FEASIBILITY STUDY

Horse Pen Creek Road

Guilford County

Prepared by
Kimley-Horn and Associates, Inc.
for the City of Greensboro

July 2004

Guilford County

Horse Pen Creek Road

I. General Description

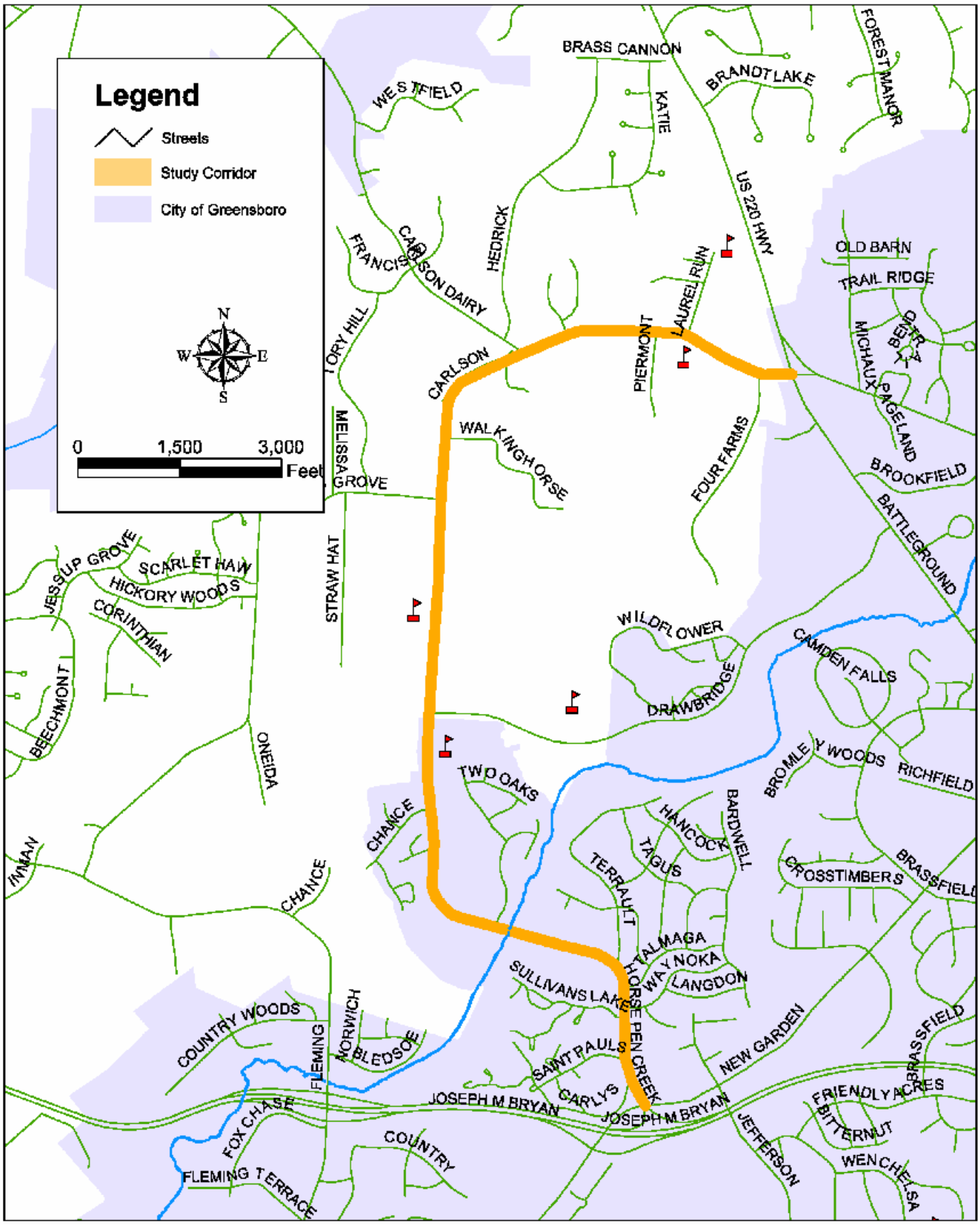
This feasibility study describes proposed improvements to the Horse Pen Creek Road corridor in northwestern Greensboro and Guilford County. The project study limits (see Figure 1) begin at Battleground Avenue and extend to New Garden Road, a distance of approximately 3.4 miles. Based on the findings of this study, it is recommended that a four-lane median divided facility be installed along Horse Pen Creek Road. It is recommended that the City of Greensboro and NCDOT seek to include the project in the State Transportation Improvement Program (TIP), and to commence the environmental document phase, engineering design, right-of-way acquisition, and construction.

It is anticipated that approximately four (4) residences will be relocated and forty-six (46) will be impacted due to the development of a 4-lane median divided facility. A preliminary opinion of probable cost was prepared by Kimley-Horn and Associates, Inc. This estimate includes construction and right-of-way (ROW) for a total cost of $18,574,972.

Construction ……. $14,137,672
Right-of-Way……. $ 4,437,300
Total Cost…….. $18,574,972

Horse Pen Creek Road south of Jessup Grove Road

Horse Pen Creek Road at Horse Pen Creek



Kimley-Horn and Associates, Inc.

HORSE PEN CREEK ROAD
FEASIBILITY STUDY

STUDY AREA

FIGURE 1

II. Study Methodology

The methodology used to conduct this study included the following steps:

- Project definition, purpose, and need
- Field reconnaissance, data collection, and observations
- Environmental screening
- Corridor mapping and opinions of probable cost
- Project documentation

Functional Criteria

The feasibility of any proposed enhancements hinges on the ability to satisfy certain design criteria. Such criteria focus on assumed travel speeds, vertical and horizontal alignment, sight distances, right-of-way, cross-section, drainage, and other features critical to providing a facility that is both safe and functional.

Basic design criteria have been established for various conditions, roadway types, and geometries. Many elements are accepted by federal, state, and local officials as minimum standards for design, the application of which generally cannot be altered without compromising the design. Others have a certain degree of flexibility and therefore can vary from alternative to alternative.

At the City's direction, the design criteria used for this evaluation are based on ***A Policy on Geometric Design of Highways and Streets***[1]***,*** the City of Greensboro Road and Utility Design Manual and the North Carolina Department of Transportation's Roadway Design Manual.

[1] AASHTO, Fourth Edition, 2001.

