LIGHT RAIL TRANSIT

(PRELIMINARY ANALYSIS)

FOR
GAINESVILLE, FLORIDA

PREPARED BY:
DISTRICT II
FLORIDA DEPARTMENT OF TRANSPORTATION

PRELIMINARY ANALYSIS
OF
LIGHT RAIL TRANSIT (LRT)
FOR
GAINESVILLE, FLORIDA

CONDUCTED BY:

THE FLORIDA DEPARTMENT OF TRANSPORTATION

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I. INTRODUCTION:

This report describes the Preliminary Analysis of a light rail transit (LRT) system proposed as an alternative transportation option for the City of Gainesville, Florida. The concept of operating a light rail transit system in Gainesville has been suggested to reduce the need for building additional highway lanes. As a result the Florida Department of Transportation was requested to conduct a preliminary feasibility analysis. This report documents the results of the Department's sketch planning feasibility analysis of a proposed Gainesville LRT system or "GLRT".

II. METHODOLOGY:

The data base for this analysis of the GLRT was based on the 1980 Census of Population for socioeconomic and trip-to-work data. Zonal data from the Gainesville Urban Area Transportation Study (GUATS) were used to make threshold comparisons of residential and employment densities. Also, GUATS and the University of Florida - Population Studies data were used to project the Census data to the forecast years 1990 and 2010.

The analysis was performed at the census tract level using a sketch planning model developed by the Department. The analysis cannot accurately analyze short trips or assign trips to particular segments of a highway network. However, the analysis can accurately predict aggregate tripmaking behavior between tracts and a modal assignment accurate to within 1 percent of the

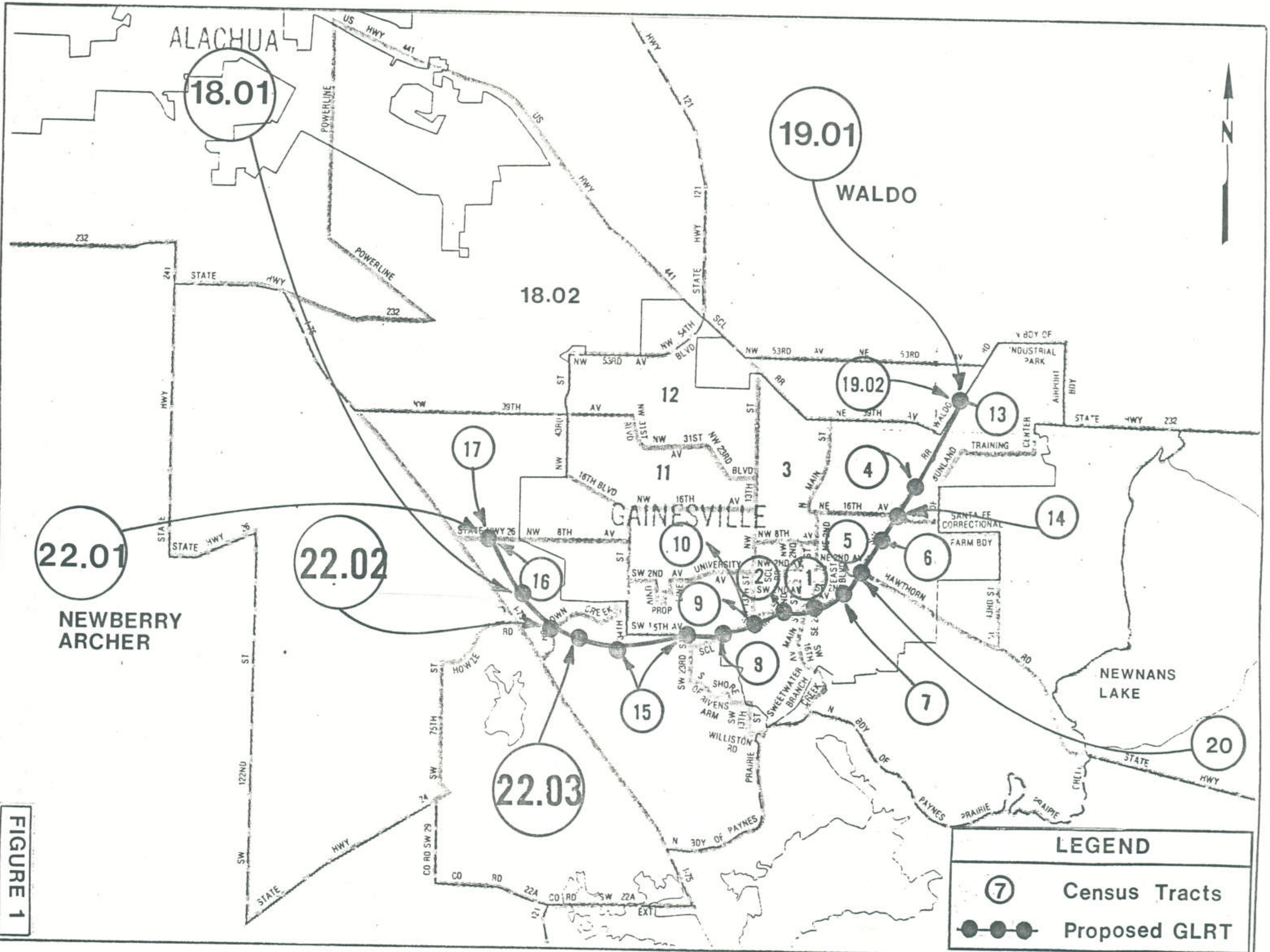
1980 Census when the model was validated.

The GLRT network was digitized using longitudes and latitudes by locating stations at points commonly used by the automobile and the transit bus, where it was possible. Areas with high commercial and/or residential activities within the urbanized area were considered as better candidates for a station location. To minimize LRT costs the abandoned CSX rail line, from the intersection of U. S. 441 (S.W. 13th Street) to the Regional Airport, was used. Two thirds (2/3) of the GLRT alignment follows the abandoned CSX rail rights-of-way . These rights-of-way were purchased by the Department for transportation uses.

