Transportation Basics in North Carolina

• Introduction

We live in a place where people move around a lot. More than most in our global neighborhood, Americans are constantly moving themselves, their goods for sale, even their homes. Our economy is built on a mobile work force, easy access to goods and services, and choice. We have the choice to pick and choose a home near or far from our work, a product 10% less expensive but available only in the next town, a vacation in Utah, or even Australia, rather than at the beach. Therefore, when we plan for transportation we must not only consider roads, rails and bus stops, we must also consider those uses of land and activities that make transportation a necessity, and we must consider the activities that may be generated by our transportation facility decisions.

Managing this world in motion is a complex task. The decisions we make regarding transportation planning affect land use and planning issues very far afield of the science of moving people from here to there.

Transportation decisions can make something out of nothing. A farmer’s tobacco field becomes valuable for other land uses if a new highway is built near it. A tract of land too far from town becomes a subdivision when a rural road is widened and improved. A desolate downtown block becomes an entertainment center when a transit stop is built.
nearby. Planning Commissions are in the business of *transportation planning* with a little "t" (How many driveways should this development be allowed?) and *Transportation Planning* with a big "T" (What corridor should be recommended to the State to bring the new US highway through town? How should the town’s planned street network encourage bicycle use as an alternative to automobiles?). Big "T" planning has to be done before little "t" planning makes sense, but the amount of time spent by most Commissions is inversely proportional to this rule.

• A Very Short History of Transportation Planning

Transportation planning has always existed in one form or another, just as transportation challenges have always existed. It has only been in the past 50 years that planners or engineers have looked with any degree of sophisticated analysis beyond specific stretches of road or other landmarks such as bridges or tunnels. Early settlement trails followed the paths of least resistance, the high ground, and river valleys. At the turn of the century roads were awful but rail travel between cities was reasonably convenient. Local roads were minimally maintained, and rail corridors were generally laid out to link major urban areas. These rail lines spawned small cities and towns across the continent, and allowed places like Chicago to grow into immense urban regions.

As the automobile began to change our ways of moving about, government became more involved in building and maintaining roads. In the early years of automobile travel it was local government, generally in the form of a county or township, that took on the responsibility to establish a better local road network. In the 20’s the 30’s state and Federal governments became more involved in planning and constructing highways. Transportation planning at this time was relatively simple. Connect the dots between the bigger towns. Establish county roads between settlements and along historic trading routes, and establish a grid layout in town that is simple and easy to navigate, allows for efficient use of land, and that facilitates property development. Rail systems connected the major cities. Within them streetcar and pedestrian travel still dominated. Air travel was in its infancy and not yet a major mode of transportation.

The institution of the Interstate Highway System in the 1950s changed everything, helping to bring about the demise of railroads as our primary way of moving between cities, and opening new land throughout the country to easy access by automobile. The rapid expansion of computer technology in the 70’s and 80’s made it possible for the Federal Government to bring about this immense public works endeavor. Computer
systems began to provide engineers with the ability to analyze large amounts of data in relatively little time and evaluate multiple alternatives. This opened the door for a lot more planning prior to building transportation infrastructure.

The Federal Aid Highway Act of 1963 changed the way transportation improvements are planned. The federal government required metropolitan areas to use the "3C" process in transportation planning in order to have access to the billions available to construct Federal Aid Highways in each state. The three Cs in this case represent the characteristics of desirable planning policy:

- Continuing
- Comprehensive
- Cooperative.

Planning should be a continuing and ongoing process to ensure that the goals of any plan are properly implemented, realized and, when necessary, updated.

It should be comprehensive so that all modes and all purposes for travel are planned for, and that the effects of transportation on society, the environment and our economy are considered.

It should also be cooperative, ensuring that all affected parties have access to the process.

Metropolitan Planning Organizations (MPO’s)

In 1973, the Federal Aid Highway Act created Metropolitan Planning Organizations (MPOs) to aid in the cooperative aspect of transportation planning. Remember this acronym, for MPO’s are likely to be playing an increasingly large role in regional planning, and not just from the point of view of managing the expenditure of funds on road projects. In 2000, the NC state legislature approved two bills affecting this planning framework. The first called for consolidation of multiple urban MPO’s in the major metro areas of the state into single regional organizations. The second allows establishment of RPO’s (Rural Planning Organizations) in NC that will provide a mechanism for rural counties and towns to come together and plan for transportation as the more urban regions in the state have.

• Transportation Planning in North Carolina

The Good Roads State. Across the country there is only one other state other than North Carolina (Texas) that has a larger number of miles of roads owned and maintained by State government. North Carolina has become the “Good Roads State” partly as a result of Depression-era financial troubles in the counties, which up until that time had a major role in local road building and maintenance. The NC State Legislature, in an attempt to restore fiscal responsibility and consistency to the road network, as well as to many other aspects of local government, took over responsibility for road construction and maintenance state-wide, forbidding counties from involvement in road building or maintenance at all. This prohibition remains in state law, and only municipalities and the
North Carolina Department of Transportation (NCDOT) now have any direct role in roadway management in this state, with NCDOT the far larger partner. In most other states counties or townships are the primary road maintenance organizations. Counties still play a big role in overall transportation planning through regional MPO’s.

NCDOT builds and maintains rural and small town roads. In smaller communities and counties, NCDOT owns and maintains all the public roads. New streets must first be approved by the NCDOT Division Engineer, and are measured against a set of minimum standards designed to ensure good access and ease of maintenance.

