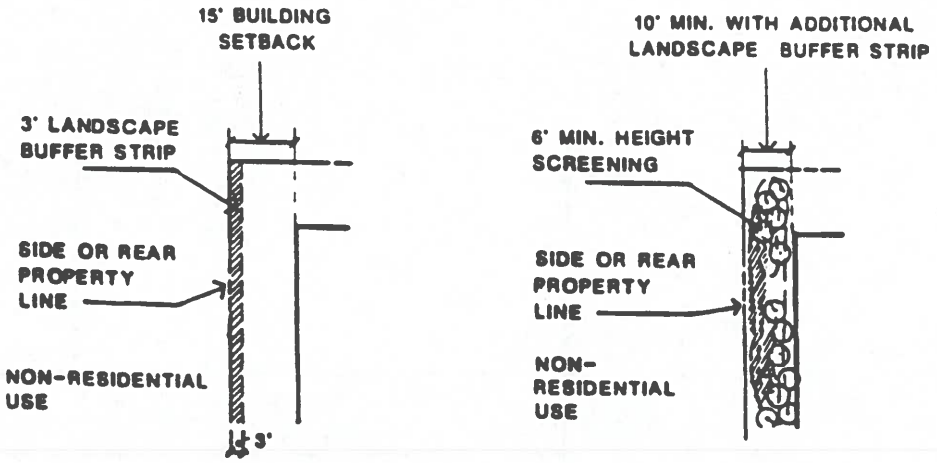


FIGURE II - 1: SETBACK FOR BUILDINGS ABUTTING NON-RESIDENTIAL DISTRICTS

1.2.1.2 Minimum 40 feet abutting residential districts for single story buildings not exceeding 30 feet in height, or 30 feet with additional landscaping as approved by the Plan Commission. (See Figure II-2).

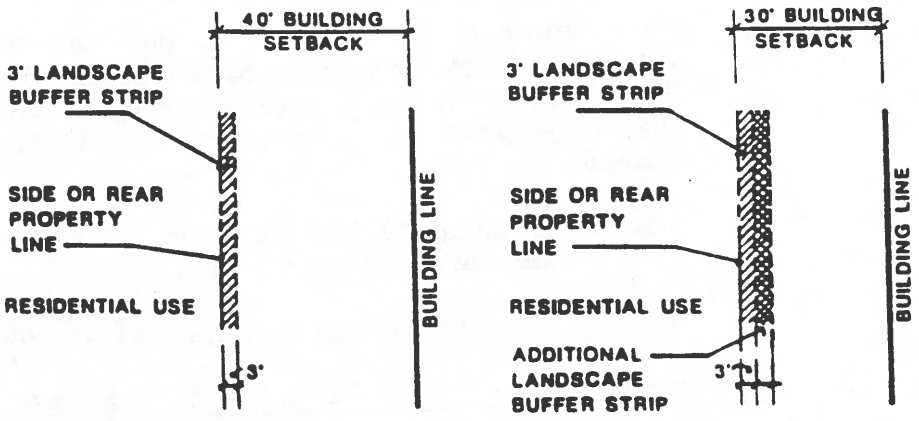


FIGURE II-2: SETBACKS FOR BUILDINGS LESS THAN OR EQUAL TO 30 FEET IN HEIGHT AND ABUTTING RESIDENTIAL DISTRICTS

1.2.1.3 All other buildings and those exceeding 30 feet in height which abut a residential district shall be set back from the residential district line not less than twice the height of the highest point on the building above grade. No setback shall be required in excess of 100 feet. (See Figure II-3).

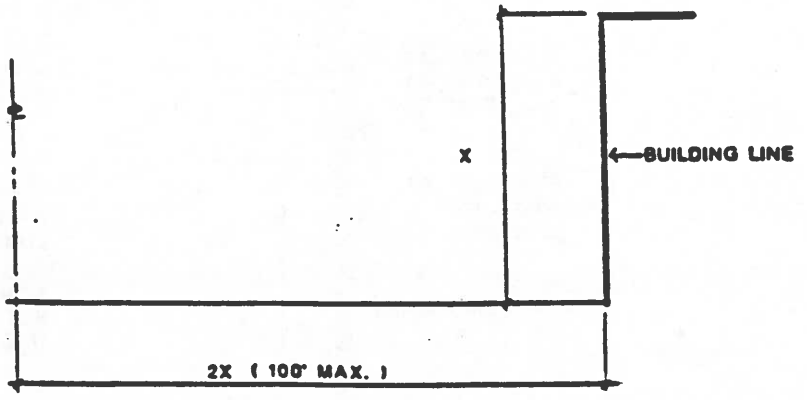


FIGURE II-3: SETBACK FOR BUILDINGS GREATER THAN 30 FEET IN HEIGHT AND ABUTTING RESIDENTIAL DISTRICTS

2.0 LOADING DOCKS AND AREAS

2.1 Loading docks and areas shall not be located on the street-side of any building. However, in those instances where 3 or more sides of the building face dedicated streets, the Plan Commission may grant approval for street-side location of loading docks and areas.

2.2 Loading docks and areas shall not be located within any required setback or landscape buffer strip except as part of a common loading area designed to serve more than one building, as approved by the Plan Commission.

3.0 PARKING AREAS

3.1 Parking areas shall not be permitted in front of the building except under the following circumstances or with approval of the Plan Commission:

3.1.1 Limited visitor parking not to exceed 15 percent of the total required parking spaces or 25 spaces, whichever is less.

3.1.2 Required parking for buildings in which the primary use is retail.

3.1.3 As part of a common parking area designed to serve more than one building, as approved by the Plan Commission. In this circumstance parking may be provided in front of not more than one of the buildings served by the common parking area.

3.2 Parking areas shall not be located within any required front yard landscaped buffer strip which abuts a public right-of-way, except as provided in II-3.1.1 above.

III. LANDSCAPING

1.0 ALL SITES

1.1 Compliance:

Landscaping shall be required on all developments and shall be complete prior to the issuance of any Certificate of Occupancy or final building inspection; or within 180 days of that date with approval of the Building Official and satisfactory assurance (e.g. performance bond) that the landscaping will be completed. Satisfactory assurance shall be determined by the Building Official.

1.2 Alternative Plan Approval:

A landscaping plan which is alternative to strict compliance with the various landscaping requirements of this section may be reviewed by the Plan Commission for irregularly shaped parcels, sites with unusual topographic constraints, or in an effort to preserve existing stands of native trees consisting primarily of oaks, pecans and elms. The alternative plan may be approved by the Plan Commission when found to be as good as or better than a plan in strict compliance with accomplishing the purposes of this section.

1.3 Landscaping Definition:

Landscaping shall be defined for the purpose of these guidelines as consisting of plant material, including but not limited to grass, trees, shrubs, flowers, vines and other ground covers, native trees and shrubs, natural land forms, water forms, planters, other landscape features, walks and plaza areas consisting of enhanced paving. The use of enhanced paving shall not dominate over the use of live plant materials. The use of artificial plant material shall be prohibited.

1.4 Site Definition:

Site shall be defined for the purposes of these guidelines as any plot, tract or parcel of land or combination of contiguous lots, tracts, or parcels of land which is developed (or intended for development) according to an overall site plan. A "site" shall be exclusive of any land dedicated for public use through the official platting process.

2.0 NON-RESIDENTIAL SITES

Landscaping shall conform to a landscaping plan sealed by a registered landscape architect. Plans will be reviewed for compliance with the following:

2.1. A minimum of 10 percent of the gross platted area of each site shall be landscaped.

2.2 A landscape buffer strip shall be provided 50 feet in depth adjacent to the right-of-way of State Highway 190, 30 feet in depth adjacent to thoroughfares designated as Type A, B, or C on the City of Garland Thoroughfare Plan, and 10 feet in depth adjacent to all other roads. (See Figure III-1).

2.2.1 No parking may take place within any landscape buffer strip.

2.2.2 In combination with required screening, landscape buffer strips shall separate any non-residential site from a residential site. (See Section IV., Screening).

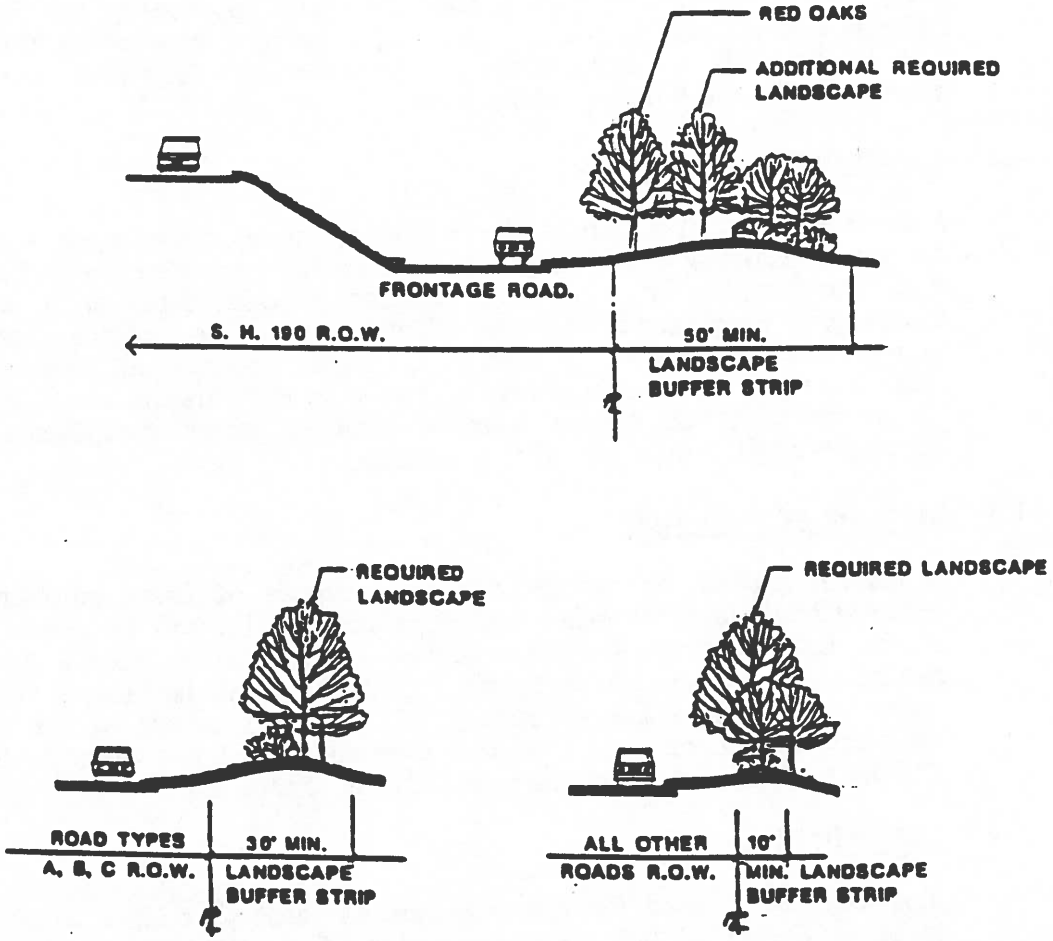


FIGURE III - 1: DEPTH OF LANDSCAPE BUFFER STRIPS

2.3 A minimum of 5 percent of the interior of each parking bay in a surface parking lot shall be landscaped. (See Figure III-2).

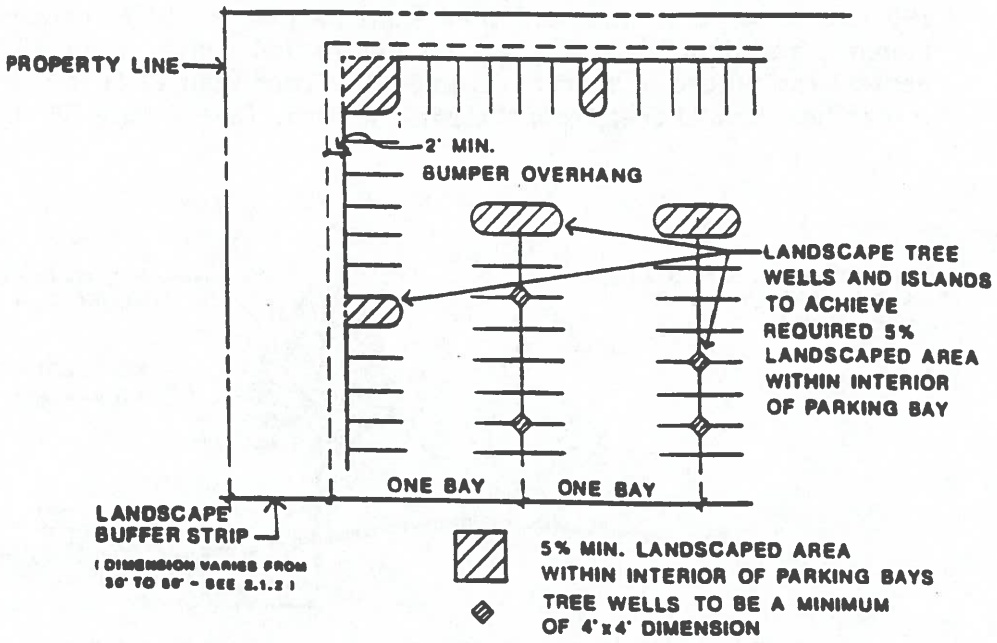


FIGURE III-2:
LANDSCAPE REQUIREMENT FOR INTERIOR PARKING BAYS

2.3.1 Required landscaping shall be distributed throughout the parking bay.

2.3.2 The minimum 2 foot vehicle overhang of each parking stall shall not be included in any required landscaping. (See VII-1.2.2.)

2.4 One (1) tree, minimum 4 inch caliper, from the Plant List (III-5.0) for street trees, shall be provided for each 50 linear feet of frontage. One (1) Red Oak (Quercus shumardii), minimum 4 inch caliper, shall be provided for each 30 linear feet of frontage for properties fronting S.H. 190 and major arterials, and they shall be planted in a boulevard-type manner, approximately 30 feet on center (no closer than 25 feet on center) and placed a uniform distance no closer than 12 feet 6 inches and no farther than 20 feet from the back of curb. (See Figure III-3).

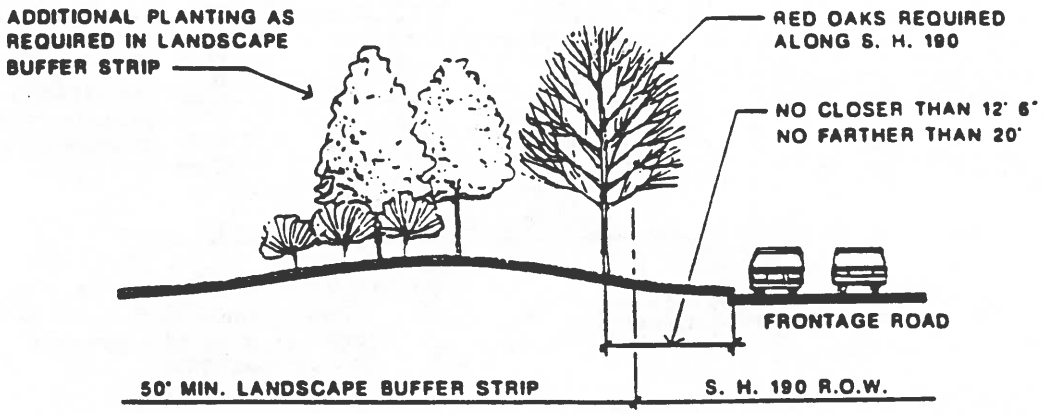


FIGURE III-3: LANDSCAPE REQUIREMENT ALONG STATE HIGHWAY 190

2.4.1 One (1) additional street or large tree of at least 3 inch caliper from the Plant List shall be provided for each 2500 square feet in the landscape buffer strip, or 1 additional ornamental tree of at least 8 feet height from the List shall be provided for each 900 square feet in the landscape buffer strip (with a minimum of three large trees or nine ornamental trees, or a combination of large and ornamental trees, to be used as desired on the site.)

2.4.2 One (1) additional tree from the Plant List shall be provided for each 10 parking spaces to be used only in the parking area.

2.4.3 A demonstrated effort shall be made to preserve existing trees.

2.5 All landscaped areas shall have automatic underground sprinkler systems. An irrigation plan shall be submitted in conjunction with a landscape plan.

2.6 All medians on all public and private streets and drives within a development shall be landscaped. Medians on peripheral or boundary streets shall be exempt from this requirement. Landscaping shall be installed and maintained by the developer/property owner and shall consist of, but not be limited to the following:

2.6.1 A maximum of 10 linear feet of the nose of the median shall be enhanced paving. Where medians are tapered to accommodate left turn lanes, the entire length of the taper less than 5 feet in width shall be enhanced paving.

2.6.2 One (1) large tree at least 3 inches in caliper from the Plant List shall be provided for every 30 feet of median length including taper, or 1 ornamental tree at least 8 feet in height from the List shall be provided for every 20 feet of median length including taper. Required trees shall be placed a minimum of 6 feet from the back of curb, or be centered within the median where it is less than 12 feet in width.

2.6.3 Grouped median plantings shall be consistent with existing or proposed parkway plantings.

2.6.4 A minimum of 20 percent of the landscape area shall be groundcover and shall be at least 4 inch pots spaced 12 inches on center. The remaining area shall be grass.

2.7 All landscaping shall be installed so as to avoid hazards as outlined in VII-1.3 and the City of Garland Blind Corner Ordinance.

3.0 MULTI-FAMILY RESIDENTIAL SITES

Landscaping shall conform to a landscaping plan sealed by a registered landscape architect. Plans will be reviewed for compliance with the following:

3.1 A minimum of 30 percent of the gross platted area of each site shall be landscaped. Landscaped areas, for the purpose of meeting this requirement, shall include all outside plantable ground surface not including areas inside buildings or any paved or hard surfaced areas such as walks, drives, parking areas, swimming pools, and hard surfaced recreation areas.

3.2 A landscape buffer strip shall be provided 50 feet in depth adjacent to the right-of-way of State Highway 190, 30 feet in depth adjacent to thoroughfares designated as Type A, B, or C on the City of Garland Thoroughfare Plan, and 10 feet in depth adjacent to all other roads. No parking may take place within any landscape buffer strip. (See Figure III-1).

3.3 Where a parking lot contains two or more parking bays, a minimum of 5 percent of the interior of each parking bay in a surface parking lot shall be landscaped. (See Figure III-2).

3.3.1 Required landscaping shall be distributed throughout the parking bay.

3.3.2 The minimum 2 foot vehicle overhang of each parking stall shall not be included in any required landscaping. (See VII-1.2.2.)

3.4 One (1) tree, of at least 4 inch caliper, from the Plant List (III-5.0) for street trees, shall be provided for each 50 linear feet of frontage. Properties fronting on S.H. 190 and major arterials shall have Red Oaks (Quercus shumardii) planted in a boulevard-type manner, approximately 30 feet on center (no closer than 25 feet on center) and placed a uniform distance no closer than 12 feet 6 inches or farther than 20 feet from the back of curb. (See Figure III-3).

3.4.1 One (1) additional street or large tree of at least 3 inch caliper from the List shall be provided for each 2500 square feet in the landscape buffer strip, or 1 additional ornamental tree of at least 8 feet height from the List shall be provided for each 900 square feet in the landscape buffer strip (with a minimum of three large trees to be used as desired on the site.)

3.4.2 One (1) additional tree of at least 3 inches caliper or 8 feet height from the List shall be provided for each 10 parking spaces to be used only in the parking area.

3.4.3 A demonstrated effort shall be made to preserve existing trees.

3.5 All landscaped areas shall have automatic underground sprinkler systems. An irrigation plan shall be submitted in conjunction with a landscape plan.

3.6 All medians on all public and private streets and drives within a development shall be landscaped. Medians on peripheral or boundary streets shall be exempt from this requirement. Landscaping shall be installed and maintained by the developer/property owner and shall consist of, but not be limited to the following:

3.6.1 A maximum of 10 linear feet of the nose of the median shall be enhanced paving. Where medians are tapered to accommodate left turn lanes, the entire length of the taper less than 5 feet in width shall be enhanced paving.

3.6.2 One (1) large tree at least 3 inch in caliper from the Plant List shall be provided for every 30 feet of median length including taper, or 1 ornamental tree at least 8 feet in height from the List shall be provided for every 20 feet of median length including taper. Required trees shall be placed a minimum of 6 feet from the back of curb, or be centered within the median where it is less than 12 feet in width.

3.6.3 Grouped median plantings shall be consistent with existing or proposed parkway plantings.

3.6.4 A minimum of 20 percent of the landscape area shall be groundcover and shall be at least 4 inch pots spaced 12 inches on center. The remaining area shall be grass.

3.7 All landscaping shall be installed so as to avoid hazards as outlined in VII-1.3 and the City of Garland Blind Corner Ordinance.

4.0 SINGLE FAMILY DETACHED AND DUPLEX SITES

4.1 Two (2) trees at least 2 inches in caliper from the Plant List (III-5.0) shall be provided in the front yard of all single-family residential lots. Duplex lots shall require 1 such tree per unit.

4.2 Yards adjacent to streets shall be turfed with hydromulch or sod. An acceptable means of soil erosion control in the rear or side yards shall also be provided.

4.3 All medians on all public and private streets and drives within a development shall be landscaped. Medians on peripheral or boundary streets shall be exempt from this requirement. Landscaping shall be installed and maintained by the developer/property owner and shall consist of, but not be limited to the following:

4.3.1 A maximum of 10 linear feet of the nose of the median shall be enhanced paving. Where medians are tapered to accommodate left turn lanes, the entire length of the taper less than 5' in width shall be enhanced paving.

