U.S. Department of Transportation
Federal Highway Administration

PlanWorks Case Study

Route 29 Corridor Assessment, Campbell County

Virginia Department of Transportation

PlanWorks is a web resource that supports collaborative decision-making in transportation planning and project development. PlanWorks is built around key decision points in long-range planning, programming, corridor planning, and environmental review. PlanWorks suggests when and how to engage cross-disciplinary partners and stakeholder groups.

Transportation decision-making phase(s): Corridor Planning

Executive Summary

Route 29 (Wards Road) in Campbell County, Virginia is a 6.6 mile corridor serving two sets of users: through travelers who value the corridor's contribution to statewide mobility and the business community which values local access. The corridor has been well examined, with five separate studies conducted during the past two decades, however, a lack of funds for major capacity investments has forced the community to look toward lower-cost solutions, such as establishment of a transportation corridor overlay district and consolidation of access points—but such solutions have not been identified, in a detailed manner, on a systematic basis. The single-most greatest **challenge,** therefore, has been the lack of an authorizing environment in which to make progress toward improving this corridor which functions as both a VDOT route of statewide significance and a local main street. A key **outcome** includes the development of a $19.43 million set of improvements that collectively improve local vehicular access (e.g., the addition of turn lanes), local nonmotorized access (e.g., construction of a shared use path), and through mobility (e.g., the closure of medians). This outcome is supported by a public involvement process (supported by the local Board of Supervisors [BOS]) that demonstrated interest in specific corridor-preservation techniques and the preparation of these projects for candidate funding sources available in Virginia: Smart Scale, the Highway Safety Improvement Program, and the MPO's Constrained Long Range Plan.

Project Snapshot

- A 6.6 mile corridor with ADT equal to about 20,376 (2015) and 365 crashes over a 5 year period (2011-2015).
- The corridor is on Virginia's Corridors of Statewide Significance (COSS), emphasizing its mobility function
- Yet, users must increase expected commuting time by about 45% if they cannot afford to be late more than twice per month.
- The corridor is the site of the county's 2006 Transportation Corridor Overlay District.
- The corridor has been studied several times outside the traditional planning process: 1997, 2003, 2005, 2009, and 2011.
- Funds for large scale capacity improvements are not available: a 2016 planning-level cost estimate for a bypass is $100 million.
- A new programming environment in Virginia (Smart Scale) emphasizes cost-effective projects, where benefits must be quantified as much as possible.
- County BOS strongly emphasized the need for an open process allowing all to participate.

SHRP2 SOLUTIONS

Agency's Challenge

The challenge VDOT faced when seeking this PlanWorks grant was how to identify specific projects that both (1) generated local support and (2) could be built with available financial resources. This challenge was exacerbated by the fact that Wards Road (Route 29) in Campbell County supports two distinct purposes: *local economic development* (as this area includes Lynchburg Regional Airport, an expanding Liberty University, and significant growth in commercial establishments) and *statewide mobility* (as US-29 is a major north-south connection providing passenger and freight service for Virginia and a designated corridor of statewide significance). The need to *improve institutional decision-making when a corridor serves both mobility and access* has been documented in Virginia (Ohlms and Roy, 2016).

For this corridor, the role of local support and the limits of financial resources are clear, based on 20 years of studies: a phase 1 statewide study (1997), a phase 2 and 3 statewide study (2003), the development of a corridor overlay district in Campbell County (2005), a statewide blueprint (2009), a roadway safety audit (2010/2011), and inclusion within comprehensive plans. The aforementioned 2003 study clearly articulates the need to both reduce the number of future access points and to secure funding for improvements in an era of scarce fiscal resources, concluding that, given that the competitive nature of transportation funding in Virginia, even with innovative financing techniques such as a retail sales tax dedicated to transportation, there exists a "need to change the priority of this project in the context of overall Commonwealth transportation projects." (VDOT, 2003). (For example, that report suggested that a retail sales tax for the *100+mile corridor* [e.g., not just Campbell County and the adjacent City of Lynchburg, but from the city of Charlottesville to the north to Danville in the south]—could generate approximately $327 million [in year 2000 dollars] over a 20 year period [about $361 million in 2016 dollars in terms of purchasing power for highway construction based on construction cost indices available for that period (FHWA, 2015, 2016)]. A 2016 planning cost estimate is that a bypass in this *county alone* would cost approximately $100 million—easily dwarfing the $26 million primary allocation for the *entire ten-county Lynchburg District* in 2004.) The corridor history also highlights the need for the generation of local support: an addendum to the 2009 statewide blueprint stated that a professional facilitator should be enlisted to build a constituency for improvements, explaining that "Local officials can collaborate with other stakeholders and one another in facilitated workshops and/or charrettes to compare interests, explore alternatives and extend corridor visions." (VDOT, 2011). Thus, a challenge faced at the beginning of this process was the *integration of sought-after needs for the corridor with local and statewide planning processes*.

The previous planning efforts do not suggest intense disagreement over the benefit of improving the corridor, and this lack of disagreement provides an important context for better understanding how these challenges—the need for local support, the corridor having multiple purposes, and funding limits—underscore what now appears to be an overarching need for getting a project unstuck: solution specificity. That is, a summary of studies of the Route 29 Corridor developed by AECOM (2016) underscores *the need for specific solutions to get a project unstuck*. For example, in an evaluation of the 2009 Route 29 Corridor Study, AECOM notes that a strength of the study is that its recommendation to close and consolidate crossovers can help enact "access management principles" and improve safety. However, AECOM (2016) also noted that a weakness of the study was that some crossovers provided "essential access" to trip generators in the corridor, necessitating a more detailed evaluation of each particular crossover to determine its impact on crash risk and local access. **It is this need for specific solutions that PlanWorks sought to address.**

Product Implementation

The project team (Campbell County, Region 2000, VDOT Lynchburg District, UVA's Institute for Environmental Negotiation, AECOM, FHWA Virginia Division, and VTRC) applied the PlanWorks corridor planning process to develop corridor preservation and access management projects that can be funded through a variety of mechanisms.

Corridor Planning Decision Guide

The decision guide influenced the manner in which tasks were undertaken. Table 1 shows the decisions that resulted from the application of each PlanWorks module and actions taken to achieve each decision.

For example, consider COR-1, where the PlanWorks decision point is to agree on the scope of the planning process. For that particular module, two outcomes were particularly relevant as shown in the middle column of Table 1: members of the public should be able to directly influence the process (which led to not using a technical advisory committee but rather having multiple public meetings) and the process should focus on shorter term projects that can be implemented, as funds for large-scale capacity expansion projects, such as a bypass, are not available. The right column of Table 1 shows the actions taken to implement COR-1, which included a December 2015 meeting with two supervisors (in whose districts the corridor exists) and a subsequent January 2016 meeting where members of the public were introduced to the corridor planning process (see Figure 1).

Implementation Summary

Decision Guide: While all 9 COR-modules were used, key decision points included *COR-2*, *COR-3*, *COR-5*, *COR-7*, and *COR-9*.

Assessments: (For the general public), a single assessment was conducted based on questions from partner collaboration and stakeholder collaboration.

Application: *Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes.*

Library: SHRP2's *Incorporating Travel Time Reliability into the HCM* and *Performance Measurement Framework for Highway Capacity Decision-Making*.

The team's experience with applying the decision guide was that several of the modules are iterative. Generally the team found that COR-1 and COR-2 (scope, problem statements, and opportunities) could be performed in tandem, that COR-3 through COR-5 (goals and performance measures) needed to be performed multiple times such that the results of COR-5 [measures] modified COR-3 [goals], and that COR-7 through COR-9 (blended solution set and prioritization of projects) needed to be performed in tandem. In particular, COR-6 requires substantial effort as a stand-alone item as it is the first instance where attendees begin to see a direct outcome of their participation.

Figure 1. Attendees listen to presentations (left) and offer solutions (middle); corridor map (right)

Table 1. Summary of Decision Points from the PlanWorks Corridor Planning Process

COR	Decisions Resulting from Application of PlanWorks	Actions
1	*Approve Scope of Corridor Planning Process* • Every landowner needs to be invited to every meeting. Avoid a technical advisory committee—rather, let participants directly influence the process. • The geographical scope of the planning process is the Route 29 Corridor within Campbell County from the City of Lynchburg (Route 29/640 interchange) to Route 24 (the MPO boundary), and the focus is on projects that can be implemented fairly soon.	• *Met* with Campbell County BOS members and Director of Economic Development (**December 2016**). • First public meeting **January 2016** (42 participants and 71 comments shown on the Website.) • *Specific deficiencies and opportunities* are identified at the public meeting where attendees are given large (6 foot by 6 foot) maps of the corridor and asked to draw comments directly on the maps. • *Deficiencies are categorized by goal and made available to the public via an* interactive GIS-based web site. For example, public comment 37 states that a 60 mph speed limit is "murderous" at a particular location. (The website is most easily found by searching for "Route 29 Corridor Assessment, Campbell County.")
2	*Approve Problem Statements and Opportunities* • Deficiencies include congestion, safety, and especially a cumbersome development review process. • Opportunities include simplifying the land development review process, improving transportation operations in this corridor, and educating the public on how the corridor overlay district applies.	
3	*Approve Goals of the Corridor* • Four goals are initially established relating to safety, effectiveness, the environment, and transportation/land use coordination.	• *Additional stakeholders are interviewed such as* residential property owners, large employers, a regional airport, transit provider, and a homeowners association representative. • *Based on the interviews and public comments, 4 goals* for the corridor are established—and then matched to specific performance measures, such that a total of 23 performance measures are identified. • *Data* for performance measures are determined.
4	*Reach Consensus on Scope* • Tentative performance measures are proposed for each goal. For example, land use coordination can be related to intersection delay based on 2040 projected volumes.	
5	*Approve evaluation criteria, methods, and measures* • Number of goals is reduced from 4 to 3, and number of performance measures is reduced from 23 to 13. • Two promising ways of determining reliability are observed: travel time reliability index [TTRI] (for recurring congestion) and crash risk (for non-recurring congestion)	• Attendees identify specific solutions at second public meeting in **June 2016 (53 comments).** • Stakeholder assessment shows that more effort needs to be devoted to explaining the process at future meetings; hence flowchart is developed. • The travel time reliability index (TTRI) in the corridor is determined.
6	*Approve range of solution sets* • Four candidate solution sets are identified, where each solution set identifies multiple projects. Each solution set has a particular theme: capacity, safety, economic development, and alternative modes supported by technology. • Number of performance measures is reduced from 13 to 4. Year 2040 conditions are used. TTRI, not crash risk alone, is chosen to measure impacts on reliability.	• Internal discussions suggest that additional constraints on how land is developed would likely generate opposition to this project, thus no modification is made to the Transportation Corridor Overlay District. • Candidate solution sets are presented at a third public meeting in **October 2016 (56 comments)**. Attendees break into small groups; each table has a team member present who can answer questions.

COR	Decisions Resulting from Application of PlanWorks	Actions
7	*Adopt preferred solution set* • Blended solution set includes roughly $19.43 million in proposed projects. Elements address safety (e.g., right in right outs), capacity (e.g., closing the median), business access (e.g., two-way left turn lane) and multiple modes (e.g., shared bicycle/pedestrian path) • Costs for each project elements in the blended set are estimated.	• Performance measures are computed for each solution set, where performance measures are Equivalent Property Damage Only (EPDO) of fatal and injury crashes expected to be reduced, mainline delay (2040 conditions), Travel Time Reliability Index, and movement delay (2040 conditions). • At the same public meeting, stakeholders are asked "which elements cause a concern? Which elements would you support?"
8	*Approve criteria for prioritization of projects* • Criteria are: (1) cost in 2016 dollars; (2) EPDO of fatal and injury crashes reduced; (3) impact on the travel time reliability index as computed from Smart Scale; (4) mainline delay; and (5) intersection delay based on 2040 conditions. • All projects will be pursued provided support remains as per COR-9, recognizing that some funding sources (e.g., the Highway Safety Improvement Program [HSIP]) may lead to construction sooner than other funding sources (e.g., the long range planning process).	• Details of projects are identified at the planning level such as cost, location, number of sites, and where possible, criteria used by funding sources to evaluate projects. Database provided by AECOM can be used as a starting point to prepare projects for submission. • Example: the projects from this corridor will compete with other projects throughout Virginia for funds made available under "Smart Scale." One such criterion is a Virginia-specific formula that is used to estimate how improvements will affect the travel time reliability index. Another criterion is the EPDO of crashes reduced. These criteria are computed for each project. • Draft memorandum prepared for the County to use as a basis for presenting these projects to the Board of Supervisors. • Project team members agree that the Campbell County Comprehensive Plan will be updated based on the results of this study.
9	*Adopt priorities for implementation* [a] • Pending the result of a presentation by the Campbell County Director of Economic Development to the County Board of Supervisors, the elements of the blended solution set will be pursued through three distinct funding sources: Virginia's Smart Scale, the development of the MPO Constrained Long Range Plan, and the Highway Safety Improvement Program.	

[a] This report is based on information current as of February 2017. It is possible that as the projects given in Table 3 and shown in Appendix C move through the transportation programming process, they will be revised

Corridor Planning Assessments

The team solicited questions **from two PlanWorks Assessments** (Partner Collaboration and Stakeholder Collaboration). The most pressing area is whether members of the public could follow the planning process for this corridor. Additionally, the assessment questions could help garner participant agreement on the goals, criteria, and performance measures—that is, to what extent does the material in PlanWorks COR-5, as implemented by the project team, resonate with attendees? The team modified the wording of these questions to make them suitable for the specific audience and the context of Campbell County. For example, we changed the PlanWorks "Neutral" category to "Neither Agree nor Disagree." As another example, we changed "I have been able to engage with others of similar interest throughout the process" to what is shown as the last question in Table 2: "At this meeting, I have been able to share my views with others."

Table 2. Result of the PlanWorks Stakeholder Assessment (June 2016)

Survey Question (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)	Score
The decision-making process is clear	2.9
The project goals are clearly stated.	3.0
The project goals (to promote a safe, efficient transportation system compatible with existing and future land uses) reflect my personal goals for the corridor.	3.1
The performance measures (for example, crashes per mile on the corridor) directly relate to the goals.	3.0
My input has been incorporated into the project performance measures.	3.0
At this meeting, I have been able to share my views with others.	3.3

The low score for clarity of the decision-making process suggested that at the next public meeting attendees should be provided with a single page handout that contains two pieces of information. (In retrospect, this score was not surprising given that some stakeholders at the second public meeting indicated they had missed the first public meeting.) The front of the handout should summarize the process used to generate candidate solutions—e.g., establishment of goals, performance measures, and candidate solutions based on limited funds. The back of the handout should summarize a few examples of how public input was incorporated directly into the solutions. That handout (Figure 2) was used at the third public meeting.

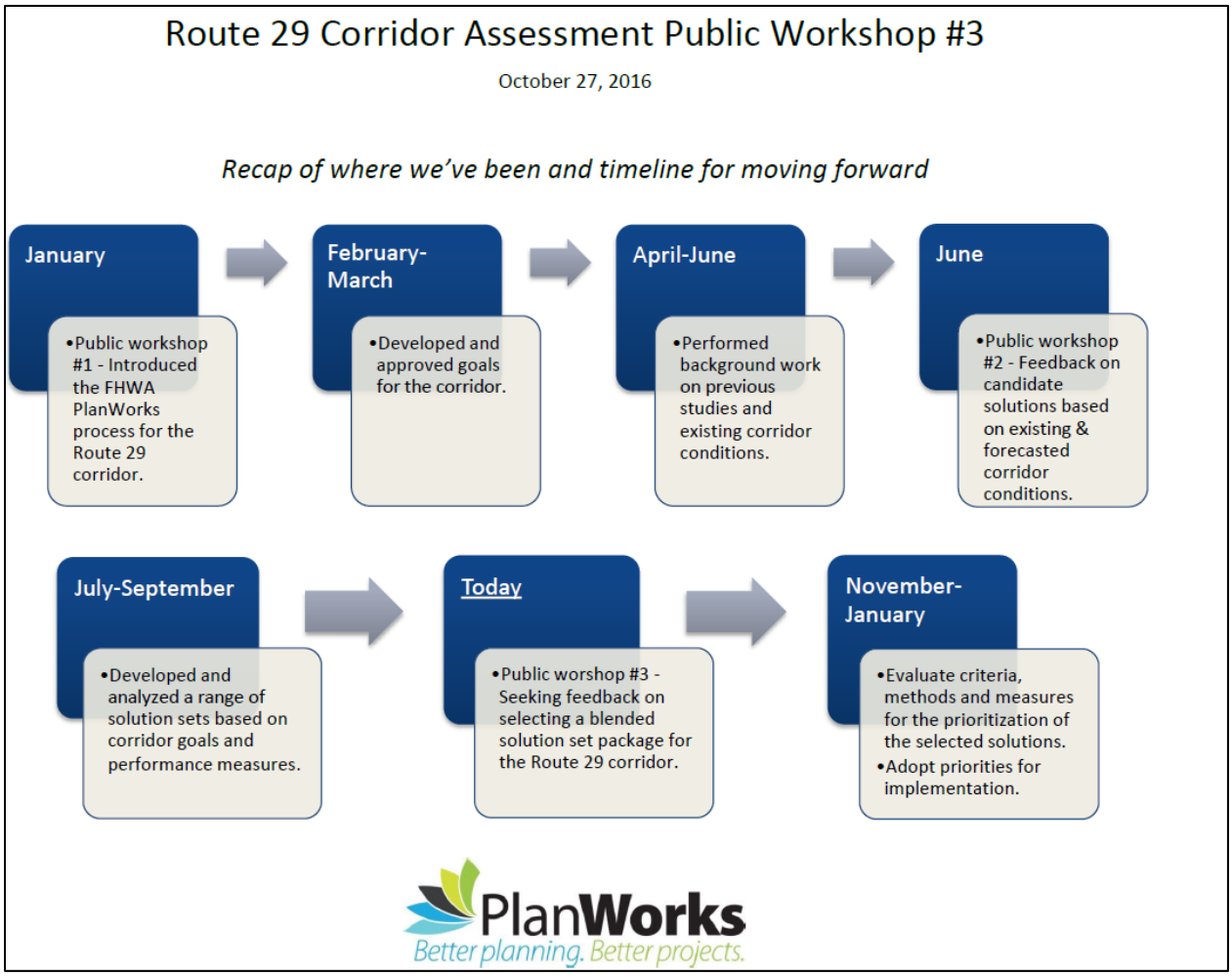

Figure 2. PlanWorks Handout Developed in Response to the Stakeholder Assessment

Integration of other SHRP2 Products and FHWA Initiatives

- The SHRP2 report titled *Incorporating Travel Time Reliability into the HCM* was actively used for this effort. Findings from that report, as applied to this corridor, are:
- **The buffer index is one promising way of assessing reliability.**
- For example, for a motorist traveling to work to avoid arriving late 90 percent of the time (that is during all but the *worst* peak period travel in a given month), the estimated **planning time index** indicated that, when traveling northbound in the morning peak hour or southbound in the evening peak hour, the expected travel time should be increased by a factor of 1.4 over the *free-flow travel time* (e.g., using the speed limit.)
- Another interpretation of the 90th percentile value in the planning time index is that assuming approximately 20 working days per month, the 1.4 multiplier should be used by *commuters who cannot afford to be late more than twice a month*.
- Further, the **buffer index** (90th percentile) shows that, if a commuter cannot afford to be late to work more than twice per month, he or she should presume that his or her *median* daily commute time will need to increase by roughly 25% and adjust his or her departure time accordingly. A characteristic of these two indices is that they can be dominated by recurring congestion.

