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When Main Street Is a Highway: Addressing Conflicts Between Land Use and Transportation

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Major at-grade regional thoroughfares in Virginia are a source of conflict for planners because of the corridors' dual, often competing, roles. For many Virginians, these routes are critical highways for cross-state travel, commuting, and movement of freight, with an emphasis on mobility and expectations of high travel speeds and limited stopping. For local residents in both long-established and developing communities, these corridors sometimes function as the community's "main street," providing access to homes and businesses, often at the cost of regional mobility.

The purpose of this study was to identify solutions to this main street / highway conflict through a review of relevant regulations, identification of planning solutions that could be implemented by localities and the Virginia Department of Transportation (VDOT), and the highlighting of resources that could help with the process of identifying and implementing solutions. In addition, case studies were selected to serve as examples of how the conflict between local access and through mobility has been managed by public agencies in various contexts.

The main street / highway conflict is fundamentally an issue of transportation and land use coordination. No individual solution can fully address the conflict. Because VDOT has limited influence over land use and development along state highways, a practice of strong interagency coordination, cooperation, and public participation is necessary. As VDOT develops roadway projects, it must respond to concerns of local stakeholders, in part by demonstrating how engineering solutions can lead to locally desired outcomes.

The study recommends that VDOT consider the previously mentioned issues in refining an existing planning process for arterial highways that may reflect the main street / highway conflict. It also recommends that VDOT ensure that its planners working on major regional thoroughfares are familiar with (1) relevant design manuals, treatments, and concepts, such as context-sensitive urban thoroughfare design and unconventional intersection designs; and (2) methods to facilitate interagency coordination and public participation.

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FINAL REPORT

WHEN MAIN STREET IS A HIGHWAY: ADDRESSING CONFLICTS BETWEEN LAND USE AND TRANSPORTATION

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ABSTRACT

Major at-grade regional thoroughfares in Virginia are a source of conflict for planners because of the corridors' dual, often competing, roles. For many Virginians, these routes are critical highways for cross-state travel, commuting, and movement of freight, with an emphasis on mobility and expectations of high travel speeds and limited stopping. For local residents in both long-established and developing communities, these corridors sometimes function as the community's "main street," providing access to homes and businesses, often at the cost of regional mobility.

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INTRODUCTION

Overview

Major at-grade regional thoroughfares in Virginia are a source of conflict for planners because of the corridors' dual, often competing, roles. For many Virginians, these routes are critical highways for cross-state travel, commuting, and movement of freight, with an emphasis on mobility and expectations of high travel speeds and limited stopping. For local residents in both long-established and developing communities, these corridors sometimes function as the community's "main street," providing access to homes and businesses, often at the cost of regional mobility. This report uses the term "main street / highway conflict" to refer to the issues that can arise with regard to these corridors.

Virginia's Commonwealth Transportation Board (CTB) designated certain thoroughfares in Virginia as Corridors of Statewide Significance (CoSS) to promote mobility of people and goods. CoSS range from limited access freeways to two-lane roads, and examples include the I-66 corridor in Northern Virginia, the north-south I-95 / U.S. 1 corridor, and U.S. 17 from Virginia Beach to Winchester (Office of Intermodal Planning and Investment, 2015). Along with transit, rail, air, and port facilities, CoSS include parallel roadways within a specified distance of the main route. Other major thoroughfares in Virginia without the CoSS designation may still exemplify the main street / highway conflict; one such example is the State Route 3 corridor west of Fredericksburg.

Localities in Virginia are required to identify CoSS in their comprehensive plans and on official maps (*Code of Virginia,* §§ 2.2-229 and 15.2-2232). In 2010, the CTB adopted a process for studying CoSS that focused on their importance as routes for long-distance travel and reflected the need for collaboration with local governments where such corridors serve as local "main streets" (Virginia Department of Transportation [VDOT], 2016c). A recent study by Howe (2015) addressed the topic of corridor planning along CoSS and other principal arterials and recommended the use of professional facilitators during the planning process.

VDOT seeks to prioritize regional mobility along these major thoroughfares. There are no specific regulations in place to ensure this is achieved, whether the facility has the CoSS

designation or not, but from a statewide perspective, problems for regional mobility can result when local trips proliferate and ultimately reduce speed and capacity along CoSS and similar corridors. Although VDOT can control the location and type of driveways and commercial entrances and can provide comments on local plans, the type and intensity of development allowed along state highways are decisions made by local governments.

Interstate corridors are not associated with the same sort of main street / highway conflict, as they are limited access facilities that do not provide direct access to adjacent land parcels. Further, in some areas a designated "business" route parallels another highway with the same numerical route designation. In such cases, the business route intentionally provides greater access and less mobility than the parallel highway. This study applied primarily to major regional at-grade thoroughfares without a business designation.

A successful resolution of the main street / highway conflict could be defined as a process that results in enough public support such that a solution, which at least partially addresses local access and state mobility concerns, is actually implemented. It is likely that no individual solution can guarantee success, but rather that several practices such as interagency coordination and public participation, among others, are necessary. Within processes of transportation planning and land use planning, VDOT and localities can work together to mitigate the problems arising from the main street / highway conflict. Although it may be impossible to formulate a one-size-fits-all solution to the problems created by the dual roles of major regional thoroughfares, some states have completed studies or projects that are relevant to Virginia. Summaries of these case studies are provided in this report.

The main street / highway conflict is fundamentally an issue of transportation and land use coordination. One reason it is of interest to VDOT is the potential for strategic land use choices to minimize the need for costly road improvement projects. Recent efforts in Virginia and elsewhere have addressed this topic, such as VDOT's *Transportation Efficient Land Use and Design: A Guide for Local Governments* (The Cox Company et al., 2012), but not from the specific perspective of the main street / highway conflict.

Functional Classification and Administrative Classification

All Virginia roads have a functional classification and an administrative classification. Functional classification is a process of designating a hierarchy of roads, reflecting the different levels of mobility and access they provide. VDOT uses the federally established categories (in order of highest to lowest mobility and lowest to highest access): Interstates, Other Freeways & Expressways, Other Principal Arterials, Minor Arterials, Major Collectors, Minor Collectors, and Locals (Federal Highway Administration [FHWA], 2013). The types of roads of interest in this study are for the most part functionally classified as other principal arterials, which in developed areas would typically be surrounded by a network of streets with other functional classifications that have driveways to homes and businesses.

The CTB designates all state-maintained roads as either a primary or secondary road. The main effect of this designation is in how funding priorities are set. According to § 33.2-334

of the *Code of Virginia*, the planning and building of new secondary roads must be approved by the CTB and therefore must meet the requirements enumerated by VDOT, i.e., the Secondary Street Acceptance Requirements (VDOT, 2011). In essence, a new secondary road must comply with the access requirements of the existing street network and negative environmental impacts must be minimized (R.W. Hofrichter, unpublished data).

Virginia's system of state-level highway ownership and management is unlike that of most other states. In Virginia, VDOT is responsible for all roads, both primary and secondary, except for those in cities, certain independent towns, and two counties. The majority of state departments of transportation (DOTs) are responsible only for interstates and major regional thoroughfares, with county transportation departments handling lower order facilities. One possible result of this arrangement is that jurisdictions without road improvement responsibilities might not fully consider the impacts of land use decisions and development approvals on the road network.

PURPOSE AND SCOPE

The purpose of the study was to identify potential solutions to the main street / highway conflict that localities and VDOT could implement. The scope included identifying related resources and examples of how other public agencies had addressed this issue.

The study addressed two questions:

1. What planning solutions and resources can help localities and VDOT address the conflict between local access and regional/statewide mobility when highways pass through developed and developing places?

2. How has this sort of conflict been addressed in Virginia and other states in the past?

METHODS

To answer the two questions, four tasks were performed:

1. Relevant Virginia regulations were identified by searching the *Code of Virginia* and reviewed to examine requirements for access management, pedestrian and bicycle facilities, land use planning, and a traffic impact analysis (TIA).

2. Planning literature was identified by searching the Transport Research International Documentation database for publications on access management, land use and transportation, freight planning, collaboration, and public participation. The literature was reviewed to find potential planning solutions and specific actions VDOT could take.

3. Planning guides were identified based on recommendations from this study's advisory panel and reviewed in order to produce summary descriptions of how these resources might be of use in addressing the main street / highway conflict.

4. Case studies in Virginia and the United States that were featured in the planning literature and planning guides and that were relevant to the main street / highway conflict were summarized and augmented by interviews of public agency staff involved in the subject projects when necessary.

RESULTS AND DISCUSSION

Review of Virginia Regulations

Several types of Virginia regulations are relevant to the main street / highway conflict, including VDOT requirements for access management, roadway functional classification, secondary roads, and pedestrian and bicycle facilities and state requirements for land use planning and TIA.

Access Management

VDOT holds the authority to manage access to state highways, whereas the authority to designate highways as limited access belongs to the CTB. Entrance permits, defined as documents that set "the conditions under which VDOT allows a connection to a highway" (VDOT, 2013) are issued by VDOT district administration (O'Leary, 1998).

