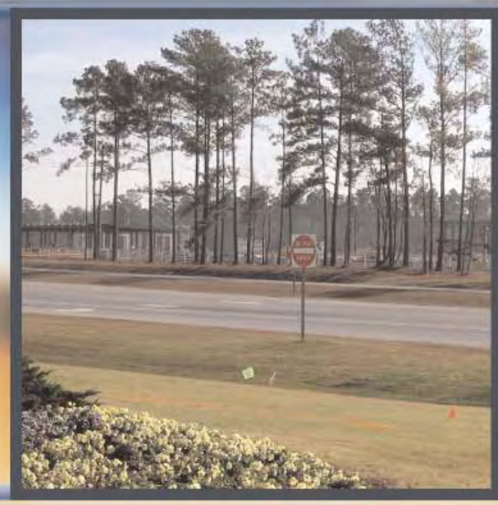
US 17/NC 133 Collector Street plan

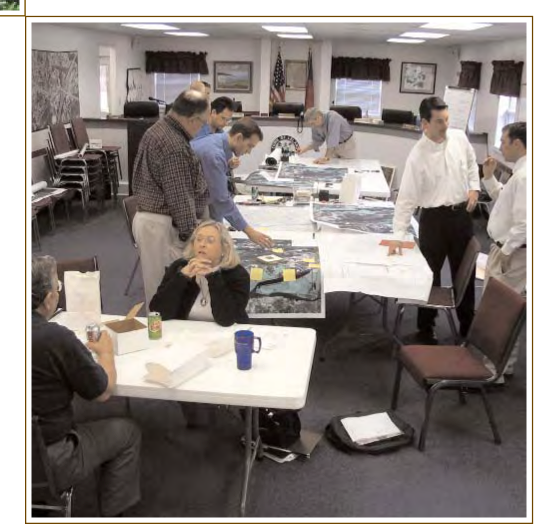


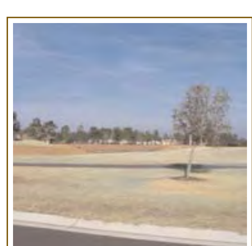
Prepared for
Wilmington Area
Metropolitan Planning Organization

May 2005

Kimley-Horn
and Associates, Inc.

US 17/NC 133 Collector Street Plan





The US 17/NC 133 Collector Street Plan was formally adopted by the Wilmington Urban Area Metropolitan Planning Organization on May 25, 2005.

Kimley-Horn
and Associates, Inc.

Wilmington Area
Metropolitan Planning Organization

c/o Mike Kozlosky

Dear Oversight Committee Members:

We are pleased to submit this summary report of our collector street plan for the US 17/NC 133 study area in Brunswick County. This report is a compilation of your vision, goals, and objectives related to transportation and of issues, findings, and recommendations prepared by Kimley-Horn and Associates. Most of the ideas were generated during a three-day transportation planning charrette held at the Belville Elementary School in January 2005.

The primary purpose of this initiative is to identify a framework of ideas and a plan for the transportation network. Once implemented, the recommended projects will not only fulfill some of the objectives stated in the Brunswick County Vision, but also will reinforce the area as a desirable place to live, work, shop, walk, and ride a bicycle.

It should be mentioned that some of the recommendations must wait until completion of the US 17 Corridor Study, but some can be constructed as soon as funding is secured and detailed designs are drawn.

We appreciate the opportunity to be a part of this effort and thank you for your involvement during the charrette.

Cordially,

KIMLEY-HORN AND ASSOCIATES, INC.

Roger B. Henderson, AICP, P.E.
Project Director

Michael M. Rutkowski, AICP, P.E.
Project Manager

eat, play, sing, stroll, sit, dine, shop, ride, view mingle, reflect, laugh work, fish, read, hike, bike, farm, chat, conserve, bird-watch refresh, listen, rest, s learn, golf, plant, prese restore, worship, grow up, grow old ...

Acknowledgements

Steering Commitee
Helen Bunch
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Mike Kozlosky
Cameron Moore
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Study Purpose

As planners continue to evaluate the suburban development pattern, it is clear that the resulting transportation system greatly impacts a community's quality of life. Reduced connectivity minimizes travelers' choices and increases the reliance on the city's major transportation arteries to facilitate a larger share of the area's travel demand. Streets that were intended to carry regional traffic do double duty, carrying cross-town and local trips. Likewise, the scale of new development has increased to the point where it gravitates to the busiest transportation corridors (i.e., US 17 and NC 133) in the community.

The end result: a transportation system reliant on a few larger streets rather than an interconnected network of larger (arterial) and smaller (collector) streets. Planners and engineers have identified the shortcomings of this pattern and have documented the impacts such as increased congestion, reduced air quality, and automobile and pedestrian conflicts.

The US 17/NC 133 Area Collector Street Plan (CSP) was developed to complement the existing arterial system and planned development. The purpose of the CSP is to inventory the existing collector street network and develop standards and policies that will promote future connectivity and accommodation for automobiles, transit, pedestrians, and bicycles as collector streets are constructed. The US 17/NC 133 Area CSP includes this written summary document and a map, which identifies existing and future collector streets. The map identifies a connected transportation system network using general proposed corridors for future collector streets, not exact street locations. The specific location of future collector streets and when they will be constructed will be determined by future development review processes.

It is important to note, however, that simply promoting connectivity will not be enough to ensure "buy-in" from local residents. To function properly, the transportation system will need to demonstrate the benefits of increased mode and route choice as well as provide improved trip convenience. Other benefits may include improved safety by providing enhanced pedestrian and bicycle connections as well as improved response times for emergency vehicles. The CSP builds on the premise that connections provide choices, improve air quality and safety, reduce congestion, and contribute to an improved quality of life.

Background

A new level of governmental cooperation and coordination was achieved over the span of three days in Brunswick County in January 2005. Citizens gathered for two sessions in the multipurpose room in the Belville Elementary School on NC Highway 133, referred to locally as River Road. Consultants from Kimley-Horn and Associates asked pointed questions, probed citizens for opinions, talked with developers and government officials about the future, and drew maps and illustrations showing what that future might look like.

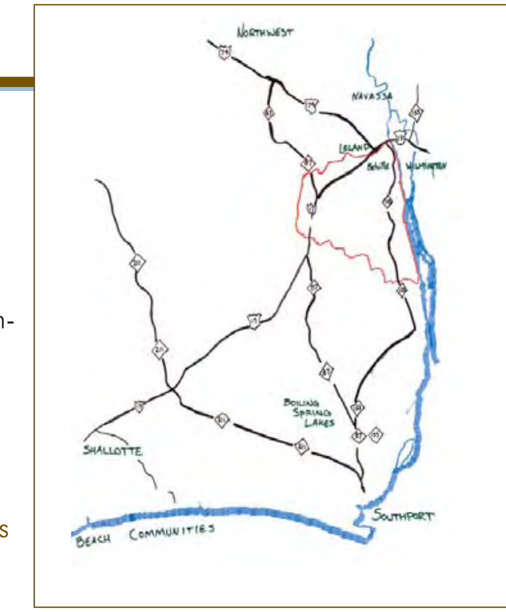
The study area is vast ... encompassing more than 32 square miles stretching from the Cape Fear River and Town Creek to points north and west of US Highway 17. Extensions of water and sewer service to the area are like a birdwatcher calling out to birds and watching them flock to the source. A proposed freeway called the Wilmington Bypass and Cape Fear Skyway brings the possibility of better access to and through the area. Congestion and high prices are bringing folks across the river from Wilmington and New Hanover County to seek opportunities in Brunswick County. The Town of Leland is growing rapidly, including a recent annexation of a large area called Brunswick Forest. All of these facts and trends were combined with others during the three-day workshop and folded into a vision for the future of the study area. The following is a summary of the salient message delivered to citizens on January 13, 2005.

Goals and Objectives

Collector Street Plan Objective

The objective of the consultants' work is to prepare a map showing a network of existing and future interconnected, paved streets that will accommodate vehicles, bicycles, buses and pedestrians and to recommend adoption of the map by the Town of Leland, Town of Belville, County of Brunswick, the Rural Planning Organization and the Wilmington Area Metropolitan Planning Organization.

Framework Plan Elements



A plan is like art in need of a frame. For this plan, the framework used to begin the work was a collection of information developed by other agencies and individuals. The following is a list of maps and facts we used to begin our work:

- Existing development
- Existing streets and major highways
- Natural features: creeks, lakes, river, wetlands
- Existing and future signalized intersections
- Planned public facilities (such as fire stations)
- Cultural and historic sites
- Public and major private easements: rail, utilities, conservation areas
- Approved developments - site plans with number of housing units/commercial acreage
- Adopted zoning
- Citizen input documented in a Brunswick County vision report entitled *Brunswick Tomorrow: Our County, Our Vision, Our Decision*, published February 2004.

Major Variables

Planning requires making assumptions about unknown variables. The major variables assumed in this plan are listed below.

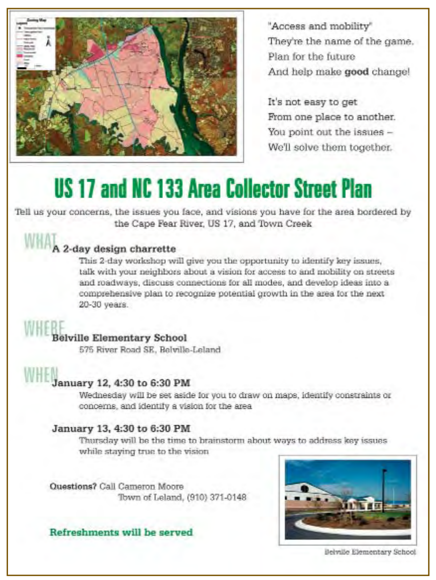
- Wetlands - Maps were obtained from the National Wetlands Inventory and United States Geological Society (USGS), however more definitive information should be gathered in the future by field delineation of wetland boundaries
- Creek crossings - permits for new streets crossing creeks are not assured
- Rail crossings - new streets crossing at-grade with the railroad are not assured
- Driveways - DOT approval is not assured for new driveways on state roads
- Wilmington Bypass/Cape Fear Skyway - funding has not been allocated
- Market forces may accelerate, decelerate, or alter the development schemes identified in this plan. To the extent practical, this plan relies on planned land uses identified by property owners and developers.

Community Workshop

Citizens Spoke ... Consultants Listened ... What We Heard

At the workshop, nearly 100 citizens participated in a visioning exercise using both sides of an index card to jot down their likes and dislikes about their community. Facilitators from Kimley-Horn encouraged everyone to think about their community as they define it, ranging from as local as the people who live immediately next to them all the way up to the entire Metro area. Citizens cited what they liked about their community that should be preserved. Then they flipped the card and wrote their dislikes noting which they wish would change and not be repeated as the area grows and expands. Consultants collected the cards, read them, and grouped them according to common trends. Following is a list of the most often-cited likes about their community:

- Maintain small neighborhood feel
- Need biking and walking paths
- Convenient access to stores
- Maintain rural character
- Preserve nature - open space - parks
- Zoning control on commercial areas near residential
- Protect environment and wildlife
- Provide stormwater regulation and water quality
- Convenient access to Wilmington
- Strong support for Wilmington Bypass
- Need parallel route to NC 133


"Access and mobility"
They're the name of the game.
Plan for the future
And help make **good** change!

It's not easy to get
From one place to another.
You point out the issues –
We'll solve them together.

US 17 and NC 133 Area Collector Street Plan

Tell us your concerns, the issues you face, and visions you have for the area bordered by the Cape Fear River, US 17, and Town Creek

WHAT **A 2-day design charrette**
This 2-day workshop will give you the opportunity to identify key issues, talk with your neighbors about a vision for access to and mobility on streets and roadways, discuss connections for all modes, and develop ideas into a comprehensive plan to recognize potential growth in the area for the next 20-30 years.

WHERE **Belville Elementary School**
575 River Road SE, Belville-Leland

WHEN **January 12, 4:30 to 6:30 PM**
Wednesday will be set aside for you to draw on maps, identify constraints or concerns, and identify a vision for the area

January 13, 4:30 to 6:30 PM
Thursday will be the time to brainstorm about ways to address key issues while staying true to the vision

Questions? Call Cameron Moore
Town of Leland, (910) 371-0148

Refreshments will be served

Belville Elementary School

The following is a list of common dislikes about existing life in 'the community that citizens wish would change and not be repeated in new developments:

- Small setback requirements that limit future widening of roads
- Lack of service roads along US Highway 17
- On-street parking
- Narrow streets
- Lack of vegetation and generally ugly parking lots

General Comments

Time was allotted for open discussion with questions and comments from any citizen. Much of the discussion related to NC Highway 133 (River Road).