Major highways are a State responsibility, often paid for in large measure by the Federal Government. Larger highways and arterials are owned and generally constructed by NCDOT, but often with up to 90% of the funding provided by the Federal Government. Because the US government provides a large proportion of the resources, there are strings attached, often in the form of a requirement for public participation in the decision-making process, and a planning process that ensures that the new road is necessary, in the right place, and environmentally responsible in its construction. The National Environmental Policy Act (NEPA) has a dramatic effect on the process of road planning across the country where Federal funds are involved, requiring extensive environmental impact statements (EIS) prior to approval of a highway project.

Rail and airport systems involve Federal, State and Regional control. Rail travel is still a viable choice for some, and is now seeing resurgence for certain types of inter-city travel. The federal government operates interstate passenger rail services while the state provides intrastate services. Interest in regional commuter rail is increasing in urban areas. The Charlotte-Mecklenburg and Triangle areas have been authorized special taxing authority to finance a local public transit system. Special public authorities such as the Triangle Transit Authority have been established by the state legislature for the specific purpose of managing local rail and bus operations. Public authorities also typically operate regional airports, under the oversight of the Federal Aviation Administration.

Local control is common for city streets, bikeways, buses and pedestrian systems. Other important transportation networks are managed at the local level. Cities and towns that are large enough to staff their own engineering and transportation departments operate a local road maintenance and construction process for municipal streets that are not on the state system, and run public bus systems, bikeways and greenways, and a general program of providing sidewalks on public streets for pedestrians. Some municipal
streets are on the state road system, but are maintained by the municipality using “Powell Bill” funds shared by the State. **This local network is often the aspect of transportation planning most affected by decisions of a Planning Commission.**

**• Federal Role in Transportation Planning – TEA-21**

TEA-21 – the Transportation Equity Act for the 21st Century – is the latest comprehensive transportation act passed by Congress in 1998. It is a “descendent” of ISTEA (the Intermodal Surface Transportation Efficiency Act) passed in 1991. Perhaps the most important difference between TEA-21 and ISTEA is the funding level. **TEA-21 increased expenditures by over $200 Billion (a 40% increase).** This increase is apportioned unequally across the states. As an example, **North Carolina has seen a change of funding of 54.7% between the two transportation acts.**

The goals of TEA-21 are fairly simple and make sense (although their implementation will perhaps be more complicated!). **The goals are incorporated into seven Planning Factors associated with TEA-21. They are:**

- **Support the economic vitality of the metropolitan area,** especially by enabling global competitiveness, productivity, and efficiency
- **Increase the safety and security of the transportation system** for motorized and non-motorized users
- **Increase the accessibility and mobility options** available to people and for freight
- **Protect and enhance the environment, promote energy conservation and improve quality of life**
- **Enhance the integration and connectivity of the transportation system,** across and between modes, for people and for freight
- **Promote efficient system management and operation**
- **Emphasize the preservation of the existing transportation system**

This Act is important in NC because of the large amount of resources placed in the hands of local governments and regional MPO’s to undertake not just more and wider lanes on the highways, but a wide variety of transportation improvements, (sometimes called “enhancements” like bikeways, greenways, etc.).
Land Use and Transportation

• The Land Use / Transportation Cycle

There is a very direct connection between the way we travel and the way we use land. This connection is one of "association" rather than "causation." This means that the way we travel affects how land is used, and conversely the way we use land affects the way we travel. Researchers have described this interaction as either a "cycle", (or even more pessimistically as a "black hole"). Perhaps it would be easiest to speak of this interaction as a cycle, because there really is no starting point. We can think of the parts of the cycle along these lines:

![Land Use Change Diagram]

• Public Policy and its Effects

Transportation policy affects land use. Land use policy affects transportation. The two are inextricably linked. Well-meaning public decisions to build “by-passes” around most sizeable communities have caused the demise of many commercial downtown areas. Well-meaning public decisions to allow low-density suburban residential growth patterns in previously rural areas have caused the taxpayer billions in improvements to rural highways that must handle urban commuter traffic. Every small land use decision made by a Planning Commission or an elected Board can affect the transportation system dramatically in the aggregate. Every small transportation decision or decision on a transportation-related capital improvement will have spin-off effects beyond the increased capacity that the improvement provides, in terms of land values, development opportunities, transit opportunities, costs of providing services, tax base, and in many more ways.

THE LINK BETWEEN PUBLIC DECISIONS ON BOTH LAND USE AND TRANSPORTATION CANNOT BE OVEREMPHASIZED. UNDERSTANDING THE SPIN-OFF EFFECTS OF PUBLIC DECISIONS IS CRITICAL TO A PLANNING COMMISSIONER’S ROLE!
• Urban Form, Sprawl and Transportation

Early communities came to be because of their location at crossroads, on rail lines, or on major navigable waterways or protected ports (all transportation centers). Older urban areas were formed with dense urban cores (to allow access to work and home for many people for whom foot travel was the sole option),

and later with radial corridors along streetcar lines, spawning the first “trolley suburbs”:

As the automobile became the primary mode of transportation, cities began to spread out at a reduced density. Automobiles and massive public investment in road infrastructure also now allows people to live many miles from work or services. Modern cities grow along interstate highways, spread out in a loose web of major thoroughfares with many dispersed centers of activity.
Regional Transportation Planning

The broad-scale transportation planning process is similar to Comprehensive Planning, involving development of goals and objectives, a data collection and analysis step, an evaluation of alternative futures, choosing a direction, and a process of implementation, reflection and revision that is ongoing. **Even more compelling than in local land use planning is the need to look at transportation patterns on a regional basis.** People’s movements are affected very little by political boundaries, so any attempt to understand or plan for a system within a political jurisdiction without considering what goes on around it is impossible.

