GINN, INC. CONSULTING ENGINEERS

June 7, 1990

Mr. Ron Whitehead, City Manager
Town Of Addison
Post Office Box 144
Addison, Texas 75001

Re: Drainage Basin Analysis
Farmers Branch/Addison Interceptor Sewer Tunnel

Dear Ron:

Attached is a final copy of our *Addison Drainage Basin Analysis* report which recalculates the projected wastewater flows from the Town of Addison to the Farmers Branch/Addison Interceptor Tunnel. After receipt of our draft report, the City of Farmers Branch revised their projected flows using the same criteria. We have met with the Farmers Branch Engineering Department and jointly concur on the percentage of participation for the interceptor tunnel. We are currently recalculating the percentages of participation for the related collector lines.

If you have any questions regarding this analysis, we will be happy to meet with you at your convenience.

Sincerely,

Sanford W. Case

Sanford W. Case, P.E.

cc: Don Preece, Director of Utilities
Randy Moravec, Director of Finance
Jerry Murawski, P.E., City of Farmers Branch
H. Wayne Ginn, P.E.
File 90373

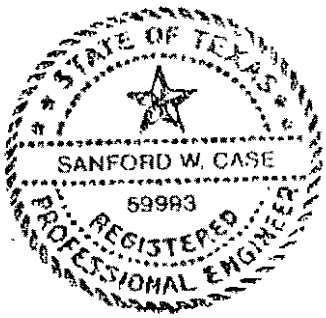
17103 Preston Road • Suite 100 • LB 118 • Dallas, Texas 75248 • Phone 214/248-4900

ADDISON DRAINAGE BASIN ANALYSIS

for the

Town of Addison

Farmers Branch/Addison Interceptor Sewer Tunnel



6-7-90

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Dallas, Texas 75248

Executive Summary

After re-analyzing the drainage basins within the Town of Addison, the revised projection of ultimate wastewater flow from the Town of Addison to the Farmers Branch/Addison sewer interceptor tunnel is an average day flow of 7.626 MGD and a peak day flow of 16.099 MGD. These revised flows are based on several assumptions:

- Population projections were based on 100% of actual net acreage minus Right-of-Ways instead of 95% of gross acreage.
- 239.8 acres on the east side of Addison Airport, including the runways, taxiways, and clear zones was removed from Basin A-2 and will be shifted to the Dallas Water Utilities system prior to completion of the tunnel.
- Industrial area populations were based on the same FAR's as the Farmers Branch areas of similar development.
- The actual square footage of existing high rise office buildings (4 stories or greater) was used in population projections.
- Down zoning to Single Family (5 units/acre) was applied to the Multi-Family area of the Les Lacs development.

The City of Farmers Branch has simultaneously re-analyized their basins to the same criteria contained herein. The Farmers Branch revisions are necessitated in part to remove the current residential areas from the proposed Public Improvement District (PID). This reduces the projected Farmers Branch flow to 12.248 MGD. Therefore, the projected total flows and percentages of ownership for the tunnel system are as follows:

Addison	16.099 MGD	56.79%
Farmers Branch	12.248 MGD	43.21%
Total	28.347 MGD	100.00%

Background

In early 1987, the Town of Addison and City of Farmers Branch authorized Freese and Nichols (F&N) to evaluate alternatives for relieving the overloaded interceptors conveying the two municipalities wastewater to the Trinity River Authority (TRA) system. A major portion of the *Farmers Branch/Addison Wastewater Study* was the analysis of existing population and land use of the study area and the projection of the future populations, land use, and wastewater flows. The total projected peak flows from the Addison drainage basins in the F&N study area was 16.95 MGD. The total projected flow from the Farmers Branch basins in the study area was 15.40 MGD. The total projected flow for the interceptor system in the F&N report was 32.34 MGD (52.4% Addison, 47.6% Farmers Branch).

The Freese and Nichols report was then used as the basis for the July 1989, *Preliminary Engineering Report For Sanitary Interceptor Sewer* by Consoer, Townsend & Associates, Inc. (CTA). The CTA report dealt with preliminary design of a 4.2 mile wastewater interceptor tunnel from the Marsh Lane/Spring Valley area to the TRA interceptor system.