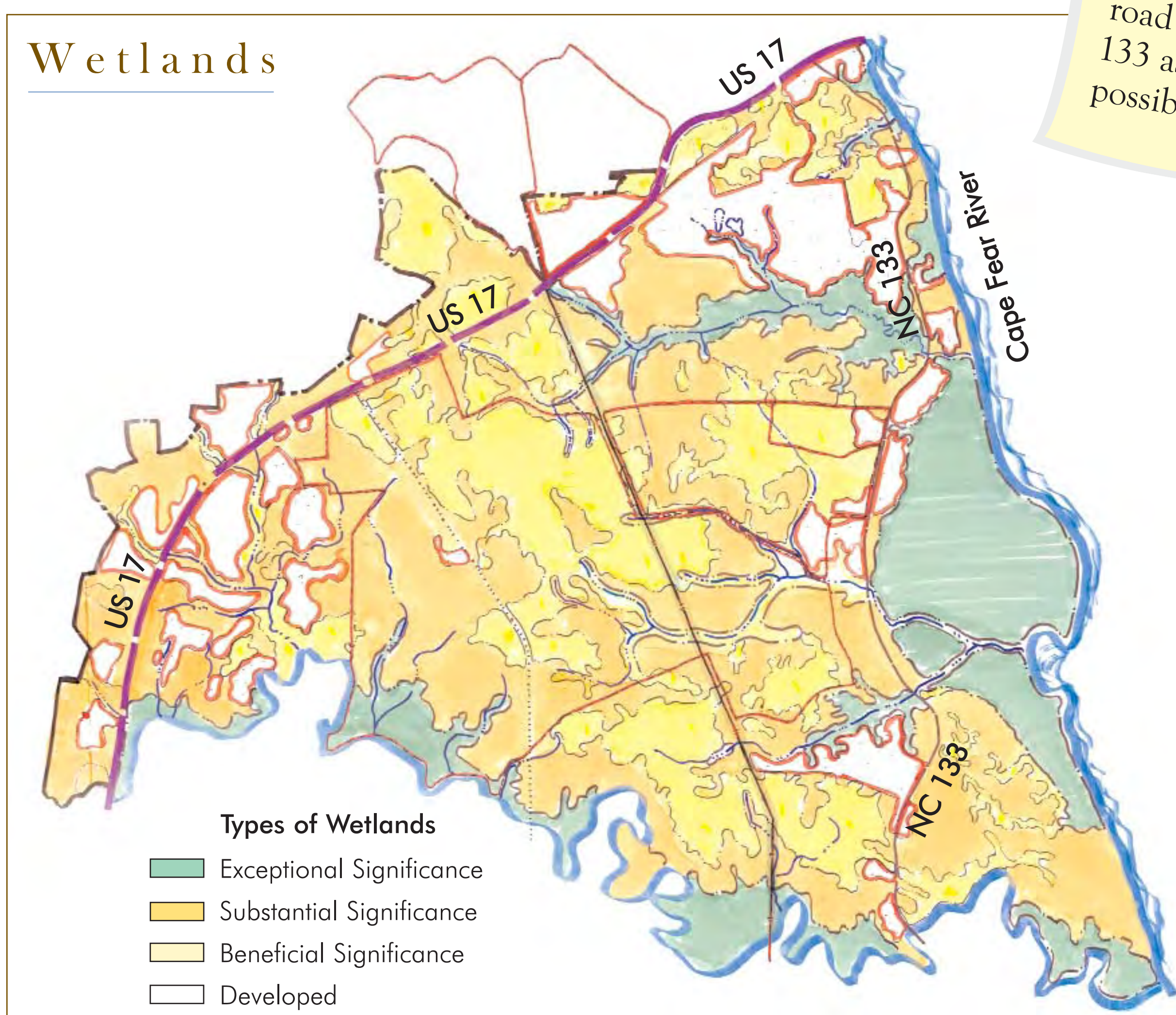
Following is a bulleted list of the issues raised at the workshop by citizens:

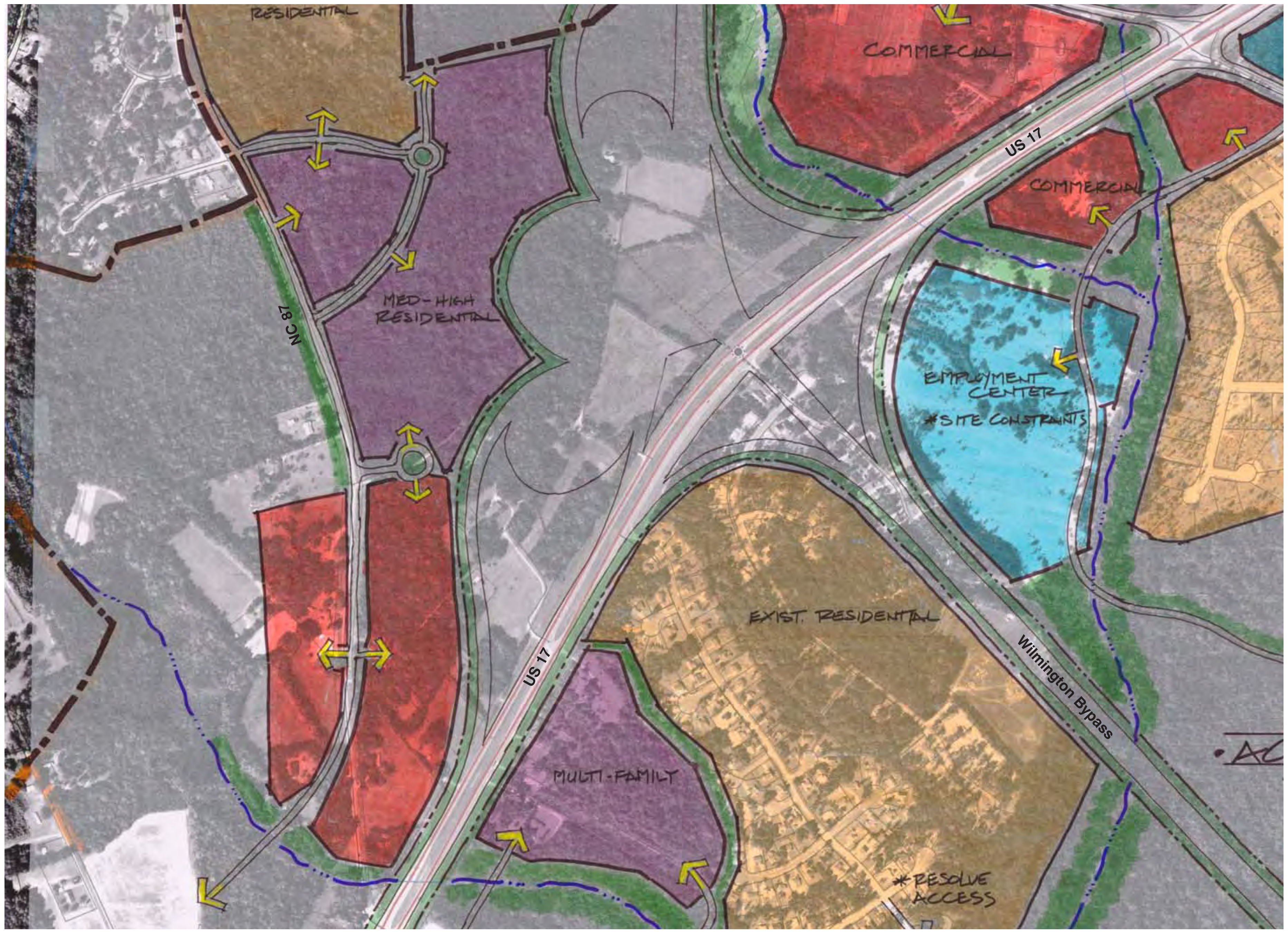
NC 133 - How will it be considered in the study?

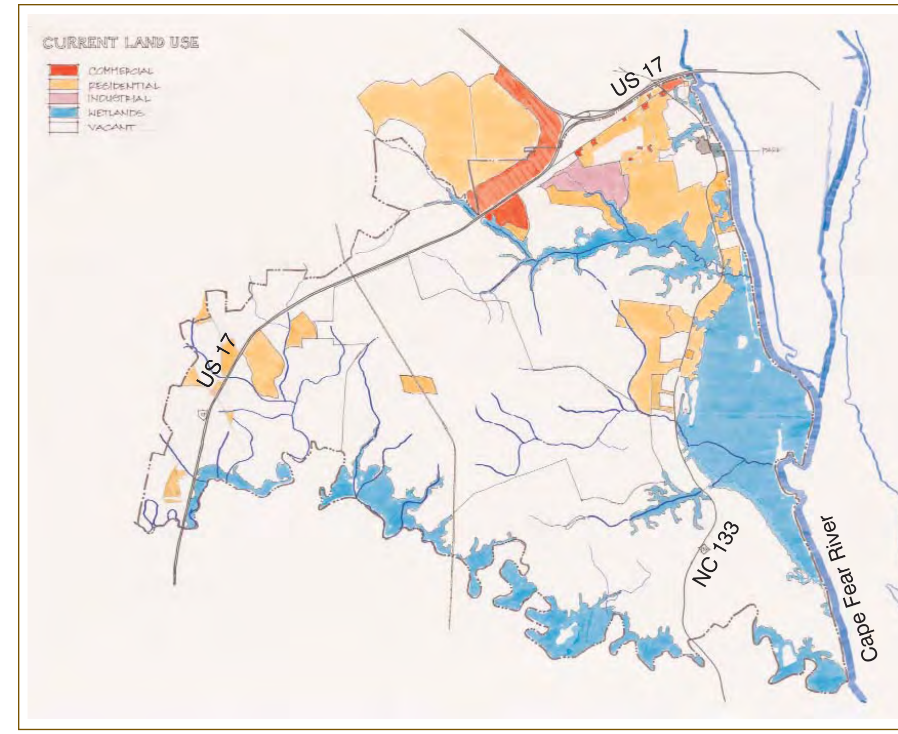
- Options and alternatives
- Leave as is - scenic
- Widen to multilanes
- Alternative north-south route within the study area
- Existing NC 133 alignment is "dangerous"
- Need to calm (slow) traffic speeds (Note that NC 133 is closed at the southern end of the study area as it crosses Town Creek due to bridge reconstruction, so existing speeding traffic is primarily residents, visitors and construction traffic.)
- Lack of shoulders along NC 133 for bicyclists or pedestrians
- Cut-through traffic problem between River Ridge and Olde Towne subdivisions
- Majority (approximately 70%) of participants support extending the Wilmington Bypass through the study area (as noted by a show of hands)
- NC 133/US 17 interchange/intersection operational problems are a concern
- Lack of trees and plantings at the NC 133/US17 interchange
- Vast majority of participants (90 percent according to hand vote) support building a parallel north-south route west of NC 133 between Town Creek and US 17
- Little support for widening NC 133 south of Belville Elementary School and modest support (perhaps 50 percent) for widening NC 133 from the elementary school north to US 17
- The majority of the public support a direct route (alignment) of the Wilmington Bypass. Through the study area under assumption, a direct route would attract more through trips off local roads.
- Support to co-locate east-west power lines along the Wilmington Bypass/Cape Fear Skyway (including existing lines crossing Cape Fear River)
- Need well-designed interchange to handle parallel road at US 17
- Build roads before development occurs
- Accelerate construction of the Wilmington Bypass by charging tolls
- Need access (driveway) limits on US 17 and building of service roads
- Provide public with contact information for an NCDOT official who is managing the US 17 corridor study. The contact person at NCDOT is Nathan Phillips. His phone number is (919) 250-4151 and his e-mail address is nphillips@dot.state.nc.us

"Need parallel road for NC 133 as soon as possible."