Using the 1980 Census map, centroid connectors for auto and walk/bike access points were determined based on the distance from a census tract population centroid to each proposed station, total work trips generated in each census tract, and roadway accessibility (see Figure 1). External zones were added to provide access from neighboring communities, such as Alachua, Newberry-Archer, Waldo, and Hawthorne to the GLRT system.

III. WHAT IS LIGHT RAIL TRANSIT (LRT):

Light Rail Transit (LRT) is commonly defined as a version of the traditional streetcar. Most LRT systems are built primarily outside of the roadway. Operation in the street on reserved lanes or with mixed motor vehicular traffic is common practice. The vehicles are electrically operated, drawing power from overhead wires. Modern articulated vehicles (two vehicles joined together


ALACHUA
18.01
18.02
19.01
WALDO
19.02
GAINESVILLE
NEWBERRY
ARCHER
22.01
22.02
22.03
NEWNANS
LAKE
LEGEND
Census Tracts
Proposed GLRT
N
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SANTA FE CORRECTIONAL
N BDY OF INDUSTRIAL PARK
TRAINING CENTER
HAWTHORN
UNIVERSITY AV
SWEETWATER BRANCH CREEK
WILLISTON RD
PAYNES PRAIRIE
POWERLINE
US HWY 441
STATE HWY 121
STATE HWY 232
STATE HWY 241
STATE HWY 26
STATE HWY 24
STATE HWY 20

FIGURE 1

by an articulated joint) are capable of carrying 400 people with one operator, thus providing significant operating savings over bus operations. Special traffic signaling systems are frequently used to give LRT vehicles preference to vehicular traffic at road crossings. In that LRT vehicles can accelerate and decelerate faster than the transit bus, they provide faster service on a given route.

According to a report published by the American Public Transit Association there are approximately twenty (20) LRT Systems presently operating in North America. Figure 2, illustrates the year each of the systems were put in service, daily passengers, and the number of cars in operation.

IV. THE STUDY AREA:

The general study area (see Figure 3) consists of the Gainesville Urbanized Area with auto access (i.e. automobile passengers being able to access transit via park-and-ride lots) from neighboring communities such as Newberry-Archer, Alachua, and Waldo.

The core corridor area consists of a one half (1/2) mile wide area on both sides of the proposed LRT alignment. The core corridor is considered as the walk access shed of a LRT system. This is the maximum distance a person can be expected to walk to ride a light rail system. Where as, the most desirable distance for auto access is about two miles from the proposed alignment.

North American Light Rail Transit Systems

(October, 1986)

Map Code	City	Operator	Year in Service	Route Miles	Daily Passengers	Number of Cars
1	Boston, Mass.	Massachusetts Bay Transportation Authority	1897	32.6	70,000	230
2	Buffalo, N.Y.	Niagara Frontier Transportation Authority	1985	6.4	21,000	27
3	Calgary, Alb.	Calgary Transit	1981	13.8	36,000	78
4	Cleveland, Ohio	Greater Cleveland Regional Transit Authority	1920	13.5	17,500	48
5	Detroit, Mich.	Detroit Department of Transportation	1976	2.0	500	7
6	Edmonton, Alb.	Edmonton Transit	1978	6.4	25,000	37
7	Fort Worth, Texas	Tandy Corporation	1962	1.0	6,500	8
8	Los Angeles, Calif.	Los Angeles County Transportation Commission	1989 *(estimated)*	40.0	100,000 *(estimated)*	54 *(estimated)*
9	Mexico City, Mexico	Sistema de Transporte Collectivo	1900	21.0	47,000	50
10	Newark, N.J.	New Jersey Transit	1935	4.3	12,000	26
11	New Orleans, La.	Regional Transit Authority	1893	6.6	21,000	35
12	Philadelphia, Pa.	Southeastern Pennsylvania Transportation Authority	1892	92.9	127,000	236
13	Pittsburgh, Pa.	Port Authority of Allegheny County	1891	22.5	20,000	90
14	Portland, Ore.	Tri-County Metropolitan Transportation District of Oregon	1986	15.1	15,000 *(estimated)*	26
15	Sacramento, Calif.	Sacramento Regional Transit District	1987	18.3	21,000 *(estimated)*	26
16	San Diego, Calif.	San Diego Trolley, Inc.	1981	20.4	23,000	30
17	San Francisco, Calif.	San Francisco Municipal Railway	1897	20.7	133,000	141
18	San Jose, Calif.	Santa Clara County Transportation Agency	1987 *(estimated)*	20.0	40,000 *(estimated)*	50 *(estimated)*
19	Seattle, Wash.	Municipality of Metropolitan Seattle	1982	1.6	2,000	4
20	Toronto, Ont.	Toronto Transit Commission	1892	45.6	334,000	284

SOURCE: LIGHT RAIL TRANSIT

FIGURE 2

Figure 3 also shows the name and location of sixteen (16) stations of the proposed alignment. The proposed LRT alignment is approximately 10 miles in length stretching from the Oaks Mall to the Regional Airport via the University of Florida.

V. GROWTH ESTIMATES

Based on the 1980 Census, the resident population of Alachua County was 151,348, and according to the University of Florida, Bureau of Economic and Business Research - Population Studies, Volume 22, Bulletin No. 88, March 1989, the county's estimated resident population for 1988 was 182,940. The report also indicates that the population forecast for the county, a total of 189,900 residents are expected in Year 1990, and 242,400 are expected in Year 2010.

About 80% (122,869 persons) of the county's 1980 population could potentially be served by the LRT system, based on the population of the census tracts that had at least half of their area within two miles of the proposed LRT alignment. This assumes that the LRT system could potentially serve park-and-ride commuter trips. Assuming that the study area grows at the county-wide rate, in 1985 approximately 138,320 county residents could have been potentially served by the GLRT system. Using the forecasted county population estimates from the University of Florida, Population Studies - March 1989 and the 80% factor noted above, residents that could potentially be served by GLRT would be:

- 151,920 in Year 1990
- 177,520 in Year 2000

and
- 196,788 in Year 2010 (81.183% of 242,400)

VI. SKETCH PLANNING MODEL APPLICATION:

Using 1980 Census data for the census tracts or study area as previously illustrated in Figures 1 & 3, the Department's sketch planning model produced 30,391 inbound work trips. Table 1 provides the results of the base year model simulation without the GLRT. About 64% of these trips were "drive alone", 21% were "shared ride", 4% were "transit", and 12% were "walk or bike".