SEE MODULE 3. COMPREHENSIVE AND STRATEGIC PLANNING, FOR MORE INFORMATION ON THE LONG-RANGE PLANNING PROCESS.

There are generally 3 steps to a transportation planning exercise:

- **Pre-Analysis Phase**

  The pre-analysis phase:
  
  - Identifies Problems
  - Formulates Goals
  - Generates Alternatives

  Some aspects of problem-identification are simple exercises in measurement. How long is the wait at a traffic signal? How bad is the air quality at certain times of day on certain corridors? The difficult part comes in weighing the relative importance of these problems. **Without an organized and comprehensive effort to get some feedback from the USERS of the transportation network, any analysis of the relative importance of problems and the overall goals of any solution is, at best, an educated guess; and at worst, will result in colossal wastes of public resources trying to fix the plumbing while the house burns down.**

- **Technical Analysis (Modeling) Phase**

  **Land Use / Activity System Model.** Currently, the availability and power of computer resources makes modeling the most prevalent means for analyzing complex transportation systems and making reasoned judgments about alternative courses of action. Computer models are only as good as the assumptions that set the “rules” that the computer uses to try to make the facsimile act like the real system. **The powerful assumptions that are essential to make models work are land use projections...the results of our general comprehensive plans.** Models must begin by setting a framework of future land uses and activities that is based on a plan, and some careful projections of trends at work in the community today. This isn’t easy. A Land Use / Activity System Model is basic to the workings of a transportation model, and its assumptions are very important.

  **Urban Transportation Model System (UTMS).** The most widely used process for analyzing the impacts of transportation policies is through the Urban Transportation Model System. The UTMS is also known as the "Four-Step" model, which accurately describes the process of forecasting transportation within an area or region. While the mathematics of this forecasting procedure can be very complex, the process that the
model represents is very straightforward and actually very intuitive. The result of the model is a tool with which to see into the future, find out where the problems will arise with the current system, and analyze alternative hypothetical changes to the system to see how they will work, and which of them might be the most cost-effective.

The UTMS requires two basic pieces of information before it can do its job:

1. **The Land Use / Activity System Model** lets the UTMS know about the character and patterns of land use within the study area.
2. **Information about the transportation network for the region** provides the framework to move people about in the model. This information includes the location and layout of the network as well as the characteristics of the network such as speed limits, turning restrictions at intersections and whether streets are "one-way" or "two-way" streets.

The four steps in the UTMS are:

**Trip Generation**
The question this first step of the model provides with regard to travel is "How much travel is being generated by each of the sub-areas in the region (often called TAZ’s or traffic analysis zones)?" Trips are generated within a zone in two ways:

- **Producing trips** based on the number of people living in a zone and some assumptions about their general habits as they go about going to work, shopping, picking up the kids, etc.; and

- **Attracting trips** based on the “activity generators” that may be located in a zone, such as a major place of employment, or a shopping center that might attract trips to the grocery store.

**Trip Distribution**
The question the second step of the model asks is "Where are those trips going?" This is determined by a number of factors. One factor is how attractive a zone is to travelers, or how accessible that zone is with respect to the number of activities that can be conducted there. Another factor is called "friction," or “impedence”, the ease of travel between two zones. The more friction, the less likely that interaction exists between two zones. Friction is a catch-all term that can include distance, speed limits and stops between two zones.

**Mode Choice**
The question this third step asks is "What mode of transportation is being used by the travelers?" Generally, this prediction is split between automobiles and transit, although more sophisticated models can be more realistic and take into account carpooling and different types of transit trips.

**Network Assignment**
The question this last step asks is "By what route are these trips traveling from one place to another?" As any traveler is aware, there is more than one way to arrive at a destination. The choice of which route to take is influenced by a number of different factors such as time of day, weather conditions, street conditions and characteristics, and perceived safety.
This step of the model considers all alternative routes among zones as well as any characteristics that can be attributed to those routes. Some models assume that all trips are made at the same time; others are more realistic as incrementally make assignments that allow for the possibility of making a route choice based on congestion conditions.

**Post-Analysis Phase / Transportation Policy**

This, of course, is what everybody REALLY gets interested in...what are we going to do about what we’ve learned by identifying issues, setting goals and using UMTS to model the system the way it works in real life? It is now time to set some transportation policy through:

- Evaluation of Alternatives
- Some Tough Decision-Making
- Financing and Implementation
- Monitoring

**Transportation Policy**

Broadly speaking, transportation policies fall under two categories:

**Demand policies** focus on influencing the travel choices we make. This influence can take the form of explicit transportation policies, land use policies and policies based on technology.

Demand Policies attempt to suppress demand for transportation services over time, until it reaches a point where the available supply is sufficient.

**Supply policies** influence the amount of transportation available through the road network - new streets, enhancing existing streets, more frequent transit service and increasing the attractiveness of transit modes.