In the interim, the Town of Addison commissioned Espey, Huston & Associates, Inc. to evaluate alternatives for wastewater flows from the Midway basin which were flowing to the City of Carrollton. The November 1988 report entitled, *Town Of Addison Evaluation Of Strategic Alternatives For Transporting Wastewater To The TRA System*, concluded that the Midway basin flows should be diverted to the proposed Farmers Branch/Addison tunnel.

As negotiations for cost sharing and percentage of participation in the tunnel project proceeded between the two cities, it became necessary to adjust the projected flows from several of the basins. To equitably accomplish this, the F&N report was analyzed to determine the criteria to be used for adjustments. The subsequent review yielded several other areas requiring adjustments to the projected wastewater flows. As a result, this analysis was necessitated to revise the projected wastewater flows for the Town of Addison's portion of the interceptor tunnel.

Objective

The objective of this report is to refine the boundaries and land use assumptions of each of the Town of Addison's seven drainage basins in the F&N study area plus the Midway basin to determine the projected ultimate wastewater flows from the Town of Addison to the tunnel system (Exhibit 1). To accomplish this, 1" = 200' base maps were prepared for each drainage basin. Current zoning and proposed changes were overlaid and acreage totals calculated for each land use (Exhibit 2).

Criteria

Right-of-ways were calculated as a separate land use in the new totals. In the F&N report, the assumption was made for a 95% utilization in commercial and industrial areas and 85% utilization in residential areas. While these utilization figures could possibly be approached in some high rise development areas, the set back, parking and streetscape requirements within the Town of Addison make these figures unrealistic. Right-of-Ways account for between 9 and 24 percent of the total acreage within the basins. Right-of-Way acreage was included for the purpose of Infiltration and Inflow calculations.

The F&N report based future population projections on Floor Area Ratio's (FAR's). The City of Farmers Branch's Zoning and Master Land Use Plan are both based on FAR's thus allowing for an accurate conversion to future population. The Town of Addison does not address FAR's in either its Zoning or Master Land Use Plan. This makes the land use conversion and population projections a difficult and subjective task for the Addison drainage basins. Since only a few tracts in the Town of Addison have "open zoning", almost all developments are platted as planned developments. This process allows the Town additional control over its' growth and development. Setbacks, parking, landscape requirements, and height restrictions within the Town typically result in a lower FAR than similar tracts in surrounding cities.

Development densities within the study area (Addison and Farmers Branch) appear to be fairly uniform for similar types of land use. The Addison area does appear to have a higher concentration of restraunts and commercial/local retail centers. The Farmers Branch study area appears to have a higher concentration of high rise office/planned developments. For the purpose of this analysis, equal FAR's were applied to areas of similar land use in each city. For existing high rise office space (4 story or greater), the actual square footages of building space were used. The following FAR's were utilized:

0.70:1	Light Industrial
1.00:1	Mixed Use - School, Atheltic Facility, etc.
1.75:1	Commercial, Local Retail, Office (3 story or less)
2.10:1	High Rise Office, High Density PD
3.00:1	Single Family (Residents/Unit)
2.50:1	Multi-Family (Residents/Unit)

It should also be noted that Infiltration and Inflow (I&I) rates are based on the F&N report. Their basis was 14.02 people/acre for both Farmers Branch and Addison. When the flow rate of 84 GPCD is applied, this yields an I&I rate of 1,178 gallons/acre/day which is extremely high considering the age, type of materials, condition of the sewer system and ongoing rehabilitation projects within the Town of Addison. A figure of 600-900 gallons/acre/day would be more realistic; however, for uniformity, the figure of 1,178 gallons/acre/day was utilized in this analysis.

Drainage Basin Analysis

Basin A-1

Basin A-1 consists of approximately 67.5 acres on the west side of the Addison Airport. The entire area is zoned light industrial with approximately 7.7 acres (11.4%) of Right-of-Ways. This revised basin is considerably smaller than in the F&N report. The northern portion of the original A-1 basin actually flows to the Midway basin. Clear zones for the airport prohibit development or buildings within 350 feet of the runway centerline; therefore, the clear zones have also been removed from the drainage basin areas.

Basin A-2

The drainage area for this basin has been reduced by approximately 239.8 acres. When the Arapaho Road Meter Station (City of Dallas) was installed, the station was sized to accomodate the ultimate flows from the east side of the Addison airport which naturally flow to the City of Dallas. The diversion of these flows can be accomplished by the installation of a new gravity sewer line beginning at the Addison Road/Mildred intersection. This sewer line is currently under design as a part of the Addison Theater/Mildred Street project. The revised A-2 basin now consists of three sub-basins.