Wetlands







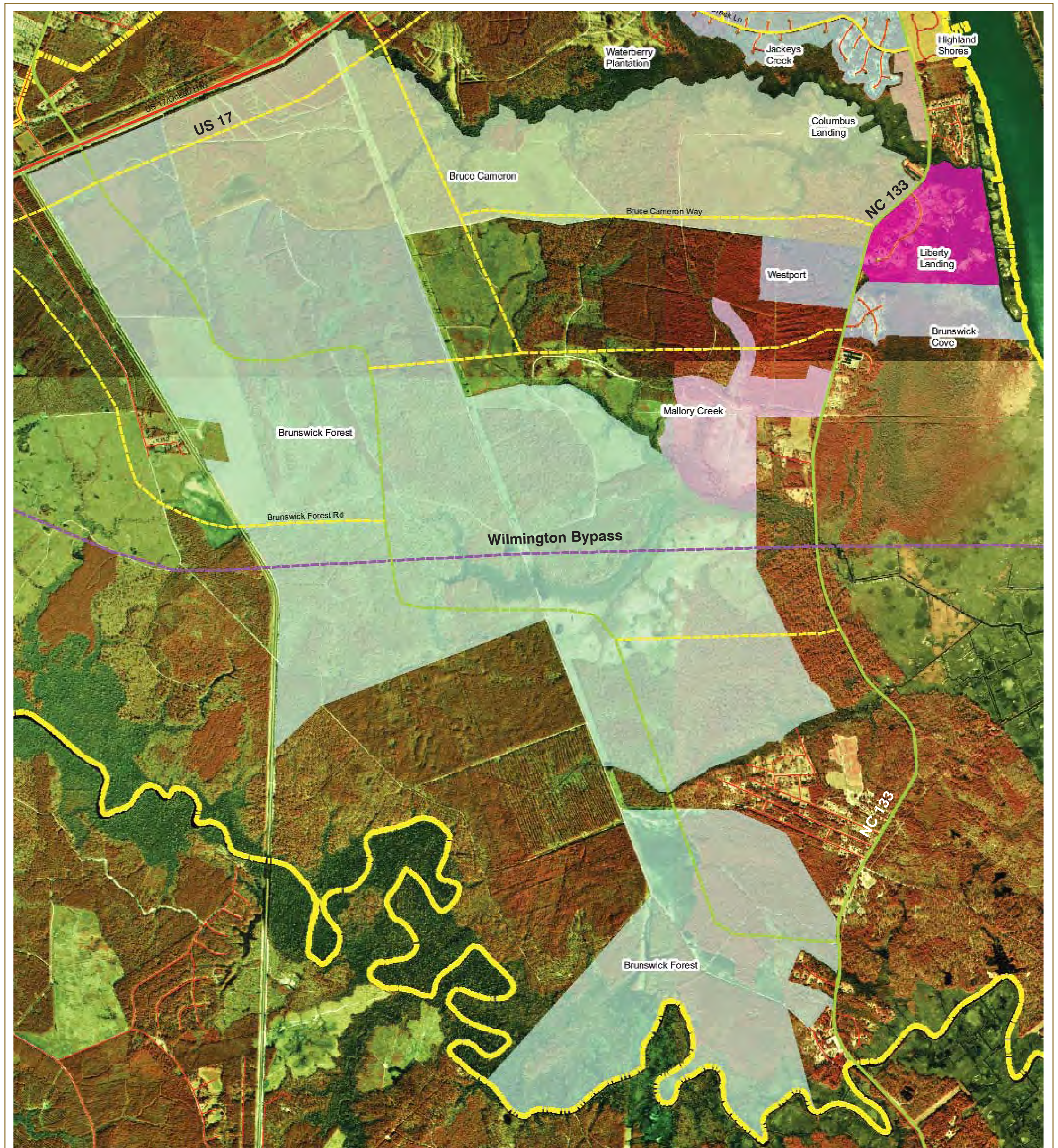
Current land uses are depicted in this map with white representing natural areas and blue showing waterways. Developed lands are shown in three basic colors: orange for commercial, yellow for residential and purple for industrial. Much of the study area is now in a natural state.

"Concentrate all Commercial business"

Land Use

Construction of the Wilmington bypass freeway as far south as US 17 near Leland will spur land speculation in areas that will be more accessible once the freeway is built. Access will be restricted from the bypass as well as from US 17. The Activity Node concept map (shown above) presented at the charrette shows a logical land use pattern in various colors.

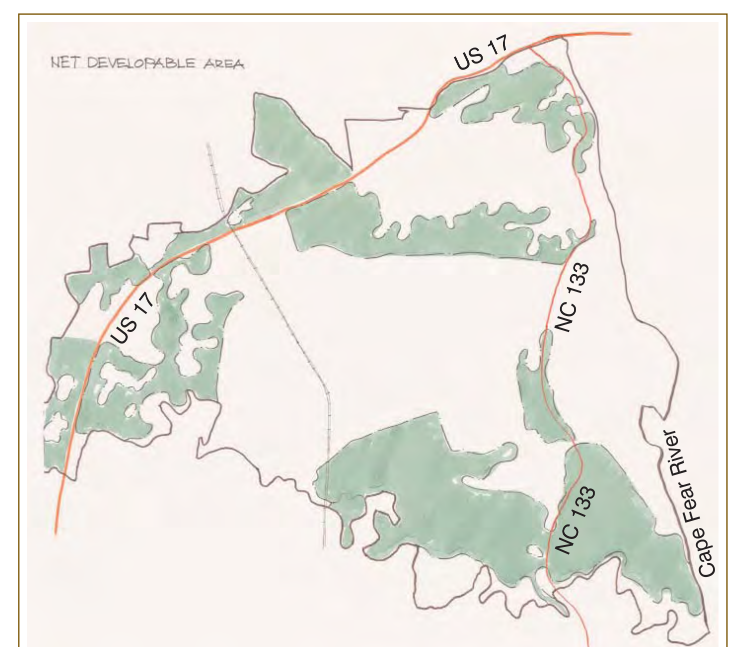
The concept follows conventional land development patterns at interchanges of two major highways. Curved roads indicate planned loop ramps connecting the two highways. Yellow arrows are used to depict where driveways serving the developable areas could be located. Creeks and riparian buffers are depicted in blue and green, respectively. The southerly extension of the Wilmington Bypass is planned, but not yet funded. The alignment of the extension has not been determined.



This map shows the locations and general outline of several developments that have been approved.

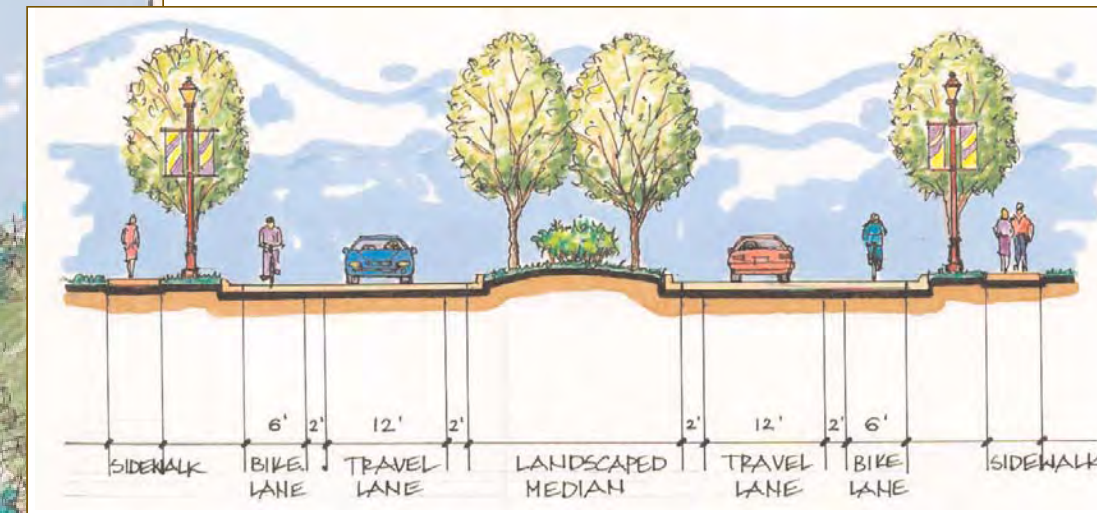
Approved Developments

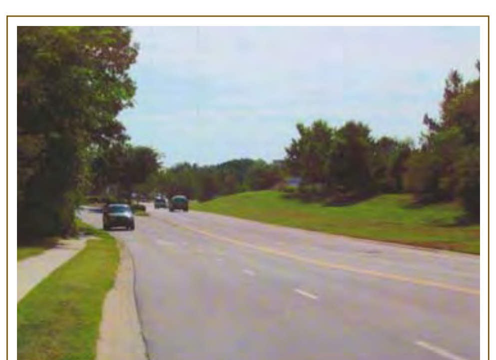
	Residential (dwelling units)	Non-Residential (acres)
Magnolia Greens	1,200	30
Waterford	950	170
Westgate	3,250	90
Westport	500	0
Mallory Creek Place	2,100 - 3,000	0
Brunswick Forest	8,000 - 12,500	450
Subtotals	16,000 - 21,400	740
Potential Additional		
7,000 acres	11,000 - 22,000	1,500
Development Totals	**16,000 - 43,400**	**2,240**
Population Estimate	up to 100,000	



A map showing additional lands that are potentially developable is shown here with green areas depicting land outside of approved developments and generally outside of affected wetland areas. The total land area shown in green is about 7,000 acres.