III. Project Purpose

The City of Greensboro and the Greensboro Urban Area Metropolitan Planning Organization have identified the need to upgrade the Horse Pen Creek Road corridor. Based on consultation with City, County, and NCDOT Division 7 Staff, and work conducted under this study, the project purpose and need is as follows:

1. Serve forecasted future traffic volumes on Horse Pen Creek Road
2. Relieve congestion on Battleground Avenue (running parallel to the corridor, about 1.0 mile to the east),
3. Address anticipated growth along the corridor and in northwest Greensboro,
4. Improve safety throughout the corridor, and
5. Provide enhanced pedestrian and bicycle mobility.

Background Information

In addition to the project purpose, specific background information is needed to further illustrate the catalyst for the project.

In May 2003, the City of Greensboro adopted the ***Greensboro Connections 2025 Comprehensive Plan***. Based on a review of this plan and discussions with city staff, it is anticipated that a combination of residential, institutional, and office land uses will continue to develop along Horse Pen Creek Road. The plan provides for strategic roadway widening and roadway extensions primarily to remove bottlenecks and fill gaps in the system. The plan also calls for coordinating pedestrian and bicycle facilities with roadway improvements. The proposed project would meet both criteria.

Planned Projects

There are three planned transportation improvement projects in the general vicinity of this proposed widening:

- Greensboro Western Loop Urban Loop from Bryan Boulevard to Battleground Avenue (NCDOT TIP Project U-2524). Current plans for this project include an interchange with Bryan Boulevard and Battleground Avenue (US 220). This project is currently scheduled to begin in 2008.

- The east-west connector street between Fleming Road and Horse Pen Creek Road is currently being constructed. Further discussion of this project is included on the following page.

- US 220 is proposed to be widened 6.3 miles to a multi-lane facility from Horse Pen Creek Road to the proposed US 220-NC 68 connector (NCDOT TIP Project R-2309). Right-of-Way acquisition is scheduled to begin in 2005 and construction is to start in 2007.

IV. Existing Conditions

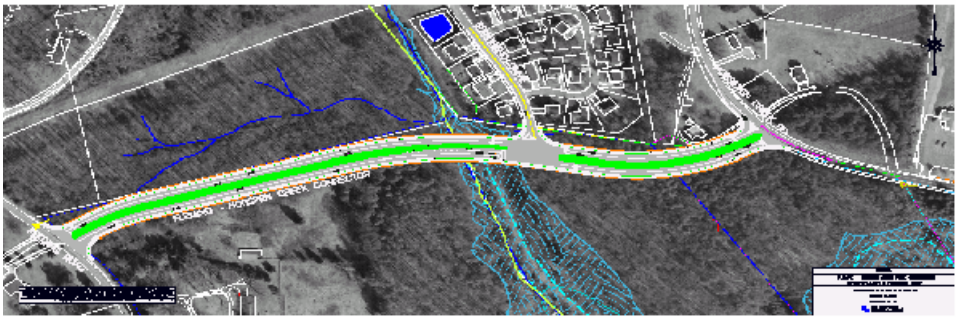
The identified study area for the project encompasses Horse Pen Creek Road northwest of Greensboro, between Battleground Avenue (U.S. Highway 220) and New Garden Road, a distance of approximately 3.4 miles (see Figure 1). A four-lane divided treatment, with a landscaped median, is the desired typical-section for the project. This has been determined through consultation with GDOT, City and County Planning Staff and NCDOT Division 7 Staff, and a review of project purpose and need including traffic forecasts and capacity analysis conducted under this study. This typical-section is preferred given the access management qualities of divided facilities and the prominence of residential development adjacent to the corridor. Enhanced safety, improved pedestrian crossings, and aesthetics are other benefits of the preferred section.

Horse Pen Creek Road is partially located in the City of Greensboro and partially in unincorporated Guilford County. The polar ends of Horse Pen Creek Road are located in the city limits of Greensboro. The majority of the corridor is a two-lane roadway with selective widening at major intersections for turn lanes. The approach to the intersection with New Garden Road is 6 lanes in width to allow for multiple turning and receiving lanes. 2001 NCDOT traffic survey maps indicate that Horse Pen Creek Road carries approximately 9,600 vehicles per day (vpd) near the intersection of Battleground Avenue and 7,000 vpd south of Jessup Grove Road. New Garden Road carries 20,000 vpd near the intersection with Horse Pen Creek Road. Recent development along the corridor includes Caldwell Academy, Alex W. Spears III YMCA, Carolyn Allen Park, as well as several residential developments.

The City of Greensboro Thoroughfare Plan identifies the need for a connector facility between Horse Pen Creek Road and Fleming Road. The purpose of this roadway has been defined as follows:

- To provide a critical link to the future roadway network, as identified on the Greensboro Thoroughfare Plan;
- To relieve traffic congestion by providing an additional east-west route to a growing residential area;
- To provide a safe, direct route that reduces driving time and distance.

A preferred alignment and typical section have been selected for the collector road. A design speed of 50 mph and a design year traffic volume of 4,500 to 8,500 vehicles per day has been estimated using data provided by the City. The Horse Pen Creek / Fleming Road connector is to be constructed as a 4-lane median divided facility with dedicated turn lanes at median openings. This connection facility is currently under construction.



Draft Image of preferred alignment, prepared by Neel-Shaffer, Inc.
Note: Laneage and section are representative and not necessarily preferred by GDOT

With approximately 20 existing intersections and numerous driveways providing access to the corridor from private properties, schools, and businesses, the strategic placement of median breaks is critical to the functionality of the facility. Significant intersections along the corridor include:

1. Battleground Avenue*
2. Four Farms Road
3. Laurel Run Drive
4. Coronet Court
5. Piedmont Drive
6. Gray Bluff Court
7. Carlson Dairy Road*
8. Brinton Drive
9. Walking Horse Lane
10. Jessup Grove Road*
11. Drawbridge Parkway*
12. Chance Road
13. Briargrove Road
14. Quaker Run Drive
15. Fleming Road Connector* (future)
16. Terault Drive
17. Talmaga Lane
18. Sullivans Lake Drive
19. Waynoka Drive
20. Saint Pauls Lane
21. Carlys Way
22. New Garden Road*

** Major Intersections*

The posted speed limit is 45 miles per hour (mph) from Battleground Avenue to Drawbridge Parkway and 40 mph from Drawbridge Parkway to New Garden Road.