Sub-basin A- 2A consists of 14.45 acres of light industrial, 10.44 acres of commercial/local retail (2 restaurants and 1 hotel), and 3.58 acres of Right-of-Way, totaling 28.5 acres.

Sub-basin A-2B consists of 3.05 acres of light industrial, 20.37 acres of office/local retail/commercial, and 7.32 acres of Right-of-Ways.

Sub-basin A-2C consists of 21.54 acres of light industrial. This tract is the Dallas Water Utilities Beltwood Reservoir. This is an unmanned pumping and storage facility which generates virtually no wastewater (less than 100 GPD).

Basin A-3

This basin consists of approximately 208.46 acres with zoning as follows: 133.24 acres light industrial, 22.65 acres office/local retail, 2.31 acres of high rise office (100,000 SF actual), and 50.26 acres (24.1%) Right-of-Ways.

Basin A-4

Basin A-4 consists of a variety of land uses and several proposed changes in land use. The current zoning/land use is 138.66 acres Office/Planned Development, 4.71 acres municipal facilities, 3.73 acres (63 units) of Townhouse (PD), 52.1 acres (378 lots) of Single Family, 11.84 acres (88 units) of Duplex, 61.19 acres of Townhouse, and 53.86 of Right-of-Way. For the purpose of developing wastewater flows, the actual number of platted lots of residences were determined in the Townhouse, Single Family, and Duplex areas. In addition, the 61.19 acres of Townhouse zoning is proposed to be down zoned to single family (5 lots/acre). The revised residential composition of basin A-4 will be as follows:

Townhouse - (PD)	63	units
Single Family	378	lots
Duplex (2 units/lot)	88	units
TH to Single Family	260	lots

Basin A-5

The southern boundary of this basin was adjusted to properly reflect the actual City Limit line between Farmers Branch and Addison. This basin now consists of approximately 17.67 acres of high rise office (404,696 SF actual), 75.10 acres of commercial, 34.06 acres of local retail, 3.8 acres (26 lots) single family, 19.23 acres Townhouse (44 units existing townhouse - 85 units (17.0 acres) proposed single family), 20.93 acres of Right-of-Ways, and 96.76 acres mixed use (Loos Field house, Stadium, and Greenhills School).

Basin A-6

Basin A-6 consists of approximately 130.31 acres of apartments (1,994 units @ 18 units/acre), 27.73 acres commercial/local retail, 4.86 acre mixed use (Loos tract), and 18.29 acres of Right-of-Ways. It should be noted that the original F&N report placed 79 single family lots into this basin which actually belong in Farmers Branch basin F-1.

Basin A-7

The boundaries of this drainage basin were also adjusted to reflect the correct City Limits boundaries. This basin now consists of approximately 57.49 acres of industrial, 49.25 acres commercial, 23.39 acres of local retail, 45.96 acres (2,124,453 SF actual) high rise office, and 34.62 acres of Right-of-Ways.

Midway Basin

The Midway basin consists of approximately 384 acres which currently drain to the City of Carrollton. The Addison Airport covers approximately 120 acres of this basin with runways, taxiways, and clear zones. Since this portion will not generate future wastewater flows, the Midway basin was split into a North and South basin to allow for the airport and its clear zones to be removed from the land areas.

Midway South Basin - 73.56 acres consisting of approximately 64.6 acres of light industrial, 1.59 acres of office, and 7.37 acres of Rights-of-Ways.

Midway North Basin - 190.42 acres consisting of approximately 39.7 acres of light industrial, 120.81 acres of commercial, 4.90 acres (112,225 SF actual) high rise office, 11.00 acres of apartments (421 units), and 14.01 acres of Right-of-Ways.

