North Carolina Department of Transportation
Planning and Environmental Branch
Statewide Planning Group
Small Urban Planning Unit

TOWN OF LIBERTY

THOROUGHFARE PLAN

"The Friendly Town"

1991

LIBERTY THOROUGHFARE PLAN

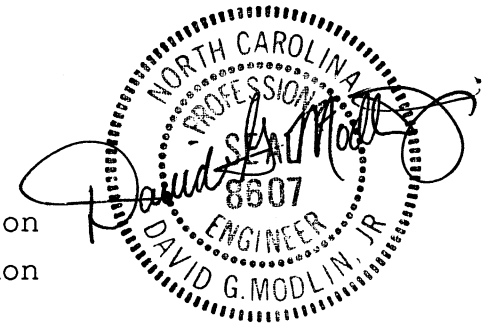
December, 1991

Prepared by the:

Small Urban Planning Unit
Statewide Planning Branch
North Carolina Department of Transportation

In Cooperation with:

The Town of Liberty
The Federal Highway Administration
The U.S. Department of Transportation



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The coordinated efforts of many individuals and government agencies made Liberty's Thoroughfare Plan possible. Liberty's Planning & Zoning Board members: Jerry Drake, David Bullard, Josephine Tinnin, Allan Marshall, Sandra Martin, Mary Lee Moore, Tommy Way, and Bill Smith along with Liberty's Town Council members: Mayor Jim Parker, Mayor Pro Tem Martha Ray, Dale Holt, Tom Meacham, Mary Priscilla Clay, Roy Carter, and Mike Tardif actively participated with the Department of Transportation to enable an effective thoroughfare planning process. By debating and choosing between difficult alternatives, Planning Board and Town Council members helped ensure this thoroughfare plan minimizes predictable community and environmental problems.

The Project Engineer and the Engineering Associate conducted Liberty's thoroughfare planning process. This report was written by the Project Engineer. The Thoroughfare Planning Engineer was responsible for providing necessary practical experience to ensure the plan was based on sound engineering principles. The Statewide Planning Branch Manager was responsible for making sure the thoroughfare plan conformed with Department of Transportation policy.

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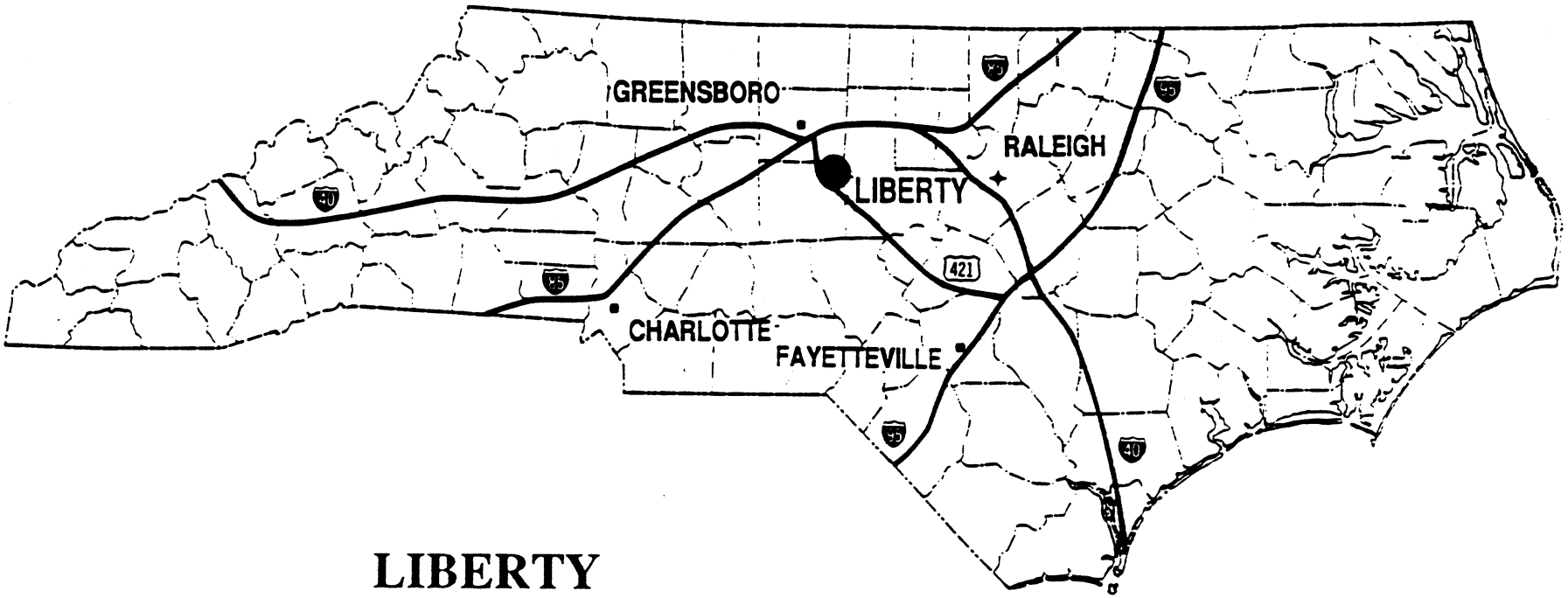
I. INTRODUCTION

Situated in the north-eastern corner of Randolph County, the Town of Liberty is located in North Carolina's Piedmont Region (Figure 1). Although no one is certain how the name "Liberty" originated, the name belonged to the rural community before the town came into being. Some say the area was named when [British] General Cornwallis released some prisoners there shortly before the end of the Revolutionary War. Others say that Union soldiers pitched their tents under an oak tree there while Generals Johnson and Sherman were negotiating the terms for the Confederate army surrender at Bennett Place in 1865, and the tree became known as Liberty Oak (Sharpe p. 1035). In any case, the community incorporated with the name Liberty in 1889.

"Liberty is made up of people who like living in a small town, because they have discovered how to make small-town living pleasurable. The people are known as exceptionally social minded and hospitable. Like most residents of Piedmont North Carolina, they have to work hard for a living, but they play hard too. It is a dull day in Liberty that doesn't see someone giving a card party, a cook-out, fish-fry, or some other get-together." (Sharpe p. 1035)

GEOGRAPHIC LOCATION



LIBERTY

NORTH CAROLINA

FIGURE 1

The Town of Liberty requested the assistance of the Department of Transportation in updating their June 30, 1977 Thoroughfare Plan. Town Council members, Planning & Zoning Board members, local officials, and local citizens participated in the Thoroughfare Planning process for this January 1991 Thoroughfare Plan. With the Planning & Zoning Board's endorsement, the Liberty Town Council adopted the recommended plan on April 8, 1991. Subsequently, the North Carolina Department of Transportation adopted this plan on June 7, 1991.

Thoroughfare plans are long range transportation plans which document how twenty years of future development will affect traffic on the existing street system. As the statewide population increases, and available land is depleted around existing cities, development will spread to areas like Liberty which have available land and a good quality of life. With Liberty only about 25 minutes from Greensboro and Burlington, thoroughfare planning is a necessary tool for guiding and controlling development to prevent traffic congestion problems. In addition, properly maintained thoroughfare plans, along with active local planning, can help protect the small town character and quality of life Liberty now enjoys.

II. THOROUGHFARE PLANNING PRINCIPLES

Through time, villages grow into towns, towns grow into small cities, and small cities grow into large cities. All communities are dynamic places, constantly changing to keep pace with the increasing demands of today's citizens. Older buildings are replaced with newer more efficient structures. Agricultural land is converted to residential or commercial land. Low density zones are raised to high density zones to allow more people to use smaller parcels of land.

Only the roads remain much the same today as they were when they were originally built. True, today's engineered asphalt and concrete roads are far superior to the horse and buggy trails of yesterday. But, often the old horse and buggy trail alignment is the only alignment available for new highways. Once communities establish development patterns based on the existing roads, improving the alignment of the roads is difficult and sometimes impossible. Even after General Sherman burned Atlanta to the ground during the American Civil War, the city was still rebuilt using the original road corridors. Since the street system is permanent and expensive to build, policy makers established thoroughfare planning principles to guide transportation planning.

OBJECTIVES

The primary objective of thoroughfare planning is to provide a transportation system which can progressively develop to meet future travel demands. By developing the urban street system to keep pace with increasing traffic

demands, street capacity can be maximized. Proper planning saves money by eliminating unnecessary improvements and minimizing the amount of land needed for streets.

Other thoroughfare planning objectives include:

1. reducing transportation related environmental impacts, such as air, water, land, and noise pollution,
2. reducing travel and transportation costs,
3. reducing the cost of street improvements to the public through the coordination of subdivision and commercial developments,
4. enabling local citizens to plan their actions with full knowledge of public intent,
5. minimizing disruption and displacement of people and businesses through published long range street improvement plans, and
6. increasing travel safety.

Thoroughfare planning objectives are achieved by improving the "operational efficiency" and the "system efficiency" of the street system. Improving the operational efficiency means increasing street capacity. Improving system efficiency means coordinating all the streets to support each other.

OPERATIONAL EFFICIENCY

A street's operational efficiency is the ability of the street to carry vehicles and people. A street's traffic capacity is the maximum number of vehicles which can pass a given location during a given time under the existing traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather. Three ways to improve street capacity are: physical roadway improvements, traffic flow management, and travel demand management.

Although physical road improvements are typically the first method people think of to increase capacity, physical improvements are very expensive and often politically controversial. Physical road improvements include: adding lanes, modifying intersections, improving vertical alignment, improving horizontal alignment, and eliminating roadside obstacles. By reducing the impedances to the main traffic flow caused by slow moving or turning vehicles, these improvements can significantly increase street capacity.

Traffic flow management improvements are another effective method for increasing street capacity. Although the political controversy can still be significant, traffic flow management generally costs less than physical road improvements. Traffic flow management improvements include:

1. Controlling land access -- A roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with the same number of lanes.
2. Removing parking -- By removing parking, additional street width is available for traffic. The additional width can make another traffic lane or simply reduce traffic friction caused by parking vehicles.
3. One-way operation -- One-way streets can handle 20-50 percent more vehicles than two-way streets with the same number of lanes. One-way streets also improve traffic flow by decreasing potential traffic accidents and increasing intersection capacity.
4. Spacing and coordinating traffic signals -- A coordinated series of traffic signals minimizes the excessive stop-and-go operation common with closely spaced signalized intersections. With adequate

spacing, coordinated signals increase street capacity by enabling traffic to flow at more uniform speeds.

Increasing concern over the world's diminishing natural resources is causing people to oppose highway improvements which take additional land and increase the total number of vehicles on the roads. Travel demand management increases street capacity by changing people's travel patterns, without building new roads and without significantly increasing environmental damage. The following policies are part of travel demand management:

1. Encourage people to form carpools and vanpools. Increasing the number of people in each vehicle reduces the number of vehicles on the road and increases the people carrying capacity of the street system.
2. Encourage people to walk. Liberty's pleasant community atmosphere and nice climate make walking fun, easy, and safe. Getting people out of their cars and on to the sidewalks changes auto-oriented business areas into friendly people-oriented community areas.
3. Encourage people to ride bicycles. Every person who rides a bicycle instead of driving removes one car from the street network. In addition, bicycle riding does not deplete our planet's protective ozone layer.
4. Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. Variable work hours spread the morning and afternoon peak travel over a longer time and increase the street's daily traffic capacity.
5. Encourage land use development in a more pedestrian oriented manner. Avoid imprisoning citizens to automobiles for daily necessities. Allow citizens

to choose whether to drive or not by providing appropriate sidewalks and bicycle facilities.

SYSTEM EFFICIENCY

Any system is only as good as each of its parts. For example, an automobile - no matter how expensive, no matter how powerful, or how high the speedometer scale - if one tire is flat, the car will not go fast. Street networks operate the same way. If one important link is missing, the whole network is burdened with unnecessary traffic. Every street has a particular functional classification which is important to the entire street system. An efficient system reduces travel distances, travel time, and travel costs.

Functional Classification

Streets have two primary functions, traffic service and land access. Traffic service involves moving many high speed vehicles; land access involves slow moving vehicles turning into driveways. Combining slow turning vehicles with high speed traffic creates significant conflicts. The conflicts are not serious if both traffic service and land access demands are low. However, when traffic volumes increase, conflicts cause intolerable traffic congestion and serious safety hazards. The thoroughfare plan designates a functional system of streets which minimizes these problems. Streets are categorized as local access streets, minor thoroughfares, or major thoroughfares.

Local access streets provide access to abutting property. Depending on the land use, local streets may be subclassified as residential, commercial, or industrial. Local streets should not carry heavy volumes of traffic, and by design, they should discourage unnecessary traffic.

Minor thoroughfares connect local access streets to the major thoroughfares. They provide some access to abutting property, but they should be protected enough to allow a safe traffic flow to the major thoroughfares. Designing minor thoroughfares to serve limited areas protects them from excessive traffic.

Major thoroughfares are the primary traffic arteries of the town. Although they may serve abutting property, their principle function is to carry large volumes of traffic. Uncontrolled strip development significantly lowers their capacity because each driveway impedes the traffic flow. Similarly, on-street parking should be avoided because it also impedes the traffic flow.

Ideal Small Urban Thoroughfare System

An ideal thoroughfare system coordinates local streets, minor thoroughfares, and major thoroughfares into a radial-loop pattern. The radial-loop arrangement provides direct access between all municipal areas. Figure 2 shows how radial streets, cross-town streets, loop streets, and bypasses work together.

Similar to the spokes on a bicycle tire, radial streets run from outside the planning area to inside the planning area. Radial streets are major thoroughfares which provide traffic movement between points located on the outskirts of the city and the central area. This major traffic movement provides economic strength in the central business district.