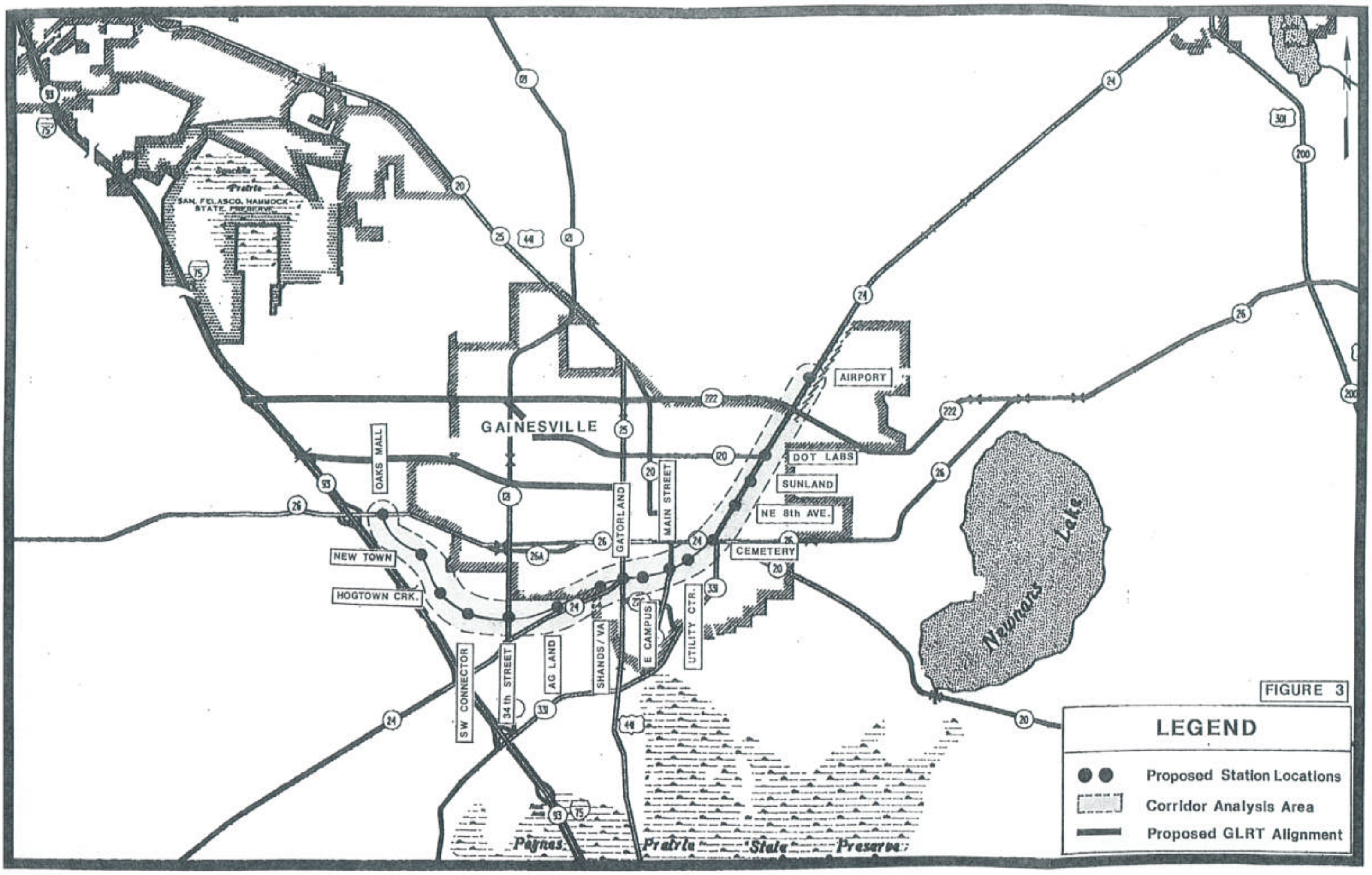
TABLE 1

1980 MODEL SIMULATION WITHOUT LRT

MODE	TRIPS	MODE SPLIT	TRAVEL TIME
Drive Alone	19,346	63.7%	16.6 min.
Shared Ride	6,410	21.1%	21.8 min.
Mass Transit	1,096	3.6%	25.6 min.
Other Modes *	3,539	11.6%	13.7 min.
All Modes	30,391	100.0%	

* Walk/Bike

A set of speeds and headways was determined for each station to station segments along the alignment, to simulate present day operational conditions for both auto and transit in the model application. The term headway is defined as the amount of time separating two transit vehicles traveling in the same direction.



SAN FELASCO HAMMOCK STATE PRESERVE
GAINESVILLE
AIRPORT
DOT LABS
SUNLAND
NE 8th AVE.
CEMETERY
OAKS MALL
NEW TOWN
HOGTOWN CRK.
SW CONNECTOR
34 th STREET
AG LAND
SHANDS / VA
GATORLAND
E CAMPUS
MAIN STREET
UTILITY CTR.
Newnans Lake
Paynes Prairie State Preserve
FIGURE 3
LEGEND
Proposed Station Locations
Corridor Analysis Area
Proposed GLRT Alignment

A. THE HIGHWAY NETWORK

The highway network was assumed to operate at a fairly modest level of service with average speeds of between 10 and 15 miles per hour during peak periods. The average speed is defined as the summation of travel distance divided by the summation of travel time.

Based on planning experience and direct observation, 15 miles per hour is a suitable planning assumption for arterial speed in smaller urban areas, such as Gainesville, Tallahassee, and Pensacola. The study assumed that out of pocket automobile operating cost was 15 cents per mile, roughly comparable to current experience.