Summary of Addison Drainage Basin Acreages

	Revised		F&N	
A-1	67.48		108.68	
A-2 *	80.75		289.35	
A-3	208.46		233.69	
A-4	326.09		337.49	
A-5	267.55		221.08	
A-6	181.19		176.40	
A-7	193.89		200.42	
Midway South	73.56		----	
Midway North	190.42		----	
	1,589.39	Acres	1,567.11	Acres

* *Approximately 239.8 acres (including runways, taxiways, and clear zones) has been removed and/or shifted to the City of Dallas Arapaho Road Meter Station.*

Projected Land Use

	Gross Acres	Gross. Sq. Ft.	F.A.R. or # of Units	SF/Emp Per/Unit	Equiv. Pop
Basin A-1					
Industrial	59.78	2,604,017	0.70	750	2,430
R.O.W.	7.70	335,412	0.00	0	0
I&I					946
Sub-Total	67.48	2,939,429			3,376
Basin A-2					
A-2A					
Industrial	14.45	629,442	0.70	750	587
Commercial	10.44	454,766	1.75	350	2,274
R.O.W	3.58	155,945	0.00	0	0
I&I					399
A-2B					
Industrial	3.05	132,858	0.70	750	124
Office	5.78	251,777	1.75	350	1,259
Local Retail	3.23	140,699	1.75	350	703
Commercial	11.36	494,842	1.75	350	2,474
R.O.W.	7.32	318,859	0.00	0	0
I&I					431
A-2C					
Ind. (DWU)	21.54	938,282	0.00	0	4
I&I					302
Sub-Total A2	80.75	3,517,470			8,558
Basin A-3					
Industrial	133.24	5,803,934	0.70	750	5,417
HR Office	2.31	100,624	*100,000*	350	286
Office/Local Retail	22.65	986,634	1.75	350	4,933
R.O.W.	50.26	2,189,326	0.00	0	0
I&I					2,923
Sub-Total	208.46	9,080,518			13,558
Basin A-4					
Office	138.66	6,040,030	1.75	350	30,200
TH - PD	3.73	162,479	63	2.5	158
PD-MUNI	4.71	205,168	1.00	750	274
Single Family	52.10	2,269,476	378	3.0	1,134
DUPLEX	11.84	515,750	88	3.0	264
TH to SF	61.19	2,665,436	260	3.0	780
R.O.W.	53.86	2,346,142	0	0	0
I&I					4,572
Sub-Total	326.09	14,204,480			37,381
	Gross	Gross.	F.A.R. or	SF/Emp	Equiv.

	Acres	Sq. Ft.	# of Units	Per/Unit	Pop
Basin A-5					
Commercial	75.10	3,271,356	1.75	350	16,357
Local Retail	34.06	1,483,654	1.75	350	7,418
Mixed Use	96.76	4,214,866	1.00	750	5,620
TH	2.23	97,139	44	2.5	110
Single Family	20.80	906,048	111	3	333
HR Office	17.67	769,705	*404,696*	350	1,156
R.O.W.	20.93	911,711	0.00	0	0
I&I					3,751
Sub-Total	267.55	11,654,478			34,745
Basin A-6					
Apartments	130.31	5,676,304	1,994	2.5	4,984
Local Retail	26.99	1,175,684	1.75	350	5,878
Mixed Use	4.86	211,702	1.00	750	282
Commercial	0.74	32,234	1.75	350	161
R.O.W.	18.29	796,712	0.00	0	0
I&I					2,540
Sub-Total	181.19	7,892,636			13,847
Basin A-7					
Local Retail	23.39	1,018,868	1.75	350	5,094
Commercial	49.25	2,145,330	1.75	350	10,727
HR Office	45.96	2,002,018	*2,124,453*	350	6,070
Industrial	57.49	2,504,264	0.70	750	2,337
R.O.W.	34.62	1,508,047	0.00	0	0
I&I					2,718
Sub-Total	193.89	8,445,848			26,263
Basin Midway-South					
Industrial	64.60	2,813,976	0.70	750	2,626
Commercial	1.59	69,260	1.75	350	346
R.O.W.	7.37	321,037	0.00	0	0
I&I					1,031
Sub-Total	73.56	3,204,274			4,004
Basin Midway-North					
Industrial	39.70	1,729,332	0.70	750	1,614
Commercial	120.81	5,262,484	1.75	350	26,312
HR Office	4.90	213,444	*112,225*	350	321
Apartments	11.00	479,160	168	2.5	421
R.O.W.	14.01	610,276	0.00	0	0
I&I					2,670
Sub-Total	190.42	8,294,695			31,338
Totals	**1,589.39**	**69,233,828**			**173,070**