The aforementioned report is accessible at: [http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L08-RW-1.pdf)](http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L08-RW-1.pdf)

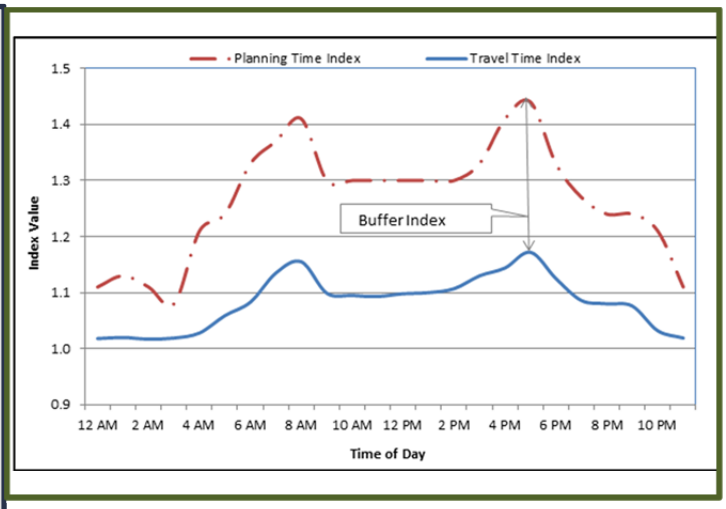

Figure 3. Planning Time Index, Travel Time Index, and Buffer Index for the Corridor. The planning time index is the 90th percentile travel time divided by the free flow travel time.

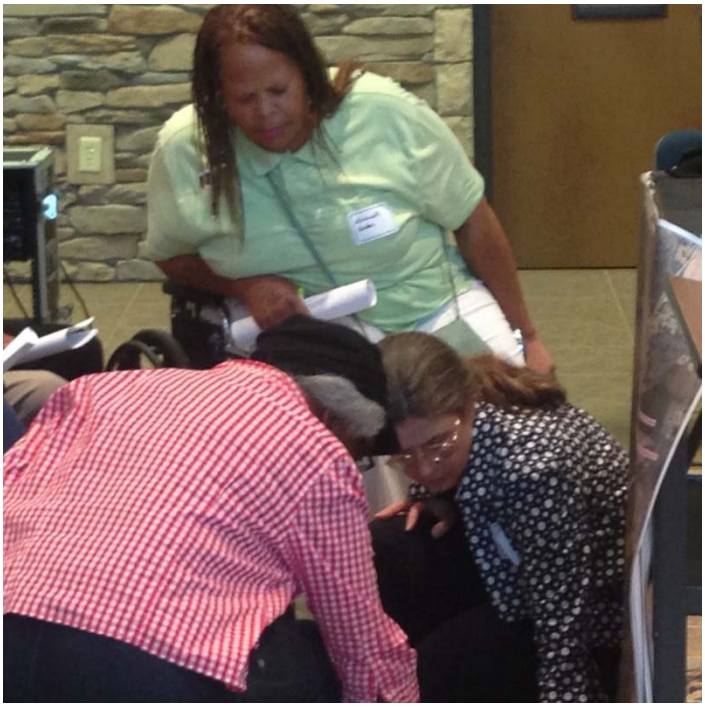

Figure 4. First-time attendees at the second public meeting talk with the facilitator to understand the process being used in the corridor, which led to the development of the flowchart (Figure 2) for the third public meeting.

The concepts in the *Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes* were used to consider reliability in in the development of the need for the project. Team members were previously aware of these concepts so we did not have to use PlanWorks to learn them for the first time, but they are useful as a reference when details of how the various indices, such as planning time index and the buffer index, are needed.

For example, we found for this corridor that the **misery index**, as its name implies, indicates the travel time when congestion is worst. Based on a different data set than that shown in Figure 3 (all days, not just weekdays, for the period from October 1, 2014 through September 30, 2015), this index is the average of the slowest 5% of all travel times divided by the travel time at the speed limit. When applied to the entire corridor and to the evening rush hour (4-7 pm), the misery index is 1.57 (northbound) and 1.67 (southbound). A loose interpretation is: about one work day per month, when traffic is unusually bad, one should assume that commuting time will be 57% (northbound) or 67% (southbound) longer than it would if one could travel at the speed limit. Ultimately, however, we focused on the travel time reliability index (see Figure 3) given its relationship to funding sources.

Library

The PlanWorks Library shows how others have **demonstrated trade-offs associated with access management standards**. For example, the library shows one case (*NJ Route 31 Integrated Land Use and Transportation Plan*) which appears to evaluate the tradeoff between access and mobility. Ultimately, the team found that one way to make this tradeoff was to provide two sets of performance measures: one for through delay in the corridor (such as through travel time) and one for access delay (such as turning left into businesses.) Both performance measures assess delay, but the former is for mobility and the latter is for local access.

One **innovation that the team used was to include the involvement of professional facilitators** (in this case, the University of Virginia Institute for Environmental Negotiation). The professional facilitators' cost was approximately $40,000 for the duration of the 14 month effort. Major contributions included stakeholder interviews (e.g., trucking firms in COR-3/4), engagement with the public at three public meetings (both to solicit comments and help present information in a one-on-one environment with individuals who had questions), and organization of select corridor planning meetings involving stakeholders. For example, the facilitator played an active role in eliciting public opinion through the application of COR-3 through four major steps:

1. Hold a public meeting at which a survey was distributed to obtain early feedback for COR-1 and COR-2.
2. Identify candidate interviewees in both the public and private sector.
3. Develop questions for interviews of partners and advisors based on COR-3. and
4. Conduct interviews with stakeholders.

For example, **one policy question from COR-3** is "Are there differences or conflicts among the stakeholder interests?" Accordingly, different stakeholders were asked how they would "define success for this particular section" of the corridor. As shown in the *Campbell County Route 29 Planning Effort Findings Report*, an example of these diverse results is the different attitudes toward a bypass: some stakeholders are hopeful for a bypass, although concerns about a bypass adversely affecting local businesses are also noted. The *Campbell County Route 29 Planning Effort Findings Report* also shows how different trip purposes are considered. For instance, the difficulty of making turns occurs at several locations: Liberty Mountain Drive (purpose is to access a major employer [Liberty University]), Calohan Road (purpose is to access a regional landfill), and the vicinity of English Tavern Road (purposes are to access residences [mobile home parks] and a place of worship [Hyland Heights

Baptist Church]). The report also exemplified the diverse purposes of the corridor: for congestion, individuals expressly noted that they did not want to see speeds deteriorate further such that the area suffered delays comparable to more urbanized areas of the Commonwealth. Safety issues are arguably paramount: some comments directly relate to increased traffic volumes (i.e., one firm has adopted a policy that trucks may not change lanes), and some concerns are driven also by geometric considerations (i.e., location of crossovers and needed turning lanes to separate flows). Economic development is viewed both as both desirable and a situation that must be mitigated, with questions about the ability of the region to accommodate growth in travel demand.

Stakeholder Collaboration

This use of PlanWorks in Virginia has always been described as a multi-agency effort involving Campbell County, Region 2000 which staffs the Central Virginia MPO, the VDOT Lynchburg District, FHWA's Virginia Division, the University of Virginia Institute for Environmental Negotiation, AECOM, and the Virginia Transportation Research Council. The collaboration among stakeholders fundamentally drove the project in several key ways.

- **COR-1** asks how stakeholders will be involved. This exact question arose in a December 2015 briefing with the County's Economic Development Director and a local supervisor with authority over the corridor. The result was that all landowners adjacent to the corridor needed to have every opportunity to influence the process, which drove the decision **to not convene a smaller technical advisory group but rather to allow all interested individuals to participate** in the development of solutions.

- **COR-2 asks for agreement on deficiencies and opportunities**, and although the corridor is a state DOT facility, it was the county's desire that "although not everyone will get everything they want, we want all voices to be heard" which contributed to an active public involvement process of **getting stakeholder agreement on deficiencies in the corridor**.

- **COR-3 and COR-4 ask for** goals, stakeholder comments, objectives, and performance measures. Collaboration with professional facilitators led to the **development of a *Campbell County Route 29 Planning Effort Findings Report* where those facilitators interviewed additional stakeholders in a one-one one format** (beyond those who came to the public meeting) such as property owners, large employers, a regional airport, transit provider, and a homeowners association representative. This was followed by the aforementioned **AECOM memorandum** which captured the results—and necessary modifications—based on previous studies (and hence previous stakeholders).

- **COR-6** asks for the development of solution sets, which was inspired by members of the public who **identified various solutions at the second public meeting**. (Figure 5 shows an example of the 54 comments received at that meeting).

Figure 5. Example of Solutions Identified at the Second Public Meeting

- **COR-8 and COR-9 require the prioritization of projects**. This prioritization involved collaboration between the MPO, the County, and VDOT—and was built on how projects were prepared for requirements of candidate funding sources by AECOM. (An example is the computations for how the travel time reliability index is computed for median closures.)

- **COR-6 and COR-9 entail compromise.** For example, during COR-6, the second public meeting generated complaints of speeding, and

COR-7 initially reduced speed limits dramatically—in some places to 35 mph. Comments received at the third public meeting during COR-7 opposed any such reductions, leading to the compromise in Table 3.

Key Outcomes

- Key outcomes are observed for both this *particular project* and for the use *of PlanWorks generally*.

- *For this particular project*, roughly **$19.43 million in improvements** have been identified at specific locations in the corridor as shown in Table 3.

Table 3. Summary of Blended Solution Set

Solution Improvement (Number of Sites)	Cost in $millions
Closure/modification of medians (12)	$0.27
Lengthen left turn lane storage & taper (13)	$1.30
Install left turn lane (8)	$1.80
Lengthen right turn lane storage & taper (5)	$0.50
Install right turn lane (6)	$1.35
Various signal improvements (1)	$0.001
Access modification (4)	$1.50
Install r-cut median access points (3)	$3.75
Sidewalks (1)	$2.75
Shared use path (1)	$6.20
Speed limit reduction (2) to 55/45 mph	Minor

- The **recommendations for this particular project** will be presented to the Campbell County Board of Supervisors by the Campbell County Director of Community Development.

- Because two BOS members whose districts include the corridor have been involved in the process and because three public meetings have helped keep citizens informed, **there will be strong interest in the community's reaction as documented by the public involvement process associated with PlanWorks**. Then, following the meeting with the county, recommendations for projects shown in the top 10 rows in Table 3 would be moved into applications for various funding sources, notably the Highway Safety Improvement Program (HSIP) and Virginia's Smart Scale.

- For the last project in Table 3 (reducing speed limits to 55 mph south of Calohan Road and 45 mph north of Calohan Road), if the BOS members are supportive, then the next step would be for **VDOT Traffic Engineering staff** to conduct a speed limit study at those locations.

- An observation that is neither positive nor negative but simply unique to the corridor planning process is that **the types of projects that are feasible from a funding perspective must be considered early in the process**. That is, when implementing PlanWorks, one must have an idea of the methods for prioritization (COR-9) at the time that candidate solution sets are developed (COR-6).

- PlanWorks can potentially serve as a resource for performing **corridor planning, especially corridor preservation**. The passage of "Smart Scale" in Virginia has fundamentally altered the transportation programming process such that projects have to score well in certain performance measures in order to be funded. A key implication is that corridor plans must lead to short-term, implementable solutions if they are to be used, at least in Virginia's current fiscal environment. The fact that PlanWorks was helpful for ensuring we kept the corridor planning process tangible has been shared with several entities (including one MPO that wanted additional information on how PlanWorks used professional facilitators).

Lessons Learned

- **PlanWorks emphasizes "going slow to go fast."** A substantial amount of time in the early modules is spent generating up-front agreement, which builds support for developing solutions in the later COR modules.

- **PlanWorks emphasizes performance-based planning.** The decision point steers transportation practitioners to match solutions (in COR-7) to the performance measures (COR-5), which are based on goals (COR-1.) **This encourages creativity**; for example, it

encourages one to ask "how might we measure a project's impact on economic development?"

- **PlanWorks should be applied in an iterative fashion**. For example, in order for a transportation agency to develop feasible projects based on a corridor planning process, the criteria for scheduling and prioritizing investments (COR-9) must be explicitly considered in the selection of the preferred solution set (in COR-7).

- **It may be more productive to conduct stakeholder assessments in the middle of corridor planning rather than at the beginning.** Some stakeholders may not even attend the initial meeting. As each corridor process is unique, the value of the assessment is to ask "what needs improvement"—which can be asked once participants better understand how the planning process might unfold.

- **Often PlanWorks policy questions must be shortened for an in-person meeting with stakeholders.** The questions are useful as an initial brainstorming exercise, but when posing the questions to stakeholders or members of the public, multi-part questions will need to be abbreviated—partly because some stakeholders may not know transportation planning details, and partly to enable a conversation. For example, one can replace "Are performance measures, evaluation criteria and methodology for assessing bicycle and pedestrian network connectivity, accessibility (to jobs, schools, essential services, recreation, etc.), equity, and safety incorporated into the project prioritization process?" with "What factors influence prioritization." Then, additional probing questions can be asked of respondents, as other descriptors besides "network connectivity" may be preferable.

Next Steps

- **For PlanWorks generally**, the team has already made four presentations regarding how PlanWorks can support corridor planning, especially better access management:

    - A presentation at *VDOT's Transportation and Land Use Forum* describing PlanWorks as a corridor planning tool for supporting regional and rural strategies (June 2, 2017)

    - A presentation at the *Virginia Annual Planning and Programming Meeting* regarding how PlanWorks can support the programming process based on corridor planning (February 1, 2017).

    - A presentation to the *VDOT Corridor Preservation Group* and VDOT staff from the Salem and Lynchburg VDOT construction districts regarding how PlanWorks can encourage better access management (February 3, 2017).

    - A *webinar presented to Caltrans* regarding the details of how PlanWorks can be implemented using the nine COR modules (February 15, 2017).

- **For PlanWorks generally**, the team will continue to share with interested parties details of how to use PlanWorks corridor planning.

    - For example, staff from another Virginia MPO met with a few team members in December 2016 to discuss recommendations for future PlanWorks applications (**Appendix A** of this report) and how PlanWorks was applied for this particular corridor (see **Appendix B**).

    - Several members of the team have produced video testimonials of the strengths and weaknesses of using PlanWorks as requested by FHWA.

- **For this project and other VDOT projects in particular**

    - VDOT is continuing to use professional facilitators on other projects, based on the experience of this use of PlanWorks and a related (separate) research effort regarding collaboration and consensus building (Ohlms and Roy, 2016).

    - For Route 29, a database has been developed that shows how the blended solution set in Table 3 scores against some of the Smart Scale programming criteria. This database, along with the

record of public input given in this report will (if the County BOS concurs) serve as a starting point to implement the projects shown in Table 3. The specific projects are shown in **Appendix C** of this report.

For More Information

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Resources

- Route 29 Corridor Assessment, Campbell County.
  http://www.virginiadot.org/projects/lynchburg/route_29__corridor.asp
- Using PlanWorks to Support Transportation Programming: the Campbell County Experience,
  http://www.virginiadot.org/projects/resources/SYIP/2016/fall/Plan_Works.pdf
- Using PlanWorks to Support Corridor Planning (The February 15, 2017 webinar will be posted at http://smartmobilityca.org/webinars/)

References Cited in the Report

AECOM. Memorandum (for Tasks 1, 2, and 3). July 8, 2016.

FHWA. National Highway Construction Cost Index (NHCCI), Washington, D.C., 2016.
https://www.fhwa.dot.gov/policyinformation/nhcci/pt1.cfm.

FHWA. Price Trends for Federal-Aid Highway Construction - Fourth Quarter 2003, Washington, D.C., 2015.
https://www.fhwa.dot.gov/programadmin/pt2003q4.cfm.

Ohlms, P.B. and Roy, K.M. When Main Street Is a Highway: Addressing Conflicts Between Land Use and Transportation, VTRC, 2016. http://www.virginiadot.org/vtrc/main/online_reports/pdf/17-r13.pdf

University of Virginia Institute for Environmental Negotiation. *Campbell County Route 29 Planning Effort Findings Report, 2016. http://www.virginiadot.org/projects/resources/Lynchburg/Rt_29_Campbell_Co_Corridor_Assessment/Findings_Summary.pdf*

Virginia Department of Transportation. Phases II and III, Route 29 Corridor Study, Technical Report, Richmond, 2003. http://www.virginiadot.org/projects/lynchburg/phases_ii_and_iii,_route_29_corridor_study.asp.

Virginia Department of Transportation. Addendum to the Route 29 Corridor Study, Richmond, 2011.
http://www.virginiadot.org/projects/resources/Culpeper/Route_29/Addendum-Route_29_Corridor_Study1.pdf

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Appendix A. Summary of Recommendations for Future Uses of PlanWorks

Appendix A shows recommendations for persons who will use the corridor planning element of PlanWorks in the future, based on the experience of using PlanWorks in Campbell County. For consistency with PlanWorks, the 15 recommendations are organized by each of the nine COR steps, with the recommendations for using the stakeholder assessment presented last. That said, the somewhat non-linear nature of the planning process means that some recommendations may apply to other steps as follows: COR-1 and COR-2 may be applied simultaneously (thus, recommendations from each COR-1 may be relevant to COR-2 and vice-versa); COR-3, COR-4, and COR-5 may be applied iteratively; and COR-7, COR-8, and COR-9 may also be applied iteratively.

COR-1: Scope of the Corridor Planning Process

1. *When using PlanWorks, focus first on the outcome in the Overview section of COR-1.*

   The detail in PlanWorks is quite helpful but can initially be daunting; for example, the 44 policy questions in COR-1 help one consider the breadth of the planning process but can also leave one confused regarding which questions should be posed first. It was helpful to examine each desired outcome and then work backwards from the outcome to specific questions. For instance, the outcome of COR-1 (a clearly defined scope to guide the corridor planning process) helped the team realize the importance of encouraging compromise in the corridor, between local access and through movements. Then, with that outcome in mind, the team could study the sample questions in greater detail.

2. *Order the policy questions such that easier questions precede harder ones.*

   In interactions with the general public, it was easier to get input when starting with questions that attendees could immediately address, regardless of their knowledge of the corridor. (For example, while some individuals were ready to provide design solutions, others who had come late to the first public meeting were not immediately certain what they were being asked to do.) Accordingly, one should ask easier questions initially (e.g., what stakeholders like or do not like about the corridor), with the hardest questions, such as "How can the corridor best serve the longer term needs of the county/the region for the next 20 years?" being posed later. For example, this order might be as follows:

   Easy questions designed to introduce respondents to the process

   - In what ways do you use this part of the corridor?
   - What are some of the key functions and roles of the corridor – now and in the future?
   - What do you like about what currently exists? (Use blue sticky notes to describe this and put it on the map.)
   - What don't you like about what currently exists? (Use pink sticky notes to describe this and put on map.)

   Harder questions designed to elicit longer term ideas

   - How can this corridor best serve the longer-term needs of Campbell County, for the next 20 years?
   - How can the corridor best serve the long-terms needs of the larger region, for the next 20 years?

   Question Designed to Elicit Specific Solutions

   - What specific ideas would you like to be considered in the development of this corridor?

COR-2: Approve Problem Statements and Opportunities

3. *The questions in COR-2 are a good starting point for brainstorming. Rather than posing all of the stakeholder questions, teams may wish to use a smaller subset, with longer or more complex questions broken into smaller ones*

   For example, consider the stakeholder question from COR-2 "What is important to you, to your neighborhood, to the local area, to the region (transportation, community, environment) in the corridor?" The intent of the question is appropriate because it illustrates how different respondents may have different uses for a corridor. However, the question includes multiple sub-questions—which can generate confusion in a public meeting. Accordingly, it was more appropriate for the team to first ask just from the point of view of the attendee, with the "larger region" being a separate concept.

4. *Provide physical maps for attendees' reference.*

   Use of two-part large-scale aerial maps (6 feet by 6 feet) shown to the right of Figure 1 in the body of this report provided a perspective that was not immediately apparent from examination of the material on the web: attendees could point out parcels (which were delineated) and geometry in higher detail. For example, the importance of the Lynchburg Airport—its size dominates much of the frontage section of Route 29—becomes clearer when one can see the airport on a physical map (as opposed to a smaller computer screen).

COR-3: Approve Goals for the Corridor

5. *Consider integrating the factors relating to context sensitive solutions (CSS) directly into the scope of the corridor analysis rather than as separate, stand-alone goals.*

   For some corridors, it will be more productive not to apply this recommendation but instead to have specific, measurable objectives related exclusively to CSS. It appears that the Minnesota "Complete Streets" Plan (see "How does PlanWorks work in the real world?") may have followed this approach for CSS, and a review of the PlanWorks example for COR-3 showed that for a related topic (environmental justice) a specific goal of outreach to the Spanish-speaking community for the Asheboro Bypass led to both greater community participation and the addition of a bridge that left a key community intact. In such instances, a separate line item measuring progress toward CSS or environmental justice is appropriate.