B. THE EXISTING TRANSIT SYSTEM

Existing transit buses operate on congested roads and streets in the one mile wide corridor at a speed of 25 mph in less congested areas and 10 mph (or less) in more congested areas. Headways range from about 15 minutes at best to 1 hour at worst.

C. THE PROPOSED GLRT SYSTEM

The GLRT was assumed to operate at the same speed of 10 to 15 miles per hour as automobile traffic on mixed right-of-way, with substantial pedestrian traffic. On exclusive right-of-way, it was assumed that the LRT operated at 35 miles per hour including dwell times (i.e. time to load and unload passengers).

For LRT to be successful, its operating conditions must be modestly competitive with that of the automobile and the system must be convenient to use. To accomplish this, the following assumptions were made for modeling the proposed LRT system:

- LRT headways were assumed to be 10 minutes during the peak commuting periods, and 20 minutes at other times.
- Park-and-ride lots and convenient feeder buses were included in the LRT system as necessary supporting features.
- Feeder buses were assumed to provide service in the suburbs of Gainesville as well as in urban locations.
- Competing bus service was eliminated and no substantive highway or parking improvements were assumed to be made in the study area. However, it is highly possible that highway improvements will be necessary with or without the proposed LRT system.
- The 2010 fuel cost was assumed to grow at the same rate as household income--roughly equivalent to the "status quo."

D. THE EFFECTS OF GASOLINE PRICING AND SUPPLY

Generally, the effects of higher gasoline prices are only a minor determinant of automobile trip making. Factors such as the availability and price of parking and the nature of the urban structure (density/access/mix) are much more important in this regard. In those countries where gasoline taxes are high by U. S. standards, the low rates of automobile trip making that one would expect simply do not materialize. Likewise, in the U.S., the price of gasoline plays a very minor role in determining the propensity to make highway trips. Thus, even with relatively high fuel costs, say two dollars a gallon, one would only expect, at most, a ten percent decrease in vehicle miles traveled, with a more modest decrease in the number of vehicle trips.

The future behavior of gasoline prices is highly debatable. History indicates that after every major oil shock, household income eventually caught up with oil prices. Oil has actually declined in price, after an adjustment for the general price level, relative to the 1970's.

E. PARKING

Parking was assumed to be available at an average cost of approximately one dollar a day. Given historical experience with other university settings, hospitals, and smaller downtown areas, this assumption is reasonable.

F. THE WALK/BIKE NETWORK

The walk/bike trips in Gainesville is of particular importance, given the very strong propensity of Gainesville residents who prefer walk and bike transportation over the other modes compared to their Florida neighbors. Refined walk/bike trip estimates had to be developed just for Gainesville in order to validate the model. The refinement in walk/bike trips was made using the 1980 Census Journey to Work Data. Walk/bike trips were assumed to operate in a fairly quick and safe manner to the point where pedestrians and bicyclists could travel short distances within the corridor at an average speed of 5 miles per hour.

G. RESULTS OF MODEL APPLICATION WITH GLRT

The results of the Department's sketch planning model simulation for the proposed LRT system with 1980 base-year Census data are illustrated in Table 2.

TABLE 2

1980 LRT MODEL SIMULATION

MODE	TRIPS	MODE SPLIT	TRAVEL TIME
Drive Alone	19,346	63.6%	19.8 min.
Shared Ride	5,155	16.9%	23.8 min.
Mass Transit(LRT)	2,580	8.5%	22.2 min.
Other Modes *	3,151	10.4%	18.9 min.
	------	------	
All Modes	30,391	99.4%	

* Walk/Bike

There were approximately 5% or 1,476 "non-transit" trips diverted to the LRT system for an overall LRT mode split of 8.5% during the peak hours. The diversion analysis indicated that most of these new LRT trips came from trips that were previously made by carpools and vanpools. Vehicle trips were derived by converting person trips via the use of a vehicle occupancy rate for shared ride of 2.5 persons per vehicle.

The diversion factor is the end result of the introduction of the new rail service. The change in modal trips was the demand model's prediction of the impact of the new service on travel patterns in the study corridor. Overall, less than 400 cars were taken off the highway in the proposed corridor or an auto diversion rate of only 1.55% (see Table 3). The most important factor in the determination of mode split is travel time. This consists of time spent inside the vehicle (running time) plus time spent outside the vehicle (waiting and access time). The LRT simulation had a significantly higher mode split than existing buses because the difference in travel time between LRT and automobiles is less than between buses and automobiles.

A diversion from automobiles greater than the 5% generated by the model would require extreme assumptions about travel times - very low for transit, very high for automobiles. The model will not accept radical values for travel time, fare, operating and parking costs, etc. by design, since it cannot make reliable predictions under these conditions. Thus, no such analysis is possible.

TABLE 3

COMPARISON OF 1980 MODEL SIMULATIONS (WITH AND WITHOUT LRT)

	w/o LRT	w/ LRT	Diff.	% Diff.
Drive Alone	19,346	19,505	159	0.8%
Shared Ride	6,410	5,155	(1,255)	(19.6)%
Transit	1,096	2,580	1,484	135.4 %
Other Modes	3,539	3,151	(388)	(11.0)%
Non-Transit *	29,295	27,819	1,476	(5.0)%
Total	30,391	30,391		---

Total Auto Diversion: 400 veh./ (19,346 + 6,410) = 1.55%

* Drive Alone @ 19,346 + Shared Ride @ 6,410 + Other Modes @ 3,539

H. FUTURE RIDERSHIP ESTIMATES

Based on the assumption that the study area would grow at the same rate as all of Alachua County, 1990 daily LRT ridership was forecast to be 7,770. The 2010 daily LRT ridership was forecast to be 9,950.

It should be noted that the major risk to these ridership estimates is that the study area may not be able to compete with outlying areas for new development even with LRT, and other strong measures to concentrate development with the corridor. Unfortunately, current land use patterns outside the City of Gainesville do not appear supportive of the ridership estimates noted above. Furthermore, the historic competition for development between county and city interests would indicate there is not much chance for extensive growth to be directed within the proposed corridor any time soon.