Cross-town streets and a loop around the central business district prevent the traffic congestion caused by all the radial streets converging at one location. Cross-town streets provide convenient access to the local

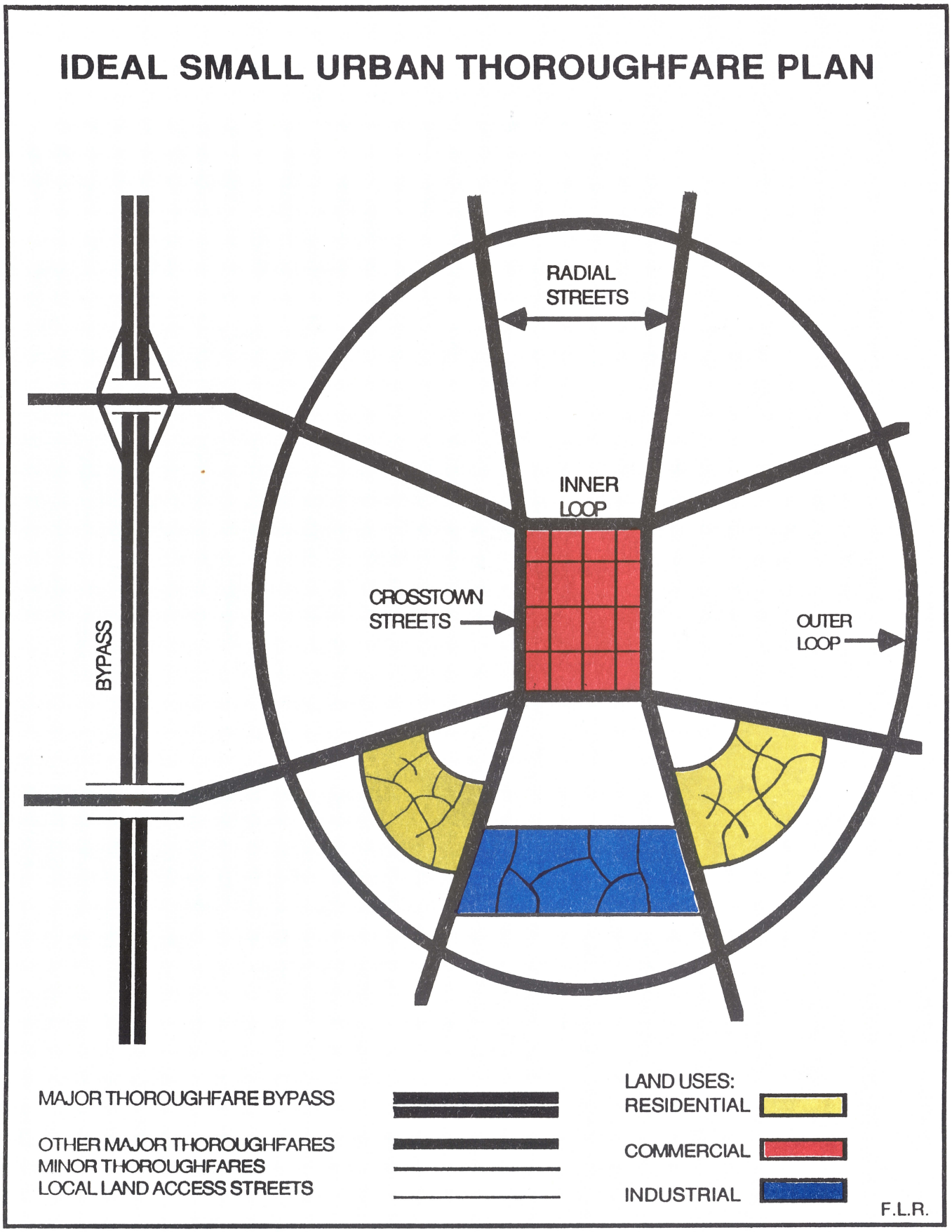

IDEAL SMALL URBAN THOROUGHFARE PLAN
RADIAL STREETS
INNER LOOP
CROSSTOWN STREETS
OUTER LOOP
BYPASS
MAJOR THOROUGHFARE BYPASS
OTHER MAJOR THOROUGHFARES
MINOR THOROUGHFARES
LOCAL LAND ACCESS STREETS
LAND USES:
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
F.L.R.

FIGURE 2

businesses and merchants. Traffic destined for downtown can circle on the loop, and then enter downtown near its destination. Local traffic not destined for downtown can drive around the loop. This cross-town system removes unnecessary traffic from the downtown and enhances the business and shopping atmosphere.

Loop streets connect suburban areas together. As people and businesses move away from the central business areas to the suburbs for cheaper land and lower taxes, many commuters drive from one suburb to another, without stopping downtown. The outer loop moves traffic between suburban areas avoiding the downtown altogether. Depending on the size of the urban area, more loops may be necessary; they should be spaced one-half mile to one mile apart.

A bypass carries through traffic around the urban area and removes it from the city street system. Bypasses are designed with controlled access to move through traffic quickly, not to access property. Occasionally, a bypass can function as a portion of an urban loop. By freeing the local streets for shopping and home-to-work traffic, bypasses typically increase the economic vitality of the local area.

PRACTICAL APPLICATIONS

The ideal radial-loop thoroughfare plan is a great goal, but most urban areas cannot attain this "ideal" thoroughfare plan. In practice, all urban areas have natural constraints which complicate the thoroughfare planning process. These constraints include: existing land uses, existing streets, existing developments, public attitudes, local politics, and future development projections. During the thoroughfare planning process, a transportation engineer analyzes the critical constraints to determine the best mix of existing and proposed roads.

III. EXISTING CONDITIONS

Since its incorporation in 1889, Liberty has invested valuable time and money in the street system for the community. Development patterns along the streets in the central business district and local neighborhoods have established a unique local character. Developing a thoroughfare plan requires detailed information on this local character and other existing local conditions. Existing roads, population trends, traffic accidents, travel demand, and street capacity are all important considerations.

EXISTING ROADS

The most heavily traveled facility in Liberty's planning area is US 421. Although US 421 does not fall within the corporate town limits, two and a half miles of US 421 are included in the town's one mile extraterritorial zoning jurisdiction. Extending from North Carolina's coast at Wilmington, to the Appalachian Mountains at Boone, US 421 is an important transportation corridor for the Town of Liberty, as well as the State of North Carolina. From Liberty, US 421 extends northwest to Greensboro, and southeast to Sanford.

The second most heavily traveled facility in Liberty is NC 49. Extending from Charlotte to the Virginia border north of Roxboro, NC 49 is also an important transportation corridor for Liberty. From Liberty, NC 49 extends southwest to Asheboro and northeast to Burlington. NC 49 makes a ninety degree turn at the corner of Swannanoa Street and Fayetteville Street at the center of town. Unfortunately, this sharp turn creates problems for the numerous trucks traveling along NC 49 through downtown Liberty.

Greensboro Street, Swannanoa Street, Starmount Avenue, and Dameron Avenue are all major thoroughfares which serve as radial streets. Lined with residential and commercial parcels of land, these radial streets have both traffic flow and land access functions. Presently, there are no loop streets which connect the radial streets. Consequently, most travel within Liberty's planning area involves driving through downtown. All of the remaining streets are either minor thoroughfares or local streets.

POPULATION TRENDS

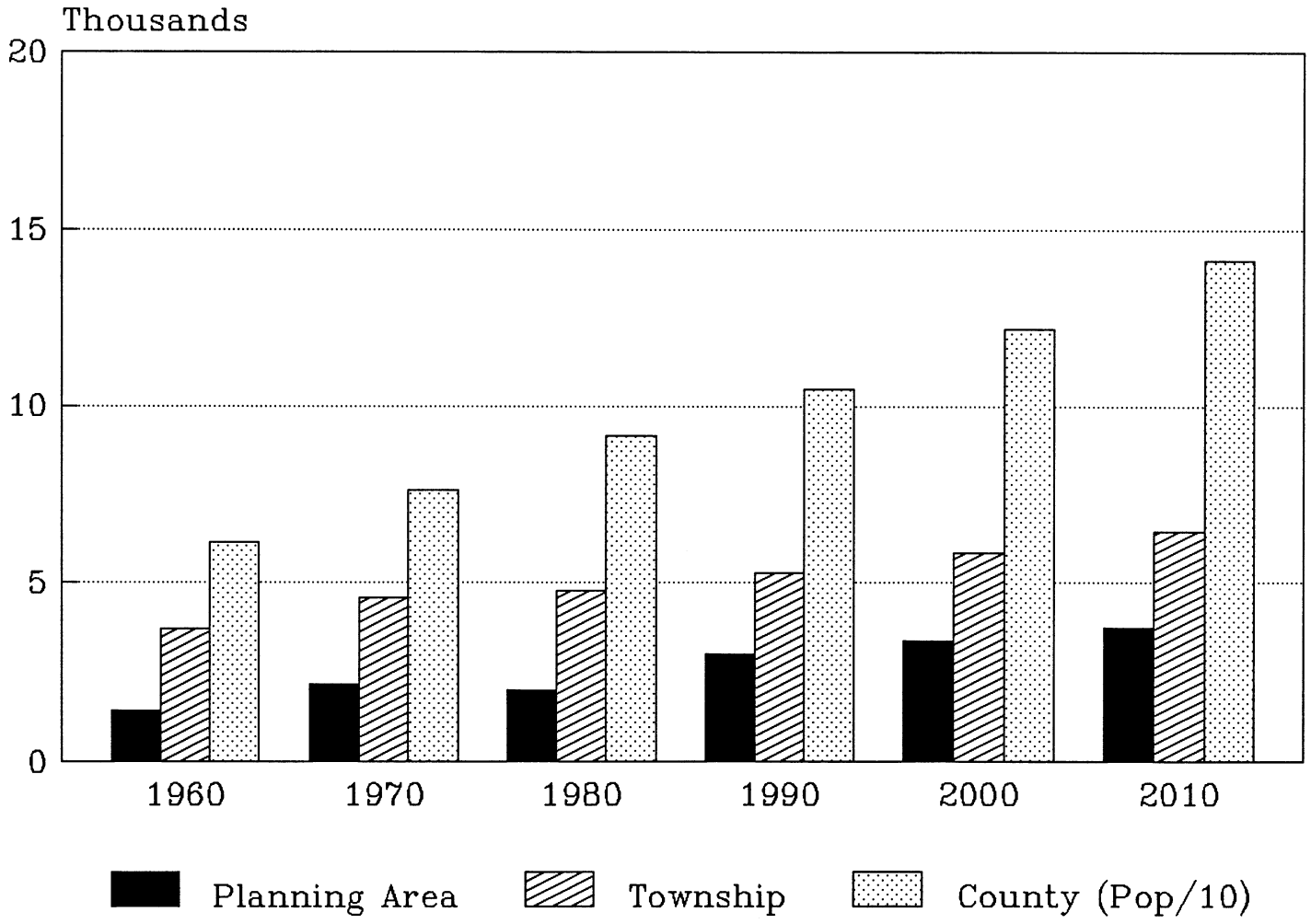
Population directly relates to automobile traffic in three different ways. First, the number of automobiles owned and driven in the planning area increases as the population increases. Second, the number of people driving into the planning area increases as the number of businesses in the planning area increases. Third, the number of trips passing through the planning area increases as the population of surrounding communities increases.

Figure 3 shows the population trends and projections for Liberty and Randolph County. Although the past thirty years show the population increased in Liberty, the growth trend shows a slight population decrease between 1970 and 1980. The population decrease probably resulted from the closing of a chair factory and the automation of the Burlington Industry Textile Plant. Because the thoroughfare planning area boundary extends beyond the existing town limits, Liberty's populations for 1990, 2000, and 2010 include the people between Liberty's Town Limits and the planning area boundary.

Based on information contained in the document *North Carolina Population Projections: 1988-2010* published by the Office of State Budget and Management, North Carolina is

Population Projections

Figure 3



projected to grow at an average rate of 0.9% per year. Randolph County and Liberty are projected to grow slightly faster, at 1.5% and 1.1% per year. These rates are reasonable based on historic data. However, raising land prices in Greensboro and Burlington, which are only 20 miles away, may change the historic trends and spur increased growth over the next twenty years. In the near future, Liberty will probably grow toward the Swannanoa Street and the Fayetteville Street interchanges with US 421.

TRAFFIC ACCIDENTS

Traffic accidents cost all insured North Carolina citizens hundreds of dollars each year in automobile insurance premiums. Traffic accidents are attributed to three general causes: driver characteristics, vehicle characteristics, and environmental characteristics. Driver characteristics include driving ability, mental alertness, and reaction time. Vehicle characteristics include vehicle type, vehicle condition, and vehicle responsiveness. Environmental characteristics include road conditions, weather conditions, physical obstructions, and traffic conditions.

All traffic accidents listed in the Division of Motor Vehicles' files from December 1984 through December 1989 in the planning area were analyzed. Table 1 lists all intersections with three or more accidents during the past five years and Figure 4 illustrates the most frequent accident locations. The intersection of Fayetteville Street with Greensboro Street tops the list with twelve accidents. All of the frequent accident locations involve Liberty's most heavily traveled radial thoroughfares, Fayetteville Street, Greensboro Street, or Swannanoa Avenue. Consequently,

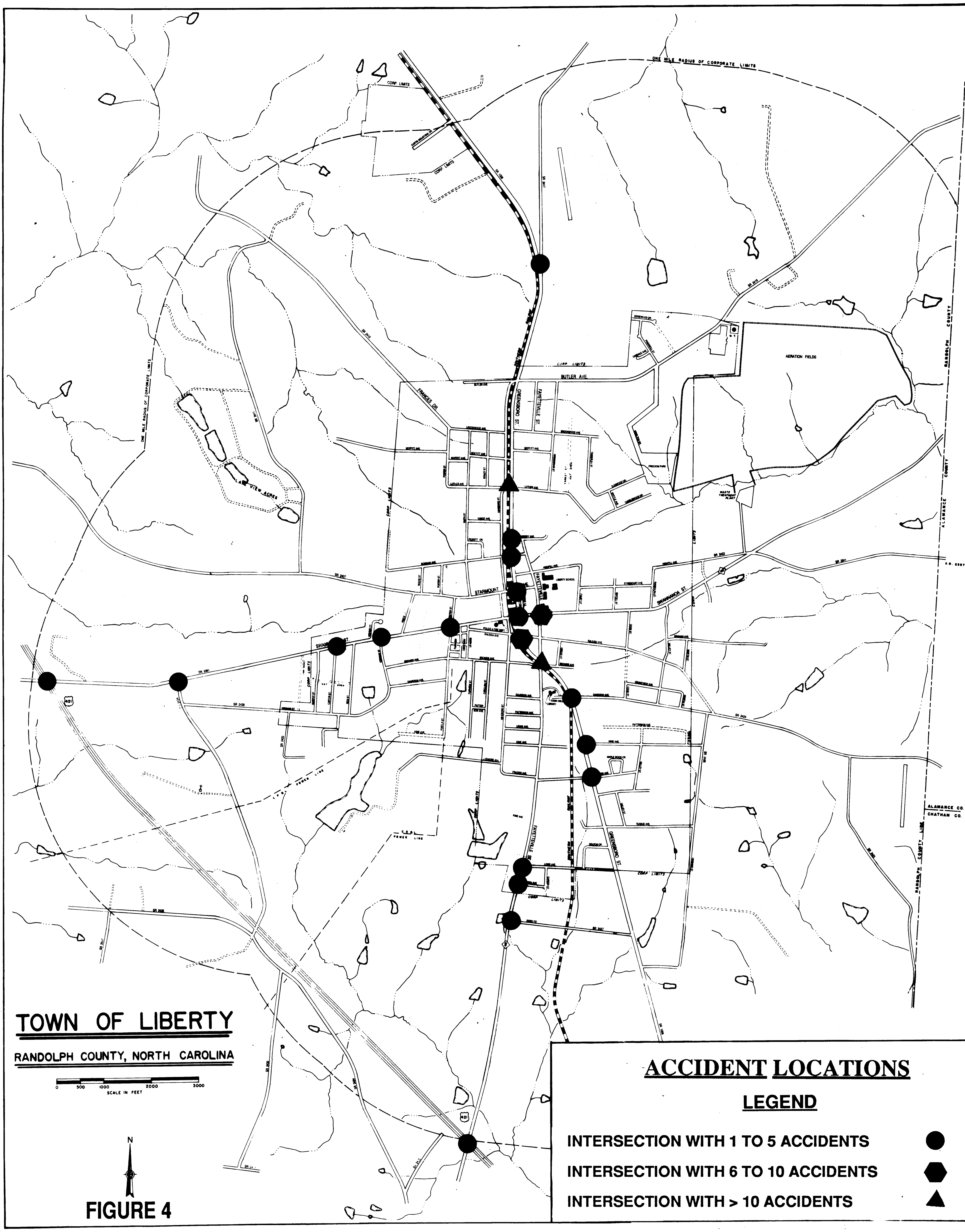

TOWN OF LIBERTY
RANDOLPH COUNTY, NORTH CAROLINA
0 500 1000 2000 3000
SCALE IN FEET
N
ACCIDENT LOCATIONS
LEGEND
INTERSECTION WITH 1 TO 5 ACCIDENTS
INTERSECTION WITH 6 TO 10 ACCIDENTS
INTERSECTION WITH > 10 ACCIDENTS
AERATION FIELDS
BUTLER AVE.
GREENSBORO ST.
FAYETTEVILLE ST.
STARMOUNT
SWANNANOA ST.
FRANCES DR.
CORP LIMITS
LAKE VIEW ACRES
ONE MILE RADIUS OF CORPORATE LIMITS
RANDOLPH COUNTY
ALAMANCE COUNTY
ALAMANCE CO.
CHATHAM CO.
POWER LINE

FIGURE 4

thoroughfare planning can help reduce these accidents by encouraging traffic not destined for downtown to use alternative routes.