VDOT's access management regulations were designed to balance the role of state highways as efficient mobility corridors with the interests of private property owners in accessing those highways (VDOT, 2013). On major thoroughfares, limiting the number of driveways and intersections best serves the purposes of VDOT, localities, and the public. These purposes as outlined in the regulations include reduction of congestion and conflict points, maintenance of acceptable levels of service and safety, efficient mobility of regional traffic to support Virginia's economy, and increased coordination of transportation and land use planning.

Specific regulations apply to commercial entrance design, sight distance for commercial entrances, existing commercial entrances, commercial entrance access management, and private entrances. These are reflected in Appendix F of VDOT's *Road Design Manual* (VDOT, 2014), VDOT's *2008 Road and Bridge Standards* (VDOT, 2015), the *Highway Capacity Manual* (Transportation Research Board, 2010), and other regulations and guidelines useful in managing state highways.

The regulations apply to commercial entrances and entrances to private roads, which occur where the road serves five or more private lots or houses. The design standards for entrances to a state highway are provided in Appendix F of VDOT's *Road Design Manual* (VDOT, 2016a). All entrances, commercial and private, must have a permit. For developments

with negative impacts on the road network, if compromises regarding access designs cannot be reached, VDOT's only option is to withhold issuance of an entrance permit. Although a property owner's preferred entrance design (say, on a major regional thoroughfare) may not be accepted, a property owner cannot be denied access to his or her property from the system of state highways.

There are six general requirements with regard to access management (VDOT, 2014):

1. The functional areas of intersections and interchanges are off limits for entrances.

2. Shared driveways must be considered an option.

3. There must be full compliance with the provisions of VDOT's *Road Design Manual* and access management regulations.

4. Connections to adjacent undeveloped properties are required on arterial roads and some collector streets.

5. There must be sufficient spacing between all proposed and existing signalized intersections.

6. Certain traffic movements (e.g., left turns) at entrances may need to be prevented through physical design.

Under Smart Scale, Virginia's prioritization system for transportation funding, transportation projects where a corridor plan or access management plan is in place that exceeds minimum VDOT standards are rewarded (VDOT, 2016b).

Pedestrian and Bicycle Facilities

For the past decade, VDOT has operated under a statewide Policy for Integrating Bicycle and Pedestrian Accommodations that requires VDOT to adopt a presumption that road projects will accommodate bicycling and walking (VDOT, 2004). For projects without such accommodations, which of six exceptions apply is to be documented. For existing roads, VDOT is to consider operational changes such as traffic calming and crosswalk striping to accommodate nonmotorized travel modes "where appropriate and feasible."

Land Use

Under Virginia law, local governments are required to prepare and adopt comprehensive plans (*Code of Virginia,* § 15.2-2223). These plans must include a transportation section detailing the existing transportation and roadway system and any anticipated future improvements. The plans must provide roadway system maps differentiating a hierarchy of roads (i.e., functional classification, although that term is not used in *the Code of Virginia* section) and infrastructure for other modes of transportation. The comprehensive plan must be consistent with the CTB's Statewide Transportation Plan, the Six-Year Improvement Program, and the established locations of roads comprising certain systems of state highways. The locality

must work with VDOT to ensure consistency and must conduct a TIA if an update to its comprehensive plan greatly impacts the state-maintained road system.

Traffic Impact Analyses

Virginia law also requires that certain rezoning proposals include a TIA, and VDOT is required to respond with comment (*Code of Virginia*, § 15.2-2222.1). Specifically, for development projects that will generate 5,000 or more vehicle trips per day or will substantially impact the existing road network, a TIA must be submitted at the time of rezoning. In some cases, a meeting is first held to discuss the scope and method for the TIA. The TIA estimates the traffic increases on state-maintained roadways and identifies ways to mitigate their impacts. It also typically addresses items such as how many trips are expected to begin and end within a particular development site (and thus not add to traffic on regional thoroughfares), known as internal capture, and how many trips are expected to come from vehicles already passing the site on regional highways on the way to another destination (again, not adding to the number of vehicles on regional thoroughfares), known as pass-by trips.

Literature Review

Planning solutions to the main street / highway conflict were found in the literature. The literature review incorporates discussion of how some elements found in the literature could apply to addressing the main street / highway conflict in Virginia, including how VDOT could encourage the efforts of localities.

Although VDOT is not the decision-maker regarding land use outside its rights of way, it can work with stakeholders to encourage certain efforts, such as zoning to create land use patterns that reduce conflicts with regional traffic while allowing for local trips, designating urban development areas, planning for reverse frontage development patterns (orienting buildings toward a major regional thoroughfare while requiring parking access to be located behind the buildings), and envisioning strong street networks at the local level. To encourage these efforts, VDOT can seek to integrate its policies into local comprehensive plans and undertake various types of public outreach efforts. The final section of this literature review covers direct actions VDOT could take to implement solutions, such as considering unconventional designs for intersections and urban thoroughfares.

Actions of Localities That VDOT Could Actively Encourage

Actions such as zoning, designating urban development areas, planning for reverse frontage development patterns, and developing well-connected street networks at the local level are primarily the responsibility of local governments. These actions can contribute to addressing mobility problems where highways traverse developed areas, and VDOT may be able to facilitate and actively encourage localities to use these strategies when participating in planning efforts, reviewing and commenting on local plans, and engaging in development reviews—functions already done, to varying degrees, by VDOT district planning staff. In many cases, Virginia's planning district commissions could assist with this process.

Zoning

Zoning patterns and maps, outlined in the comprehensive plan of any locality, can directly affect local trip generation for all modes of travel. Although a comprehensive plan designates land use, the typical tool for effectively implementing the land use plan is the zoning ordinance. A number of zoning strategies that affect transportation patterns can be incorporated into a land use or corridor plan. Zoning techniques can facilitate development that will minimize additional traffic or congestion along regional thoroughfares, and the three highlighted here share a common theme of seeking to place development in specific, defined areas rather than haphazardly along a corridor. Three types of zoning—nodal, traditional neighborhood development (TND), and transit-oriented development (TOD)—are discussed here.

Nodal Zoning Patterns. Concentration of development can vary substantially along a single corridor. Uncontrolled, linear/strip development can lead to frequent driveways and closely spaced signalized intersections, which impose safety issues and increase delay for through traffic. Certain land use development patterns can mitigate this problem by reducing trip generation (Michaelson et al., 2008). In the Route 16 Corridor Study, the New Hampshire Department of Transportation (DOT) reported transportation benefits from creating nodes of development through land use planning (Rockingham Planning Commission and Herr & James Associates, 1998). In this case, designated nodes of highway commercial development were to be zoned for denser development while relatively undeveloped areas were left between them. Examples of a node or activity center could include a town center or cluster of residential uses. Although development nodes might include mixed-use development such as commercial uses with residential uses above, nodal zoning does not necessarily require it.

When compared to linear or strip development, nodal development achieves transportation benefits by naturally reducing the number of access points and signalized intersections along a corridor, which in turn can preserve traffic flow. The Route 16 study found other benefits, including decreased average trip lengths and more opportunities for implementing infrastructure for bicyclists, pedestrians, and transit (Rockingham Planning Commission and Herr & James Associates, 1998).

Activity centers such as those produced by nodal zoning mitigate the negative effects of linear or strip development along a corridor. Rather than having strip commercial activity along both sides of a highway for many miles with no specific focal point, an activity center is developed as a node of activity on one side or the other of the thoroughfare. The decision to develop around a focal point on one side of a highway corridor should influence what ordinances, design standards, and other tools are used. For example, within each development node, a well-planned circulation system is critical to provide access to parcels within the activity center and to preserve mobility on the regional thoroughfare. Outside development nodes, zoning tools and strategies to limit access to the highway can be used to prevent strip development.

Nodal zoning is implemented through a local zoning code and comprehensive plan with specific nodes for development outlined in the land use plan. Nodal zoning requires collaboration among land use planners, transportation planners, and the development community

and may also require collaboration between adjacent localities. By the bringing together of planning commissions, zoning boards, transportation planners and engineers, and other interested parties, issues may be brought to the table that might not have been recognized by all parties otherwise. A consensus-based process can help develop solutions agreeable to many different types of agencies.

TND Zoning. TND is a community design approach aimed at creating livable communities based on pre-1950s town planning principles. It emphasizes compact, walkable developments with neighborhood centers, mixed land uses, and interconnected street networks. VDOT's *Transportation Efficient Land Use and Design: A Guide for Local Governments* covered many of these concepts and noted that by providing many activities and destinations within a connected neighborhood, TNDs can reduce the need to make auto trips outside the neighborhood (The Cox Company et al., 2012).

A Virginia example of TND implementation in the local zoning context is the neighborhood model used by Albemarle County (Albemarle County Virginia, 2014). It includes TND elements such as pedestrian orientation, interconnected transportation networks, neighborhood centers, parking relegated to the sides or rear of a building rather than in front, and mixed uses.

TOD Zoning. TND zoning is used to encourage transit-supportive development patterns around transit stations (Williams et al., 2014). Zoning for TOD can also be useful in a place with a less developed transit system by creating a framework for the system to improve or expand. TOD is codified through zoning ordinances structured to create a pattern of walkable, high-density, mixed-use development in close proximity to designated station areas and lower density and/or single-use development and open space between station areas.

To create such areas, the streets in the immediate vicinity of the transit station typically provide high access and low mobility and connect to a network of regional arterial streets that provide higher levels of mobility with lower access. That is, the transit station in a TOD is not accessed directly from a major regional thoroughfare.

