

TRAFFIC SEPARATION STUDY

For

CLAYTON, NORTH CAROLINA

And

THE NORTH CAROLINA DEPARTMENT OF
TRANSPORTATION

RAIL DIVISION

ENGINEERING AND SAFETY BRANCH



RAIL DIVISION



PREPARED BY

TRANSYSTEMS
CORPORATION
CONSULTANTS



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FOR CLAYTON, NORTH CAROLINA
AND THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**

EXECUTIVE SUMMARY

The Town of Clayton and the North Carolina Department of Transportation (NCDOT) have developed and entered into a Municipal Agreement to conduct a Traffic Separation Study of the nine public at-grade crossings of the North Carolina Railroad Company (NCR) / Norfolk Southern Railway (NS) corridor in Clayton. As part of a comprehensive evaluation of traffic patterns and road usage for an entire municipality or region, traffic separation studies determine the need for improvements and/or elimination of public grade crossings to improve safety for motorists, rail passengers and train crews.

These improvements may include crossing closures/consolidation, improved warning devices, roadway improvements, and elimination of sight obstructions. The study includes the nine (9) existing public railroad-highway crossings between Shotwell Road (SR 1553) and NC 42 and one existing public pedestrian crossing (located between Church Street and Smith Street).

For the purposes of this study, the railroad will be referred to as Norfolk Southern. Norfolk Southern is the operating railroad company, however, the route's right-of-way is owned by the North Carolina Railroad Company, which is a private company owned wholly by the State of North Carolina. Norfolk Southern operates a single main track on a northwest-to-southeast orientation through the Town of Clayton, roughly paralleling Main Street.

Currently, there are twelve train movements per day through the study area, which includes eight NS freight trains and four passenger trains operated by Amtrak. Passenger train activity is expected to increase in the future, as this stretch will serve as the primary commuter route between Raleigh and Selma/Smithfield. Additional passenger train activity will occur if this route is utilized as an alternate route for the Southeast High Speed Corridor.

Trains are currently limited to a speed of 49 miles per hour through the study area, however the line may be upgraded in the future to higher speeds with the installation of a train control signal system and rail replacement.

Vehicular crossing volumes range from a low of approximately 500 vehicles per day at W. Stallings Street to over 14,600 vehicles per day at NC 42.

With a population approaching 6,900, Clayton is the second largest town in Johnston County. Based on population and job growth factors, future traffic volumes are projected to grow 1.5 percent per year on Smith, Church, Robertson, W. Stallings and Central

Streets. Traffic volumes are projected to grow at a rate of 4 percent per year on O’Neil Street, Fayetteville Street, Front Street, and Shotwell Road.

As Clayton’s population continues to grow, along with anticipated increases in daily train movements, traffic delays and the probability of accidents can be expected to increase at the crossings within the study area unless improvements are implemented to better control and/or separate rail traffic from highway and pedestrian traffic. The recommended improvements are as follows:

Near-term Recommendations (0-2 years):

Close Smith Street crossing to vehicular traffic	\$10,000
Remove existing pedestrian crossing and install landscaping.....	\$5,000
Install pedestrian crossing at existing Smith Street location with a proven design, signage, and appropriate fencing of the right-of-way	\$50,000
Install raised concrete median with tube delineators at Shotwell Road.....	\$3,000
Install raised concrete median with tube delineators at NC 42	\$3,000
Install Traffic Signal at Central Street/Main Street Intersection	<u>\$50,000</u>
	\$121,000

Mid-Term Recommendations (2-5 years):

Construct Fayetteville St. extension to O’Neil St.	\$500,000
Additional Right-of-Way	\$250,000
Install Rubberized Crossing at Fayetteville St.....	\$30,000
Install Signal at Fayetteville/Main Intersection	\$40,000
Remove Signal at O’Neil/Main Intersection	\$4,000
Close O’Neil Street Crossing.....	\$16,000
Construct West Stallings St. Extension to Old US 70.....	\$300,000
Additional Right-of-Way	\$100,000
Close West Stallings St. Crossing	<u>\$16,000</u>
	\$1,256,000

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PURPOSE OF THE STUDY

The Town of Clayton and the North Carolina Department of Transportation (NCDOT) have developed and entered into a Municipal Agreement to conduct a Traffic Separation Study of the nine public at-grade crossings of the North Carolina Railroad Company (NCRRA)/Norfolk Southern Railway (NS) corridor in Clayton. As part of a comprehensive evaluation of traffic patterns and road usage for an entire municipality or region, traffic separation studies determine the need for improvements and/or elimination of public grade crossings to improve safety for motorists, rail passengers and train crews. These improvements may include crossing closures/consolidation, improved warning devices, roadway improvements, and elimination of sight obstructions.

The study involves evaluation of nine (9) existing public railroad-highway crossings, including Shotwell Road (SR 1553), W. Stallings Street (SR 1709), Robertson Street (SR 1552), O'Neil Street (SR 1708), Fayetteville Street, Church Street, Smith Street, Central Street, and NC 42 and one existing public pedestrian crossing (located between Church Street and Smith Street).

Preamble

Across the United States of America, several hundred people are killed each year in collisions at highway-rail crossings. Collisions between trains and highway vehicles are the principal cause of death in the railroad industry. In 1998, there were 109 highway/rail-crossing collisions in North Carolina, resulting in 15 deaths and 48 injuries. North Carolina ranks 14th in the nation for such collisions. As the number of freight and passenger trains increases and highway traffic volumes grow, the need to identify and prioritize safety enhancements will become even more critical.

Since the late 1970's aggressive safety programs have lead to steady reductions in deaths and injuries due to train-vehicle collisions. The NCDOT Rail Division administers a comprehensive program to improve rail-crossing safety. The Federal Railroad Administration, Federal Highway Administration, and affected railroad operators all support and participate in this program.

The Clayton Study

For the purposes of this study, the railroad will be referred to as Norfolk Southern. Norfolk Southern is the operating railroad company, however, the route's right-of-way is owned by the North Carolina Railroad Company, which is a private company owned wholly by the State of North Carolina. Norfolk Southern operates a single main track on a northwest-to-southeast orientation through Clayton, roughly paralleling Main Street.

Currently, there are twelve train movements per day through the study area, which includes eight NS freight trains and four passenger trains operated by Amtrak. Passenger train activity is expected to increase in the future, as this stretch will serve as the primary commuter route between Raleigh and Selma/Smithfield. Additional passenger train activity will occur if this route is utilized as an alternate route for the Southeast High Speed Corridor.

Trains are currently limited to a speed of 49 miles per hour through the study area, however the line may be upgraded to higher speeds in the future with the installation of a train control signal system and rail replacement.

Vehicular volumes at the studies crossings range from a low of approximately 500 vehicles per day at W. Stallings Street to over 14,600 vehicles per day at NC 42.

The evaluation of the Clayton crossings included the following:

- Twenty-four hour average daily traffic counts (ADT) were obtained from the North Carolina Department of Transportation for the crossings as well as other streets within the network.
- Interviews with state and local officials were conducted to gain local insight into the potential improvements to each crossing.
- Data was collected from the Johnston County School System, the Clayton Fire and Rescue Department, and the Johnston County Emergency Medical Service as to frequency of use associated with each crossing and the impacts to service that would result if a crossing were closed or modified.
- Available historic information and mapping was utilized in the development of the report conclusions and recommendations.

Based on this evaluation, this report will:

- Identify impacts of any proposed crossing closure on adjacent property and the roadway network.
- Include conclusions and recommendations necessary to accommodate any proposed crossing closure.
- Identify potential grade separations.
- Recommend corrective action for identified safety issues relating to the nine (9) railroad/highway crossings and the pedestrian crossing.
- Include preliminary cost estimates for recommended improvements.
- Development of a proposed Plan of Implementation.

EXISTING CONDITIONS

The Town of Clayton, located in the western portion of Johnston County, was built along the route that was cut by Governor Tryon's troops as they marched from New Bern to Hillsborough against the Regulators around 1770. The community was first known as Stallings' Station, a depot for the North Carolina Railroad in the home of Mrs. Sarah Stallings. On January 30, 1856, the name was officially changed to Clayton so-named for a senator from Delaware. The Town of Clayton was incorporated in 1869.

With a population approaching 6,900, Clayton is the second largest town in Johnston County. Based on population and job growth factors, future traffic volumes are projected to grow 1.5 percent per year on Smith, Church, Robertson, W. Stallings and Central Streets. Traffic volumes are projected to grow at a rate of 4 percent per year on O'Neil Street, Fayetteville Street, Front Street, and Shotwell Road.

Clayton's Town Hall, Fire and Rescue Stations and Police Station are located at the intersection of Second Street and Barbour Street, one block southwest of Main Street (see Figure 1). Construction of Fire Station No. 2, located along NC 42, was recently completed and is expected to be operational in late spring of 2000. The commercial area of Clayton is mainly located to the southwest of the railroad along Main Street and along US 70. Scattered commercial uses are located northeast of the railroad along Fayetteville Street and O'Neil Street. Clayton's new United States Post Office is located in the northeast quadrant at the intersection of Central Street and Front Street.

Northeast of the railroad between Robertson Street and Central Street, the land use is primarily residential interspersed with services such as churches and schools. Development to the north of Front Street has occurred along the ridge areas of several major drainage areas of the Neuse River. NC 42 provides the only direct route from US 70 into the northwestern areas of Clayton and Johnston County. Likewise, east-west circulation north of Front Street is limited with no direct access from NC 42 to Stallings Road.

INVENTORY OF EXISTING AT-GRADE CROSSINGS

(See Figure 1 and Appendix A)

Crossing No. 735 394Y Shotwell Road (SR 1553)

Shotwell Road (SR 1553) is an important north-south route from US 70 to northern Johnston County and southern Wake County. Crossing No. 735 394Y is located approximately 4200 feet north of US 70 and approximately 330 feet south of the intersection of Shotwell Rd. and Old US 70 (SR 1004). Four (4) school buses per day cross the Shotwell Road railroad crossing. The at-grade rail crossing is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided well in advance of the crossing in each direction. Land use in the area is primarily agricultural with sparse residential development around the Old US 70 /Shotwell Road intersection and a Winn-Dixie distribution warehouse south of the crossing.

Crossing No. 735 396M West Stallings Street (SR 1709)

West Stallings Street (SR 1709) is an east-west local street that begins at Main Street (SR 1004), crosses the NS track and a siding track at Crossing No. 735 396M, then turns to the southeast and leads into Clayton, terminating at O'Neil Street (SR 1708). Crossing No. 735 396M is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided well in advance of the crossing in each direction. Sight distance approaching the crossing is poor due to the fact that the alignment of both approaches is parallel to the track with 90-degree "S" curves occurring each side of the crossing. Five (5) school buses per day use the W. Stallings Street crossing. Land use in the vicinity is primarily residential. The distance to adjacent crossings, as measured along the NS track, is approximately 3220 feet to Crossing No. 735 394Y (Shotwell Road) and 3060 feet to Crossing No. 735 397U (Robertson Street).

Crossing No. 735 397U Robertson Street (SR 1552)

Robertson Street (SR 1552) is a north-south collector from US 70 through downtown Clayton, terminating at West Stallings Street (SR 1709). At Crossing No. 735 397U, Robertson Street crosses both the NS track and a siding track. The NS track is located approximately 314 feet north of Main Street and 65 feet south of Front Street. The siding track is located to the north of the NS track, with a center-to-center distance of 14 feet. Crossing No. 735 397U is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided in advance of the crossing in each direction. Seventeen (17) school buses per day utilize the Robertson Street crossing. Land uses are residential in the northern quadrants and business in the southern quadrants. The distance to adjacent crossings, as measured along the NS track, is approximately 3060 feet to Crossing No. 735 396M (West Stallings Street) and 790 feet to Crossing No. 735 398B (O'Neil Street).