Supply Policies attempt to increase supply faster than increasing demand.
**TDM and TSM**

**Transportation Demand Management**, or TDM, is the practice of implementing policies that modify travel behavior or travel choices made by an individual. These policies can be linked to the specific steps of the UTMS. Each step has a specific objective:

- **Trip Generation** – Eliminated trips
- **Trip Distribution** – Shifting the location of origins or destinations
- **Mode Choice** – Encouraging higher occupancy modes
- **Network Assignment** – Shifting trips from more congested routes or time periods to less congested routes or time periods

TDM policies have met with mixed success. A traveling public that has not responded well to TDM policies has discouraged policymakers from trying this on a more comprehensive basis.

Transportation Demand Management strategies are focused on the commuting trips, which make up approx. 10% of the total trips experienced on the street system, but because these trips all happen at once in the morning and evening, they contribute most to periodic congestion problems. TDM strategies run the gamut of transportation and non-transportation policies such as technology- and land use-based strategies. Some typical policies include:

- **Congestion Pricing** – Varying tolls on roads in order to shift trips away from congested parts of the network to less congested parts of the network. Prices vary by time of day or by level of congestion.
- **Parking Policies** – Either reduce the amount of parking in an area (which may encourage the use of a mode other than the automobile), or to increase the cost of parking, thus accomplishing the same goal. In some instances discouraging free parking offered by employers to their employees is a way of increasing the cost of parking.
- **Telecommuting** – Employers often allow their workers to telecommute via computer or phone, thus reducing the demand for commuting space on the transportation network. In addition, telecommuting centers have been establish that allow workers to come to a "satellite" office which may be closer to home.
- **Land Use Planning** – Encouraging more mixed uses and densities to encourage development around transit nodes, and to bring homes and workplaces closer together. Other types of policies include allowing districts with a "downtown" feel where retail business are compatible with residential uses, or allowing apartments above shops. These land use policies have been promoted by proponents of Traditional Neighborhood Development (TND) or as it is sometimes called, the New Urbanism.
- **Infill Development (Re-urbanization)** – Encouraging "infill" development as opposed to development on the fringe of an area is seen as a way of ensuring more efficient travel patterns. In this way, vacant and unused land closer to the urban center is developed. This policy is aimed at reducing “urban sprawl”, the tendency for urbanizing areas to spread outward to cheaper “greenfield” lands and to develop at lower densities, requiring large expenditures by the public to bring rural infrastructure up to a standard that can handle urban demands.
Transportation System Management, or TSM, addresses the infrastructure itself rather than the user of transportation services. More directly, TSM policies affect the supply or quality of infrastructure available to the users of the transportation network.

Within the context of TSM are policies that supply new infrastructure and policies that enhance existing infrastructure. TSM isn’t road building nor is it the implementation of a new transit system. TSM are those actions or construction that improves the movement of traffic throughout the transportation network.

Some typical TSM policies include:

- Adding High Occupancy Vehicle (HOV) lanes on an existing network
- Encouraging vanpools or carpools
- Optimizing traffic signals through computerized coordination
- Increasing the frequency or extent of transit service
- Improving the transit system to make it more enjoyable or convenient
- Access management on existing systems

The Ultimate Supply Policy...More Asphalt

More lanes, wider roads, new thoroughfares...this has been the implementation strategy that has dominated all others, because of the predominance of automobile travel as the mode of choice, and because it is the quickest, easiest and most politically tangible (though probably not the cheapest) way to have an impact on congestion. There is no question that widening or extending thoroughfare systems helps temporarily. There is some debate over the long-term efficacy of this policy.

Opponents of ever-increasing addition of new lanes point to the fact that most newly widened corridors are almost instantaneously congested upon opening, as travelers change their habits when they become aware of the increased capacity. This “induced demand” is defined as:

- more vehicle trips resulting from more households due to additional development, and
- more vehicle trips resulting from same households due to increased road capacity.

Additionally, the increased road capacity is itself a magnet for trips that would otherwise happen on other road systems, making the local road system less efficient by drawing trips off of that network, congesting new thoroughfares and making less effective the millions in improvements meant to reduce congestion. Induced demand is a debatable concept, but the fact remains that supply strategies alone will not solve the problem. A blend of infrastructure improvements, Transportation Demand Management and Transportation System Management is increasingly being looked toward for a more comprehensive solution to congestion.

Source: The Land Use-Transit Connection, Creating Livable and Sustainable Communities in North Carolina. NCDOT September 1999
Already in North Carolina’s major metropolitan areas it is becoming clear that highway planners cannot keep up with the automobile traffic demand anticipated in the future through the normal capital budgeting process. Alternatives must be explored to address the problem. Creativity, forward thinking, and a willingness to make tough choices are necessary to be able to solve the ever-widening gap between infrastructure supply and traffic demand.

“It's time we got more creative about how we plan our state's transportation network for the future. We're beginning to do that. We know we can't pave our way out of congestion.”

Site Level Transportation Issues:
Streets, Sidewalks, Access, Parking and Driveways

• Planning streets at the site level

Most Planning Commissions will be dealing directly with street design in the site plan approval process for residential and commercial developments, shopping centers and through the subdivision management process. General thoroughfare and collector street planning should be a big part of the comprehensive or long-range planning program that the Planning Commission should be managing in a community, and can also be a part of the conditional use zoning process if used in your community, but the local access street system is generally designed on a site-by-site basis as land develops.

