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research report

A Methodology to Evaluate Unplanned Proposed Transportation Projects

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16. Abstract

The Virginia Department of Transportation may be asked to consider proposed transportation projects that have not originated within the transportation planning process. Examples include offers by the private sector to build infrastructure in exchange for permission to develop land, advocacy by a regional government to add an interchange to a National Highway System route to encourage economic growth, a city's plan to narrow an arterial facility to increase community cohesion, and a county's request for pedestrian crossings on a high speed arterial facility. This report refers to these proposals as *stand-alone projects.*

In the short term, stand-alone projects may have significant merit as they can result in the provision of additional infrastructure or improved relations between state and local stakeholders. In the long term, they may not be beneficial if they result in adverse safety or operational consequences for the overall transportation system. Stand-alone proposals are difficult to evaluate because they lack detailed data, have not been studied as part of a region's planning process, require a relatively short response time, and are not discussed in the literature.

This report describes stand-alone projects that have been proposed in Virginia, describes a methodology for evaluating them, and applies the methodology to two such projects: (1) a developer's proposal to provide additional infrastructure as part of a desired rezoning, and (2) a county's request to accommodate pedestrians on a 45 mph arterial facility bisecting residential and commercial development. Application of the methodology yielded the advantages and disadvantages for each proposal. For example, although the first project will reduce mainline delay for one facility, it will increase queue delay on another, will preclude the construction of two interchanges, and will increase delay overall. Yet the methodology also reveals that there is not necessarily a best answer: although the second project showed that a pedestrian overpass could accommodate pedestrian crossings at a capital cost of $0.16 per pedestrian crossing (compared to a capital cost of less than $0.01 per crossing for a pedestrian phase at an existing signal), neither alternative ensured that pedestrian risk would be minimized because pedestrian compliance with traffic laws could not be forecast precisely given the data available. In such situations, the utility of the methodology is that it delineates aspects of the proposal that can be assessed with available data in contrast to those that require judgment by decision makers.

Because the study found that stand-alone projects are more common than expected and that they may yield negative or positive results, the report recommends that the methodology developed in this study be considered where stand-alone projects are to be evaluated and no other planning process is applicable. Depending on the availability of data, the level of accuracy desired, and the ability of the analyst to select the most appropriate performance measures, the methodology requires roughly 40 person-hours and does not require specialized software.

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DISCLAIMER

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INTRODUCTION

At the regional level, the selection of specific transportation improvements has historically been accomplished through the standard planning process. Within the framework of this process, improvements may be recommended through a number of studies (e.g., corridor studies, county transportation plans) but then more rigorously evaluated as part of a region's long-range plan (LRP). The difficult decision of reconciling desired projects with available funds occurs when projects are placed in the Virginia Department of Transportation's (VDOT) Six-Year Improvement Program (SYIP) and, for projects within an urban area of 50,000 or more, the Transportation Improvement Program (TIP). Each document (i.e., the local plan, the LRP, the SYIP, the TIP, and by extension the State Transportation Improvement Program [STIP, which combines the TIP and SYIP] entails public involvement and some form of external review. For example, projects in the STIP are sent to the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) for approval. Traditionally, motor vehicle fuel taxes have been the principal sources of funds for the projects identified by this standard planning process.

The real revenue generated by these taxes has dropped as a result of increased use of alternative fuels, improved gas mileage (Transportation Research Board [TRB], 2001), and a constant nominal statewide gas tax (unchanged in Virginia since 1986 at 17.5 cents per gallon) (VDOT, 2005). Accordingly, localities have considered fees paid by developers as an alternative means of funding transportation infrastructure that is apart from the standard planning and programming process. Known as proffers, subdivision exactions, and impact fees (Wegner, 1987), these fees have become popular; by the mid 1980s they were in use in 60% of U.S. localities (Zegras, 2003).

Although these unsolicited privately funded proposals illustrate one type of project that does not result from the standard planning process, there are others. Examples are a developer who wishes to improve access to a site, a locally initiated transportation project funded with a bond referendum, a project recommended by the state department of transportation (DOT), a county-initiated rezoning, or a design change to the way existing infrastructure is operated. The common theme of these projects—whether privately or publicly funded—is that they do not result from the standard planning process but rather are external to it. Thus, they may or may not have incorporated the views of all stakeholders (e.g., local travelers, regional travelers, residents in the immediate vicinity of the project, taxpayers, advocacy groups, the business community, and elected officials). Further, these projects may or may not align with the products of the standard planning process, such as the goals established in the region's LRP.

In 2005, the Virginia Transportation Research Council's Transportation Planning Research Advisory Committee asked the following two questions as they relate to stand-alone projects (Miller, 2005):

1. How can planners ensure that such short-term improvements are coordinated with the longer term conceptual improvements planned for the area?

2. How do you block "short-term fixes" that are not real solutions but instead are driven only by political pressure and may interfere with the long-term plan?

Subsequent discussions with VDOT staff showed that although stand-alone projects are a challenge to evaluate, they are also difficult to characterize and a single definition of them was not yet available.

PURPOSE AND SCOPE

The purpose of this study was twofold: (1) to define *stand-alone projects*, and (2) to create a methodology to help planners quickly and effectively decide whether a proposed stand-alone project should be accepted or at least supported.

The scope of this research was limited to stand-alone projects for which policy guidance is not already available. Existing administrative requirements, such as rezoning requests where, as per § 15.2-2222.1 of the *Code of Virginia* (the *Code)*, localities will submit to VDOT certain traffic impact analyses (VDOT, 2007), were beyond the scope of this research.

METHODS

Three tasks were conducted to achieve the study objectives:

1. VDOT planners in six of the nine VDOT districts were interviewed in order to define and identify examples of stand-alone projects, and a steering committee for project guidance and review was created.

2. A methodology for evaluating stand-alone projects was developed based on the types of information typically available for such projects.

3. The methodology was applied to two projects, one that involved a great increase in capacity and change to road alignment, and another that involved pedestrian accommodations to determine the overall value of such a methodology.

Interviews of District Staff and Creation of the Steering Committee

VDOT staff who perform planning functions in six VDOT districts (Culpeper, Fredericksburg, Hampton Roads, Lynchburg, Northern Virginia, and Salem) were interviewed concerning examples of stand-alone projects and problems (or solutions) offered by such projects. Eight standard questions (see Appendix A) were asked of each interviewee concerning the definition of stand-alone projects, the problems associated with these stand-alone projects, and examples of stand-alone projects in Virginia. Depending on a planner's experience with stand-alone projects, more detailed explanations were sought.

The steering committee consisted of professionals from the transportation planning field, specifically senior VDOT transportation planners, an administrator from the Office of the Secretary of Transportation, and a representative from a metropolitan planning organization (MPO).

Development of Methodology to Evaluate Stand-Alone Projects

A draft methodology to evaluate stand-alone projects was developed based on the comments from interviewees and the steering committee. These comments suggested three constraints of the methodology:

1. *The methodology should be able to be completed within approximately 40 person-hours.* The reason for this guideline is that some stand-alone projects, such as proffers or site plan reviews, require a response time of 60 days or less. Therefore, analytical techniques that could be applied quickly with a minimal amount of data were identified in the literature to be included in the methodology. For example, although simulation software might provide an accurate estimate of the vehicle queue length at an intersection, if the calibration of such software was time-consuming, simpler queuing equations might be preferable. Although there are instances where fewer than 40 work hours are available to provide a response, the spirit of the 40-hour requirement was to identify techniques that could be applied reasonably quickly as opposed to those that would require extensive travel demand model calibration.

2. *The methodology should be relatively short and ideally in the form of a one-page outline.* For example, one set of interviewees specifically referred to detailed manuals in their office as examples of methodologies they considered to be too long for the evaluation of stand-alone projects.

3. *The methodology should not duplicate existing processes for which there is already detailed guidance, such as the regional comprehensive planning process used to develop constrained LRPs and the administrative procedures associated with Chapter 527 of § 15.2-2222.1* of the *Code.* The latter process requires localities to seek comments on site impact analyses (related to rezoning requests) and comprehensive plan updates and amendments, and the process is specified in 24 VAC 30-155 (VDOT, 2007). Several meetings with the steering committee were helpful in ensuring that the methodology did not duplicate current practices. For example, although an identification of the non-travel impacts {e.g., noise, air quality, or community cohesion) might be productive, it was critical that the methodology not duplicate the National Environmental Policy Act (NEPA) process.

The methodology was developed in an iterative manner. After considering the three constraints noted here and analytical techniques available in the literature (Forkenbrock and Weisbrod, 2001; Garber and Hoel, 2002; Institute of Transportation Engineers [ITE], 2003, 2006; Martin and McGuckin, 1998; Meyer and Miller, 2001), the researchers developed a draft methodology, refined it based on feedback from the steering committee, and applied it to two case studies, as described in Task 3. Based on lessons learned from the two case studies, the methodology was revised.