Crossing No. 735 398B O'Neil Street (SR 1708)

O'Neil Street (SR 1708) is a north-south collector that begins at Blanche Street, extends through downtown Clayton and continues into the northeastern communities of Johnston County. Crossing No. 735 398B, which is located approximately 380 feet north of Main Street and 65 feet south of Front Street, is currently equipped with gates and cantilevers with flashers and bells. Advance warning signs is provided in advance of the crossing in each direction. Advance warning pavement markings are provided on the northern approach. Six (6) school buses per day use the O'Neil Street crossing. Land use in all quadrants is mix of residential and business. The distance to adjacent crossings, as measured along the NS track, is approximately 790 feet to Crossing No. 735 397U (Robertson Street) and 265 feet to Crossing No. 735 399H (Fayetteville Street).

Crossing No. 735 399H Fayetteville Street

Fayetteville Street is a north-south collector from US 70 through downtown Clayton, terminating at Wilson Street. Clayton High School is located along Fayetteville Street

immediately north of US 70. Crossing No. 735 399H, which is located approximately 380 feet north of Main Street and 60 feet south of Front Street, is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided in advance of the crossing in each direction, however, the northern approach pavement markings have been partially obscured by previous pavement patching activities. Three (3) school buses per day use the Fayetteville Street crossing. Land uses are residential in the northern quadrants and business in the southern quadrants. The distance to adjacent crossings, as measured along the NS track, is approximately 265 feet to Crossing No. 735 398B (O'Neil Street) and 475 feet to Crossing No. 735 400A (Church Street).

Crossing No. 735 400A Church Street

Church Street is a north-south local street that begins at Horne Street and terminates at Wilson Street. Crossing No. 735 400A, which is located approximately 320 feet north of Main Street and 60 feet south of Front Street, is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided in advance of the crossing in each direction. The vertical alignment is slightly "humped" at the crossing and moderately steep north of the crossing to Front Street. Seven (7) school buses per day utilize the Church Street crossing. Land uses are residential in the northern quadrants and business in the southern quadrants. A church is located on Front Street near Church Street, as is the Front Street Park. The park, which is owned by the Town of Clayton, provides a playground area and basketball courts for area residents. The distance to adjacent crossings, as measured along the NS track, is approximately 475 feet to Crossing No. 735 399H (Fayetteville Street) and 1900 feet to Crossing No. 735 401G (Smith Street).

Crossing No. 904 416N Pedestrian

Crossing No. 904 416N, a pedestrian crossing, is located approximately midway between Crossing No. 735 400A (Church Street) and Crossing No. 735 401G (Smith Street). On the north side of the tracks, concrete stairs lead from Front Street to the tracks. On the south side, a concrete sidewalk leads from the tracks to a parking lot situated between the tracks and Main Street (SR 1004). Discussions with the Chamber of Commerce indicate that an office building is proposed to be built on parking lot property. There are currently "No Trespassing" signs located at the top of the stairs near the railroad tracks, however according to the latest AAR Crossing Inventory Form, track charts and railroad plans, a pedestrian easement exists at this location. Topography of the track in relation to the surrounding area is such that pedestrians can easily cross or access the track bed to walk along the track in several areas. However, the topography slopes steeply in several areas, which creates a hazard for "trespassers" in the event of an oncoming train.

Crossing No. 735 401G Smith Street

Smith Street is a north-south local street from US 70 through the eastern edge of downtown Clayton, terminating in a residential area north of the railroad. Smith Street's

alignment is offset at Main Street (SR 1004) and Front Street, creating “dog-leg” movements at these intersections. Crossing No. 735 401G, which is located approximately 220 feet north of Main Street and 60 feet south of Front Street, is currently equipped with crossbucks and stop signs. Advance warning signs and pavement markings are provided in advance of the crossing in each direction, although the pavement markings on the northern approach are nearly obliterated. The vertical alignment is severely “humped” at the crossing and extremely steep north of the crossing to Front Street. Since a March 18, 1998, fatality at this crossing involving a train and van, no school buses have used this crossing. Land uses are residential in the northern quadrants and a mix of residential and business in the southern quadrants. The distance to adjacent crossings, as measured along the NS track, is approximately 1900 feet to Crossing No. 735 400A (Church Street) and 1055 feet to Crossing No. 735 402N (Central Street).

Crossing No. 735 402N Central Street

Central Street is a north-south local street that begins at Main Street (SR 1004) and terminates in a residential area north of the railroad. Crossing No. 735 402N, which is located approximately 100 feet north of Main Street and 80 feet south of Front Street, is currently equipped with flashers, gates, and bells. Advance warning signs and pavement markings are provided on both approaches immediately before the crossing. Additional advance warning signs are located on Main Street and Front Street near their intersections with Central Street. Nine (9) school buses per day utilize the Central Street crossing. No development exists along Central Street between Main Street and Front Street. Clayton’s new United States Post Office is located in the northeast quadrant of the intersection of Central Street and Front Street. Otherwise, land uses are primarily residential north of the railroad and a mix of residential and business along Main Street in the southern quadrants. Front Street Church of God is located near Central Street on Front Street. The distance to adjacent crossings, as measured along the NS track, is approximately 1055 feet to Crossing No. 735 401G (Smith Street) and 3115 feet to Crossing No. 735 404C (NC 42).

Crossing No. 735 404C NC 42

NC 42 is a primary southwest-to-northeast route through Johnston County. From its intersection with US 70, NC 42 provides access to the rapidly developing residential corridor northeast of Clayton along the Neuse River, as well as major employment centers such as Caterpillar Corporation. Clayton Fire Station No. 2 (currently under construction) and East Clayton Elementary School are also located on NC 42 northeast of the railroad crossing. Crossing No. 735 404C, which is located approximately 100 feet northeast of US 70, is a rubberized crossing equipped with gates and cantilevers with flashers and bells. The crossing gates and flashers are interconnected with the signals at the US 70 / NC 42 intersection to assure that the crossing area can be cleared of vehicles as trains approach. Advance warning signs and pavement markings are provided in advance of the crossing on both approaches. Additional advance warning signs are located on US 70. Forty-three (43) school buses per day utilize the NC 42 crossing. Guy C. Lee Building Supply is located in the northwest quadrant and the northeast quadrant is undeveloped. Land use in the southern quadrants along US 70 is a mix of residential and commercial.

Town of Clayton Thoroughfare Plan

The NCDOT, Statewide Planning Branch in conjunction with the Town of Clayton, is in the process of updating the Town of Clayton Thoroughfare Plan. The current Thoroughfare Plan (dated August 6, 1990) is shown as Figure 2. As part of the process, a “Clayton Goals and Objectives Survey” was conducted. The survey was mainly distributed with the town’s utility bills. Question 1 of the survey asked the participants to evaluate which three railroad crossings were most important (Shotwell Road and NC 42 were not included in the survey). The results are listed below.

Rank	Road	Important Crossing
1	O’Neil Street	82.8%
2	Central Street	75.9%
3	Robertson Street	39.7%
4	Church Street	36.2%
5	W. Stallings Street	27.6%
6	Fayetteville Street	22.4%
7	Smith Street	10.3%

The two most frequently selected crossings were O’Neil Street and Central Street, while Smith Street was selected the least often. Other questions in the survey dealt with roadway improvements to increase capacity, congestion, desirability of various transportation measures, and the ranking of transportation issues (closure of railroad crossings ranked 11th of 19 issues).

EVALUATION CRITERIA

All crossings were evaluated using the criteria developed for the NCDOT rail crossing closure program. Criteria used is evaluating the crossings include:

- Accident history - The accident classification system developed by the Federal Highway administration was utilized for this report. Under this system, accidents are classified as shown below.

Classification	Description
K	Killed
Class A	Injured/Transport to Hospital
Class B	Injured/Treat on Scene
Class C	Complains of injury/No treatment
PDO	Property Damage only

- Vehicle traffic - Present and Future
- Train traffic

- Truck traffic/Truck Route
- Hazardous Materials
- Type roadway (thoroughfare, collector, local access, etc.)
- Type of property being served (residential, industrial, commercial)
- School bus route
- Emergency Route
- Type warning devices present
- Redundant crossing (yes/no)
- Potential for grade separation
- Feasibility of implementing roadway improvements (high, medium, low)
- Economic impact if crossing closed (high, medium, low)

The evaluations are shown in Table 1 on the following pages.

Table 1
Evaluation of Street/Railroad At-Grade Crossings

Crossing #	Railroad	Town or County	Street Name	Maintenance Responsibility	Secondary Road Number	Street Class.	Warning Devices (Type)*
735-394Y	NS	Clayton	Shotwell	NCDOT	SR 1553	Collector	5
735-396M	NS	Clayton	W. Stallings	NCDOT	SR 1709	Local	5
735-397U	NS	Clayton	Robertson	NCDOT	SR 1552	Local	5
735-398B	NS	Clayton	O'Neil	NCDOT	SR 1708	Collector	5
735-399H	NS	Clayton	Fayetteville	Clayton	-----	Collector	5
735-400A	NS	Clayton	Church	Clayton	-----	Local	5
735-401G	NS	Clayton	Smith	Clayton	-----	Local	3
735-402N	NS	Clayton	Central	Clayton	-----	Local	5
735-404C	NS	Clayton	NC 42	NCDOT	NC 42	Arterial	5,6

Type 1: Unmarked
Type 2: Crossbucks
Type 3: Stop signs/Crossbucks

* Warning Device Descriptions
Type 4: Flashing signals & bells
Type 5: Flashing signals, bells & gates
Type 6: Traffic Signal Interconnect

Type 7: Traffic Signals

Street Name	24 Hour ADT	2025 ADT (Projected)	24 hour Train Volume	10 Year Accident History (Number)	School Bus Route (Y/N)	Emergency Route (Y/N)	Hazardous Materials (Y/N)
Shotwell	6,535	18,840	12	1 (IPDO)	Y	Y	N
W. Stallings	518	774	12	0	Y	Y	N
Robertson	1,912	2,858	12	2(1A, 1PDO)	Y	Y	N
O'Neil	4,665	13,449	12	0	Y	Y	N
Fayetteville	854	2,462	12	0	Y	Y	N
Church	1,301	1,945	12	1(1C)	Y	Y	N
Smith	543	812	12	1 (1K)	N	Y	N
Central	2,035	3,042	12	1 (1B)	Y	Y	N
NC 42	14,607	42,185	12	1 (1inj.)	Y	Y	N

Table 1 (con't)
Evaluation of Street/Railroad At-Grade Crossings

Street Name	Designated Truck Route (Y/N)	% Trucks	Crossing Condition (Good, Fair, Poor)		Redundant Crossing (Y/N)	Adequate Storage Space NB/SB (Y/N)	Property Served
Shotwell	N	5	Good	Good	N	Y/Y	Res./Comm.
W. Stallings	N	3	Fair	Poor	N	Y/Y	Res.
Robertson	N	3	Fair	Good	N	Y/N	Res./Comm.
O'Neil	N	3	Good	Good	Y	N/N	Res./Comm.
Fayetteville	N	3	Good	Good	Y	Y/N	Res./Comm.
Church	N	3	Poor	Good	Y	Y/N	Res./Comm.
Smith	N	0	Poor	Fair	Y	Y/Y	Res./Comm.
Central	N	3	Fair	Good	N	N/N	Res./Comm.
NC 42	Y	6	Good	Good	N	N/Y *	Res./Comm./Ind

Street Name	Economic Impact if Closed (Hi, Med, Low)	Need for Enhanced Warning Devices **	Need for Roadway Impvts (Hi, Med, Low)	Feasibility of Implementing Rdway Impvts (Hi, Med, Low)	Potential for Grade Separation (Hi, Med, Low)
Shotwell	Hi	---	Low	Low	Low
W. Stallings	Low	---	Low	Med.	Low
Robertson	Med	---	Low	Low	Low
O'Neil	Med	---	Low	Low	Low
Fayetteville	Med	S	Low	High	Low
Church	Low	S	Low	Low	Low
Smith	Low	S,S&M	High'	Low	Low
Central	Med	S	Low	Low	Low
NC 42	Hi	---	Low	Low	Low

* There is however, storage space on US 70 and an existing signal interconnect.