The most typical issues regarding streets on the site or subdivision level are:

• Street interconnectivity (stub streets) and stream crossings
• Access to individual properties (driveways)
• Right-of-way dedication or major road improvements on thoroughfares and construction standards of streets that are required to be built

Connecting the dots...when to extend a stub street

Developers are often resistant to extending street stubs to adjacent property because of these factors:

✓ Concern about unpredictability in quality of neighboring developments.
✓ Competition from neighboring property owners who will utilize the access provided to develop their own tracts.
✓ The loss of privacy or exclusivity of their development if they intend to market these characteristics.
✓ The cost of building portions of streets that they do not need to serve the residences in their development.
✓ Stubs often must cross stream corridors, causing environmental concerns and great expense for large culverts or bridges.

Taxpayers who must cover the long term cost of serving residential areas with fire, police, garbage pickup, emergency services, street maintenance and other municipal functions have good reasons to want many residential street interconnections:

✓ The “dead-heading” time for garbage crews, street maintenance crews, etc. (the time crews must back-track through areas they have already served to get to the next area) is greater in disconnected street systems, causing inefficiency.
✓ Response time in emergencies increases dramatically in poorly connected street systems, causing extra investment in more police cruisers, fire stations, etc. to provide adequate public safety.
✓ Fewer residential street connections mean more local access traffic must use collectors and thoroughfares, causing decline in residential property values along collectors, and expensive improvements to intersections and premature need to widen thoroughfares at great cost, not to mention the inconvenience of movement within neighborhood areas.

A general rule of thumb: The more residential street connections, the more diffuse the traffic pattern, the smaller in width residential streets may be. Fewer residential street
connections mean more local access traffic must use other local roads. Everyone wants to live on a cul-de-sac street with traffic limited to only the houses on the street, but if most of us were to do that, the rest of us who lived on streets that did go somewhere would be burdened with much higher volumes of traffic on wider streets than is comfortable in a residential area, and all of us must be willing to pay higher taxes to support the inefficiencies inherent in this type of street layout.

Stream crossings are expensive, sometimes environmentally damaging, and yet necessary, for it is impossible to establish an urban street network without occasionally crossing streams. The further downstream the crossing is made, the more expensive and environmentally troublesome it becomes. Though far more expensive, bridges rather than culverts require fewer disturbances to natural systems. A community policy must be established that balances the need to protect the stream corridors (for water quality, stormwater management and wildlife protection), with the community’s need to efficiently provide urban services and create connections between neighborhoods and between residential areas and shops that are essential to our community quality of life.

Commercial driveway access on thoroughfare streets

This is always a major issue in the review of site plans for commercial developments. Property owners have these interests:

- Business is doomed if customers cannot get there.
- The more and easier the access to their business, the better.
- Access in and out of their property in multiple directions is very important.

On the other hand, the public’s investment in the thoroughfare and its function of allowing cross-town traffic is threatened by unlimited access for these reasons:

- Multiple driveways in a limited area cause “side friction” slowing traffic and limiting the capacity of the road to handle “through” trips.
- Frequent turning movements in a variety of directions in a congested area cause collisions.
- Areas of concentrated commercial development create a need for frequent traffic signalization, causing increased congestion and reduced capacity.

All this has to be balanced with the community’s need to support its businesses and the tax base they represent. Good planning strategies establish access plans and spacing policies for full movement signals and crossovers.

Medians are excellent tools to limit access to controlled points.

Site restrictions on driveway numbers, sizes and distance from intersections are commonly incorporated in local development regulations.

Requirements that developers provide private cross-access driveways and pedestrian connections to adjacent developments ensure that customers won’t have to use the thoroughfare to go to the store next door.

Street construction policies, thoroughfare widening and right-of-way dedication

Planning Commissions are often put in the position of resolving disputes between professional staff and private developers over the magnitude of street construction or
thoroughfare widening that should be associated with a development. Developments abutting thoroughfares contribute to the demand on the road and should contribute in some way. Many communities now use impact fees to set a level of financial contribution each development must offer upon construction of a project. These fees are based on an analysis of the incremental cost of development to the public. Fees are placed in an account that must be spent on transportation improvements in the same area where the fees are collected.

Other communities require the developer to widen or install curb, gutter and sidewalk along the thoroughfare in association with development of land. Legally, a required improvement of this type must be proportional to the additional demand the development places onto the public road system. Good public policy strikes a balance between the interests of the general taxpayer not to be financing the infrastructure necessary for private gain, and the interests of the private citizen not to be asked to make improvements to a community resource out of proportion to the magnitude of the development proposal.

SEE MODULE 5. SUBDIVISION MANAGEMENT, FOR MORE DISCUSSION ON PUBLIC IMPROVEMENTS. SEE MODULE 6. LANDMARK LEGAL CASES FOR MORE DISCUSSION ON THE COURT’S INTERPRETATIONS OF WHAT “PROPORTIONAL” IMPROVEMENTS ARE.

• **Street Hierarchies**

**Freeways.** These roads move people through an area at high speed and do not provide access to adjacent property. These are expensive roads that demand lots of right-of-way to construct. GOVERNMENT (USUALLY STATE) BUILDS FREEWAYS.

- Multi-lane, median-divided, high speed
- Ramp-only interchange access / grade separations (bridges or tunnels) for intersecting roads
- No traffic signals
- Designed for high-speed interstate and intrastate travel

**Expressways.** These roads generally connect towns and cities together, but have some limited role in providing access to adjacent properties. GOVERNMENT (USUALLY STATE, BUT SOMETIMES MUNICIPAL) BUILDS EXPRESSWAYS, BUT PRIVATE DEVELOPERS ARE SOMETIMES ASKED TO MAKE IMPROVEMENTS OR PROVIDE TURN LANES IN ASSOCIATION WITH THEIR DEVELOPMENTS.