   However, for this particular study, the team found it helpful to view CSS as emphasizing accommodation of all modes of transportation—a point that had been noted throughout meetings with elected officials and the community since the project's inception. Accordingly, rather than having a separate line item for CSS, the project team ensured that the application of the goals in the county's transportation plan (e.g., improve safety and accommodate future land uses) could be applied to all transportation modes that used, or sought to use, the corridor.

6. *When interviewing external stakeholders who have limited time to participate in the planning process, consider combining questions from COR-1, COR-2, and COR-3 and tailor the questions to the audience.*

   - Conceptually, it is appropriate to pose questions in COR-1 and COR-2 regarding goals and scope, digest answers, and then move on to COR-3 and examine whether the candidate goals are sufficiently broad. However, "interviewee fatigue" can result if individuals (for whom planning is not the focus of their job) are consulted too frequently. Therefore, it can be helpful to conduct detailed interviews with advisors and observers once in an attempt to capture key information for COR-1 through COR-3 and let

those insights guide the scope. (This concern did not apply as much to the planning partners, where insights could be obtained in a more frequent manner given their full involvement in the project.)

- Interview questions should be tailored to intended audiences. In developing the interview questions, the project team found it easier to ask the same questions of the FHWA observer as the local, regional, and state decision makers—largely because these entities were intimately familiar with the details of the planning process. By contrast, it was appropriate to segment the advisors into two distinct groups: advisors with a large amount of land development influence (e.g., single large employers) and advisors who represented a collection of dispersed interests (such as a homeowners association).

7. *Be patient, be flexible, and be a good listener.*

The professional facilitators who were part of this team strongly emphasized this recommendation: in bringing together different partners and advisors, any collaborative process will evolve. Goals, players and conditions may all change. Thus, project team members must be patient and adaptive – allowing themselves and each other to be open to new ideas and perspectives. Thus, project elements that team members do not individually envision at the start of the effort, such as three different sets of interview questions, can result. Similarly, project elements that were envisioned were also moved—for example, the stakeholder assessment (see recommendation 15) was moved from COR-3 to COR-6, in order to give stakeholders more experience with the planning process that they were subsequently asked to evaluate.

COR-4: Reach Consensus on Scope of Environmental Review and Analysis

8. *Consider pursuing COR-3, COR-4, and COR-5 simultaneously such that two iterations of COR-4 (and later, COR-5) are performed.*

Two challenges compound the transition from high level goals in COR-3 to the level of data needs and analysis in COR-4 and then the use of performance metrics in COR-5. The first challenge is to differentiate between high-level goals that result from COR-3 (e.g., improve corridor safety) and meaningful metrics for assessing progress toward these goals in COR-5 (i.e., crashes per mile), and resultant data needs in COR-4 (i.e., rear-end crashes over a three year period). The second challenge is to determine which performance measures are feasible to compute for candidate solution sets in COR-6 (i.e., crashes per mile and near-misses per mile are both meaningful, but the extent to which one can compute them in a defensible manner may vary). Because addressing these two challenges at the same time is difficult, agencies using PlanWorks may wish to first develop an initial result of COR-5 assuming all measures are meaningful. Then, agencies may wish to revise their initial version based on an informed application of COR-5.

COR-5: Approve Evaluation Criteria, Methods and Measures

9. *Consider measuring reliability through safety metrics.*

Because probe-based data have become increasingly common, it is natural to quantify reliability through measures that require such data, such as the buffer index, planning time index, or even the misery index. However, when considering alternative scenarios, it may not be easy to forecast those measures—and while they can in theory represent both recurring and nonrecurring congestion, they may be weighted more towards the former. A complementary approach is to recognize that reliability is influenced by unplanned incidents—crashes—and thus look at ways to determine how alternative scenarios will influence crash risk. For example, the number of access points per mile (a geometric measure that can be estimated for access management alternatives) and the number of vehicle stops (available through some simulation programs) are correlated with crash risk. Thus, these can be used with project alternatives to

determine how such alternatives may influence reliability. (Ultimately, the team did not use crash risk alone to measure reliability but instead used a more traditional measure—the TTRI—because that measure was required for the Smart Scale funding source).

10. *Consider the use of handouts if performance measures or technical concepts are being presented.*

    While the team had used handouts extensively to show corridor problems and to gather feedback, a relatively last-minute decision was to provide handouts regarding how "access management" affects traffic flow. In retrospect, this appears to have been helpful, as attendees could refer to handouts as needed during the presentation.

11. *When applying COR-5, present a tentative solution.*

    COR-5 calls for development of performance measures, while COR-6 calls for the development of candidate solution sets. This makes complete sense in theory, however, the timeline for public involvement means that one must be careful in how these steps are applied: if one completely finishes COR-5 first, one may frustrate participants (who, after seeing several COR steps, wish to begin to see solutions). If one begins COR-6 too early, however, one may spend substantial resources developing candidate solutions that have little likelihood of being implemented. One approach is to complete a draft of COR-5 and then at least be able to offer ideas of the types of solutions being considered. (For this particular case, those solutions were frontage road modifications and local street connections to improve access to adjacent development, along with some geometric changes to reduce conflict points.)

COR-6: Approve Range of Solution Sets

12. *Consider bringing one-or more programming-related policy questions from COR-8 into COR-7 and COR-6*. Such questions include (1) "Do candidate solution sets have enough detail to allow the identification of funding sources?" and (2) "What are the prioritization criteria established for programming?"

    Rationale for the recommendation

    - COR-8 shows policy questions that ask, in relation to other PlanWorks phases, "What are the prioritization criteria established for programming? Are our criteria compatible with that? Do candidate solution sets have enough detail to allow the identification of funding sources?" While it is conceptually logical to draw a dividing line between the development and selection of solutions (COR-6 and COR-7) and the prioritization of projects (COR-8), *the limited funding opportunities for some corridor projects means that the manner in which projects are programmed must be considered throughout the development of the potential solution sets*. It is especially critical to consider how projects are programmed if it is expected that multiple funding sources will be needed to implement the solution set. (For example, for this particular corridor, some projects are being pursued through Highway Safety Improvement Program [HSIP] funds whereas others are candidates for Virginia's statewide programming process, known as Smart Scale). Because each of these funding sources has their own data requirements, it was essential in this effort to consider the "criteria for programming" (posed in COR-8) at the time the candidate solution sets were developed—that is, in COR-6.

    - *To be clear, PlanWorks does connect the programming process (the "PRO" steps) and the corridor planning process (the "COR" steps)*. For example, under step COR-8, the "links to decisions" box on the left of the screen provides a connection from COR-8 to PRO-2, where one considers criteria for allocating revenue, as shown in Figure A1. However, by adding a policy question directly to COR-6 and

COR-7 that relates to programming, one may increase the likelihood that projects will be developed such that they meet the information requirements for available funding sources. For this corridor in particular, because Virginia's Smart Scale is a likely funding source for at least some improvements, key Smart Scale criteria must be considered early in the process such as points resulting from the travel time reliability index, equivalent property damage only reduction of fatal and injury crashes, and the reduction in person hours of delay. In particular, because the overall score is calculated as the total points divided by the project cost, the "bang for the buck" highly influences whether a project will be funded. Realistically, planners must consider these programming criteria early in the process—when candidate solution sets are being developed—if they want to see projects move to implementation under this funding source.

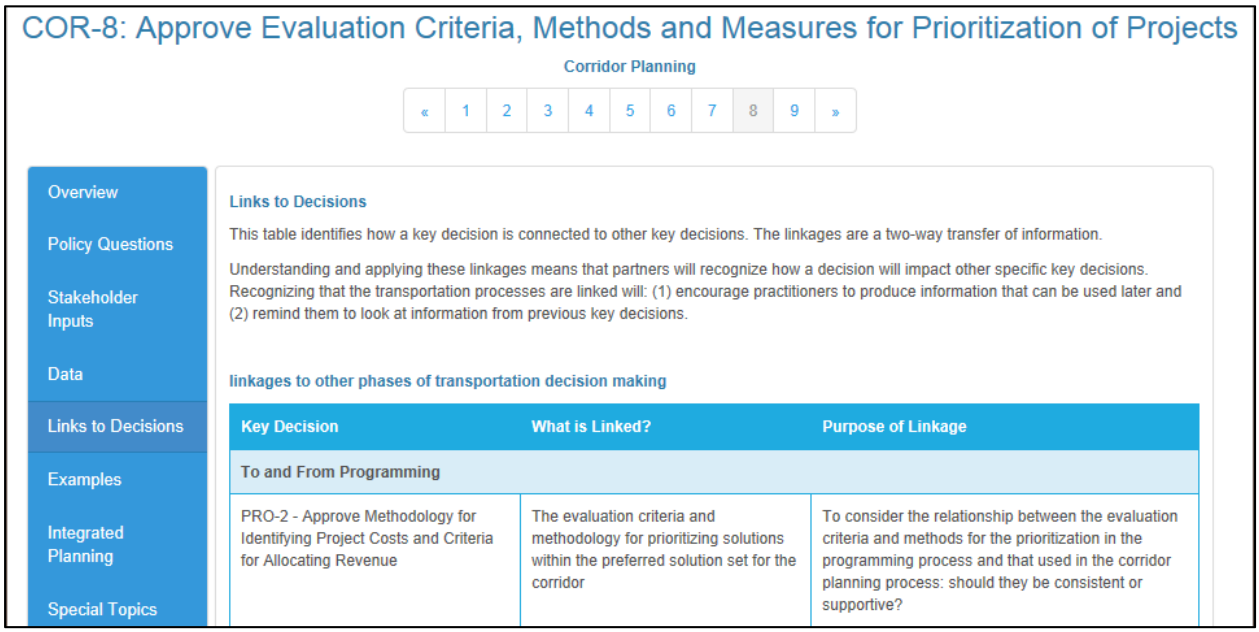


Figure A1. Example of a Link Between Corridor Planning (COR-8) and Programming (PRO-2).

- *To understand why this recommendation may be needed for the COR steps, contrast corridor studies (e.g., the COR steps) with long range planning studies (e.g., the LRP steps).* For the latter, the MPO routinely considers a large variety of projects in the development of the long range plan and then, through careful consideration of available funds, places projects in the shorter range Transportation Improvement Program. These long range planning processes and programming processes are institutionalized and performed on a large scale: there is an expectation every year that substantial agency resources will be devoted to updating projects in the TIP, and (every five years) updating the long range plan. For that reason, having a long planning process (LRP steps) and a programming process (PRO steps) that are separate processes in PlanWorks makes sense—within a state DOT or large MPO, these two processes may be performed by two separate groups of staff. These processes are then connected at formal decision points: for example, LRP-10, which is where the MPO adopts the long range transportation plan, shows under "Links to Decisions" a connection between the LRP and three major programming steps: project prioritization, approve the TIP, and incorporate the TIP into the STIP. However, corridor projects—especially those that may be "stuck"—are not institutionalized and do not necessarily have a specific point at which a decision must be made. Whereas a long range transportation plan is eventually translated into a set of projects for a TIP, there is no requirement that this be performed for a corridor plan. Thus, for corridor projects to move forward—especially in an era of limited funds—planners need to be cognizant of potential funding sources and their associated requirements. This recognition needs to be performed early: planners must be providing enough data in the development of candidate solution sets (COR-6) such that these projects at least have the opportunity to be funded.

COR-7: Adopt Preferred Solution Set

13. *Add a feedback loop between COR-9 and COR-7*. In order for a transportation agency to develop feasible projects based on a corridor planning process, the criteria for scheduling and prioritizing investments (e.g., the results of COR-9) must be explicitly considered in the selection of the preferred solution set (in COR-7). Failure to do this could result in a set of improvements emanating from COR-7 that ultimately are infeasible. Thus, as shown in Figure A2, a feedback loop that emphasizes the importance of considering COR-7 through COR-9 simultaneously should be added.

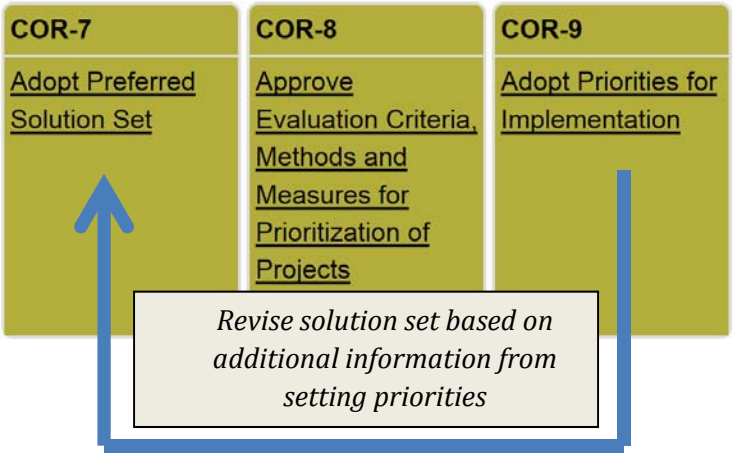


Figure A2. Suggested Feedback Loop between COR-7 and COR-9. Adapted from FHWA. *PlanWorks Decision Guide*, Washington, D.C. https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide. Accessed February 2, 2017.

COR-8: Approve Evaluation Criteria, Methods and Measures for Prioritization of Projects

14. *Consider separating major questions from the details that can be provided*. Future deployments of PlanWorks might benefit from a shorter question stem (such as those shown in the right columns of Table A1) and then a separate section that lists optional detail for each question. For example, when working with diverse partners in person, it was easier to ask a short, general question (such as "What factors influence prioritization") and then to be prepared to specify that "factors" might mean specific performance measures (which in this project included measurable items such as the amount of delay at various intersections based on 2040 volumes). To be clear, the detail in the PlanWorks questions can be quite helpful in terms of providing a breadth of considerations (e.g., accessibility to jobs, equity, and bicycle network connectivity can all be relevant in different corridors). By separating the detail from the core questions in COR-8 and COR-9, the general intent of the questions can be clarified.

Table A1. Revised PlanWorks Questions

No.	Original PlanWorks Question	Question Used by the Team
1	Are performance measures, evaluation criteria and methodology for assessing bicycle and pedestrian network connectivity, accessibility (to jobs, schools, essential services, recreation, etc.), equity, and safety incorporated into the project prioritization process?	What factors influence prioritization?
2	Who developed the prioritization evaluation criteria and methodology? [COR-8] and How were stakeholders, including modal and operational partners, engaged in providing input and recommendations? [COR-9]	How does this prioritization process reflect stakeholders' input?

COR-9: Adopt priorities for implementation

There are no additional recommendations for this section except recommendation 13 as discussed previously (a feedback loop between COR-7 and COR-9). With this feedback loop, the questions common to COR-7, COR-8, and COR-9 can be considered jointly throughout the process.

Using the PlanWorks Assessment

15. *When using the results of the Corridor Assessment, it may be easier to enter the worst-case scenarios one at a time and then identify the PlanWorks recommendations rather than entering the survey responses all at once.*

    In theory, the PlanWorks assessments are intended to be completed on line, where stakeholders or partners receive immediate feedback from the process. However, the project team used the assessment questions in a slightly different way: public participants were given the questions but then the assessment was used to identify where the greatest amount of improvement was needed. For example, consider the response to "The decision-making process is clear" which gave the lowest average score (2.9 received in the survey). To use the assessment results, one can go to the two PlanWorks elements which were the source of that question and simply enter a "Strongly Disagree" for both of those (Figure A3) and then use the appropriate feedback from PlanWorks (Figure A4). Note that to make full use of the PlanWorks Assessment, one needs to keep track of the original PlanWorks element (e.g., the two lines shown in Figure A3) and the modified question given to the public (e.g., the first question in Figure A5).

PlanWorks Element	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
The process steps are clearly stated/documented	◉	○	○	○	○	○
The collective goals are clearly stated and documented	◉	○	○	○	○	○

Figure A3. PlanWorks Elements in Support of Question 1 ("The decision-making process is clear.")

Category	Score and Strategy
Process Steps	Effectiveness Score: **Weak** Potential Risks Things You Can Do How PlanWorks Can Help
Shared Goals	Effectiveness Score: **Weak** Potential Risks Things You Can Do How PlanWorks Can Help

Clicking on the links at the left leads to text suggesting an "organizational outcome map" which led the project team to consider a handout at the 3rd public meeting shown as Figure 2 in the body of this report.

Figure A4. Excerpt of PlanWorks Recommendations to Clarify the Decision-Making Process

Route 29 Project Assessment, Campbell County

The participation of property owners, business interests, other roadway users, and any other individuals affected by the corridor is a critical part of this public involvement phase. We would like you to answer seven questions regarding how we can best conduct public involvement in Route 29 corridor planning. Each question has 5 options: Strongly Disagree (**SD**), Disagree (**D**), Neither Agree nor Disagree (**N**), Agree (**A**), or Strongly Agree (**SA**). There is also space to provide free responses (below or on reverse).

1. The decision-making process is clear.	SD	D	N	A	SA
2. The project goals are clearly stated.	SD	D	N	A	SA
3. The project goals (to promote a safe, efficient transportation system compatible with existing and future land uses) reflect my personal goals for the corridor.	SD	D	N	A	SA
4. The performance measures (for example, crashes per mile on the corridor) directly relate to the goals.	SD	D	N	A	SA
5. My input has been incorporated into the project performance measures.	SD	D	N	A	SA
6. At this meeting, I have been able to share my views with others.	SD	D	N	A	SA
7. Please indicate the primary reason for your attendance: (**a**) resident of the corridor; (**b**) business owner in the corridor; (**c**) commuter; (**d**) other (please specify).	a	b	c	d_____.	

Goal	Performance Measure(s)
Provide a **safe** transport system	• Crashes per mile • Number of rear-end crashes • Number of crashes involving vehicles entering and exiting highway
	• Number of stops
Provide an **efficient** transport system	• Number of times peak travel time through the corridor is below 20 minutes
	• Degree of variation of travel speeds
	• Number of median crossovers per mile
Provide a transportation system that is **compatible with land uses**	• Delay for turning left and right into certain businesses
	• Multi-modal connectivity index • Number of parcels where connection points for pedestrians
	• Travel time to the Norfolk Southern general freight facility (which offers piggyback service for truck to rail)

You may complete this copy OR on line at: https://www.surveymonkey.com/r/Q9G7D9P

Figure A5. PlanWorks Assessment Used During COR-6

Appendix B. Summary of How PlanWorks Was Implemented for the Route 29 Corridor Assessment

Appendix B shows how the nine COR modules were applied for the Route 29 Assessment. As is the case with Appendix A, material is presented by module for consistency with PlanWorks, although in practice there were several cases where modules were pursued in tandem. For each COR, there are two subsections: the *outcomes* of applying the COR and the *steps taken* as part of the COR. (Additional details, if needed, are available from the authors in the form of individual task reports provided to FHWA.)

COR-1: Scope of the Corridor Planning Process

Outcomes of COR-1

- The *geographical scope* of the planning process is the Route 29 Corridor within Campbell County from the City of Lynchburg (Route 29/640 interchange) to Route 24 (the MPO boundary).

- The *temporal scope* is a nine month study, with the goal being to have a plan of action by the end of 2016 that the County Board of Supervisors can use to identify local priorities for funding which would submitted to VDOT.

- The *technical scope* remains open but will draw heavily upon existing work: notably five previous studies in the corridor, with the newer contributions from this effort being geared toward reducing conflict points and supportive land use strategies.

- The *planning process scope* is that there will not be a citizens' technical advisory committee which could inadvertently restrict participation; rather, every citizen will be able to participate in the planning process through attending public meetings. Mailings, message boards advertising the meeting, and social media will be used to communicate the planning process and maximize public involvement.

Steps Taken in COR-1

- *Meet with* ***a key member of the Board of Supervisors*** *on December 15, 2016*

  The two BOS members with supervisory authority within the scope of the project—Dr. James Borland and Mr. Eric Zehr—were invited to attend an in-person meeting for the project. (Mr. Zehr was unable to attend, however, Dr. Borland and the county's Economic Development Director, Mr. Mike Davidson, were able to attend and were briefed about the project through a presentation by Rick Youngblood [district planner for VDOT] and Judie Talbot [University of Virginia Institute for Environmental Negotiation]). Slides were not used for the presentation but rather presenters highlighted key points of the project as they relate to COR-1 and COR-2. For example, under COR-1, a key policy question is "How will stakeholders, including modal and operational partners, and the public be involved?" This particular point was of interest to the two board members, who highlighted the need for landowners to have every opportunity to attend public meetings for the project, and was a factor in the planning partners' decision to not convene a smaller technical advisory group immediately but rather allow all individuals to participate.