4.3.2 One (1) large tree at least 3 inches in caliper from the Plant List shall be provided for every 30 feet of median length including taper, or 1 ornamental tree at least 8 feet in height from the List shall be provided for every 20 feet of median length including taper. Required trees shall be placed a minimum of 6 feet from the back of curb, or be centered within the median where it is less than 12 feet in width.

4.3.3 Grouped median plantings shall be consistent with existing or proposed parkway plantings.

4.3.4 A minimum of 20 percent of the landscape area shall be groundcover and shall be at least 4 inch pots spaced 12 inches on center. The remaining area shall be grass.

4.4 All landscaping shall be installed so as to avoid hazards as outlined in VII-1.3 under and the City of Garland Blind Corner Ordinance.

5.0 PLANT LIST

This list specifies acceptable trees to meet minimum tree planting requirements and acceptable evergreen shrubs to meet screening requirements. Additional trees and shrubs used on a site may be other than those listed herein.

PLANT LIST

Street Trees

Red Oak	(Quercus shumardii)
Live Oak	(Quercus virginana)
Cedar Elm	(Ulmus crassifolia)

Large Trees

All of the above, plus:

Pecan	(Carya illinoisensis)
Sweetgum	(Liquidambar styraciflua)
Magnolia	(Magnolia grandiflora)
Bald Cypress	(Taxodium distichum)

Smaller/Ornamental Trees

Crape Myrtle	(Lagerstroemia indica)
Yaupon Holly	(Ilex vomitoria)
Bradford Pear	(Pyrus calleryana)

Evergreen Shrubs

Red Cedar	(Juniperus virginiana)
Fraser's Photinia	(Photinia fraseri)
Nellie R. Stevens Holly	(Ilex "Nellie R. Stevens")
Burford Holly	(Ilex cornuta "Burfordii")
Waxleaf Ligustrum	(Ligustrum japonicum)
Japanese Ligustrum	(Ligustrum lucidum)
Eleagnus	(Eleagnus ebbingi) or (Eleagnus angustifolia)

IV. SCREENING

1.0 SCREENING OF NON-RESIDENTIAL USES FROM RESIDENTIAL USES

1.1 Side Yards, Rear Yards and Service Sides:

Side yards, rear yards, and service sides of non-residential uses abutting residential uses shall be screened.

1.2 Screening Height:

Screening height shall be a minimum of 6 feet above the grade of abutting residential uses.

1.2.1 In cases of extreme height differential, the Plan Commission may:

1.2.1.1 Raise screening height requirements or alter material requirements (e.g. including, but not limited to, the use of canopy-forming trees where the non-residential use is at a much lower grade than the residential use).

1.2.1.2 Lower or waive height requirements, or change material requirements (e.g. where a non-residential use is greatly elevated from surrounding residential grades).

1.2.2 All landscaping shall be installed so as to avoid hazards as outlined in VII-1.3 and the City of Garland Blind Corner Ordinance.

1.3 Materials and Methods:

1.3.1 Masonry walls:

1.3.1.1 Shall be defined as an exterior wall consisting of brick, stone, rock, marble or other built-up panels of these materials designed for exterior use. Both sides of the wall shall be treated with a finish compatible with the architecture of the non-residential use.

1.3.1.2 Shall have a minimum 3 feet landscape buffer strip on the non-residential property side to allow for required landscaping in connection with all such masonry walls. (See Figure IV-1).

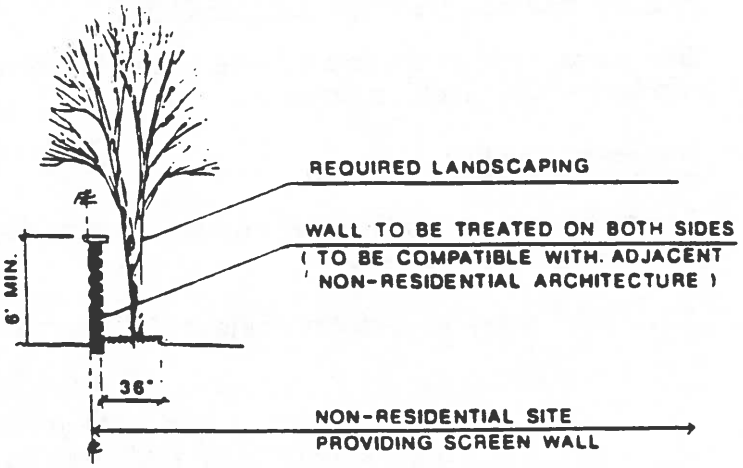


FIGURE IV-1: MASONRY WALL WITH 3 FOOT LANDSCAPE BUFFER STRIP

1.3.1.3 Landscaping adjacent to masonry walls shall consist of a minimum of 1 small ornamental tree at least 8 feet in height for each 10 linear feet, or 1 large tree at least 3 inch in caliper evenly distributed for each 30 linear feet, placed no closer than 25 feet on center. This is in addition to other required landscaping, i.e. parking and landscape buffer strip. (See Plant List, III-5.0 for acceptable species.)

1.3.2 Earthen berms:

1.3.2.1 Shall have a maximum side slope of 3:1.

1.3.2.2 Shall be entirely vegetated with turf or groundcover.

1.3.3 Allowed combinations:

1.3.3.1 A combination of evergreen shrubs from the Plant List, at least 36 inches in height and spaced triangularly no greater than 48 inches on center, and earthen berms may be used to accomplish the required screening height. The berms shall have an average height of 3 feet.

1.3.3.2 A combination of masonry walls with required landscaping and earthen berms may be used to accomplish the required screening height.

2.0 SCREENING OF NON-RESIDENTIAL USES FROM PUBLIC THOROUGHFARES

2.1 Side Yards:

Where the side yard of a non-residential use is not service or parking area and is adjacent to a public thoroughfare, such side yard shall be landscaped in accordance with the landscaping standards set forth in III-2.

2.2 Rear Yards or Service Sides:

Where the rear yard or service side of a non-residential use is adjacent to a public thoroughfare and screening of the use is not specifically addressed elsewhere in this ordinance, it shall be screened according to IV-1.3.

2.3 Exception:

Where stringent enforcement of this Section can be demonstrated to be in conflict with the goal of compatibility of uses, or if compliance with this Section precludes the use of a more effective screening device, the Plan Commission may waive or add certain requirements.

3.0 SCREENING OF MULTI-FAMILY RESIDENTIAL USES FROM SINGLE-FAMILY RESIDENTIAL USES

3.1 Devices that shall be used to fulfill requirements for the screening of multi-family residential uses from single-family residential uses shall be the same as devices for screening non-residential uses from residential uses. (See IV-1.3.)

3.2 Exception:

Where stringent enforcement of this Section can be demonstrated to be in conflict with its goal of compatibility of uses, or if compliance with this Section precludes the use of a more effective screening device, the Plan Commission may waive certain requirements. This Section shall not waive the requirements of IV-1 and IV-2; however, the provisions of IV-1 and IV-2 may, in some cases, fulfill the requirements of this Section.

4.0 SCREENING OF SITE FEATURES

This Section shall not waive the requirements of IV-1 and IV-2; however, the provisions of IV-1 and IV-2 may, in somes cases, fulfill the requirements of this Section.

4.1 Loading Areas:

Freight docks, loading areas, truck berths, and heavy vehicle storage areas shall be screened from all public rights-of-way. Further, they shall be screened from all abutting uses except when the abutting use is determined to be of equal or greater intensity.

4.1.1 When stated activities abut or are otherwise parallel with and visible to public rights-of-way or residential uses, screening for the activity shall:

4.1.1.1 Meet the requirements of IV-1.2.

4.1.1.2 In addition, trees of a type normally attaining or exceeding a height of 10 feet must be planted not more than 30 feet on center.

4.1.2 When stated activities are visible from a public thoroughfare, screening height shall be adequate to screen truck berths, loading docks, heavy vehicles that are parked or stored, and storage of equipment or materials. Screening shall consist of one or a combination of the following:

4.1.2.1 Wing walls or fences which are architecturally and aesthetically compatible with the exterior of the building.

4.1.2.2 Earthen berms in conjunction with trees and other landscaping.

4.1.3 When stated activities abut public rights-of-way other than thoroughfares, such as alleys, screening shall meet the requirements of IV-1.2, except when these or similar activities abut one another and are situated in a manner which precludes their being visible from a public thoroughfare.

4.1.4 When stated activities abut a use of lesser intensity (other than residential), these activities shall be screened by one or a combination of the following:

4.1.4.1 Earthen berms and landscaping, including evergreen shrubs and trees used in combination to achieve a minimum screening height of 8 feet. Berms shall have a minimum average height of 3 feet as measured from the top of adjacent street curbs, but in all cases shall have a maximum side slope of 3:1. (See Figure IV-2).

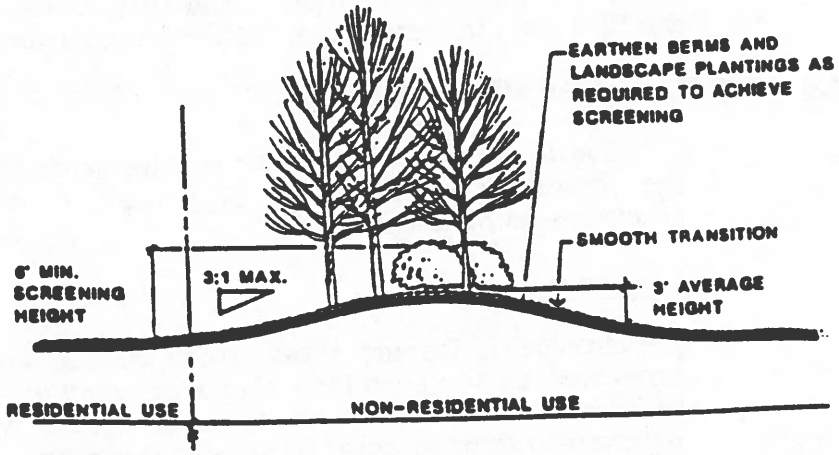


FIGURE IV-2: EARTHEN BERM WITH LANDSCAPING

4.1.4.2 Masonry walls and landscaping, including evergreen shrubs and trees used in combination to achieve a minimum screening height of 8 feet. Walls shall be a minimum of 4 feet in height as measured from the top of adjacent street curbs.

4.2 Outdoor Storage Areas:

4.2.1 Outdoor storage of merchandise, equipment, or materials which are essential or incidental to the use and which are not on temporary display for the purpose of being immediately available for sale to the public at large (where allowed by the Zoning Ordinance) shall be screened from all public rights-of-way and abutting uses, except when the abutting use is determined by the Plan Commission as being of equal or greater intensity.

4.2.2 When outdoor storage areas abut or are visible to public thoroughfares or residential areas, screening shall meet the requirements of IV-1.2.

4.2.3 When outdoor storage areas abut a use of lesser intensity (other than residential), the outdoor storage area shall be screened by one or a combination of the following:

4.2.3.1 Earthen berms and landscaping, including evergreen shrubs used in combination to achieve a minimum screening height of 6 feet. Berms shall have a minimum average height of 3 feet as measured from the top of adjacent street curbs, but in all cases shall have a maximum side slope of 3:1.

4.2.3.2 Masonry walls and landscaping, including evergreen shrubs or trees used in combination to achieve a height of at least 6 feet. Walls shall have a minimum height of 4 feet as measured from the top of adjacent street curbs.

4.2.4 When outdoor storage areas abut a public right-of-way which is not a thoroughfare, such as an alley, screening shall meet the requirements of IV-1.2 except when these or similar uses predominate an area and when such use is situated in a manner that precludes its being visible from a public thoroughfare, as determined by the Plan Commission.

4.3 Parking Areas:

Parking areas (other than those described for heavy vehicles) shall be screened so that the lower portions of passenger cars and light trucks are obscured from view of the public rights-of-way and adjacent properties. Screening shall consist of one or a combination of the following alternatives. In each case, screening shall have a continuous height of 3 feet above the parking area.

4.3.1 Landscaped earthen berms.

4.3.2 Evergreen shrubbery and trees.

4.3.3 Any combination of 4.3.1 and 4.3.2. (See Figure IV-3).

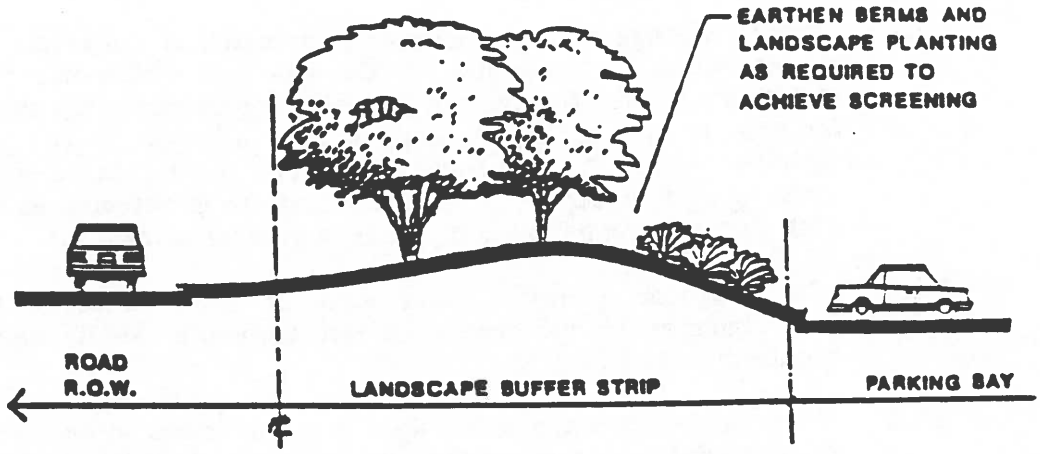


FIGURE IV-3: SCREENING OF PARKING AREAS

4.3.4 In some cases, compliance with other sections of this ordinance may meet the requirements of this Section. Where slopes and/or grade differential between parking areas and surrounding properties accomplish the intent of this Section, the Plan Commission may waive requirements. **In any case, view triangles as described in VII-1.2.2 shall be respected.**

4.4 Refuse Areas:

Refuse storage containers shall be screened from the view of public rights-of-way and from the view of adjacent private properties. Where they are not entirely screened from these areas by meeting the requirements of other sections, they shall be screened on three sides by the construction of masonry walls. An opening shall be provided on the fourth side for access by refuse collectors. However, the opening shall be situated so that the container is not visible from adjacent public rights-of-way or private properties.

4.5 Ground-Mounted Equipment:

All ground-mounted equipment, including pad-mounted transformers, telephone switch boxes, and gas meters, shall be reasonably screened from the view of public rights-of-way and from the view of adjacent properties. Whenever possible, appurtenances for utility services shall be installed at the rear of the structures which they service.

4.5.1 Reasonably screened shall mean screening to the greatest extent possible and shall be toward the goal of balancing the negative aesthetic impact of the appurtenance without interference with the safe operation and maintenance of the equipment being screened.

4.5.2 Acceptable means of screening are:

4.5.2.1 Landscaping, including trees or evergreen shrubbery.

4.5.2.2 Earthen berms in conjunction with landscaping.

4.5.2.3 Masonry walls in conjunction with landscaping.

4.6 Wall-Mounted Equipment:

Wall-mounted equipment, including various meters (such as electric meters), shall be screened by:

4.6.1 Landscaping, including trees or evergreen shrubbery.

4.6.2 Masonry walls in conjunction with landscaping.

4.6.3 Wall-mounted screening devices such as cabinets or partitions which are architecturally compatible with the structure.

4.7 Roofscape.

4.7.1 All roof-mounted equipment including, but not limited to, fans, vents, and cooling towers shall be screened so as not to be visible to the immediate ground level and the ground level of adjacent properties.

4.7.2 Overall screening height shall be the height of the highest element of roof-mounted equipment.

4.7.3 Roof color shall be compatible with building color.

4.7.4 Roof-mounted equipment and the rear sides of visual screens shall be painted or otherwise treated in such a manner as to match the color of the roof.

4.7.5 All roof-mounted equipment shall be placed in a uniform and linear manner except for normal plumbing vents or flues.

V. SIGNS

1.0 DEFINITIONS

1.1 **Site** shall mean a building which houses a single activity and the contiguous grounds and parking areas which exclusively service that building or any number of activities housed by a single building or multiple buildings which share common egress or ingress from a public street or right-of-way.

1.2 Item shall mean: (See Figure V-1).

1.2.1 A syllable of a word.

1.2.2 An abbreviation.

1.2.3 A number.

1.2.4 A non-continuous plane.

1.2.5 A symbol.

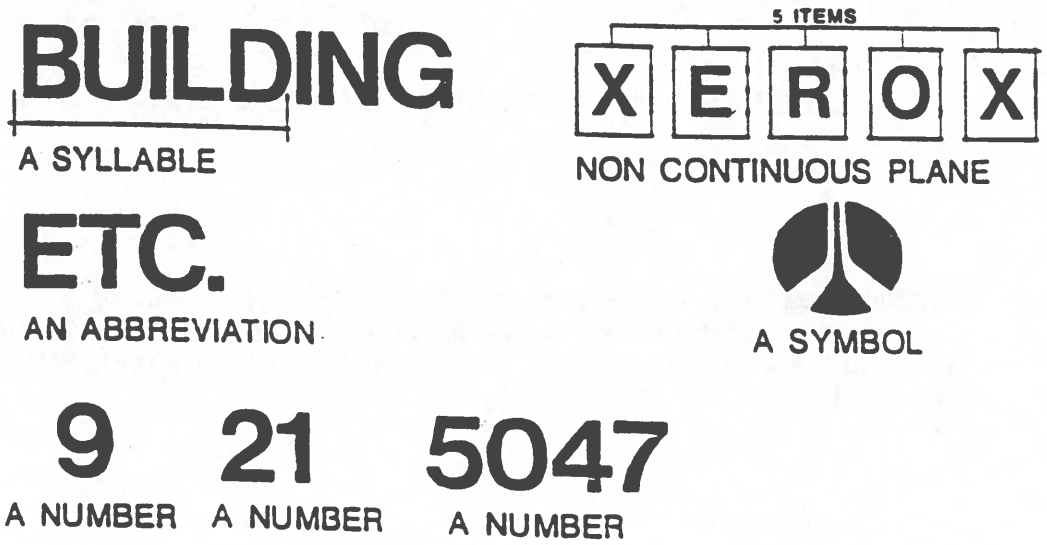


FIGURE V-1: EXAMPLES OF ITEMS (SIGNAGE)

1.2.6 The following shall not be considered items:

1.2.6.1 Lettering less than 3 inches in height when it is part of a wall sign.

1.2.6.2 Lettering and symbols less than 10 inches in height which are carved into or attached to a building facade in such a manner as to constitute an architectural

detail, provided that such symbols or letters are not internally illuminated or made of a material which is reflective or which sharply contrasts with the color of the building. However, letters and symbols in excess of 10 inches shall be considered as part of the total number of items. (See Figure V-2).

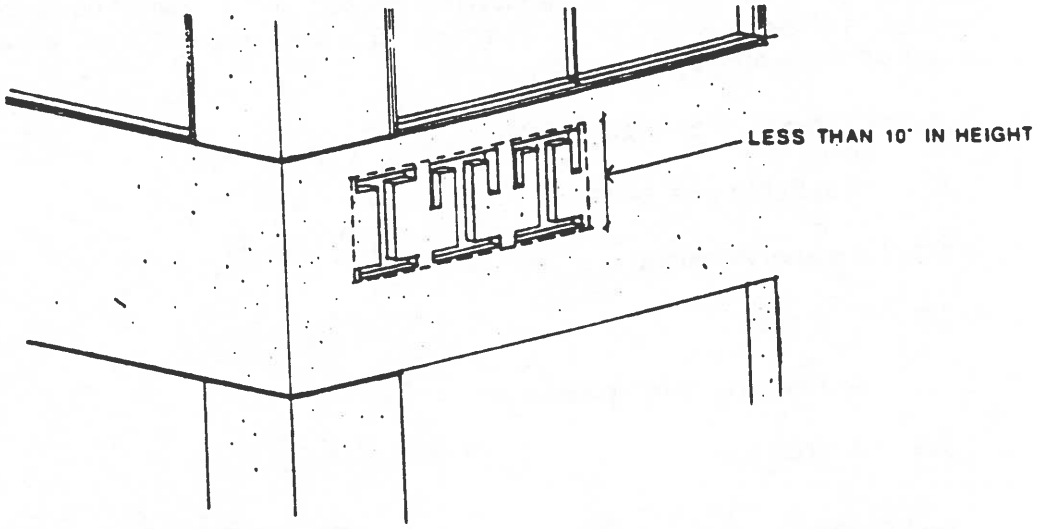


FIGURE V - 2: SIGNAGE AS AN ARCHITECTURAL DETAIL

1.3 **Signable Area** shall mean a continuous portion of a wall of a building which is unbroken by doors, windows, or major architectural detail and which can be entirely enclosed by imposition of a single rectangle. (See Figure V-3).