Horse Pen Creek road crosses Horse Pen Creek Road at a location approximately one mile north of the New Garden Road intersection. Horse Pen Creek feeds into Lake Brandt, a water supply for the City of Greensboro

Existing Conditions Analysis

A thorough evaluation of traffic operations is essential to the determination of needs for the project corridor. To accomplish this, the consulting firm of Martin Alexiou Bryson (MAB) evaluated the following six (6) critical intersections for existing and design year capacity and level-of-service analyses:

1. New Garden Road (signalized)
2. Drawbridge Parkway (signalized)
3. Jessup Grove Road (unsignalized)
4. Carlson Dairy Road (unsignalized)
5. Battleground Avenue (signalized)
6. Fleming Connector (unsignalized)

The City of Greensboro DOT contracted with the firm of Martin / Alexiou / Bryson to prepare the traffic forecast and capacity analysis work cited above. A technical memorandum was prepared to summarize the assumptions, methodology, and results of the traffic forecasts. A copy of this memorandum is included in the Appendix.

MAB forecasts that Horsepen Creek Road will carry approximately 25,500 vehicles per day (near New Garden Road) and 15,800 vehicles per day (west of US 220) in 2030. This estimate was derived primarily from the Piedmont Triad Regional Travel Model, and assumes the following projects were completed in the future year network:

- Entire Greensboro Urban Loop
- Fleming-Horsepen Creek Road Connector & Interchange at the Urban Loop
- Widened US 220 (Horsepen Creek Road-NC 68/220 Connector)
- NC 68 / US 220 Connector
- Fleming Lewiston Connector
- Lewiston / Pleasant Ridge Roads
- Bryan Boulevard Relocation

In addition to projecting the 2030 daily traffic volumes on Horse Pen Creek Road, MAB projected the 2030 PM peak hour traffic volumes. These volumes are part of the technical memorandum in the Appendix of this study and were used in performing a Synchro analysis at the major intersections along Horse Pen Creek Road.

On an average weekday, peak travel periods typically occur between 7:00 AM and 9:00 AM, and between 4:00 PM and 6:00 PM. Roadways are therefore more congested during these hours than during non-peak periods. Existing conditions analyses of the subject intersections were conducted using current intersection geometries, control measures, and the peak hour volumes collected by the City of Greensboro. . Table 2 summarizes the findings for existing conditions.

Table 2 Existing (2004) Traffic Conditions Summary						
Intersection	AM Peak Hour			PM Peak Hour		
	LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
Horse Pen Creek Road & New Garden Road (signalized)	F	87.9	0.93	F	*	1.42
Horse Pen Creek Road & Drawbridge Parkway (signalized)	B	11.6	0.49	B	11.4	0.48
Horse Pen Creek Road & Jessup Grove Road (unsignalized)	C	20.7	0.11	C	21.4	0.12
Horse Pen Creek Road & Carlson Dairy Road (signalized)	B	17.1	0.61	B	17.5	0.55
Horse Pen Creek Road & Battleground Avenue (signalized)	D	51.3	0.88	D	50.2	0.98

* *Delay beyond measurable limits*

These analyses indicate that existing levels-of-service (LOS) along the Horse Pen Creek Road corridor for the AM and PM peak hours of operation are within acceptable limits with the exception of New Garden Road.

Design Year Projections and "No Build" Conditions Analysis

To effectively evaluate the impacts of the identified alternatives, traffic volumes must be estimated and reassigned appropriately to reflect design year (2030) conditions. To establish a baseline for design year comparison, each of the subject intersections was evaluated for a "no build" scenario, which assumes that roadway and traffic control conditions will remain unchanged from the current configurations. The results of this evaluation indicate that intersection operations will deteriorate dramatically to unacceptable LOS. For all locations and time periods, the estimated delay time per vehicle reduces LOS to either "C" or "F", and volumes exceed capacities. These results are shown in Table 3.

By 2030 Average Daily Traffic (ADT) No-Build volumes along Horse Pen Creek Road range from 24,600 vehicles per day (vpd) near the intersection with New Garden Road to 10,900 vpd between Carlson Dairy Road and Jessup Grove Road. With this increased volume of traffic, intersection roadway capacity will be at or beyond the capacity of the roadway. Intersection level of service throughout the corridor will likewise deteriorate further beyond acceptable limits, thus necessitating improvements to the corridor.

Table 3 2030 Traffic Conditions Summary No Build						
Intersection	AM Peak Hour			PM Peak Hour		
	LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
Horse Pen Creek Road & New Garden Road (signalized)	F	139	1.26	F	*	*
Horse Pen Creek Road & Drawbridge Parkway (signalized)	C	24.3	0.61	C	23.5	0.51
Horse Pen Creek Road & Jessup Grove Road (unsignalized)	F	85.3	0.80	F	285.7	1.35
Horse Pen Creek Road & Carlson Dairy Road (signalized)	C	29.9	0.66	C	20.8	0.65
Horse Pen Creek Road & Battleground Avenue (signalized)	F	100.3	1.41	F	136.4	*
Horse Pen Creek Road & Fleming Connector (unsignalized)	F	298.8	1.24	F	*	*

** Delay beyond measurable limits*

Design Year Projections and "Build" Conditions Analysis

To effectively evaluate the impacts of the improvement alternative, traffic volumes must be estimated and reassigned appropriately to reflect design year (2030) conditions. The "Build" scenario evaluates traffic analysis with the preferred 4-lane divided section. The results are shown in Table 4; in summary, the addition of through lanes and left turn lanes provides relief for vehicle delay at the signalized intersections, but operational conditions remain below acceptable levels-of-service for unsignalized intersections. For the intersections of Horse Pen Creek Road at New Garden Road and Battleground Road, major road improvements were not implemented.

Table 4 2030 Traffic Conditions Summary Build						
Intersection	AM Peak Hour			PM Peak Hour		
	LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
Horse Pen Creek Road & New Garden Road (signalized)	F	152.5	1.21	F	226.3	1.72
Horse Pen Creek Road & Drawbridge Parkway (signalized)	C	31.9	0.37	C	34.6	0.42
Horse Pen Creek Road & Jessup Grove Road (unsignalized)	F	145.1	1.09	F	298.0	1.39
Horse Pen Creek Road & Carlson Dairy Road (signalized)	C	24.4	0.43	B	18.4	0.62
Horse Pen Creek Road & Battleground Avenue (signalized)	F	97.5	1.19	F	135.6	2.03
Horse Pen Creek Road & Fleming Connector (unsignalized)	F	*	*	F	*	*

** Delay beyond measurable limits*

The 2030 Average Daily Traffic (ADT) Build volumes increase slightly too significantly as compared to the No-Build volumes. ADT volumes increase from 14,100 vpd in the No-Build scenario to 18,000 vpd in the Build scenario. North of New Garden Road ADT volumes are projected at 25,500 vpd. The additional increases in traffic volumes further justify the need for roadway improvements, to maintain acceptable limits in roadway and intersection capacity. 2030 Build and No-Build volumes are depicted below.