- *Agree* ***internally on the scope*** *of the project.*

In-person meetings of the internal partners held on December 7 and 14 (2015), and January 4 (2016 along with a conference call on January 11, (2016), helped develop agreement on the environment for the project. For example, consider the two policy questions from COR-1 and COR-2, which are respectively: "Who are the proponents and opponents?" and "Are there identified performance measure and data sources for evaluation of strategies?"

Regarding the first question, planning staff with Campbell County were able to note that there were two likely viewpoints that would shape the discussion: businesses who want to ship their products out of the area, and businesses that want to use the corridor for local access. Staff also recognized that any restrictions placed on what a property owner can do will be scrutinized, placing importance on getting agreement early on in the process.

Regarding the second question, the VDOT district planner noted that much of the technical work may have already been accomplished in previous studies, including those done for the recent constrained long range plan (CLRP). While some updates of these study recommendations may be necessary, a key part of the strategy will be to think about how to use land use tools such as waivers and exception requests (and the selected consultant has expertise in this area.)

COR-2: Approve Problem Statements and Opportunities

Outcomes of COR-2

- *Key deficiencies* in the corridor include the following (not listed in priority order).

  First, there is **noticeable congestion** during the peak hour. This congestion contributes to at least two different negative impacts cited by attendees at the January 28, 2016 public meeting: (1) it can be difficult to access businesses, such as hotels, during the peak hour; and (2) the congestion slows down through movements both for commuters and through travelers

  Second, there are **potential safety hazards**. Some of these hazards may be in response to congestion; one attendee referred to a portion of the corridor as "murderous" where there are several access points in close proximity to one another. However, in response to this comment, another attendee noted a potential safety hazard that could result when there is not congestion: large trucks often need to turn around in a portion of the corridor, and this creates a hazard given that some vehicles are traveling at 60 mph. At another table, an attendee cited a fatal crash in the portion of the corridor where there is a school entrance.

  Third, some **turn lanes** are too short.

  Fourth, the **development review process** can be time consuming for landowners in the corridor. This is also an opportunity: during the meeting, it was noted that "time is money" and that a clearer vision of how the corridor should be developed could expedite reviews, saving both the private and public sector time.

- *Potential opportunities* include the following (not listed in priority order).

  Several potential **transportation opportunities** have been noted: improved access management through the consolidation of commercial driveways, addition of frontage roads, and some attendees expressed an interest in alternative routes.

There may be **opportunities for public education**. For example, one comment made prior to the meeting was the regulations on establishment of signs within the corridor. While a restriction exists in terms of sign size within the setback area, it recently changed and many people may be unaware (e.g., the maximum sign size is now 100 square feet with a maximum height of 20 feet for a free-standing sign– this is an increase from 32 square feet and 15 feet in height). Also, one individual thought that sign size applied to signs placed on the buildings themselves. (This is not the case: there is no additional limit on the sign size associated with the TCO when the sign is attached to the building; see the county's memorandum of May 15, 2007.)

There may be opportunities to **obtain funding for improvements**. Under the current environment, Virginia's decision-making process for selecting transportation projects—known as HB2 [which was later renamed to Smart Scale]—tends to favor projects that both (1) have statewide ramifications and (2) strong community support. Given that Route 29 is a corridor of statewide significance, and given the Board's involvement at this stage (including the Board and the community in the development of a list of recommended projects), the likelihood of funding may be increased.

There may be opportunities to **improve transportation in other locations in the area**. A key point was made that by investing in the Route 29 Corridor (in Campbell County) one can reduce heavy truck traffic in other locations (e.g., Madison Heights).

Steps Taken in COR-2

- **Meet with key public stakeholders on January 28, 2016**

A two hour meeting with an estimated 42 stakeholders (who signed in) was held on January 28th at Hyland Heights Baptist Church, which is located within the study corridor. An additional 13 staff were present. The meeting was advertised in the local paper, letters were sent to 140 stakeholders who live in the corridor, variable message boards signs were reserved to display meeting information (however an impending severe winter storm one week before the meeting prevented their deployment), and a website with project information was developed; the web address is http://www.virginiadot.org/projects/lynchburg/route_29__corridor.asp.

At the meeting, the project was introduced as one where attendees would be briefed rather than "talked at" for two hours—to provide opportunities for them, the stakeholders to provide input (Figure 1 in the body of the report). Attendees were given a business card with the web address and a drawing of the corridor (Figure B1, *left*), to encourage follow-up after the meeting. During the meeting, attendees were asked to provide input by identifying, on large scale maps, deficiencies in the corridor by using post-it notes and placing them on the map (see Figure B2 for an example of results of that exercise). During the presentation the transportation role of the corridor (where the corridor is of statewide importance for through movements) and the economic role of the corridor (as a local access point for businesses) were noted, and attendees were briefed that multiple studies of the corridor pointed to the need for a collaborative approach given limited funds available for corridor improvements. Then, 75 chairs and 8 tables were arranged for attendees, along with large-scale maps on which individuals could place post-it notes of 3 different colors with their written comments on what they liked about the corridor, what they didn't like about the corridor, or other ideas/comments about the corridor.. In practice, many cases attendees chose to make their comments aloud and then have staff (internal partners and their associates) write them down and place them at a specific location on the map.

A key point of the presentation was the SHRP2 PlanWorks planning process being used, with an emphasis that there would be at least three public meetings: January 28th (to develop a vision); a

second meeting (to discuss possible solution sets—e.g., pros and cons, are there other ideas the internal partners did not consider?) and a third meeting where the internal partners would describe a proposal for a preferred solution set (terminology used in COR-7 of PlanWorks).

In sum the initial public meeting was aimed to be a two-way conversation. For example, consider the role of access management. Attendees were given some examples of recent success in the corridor: the presentation showed how two signalized entrances—one to a Walmart and one to an adjacent Sam's Club—were converted to right-in right-out movements only, with a new (single) access point replacing these two access points (Figure B1, *right*). Then, attendees provided comments relating to how better access needed to be provided for certain businesses.

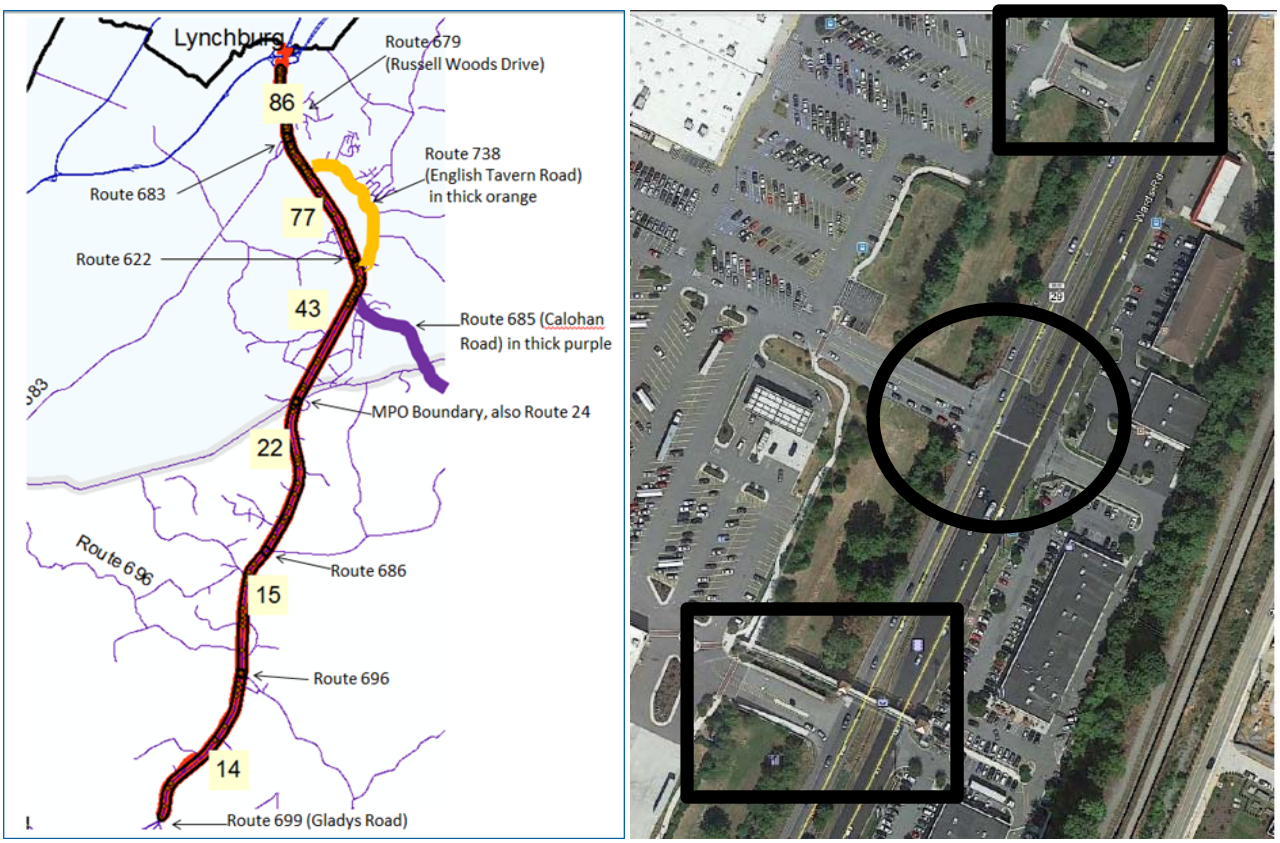


Figure B1. (*Left*). Drawing of the Corridor on a Business Card Given to Attendees at the First Public Meeting. (The reverse side of the card has the web address through which public comments may be distributed. The actual corridor will only be the northern portion, from Lynchburg to the MPO boundary). (*Right*). Example of access management, where the north and south entrances (square) were converted to right-in/right-out, with left turns consolidated to the single middle entrance (circle).

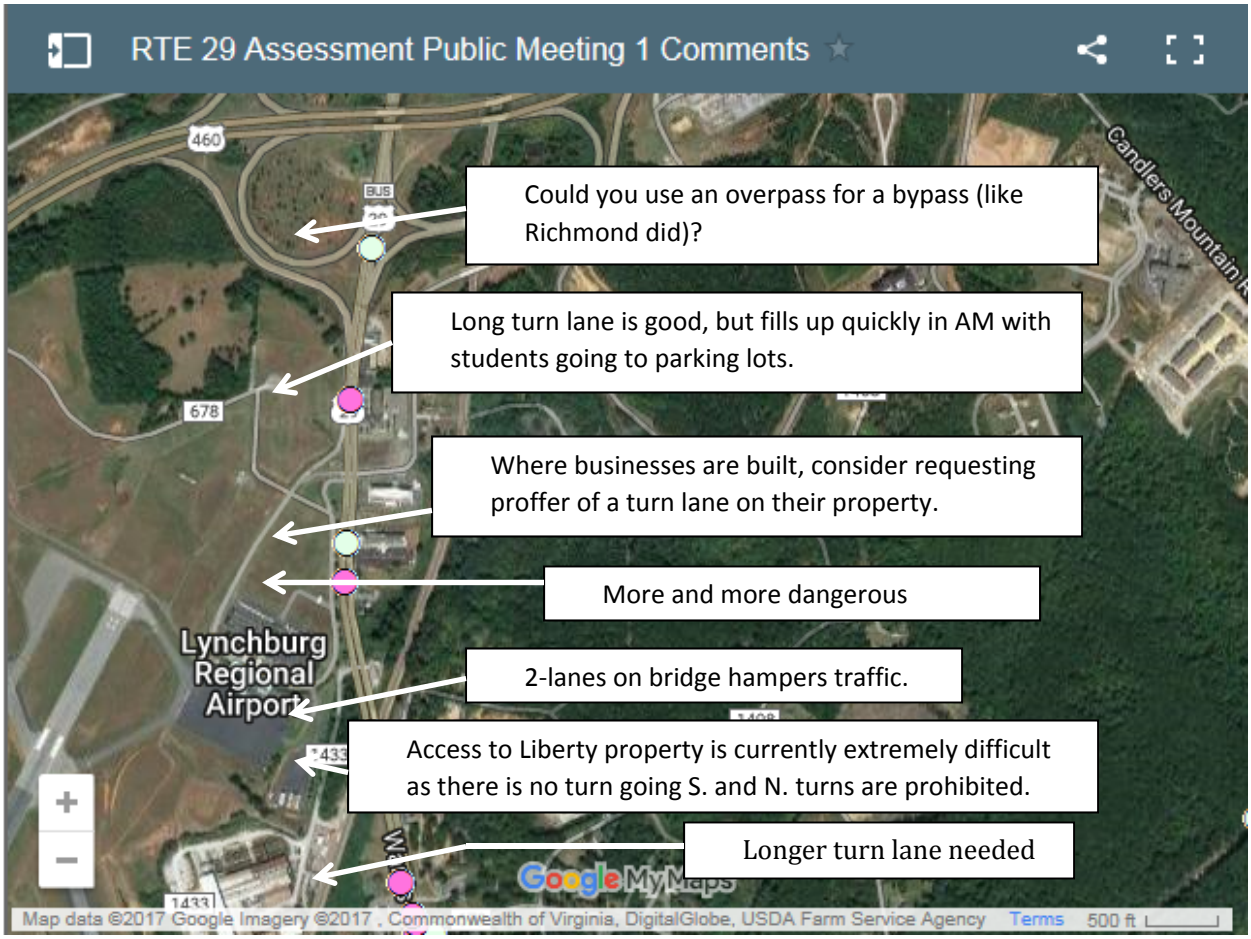


Figure B2. Examples of Deficiencies Identified at the First Public Meeting (January 28, 2016)

COR-3: Approve Goals for the Corridor

Outcomes of COR-3

- *Public input indicates that there are three key areas of concern for the corridor: safety, economic development, and congestion.*

  The separate Campbell County Route 29 Planning Effort Findings Report shows that stakeholders identified specific areas of concern in all three areas. For *congestion*, individuals expressly noted that they did not want to see speeds deteriorate further such that the area suffered delays comparable to more urbanized areas of the Commonwealth. *Safety* issues are arguably paramount: some comments directly relate to increased traffic volumes (i.e., one firm has adopted a policy that trucks may not change lanes), and some concerns are driven also by geometric considerations (i.e., location of crossovers and needed turning lanes to separate flows). *Economic development* is viewed both as both desirable and a situation that must be mitigated, with questions about the ability of the region to accommodate growth in travel demand.

Steps Taken in COR-3

As stated in the body of the report, COR-3 was applied through four major steps: hold a public meeting at which participants provided early feedback based on COR-1 and COR-2; identify candidate interviewees in both the public and private sector; develop questions for interviews of partners and advisors based on COR-3; and conduct interviews with stakeholders.

- In addition to members of the project team, participants in these *separate interviews* included Banker Steel, Boxley, First National Bank, Foster Fuels, Georgia Pacific, Greater Lynchburg Transit Company, Highland Heights Baptist Church, Liberty University, Lynchburg Regional Airport, Lynchburg Regional Business Alliance, Moore's Electrical and Mechanical, and Nealbrook Chips. The *Campbell County Route 29 Planning Effort Findings Report* lists comments based on the interviews, as well as comments from the first public meeting, on a section-by-section basis for the corridor. For example, for the section between Calohan Road and Route 24, deficiencies include a median crossing where there have been collisions, conflicts at some unsignalized intersections given the 60 mph speed limit, and access via another median crossing to two businesses in particular.

- The results of the interviews (UVA IEN, 2016) and the public meeting underscored a point raised in the review of previous studies by AECOM (2016) in that specific solutions were needed. It was at this stage of the process that the team began to view the corridor as discrete sections; as shown in Figure B3, there were six specific segments of the corridor that could be analyzed. (This fed COR-4 directly.)

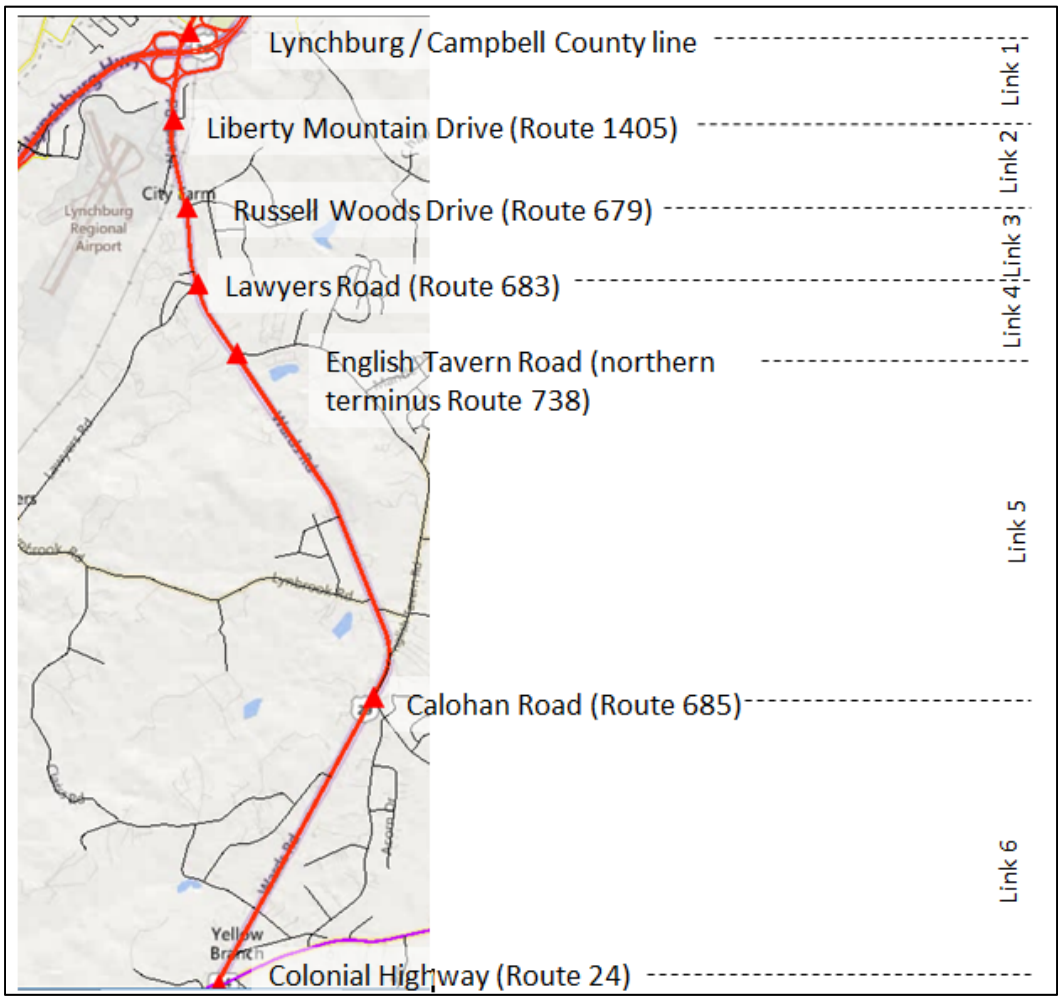


Figure B3. Six Study Segments of the Corridor (VDOT GIS Integrator)

COR-4: Reach Consensus on Scope of Environmental Review and Analysis

Outcomes of COR-4

- *An initial list of six elements—goals, stakeholder comments, objectives, performance measures, quantitative tools, and key data details—was developed as shown in Table B1*.

  In theory, only the goals (which come from COR-3 and the findings in the *Campbell County Route 29 Planning Effort Findings Report*) and the data needs (which come from COR-4) are required for this task, with the performance measures and quantitative tools forthcoming from COR-5. However, development of these six elements enabled the team to better understand which data elements for COR-4 could be the most meaningful. Several comments from the public input meetings relate expressly to transportation safety—a finding not necessarily expected at the time the team sought the grant from FHWA and a finding which places more emphasis on geometric improvements than originally anticipated. Thus, one data need that has become apparent is a fairly detailed understanding of how the physical and operational characteristics of the corridor (lane width, turning movements, signal timings, and possibly sight distance) change by corridor section.