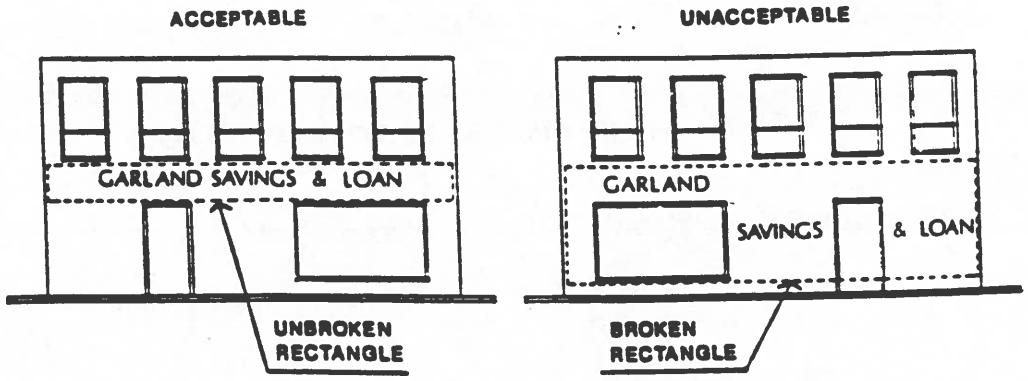


FIGURE V - 3: SIGNABLE AREA

1.3.1 Where under certain conditions wall and, therefore, signable area may be shared (as is the case for sign bands in strip centers), signable area shall further be delineated by the width of the front of the space occupied by the particular activity.

1.4 **Effective Area, for detached signs** shall mean the area enclosed by the minimum imaginary rectangle of vertical and horizontal lines which fully contains all extremities of the sign, exclusive of its supports. This rectangle is to be calculated from an orthographic projection of the sign viewed horizontally. A viewpoint for this projection is to be taken which gives the largest rectangle of that kind, as the viewpoint is rotated horizontally around the sign. If elements of the sign are movable or flexible, as a flag or string of lights, the measurement shall be taken when the elements are fully extended and parallel to the plane of view. **Effective Area, for attached signs** shall mean the sum of the areas of the minimum imaginary rectangles enclosing each word attached to any particular facade. This definition shall also apply to signs which are composed solely of words which identify a premise and which are attached to free-standing walls.

1.5 **Monument Sign** shall mean a sign whose display face is contiguous with the ground; and is not elevated above-grade by use of poles, beams, struts or wires; and which (other than the copy itself) is made of masonry or stone. Other appropriate materials may be determined by the Plan Commission. (See Figure V-4).

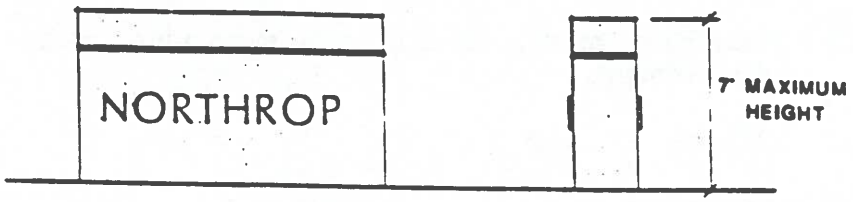


FIGURE V - 4: MONUMENT SIGN

1.6 **Canopy** shall mean a projecting roof-like covering which is a permanent and integral part of the building's structure.

1.7 **Awning** shall mean a roof-like structure which is not an integral structural part of, and is accessory to, the building which it serves.

1.8 **Sign Band** shall mean an architectural element of a building expressly designed to accomodate signage.

1.9 **Facade** shall mean any separate face of a building, including parapet walls and omitted wall lines, or any part of a building which encloses or covers usable space. Where separate faces are oriented in the same direction or in the directions within 45 degrees or less of one another, they are to be considered as part of a single facade.

1.10 **Public Entrance** shall mean an entrance to an activity normally used by the public consisting of any number of doors or other openings in a single facade of a building.

1.11 **Activity** shall mean any person, business, organization or other entity.

1.12 **Roof Sign** shall mean any sign attached to a roof of a building or awning or which is attached to a wall or awning face in such a manner as to project above the top edge of the wall or awning face to which the sign is mounted.

1.13 **Portable Sign** shall mean a sign which is easily moved from one location to another including signs which are mounted on skids, trailers, wheels, legs or stakes and which are not fixed permanently to the ground, and which is not an attached sign, political sign, vehicular sign or sign which refers solely to the sale or lease of the premises.

2.0 SPECIFICATIONS: ALL DISTRICTS

2.1 Prohibited Signs:

2.1.1 Portable signs.

2.1.2 Flashing or moving signs or those signs which create an illusion of movement.

2.1.3 Off-premise signs.

2.1.4 Roof signs.

2.1.5 Projecting signs which are mounted on a wall or a building or other architectural element in such a manner that the sign face is not parallel with the face of the wall, building or other architectural element to which the sign is mounted.

2.2 Maximum Number of Items:

No sign shall display more than 10 items, except where an undue hardship is determined by the Plan Commission.

2.3 Sign Content:

All signs shall be limited to site or activity identifications, unless specifically exempted as auxiliary signs under V-6.0.

2.4 Sign Height:

In no case shall a sign (except under the provision of V-3.2.3) project above the site roof or parapet wall heights, whichever is greater.

2.5 Materials:

The color, construction, and material of each sign shall be compatible with the architecture and other signs on the site. Each activity shall be restricted to the use of a maximum of three colors, including backgrounds, on all internally illuminated signs employed by the activity.

2.6 Monument Signs:

2.6.1 Shall be erected no closer than 10 feet to a frontage property line adjacent to a street.

2.6.2 Shall be erected no closer than 10 feet from a property line which abuts a non-residential or multi-family use, and 20 feet from a side property line which abuts a single-family use.

2.6.3 Shall not exceed 7 feet in height as measured from the top of the most immediately adjacent curb. (See Figure V-4). Area shall be regulated by the provisions of V-4.2.2.

2.6.4 In excess of 6 square feet shall be erected no closer than 100 feet to another freestanding or monument sign.

2.7 Freestanding Signs:

2.7.1 No more than one freestanding sign shall be allowed per site unless specifically exempted as an auxiliary sign under V-6.0.

2.7.2 No freestanding sign structure shall be used to support more than one sign unless specifically exempted as an auxiliary sign under V-6.0.

2.7.3 Freestanding signs in excess of 6 square feet shall be erected no closer than 100 feet to another freestanding or monument sign.

2.7.4 Where a site possesses frontage on at least two non-intersecting streets, a maximum of two monument signs may be used in lieu of a single freestanding sign.

2.8 Attached Signs:

2.8.1 Attached signs shall be allowed only when the activity individually possesses a public entrance on the exterior of the building which fronts and is immediately accessible to and from a public street or a street, walkway or driveway used by the public.

2.8.2 Number of attached signs:

2.8.2.1 Where an autonomous, non-residential building houses a single activity:

2.8.2.1.1 A total of two attached signs shall be allowed when such building fronts on two or more streets.

2.8.2.1.2 No more than one attached sign shall be allowed on any facade of the building.

2.8.2.2 Where a non-residential building houses more than one activity, one attached sign shall be permitted per public entrance, provided that not more than one attached sign shall be used per portion of the building facade occupied by the activity. (See Figure V-5).

2.8.2.3 Non-illuminated street address numbers and placards which identify the activity may be used in addition to other attached signs. Where used, such signs shall be placed immediately above or adjacent to a public entrance, attached to a wall surface, and shall not exceed 10 square feet in effective area for single tenant buildings nor 6 square feet for multiple tenant buildings.

2.8.3 Sign type:

2.8.3.1 Architectural elements to which signs may be attached shall be limited to building wall surfaces, canopy facia, or sign bands. Each activity shall attach signs to no more than one type of architectural element (e.g., if signs are attached to canopy facia, additional signs shall not be attached to building wall surfaces). (See Figure V-5).

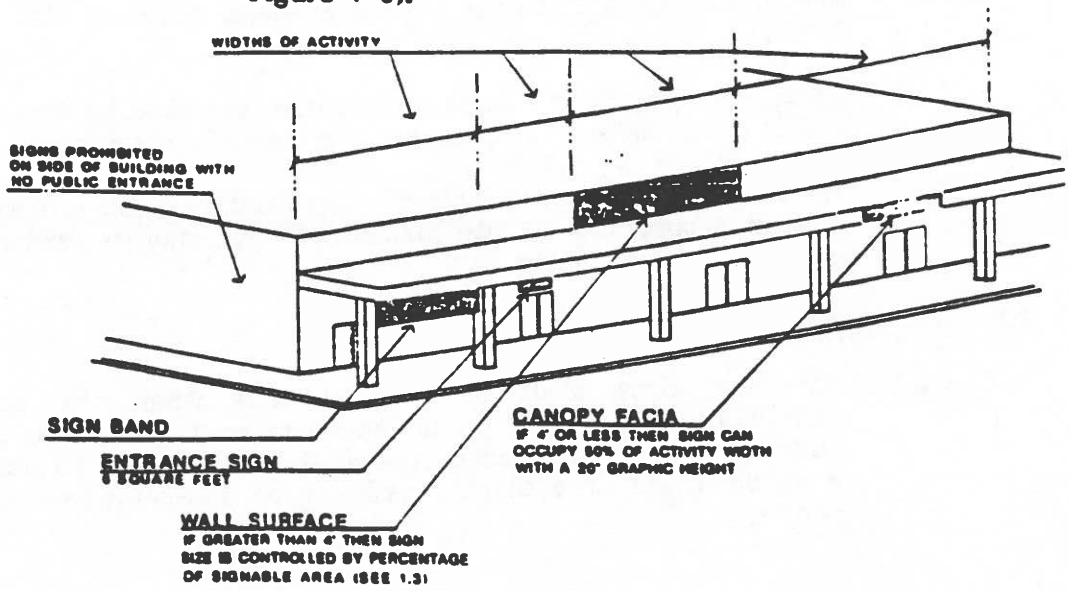


FIGURE V-5: ATTACHED SIGNS FOR MULTI-TENANT BUILDINGS

2.8.3.2 Non-illuminated street address numbers and placards which identify the activity may be used in addition to other attached signs. Where used, such signs shall be placed immediately above or adjacent to a public entrance, shall be attached to a wall surface, and shall not exceed 10 square feet in effective area for single tenant buildings nor 6 square feet for multiple tenant buildings.

2.8.4 Attached signage size: (See Figure V-5).

2.8.4.1 Where the width of the architectural element to which the sign is attached is greater than 4 feet as measured from top to bottom, sign size shall be regulated by the prescribed percentages of signable area and maximum sizes in V-3.3.1, V-4.3.1 and V-5.3.1.

2.8.4.2 Where the width of the architectural element is less than 4 feet as measured from top to bottom, the following shall apply:

2.8.4.2.1 Graphic size shall not exceed 20 inches in height.

2.8.4.2.2 Where a non-residential building houses a single activity, the length of the sign shall not exceed 75 percent of the length of the architectural element to which it is attached or 25 feet, whichever is less.

2.8.4.2.3 Where a non-residential building houses multiple activities, the length of the sign shall not exceed 50 percent of the length of the facade occupied by the activity or 20 feet, whichever is less.

2.8.5 Location and heights:

2.8.5.1 Where an activity is located in a one-story building, the wall sign shall be placed no higher than the roof line of the architectural element to which it is affixed.

2.8.5.2 Where an activity is located on the first floor of a multi-story building, an attached sign shall be placed no higher than the floor level of the second story.

2.8.5.3 Where an activity is located on the second floor of a multi-story building, an attached sign shall be placed no higher than the floor of the third floor or, in the case of a two-story building, the roof line of the building.

2.8.5.4 In no case shall attached sign height exceed the height of the third floor of a building.

2.8.5.5 Where signs are attached to canopy facia, such signs shall not protrude above or below the canopy facia.

2.8.5.6 No attached sign shall project a distance greater than 18 inches from the architectural element to which it is affixed.

2.8.5.7 Where an attached sign is placed in such a manner as to project a distance greater than two inches into a private driveway or other private area likely to be used by vehicular traffic, or where such sign is placed in a manner which allows the passage of vehicular traffic beneath it, there shall be a minimum distance of 12 feet as measured from the bottom of the sign to the ground immediately below.

2.8.5.8 Where an attached sign is placed in such a manner as to project a distance greater than two inches into a private pedestrian walkway or other private area likely to be used by pedestrian traffic, or where such sign is placed in a manner which allows the passage of pedestrian traffic beneath it, there shall be a minimum distance of 7 feet as measured from the bottom of the sign to the ground immediately below.

3.0 SPECIFICATIONS: NON-RESIDENTIAL PROPERTIES ABUTTING HIGHWAY 190 AND ADJACENT FRONTAGE ROADS

3.1 Monument Signs:

(Refer to V-2.6 under Specifications-All Districts)

3.2 Freestanding Signs:

3.2.1 Shall observe a minimum setback of: (See Figure V-6).

3.2.1.1 Twenty-five (25) feet from front property lines adjacent to streets.

3.2.1.2 Ten (10) feet from side property lines which abut non-residential uses.

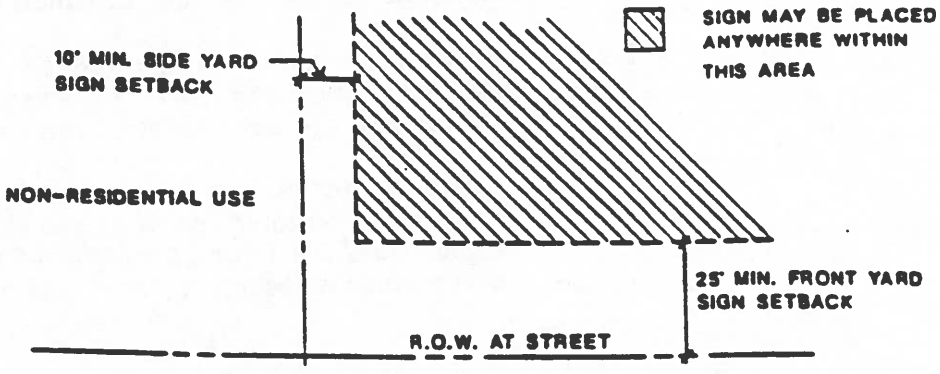


FIGURE V - 6: SETBACK REQUIREMENTS FOR FREESTANDING SIGNS

3.2.1.3 The full distance of the required side building setback line when the property abuts a residential use.

3.2.2 Shall not exceed 160 square feet in area.

3.2.3 Shall not exceed 22 feet in height. Where premises are contiguous to elevated portions of the highway and are located in such a manner that sign visibility is affected, the Plan Commission may grant variances in height up to 13 additional feet (i.e. allowing a maximum height of 35 feet). (See Figure V-7).

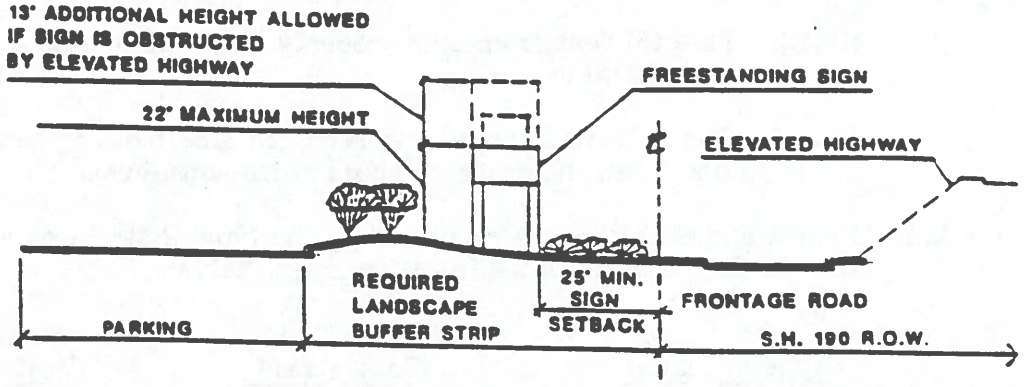


FIGURE V - 7: HEIGHT REQUIREMENTS FOR FREESTANDING SIGNS

3.2.4 Except by variance described in V-3.2.3, no freestanding sign shall project beyond the roof or parapet wall lines of a building located on the same site.

3.2.5 Additional standards may apply - Refer to V-2.7 under Specifications-All Districts.

3.3 Attached Signs:

3.3.1 Shall not exceed 30 percent of signable area or 160 square feet, whichever is less.

3.3.2 Signs attached to screening or decorative walls for the purpose of announcing non-residential development and whose primary objective is decorative shall be allowed. However, they shall not exceed 8 feet above grade nor 16 square feet in area. (See Figure V-8).

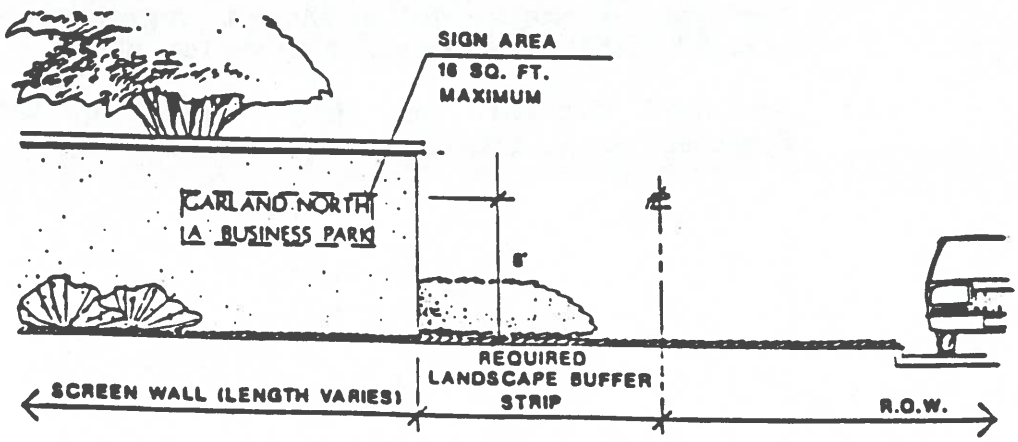


FIGURE V - 8: SIGNS ON DECORATIVE AND SCREENING WALLS

3.3.3 Additional standards may apply - Refer to V-2.8 under Specifications-All Districts.

4.0 SPECIFICATIONS: OTHER NON-RESIDENTIAL PROPERTIES

4.1 Monument Signs:

(Refer to V-2.6 under Specifications-All Districts)

4.2 Freestanding Signs:

4.2.1 Shall observe a minimum setback of:

4.2.1.1 Fifteen (15) feet from frontage property lines.

4.2.1.2 Five (5) feet from side property lines which abut a non-residential use.

4.2.1.3 The full distance of the required side building setback line when the property abuts a residential use.

4.2.2 Height and area shall be regulated by the type of street on which the site fronts as provided in the following table:

*Type of Street	Maximum Area (Square Feet)	Maximum Height (Feet)
A, B, C	50	16
D, E	40	14
All other streets	25	12

*As identified on the City of Garland Thoroughfare Plan.

4.2.3 Additional standards may apply. Refer to V-2.7 under Specifications-All Districts.

4.3 Attached Signs:

4.3.1 Shall not exceed 30 percent of signable area or 70 square feet, whichever is less.

4.3.2 Signs attached to screening or decorative walls for the purpose of announcing a non-residential development and whose primary objective is decoration shall be allowed. However, they shall not exceed 8 feet above grade nor 16 square feet in area.

4.3.3 Additional standards may apply - Refer to V-2.9 under Specifications-All Districts.

5.0 SPECIFICATIONS: RESIDENTIAL PROPERTIES

5.1 Monument Signs:

(Refer to V-2.6 under Specifications-All Districts)

5.2. Freestanding Signs:

5.2.1 Shall be limited to monument types.

5.2.2 Shall not exceed 35 square feet in area.

5.2.3 Shall not exceed 7 feet in height.

5.2.4 An area immediately surrounding or contiguous with the sign shall be landscaped proportionately with the area of the sign (e.g. if the sign area is 35 square feet; then the landscaping of the area surrounding the sign shall not be less than 35 square feet); except that such signs with an area of 8 square feet or less shall be exempted from this requirement.

5.2.5 Additional standards may apply - Refer to V-2.7 under Specifications-All Districts.

5.3 Attached Signs:

5.3.1 Shall not exceed 20 percent of the signable area or 35 square feet, whichever is less.

5.3.2 Signs attached to screening or decorative walls for the purpose of announcing a residential subdivision, and whose primary objective is decoration, shall be allowed. However, they shall not exceed 8 feet above grade nor 16 square feet in area.

6.0 AUXILIARY SIGNAGE: ALL NON-RESIDENTIAL PROPERTIES

6.1 Fuel Stations:

6.1.1 Establishments providing engine fuel sales may attach signs for the purpose of indicating fuel price, fuel type, and full- or self-service to fixed awning supports. Fuel price signs shall not exceed 16 square feet in area nor shall those signs indicating full-or self-service or fuel type exceed 6 square feet in area (See V-6.6.3 for further regulation regarding signs attached to awnings).

6.1.2 In no case shall such sign be erected as a freestanding sign, except that where a freestanding pole sign exists and is permitted, said sign may be attached to the pole sign support in addition to signs thereon supported; and at heights prescribed under Chapter 20 of the Code of Ordinances.

6.1.3 Letters, symbols and other graphics contained within each sign shall not be considered as items and such signs shall further be exempted from V-2.2 and V-2.3.

6.2 Restaurants:

Eating establishments with drive-through facilities are permitted menu boards compatible with the establishment's architecture and not exceeding a height of 8 feet or 35 square feet in area. (Such signs are exempt from V-2.2, 2.3, 2.6.4, 2.7.1, 2.7.2, and shall not be considered a part of the total number of items.)

6.3 Entertainment Facilities:

Establishments whose primary function is to provide entertainment in the form of shows, motion pictures, theatre, or music and which change the nature of the entertainment on a regular basis shall, for the sole purpose of listing entertainment available, be permitted:

6.3.1 To exceed the allowed number of items providing that the letters or symbols used do not exceed 7 inches in height.

6.3.2 Attached signs up to 70 square feet in area (V-2.2, 3.3.1, and 4.3.1 notwithstanding). Use of freestanding signs is prohibited.