Projected Wastewater Flows

	Equiv. Pop	GPCD	Avg. Flow MGD	Peak Factor	Peak Flow (MGD)
Basin A-1					
Industrial	2,430	23	0.056	2.40	0.134
R.O.W.	0	0	0.000	1.00	0.000
I&I	946	84	0.079	1.00	0.079
Sub-Total	3,376		0.135		0.214
Basin A-2					
A-2A					
Industrial	587	23	0.014	2.40	0.032
Commercial	2,274	34	0.077	2.40	0.186
R.O.W	0	0	0.000	1.00	0.000
I&I	399	84	0.034	1.00	0.034
A-2B					
Industrial	124	23	0.003	2.40	0.007
Office	1,259	34	0.043	2.40	0.103
Local Retail	703	34	0.024	2.40	0.057
Commercial	2,474	34	0.084	2.40	0.202
R.O.W.	0	0	0.000	1.00	0.000
I&I	431	84	0.036	1.00	0.036
A-2C					
Ind. (DWU)	4	23	0.000	2.40	0.000
I&I	302	84	0.025	1.00	0.025
Sub-Total A2	8,558		0.340		0.682
Basin A-3					
Industrial	5,417	23	0.125	2.40	0.299
HR Office	286	34	0.010	2.40	0.023
Office/Local Retail	4,933	34	0.168	2.40	0.403
R.O.W.	0	0	0.000	1.00	0.000
I&I	2,923	84	0.245	1.00	0.245
Sub-Total	13,558		0.548		0.970
Basin A-4					
Office	30,200	34	1.027	2.40	2.464
TH - PD	158	138	0.022	2.77	0.060
PD-MUNI	274	34	0.009	2.40	0.022
Single Family	1,134	138	0.156	2.77	0.433
DUPLEX	264	138	0.036	2.77	0.101
TH to SF	780	138	0.108	2.77	0.298
R.O.W.	0	0	0.000	1.00	0.000
I&I	4,572	84	0.384	1.00	0.384
Sub-Total	37,381		1.742		3.764
	Equiv.		Avg. Flow	Peak	Peak Flow

	Pop	GPCD	MGD	Factor	(MGD)
Basin A-5					
Commercial	16,357	34	0.556	2.40	1.335
Local Retail	7,418	34	0.252	2.40	0.605
Mixed Use	5,620	23	0.129	2.40	0.310
TH	110	138	0.015	2.77	0.042
Single Family	333	138	0.046	2.77	0.127
HR Office	1,156	34	0.039	2.40	0.094
R.O.W.	0	0	0.000	1.00	0.000
I&I	3,751	84	0.315	1.00	0.315
Sub-Total	34,745		1.353		2.829
Basin A-6					
Apartments	4,984	138	0.688	2.77	1.905
Local Retail	5,878	34	0.200	2.40	0.480
Mixed Use	282	23	0.006	2.40	0.016
Commercial	161	34	0.005	2.40	0.013
R.O.W.	0	0	0.000	1.00	0.000
I&I	2,540	84	0.213	1.00	0.213
Sub-Total	13,847		1.113		2.627
Basin A-7					
Local Retail	5,094	34	0.173	2.40	0.416
Commercial	10,727	34	0.365	2.40	0.875
HR Office	6,070	34	0.206	2.40	0.495
Industrial	2,337	23	0.054	2.40	0.129
R.O.W.	0	0	0.000	1.00	0.000
I&I	2,718	84	0.228	1.00	0.228
Sub-Total	26,263		1.011		2.106
Basin Midway-South					
Industrial	2,626	23	0.060	2.40	0.145
Commercial	346	34	0.012	2.40	0.028
R.O.W.	0	0	0.000	1.00	0.000
I&I	1,031	84	0.087	1.00	0.087
Sub-Total	4,004		0.159		0.260
Basin Midway-North					
Industrial	1,614	23	0.037	2.40	0.089
Commercial	26,312	34	0.895	2.40	2.147
HR Office	321	34	0.011	2.40	0.026
Apartments	421	138	0.058	2.77	0.161
R.O.W.	0	0	0.000	1.00	0.000
I&I	2,670	84	0.224	1.00	0.224
Sub-Total	31,338		1.225		2.647
Totals	**173,070**		**7.626**		**16.099**