- *It may be appropriate to divide the corridor into six discrete segments for analysis.*

  The stakeholder interviews suggest that the application of performance measures, quantitative tools, and supporting data sets may, in some cases, be performed on six discrete segments as shown in Figure B3: (1) Lynchburg City Limit to Liberty Mountain Drive (Route 1405); (2) Liberty Mountain Drive to Russell Woods (Route 679); (3) Russell Woods to Lawyers Road (Route 683); (4) Lawyers Road to English Tavern Road's northern terminus (Route 738), (5) English Tavern Road's northern terminus to Calohan Road (Route 685), and (6) Calohan Road to Colonial Highway (Route 24). Examples of specific improvements suggested by stakeholders for each section include adding acceleration lanes, closing median crossings, adding speed limits, lengthening turn lanes, adding signals, improving signal timings, and adding service roads.

Steps Taken in COR-4

- Chapter 9, titled *Transportation Systems and Facilities*, from the Campbell County Comprehensive Plan was chosen as a starting point for identifying community values. The Plan identifies two goals: (1) "promote a safe, effective, and environmentally sound transportation system throughout Campbell County" and (2) "promote a transportation system compatible with existing and future planned land uses." These two goals were used by the project management team to identify *possible* goals, objectives, performance measures, quantitative approaches, and relevant key data details as shown in Table B1. Information given in the Plan offered guidance for developing these performance measures. For example, the importance of accommodating truck traffic (given the general freight carriers in the area) and connecting Route 29 to the general freight terminal used by the Norfolk Southern railway (which offers freight service from rail to road at that terminal) offered detail for better understanding the second goal in the Plan. As another example, one of the priority projects for (from the MPO's 2010 bicycle plan which is referenced in the Plan) was to have signing on Route 29 with a wide outside lane (which could accommodate bicyclists). Accordingly, a performance measure based on bicycle level of service (which considers the width of that curb lane) has been included in Table B1. As a third example, the Plan highlights the challenge of congestion on U.S. 29 between English Tavern Road and the border with the City of Lynchburg, with traffic volumes approaching 44,000 vehicles per day. Because the Plan emphasizes the management of access as one tool for accommodating these volumes, measures related to access are included in Table B1.

Table B1. Candidate Performance Measures and Data Needs (Developed in COR-3 and COR-4, but Revised in COR-5)

Goal	Stakeholder Comments	Objective	Performance Measure(s)	Quantitative Tools	Key data details
Promote a **safe** transport system throughout the county.	Roadwork crew safety must be considered as well as motorists. High volume of truck traffic in the area that causes safety concerns Signals are needed to provide safe gaps in the traffic stream. Visibility may be restricted by guardrail over the train tracks and a crest in the intersection at English Tavern Road Lack of acceleration when turning out of a median causes travel problems	Reduce motor vehicle crash risk	Crashes per mile Crashes of a certain type (rear-end crashes) Crashes involving trucks Crashes near spots of reduced visibility	NCHRP Report 420 (relate access points to crash risk)	Crash history in the corridor: 229 crashes for the period January 1, 2010 -October 27, 2015
			Number of stops (or another performance measure)	SimTraffic/Synchro software (evaluate near misses)	Crashes are not always complete (hence simulation results may be needed)
		Reduce non-motorized crash risk	Bicycle Compatibility Index Bicycle Level of Service Quality of pedestrian access for transit stop locations Number of crashes in work zones	Standard methods for applying BLOS and BCI are available (including some online tools) Transit Capacity and Quality of Service Manual chapters 4 and 5	VDOT's Statewide Planning System (SPS) provides BLOS as a baseline measure which can help calibrate calculated values It may be more meaningful to simply indicate "yes/no" in terms of availability of pedestrian features; GIS data may be appropriate.

Goal	Stakeholder Comments	Objective	Performance Measure(s)	Quantitative Tools	Key data details
Promote an **effective** transport system throughout the county.	Traffic signals impede the flow of traffic Traffic signal timing does not account for acceleration of trucks Turning trucks impede traffic because they require more than one lane Turning vehicles at Calohan Rd form a queue that extends to the left passing lane	Reduce delay	Number of times peak travel time in the corridor is below 20 minutes as measured from A to B Time spent at traffic signals Delay caused by trucks at traffic signals	SimTraffic/Synchro software (reports delay as a function of volume)	Should the limits of the corridor be English Tavern Road to Route 460?
		Improve reliability	Coefficient of variation of travel speeds [Various other measures in Task 4] Planning Time Index Buffer Index Misery Index Skew Statistic	Variance in speeds from simulation runs if that is reasonable	Any calibration data challenges would be noted here.
Promote an **environmentally sound** transport system throughout the county.	[The topic of the environment was not mentioned during the stakeholder interviews]	Improve air quality	Greenhouse gas emissions (kg of CO_2)	Sum total fuel consumption from SimTraffic/Synchro (for a given volume) and convert to CO_2 emissions	Should we just use CO_2 or should we consider VOCs and NOx (which are given by Synchro) Is a simple conversion (say 10 kg of CO_2 per gallon of fuel) acceptable?
Promote a transportation system **compatible with existing and future land uses**	Ewing Drive will likely need a signal due to economic development (although this is 1.5 miles south of the corridor)	Improve vehicular access to points in the corridor for passenger travel	Delay for turning left and right into certain businesses	Stopped delay at a given intersection for left or right turning vehicles Delay to reach the mainline from the minor street	At what points should delay be computed (e.g., each intersection or for key businesses)?

Goal	Stakeholder Comments	Objective	Performance Measure(s)	Quantitative Tools	Key data details
		Improve pedestrian access to points within the corridor	Connectivity index (or some other measure indicating the extent to which streets are interconnected) Tabulate the number of parcels where connection points for pedestrians exist	Possibly a GIS layer of local land development	As this pertains to future land use, some data details may be missing from anticipated future development
		Improve freight access within the corridor	Travel time to the Norfolk Southern general freight facility (which offers piggyback service for truck to rail	SimTraffic/Synchro software (reports delay as a function of volume)	The from which travel should be measured is relevant
		Provide an equal level of improvements to all residents of the corridor.	Impacts on high and low income areas: are they the same	Use census data to identify high and low income areas. Use the simulation model to determine if these areas are impacted equally.	Is Census income data available at the block level (or level suitable for analysis?) Can Synchro/Sim Traffic be used to identify positive and negative impacts in the corridor

COR-5: Approve Evaluation Criteria, Methods and Measures

Outcomes of COR-5

- *There are two promising traditional ways of assessing reliability: the planning time index and the buffer index***.**

  Both have been applied to this corridor and will be a baseline for future measures. For example, for a motorist traveling to work to avoid arriving late 90 percent of the time (that is during all but the *worst* peak period travel in a given month), the estimated **planning time index** indicated that, when traveling northbound in the morning peak hour or southbound in the evening peak hour, the expected travel time should be increased by a factor of 1.4 over the *free-flow travel time* (e.g., using the speed limit.) Another interpretation of the 90th percentile value in the planning time index is that assuming approximately 20 working days per month, the 1.4 multiplier should be used by commuters who cannot afford to be late more than twice a month. Further, the **buffer index** (90th percentile) shows that, if a commuter cannot afford to be late to work more than twice per month, he or she should presume that his or her *median* daily commute time will need to increase by roughly 25% and adjust his or her departure time accordingly. A characteristic of these two indices is that they can be dominated by recurring congestion. (If only one of these metrics could be chosen, then the recommendation would be to choose the buffer index.)

- *Crash risk offers a promising nontraditional way of assessing reliability***.**

  While an increase in rush hour travel time may be expected, crashes can lead to unexpected decreases in speeds in the corridor. The Strategic Highway Research Program (SHRP 2) lists safety as one of the important performance metrics to study reliability on a given corridor, as a way of detecting nonrecurring crashes. As a baseline of current conditions, the total number of crashes (fatal, injury, and property damage only) and injury crashes, as well as the rate in terms of number of crashes per million vehicle miles traveled shows higher crash rates in the portion of the corridor with less reliability, which is the northern segment between English Tavern Road and Route 460. Surrogate measures that can help quantify this crash risk include the number of stops (from the SimTraffic simulation package) and the number of access points per mile.

- *Candidate performance measures are (in addition to the planning time index, the buffer index, access points per mile, and number of stops) the delay for turning left and right into certain businesses, and the feasibility of constructing the proposed alternatives***.**

  While the public meeting held June 23, 2016 did not positively confirm or refute these measures, informal comments from participants suggested that at this point in time, it is premature to eliminate metrics from consideration. Informal comments also suggested that participants are interested in seeing action on an alternative be taken: a concern voiced by several attendees was that alternatives which have been discussed in years past (such as construction of a bypass) had not been implemented as VDOT has experienced funding shortfalls in some years. Thus, implementation feasibility is a measure to be considered when solutions are prioritized (in COR-8) (and which ultimately drove the development of the database noted in COR-9).

- *At the next public meeting attendees should be provided with a single page handout that has two pieces of information*.

  The front of the handout should summarize the process used to generate candidate solutions—e.g., establishment of goals, performance measures, and development of a candidate solutions under the limitation of available funds. The back of the handout should summarize a few examples of how

public input was incorporated directly into the solutions. This recommendation is based on the results of the corridor assessment.

- *Attendees expressed a strong interest in some actions that may be feasible*.

  Some comments supported relatively expensive infrastructure: of the 53 comments recorded on the pin map of improvements (see Figure B4), seven referred to a bypass and others (e.g., a new road connection consisting of a ramp to the bypass at Rustburg or "remove a majority (if not all) traffic lights leading into and out of Lynchburg" may not be doable in full. Further a few other comments (electronic speed cameras or a liquor license for a particular establishment) are outside the study scope. However, many comments supported specific, tangible spot improvements that can at least inform candidate solution sets in COR-6 such as rerouting traffic at Rangoon Street, revisiting the speed limit in the corridor, removing signals (although one comment suggested the need for an additional signal at Patterson Road), allowing right turn on red at Calohan Road, making the southern connection of English Tavern Road and Route 29 right-in/right-out only, adding sidewalks, adding bike lanes near Lynbrook Road, and improving or adding deceleration lanes at the median north of Amy Road/Moorman Mill Road.

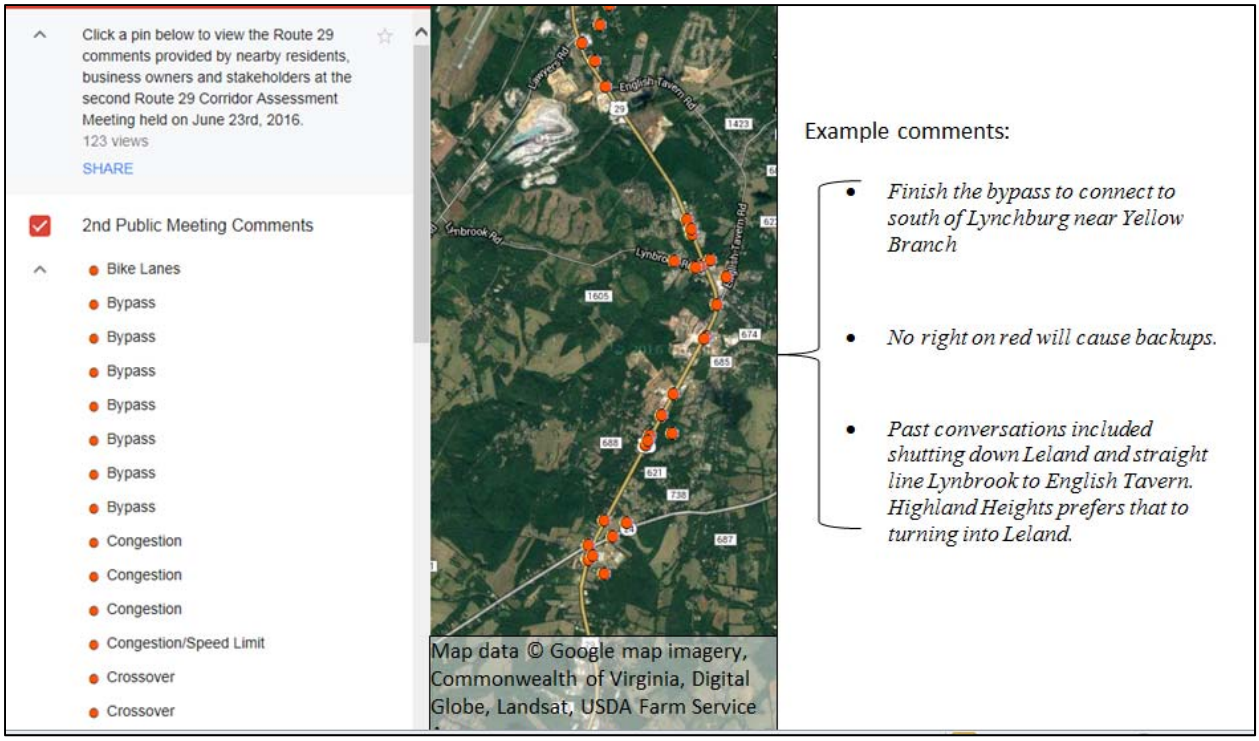


Figure B4. Example of Comments from the Second Public Meeting

Steps Taken in COR-5

As shown in the stand-alone memorandum (AECOM, 2016), a variety of candidate performance measures were considered. Some were eliminated from consideration because they did not meet the core goals of the county comprehensive plan (for example, the Plan does not explicitly consider greenhouse gas emissions). Other measures were eliminated because of imperfect data—for example, while coefficient of variation of travel speeds does directly measure reliability, it may be less understandable than the number of stops. Tentatively recommended metrics are shown in Table B2 based on synthesizing the AECOM June 1 memorandum and the performance measures presented at the public meeting held June 23. At the time COR-

5 was completed, the team noted that "It is still probably the case that not all measures will ultimately be used, but these give a framework for presenting the alternatives from COR-6."

In retrospect, after COR-5 was completed, despite the discussion of how improved reliability could be measured through a reduction in crash risk, the team ultimately assessed reliability through a more traditional performance measure (a travel time reliability index [TTRI]). This resulted because of the need to use performance measures associated with funding sources, and TTRI is used by Virginia's Smart Scale. Thus, later considerations (which came from COR-7, COR-8, and COR-9) ultimately modified the metrics shown in Table B2. That said, Virginia's computation of TTRI does used a surrogate for crash risk, as discussed in Table B3 under COR-6.

Table B2. Tentatively Recommended Performance Measures [b]

Goal	Objective	Performance Measure(s)	Quantitative Tools
Promote a **safe** transport system throughout the county.	Reduce motor vehicle crash risk	• Crashes per mile • Number of rear-end crashes	• NCHRP Report 420 (relate access points to crash risk)
		• Number of stops	• SimTraffic/Synchro software (evaluate number of stops)
Promote an **effective** transport system throughout the county.	Reduce delay	• Number of times peak travel time in the corridor is below 10 minutes • Number of driveways per mile[b] • Number of median crossovers per mile[b]	• SimTraffic/Synchro software (reports delay as a function of volume)
	Improve reliability	• Travel Time Index • Planning Time Index • Buffer Time Index	• The three indices (travel time, planning time, and buffer time) may be influenced more by recurring congestion.
		• Number of driveways per mile[b] • Number of median crossovers per mile[b]	• Nonrecurring congestion can also be captured by the safety measures (e.g., driveways per mile noted previously)
Promote a transportation system **compatible with existing and future land uses**	Improve vehicular access to points in the corridor[c]	• Stopped delay at a given intersection for left or right turning vehicles into certain businesses • Delay to reach the mainline from the minor street	• One could also consider delay to reach the mainline from the minor street

[a] While it does not fit into the goals and objectives per se, the feasibility of implementing a solution is itself a performance measure. This can be addressed by determining, in COR-8, if enough information regarding the solution is available so that it can be prepared for candidate funding sources.
[b] It may be the case that ultimately these measures are not carried forward if they duplicate the other metrics shown.
[c] An earlier version of this table had the objective "improve nonmotorized access to points in the corridor" with a performance measure being a level of service measure for pedestrians and bicyclists. However, because nonmotorized access improvements may be part of any package of projects, such a performance measure may not help discriminate among project alternatives and thus is not shown in Table B2.

An earlier version of the performance measures shown in Table B2 were presented at the public meeting held June 23, 2016. The first portion of the meeting consisted of two presentations (Figure B5) with the latter part

of the meeting giving attendees a chance to provide comments—both aloud and on handwritten maps (Figure B6). The meeting was not as well attended as the initial public meeting, however, one factors may have contributed to the lower-than-expected turnout: a severe storm (with hail) had been forecast and in fact this storm struck during the meeting. Because of the loud noise from the hail, it was necessary to interrupt the presentation a few times until the storm softened such that the speakers could be heard—which demonstrated the value of the handouts.

Table B2 uses Context Sensitive Solutions (CSS) concepts but does not show a specific CSS performance measure. Rather, four attributes of CSS are evident in the performance measures: (1) supporting all users of the transportation system; (2) reflecting community values; (3) integrating solutions throughout the design of solutions in COR-6; and (4) joint consideration of land use and transportation investments. For example, the application of principles 1 and 4 is evident in that diverse users (freight, pedestrian, and bicycle) are considered in the goal of integrating transportation and land use investments. The goals shown in Table B2 originated from the county comprehensive plan, thereby supporting the second CSS principle.

Figure B5. (*left*) Presentation by Paul Harvey, Campbell County; (*middle*) Presentation by Chris Lawrence, AECOM; (*right*) attendees listening to the presentations at the Second Public Meeting.

Figure B6. Attendees review plans after the presentations at the Second Public Meeting

Note that several candidate performance measures noted in COR-3 (see Table B1) were ultimately not selected due to either incomplete data, difficulty with computing the measure, or concerns that the measure would not provide insights into project selection:

- *Greenhouse gas emissions* are difficult to evaluate as traffic counts were only taken at signalized intersections, yet many of the proposed changes will involve unsignalized intersections for which we don't have traffic data.

- As there is little interconnectivity of streets at present, and because it is not reasonable to determine future land uses in detail, the *connectivity index* was eliminated.

- Nearly all of the parcels lack pedestrian facilities, thus tabulation of the *number of parcels with pedestrian accommodations* was eliminated.

- The *travel time to the Norfolk Southern general freight facility* is not known and appears to duplicate the reliability metrics that have been chosen.

- Impacts on *high and low income areas* were eliminated because almost the entire frontage of Route 29 is either zoned business or industrial; further, measuring the impacts to the adjacent residential areas would be difficult to clearly quantify.

These changes thus led to the performance measures shown in Table B2.

COR-6: Approve Range of Solution Sets

Outcomes of COR-6

- *Four candidate solution sets have been identified, where each solution set identifies multiple solutions*.

  In contrast to some corridor studies where one might choose a single alternative, the solution sets are designed such that one is not required to choose one particular set; rather, it is expected that stakeholders may choose elements from multiple solution sets. Each solution set has a theme: (throughput, safety, economic development, and innovative ["smart"] approaches). The four solution sets contain geometric changes relating to the spacing of access points, operational changes such as signal retiming or the installation of a flashing yellow arrow, land access approaches, accommodation of pedestrian and bicycle modes through sidewalks and shared use paths, and new technologies such as a traffic management system. Figure B7 shows how some of these solution sets compare at one particular location: Route 29 and Russell Woods Drive, one of several intersections within the corridor. At that intersection, solution sets one and two show access-related improvements, such as closing the median, extending a left turn lane, and making a commercial driveway right-in/right-out only. At that same intersection, solution set 3 adds a two-way left turn lane and a continuous right turn lane, thereby increasing access to businesses. At that same intersection, solution set 4 adds a shared use bicycle/pedestrian path for the length of the corridor. To be clear, Figure B7 only shows the geometric improvements; for example, while solution sets 1 and 2 have identical geometric changes to that intersection; solution set 2 also includes speed limit changes and the addition of signals to improve safety at other locations in the corridor, and solution set 4 also includes a Traffic Management System (TMS) for the entire area. These four solution sets were presented during the third public meeting held October 27, 2016.

Solution Sets 1 and 2

Install westbound left turn lane

Extend eastbound left turn lane

Install commercial driveway (right-in, right-out, limited lefts)

Close median

Solution Set 3

Install continuous right turn lane east of the intersection

Install two-way left turn lane west of the intersection

Solution Set 4

Add shared use-path for bicyclists and pedestrians (eastbound and westbound)

Figure B7. Examples of Improvements from the Four Candidate Solution Sets at the Intersection of Russell Woods Drive and Route 29.