6.4 Commercial Subdivisions:

Signs attached to screening or decorative walls for the purpose of announcing a commercial subdivision, and whose primary objective is decoration shall be allowed. However, they shall not exceed 8 feet in height or 16 square feet in area.

6.5 Construction Sites:

Temporary construction signs denoting the future locations of a business or other concern shall be allowed one sign per adjacent street; area and height shall be prescribed by V-4.2.2. However, in no case shall the height exceed 14 feet or the area exceed 30 square feet.

6.6 Other Uses:

6.6.1 Banners, flags and pennants may be used in all non-residential areas on a temporary basis for three 14-day periods per year at 90-day intervals.

6.6.2 Movement control signs shall not exceed 3 feet in height or 6 square feet in area. (Such signs are exempt from V-2.2, 2.7.1, 2.7.3, and shall not be considered a part of the total number of items).

6.6.3 Signs consisting of cut-out. painted, embroidered, embossed, decaled or appliqued logos, symbols and letters may be displayed on awning surfaces provided that such signs shall be contained entirely within a single awning and shall be parallel as viewed horizontally with the surface to which it is attached.

6.6.3.1 Awning signs may be used in conjunction with other attached signs provided that not more than 1 sign is used per awning and that such sign shall not exceed 6 square feet in area.

6.6.3.2 Where awning signs are used in lieu of other attached signs, a maximum of 3 signs may be used provided that:

6.6.3.2.1 Only 1 sign shall be visible from a 90 degree angle in relation to the surface on which the sign is attached.

6.6.3.2.2 The area of all signs does not exceed 20 square feet.

VI. GLARE AND ILLUMINATION

1.0 PARKING AREA LIGHTING

1.1 No light standard shall exceed a height of 20 feet.

1.2 Light standard heights shall not exceed the height of the roof line of the building(s) which the parking area serve(s).

1.3 Standards, poles and fixtures shall be of a single color, compatible with the architecture of the building.

1.4 All lighting fixtures shall be restricted to down-light or cut-off types.

1.5 Low-pressure sodium lighting or lighting of a similar color shall not be used.

1.6 For distance between lights reference City of Garland Zoning Ordinance 3237, 16-311.

2.0 WALKWAY LIGHTING

2.1 Standard, pole, bollard and wall-mounted fixtures shall be allowed.

2.2 Light pole and standard height shall be limited to a maximum of 12 feet.

2.3 Pole and wall-mounted fixtures mounted above 6 feet shall be of a down-light or cut-off type.

3.0 ACCENT LIGHTING

3.1 Up-lighting shall be concealed or otherwise positioned in such a manner that the light source cannot be seen from any property line of the site on which the light is located.

3.2 Floodlighting or spotlighting of architecture, graphics, or natural features shall not create spillage of light onto adjacent properties.

4.0 RECREATIONAL AREA LIGHTING

4.1 Where recreational uses (e.g. athletic courts and fields) are adjacent to residential uses, separation by streets notwithstanding, live screens consisting of large trees selected from the Plant List (see III-5.0) shall be planted along each property line which is contiguous with the residential use.

VII. TRAFFIC MANAGEMENT

1.0 PARKING STANDARDS

1.1 Stall and Aisle Dimensions:

1.1.1 Except as provided in VII-1.1.2 below, minimum dimensions of parking stalls and aisles shall be as shown in Figure VII-1.

1.1.2 In lots whose primary use is not retail, and which have 100 or more spaces, up to 15 percent of the spaces may be set aside for compact cars using the minimum dimensions shown in Figure VII-2. Any such spaces or aisles shall be conspicuously signed for use by compact cars only. Compact car parking spaces shall not be allowed in a lot whose primary use is retail.

1.2 Raised Curbing:

1.2.1 Raised curbing shall be provided to separate parking areas from all areas (such as landscaped islands at ends of parking rows, sidewalks, etc.) not intended for vehicle movement.

1.2.2 To allow for bumper overhang, raised curbing at the end of parking stalls shall be set back at least two feet from any property line or landscape buffer strip.

1.3 Internal Islands; Sight Triangle:

1.3.1 Minimum dimensions of internal islands shall be as shown on Figure VII-3.

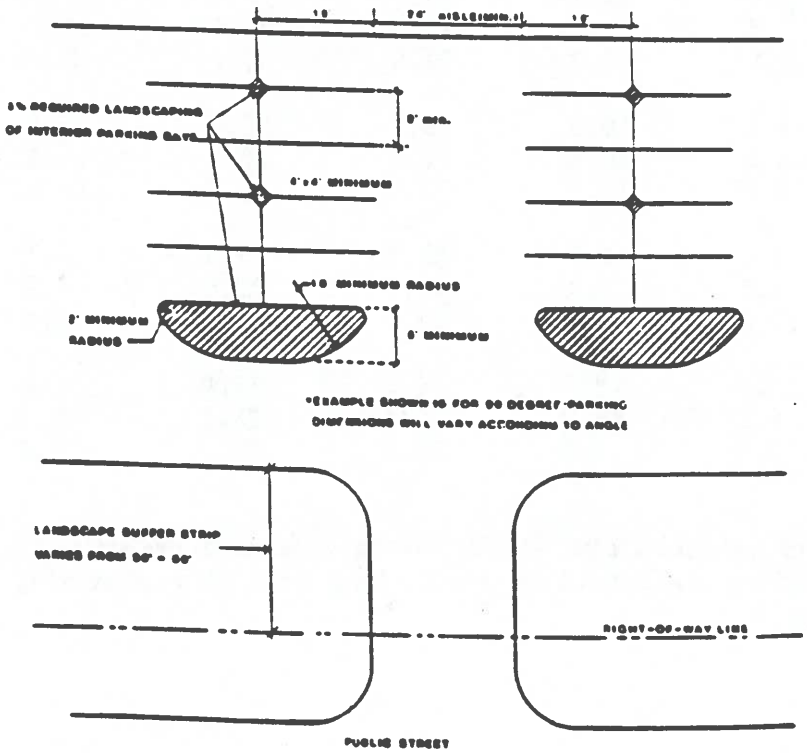


FIGURE VII - 3: MINIMUM DIMENSIONS OF INTERNAL ISLANDS

FIGURE VII-1

PARKING DESIGN STANDARDS
FULL-SIZE CARS

(Angles in Degrees; All Other Dimensions in Feet)

Parking Angle	Stall Width	Stall Depth	Minimum Aisle One-Way	Width Two-Way	Aisle Length Per Stall	Module Width One-Way	(Wall to Wall) Two-Way	Curb Overhang
A	B	C	D	D	E	F	F	G
Parallel	8.0	8.0	12.0	20.0	22.0*	28.0	36.0	0.0
	8.5	8.5	11.5	20.0	22.0*	29.0	37.0	0.0
	9.0	9.0	11.0	20.0	22.0*	30.0	38.0	0.0
20°	8.0	12.3	11.0	20.0	23.4	35.6	44.6	0.7
	8.5	12.3	11.0	20.0	24.9	35.6	44.6	0.7
	9.0	12.3	11.0	20.0	26.3	35.6	44.6	0.7
30°	8.0	14.6	11.5	20.0	16.0	40.7	49.2	1.0
	8.5	14.6	11.0	20.0	17.0	40.2	49.2	1.0
	9.0	14.6	11.0	20.0	18.0	40.2	49.2	1.0
45°	9.0	17.3	12.0	20.0	12.7	46.6	54.6	1.4
	9.5	17.3	11.5	20.0	13.4	46.1	54.6	1.4
	10.0	17.3	11.0	20.0	14.1	45.6	54.6	1.4
50°	9.0	18.0	13.0	20.0	14.0	49.0	56.0	1.5
	9.5	16.0	12.5	20.0	14.8	48.5	56.0	1.5
	10.0	18.0	12.0	20.0	15.6	48.0	56.0	1.5
60°	9.0	18.8	16.0	20.0	10.4	53.6	57.6	1.7
	9.5	18.8	15.5	20.0	11.0	53.1	57.6	1.7
	10.0	18.8	15.0	20.0	11.6	52.6	57.6	1.7
75°	9.0	19.1	23.0	23.0	9.3	61.2	61.2	1.9
	9.5	19.1	22.5	22.5	9.8	60.7	60.7	1.9
	10.0	19.1	22.0	22.0	10.4	60.2	60.2	1.9
90°	9.0	18.0	24.0	24.0	9.0	N/A	60.0	2.0
	9.5	18.0	23.5	23.5	9.5	N/A	59.50	2.0
	10.0	18.0	23.0	23.0	10.0	N/A	59.00	2.0

*For parallel stalls, the following alternate design is recommended: 18-foot long parking stalls with an 8-foot long marked maneuvering area between every other space.

FIGURE VII-2

PARKING DESIGN STANDARDS
COMPACT CARS

(Angles in Degrees; All Other Dimensions in Feet)

arking Angle	Stall Width	Stall Depth	Minimum Aisle One-Way	Width Two-Way	Aisle Length Per Stall	Module Width One-Way	(Wall to Wall) Two-Way	Curb Overhang
A	B	C	D	D	E	F	F	G
Parallel	7.0	7.0	10.0	20.0	18.0	24.0	34.0	0.0
	7.5	7.0	10.0	20.0	18.0	24.0	34.0	0.0
	8.0	7.0	10.0	20.0	18.0	24.0	34.0	0.0
20°	7.0	10.3	10.0	20.0	20.5	30.6	40.6	0.6
	7.5	10.3	10.0	20.0	22.0	30.6	40.6	0.6
	8.0	10.3	10.0	20.0	23.4	30.6	40.6	0.6
30°	7.0	12.3	10.0	20.0	14.0	34.5	44.5	0.9
	7.5	12.3	10.0	20.0	15.0	34.5	44.5	0.9
	8.0	12.3	10.0	20.0	16.0	34.5	44.5	0.9
45°	8.0	14.5	10.0	20.0	11.3	39.0	49.0	1.3
	8.5	14.5	10.0	20.0	12.0	39.0	49.0	1.3
	9.0	14.5	10.0	20.0	12.7	39.0	49.0	1.3
50°	8.0	15.0	10.0	20.0	10.5	40.1	50.1	1.4
	8.5	15.0	10.0	20.0	11.1	40.1	50.1	1.4
	9.0	15.0	10.0	20.0	11.8	40.2	50.1	1.4
60°	8.0	15.8	12.5	20.0	9.3	44.0	51.5	1.6
	8.5	15.8	12.0	20.0	9.8	43.5	51.5	1.6
	9.0	15.8	11.5	20.0	10.4	43.0	51.5	1.6
75°	8.0	16.0	17.5	20.0	8.3	49.4	51.9	1.8
	8.5	16.0	17.0	20.0	8.8	48.9	51.9	1.8
	9.0	16.0	16.5	20.0	9.3	48.4	51.9	1.8
90°	8.0	15.0	N/A	20.0	8.0	N/A	50.0	1.8
	8.5	15.0	N/A	20.0	8.5	N/A	50.0	1.8
	9.0	15.0	N/A	20.0	9.0	N/A	50.0	1.8

NOTES: Spaces designed specifically for compact cars shall be grouped together and conspicuously signed for compact cars only.

1.3.2 At all aisle intersections. there shall be a sight triangle having minimum dimensions of 15 feet by 15 feet. Within this triangle, there shall be no walls, fences, signs, or shrubbery higher than 2.5 feet above pavement surface grade. Single trunk trees shall be permitted within this triangle if kept pruned of all leaves and branches below seven feet above pavement grade. (The parked vehicle itself may be within this triangle.)

1.4 Paving Materials:

1.4.1 Except as provided in VII-1.4.2, paving shall be 5-inch reinforced concrete over appropriately engineered subbase.

1.4.2 Alternate materials may be approved by the Plan Commission provided that the strength and durability is at least equal to that specified.

1.5 Joint Use of Parking Facilities

1.5.1 Joint use of parking facilities is encouraged. The total parking space requirement may be reduced if the peak accumulation for one major parking generator will normally occur at a different time of day than the peak accumulation for another major parking generator.

1.5.2 The developer shall be responsible for providing competent engineering data to support any request for reduction in total parking space requirement due to joint use.

2.0 DRIVEWAY STANDARDS

2.1 Maximum Number of Driveways; Minimum Corner Clearance:

2.1.1 The maximum number of driveways per platted lot and the minimum spacing between such driveways shall be as provided for in Figure VII-4.

2.1.2 The minimum corner clearance between a driveway and an intersection shall be as provided for in Figure VII-5. Corner clearance shall be defined as the distance between the intersection of the projected curb lines of the two streets and the point of tangency of the driveway curb return at the street curb. In no case shall the driveway curbcut encroach into the curb return of a street intersection. Encroachment by the curb return of a driveway onto the frontage of an adjoining property shall be allowed only if a common access agreement has been entered and filed of record between the adjoining property owners.

FIGURE VII-4

MAXIMUM NUMBER OF DRIVEWAYS AND MINIMUM SPACING BETWEEN DRIVEWAYS

(Per Platted Lot)

Land Use	Frontage (Feet)	Maximum Number of Driveways Per Property	Minimum Spacing Between Driveways On Same Property
Single-Family Residential	Less than 60	1	N/A
"	60 or more	2	20
Multi-Family, Commercial, or Industrial	Less than 120	1	N/A
	120 to 500	2	75
	More than 500	1 per 500 plus 1	100

NOTE: State standards, if more restrictive, shall apply for properties fronting S.H. 190 and S.H. 78.

FIGURE VII-5

MINIMUM CORNER CLEARANCES BETWEEN DRIVEWAY AND INTERSECTION

Type of Street Driveway Is On	Type of Street Intersected	MINIMUM CORNER CLEARANCE	
		Approach Side of Intersection	Departure Side of Intersection
Arterial	Arterial	150	100
"	Collector	100	70
"	Local	50	30
Collector	Arterial	100	70
"	Collector	70	50
"	Local	40	30
Local	Arterial	50	30
"	Collector	40	30
"	Local	30	30

NOTES:

1) "Arterial" is any Type A, B, or C thoroughfare on the City of Garland Thoroughfare Plan; "Collector" is any Type D, E, or F thoroughfare on that Plan; and " Local" is any other street.

2) The above distances notwithstanding, any platted lot may have at least one minimum width driveway onto each street which the lot abuts.

3) Service roads shall be classified as an arterial for driveway purposes.

2.1.3 The requirements of VII-2.1.2 notwithstanding, every platted lot shall be permitted to have at least one driveway of minimum width onto each street which the lot abuts.

2.2 Design Standards; Storage Length:

2.2.1 Driveway design standards shall be as provided for in Figure VII-6.

2.2.2 Driveway storage shall be defined as the distance between the street right-of-way line and the near side of the first intersecting interior aisle. The minimum length of this storage shall be as provided for in Figure VII-7.

3.0 LOADING AND UNLOADING AREAS

3.1 General Criteria:

3.1.1 Driveways, aisles, maneuvering areas, and truck berths shall be designed to accommodate the largest vehicles that would normally be expected to use those particular driveways, aisles, maneuvering areas, and truck berths.

3.1.2 Whenever possible, the site should be designed for counterclockwise circulation of large trucks. This is because left turns and left-hand backing maneuvers are easier and safer since the driver's position is on the left-hand side of the vehicle.

3.2 Truck Berths at Loading Docks:

3.2.1 A truck berth shall be defined as an area which is designed for trucks to back up to for loading and unloading at truck bed level.

3.2.2 The minimum dimensions of a truck berth shall be as shown in Figure VII-8.

4.0 STREET DESIGN ELEMENTS

4.1 Right-of-Way Requirements:

4.1.1 On Type A or B arterials, right-of-way in addition to that prescribed by the Thoroughfare Plan shall be dedicated near the intersection with other Type A or B arterials to provide for the future construction of turn lanes. The amount of additional right-of-way shall be as specified in Figure VII-9.

4.1.2 In addition to the right-of-way width prescribed by the Thoroughfare Plan, and by 4.1.1 above, additional right-of-way or pedestrian easement shall be dedicated to provide for the following minimum parkway widths:

4.1.2.1 Type A, B, or C: 20 feet

FIGURE VII-6

DRIVEWAY DESIGN STANDARDS

Land Use	Approach Width in Feet		Driveway Approach Curb Radius in Feet	
	Min	Max	Min	Max
RESIDENTIAL				
Single-Family	10	20	5	10
Multi-Family	20	30	15	30
COMMERCIAL (UNDIVIDED DRIVEWAYS)				
Office	24	30	15	30
Retail (Except Service Stations)	24	30	15	30
Service Stations	24	40	15	30
Industrial	30	45	25	50
HIGH-DESIGNED DIVDED DRIVEWAYS*				
Multi-Family, Office or Retail	18 to 24	24	15 to 25	40

*Must have raised, landscaped median at least 6 feet wide; approach widths are for each side.

NOTES:

1. The minimum and maximum approach widths are for the point where curb radii (from the public street) end.

2. Where the width of an aisle changes or where the approach width is different than the width of the aisle or driveway farther into the property, the following formula shall be used to determine the minimum taper length:

$$L = 20 \times W$$

where L = taper length and

W = difference in width

FIGURE VII-7

MINIMUM DRIVEWAY STORAGE LENGTH

Number of Parking Spaces Per Driveway	Minimum Storage Length* (Feet)
Less Than 50	18
50 to 200	50
More Than 200	78

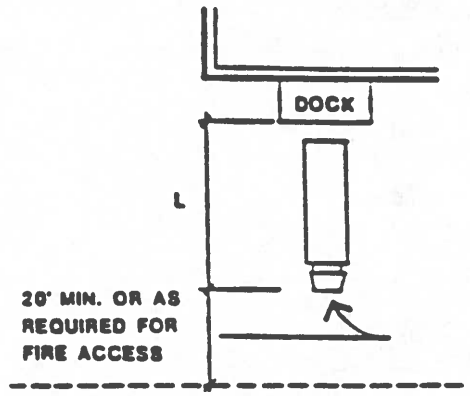
*Storage length is defined as the distance between the street right-of-way line and the first intersecting aisleway on site.

FIGURE VII-8

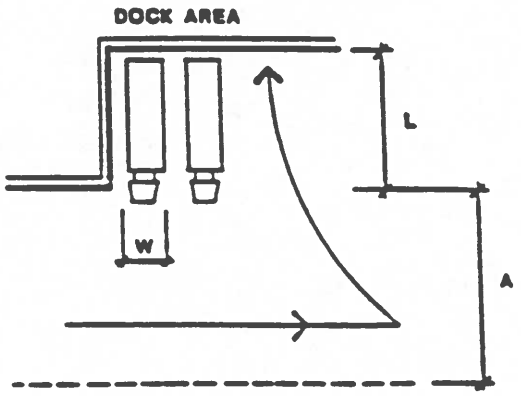
DESIGN STANDARDS FOR TRUCK LOADING BERTHS

(All Dimensions Are in Feet)

SINGLE BERTH



MULTIPLE BERTH



MINIMUM APRON SPACE REQUIREMENTS

Length of Design-Vehicle (L)	Width of Berth (W)	Apron Space Required (A)
Single-Unit Truck or 35' Tractor Trailer	10	46
	12	43
	14 or more	39
40' Tractor Trailer	10	48
	12	42
	14 or more	42
45' Tractor Trailer	10	57
	12	49
	14	48
50' Tractor Trailer	10	63
	12	56
	14 or more	53

NOTE: The apron space (A) is measured from the outermost part of any vehicle or other possible obstruction in the area of the maneuver. Four general conditions are presented: (1) Single-berth unobstructed dock where the apron distance is measured from the face of the dock.; (2) Post-supported canopy where the distance is measured from the posts; (3) Alongside other vehicles where the distance is measured from the outermost point of the other vehicles; and (4) Driveways and stalls where the distance is measured from the outermost obstruction such as curb, pole, wall or parked vehicle.

FIGURE VII-9

ADDITIONAL RIGHT-OF-WAY REQUIREMENTS AT MAJOR INTERSECTIONS

(All Dimensions in Feet)

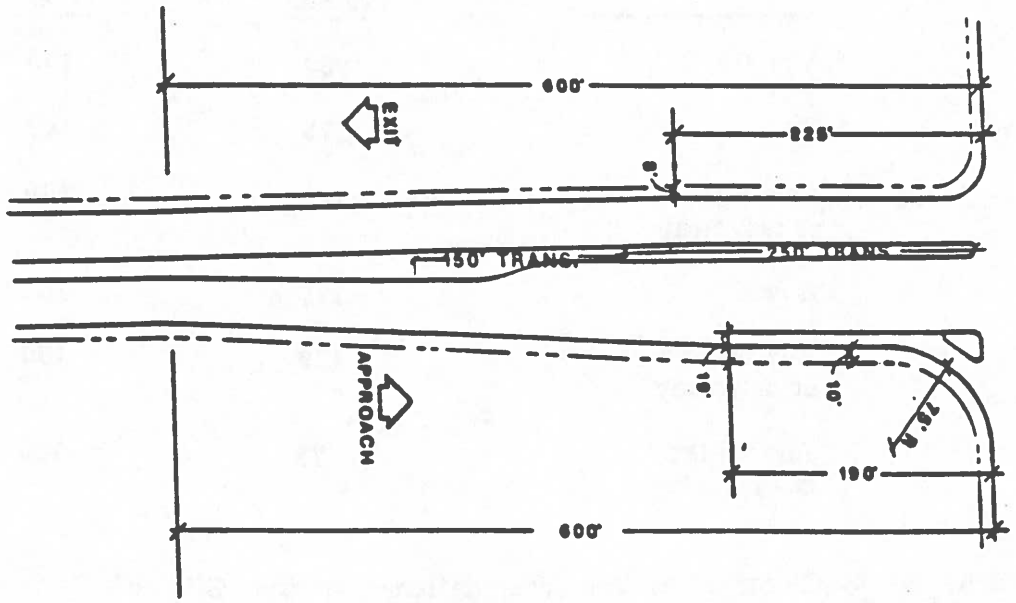
I. CORNER RADIUS - In addition to the additional right-of-way required below, a corner clip or radius shall be dedicated to provide a 10-foot minimum parkway width behind a 75 foot curb radius.