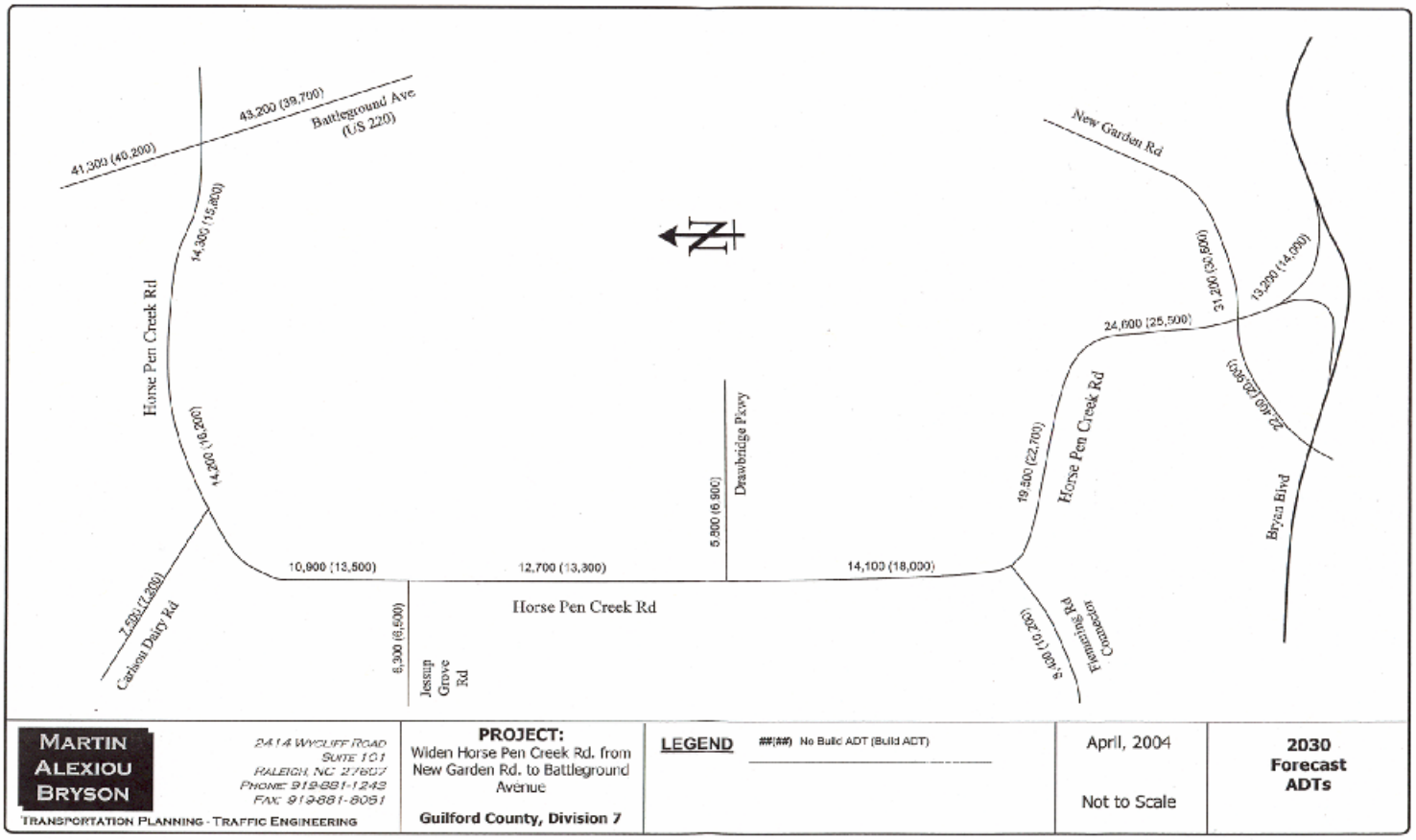


Image provided by Martin Bryson Alexiou

Conclusion

The analyses presented herein support the need to widen Horse Pen Creek Road. 2030 Average Daily Traffic volumes indicate the need for increased capacity between Battleground Avenue and New Garden Road. Development within the area will likely continue at an aggressive rate and will be accelerated with the completion of the Greensboro Urban Loop and the proposed Fed-Ex hub. The result will be increased traffic volumes along Horse Pen Creek Road. Traffic volumes could be even higher than projected if projects such as the Fleming-Lewiston connector interchange with the Urban Loop are not constructed. The proposed interchange will provide an alternative to the interchange with US 220 reducing dependence on Horse Pen Creek Road to feed traffic to the urban loop via US 220.

A copy of the technical memorandum prepared by Martin Alexiou Bryson is included in the appendix of this document.

Crash Summary

The crash history of the corridor was reviewed. Using the latest available data provided by the North Carolina Department of Transportation, 141 crashes occurred during the three-year period from June 1, 2000 to May 31, 2003 (reports are attached). A review of this data did not conclusively reveal a pattern of incidents occurring at isolated locations that might be either the result of existing deficiencies or correctable by means of enhanced traffic control measures and/or devices.

As shown in the summaries provided in Table 5 and 6, 48 of the 141 recorded collisions occurred along Horsepen Creek Road. The remaining collisions occurred at major intersections.

None of the reported collisions involved fatalities, 50 produced injuries, and 91 resulted in property damage only (PDO). Thirty-nine of the collisions occurred at night and 29 were on wet pavement. Four of the collisions recorded during this period involved the use of alcohol. None of the collisions were reported to involve drug use.

The most prevalent collision type along the Horse Pen Creek Road corridor was the rear end type. This type of collision is common on two-lane roadways where traffic is queued and dedicated turn lanes or additional through lanes are not present.

The crash rate for Horse Pen Creek Road was calculated to be 520.33 per 100 million vehicle miles (mvm). The Guilford County crash rate from 2000-2002 was calculated to be 315.26 per 100 mvm for all state highways and 687.69 per 100 mvm for non-system roadways. The 2000-2002 North Carolina state wide average crash rate was calculated to be 254.64 per 100 mvm. Crash rates were provided by NCDOT Safety Evaluation Section.