- Multi-lane, median-divided, moderate-high speed
- Restricted access with some at-grade intersections. Grade-separations when feasible
- Few traffic signals, widely spaced
- Designed to connect cities and towns

**Arterials or Thoroughfares** can be defined as "major" or "minor" depending on their size and design capacity. Thoroughfares serve traffic within or through an urban area, and bring traffic to and from expressways or freeways. The typical trip on an arterial should exceed one mile. Access from adjacent properties onto these roads is a major issue for most Planning Commissions.
GOVERNMENT OFTEN BUILDS THOROUGHFARES (EITHER STATE OR MUNICIPAL) BUT DEVELOPERS ARE OFTEN ASKED TO WIDEN OR OTHERWISE IMPROVE THOROUGHFARES IN ASSOCIATION WITH THEIR DEVELOPMENT.

- Multi-lane, median-divided or with center turn lane, low-moderate speed
- General access limited only by local development regulations
- Many traffic signals, often closely-spaced in commercial areas
- Generally designed for trips of 1 mile or more across town

**Collector and Commercial Streets** provide some continuity through residential or commercial areas, connect neighborhoods and districts together, and connect to the arterial system. MUNICIPALITIES SOMETIMES BUILD COLLECTORS, BUT MORE OFTEN THESE STREETS ARE CONSTRUCTED AS PART OF A PRIVATE DEVELOPMENT PLAN.

- Two-lane or three-lane, low speed, on-street parking
- General access limited only by local development regulations
- Designed for trips within a “superblock” area, not cross-town

**Residential Streets** provide direct access to adjacent residences and connect neighborhoods together. These types of local streets constitute the largest share of total street mileage, but they accommodate the smallest share of street usage per mile. RESIDENTIAL STREETS, EXCEPT IN RARE CIRCUMSTANCES, ARE CONSTRUCTED AS PART OF THE PRIVATE DEVELOPMENT PROCESS.

- Two-lane streets, low speed, on-street parking
- Mostly unrestricted access by driveways
- Designed for direct access to individual properties

**Minor Residential Streets** provide direct access to adjacent residences. These streets are generally not continuous beyond a block or two, or end in “cul-de-sacs” or dead-end turnarounds. They carry extremely low volumes of traffic and may be very narrow. MINOR RESIDENTIAL STREETS ARE CONSTRUCTED AS PART OF THE DEVELOPMENT PROCESS.

- Narrow two-lane streets, sometimes dead-ends, very low speed, on-street parking
- Mostly unrestricted access by driveways
- Designed for direct access to individual properties

• **Sidewalks**

Sidewalks have been part of street infrastructure since the days of horses and buggies. Originally designed to keep pedestrians out of the muddy, unpaved streets of cities and towns, they now serve to keep pedestrians separated from dangerous traffic, and to provide the opportunity to traverse the community on foot, and perhaps also on bicycle,
skateboard or scooter. In rural areas sidewalks may not serve a purpose, but in urban and suburban areas residents served by them almost universally value them highly. Developers often object to providing sidewalks in new developments. They see them as an unnecessary infrastructure cost that does not substantially raise the value of the homes they are trying to sell or rent. **It is generally good policy to require sidewalks on one side of each residential street (at a minimum) and in commercial areas where any pedestrian activity is expected.** Without sidewalks, it is almost certain that pedestrian activity will be non-existent, and as people are forced to mingle with automobile traffic to push baby strollers and walk for exercise, safety concerns arise. If “traditional neighborhood design” or “new urbanist” philosophies are held in high regard, sidewalks on both sides of the street are essential to the pedestrian-friendly character of these neighborhoods.

Sidewalks are generally constructed of 4” deep concrete either 4 or 5 feet in width. A 5’ sidewalk is comfortable for two people walking side-by-side. Handicap ramps should be installed at every intersection. Brick sidewalks, or special concrete paver blocks are used in special areas and downtowns. If any substantial bicycle traffic is to share the path, the width should be at least 8-10’. Asphalt pathways are sometimes used, but the long-term maintenance costs for such paths is higher than concrete. It should be noted that sidewalks in general are not great places to encourage adult bicycle use. They are generally narrower than necessary for both bicyclists and pedestrians, and substantial safety concerns may arise at intersections with vehicle pathways if the sidewalk paths are not strictly controlled with stop signs, etc. for the bicycle users. Most bicycle advocates agree that the best place for bicycles is with other vehicles, in the roadway in lanes wide enough to allow them to co-exist happily and safely with cars. **See the Alternative Transportation section of this module for more information on planning for pedestrians and bicycles.**

**Transit Access**

If your community is in an urban area, providing alternatives for the traditional mode of travel by automobile is an important, but often overlooked, issue. Try to imagine how a user of public transportation might get from a building to a place where the vehicles may stop, and establish design standards that provide for this movement. In larger developments, create some responsibility for the developer to accommodate transit access on-site.