TABLE 1: LIBERTY ACCIDENT INVENTORY
December 1985 - December 1989

LOCATION	NUMBER OF ACCIDENTS
Greensboro St. & Fayetteville St.	12
Greensboro St. & Luther Ave.	11
Greensboro St. & Raleigh Ave.	7
Fayetteville St. & Swannanoa Ave.	6
Fayetteville St. & Kinro Rd.	4
Greensboro St. & Swannanoa Ave.	4
Greensboro St. & Bowman Ave.	3
Swannanoa Ave. & Foster St.	3
Swannanoa Ave. & Kirkman St.	3
Swannanoa Ave. & Troy Estate Rd.	3
Swannanoa Ave. & US 421	3

TRAVEL DEMAND

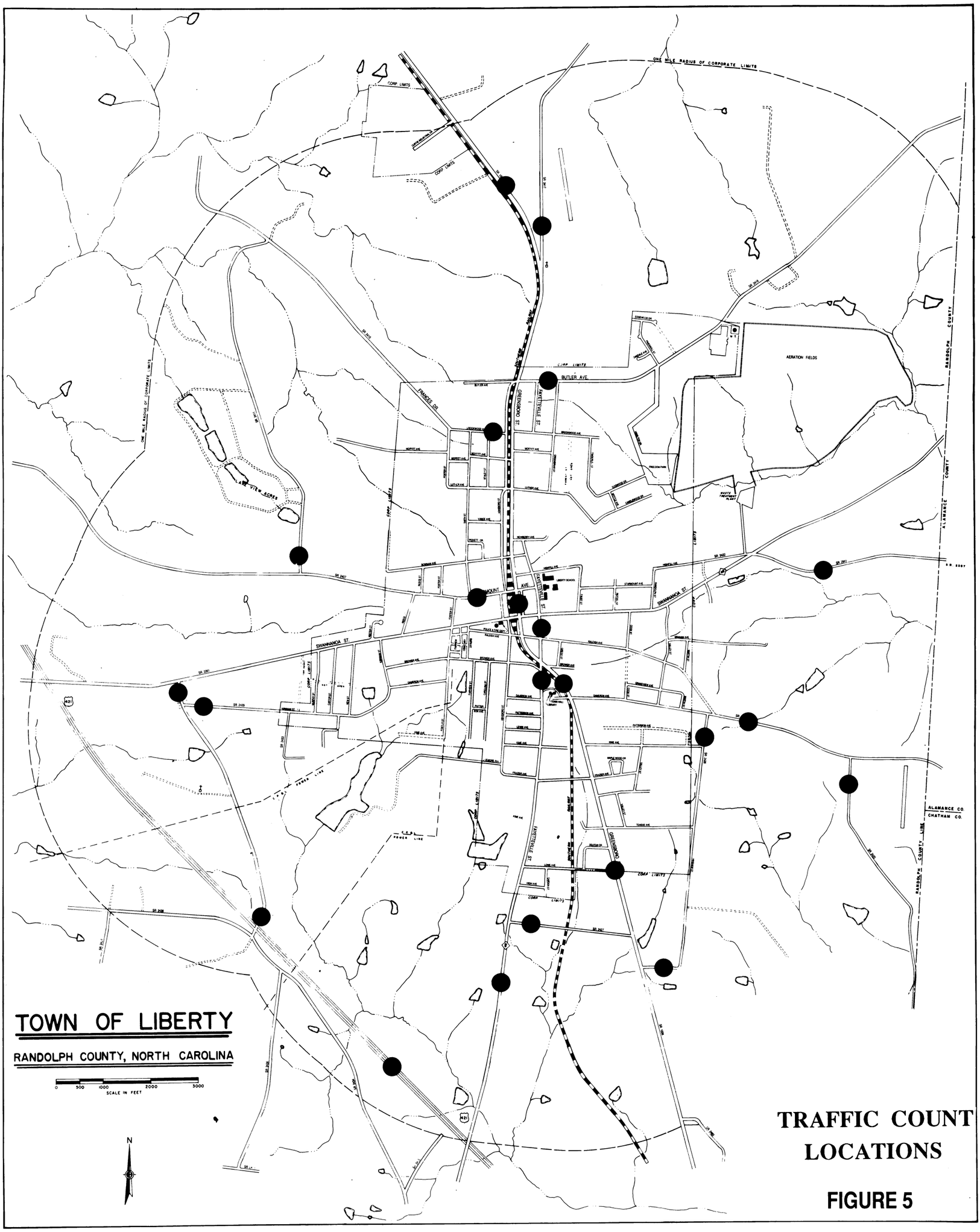
Have you ever traveled on a busy interstate and wondered where all the other thousands of cars were going? Travel demand is the technical term for analyzing this question. The name comes from the concept of people wanting to "travel" and "demanding" the road adequately handle all the traffic. Existing travel demand is reported as average daily traffic. Average daily traffic is the average amount of traffic which passes a particular point on the road in a typical day. Figure 5 shows where traffic counts were taken in Liberty to analyze the existing travel demand.

Future travel demand was estimated by using a mathematical "sketch" transportation model documented in *Technical Report #11: Allocation Type Approach To Estimation of Travel For Small Urban Areas*. The sketch model analyses all of the automobile trips inside a planning area in three separate groups: through trips, external trips, and internal trips. Through trips require an additional analysis documented in *Technical Report #3: Synthesized Through Trip Table For Small Urban Areas*. Once the model can estimate the existing traffic patterns, the trips are projected to the 2010 design year and assigned to the street network.

CAPACITY ANALYSIS

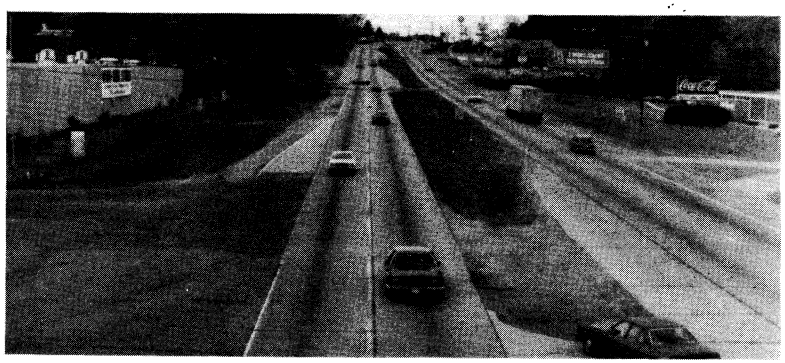
The maximum number of vehicles that can drive on a street at the same time is called the street's traffic capacity. Unlike the definite "capacity" of a glass holding water, the "capacity" of a street includes a variable element based on driver acceptance. People will not accept bumper-to-bumper traffic 24 hours a day, but they will accept bumper-to-bumper traffic for a short time. People accept different street capacities based on expected "level of service." Figure 6 illustrates the traffic conditions for six typical levels of service:

1. Level-of-service "A" describes free flow operations. People can choose a desirable speed and maneuver easily in the traffic stream.
2. Level-of-service "B" describes almost free flowing operations. People can drive at posted speeds and are only slightly restricted maneuvering in the traffic stream.
3. Level-of-service "C" describes stable operations. Many vehicles have to drive at the same speed because of moderately restricted maneuverability. Motorists experience some tension from driving.