A-1 thru A-7 Ave flow per day = 6,242,000 gpd

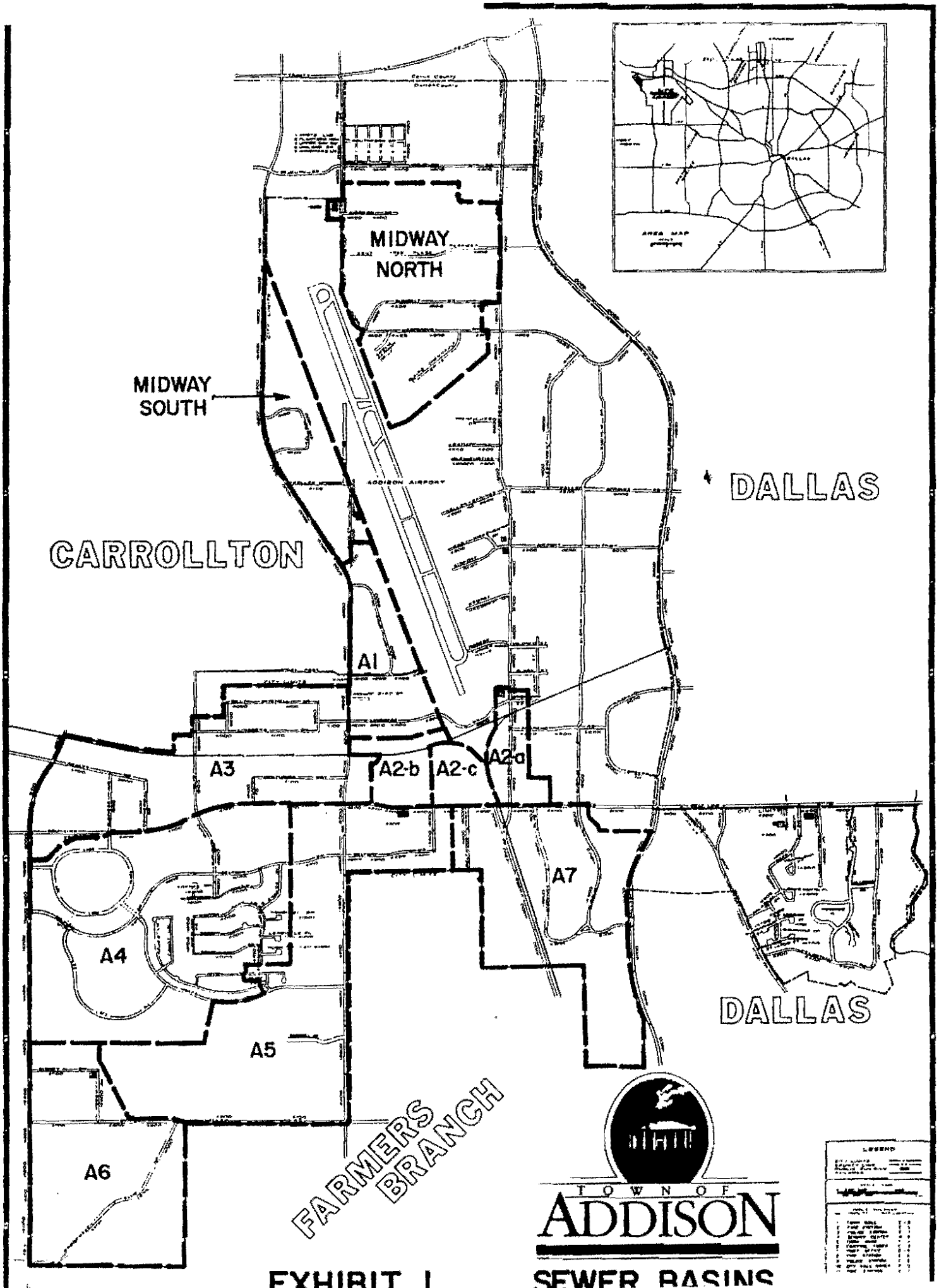


EXHIBIT I