- *The four solution sets are designed to be complementary, not mutually exclusive.*

  It is conceivable that there will not be just one "solution set" which is adopted. *Rather, elements of each solution set may be adopted into a proposed "blended" solution set*. For example, one might choose median closures (from solution set 1), speed limit changes (from solution set 2), a two-way left turn lane (from solution set 3), and signal optimization along with a shared-use path (from solution set 4).

Steps Taken in COR-6 (Iteration 1)

A draft memorandum developed by AECOM on August 30, 2016 introduced baseline and forecast (year 2040) conditions for the corridor, in terms of intersection delay and crash risk. The memorandum also outlined four candidate solution sets, where each solution set contained multiple actions, such as geometric improvements (e.g., reducing the number of access points), operational changes (e.g., changing signal timings or, in some cases, the locations of the signals themselves), and administrative changes (such as how the transportation corridor overlay district is implemented). For example, one element of the third solution set was a continuous two-way left-turn lane for the length of the corridor. For that element, the memorandum showed that some decrease in fatal and injury crashes could be expected in year 2040; the memorandum explained that this could be quantified as 155.60 equivalent property damage only (EPDO) crashes, based on application of crash modification factors from the FHWA Crash Modification Factor (CMF) clearinghouse for a two-way left-turn lane. As another example, one element in the fourth solution set was signal optimization, where a reduction of the 62.24 EPDO crashes was estimated. In addition to impacts on expected crashes, the memorandum quantified the expected delay impacts of some improvements. For example, one element of solution set 1 (adding a flashing yellow arrow to the intersection of Route 29 and Calohan Road to provide a permitted left turning phase rather than a protected only left turning phase) was expected to reduce 2040 average intersection delay from 68 seconds to 41 seconds during the peak hour. This memorandum was reviewed at an internal team meeting held on September 2, 2016.

- *The impacts of the elements of each solution set in terms of performance measures similar to those identified in COR-5 were determined*.

  Recall that COR-5 identified three goals, abbreviated here as promote a safe transport system, promote an effective transportation system, and promote a transportation system compatible with existing and future land uses. For each goal, at least one performance measure is given (reduction in equivalent property damage only (EPDO for fatal and injury crashes for the first goal, reduction in vehicle hours of delay in the corridor and improvement in the travel time reliability index for the second goal, and reduction in movement delay for left and right turns for the third goal). The impact of each element from each of the four candidate solution sets on these measures has been determined.

  For example, consider the first goal (promote a safe transportation system). The performance measure is the *equivalent property damage only* (EPDO) of fatal and injury crashes expected to be reduced. (EPDO is a way of weighting crash reductions by severity level: the Smart Scale Technical Guide [VDOT, 2016] indicates four weights: 540 points [for fatal crashes], 30 points [for severe injury crashes], 10 points [for moderate injury crashes], and 5 points [for minor injury crashes]. Thus suppose a hypothetical improvement was believed to reduce all crash severities by 12%, and it was applied to a site where the number of crashes (without treatment) was 0 fatal, 1 severe injury, 2 moderate injury, and 5 minor injury. The EPDO for fatal and injury crashes expected to be reduced for this hypothetical improvement would be calculated as (0 fatal crashes)(540 points)(12%) + (1 severe injury crash)(30 points)(12%) + (2 moderate injury crashes)(10 points)(12%)+ (5 minor injury crashes)(5 points)(12%) = 9. In practice, the EPDO in fatal and injury crashes will vary for each improvement type and by location. For example, consider a T-intersection with Route 29. The expected EPDO reduction in fatal and injury crashes that results from eliminating all left turns (except from Route 29) is estimated to be 0.35 for one intersection (Route 29 and Dennis Riddle Drive) but

more than ten times that amount (4.90) for another intersection (Route 29 and a business south of Baker Road), as shown in Figure B8.

Figure B8. Examples of Eliminating Left Turns (Except From Route 29) at T-intersections. (*left*: Dennis Riddle Drive. *right*: access for a business south of Baker Road.)

Table 18 - Performance Measures Applied to the Candidate Solution Sets

Goal	Objective	Performance Measure	Set 1 - Arterial Capacity and Throughput	Set 2 - Corridor Safety	Set 3 - Economic Development	Set 4 - Smart and Alternative Transportation Solutions
Promote a Safe Transportation System	Reduce motor vehicle crashes	Equivalent Property Damage Only (EPDO) of fatal and injury crashes expected to be reduced	• 31 - Median Crossover Closures • 11 - Turn Lane Extensions • 13 - New Turn Lanes • 9 - RCUT Intersections	• 190 (Fatal Injury) & 72 (Serious Injury) - Speed Limit Reduction • 31 - Median Crossover Closures • 11 - Turn Lane Extensions • 13 - New Turn Lanes • 9 - RCUT Intersections	• 156 - Install TWLTL in median space along Route 29	Traffic Management System • 252 - Red Light Camera • 132 - Speed Enforcement Cameras • 62 - Signal Optimization
Promote an Efficient Transportation System	Reduce delay	SimTraffic delay - 2040 conditions	• 0.80 min. decrease - Flashing Yellow Arrow (FYA) Installation at Calohan Rd. and Route 29 intersection	• 4.91 min. increase (two directions combined)- Speed Limit Reduction along Route 29	N/A	N/A
	Improve Reliability	Travel Time Reliability Index	• 1.00 - Median Crossover Closures • 0.50 - Median Left-In Only with Right-In/Right-Out • 2.75 - Left Turn Lane Extensions • 0.75 - Right Turn Lane Extensions • 0.25 - Left Turn Lane Addition • 0.75 - Right Turn Lane Addition • 0.25 - RCUTS • 0.25 - Install FYA at Calohan Rd. Signal	• 1.00 - Median Crossover Closures • 0.50 - Median Left-In Only with Right-In/Right-Out • 2.75 - Left Turn Lane Extensions • 0.75 - Right Turn Lane Extensions • 0.25 - Left Turn Lane Addition • 0.75 - Right Turn Lane Addition • 0.25 - RCUTS • 3.00 - Proposed Speed Limit Changes	• 0.25 - Future Signal Locations: Moorman Mill Road Patterson Road Lynbrook Road Hyland Drive • 2.75 - Install Two-way left-turn lane within the median space along Route 29	• 1.50 – Traffic Management System to include red-light camera, speed enforcement cameras, and signal optimization/adaptive
Promote a Transportation System Compatible with Existing and Future Land Use	Improve vehicular access to points in the corridor for passenger travel	Movement Delay for turning lefts and rights at existing and proposed solution conditions - 2040 conditions				N/A

RCUTs (Movement Delay/Veh. (sec.)) with Existing Corridor Speed Limit

Intersection	NBL	SBL	EBR	WBR	NBU	SBU
Moorman Mill Rd	10.5 (17.0)*	15.2 (10.9)	15.3 (34.7)	28.2 (16.3)	12.8 (86.8)	22.8 (11.2)
Patterson Rd	10.5 (17.0)	27.2 (15.1)	15.3 (34.7)	N/A	10.6 (50.7)	46.6 (10.5)
Lynbrook Rd	9.9 (16.5)	27.0 (15.3)	14.0 (32.8)	88.5 (28.7)	52.8 (81.8)	324.4 (36.8)
Hyland Drive	9.9 (16.5)	27.0 (15.3)	14.0 (32.8)	88.5 (28.7)	56.8 (42.6)	469.2 (53.7)

Median Crossover (Movement Delay/Veh. (sec.)) with Existing Corridor Speed Limit

Median Locations on Route 29 Corridor	NBL	SBL	EBR	WBR
Northern End of Corridor	10.8 (25.2)	26.1 (15.1)	∗	∗
Southern End of Corridor	9.9 (15.6)	14.0 (10.3)	∗	∗

RCUTs (Movement Delay/Veh. (sec.)) with Speed Limit Changes along the Corridor

Intersection	NBL	SBL	EBR	WBR	NBU	SBU
Moorman Mill Rd	10.5 (17.0)	15.2 (10.9)	15.3 (34.7)	28.2 (16.3)	12.6 (103.0)	23.0 (14.8)
Patterson Rd	10.5 (17.0)	27.2 (15.1)	15.3 (34.70)	N/A	10.3 (51.2)	33.6 (14.5)
Lynbrook Rd	9.9 (16.5)	27 (15.3)	14.0 (32.8)	88.5 (28.7)	10.0 (76.8)	160.7 (33.9)
Hyland Drive	9.9 (16.5)	28 (15.3)	14.0 (32.8)	88.5 (28.7)	13.4 (33.8)	385.5 (33.9)

Median Crossover (Movement Delay/Veh. (sec.)) with Existing Corridor Speed Limit

Median Locations on Route 29 Corridor	NBL	SBL	EBR	WBR
Northern End of Corridor	10.8 (25.2)	26.1 (15.1)	∗	∗
Southern End of Corridor	9.9 (15.6)	14.0 (10.3)	∗	∗

Future Signalized Intersections

Proposed Signalized Intersection	AM Overall Intersection Delay/Veh. (sec)	PM Overall Intersection Delay/Veh. (sec)
Moorman Mill Rd	22.2 (LOS C)	29.6 (LOS C)
Patterson Rd	14.4 (LOS B)	50.1 (LOS B)
Lynbrook Rd	29.9 (LOS C)	22.8 (LOS C)
Hyland Dr	21.1 (LOS C)	18.0 (LOS B)

VDOT Planning Level Cost Estimates per Solution Set	$11,280,000	$10,420,000	$26,550,000	$11,445,000

∗- Movement Delay Exceeds 300 seconds *XX(XX) - AM(PM) Peak Hour

Figure B9. Performance Measure Impacts of the Four Candidate Solution Sets, Final Version. (Initially based on Table 18 of AECOM Technical Memo dated October 17, 2016, however, EPDO for RCUTs and Median Crossover Closures were updated from 5 to 9 and from 34 to 31, respectively, as shown. On February 27, the number of new turn lanes projects was updated from 11 to 13 as shown, and total costs were changed from $11,155,000; $10,295,000; $26,350,000; and $11,445,000 for solution sets 1, 2, 3, and 4, respectively, to the values shown in Figure B9.

The benefits resulting from such individual improvements, such as median closures, extensions or additions of turn lanes, changes in speed limits, and so forth, may then be aggregated for each of the four solution sets. Figure B9 shows that, for the four solution sets, the expected EPDO reduction for fatal and injury crashes are as follows: 61 (solution set 1-arterial capacity and throughput); 251 (solution set 2-corridor safety); 156 (solution set 3—economic development); and 446 (solution set 4—smart and alternative transportation solutions). Figure B9, which is an excerpt of the attached memorandum from AECOM, summarizes these impacts for each candidate solution set. These have been provided to the public (click here for the website or go directly to http://www.virginiadot.org/projects/lynchburg/route_29__corridor.asp).

- *Planning level costs for each of the solution sets have been identified*.

  For example, the cost of adding a left turn lane at each intersection ($225,000) to eight intersections in the corridor (for a total of $1.8 million) is shown in Table 19 of the AECOM memorandum. That memorandum gives a rough indication of how the cost magnitude varies by element; for instance, the cost of adding a continuous two-way left-turn lane from solution set 3 ($12 million) is more than six times the cost of adding the left turn lane at all eight intersections ($1.8 million) in solution set 1. By contrast, the proposed realignment of Rangoon Street (Figure B10) such that Rangoon Street intersects Terminal Drive rather than Route 29 would cost only $50,000—slightly less than a quarter of the cost of adding a new turn lane to an existing intersection. The proposed restricted crossing U-turn intersection (RCUT)—which eliminates left turns from the minor approaches as well as through movements from the minor approaches—has a considerably larger cost ($1.25 million per intersection).

Figure B10. An Example of a Low-Cost ($50,000) Improvement (realigning Rangoon Street to intersect Terminal Drive rather than Route 29).

- *Projects have been partially prepared for use with candidate funding sources. The two chief funding sources for these candidate solution sets are believed to be the Highway Safety Improvement Program (HSIP) and the Virginia Smart Scale*.

  For a project to receive funding under Smart Scale, the project must be scored by the submitter across a dozen criteria (for projects that are in areas of under 200,000 people, such as Lynchburg). The impacts for three of those criteria have been computed: EPDO of fatal and injury crashes expected to be eliminated by the project, EPDO of fatal and injury crashes expected to be eliminated by the project *per 100 million vehicle miles traveled*, and the travel time reliability index (TTRI). Each criterion requires a mix of data and judgment to compute. For example, consider the third criterion (TTRI) and one solution from candidate solution set 1: closure of median crossovers. The TTRI is computed as shown in Table B3 and found to be 1.0.

Table B3. Example of Scoring a Project (Closure of Median Crossovers) based on One Smart Scale Criterion: TTRI [a]

Step	Value	Explanation
Compute buffer time index	0.25	BTI was estimated using INRIX speed data and it was found to vary between 0.23 and 0.25. The value of 0.25 was adopted for this corridor.
Determine impact of incidents	2.0	The Smart Scale Technical Guide (p. 77) suggests an impact value of 2 for projects "directly improving incident frequency" and median closure is believed to fall directly in this category.
Determine frequency of incidents on the network using historical crash data	1.0	The Smart Scale Technical Guide (p. 77-78) suggests using Equivalent Property Damage Only (EPDO) value as a surrogate measure to determine frequency of incidents. The estimated EPDO value for closure of median crossovers was between 25 and 75, which corresponds to an incident frequency score of 1.0.
Determine impact of weather events	2.0	The Smart Scale Technical Guide (p. 78) suggests an impact value of 2.0 for projects that "directly mitigate weather events by geometric improvements" and median closure is believed to fall directly in this category.
Determine frequency of weather events using historical weather data	1.0	With lack of historical weather data available, the team assumes 20-40 hours of combined weather events per year, which would correspond to a value of 1.0 (Smart Scale Technical Guide p. 78).
Compute TTRI (Travel Time Reliability Index)	1.0	TTRI = Buffer Time Index * (Impact of Incidents*Incident frequency) + (Impact of weather * Weather frequency) = 0.25 * (2*1 + 2*1)

[a] Virginia Department of Transportation. *Smart Scale Technical Guide*, Richmond, (September 9) 2016. http://vasmartscale.org/documents/201606/sstechnicalguide_final_9_8_2016.pdf. Accessed October 12, 2016.

Steps Taken in COR-6 (Iteration 2)

During the review of the candidate solution sets, project team members considered three questions that are shown within the PlanWorks Policy Questions for COR-7 (but which were chosen because they are relevant to evaluating solution sets in COR-6):

1. Are any solution sets fatally flawed?
2. Is the range of solution sets broad enough to address corridor goals?
3. Are there certain combinations of solution sets that are essential to consider

A draft memorandum provided by AECOM on August 30 served as a briefing tool for the project team on September 2, 2016. The team's answers to the above questions guided revisions to the candidate solution sets.

1. Are any solution sets fatally flawed?

   - The second candidate solution set included one solution which was to tighten the ordinance governing the transportation corridor overlay district. The TCOD currently requires a minimum frontage for any lot adjacent to a primary highway (such as Route 29) of 800 feet (which may be reduced if access points are shared). Because the underlying zoning allows a frontage of 75 feet, and because the area contains numerous narrow lots, a recommended change was to expand the minimum lot frontage from 75 feet to 200 feet. However, a county staff member noted that in practice, developers tended not to build commercial infrastructure on a single small lot; rather, developers tended to acquire multiple lots and then combine them. Because such a proposed change could be seen as adding additional regulations, and given that the constituency in this

location strongly prefers non-regulatory approaches, making the TCOD seem restrictive (even if those restrictions would not materially affect actions taken by persons in the corridor) could make the solution set difficult to implement.

- The candidate solution sets also included locations where traffic signals might be added and where speed limits might be decreased. In some cases it might be possible to justify these solutions on the basis of safety, however, it was noted that in general, actions such as reducing travel speeds and adding signals would receive a very high level of scrutiny.

- There have been some minor changes in the corridor that eliminated the need for a few of the specific geometric improvements cited. For example, the abandonment of a particular road (Quartz Road) by the state DOT, the adjacent reconstruction of a commercial entrance (to become a right-in/right-out entrance), and the change in the median opening in the proximity of this reconstruction (to have a left-turn only), eliminated the need for one of the four recommended conversions of median crossovers to median left-in only movements for candidate solution set 1.

2. Is the range of solution sets broad enough to address corridor goals?

- The solution sets were indeed broad—addressing safety, congestion, economic development, and multimodal solutions. Further, the impact of the solution sets on safety, through estimates of how 2040 crashes would be affected, was promising. Thus given the goal established in PlanWorks COR-5 of "promote a safe transport system throughout the county" it was possible to determine how each element in each solution set affected that goal. For example, the impact of extending a left turn lane at the southern connection of English Tavern Road and Route 29—one of ten such extensions proposed for candidate solution set 1—was expected to reduce 7.35 EPDO crashes.

- Following the example of how the crash impacts of solution set elements were reported, a revision was suggested: provide similar indicators of performance for the remaining two PlanWorks goals: "promote an effective transport system throughout the county" and "promote a transportation system compatible with existing and future land uses." For example, elements of candidate solution set 4 including providing shared-use paths and better signal coordination. The latter element can use performance measures presented in COR-5 (such as delay in the corridor or stopped delay for certain businesses) and while a performance measure associated with the former was not immediately apparent, it seemed plausible that candidate measure might be number of persons served by alternative modes.

3. Are there certain combinations of solution sets that are essential to consider?

- Several public comments had suggested that a bypass around Route 29 should be considered. This concept had arisen through seven public comments made during the first public meeting held January 28 and then through another seven public comments made during the second public meeting on June 23rd. Additionally, one project team member observed numerous responses on social media for this project, asking why the study had not considered a bypass. Although the study had been focused on lower cost alternatives that could be implemented within the corridor (rather than the additional cost and expense of new right of way acquisition), there clearly were individuals who felt the scope should be expanded. Accordingly, in reviewing the candidate solution sets, one modification was to clarify the reasons for having to exclude a bypass from the candidate solution sets, with such reasons including cost, environmental impacts, and feasibility of construction.

- The solution sets had considered the "Smart Scale" funding source. (While the acronym refers to System for the Management and Allocation of Resources for Transportation, this is a prioritization process for ranking transportation projects submitted by local governments [such as Campbell County] and MPOs [such as the Central Virginia MPO, which is staffed by the Regional 2000 Planning District Commission whose staff have been active in this study]). However, there are other funding sources besides Smart Scale, such as the Highway Safety Improvement Program (HSIP) (used for at-grade rail crossings, highway safety, and bicycle or pedestrian safety); the State of Good Repair (SGP) program (used for pavements and bridges); the Revenue Sharing Program (where VDOT and the localities may share the costs of projects); and the Transportation Alternatives Program (TAP) (which can be used for funding pedestrian and bicycle trails.) Note that TAP now encompasses programs which had previously been separate: Safe Routes to School, Transportation Enhancement, and the Recreational Trail Program.

- *Revise Solution Sets Based on Project Partner Input*

  AECOM revised the solution sets based on these comments. Key changes included (1) the addition of a summary table showing how each solution set affected performance measures (Figure B9 presented in this Appendix), (2) computation of the costs for the solutions and how they would affect scoring across PlanWorks, (3) additional discussion of the pros and cons of the various solution packages, and (4) an explanation of why the bypass was not part of the candidate solution sets. As an example of the first two changes, the discussion points out that the costs of reducing crashes with a two-way left-turn lane (estimated cost of $12 million) is more than double the cost of providing turn lane extensions plus new turn lanes (roughly $5 million). As an example of the third type of change, the discussion notes that modification of the corridor overlay district could require extra effort on behalf of landowners to coordinate access points. Finally, the discussion explains that the bypass has not been considered for the past two decades but has a total cost of roughly $100 million, whereas the total funding available for the entire region (Campbell County which is the focus of the study plus the adjacent jurisdictions of Lynchburg, Amherst, and Bedford) is $137 million.

  Notice that because it is a required performance measure for Smart Scale, TTRI, rather than crash risk reduction, was used to assess reliability.