In the big picture, your community may wish to **preserve corridors** for regional mass transportation links to other activity centers in your region, or **encourage mixed land uses** in areas that are to be served by transit, so transit commuters can get their daily needs for lunch, banking, postal services, etc. met within walking distance of their workplace. **See the Alternative Transportation section of this module for more discussion of the role of mass transit in a transportation management strategy.**

**Traffic Calming**

Much attention has recently been paid to the body of techniques for managing the speed of travel and safety of streets known as “traffic calming” devices. These can be inexpensive, highly effective techniques for slowing traffic or bringing motorists attention to an interface with pedestrian systems or to a particularly hazardous situation in the street corridor. Traffic calming devices also allow streets to be more safely shared by bicycles and other vehicles. Each situation may demand a different solution, but a large variety of traffic calming techniques have been embraced by the Institute of
Transportation Engineers, and are increasingly used to solve traffic speed and volume conflicts with adjacent land uses. Some techniques include:

- Partial closures
- Median barriers
- Speed tables or raised crosswalks
- Neckdowns of street width
- Chicanes (deliberate shifting in horizontal alignment)
- Center islands
- Textured pavements

**Roundabouts**

A technique that is gaining popularity once again is the modern roundabout. The major differences between a traffic circle and a roundabout are:

- **Yield at Entry**
  At roundabouts the entering traffic yields the right-of-way to the circulating traffic. This yield-at-entry rule prevents traffic from locking-up and allows free flow movement.

- **Deflection**
  The entry and center island of a roundabout deflects entering traffic to slow traffic and reinforce the yielding process.

- **Flare**
  The entry to a roundabout often flares out from one or two lanes to two or three lanes at the yield line to provide increased capacity.

The benefits of the roundabout are:

- Continuous movement of traffic with no signalization
- Greater capacity and reduced delay
- Reduced cost for installation and maintenance of traffic signals
- General traffic calming characteristics as motorists slow to enter the circle
- Urban design opportunities for placing landmarks within the island itself

Comparison of vehicle / vehicle and vehicle / pedestrian conflicts at traditional signalized intersections and modern roundabout. Source: Roundabouts USA.com
Alternative Transportation

Planning for alternative transportation should not be an afterthought. It is very expensive to try to retrofit transit facilities, sidewalks and bicycle-friendly streets into a transportation system that has been designed to accommodate only automobiles. If plans are in place early in the development of a community, transportation facilities (roads and bridges) and land development plans (subdivisions and site plans) can be designed to accommodate local transit, bicycle and pedestrian needs.

Why bother? Don’t most people get around in cars, anyway? Why divert scarce resources toward this? The United States as a whole is currently experiencing a trend towards an increase in bicycling and walking both for commuting and for recreation. Many people still depend on publicly provided transportation to get to work, school, shopping, etc. As popular automobile routes become more congested, major metropolitan areas must provide alternatives to the single individual in an automobile to continue the economic boom that brought economic and physical growth in the first place.

According to a 1990 Harris Poll, 59 percent of respondents said they would be willing to walk more often if there were safe, designated paths or walkways.

National demographic projections also indicate that the population as a whole is aging. Senior citizens frequently depend upon walking as a means of transportation and often choose to live in areas with convenient shopping for that reason. Other demographic groups that are biking and walking more include: college students, children, the health conscious, those concerned about the environment and those working families or couples who cannot afford two or even one car. The Federal Highway Administration’s National Bicycling and Walking Study estimates a three to fivefold increase in bicycling and walking over the next several years, assuming adequate and safe circumstances to do so.

TEA-21 (the Federal transportation funding mechanism) includes substantial resources targeted to alternative transportation systems, so funding is not always a trade-off with automobile-oriented improvements.

• Bicycle and Pedestrian Planning

Like any planning exercise, the development of a bicycle and pedestrian plan must involve many groups in a program of active involvement to identify goals, establish a framework for talking about the issue, lay out some alternatives and develop an implementation strategy:

• Neighborhood groups
• Developers
• Bicycle or Pedestrian Advocacy Groups
• County or Town Staff
• NCDOT
• Elected Officials
• Planning Board members

Regional cooperation – An important objective of a bicycle / pedestrian plan is to coordinate and connect your major bike/pedestrian routes (especially those primarily serving commuting purposes) with surrounding jurisdictions. Regional plans often receive higher funding priority by transportation agencies using federal funds.
Reviewing the goals and objectives from other plans will help you to determine what is suitable for your jurisdiction’s needs and wants for bicycling and walking.

**What’s in the plan?** - Bicycle / pedestrian plans are generally focused on one or all of the following strategies:

- **Creation of a separate system** of paths along creeks (greenways), old railroad grades or otherwise outside traditional rights-of-way for the exclusive use of bicyclists, skaters and pedestrians.
- **Identification of corridors** where pedestrians and bicyclists can share the rights-of-way with automobiles safely.
- **Development of policies** that will make each individual development pedestrian and bicycle-friendly, by including pathways to and from the front door and the street, bike racks, lockers, street furniture, etc.
- **Sidewalk requirements** on all new streets.

**Typical problems with bicycle / pedestrian plans:**

- **Good ideas and no funding** – get involved in the capital budgeting process in the community. Through NCDOT, get to know the state-wide funding mechanisms available through TEA-21 for non-traditional transportation “enhancements”.
- **Incremental implementation** – If your strategy is heavily oriented to regulation of private development, your system will emerge piecemeal in a patchwork quilt that will not be fully functional until all the pieces are in place. A regulatory emphasis must be accompanied by a public funding priority in order to “connect the dots” and make completion of usable segments of the system possible quickly.
- **Overkill** – A plan that calls for the major expressway in town to be retrofitted for pedestrian and bicycle access may be a noble goal, but its chances of implementation are slim. Pick achievable goals, and establish a strategic plan to put usable pieces in place as quickly as possible.