After





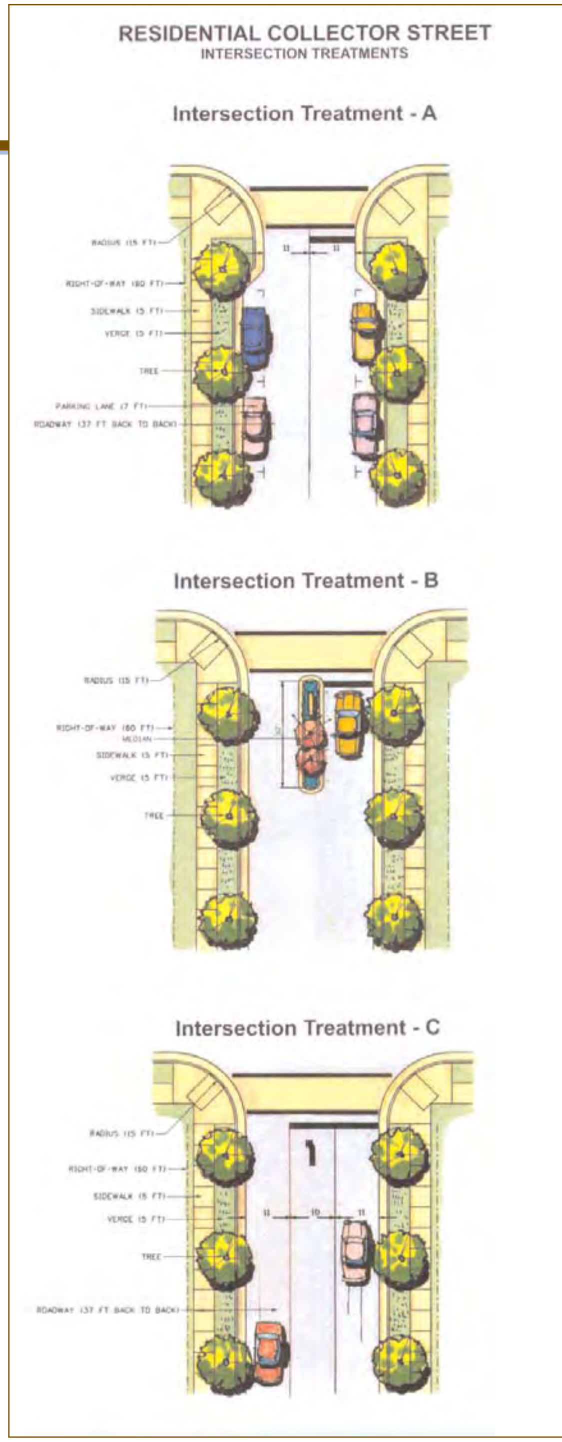
Before

Collector Streets

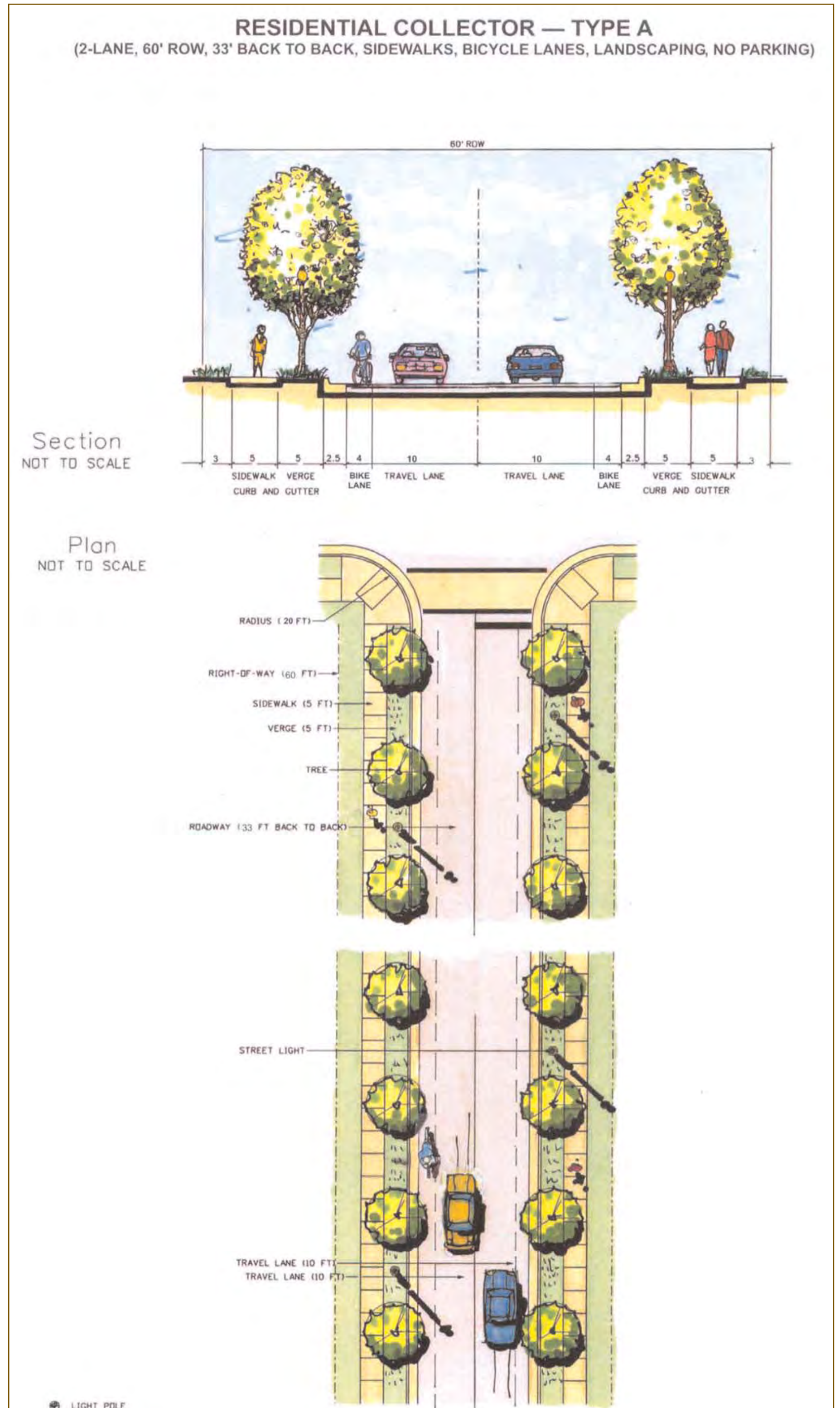
This illustration and photograph show how an existing typical four-lane roadway can be enhanced to be a complete collector street with walkways, bikeways, and a landscaped median. A critical dimension is to provide 20 feet of paved area between curbs so that emergency vehicles can pass stopped vehicles. This space can be optimized by striping a bicycle lane that will separate bikes from vehicular traffic. The speeds on these streets should be posted at 30 mph, enforced at 35 mph.

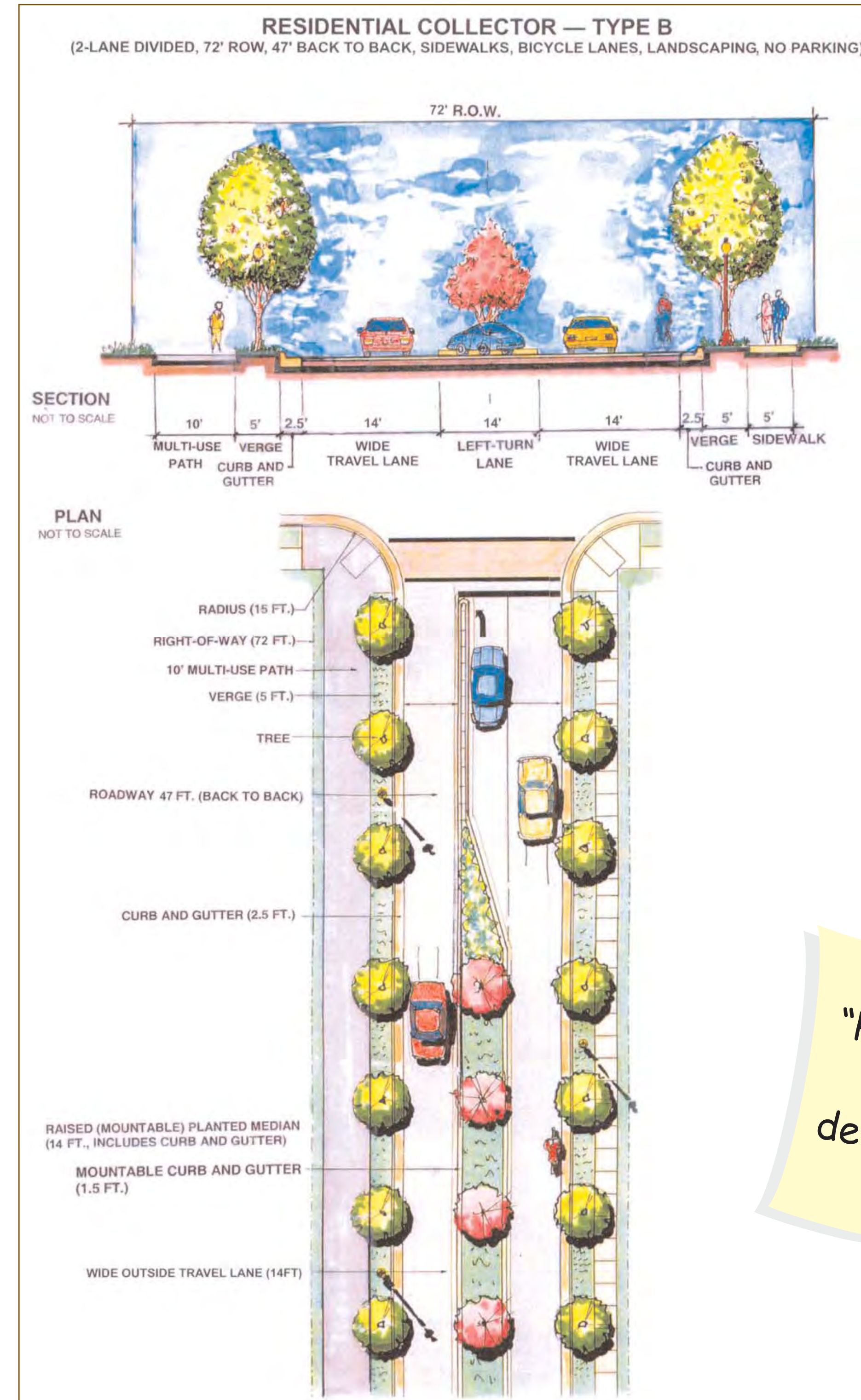
"Plan should address designing better streets."

Collector Street Alternatives



The renderings on this page represent typical collector street cross sections that should be used during the development review process. The renderings provide cross sectional features (including bicycle, pedestrian, and street tree provisions) as well as mid-block plan view and intersection treatments. Their application to a specific development scenario will depend on the adjacent land use, access control, and the type of facility it is connecting. It is important to note that proposed collector streets that are to be maintained by NCDOT must receive design approval prior to implementation.





"Put in roads before development"

Street Spacing

Land Use/Type of Collector Street	Intensity	Access Function	Approximate Street Spacing
Low Intensity Residential	Less than 2 dwelling units per acre	High	3,000 to 6,000 ft apart
Medium Intensity Residential	2 to 4 dwelling units per acre	High	1,500 to 3,000 ft apart
High Intensity Residential	More than 4 dwelling units per acre	High	750 to 1,500 ft apart
Activity Center	Mixed-use residential/commercial	Medium	750 to 1,500 ft apart

Modeling and Collector Street Spacing

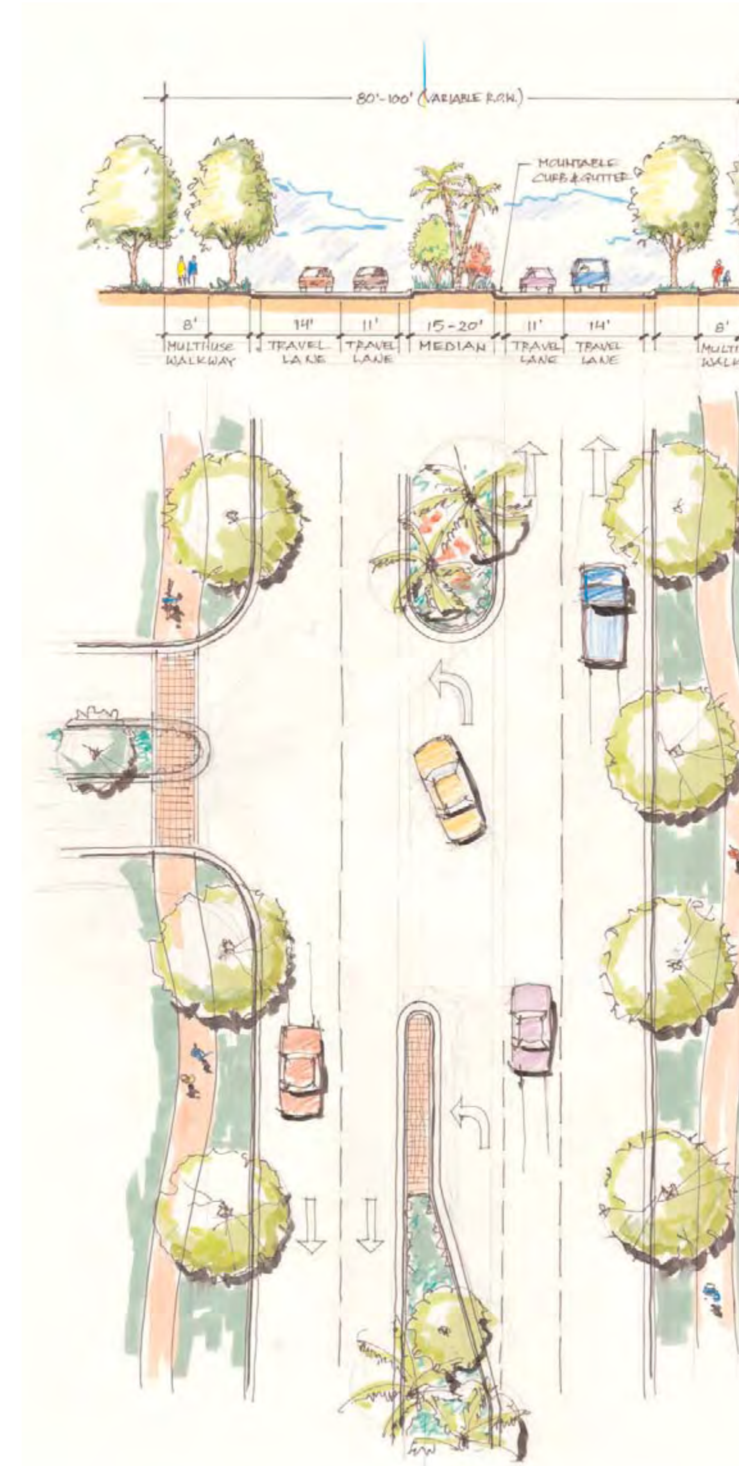
The determination of an appropriate set of collector street spacing guidelines was an important exercise to consider in the development of this plan. It has been theorized that 1,500 feet is an appropriate spacing for collector streets in a suburban area; unincorporated areas of Buncombe County, however, have much lower commercial and residential development intensities than suburban areas that are serviced by municipal water and sewer. Understanding this reality, a theoretical model largely influenced by land use intensity ranges was developed in previous planning efforts to determine the desired collector street spacing for a given area.

To understand the effect of land use intensity and transportation system density, a travel model was run for different land use intensity scenarios. For each model run, trips were allowed to divert to the most desirable path based on the level of congestion (i.e., length of travel time) experienced.

The results show that a 1,500-3000' grid is typically the most appropriate for the mixed suburban and rural development pattern that is envisioned throughout most of the study area. For more intense development (i.e., US 17/I-140 Bypass activity node) a 750-1,500' grid proves optimal, but this is independent of the costs that would be incurred to build a network of such intensity. In addition, this modeling exercise revealed a greater sensitivity to housing than employment. This is logical when one considers that even in high employment areas, the employment is focused at nodes (intersections), whereas housing in highly developed areas is more likely to be distributed throughout a larger "block" area. Summary results of the analysis are indicated in the above table.