II. ADDITIONAL RIGHT-OF-WAY ON APPROACH SIDE

Distance From Intersection	Additional R.O.W. Required
0 to 190	19
190 to 600	19 tapering to 0

III. ADDITIONAL RIGHT-OF-WAY ON EXIT SIDE

Distance From Intersection	Additional R.O.W. Required
0 to 225	8
225 to 600	8 tapering to 0



4.1.2.2 Type D or E: 15 feet

4.1.2.3 Type F: 12 feet

4.1.2.4 Type G: 10 feet

If pedestrian easement is dedicated, it may fall within the landscape buffer strip.

4.2 Median Openings:

4.2.1 To the greatest extent practicable, median openings shall be located at public street intersections or major driveways.

4.2.2 Cross access easements shall be granted such that each platted lot will have access to at least one median opening on each divided street which that lot abuts.

4.2.3 Minimum spacing (nose to nose) between median openings shall be governed by the following criteria:

4.2.3.1 The minimum length of the full-width left-turn bay and the length of one transition into the left turn bay shall be as shown in Figure VII-10.

4.2.3.2 The minimum length of full-width median (between the transitions into left-turn bays) shall be 100 feet.

4.2.4 Left-turn bays shall be provided at all median openings except where the particular left-turn movement is prohibited by ordinance.

FIGURE VII-10

MINIMUM LENGTHS OF LEFT-TURN BAYS AND TRANSITIONS

Type Street On	Type Street At	Minimum Length of Full-Width Bay (Feet)	Length of Transition (Feet)
A or B	A or B	250	150
A or B	C	175	100
A or B	Any other street or driveway	100	100
C	A or B	175	100
C	Any other street or driveway	100	100
Any other divided street	Any street or driveway	75	100

NOTE: A, B, & C refer to the designations on the City of Garland Thoroughfare Plan.

VIII. UTILITIES

1.0 ALL UTILITIES SHALL BE PLACED UNDERGROUND EXCEPT UNDER THE FOLLOWING CONDITIONS

1.1 For the purpose of interpreting these standards, the following definitions shall apply:

1.1.1 "Transmission line" shall mean any line, wire, or cable which distributes, transmits or delivers a utility service from a substation or generating plant to a feeder system.

1.1.2 "Feeder line" shall mean any line, wire, or cable which distributes, transmits or delivers a utility service to a general area and not to a specific end user.

1.1.3 "Lateral line" shall mean any line, wire, or cable used to distribute, transmit, or deliver a utility service from a feeder line to two or more sites or end users of the utility service.

1.1.4 "Service line" shall mean any line, wire, or cable used to distribute, transmit, or deliver a utility service from a feeder or lateral line to an end user.

1.2. Electric utility lines which are no closer than 800 feet to the center line of S.H. 190 may be placed overhead, except that transmission lines may be placed overhead no matter where they are located. As land use and street patterns begin to emerge in the development corridor, the 800 foot limit shall be determined by the location of streets, alleys and other physical features which generally correspond to an 800 foot distance from the center line of S.H. 190. As a logical boundary line is established, it shall be graphically delineated and adopted as part of these standards.

1.3 Electrical distribution feeder lines which cross S.H. 190 may be placed overhead with the approval of the Plan Commission provided that they cross at $\pm$ 10° perpendicular to the center line of S.H. 190 and that crossings are made at planned locations.

1.4 The Plan Commission may, through the standards review process established in Section XI., approve overhead placement of distribution feeder and lateral lines if it can be demonstrated that placement underground would be an undue financial hardship and that measures will be taken to minimize the visual impact of overhead utilities. Such measures shall include:

1.4.1 Construction alternatives.

1.4.2 Coordination and sharing of facilities and easements among all utilities with overhead lines.

1.4.3 Placement of overhead lines behind structures in alleys and easements rather than in the street r.o.w.

1.5 Auxiliary equipment for underground utility service such as transformers, connection enclosures, switching devices and amplifiers may be padmounted on grade or placed underground.

2.0 ADDITIONAL UTILITY REQUIREMENTS

2.1 All electrical distribution service lines shall be placed underground.

2.2 All utility companies and City departments which provide utility service within the S.H. 190 development corridor shall share facilities and easements where possible to minimize the visual impact of overhead utilities.

2.3 Any utility lines in place prior to the effective date of this resolution that are contrary to same are "non-conforming". However, relocation or substantial improvement of existing utility lines shall occur in accordance with the standards set forth herein. "Substantial improvement" shall mean any improvement which results in an increase in the capacity of existing lines, such as the addition of lines or upgrading the size of lines.

2.4 Nothing contained herein is intended to alter the intent of the electrical franchise agreement ordinance in effect on the effective date of this amendment.

3.0 UTILITIES WITHIN THE ECOLOGICAL BOUNDARY OF THE SPRING CREEK FOREST PRESERVE SHALL MEET THE FOLLOWING RECOMMENDATIONS

3.1 Utilities shall only be allowed to cross the Spring Creek Forest Preserve in those areas designated as suitable crossing channels.

3.1.1 Overhead Utilities. Crossings shall be made only along existing roads. The lines should be situated such that no tree pruning will be necessary. Any tree pruning that does occur shall be performed by a recognized arborist. Alignments through the Spring Creek Forest Preserve shall be approved by the Plan Commission.

3.1.2 Underground Utilities. Utility lines that function independently of gravity shall be routed such that they cross the Preserve along Holford Road and North Garland Avenue. All construction activity shall be confined to the road right-of-way. Gravity-powered lines needing access to the creek shall cross through the Forest only in the areas so designated. It is recommended that each easement contain a collector capable of having connections from multiple sources.

3.2 In addition to being restricted to designated crossing points, construction activities shall be subject to the following conditions:

3.2.1 Under the observation of the Parks and Recreation Department the exact path shall be surveyed, marked and photographed in order to establish a record of preconstruction conditions.

3.2.2 No tree six inches Diameter at Breast Height (DBH) or larger is to be removed during construction without prior written approval of the Parks and Recreation Department.

3.2.3 The easement shall not exceed 15 feet with a maximum working width during construction of 20 feet.

3.2.4 Top soil shall be saved and replaced following construction activities. Creek bed and banks will be restored to original contours.

3.2.5 Surface shall be revegetated with native vegetation saved from the construction site and replanted following construction. The Parks and Recreation Department shall observe the removal and replacement of top soil and vegetation.

3.2.6 Underground utilities shall be constructed so as to prevent ground water from seeping into the filled trench and flowing to the creek.

4.0 A TECHNICAL UTILITY COORDINATION COMMITTEE SHALL BE ESTABLISHED

4.1 The purpose of this committee shall be to review and coordinate:

4.1.1 Utility placement, both overhead and underground.

4.1.2 Utility construction plans.

4.1.3 Long-range planning for utility demand and facilities.

4.2 The committee shall be composed of representatives of all companies and City departments which provide utility service within the S.H. 190 corridor, including:

4.2.1 Garland Power & Light System

4.2.2 Texas Power & Light Company

4.2.3 Farmer's Electric Cooperative, Inc.

4.2.4 General Telephone Company

4.2.5 Storer Cable Communications

4.2.6 Lone Star Gas Company

4.2.7 City of Garland Department of Water Utilities

4.3 The Assistant City Manager for Utility Services shall serve as Chairman. He shall be responsible for establishing meeting times and coordinating the committee's activities.

4.4 The Director of Planning and Economic Development and the City Engineer shall serve in an advisory capacity.

IX. WATERSHED MANAGEMENT

1.0 SITE DRAINAGE

Site drainage is the responsibility of each property developer and shall be in accordance with Chapter 22, Code of Ordinances of the City of Garland, the Garland Storm Drainage Study 1976, and any subsequent studies such as referenced in 2.0 below.

1.1 Each site developer shall take measures to mitigate impacts to downstream and adjoining property from stormwater runoff and sedimentation.

1.2 Building sites shall require, to some degree, on-site detention as determined by the Engineering Department, to insure the needed mitigation.

2.0 ALTERATION OF THE FLOODPLAIN

No alteration of the flood plain as shown on current FEMA flood maps 485471 0001-0005, 0010. 0020. 0025, & 0030 shall take place until new engineering studies conveying ultimate development conditions are completed by a qualified engineer and approved by City Council.

3.0 CONTINUOUS GREENBELT ESTABLISHED

A continuous greenbelt shall be established along the creek corridors of Rowlett Creek and Spring Creek.

3.1 Each development adjacent to the greenbelt shall handle stormwater runoff so as to minimize negative impacts.

4.0 BUFFER ZONE ESTABLISHED

A buffer zone consisting of a street, alley, or 15 foot minimum access easement (exclusive of the Spring Creek Forest Preserve) shall be required within the FEMA identified flood fringe to assure access for maintenance and provide for separation of the flood zones/greenbelt and development. Where the flood fringe slope is greater than 5 percent, the access easement shall be measured from the edge of the flood fringe. (See Figure IX-1).

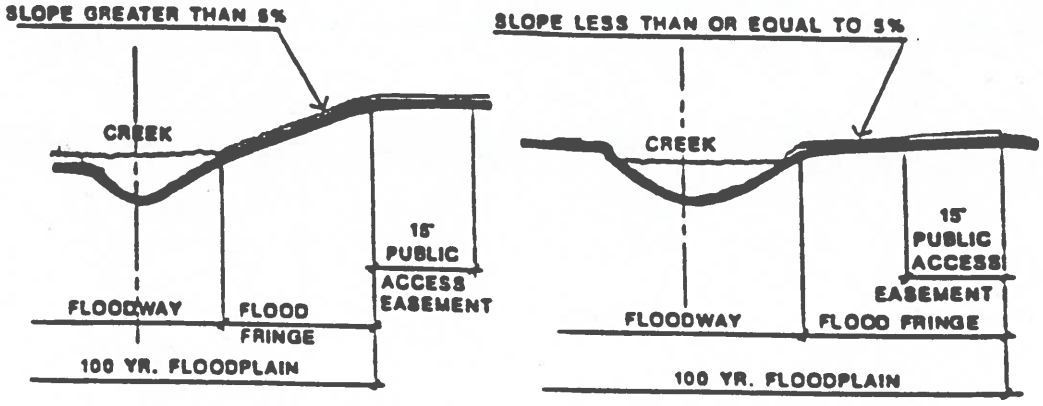


FIGURE IX - 1: LOCATION OF 15 FOOT ACCESS EASEMENT

5.0 REQUIREMENTS WITHIN THE SPRING CREEK FOREST PRESERVE

Special precautions shall be taken when developing within the drainage area abutting the ecological boundary of the Spring Creek Forest Preserve. A demonstrated effort shall be made, including submittal of information for evaluation, to provide for the following:

5.1 No alteration or channelization of Spring Creek within the ecological boundary of the Spring Creek Forest Preserve shall be permitted except where required for public safety and welfare as approved by City Council.

5.2 Existing surface drainage patterns are to be maintained. Changes of more than ± 10 percent to the current calculated volume and velocity shall be prohibited as it leaves the site.

5.3 Drainage channels shall not be altered or moved.

5.4 Soil absorption and runoff rates shall closely approximate pre-development rates.

5.5 Preservation of existing trees, especially oak, pecan, walnut and elm species, shall be accomplished to the maximum extent possible.

5.6 Utility construction shall take place in pre-determined utility corridors or as permitted by the Plan Commission. Construction shall follow standards outlined in Section VIII, Utilities and shall include revegetation with native plant materials.

5.7 A street shall function as the primary buffer between the Spring Creek Forest and adjacent property. This buffer street shall be 27 feet wide, curvilinear in design and discontinuous across major thoroughfares, and shall have no direct driveway access.

6.0 TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL

Contractors performing sitework shall meet the provisions of the section titled TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL, Item 3.12 of the Standard Specifications for Public Works Construction - North Central Texas.

X. WATER QUALITY PROTECTION

1.0 OUTSIDE STORAGE OF CHEMICALS

All outside storage of chemicals or chemical wastes which exist as liquids at ambient temperatures must be conducted in a manner which will prevent the leakage or spillage of said chemicals or chemical wastes to the storm sewer or any appurtenance to the storm sewer. The following spill prevention requirements shall be met:

1.1 Drum Storage:

Drum storage shall be on an impervious surface, surrounded by an impervious dike or containment curb with no direct connections to the sanitary sewer or storm sewer. The diked enclosure shall be of sufficient volume to contain 10 percent of the total volume of drums stored or 100 gallons, whichever is greater.

1.2 Bulk Storage Tanks:

Bulk storage tanks shall be installed on an impervious surface and surrounded by an impervious dike, containment curb, or pit with no direct connection to the sanitary sewer or storm sewer. The containment enclosure shall be of sufficient volume to contain the total volume of the single largest tank plus 5 percent of the volume of the single largest tank to account for impounded rainwater.

2.0 RAILROAD AND TANK CAR UNLOADING/LOADING FACILITIES

2.1 Tank Truck Unloading/Loading Facilities:

A system of containment curbs shall be used for tank truck unloading/loading areas, using ramps to provide truck access into the confines of the containment curb. The curbed enclosure shall be of sufficient volume to contain the total volume of any single tank truck unloading or loading at the facility.

2.2 Railroad Tank Car Unloading/Loading Facilities:

A trenching or similar system shall encompass each railroad tank car unloading/loading facility. The trench shall be designed to carry away any spill to a containment basin, holding pond, or lagoon, with sufficient volume to contain the total volume of any single railroad tank car unloading or loading at the facility.

3.0 DISPOSAL OF IMPOUNDED STORMWATER FROM SPILL CONTAINMENT AREAS

3.1. Drum storage areas, tank farms, and tank truck/tank car unloading/loading areas shall be visually inspected no less than once each week for evidence of leakage or spills of chemicals. These areas shall be maintained in a condition free of accumulated chemicals to minimize contamination of storm water.

3.2. Impounded stormwater within spill containment areas shall be field-tested for the presence of chemicals which are currently stored or which have recently been stored in the area. Such field tests may be conducted using chemically treated paper or portable meters and instruments; or grab samples may be taken from the containment area and analyzed at an in-house laboratory facility. A log must be kept which documents the date stormwater was sampled and tested, the test results obtained, the volume of stormwater impounded, and the name of the person responsible for testing and discharging such stormwater. If all necessary tests indicate that the stormwater is in compliance with all applicable sections of Chapter 27 of Garland's Code of Ordinances, and in compliance with applicable state regulations and statutes, said stormwater may be released to the storm sewer. Records of all stormwater discharges from chemical storage areas shall be maintained on file for a period of 3 years from date of discharge. All such records shall be made available to employees of the Environmental Health Department at any time said records are requested.

3.3 Impounded stormwater which has concentrations of pollutants which make it unfit for stormwater discharge must be disposed of in accordance with all applicable local, state, and federal laws.

XI. STANDARDS REVIEW PROCESS

1.0 The Technical Plan Review Committee, composed of staff personnel as established by the City of Garland Zoning Ordinance, shall review the specific elements of site and building plans for development within the State Highway 190 development corridor. Such plans shall be reviewed for compliance with the adopted development standards, concurrent with the normal staff plan review process.

2.0 The Plan Commission shall review all exceptions and requests for variations to the development standards and determine compliance with the intent of the standards. The Director of Planning shall be responsible for determining when review by the Plan Commission is necessary.

2.1 The Plan Commission shall hold a public hearing on any request for a variation or exception to the Development Standards. At least 15 days notice of the time and place of such hearing shall be published in the official newspaper of the City of Garland.

2.2 Prior to hearing a request for a variation or exception to the Development Standards, notice of public hearing shall be sent to all owners of property, or to the person rendering the same for City taxes, located within the area of application and within four hundred (400) feet of any property affected thereby, within not less than ten (10) days before such hearing is held. Such notice may be served by using the last known address as listed on the City tax roll and depositing the notice, postage paid, in the United States Mail.

3.0 All decisions of the Plan Commission in this regard shall be final unless appealed to City Council. When the Commission denies a request for a variation or exception to the standards set forth in this document, a hearing before the City Council shall be set on a denied request only when an appeal is filed by the applicant with the City Manager within 15 days of the date of denial.

4.0 At such time that development activity in the S.H. 190 Corridor is substantially increased, the City Council in place at that time is encouraged to reevaluate the review process set forth here and consider appointment of a special review board. Such a board would assume the responsibilities of the Plan Commission set forth in XI-2.0, above.

Appendix E

HERBACEOUS PLANTS OBSERVED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Allium canadense	Canada garlic
Allium sp.	Onion
Anemone sp.	Anemone
Asclepias viridis	Green milkweed
Asclepias asperula	Antelope horns milkweed
Biflora americana	Queen Ann's lace
Bouteloua rigidiseta	Texas grama
Bromus tectorum	Downy brome
Bromus unioloides	Resque grass
Bupleurum rotundifolium	Thoroughwax
Callirhoe digitata	Winecup
Carex amphibola	Amphibious sedge
Carex davisii	Davis sedge
Chaerophyllum tainturieri	Chervil
Croton monanthogynous	Oneseed croton
Cryptotaenia canadensis	Cryptotaenia
Daucus pusillus	Wild carrot
Daucus carota	Wild carrot
Dichanthelium lindheimeri	Lindheimer's panic grass
Dracopis amplexicaulis	Dracopis
Dyschoriste linearis	Narrowleaf dyschoriste
Elymus virginicus	Virginia wild rye
Engelmannia pinnatifida	Engelman daisy
Equisetum hyemale var. affine	Horsetail
Erythronium albidum	White trout lily
Euphorbia spathulata	Warty euphorbia
Gaillardia pulchella	Indian blanket
Galium aparine	Catchweed bedstraw
Gaura suffulta	Roadside gaura

HERBACEOUS PLANTS OBSERVED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Geranium texanum	Texas geranium
Geum canadense	White avens
Hedeotis nigricans	Fineleaf bluets
Helianthus annuus	Common sunflower
Heliotropium tenellum	Pasture heliotrope
Hordeum pusillum	Little barley
Hymenopappus scabiosaeus	Ragweed woollywhite
Hymenopappus tenuifolius	Old plainsman
Hymenoxys linearifolia	Narrowleaf bitterweed
Ipomopsis rubra	Standing cypress
Iris sp.	Cultivated iris
krameria lanceolata	Krameria
Lamium amplexicaule	Henbit
Latherus hirsutus	Singletary peavine
Leptoloma cognatum	Fall witchgrass
Lindheimera texana	Lindheimer daisy
Linum pratense	Meadow flax
Lolium perenne	Pernnial ryegrass
Marshallia caespitosa	Marshallia
Melilotis alba	White sweet clover
Melilotus officinalis	Yellow sweet clover
Mirabilis nyctaginea	Wild four-o'-clock
Muhlenbergia reverchoni	Seep muhlygrass
Myosotis macrosperma	Spring forget-me-not
Nothoscordum bivalve	False garlic
Oenothera laciniata	Cutleaf evening primrose
Oenothera missouriensis	Missouri evening primrose
Oenothera speciosa	Showy evening primrose
Oenothera triloba	Evening primrose

HERBACEOUS PLANTS OBSERVED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Osmorhiza longistylis	Anise root
Oxalis dillenii	Yellow wood sorrel
Oxalis violacea	Violet wood sorrel
Passiflora lutea	Yellow passion flower
Phryma leptostachya	Lopseed
Phyllanthus polygonoides	Knotweed leafflower
Polygonatum biflorum	Great Solomon's seal
Polytaenia nuttallii	Prairie parsley
Psoralidium linearifolium	Narrowleaf scurvy pea
Pyrrhopappus geiseri	False dandelion
Ratibida columnifera	Upright Mexican hat
Ravina humilis	Bloodberry
Ruellia humilis	Wild petunia
Rumex altissimus	Pale dock
Salvia lyrata	Lyreleaf sage
Salvia azurea	Blue sage
Sanicula gregaria	Cluster sanicle
Schizachyrium scoparium	Little bluestem
Scutellaria drummondii	Drummond's skullcap
Setaria geniculata	Knotroot bristlegrass
Sherardia arvensis	Spurwort
Silene stellata	Starry catchfly
Solanum carolinense	Carolina horse mettle
Sorghastrum nutans	Indian grass
Sorghum halepense	Johnson grass
Stellaria media	Common chickweed
Stillingia texana	Texas queen's delight
Stipa leucotricha	Spear grass
Thalictrum dasycarpum	Purple meadowrue

HERBACEOUS PLANTS OBSERVED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Torilis arvensis	Hedge parsley
Trifolium campestre	Low hop clover
Triodanis perfoliata	Clasping Venus looking glass
Urtica chamaedryoides	Stinging nettle
Valerianella stenocarpa	Narrowcell cornsalad
Verbena bipinnatifida	Small flowered verbena
Vicia sativa	Common vetch
Viola sp.	Violet
Zizia aurea	Golden Alexanders