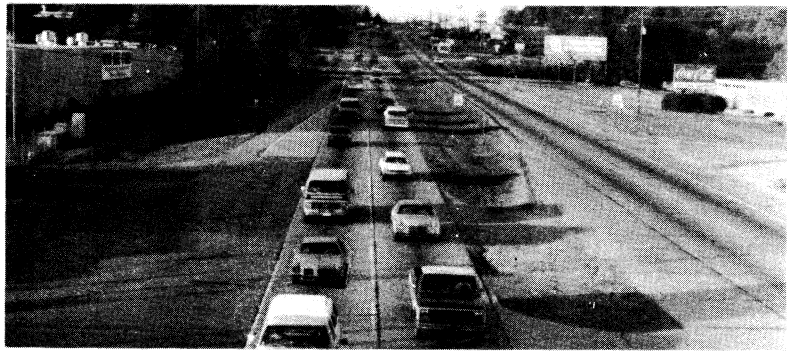


TRAFFIC COUNT LOCATIONS

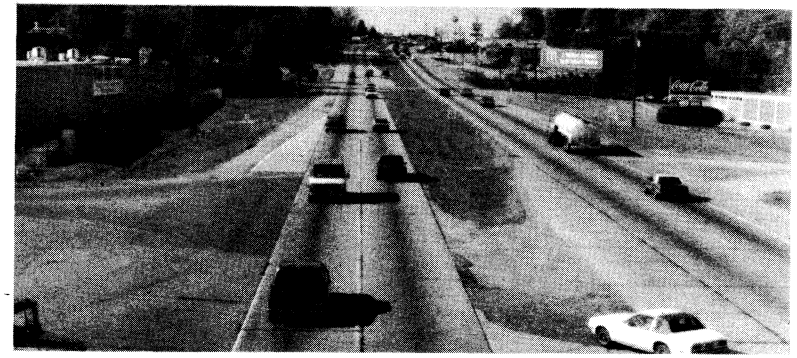
FIGURE 5



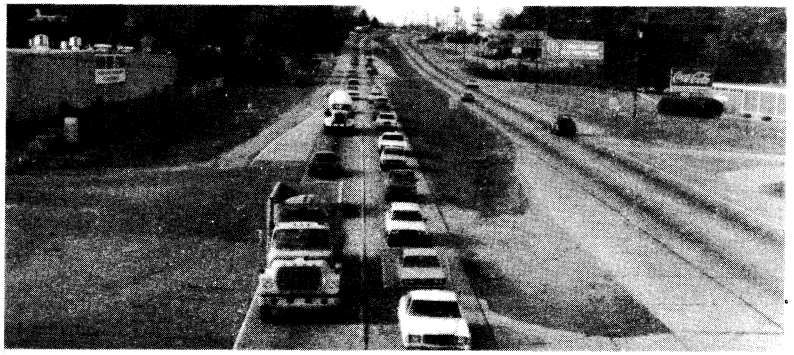
LEVEL OF SERVICE - A



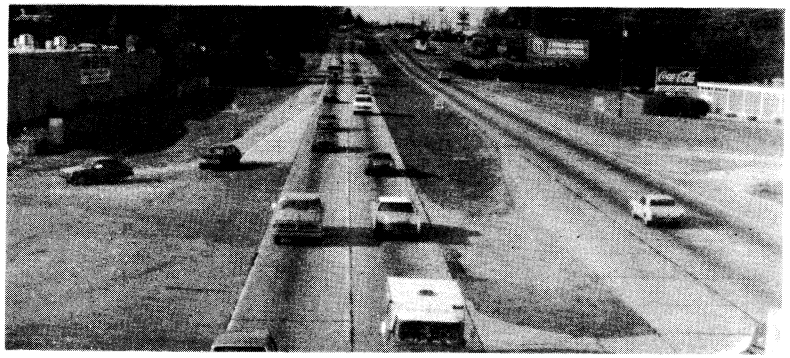
LEVEL OF SERVICE - D



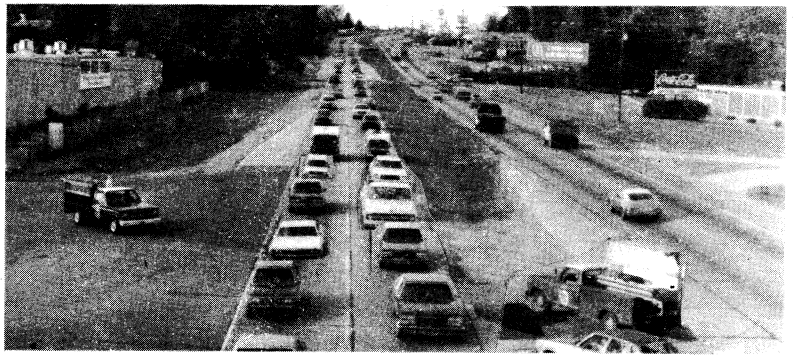
LEVEL OF SERVICE - B



LEVEL OF SERVICE - E



LEVEL OF SERVICE - C



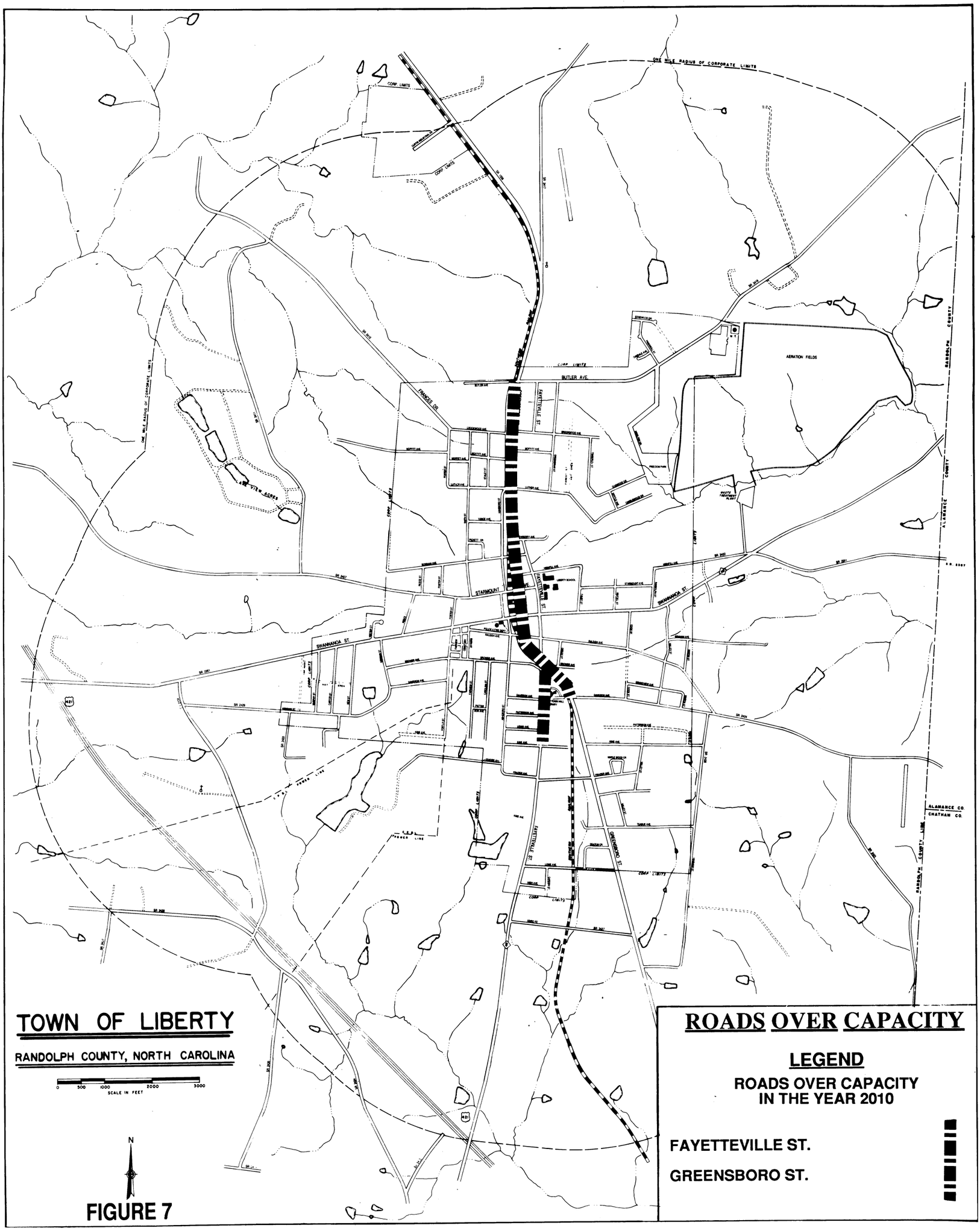
LEVEL OF SERVICE - F

LEVELS OF SERVICE

FIGURE 6

4. Level-of-service "D" describes acceptable congestion during rush hour. Most vehicles have to drive slightly below the posted speed because of restricted maneuverability. Motorists experience noticeable driving tension.
5. Level-of-service "E" describes congested rush hour conditions. All vehicles have to drive below the posted speed because maneuvering is very difficult. Tense motorists often become annoyed waiting at traffic signals and feel fatigued after driving.
6. Level-of-service "F" describes a traffic jam. Vehicles are subject to stop-and-go traffic because maneuvering is seemingly impossible. Intersection congestion and delays are common. Tense motorists, annoyed at traffic signals and irritated with the other "incompetent" drivers, feel angry after driving.

The thoroughfare plan recommendations are based on a minimum level-of-service D. Although most people prefer a better level of service, level-of-service D is the highest level of service people are willing to fund. Figure 7 illustrates the sections of Greensboro Street and Fayetteville Street which will experience future capacity problems.



TOWN OF LIBERTY

RANDOLPH COUNTY, NORTH CAROLINA

ROADS OVER CAPACITY

LEGEND

ROADS OVER CAPACITY
IN THE YEAR 2010

FAYETTEVILLE ST.

GREENSBORO ST.

FIGURE 7

IV. MUNICIPAL AND PUBLIC INVOLVEMENT

In today's complex democratic society, creating a thoroughfare plan requires working with many different people. Good thoroughfare planning involves: transportation planning engineers, roadway design engineers, community planners, environmental specialists, federal agencies, state agencies, local officials, and local citizens. In October 1990, Liberty's thoroughfare planning process began when Department of Transportation Engineers met with Mike Tardif, the town manager, to discuss the process for updating Liberty's 1977 Thoroughfare Plan.

On November 14, 1990, Liberty's Planning & Zoning Board met with Department of Transportation engineers. After reviewing Liberty's 1977 Thoroughfare Plan, the process for developing an updated thoroughfare plan was discussed. Similarly, on November 26, 1990, Liberty's Town Council met with Department of Transportation engineers to review Liberty's 1977 Thoroughfare Plan and learn the process for developing an updated thoroughfare plan.

With an impressive front page article published in the December 12, 1990 issue of *The Liberty News*, local officials advertised a public drop-in session for local citizens to comment on Liberty's Revised Thoroughfare Plan. Twelve people dropped by over the course of the afternoon to make comments and ask Department of Transportation engineers questions. Later that same evening, Department of Transportation engineers met with a combined meeting of the Planning & Zoning Board and the Town Council. Public drop-in session comments, predictable future transportation problems, and preliminary solutions were discussed.

Considering the comments from the Town Board members and members of the general public, Department of Transportation engineers reevaluated the controversial location of the northeastern section of the proposed loop. Of the two most feasible locations, one location (west of Freedom Park) had significant adverse effects on a residential community; the other location (shown on the thoroughfare plan) encroached on a new four million dollar waste water treatment facility. After consulting with the Department of Environment, Health, and Natural Resources personnel and making rough cost estimates, Department of Transportation engineers discussed this new information with the Planning & Zoning Board on February 13, 1991.

On February 25, 1991, the same cost estimate information on the northeastern section of the proposed loop was presented to the Town Council by Department of Transportation engineers. With the Planning & Zoning Board's endorsement, the Town Council endorsed a set of proposed thoroughfares as a recommended thoroughfare plan. Once again, local officials coordinated another impressive front page article in *The Liberty News* advertising the public hearing.

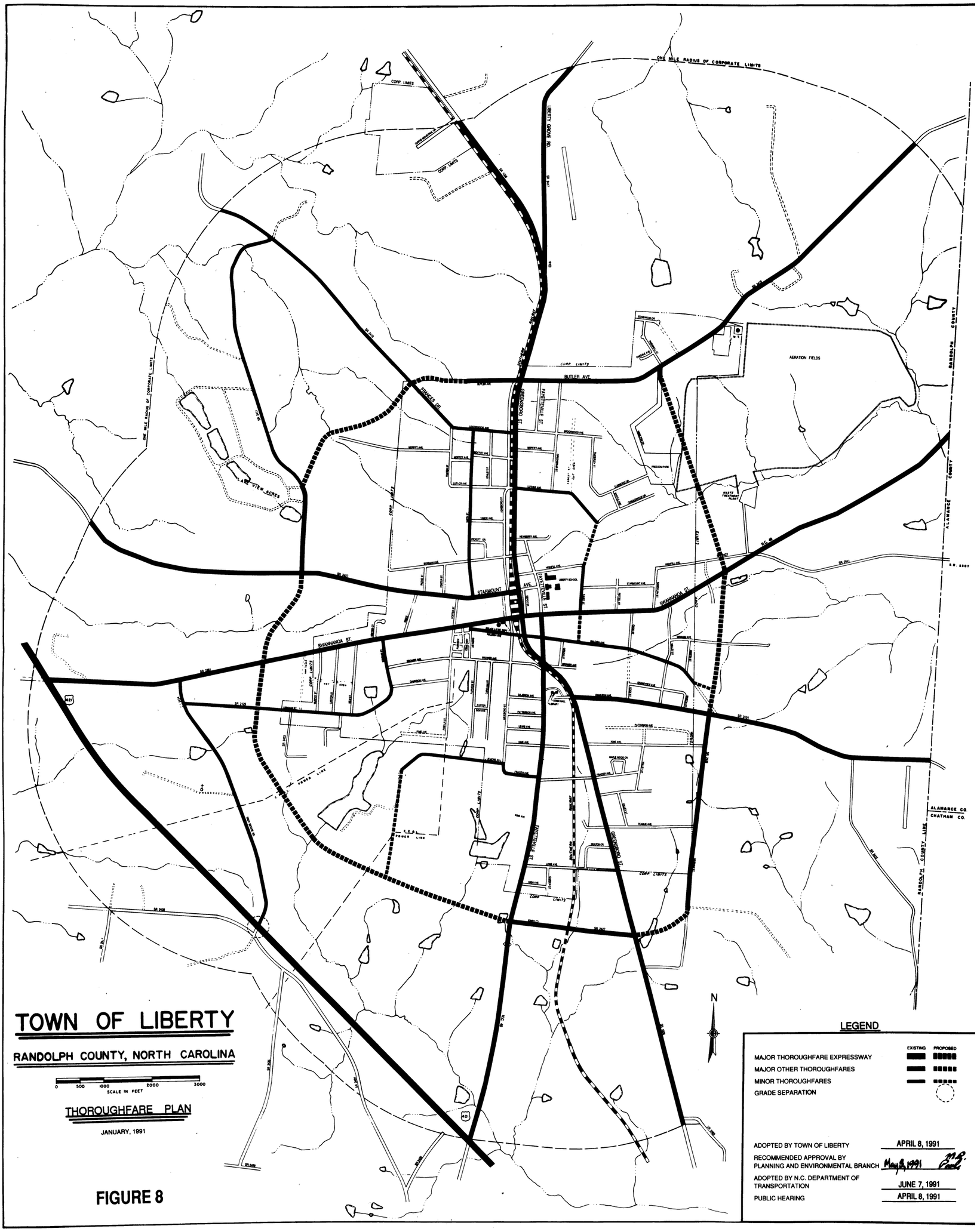
During the afternoon of April 8, 1991, Liberty citizens were invited to a second public drop-in session with Department of Transportation engineers. Six citizens stopped by to make comments and ask questions about the recommended thoroughfare plan. On the evening of April 8, 1991, the Town Council held a public hearing, and adopted the recommended thoroughfare plan.

V. RECOMMENDATIONS

Figure 8 illustrates the thoroughfare plan mutually adopted by Liberty and the North Carolina Department of Transportation. Table 2 lists statistics for all of the thoroughfares shown on the thoroughfare plan. The estimated 2010 average daily traffic is based on the existing street network, without any of the proposed thoroughfares constructed. The text in this chapter discusses recommendations in detail. Recommendations are organized by functional classification and ideal thoroughfare purpose in four categories: major thoroughfare bypasses, major radial thoroughfares, major thoroughfare loops, and minor thoroughfares.

MAJOR THOROUGHFARE BYPASSES

Because US 421 primarily serves through traffic and does not provide direct land access, US 421 is designated as a major thoroughfare bypass. As North Carolina's population grows and traffic on US 421 increases, US 421 will probably be upgraded into a full control-of-access facility. Changing US 421 to a fully controlled access facility will not affect the existing interchanges with Fayetteville Street and Swannanoa Avenue. However, the at-grade intersection with Troy Estate Road will be affected. Because the at-grade intersection is so close to the other interchanges, Troy Estate Road will most likely bridge over US 421 with no interchange.



TOWN OF LIBERTY

RANDOLPH COUNTY, NORTH CAROLINA

0 500 1000 2000 3000
SCALE IN FEET

THOROUGHFARE PLAN

JANUARY, 1991

FIGURE 8

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE EXPRESSWAY		
MAJOR OTHER THOROUGHFARES		
MINOR THOROUGHFARES		
GRADE SEPARATION		

ADOPTED BY TOWN OF LIBERTY	APRIL 8, 1991
RECOMMENDED APPROVAL BY PLANNING AND ENVIRONMENTAL BRANCH	May 8, 1991
ADOPTED BY N.C. DEPARTMENT OF TRANSPORTATION	JUNE 7, 1991
PUBLIC HEARING	APRIL 8, 1991

TABLE 2: ROUTE INVENTORY & RECOMMENDATIONS
(Page 1 of 5)

FACILITY & SECTION	EXISTING		CAPACITY	VOLUME		RECOMMENDED			
	ROAD WIDTH	R/W WIDTH	CURRENT (FUTURE)	1990 ADT	2010 ADT	# OF LANES	ROAD WIDTH	R/W WIDTH	ROAD TYPE
Brookwood Ave.									
Frances - Greensboro St.	-	-	-	-	-	ADQ	24	ADQ	ADQ
Butler Ave. (SR 2419)									
Dead End - Greensboro St	18	-	(15,000)	100	400	ADQ	24	ADQ	ADQ
G-boro St. - Town Limit	18	-	15,000	1,800	4,300	ADQ	24	ADQ	ADQ
Town Limit - Co. Line	18	-	15,000	500	1,100	ADQ	24	ADQ	ADQ
Butler Ave. (Proposed)									
SR 2411 - Frances Drive	NA	NA	(15,000)	NA	-	2	24	100	J
Frances Dr. - Dead End	NA	NA	(15,000)	NA	-	2	24	100	J
Dameron Ave. (SR 2424)									
G-boro St. - Town Limit	23	-	9,900	1,000	1,700	ADQ	24	ADQ	ADQ
Town Limit - Co. Line	23	-	9,900	1,000	1,700	ADQ	24	ADQ	ADQ
Faust St. (Existing)									
Highfill - Swannanoa Ave	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
Faust St. (Proposed)									
Candlewood Dr - Highfill	NA	NA	(9,900)	NA	-	2	24	100	J
Swannanoa - Raleigh Ave.	NA	NA	(9,900)	NA	-	2	24	100	J

ADT = Average Daily Traffic | R/W = Right-of-Way | ADQ = Adequate

NA = Not Applicable | P.A.B. = Planning Area Boundary | J = See Appendix A

TABLE 2: ROUTE INVENTORY & RECOMMENDATIONS
(Page 2 of 5)