The Transportation Research Board's *Access Management Manual* details criteria important to the success of a TOD district (Williams et al., 2014). These include provision of on-street parking, a clear and comfortable bicycle and pedestrian system, and location of arterials and other thoroughfares where they will not pass through the TOD.

Although TOD can provide opportunities for increased use of transit, walking, and bicycling, it can sometimes attract increased auto traffic, whether to the transit station itself or to other uses nearby. Commuter rail systems are especially reliant on passengers who drive to stations, and the issue of convenient station-area parking versus compact development is a challenge for planners in many transit station areas (Cervero et al., 2004).

Designating Urban Development Areas

Virginia law allows the designation of urban development areas (UDAs) to aid in the coordination of land development and public facilities, including transportation facilities (*Code of Virginia*, § 15.2-2223.1). Designation of UDAs is not required, but Smart Scale considers whether proposed transportation projects promote UDAs (*Code of Virginia*, § 33.2-214.1), and some localities have begun taking action as a result (for example, see Cornell, 2015).

Also known by other names such as targeted growth areas, localities may establish UDAs in their comprehensive plans to allow for higher density growth to be directed to locations near existing development, transportation facilities, and public utility lines. By the direction of new growth to these locations, linear development and development in exurban areas can be avoided and destinations can be concentrated in a smaller area near existing public facilities.

Additional research is needed to evaluate whether this practice has resulted in reduced traffic pressures on regional thoroughfares in Virginia. As a form of infill development, higher density development within UDAs is likely to produce fewer auto trips per person but more trips per unit of area than dispersed lower density development, so there is some potential for increased local traffic congestion (ICF Consulting, 2005). The location of UDAs and their relationships to other developed areas are likely to have an effect on whether this localized traffic congestion is manifested on major regional thoroughfares.

Planning for Reverse Frontage Development Patterns

Reverse frontage is the practice of allowing developments to face a major regional thoroughfare while requiring parking access to be located behind the building (Williams et al., 2014). Drivers access all buildings and parking areas by traveling on interior service roads rather than directly from the thoroughfare (Figure 1). Reverse frontage is typically outlined in a neighborhood or comprehensive plan and zoning ordinance and is considered from the beginning of development. A service road can also be built in retrofit situations and, in such cases, is often less costly (e.g., in terms of impacts to private property and public rights of way) and more functional than a typical frontage road (Williams et al., 2014).

The concept does not allow vehicular access to every business or residence directly from a major regional thoroughfare. For residential properties, a landscaped buffer is typical, but in the case of commercial development, reverse frontage need not inhibit visual access (or pedestrian access, if applicable) to the business from the highway. Vehicular access is usually achieved through the development of a supporting network of collector roads and local streets with consolidated entrances from the major thoroughfare. This results in a decrease in access points along the arterial, which can result in more efficient movement of through traffic.

Figure 1. An Area of Route 17 in Gloucester County, Virginia. This area exhibits a reverse frontage development pattern. Businesses are visible from the major regional corridor (Route 17) but have vehicular entrances only on Fox Centre Parkway and Walton's Lane. Imagery ©2015 Google, map data ©2015 Google.

Developing Strong Street Networks at the Local Level

A strong street network is a well-connected system of minor arterial, collector, and local streets that can provide access to properties without relying on principal arterials. By the establishment of a street network that disperses traffic throughout a development area, individual

site access points along regional principal arterials can be reduced or eliminated and trips within the area can be made without using the regional thoroughfare.

Virginia's *Multimodal System Design Guidelines* (Renaissance Planning Group, 2013) noted that the purpose of a strong street network is to place activity centers to either side of the regional thoroughfare rather than centered on it. Diverting local traffic off regional thoroughfares can meet VDOT's regional mobility goals and place-making goals of neighborhoods and local governments, but this technique requires the cooperation of the locality and VDOT to be executed properly. Local streets will need to meet VDOT standards and need to be part of the vision outlined in the locality's comprehensive plan. The network should be developed by both parties, incorporating public involvement.

Bealeton, in Fauquier County, developed on both sides of U.S. 17, which has led to an increased number of traffic signals and an increase in traffic congestion on this CoSS. The county has plans for a well-connected street network that would allow local trips to avoid using the thoroughfare (Fauquier County Virginia, 2014).

Testing Land Use Scenarios With Traffic Models

VDOT could encourage collaboration with localities to produce travel demand model outputs to test land use scenarios such as those found in a comprehensive plan. For example, if a jurisdiction desired to retain a rural context including only two-lane roads, it could submit a land use scenario with appropriate data to VDOT for modeling. If the travel model suggested that some roadways would need to be widened to four lanes, the jurisdiction could test other land use scenarios until one was found that satisfied both the jurisdiction's desires for a rural context and VDOT's goals for acceptable and safe traffic operations.

Such an initiative might require completion of a statewide travel demand model, a work in progress as of July 2016. Travel demand models for several urbanized areas are in place, and metropolitan planning organizations (MPOs) may be able to conduct the travel modeling rather than VDOT. Larger MPOs tend to have in-house modeling staff. In the past, the Fredericksburg Area MPO developed a land use model to use as an input for its traffic model (Ju-Yin Chen, personal communication, January 27, 2016). Most localities and smaller MPOs lack traffic modeling staff and could be encouraged to work with VDOT district planning staff to pursue similar objectives.

How VDOT Could Encourage These Efforts

Although VDOT does not control land use decisions directly, it can work with local jurisdictions and planning district commissions to encourage local land use practices that are compatible with statewide mobility goals on CoSS and similar facilities at the planning level and as individual road projects are developed. VDOT's level of involvement with local government planning, whether through membership on local review committees for comprehensive plans or through one-on-one meetings with local planners, can vary by VDOT district. Other than the statutorily required actions such as reviewing TIAs, much of this involvement is determined by

the initiative taken by VDOT planners, which itself is a function of factors such as the time they have available.

VDOT Could Provide Training for Local Government Planners

It may be difficult for local government planners to become familiar with the various regulations and guidelines related to land use and transportation, and VDOT could provide training. VDOT's Office of Land Use offers training on topics including TIA regulations, access management issues, and comprehensive plan review requirements. Since 2007, these training opportunities have been made available to all interested parties in Virginia, such as local government planners, developers, and consultants (Hofrichter, 2016). The biennial VDOT Coordinating Transportation and Land Use Forum is focused on locality staff and provides another opportunity for education and cooperation.

VDOT Could Seek to Integrate Its Policies Into Local Comprehensive Plans

Although VDOT maintains statewide road design standards and access management policies, mechanisms are available for localities to adopt more stringent access management standards that supersede VDOT's. One such mechanism allows localities to adopt VDOT-approved access management corridor plans with standards that vary from and supersede VDOT's standards. Such standards could include policies to preserve the roadways' mobility function, to provide entrances on local/collector roads to preserve the efficiency of arterials, and to keep access points to a minimum along arterials. Comprehensive plans or corridor plans could also include land use components that support these objectives. As noted previously, localities must work with VDOT to ensure consistency between local comprehensive plans and statewide plans and programs. In the course of providing comments on local comprehensive plans, VDOT staff could encourage local standards that go beyond the statewide minimum requirements.

Land use sections within a locality's comprehensive plan—or related ordinances outside the comprehensive plan—may benefit from the inclusion of, or reference to, VDOT policies. By incorporating an overview of VDOT policies, land use and transportation planning may be better integrated, which may result in a more cohesive system of roadways and destinations. This could also avoid unnecessary delays on either end by establishing regulations clearly from the start. The integration of these policies into local planning documents can lead to a better mutual understanding of VDOT policies, their purposes, and how best to apply them.

One example of this is Goochland County, which incorporated access management regulations into its subdivision ordinance (Goochland County, VA, 1989). The ordinance predates VDOT's access management regulations, but it includes similar concepts such as arterials, collectors, and local streets and their varying levels of mobility and accessibility, and it classifies state and local thoroughfares for access purposes. The county's subdivision ordinance also referenced VDOT's Subdivision Street Acceptance Requirements and noted that certain streets must be constructed to VDOT standards.

VDOT Could Perform Public Outreach and Create Advisory Committees

Public outreach is integral to the planning process for a road construction project and traditionally exists in the form of scheduled public meetings. VDOT could also identify key local stakeholders from within the community. These individuals, who have a strong stake in the issue at hand and are therefore able to serve as members and leaders on committees to represent the public's perspective, can help guide the planning process.

A core participation group, often in the form of an advisory committee, would work directly with VDOT, local officials, decision makers, and consultants. Concerns from the community would be brought to the table in meetings throughout the duration of the project. These committees and the champions that served on them could act as liaisons on all matters with a community viewpoint. Committee members would become educated on technical issues and how the process works and would be empowered to ask questions (FHWA, 2015a).

VDOT Could Organize Design Workshops, Charrettes, or Facilitated Stakeholder Meetings

At the project level, design workshops, charrettes, and facilitated stakeholder meetings that bring together all stakeholders at one time can decrease the unnecessary revisiting of earlier decisions by ensuring that all stakeholders' concerns are addressed in the formation of the solution rather than afterward.