COR-7: Adopt Preferred Solution Set

Outcome of COR-7

Table 3 in the body of the report (and as detailed in Table B4 in this Appendix) summarizes the blended solution set for the corridor improvements. A total of $19.43 million in improvements have been identified, and pending the result of a presentation by the Campbell County Director of Economic Development to the County Board of Supervisors, the elements of the blended solution set will be pursued through three distinct funding sources: Virginia's Smart Scale, the development of the MPO Constrained Long Range Plan, and the Highway Safety Improvement Program. Approximately a quarter of these funds (26%) would be used to improve local vehicular access within the corridor—that is, ways for drivers to enter and exit local businesses, such as through the addition of turn lanes. Almost half the monies—about 46%--would support local pedestrian and bicycle access along the corridor. About 28% of the investments would support through mobility (e.g., closing median openings). Note that nearly all of the improvements address safety, especially the access modifications which reduce the number of conflict points. As discussed COR-9 and as initiated in COR-6, part of the planning effort has been to prepare these projects for submission to these funding sources.

Table B4. Results of COR-7: Preferred Solution Set (Known as the "Blended" Solution Set when Presented)

Solution Element	Number of sites	Cost	Impact Area
Closure of Median Crossovers Low Cost	2	$20,000	Mobility [a]
Closure/Modification of Median Crossovers High Cost	10	$250,000	Mobility [a]
Lengthen Left Turn Lane Storage & Taper	13	$1,300,000	Local access [b]
Install Left Turn Lane	8	$1,800,000	Local access [b]
Lengthen Right Turn Lane Storage & Taper	5	$500,000	Local access [b]
Install Right Turn Lane	6	$1,350,000	Local access [b]
Various Signal Improvements (Calohan Road)	1	$10,000	Local access [b]
Access Modification - Antsey Road	1	$25,000	Mobility [a]
Access Modification - Realignment of Lynbrook Road	1	$775,000	Mobility [a]
Access Modification - Realignment of Lawyers Road	1	$650,000	Mobility [a]
Access Modification - Realignment of Rangoon Street	1	$50,000	Mobility [a]
Install RCUT Median Access Points	3	$3,750,000	Mobility [a]
Sidewalks - Calohan to Rt. 460	1	$2,750,000	Local access [b]
Shared Use Path - Calohan to Rt. 460	1	$6,200,000	Local access [b]
Speed Limit Reduction	2	Minor Costs	Local access [b]
Total cost		$19,430,000	

Steps Taken in COR-7

COR-7 was largely completed in its initial form at the third public meeting held October 27 but was also revised as part of COR-8 and COR-9. Based on the results of the stakeholder assessment, attendees were provided with handouts regarding the overall process, where the emphasis of this public meeting was geared toward identifying implementable solutions. Two major deliverables were considered—first, the four candidate solution sets in the areas of safety, capacity, economic development, and "SMART" strategies (smart and alternative transportation solutions), and second, public reaction to the blended solution set was sought. Comments came from two sources—a roundtable discussion and comments placed on the maps.

Comments Based on Roundtable Discussions

Attendees were presented with the four solution sets as discussed in the earlier report to FHWA regarding Tasks 6 and 7. For each of these solution sets attendees were asked three questions. (These questions were chosen based on the policy questions shown in COR-7, COR-8, and COR-9). With one member from each team at each table, it was possible to directly answer questions posed by stakeholders.

- Is it clear what the solutions mean? If not, what questions do you have?
- Is it clear how different solutions relate to the outcomes of through-travel, safety, economic development and "SMART" transportation?
- Are there any surprises or insights about the solutions?

Attendees were then presented with a blended solution set (see Figure B11), where the blended solution set was a hybrid of candidate solutions.

Solution Elements	*Emphasis Areas (Theme)*				Cost Range **Per Location**	Blended Solution Package
	Arterial Capacity and Throughput	Corridor Safety	Economic Development	"SMART" and Alternative Transportation Solutions		
Closure of median crossovers	++	++	– –	+	$	X
Modify existing median crossovers: left-in only with right-in/right-out	++	++	–	+	$	X
Restricted crossing U-turn (RCUT) intersection	++	++	–	+	$$$	X
New turn lanes and improvements to existing turn lanes	++	++	+	+	$$	X
Signal modification: Flashing Yellow Arrow (FYA)	++	–	+	+	$	X
Modify current Transportation Corridor Overlay District	↔	++	++	↔	$	
Reduction in existing speed limits along the corridor	–	++	↔	+	$	X
Realign roadway/modify access: Anstey Road, Leland Road, Rangoon Street, Lawyers Road	++	+	++	++	$-$$$	X
Two-way left-turn lane (TWLTL)	+	+	++	↔	$$$$*	
Continuous right-turn lane	+	+	++	↔	$$$$*	
Future traffic signals	– –	+	++	↔	$$	
Traffic Management System - red light cameras, speed enforcement cameras, signal optimization	+	+	↔	++	$$	
Multi-modal services: sidewalks and shared-use paths	↔	+	+	++	$$$$*	X

Emphasis Area Key:

☐ Solution element is included in emphasis area.
++ Moderate improvement in current conditions (or very good alignment with funding sources).
\+ Minor improvement in current conditions (or good alignment with funding sources).
– Minor reduction in current conditions.
– – Moderate reduction in current conditions.
↔ Change from current conditions and/or alignment with funding source will depend upon specification.

Cost Estimate Key:

$	≤$50,000
$$	$50,001 - $775,000
$$$	$775,001 - $1,500,000
$$$$	≥$1,500,001
*	Continuous improvement throughout most of corridor.

Figure B11. Route 29 Blended Solution Matrix

Attendees' answers to the following questions were recorded:

- Do you think some people might object to a particular solution? What objections do you think they might have?
- What could be done to improve or enhance the solution package?
- Are there any solutions that you personally would be willing to actively support and help implement?

The intention was that each question would be answered separately, however, generally the comments received could be categorized as either supporting a change, being concerned about a change, or raising a suggestion (or additional comment). For example, consider the eight comments that were received concerning changing the speed limits. Of those eight comments, three clearly supported lowering speed limits, four were concerned with lowering speed limits, and one contained a suggestion about how speeds should be managed. (Table B5 also shows that there is some uncertainty when categorizing these comments; for example, comment 5 might be categorized as both concern about speed limits as well as providing a suggestion. Similarly, comment 7 could be categorized as a concern [given the literal use of the word "concern"] or a suggestion [minimize speed limit changes, as the professional facilitator who was at that table explained that the comment was support for lowering the speed limit on a stretch of road to match the "bookends" of lower speed limits at either end of that stretch of road..) Table B5 also shows that there can be areas of disagreement, as shown between comments 2 and 4 regarding the 35 mph speed limit.

Table B5. Example of Comments Received at the Third Public Meeting Pertaining to Speed Limits (Based on the Discussion at the Tables)

No.	Comment	How Categorized
1	Yes to a 45 mph speed limit north of Calohan	Support
2	OK with 45 mph step-down to 35 mph between English Tavern and end of subsection 3 (north end)	Support
3	For English Tavern south, there is composition of land uses - slower speed limits make sense there.	Support
4	35 mph speed limit is totally unacceptable.	Concern
5	45 mph from English Tavern Road to end of subsection 6 (at south end), is too low. Move to 55 mph after English Tavern Road, but maintain existing short 45 mph zone leading up to Calohan Road intersection.	Concern
6	Don't want to reduce speed limits.	Concern
7	There are concerns about raising and lowering speed limits on the corridor and creating speed traps. It is better to have a more consistent speed limit throughout the corridor.	Concern
8	If any speed limits are reduced, state should be committed to hiring at least one new trooper to patrol it regularly.	Suggestion

Table B6 summarizes the 47 comments received based on the discussions at the tables as recorded by team members. The first column shows the general area, such as building a bypass, modifying crossovers or turn lanes, or adding sidewalks. The next two columns show examples of comments that, in the team's opinion, exemplified either support for improvements or concern about the improvements. The right column shows examples of comments that related to a suggestion or which posed a question. The total number of comments in each category is shown in parentheses. For example, for crossovers and turn lanes, one comment is shown in Table B6. The other three comments that were categorized as supporting in this regard (but which are not given in Table B6) were "There may be too many crossovers north of Lawyers Road," "No objection to proposed median crossover closure," and "Support for closure of some medians, providing right turn only."

Table B6. Summary of Public Comments from the Third Public Meeting (Based on Discussions at the Tables)

Area (total comments)	Example of a supporting comment (total comments)	Example of a concern comment (total comments)	Example of a comment related to a suggestion or a question
Bypass **(3)**	• Bypass for the project area and Charlottesville would bring economic opportunity form North Carolina. **(1)**	• While a bypass increases flow, it may adversely affect business. **(1)**	• Need to address costly long-range projects in a productive way, that captures preference but allows conversation for other smaller-scale preferences. **(1)**
Crossovers and turn lanes (**14**)	• Closure of crossovers, and going south to go north on 29, makes sense. It is too risky to cut across two lanes of traffic to directly access the current crossover, and make a left onto 29 north **(4).**	• Closing medians will reduce access to businesses **(2)**	• Consider u-turns, which are easier than trying to cross traffic. • Close the southern crossover from English Tavern Road. (**8**)
Extra lane or congestion reduction (**5**)	• Supports efforts to reduce congestion at Lawyers Road from west side of road. (**1**)	• None	• Add a third lane in the most congested area (Route 460 to English Tavern). (**4**)
Restricted Crossing U-Turns (RCUTs) (**4**)	• None	• The RCUT is too dangerous with the speed. Do RCUTs cause people to speed up or slow down? (**1**)	• Consider Superstreets at RCUTS • The concept of the matrix was too general, and then realized that the maps provide greater detail. (**3**)
Sidewalks (**3**)	• Sidewalks make sense through subsections 1 and 2, up to Lawyers Road. Pedestrian areas within area of airport make sense. (**1**)	• Do not support high price tag for sidewalks and multi-use paths outside of subsections 1 and 2. (**1**)	• Consider deleting the sidewalk and/or the multi-use path. Would be under-utilized unless Liberty University expands south. Bike riders will go to the Parkway, etc. for a safer ride (very few 18-wheel trucks) and a better view. (**1**)
Speed Limits (**8**)	• For English Tavern south, there is composition of land uses - slower speed limits make sense there. (**3**)	• 35 mph speed limit is totally unacceptable. (**4**)	• If any speed limits are reduced, state should be committed to hiring at least one new trooper to patrol it regularly. (**1**)
Traffic signals (**4**)	• Would like to see Traffic Management System implemented (for trucks and out-of-area through traffic. (**1**)	• More stop lights and lowering speed limit will not help traffic flow. (**1**)	• Improve timing of lights, so that traffic does not hit multiple red lights. (**2**)
Other (**6**)	• Most interests in improving arterial capacity and throughput (speed and mobility). (**1**)	• The presentation should have spent a bit more time on explaining the tradeoffs associated with different solutions. (**1**)	• There are different interests associated with different users: Those who live within the project area, and those using as a through road. **(4)**

Comments Based on Maps of the Blended Solution Set

Note that there were two potentially overlapping sources of comments from the third public meeting. The aforementioned comments reported in Tables B5 and B6 were based on a spreadsheet of 47 comments

recorded on worksheets by one team member who sat at each table (or comments may have been turned in by participants.) These comments are not necessarily tied to a specific geographic location. Another 56 comments were written by attendees on the map of the blended solution set, and these comments are tied to a specific geographic location and are available on the public website (e.g., http://www.virginiadot.org/projects/lynchburg/route_29__corridor.asp). There is potential overlap between these comments as it is possible for an individual to have both said a comment aloud (such that it was recorded in Table B6) and then written a related comment on the map of the blended solutions (such that it is shown on the section of website titled "Route 29 Assessment Public Meeting 3 Comments."

The 56 map-based comments show some different areas of emphasis than those shown in Table B6; for example, there are three comments that indicate a particular location is a "priority" and other comments are very location-specific (e.g., a noise-related comment is that "Trucks have to break hard in this area. Loud and windows shake.") That said, the map-based comments generally show areas of support, suggestions, and concern for various types of improvements, as is the case in Table B5. For example:

- Just as there were eight comments regarding speed limits in Table B5 (with some in favor of making changes and some opposed), there were also comments regarding speed limits shown on the map of the blended solution set. A total of seven such comments were received, with four indicating not to reduce speed limits (e.g., "Do not cut speed limits in this corridor") and three supporting a change in speed limits (e.g., "Can support lower speed limit from FNB Dr northward if warranted.")
- There were two comments shown on the map that related to RCUTs, with one in support ("R-cuts are a good idea") and one that could be categorized as support or concern ("Don't think R-cut design will work at Lynbrook.") The seven access-related comments also showed areas of support for median closures (e.g., "I support median closures along the corridor" and concern (e.g., "Business owner at adjacent parcel has an issue with closing this crossover.")
- The map-based comments do show some areas of disagreement, however: of the six comments that are categorized as bicycle/pedestrian, two are a suggestion "Sidewalk should be on northbound side south of Lawyers Rd b/c most attractions on NB side" and four are opposed (e.g., "Can't support sidewalks/shared use path in this area. Not enough benefit and high cost.")

Changes in the Blended Solution Set Based on Comments

The public comments also led to two demonstrable changes in the blended solution set:

- In response to these concerns about the speed limit, the blended solution set was to reduce the speed limit to 55 MPH in the southern portion of the corridor (south of Calohan Road) and to 45 MPH in the northern portion of the corridor (north of Calohan Road). (Prior to implementation, VDOT will have to conduct a safety analysis and a speed study.)

- Based on the comments, as well as consideration of the crash history, the southern English Tavern Road intersection should provide only provide right-in/right-out access. This improvement must be installed in combination with the Lynbrook Road extension (to English Tavern Road) in order to replace the movements that become restricted.

COR-8: Approve Evaluation Criteria, Methods and Measures for Prioritization of Projects

Outcomes of COR-8

There are two sets of outcomes associated with COR-8: the methods for prioritization and the results of public opinion.

- Regarding the first outcome, all sources will be pursued simultaneously: HSIP, Smart Scale, and the MPO's prioritization process.

- Regarding the second outcome—**an understanding of the public's viewpoint regarding these improvements**—the comments received in the final public meeting show (see COR-7) areas of both support and concern for the diverse types of improvements proposed, with about a quarter of the comments showing support for each type of improvement, about a quarter of the comments showing a concern about the improvement, and about half the comments containing a suggestion, a follow-up question, or some other type of statement. For example, of the 14 comments that pertained to access management improvements (e.g., closure of median crossovers or the addition of turn lanes), four generally supported the concept (e.g., "There may be too many crossovers north of Lawyers Road"), two raised a concern (e.g., "Closing medians will reduce access to businesses"), and eight were categorized as Other because they contained a suggestion or question such as "Favors no left turns at Lynbrook and Moorman Mill; however, others may object to this idea" [this was a single quote from one person] and "Close the southern crossover from English Tavern Road." (These last two comments categorized as "Other" show also that there is not always a firm delineation between support and a suggestion, as one could argue that they are generally supportive of access management.) The comments to some degree reflect the diverse nature of the corridor in that it supports both a mobility and a local access function. As pointed out by one respondent at this third public meeting, "*There are different interests associated with different users: Those who live within the project area, and those using as a through road*." This matches a statement made by the county planner at the outset of the study: not everyone will get everything they want from this process, but we want all voices to be heard.

Steps Taken in COR-8

A meeting of the project team was held in Lynchburg November 14, 2016 where four questions, each from COR-8 and COR-9, appeared particularly relevant for determining how to evaluate projects (COR-8) and then how to prioritize corridor improvements (COR-9). Generally, as was noted in earlier modules, it was appropriate to perform certain modules in tandem; the results are presented separately here in order to be consistent with the flow of PlanWorks modules. In this particular case, the answers to the questions from COR-8 and COR-9 were developed simultaneously, and in fact one of the questions from COR-9 (pertaining to matching goals and prioritization) was pursued as part of COR-8. Note also that questions where shortened in a few cases to facilitate an in-person discussion.

- *What factors influence prioritization?*

  There are two ways to answer this question. In terms of how capital improvements are prioritized within the formal planning process, this process follows the development of the MPO's Constrained Long Range Plan (CLRP) where three factors—accessibility (20%), safety (25%), and economic development (25%)—play a dominant role in prioritizing projects within the CLRP. However, a more appropriate answer is that there are at least three different funding sources for corridor projects: Virginia's Smart Scale, the

development of projects based on the aforementioned MPO's CLRP, and the Highway Safety Improvement Program (HSIP). For HSIP, projects are prioritized based on benefit cost, where the expected crashes reduced are divided by the cost of the improvement.

- *How does this prioritization process reflect stakeholders' input?*

  There are two distinct mechanisms. First, the corridor process used for PlanWorks (e.g., the three public meetings held in January, June, and October [2016] plus the earlier meeting with select BOS members [December 2015] as well as any comments submitted through other channels) will generate projects of interest. For example, the interest in multimodal travel is evident in the fact that of the slightly less than a third of the $19.43 million in total improvements (see Table 1) is attributed to the shared bicycle/pedestrian use path. Second, the MPO CLRP process itself is the product of public involvement.

- *Is there a clear connection between the prioritization process and the corridor goals?*

  Recall that the Campbell County Comprehensive Plan identified three corridor goals: (1) promote a safe transport system throughout the county; (2) promote an effective transport system throughout the county; and (3) promote a transportation system compatible with existing and future land uses. We can view goal (2) as relating to the statewide mobility purpose of the corridor, and goal (3) as relating to the local access function of the corridor: goal (1)—safety—influences both mobility and access. Table 1 shows that some improvements (8 rows) reflect improved **local access**, and other improvements (7 rows) reflect improved through mobility. Overall, a total of $4.96 million is focused on such local access improvements (for vehicles), $5.52 million is focused on through mobility improvements (for vehicles), and approximately $8.95 million is focused on local access improvements for bicyclists and pedestrians.

- *Are more specific evaluation criteria needed to prioritize investments?*

  Generally the answer is no—given the three public meetings, the decision process used to prioritize these projects rests with the County Board of Supervisors. That said, there is one additional element that could become necessary on a case-by-case basis: when new businesses are being developed, they may require information regarding site plan review. Thus, if there is a particular project (say an intersection improvement and a site plan adjacent to that intersection), then possibly additional construction details (such as the exact length of the turn lane and how that will influence access to the business) could be needed. That said, this more specific evaluation criteria would become part of the land development review process as the need arises.

COR-9: Adopt priorities for implementation

Outcome of COR-9

The Campbell County Director of Community Development will brief the county BOS regarding the blended solution set. The reaction of the BOS will be used to confirm or modify the blended solution set elements, and help determine the overall strategy for pursuing funding sources. Appendix C shows the locations of these projects (the drawing has been updated to address changes made since October 2016, when an initial version of COR-7 was developed). A database that contains some, but not all, of the information needed to submit projects for funding has been prepared by AECOM as of February 8, 2017. That database shows how projects can be prepared for funding through MPO prioritization process, Smart Scale, and the Highway Safety

Improvement Program. While the database will not provide all necessary data for these three processes, it should provide a useful starting point. The database has four worksheets: (1) a table of each improvement and the supporting input data information, (2) the crash records arranged by corridor intersection, (3) the relevant data items for input into the MPO process, and (4) the relevant data items for input into Smart Scale (which can also provide the input into HSIP).

For example, consider one of the median closures (from Anstey Road to Route 29 and conversion of Anstey Road to a cul-de-sac. The database shows the following: (1) the cost is $25,000 per site; (2) the EPDO for fatal and injury crashes (which is S.1 under Smart Scale) is 80.63; (3) the EPDO rate (S.2 under Smart Scale) is 94.97; (3) the travel time reliability index (ED.3 under Smart Scale) is 1.5; (4) additional data elements are needed to prepare the projects for Smart Scale: A1-A3, E1-E3, ED1-ED2, and L1, and (5) the crash history is available at this location.

Steps taken to arrive at the outcomes of COR-9

In November 2016, the team considered four questions associated with COR-9:

- *What is the priority order for improvements to the corridor?*

  The MPO planning matrix will provide a starting point. However, some projects will rise in priority primarily because the associated funding source is easier to obtain! For example, because HSIP has a faster timeline than the CLRP process, a project that can be funded through HSIP will be steered in that direction. To be clear, any projects from the list in Table 1 that are viewed negatively by the BOS will be removed, but easier-to-fund-or-build projects will be pursued first and the remaining projects will be chosen based on the MPO Policy Board's voting.

- *What are the next steps for each identified improvement?*

  All projects will be pursued simultaneously, recognizing that some projects have longer timelines.