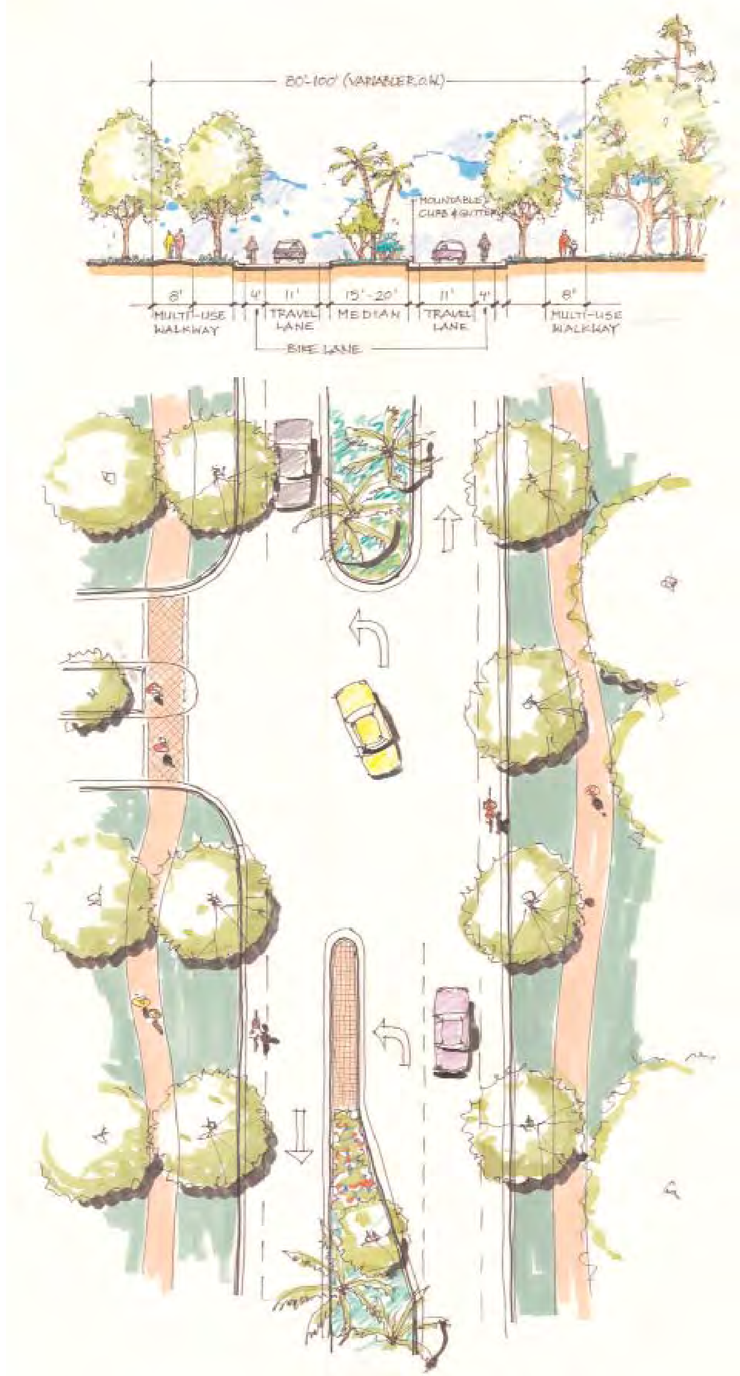
Ultimately, these street spacing guidelines can be used as a "rule of thumb" during the development review process.

Four-Lane Boulevard

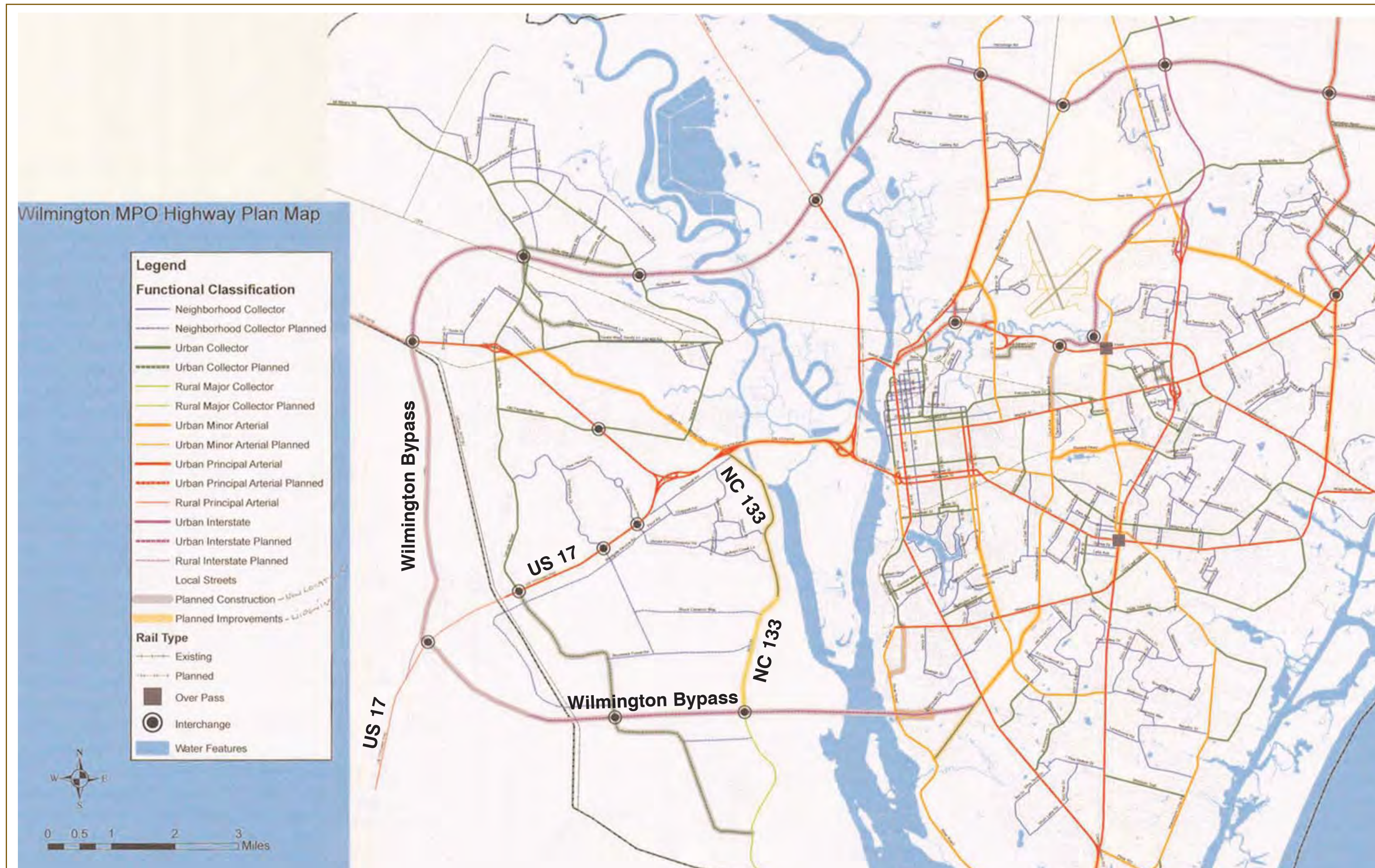


This view of a four-lane street shows what a widened NC 133 could look like. It also depicts a four-lane boulevard that could be built within the developing areas to balance the need for mobility through the study area with access to local streets via well-designed intersections.

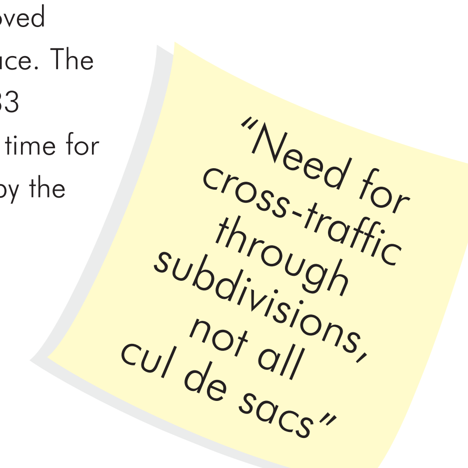
Two-Lane Collector Streets



This view of a well-designed two-lane complete street includes one travel lane in each direction along with bicycle lanes and multi-use paths for pedestrians and other non-motorized travelers. It shows what an improved NC 133 could look like. This improvement could only be applied if a parallel facility to NC 133 could be constructed.

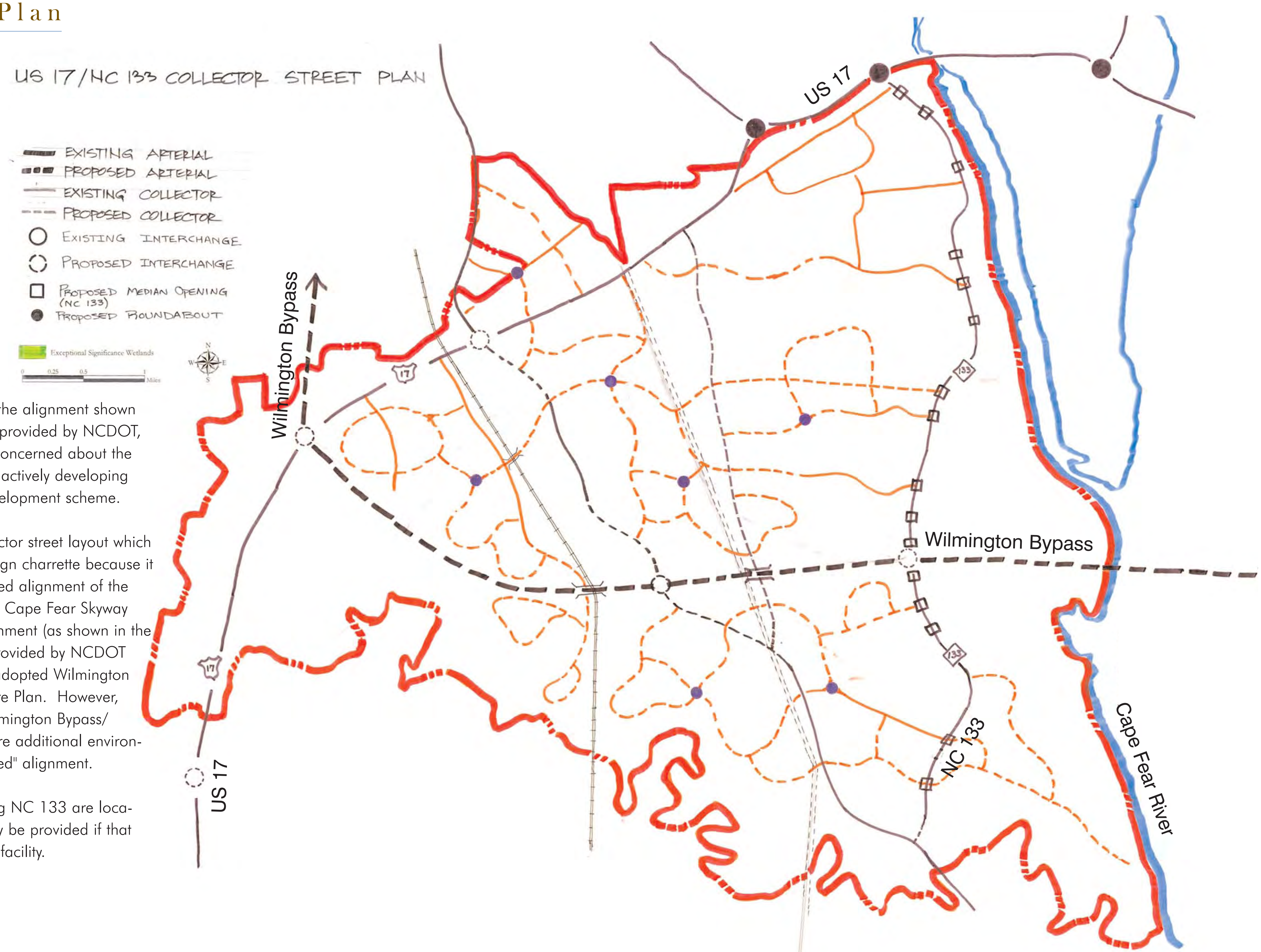


This Wilmington Highway Map shows the intended function of various major highways serving the study area and connecting it with the greater Wilmington area. It shows that US 17 is considered an "urban principal arterial" and NC 133 is an "urban collector" north of the approved developments and a "rural collector" south of Mallory Creek Place. The map also shows planned widening of corridors including NC 133 through the study area, although funding is not available at this time for such widening. The map was developed for planning purposes by the Wilmington Area Metropolitan Planning Organization.