Validation of Methodology with Case Studies

Two projects were chosen from the stand-alone projects identified by interviews with VDOT district staff. Three criteria guided the selection: (1) the level of data available, (2) whether the project was proposed by a private or public entity, and (3) the diversity of the proposed transportation improvements. The first case study was chosen because substantial data were available and it originated with the private sector. The second project was chosen in part because it was a request from the public sector and in part because it entailed a very different type of transportation improvement than did the first case study: improvements for pedestrians.

Case Study 1: Cosner's Corner

Cosner's Corner, in Spotsylvania County, Virginia, is a large retail development that required the county to rezone large tracts of land before development could proceed. The developer had proposed numerous privately funded transportation improvements as a condition to be met for the rezoning to be granted. The challenge facing the analyst of this stand-alone project was to determine how the proffered improvements would affect transportation operations relative to operations without the stand-alone projects.

In the short term, this stand-alone project had appeal for two reasons: it allowed the county to expand its commercial tax base, and it provided some infrastructure at private expense. In the longer term, two questions were raised regarding this proposal.

1. Do the transportation improvements proffered by the developer adversely affect any other state-planned improvements for the future?

2. Will the transportation system perform as well with the stand-alone project (and the additional demand created by the accompanying development) as it would without the stand-alone project?

Case Study 2: Eagle Harbor

The second case study shows that stand-alone projects need not necessarily be privately funded. Isle of Wight County (Virginia) asked VDOT to build a pedestrian crossing that would serve residential and retail development adjacent to a major arterial roadway. This project was in conflict with the local comprehensive plan. The local plan sought to have crosswalks placed at the intersections, and two questions arose before VDOT could agree to place the crosswalks:

1. Will installing the crosswalks place the pedestrians at risk?

2. If crosswalks are installed and if signals are retimed to facilitate pedestrian crossings, will vehicle queues affect the operation of the three closely spaced signals?

Summary of the Case Studies

In both cases, the decision maker must decide whether to accept or reject the stand-alone project. If accepted, the first project might increase the county's tax base without adverse transportation consequences or it might adversely affect the transportation system because the improvements do not offset the additional demand or because they preclude the use of right of way for other transportation improvements. If accepted, the second project might accommodate pedestrians, thereby serving an important set of users of the transportation system, or it might place these users at risk or adversely affect signal operations.

RESULTS

Interviews with District Staff

Definition and Symptoms of a Stand-Alone Project

A crucial finding of the interviews was the difference between the *definition* of a stand-alone project and the *symptoms* that suggest a project might be a stand-alone project.. A *stand-alone project* is defined as any project that requires an ad-hoc decision on the part of state, regional, or local government without the benefit of firm policy guidance that otherwise clearly indicates what decision should be made. *Symptoms* of stand-alone projects are any of the following:

- The project conflicts with or is not included in the local county comprehensive plan, the regionally constrained LRP, the VDOT statewide plan, or some other source of policy guidance. (An example is a stand-alone project that uses a particular tract of land for new residential development whereas the county LRP indicates the tract of land should be used for an interchange.)

- The project leads to disagreement among VDOT, a constituent, and a locale. (An example is a private entity that requests additional interstate interchange and notes that similar requests have been granted in the past to other parties.)

- The project leads to a proposed significant change in the transportation system that is made without such explicit policy guidance. (An example is a dramatic reduction of access breaks on an arterial facility.)

Although stand-alone projects might have these symptoms, the reverse is not necessarily true. For example, the second symptom—disagreement among stakeholders—can occur not only with stand-alone projects but also with projects that have moved through the standard planning process. Thus the symptoms helped identify stand-alone projects but themselves did not replace the definition's emphasis on a lack of clear policy guidance.

Potential Problems of Stand-Alone Projects

In the short run, stand-alone projects have immediate appeal for one of two reasons: (1) if they entail private construction of public transportation infrastructure, they may fulfill an immediate transportation need without requiring scarce funds from other transportation efforts, or (2) if they are proposed by a local or regional government as an operational or design change, such as the addition of an interchange, the narrowing of a four-lane arterial, or the addition of pedestrian crosswalks, their acceptance enables the state to meet the needs of one of its stakeholders.

In the longer term, typically up to 10 years after construction is completed, negative aspects of stand-alone projects may include any of the following:

- *The project may allocate right of way ineffectively*. An example is providing right of way for a widening project that precludes the later construction of grade-separated interchanges at the same location.

- *The project may require funding that precludes future projects.* An example is a commitment to construct a limited access facility to attract a particular industry where the construction of the facility means other projects for the region will not be implemented.

- *The project may preclude, complicate, or negate another type of improvement.* An example is a decision to narrow an existing three-lane street that is a feeder to an adjacent facility scheduled to be improved to accommodate heavy traffic. Another example is an improvement that is undertaken to offset traffic generated by a new commercial development where the benefits of the improvement are smaller than the disbenefits of the increased traffic.

- *The project may conflict with an existing comprehensive plan.* An example is a region that has designated a specific facility as limited access where a particular jurisdiction in that region is requesting another signal for the same facility.

Examples of Stand-Alone Projects in Virginia

The interviews and steering committee meetings led to the identification of 22 stand-alone projects in Virginia, listed in Table 1. The projects vary by type (e.g., some entail new construction whereas others entail an operational change made by VDOT), information available (e.g., for some the reason for incongruity is clear, whereas for others the trade-offs are not fully elaborated), and impact (some have a net positive impact and others do not).

Not surprisingly, at least 9 of these projects (Table 1, Projects 3, 5, 6, 12, 14, 15, 16, 19, and 20) entailed the creation of privately funded infrastructure such as new connector roads, roadway widenings, additional right of way for passenger rail stations, the realignment of existing roads, improved site access for a port terminal, and the construction of a new interchange. New infrastructure was not the only reason for stand-alone projects: at least 8 (Table 1, Projects 1, 2, 4, 9, 11, 13, 17, and 21) entailed operational change. Examples included adding a new arterial access point, reducing the number of arterial access points, building a new interchange, and narrowing the number of lanes for an existing facility. Two other projects (Projects 18 and 22) were substantially different: No. 18 entailed a rezoning dispute between a town and a county, and Project 22 entailed the use of discrepant population forecasts. (The difference in forecasts meant that the travel demand model for the affected area produced different estimates of infrastructure required to accommodate travel demand.)

For several of the projects listed in Table 1 (e.g., Projects 1, 2, and 4), there is a clear trade-off between competing objectives, such as improved access for an industrial facility and improved corridor mobility. Assuming the information in Table 1 is accurate, it does not appear plausible that more precise data would make the trade-off easier for a decision maker: better data cannot eliminate the competing objectives. However, in several instances (e.g., Projects 15, 19, and 20), it appears that better information would be productive because the trade-offs have not been fully identified. For example, for Project 19, where a developer offered to build a new rest stop in exchange for an additional interchange, the impacts of the interchange on delay have not been quantified. Deciding whether to accept the interchange should be easier with such clarification.

Table 1. Examples of Stand-Alone Projects in Virginia

No.	Name	Project Description	Status of Project
1	Rt. 730, Danville	Adding interchange to limited access arterial facility	MPO wants to add interchange to provide access to proposed industrial park. State prefers interchange at different location so that route may continue to meet interstate standards.
2	Rt. 29, Campbell County	Adding access point to Rt. 29	Development is proposed adjacent to Rt. 29 and county's ability county to follow its access management overlay plan may be tested as development occurs.
3	Wyndhurst development, Lynchburg	Constructing connector road between Rts. 220 and 460 and encouraging mixed-use development	Developer funded about 75% of new facility, and localities paid for rest; VDOT involved in design.
4	5th Street, Lynchburg	Narrowing 3-lane facility to 2 lanes	VDOT widened major facility in past (outside the city limits); Lynchburg wants to narrow adjacent section of this facility.
5	Hollymeade Town Center, Charlottesville	Widen arterial route from 4 to 8 lanes	Widening done to accommodate shopping area—VDOT staff questioned whether 6-lane widening, combined with access management, could have sufficed in lieu of 8-lane facility
6	Willow Run, Culpeper County	Widen arterial to 6 lanes, reserve right of way for VRE stations, construct interchange	Improvements being negotiated and would be done as part of rezoning that allows developer to construct upscale mall/mixed use development.
7	Disney America, Prince William County	Theme park would be constructed and various transportation improvements made	Theme park stopped due to controversy; area developed in residential fashion.
8	Biscuit Run, Charlottesville	Farm will be developed into residential subdivision	TBA, but traffic impact study will undoubtedly be required.
9	Rt. 104/Dominion Blvd., Chesapeake	Creating limited access facility	Originally 30 to 100 access breaks, in the form of residential and farm driveways, existed along boulevard. City of Chesapeake asked VDOT for help and then converted road into limited access facility with 8 access breaks. It greatly improved traffic flow and is example of good access management.
10	Rt. 17 and Rt. 171, Newport News	Right of way being reserved for future project	Walgreens has been proposed. A few years ago, at same intersection, a Single Point Urban Interchange (SPUI) was recommended in study of area. The intersection is over capacity already and Walgreens will create even more trips. Walgreens has donated right of way so that SPUI can be built in future.
11	I-64, Exit 242, James City County	Improvement to interchange at Exit 242	A few years ago, interchange of I-64 and Exit 243 was improved to meet needs of Busch Garden's Williamsburg. Developer now creating large retail facility wants interchange at Exit 242 improved to increase accessibility to his parcel of land.
12	MAERSK Terminal, Portsmouth	New roads being built for access to terminal from I-64, using right of way that could be used to increase I-64 capacity	MAERSK building roads to connect site with I-64 and then using I-64 right of way by creating overpass for rail cars to go under and improving interchange for exit their trucks will be using. Radius of impact is much larger than road network being improved, I-64 will be impacted by additional trucks but not widened, and right of way that may be needed later to expand I-64 being used by developer. *(continues)*