FACILITY & SECTION	EXISTING		CAPACITY	VOLUME		RECOMMENDED			
	ROAD WIDTH	R/W WIDTH	CURRENT (FUTURE)	1990 ADT	2010 ADT	# OF LANES	ROAD WIDTH	R/W WIDTH	ROAD TYPE
Frances Dr. (SR 2410)									
P.A.B. - SR 2411	-	-	9,900	200	400	ADQ	24	ADQ	ADQ
SR 2411 - Town Limit	20	60	9,900	200	400	ADQ	24	ADQ	ADQ
Town Limit - Brookwood	20	-	9,900	400	800	ADQ	24	ADQ	ADQ
Frazier Ave.									
Fayetteville - Asheboro	-	-	-	-	-	2	24	ADQ	ADQ
Greensboro St. (SR 1006)									
S P.A.B. - Town Limit	20	60	15,000	1,000	6,500	ADQ	24	ADQ	ADQ
Town Limit - Brower Ave.	20	-	15,000	5,500	11,300	ADQ	24	ADQ	ADQ
Brower Ave. - Bowman St.	44	-	15,000 (10,700)	8,400	22,300	ADQ	ADQ	ADQ	ADQ
Bowman St. - Town Limit	20	-	15,000 (10,700)	8,400	21,200	ADQ	24	ADQ	ADQ
Town Limit - N P.A.B.	20	60	15,000	4,000	10,000	ADQ	24	ADQ	ADQ
Hinshaw St. (SR 2426)									
Connector - Dameron Ave.	16	-	9,900 (15,000)	150	400	ADQ	24	60	ADQ
Hinshaw St. (Proposed)									
Kinro Rd. - Hinshaw St.	NA	NA	(15,000)	NA	-	2	24	100	J
Dameron Ave. - NC 49	NA	NA	(15,000)	NA	-	2	24	100	J
NC 49 - Butler Ave.	NA	NA	(15,000)	NA	-	2	24	100	J

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TABLE 2: ROUTE INVENTORY & RECOMMENDATIONS
(Page 3 of 5)

FACILITY & SECTION	EXISTING		CAPACITY	VOLUME		RECOMMENDED			
	ROAD WIDTH	R/W WIDTH	CURRENT (FUTURE)	1990 ADT	2010 ADT	# OF LANES	ROAD WIDTH	R/W WIDTH	ROAD TYPE
Kinro Rd. (SR 2427)									
Greensboro St. - NC 49	20	60	9,900 (15,000)	500	1,000	ADQ	24	ADQ	ADQ
Kinro Rd. (Proposed)									
NC 49 - Swannanoa Ave.	NA	NA	(15,000)	NA	-	2	24	100	J
Swannanoa - Starmount	NA	NA	(15,000)	NA	-	2	24	100	J
Kirkman St.									
Swannanoa - Troy Estate	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
Liberty Grove Rd (SR 2417)									
N P.A.B. - SR 1006	18	-	9,900	800	2,000	ADQ	24	ADQ	ADQ
Luther Ave.									
Greensboro - Candlewood	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
NC 49 (Fayetteville St.)									
US 421 - S. Town Limit	22	100	15,000	4,000	7,200	ADQ	24	ADQ	ADQ
S Town Limit - Lewis Ave	22	60	15,000	5,000	13,200	ADQ	24	ADQ	ADQ
Lewis Ave. - SR 1006	44	60	15,000 (10,700)	5,000	13,200	ADQ	ADQ	ADQ	ADQ
SR 1006 - Swannanoa Ave.	40	60	15,000 (10,700)	3,700	7,600	ADQ	ADQ	ADQ	ADQ

ADT = Average Daily Traffic	R/W = Right-of-Way	ADQ = Adequate
NA = Not Applicable	P.A.B. = Planning Area Boundary	J = See Appendix A

TABLE 2: ROUTE INVENTORY & RECOMMENDATIONS
(Page 4 of 5)

FACILITY & SECTION	EXISTING		CAPACITY	VOLUME		RECOMMENDED			
	ROAD WIDTH	R/W WIDTH	CURRENT (FUTURE)	1990 ADT	2010 ADT	# OF LANES	ROAD WIDTH	R/W WIDTH	ROAD TYPE
NC 49 (Swannanoa Ave.)									
Fayetteville - Faust St.	30	60	15,000 (10,700)	3,500	9,800	ADQ	ADQ	ADQ	ADQ
Faust St. - E Town Limit	24	60	15,000 (10,700)	3,500	9,800	ADQ	ADQ	ADQ	ADQ
Town Limit - 1 mile	18	60	15,000	1,800	5,800	ADQ	24	100	ADQ
.2 miles to Co. Line	24	100	15,000	1,800	5,800	ADQ	ADQ	ADQ	ADQ
Raleigh Ave.									
Swannanoa - Martin St.	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
Raleigh Ave. (Proposed)									
Martin St. - Hinshaw St.	NA	NA	(9,900)	NA	-	2	24	100	J
Secondary Road 2411									
Frances Dr- Prop Butler	14	-	9,900	100	400	2	24	ADQ	ADQ
P Buttler- Starmount Ave	14	-	9,900	100	400	2	24	100	J
Sizemore Ave.									
Frazier Ave. - corner	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
Sizemore Ave. (Proposed)									
corner - Proposed loop	NA	NA	(9,900)	NA	-	2	24	100	J

ADT = Average Daily Traffic	R/W = Right-of-Way	ADQ = Adequate
NA = Not Applicable	P.A.B. = Planning Area Boundary	J = See Appendix A

TABLE 2: ROUTE INVENTORY & RECOMMENDATIONS
(Page 5 of 5)

FACILITY & SECTION	EXISTING		CAPACITY	VOLUME		RECOMMENDED			
	ROAD WIDTH	R/W WIDTH	CURRENT (FUTURE)	1990 ADT	2010 ADT	# OF LANES	ROAD WIDTH	R/W WIDTH	ROAD TYPE
Smith St.									
Brookwood - Starmount	-	-	9,900	-	-	ADQ	24	ADQ	ADQ
Starmount Ave. (SR 2407)									
Greensboro St. - P.A.B.	18	-	15,000	900	1,500	ADQ	24	ADQ	ADQ
Swannanoa Ave. (SR 2261)									
Fayetteville - SR 1006	40	-	19,500	-	-	ADQ	ADQ	ADQ	ADQ
SR 1006 - Town Limit	37	-	19,500 (14,000)	6,000	12,500	ADQ	ADQ	ADQ	ADQ
Town Limit - .2 mi E 421	24	-	15,000	2,300	4,000	ADQ	ADQ	ADQ	ADQ
E of US 421 - US 421	18	-	15,000	2,300	4,000	ADQ	24	ADQ	ADQ
Troy Estate Rd. (SR 2434)									
Swannanoa Ave. - US 421	20	-	9,900	600	1,300	ADQ	24	ADQ	ADQ
US 421									
NC 49 - Swannanoa Ave.	48	350	53,300	7,200	14,000	ADQ	ADQ	ADQ	ADQ

ADT = Average Daily Traffic	R/W = Right-of-Way	ADQ = Adequate
NA = Not Applicable	P.A.B. = Planning Area Boundary	J = See Appendix A

Bridging Troy Estate Road over US 421 should not have significant negative effects on the current residential land use. However, the Town of Liberty should avoid permitting industrial or commercial development which requires direct access to US 421 along Troy Estate Road or at the intersection. Typically, restaurants, gas stations, and convenient stores sprout at intersections along four-lane divided facilities. By protecting Troy Estate Road and its intersection with US 421 from inappropriate development, the State will save substantial time and money by not needing to relocate any businesses if or when a grade separation is provided.

MAJOR RADIAL THOROUGHFARES

Seven roads are designated as major radial thoroughfares: Fayetteville Street, Greensboro Street, Swannanoa Avenue, Butler Avenue, Dameron Avenue, Liberty Grove Road, and Starmount Avenue. These major thoroughfares are the primary traffic arteries of the town. Although they may serve abutting property, their principle function is to carry large volumes of traffic. These radial thoroughfares provide Liberty's economic vitality by carrying traffic from outside Liberty to inside Liberty. For Liberty to remain economically competitive, each road should be protected as an important transportation corridor. When practical, all major radial thoroughfares should be widened to have 12 foot paved travel lanes.

Fayetteville Street (NC 49)

Fayetteville Street, also designated as NC 49, is the shortest link between downtown Liberty and US 421 heading toward Sanford. The drive from US 421 to downtown on this section of Fayetteville Street is quick and easy. Fayetteville Street has enough additional existing capacity

to handle the future traffic growth over the next 20 years. Unfortunately, as Liberty expands southward toward US 421 and additional traffic signals are installed on Fayetteville Street, the traffic capacity will decrease. Each additional traffic signal adds to the total travel time and travel friction experienced by drivers on Fayetteville Street.

The future traffic on Fayetteville Street between Swannanoa Avenue and Greensboro Street will be greater than the future capacity of Fayetteville Street. Increasing capacity by adding new lanes to Fayetteville Street is not feasible in the central business district. The thoroughfare plan uses a loop facility to divert the NC 49 through traffic from the congested section of Fayetteville Street to a bypass facility. Consequently, when the NC 49 Bypass facility is constructed, traffic on Fayetteville Street will decrease.

Greensboro Street

Before US 421 was constructed, Greensboro Street was Liberty's main road to Greensboro and Sanford. Paralleling the Southern Railway tracks through the center of town, Greensboro Street is still one of Liberty's most important transportation corridors. Greensboro Street from Fayetteville Street to the southern planning area boundary has enough additional capacity to handle the traffic growth over the next 20 years.

The future traffic on Greensboro Street between Butler Avenue and Fayetteville Street will be greater than the capacity of Greensboro Street. Due to the existing railroad parallel to the street and the existing land uses, increasing capacity by adding new lanes to Greensboro Street is not feasible. To make matters worse, any traffic signals added to Greensboro Street in the future will reduce the street's traffic capacity. The proposed extension of Butler Avenue

and the loop road east of Freedom Park will divert part of the traffic from the congested section of Greensboro Street to alternative routes. Consequently, when the proposed roads are constructed, traffic on Greensboro Street will decrease.

Swannanoa Avenue (NC 49)

Although additional traffic signals will reduce Swannanoa Avenue's traffic capacity, the existing roadway should have adequate traffic capacity. However, NC 49 from Burlington follows Swannanoa Avenue from the Town Limit to Fayetteville Street. Then, with a ninety degree turn in downtown Liberty, NC 49 continues along Fayetteville Street to US 421 and the southern planning area boundary. The traffic traveling from Burlington to Asheboro, including heavy trucks, must drive through downtown Liberty alon this route. In addition to the unnecessary through traffic on local streets, the trucks often have problems turning at the ninety degree intersection by the movie theater. The NC 49 bypass will eliminate this problem.

Butler Avenue, Dameron Avenue, Starmount Avenue, and Liberty Grove Road

Butler Avenue, Dameron Avenue, Starmount Avenue, and Liberty Grove Road between the planning area boundary and the town will get increasing development pressure as Liberty grows. The existing traffic lanes should provide adequate capacity for the next twenty years. Although these roads will probably never carry as much traffic as Fayetteville Street, Greensboro Street or Swannanoa Avenue, these transportation corridors should be protected as local gateways into town for traffic movement.

MAJOR LOOP THOROUGHFARES

Liberty's street system lacks any continuous loop thoroughfares. Without this necessary part of the street system, other streets, including neighborhood streets, carry unnecessary traffic. Loop system streets allow direct travel between suburban areas of town by connecting major radial streets. When loop system streets are available, people drive directly to their destination instead of winding through local subdivisions or commercial streets.

Liberty should have a two-lane, 24-foot wide roadway with 100 feet of right-of-way for the loop facility. Several existing road segments (Butler Avenue, Hinshaw Street, Kinro Road, and Secondary Road 2411) can be connected with new two-lane roads to form the loop. There are eight separate sections where right-of-way should be protected for the future two-lane road connections.

Section 1 connects Butler Avenue with Swannanoa Avenue.

Section 2 connects Swannanoa Avenue with Dameron Avenue.

Section 3 connects Hinshaw Street with Kinro Road.

Section 4 connects Kinro Road with Kirkman Street.

Section 5 connects Kirkman Street with Swannanoa Avenue.

Section 6 connects Swannanoa Avenue with Starmount Avenue.

Section 7 connects Secondary Road 2411 with Frances Drive.

Section 8 connects Frances Drive with Butler Avenue.

In addition, building setbacks along Butler Avenue, Hinshaw Street, Kinro Road, and Secondary Road 2411 should be protected or increased to minimize the adverse effects from widening the existing roadways to 24 feet.

MINOR THOROUGHFARES

Ten roads are designated as minor thoroughfares: Brookwood Avenue, Faust Street, Frances Drive, Frazier Avenue, Kirkman Street, Luther Avenue, Raleigh Avenue, Sizemore Avenue, Smith Street, Secondary Road 2411, and Troy Estate Road. These roads connect local land access streets with major thoroughfares. Two lanes should have enough traffic capacity to handle design year traffic.

Since minor thoroughfares serve traffic movement and land access, minor thoroughfares do not necessarily need to have full twelve-foot lanes. Land use, neighborhood character, aesthetic quality, bicycle traffic, and pedestrian traffic will influence the appropriate right-of-way and pavement widths. By planning for twelve-foot pavement widths, future policy makers will have the flexibility to choose the most appropriate pavement width. On-street parking and on-street bicycle lanes require additional pavement width. Local subdivision ordinances should address these issues for minor thoroughfares (in addition to major thoroughfares and local streets).

PROJECT BENEFITS

Liberty's Thoroughfare Plan contains numerous thoroughfare corridor recommendations. Each recommendation affects different transportation users, and each recommendation has different costs and benefits. This section of the report quantifies the positive and the negative aspects of each project. The analysis is based on *Technical Report #8: Transportation Project Evaluation Using The Benefits Matrix Model* published by the Statewide Planning Branch of the Department of Transportation. This analysis provides general information on the relative significance of individual projects to Liberty's thoroughfare system.

Figure 9 illustrates how the major thoroughfare recommendations are grouped into four distinct projects. Although individual links in these four projects may be constructed independently, the street system's benefits will not be significant until the entire project is completed. Each project's benefits are determined independently of all other projects by using the existing street network for comparison. A more detailed cost and benefit analysis will be conducted on particular projects when the traffic demand exists and Liberty requests a feasibility study.

Table 3 shows the results from this analysis. Column two shows the monetized project benefits. Project benefits include vehicle operating cost savings, travel time cost savings, and accident cost savings. Cost savings were calculated by comparing how much existing and future traffic would shift to use the proposed project.

Column three shows the project cost estimates. The cost estimates are based on average cost-per-mile construction information from across North Carolina. Because these cost estimates are not particular to Liberty or to specific roadway design plans, the actual construction costs may be significantly different. The costs listed in the table are useful for illustrating the relative cost difference between alternative projects.