Table 5
Collisions History Summary

Intersection	**Collisions**		
	Fatal	**Injury**	**PDO**
Horsepen Creek Road at Battleground Avenue	0	14	24
Horsepen Creek Road at Carlson Dairy Road	0	1	1
Horsepen Creek Road at Jessup Grove Road	0	1	6
Horsepen Creek Road at Drawbridge Parkway	0	0	1
Horsepen Creek Road at New Garden Road	0	12	33
Corridor	**Collisions**		
	Fatal	**Injury**	**PDO**
Horsepen Creek Road		22	26
TOTAL	**0**	**50**	**91**

Table 6 Collision History by Type		
Collision Type		**Collisions**
Horsepen Creek Road at Battleground Avenue		
	Angle	13
	Left Turn, Same Roadway	3
	Rear End, Slow or Stop	16
	Sideswipe, Same Direction	2
	Head On	1
	Sideswipe, Opposite Direction	1
	Right Turn, Different Roadways	1
	Left Turn, Different Roadways	1
Horsepen Creek Road at Carlson Dairy Road		
	Left Turn, Different Roadways	1
	Rear End, Slow or Stop	1
Horsepen Creek Road at Jessup Grove Road		
	Rear End, Slow or Stop	1
	Right Turn, Different Roadways	1
	Left Turn, Different Roadways	5
Horsepen Creek Road at Drawbridge Parkway		
	Right Turn, Different Roadways	1
Horsepen Creek Road at New Garden Road		
	Ran Off Road, Right	1
	Angle	24
	Sideswipe, Same Direction	4
	Rearend, Slow or Stop	7
	Left Turn, Different Roadways	1
	Right Turn, Different Roadways	5
	Right Turn, Same Roadways	1
	Left Turn, Same Roadways	1
	Animal	1
Horsepen Creek Road Corridor		
	Angle	9
	Rear End, Slow or Stop	16
	Rear End, Turn	2
	Sideswipe, Opposite Direction	3
	Fixed Object	4
	Backing Up	1
	Head On	2
	Ran-off Road, Right	5
	Other Non-Collision	4
	Animal	2
TOTAL		**141**

Environmental Screening

The following is a preliminary review of environmental issues related to the proposed widening project. The information obtained for the environmental screening is from readily available database information. No survey work, other than a field inspection was prepared for this study. The environmental screening is not a substitute for the project planning / environmental documentation process. The purpose of the screening is to identify potential environmental issues early in the process. For this study, these issues were identified within the corridor along the alignment of existing Horse Pen Creek Road between Battleground Avenue and New Garden Road. Figure 2 shows the water-related environmental features, and Figure 3 shows the locations of other potential environmental issues.

Stream Classification

The proposed project corridor is located in the Cape Fear River Basin. The project corridor crosses Horse Pen Creek. Horse Pen Creek is classified as a Water Supply III Watershed (WS-III). Horse Pen Creek is also listed as a Nutrient Sensitive Waters (NSW) which is classification for lakes and rivers that need additional nutrient management due to their inherent excessive growth in vegetation. The northwest side of Horse Pen Creek Road from Jessup Grove Road to Battleground Avenue is located in the critical watershed area. The regulations concerning this watershed area are provided in the Water Supply Watershed Protection Rules, sections 15A NCAC 2B .0248 through .0251, defined by the North Carolina Department of Environmental and Natural Resources (NCDENR), Division of Water Quality (DWQ).

There is an existing two-lane, four-barrel culvert over Horse Pen Creek at the crossing of Horse Pen Creek Road. The creek will be surveyed and have the appropriate coordination with NCDENR and the U.S. Army Corps of Engineers (USACE) during any environmental document study.