No.	Name	Project Description	Status of Project
13	I-4/Battlefield Boulevard, Chesapeake	VDOT recommended not allowing access break	VDOT reviewed and made recommendations on rezoning request before it was approved by the City of Chesapeake; they recommended that city not allow access break and compromise the roadway.
14	St. Luke's Realignment, Isle of Wight	Realigning exiting road by developer	Developer redeveloping golf course for residential and commercial use instead. Has proposed to realign Rt. 258 and Rt. 32 where they connect with Rt. 10.
15	Benn's Church Development, Isle of Wight	New road being built without reserve capacity	Residential development being built and developer is building road for it as if there will be no growth in area. In plans, road that developer is leaving at a dead end will connect with Rt. 258. Once this happens, area will likely be further developed, so growth is inevitable. Problem is that road is not being designed for this growth because VDOT cannot require developer to make future connection part of his study.
16	Harbour View Blvd., Suffolk	Proffered roads	A developer built 4-lane divided highway to access all of his property, now used for both residential and commercial purposes.
17	Eagle Harbor, Isle of Wight	Bicycle and pedestrian issues on limited access Rt. 17	Rt. 17 near James River Bridge is a limited access divided highway with 8 access points within 2-mile section (taking rural arterial and introducing urban features). VDOT getting complaints from citizens about number of signals, speed limit changes, and congestion. Developments are on both sides of 45 mph road, and citizens are requesting crosswalks and pedestrian signals at numerous locations; this is not conducive to pedestrian facilities.
18	Northampton County	Rezoning conflict between town and county	Town wanted parcel of land rezoned and the county did not, so town annexed the land from county and allowed for the rezoning.
19	I-95 Rest Area, Fredericksburg	Developer proposes interchange and relocation of rest stop	Developer wants interstate access to his parcel of land (300+ acres) that is located around rest stop. To gain access, he has proposed adding an interchange where rest stop is located. In return for access, he offered to build state-of-the-art $10 million rest stop/welcome center. Discussions focused mainly on new rest stop and to lesser extent on consequences or benefits of having access break.
20	Cosner's Corner, Spotsylvania	Removing limited access to portion of Rt. 17	At intersection of Rt. 1 and Rt. 17 bypass is heavy congestion and many turns from Rt. 1 onto 17. Developer requested access to bypass to develop his parcel of commercial land. Developer has offered to build new turn lanes at the major intersection and improve current conditions. VDOT accepted developer's offer even though VDOT felt flyover would be better solution. No other funding was available to resolve congestion at site.
21	I-295 and Meadowville Rd. Interchange, Chester	Creating new access point to interstate	Interchange originally planned to be built in 2004; was never built because growth in area did not justify creating new access point through Interstate Justification Report. Region is looking again to build interchange.
22	North I-95 corridor, Hanover County	County and VEC had different growth rates for area	Virginia Employment Commission (VEC) and Hanover County had different 20-year population forecasts, which resulted in significantly different outcomes when applied to transportation modeling program. To achieve the same level of service, with VEC rate 10 lanes necessary, and with county rate only 4 lanes necessary.

Finally, the data suggest that stand-alone projects are not inherently problematic. For example, Project 3 (the Wyndhurst development in Lynchburg) led to land use densities sought by the City of Lynchburg and increased transportation infrastructure. Project 9 reduced the number of access points on an arterial and increased its capacity. Further, both increased state and local cooperation.

Table 1 suggests that stand-alone projects may have beneficial and/or adverse impacts and thus should not be arbitrarily accepted or rejected. Rather, they must be considered on an individual basis. Because the impacts of some of the projects in Table 1 are not readily apparent, an approach for evaluating these projects is needed.

Methodology for Evaluating Stand-Alone Projects

An eight-step methodology was developed to evaluate stand-alone projects. The methodology is based on the project's consistency with other sources of policy guidance, the impact of the project on the transportation system, and specific issues of concern to the evaluator. The result of the methodology is not necessarily a definitive acceptance or rejection of the proposed project but rather a clearer understanding of its advantages, disadvantages, and uncertainties. The methodology is summarized here and detailed in Appendix B.

- *Step 1: Define the evaluator's perspective and horizon year.* Determine whether the evaluator is to consider only transportation impacts (e.g., congestion, safety, and access for other modes) or alternative impacts (such as community cohesion, noise, and economic development). For example, an evaluator representing the state DOT may take the position that the non-transportation issues have been addressed by the county and that the evaluator's role is to identify the improvements that will accommodate the project's traffic. The horizon year must be far enough into the future to provide a long-term outlook but no so far that data projections are unreliable.

- *Step 2: Identify the potential problem created by the stand-alone project.* The potential problem may be an ineffective allocation of right of way (as in the first case study), a conflict with a local or regional comprehensive plan (as in the second case study), a commitment of funding which affects another project, or the introduction of a complication that negates another planned improvement.

- *Step 3: Compare relevant policy guidance with the proposed project.* Determine sources of policy guidance such as local plans or design standards, and compare the proposed project to these policies.

- *Step 4: Identify future transportation improvements impacted by the stand-alone project.* Identify projects, other than the stand-alone project, that are already planned, programmed, or are being discussed that will be impacted by the stand-alone project.

- *Step 5: Establish appropriate performance measures.* Identify social, economic, and user impacts that are of greatest interest to the stakeholders and select associated performance measures for evaluating the impacts.

- *Step 6: Evaluate the impacts of the stand-alone project over the horizon period.* Using the performance measures selected in Step 5, evaluate the impacts that will occur prior to the horizon year (Step 1) assuming the stand-alone project is built.

- *Step 7: Evaluate the impacts of not building the stand-alone project over the horizon period.* Using the performance measures chosen for Step 6, evaluate the impacts that will occur prior to the horizon year (Step 1) assuming the stand-alone project is not built.

- *Step 8: Summarize the impacts with and without the project.* Summarize the impacts of the project (and alternatives) by contrasting the performance measures computed in Steps 6 and 7 and the policy information from Step 3.

Validation of Methodology to Evaluate Stand-Alone Projects

Cosner's Corner

The first case study shows how the methodology can be applied to privately funded infrastructure. Cosner's Corner is a 105-acre parcel of land in Spotsylvania County that lies between Route 1 and I-95 with the Route 17 Bypass bordering its northern boundary and the new Spotsylvania County Parkway to the south. The property is shown in Figure 1.

Step 1: Define the Evaluator's Perspective and Horizon Year

The evaluator's perspective is that of a VDOT planner where the primary considerations are the mobility and safety of travelers and the mitigation of adverse impacts for residents immediately adjacent to the roadway. Accordingly, travel time changes on Route 1 and queue lengths on the Route 17 Bypass were examined. Had another perspective been chosen, such as that of a county planner, impacts in other areas such as community cohesion, changes in the tax base, and air quality might have been examined.

A horizon year of 2015 was identified. With buildout at 2010, a horizon year of 2015 enables full consideration of the project's impacts yet is not so far into the future that data projections are unreliable. This is roughly consistent with the administrative requirements that implement Chapter 527 of § 15.2-2222.1 of the *Code* (24 VAC 30-155) (VDOT, 2007) that recommend a horizon year 6 years after buildout be selected for developments generating a large number of trips (VDOT, 2006).