Effective design workshops including all stakeholders (VDOT, local government, agencies, business owners, and the public) act as a means for achieving the best outcome for all parties in the shortest time. Design workshops bring all players to the table for several hours. For a typical project, multiple design workshops are scheduled over a period of time ranging from 1 month to several months. Two case studies in this report, New Hampshire's Route 16 Corridor Study (Rockingham Planning Commission and Herr & James Associates, 1998) and New Jersey's Route 31 Study (ICF International, n.d.), reference the design workshop technique.

Depending on the topic, a charrette can be a single-day event similar to a design workshop or it can take the form of a series of design workshops concentrated in a 4- to 7-day period rather than spread over a period of several months, which speeds up the development of project solutions. Lennertz and Lutzenhiser (2014) wrote a handbook designed to aid in the charrette process from beginning to end. Planning for a charrette is more extensive than for a typical public meeting and may take several months because of the need to gather extensive materials, information, and stakeholders. Benefits of charrettes include building ownership, enthusiasm, and support for a project and helping to educate stakeholders about the trade-offs of different solutions (Williams et al., 2014).

Facilitated stakeholder meetings can be effective in achieving consensus on a set of proposed improvements. In a recent study, Howe (2015) recommended that VDOT hire professional facilitators to assist in reaching agreement with stakeholders for corridor planning along CoSS and other principal arterials, a recommendation VDOT was implementing as of summer 2015.

Actions VDOT Could Take Directly

Although it is VDOT's goal to work cooperatively with all local jurisdictions, there are situations when VDOT may need to pursue a transportation project, such as one designed to address safety concerns, despite a lack of unanimous support from stakeholders. As VDOT is responsible for the state highway network, VDOT has the authority to make changes necessary for the safety of the traveling public. In some cases, VDOT can address safety and the conflicting roles of major arterial roadways at the same time, such as by reconfiguring major intersections and applying context-sensitive design principles for urban thoroughfares.

Consider Unconventional Intersection Designs

Intersections of major roadways with high traffic volumes are often a major source of congestion along regional thoroughfares. Land use and engineering solutions can help address the problems arising from these conflict points. In some cases, intersection issues can be addressed by restricting some movements and developing parallel streets. These actions can result in a stronger local street network and a functioning intersection of major roadways.

Sometimes, unconventional designs can address traffic issues while addressing community concerns. TRB's *Access Management Manual* provides concise descriptions, applications, special considerations, advantages and disadvantages, and examples for alternative intersection designs including the indirect left turn (jug handle), indirect U-turn, Michigan U-turn, restricted crossing U-turn, quadrant roadway, jug handle with far-side ramp, jug handle with near-side ramp, and jug handle with median U-turn (Williams et al., 2014). Although unconventional, not all of these concepts are new, and VDOT incorporated several of them into the *Road Design Manual* (VDOT, 2016a) and has designed and constructed them.

An example of an intersection reconfiguration in the case studies identified in this study is Flemington Circle, a complex and congested intersection of three major regional routes in Flemington, New Jersey. In this case, the existing intersection was already unconventional but was not ideal. A new interchange was originally scoped as a grade-separated project. As part of a "Smart Growth" study, the project was redesigned to a two-lane at-grade roundabout costing less than one-fifth as much as the interchange and "more compatible with the community's views on their future" (New Jersey DOT [NJDOT], 2013). The project was funded and in design as of spring 2015.

Three types of at-grade unconventional intersections are highlighted here. In all three cases, certain movements such as left turns, and the conflict points they represent, are eliminated from the main intersection, which simplifies traffic signal phasing and reduces stop time at the main intersection.

The *quadrant roadway intersection* (Figure 2) removes all left turns and their associated conflict points away from the major intersection and diverts them to two T-intersections. Moving these turns and the resulting conflict points to the T-intersections allows for a higher level of through movement on both corridors.

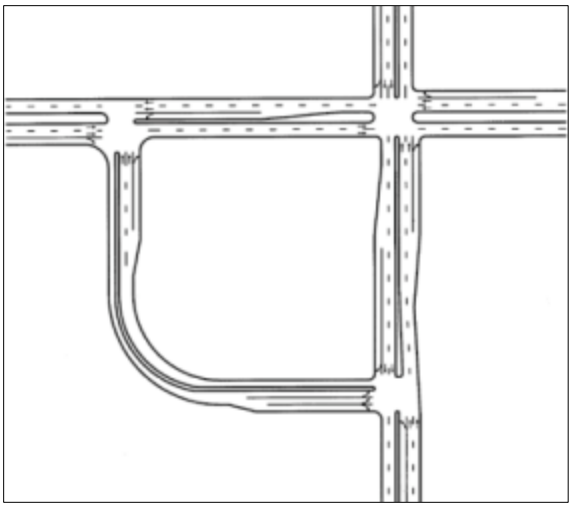

Figure 2. Depiction of Quadrant Roadway Intersection. From Rodegerdts et al. (2004).

The *continuous flow intersection*, also known as a displaced left turn, is an at-grade intersection without left turn movements from one or both major streets (Figure 3). Drivers wishing to turn left do so at an intersection in advance of the main intersection and complete the turn at a location downstream of the intersection.

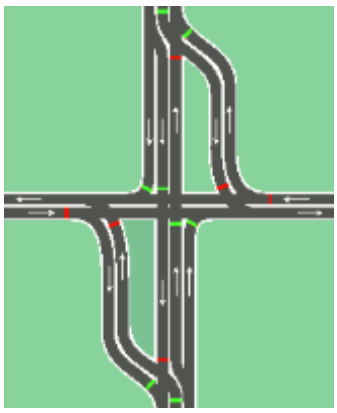

Figure 3. Depiction of Continuous Flow Intersection. Image by Hans Haase (2013) under a Creative Commons license (https://creativecommons.org/licenses/by-sa/3.0/deed.en).

A *restricted crossing U-turn intersection* (RCUT) is also known as a J-turn, superstreet, or synchronized street intersection. This type of intersection diverts through and left-turning side-street motorists onto the major street by way of U-turn crossovers on either side of the intersection (Figure 4). A typical signalized RCUT intersection can accommodate side street demand of up to 25,000 vehicles per day (Hummer et al., 2014).

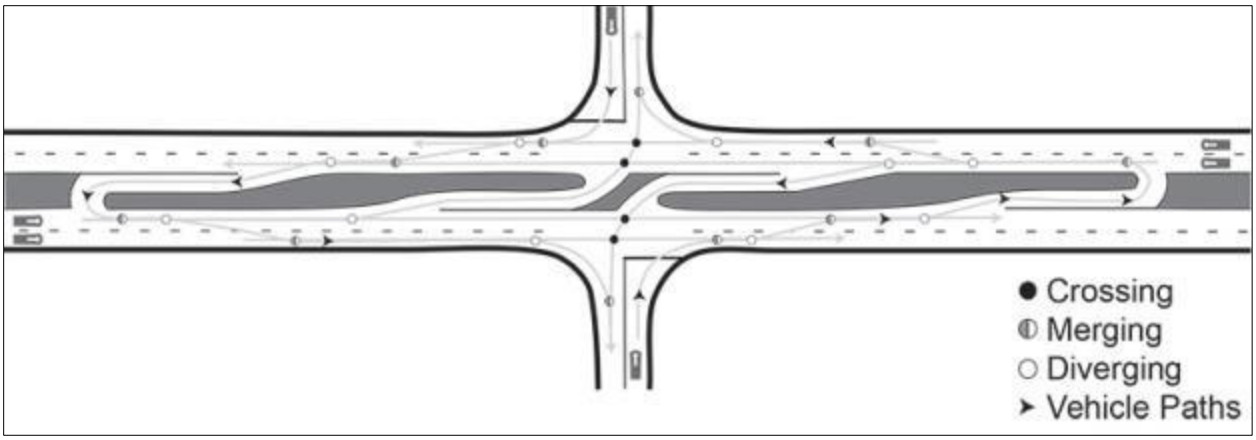

Figure 4. Depiction of Restricted Crossing U-turn Intersection Showing Vehicle Paths and Types of Conflict Points. From Brewer et al. (2014).

Use Context-Sensitive Urban Thoroughfare Design

Urban thoroughfares are arterials traversing urban areas, sometimes handling large volumes of regional traffic. Road design principles specific to urban thoroughfares are formed to accommodate these mobility needs while creating walkable, multimodal corridors for communities.

Evaluating the needs of people who walk, bike, take transit, and drive is the first step in developing a thoroughfare design in an urban area. The context of the surrounding land use is also important. The transect concept, which categorizes types of land uses comprising a multimodal district to provide the best transportation guidelines for each scenario, can be used to identify the most appropriate transportation and land use practices for specific types of communities. A better understanding of the land use conditions for a segment can assist transportation planning decision makers by allowing for the analysis of factors beyond average daily traffic levels and automotive level of service.

It is beneficial to analyze thoroughfare corridors in segments. Each segment has an identity of its own based on the land use context. Identifying the land use context for each segment is critical to understand the sources of conflict among road users. Such segmentation played a key role in a corridor study in Bloomington-Normal, Illinois (Gewalt Hamilton Associates et al., 2012) described later.