Horse Pen Creek Culvert

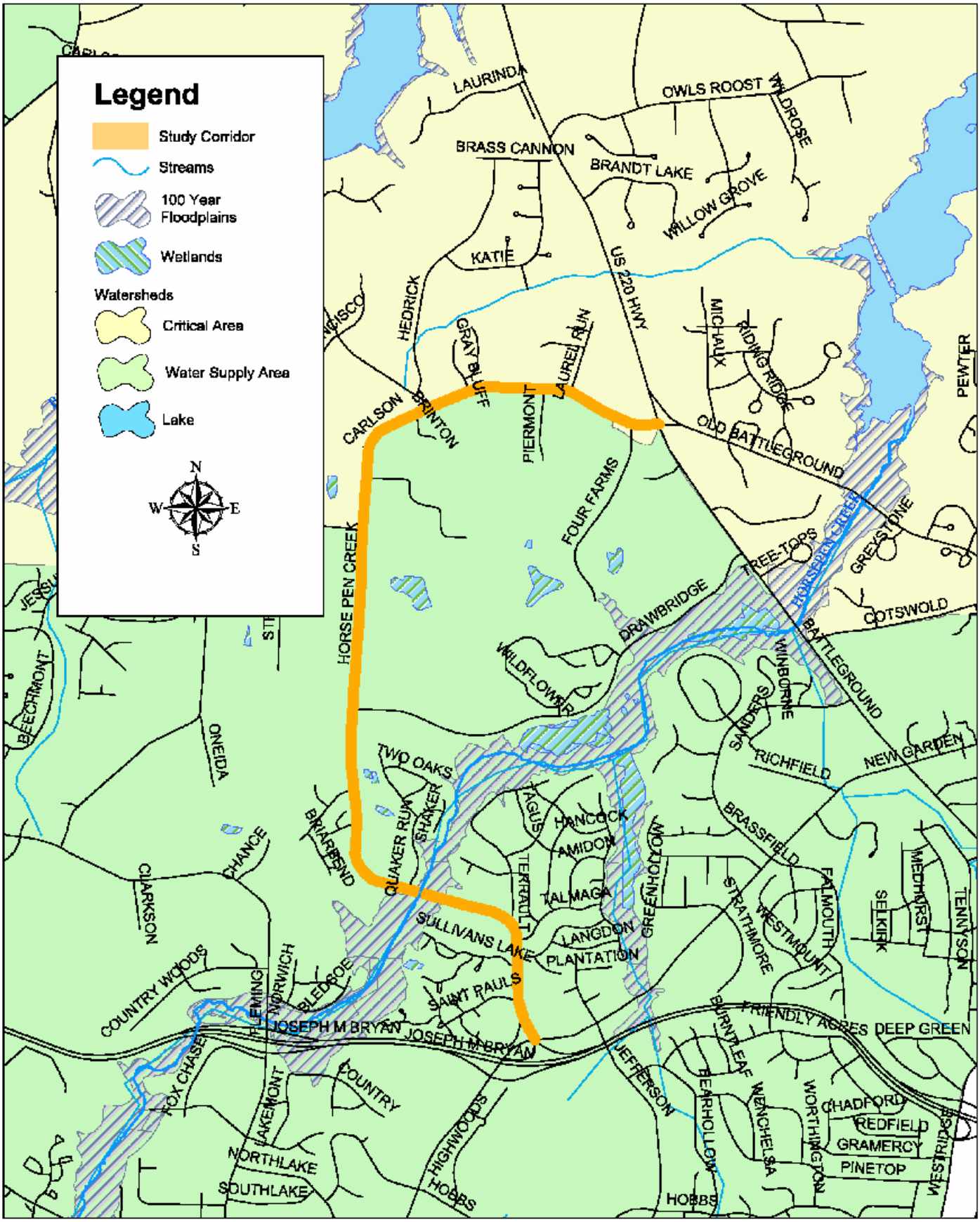
Floodplains

Guilford County is a regular participant in the National Flood Insurance Program. Digital Federal Emergency Management Agency (FEMA) floodplain maps were reviewed to determine whether the proposed project corridor would cross the 100 year floodplain. The 100-year floodplain is located along Horse Pen Creek, and the width of the floodplain at the Horse Pen Creek Road crossing is approximately 500 feet. No base flood elevations were provided. When constructing this project, local and state regulations regarding the 100-year floodplain will be followed.

Wetlands

National Wetland Inventory (NWI) maps Summerfield and Lake Brandt (USGS) were reviewed to determine whether the proposed project corridor impacts any wetlands. The only wetlands encountered by the project corridor are those associated with Horse Pen Creek. During the preparation of any environmental documentation, it is recommended that these wetlands be surveyed and delineated. Wetlands within the corridor are a minimum 1/8 of a mile from the project corridor. Proper permitting from the U.S. Army Corps of Engineers and North Carolina Division of Water Quality will be obtained before construction of the project, and appropriate mitigation measures will be taken. A complete listing of wetlands in the area can be found in the technical appendix.

Horse Pen Creek



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HORSE PEN CREEK ROAD FEASIBILITY STUDY

WATER FEATURES

FIGURE 2

Historic Properties and Archaeological Sites

As part of the environmental screening process, the North Carolina State Historic Preservation Office (SHPO) and the Guilford County Historic Preservation Commission was contacted to determine if any historic resources on the National Register of Historic Places or state lists exist within the proposed project corridor. No historic properties were found on the National Register or any North Carolina surveys.

One structure was located adjacent to the Horse Pen Creek Road corridor that is eligible for historic preservation. Listed as the Jeffers Complex, the structure is dated between 1825 and 1915. The Jeffers Complex consists of the residential homestead and associative outbuildings. The exact acreage of this complex is unknown at this time.

Threatened and Endangered Species

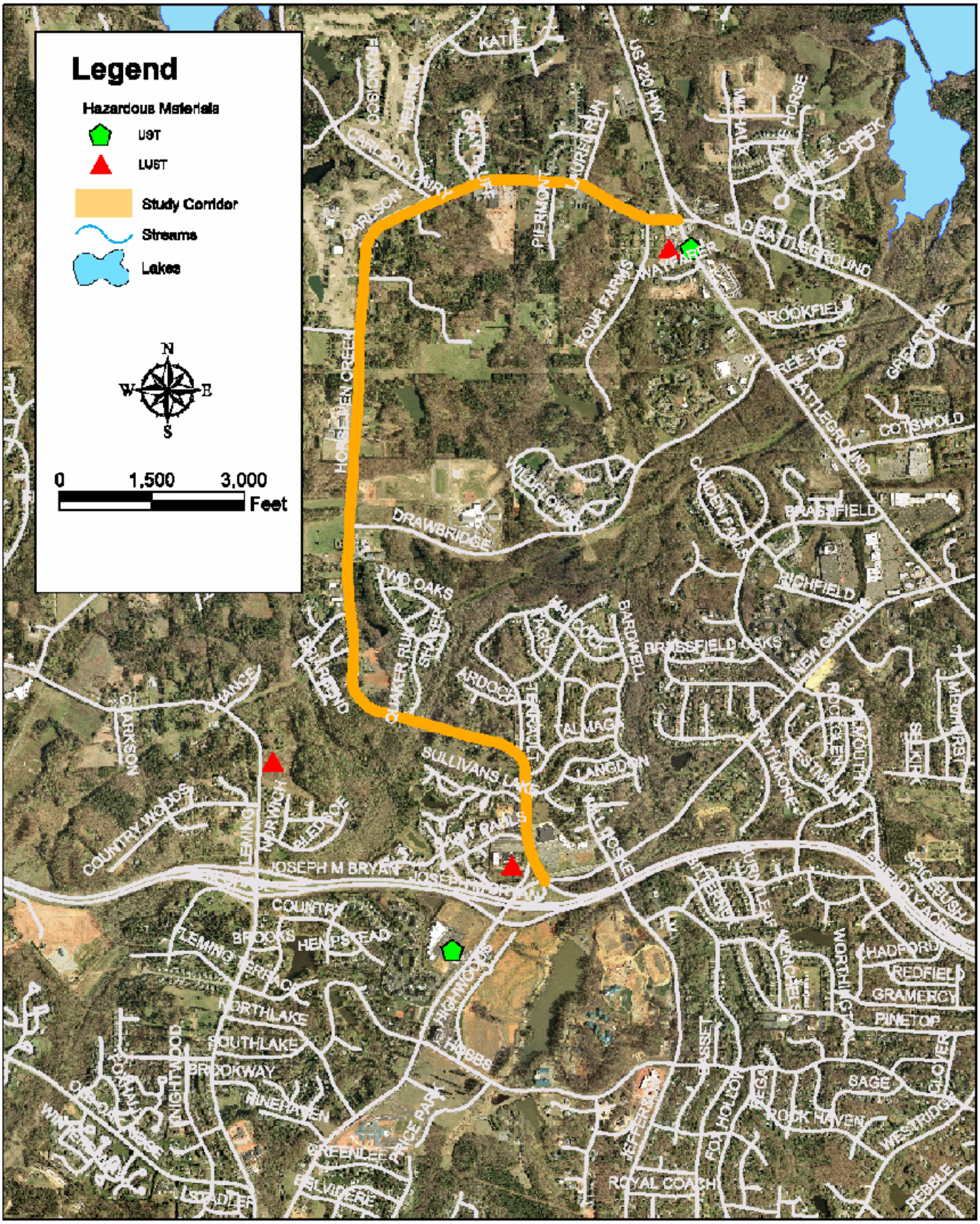
The North Carolina Natural Heritage Program was contacted to determine the presence of any threatened and endangered species within the proposed project corridor. One rare animal species was found in the vicinity of the proposed project. This is the Greensboro Burrowing Crayfish *(Cambarus Catagius)*, which has a state status of Significantly Rare. The species is not listed on Federal Threatened and Endangered Species lists[2].