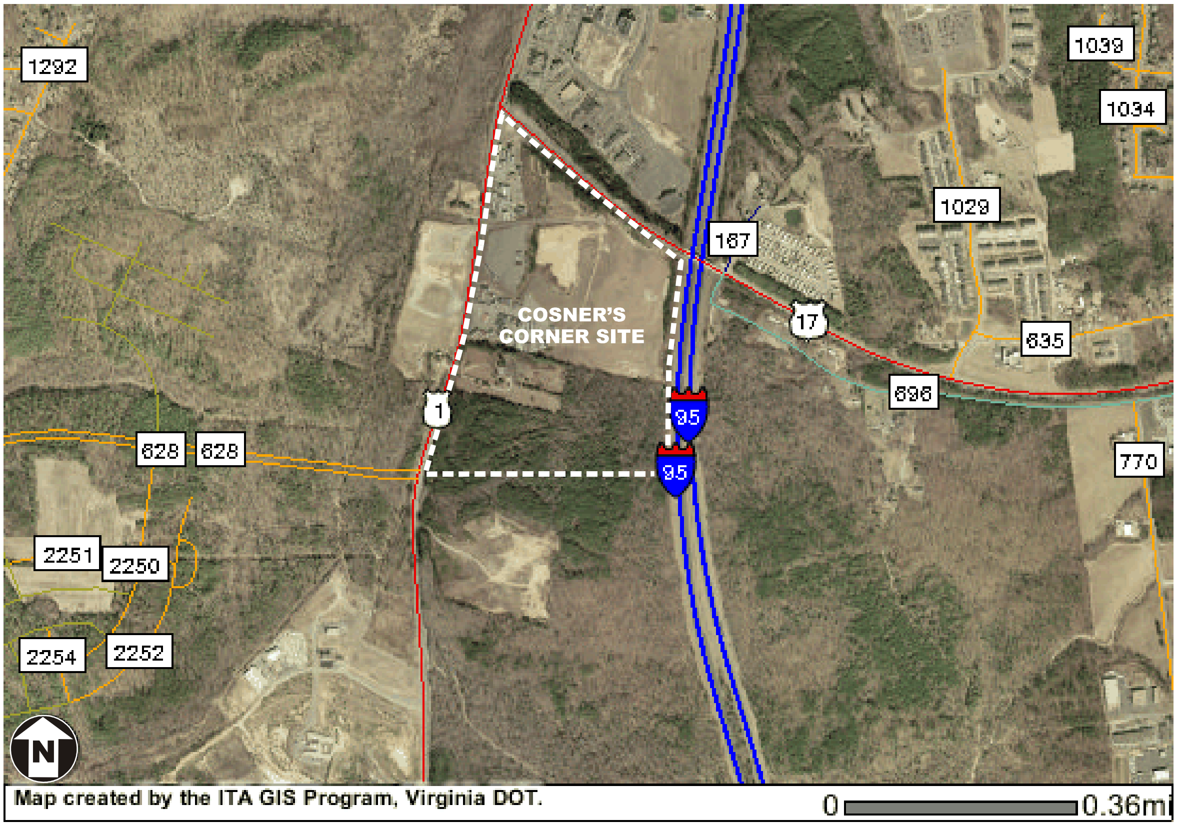

Figure 1. Cosner's Corner Stand-Alone Project

Step 2: Identify the Potential Problem Created by the Stand-Alone Project

As part of a proposal to build an 850,000-square-foot retail complex, the developer proffered several transportation improvements (Wells & Associates, 2003):

- the widening of Route 1, shown in Figure 2, from two to three through lanes in each direction and additional turn lanes
- a realignment of the Route 17 Bypass, also shown in Figure 2, which includes widening it to two lanes in each direction
- additional traffic signals and signal modifications as necessary (shown in Figure 2); the signal at the Route 1/Route 17 intersection is the modification.
- right-of-way designation for the Spotsylvania County Parkway to the south of the property
- improvements to the current interstate access point at Exit 126, north of the property
- a monetary contribution to a bridge crossing improvement of I-95.

Figure 2. Cosner's Corner Stand-Alone Project (Relocated Route 17 Bypass and Widening of Route 1)

Three potential problems were noted: (1) whether the proffered improvements obstructed other potential improvements, (2) whether the proffered improvements offset the additional demand created by the development, and (3) whether there would be adverse impacts to adjacent Route 17.

Step 3: Compare Relevant Policy Guidance with the Proposed Project

Three agencies have sources of policy guidance that affect the stand-alone project at Cosner's Corner: the Fredericksburg Metropolitan Planning Organization (FAMPO), Spotsylvania County, and VDOT. Table 2 compares the policies of these agencies with elements of the proposed project.

As shown in Table 2, sources of policy guidance for a specific area are not necessarily identical and can vary within one source. For example, the widening of Route 1 is listed in Spotsylvania County's Comprehensive Plan (Spotsylvania County Office of Planning, 2002) and the FAMPO Unconstrained LRP (FAMPO, 2004) but not in the state's SYIP (Commonwealth Transportation Board, n.d.). This does not necessarily comprise a conflict as the SYIP has a shorter horizon than the LRP, but it does shows that judgment is required to assess consistency.

Table 2. Cosner's Corner Stand-Alone Improvement Compared to Policies of Involved Agencies

Proffered Improvement	**FAMPO Long-Range Plan (Constrained Project List)[a]**	**FAMPO Long-Range Plan (Unconstrained Project List)[a]**	**Spotsylvania County Comprehensive Plan[b]**	**VDOT Six-Year Improvement Program[c]**	**VDOT 2025 State Highway Plan[d]**
Route 1 widening		Yes	Yes		Yes
Route 17 Bypass widening			Yes		Yes[e]
I-95 Spotsylvania County Parkway interchange	Yes				
Exit 126 improvements			Yes		
Spotsylvania County Parkway			Yes	Yes	Yes

[a] Fredericksburg Area Metropolitan Planning Organization (2004).
[b] Spotsylvania County Office of Planning (2002).
[c] Commonwealth Transportation Board (n.d.).
[d] VDOT (n.d.).
[e] VDOT's Fredericksburg district planner clarified that VDOT had identified as an alternative suggestion a flyover (Vogel, 2008) [rather than an at-grade intersection for Route 1 and Route 17].

Step 4: Identify Future Transportation Improvements Impacted by the Stand-Alone Project

Two proposed roadway improvements are impacted by the stand-alone project: (1) a flyover from Route 1 to Route 17 and (2) a Spotsylvania County Parkway and I-95 interchange.

For the first, VDOT had suggested a flyover to be built for Route 1 southbound traffic turning left onto the Route 17 Bypass. Instead of a flyover, however, the developer proposed to realign the Route 17 Bypass (Vogel, E., personal communication, 2006-2007), making it a four-lane divided facility, and to create two at-grade left-turn lanes in place of the flyover (see the lower left corner of Figure 2).

For the second, although the developer donated a small amount of right of way for the potential interchange, planners noted there was not sufficient land for the type of interchange FHWA would require (Vogel, E., personal communication, 2006-2007). Therefore, the interchange will most likely be constructed further south of the one shown in the Spotsylvania County Constrained LRP (Spotsylvania County Office of Planning, 2002). This would keep traffic on Route 1 for a longer period of time while it travels to an I-95 interchange, leading to more congestion on Route 1.

The proposed realigned Route 17 Bypass creates another potential problem: a bottleneck that will result when traffic must merge from the new four-lane facility to the unimproved two-lane bridge. This area is already congested, and the additional traffic created by the new Cosner's Corner development could exacerbate this bottleneck. It was later learned that because of these delays, the developer proffered some funding for widening the two-lane bridge (Vogel, 2008).

Step 5: Establish Appropriate Performance Measures

Four types of performance measures were assessed:

1. speeds on Route 1 (shown in Table 3)
2. mainline delay on Route 1 (shown in Table 4)
3. need for a flyover for the Route 1 and Route 17 intersection (Table 5)
4. queue lengths and delays for the Route 17 Bypass bridge (Table 6).

Steps 6 and 7: Evaluate the Impacts of the Stand-Alone Project Over the Horizon Period and Evaluate the Impacts of Not Building the Stand-Alone Project Over the Horizon Period

For clarity of presentation, the results of Steps 6 and 7 are combined. However, in terms of performing the analysis, it is appropriate to perform the calculations for Step 6 separate from those for Step 7 to ensure that two sets of impacts—those with the project and those without the project—are considered.

Speeds on Route 1. Table 3 shows travel speeds for Route 1 with and without the stand-alone project. One noteworthy characteristic is that the stand-alone project may improve conditions as it increases mainline travel speeds on Route 1.

Table 3. Mainline Travel Speeds for Cosner's Corner (Route 1)

Scenario	**Mainline Travel Speeds (PM Peak)**[a]			
	2003	**2003**	**2010**	**2015**
Base case	66.6	41	29[b]	16
Stand-alone project	67.1	41	35	20

[a] Calculations reflect mainline speeds only and do not include intersection delay.

[b] Calculations based on volume-delay curves given in the literature (Martin and McGuckin, 1998). For example, the 2010 base case evening peak hourly volume is estimated as 2,429 veh/hr, the free flow speed is assumed to be 45 mph, and the capacity is estimated as 1,375 veh/lane for two lanes. Thus speed is estimated as free flow speed/[1 + 0.71 (hourly volume/capacity)$^{2.1}$
$= 45/[1 + 0.71(2{,}429/2{,}750)^{2.1}] = 29.0869 \approx 29$ mph.

Mainline Delay on Route 1. Table 4 shows an alternative approach for presenting the travel time data shown in Table 3 where the benefits of increased mainline speeds for existing travelers and new travelers are compared. The benefit for existing travelers is the net reduction in travel delay; the benefit for new travelers attracted to the facility involves the concept of consumer surplus (FHWA, 1995). For example, for the mainline delay on Route 1, much of the benefit accrues to the original users rather than new users.

Need for Flyover for Route 1 and Route 17 Intersection. The need for a flyover from Route 1 to the Route 17 Bypass was evaluated using traffic forecasts for the years 2010 and 2015 along with an approach adapted from the literature (Martin and McGuckin, 1998). According to the data collected for the development, there are 1,261 left turns from Route 1 onto the Route 17 Bypass during the PM peak hour and a total of 2,753 vehicles approaching the intersection from the north. Table 5 shows that an at-grade intersection will suffice until there are about 3,350 vehicles from one approach, meaning that in year 2010 a flyover will not be warranted.