Collector Street Plan

The proposed Collector Street Plan shows in dashed lines where future roads should be considered. The exact alignment shown is not as important as the need for street connections so as developers consider this illustration and perform ground-truthing, wetlands delineation surveys, and such, they should have the flexibility to suggest alternate alignments for streets, as long as they are interconnected. The average street spacing here in the Collector Street Plan is 3,200 feet; that is, on average there is an interconnected street shown every 3,200 feet. Note that the alignment shown for the Wilmington Bypass extension was provided by NCDOT, but the developer of Brunswick Forest is concerned about the impacts on a residential community he is actively developing within the Brunswick Forest approved development scheme.



This study considered an alternative collector street layout which was eliminated after the design charrette because it was based on an unapproved alignment of the future Wilmington Bypass / Cape Fear Skyway Freeway. The current alignment (as shown in the plan on this page) was provided by NCDOT and is identified on the adopted Wilmington Urban Area Thoroughfare Plan. However, this alignment of the Wilmington Bypass/ Cape Fear Skyway will require additional environmental studies to clearly define a "preferred" alignment.

"Put burden on developers to build roads and turn lanes"

Also, the boxes shown along NC 133 are locations where median openings could safely be provided if that roadway is widened to a median-divided facility.

Implementation Strategies

The key to success in master planning an area is implementation. A number of transportation and land development issues were raised by citizens during the charrette, some of which drew emotions from participants who expressed frustration over delays in getting things done. Unfortunately the planning, design and construction of publicly funded transportation projects typically takes 10 years or longer in environmentally-sensitive areas. Public-private partnerships with the development community offer strategic advantages to implementing improvements on a timely basis, as long as the real estate market remains strong. Following are general recommendations and action strategies offered by the consultant.

General Recommendations

- Increase the number of collector streets to better facilitate travel between local streets and arterials
- Improve accessibility to high-density residential areas and activity centers such as Brunswick Forest, activity nodes, and other planned retail centers
- Integrate design standards and provisions for residential collector streets through the residential development process
- Amend the Collector Street Plan as necessary to include new streets as they are identified during the development review process
- Use the plan as a tool to review proposed development projects and plans as they locate and design future collector streets
- Integrate future bikeway, greenway, and trail networks with the Collector Street Plan to create an interconnected network
- Avoid and/or minimize impacts to environmentally sensitive areas to preserve the natural environment
- As the transportation system is improved and expanded, minimize impacts that negatively affect the character and integrity of neighborhoods
- Require that new developments reserve right-of-way for, and in some cases construct, future collector streets
- Incorporate the Collector Street Plan as an addendum to the Comprehensive Plan and subdivision regulations
- Pursue NCDOT Enhancement grant funding to install bike lanes on existing facilities
- Promote alternative modes of transportation through better street design and developer participation
- Promote interconnectivity between existing and proposed developments

"US 17 must remain free-flowing"

Action Strategies

- **Plan Adoption** - by implementing agencies including the towns, County, MPO, RPO, and NCDOT.
- **Intergovernmental Cooperation** - form an advisory committee to meet regularly and aid in the implementation process.
- **Transportation Plan Amendments** - following a formal public outreach process and consideration of the proposed Collector Street Plan (CSP), amend the Wilmington Urban Area MPO Transportation Plan to incorporate the CSP. Include a decision concerning improvements along NC 133.
- **Adopt a land development ordinance** that requires that developers implement the "intent" of the collector street plan, building in flexibility in street alignments to fit their individual development schemes.
- **NCDOT form a study process** that includes citizen outreach related to the Wilmington Bypass extension and the Cape Fear Skyway projects with formal consideration of toll revenue alternatives that would accelerate construction of this important project.
- **Pursue state and federal transportation funds** to implement NC 133 improvements.
- **Pursue planning grant funds** to prepare a master plan for downtown Belville.
- NCDOT complete the **US 17 corridor plan** and include funding in the next Transportation Improvement Program (TIP) to design and implement.
- **Conduct a design charrette** for activity centers in and adjacent to the study area.
- The county and local municipalities should **develop street design standards** to include the street spacing and general street design requirements and recommended cross sections (pages 7 and 8).
- Local jurisdictions should **consider dedicating collector streets as public right-of-way** to allow proper design and maintenance of facility.
- **Interconnectivity** - The local jurisdictions should amend the subdivision ordinances to require all new subdivisions with fewer than 100 dwelling units to provide at least one stub-out street to extend and connect with future streets. In the event that adjacent land is already developed with stub-out requir ments, the city should require the new development to build the street connections.

  The local jurisdictions also should amend subdivision ord nances to require all new subdivisions with 100 or more dwelling units to include at least two stub-out streets to extend and connect with future streets. In the event that adjacent land is already developed with stub-out requirements, the city should require the new development to build the street connections.
- **Traffic Calming** - The local jurisdictions should adopt a traffic calming program and policy to support neighborhood traffic calming efforts. The program should address the retrofit of existing residential streets while the policy should relate to developer requirements as new residential streets are built. The intent of the policy should be to eliminate the need for retrofits on future streets as the area continues to grow and build new residential neighborhoods.

Plan ahead

EDITOR: First, congratulations to the towns of Leland, Belville, the Metro Planning Organization, Brunswick County, the N.C. Department of Transportation and all who participated in organizing the street plan seminar the week of Jan. 10. The consultants Kimley, Horn & Associates were terrific.

Much concern was expressed by participants to improve N.C. 133 and preserve its environmental character.

Why not begin a planning process now that would accomplish such a vision in manageable segments?

The highest priority, I submit, is the segment between Leland and the new developments of Westport and Mallory Place. ...

If the N.C. 133 Leland project were combined with a critical analysis and improvement of signage, landscape and commercial frontage property, the net result has the potential for a fantastic upgrade.

Population and traffic have grown and will continue to grow sharply.

A multi-use highway segment, as defined, is needed now to provide for safer vehicle, pedestrian and bicycle use. ...

Rodman P. Roberts
Wilmington

Appendix A

Interconnected Street Systems

This report was prepared based on research conducted by Dan Howe, AICP, and Ed Johnson, P.E., presented at an ITE conference.

Is this a legitimate public policy issue? It seems logical that a grid street pattern should be able to allow efficient municipal services and other governmental and quasi-governmental functions such as school transportation, mail and package delivery, but does it really make a difference? Evidence shows that if a reasonable grid of streets is maintained, the vehicle trips on all residential streets can be held down to a modest, safe traffic load, made up almost entirely of local trips (not "cut-through" trips") and that this can be done at a level which is no more costly to the developer than the more common collector-and-cul-de-sac pattern. Many argue that connected streets mean more interaction between neighbors, create a design framework that fosters quality urban architecture and spaces, and can reduce response time for emergency service providers. It seems to make sense that the public encourage streets to connect in a relatively dense grid pattern, no? For some...that's the answer, but others do not want “their” street connected.

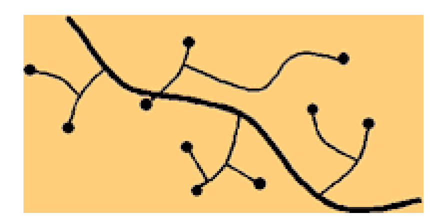
This issue is a classic planning decision-making conundrum. A lot of evidence can be brought to bear that long-term costs of providing municipal services such as fire protection, refuse collection, thoroughfare widenings and EMS services are affected by residential street patterns and that some level of interconnectivity needs to be maintained. At the same time, the prospect of implementing a connection to an existing residential neighborhood is invariably met with staunch opposition by those already living there, who are concerned about the safety and livability of their immediate environment.

Typical Suburban Street Hierarchy

How much interconnectivity is too much? Is there such a thing? New Urbanists are major supporters of more interconnected street systems on a very tight grid akin to that established in the early 20th-century neighborhoods of the US. This model for new developments is becoming popular, and is certainly driving debate about city design. Environmentalists, on the other hand, may find fewer streets in general to be better. Classic collector-and-cul-de-sac systems (termed by New Urbanist guru Andres Duany as "the dead worm") require less street and follow the contours of the land more closely, requiring less land disturbance to construct. It can be shown that dead-end systems can be efficient from a development point of view, serving more units with less linear footage of pavement.

The Grid taken to extremes - Plan for Savannah, GA

It all comes down to what sort of town we want to create. If folks don't mind paying higher taxes for refuse collection, and don't mind sitting in traffic at collector street intersections, should they not be able to live at the end of the cul-de-sac? Maybe so. Should the citizen dwelling in an interconnected neighborhood which is efficient, pleasant and safe have to pay extra taxes and suffer suburban traffic gridlock in order for others to live at the end of the cul-de-sac? Maybe not. Like most democratic solutions, the right answer is probably somewhere in the middle. Whatever the ultimate level of interconnectivity in a local street pattern, we argue that the maintenance of a generalized grid of residential streets is a legitimate public policy issue that local government should establish a set of standards for. We also argue that there are a variety of solutions that establish a reasonable grid of residential streets, continue to allow for some dead-end streets, protect the environment and still allow the fire truck to get to the fire.

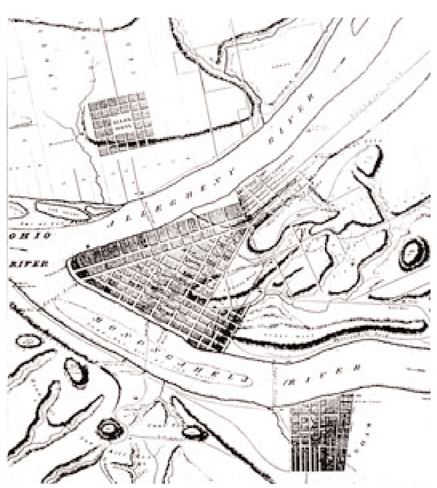


The "Dead Worm"

Historical Trends in Street System Design

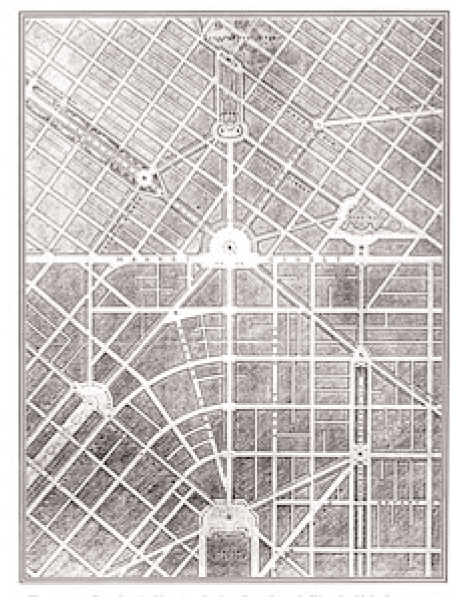
A Short History of the Grid

The grid made sense to the early town-builders in this country, primarily because it was a paradigm for convenient and efficient land sales. Simple, easy to measure, easy to know where your Monticello ended and the next man's began, the grid layout of lots divided by streets was the design of choice whether on the flat plains of Kansas or the tortured geology of riverine western Pennsylvania. Streets, in the days where the grid marched unchallenged across the landscape of town planning, were mostly the spaces between saleable lots. Unimproved for the most part and subject to utilization primarily by horse hooves and wagon wheels, streets which would become the skeleton of modern town form were laid out strictly for utilitarian access to property. With a few exceptions, very little thought was given to how this particular form would affect privacy, "traffic" (not really on the radar screen in the 19th century), interaction between and among communities, or even the efficient provision of services. It was a real estate tool first and foremost.



Plan for Pittsburgh. The rectilinear grid assaults a topographically-challenged site.

Around the turn of the 20th century town planners began to nudge the grid, bend it and slice it apart diagonally. Pierre L'Enfant and Daniel Burnham loved the urban design potential of the grid, particularly when it was enhanced with broad diagonal boulevards that provided views and a hierarchy of importance to streets that was less apparent in the layout of the traditional grid. Spice that liberally with voids... plazas and squares, and the City Beautiful designs of Chicago and Washington DC are the result. Much of this conscious urbanism that has now spawned the nostalgic return to these concepts in the guise of the "new" urbanism reflect Burnham's, L'Enfant's and Raymond Unwin's attraction to this "enhanced" grid of streets. Topography, natural features, hydrology played little role in shaping this emerging urbanism. The form itself was primary. In fact, the conflict between the grid and natural topography actually enhanced the rectilinear grid by adding a third dimension and a creative foil to the monotony of evenly-spaced blocks marching across the landscape.