SEWER BASINS

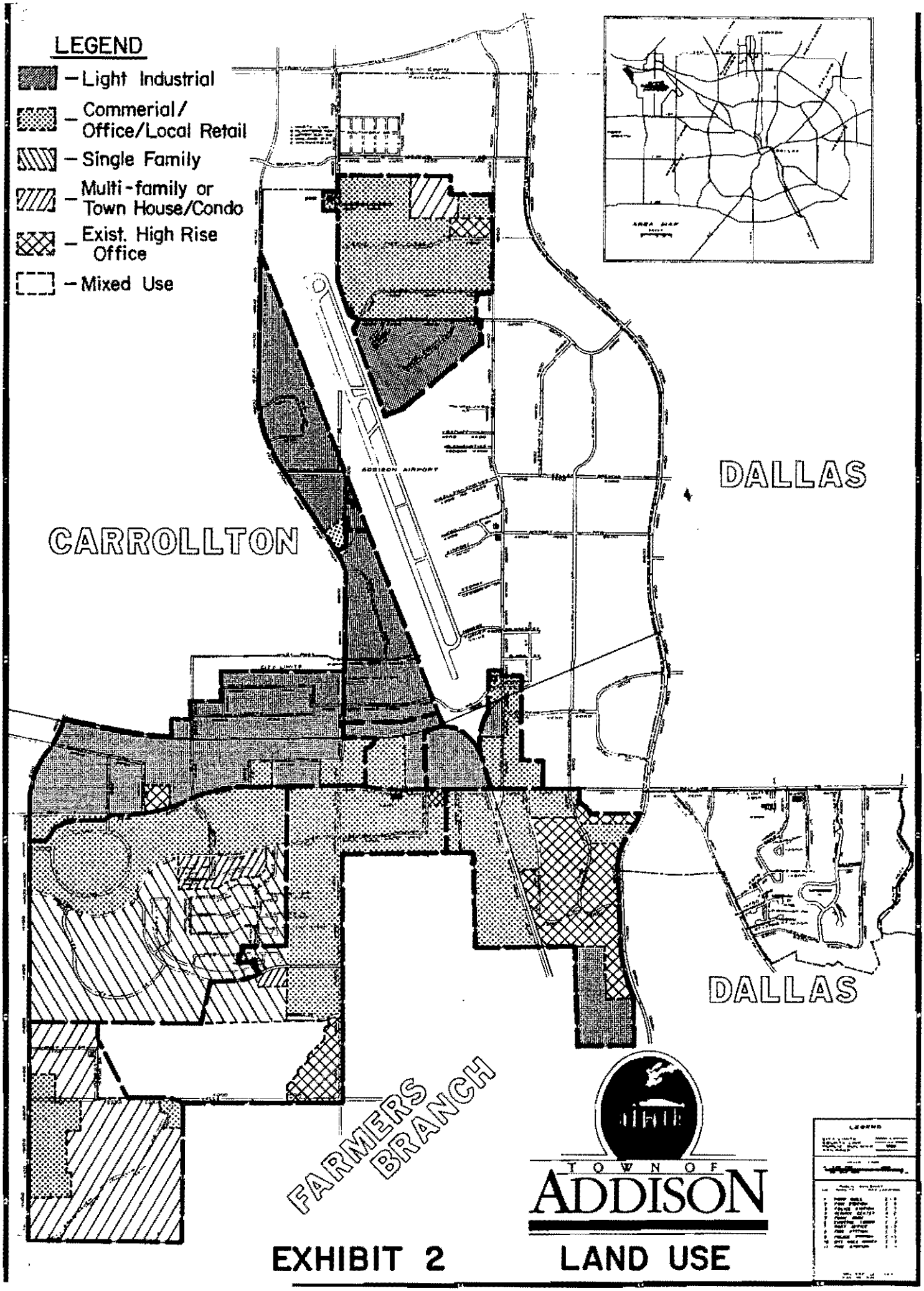
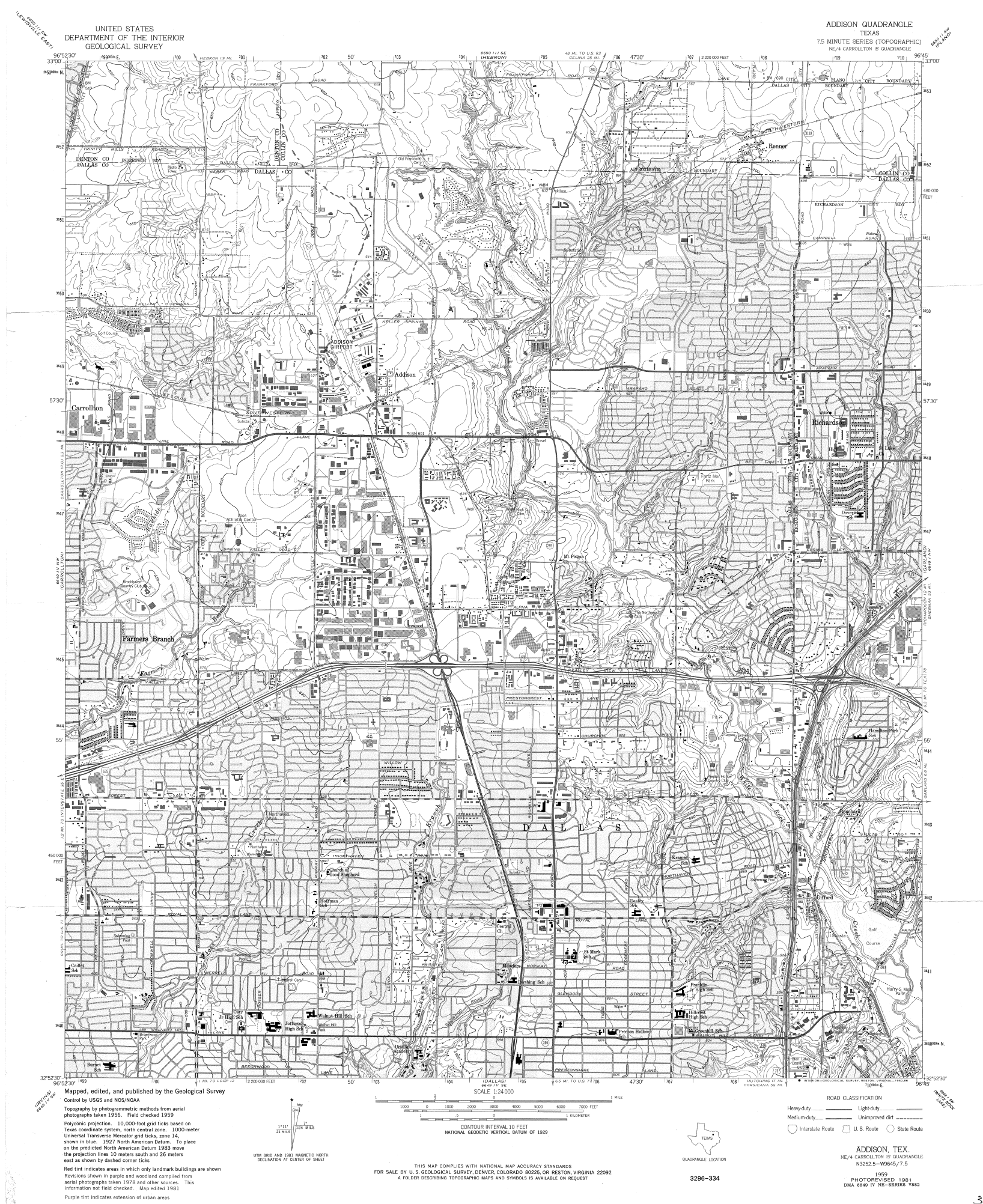