** S, S&M - Signs, signals & markings (12" lenses)

Level of Service Analysis

Level of Service (LOS) is a measure of congestion for signalized and unsignalized intersections as well as roadway segments. For each type of facility, six levels of service are defined. These levels are given letter designations which range from “A” to “F”.

LOS “A” represents the best operating conditions. With this level of service the intersection or roadway would operate virtually free of congestion and with almost no delay or interruption to travel. LOS “F” represents the worst operating conditions and would be perceived by the driver as the volume of traffic which can be accommodated under stop and go conditions. For most planning and design purposes, flow rates associated with LOS “C” or “D” are used since these levels are associated with a quality of service generally accepted by the motoring public.

Analysis techniques are described in the Highway Capacity Manual, Special Report 209 (1994) for unsignalized and signalized intersections. The analysis determines the amount of delay the motorist would experience in clearing the intersection, which determines the level of service.

Unsignalized Intersections

Traffic laws of the State of North Carolina mandate the opening characteristics of roadway intersections and driver behavior. These laws require that drivers on “minor” streets yield to traffic on the “major” streets. These laws led to the development of the following assumptions, which are used in the analysis of unsignalized intersections.

- “Major” street traffic are not impeded by “minor” street movements.
- Left turns on the “major” street are impacted only by opposing “major” street through movements.
- Right turns on the “minor” street are influenced only by “major” street traffic coming from the left.
- “Minor” street left turns are impeded by all “major” street traffic plus opposing “minor” street traffic.
- Through traffic on the “minor” street is influenced by all movements on the “major” street.

The level of service at both unsignalized and signalized intersections are based on the average total delay (in seconds per vehicle) to the motorist waiting to execute a particular maneuver. Total delay is defined as the total elapsed time from when the vehicle stops at the end of a queue to when the vehicle departs the stop line. Delay is calculated for all vehicles through the intersection for the peak hour or peak 15-minute interval. Criteria used to determine the level of service (based on delay) at an unsignalized intersection is as follows:

Level of Service	Average Total Delay (sec./veh.)
A	≤ 5
B	>5 and ≤ 10
C	>10 and ≤ 20
D	>20 and ≤ 30
E	>30 and ≤ 45
F	>45

Signalized Intersections

The level of service criteria for signalized intersections is based on stopped delay per vehicle (in seconds). This delay is based on a number of factors including the quality of progression, the cycle length, the green ratio and the v/c ratio.

The criteria for level of service based on delay from the Highway Capacity Manual, Special Report 209 (1994) is:

Level of Service	Description	Stopped Delay/Vehicle (Seconds)
A	Very low delay, progression extremely favorable; most vehicles do not stop at the intersection.	≤ 5.0
B	Generally good progression and/or short cycle lengths; more vehicles stop at intersection than LOS A.	>5.0 and ≤ 15.0
C	Fair progression and/or longer cycle lengths; individual cycle failures may appear; significant number of vehicles stop at intersection although many may still pass through,	>15.0 and ≤ 25.0
D	Congestion becomes more noticeable, longer delays from unfavorable progression, long cycle lengths and/or high volume to capacity ratios (v/c); most vehicles stop at the intersection.	>25.0 and ≤ 40.0
E	Considered by many agencies to be the limit of acceptable delay, poor progression, long cycle lengths, high v/c ratios; frequent individual cycle failures.	>40.0 and ≤ 60.0
F	Unacceptable delay, oversaturation (arrival flows exceed the capacity of intersection).	>60.0

Traffic Volume

Twenty-four hour traffic counts were conducted in 1998 by the North Carolina Department of Transportation at each crossing. The nine crossings in Clayton rank in terms of vehicles served as follows:

Crossing	1998 Existing Average Daily Traffic (vehicles per day)	2025 Design Year Average Daily Traffic (vehicles per day)
NC 42	14,607	42,185
Shotwell Road	6,535	18,840
O’Neil Street	4,665	13,449
Central Street	2,035	3,042
N. Robertson Street	1,912	2,858
Church Street	1,301	1,945
Fayetteville Street	854	2,462
Smith Street	543	812
W. Stallings Street	518	774

Accident History

Accident crash summaries were obtained from the North Carolina Department of Transportation, Division of Highways, Traffic Engineering and Safety Systems Branch and the Federal Railroad Administration. This data included accidents at each crossing and adjacent roadway for the ten year period from September 1, 1988 to August 31, 1998. Accidents involving trains are summarized in Table 1.

During the last ten years, one train/car accident occurred at Crossing No. 735 394Y (Shotwell Road). According to historical data, the accident occurred prior to installation of flashers, gates and bells at this location and no injuries were reported. No accidents involving trains have been recorded at this crossing since the installation. Three other accidents (involving highway vehicles only, no trains) have been recorded at the crossing during the ten-year period.

Seven accidents were reported in the vicinity of Crossing No. 735 396M (W. Stallings Street) during the ten-year study period. None of the accidents involved trains.

Two train/car accidents occurred at Crossing No. 735 397U (Robertson Street) during the ten-year period. Both accidents occurred prior to the installation of flashers, gates and bells at the crossing. One of the accidents resulted in one Class A injury, the other accident reported no injuries. No accidents involving trains have been recorded at this location since the installation of the above mentioned safety devices.

Sixteen accidents occurred in the vicinity of Crossing No. 735 398B (O'Neil Street) during the ten-year period. None of the accidents involved trains or occurred at the crossing.

Twenty accidents occurred in the vicinity of Crossing No. 735 399H (Fayetteville Street) during the ten-year study period. No accidents occurred at the railroad crossing or involved trains.

During the last ten years one train/car accident (with one Class C injury) occurred at Crossing No. 735 400A (Church Street). According to the historical data, the accident occurred prior to the installation of flashers, gates and bells. No accidents involving trains have been recorded at this crossing since the installation of these safety devices.

One train/car accident (one fatality/Class K) occurred at Crossing No. 735 401G (Smith Street) in the ten-year study period. Advance warning signs and railroad crossbucks were in place at the time of the accident. Since the accident "Stop Signs" have been added on both roadway approaches to the crossing by the municipality.

Two train/car accidents have occurred at Crossing No. 735 402N (Central Street) during the ten-year period. The first train/car accident (with one Class B injury) occurred prior to installation of flashers, gates, and bells at the crossing. The second train/car accident occurred after installation of warning devices. This accident involved a vehicle stalling on the tracks. The vehicle's occupants abandoned their vehicle and left the crossing area when the approaching train activated the warning devices.

NC 42 in the vicinity of Crossing No. 735 404C has undergone major alignment changes in recent years providing better alignment and increased protection. One train/car accident occurred at this crossing in the ten-year study period. This accident occurred prior to the installation of flashers, gates and bells at the crossing. No accidents involving trains have occurred at this crossing since the installation of warning devices.

Cost of Railway/Highway Collisions

Average costs for accidents and injuries are computed on at annual increments based on reported accidents and injury costs for that year. The Federal Highway Administration analyzes data obtained from accidents reports nationwide and produces an annual report detailing the statistics and the average costs for accidents. According to a report prepared by the Federal Highway Administration, accident costs for 1995 were as follows:

Fatal accident.....	\$2,780,000
Injury Accident	\$55,000
Property damage only accident.....	\$3,000

Utilizing this data, the car/train accidents in Clayton during the ten-year period have cost the community, in addition to pain and suffering, nearly \$3,000,000.

MENU OF AVAILABLE TRANSPORTATION SYSTEM ENHANCEMENTS

As Clayton’s population continues to grow, along with anticipated increases in daily train movements, traffic delays and the probability of accidents can be expected to increase at the crossings within the study area unless improvements are implemented to better control and/or separate rail traffic from highway and pedestrian traffic.

Grade Separation Structures

Several factors are taken into consideration when examining a crossing for potential grade separation. Among these factors are:

- Traffic volumes (both vehicle and train)
- Accident history
- Topography
- Construction impacts
- Costs

Traffic volumes ranging from 15,000 to 20,000 vehicles per day and above are usually considered to be the threshold for considering placement of a grade separation structure for local streets. Only NC 42 and Shotwell Road exhibit 2025 Design Year volumes over 15,000 vehicles per day. Volumes of 30,000 vehicles per day and more can be accommodated without significant delay if the volume of train traffic is low.

The NCDOT utilizes an “exposure index” rating to determine if a grade separation is warranted at existing and proposed railway/highway crossings. The exposure index is obtained by multiplying the number of trains per day by the number of vehicles per day (in the design year) on the roadway. The design year is a future year when the roadway is expected to reach its theoretical capacity. Typically, the design is anticipated for a “life” of 20 years. Therefore, an improvement constructed in 2005 will reach capacity in 2025.

For example, if a crossing had three trains per day and a design year traffic volume of 5000 vehicles per day, the exposure index is 15,000. The threshold for consideration for either an overpass or underpass is an exposure index of 15,000 in rural areas and 30,000 in urban areas. The exposure index for each of the Clayton crossings is listed below.

Crossing	Exposure Index Based on 2025 Traffic Projections
1. NC 42	506,220
2. Shotwell Road	226,080
3. O’Neil Street	161,388
4. Central Street	36,504
5. Robertson Street	34,296
6. Church Street	23,340
7. Fayetteville Street	29,544
8. Smith Street	9,744
9. Stallings Street	9,288

Accident history is another factor considered in the evaluation of a crossing for grade separation. Crossings with repeated occurrences of accidents would be further evaluated for a grade separation.

Topography, or lay-of-the-land, is an important consideration. When the street, railroad, surrounding land are at the same elevation, the construction of a grade separation is considerably more difficult. Likewise, construction of a grade separation requires adequate distance to allow the roadway to maintain a reasonable grade, which is not possible in areas with short approaches to the railroad crossing from adjacent intersections. All five of the crossings which have 2025 Exposure Indexes above 30,000, also have short distances between the railroad crossing and adjacent intersections.

Construction impacts are of considerable importance. These impacts can sometimes impose greater harm to the community than leaving the condition "as-is". Construction impacts include the destruction of the natural environment (woodlands, streams, etc.) and disruption of historic and archaeological sites. While some of the impacts are temporary in nature, others result in permanent impacts to the surrounding communities.

Costs for grade separation structures can range from \$1 to \$5 million and must be carefully considered before proceeding with funding and construction.