- *How will you let stakeholders know the results?*

  The results of the public involvement process have been posted on the project website titled *Route 29 Corridor Assessment, Campbell County*, which is accessible at this URL: http://www.virginiadot.org/projects/lynchburg/route_29__corridor.asp. In addition, this information will be shared by the Board of Supervisors and the Campbell County Planning Commission as appropriate, through steps such as putting projects into the prioritization matrix and through the statewide Smart Scale process.

- *How will the Campbell County Comprehensive Plan be updated based on this study?*

  In 2019 there will be an update to the transportation chapter based on these improvements. At this point, it believed that the overlay district will not change but will be retained. In addition, the results of two actions will be included in that chapter, and it is expected that both actions will occur by June 2017. First, the Campbell County Director of Community Development will brief the county BOS regarding the blended solution set. Second, the reaction of the BOS will be used to confirm or modify the blended solution set elements, and help determine the overall strategy for pursuing funding sources.

Appendix C. Location of Projects in Table 1

Table 1 lists several sites where improvements are being made, such as the addition of left turn lanes. Figures C1-C6 shows the location of these improvements throughout the 6.6 mile corridor.

Figures C1 and C2 show the key for understanding the types of improvements made and the division of the corridor in eight sections.

Figures C3, C4, C5, and C6 show the improvements in each of the eight sections.

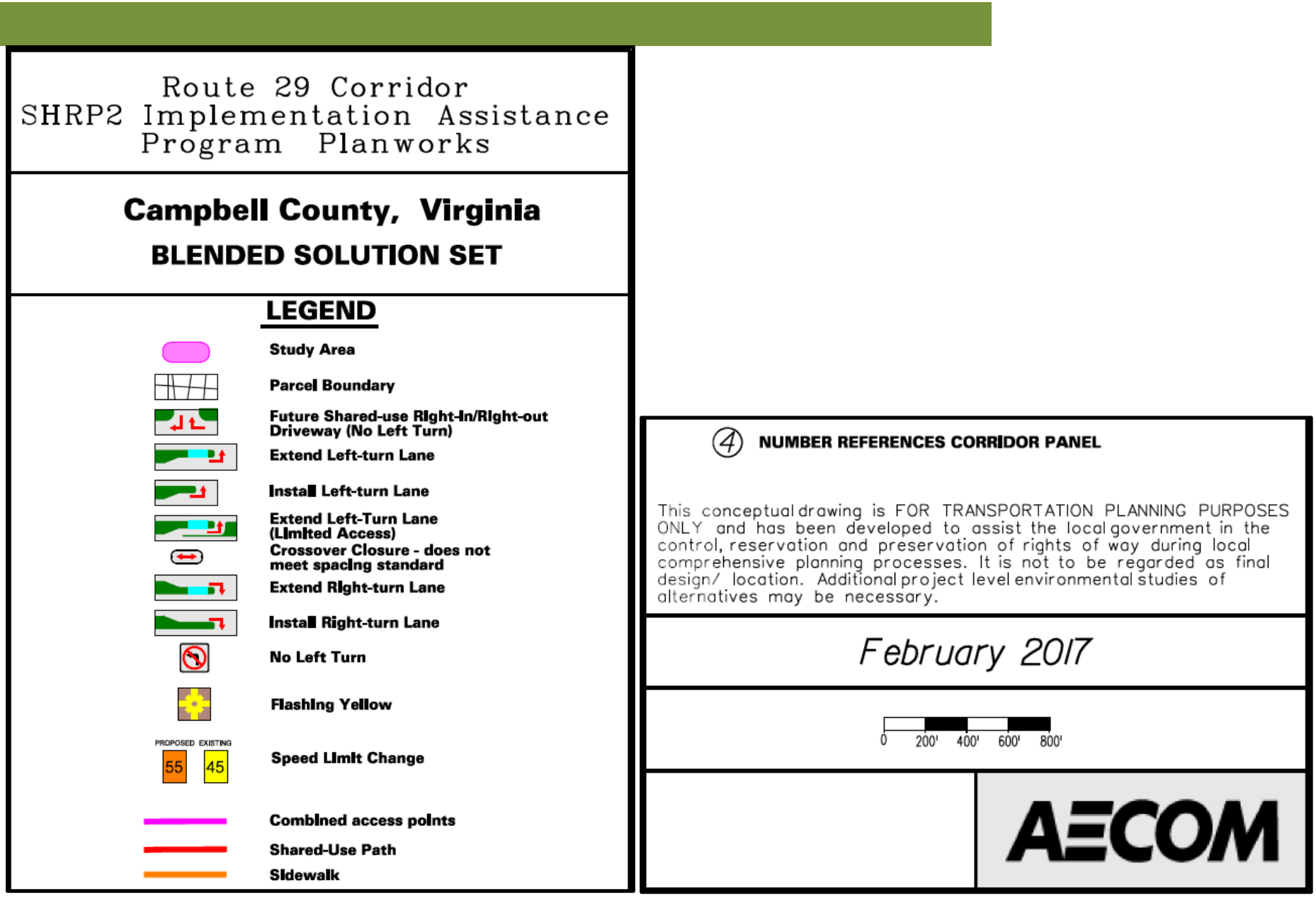
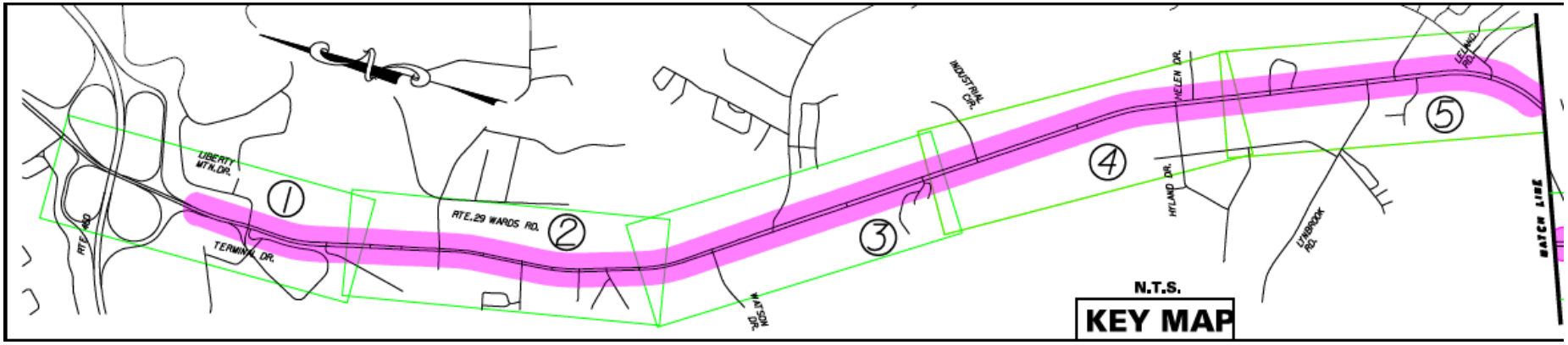


Figure C1. Key to Improvements Shown (This drawing was revised in February 2017 and the revised version is shown here)



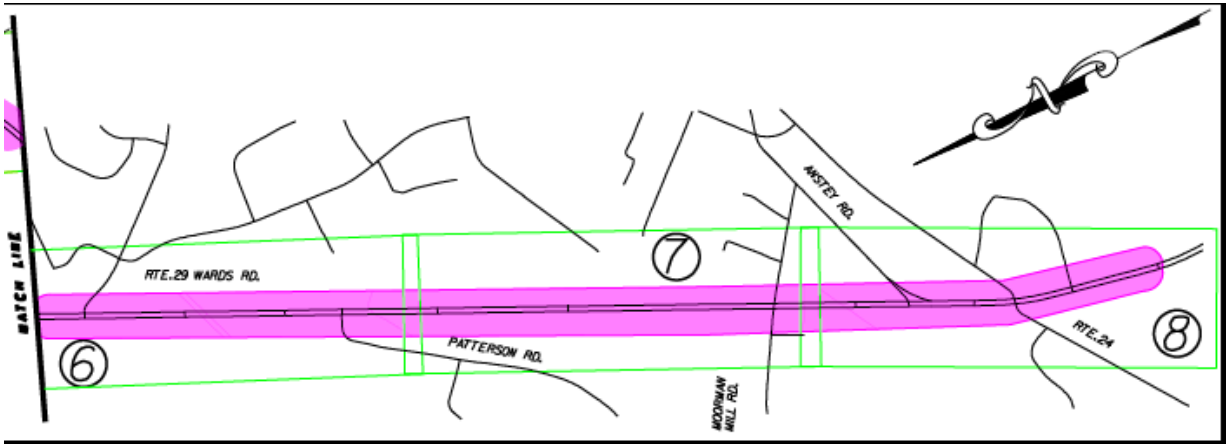


Figure C2. Overview of Eight Corridor Sections. (Section 1 is the northernmost section; Section 8 is the southernmost section.)

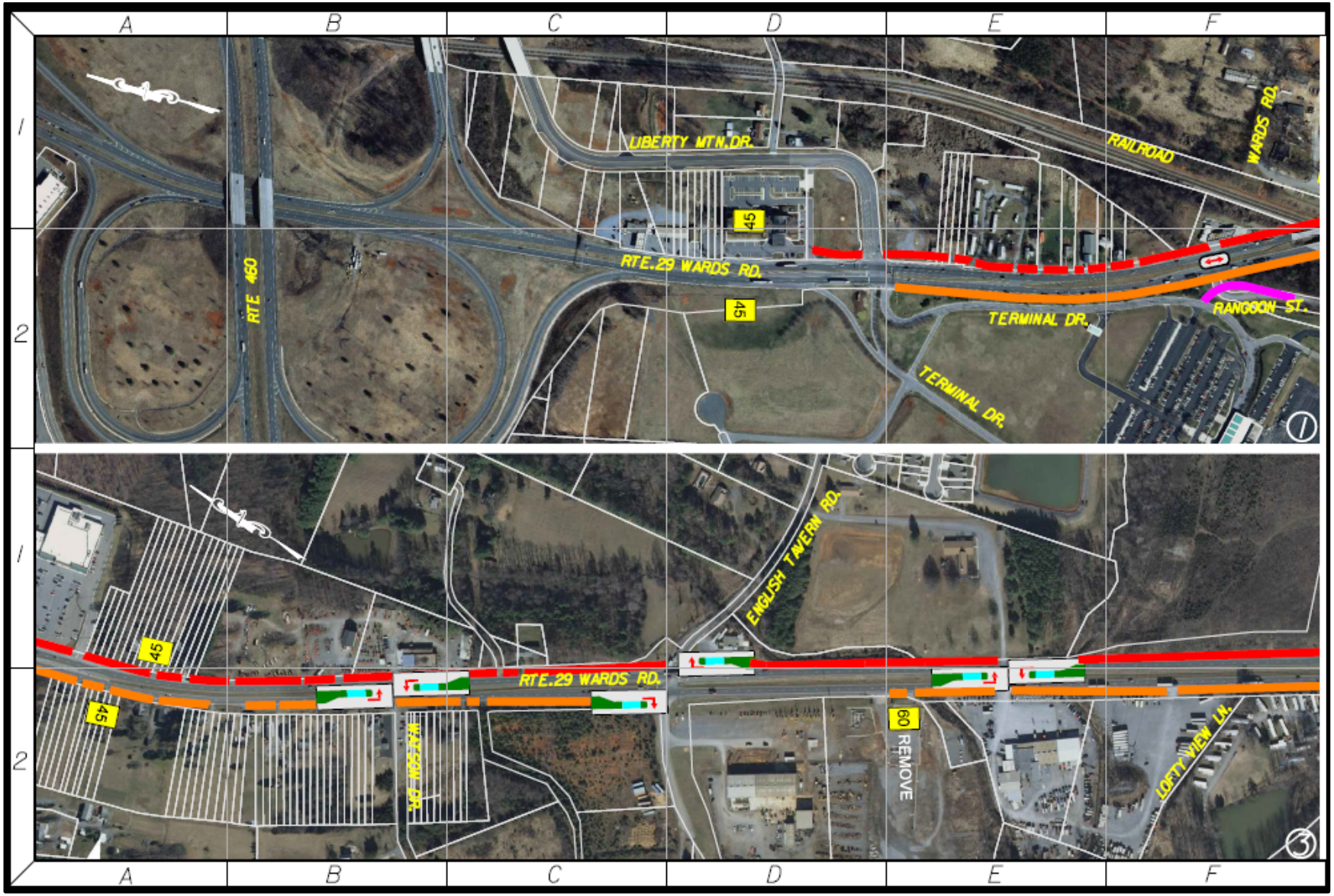


Figure C3. Improvements in Sections 1 and 3

Figure C4. Improvements in Sections 2 and 4

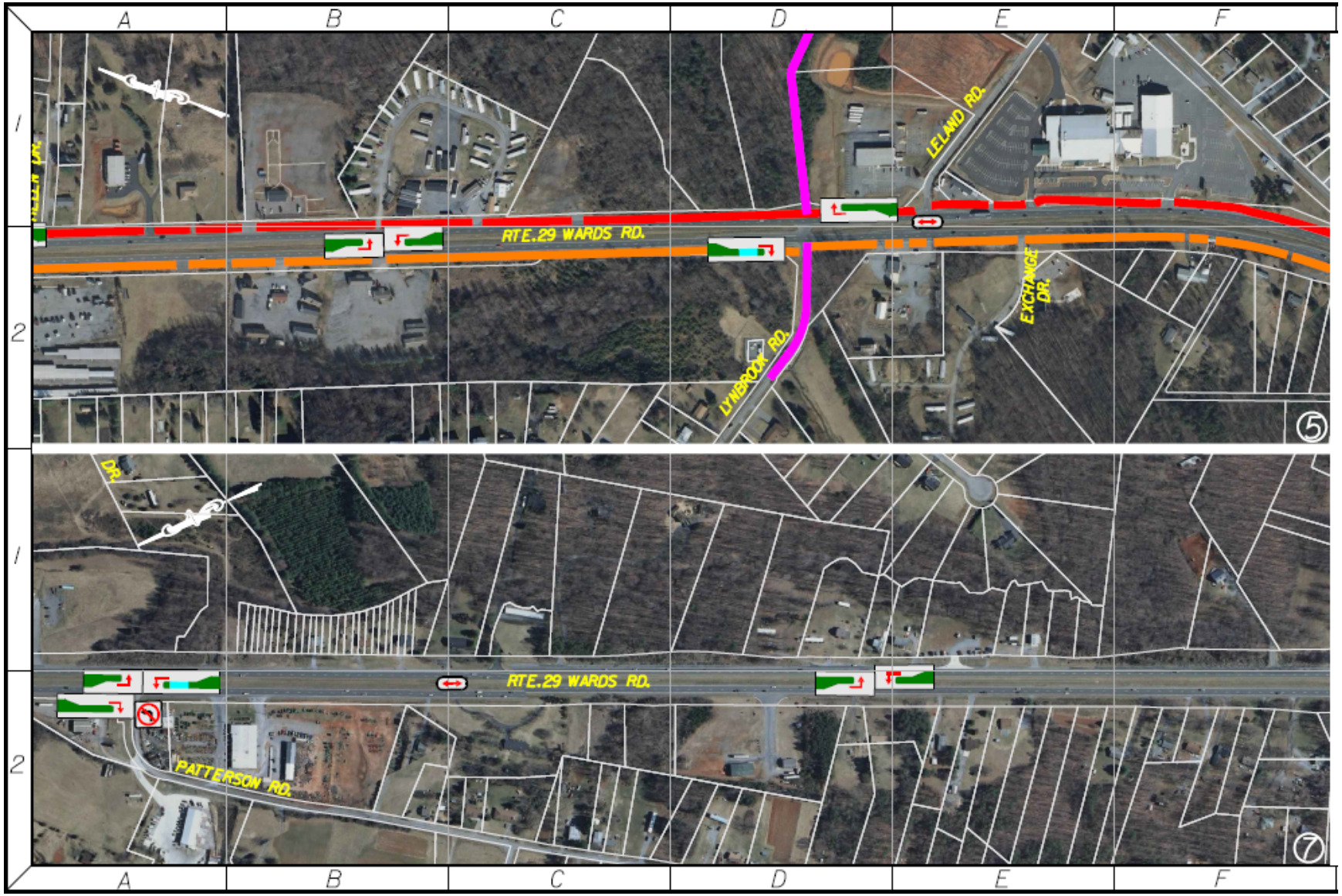


Figure C5. Improvements in Sections 5 and 7.

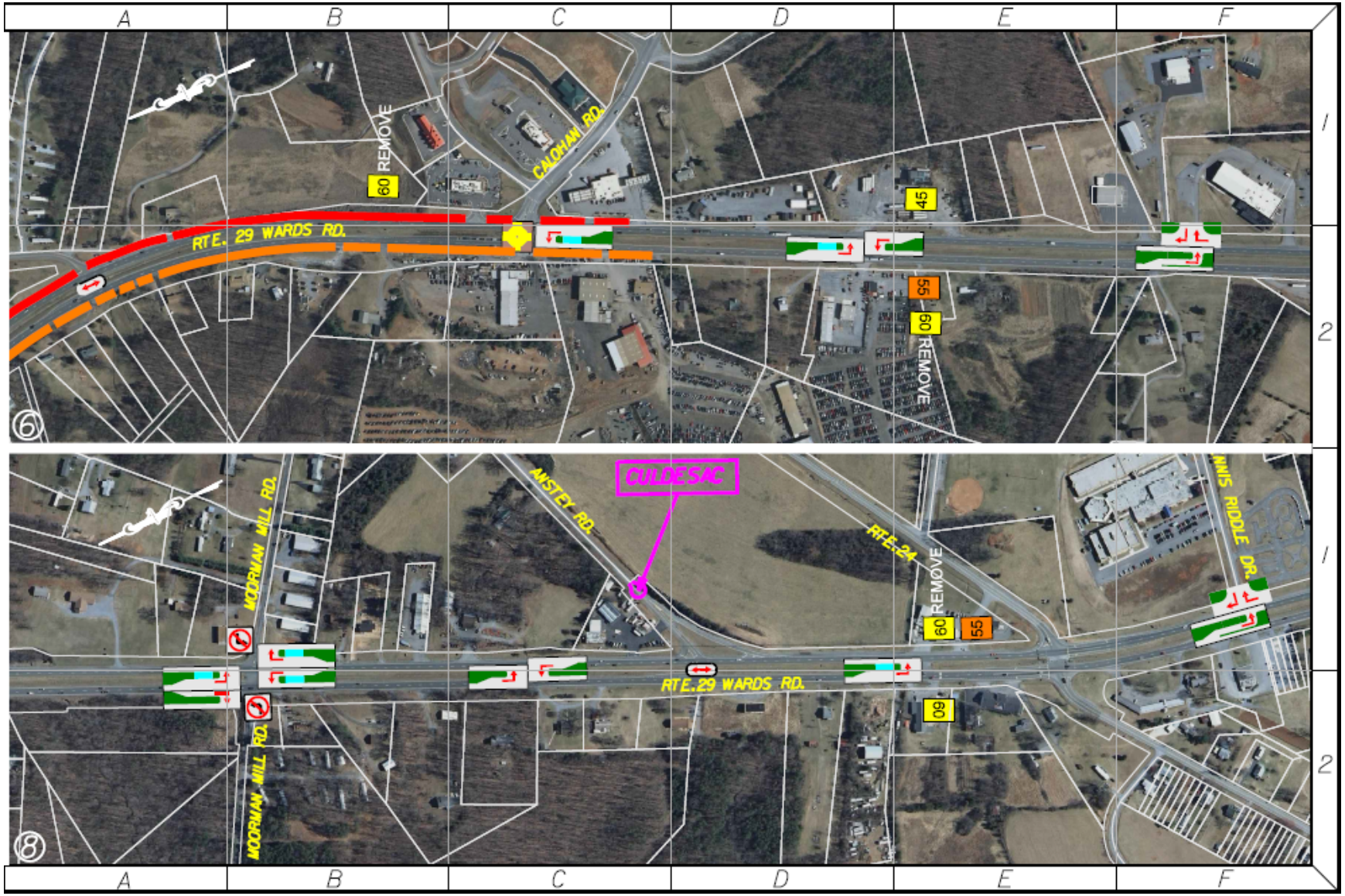


Figure C6. Improvements in Sections 6 and 8.