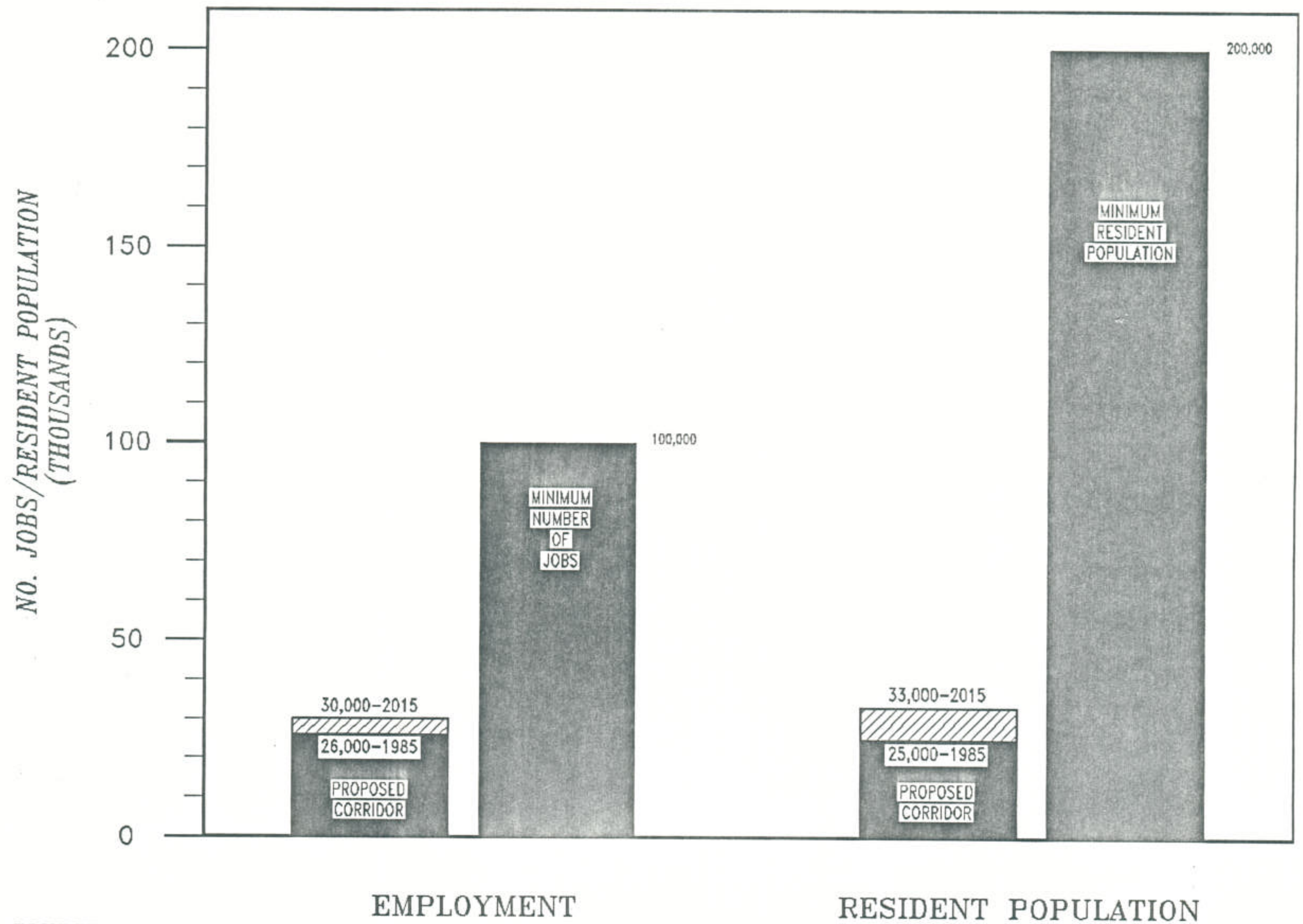
I. THRESHOLD COMPARISONS

According to a publication entitled "Public Transportation and Land Use Policy," light rail seems promising for downtowns in the 35 to 50 million square foot range, generally found in metropolitan areas of more than three-quarter million inhabitants. Under fortuitous circumstances of existing rights-of-way, individual lines may be workable to downtowns as small as 20 million square feet. Averaged over the length of a proposed LRT route, residential densities of 9 to 12 dwellings per acre can be served.

The results of a study entitled, "Urban Densities for Public Transportation," a residential population of about 200,000 and a about 100,000 jobs are needed within a given corridor for rail transit to be successful. Based on the Gainesville Urban Area Transportation (GUATS) Study zonal data, there were about 26,000 jobs and 25,000 people in the proposed one mile corridor in 1985. A projection of 1980 Census data to the year 2015 indicate there will be about 30,000 jobs and about 33,000 people can be expected in the one mile corridor.

Figures 4 & 5 graphically illustrates how Gainesville's employment, population, dwelling unit density estimates stack-up against the minimum requirements accepted nationally. The U.S. DOT's Urban Mass Transportation Administration (UMTA) requires that any given area proposing rail transit have about 15,000 daily transit trips being