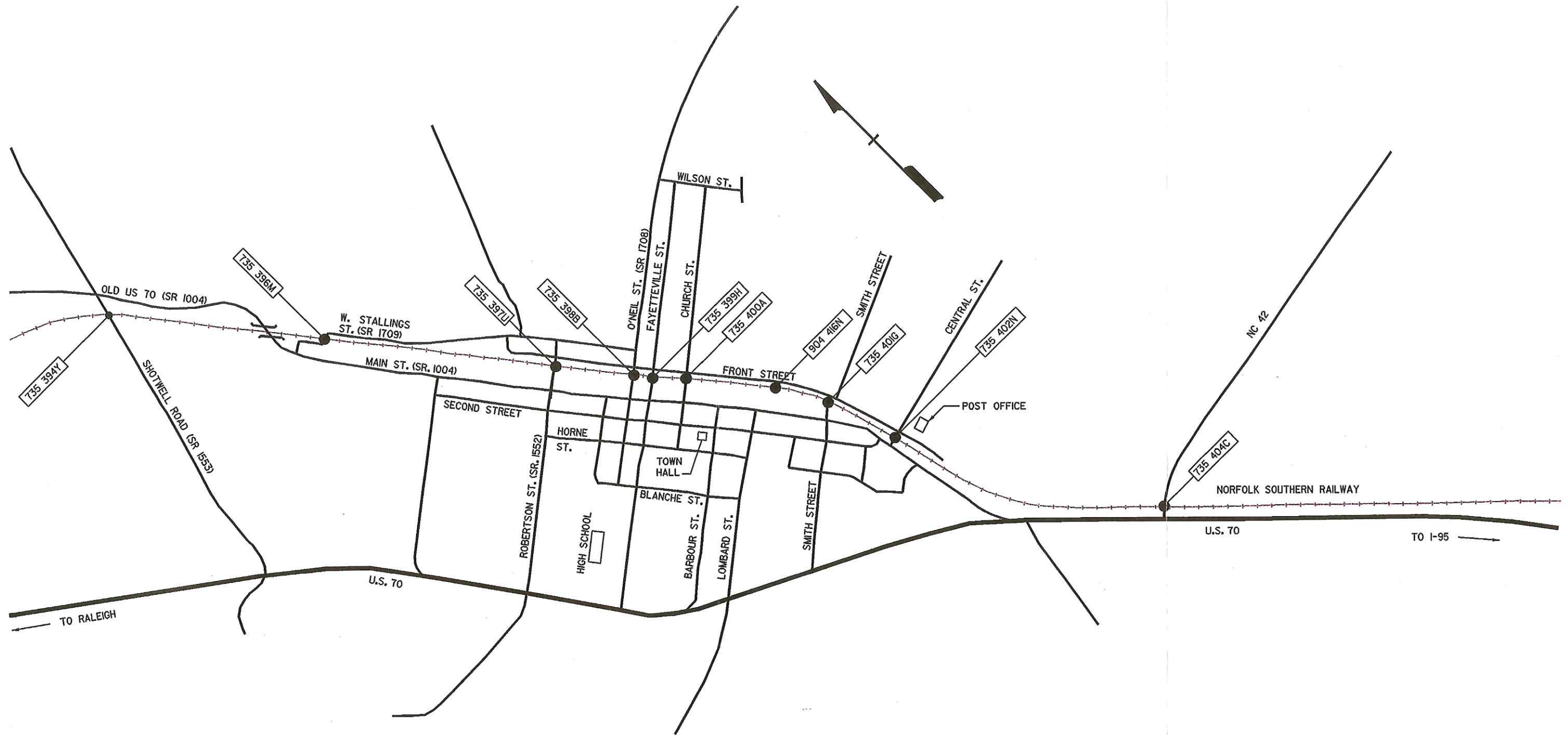
An existing grade separation exists along the NS route between the Shotwell Road and W. Stallings Street crossings. The grade separation is a railroad overpass of W. Main Street and has a vertical clearance of 14'-5", which is substandard for roadways. The low clearance effectively restricts large trucks from utilizing this route, thereby prohibiting truck access to Main Street in the downtown area from the west.

Crossing Protection Devices Upgrade

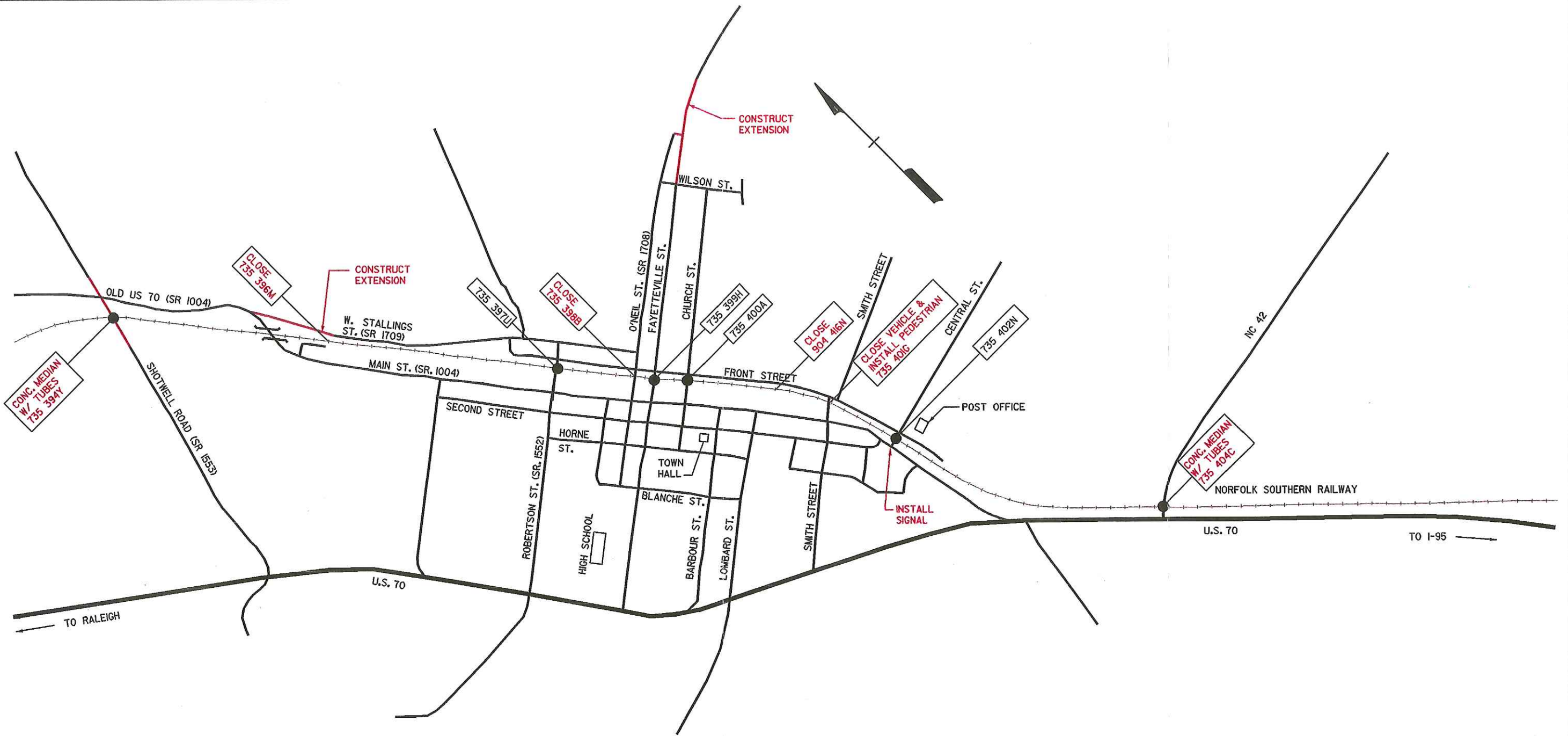
Other than closures or grade separations, the most effective way of dealing with safety issues at rail crossings is the implementation of more advanced crossing protection devices.

These devices include advance-warning signs, which warn motorists of the pending crossing; along with gates, flashing signals, and bells, which alert motorists of an approaching train. Passive devices, which include advance warning signs, regulatory signs such as standard stop signs, pavement markings (stop bars and railroad crossing) and railroad crossbucks are usually used on low volume crossings with good sight distance.

Active devices, including signals, bells and gates, are generally used on higher volume crossings with greater accident potential or where existing conditions warrant more positive control. The ranking of passive and active devices from lowest to highest is as follows:



CLAYTON VICINITY MAP AND CROSSING IDENTIFICATIONS



RECOMMENDED ENHANCEMENTS

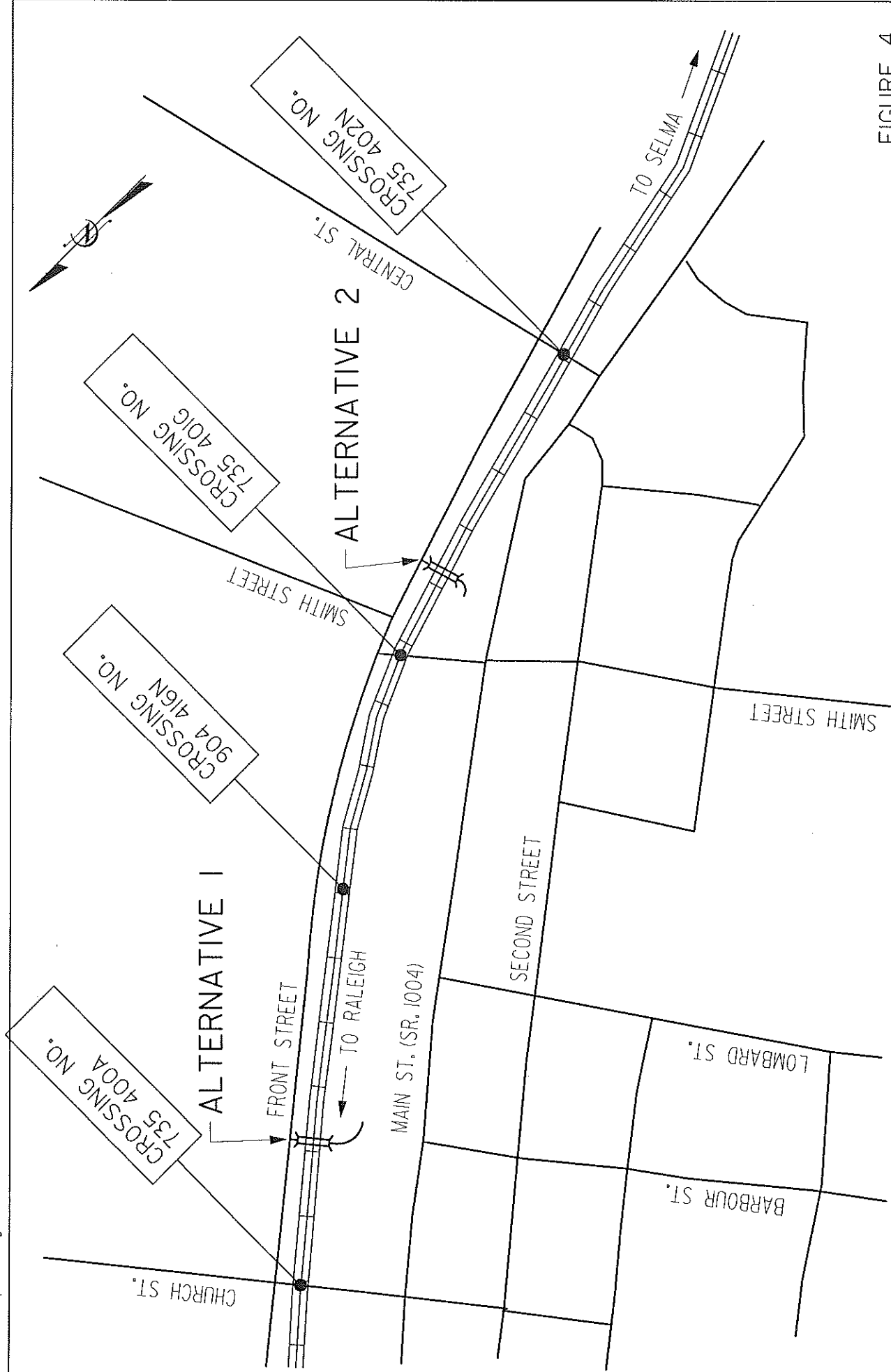
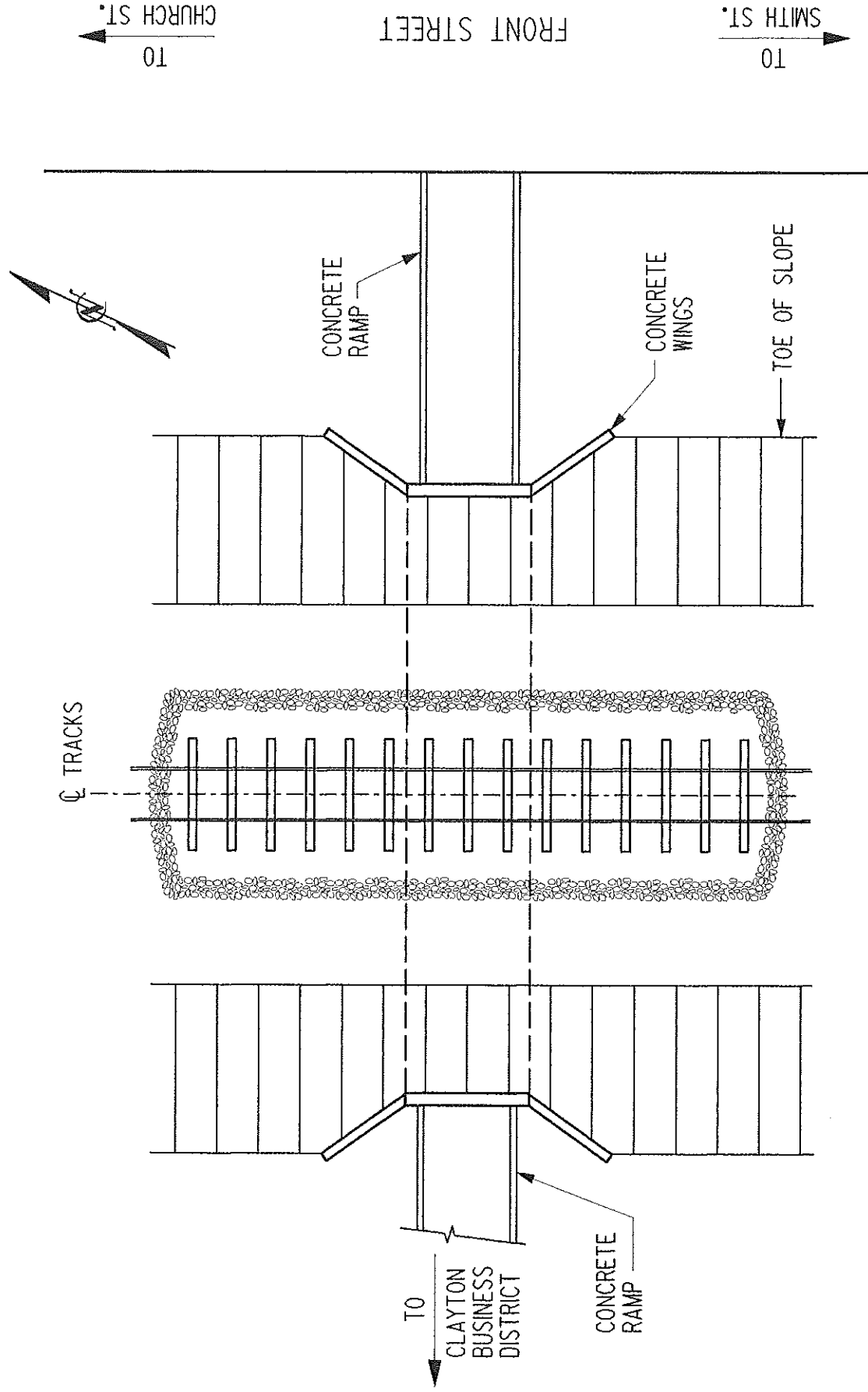