Review of Planning Guides

Several resources created at the federal and state levels can help planners navigate situations where conflicting interests must be balanced. Four examples were reviewed and are summarized here: FHWA's PlanWorks, Virginia's *Multimodal System Design Guidelines*, VDOT's *Transportation Efficient Land Use and Design: A Guide for Local Governments*, and the Institute of Transportation Engineers' *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach: An ITE Recommended Practice (*hereinafter *Designing Walkable Urban Thoroughfares).*

FHWA's PlanWorks

PlanWorks, formerly known as Transportation for Communities—Advancing Projects Through Partnerships, is an online resource through the FHWA and a product of the second Strategic Highway Research Program, or SHRP2 (FHWA, n.d.a.). The resource offers guidance for long-range transportation planning, corridor planning, programming, and environmental review. It ensures that the entire planning process, from initial decision making and assessments through project prioritization and allocation of funding, entails appropriate public participation, stakeholder involvement, and environmental considerations. The site includes case studies, reports, and other relevant documents for reference. A library of tools is also provided for specific purposes such as economic analysis, freight planning, travel demand modeling, and more.

Figure 5 shows the key decisions for corridor planning as depicted in the Decision Guide module of PlanWorks (FHWA, n.d.b.). On the site, clicking on each key decision brings the user to an overview of the particular decision point, which links to (as available) policy questions for discussion, questions to gather stakeholder interests, data needed for the decision, connections to other decisions in other planning processes within PlanWorks, interactions with processes related to transportation planning but outside PlanWorks, case studies, and related special topics.

The Charlottesville-Albemarle MPO conducted a pilot test of the Decision Guide module in 2013-2014 as part of its long-range planning process (Rhodes et al., 2015). As of July 2016, VDOT's Lynchburg District was using PlanWorks to guide a corridor plan for the U.S. 29 corridor in an environment of intense land development pressure.

Figure 5. Key Decisions for Corridor Planning as Depicted in PlanWorks. From Federal Highway Administration, n.d.b.

Virginia's *Multimodal System Design Guidelines*

The Virginia Department of Rail and Public Transportation published Virginia's *Multimodal System Design Guidelines* in October 2013 (Renaissance Planning Group, 2013). Multimodal planning is the central topic of the guidelines, but several of the concepts may be useful in planning for major regional thoroughfares where they pass through developed and developing areas.

Major highways in Virginia traverse a number of different types of land contexts. *Multimodal System Design Guidelines* makes use of the transect concept. Each of the six transect zones receives a category label and a zone number. The document describes typical characteristics of these zones, which range from Urban Core to Rural Village Center.

Multimodal System Design Guidelines also categorizes the roadways interacting with each zone. Most closely resembling major regional thoroughfares are the "multi-modal through corridors," which prioritize regional mobility. Other types of roadways—local roads, avenues, boulevards, and transit boulevards—interact directly with the various transect zones of a multimodal center, whereas the multimodal through corridors are best located on the outskirts of a multimodal center to support through traffic best. These roadways support higher speeds to connect activity centers effectively. The other roads are intended to support local traffic within the multimodal centers, whereas the through corridors act as connections between the centers themselves.

VDOT incorporated the best practices identified in *Multimodal System Design Guidelines* in Appendix B(2) of the *Road Design Manual* (VDOT, 2016a). It provides detailed design standards and a comparison of VDOT functional classification categories to the multimodal corridor types.

Multimodal System Design Guidelines provides guidance and steps to take in identifying transect zones and developing and modifying multimodal roadway solutions and the overall design process for multimodal centers. Its diagrams and guidance can be useful for transportation and land use planning for major regional thoroughfares, particularly for understanding the changing planning context within different segments of a long corridor.

VDOT's *Transportation Efficient Land Use and Design: A Guide for Local Governments*

VDOT's *Transportation Efficient Land Use and Design: A Guide for Local Governments* prescribes design elements that local government planners, architects, and engineers should include in UDAs or designated growth areas (The Cox Company et al., 2012). It provides tools for improving coordination of local plans, transportation design standards, and infrastructure financing strategies.

By "transportation efficient," the guide means integrated land use, housing, employment, and transportation planning that leads to reduced traffic congestion and lower construction and maintenance costs for infrastructure. It includes many of the same concepts as other resources discussed here, including TND, mixed-use development, pedestrian-friendly and multimodal

design, and the transect. A chapter on engaging the public reviews several tools, such as charrettes, and suggestions, such as including the real estate development community and elected officials as stakeholders. Implementation options are discussed, including zoning possibilities, elements of subdivision ordinances, and adjustments to traffic impact studies.

The guide's transportation elements focus on a connected street network with relatively small block sizes and alternative routes parallel to major roadways. It addresses thoroughfares by noting that in a TND context, the street hierarchy is based more on the relationship between streets and building form than on traffic flow capacity. It refers to the street typologies from *Designing Walkable Urban Thoroughfares.*

Institute of Transportation Engineers' *Designing Walkable Urban Thoroughfares*

Designing Walkable Urban Thoroughfares provides guidance for context-sensitive corridor planning for transportation networks incorporating all modes (Institute of Transportation Engineers, 2010). *Designing Walkable Urban Thoroughfares* defines a thoroughfare as "facilities commonly designated by the conventional functional classifications of arterials and collectors"; this definition excludes freeways, expressways, and local streets.

Designing Walkable Urban Thoroughfares reflects the fact that a vehicle-oriented thoroughfare may need to adopt some characteristics of more walkable thoroughfares in order to meet the transportation needs of the community it passes through as well as the greater region. When a road traverses a developed community, it may not be possible to maintain all design elements that give priority to through traffic, such as a high target speed and minimal stoppages. Instead, aspects of walkable thoroughfares such as lower target speeds, crosswalks, and smaller block lengths may appear within concentrated nodes of development while the corridor retains a more auto-oriented nature elsewhere.

Designing Walkable Urban Thoroughfares places an emphasis on the creation of fine-grained local street networks in order to balance the demand for regional mobility with the need for local access. These conventional street networks function with smaller blocks, higher connectivity, and direct access and allow local traffic to make short trips without using regional thoroughfares. Communities' long-range comprehensive and transportation plans should guide the development of such networks. The development patterns and land use designations should also be supported by the design, capacity, and density of the transportation network. *Designing Walkable Urban Thoroughfares* emphasizes balance: although all required regulations must be followed, decisions should also be made in a context-sensitive manner.

Designing Walkable Urban Thoroughfares contains specific, detailed guidelines for various transportation scenarios on topics such as building design, the road design process, right-of-way parameters, quality of a main street, intersections, signage, and alternatives analysis. Design features such as lane width, median type, sidewalk width, and landscaping elements can be adjusted to find compromise between the needs of the community and those of the region. In 2015, FHWA proposed to increase flexibility in geometric design for several controlling criteria that apply to the National Highway System, reinforcing this perspective (FHWA, 2015b).

Like Virginia's *Multimodal System Design Guidelines*, *Designing Walkable Urban Thoroughfares* relied on the transect to guide the decision-making process in corridor planning. Context is highly relevant and guides decision makers toward the best possible thoroughfare design. The guidebook also noted that its recommendations can help communities implement "complete streets" policies along urban thoroughfares. Such policies require, at a minimum, consideration of accommodations for people walking, biking, and taking transit, and Virginia's Policy for Integrating Bicycle and Pedestrian Accommodations (VDOT, 2004) is an example of one.

Summaries of Four Case Studies

Four case studies that exemplify successful incorporation of planning solutions to address the main street / highway conflict are summarized here. The cases and their thoroughfares demonstrate a wide variety of issues, transportation modes, traffic volumes, and solutions. However, a common thread is the underlying theme of interagency coordination and public participation beyond minimum requirements. In addition, all of the case studies describe various steps in the creation of a multifaceted solution that resolves the problems.

With one Virginia exception, the case studies reflect states that are unlike Virginia in terms of state-level highway ownership and management. In Virginia, VDOT is responsible for all roads except for those in cities, certain independent towns, and two counties; many other state DOTs are responsible only for interstates and major regional thoroughfares, with county transportation departments handling lower order facilities. Although this distinction may affect the applicability of the case studies, the type of road that is of interest in this study is one that would still be under state control in most states.

New Hampshire Land Use Changes to Support Transportation

New Hampshire completed a study of its Route 16 corridor in the late 1990s after much of the corridor had begun to have issues with safety and congestion. The study made recommendations on access management, bicycle and pedestrian infrastructure, and improved development patterns (Rockingham Planning Commission and Herr & James Associates, 1998). The results of the study succeeded in influencing subsequent community studies and locally administered projects.

Route 16 is the primary highway used to connect Portsmouth to several communities in New Hampshire and Maine along New Hampshire's eastern border (Figure 6). From Portsmouth, it runs north for about 30 miles as a controlled access toll road, but from the end of the toll road it runs for more than 100 miles as primarily a two-lane at-grade highway with a few four-lane undivided segments. Average daily traffic ranged from below 3,000 on the northern end of the corridor to around 14,000 near Conway (State of New Hampshire, 2016).

Figure 6. Aerial Image of Route 16 Corridor in New Hampshire (from Errol in the north to Portsmouth in the south). Map data ©2015 Google.

After numerous concerns were raised about development, safety, congestion, and loss of the highway's scenic qualities, the New Hampshire DOT determined that the issues along the route were directly related to surrounding land use patterns. According to the manager of the Route 16 study, several projects of a local nature were completed through the Lakes Region Planning Commission and came about because of the corridor study (A. Sanborn, personal communication, April 13, 2015).