Table 4. Benefits to Users and Non-Users in Hours of Mainline Delay per Year (Route 1)

Period	Impacted Group	2010	2015
AM Peak	Original user benefit[a]	722	4478
	New user benefit[b]	0	0
PM Peak	User benefit[a]	1,971[c]	8,928
	New user benefit[b]	131	1069
Off Peak	User benefit[a]	201	63
	New user benefit[b]	24	15
Total	User benefit[d]	5,502	14,289
	New user benefit[d]	466	1273
Grand total	All users	5,968	15,562

[a] Based on comparing total vehicle hours of travel for base case average daily traffic.

[b] Computed as 0.5 (Induced vehicle miles traveled [VMT]) (–Change in VHT for original users/Original VMT).

[c] For example, based on speeds from Table 3, during the PM peak hour the stand-alone project would reduce travel time from 1.238 to 1.043 min in 2010. Travel time of 1.238 is calculated based on the length of 0.6 mi divided by the speed in Table 3 of 29.0869 mph (0.6 mi/ 29.0869mph = 1.238 min). For the existing 2,429 vehicles using Route 1 each day during the PM peak hour , the change in travel time is (2,429) x (1.238 – 1.043)/60 = 8.1 hr/day or, assuming 250 workdays/year, approximately 1,971 hr/year.

[d] Based on summing the AM peak, PM peak, and 14 multiplied by off-peak values.

Table 5. Capacities for Signalized Intersection Approaches[a]

No. of Through Lanes	Proportion Green Time for Approach (%)	Capacity for Approach (veh/hr)[a]
2	33	1,150
2	50	1,600
2	67	2,300
3	33	1,600
3	50	2,225
3	67	3,350 [a]

[a] Values determined from applying Tables 55, 56, and 57 in Martin and McGuckin (1998). For example, the last row showing a value of 3,350 was determined as follows: 2,000 veh/hr (Table 56, exclusive left, two lanes, high turns) + 900 veh/hr (Table 57, exclusive left, one additional through lane, high turns) + 450 veh/hr (add 150 veh/hr for each through lane due to presence of exclusive turn for right lanes). Although right turns are not physically possible, the fact that this is a T-intersection means that right turns from this approach will not affect the through movement.

However, during the year 2015, there will be potentially 5,396 vehicles approaching the intersection from the north during the PM peak hour, suggesting that a flyover will be needed by 2015.

Queue Lengths and Delays for Route 17 Bypass Bridge. For conditions where demand was less than capacity, average waiting times for vehicles on the Route 17 Bypass approaching the bridge over I-95 were initially calculated based on the single-channel undersaturated infinite queue (Garber and Hoel, 2002). However, by 2015, demand will exceed capacity. Accordingly, Eqs. 1 through 5 were used to determine queue behavior at the bridge bottleneck (Gerlough and Huber, 1975), where it is assumed that demand exceeds capacity for a period of 3 hr, after which demand drops substantially below the capacity of the bridge. Eqs. 3 and 5 were modified slightly to convert units from hours to minutes.

Duration of queue in minutes, $t_q = r\left(\frac{s - s_r}{s - q}\right)$ [Eq. 1]

Time for queue to dissipate in minutes, $t_o = t_q - r$ [Eq. 2]

Maximum number of vehicles in the queue, $q_{max} = r\left(\frac{q}{60} - \frac{s_r}{60}\right)$ [Eq. 3]

Maximum delay per vehicle, $d_m = r\left(1 - \frac{s_r}{q}\right)$ [Eq. 4]

Total delay in vehicle minutes, $D = \frac{q_{max}t_q}{2} = \frac{r}{2}\left(\frac{q}{60} - \frac{s_r}{60}\right)t_q$ [Eq. 5]

where

r = duration of blockage in minutes (assumed to be 180 min)
s = capacity of four-lane road (assumed to be 3,200 veh/hr)
s_r = capacity of two-lane bridge (assumed to be 1,500 veh/hr)
q = peak hour volume in vehicles per hour.

Application of these equations yields Table 6 for the PM peak hour for 2010 and 2015. The results show that the stand-alone project will increase delay substantially for 2010 and more in 2015. For example, Table 6 suggests that in 2015, the maximum delay will be about 37% larger than would be the case without the stand-alone project. Clearly some of the delays shown are quite large and do not reflect a likely change in travel patterns attributable to this increased congestion. Thus, some of the larger calculations should not be viewed as predictions but as showing that in this particular case, a decision not to widen the Route 17 Bypass Bridge will lead to a substantial increase in delay.

Table 6. Queue Lengths and Delays for Eastbound PM Peak Hour on Route 17

Year	**Situation**	**Q**[a]	**t_q = Total Elapsed Time**	**t_0 = Time for Queue to Dissipate**	**q_{max} = Max. Vehicles in Queue**	**d_m = Max. Min Delay/ Vehicle**	**D = Total Vehicle Min Delay**
2010	w/o Proj.	1,639	196[b]	16[c]	417[d]	15[e]	40,872[f]
	w/Proj.	1,902	236	56	1206	38	142,156
2015	w/o Proj.	2,404	383	203	2705	68	521,276
	w/Proj.	3,100	3047	2867	4799	93	7,344,000

[a] Wells & Associates (2003).

[b] Total elapsed time is calculated from Eq. 1, using q =1,639, r = 180, s = 3,200, and s_r = 1,500, then t_q= (180)((3200 – 1500)/(3200 – 1639) = 196.0282 ≈ 196.

[c] Time for queue to dissipate is calculated from Eq. 2 as t_0 = 196 – 180 = 16.

[d] Maximum number of vehicles affected by queue from Eq. 3 is q_{max} = (180)((1639/60) – (1500/60)) = 417.

[e] Maximum minutes of delay per vehicle is calculated using Eq. 4, d_m = (180)(1 – (1500/1639)) = 15.265 ≈ 15.

[f] Total vehicle-minutes of delay using Eq. 5 are (180/2)(1,639/60 – 1500/60)(196.0282) = 40,872.

Step 8: Summarize the Impacts With and Without the Project

Tables 3 and 4 suggest the project will reduce delays (due to widening Route 1), whereas Tables 5 and 6 suggest the project will increase delays (due to lack of flyover and congestion at

Route 17 Bypass Bridge). An aggregation of these results suggests that the stand-alone project will likely increase delay. For example, the beneficial aspect of the project—the widening of Route 1—will in 2015 eliminate an estimated 15,562 min of delay *per year*, as shown in the last row of Table 4. One disadvantage of this project—the additional delay at the Route 17 Bypass Bridge—will add an estimated 101,284 min of delay in 2010 per *peak hour* based on the difference between the first two rows in Table 6.

This net increase in delay is explained in non-quantitative terms in the top two rows of Table 7, which summarizes the impact of the stand-alone project.

Thus, if the evaluator in Step 1 is concerned only with long-term transportation impacts, the stand-alone project would be rejected based on the data herein. However, other factors might be considered based on the perspective of the evaluator in Step 1, such as shorter term transportation benefits for Route 1 or the ability to accommodate extra development. Table 7 thus can support any of these four decisions, depending on the perspective of the evaluator:

1. The project should be accepted because better conditions in the short term are more important than worse conditions in the long term.

2. The project should be rejected because long-term transportation performance matters more than short-term performance.

3. The project should be accepted because although transportation system performance is important, so is accommodating a change in land use that is desired by the county.

4. Additional transportation improvements, such as the construction of a flyover, should be sought such that the long-term transportation performance is similar to what it would have been had the rezoning request not been improved.

Table 7. Summary of Impacts of Cosner's Corner Stand-Alone Project[a]

Proposed Improvements	**Pro**	**Con**
Widen Route 1 and use signal instead of flyover at intersection of Route 1 and Route 17 Bypass.	Increase in mainline travel speeds on Route 1[a]	Long-term increase in intersection delay because needed flyover not built[b]
Realign and widen Route 17 Bypass	Possible short-term decrease of mainline travel time on Route 17	Substantial increase in delays because although demand exceeds capacity at bridge without project, ratio of demand to capacity increases with project[c]
Allow project to proceed	Increase tax base for county and customer's request accommodated	Needed interchange immediately north or south of development not built

[a] For example, Table 3 showed that PM peak hour speeds in 2015 will be 4 mph faster with project, and Table 4 showed that much of benefit of resultant travel time reduction accrues to existing users.

[b] For example, Table 5 showed that although the at-grade signalized intersection can accommodate demand in 2010, the intersection will be over capacity by 2015.

[c] For example, Table 6 showed that during PM peak hour in 2015, maximum delay with project will be 37% greater than without project (93 min/68 min = 37% increase).

Eagle Harbor

This case study focused on the request by Isle of Wight County for pedestrian crossings on Route 17. It differed from the previous case study in three respects: (1) an operational change for existing infrastructure was sought, (2) less data were available, and (3) a substantial focus of the project was pedestrians.