FIGURE 4

PEDESTRIAN UNDERPASS
ALTERNATIVE LOCATIONS

TRANSYSTEMS
CORPORATION
4917 Waters Edge Drive, Suite 235
Raleigh, NC 27606 (919) 233-8125

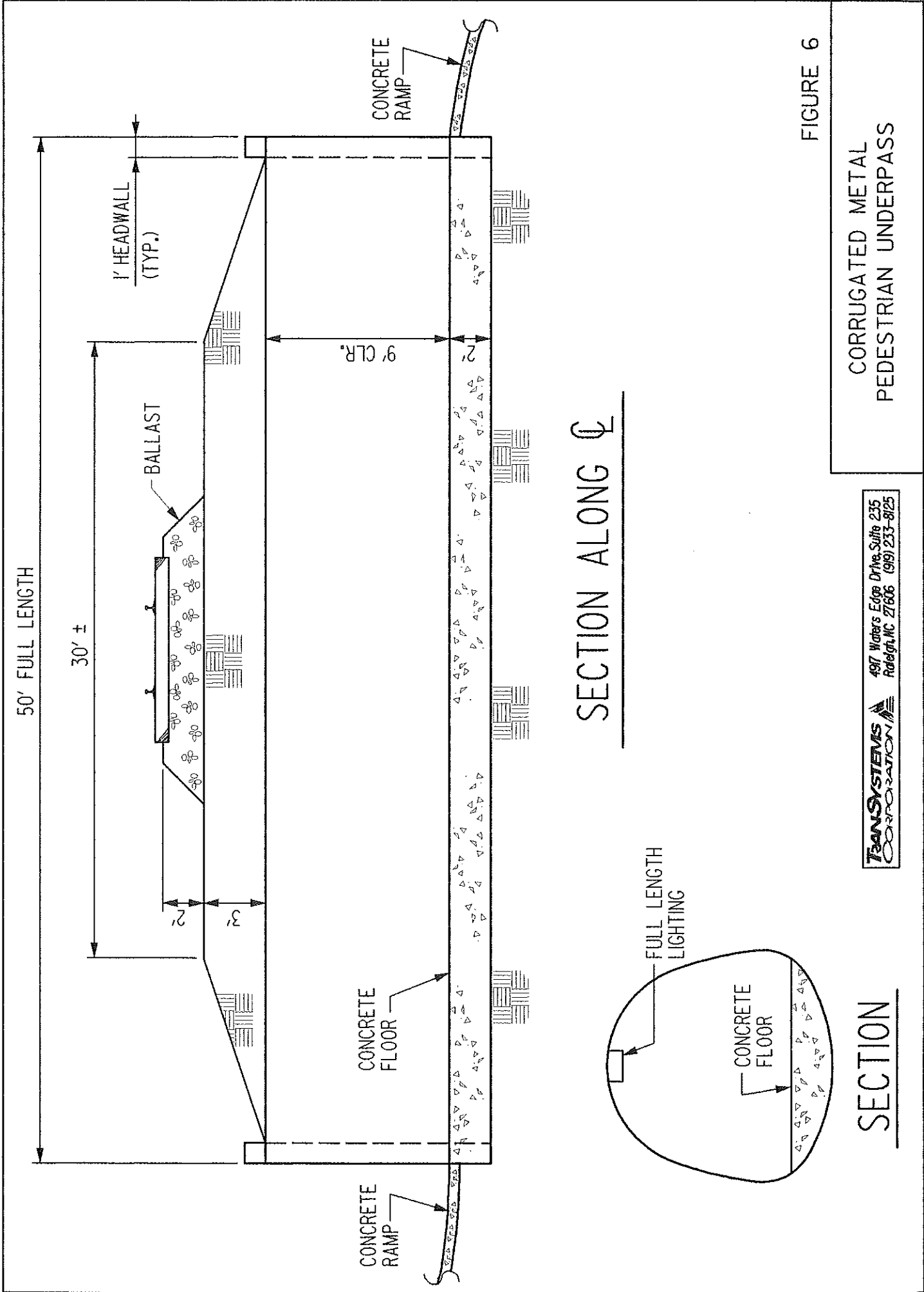


PLAN

FIGURE 5

CORRUGATED METAL
PEDESTRIAN UNDERPASS

TRANSYSTEMS
CORPORATION
4917 Waters Edge Drive, Suite 235
Raleigh, NC 27606 (919) 233-8125



APPENDIX A

Existing Conditions of At-Grade Railroad Crossings



INSTALL RAISED CONCRETE
MEDIAN WITH TUBE DELINEATORS



WATER
TOWER

UTIL.
BLDG.

BRICK
MAINTENANCE
BUILDING

WINN DIXIE DISTRIBUTION
WAREHOUSE

R/R SIGN

OLD US 70 (SR 1004)

TO CLAYTON

MOBILE HOME

INSTALL RAISED CONCRETE
MEDIAN WITH TUBE DELINEATORS

POWER HOUSE

TO SELMA

SHOTWELL ROAD (SR 1553)

LEGEND

- x— GATE W/ FLASHERS
- UTILITY POLE
- ⊕ FIRE HYDRANT
- x— FENCE

SIGN LEGEND

- ▲ (A)
- ▲ (B)

SHOTWELL ROAD / SR 1553
AAR CROSSING #735 394Y

TRANSYSTEMS
CORPORATION

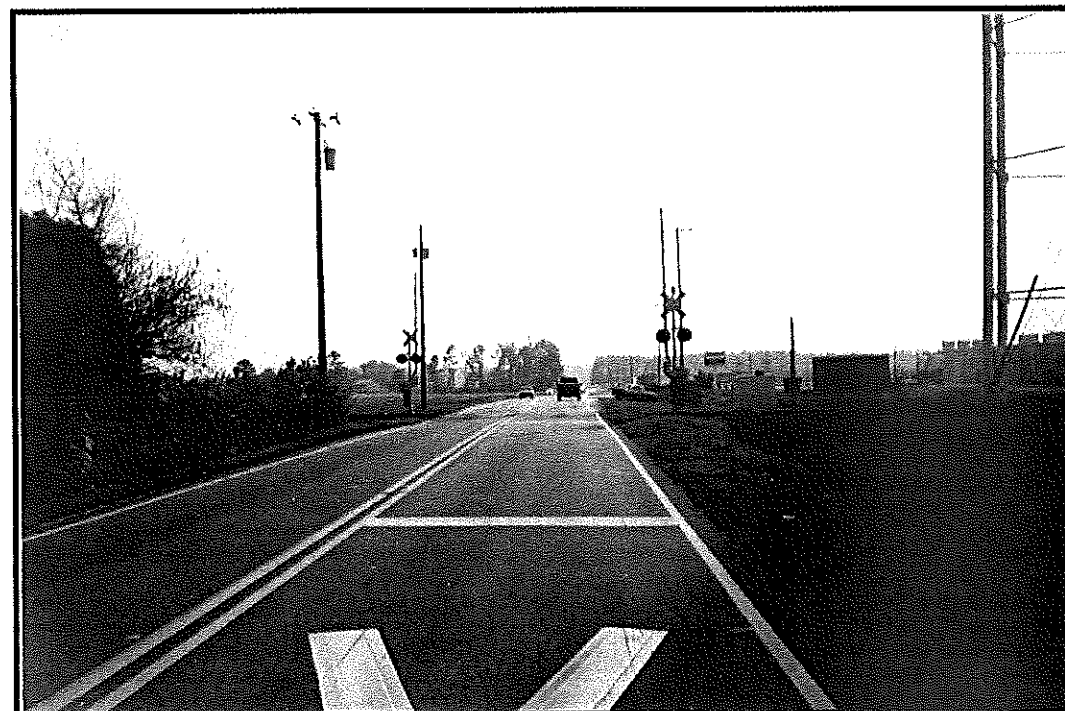
4917 Waters Edge Drive, Suite 235
Raleigh, NC 27606 (919) 233-8125