Cooperation with local communities was key to the study's success. Michaelson et al. (2008) in a collection of case studies of successful corridor planning projects quoted Sanborn as follows: "Once the DOT assumed the role of partner rather than expert, the truly innovative solutions of the study began to emerge." One element of this partnership was that educational pamphlets and videos on access management were created for distribution to localities and to the divisions of the New Hampshire DOT.

The project altered the nature of transportation planning in the New Hampshire DOT. A memorandum of understanding formalizing cooperation between localities and the New Hampshire DOT in access management and planning was established in 2002 as a result of the study. Land use regulations and zoning were instituted that encouraged development in nodes or activity centers. The study's planned improvements to the highway included limiting and predefining access points and developing accommodations for people walking and bicycling.

One example of increased interagency cooperation resulting from this corridor study was a pamphlet developed by a regional planning agency with strategies for how best to integrate land use and transportation (Strafford Regional Planning Commission, 2003). It addresses nodal development/zoning; livable, walkable communities; and access management, and it outlines several major steps to integrating land use and transportation planning, as was done in the Route 16 study. These include adding a transportation section to the town's master plan, asking the right questions during site plan/subdivision plan review, and enacting local driveway access regulations beyond the minimum requirements of the New Hampshire DOT.

New Jersey: Integrated Transportation and Land Use Planning

New Jersey Route 31 connects New York and Philadelphia and serves many bedroom communities in between. For years, to address high levels of congestion, a bypass of the borough of Flemington in Hunterdon County was planned. The borough is equidistant from the two major metropolitan areas. When the bypass concept was abandoned because of environmental concerns, the local planning departments and NJDOT worked together on a land use and transportation plan for the corridor. Completed in 2008, it was one of NJDOT's (2008) first integrated land use and transportation plans.

Congestion along Route 31, used by commuters from Flemington to New York and Philadelphia, was present for decades, with Flemington Circle being a key hot spot (Figure 7). This large one-way oval serves as the intersection of U.S. 202 and Routes 12 and 31, which merges with U.S. 202 on the southwest edge of the circle. North of the circle, Route 31 has four lanes plus a center turning lane but transitions into a two-lane road passing under a railroad bridge where the annual average daily traffic (AADT) was approximately 29,400 in 2012. U.S. 202 northeast of the circle is a four-lane median-divided highway with a 2011 AADT of approximately 28,800; to the west, Route 12 is a lower speed four-lane median-divided street with a 2013 AADT of approximately 10,900 (State of New Jersey, 2014).

Figure 7. Aerial Image of State Route 31 Through Flemington, New Jersey. Imagery ©2015 Google, map data ©2015 Google.

The Flemington bypass received federal funding through NJDOT before it was halted because of inconsistencies with smart growth principles implemented by the state. The project had included additional lane-miles and grade-separated interchanges that, after being studied, appeared to trigger additional growth that would nullify the intended congestion relief from the added roadway capacity. In addition, the cost of the project was found to be prohibitively high when compared to state highway funds available for improvements in the area. Concerns were also raised about the economic impacts it would have on the Flemington business community.

The ensuing integrated land use and transportation plan included not only roadway solutions but also an economic analysis and land use recommendations (NJDOT, 2008). The plan's key recommendations consisted of a series of roadway changes in the local street network, an at-grade parkway, the detangling of Flemington Circle, zoning code changes, and an open space system of trails and greenways to act as linkages between cultural and historic resources in the area.

Information on implementation of the plan was obtained through an interview with Charles Henry, Project Manager with the NJDOT Office of Project Management. As of April 2015, construction of the Flemington Circle reconfiguration was scheduled to begin by December 2015. A reorganization of departments within NJDOT resulted in a change in focus for the office formerly responsible for integrated land use and transportation planning, which shifted away from corridor-level planning linked to local planning efforts and toward maintaining and enhancing existing roadway and bridge infrastructure. As a result, a project to address congestion hot spots on Route 31 north of Flemington Circle is proceeding, whereas elements of the integrated land use and transportation plan—such as changes to the local street network and the creation of an at-grade parkway—are not fully funded.

Despite these implementation challenges and the lack of evaluative data for the Route 31 Integrated Land Use and Transportation Plan, the plan's section on lessons learned stated that the new approach used to develop it was a success, attributable in large part to the process being inclusive of key participants (NJDOT, 2008). A PlanWorks case study of the plan also deemed it a success because of its state and local champions, its flexible process that was adapted to meet needs and address issues as they arose, the use of state funding for local planning efforts, and the plan's inclusion of a fiscal impact analysis and quick visualizations of design alternatives (ICF International, n.d.).

Illinois: Corridor Segmentation and Public Participation

U.S. 51 Business passes through the adjacent Illinois municipalities of Bloomington and Normal (Figure 8). Despite its business designation and the parallel freeway, it is used by both local and regional traffic. Local leaders were becoming concerned about the safety of pedestrians and bicyclists, and the Illinois DOT (IDOT) had growing concerns about congestion. Division of the corridor into smaller segments and public participation were critical elements in formulating a highly detailed plan to meet the needs of the localities and IDOT.

In March 2012, the *Main Street Transportation Improvement Feasibility Study: Bloomington-Normal, Illinois* was completed (Gewalt Hamilton Associates et al., 2012). The study looked at the U.S. 51 Business corridor and used a number of practices in its analyses including effective public participation in the form of committees; technical advising; community feedback tools, both online and in person; and interviews of key stakeholders. The study also adhered to principles of context-sensitive solutions.

Information on the study was obtained through an interview with Mercy Davidson, Town Planner with the Town of Normal. A key practice used in the Bloomington-Normal study was the segmentation of the study corridor into manageable pieces. Just as Virginia's major highway corridors vary in land use context throughout their length, these study areas also differed on a small scale, with segment lengths ranging from under 1 mile to almost 3 miles. The U.S. 51 segments used had varying traffic volumes (see Table 1), varying right-of-way features, and a varying number of travel lanes.

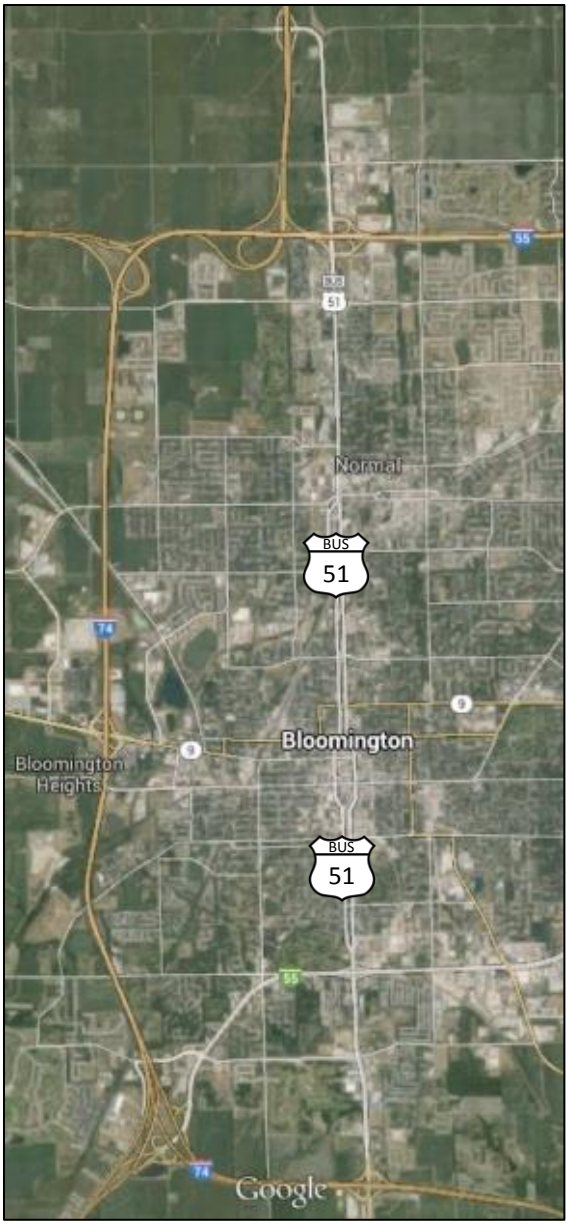

Figure 8. Aerial Image of U.S. 51 Business Through Bloomington and Normal, Illinois. Imagery ©2015 Google, map data ©2015 Google.

Table 1. Corridor Segmentation as Performed in Bloomington-Normal, Illinois

Segment	Direction	AADT Range[a]	Distance (mi)
1	Both	3,500-8,900	1.7
2	Both	13,800-26,500	1.9
3	Southbound[b]	11,400-15,200	1.9
3	Northbound[b]	11,700-15,000	1.9
4	Southbound[b]	10,800-14,800	0.8
4	Northbound[b]	10,900-12,500	0.8
5	Southbound[b]	10,200-10,800	2.5
5	Northbound[b]	9,500-12,000	2.5

[a]Annual average daily traffic data from IDOT (n.d.).
[b]Segments 3, 4, and 5 operate as one-way pairs.