MINIMUM EMPLOYMENT – POPULATION REQUIREMENTS FOR PROPOSED CORRIDOR

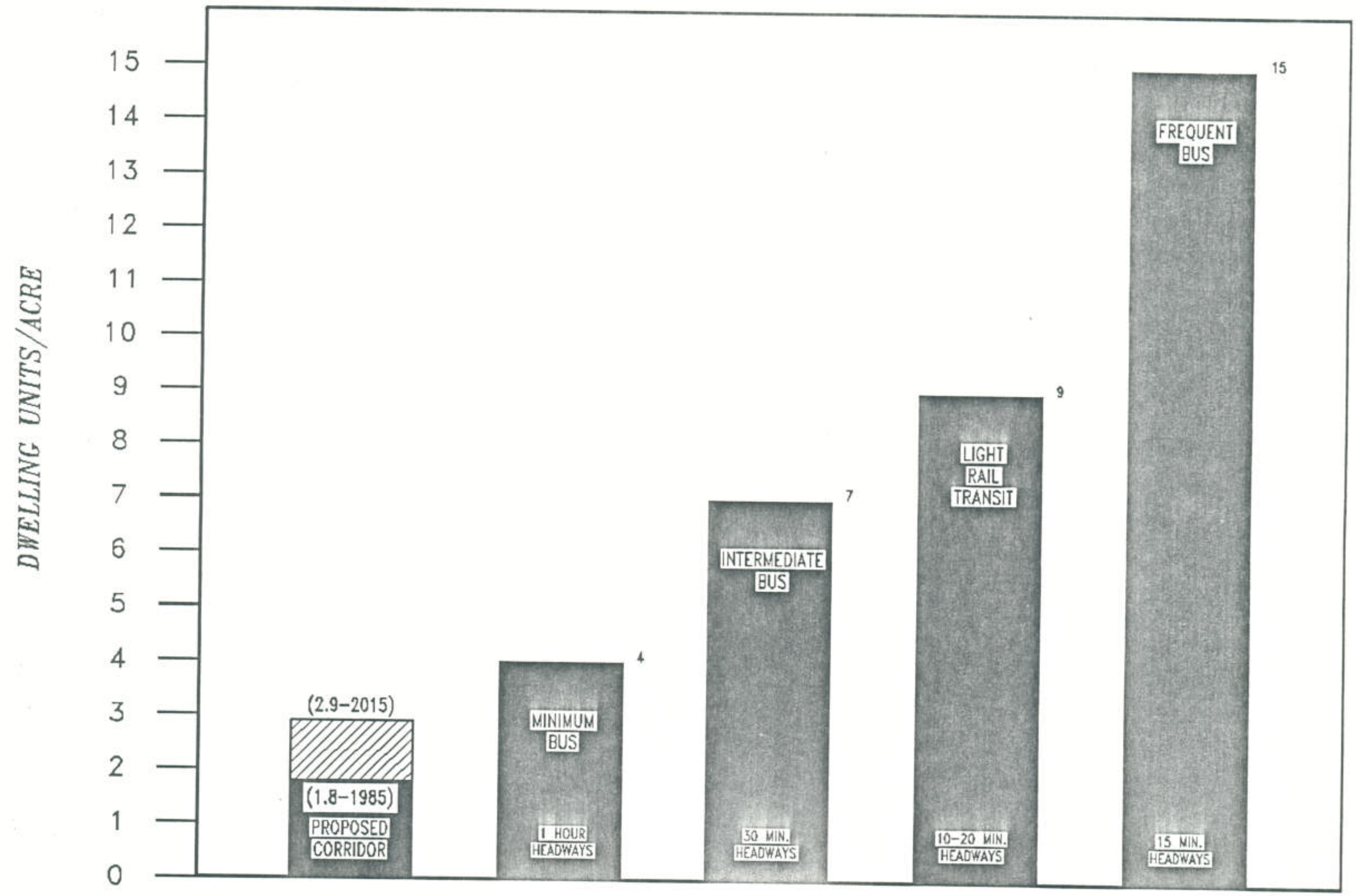


SOURCE:

Proposed Corridor – GUATS ZONAL DATA
Minimum Densities – REGIONAL PLAN ASSOCIATION

FIGURE 4

MINIMUM RESIDENTIAL DWELLING UNIT DENSITY PROPOSED/REQUIRED DENSITY



SOURCE:

Proposed Corridor – GUATS ZONAL DATA
Average Bus/Transit – REGIONAL PLAN ASSOCIATION

FIGURE 5

generated before it can be considered for Feasibility/Alternative Analysis funding. On Gainesville's Regional Transit System (RTS) routes passing through the study area, only 4,300 daily one-way trips were produced in 1986.

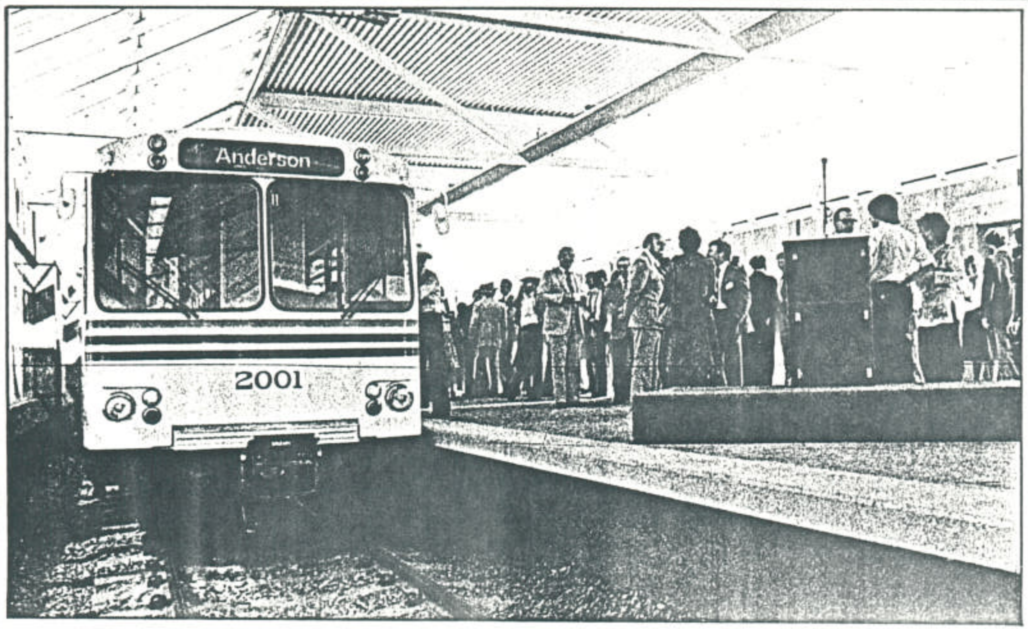
VII. CAPITAL COST:

Based on national LRT cost averages, noted in a USDOT study called "Characteristics of Urban Transportation Systems, the approximate capital cost for the proposed LRT system, which includes planning, design, and engineering, is $3 million. The 10 miles of guideway/catenary/signals at a cost of $4 million per mile, come to $40 million.