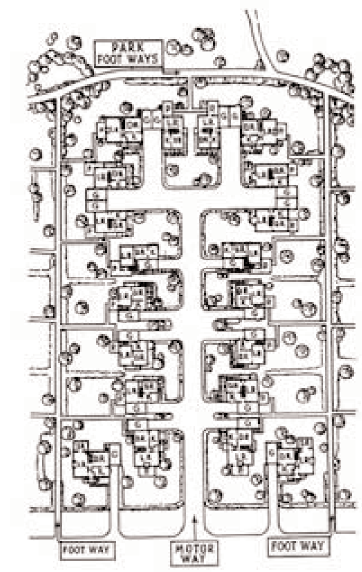
San Francisco Civic Center Plan, 1905

All this began to change in the first couple of decades of this century, when designers of streetcar suburbs began to find it cheaper and easier to build with the land rather than against it. More importantly, buyers of suburban homes seemed to actually enjoy the closer connection to the topographic underlayment of their communities, its contrast to the stiff urbanity of downtown's grid. The grid began to bend around the contours of the hills it was laid upon. The "curvilinear" streets were aesthetically satisfying in their own right, still afforded a generally efficient means of selling residential property, and reduced the cost of development by reducing earthwork in general. But it was still a grid. There were few or no dead-end streets even in these curvilinear designs. The design of Radburn NJ is generally credited as the progenitor of the "cluster" subdivision, with discrete clusters of dead-end "streets" (both vehicular and pedestrian) that existed <u>within</u> a more traditional grid. It didn't turn a lot of heads at the time, but its grandchildren are all around us today. Its real value wasn't made apparent until later in the century. As with all else urban in this country, as automobiles began filling up garages across the land, everything changed. It's not that the grid went away. It just got bigger. And the spaces between began to be filled up by newer, more efficient and more environmentally sensitive patterns of access to residential properties.

The automobile made possible the development of tract housing in the 50's and 60's. Large areas of land on the far fringes of the existing town could be planned and developed at one time as discrete communities, not simply extensions of the existing urbanism. They were connected to the grid, but not of it. In fact, it made sense to distinguish one's development from the rest of the community to be able to market it as a new, better kind of place to live. Even these pioneering developments continued to use the curvilinear grid as the basic building-block, even though the edges of the development were effectively sealed, but for a few carefully planned connections to the wider grid of major streets. As towns grew rapidly further and further from the old densely-gridded centers, the only remnant of the grid became a large network of old cow-path traditional rural highways, gentrified into suburban thoroughfares. These became the "superblock" suburban grid. Beginning in the 1970's we began to fill it in with what we learned from Ian McHarg.

McHarg's seminal 1972 work, *Design With Nature*, showed compellingly how the natural form and systems of the landscape are not impediments to be overcome and engineered into obscurity in our communities. Nature is the basic building block of city form, and when analyzed carefully for a variety of clues to where urbanism and natural form can co-exist, it will tell us what form our community is to take. Instead of engineering complex structures to allow us to overcome natural systems and impose our rectilinear grid upon it, McHarg taught us to design around sensitive natural areas, respecting what they tell us about where streets and buildings should go. Landscape architects and planners across the country embraced the elegant logic of this theory, and began designing urban areas that fit the land, aided ably by development advocacy organizations who began to publish how-to manuals extolling common open space, clustering of housing on smaller lots, and the use of dead-end streets. Designers began to realize that "cul-de-sacs" made possible an overall reduction in the amount of street infrastructure necessary to serve a fixed number of units and eliminated the need for most expensive stream crossings. On top of all this cost reduction, the marketing people realized that this pattern had revenue benefits as well to the developer.

They could, and still do, demand a premium for residential lots that front on dead-end streets.

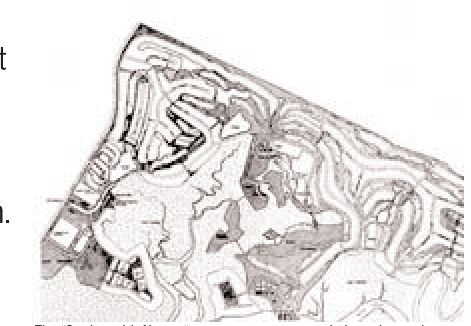


The first cul-de-sac? Radburn, NJ

Wow, this all seemed like a win-win arrangement for quite a while. Not only were we being environmentally aware, but we were generating urban forms that were unique...we were making our own statement in the latter half of the 20th century. This was a new thing...almost a rejection of the City Beautiful insistence on geometry as the determining form of a city. We were designing "new towns" around these principles in Reston, VA and Columbia, MD. We were giving people privacy and a connection to the land within commuting distance from their source of work and wealth. We were doing it all in a context that was in the developers interest, and the whole program seemed so much more sophisticated than the Levittowns of the 50's and 60's.

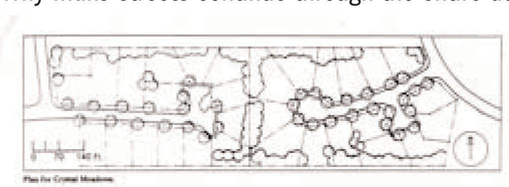
So Why Go To Grid?

Does it make sense today? Streets in this country in urban areas are now paved (for the most part), carry automobiles at sometimes breakneck speed, are generally wider, more dangerous, and used by far more entities from utility companies to kids on skateboards than their 18th and 19th century ancestors. 19th century streets were the negative spaces between valuable land. 20th century streets are the creators of land value. They are expensive to build and maintain but carry all the nectar of land value to the target...water, often sewer, electricity, buyers. Without these things land at the fringe of urban areas is just land. With it, the land becomes wealth. But why a grid? Convenient in a time of limitless cheap land, the grid has become somewhat inefficient from the point of view of land development now. Land sells by the square foot.



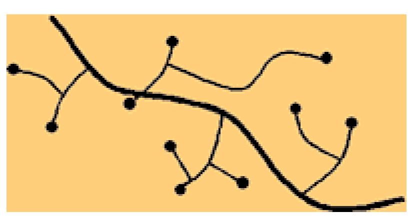
The "Design with Nature" movement encouraged clustering and curvilinear streets that followed contours and avoided sensitive natural areas.

Streets don't sell for anything. They just make possible sales on adjacent property. Why run streets north and south if you can provide access to your property by the east or west only? Why make streets continue through the entire development if they need only go part way through to provide access to all the property? Why not maximize the square footage of marketable land by providing the absolute minimum in access to residential property in particular?



This excerpt from an Urban Land Institute publication form the 1970's encourages the use of dead-end streets and clustering.

Proponents of New Urbanism counter that, even if you discount all the obvious efficiency advantages of providing municipal services on a grid system of streets, the grid is still better as a framework for successful urbanism. The New Urbanism is gaining in popularity because it speaks to a living style that otherwise seems unreachable in our typical suburbs. Oft dismissed as an architectural solution to a planning problem, it is, like City Beautiful, like Frank Lloyd Wright's Broadacre City, like Levittown, a paradigm of planning meant to alter the social character of community. Essential to true New Urbanism is a mixture of uses, a mixture of housing types and sizes and above all, connectivity not separation. The grid unites where the cul-de-sac divides. The New Urban town is a community. The suburbs are enclaves. This separation is reinforced by the street pattern New Urban guru Andres Duany calls the "dead worm".



The "Dead Worm"

New Urbanists champion the classic rectilinear grid for the center of a community, and allow it to evolve into a more curvilinear grid with distance from a center. The grid is dense. The narrowest street, they argue, consistently has the highest land value. Traffic, when distributed through many, smaller, interconnected streets, is naturally calmed but still flows. Why destroy real estate values building wide, high-speed roads when you can build a network of boulevards and residential blocks? Designers working with this theory often use diagonal streets like L'Enfant and Burnham. In the model the street is a positive space, a contributor to the connections between people, not just a conduit for water, trash collection and vehicles.

"New Urbanism" project from Memphis harkens back to San Francisco and Pittsburgh grid plans

The ever-expanding web of major streets is going to be the model for transportation systems in the future. Because jobs are spread much more widely, the old radial forms (spokes of a wheel) for thoroughfares and transit corridors do not make sense. Whether we choose to infill this grid of major streets with a denser grid of residential streets, or with the "dead worm", is in great measure determined by what sort of a town we wish to build, how connected we wish to make our neighborhoods both functionally and socially, and how much future taxpayers may be willing to pay in additional costs for urban service for the luxury of privacy and exclusivity.

Neighborhood Protection

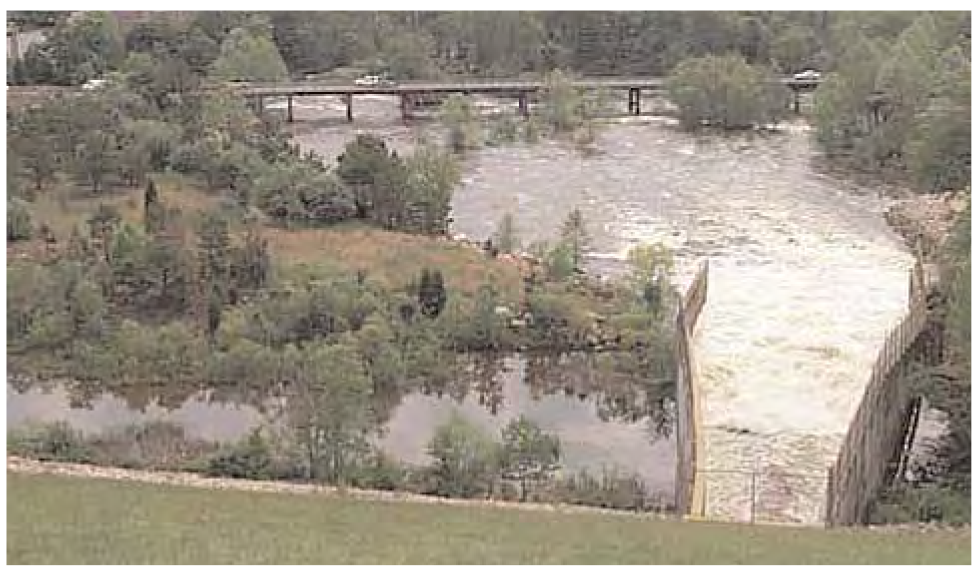
It may make perfect sense to planners to work toward connecting up the residential street network in their communities, but it doesn't to everybody, and sometimes when the dots get connected the political atmosphere gets charged. One of the folks in the middle of this combustion chamber has a point of view that is unequivocal. “The biggest thing about this is it doesn't serve any purpose. There are probably 35 kids on this section of street. We can get around out to the thoroughfares now. It's a natural cut-through. It just doesn't make any sense.” This individual and his neighbors have petitioned to reconsider a request by the adjacent neighborhood to pave their existing unpaved streets. In the process, a stub street from his early-90's-era subdivision will connect with a gravel road in an old neighborhood of small houses that far pre-dates his. This older neighborhood is a classic “donut-hole,” a forgotten oasis of rural living which has been surrounded by suburban development. The development of a soccer field on a vacant tract spurred a project to improve all the streets in the neighborhood to City standards. One part of this paving project would connect them, as long planned, to the stub.

Issues like this one create a considerable conundrum for elected officials, even towns with policies to connect street systems wherever possible. The text change was not controversial. But when the issue strikes home, the tone of the discussion changes. Visions of small children and NASCAR traffic speeds on residential streets spur neighbors to print flyers and buttons and show up in the Council chambers in numbers. If considered on a strictly political basis, there is no question about the result. Why anger so many over so little? Why not let them control their own neighborhoods access? The more you know, the more difficult this is. Political salve in this case, and the next, and the next may eventually end up in a tax increase to support the inefficiencies created for municipal service delivery. Elected officials must worry about response time for emergency service providers. They also realize that from a traffic standpoint this is a zero-sum game. Traffic that cannot use this particular stub will use another street to get to the same place, perhaps unnecessarily going through one or two major thoroughfare intersections to get there.