EXHIBIT 2 LAND USE


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ADDISON QUADRANGLE
TEXAS
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 CARROLLTON 15' QUADRANGLE
Addison
Carrollton
Farmers Branch
Richardson
Renner
DALLAS
ADDISON AIRPORT
Mapped, edited, and published by the Geological Survey
Control by USGS and NOS/NOAA
Topography by photogrammetric methods from aerial photographs taken 1956. Field checked 1959
Polyconic projection. 10,000-foot grid ticks based on Texas coordinate system, north central zone. 1000-meter Universal Transverse Mercator grid ticks, zone 14, shown in blue. 1927 North American Datum. To place on the predicted North American Datum 1983 move the projection lines 10 meters south and 26 meters east as shown by dashed corner ticks
Red tint indicates areas in which only landmark buildings are shown
Revisions shown in purple and woodland compiled from aerial photographs taken 1978 and other sources. This information not field checked. Map edited 1981
Purple tint indicates extension of urban areas
SCALE 1:24 000
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
UTM GRID AND 1981 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
Interstate Route
U. S. Route
State Route
QUADRANGLE LOCATION
ADDISON, TEX.
NE/4 CARROLLTON 15' QUADRANGLE
N3252.5—W9645/7.5
1959
PHOTOREVISED 1981
DMA 6049 IV NE—SERIES V882
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
3296-334