Economic impacts are listed in the fourth column. The probability of economic development enhanced by the project is ranked on a continuous scale from low to high. Projects which have a minimal probability of economic development have a value of zero. Projects which have a high probability of economic development have a value of one.

TABLE 3: PROJECT COMPARISON SUMMARY

Project Description	Benefits (Thousands)	Cost (Thousands)	Economic Impacts	Environmental Impacts	Through Trips
Hinshaw Street (NC 49 Bypass)	$19,398	R/W $ 30 Const $1,288 --- Total $1,318	0.75	-0.54	2,100
Hinshaw Street (NE part of loop)	$ 7,586	R/W $ 31 Const $ 850 --- Total $ 881	0.25	-0.23	100
Buttler Avenue (NW part of loop)	$ 3,276	R/W $ 31 Const $ 897 --- Total $ 928	1.00	-0.23	100
Kinro Road (SW part of loop)	$ 1,798	R/W $ 72 Const $1,989 --- Total $2,061	1.00	-0.31	100

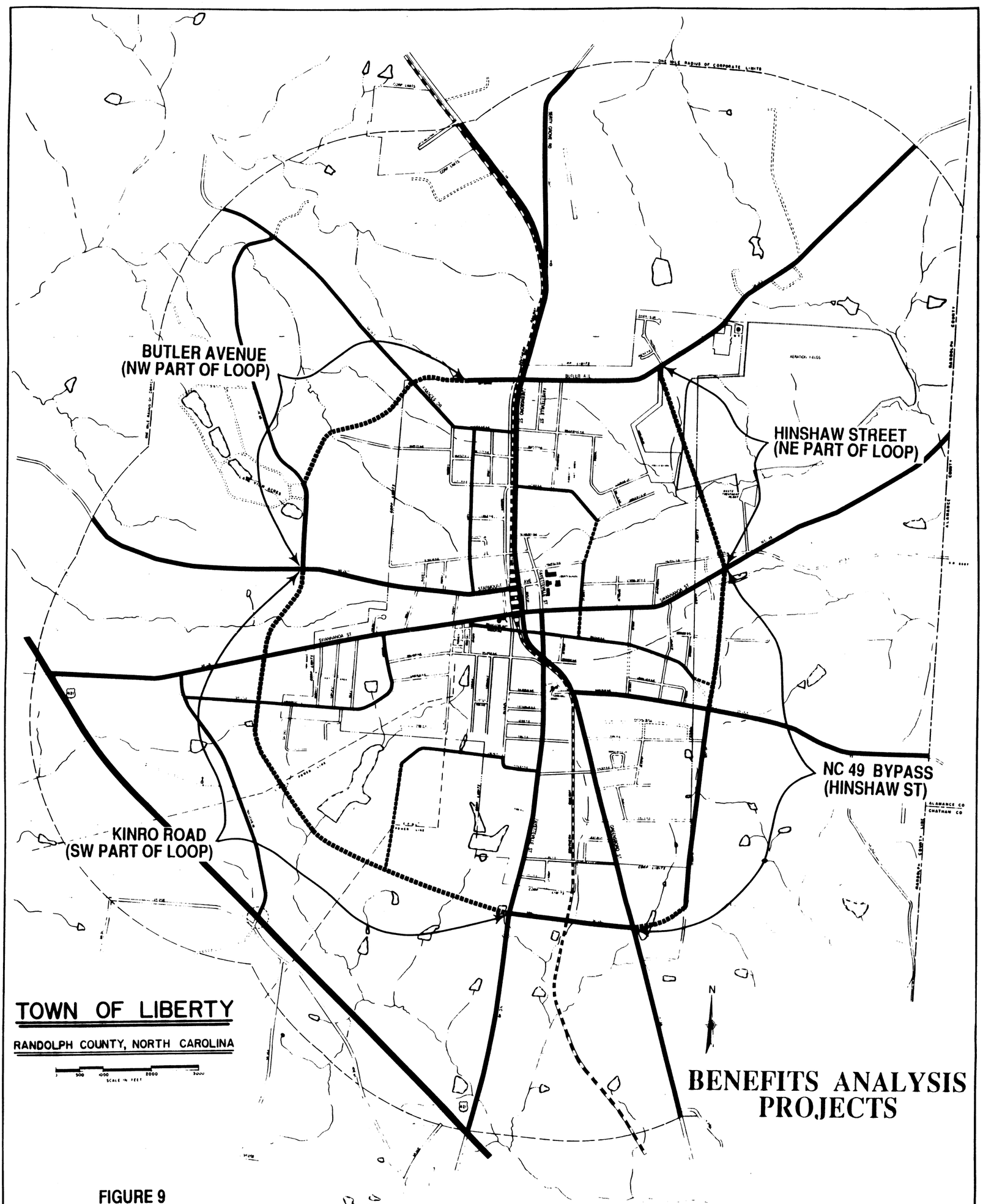

BUTLER AVENUE
(NW PART OF LOOP)
HINSHAW STREET
(NE PART OF LOOP)
NC 49 BYPASS
(HINSHAW ST)
KINRO ROAD
(SW PART OF LOOP)
TOWN OF LIBERTY
RANDOLPH COUNTY, NORTH CAROLINA
N
BENEFITS ANALYSIS
PROJECTS

FIGURE 9

Environmental impacts are listed in the fifth column. Impacts ranging from very negative to very positive correspond to values ranging from negative one to positive one. Physical environment considerations include: air pollution, water pollution, land pollution, noise pollution, geological resources, wildlife habitats, and natural vegetation. Social environmental considerations include: housing, neighborhoods, schools, churches, parks, public safety, national defense, and aesthetics. Each of these standard environmental factors are ranked and averaged for each project to generate the value listed in the table.

The average daily through trips in the design year are listed in the last column. The number of through trips indicate the significance the project will have on the State Arterial system. Projects which have high volumes of through traffic are more important to the State Arterial system. Projects which have very few through trips are more important to the local street system.

NC 49 Bypass (Hinshaw Street)

This project is the southeastern portion of Liberty's proposed loop. Constructing the NC 49 Bypass involves three separate links:

1) Constructing a new two-lane road from Swannanoa Avenue to Dameron Avenue.
2) Widening the existing section of Hinshaw Street.
3) Constructing a new two-lane road connector from Hinshaw Street to Greensboro Street.

Cost estimates for section one is based on a twenty-four foot wide road with shoulders. Cost estimates for sections two and three are based on a twenty-four foot wide road with curb and gutter.

Hinshaw Street (Northeastern Loop)

This project is the northeastern portion of Liberty's proposed loop. This project involves constructing a new two-lane road from Swannanoa Avenue to Butler Avenue (east of Freedom Park). Cost estimates are based on a twenty-four foot wide road with shoulders.

Butler Avenue (Northwestern Loop)

This project is the northwestern portion of Liberty's proposed loop. Constructing this project involves three separate links:

1) Constructing a new two-lane road from the existing end of Butler Avenue to Frances Drive.
2) Constructing a new two-lane road from Frances Drive to Secondary Road 2411.
3) Widening Secondary Road 2411 to Starmount Avenue.

Cost estimates are based on a twenty-four foot wide road with shoulders.

Kinro Road (Southwestern Loop)

This project is the southwestern portion of Liberty's proposed loop. Constructing this project involves three separate links:

1) Constructing a new two-lane road from Starmount Avenue to Swannanoa Avenue.
2) Constructing a new two-lane road from Swannanoa Avenue to Kirkman Street.
3) Constructing a new two-lane road from Kirkman Street to Fayetteville Street.

Cost estimates are based on a twenty-four foot wide road with shoulders.

VI. IMPLEMENTATION

Liberty's Thoroughfare Plan is a detailed set of recommendations for how Liberty should develop a street system to keep up with the town's growth. Because there are no guarantees Liberty will develop as planned, anticipated traffic growth and future capacity deficiencies may change. Before any of the proposed roads will be considered for construction, a detailed project study will determine if actual development justifies the projects. Environmental studies and design studies will determine specific road alignments.

No one in the Department of Transportation has the job of implementing the recommendations listed in thoroughfare plans because funding is not available for building roads based on predicted need. Local officials are responsible for requesting projects as the need arises. With hundreds of municipalities competing for projects funded by the state's tight budget, Liberty must make logically organized requests to be effective. The documented public and political involvement, in addition to technical feasibility, give thoroughfare plan project requests the competitive edge over all other requests.

REGULATIONS

Communities which actively protect their thoroughfare corridors have the best success actually getting projects constructed. Protecting thoroughfare corridors saves citizens hundreds of thousands and even millions of dollars each year. Thoroughfare Plan adoption, subdivision regulations, future street line ordinances, zoning ordinances, development reviews, and official maps are regulations available to protect thoroughfare corridors.

Thoroughfare Plan Adoption

Section 136-66.2 of the North Carolina General Statutes provides guidelines for adopting a thoroughfare plan. After the municipality and the Department of Transportation cooperatively develop a thoroughfare plan, the plan may be adopted by the municipality and the Department of Transportation. Subsequently, the thoroughfare plan serves as the basis for future street and highway improvements.

Section 136-66.1 of the General Statutes requires the municipality and Department of Transportation to develop a Systems Responsibility Agreement for all thoroughfares included in the plan. After mutual plan adoption, the Department of Transportation will initiate street system responsibility negotiations. The Department of Transportation is responsible for facilities which serve primarily through traffic and external traffic. The municipality is responsible for facilities which serve primarily internal traffic. Facilities designated as a State responsibility will be constructed and maintained by the Division of Highways. Facilities designated as a municipal responsibility will be constructed and maintained by the municipality.

After the Systems Responsibility Agreement is adopted, the plan should be reviewed locally at least once a year. When significant changes are necessary, the municipality should request the Statewide Planning Branch of the Department of Transportation to update the thoroughfare plan. Depending on actual growth patterns, the plan should be formally updated once every five to ten years.

Subdivision Regulations

Subdivision regulations specify roadway width, right-of-way, and sight distances in new subdivisions. The Department of Transportation manual *Subdivision Roads: Minimum Construction Standards* documents the design, construction, and utility placement standards necessary for state maintained roads. Regulations are classified by road functions (local street, collector street, etc). These regulations minimize roadway safety hazards and maintenance costs. Municipalities must have developers construct roads to North Carolina subdivision road standards for the North Carolina Department of Transportation to accept and maintain the road. Roads not meeting state regulations must be constructed and maintained by local or private funding.

Liberty's proposed thoroughfares, especially the loop facility, depend on local officials actively using subdivision regulations. When a proposed subdivision conflicts with the thoroughfare plan, the municipalities should protect the transportation corridor. During the planning stage, the conflicting subdivision roads can be realigned and improved to match the thoroughfare plan. Developers who construct thoroughfare plan streets can benefit from local or state agency coordination. Developers who do not help build the thoroughfare plan improvements should dedicate the necessary road right-of-way. As a minimum, developers should reserve property needed for future road right-of-way.

Future Street Line Ordinances

Typically, by the time an existing road needs widening, houses and buildings line both sides of the road with no room to spare. Residents are understandably upset when widening the road swallows their entire yard, or worse their whole

house. Businesses are equally upset when widening the road eliminates their only customer parking spaces, or their entire office. Building setbacks based on the thoroughfare plan recommendations reduce this problem.

As time passes, existing buildings age; some are renovated, others are replaced with newer buildings. Simultaneously, new buildings fill in the land between established buildings as zoning density limits increase. With adequate setback requirements, all the buildings constructed or renovated after thoroughfare plan adoption can have space for road widening. Ultimately, when the road is widened, fewer property owners will be negatively affected. The existing section of Hinshaw Street which will be widened as part of the proposed NC 49 Bypass could benefit from a future street line ordinance.

Zoning Ordinances

Zoning is a legal device available for implementing a land use plan. Most legislation today is based on the U.S. Department of Commerce 1924 Standard Zoning Enabling Act. Zoning involves dividing a municipality into districts and regulating each district's population density, land use, open space, and other local concerns. Although zoning ordinances do not regulate street design or right-of-way, zoning directly influences transportation by protecting thoroughfare corridors and controlling transportation demand.

Troy Estate Road near the intersection of US 421 is an excellent example of how zoning can protect a thoroughfare corridor. Troy Estate Road is currently zoned residential; commercial and industrial development dependent on direct US 421 traffic is not permitted. Ultimately, when Troy Estate Road bridges over US 421 with no access to US 421 traffic, residential land uses will have minimal adverse effects.

However, if the area were allowed to rezone, commercial and industrial developments dependent on US 421 traffic would endure unnecessary hardships.

Zoning can control transportation demand by discouraging strip development zones along highways which create inefficient traffic flows. Isolated, single purpose businesses connected by highways congest the roads with people driving from one place to another for everyday activities. Driving to the grocery store for a loaf of bread and then driving to the post office to buy a roll of stamps often takes more driving time than shopping time. Zoning business areas for campus developments instead of strip development reduces automobile traffic by eliminating unnecessary automobile trips. Fayetteville Street, Greensboro Street, and Swannanoa Avenue can benefit from well planned campus developments.

Zoning can also reduce automobile traffic by encouraging walking or bicycling. Just as shopping malls encourage people to walk from one shop to another, other developments can encourage people to walk from one business to another. Sidewalks should connect office complexes with lunch time eating and shopping areas. Neighborhoods, schools, libraries, and parks should also have connecting sidewalks and bicycle paths so people can choose their travel mode. Liberty's existing investment in sidewalks can provide an excellent base for developing a complete pedestrian system.

Development Reviews

Development reviews save developers and municipalities the headache of dealing with avoidable transportation related problems. Reviews done at an early stage often save developers and municipalities money and increase the site's

accessibility. Depending on how the development will affect existing and future traffic, different Department of Transportation specialists review the development plans.

Since the developers usually contact the municipality first, the municipality should advise them to contact the District Engineer. The District Engineer reviews all requests for driveway access to State maintained roads. If necessary, the District Engineer will forward development requests to other Department of Transportation branches. If requested, the Statewide Planning Branch reviews all development requests on or near proposed thoroughfares and all requests which may prevent existing thoroughfares from being widened in the future. The Traffic Engineering and Highway Design Branches review large traffic generating developments like shopping centers, large industries, and fast food restaurants.

The District Engineer can be contacted through the Division Office by writing:

Randolph County District Engineer
N.C. Department of Transportation
P.O. Box 1164
Asheboro, NC 27203

Official Maps

The North Carolina Statutes 136-44.50 through 136-44.53 are collectively designated as the "Roadway Corridor Official Map Act." This act gives state and municipal governments the power to protect transportation corridors based on official corridor maps. The official map which details the proposed thoroughfare alignment, the functional design, and the preliminary right-of-way boundaries is filed with the county Register of Deeds.