28 MAR 2000
17:45:11
r:\98044.00\cad\mtbnc42.dgn

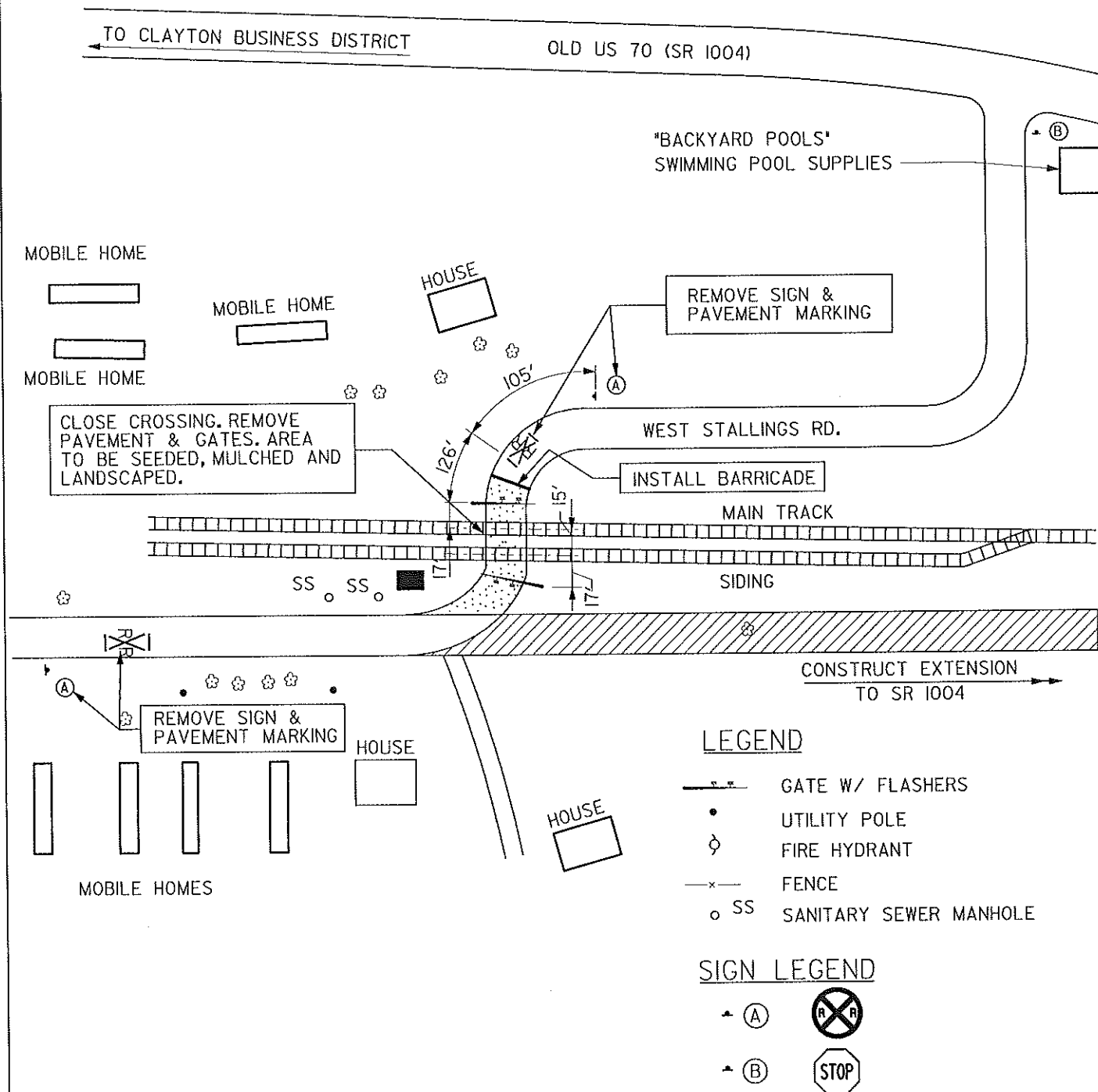
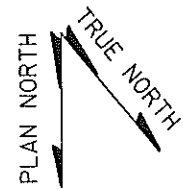
Municipality: Clayton
Crossing Number: 735 394Y **Street Name: Shotwell Road**



Northbound Approach



Southbound Approach



27 MAR 2000
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r:\9804400\cad\mfbnc42.dgn

Municipality: Clayton

Crossing Number: 735 396M

Street Name: W. Stallings St.

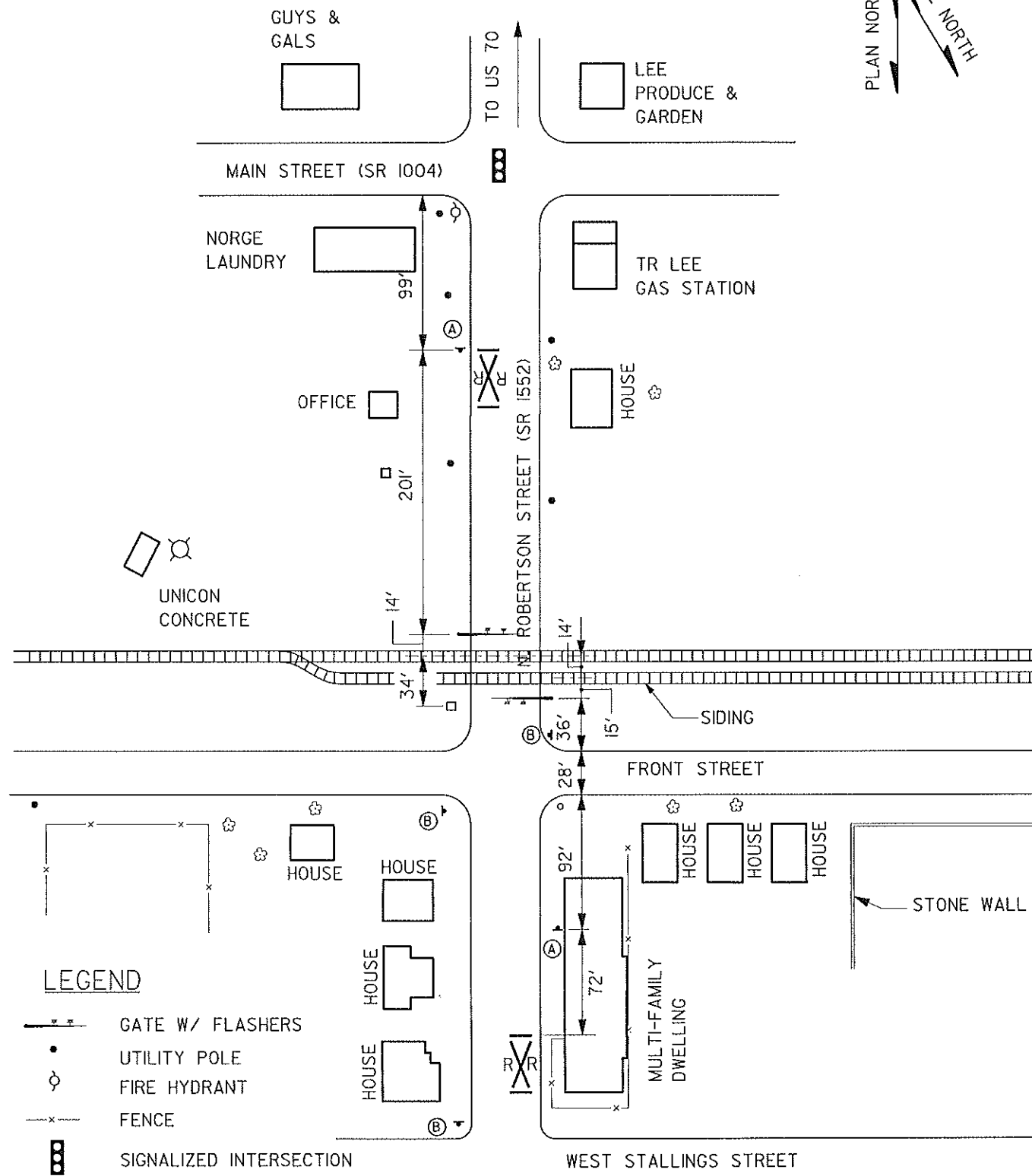


Northbound Approach



Southbound Approach

PLAN NORTH
TRUE NORTH



LEGEND

- GATE W/ FLASHERS
- UTILITY POLE
- FIRE HYDRANT
- FENCE
- SIGNALIZED INTERSECTION

SIGN LEGEND

- (A)
- (B)
- STOP



4917 Waters Edge Drive, Suite 235
Raleigh, NC 27606 (919) 233-8125

N. ROBERTSON STREET
AAR CROSSING #735 397U

27 MAR 2000
16:39:28
r:\98044\00\oad\mibnc42.dgn

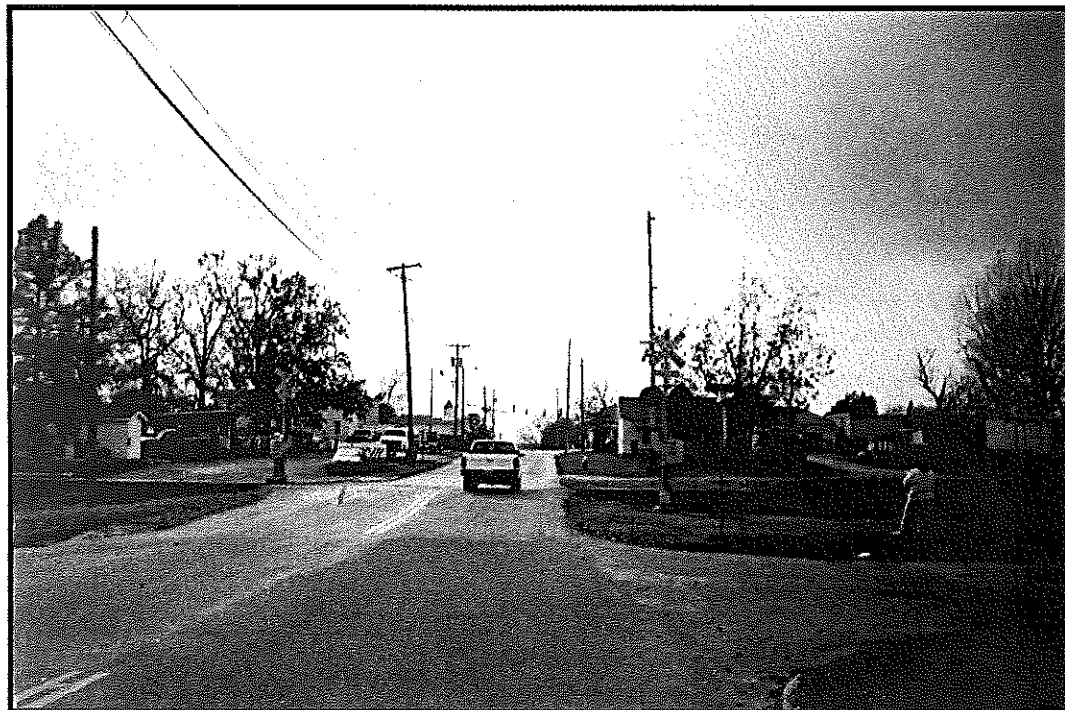
Municipality: Clayton

Crossing Number: 735 397U

Street Name: Robertson Street

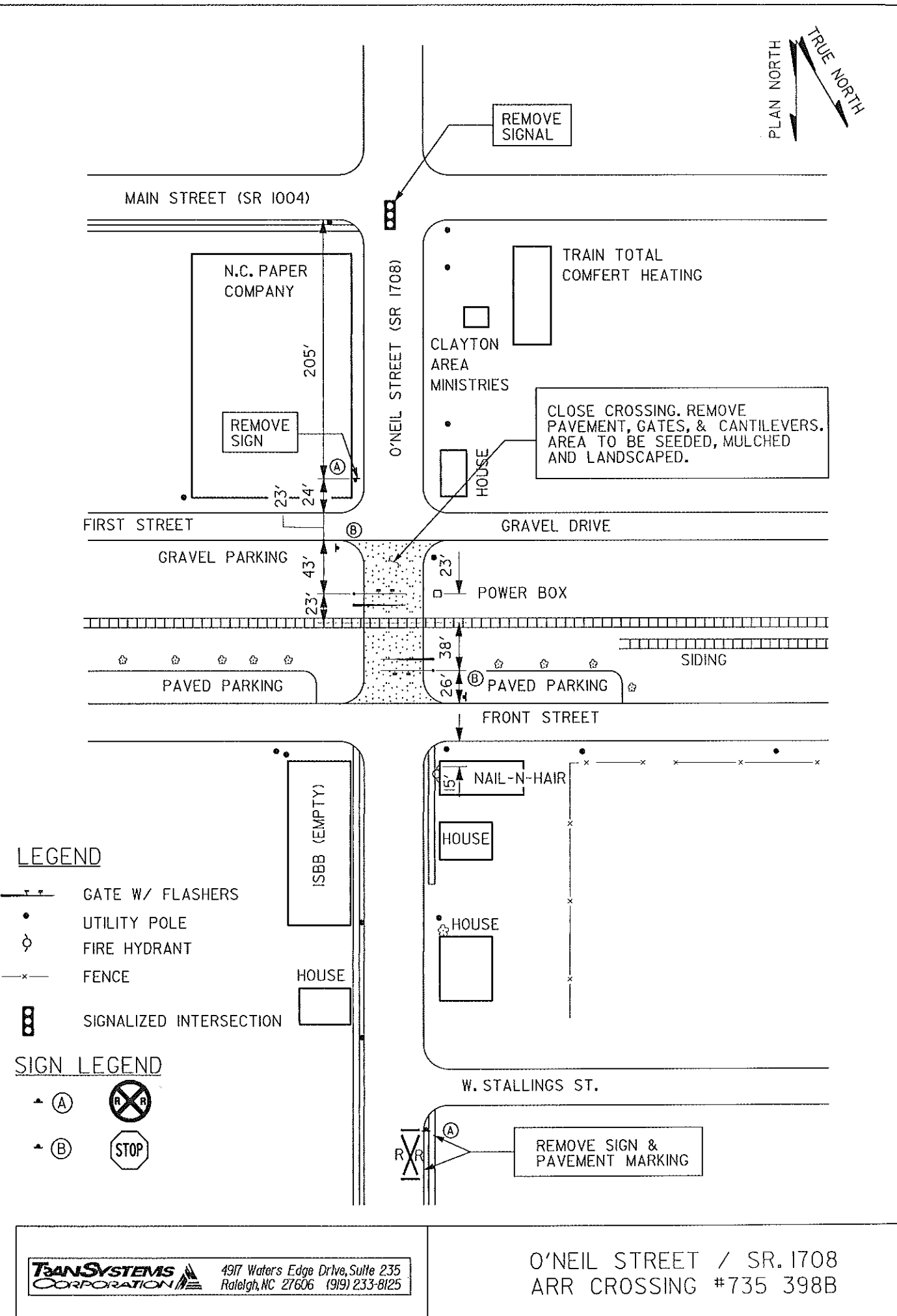


Northbound Approach



Southbound Approach

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12:43:32
r:\98044\00\cad\mfbnc42.dgn