Step 1: Define the Evaluator's Perspective and Horizon Year

The perspective chosen was that of a VDOT district planner who needs to respond to the county's request for pedestrian crossings by examining safety and vehicular travel.

Because Eagle Harbor Realtors expects all residential and retail development to be built and occupied by 2010, that year was chosen as the horizon year. Since this effort focused on a shorter term operational change, it did not appear necessary to perform the analysis several years after buildout as was done with the previous case study. As with the first case study, this is consistent with the administrative requirements that implement Chapter 527 of § 15.2-2222.1 of the *Code* (24 VAC 30-155) (VDOT, 2007) that suggests a horizon year that reflects conditions when the project is built for developments generating a small number of trips (VDOT, 2006).

Step 2: Identify the Potential Problem Created by the Stand-Alone Project

Isle of Wight County asked VDOT to build a pedestrian crossing that would serve the demand generated by residential and retail development adjacent to Route 17, a principal arterial, four-lane divided highway that currently has a speed limit of 45 mph and an average daily traffic (ADT) volume of 30,000. Figure 3 shows the portion of the road where the county has requested crosswalks. The current pedestrian facilities consisting of two unconnected sidewalks and three traffic signals are also shown. There is residential and retail development on both sides of Route 17.

This case study represents a stand-alone project because of a conflict between the county's comprehensive plan (which shows pedestrian crosswalks at the intersections) (Isle of Wight County Department of Parks and Recreation, 2006) and VDOT (which had concerns about pedestrian safety on this arterial facility). There are two missing pieces of information that contribute to this conflict: (1) the demand for pedestrian travel and (2) the extent to which such pedestrians can safely traverse Route 17.

Step 3: Compare Relevant Policy Guidance with the Proposed Project

Both state and local policies were directly relevant to this project. VDOT's 1996 Subdivision Street Requirements (VDOT, 1996), in effect in 2001 when the crosswalks were proposed in the county's bicycle/pedestrian plan (Isle of Wight, 2006), did not emphasize pedestrian accommodations. However, in 2004, VDOT's policy changed, stating that pedestrian and bicycles should be accommodated when possible (VDOT, 2004). This meant that the pedestrian accommodations along Route 17 merited serious consideration, making the focus of the analysis on whether they could be implemented

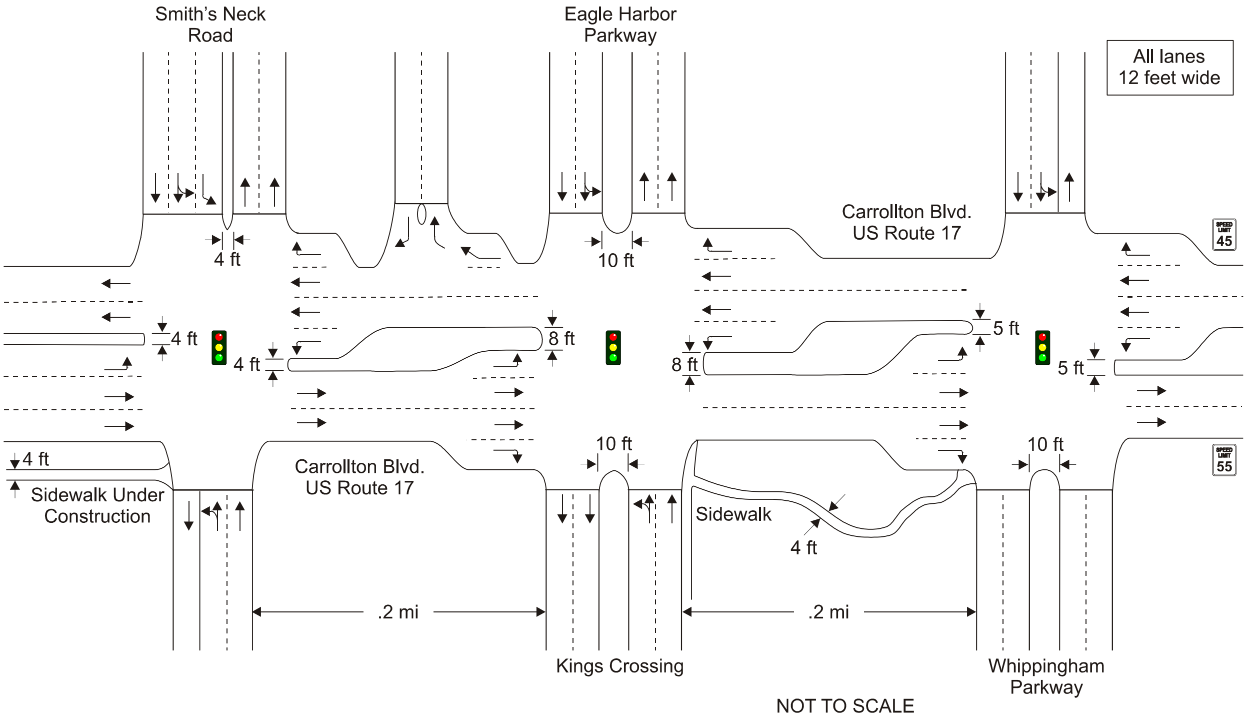

Figure 3. Isle of Wight Stand-Alone Project (Pedestrian Facilities Adjacent to Route 17)

safely. In 2006, Isle of Wight adopted a bicycle and pedestrian plan that recommended crosswalks on Route 17 to serve the Eagle Harbor development (Isle of Wight, 2006). Figure 4 shows the timeline of policy changes that directly affect the request for crossings.

One design standard provides policy guidance for this project. Many of the pedestrian attractions at Eagle Harbor are family friendly activities such as swimming and miniature golf. Accordingly, a walking speed suitable for children (3.3 ft/sec) rather than adults (4.0 ft/sec) should be used (Gates et al., 2006; TRB, 2000).

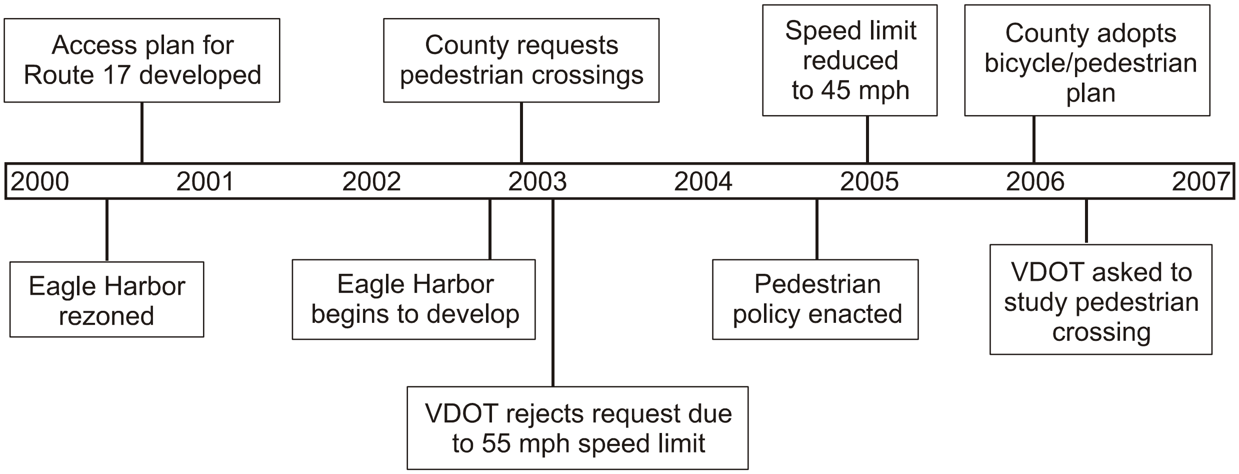

Figure 4. Chronology of Events for Pedestrian Crossings at Eagle Harbor

Step 4: Identify Future Transportation Improvements Impacted by the Stand-Alone Project

The pedestrian crossings have no impact on future transportation improvements that are already planned or programmed.

However, the crossings have one potential impact on existing infrastructure: if the crossings cause vehicle queues to extend from one signal to another signal, arterial operations will be compromised substantially. Thus, it is important to determine whether additional red time attributable to pedestrians crossing a signalized intersection will extend the vehicle queue as far back as the next traffic signal.

Step 5: Establish Appropriate Performance Measures

Given the county's request for a pedestrian crossing, there are four alternatives:

1. Provide a crosswalk at existing traffic signals.
2. Install a pedestrian crossing at a midblock location.
3. Construct a pedestrian overpass.
4. Do nothing.

To evaluate these alternatives, five performance measures that reflect cost, pedestrian demand, ease of crossing, adverse impacts on vehicles, and pedestrian crash risk were selected:

1. feasibility of pedestrians crossing Route 17 (applicable to all alternatives)
2. demand for pedestrians crossing Route 17 (applicable to all alternatives)
3. capital cost of the alternative (applicable to first three alternatives)
4. resultant change in vehicle queues on Route 17 (applicable to first two alternatives)
5. risk of pedestrian injury (applicable to all five alternatives).

The fifth performance measure was not initially considered but was added as the case study progressed and the results showed that risk needed to be considered for each alternative.