Roadway corridor maps may be adopted by the Department of Transportation or the municipality. The Department of Transportation makes official corridor maps only for fully controlled access facilities outside municipal jurisdiction. Municipalities must make official corridor maps for facilities without fully controlled access or facilities inside municipal jurisdictions. County Commissioners must approve municipal official corridor maps that extend beyond the municipality's extraterritorial jurisdiction.

Municipalities protect road corridors by prohibiting building permits or subdivision approvals on property within the corridor alignment. Because this places severe restrictions on private property rights, land owners are sometimes compensated by having a reduced tax rate on any undeveloped or unsubdivided land within the transportation corridor.

Awkward legislation makes official corridor maps ineffective or inappropriate for most road corridors. Unless an environmental impact study or preliminary engineering study begins within one year of the official corridor map recording, the official map becomes legally void. If the environmental impact process is initiated, property restrictions only last up to three years, beginning when the developer requests permit or subdivision approval. Even if all other criteria are met, if federal funds are used, the environmental impact process chooses the road corridor with the least environmental damage, not necessarily the official map corridor.

The document *Guidelines for Municipalities Considering Adoption of Roadway Corridor Official Maps* has more details. Request this document from:

Program and Policy Branch
N.C. Department of Transportation
P.O. Box 25201
Raleigh, North Carolina 27611.

The Program and Policy Branch of the North Carolina Department of Transportation is responsible for coordinating Official Corridor Maps.

Regulation Coordination

Individually, thoroughfare plan adoption, subdivision regulations, zoning ordinances, development reviews, and official maps are all useful regulation tools. However, these regulations should be coordinated together to enhance their total effectiveness. Although each regulation applies to different items, each regulation can support other regulations. Table 4 lists the regulations which should be coordinated for each thoroughfare plan project. Municipalities with coordinated regulations can transfer severable development rights as bargaining chips to attract and influence development in the community's best interest.

FUNDING

Almost every city, town, and village from the mountains to the coast would like some type of road improvements. Each year communities request funding for everything from new Interstates to bicycle paths. Right-of-way costs consume up to half of the total project costs. When municipalities can actively protect transportation corridors, reduce right-of-way costs and save North Carolina tax payers millions of dollars, Board of Transportation members notice.

TABLE 4: PROJECT REGULATION COORDINATION

Facility & Section	T-fare Plan	Subdivision Ordinance	Future Street Line Ordinance	Zoning Ordinance	Development Review
Butler Avenue (Proposed)					
SR 2411 - Frances Drive	x	x		x	x
Frances Dr. - Dead End	x	x		x	x
Faust St. (Proposed)					
Candlewood Dr - Highfill	x			x	
Swannanoa - Raleigh Ave.	x			x	
Hinshaw St. (Proposed)					
Kinro Rd. - Hinshaw St.	x	x		x	x
Dameron Ave. - NC 49	x	x		x	x
NC 49 - Butler Ave.	x	x		x	x
Hinshaw St. (Widening)					
Connector - Dameron Ave.	x		x	x	x
Kinro Road (Proposed)					
NC 49 - Swannanoa Ave.	x	x		x	x
Swannanoa - Starmount	x	x		x	x
Raleigh Ave. (Proposed)					
Martin St. - Hinshaw St.	x			x	
Sizemore Ave. (Proposed)					
corner - Proposed loop	x			x	
SR 2411					
(Paving existing road)					
Starmount - Prop Buttler	x	x		x	x
P Buttler- Frances Drive	x	x		x	x

Municipal Funding

Inside municipal corporate limits, municipalities are responsible for all local streets, all minor thoroughfares, and specially designated major thoroughfares. Thoroughfare plan recommendations should be incorporated in Liberty's Capital Improvement Program to match projected revenues with funds for street improvements. In addition to property taxes and Powell Bill money, municipal funds can be raised by impact fees and bond referendums.

Impact fees are a one-time tax paid by developers to help pay for negative impacts, such as traffic congestion, caused by new development. For example, impact fees can cover the additional public capital costs for widening streets to relieve traffic congestion caused by new construction. Well planned impact fees enable the town to minimize the lag time between when road improvements are needed and when road improvements are constructed.

The North Carolina General Statutes give municipalities authority to create municipal service districts to raise funds for capital improvements. Districts may float bond issues to facilitate traffic flow and parking. Bonds would be paid off with revenues from ad valorem taxes on all property within the district's boundaries. Once the improvements have been completed and the bonds retired, the extra tax would cease and the district would dissolve.

State and Federal Funding

The Department of Transportation, Division of Highways, is responsible for all state maintained roads outside municipal corporate limits. Inside municipal corporate limits, the Division of Highways is responsible for major streets and highways which carry primarily through traffic

and traffic to major commercial, industrial, or governmental destinations. Division of Highways funds for the construction, maintenance, and improvements to the state road system can help implement thoroughfare plan recommendations.

North Carolina's Transportation Improvement Program (TIP) is a document which lists all major construction projects the Department of Transportation plans for the next seven years. Similar to local Capital Improvement Program projects, TIP projects are matched with projected funding sources. Each year when the TIP is updated, completed projects are removed, programed projects are advanced, and new projects are added (typically during the seventh year).

During annual TIP public hearings, municipalities request projects such as the proposed NC 49 Bypass to be put in the TIP. A Board of Transportation member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

Non-TIP funds are also available for special purposes. The Department of Transportation has separate funds for paving secondary roads, building industrial access roads, and miscellaneous spot improvements in small urban areas. If traffic conditions are met, Secondary Road funds could pave Secondary Road 2411 - which is part of the northwestern portion of Liberty's loop. If an industry will develop land-locked property, and economic conditions are met, Industrial Access funds may be able to construct a part of Liberty's southwestern loop. The Federal Government provides useful block grants such as urban renewal grants and demonstration

project funding. Table 5 lists possible funding sources for implementing particular projects. Used in coordination with thoroughfare planning objectives, these other funding sources can make significant transportation improvements.

TABLE 5: PROJECT FUNDING SOURCES

Facility & Section	Local Funds	TIP Funds	Secondary Road Funds	Industrial Access Funds	Small Urban Spot Improvement
Butler Avenue (Proposed)					
SR 2411 - Frances Drive		x			
Frances Dr. - Dead End		x			
Faust St. (Proposed)					
Candlewood Dr - Highfill	x				
Swannanoa - Raleigh Ave.	x				
Hinshaw St. (Proposed)					
Kinro Rd. - Hinshaw St.		x			
Dameron Ave. - NC 49		x			
NC 49 - Butler Ave.		x			
Hinshaw St. (Widening)					
Connector - Dameron Ave.		x			
Kinro Road (Proposed)					
NC 49 - Swannanoa Ave.		x			
Swannanoa - Starmount		x			
Raleigh Ave. (Proposed)					
Martin St. - Hinshaw St.	x				
Sizemore Ave. (Proposed)					
corner - Proposed loop	x				
SR 2411					
(Paving existing road)					
Starmount - Prop Buttler			x		
P Buttler- Frances Drive			x		

APPENDICES

APPENDIX A

TYPICAL THOROUGHFARE CROSS SECTIONS

Cross section "A" illustrates a fully controlled access freeway. Rural Interstates typically have this cross section. The twelve-foot lanes, wide median and wide shoulders provide maximum speed, efficiency, and safety for travelers.

Cross section "B" illustrates a rural four-lane divided highway which may have either full or partial control of access. The twelve-foot lanes, median, and shoulders provide high speed, efficient, and safe traffic flow.

Cross section "C" illustrates an urban four-lane divided highway with curb, gutter and partial control of access. This curb and gutter section only uses half of the shoulder section right-of-way and still allows efficient and safe traffic flow.

Cross section "D" illustrates an urban four-lane highway with a raised median and partial control of access. Since raised medians are narrower than sloped medians, only 100 feet of right-of-way are necessary for efficient and safe traffic flow.

Cross section "E" illustrates a five-lane urban roadway with four through lanes and a center turning lane. Turning vehicles crossing the main traffic flow create accident hazards and traffic friction.

Cross section "F" illustrates a four-lane roadway with no center lane for left turns. When traffic volumes are high, vehicles turning left into driveways block traffic in the through lane. Additional left turn lanes are typically necessary at major intersections.

Cross section "G" illustrates a two-lane road with parking on both sides. Because this facility serves both land use and traffic, it should be designated a minor thoroughfare or a local street.

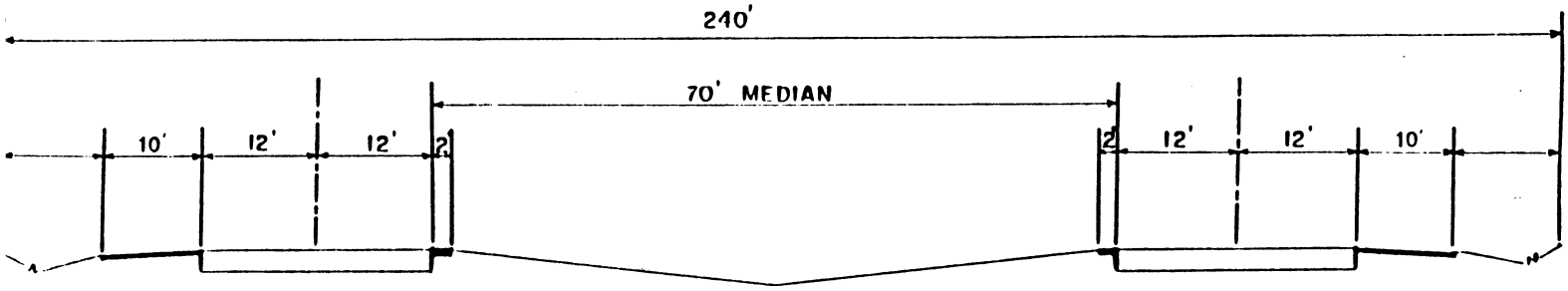
Cross section "H" illustrates a three-lane roadway. For two-directional traffic flow, the center lane can be a turning lane. For one-way traffic flow, all three lanes flow in the same direction with a parallel road operating in the opposite direction.

Cross section "I" illustrates a two-lane road with parking on one side. Because this facility serves both land use and traffic, it should be designated a minor thoroughfare or a local street.

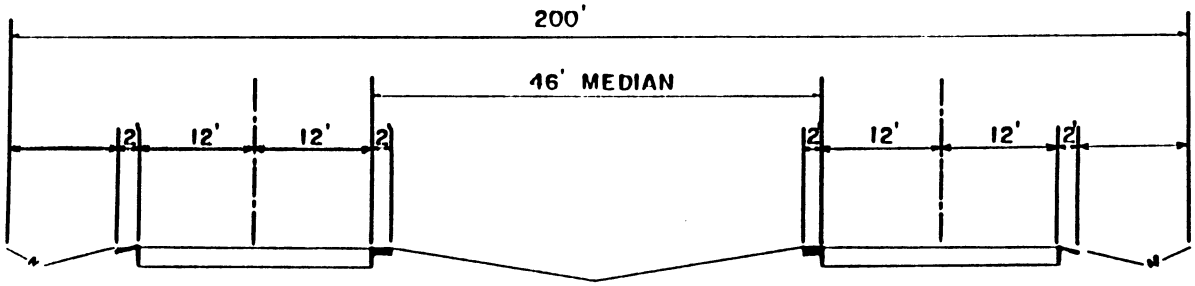
Cross section "J" illustrates a rural two-lane roadway with shoulders. When two lanes will have enough capacity through the design year, but may ultimately need additional capacity, 100 feet of right-of-way are recommended. This allows future local officials the ability to widen the road as much as necessary, up to a four-lane divided cross section with a raised median.

The curb and gutter urban cross sections illustrate the sidewalk between the road and the utility strip. The sidewalk width is the minimum recommended safety buffer between moving automobiles and utility poles. For additional pedestrian safety and community aesthetics, municipalities often place sidewalks outside of this buffer zone. Additional right-of-way is necessary if the sidewalk is moved farther away from the street. In addition, communities encouraging bicycling should allow additional right-of-way for the bicycle facilities. The *Guide For Development of New Bicycle Facilities* published by the American Association of State Highway and Transportation Officials details design standards for bicycle facilities.

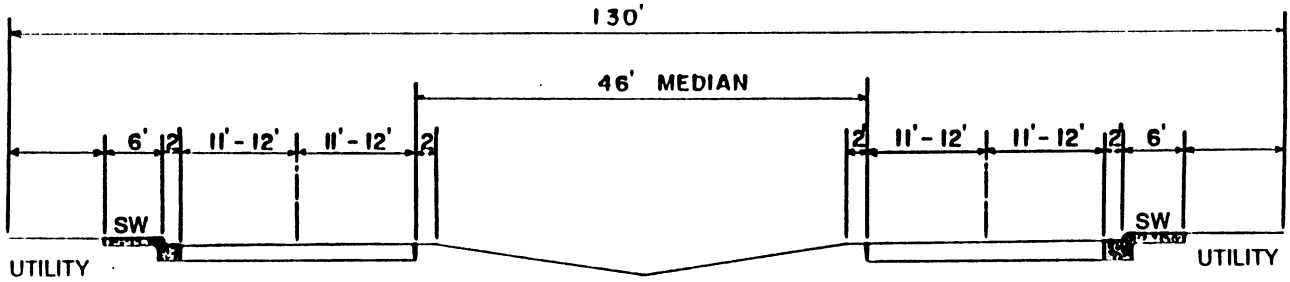
TYPICAL THOROUGHFARE CROSS SECTIONS



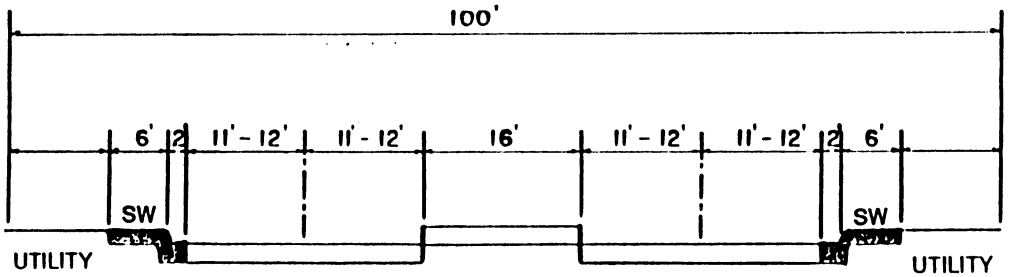
A. FOUR LANES DIVIDED WITH MEDIAN - FREEWAY