Municipality: Clayton

Crossing Number: 735 398B

Street Name: O'Neil Street

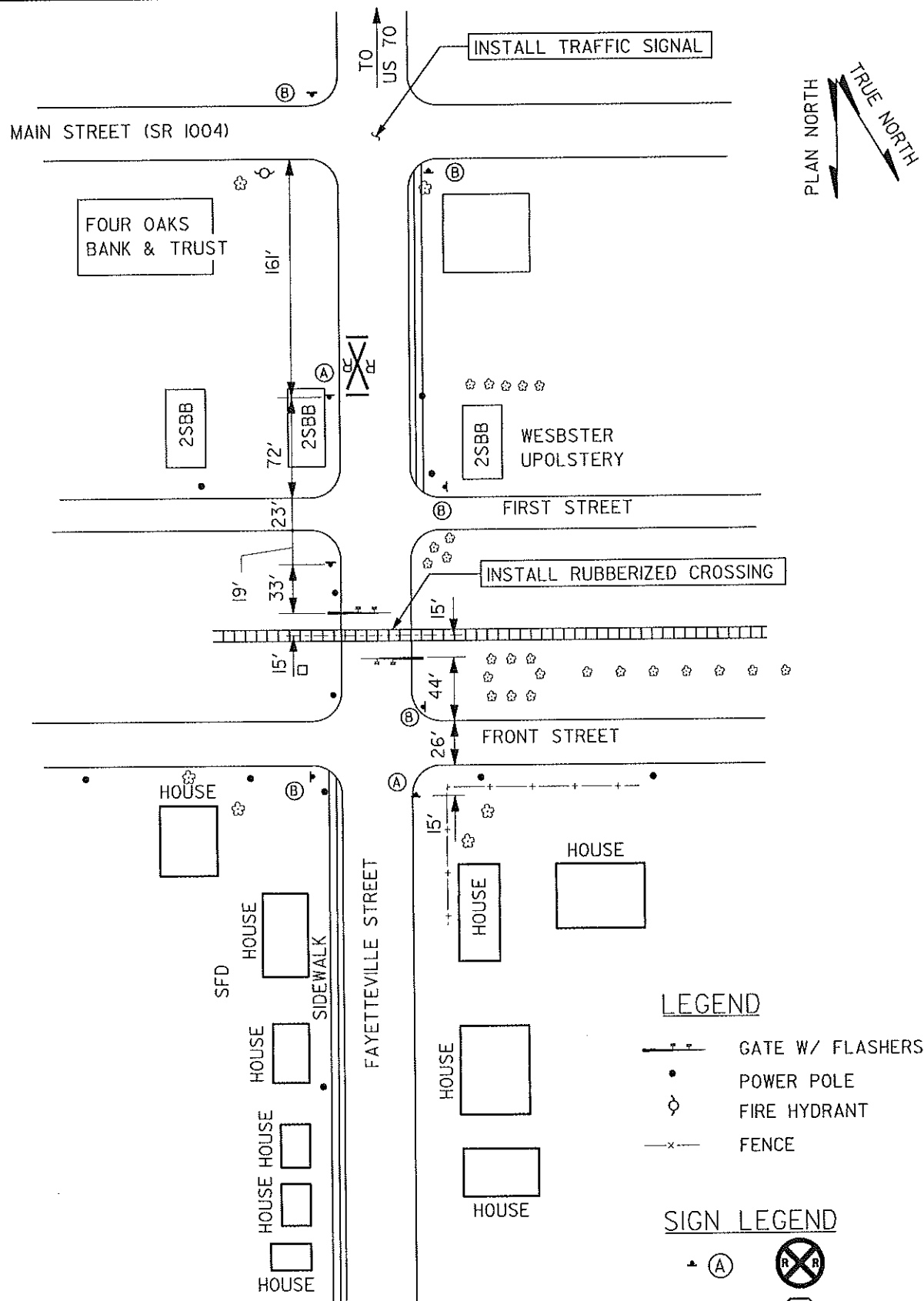


Southbound Approach



Eastbound Approach

27 MAR 2000
16:40:13
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Municipality: Clayton
Crossing Number: 735 399H **Street Name: Fayetteville Street**

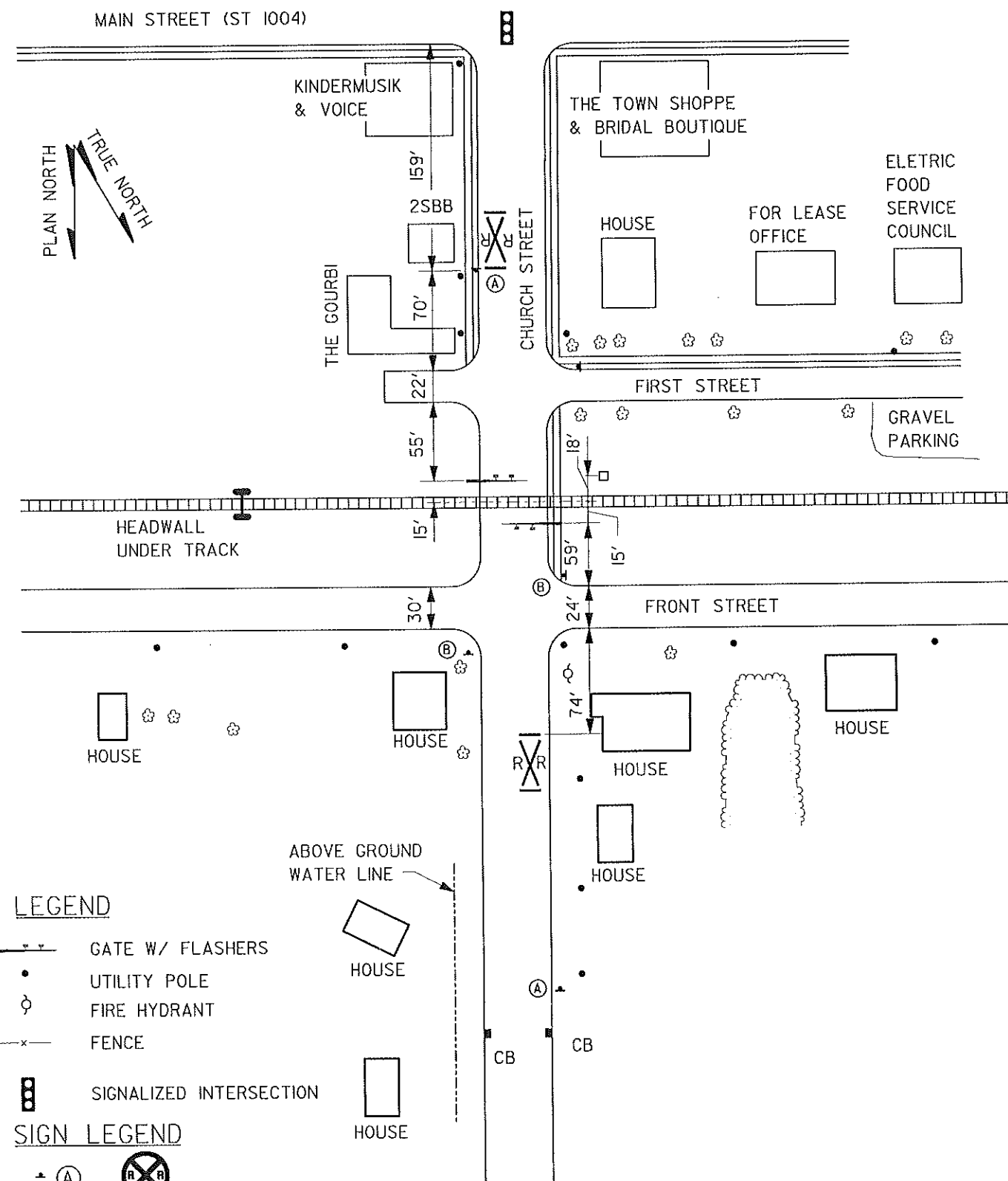


Northbound Approach



Southbound Approach

27 MAR 2000
16:41:07
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TRANSYSTEMS CORPORATION
4917 Waters Edge Drive, Suite 235
Raleigh, NC 27606 (919) 233-8125