Steps 6 and 7: Evaluate the Impacts of the Stand-Alone Project Over the Horizon Period and Evaluate the Impacts of Not Building the Stand-Alone Project Over the Horizon Period

As with the first case study, the calculations for Steps 6 and 7 are performed separately, as they indicate different situations. However, the results of these two steps are presented jointly where the five performance measures are each applied to the four alternatives identified in Step 5.

Feasibility of Pedestrians Crossing Route 17. If no operational changes were made, pedestrians who desired to cross Route 17 would have to use the existing green time at the signals. Thus, the time pedestrians need to cross Route 17 should be compared to the time pedestrians have to cross Route 17.

Eq. 6 may be used to estimate the time (T_c) pedestrians need to cross Route 17:

$$T_c = \frac{L}{S_p} + t_s \qquad \text{[Eq. 6]}$$

where

S_p = average pedestrian walking speed (ft/sec)
L = crosswalk length (ft)
T_s = pedestrian start-up time and clearance time (sec),

To apply Eq. 6, a pedestrian startup time, t_s, of 3.2 sec was used (TRB, 2000). Since families with children would be crossing the road, a walking speed of 3.3 ft/sec was used (Gates et al., 2006) and the length of the crosswalk was estimated as 80 ft (based on six 12-ft lanes and an 8-ft median). Thus, the time pedestrians require to cross Route 17 may be estimated from Eq. 6 as

$$T_c = \frac{L}{S_p} + t_s = \frac{80\ \text{ft}}{3.3\ \text{ft}/\text{sec}} + 3.2\ \text{sec} = 27.44\ \text{sec} \approx 30\ \text{sec}$$

Figure 5 shows the gaps currently available in the traffic stream during an off-peak period; none is as big as the required crossing time of 30 sec obtained from Eq. 6. Figure 5 shows that it might be possible to provide pedestrians sufficient time to cross Route 17 if a pedestrian refuge area were created at the median; however, at present, the slanted, narrow median does not provide such a refuge area.

Thus, with the do-nothing alternative, pedestrians do not have sufficient time to cross Route 17 based on a comparison of the length of time between vehicles and the length of time a pedestrian needs to traverse the facility at the assumed walking speed. With the two at-grade

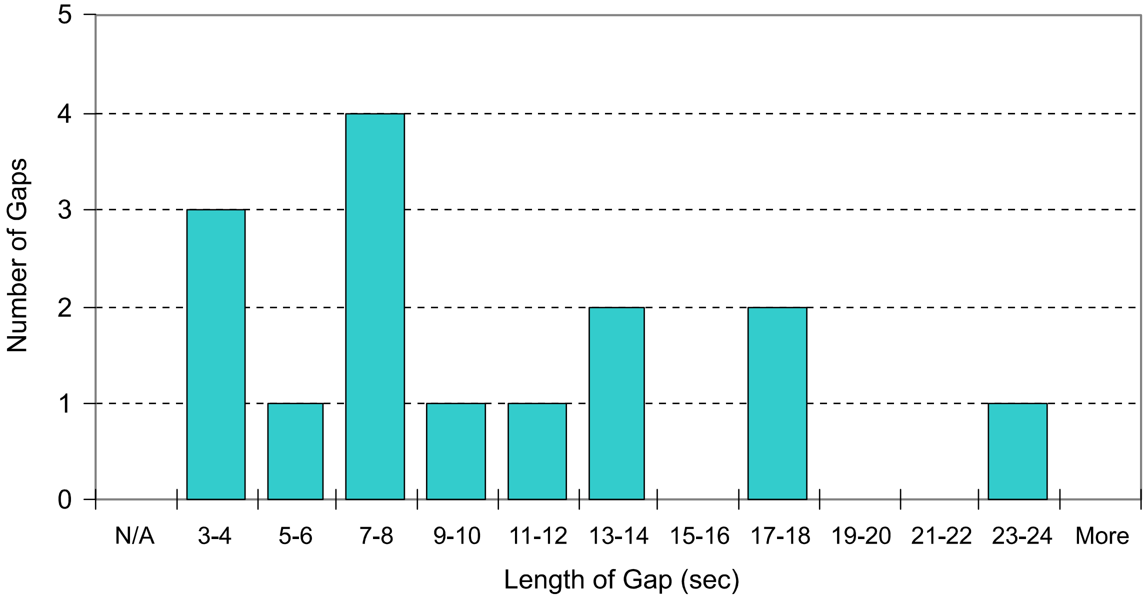

Figure 5. Number and Duration of Gaps Exceeding Two Seconds in Length Observed During a Six-Minute Period on Route 17

crossing alternatives (whether at an existing signal or a new midblock crossing), pedestrians do have sufficient time to cross Route 17 as long as adequate green time is provided. The grade-separated overpass alternative gives pedestrians sufficient time to cross Route 17 regardless of the amount of green time provided.

Demand for Pedestrians Crossing Route 17. The importance of the comparison between required and actual time to cross Route 17 depends on the number of pedestrians affected. For the three crossing alternatives, the number of potential pedestrian trips crossing Route 17 may be roughly estimated as between 0 and 2,000.

This estimate was derived as follows. It was assumed that each household generates 9.57 vehicle trip ends (ITE, 2003) or half that number (4.785) of round trips; that 40% of such round trips are made to some point within the Eagle Harbor Area; and that for half of these trips, a pedestrian crossing of Route 17 would never occur (because either the home and destination are on the same side of Route 17 or the trip purpose necessitates a vehicle, such as making a large number of purchases at a grocery store). If pedestrian amenities were present, then each home could generate *up to* (4.785)(40%)(50%) = 0.957 pedestrian round trips or 1.914 pedestrian crossings. There are 400 homes east of Route 17 and 800 west of Route 17, and both sides of Route 17 have retail and commercial facilities. Thus, using a *maximum* potential pedestrian trip end crossing rate of 1.914 crossings per home yields

$$\text{Potential pedestrian crossings} = \left(\frac{1.914 \text{ crossings}}{\text{Home}}\right)(1{,}200 \text{ homes}) = 2{,}297 \qquad \text{[Eq. 7]}$$

Although Eq. 7 gives an exact value of 2,297, such a value portrays a higher level of precision than warranted by the data. In this case, judgment suggests that a *maximum* value of roughly 2,000 pedestrian crossings is appropriate, as the methodology may be able to estimate pedestrian trips to the nearest thousand but not with a greater degree of precision. Since it is possible that no pedestrians may use the facility, a *minimum* of zero pedestrian crossings is noted, with a *midpoint* value of 1,000 pedestrian crossings.

Capital Costs for the Crossing Alternatives. The grade-separated overpass is the most expensive alternative and the most variable in terms of capital cost. Costs for four Virginia pedestrian overpasses completed in 1991, 1993, 2001, and 2003 (Boggs, 2007), converted to 2005 dollars using the Federal Aid Composite Index (FHWA, 2007), were $0.81 million, $0.91 million, $1.17 million, and $1.8 million, suggesting a rough order of magnitude value of $1.17 million.

The costs for an at-grade intersection will be considerably lower. For the first alternative—an at-grade crossing at an existing signal—costs are estimated as $48,300, based on a midpoint value of $30,000 to install a push-button pedestrian signal, $300 for a ladder crosswalk, $1,000 to change the phasing of the existing signal, and $17,000 for installation of a pedestrian island (Pedestrian and Bicycle Information Center, n.d.). For a midblock location crossing, the total cost would be $128,300 based on the same treatments plus the cost of a new signal, estimated as $80,000 (Pedestrian and Bicycle Information Center, n.d.).

Resultant Change in Vehicle Queues on Route 17. A concern with the first two alternatives—which entail additional green time for pedestrians at an at-grade crossing—is that vehicular delay will increase, especially if the pedestrian phase causes queues to extend as far back as the next upstream signal. To estimate the length of the queues that would form when pedestrians were given a walk indication at the midblock location, a simplified shockwave approach was used.

This approach assumes that traffic on Route 17 can be represented by the Greenshields model. When pedestrians are given the walk signal, the northbound and southbound Route 17 vehicles have a red signal and a shockwave propagates backward from the signal. The speed of this shockwave is calculated from Eq. 8 as

$$\left|U_w\right| = U_f \frac{K_i}{K_j} \qquad \text{[Eq. 8]}$$

where

U_w is the speed of the shockwave moving backward from the red signal
U_f is the mean free speed of vehicles on Route 17 moving toward the signal
K_i is the density of those vehicles driving toward the signal at speed U_f
K_j is the jam density, i.e., the density of nonmoving vehicles stopped at the signal.