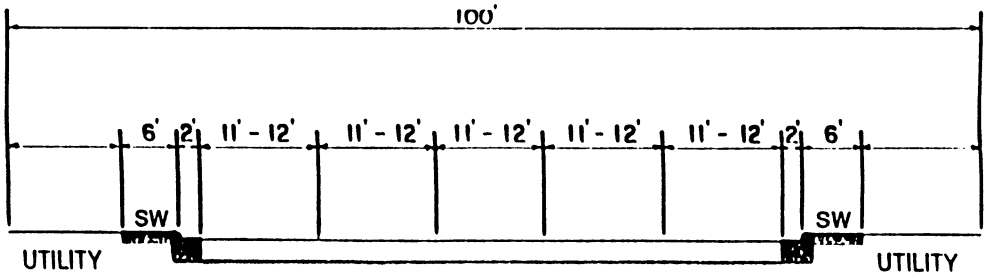
B. FOUR LANES DIVIDED WITH MEDIAN - RURAL



C. FOUR LANES DIVIDED - URBAN BOULEVARD

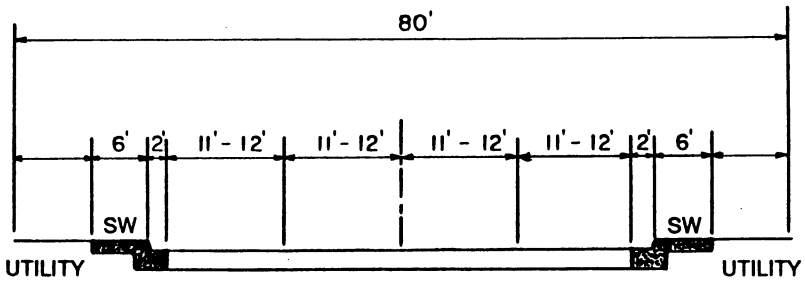


D. FOUR LANES DIVIDED WITH RAISED MEDIAN

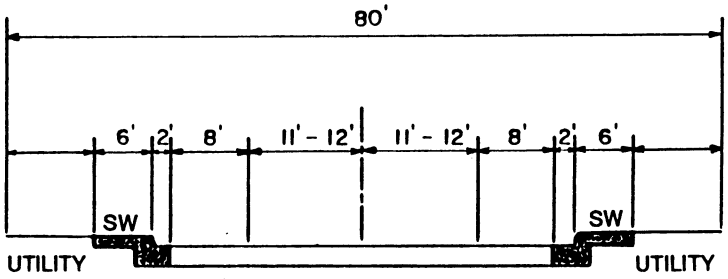


E. FIVE LANES

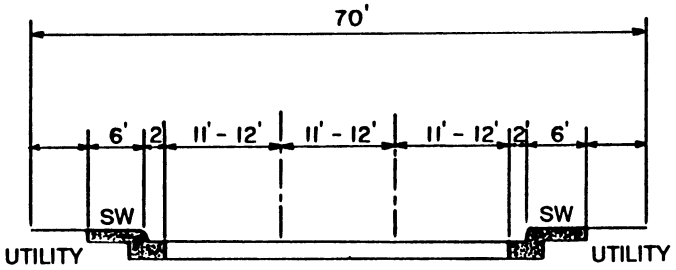
FIGURE 10



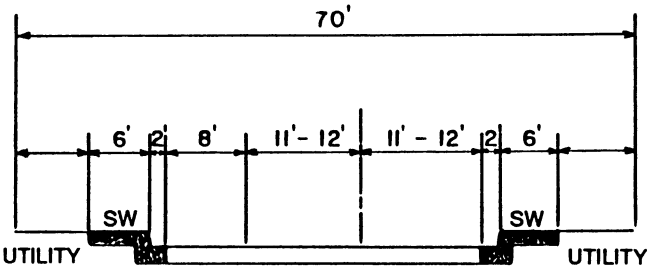
F. FOUR LANES



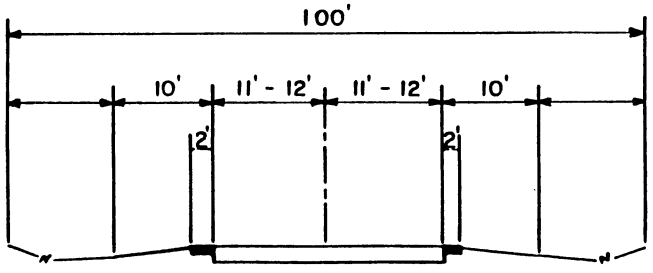
G. TWO LANES
PARKING ON EACH SIDE



H. THREE LANES



I. TWO LANES - PARKING ON ONE SIDE



J. TWO LANES - RURAL

APPENDIX B
EXAMPLE SUBDIVISION ORDINANCES

DEFINITIONS

I. Streets and Roads:

A. Rural Roads

1. Principal Arterial - a rural road serving statewide or interstate travel. Principal Arterial roads should serve high volumes of through traffic, not direct land access.

2. Minor Arterial - a rural road serving intrastate and inter-county travel by connecting cities and towns. Minor Arterial roads should provide efficient traffic flow, but may have limited direct land access.

3. Major Collector - a rural road serving major intra-county travel and large traffic generators. Major Collector roads should connect traffic to the Arterial roads.

4. Minor Collector - a rural road serving local communities and moderate traffic generators. Minor Collector roads should provide both traffic movement and direct land access.

5. Local Road - a rural road which provides direct access to adjacent land.

B. Urban Streets

1. Major Thoroughfare - a major street which carries high volumes of traffic in and through urban areas. Major Thoroughfares primarily serve traffic movement, not direct land access.

2. Minor Thoroughfare - a street which connects local streets to Major Thoroughfares. Minor Thoroughfares should serve both traffic movement and direct land access.

3. Local Street - a street which provides direct access to adjacent land.

C. Specific Streets (Rural or Urban)

1. Interstate Highway - a divided multilane highway designed to carry large volumes of high speed traffic through states. Interstate Highways must be accessed by interchanges because they do not provide any direct land access.

2. Freeway - a divided multilane highway designed to carry large volumes of high speed traffic. Freeways must be accessed by interchanges because they do not provide any direct land access.

3. Expressway - a divided multilane roadway designed to carry large volumes of high speed traffic. Expressways have either full or partial control of access and generally have grade separations at major intersections.

4. Parkway - a roadway designed for non-commercial traffic. Parkways may have either full or partial control or access.

5. Frontage Road - a road that is parallel to a partial or full access controlled facility. Frontage roads provide direct land access.

6. Local Residential Street - a street less than one mile long that does not serve major traffic generators or collect traffic from more than 100 dwelling units. Local residential streets can be cul-de-sacs or circles.

7. Alley - a narrow road used only for service vehicles accessing the back side of properties.

8. Cul-de-sac - a short street having one end open to traffic and the other end a vehicular turnaround.

II. Property

A. Building Setback Line - a line parallel to the street which specifies the minimum distance between the street right-of-way and buildings.

B. Easement - a grant by the property owner limiting the land use on a specific piece of property. For example, the property owner can give or sell easement rights for a street across a particular section of the property.

C. Lot - a portion of land which can be bought or sold. A lot may also be referred to as a plat, parcel, or tract.

III. Subdivision

A. Subdivider - a person, firm, corporation or official agent who divides large lots into smaller lots.

B. Subdivision - (1) All divisions of a tract of land into two or more lots or building sites for sale or development (2) All divisions of land involving the dedication of new streets or changes in existing streets.

C. Dedication - Property given by the owner to another party. Official dedications are made and accepted in writing.

D. Reservation - An agreement to keep property free from development for a period of time. Property reservations do not involve any transfer of property rights.

DESIGN STANDARDS

All roads shall be designed in accordance with the North Carolina Department of Transportation policies or American Association of State Highway and Transportation Officials' policies.

I. Right-of-way - Minimum right-of-way (ROW) for roads shall conform with the recommendations listed in the thoroughfare plan. When the thoroughfare plan does not specify a ROW, the following widths should be used:

	Min. ROW
A. Rural Roads	
1. Principle Arterial Freeway	350 ft.
2. Other Principle Arterial	200 ft.
3 Minor Arterial	100 ft.
4. Major Collector	100 ft.
5. Minor Collector	80 ft.
6. Local Road	60 ft. (1)
B. Urban Roads	
1. Major Thoroughfare other	100 ft.
2. Minor Thoroughfare	70 ft.
3. Local Street	60 ft. (1)
4. Cul-de-sac	Variable (2)

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(1) The minimum desirable ROW is 60 feet, but if curb and gutter is provided, 50 feet of ROW is adequate on local residential streets.

(2) The ROW dimension will depend on radius used for vehicular turnaround. The distance from the edge of the pavement of the turnaround to ROW should not be less than distance from edge of pavement to ROW on the street approaching turnaround.

Subdivisions should provide access to properties from local streets. Direct property access to major thoroughfares, principle arterials, minor arterials, and major collectors should be avoided.

When proposed subdivisions conflict with proposed thoroughfares, the subdivider shall dedicate the necessary ROW for the proposed thoroughfare. The subdivider will only be required to dedicate a maximum of 100 feet of ROW. In cases where over 100 feet of ROW are needed, the subdivider should dedicate 100 feet, and reserve the amount in excess of 100 feet.

When a proposed subdivision borders a proposed thoroughfare, and undeveloped land boarders the opposite side of the proposed thoroughfare, partial width ROW may be dedicated. However, the partial ROW must be at least

sixty feet, and the width of the partial dedication must be wide enough to construct necessary facilities to serve abutting lots. Subsequently, when the undeveloped land on the opposite side of the road is subdivided, the remainder of the required ROW shall be dedicated.

When proposed subdivisions are adjacent to proposed thoroughfare widenings, subdividers shall dedicate the necessary ROW for the proposed thoroughfare widening.

II. Street Widths - Street widths should conform with the recommendations listed in the thoroughfare plan. When the thoroughfare plan does not specify a street width, the following widths should be used:

A. Local residential streets with a curb and gutter should have 26 feet of pavement from face-to-face of the curb. Local residential streets with a shoulder should have twenty feet of pavement and four foot shoulders.

B. Residential collector streets with a curb and gutter should have 34 feet from face-to-face of the curb. Residential collector streets with a shoulder should have twenty feet of pavement and six foot shoulders.

III. Geometric Characteristics - The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System.

A. Design Speed - The design speed should be a minimum of 5 miles per hour greater than the posted speed limit. The design speeds for subdivision streets shall be:

DESIGN SPEEDS			
Facility Type	Desirable	Minimum Level	Rolling
RURAL			
Minor Collector Roads	60	50	40
Local roads	50	50 (1)	40 (1)
URBAN			
Major Thoroughfares other than Freeway or Expressway	60	50	50
Minor Thoroughfares	60	50	40
Local Streets	40	40 (2)	30 (2)

(1) Based on average daily traffic of 400-750.
(2) Based on average daily traffic of 50-250.

B. Maximum and Minimum Grades

1. The maximum grades in percent shall be:

MAXIMUM VERTICAL GRADE		
Design Speed	Terrain Level	Rolling
60	4	5
50	5	6
40	6	7
30		9

2. Minimum grade should not be less than 0.5%.

3. Grades for 100 feet each way from intersections (measured from edge of pavement) should not exceed 5%.

4. For streets and roads with projected annual average daily traffic less than 250, short grades less than 500 feet long, may be 150% of the value in the above table.

C. Minimum Sight Distance - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the following parameters:

SIGHT DISTANCE				
Design Speed	30	40	50	60
Stopping Sight Distance:				
Minimum (ft.)	200	275	400	525
Desirable Minimum (ft.)	200	325	475	650
Minimum K (1) Value for:				
Crest curve	30	80	160	310
Sag curve	40	70	110	160

(1) K is a coefficient which the algebraic difference in grade is multiplied to determine the length of the vertical curve which will provide the desired sight distance. (General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case.)

D. The superelevation table below shows the maximum degree of curve and maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter of 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

SUPERELEVATION TABLE

Design Speed	Maximum e	Minimum Radius ft.	Max. Deg. of Curve.
30	0.04	302	19 00′
40	0.04	573	10 00′
50	0.04	955	6 00′
60	0.04	1,528	3 45′
30	0.06	273	21 00′
40	0.06	509	11 15′
50	0.06	849	6 45′
60	0.06	1,380	4 15′
30	0.08	252	22 45′
40	0.08	468	12 15′
50	0.08	764	7 30′
60	0.08	1,206	4 45′

e = rate of superelevation in feet per foot

IV. Intersections

A. Streets shall intersect as nearly as possible at right angles. No street should intersect any other street at an angle less than sixty-five degrees.

B. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

C. Offset intersections should be avoided. Intersections which cannot be aligned should be separated by a minimum length of 200 feet between survey center lines.

D. Intersections along major thoroughfares should be spaced at regular intervals. Five hundred feet is the minimum desirable spacing between intersections.

V. Cul-de-sacs

Cul-de-sacs shall not be more than five hundred feet long.

VI. Alleys

Alleys shall be at least twenty feet wide. Dead-end alleys shall be avoided. However, if dead-end alleys are unavoidable, adequate turnaround facilities shall be provided at the dead-end.

VII. Driveways Connecting To State Roads

A permit from the Department of Transportation is required for connecting driveways to any state maintained road. Permit approval is required prior to any construction on the road. Driveway permit applications are available from the District Engineer's office.

VIII. Offsets To Utility Poles

On roadways with shoulders, utility poles should be located a minimum of thirty feet from the edge of pavement. On streets with curb and gutter, utility poles should be a minimum of six feet behind the face of the curb.

IX. Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

X. Bridge Deck Width

A. The bridge deck widths for new bridges serving 2-lane, 2-way traffic should meet the following specifications:

1. Shoulder section approach
   a. If the design year average daily traffic is under 800 vehicles per day, the bridge deck should be ten feet wider than the roadway width or 28 feet, whichever is greater.

b. If the design year average daily traffic is between 800 and 2000 vehicles per day, the bridge deck should be twelve feet wider than the roadway width or 34 feet, whichever is greater.

c. If the design year average daily traffic is over 2000 vehicles per day, the desirable bridge deck is 44 feet. The minimum bridge deck width is 40 feet.

2. Curb and gutter approach

a. If the design year average daily traffic is under 800 vehicles per day, the bridge deck should be a minimum of 24 feet from face-to-face of curbs.

b. If the design year average daily traffic is over 800 vehicles per day, the bridge deck should be the width of the approach pavement from face-to-face of curbs.

c. Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of one and a half feet. (greater if sidewalks are desired).

B. The bridge deck widths for new bridges having four or more lanes serving undivided two-way traffic should meet the following specifications:

1. If the approaching roadway has a shoulder, the bridge deck should have the width of approach pavement plus width of usable shoulders on both sides. Ten foot shoulders are desirable, but minimum shoulders of eight feet acceptable.

2. If the approaching roadway has a curb and gutter, the bridge deck should have the width the of approach pavement measured from face-to-face of the curbs.

APPENDIX C
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