CHURCH STREET
AAR CROSSING #735 400A

Municipality: Clayton
Crossing Number: 735 400A **Street Name: Church Street**

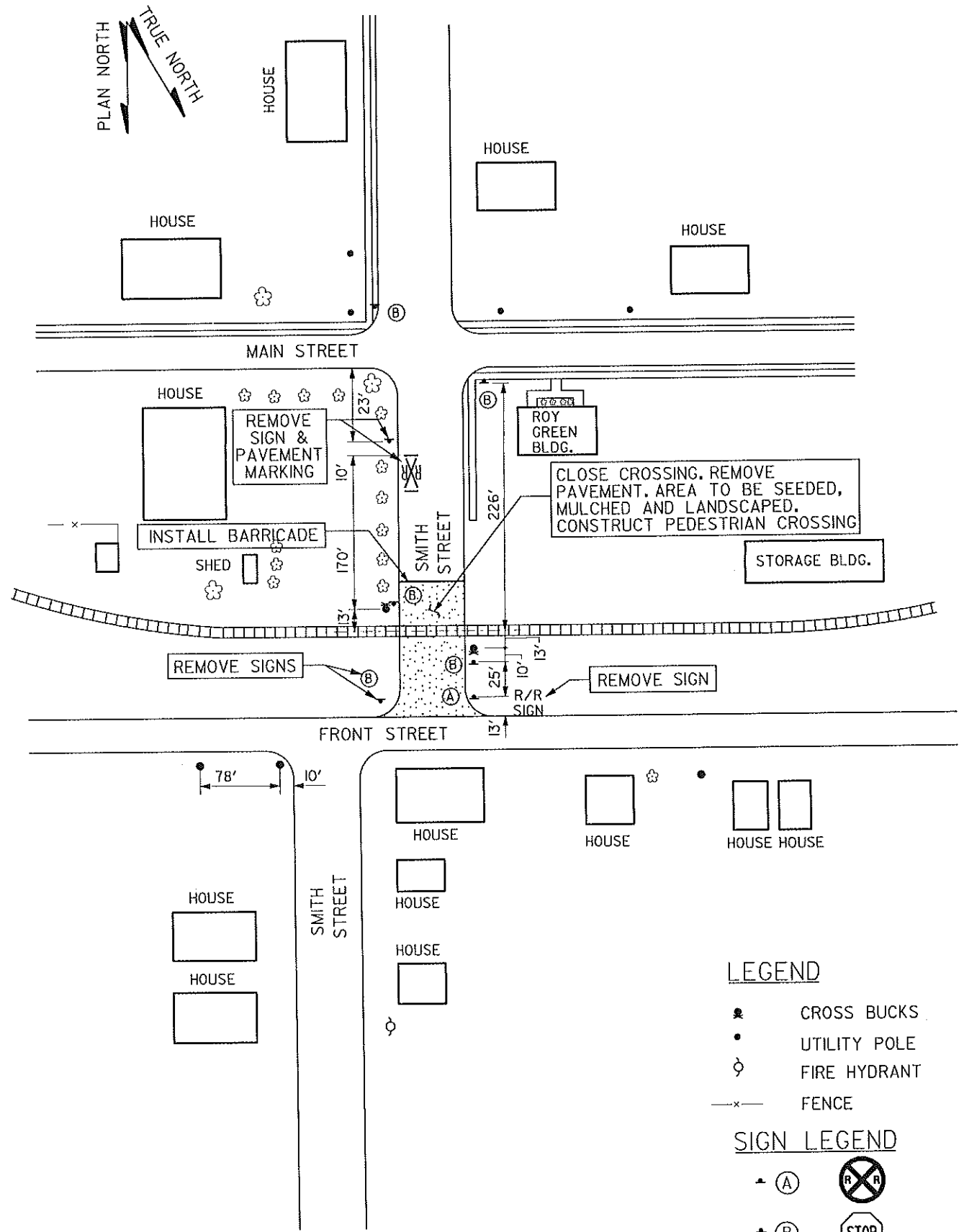


Northbound Approach



Southbound Approach

PLAN NORTH
TRUE NORTH

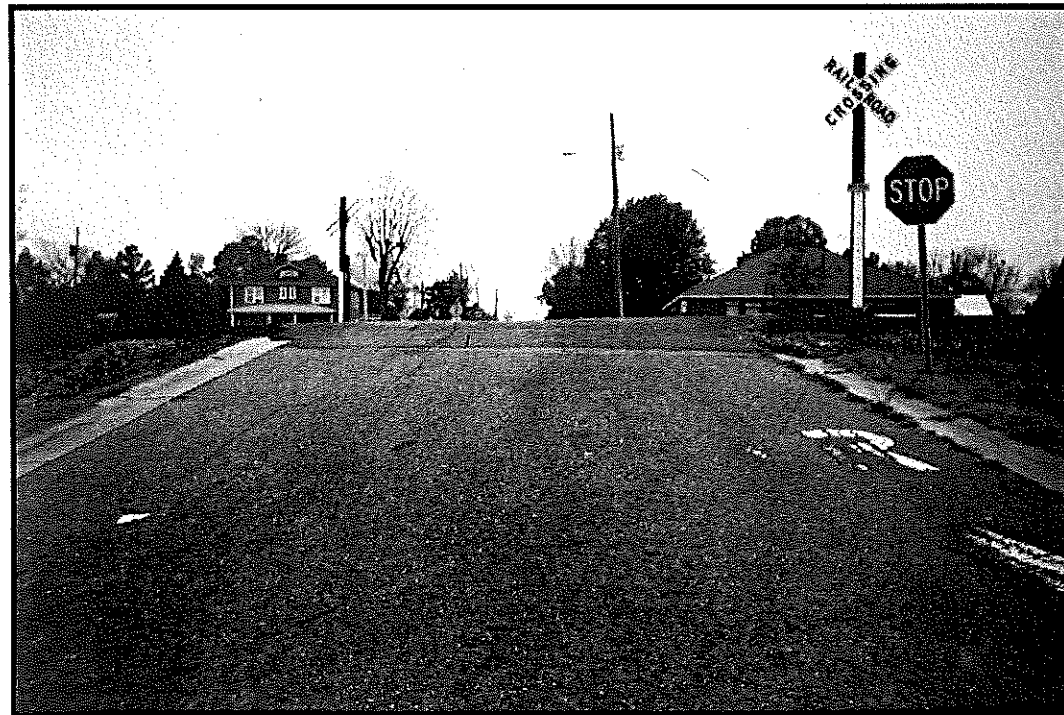


- LEGEND**
- CROSS BUCKS
 - UTILITY POLE
 - FIRE HYDRANT
 - FENCE
- SIGN LEGEND**
- (A) No Right Turn
 - (B) Stop

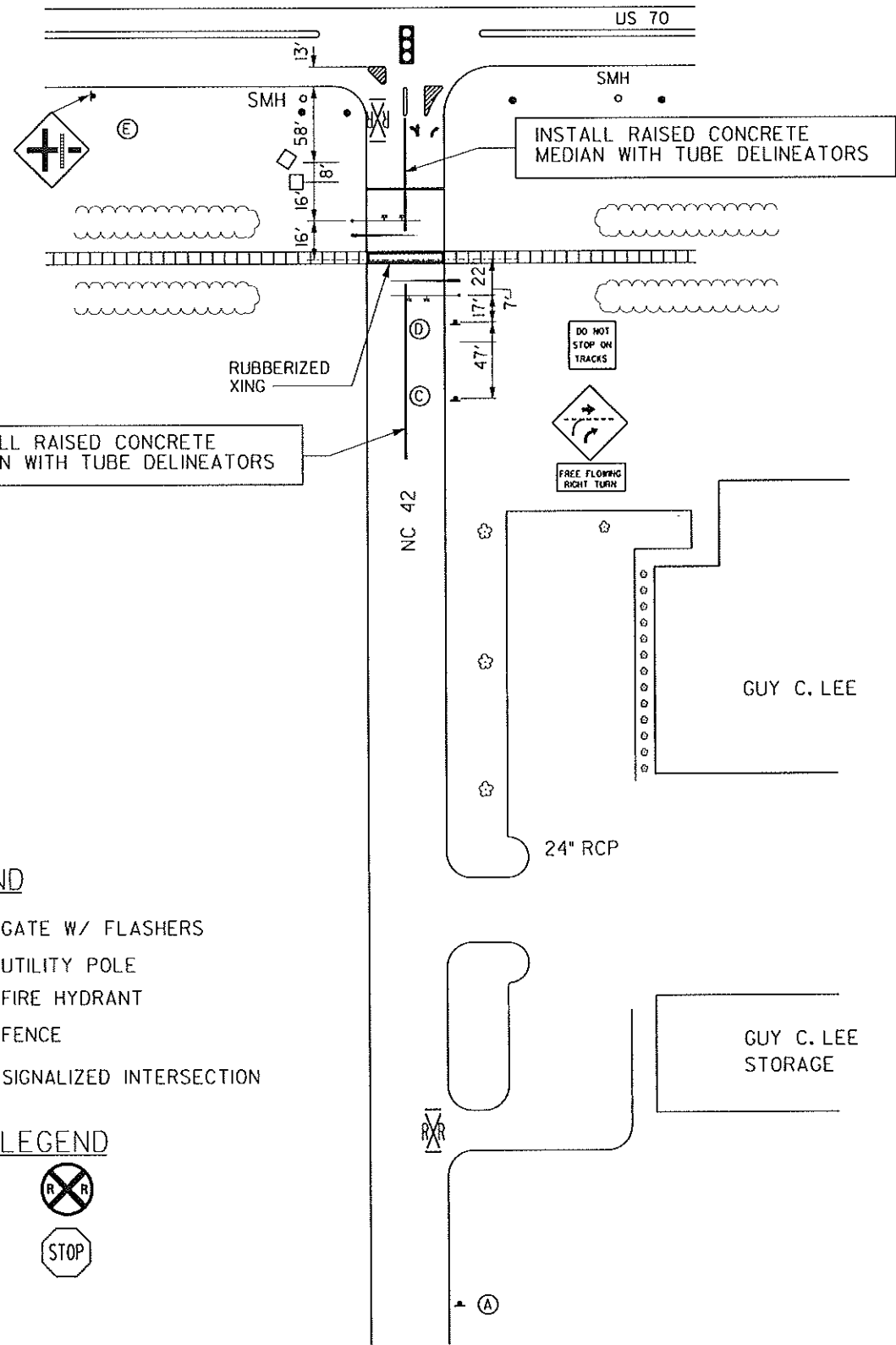
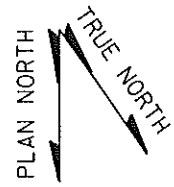
Municipality: Clayton
Crossing Number: 735 401G **Street Name: Smith Street**



Northbound Approach



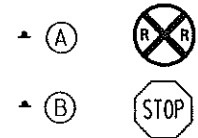
Southbound Approach



LEGEND

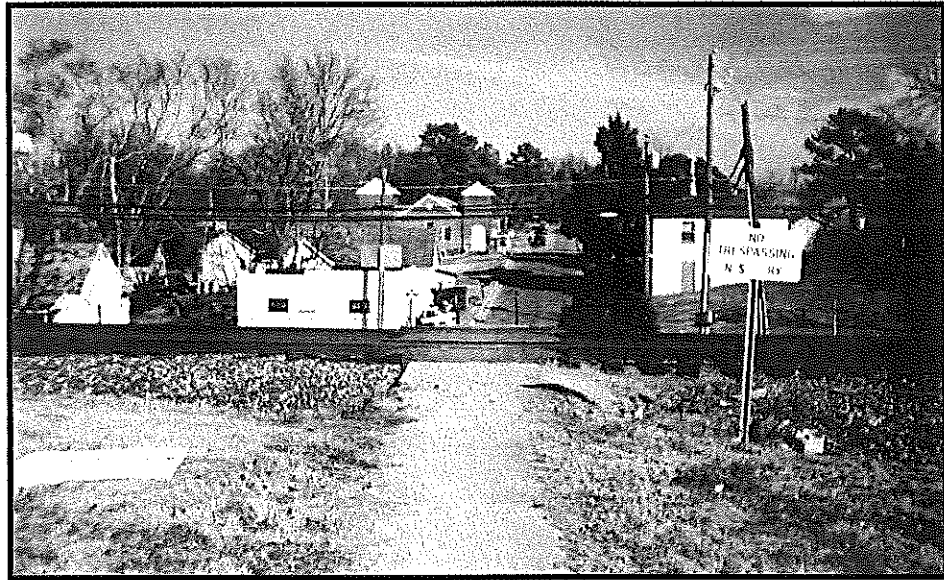
- GATE W/ FLASHERS
- UTILITY POLE
- FIRE HYDRANT
- FENCE
- SIGNALIZED INTERSECTION

SIGN LEGEND

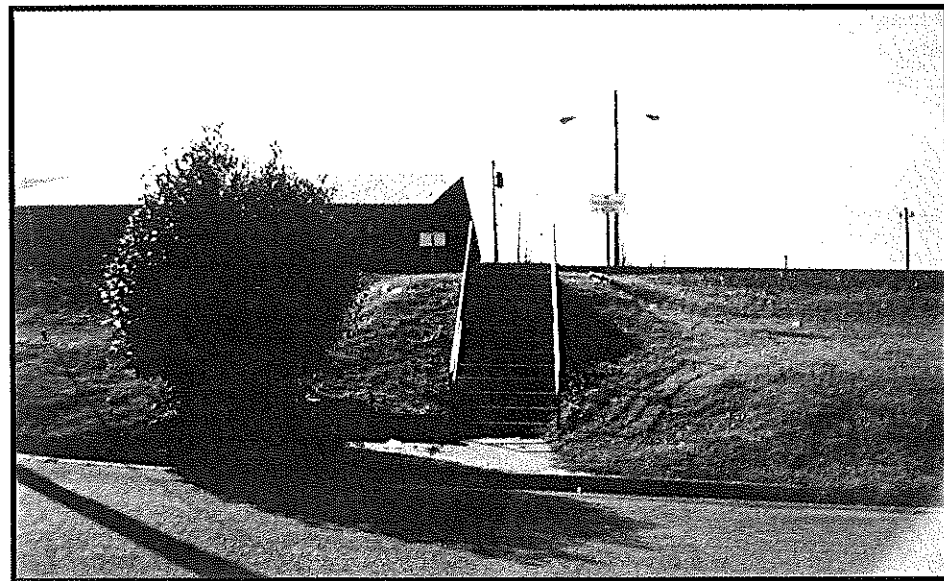


NC 42
AAR CROSSING #735 404C

Municipality: Clayton
Crossing Number: 904 416N **Existing Pedestrian Crossing**



Northbound Approach



Southbound Approach