There are a total of 16 stations (terminals) needed for the system. In that the structural make-up of these stations could vary from low-level to high-level platforms (see Figure 6), an average cost of $0.5 million per station was estimated. Also, some of the stations would include only shelter, a wheel chair ramp, and a number of minor amenities, including waste receptacles and vending machines for tokens. The total cost for stations would be $8 million.

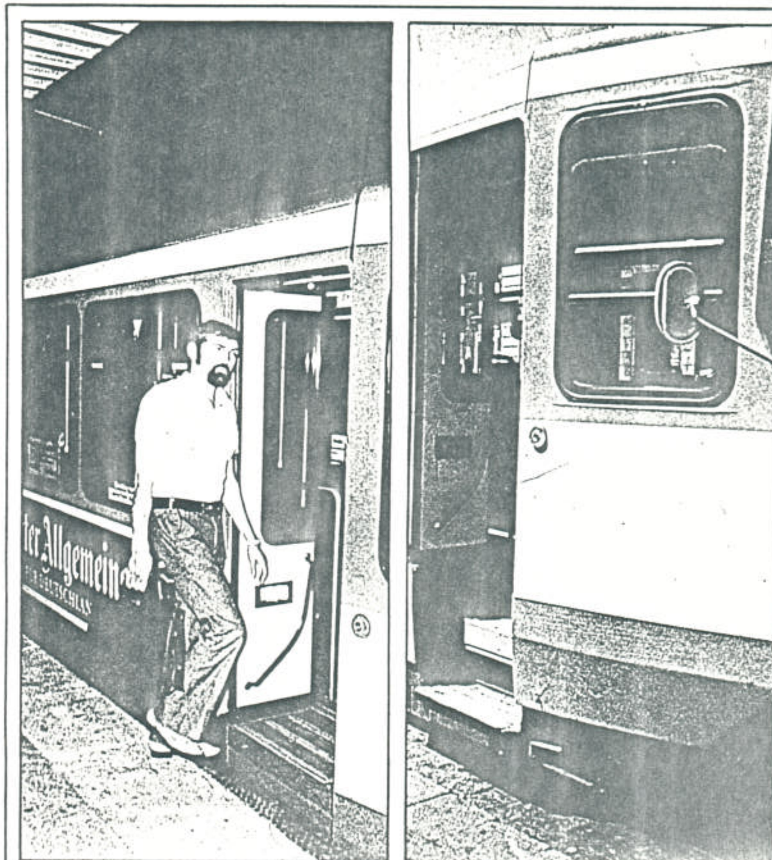
Calculations from the model analysis showed that a complete round trip on the system took 56 minutes. The system requires the operation of 7 vehicles during each of 6 peak hours, and 4 vehicles during each of 8 off-peak hours per day. At least 2

LRT—It's Adaptable



LRT can use high-level platforms

. . . or low-level platforms



LRT vehicles can be designed to accommodate high- and low-level passenger boarding on the same car

SOURCE: LIGHT RAIL TRANSIT

FIGURE 6

vehicles will be needed as back-up (spare) units. The system will require a total of 9 articulated light rail vehicles at $1.5 million each, for a total of $13.5 million. Other LRT components needed would include a carshop at about $2.5 million and maintenance equipment, spare parts, and miscellaneous, at about $5 million.

The total estimated capital cost for the LRT system is about $72 million. If the usual 10% is added for contingencies, the overall system would cost $79.2 million, excluding the effects of inflation and exchange rate fluctuations.

In comparison, the cost of a comparable set of highway improvements in the proposed corridor would be roughly equivalent to the $79.2 million estimate for LRT. Using estimates of cost for urban streets compiled by the Federal Highway Administration, and updated by the Department, an "add lanes" project would cost $1 million to $2 million per lane mile. As for Gainesville, because of development considerations, the higher highway estimate would be more appropriate. A $2 million per lane mile figure would produce a basic highway cost of approximately $40 million. In that the GLRT system removed less than 400 cars off the highway system and no substantive highway improvements were assumed to be made in the study area, exiting proposals for multi-lanes may need to remain as viable alternatives.

The $40 million highway improvement estimate does not include the cost of upgrading the local street grid to permit better access to the central corridor, nor does it include the cost of traffic operations improvements at intersections that could improve highway system performance.

VIII. OPERATING EXPENSES:

Approximate operating expense for the system was based on a national average for LRT systems of $9.17 per car mile in 1987. As indicated in Table 4, the system will operate about 1,480 vehicle-miles per day. Assuming no weekend operation, 255 days per year operation, and a 4% average rate of inflation the operating expense for 1990 (see Figure 7) was forecast to be $3.81 million. Operating cost would rise to $7.29 million in 2010. If the amortized capital cost of $8 million dollars per year were added to these figures, then fully allocated cost would be $11.81 million in 1990 and $15.29 in 2010.

It should be noted that these figures do not reflect the cost of feeder and circulator buses, $2 million per year in depreciation, or other fixed charges against capital such as interest or leases.

Current RTS bus expenses are in the range of $3.2 million for all operations. Because of the need for feeder buses in the suburbs and circulation around urban station locations, it is unclear how much, if any, reduction in RTS bus expenditures will be facilitated by the LRT system.

OPERATIONAL COST

($ MILLION)

1990 Operating Cost *$3.8*

2010 Operating Cost *$7.3*

Estimates based on:

- Cost per car mile of $9.17 for LRT
- 7 vehicles during 6 peak hours per day
- 4 vehicles during 8 off-peak hours per day
- weekend operating was not assumed

Items not reflected in Estimate, but must be covered:

- Cost of Feeder and Circulator Buses
- $2 million per year in Depreciation
- Other Fixed changes against capital

RTS Bus operating expenses approx. *$3.2*

FIGURE 7

TABLE 4

LRT VEHICLE OPERATION

Period	# of Vehicles	Hours	Miles	Vehicle Miles Per Day
AM Peak	7	3	20	420
PM Peak	7	3	20	420
Off Peak	4	8	20	640

				1,480

According to general transit accounting practice the annual costs from amortizing the capital investment are paid out early in the process and are not usually included in operating costs. However, assuming a factor of ten percent including the combined effects of interest and depreciation on the entire investment an additional $8 million in annual cost will be generated.