WOODY PLANTS SURVEYED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Acer negundo	Boxelder
Albizia julibrissin	Mimosa
Amorpha fruticosa	Indigo bush amorpha
Berchemia scandens	Alabama supplejack
Bumelia lanuginosa var. oblongifolia	Chittimwood
Callicarpa americana	American beautyberry
Carya cordiformis	Bitternut hickory
Carya illinoensis	Pecan
Catalpa speciosa	Northern catalpa
Ceanothus herbaceus	Redroot
Celtis laevigata	Sugar hackberry
Celtis occidenctalis	Hackberry
Cercis canadensis	Redbud
Clematis sp.	Clematis
Cocculus carolinus	Carolina snailseed
Cornus drummondii	Roughleaf dogwood
Diospyros virginiana	Common persimmon
Euonymus atropurpureus	Eastern wahoo
Forestiera pubescens	Elbo bush
Fraxinus americana	White ash
Fraxinus pennsylvanica	Green ash
Fraxinus texensis	Texas ash
Gleditsia triacanthos	Honey locust
Ilex decidua	Deciduous holly
Juglans nigra	Black walnut
Juniperus virginiana	Eastern red cedar
Ligustrum sp.	Privet
Lonicera japonica	Japanese honeysuckle
Maclura pomifera	Osage orange
Melia azedarach	Chinaberry

WOODY PLANTS SURVEYED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Morus rubra	Red mulberry
Nandina domestica	Nandina
Opuntia phaeacantha	Prickly pear cactus
Parthenocissus quinquefolia	Virginia creeper
Platanus occidentalis	Sycamore
Populus deltoides	Eastern cottonwood
Prunus angustifolia	Chickasaw plum
Prunus mexicana	Mexican plum
Phyllostachys aureosulcata	Yellowgroove bamboo
Pyrus communis	Common pear
Quercus macrocarpa	Burr oak
Quercus muhlenbergii	Chinkapin oak
Quercus shumardii var. shumardii	Shumard red oak
Quercus shumardii var. microcarpa	Texas red oak
Rhamnus caroliniana	Carolina buckthorn
Rhus aromatica	Fragrant sumac
Rhus glabra	Smooth sumac
Rhus toxicodendron	Poison ivy
Salix nigra	Black willow
Sambucus canadensis	Common elderberry
Sapindus saponaria	Western soapberry
Schrankia roemeriana	Sensitive vine
Smilax hispida	Common greenbrier
Smilax bona-nox	Saw greenbrier
Sophora affinis	Texas sophora
Symphoricarpos orbiculatus	Coral berry
Ulmus americana	American elm
Ulmus crassifolia	Cedar elm
Ulmus rubra	Slippery elm
Ungnadia speciosa	Mexican buckeye

WOODY PLANTS SURVEYED IN THE SPRING CREEK FOREST PRESERVE	
SPECIES NAME	**COMMON NAME**
Viburnum rufidulum	Rusty blackhaw
Vitis cinerea	Sweet winter grape
Vitis mustangensis	Mustang grape
Vitis riparia	Riverbank grape
Yucca sp.	Yucca
Zanthoxylum clava-herculis	Toothache tree

Appendix F

TRANSECT 1
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
ULMUS RUBRA	38	76.00	18.18	85	1.70	20.68	7909	16.82	55.68
FRAXINUS AMERICANA	42	84.00	20.10	86	1.72	20.92	5064	10.77	51.79
CELTIS LAEVIGATA	33	66.00	15.79	95	1.90	23.11	842	1.79	40.69
QUERCUS MUHLENBERGII	8	16.00	3.83	8	.16	1.95	12912	27.46	33.24
QUERCUS SHUMARDII	6	12.00	2.87	7	.14	1.70	9724	20.68	25.25
ACER NEGUNDO	14	28.00	6.70	13	.36	4.38	421	.90	11.98
CARYA ILLINOENSIS	1	2.00	.48	1	.02	.24	4778	10.16	10.88
SAMBUCUS CANADENSIS	11	22.00	5.26	22	.44	5.35	24	.05	10.66
MORUS RUBRA	10	20.00	4.78	14	.28	3.41	604	1.28	9.47
JUGLANS NIGRA	1	2.00	.48	1	.02	.24	3421	7.27	7.99
RHAMNUS CAROLINIANA	7	14.00	3.35	17	.34	4.14	47	.10	7.59
PARTHENOCISSUS QUINQUEFOLIA	6	12.00	2.87	13	.26	3.16	66	.14	6.17
ULMUS CRASSIFOLIA	7	14.00	3.35	10	.20	2.43	106	.23	6.01
JUNIPERUS VIRGINIANA	6	12.00	2.87	7	.14	1.70	81	.17	4.74
BUMELIA LANUGINOSA	3	6.00	1.44	3	.06	.73	929	1.98	4.15
VITIS RIPARIA	5	10.00	2.39	6	.12	1.46	32	.07	3.92
ILEX DECIDUA	3	6.00	1.44	5	.10	1.22	15	.03	2.69
SMILAX HISPIDA	2	4.00	.96	7	.14	1.70	10	.02	2.68
VIBURNUM RUFIDULUM	2	4.00	.96	2	.04	.49	26	.06	1.51
RHUS TOXICODENDRON	2	4.00	.96	2	.04	.49	8	.02	1.47
CERCIS CANADENSIS	1	2.00	.48	1	.02	.24	7	.01	.73
CORNUS DRUMMONDII	1	2.00	.48	1	.02	.24	1	.00	.72
TOTAL			100.02	411	8.22	99.98	47027	100.01	300.01

SPECIES DIVERSITY

Diversity Index	=	3.287
Evenness	=	.737
Richness	=	3.489

TRANSECT 2
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
FRAXINUS AMERICANA	35	70.00	20.35	69	1.38	23.47	4206	9.79	53.61
ULMUS RUBRA	33	66.00	19.19	62	1.24	21.09	1326	3.09	43.37
ACER NEGUNDO	26	52.00	15.12	59	1.18	20.07	770	1.79	36.98
CELTIS LAEVIGATA	20	40.00	11.63	38	.76	12.93	4030	9.38	33.94
CARYA ILLINOENSIS	9	18.00	5.23	9	.18	3.06	10464	24.36	32.65
QUERCUS SHUMARDII	4	8.00	2.33	5	.10	1.70	7659	17.83	21.86
QUERCUS MACROCARPA	2	4.00	1.16	2	.04	.68	8528	19.85	21.69
MORUS RUBRA	11	22.00	6.40	12	.24	4.08	1285	2.99	13.47
ULMUS CRASSIFOLIA	11	22.00	6.40	11	.22	3.74	1302	3.03	13.17
BUMELIA LANUGINOSA	6	12.00	3.49	6	.12	2.04	1603	3.73	9.26
VITIS RIPARIA	6	12.00	3.49	6	.12	2.04	95	.22	5.75
QUERCUS MUHLENBERGII	1	2.00	.58	1	.02	.34	1662	3.87	4.79
SMILAX HISPIDA	2	4.00	1.16	8	.16	2.72	10	.02	3.90
PRUNUS MEXICANA	3	6.00	1.74	3	.06	1.02	11	.03	2.79
JUNIPERUS VIRGINIANA	1	2.00	.58	1	.02	.34	3	.01	.93
BERCHEMIA SCANDENS	1	2.00	.58	1	.02	.34	1	.00	.92
RHAMNUS CAROLINIANA	1	2.00	.58	1	.02	.34	1	.00	.92
TOTAL:			100.01	294	5.88	100.00	42956	99.99	300.00

SPECIES DIVERSITY
Diversity Index = 3.029
Evenness = .741
Richness = 2.815

TRANSECT 3
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
FRAXINUS AMERICANA	43	86.00	20.77	131	2.62	32.35	6219	11.89	65.01
QUERCUS SHUMARDII	21	42.00	10.14	51	1.02	12.59	9245	17.67	40.40
ULMUS RUBRA	28	56.00	13.53	54	1.08	13.33	6397	12.23	39.09
ACER NEGUNDO	24	48.00	11.59	57	1.14	14.07	1084	2.07	27.73
CARYA ILLINOENSIS	7	14.00	3.38	8	.16	1.98	10168	19.44	24.80
QUERCUS MACROCARPA	3	6.00	1.45	5	.10	1.23	11032	21.09	23.77
CELTIS LAEVIGATA	23	46.00	11.11	37	.74	9.14	88	.17	20.42
QUERCUS MUHLENBERGII	5	10.00	2.42	5	.10	1.23	6963	13.31	16.96
JUNIPERUS VIRGINIANA	8	16.00	3.86	9	.18	2.22	164	.31	6.39
VIBURNUM RUFIDULUM	8	16.00	3.86	8	.16	1.98	22	.04	5.88
ULMUS CRASSIFOLIA	7	14.00	3.38	7	.14	1.73	354	.68	5.79
MORUS RUBRA	6	12.00	2.90	7	.14	1.73	279	.53	5.16
RHAMNUS CAROLINIANA	6	12.00	2.90	6	.12	1.48	26	.05	4.43
VITIS RIPARIA	4	8.00	1.93	4	.08	.99	165	.32	3.24
CORNUS DRUMMONDII	3	6.00	1.45	4	.08	.99	7	.01	2.45
ILEX DECIDUA	3	6.00	1.45	3	.06	.74	62	.12	2.31
PARTHENOCISSUS QUINQUEFOLIA	2	4.00	.97	2	.04	.49	21	.04	1.50
SOPHORA AFFINIS	2	4.00	.97	2	.04	.49	4	.01	1.47
CERCIS CANADENSIS	2	4.00	.97	2	.04	.49	2	.00	1.46
RHUS TOXICODENDRON	1	2.00	.48	2	.04	.49	2	.00	.97
PRUNUS MEXICANA	1	2.00	.48	1	.02	.25	3	.01	.74
TOTAL			99.99	405	8.10	99.99	52307	99.99	299.97

SPECIES DIVERSITY

Diversity Index	=	3.156
Evenness	=	.718
Richness	=	3.331

TRANSECT 4
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANC VALUE
ULMUS RUBRA	21	58.33	17.80	31	.86	16.85	4036	16.06	50.71
FRAXINUS AMERICANA	19	52.78	16.10	36	1.00	19.57	3132	12.46	48.13
CELTIS LAEVIGATA	16	44.44	13.56	35	.97	19.02	895	3.56	36.14
QUERCUS MUHLENBERGII	3	8.33	2.54	3	.08	1.63	7127	28.36	32.53
QUERCUS MACROCARPA	2	5.56	1.69	2	.06	1.09	4738	18.85	21.63
SAPINDUS SAPONARIA	12	33.33	10.17	18	.50	9.78	77	.31	20.26
ULMUS CRASSIFOLIA	9	25.00	7.63	11	.31	5.98	310	1.23	14.84
CARYA ILLINOENSIS	1	2.78	.85	1	.03	.54	3019	12.01	13.40
MORUS RUBRA	7	19.44	5.93	7	.19	3.80	260	1.03	10.76
MACLURA POMIFERA	5	13.89	4.24	6	.17	3.26	800	3.18	10.68
PRUNUS MEXICANA	6	16.67	5.08	7	.19	3.80	125	.50	9.38
QUERCUS SHUMARDII	4	11.11	3.39	5	.14	2.72	7	.03	6.14
CORNUS DRUMMONDII	3	8.33	2.54	6	.17	3.26	15	.06	5.86
SMILAX SPP.	2	5.56	1.69	6	.17	3.26	7	.03	4.98
GLEDITSIA TRIACANTHOS	1	2.78	.85	1	.03	.54	573	2.28	3.67
PARTHENOCISSUS QUINQUEFOLIA	2	5.56	1.69	2	.06	1.09	2	.01	2.79
BERCHEMIA SCANDENS	1	2.78	.85	2	.06	1.09	4	.02	1.96
SMILAX HISPIDA	1	2.78	.85	2	.06	1.09	2	.01	1.95
JUNIPERUS VIRGINIANA	1	2.78	.85	1	.03	.54	3	.01	1.40
VIBURNUM RUFIDULUM	1	2.78	.85	1	.03	.54	1	.00	1.39
ACER NEGUNDO	1	2.78	.85	1	.03	.54	1	.00	1.39
TOTAL			100.00	184	5.14	99.99	25134	100.00	299.99

SPECIES DIVERSITY

Diversity Index	=	3.488
Evenness	=	.794
Richness	=	3.835

TRANSECT 5
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	41	113.89	23.70	206	5.72	48.47	2320	3.66	75.83
ULMUS RUBRA	36	100.00	20.81	73	2.17	18.35	8661	13.64	52.80
QUERCUS MUHLENBERGII	6	16.67	3.47	8	.22	1.88	20518	32.33	37.68
CARYA ILLINOENSIS	6	16.67	3.47	6	.17	1.41	11868	18.70	23.58
FRAXINUS AMERICANA	15	41.67	8.67	19	.53	4.47	5776	9.10	22.24
QUERCUS SHUMARDII	6	16.67	3.47	9	.25	2.12	4590	7.23	12.82
SMILAX SPP.	10	27.78	5.78	29	.81	6.82	34	.05	12.65
VITIS RIPARIA	10	27.78	5.78	11	.31	2.59	207	.33	8.70
QUERCUS MACROCARPA	3	8.33	1.73	3	.08	.71	3953	6.23	8.67
JUGLANS NIGRA	1	2.78	.59	1	.03	.24	4778	7.53	8.35
VIBURNUM RUFIDULUM	7	19.44	4.05	8	.22	1.88	31	.05	5.98
CORNUS DRUMMONDII	5	13.89	2.89	10	.28	2.35	39	.06	5.30
PARTHENOCISSUS QUINQUEFOLIA	5	13.89	2.89	7	.19	1.65	61	.10	4.64
MORUS RUBRA	4	11.11	2.31	4	.11	.94	102	.16	3.41
ACER NEGUNDO	3	8.33	1.73	3	.08	.71	3	.00	2.44
BUMELIA LANUGINOSA	2	5.56	1.16	2	.06	.47	381	.60	2.23
SAPINDUS SAPONARIA	2	5.56	1.16	4	.11	.94	23	.04	2.14
SAMBUCUS CANADENSIS	2	5.56	1.16	4	.11	.94	4	.01	2.11
PRUNUS MEXICANA	2	5.56	1.16	3	.08	.71	77	.12	1.99
RHUS TOXICODENDRON	2	5.56	1.16	3	.08	.71	15	.02	1.89
CERCIS CANADENSIS	2	5.56	1.16	2	.06	.47	20	.03	1.66
SMILAX HISPIDA	1	2.78	.58	3	.08	.71	5	.01	1.30
ULMUS CRASSIFOLIA	1	2.78	.58	1	.03	.24	7	.01	.83
JUNIPERUS VIRGINIANA	1	2.78	.58	1	.03	.24	1	.00	.82
TOTAL			100.03	425	11.81	100.02	63474	100.01	300.06

SPECIES DIVERSITY

Diversity Index	=	2.778
Evenness	=	.606
Richness	=	3.800

TRANSECT 6
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTAN VALUE
ULMUS RUBRA	23	63.89	13.86	75	2.08	20.16	4877	21.82	55.84
JUNIPERUS VIRGINIANA	20	55.56	12.05	27	.75	7.26	4581	20.50	39.81
FRAXINUS AMERICANA	18	50.00	10.84	59	1.64	15.86	1418	6.35	33.05
ULMUS CRASSIFOLIA	15	41.67	9.04	35	.97	9.41	3184	14.25	32.70
CELTIS LAEVIGATA	23	63.89	13.86	64	1.78	17.20	131	.59	31.65
QUERCUS MUHLENBERGII	8	22.22	4.82	10	.28	2.69	3936	17.61	25.12
SAPINDUS SAPONARIA	8	22.22	4.82	24	.67	6.45	807	3.61	14.88
RHAMNUS CAROLINIANA	10	27.78	6.02	21	.58	5.65	73	.33	12.00
QUERCUS SHUMARDII	3	8.33	1.81	4	.11	1.08	1593	7.13	10.02
GLEDITSIA TRIACANTHOS	7	19.44	4.22	9	.25	2.42	422	1.89	8.53
VITIS RIPARIA	5	13.89	3.01	12	.33	3.23	105	.47	6.71
MELIA AZEDARACH	4	11.11	2.41	4	.11	1.08	701	3.14	6.63
MACLURA POMIFERA	5	13.89	3.01	5	.14	1.34	309	1.38	5.73
CORNUS DRUMMONDII	5	13.89	3.01	8	.22	2.15	23	.10	5.26
ACER NEGUNDO	2	5.56	1.20	2	.06	.54	134	.60	2.34
MORUS RUBRA	2	5.56	1.20	2	.06	.54	29	.13	1.87
SOPHORA AFFINIS	2	5.56	1.20	2	.06	.54	2	.01	1.75
CARYA ILLINOENSIS	1	2.78	.60	3	.08	.81	15	.07	1.48
BERCHEMIA SCANDENS	1	2.78	.60	2	.06	.54	2	.01	1.15
LONICERA JAPONICA	1	2.78	.60	1	.03	.27	2	.01	.88
LIGUSTRUM SPP.	1	2.78	.60	1	.03	.27	1	.00	.87
PARTHENOCISSUS QUINQUEFOLIA	1	2.78	.60	1	.03	.27	1	.00	.87
RHUS TOXICODENDRON	1	2.78	.60	1	.03	.27	1	.00	.87
TOTAL			99.99	372	10.35	100.03	22347	100.00	300.01

SPECIES DIVERSITY

Diversity Index	=	3.492
Evenness	=	.772
Richness	=	3.717

TRANSECT 7
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
FRAXINUS AMERICANA	26	72.22	25.00	51	1.42	28.33	5566	23.37	77.70
ULMUS CRASSIFOLIA	10	27.78	10.00	14	.39	7.78	6031	25.32	43.10
ULMUS RUBRA	11	30.56	11.00	14	.39	7.78	4620	19.40	38.18
CELTIS LAEVIGATA	10	27.78	10.00	16	.44	8.89	1500	6.30	25.19
ACER NEGUNDO	7	19.44	7.00	13	.36	7.22	1787	7.50	21.72
SAPINDUS SAPONARIA	7	19.44	7.00	26	.72	14.44	38	.16	21.60
QUERCUS MUHLENBERGII	1	2.78	1.00	1	.03	.56	3421	14.36	15.92
VIBURNUM RUFIDULUM	8	22.22	8.00	8	.22	4.44	153	.64	13.08
SMILAX HISPIDA	1	2.78	1.00	17	.47	9.44	18	.08	10.52
VITIS RIPARIA	4	11.11	4.00	5	.14	2.78	52	.22	7.00
PRUNUS MEXICANA	3	8.33	3.00	3	.08	1.67	137	.58	5.25
MACLURA POMIFERA	2	5.56	2.00	2	.06	1.11	155	.65	3.76
QUERCUS SHUMARDII	2	5.56	2.00	2	.06	1.11	77	.32	3.43
QUERCUS MACROCARPA	2	5.56	2.00	2	.06	1.11	2	.01	3.12
PARTHENOCISSUS QUINQUEFOLIA	2	5.56	2.00	2	.06	1.11	2	.01	3.12
MORUS RUBRA	1	2.78	1.00	1	.03	.56	254	1.07	2.63
RHAMNUS CAROLINIANA	1	2.78	1.00	1	.03	.56	3	.01	1.57
RHUS TOXICODENDRON	1	2.78	1.00	1	.03	.56	2	.01	1.57
ILEX DECIDUA	1	2.78	1.00	1	.03	.56	1	.00	1.56
TOTAL			100.00	180	5.02	100.01	23819	100.01	300.02

SPECIES DIVERSITY
Diversity Index = 3.335
Evenness = .785
Richness = 3.466

TRANSECT 8
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANC VALUE
ACER NEGUNDO	26	52.00	18.18	47	.94	18.58	3645	7.86	44.62
FRAXINUS AMERICANA	21	42.00	14.69	29	.56	11.07	7031	15.15	40.91
ULMUS RUBRA	20	40.00	13.99	27	.54	10.67	6271	13.52	38.18
PLATANUS OCCIDENTALIS	2	4.00	1.40	2	.04	.79	12756	27.49	29.68
SMILAX SPP.	11	22.00	7.69	51	1.02	20.16	68	.15	28.00
VIBURNUM RUFIDULUM	13	26.00	9.09	29	.56	11.07	168	.36	20.52
CELTIS LAEVIGATA	12	24.00	8.39	18	.36	7.11	1682	3.63	19.13
CARYA ILLINOENSIS	3	6.00	2.10	9	.18	3.56	5607	12.08	17.74
ULMUS CRASSIFOLIA	11	22.00	7.69	16	.32	6.32	816	1.76	15.77
QUERCUS MACROCARPA	1	2.00	.70	1	.02	.40	3019	6.51	7.61
QUERCUS MUHLENBERGII	1	2.00	.70	1	.02	.40	2734	5.89	6.99
VITIS RIPARIA	5	10.00	3.50	6	.12	2.37	189	.41	6.28
MACLURA POMIFERA	3	6.00	2.10	4	.08	1.58	944	2.03	5.71
QUERCUS SHUMARDII	2	4.00	1.40	2	.04	.79	528	1.14	3.33
MORUS RUBRA	3	6.00	2.10	3	.06	1.19	9	.02	3.31
BUMELIA LANUGINOSA	1	2.00	.70	1	.02	.40	908	1.96	3.06
CORNUS DRUMMONDII	2	4.00	1.40	3	.06	1.19	5	.01	2.60
PRUNUS MEXICANA	2	4.00	1.40	2	.04	.79	14	.03	2.22
RHUS TOXICODENDRON	1	2.00	.70	1	.02	.40	1	.00	1.10
LONICERA JAPONICA	1	2.00	.70	1	.02	.40	1	.00	1.10
SMILAX HISPIDA	1	2.00	.70	1	.02	.40	2	.00	1.10
MELIA AZEDARACH	1	2.00	.70	1	.02	.40	1	.00	1.10
TOTAL			100.02	253	5.06	100.04	46399	100.00	300.06