A survey for this species may need to be completed during preparation of any environmental documentation, and if the species is found to be present, additional investigations may be warranted.

Hazardous Materials

Because of the liability associated with purchasing properties containing hazardous materials, State and Federal hazardous materials databases were reviewed using information provided by Environmental Data Resources, Inc. Five sites near the proposed corridor were determined to contain potential hazardous materials. Two sites contained registered underground storage tanks, and four sites have reported incidents of leaking underground storage tanks. Figure 3 shows the location of sites of potential concern, and Table 7 provides information regarding each site. Before purchasing right-of-way property for the proposed project corridor, a Phase I environmental audit will be conducted to determine potential hazardous materials impacts.

[2] North Carolina Natural Heritage Program, 2001.



Kimley-Horn and Associates, Inc.	HORSE PEN CREEK ROAD FEASIBILITY STUDY	ENVIRONMENTAL FEATURES	FIGURE 3

Table 7 Potential Hazardous Materials Impacts			
	Facility Name	**Facility Address**	**Type of Potential Impact**
1	St. Paul Apostle Catholic Church	2715 Horse Pen Creek Road	LUST[a]
2	Sav-Way Convenient Store.	3930 Battleground Avenue	LUST, UST[b]
3	Fellowship Hall	1932 Fleming Road	LUST
4	Battleground Family Fare #112	3931 Battleground Avenue	UST
5	Gate Station	1585 New Garden Road	UST
Total			3 USTs 3 LUSTs

[a]LUST = Leaking Underground Storage Tank – Facility has reported leaking underground storage tank incident(s).
[b]UST = Underground Storage Tank – Facility manages registered underground storage tanks.

Source: Environmental Data Resources, Inc., 2003.

Noise Contour

According to the Piedmont Triad Airport Area Plan, portions of Horse Pen Creek lie within the noise contour for the existing runway. The noise contour covers Horse Pen Creek Road from approximately Drawbridge Parkway north to Battleground Avenue.

Conclusion

Based upon the preliminary environmental screening for the general area surrounding the Horse Pen Creek corridor, no known or documented environmental elements have been identified that would detrimentally impact the continuance of this project.

V. Description of Alternative

Functional Plan Preparation

The preparation of functional plans is a major step toward protecting a roadway corridor from proposed development activities. Using available mapping received from the City of Greensboro and other resources, alternative alignments were prepared, evaluated, and offered for consideration.

Following consultation with agency stakeholders and a review of study information including the project purpose and need, the City of Greensboro Department of Transportation, determined that a typical four-lane divided "parkway" typical-section would include sidewalk on both sides of the corridor, as well as 5 foot bike lanes to accommodate cyclists

Consultation with Greensboro Department of Transportation staff and a review of corridor conditions led to the determination that wherever possible, the basic centerline alignment should follow the existing Horse Pen Creek Road route. Deviations from the corridor were to be made only as necessary to meet specific design criteria, to reduce the impacts on abutting properties, or to avoid constraining features that would be impractical or costly to relocate (such as an electric power transmission line). The design criteria for the project are depicted in Table 8.

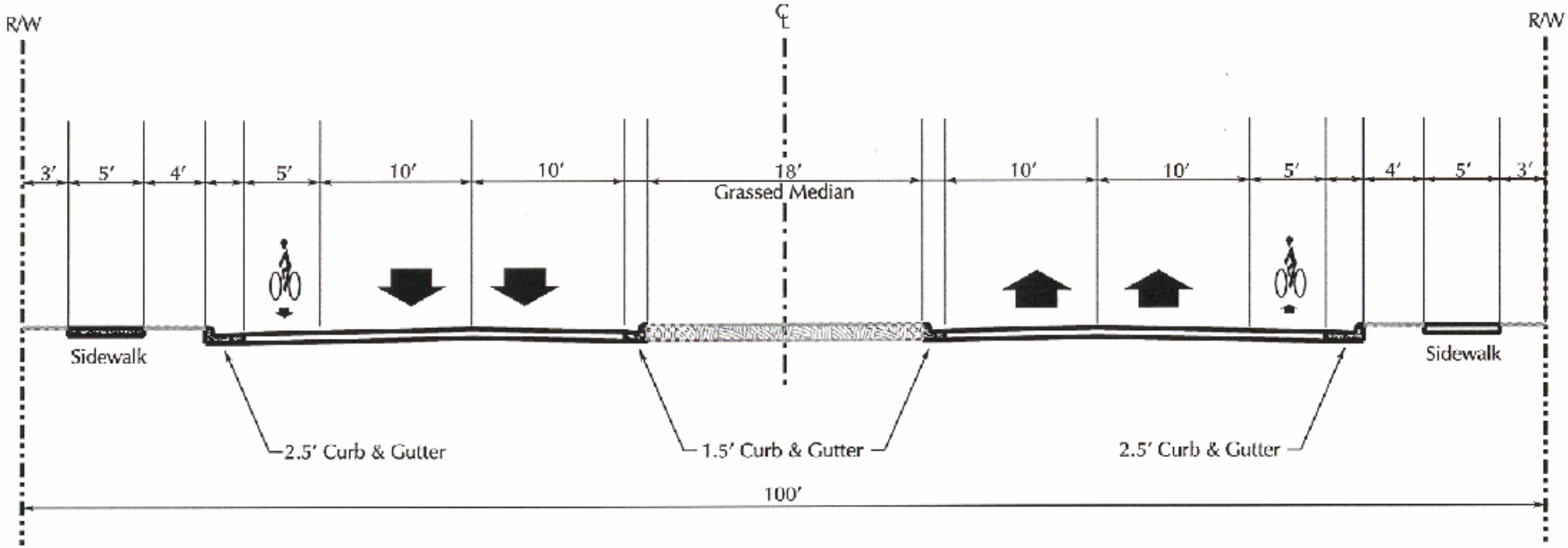
Functional plans for the corridor also took into consideration the construction of the Fleming Road connector. As discussed earlier, the Fleming Road connector will provide a connection between Fleming Road and Horse Pen Creek Road. Construction on the connector road began in December of 2003.