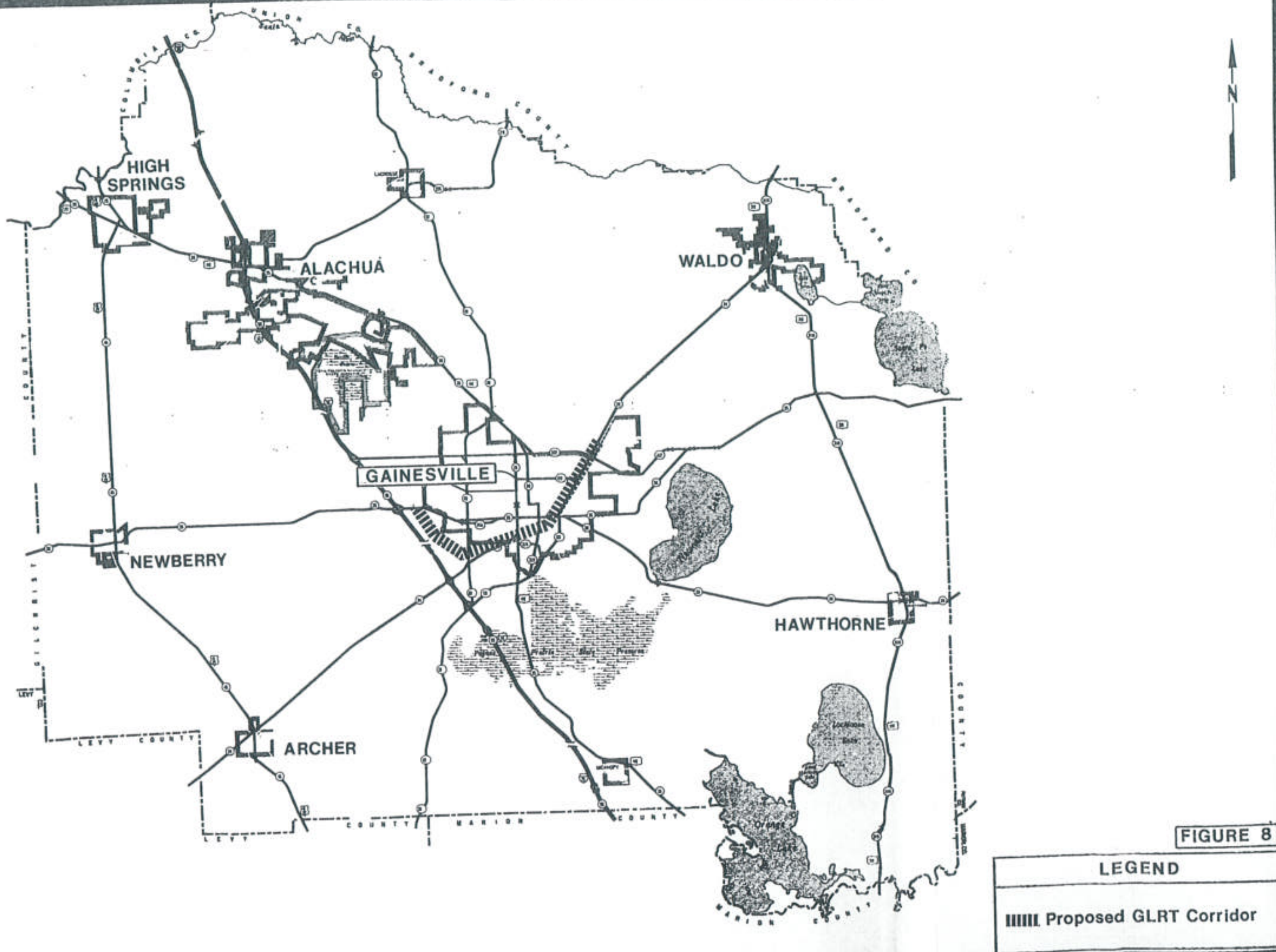
IX. FAREBOX REVENUE:

In comparison to other LRT systems nationally the basic one-way fare was set at $1.00 with a $0.20 transfer charge to maximize farebox revenue. This assumption of fare and transfer charge produced an average revenue of $0.82 per LRT trip based on how riders access the LRT system. This estimate is considerably higher than the national average of about $0.50 per trip, and presumes no discounts for passes, tokens, children, students, or senior citizens. Currently bus fare charged by RTS is $0.50 per one-way trip with a $0.10 transfer charge.

The 1990 forecast of revenue was estimated to be $1.62 million. It would be noted that, if discounts were permitted, ridership would rise by about 12%, but revenue would fall by about 29%. If fares were allowed to inflate by about 2% per year, the 2010 revenue forecast would be $2.51 million.

X. CONCLUSION:

The "rules of thumb" for successful rail transit include a resident population of about 200,000 people and 100,000 jobs located within one half mile of the rail line. In the case of the study area (see Figure 8), about 30% of the necessary population concentration exists along the LRT corridor. The north side of the corridor, running from the Regional Airport to the University of Florida campus has about 40% of the necessary concentration of employment. The "media" projection for Alachua County's population growth between 1980 and 2010 is about 90,000 new residents. Roughly speaking, if a majority of these new residents were to live within the corridor, and virtually all forecast employment growth were to locate within the corridor, then the thresholds for success could be substantially met.


HIGH
SPRINGS
ALACHUA
WALDO
GAINESVILLE
NEWBERRY
HAWTHORNE
ARCHER
LEVY COUNTY
MARION COUNTY
N
FIGURE 8
LEGEND
Proposed GLRT Corridor

R E F E R E N C E S

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- The Socioeconomic Growth Analysis Report for 1985 Base Year Data; 2000 Interim and 2015 Target Years Data. GUATS, November, 1987, revised December, 1987 by the North Central Florida Regional Planning Council.

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