SPECIES DIVERSITY
Diversity Index = 3.420
Evenness = .767
Richness = 3.795

TRANSECT 9
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
QUERCUS MUHLENBERGII	12	24.00	5.61	12	.24	3.31	18661	46.09	55.01
CELTIS LAEVIGATA	37	74.00	17.29	84	1.68	23.14	2070	5.11	45.54
FRAXINUS AMERICANA	26	52.00	12.15	49	.98	13.50	5234	12.93	38.58
ULMUS RUBRA	29	58.00	13.55	56	1.12	15.43	1048	2.59	31.57
CORNUS DRUMMONDII	15	30.00	7.01	41	.82	11.29	118	.29	18.59
CARYA ILLINOENSIS	4	8.00	1.87	4	.08	1.10	5355	13.23	16.20
MORUS RUBRA	15	30.00	7.01	17	.34	4.68	1143	2.82	14.51
QUERCUS SHUMARDII	3	6.00	1.40	3	.06	.83	4300	10.62	12.85
ACER NEGUNDO	11	22.00	5.14	15	.30	4.13	129	.32	9.59
SAPINDUS SAPONARIA	8	16.00	3.74	16	.32	4.41	81	.20	8.35
PARTHENOCISSUS QUINQUEFOLIA	10	20.00	4.67	11	.22	3.03	27	.07	7.77
VIBURNUM RUFIDULUM	9	18.00	4.21	12	.24	3.31	66	.16	7.68
ULMUS CRASSIFOLIA	3	6.00	1.40	4	.08	1.10	1726	4.26	6.76
VITIS RIPARIA	8	16.00	3.74	9	.18	2.48	148	.37	6.59
MACLURA POMIFERA	6	12.00	2.80	7	.14	1.93	259	.64	5.37
PRUNUS MEXICANA	4	8.00	1.87	4	.08	1.10	64	.16	3.13
RHAMNUS CAROLINIANA	4	8.00	1.87	4	.08	1.10	27	.07	3.04
SOPHORA AFFINIS	3	6.00	1.40	5	.10	1.38	5	.01	2.79
CERCIS CANADENSIS	2	4.00	.93	2	.04	.55	8	.02	1.50
LIGUSTRUM SPP.	1	2.00	.47	3	.06	.83	8	.02	1.32
SMILAX HISPIDA	1	2.00	.47	2	.04	.55	4	.01	1.03
SAMBUCUS CANADENSIS	1	2.00	.47	1	.02	.28	1	.00	.75
ILEX DECIDUA	1	2.00	.47	1	.02	.28	1	.00	.75
MELIA AZEDARACH	1	2.00	.47	1	.02	.28	1	.00	.75
TOTAL			100.01	363	7.26	100.02	40484	99.99	300.02

SPECIES DIVERSITY

Diversity Index	=	3.605
Evenness	=	.786
Richness	=	3.902

TRANSECT 1L
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
ULMUS RUBRA	15	41.67	18.52	32	.89	24.43	6511	26.10	69.05
ACER NEGUNDO	21	58.33	25.93	33	.92	25.19	1629	6.53	57.65
FRAXINUS AMERICANA	11	30.56	13.58	16	.44	12.21	3150	12.63	38.42
CELTIS LAEVIGATA	11	30.56	13.58	20	.56	15.27	2214	8.87	37.72
QUERCUS SHUMARDII	2	5.56	2.47	2	.06	1.53	5154	20.66	24.66
SAPINDUS SAPONARIA	9	25.00	11.11	15	.42	11.45	31	.12	22.68
QUERCUS MACROCARPA	2	5.56	2.47	2	.06	1.53	2570	10.30	14.30
CARYA ILLINOENSIS	2	5.56	2.47	2	.06	1.53	2291	9.18	13.18
ULMUS CRASSIFOLIA	2	5.56	2.47	2	.06	1.53	1041	4.17	8.17
MORUS RUBRA	2	5.56	2.47	2	.06	1.53	338	1.35	5.35
MELIA AZEDARACH	2	5.56	2.47	2	.06	1.53	2	.01	4.01
RHUS TOXICODENDRON	1	2.78	1.23	2	.06	1.53	14	.06	2.82
SMILAX HISPIDA	1	2.78	1.23	1	.03	.76	2	.01	2.00
TOTAL			100.00	131	3.68	100.02	24947	99.99	300.01

SPECIES DIVERSITY

Diversity Index	=	2.939
Evenness	=	.767
Richness	=	2.461

TRANSECT 11
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	27	54.00	20.00	54	1.08	27.84	8479	15.00	62.84
CARYA ILLINOENSIS	13	26.00	9.63	13	.26	6.70	17379	30.74	47.07
ACER NEGUNDO	17	34.00	12.59	26	.52	13.40	9418	16.66	42.65
ULMUS RUBRA	18	36.00	13.33	23	.46	11.86	6319	11.18	36.37
FRAXINUS AMERICANA	8	16.00	5.93	9	.18	4.64	8042	14.23	24.80
SMILAX HISPIDA	12	24.00	8.89	16	.32	8.25	68	.12	17.26
SAPINDUS SAPONARIA	7	14.00	5.19	11	.22	5.67	38	.07	10.93
QUERCUS SHUMARDII	5	10.00	3.70	3	.16	4.12	78	.14	7.96
MORUS RUBRA	5	10.00	3.70	5	.10	2.58	838	1.48	7.76
VITIS RIPARIA	5	10.00	3.70	7	.14	3.61	123	.22	7.53
JUGLANS NIGRA	1	2.00	.74	1	.02	.52	3421	6.05	7.31
RHUS TOXICODENDRON	4	8.00	2.96	7	.14	3.61	40	.07	6.64
MACLURA POMIFERA	1	2.00	.74	1	.02	.52	1195	2.11	3.37
BUMELIA LANUGINOSA	1	2.00	.74	1	.02	.52	1018	1.80	3.06
ULMUS CRASSIFOLIA	2	4.00	1.48	2	.04	1.03	16	.03	2.54
CORNUS DRUMMONDII	2	4.00	1.48	2	.04	1.03	4	.01	2.52
MELIA AZEDARACH	1	2.00	.74	2	.04	1.03	4	.01	1.78
QUERCUS MACROCARPA	1	2.00	.74	1	.02	.52	38	.07	1.33
ILEX DECIDUA	1	2.00	.74	1	.02	.52	8	.01	1.27
VIBURNUM RUFIDULUM	1	2.00	.74	1	.02	.52	1	.00	1.26
JUNIPERUS VIRGINIANA	1	2.00	.74	1	.02	.52	1	.00	1.26
QUERCUS MUHLENBERGII	1	2.00	.74	1	.02	.52	1	.00	1.26
PARTHENOCISSUS QUINQUEFOLIA	1	2.00	.74	1	.02	.52	1	.00	1.26
TOTAL.			99.98	194	3.88	100.05	56530	100.00	300.03

SPECIES DIVERSITY

Diversity Index	=	3.494
Evenness	=	.772
Richness	=	4.176

TRANSECT 12
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
ULMUS CRASSIFOLIA	33	66.00	19.76	78	1.56	19.95	12110	41.00	80.71
SAPINDUS SAPONARIA	43	86.00	25.75	147	2.94	37.60	4174	14.13	77.48
FRAXINUS AMERICANA	31	62.00	18.56	66	1.32	16.88	6733	22.80	58.24
CELTIS LAEVIGATA	20	40.00	11.98	29	.58	7.42	3902	13.21	32.61
CORNUS DRUMMONDII	10	20.00	5.99	35	.70	8.95	49	.17	15.11
QUERCUS SHUMARDII	2	4.00	1.20	2	.04	.51	1966	6.66	8.37
ULMUS RUBRA	7	14.00	4.19	8	.16	2.05	124	.42	6.66
RHUS TOXICODENDRON	5	10.00	2.99	10	.20	2.56	12	.04	5.59
MORUS RUBRA	4	8.00	2.40	4	.08	1.02	31	.10	3.52
PARTHENOCISSUS QUINQUEFOLIA	3	6.00	1.80	3	.06	.77	28	.09	2.66
JUNIPERUS VIRGINIANA	2	4.00	1.20	2	.04	.51	20	.07	1.78
MACLURA POMIFERA	1	2.00	.60	1	.02	.26	201	.68	1.54
QUERCUS MUHLENBERGII	1	2.00	.60	1	.02	.26	177	.60	1.46
VIBURNUM RUFIDULUM	1	2.00	.60	1	.02	.26	3	.01	.87
SMILAX SPP.	1	2.00	.60	1	.02	.26	2	.01	.87
SOPHORA AFFINIS	1	2.00	.60	1	.02	.26	3	.01	.87
CERCIS CANADENSIS	1	2.00	.60	1	.02	.26	1	.00	.86
BUMELIA LANUGINOSA	1	2.00	.60	1	.02	.26	1	.00	.86
TOTAL			100.02	391	7.82	100.04	29537	100.00	300.06

SPECIES DIVERSITY
Diversity Index = 2.621
Evenness = .629
Richness = 2.848

TRANSECT 13
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	27	75.00	13.92	67	1.86	18.31	1247	5.71	37.94
QUERCUS MUHLENBERGII	10	27.78	5.15	14	.39	3.83	5971	27.35	36.33
ULMUS CRASSIFOLIA	17	47.22	8.76	28	.78	7.65	4294	19.67	36.08
FRAXINUS AMERICANA	15	41.67	7.73	29	.81	7.92	3735	17.11	32.76
ULMUS RUBRA	23	63.89	11.86	52	1.44	14.21	858	3.93	30.00
QUERCUS SHUMARDII	11	30.56	5.67	17	.47	4.64	4034	18.47	28.78
CORNUS DRUMMONDII	12	33.33	6.19	29	.81	7.92	46	.21	14.32
PARTHENOCISSUS QUINQUEFOLIA	12	33.33	6.19	20	.56	5.46	41	.19	11.84
BERCHEMIA SCANDENS	7	19.44	3.61	23	.64	6.28	58	.27	10.16
MORUS RUBRA	9	25.00	4.64	9	.25	2.46	311	1.42	8.52
SAPINDUS SAPONARIA	8	22.22	4.12	11	.31	3.01	170	.78	7.91
VIBURNUM RUFIDULUM	8	22.22	4.12	11	.31	3.01	39	.18	7.31
MELIA AZEDARACH	5	13.89	2.58	8	.22	2.19	276	1.26	6.03
UNGNADIA SPECIOSA	3	8.33	1.55	14	.39	3.83	22	.10	5.48
ACER NEGUNDO	6	16.67	3.09	7	.19	1.91	35	.16	5.16
BUMELIA LANUGINOSA	3	8.33	1.55	3	.08	.82	352	1.61	3.98
JUNIPERUS VIRGINIANA	3	8.33	1.55	4	.11	1.09	49	.22	2.86
RHAMNUS CAROLINIANA	3	8.33	1.55	3	.08	.82	36	.16	2.53
PRUNUS MEXICANA	2	5.56	1.03	2	.06	.55	45	.21	1.79
NANDINA DOMESTICA	1	2.78	.52	4	.11	1.09	5	.02	1.63
CERCIS CANADENSIS	2	5.56	1.03	2	.06	.55	6	.03	1.61
LIGUSTRUM SPP.	2	5.56	1.03	2	.06	.55	4	.02	1.60
RHUS TOXICODENDRON	2	5.56	1.03	2	.06	.55	5	.02	1.60
SMILAX HISPIDA	1	2.78	.52	3	.08	.82	4	.02	1.36
MACLURA POMIFERA	1	2.78	.52	1	.03	.27	113	.52	1.31
CARYA ILLINOENSIS	1	2.78	.52	1	.03	.27	79	.36	1.15
TOTAL			100.03	366	10.19	100.01	21835	100.00	300.04

SPECIES DIVERSITY
Diversity Index = 3.945
Evenness = .840
Richness = 4.235

TRANSECT 14
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	28	56.00	16.28	73	1.46	19.68	7206	21.49	57.45
FRAXINUS AMERICANA	38	76.00	22.09	98	1.96	26.42	643	1.92	50.43
ACER NEGUNDO	33	66.00	19.19	107	2.14	28.84	720	2.15	50.18
QUERCUS MUHLENBERGII	5	10.00	2.91	6	.12	1.62	13391	39.94	44.47
ULMUS RUBRA	21	42.00	12.21	31	.62	8.36	2063	6.15	26.72
QUERCUS MACROCARPA	2	4.00	1.16	2	.04	.54	5418	16.16	17.86
ULMUS CRASSIFOLIA	9	18.00	5.23	10	.20	2.70	1874	5.59	13.52
QUERCUS SHUMARDII	10	20.00	5.81	10	.20	2.70	134	.40	8.91
MORUS RUBRA	5	10.00	2.91	7	.14	1.89	344	1.03	5.83
VITIS RIPARIA	3	6.00	1.74	5	.10	1.35	154	.46	3.55
CORNUS DRUMMONDII	3	6.00	1.74	4	.08	1.08	20	.06	2.88
SAPINDUS SAPONARIA	3	6.00	1.74	4	.08	1.08	17	.05	2.87
MACLURA POMIFERA	1	2.00	.58	1	.02	.27	573	1.71	2.56
CARYA ILLINOENSIS	2	4.00	1.16	2	.04	.54	177	.53	2.23
VIBURNUM RUFIDULUM	2	4.00	1.16	3	.06	.81	8	.02	1.99
JUGLANS NIGRA	1	2.00	.58	1	.02	.27	380	1.13	1.98
BUMELIA LANUGINOSA	1	2.00	.58	1	.02	.27	346	1.03	1.88
PARTHENOCISSUS QUINQUEFOLIA	2	4.00	1.16	2	.04	.54	4	.01	1.71
RHUS TOXICODENDRON	1	2.00	.58	2	.04	.54	29	.09	1.21
SOPHORA AFFINIS	1	2.00	.58	1	.02	.27	28	.08	.93
LONICERA JAPONICA	1	2.00	.58	1	.02	.27	1	.00	.85
TOTAL			99.97	371	7.42	100.04	33530	100.00	300.01

SPECIES DIVERSITY

Diversity Index	=	2.829
Evenness	=	.644
Richness	=	3.381

TRANSECT 15
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
ACER NEGUNDO	35	70.00	23.81	70	1.40	23.81	8074	18.51	66.13
CELTIS LAEVIGATA	24	48.00	16.33	80	1.60	27.21	3322	7.62	51.16
QUERCUS SHUMARDII	3	6.00	2.04	4	.08	1.36	9635	22.09	25.49
CARYA ILLINOENSIS	2	4.00	1.36	2	.04	.68	9523	21.84	23.88
FRAXINUS AMERICANA	9	18.00	5.12	14	.28	4.76	4861	11.15	22.03
MORUS RUBRA	14	28.00	9.52	16	.32	5.44	2678	6.14	21.10
VITIS RIPARIA	11	22.00	7.48	18	.36	6.12	265	.61	14.21
CORNUS DRUMMONDII	8	16.00	5.44	23	.46	7.82	71	.16	13.42
ULMUS RUBRA	10	20.00	5.80	15	.30	5.10	534	1.22	13.12
QUERCUS MACROCARPA	3	6.00	2.04	3	.06	1.02	4099	9.40	12.46
SAPINDUS SAPONARIA	9	18.00	6.12	15	.30	5.10	214	.49	11.71
SMILAX HISPIDA	7	14.00	4.76	18	.36	6.12	24	.06	10.94
SMILAX SPP.	3	6.00	2.04	6	.12	2.04	8	.02	4.10
MELIA AZEDARACH	3	6.00	2.04	3	.06	1.02	268	.61	3.67
QUERCUS MUHLENBERGII	2	4.00	1.36	2	.04	.68	2	.00	2.04
RHUS TOXICODENDRON	1	2.00	.68	2	.04	.68	3	.01	1.37
JUNIPERUS VIRGINIANA	1	2.00	.68	1	.02	.34	28	.06	1.08
SAMBUCUS CANADENSIS	1	2.00	.68	1	.02	.34	1	.00	1.02
LONICERA JAPONICA	1	2.00	.68	1	.02	.34	1	.00	1.02
TOTAL			99.98	294	5.88	99.98	43611	99.99	299.95

SPECIES DIVERSITY

Diversity Index	=	3.225
Evenness	=	.759
Richness	=	3.167

TRANSECT 16
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	30	60.00	18.40	60	1.20	24.00	905	2.45	44.85
ACER NEGUNDO	27	54.00	16.56	49	.98	19.60	2275	6.15	42.31
CARYA ILLINOENSIS	5	10.00	3.07	5	.10	2.00	12202	32.99	38.06
ULMUS RUBRA	13	26.00	7.98	15	.30	6.00	6010	16.25	30.23
FRAXINUS AMERICANA	20	40.00	12.27	30	.60	12.00	2160	5.84	30.11
QUERCUS MUHLENBERGII	3	6.00	1.84	3	.06	1.20	7823	21.15	24.19
QUERCUS SHUMARDII	16	32.00	9.82	21	.42	8.40	871	2.35	20.57
MORUS RUBRA	15	30.00	9.20	17	.34	6.80	1638	4.43	20.43
SAPINDUS SAPONARIA	9	18.00	5.52	15	.30	6.00	586	1.58	13.10
SMILAX SPP.	7	14.00	4.29	10	.20	4.00	86	.23	8.52
QUERCUS MACROCARPA	1	2.00	.61	1	.02	.40	1886	5.10	6.11
CORNUS DRUMMONDII	4	8.00	2.45	6	.12	2.40	23	.06	4.91
ULMUS CRASSIFOLIA	3	6.00	1.84	5	.10	2.00	217	.59	4.43
SMILAX HISPIDA	3	6.00	1.84	4	.08	1.60	5	.01	3.45
COCCULUS CAROLINUS	2	4.00	1.23	4	.08	1.60	5	.01	2.84
JUGLANS NIGRA	1	2.00	.61	1	.02	.40	254	.69	1.70
FRAXINUS TEXENSIS	1	2.00	.61	1	.02	.40	38	.10	1.11
BUMELIA LANUGINOSA	1	2.00	.61	1	.02	.40	4	.01	1.02
VIBURNUM RUFIDULUM	1	2.00	.61	1	.02	.40	3	.01	1.02
PARTHENOCISSUS QUINQUEFOLIA	1	2.00	.61	1	.02	.40	1	.00	1.01
TOTAL			99.97	250	5.00	100.00	36992	100.00	299.97

SPECIES DIVERSITY

Diversity Index	=	3.372
Evenness	=	.780
Richness	=	3.441

TRANSECT 17
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
QUERCUS SHUMARDII	25	50.00	15.72	51	1.02	19.69	5049	17.31	52.72
ACER NEGUNDO	29	58.00	18.24	51	1.02	19.69	3163	10.85	48.78
CELTIS LAEVIGATA	21	42.00	13.21	35	.70	13.51	2814	9.65	36.37
ULMUS RUBRA	10	20.00	6.29	11	.22	4.25	7393	25.35	35.89
CARYA ILLINOENSIS	8	16.00	5.03	9	.18	3.47	5227	17.92	26.42
VITIS RIPARIA	14	28.00	8.81	25	.50	9.65	408	1.40	19.86
SMILAX HISPIDA	9	18.00	5.66	25	.50	9.65	36	.12	15.43
MORUS RUBRA	8	16.00	5.03	8	.16	3.09	1316	4.51	12.63
FRAXINUS AMERICANA	9	18.00	5.66	14	.28	5.41	328	1.12	12.19
QUERCUS MUHLENBERGII	2	4.00	1.26	2	.04	.77	2041	7.00	9.03
SMILAX SPP.	6	12.00	3.77	8	.16	3.09	12	.04	6.90
SAPINDUS SAPONARIA	5	10.00	3.14	5	.10	1.93	336	1.15	6.22
JUGLANS NIGRA	1	2.00	.63	1	.02	.39	755	2.59	3.61
PARTHENOCISSUS QUINQUEFOLIA	3	6.00	1.89	3	.06	1.16	40	.14	3.19
CORNUS DRUMMONDII	2	4.00	1.26	3	.06	1.16	16	.05	2.47
JUNIPERUS VIRGINIANA	2	4.00	1.26	2	.04	.77	41	.14	2.17
QUERCUS MACROCARPA	1	2.00	.63	1	.02	.39	133	.46	1.48
VIBURNUM RUFIDULUM	1	2.00	.63	2	.04	.77	13	.04	1.44
MACLURA POMIFERA	1	2.00	.63	1	.02	.39	38	.13	1.15
SMILAX BONA-NOX	1	2.00	.63	1	.02	.39	1	.00	1.02
COCCULUS CAROLINUS	1	2.00	.63	1	.02	.39	1	.00	1.02
TOTAL			100.01	259	5.18	100.01	29161	99.97	299.99

SPECIES DIVERSITY

Diversity Index	=	3.440
Evenness	=	.783
Richness	=	3.599

TRANSECT 19
FREQUENCY, DENSITY AND DOMINANCE DATA FOR PLANT SPECIES

SPECIES	PLOTS	FREQUENCY %	RELATIVE FREQUENCY %	PLANTS	DENSITY NO./PLOT	RELATIVE DENSITY %	BASAL AREA	RELATIVE BASAL AREA %	IMPORTANCE VALUE
CELTIS LAEVIGATA	30	60.00	17.24	58	1.16	17.31	8176	15.72	50.27
ACER NEGUNDO	33	66.00	18.97	78	1.56	23.28	2453	4.72	46.97
FRAXINUS AMERICANA	19	38.00	10.92	40	.80	11.94	6721	12.93	35.79
ULMUS RUBRA	7	14.00	4.02	9	.18	2.69	14116	27.15	33.86
QUERCUS SHUMARDII	14	28.00	8.05	20	.40	5.97	9024	17.36	31.38
VITIS RIPARIA	16	32.00	9.20	23	.46	6.87	259	.50	16.57
SMILAX HISPIDA	12	24.00	6.90	29	.58	8.66	45	.09	15.65
QUERCUS MACROCARPA	2	4.00	1.15	2	.04	.60	6794	13.07	14.82
SAPINDUS SAPONARIA	10	20.00	5.75	17	.34	5.07	155	.30	11.12
CARYA ILLINOENSIS	8	16.00	4.60	9	.18	2.69	642	1.23	8.52
SMILAX SPP.	4	8.00	2.30	13	.36	5.37	25	.05	7.72
MORUS RUBRA	6	12.00	3.45	9	.18	2.69	349	.67	6.81
POPULUS DELTOIDES	1	2.00	.57	1	.02	.30	2827	5.44	6.31
PARTHENOCISSUS QUINQUEFOLIA	4	8.00	2.30	6	.12	1.79	83	.16	4.25
ULMUS CRASSIFOLIA	3	6.00	1.72	4	.08	1.19	49	.09	3.00
CORNUS DRUMMONDII	2	4.00	1.15	5	.10	1.49	16	.03	2.67
VITIS MUSTANGENSIS	1	2.00	.57	4	.08	1.19	5	.01	1.77
QUERCUS MUHLENBERGII	1	2.00	.57	1	.02	.30	254	.49	1.36
RHAMNUS CAROLINIANA	1	2.00	.57	2	.04	.60	2	.00	1.17
TOTAL			100.00	335	6.70	100.00	51995	100.01	300.01

SPECIES DIVERSITY

Diversity Index = 3.453
Evenness = .814
Richness = 3.096

WOODY VEGETATION OF AN OLD-GROWTH CREEKBOTTOM FOREST IN NORTH-CENTRAL TEXAS

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Abstract.—Slope, creekbottom, and creekside forest stands were analyzed along Spring Creek just north of Garland, Texas. Important overstory species were *Fraxinus* sp., *Ulmus* sp., *Carya illinoensis*, *Celtis laevigata*, *Quercus shumardii*, and *Q. muhlenbergii*. The most prevalent shrubs and small trees were *Cornus drummondii*, *Viburnum rufidulum*, and *Rhamnus caroliniana*. Common vines were *Vitis riparia*, *Toxicodendron radicans*, and *Parthenocissus quinquefolia*. A vegetational continuum existed from creekside to creekbottom to slope. Total density was greatest in the slope community, whereas basal area was greatest in the creekside community. Species diversity increased along the continuum from creekside to slope. *Key words*: old-growth forest; floristic composition; creekbottom vegetation; species diversity.