Dividing the study area into smaller segments of varying lengths by context created a less overwhelming atmosphere for suggestions and improvements. This allowed for more attention to detail and more accurate engineering analyses, and it reflected the land use context surrounding each portion of the roadway. It was determined that the segmentation would best be done by local staff rather than IDOT because of the locals' knowledge of and experience with the corridor and surrounding land uses.

After public input was received, alternatives were created and analyzed through traffic simulation to determine the most feasible design for each segment. Those feasible alternatives were then presented to the public and stakeholders. The division of the roadway into smaller segments emphasized that there is no one-size-fits-all solution for the main street / highway conflict.

Virginia: Arterial Management Plans

Based on a concept used in the 1980s known as functional plans, VDOT recently began developing arterial management plans (AMPs) to address arterial corridors with considerable development pressures. The goals of the AMP program include supporting local land development objectives and economic development, preserving mobility and safety, and maximizing transportation efficiency while minimizing the public investment required (Shelton, 2015). Part of the rationale for creating AMPs was to respond to the CTB's direction regarding studies on CoSS (Baker and Kimley-Horn, 2015).

The first pilot AMP was adopted in August 2015 for a section of Goochland County near the Short Pump area of metropolitan Richmond. U.S. 250 between State Route 623 and the Henrico County line (Figure 9), a four- to six-lane median-divided highway, and Route 623 from U.S. 250 to I-64, a two-lane roadway, were having rapid development that was likely to degrade traffic operations and worsen safety issues. VDOT created the AMP with the input of the community and stakeholders including local staff and elected officials to address access management issues and the needs of business owners.

The AMP included 10 intersections along the two roads in the context of four planned developments to the east in Henrico County that, combined, were anticipated to add more than 20,000 daily vehicle trips by 2018 to the 29,200 trips already occurring daily on U.S. 250. Traffic data including turning movement counts, traffic volumes, 85th percentile speeds, and crashes were combined with field observations of current traffic issues and an inventory of existing access points and compared with improvements already planned.

The project also used community feedback in the form of stakeholder interviews, questionnaires, and public meetings to formulate transportation solutions in conjunction with current land uses and future land use scenarios. "Minimally" and "optimally" managed access scenarios were analyzed, with the optimally managed scenario having an additional traffic signal and 26% fewer total access points. The two scenarios performed similarly in terms of travel time, whereas the optimally managed scenario had a 40% reduction in the number of conflict points, suggesting possible safety benefits.

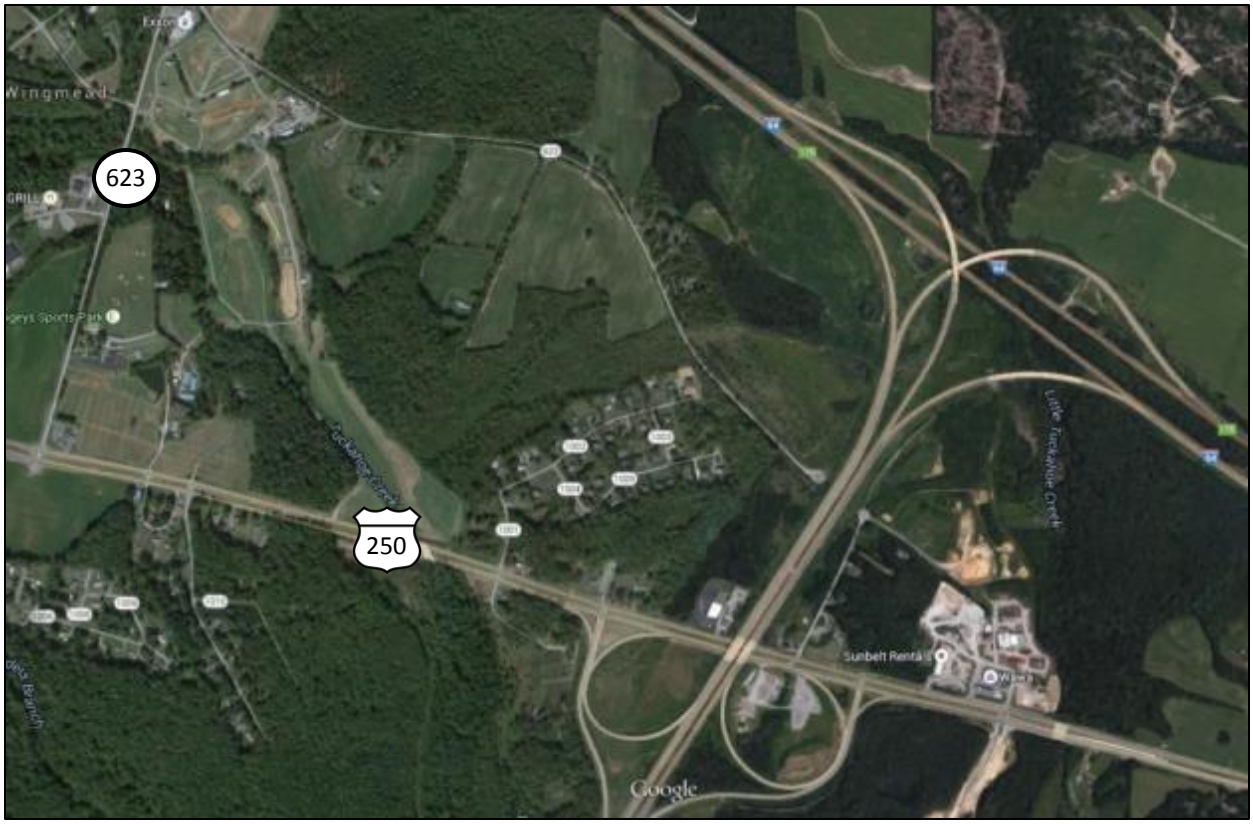

Figure 9. Aerial Image of U.S. 250 and State Route 623 West of Short Pump, Virginia. Imagery ©2015 Google, map data ©2015 Google.

The AMP's recommendations covered mobility (e.g., widening of nearby roads to provide a supportive street network, providing connections to facilitate internal circulation); policy (e.g., access management); bicycle and pedestrian accommodations (e.g., multiuse paths to be built as sites were developed); and travel demand management (e.g., park-and-ride lot development and planning for transit service). Goochland County incorporated the study's recommendations into its comprehensive plan in fall 2015 (Goochland County, 2015).

Maine: Zoning for Activity Centers of Varying Intensity

The Town of York, Maine, is located 60 miles north of Boston and is traversed by two parallel north-south thoroughfares: I-95 and U.S. 1 (Figure 10). Although the two routes run parallel through the town for 9.5 miles, Route 1 offers a toll free alternative to I-95 and thus handles a high volume of regional and truck traffic as well as local trips. The Town of York used zoning strategies to protect existing neighborhoods and address a growing pattern of linear development to preserve mobility along Route 1.

In 2013, the AADT on Route 1 ranged from approximately 9,000 to 20,000 (State of Maine, 2014). It is primarily a four-lane undivided facility south of the Cape Neddick area and a two-lane facility to the north. A large portion of Route 1 through the town is designated a Mobility Corridor by the Maine DOT, which indicates that the roadway serves as a connecting route between urban centers (Town of York Planning Department, 2005).