• **Planning for Transit**

Transit is a controversial subject, particularly when rail-based systems for major metropolitan areas are discussed. The capital costs (rails, right-of-way, trains, stations) of rail-based transportation systems are very high. **Ridership varies widely depending on mode of transit and location of facilities, but some density of development along the corridor served by rail transit is necessary to provide both riders and destinations that are convenient enough to draw “trips” off the automobile pathways and onto the rail corridors.** If this is the case, rail systems can be very efficient about moving large numbers of commuters to work and back each day, as is true in many large cities like Chicago, Boston and New York. Rail-based transit systems are in various stages of planning in both the Triangle and in the Charlotte metro area, and have the potential to completely change the development pattern in these major regions, if successful at improving mobility and providing high quality transportation services.
Transit does not have to be a commuter rail or “light rail” (streetcar) system. Transit also can mean separate busways, traditional on-street bus service, jitneys, on-demand van services and a variety of other attempts to provide mobility in alternative ways to the automobile.

For any system of transit to work, it must be seamlessly integrated in to the land use and transportation planning process in the community. For Planning Commissions, involvement in a transit-planning program includes both broad scale decision-making about how to pursue a transit strategy, and site-related review regarding access from individual developments. Actions that communities can take to make it “transit-friendly” (no matter what the mode of transit chosen) include the following:

- Revise zoning ordinances to encourage transit-oriented land uses
- Include access standards in development review
- Provide transit-friendly design criteria in the form of a checklist to developers
- Encourage small-lot or multi-family infill in existing developed areas
- Consider minimum density standards near transit transfer facilities
- Encourage new development in areas already served by transit
- Allow accessory housing units associated with single-family owner-occupied homes
- Develop a community strategy to allow a mix of uses in a geographic area
- Establish public-private partnerships to develop areas around transit stops

Transit is certainly in our future to one degree or another. Even in rural areas, public van systems or town-to-town shuttles are becoming more available as transportation options. The degree to which your community utilizes transit to meet a portion of its transportation demand is in great measure determined by public policy.

Transit-Oriented Development:

Transit can only be successful if land uses are organized in a way to support it. Transit-oriented development involves some foresight on the part of the elected and appointed planners in a community, who must be responsible for making higher intensity and mixed use land use options available around transit stops. Making development transit friendly depends primarily on pedestrians being able to access transit stops. This means having a lot of residences close by, with convenient pedestrian access to the stop, without that access being hindered by intervening non-residential development.
Some Exercises:

Situation 1.

Route 47 through Smithville was widened to four lanes several years ago by virtue of funding secured by the local state legislature and included in the State’s Transportation Improvement Program (TIP). Growth in Smithville in the intervening years has caused increasing traffic, which has now congested the widened thoroughfare, which runs through the middle of town. NCDOT officials have approached the Smithville town board with some alternatives: They can build a bypass around the town, widen Route 47 further, requiring expensive right-of-way and some loss of structures in the older portions of town, or implement a combination of access limitations on existing businesses with the minor widening of two parallel routes through town, diverting trips onto these alternates that now traverse primarily residential areas. The town board asks the Planning Commission what their recommendation is.

What should the Planning Commission recommend? What are some of the trade-offs with each alternative? What effect will each alternative have on land use?

Situation 2.

The City of Westville is enjoying substantial growth. The pressures of the community’s expansion are straining its road system. An advocacy group approaches the City Council in the budget process and requests that the Council include in its transportation priorities for funding a new cross-town bicycle path to allow commuters access to the main job center in a way that does not require further strain on the thoroughfare system. Mayor Billings replies that this cannot be done, since the regional MPO makes all the major decisions regarding transportation priorities, and because if they include resources for the bike path, funding will be diverted from the needed street improvements to East-West Boulevard.

Is the mayor right?

Situation 3.

The Conifer Level subdivision ordinance requires extension of stub streets to undeveloped tracts that have future development potential, and limits the length of dead-end streets. Years ago, under these rules, a stub street was extended in the Blue Heaven Subdivision to a piece of property that fell between the end of the stub and a major thoroughfare. It was intended that when the adjacent undeveloped tract was built upon, the street would be extended to the thoroughfare. A development proposal has been submitted for the undeveloped tract showing construction of the extension of this stub street to the thoroughfare as previously planned. By this time there are many homeowners in Blue Heaven, who have organized to make the stub a dead-end street and have petitioned the Spruce Level town board to block off the proposed connection.

What should the town board do? Why? What do the board members have to consider?
Other related subjects:

Ask your professional staff to provide you with more training on these issues:

• The Economics of Mass Transit

• NC Legal Cases Regarding “Reasonable” Road Improvements Associated with Development

• Traffic Calming and Modern Roundabouts

• The Americans with Disabilities Act

• The NCDOT Transportation Improvement Program (TIP) Process

• Public Participation in Transportation Decision-Making
Bibliography and sources for this module:


Hanson, Susan, ed.  The Geography of Urban Transportation.  Guilford Press (1995)


Web Sites of Interest:

http://www.bts.gov/ntl/  US Department of Transportation, National Transportation Library.
http://www.bts.gov/  US Department of Transportation, Bureau of Transportation Statistics.
http://roundabouts.kittelson.com/  Roundabout clearinghouse
http://www.ite.org/traffic/index.htm  Institute of Transportation Engineers. Traffic calming information

Special Thanks to Harrison Marshall of the NCDOT for providing web resources for this module.