Old-growth forests are not easily defined. Runkle (1982) indicated that they are without obvious large-scale human or natural disturbances and contain large trees. Abrell and Jackson (1977) indicated they are near virgin. There is a streamside bottomland forest in Garland, Texas, that generally fits these descriptions and thus needs to be characterized.

In Texas, old-growth forests are rare. Nixon et al. (1977, 1980) described two such forests in eastern Texas, one associated with the Neches River and dominated by *Carpinus caroliniana* Walt., *Quercus nigra* L., and *Fraxinus caroliniana* Mill., and a second on the shore of Toledo Bend Reservoir that is dominated by *Fagus grandifolia* Ehrh. Old-growth hardwood communities exist elsewhere in the eastern United States, and most have been analyzed and described (for example, Abrell and Jackson, 1977, in Indiana, and Adams and Barrett, 1977, in Ohio). It is important that we characterize these old-growth forests because they suggest the past structure and composition of such communities. Furthermore, central Texas bottomland communities have received little attention. The purpose of this study, therefore, is to provide a description of a rare old-growth streamside forest in north-central Texas and to compare it with other forests previously described. Of additional interest is the purchase of this site by the city of Garland and its designation as the Spring Creek Forest Preserve. Our study should provide basic information to aid in the management of this preserve.

Study Area

The Spring Creek Forest Preserve is located within the Blackland Prairies Vegetational Area of Hatch et al. (1990). It is a forested site situated along Spring Creek in northeastern Dallas County just north of

Garland, Texas. More specifically, it is at the junction of Spring Creek and Holford Road. Characterized by rather steep banks and a deep and wide channel, Spring Creek meanders somewhat as it borders the study area. Occasional flooding occurs, with water overflowing the channel into the creekbottom. Woodlands are generally restricted to the creekbottom but occasionally extend onto adjoining slopes, where they may be disrupted by pastures, farmland, quarries, or gravel pits. The study area, as such, was approximately 500 meters long and 50 to 100 meters wide.

Dallas County is transitional between the Subtropical Humid climatic region of eastern Texas, which is characterized by warm summers, and the Subtropical Subhumid climatic region of central Texas, which is characterized by hot summers and dry winters (Larkin and Bomar, 1983). The average annual precipitation for the study area is about 89 centimeters; highest monthly totals occur in April, May, and September. The average annual temperature is 19° C, with an average annual low of 12° C and an average annual high of 25° C (Larkin and Bomar, 1983).

Methods

Three habitat types were designated—creekside, creekbottom, and slope. A total of 10 forest stands were analyzed, three at creekside, five in the creekbottom, and two on the slope. Stands were studied using the quadrat method. Quadrats were five by five meters, with each positioned end to end within belt transects. Transects were systematically placed adjacent to, and parallel with, the creek in creekside stands and in the center area of each of the creekbottom and slope stands. Fifty quadrats in each stand were sampled to estimate stand composition. Frequency, density, and basal area data were obtained. Importance values were determined by summing relative frequency, relative density, and relative basal area. Only those trees, shrubs, and woody vines with diameters at about 1.4 meters above ground equal to or greater than half a centimeter were included. Scientific nomenclature followed Hatch et al. (1990).

To compare stands, a polar ordination (Bray and Curtis, 1957) was developed following procedures outlined by Cox (1980). Community species diversity also was measured using the Shannon-Weiner diversity index (Shannon and Weaver, 1949): $H' = -\Sigma$ pi log$_2$ pi, where pi is the decimal fraction of the individuals belonging to the i th species. Species richness is the number of species per stand.

Seven soil samples were collected from the study area—one from the slope, three from creekside, and three from the creekbottom. Soil samples were taken from the top 20 centimeters of the soil. Analyses were performed by the Stephen F. Austin State University Soil Testing Laboratory. Ion levels were determined for Ca, P, K, and Mg by atomic absorption spectrophotometry and soil texture by the hydrometer method (Bouyoucos, 1962).

Statistical analyses of vegetation and soil parameters were carried out using a one-way analysis of variance (ANOVA). An alpha level of .05 was used to determine significance.

Without fruits, and in most cases without leaves and twigs, interspecific differences between *Ulmus americana* L. and *U. rubra* Muhl. and between *Fraxinus pennsylvanica* Marsh. and *F. americana* L. were not easily determined. This was especially the case for mid- and upper canopy trees where access to leaves and twigs was utterly impractical. As a result, these are listed as *Ulmus* sp. and *Fraxinus* sp.

TABLE 1. Mean values of the chemical and physical properties of the soil at the Spring Creek study area. Sample sizes are in parenthesis.

Communities	pH	Ca	P	K	Mg	Sand	Silt	Clay	Texture
Slope (1)	7.6	>6000	30	400	>400	16	32	52	Clay
Creekbottom(3)	7.7	>6000	31	473	>400	17	34	49	Clay
Creekside(3)	7.7	>6000	18	360	>400	29	25	46	Clay

RESULTS

Soils

The 10 forest stands were located on two soils—the Frio silty clay, frequently flooded phase, and the Austin-Lewisville complex. The creekside and creekbottom stands were on the Frio silty clay. This is a deep, well drained, nearly level soil that occurs on flood plains (Coffee et al., 1980). It is a calcareous, moderately alkaline soil with a dark grayish color. The Austin-Lewisville complex was formed over chalky limestone and is located on slopes up from floodplains. The slopes are usually five to eight percent and eroded. These soils are calcareous and moderately alkaline and are usually dark grayish in color.

Our soil analyses indicate that surface soils of the study area were basic calcareous clays (Table 1). Soil pH ranged from 7.6 to 7.8 and showed no significant difference between stands. Creekside sites had significantly less phosphorus ($P = .014$); although potassium ranged from 360 parts per million at creekside to 473 in creekbottom sites, differences were not significant. There were no significant differences between sites in regard to sand, silt, and clay content.

Vegetation

The polar ordination displayed a vegetational continuum with creekside stands at one end of the spectrum and slope stands at the other (Fig. 1). In creekside stands, overstory species with the greatest basal area were, in descending order, *Quercus shumardii* Buckl., *Fraxinus* sp., *Juglans nigra* L., and *Quercus macrocarpa* Michx. (Table 2). *Celtis laevigata* Willd. and *Ulmus* sp. had the greatest densities and highest importance values. Although these same species occurred in the overstory of creekbottom stands, their basal area generally declined. *Carya illinoensis* (Wang.) K. Koch and *Quercus muhlenbergii* Engelm. had considerably higher basal areas in creekbottom stands, whereas *Fraxinus* sp. and *Ulmus* sp. had the greatest densities and highest importance values (Table 2).

The greatest basal areas of overstory species on the slope were exhibited by *Q. shumardii*, *C. illinoensis*, *Fraxinus* sp., and *Q. muhlenbergii* (Table 2). *Fraxinus* sp. and *Ulmus* sp. displayed the highest density, whereas *Fraxinus* sp., *Q. shumardii*, and *C. illinoensis* had the highest importance values.

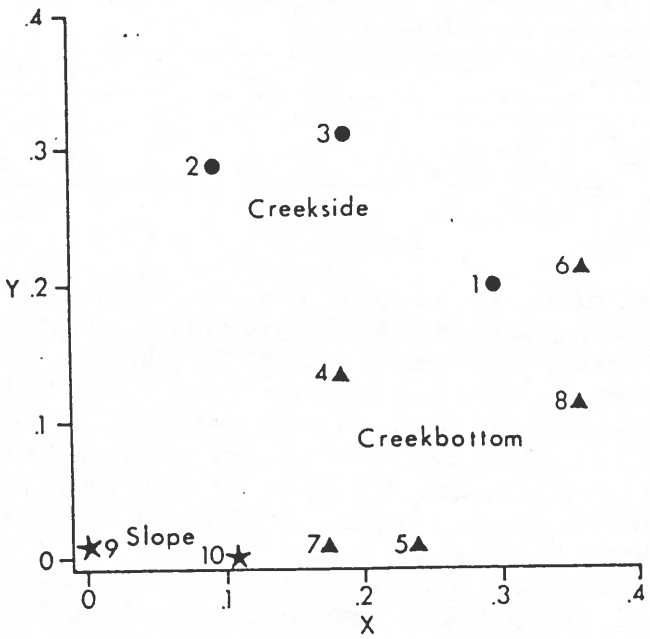

FIGURE 1. Polar ordination of the 10 plant communities.

The more prevalent shrubs and small trees in the creekside stands were *Cornus drummondii* C. A. Mey., *Viburnum rufidulum* Raf., *Rhamnus caroliniana* Walt., and *Juniperus virginiana* L. These sames species, along with *Prunus mexicana* S. Wats. and *Ilex decidua* Walt., were common creekbottom stand components. Common vines at the three sites were *Vitis riparia* Michx., *Toxicodendron radicans* (L.) Mill., *Parthenocissus quinquefolia* (L.) Planch., and *Berchemia scandens* (Hill) K. Koch. The first three listed were more notable creekside and creekbottom constituents, whereas *Berchemia scandens* was the most common slope species.

Species richness was relatively constant with means of 32, 29, and 31 species in creekside, creekbottom, and slope communities, respectively. Total density at creekside was 2374 plants per hectare, whereas the creekbottom was 1894 and the slope 3040. Thus density decreased from creekside to creekbottom and increased to highest values in the slope stands. There were no significant differences among the three groups. Total basal area of creedside, creekbottom, and slope stands was 49.56, 39.31, and 32.14 square meters per hectare, respectively. These differences were not statistically significant. The slope stands had the highest mean species diversity ($H^1 = 4.02$) (Fig. 2). Conversely, the creekside stands had the lowest value ($H^1 = 3.40$). Creekbottom stand species diversity was 3.60.

TABLE 2. Comparison of density, basal area and importance value of the six dominant woody species occurring in creekside, creekbottom, and slope communities. Species are ranked according to basal area.

	Creekside			Creekbottom			Slope		
	Density (stems/ha)	Basal area (m^2/ha)	IV	Density (stems/ha)	Basal area (m^2/ha)	IV	Density (stems/ha)	Basal area (m^2/ha)	IV[3]
Carya illinoensis	48	5.40	16.1	77	12.32	41.5	142	8.49	35.3
Quercus shumardii	152	9.03	32.6	27	1.87	8.1	200	9.27	40.4
Quercus muhlenbergii	21	5.00	12.3	45	8.56	27.8	208	4.57	27.5
Fraxinus sp.[1]	312	8.62	43.4	386	3.29	45.5	623	5.56	53.8
Juglans nigra	29	6.70	16.8	21	2.27	8.4	23	1.98	7.9
Ulmus sp.[2]	456	4.46	48.6	333	3.10	42.0	373	0.87	27.4
Quercus macrocarpa	29	6.42	16.3	8	1.41	4.7	12	0.07	1.2
Celtis laevigata	725	2.33	51.5	274	2.85	33.3	92	0.14	6.9
Others[4]	511	1.02	62.4	504	2.60	88.6	1340	1.13	99.6
Total	2283	48.98	300.0	1675	38.27	299.9	3013	32.08	300.0

[1]Includes *Fraxinus pennsylvanica* and *F. americana*.

[2]Includes *Ulmus americana* and *U. rubra*.

[3]Importance value is equal to the sum of relative frequency, relative density, and relative basal area.

[4]Other species present and their importance values (creekside, creekbottom, slope). *Acer negundo* (8.7, 24.2, 2.1), [illegible] (0.0, 0.0, 0.4), *Amorpha fruticosa* (0.0, 0.0, 0.3), *Berchemia scandens* (0.4, 0.4, 7.5), *Bumelia lanuginosa* (1.4, 2.4, 2.5), *Callicarpa americana* (0.0, 0.0, 0.3), *Catalpa speciosa* (0.3, 0.0, 0.0), *Cercis canadensis* (0.6, 0.0, 0.0), *Cocculus carolinus* (0.3, 0.0, 0.0), *Cornus drummondii* (0.4, 0.0, 0.0), *Diospyros virginiana* (0.4, 0.0, 0.0), *Fraxinus americana* (0.0, 0.0, 0.3), *Gleditsia triacanthos* (0.6, 1.2, 1.9), *Ilex decidua* (0.0, 1.1, 3.0), *Juniperus virginiana* (1.6, 2.4, 13.5), *Maclura pomifera* (2.3, 3.1, 1.0), *Melia azedarach* (0.8, 0.0, 0.0), *Morus rubra* (5.2, 13.2, 10.5), *Parthenocissus quinquefolia* (3.2, 2.0, 4.6), *Platanus occidentalis* (1.4, 0.0, 0.0), *Prunus mexicana* (0.5, 2.6, 5.0), *Rhamnus caroliniana* (1.9, 1.7, 10.5), *Toxicodendron radicans* (1.7, 1.5, 0.3), *Sambucus canadensis* (0.0, 1.0, 0.0), *Sapindus saponaria* (2.5, 2.5, 0.0), *Smilax bona-nox* (0.3, 0.0, 0.3), *Smilax hispida* (0.3, 0.0, 0.0), *Sophora affinis* (0.0, 0.0, 2.0), *Ulmus crassifolia* (8.2, 18.3, 12.1), *Viburnum rufidulum* (2.2, 4.3, 11.2), *Vitis cinerea* (0.0, 0.0, 0.7), *Vitis riparia* (8.1, 4.8, 1.5), *Zanthoxylum clava-herculis* (0.4, 0.9, 0.0).

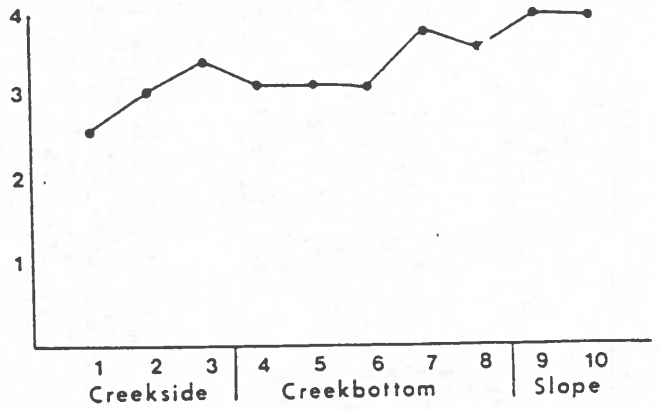

FIGURE 2. Species diversity of creekside, creekbottom, and slope communities.

DISCUSSION

The overall dominants in the Spring Creek forest are *Fraxinus* sp., *Ulmus* sp., *Carya illinoensis*, *Celtis laevigata*, *Quercus shumardii*, and *Q. muhlenbergii*. Upper Trinity River Basin forests in north-central Texas are generally characterized by an abundance of *Ulmus crassifolia* Nutt., *Fraxinus pennsylvanica*, and *C. laevigata* (Nixon and Willett, 1974). In the Spring Creek forest, *U. crassifolia* is of minor importance. *Ulmus americana* is consistently associated with these Trinity riverbottom species, oftentimes being among the dominants (Nixon and Willett, 1974). The association of *C. laevigata*, *U. americana*, and *F. pennsylvanica*, therefore, is not uncommon. In fact, these species occur together throughout the southern deciduous forest, having been designated the Sugarberry-American Elm-Green Ash Forest Cover Type (Eyre, 1980). *C. illinoensis* and *Q. shumardii* also occasionally are present in bottomland forests in north-central Texas and they, too, may be among the dominant species (Nixon and Willett, 1974; Cox, 1983). They also occur eastward as associated species of various forest cover types (Eyre, 1980). Thus the more notable inconsistency of the Spring Creek forest is the presence of *Q. muhlengergii* among the dominants. Robertson et al. (1978) found this species to be more representative of transitional sites up from bottomland. There are many more plants of *Q. muhlenbergii* on the slope at Spring Creek, but basal area is less than that in the creekbottom. Of interest is the recent designation of a *Q. macrocarpa-Q. muhlenbergii* forest community type, which ranges from Kansas and Nebraska into Wisconsin (Monk et al., 1990). Additional studies are needed to better understand the distribution and importance of *Q. muhlenbergii* in north-central Texas.

When comparing the vegetational composition of the Spring Creek forest with bottomland vegetation of nearby regions, it was found that 18

of the 28 most common bottomland forest species of north-central Oklahoma were found at Spring Creek, including nine of the 10 dominant Spring Creek species (Rice, 1965; Collins et al., 1981). *U. americana* is the principal tree species of Oklahoma bottomlands. Petranka and Holland (1980) found that mature stands of forest vegetation of creekbottoms in south-central Oklahoma contained *Celtis* sp., *U. americana, Sapindus saponaria* L., *Acer negundo* L., *C. illinoensis*, *Q. macrocarpa*, *F. pennsylvanica*, and *Q. shumardii* in decreasing order of importance. These species, with the exception of *S. saponaria*, were dominants at Spring Creek. Shrub and woody vine species were also similar. Six of nine shrubs and five of nine vines mentioned by Rice (1965) also occurred at Spring Creek.

Riparian communities associated with the Guadalupe and San Antonio rivers and with creekbottoms on the Edwards Plateau in south-central Texas display affinities to Spring Creek woody vegetation (Van Auken et al., 1979; Ford and Van Auken, 1982; Bush and Van Auken, 1984). *Celtis laevigata*, *Carya illinoensis*, *Acer negundo*, *Juglans nigra*, *Ulmus americana*, and *Sapindus saponaria* are important components. Twenty-one of 32 species present in the Guadalupe floodplain were in common with Spring Greek communities (Ford and Van Auken, 1982). Only four of 32 species recorded in south-central Texas were not found in eastern Texas; however 28 appear to be at the westernmost margin of their range.

Species diversity and evenness in Spring Creek communities increased with distance from the creek (H^1 = 3.40 for creekside, 3.60 for creekbottom, and 4.02 for slope). Bush and Van Auken (1984) also found that diversity increased as distance from the San Antonio River increased. It was obvious that the Spring Creek bottomland was subjected to flooding. Studies have shown that species diversity increases with decreasing flood stress (Bell and del Moral, 1977). It is not uncommon for species diversity to increase from dry to mesic (Cox, 1983) and from wet to mesic (Nixon et al., 1983). Stressful environments tend to reduce diversity (Barbour et al., 1980).

Literature Cited

Abrell, D. B., and M. T. Jackson. 1977. A decade of change in an old-growth beech-maple forest in Indiana. Amer. Midland Nat., 98:22-32.

Adams, D. L., and G. W. Barrett. 1977. Species importance within a virgin and a timbered beech-maple forest ecosystem. Ohio J. Sci., 77:84-87.

Barbour, M. G., J. H. Burk, and W. D. Pitts. 1980. Terrestrial plant ecology. The Benjamin/Cummings Publ. Co., Inc., Menlo Park, California, 604 pp.

Bell, D. T., and R. del Moral. 1977. Vegetation gradients in the streamside forest of Hickory Creek, Will County, Illinois. Bull. Torrey Bot. Club, 104: 127-135.

Bouyoucos, G. J. 1962. Hydrometer method improved for making particle size analysis of soil. Agron. J., 54:464.