The more streets that are cut off, the more residential traffic internal to a major block must be diverted to "collectors", which in many communities become de facto thoroughfares themselves. This makes life miserable for the folks who reside directly on these through streets. Educated Councils understand that appeasing an angry crowd now may simply result in a larger, angrier crowd of collector street residents later, calling for traffic calming and more interconnectivity, after the traffic on their streets reaches beyond the limit of tolerance.

Public Policy Trade-offs

Public Services



The Neuse River... a primary water source in North Carolina.

Water — Though water flows from a dendritic drainage system (little creeks flow into bigger ones which flow into rivers, etc.) into municipal water systems, it does not work to distribute it back out that way after treatment. Dead-end (dendritic) water systems suffer from chronic lack of water pressure. Water is continually drawn off along the pipes until by the end, just like the Colorado River as it slowly trickles across the desert in Mexico trying desperately to get to the sea, there is very little left at the end of the pipe. Water systems work far more effectively when the pipes can be looped and interconnected, allowing even pressure to be distributed throughout the network. Because municipal water pipes are typically built within streets, street interconnectivity standards can be used to interconnect the water system (which is typically built in public street rights-of-way). That is not the only service provision issue.

Garbage — One of the basic services provided by municipalities is trash collection. No one has yet figured out a better way of serving single-family residences than driving a large truck around town to every single home, picking up the refuse either by hand or mechanically, going on to the next house and eventually to the landfill to dump it. Many municipal refuse collection systems have a set route. If they go fast they get done early and can cut their day short. The wise ones vie for routes in the parts of town where the streets are organized in a grid or curvilinear grid. One reason for this is to avoid dead-heading. On a dead-end street the truck works its way down to the end, picking up trash at each residence. Once at the turnaround, everybody hops on the truck and drives back down the street, "dead-heading", until the crew gets to the next street. While they are riding they are burning gas, time and vehicle wear-and-tear and are picking up nobody's refuse. This costs money. Interconnected residential street networks mean you never back up. If the grid is a dense one with houses close to the street, even expensive back-yard pickup can be reasonably efficient. In the cul-de-sac friendly suburbs, workers have to use a lot of fuel and shoe leather to serve the same number of homes.

Garbage Truck

Environmental Issues

Some of the most powerful barriers to a regularly-connected grid of streets are erected by planners...environmental planners, and their issues are no less valid than those of street interconnectivity proponents. John Dorney is one of them. Dorney is head of the wetlands division in the Division of Water Quality (DWQ), a powerful subsection of the NC Department of Environment and Natural Resources, whose daunting task is to address the severe water quality issues the state has experienced in recent years. Fish kills and pfisteria scares have resulted in a management plan that enforces vegetated riparian buffers in the stream banks.

This map shows riparian buffers. These corridors are regulated by the NC Division of Quality, which can deny a permit for road crossings of these riparian areas.

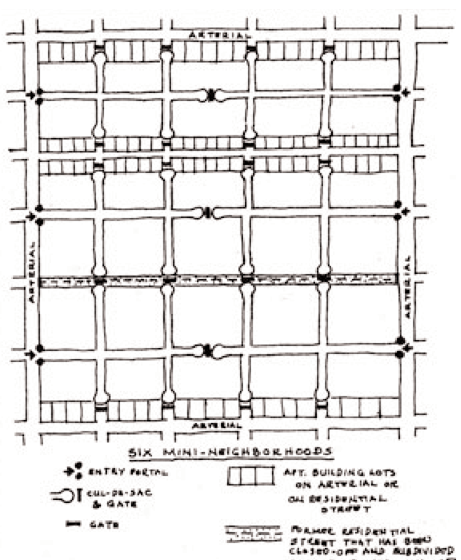
"We understand that there are good planning reasons to connect these streets." Says Dorney. "For a lot of developers access is important. These rules give us the power to deny a permit to fill in the buffer zones to cross a stream, thus limiting access. We know that, but I tell you...we don't really care. Our job is to fix the water quality issue, and there is a lot of evidence in the literature that buffers work." Dorney is not being arrogant about this. He's a scientist. This is an issue of substantial concern in North Carolina, with rural farming interests blaming urban regions and vice versa for the water quality problems. And buffers work.

The 50' buffer imposed by the State of NC in some river basins (30' of which is undisturbed) removes 70-80% of the sediment in stormwater runoff, 50% of the phosphorus and 75% of the nitrogen. More stream crossings mean more impervious surface draining directly into the streams and less buffer area. But the real reason stream crossings are bad from an environmental standpoint is biological, not chemical. Under a typical road culvert the stream is dead. There is no light and no natural stream bed. The fill necessary for the road and culvert creates a barrier to the migration of animals along the stream corridor. These corridors are essential for wildlife to find new food sources and mates in a protected environment. Bridges are far better from a biological standpoint, but right now they cost about 3 times the cost of a standard culvert. Even if a clever engineer figures out how to reduce the cost by half, a bridge will still be more costly than a culvert.

- **Riparian Buffers have been shown to remove 70-80% of the sediment, 50% of the phosphorus, 75% of the nitrogen in urban stormwater runoff.**
- **Culverts are biologically dead underneath.**
- **Bridges still cost roughly 3 times what a culvert costs to construct.**
- **Every time a stream is crossed with a road, wildlife migration patterns and biological filtering systems are disrupted.**

Public Safety

How do interconnected street systems affect public safety? Well, if response time is the major concern, the Fire Response Research Project noted on this site makes a strong case for interconnectivity. Overall acreage covered from a single point is roughly double in interconnected street networks when compared to a collector and cul-de-sac system. For emergency services like fire protection and EMS service, the value of an interconnected street network in getting the provider to the emergency appears to have validity. But that is not the only criteria for public safety when it comes to community policing.



This sketch, from "Creating Defensible Space" by Oscar Newman, shows how to retrofit an existing grid to establish "mini-neighborhoods" where access is limited to a single point, and through connections between neighborhoods are controlled by locked gates.

The nature of crime in a town, the nature of neighborhoods and the frequency and seriousness of the crime problem vary across communities. Techniques of using street layout to address this issue will vary as well. Oscar Newman, an architect whose "Defensible Space" concepts have been used since the 1970's to address crime problems through better design, is an advocate for defensible neighborhoods. Many crime-problem areas in the US are in urban neighborhoods wherein streets are often part of the original grid that characterizes most older cities. Newman believes that establishing defined neighborhoods by breaking up the grid can contribute to a feeling of safety and ownership of the streets by the residents. The illustration to the right shows how he suggests the grid ought to be broken down, by gates and physical disconnections, into defensible neighborhoods. Police departments generally endorse the idea of self-policing through techniques like this and community watch programs, but these techniques form a double-edged sword.

Connections between neighborhoods are controlled by locked gates.

Russell Higgins lives in the older Chicago suburb of North Beverly. His community embarked on a safety and defensibility program by following the Newman model and creating "diverters", disconnections in the middle of formerly-through grid streets that either force the driver to turn around or to make a left or right turn. Mr. Higgins, who unfortunately lived on one of the streets that were left as through streets, saw the traffic on his street go from 350 vehicle trips per day to 2000 after the diverters were constructed. He also related two incidences where emergency service providers were foiled in their attempt to respond to a call. The first was a robbery where the suspect simply hopped out of his vehicle and ran across a diverter into the next block. The police cruisers who were following attempted to cut him off, but the diverters effectively ensured his getaway. Also, Mr. Higgins relates a story of an ambulance driver sent to a life-threatening emergency who got to the correct street, but because of the diverters, became lost and had to call for help, substantially delaying response to the call. As long as the primary mode of patrolling is by police cruiser, the advantages of community surveillance and access limitation inherent in the "defensible neighborhoods" concept may be outweighed by the inability of the good guys to get to the crime when it does occur, or at least to have a presence through regular patrols.

Fire Response Research Project

Methodology:
This project required a GIS analysis of fire response areas based on a 1.5 mile access reach. Streets were mapped using a GIS network analysis program to 1.5 miles from the station, and were buffered to capture abutting parcels. Records were then analyzed for these parcels to determine the acreage of non-residentially zoned property and the number of dwelling units abutting streets within 1.5 miles of the fire station. 6 fire stations were chosen. Two (stations 1 and 6) were located in an older part of the town where the street pattern was quite well interconnected, where the utilization of dead-end streets was essentially non-existent, and where the grid was relatively dense. Station 4 is in the center of an area essentially built-out but with some vacant land remaining. The street interconnectivity pattern here is not as consistent as 1 and 6, and many more dead-end streets were constructed. Areas 21, 22 and 23 are in the area where development is currently active, with most existing development having been constructed in the late 80's and early 90's. Street interconnectivity is limited around these stations. Many dead-end streets have been utilized.

Cul-de-sac Density Map showing locations of Fire stations used for response area test. Stations 1 and 6 are located in a relatively dense grid of streets established prior to 1950. Stations 21-23 are in outlying areas in a relatively disconnected network of streets. Station 4 is in a typical collector and cul-de-sac network established in the 1970's and 80's.

Land within the response areas for stations 1 and 6 is essentially built-out, though some un-developed or under developed property still exists in these response areas. Land in response area 4 includes more vacant land than 1 and 6, but less than stations 21, 22 and 23, which are located in actively-developing areas of town. The vacant tracts were removed from the analysis of land use for these stations. To account for relative areas of developable land a factor of 1.6 was applied to the underdeveloped fire response areas 21, 22 and 23, and a factor of 1.3 applied to fire response area 4 based on an estimate of the potential further development within 1.5 miles.

Results:
In all cases, even after factoring for potential future development, the coverage of areas 1 and 6 (high degree of interconnectivity and a relatively dense grid) far exceeded the coverage of fire response areas that had a less-interconnected street network (more than double from least to most covered). Even discounting the density of development in these areas, the raw acreage covered in each case confirmed the greater efficiency in fire response coverage for areas with better street interconnectivity.

Station	Acres Commercial	Dwelling Units
1 & 6 (Avg.)	445	5591
4	186	2873
*1.3	242	3735
21-23 (Avg.)	68	1105
*1.6	109	1767

Station	Total Acres Covered
1 & 6 (Avg.)	1940
4	1256
21-23 (Avg.)	870

How Dense a Grid?

Some interesting facts comparing older neighborhoods with interconnected streets (A) to similar residential neighborhoods built in the 70's and 80's on a typical collector / cul-de-sac pattern (B):

Typical acreage circumscribed by through streets:	Linear feet of connected street relative to linear feet of non-connected street:
A 14 acres B 45 acres	A 9:1 B 1.5:1

In both cases a grid exists. Reasonable traffic flow demands some sort of east-west and north-south connectivity. The real question is how much? How dense should the grid be? Staff attempted to analyze this by using a transportation planning model to distribute traffic on theoretical grids as follows:

6000' x 6000' (about 1 Square Mile)

Bounded externally by thoroughfares

Typical suburban density (~4 DUs / acre)

Subdivided into 64 zones (8 x 8), 10 acres each, 40 DU =400 trips per day

4 grid sizes (750', 1500', 3000', "Typical")

Several variants of each size tested

External trips were distributed as follows:

External Trip Attractions:

Balanced: 12.5% to each cordon point

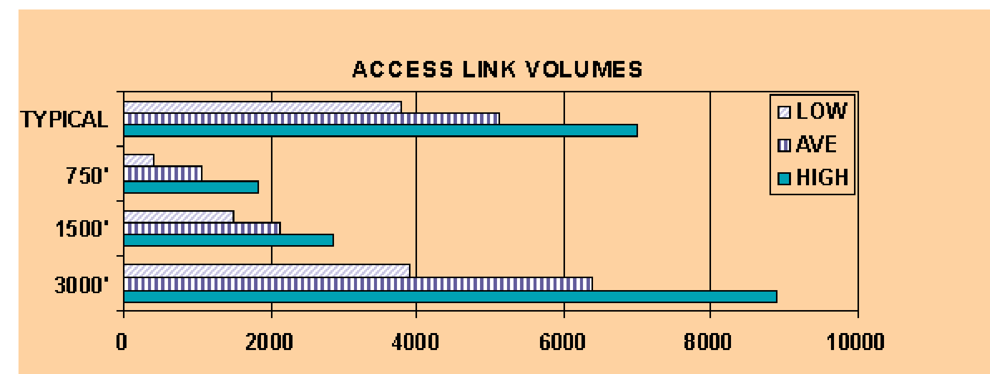
Unbalanced: 60% to south, 40% to north

No External - External "Through" Trips

100% Minimum Path Assignment

Results:

Reducing grid size gets traffic to adjacent thoroughfares faster, resulting in lower and more balanced internal street loads.



Reducing grid size from 3,000' to 1,500' achieves significant benefit, reduction to 750' is not worth the added construction cost.