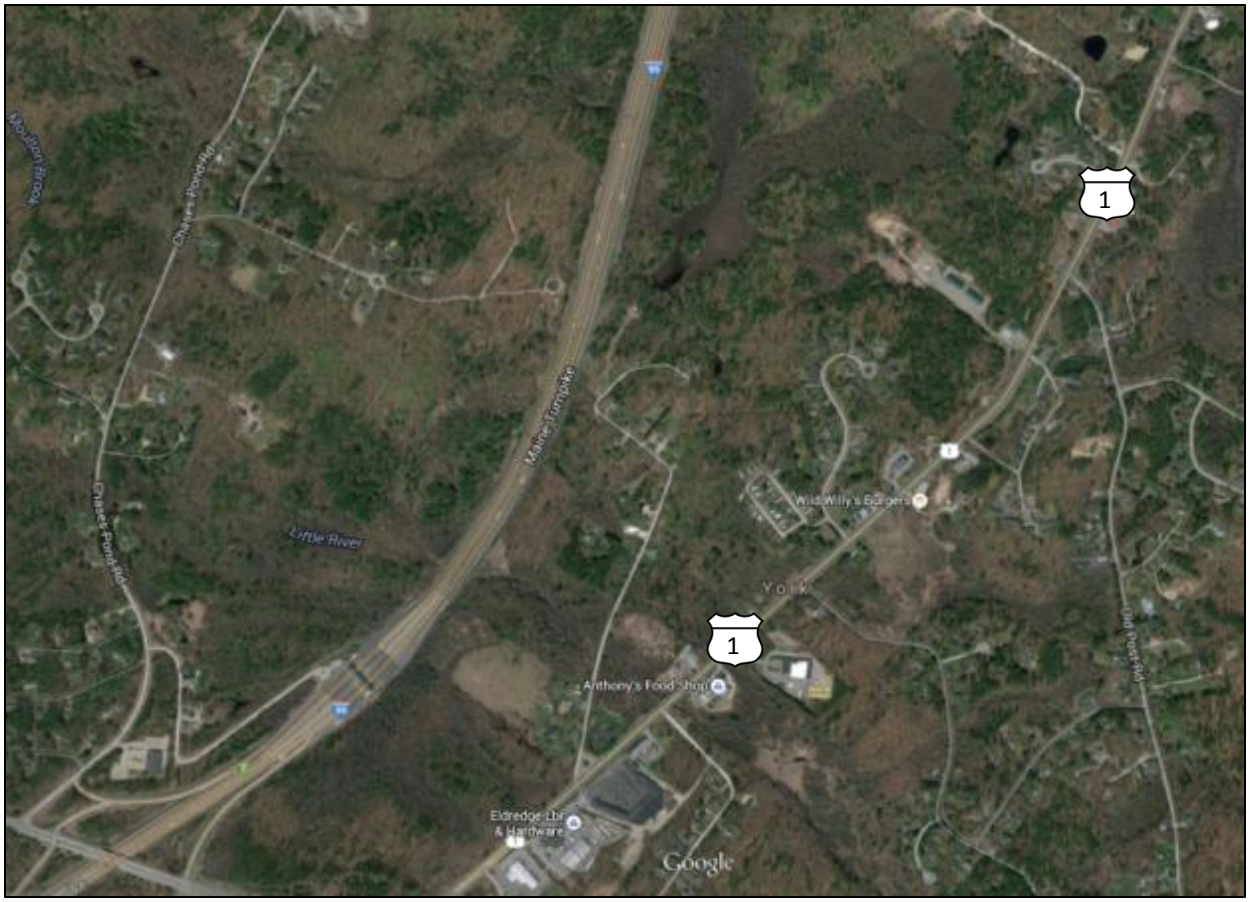

Figure 10. Aerial Image of U.S. 1 Through York, Maine. Imagery ©2015 Google, map data ©2015 Google.

The New Hampshire DOT performed a study of practices in other states, one of which was Maine, and York was included as an example of a zoning district designed to direct higher intensity business uses to areas of a corridor able to accommodate them (e.g., having adequate turn lanes or available capacity) and to designate other areas of the corridor for lower intensity business uses (Rockingham Planning Commission and Herr & James Associates, 1998). That study termed this approach "multi-intensity zoning."

Before the zoning change, a linear pattern of commercial development had occurred along the corridor. The town adopted a zoning ordinance in 1982 that established three districts along the corridor to create hubs of varying intensity along Route 1.

The town's ordinance was updated in 1996 from three districts to six districts, and the standards of use and dimension were adjusted in order to continue developing a specific character and purpose in each district. The town hoped to maintain existing conditions along less developed, environmentally sensitive, and historic parts of the corridor. One ancillary benefit of such a zoning approach could be to preserve the mobility function of a highway by guiding development to hubs or nodes rather than have development occurring all along the corridor.

CONCLUSIONS

- *There are at least six candidate planning solutions for solving the main street / highway conflict.* They are not mutually exclusive and, in practice, can be considered in any effort aimed at addressing this conflict. If success is defined as a solution that is feasible to implement in a relatively short period of time and that at least partially addresses mobility concerns and issues of local context, these candidate planning solutions leading to success include the following:

  — *The process allows for compromise.* A successful planning process for managing the main street / highway conflict may result in a corridor that is not ideal for either statewide mobility or local access but improves conditions for both. A process can facilitate implementation by making room for compromise.

  — *Planning and zoning decisions made by localities contribute to the solution.* Such decisions are often seen as the source of conflict, but three key elements of success are evident based on the New Jersey and Illinois case studies: (1) direct discussions between entities with land use responsibility and entities with transportation responsibility; (2) explicit consideration of future land use effects and future transportation effects; and (3) segmentation of the problem into manageable chunks to avoid an overlarge project scope.

  — *State DOTs work together with local jurisdictions.* Cooperation and coordination are needed early and often, whether planning a road widening or reviewing a local comprehensive plan.

  — *Context is considered.* Physical, community, environmental, political, and other characteristics can influence what methods and solutions are appropriate.

  — *Public participation is done intentionally rather than merely to satisfy a requirement.* Context determines which public engagement methods are appropriate, but it is hard to achieve consensus on decisions made without regard to factors such as opinions from the public.

  — *The process shows how engineering solutions can address concerns.* Whether evaluating unconventional intersection designs or access management scenarios, sharing clear indicators on outcomes can help decision makers and the public choose wisely.

- *The case studies demonstrate that each of the six planning solutions has been applied at least once.* Compromise was evident in all case studies, and its degree can change over time (e.g., before the NJDOT was restructured, through mobility was emphasized less; after the restructuring, elements of the plan addressing local concerns were not fully funded). Consideration of local planning and zoning decisions contributed to the solution in New Jersey. State DOTs worked with local jurisdictions in all case studies; context was especially important in Maine and New Hampshire; and public participation was a key element of the Illinois approach. Illinois and Virginia provided examples of processes that showed stakeholders how engineering solutions could address issues.

RECOMMENDATIONS

1. *VDOT's Transportation and Mobility Planning Division (TMPD) in coordination with VDOT's Office of Land Use should consider how implementing the results of this study could enhance the process for developing AMPs.* The AMP process evolved in parallel with this study, and many of the study topics are already reflected in the process. Incorporating additional information from this study (e.g., organizing facilitated stakeholder meetings or using context-sensitive urban thoroughfare design) into the AMP process could allow the process to serve as VDOT's default method for addressing conflicts that arise with regard to major regional thoroughfares that also function as main streets.

2. *VDOT's TMPD should provide the knowledge and resources so VDOT planners working with major regional thoroughfares are familiar with the relevant design manuals, treatments, and concepts discussed in this report.* This would include context-sensitive urban thoroughfare design as outlined in Virginia's *Multimodal System Design Guidelines* and the Institute of Traffic Engineers' *Designing Walkable Urban Thoroughfares* and unconventional intersection designs. Planners, especially those new to corridor planning, could benefit from consulting FHWA's PlanWorks resource.

3. *VDOT's TMPD should work with VDOT district planning staff to ensure that a process is in place that incorporates interagency coordination and public participation in the early stages of highway projects in areas facing the main street / highway conflict.* The conflicting roles of these major thoroughfares make it advisable to consider stakeholder engagement efforts that are beyond the minimum requirements for typical highway projects. This recommendation is likely to be satisfied if the AMP process is used, especially if it is enhanced as noted in Recommendation 1, so the recommendation may be applicable only if and when projects occur on these thoroughfares where that process has not been conducted.

BENEFITS AND IMPLEMENTATION

Benefits

The main benefit of implementing the three study recommendations would be that guidance requested by some of VDOT's district planners would be provided. This guidance would help them consider ways to address the main street / highway conflict.

Application of some of the tools and approaches discussed in this report would benefit VDOT and Virginia by preserving capacity along major thoroughfares of state and regional importance, possibly avoiding costly widening projects. It could also benefit local communities by addressing their concerns regarding traffic flow, business access and vitality, bicycle and pedestrian accommodations, and livability. Innovative intersection designs are typically much less expensive than traditional grade-separated solutions and offer mobility and safety benefits compared to full-movement signalized intersections. Other benefits could include improved relationships between local governments and VDOT and improved conditions for freight.

Recommendation 2 suggests that VDOT planners become familiar with certain resources that can help address this conflict. One possible benefit of this would be increased in-house capabilities and a reduced need to expend funds for outside consultants. A balancing factor, however, could be that a more robust process for stakeholder engagement and public participation (as presented in Recommendation 3) might require additional resources such as outside consultants.

Implementation

Recommendation 1 will be implemented by the TMPD's Assistant Division Administrator of Performance Based and Conceptual Planning in coordination with the Office of Land Use's Access Management and Traffic Impact Analysis Programs Manager, who will consider whether any of the information in this report merits inclusion in the AMP process as that process continues to be refined. This will be completed by June 2017 unless related items are delayed that are currently scheduled to be presented to the CTB in April.

Recommendation 2 will be implemented through VDOT's joint planning managers meetings. TMPD's Assistant Division Administrator of Performance Based and Conceptual Planning will work with the district planning managers to define training needs and set up training sessions. This will be completed by June 2017 in concert with arranging training for a related effort (the Alternative Intersection Evaluation Tool).

Recommendation 3 will be implemented by TMPD's Assistant Division Administrator of Performance Based and Conceptual Planning in coordination with the district planning managers. Workshops about interagency coordination and public participation could be developed for planners and engineers by TMPD in collaboration with the Office of Land Use. The Transportation Training Academy at the University of Virginia's Center for Transportation Studies offers training workshops throughout Virginia, and topics have included unconventional interchange and intersection design; another potential venue is the biennial VDOT Coordinating Transportation and Land Use Planning Forum. Similar training opportunities could also be extended to VDOT's district transportation and land use directors and VDOT's area land use engineers. This will be completed in Fall 2017.

As this study was concluding, TMPD began drafting a corridor preservation strategy in response to a question from the CTB about the degrading mobility function of major regional and statewide thoroughfares from ongoing land development and additional traffic signals. That process occurred in parallel to this study (and, to be clear, not in response to it), but both address the topic of such thoroughfares becoming local "main streets" in localities experiencing growth. Both recognize that economic development interests, including the addition of access points and new traffic signals, require appropriate examination and must be balanced with statewide interests in preserving the corridors' mobility function. The corridor preservation strategy is expected to be presented to the CTB in April 2017, and should it be adopted, it is possible that it will serve to implement some elements of this study.

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