Plans were prepared as overlays on existing aerial photography of the corridor, and depict the proposed right-of-way, typical laneage graphics, existing edge of pavement, and edge of pavement limits for the proposed section. Current standards used by the North Carolina Department of Transportation for roadway design were applied throughout.

Table 8 Roadway Design Criteria	
Design Element	**Recommended Standards**
Functional Classification	Urban Arterial
Design Speed	50 mph
Typical Section	
Lane Width	10 feet inside lane 10 feet outside lane
Median Width	18 feet
Bike Lane	5 feet
Sidewalk Width	5 feet
Sidewalk Setback	4 feet
Roadway Curb	2'-6" C&G
Median Curb	1'-6" C&G
Right-of-Way Width	100 feet
Stopping Sight Distance	2001 AASHTO Standards
Length of Vertical Curve	2001 AASHTO Standards
Hydraulics	
Design Discharge	50 year frequency cross pipes and culverts 10 year frequency for storm drains 10 year frequency for ditches 4 inches per hour for inlet capacities and gutter spread
Hydrology	City of Greensboro Standard and NCDOT Guidelines for Drainage Studies and Hydraulic Design in conjunction with "USGS Water Resources Investigations Report 87-4096"
Hydraulics	City of Greensboro Standard and NCDOT Guidelines for Drainage Studies and Hydraulic Design in conjunction with FHWA's Publication Circular Nos. 5, 11, 12, 15, 19.
Sources: ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2001 and North Carolina Department of Transportation Roadway Design Manual.	

The proposed cross-section is depicted on Figure 4. This rendering depicts the four-lane parkway concept within the proposed 100-foot right-of-way. The functional designs are provided at the end of this report.

4-Lane Median Divided Section



NOT TO SCALE

Kimley-Horn and Associates, Inc.

Horse Pen Creek Road Feasibility Study

Typical Section

Figure 4

VI. Opinion of Probable Cost

A planning level opinion of probable cost was prepared for the preferred alternative. The estimate was based on data acquired from the City of Greensboro and current construction pricing experience in accordance with NCDOT estimating procedures utilizing a spreadsheet obtained from NCDOT State wide planning. The opinion of probable costs includes project design; right-of-way and easements; roadway and intersection construction; culverts and other significant hydraulic features.

It is anticipated that approximately four (4) residences will be relocated and forty-six (46) will be impacted due to the development of a 4-lane median divided facility. The impact upon house can possibly be minimized through asymmetrical widening. No business relocations will be required as apart of this widening. Upon field investigations, it was determined that the existing culvert can be extended to accommodate the widening. The cost provided in Table 7 includes: removal of the head and end walls, channel diversion, and traffic control for this task.

Table 7
Opinion of Probable Cost

Length of Project: 3.4 miles, 4-lane divided roadway

Construction Costs			
Description	Quantity	Cost ($/mile)	Amount ($)
4-lane curb & gutter w/raised median plus bike lanes	3.4 miles	$2,400,000	$8,160,000
5 ft sidewalk on both sides of roadway	3.4 miles	$218,000	$741,200
4 ft Bicycle lane on both sides	3.4 miles	$218,000	$741,200
Existing culvert extension	-	-	$420,000
Sub-Total			*$10,062,400*
Total Roadway Cost with Terrain Adjustment(1.15 * $10,062,400)			$1,509,360
Contingency (20% of $13,065,380)			$301,872
Total Roadway Cost + Contingency			$1,811,232
Preliminary Engineering (10% of Cost + Contingency)			$181,123
Overhead (15% of Cost + Contingency)			$2,351,768
Construction Sub-Total			***$14,137,672***

Right-of-Way Costs				
Description	Quantity	Cost ($/acre)		Amount ($)
Commercial / office	0.5 acres	$800,000		$400,000
Residential	19.5 acres	$33,000		$643,500
Residential Houses	4	$150,000 / house		$600,000
Proximity Damages	Property Cost	% Damage	Number of Properties	Cost
40 ft to 50 ft	$140,000	5%	21	$147,000
20 ft to 30 ft	$140,000	25%	19	$665,000
10 ft to 20 ft	$140,000	35%	6	$294,000
Less than 10 ft	$140,000	50%	6	$420,000
			Sub-Total:	*$3,169,500*
Administration / Right –of-Way Acquisition (30% of $3,289,500)				$950,850
Relocation (10% of $3,289,500)				$316,950
Right-of-Way Sub-Total:				***$4,437,300***
TOTAL PROJECT COST				**$18,574,972**

Recommendations and Additional Comments

The results of this study indicate that roadway improvements along the Horsepen Creek Road corridor northwest of Greensboro are needed to address the purpose and need elements defined in this study, including accommodating future year traffic. The study also demonstrates such improvements are feasible with manageable impacts to surrounding properties.

As continued development occurs in northwest Guilford County so will traffic along the Horse Pen Creek Road Corridor. As traffic continues to grow, improvements in infrastructure will be needed to maintain acceptable limits on delay and capacity. The widening of Horse Pen Creek Road will be crucial to maintaining a network of roadways.

It is recommended that the Horse Pen Creek Road widening project be included in the Transportation Improvement Program (TIP). Adoption of a preferred alignment and typical section will ensure that proposed projects will incorporate the widening into the design plans prior to the widening of Horse Pen Creek Road. Design plans for the Greensboro Urban Loop are currently under development. The planned grade separation for Horse Pen Creek Road over the Greensboro Urban Loop will need to be widened to accommodate the added laneage as well as bicycle and pedestrian accommodations described in this report.

The Greensboro Metropolitan Planning Organization has already contacted NCDOT about this potential design modification to the urban loop design plans in a letter dated April 6, 2004. A copy of this correspondence can be found in the appendix.

Based on the environmental screening information available to and reviewed for this study, environmental impacts within the corridor are minimal.

Functionally, a four-lane parkway type facility can be accommodated within the proposed 100-foot right-of-way. This typical-section with the implementation of consistent access management principles and with certain intersection elements will generally provide for acceptable peak hour levels-of-service through the corridor at signalized intersections. For unsignalized intersections long side street delays are not uncommon. These intersections should be investigated for possible signalization.