Although precise data are not available, Eq. 8 may be determined using planning level estimates. Given that Route 17 has an ADT of 30,000 veh/day, a standard assumption of 10% of the volume using the facility during the peak hour suggests a peak hour volume of 3,000 veh/hr. Assuming a 65/35 directional split during the peak hour and two lanes in each direction, there will be (0.65)(3,000 veh/hr)/2 lanes = 975 veh/hr/lane in the more heavily traveled direction. If these vehicles are moving at the speed limit of 45 mph, then the density (K_i) is (975 veh/hr/lane)/(45 mph) = 21.67 veh/mi/lane. The jam density (K_j) based on 40 ft per vehicle is 132 veh/mi/lane. A mean free speed, U_f, of 60 mph may be assumed for Route 17. Thus, Eq. 8 may be used to determine the speed of the backward moving shockwave, U_w, as

$$\left|U_w\right| = U_f \frac{K_i}{K_j} = (60\ \text{mph})\frac{21.67\ \text{veh/mi/lane}}{132\ \text{veh/mi/lane}} = 9.85\ \text{mph}$$

The length of this shockwave, L. will depend on the amount of time the signal remains red (T_{red}). The length may be calculated from Eq. 9 as

$$L = (U_w)(T_{red}) = \left(\frac{9.85\ \text{mi}}{\text{hr}}\right)(30\ \text{sec})\left(\frac{1\ \text{hr}}{3{,}600\ \text{sec}}\right)\left(\frac{5{,}280\ \text{ft}}{1\ \text{mi}}\right) = 433.4\ \text{ft} \qquad \text{[Eq. 9]}$$

Based on these assumptions, it is clear that additional green time at an existing signal is unlikely to cause queue spillback since the length of the queue (calculated as 443 ft) is less than the distance between signals (1,056 ft). For a midblock location between the two signals, the shockwave of 433 ft is still less than the distance between signals of 1,056/2 = 528 ft.

Pedestrian Crash Risk. The initial pedestrian gap analysis clearly showed that there were zero acceptable gaps during the observed period to accommodate a child walking at a rate of 3.3 ft/sec (Gates et al., 2006). This showed that pedestrians could not safely cross the road without one of the three alternative improvements, and a first assessment would suggest that the grade-separated option would have the lowest risk of a pedestrian injury.

However, reviewers of the methodology noted that there was a risk of pedestrian noncompliance, which complicates the analysis. In Virginia, more than 95% of pedestrian crashes that occurred in 2005 involved a pedestrian who violated the law (Department of Motor Vehicles, 2006). In fact, pedestrians might cross the street at grade even if there is an overpass or there is no crosswalk. Table 8 shows factors that influence noncompliance. Although it is possible to reduce the risk of noncompliance when designing these crossings, none of the four alternatives eliminates this risk.

Table 8. Risks of Pedestrian Noncompliance for Each Alternative

Pedestrian Traffic Control	Desired Pedestrian Action	Noncompliant Pedestrian Actions	Factors Affecting Noncompliance
Crossing at existing traffic signal	Cross only at intersection and wait for signal to give green indication	Jaywalking	Lateral distance of intersection from "ideal" location for pedestrians to cross street. Pedestrians may have to detour from their path to use signalized intersection.
New midblock crossing signal	Cross only at midblock location and wait for signal to give green indication	Jaywalking	Lateral distance of midblock location from the "ideal" location for pedestrians to cross street. Pedestrians may have to detour from their path to use the midblock crossing.
Grade-separated overpass	Use overpass to cross Route 17	Walking across street without using bridge	Steepness of slope accessing bridge. Using bridge may be more tiring than crossing at grade.
No crossing	Do not cross street	Crossing street	Demand for pedestrian travel. Pedestrians may choose to walk despite lack of crossing.

Step 8: Summarize the Impacts With and Without the Stand-Alone Project

The capital costs, the ratio of these capital costs to demand, and the "cost" in terms of vehicle queue length are shown in Table 9. The demand assessment was discussed following Eq. 7 and the vehicle queue lengths were discussed following Eqs. 8 and 9. Each alternative may itself lead to additional choices. For example, with the grade-separated overpass, one option the county might support is to ask VDOT to consider an investment of the same level of funds at another location in Isle of Wight where greater pedestrian demand yields a lower ratio of capital cost to demand. A second option might be to reconsider these locations after development has been completed in 2010 to estimate demand better. A third option might be to construct the overpass and then monitor demand thereafter in order to apply these results to other locations.

Table 10 summarizes the information about each alternative in light of the five performance measures initially identified (cost, pedestrian demand, feasibility of pedestrian crossing, and impact on vehicle queue length) and the fifth performance measure that became important as the case study progressed (risk of pedestrian crashes). For three of the five

Table 9. Cost-Effectiveness of Pedestrian Alternatives (Eagle Harbor)

Traffic Control	Estimated Capital Cost[a]	Capital Cost per Pedestrian Crossing per Day[b]	Length of Vehicle Queue Due to Pedestrian Signal	Distance From End of Vehicle Queue and Next Traffic Signal[c]
Crossing at existing traffic signal	$48,300	$0.007[b]	443 ft	613 ft[c]
New midblock crossing signal	$128,300[a]	$0.018	443 ft	85 ft[c]
Grade-separated overpass	$1,170,000	$0.160	0 ft	Not applicable
No crossing	$0	$0	0 ft	Not applicable

[a] Costs are order of magnitude estimates only based on midpoint values identified in the literature (Boggs, 2007; Pedestrian Bicycle Information Center, n.d.).

[b] Costs based on a 20-year life cycle and a midpoint demand of 1,000 pedestrian crossings; e.g., a $48,300 capital cost (spent today) amortized over 20 years, 365 days/year, and 1,000 crossings/day yields $48,300/(20 x 365 x 1,000) = $0.007—less than $0.01 per daily pedestrian crossing.

[c] Larger values are desirable; e.g., existing signals are 1,056 ft apart and the queue due to additional pedestrian crossing time is 443 ft, such that this difference is 1,056 ft – 443 ft = 613 ft between the end of the vehicle queue and the next signal. For a midblock crossing evenly spaced between signals, this difference is 1,056/2 – 443 = 85 ft between the end of the vehicle queue and the next signal.

Table 10. Summary of Impacts of Pedestrian Alternatives

Traffic Control	Feasibility of Pedestrian Crossing Route 17[a]	Potential Pedestrian Demand	Capital Cost	Impact on Vehicle Queues[b]	Is There Pedestrian Crash Risk?[c]
Crossing at existing traffic signal	Medium	Uncertain (0 to 2,000)	Low ($48,300)	Low	Yes
New midblock crossing signal	Medium	Uncertain (0 to 2,000)	Low ($128,300)	Medium low	Yes
Grade-separated overpass	High	Uncertain (0 to 2,000	High ($1,170,000)	None	Yes
No crossing	None	None	None	None	Yes

[a] Based on a comparison of available gaps in the traffic stream (Figure 5) and the gap needed by pedestrians.

[b] Based on calculations in Table 9.

[c] Based on analysis in Table 8.

metrics, the impacts are fairly clear: the literature suggests capital costs (Boggs, 2007), Eq. 6 and the gaps in the traffic stream indicate whether a pedestrian can cross Route 17, and Eqs. 8 and 9 can estimate the length of the vehicle queue. For one of the performance measures, however, there is substantial variability: the demand may be between 0 and 2,000 pedestrian crossings per day. For the last measure, it is clear that there is a risk but what is not clear is which alternative presents the lowest crash risk.

DISCUSSION

Table 1 showed that stand-alone projects are not uniformly helpful or harmful to the transportation system; rather, each project must be evaluated individually. The results of applying the methodology to evaluate such projects showed five lessons. Because each lesson applied to both case studies, because the two case studies were different, and because there is no reason to believe that insights from the two case studies would not apply to the remaining 20 stand-alone projects shown in Table 1, it appears that these five lessons can be generalized to other locations:

1. Even when extensive data are available, site-specific assumptions must be made.
2. Documentation of assumptions is needed.
3. Judgment is required when presenting the results.
4. The methodology is iterative.
5. The analytical techniques are found in planning references and engineering references.

Site-Specific Assumptions Must Be Made

The biggest challenge of the Eagle Harbor case study was that when it was first identified in Table 1, there was little documentation available. The history of the request, the sources of policy guidance, and even the exact location had to be determined through contacts with state and local planners, and field visits were necessary to obtain much of the data used in the computations of the performance measures. This lack of data thus added complexity but made the Eagle Harbor no less relevant as a case study and in fact showed that the methodology is applicable to projects for which little published data are available.

Yet assumptions remain necessary even for better-documented case studies such as Cosner's Corner. For example, for that study, volumes for 2015 were unavailable for some of the routes, so growth rates were developed based on observations of traffic volume in 2003 and 2010 in order to estimate 2015 volumes. Table 11 shows that AM peak, PM peak, and off peak hourly volumes and speeds can be obtained but that a mixture of data and assumptions is necessary. For non-controversial projects, it may not be necessary to provide all parties with material such as that shown in Table 11, but archiving such material may be helpful when assumptions are challenged.

Documentation of Assumptions Is Needed

Assumptions made for the calculation of performance measures in Steps 6 and 7 were placed in a summary table, such as that shown in Table 12, rather than simply described in the appropriate portions of the text. Such documentation provides two pieces of information: the data elements themselves (e.g., the specific traffic volume that was used for a particular route) and the type of data that is not available from published sources (e.g., a volume for Route 17 for year 2015 was derived through the use of a growth factor).

Another critical assumption that became evident in the conduct of the two case studies is the perspective of the evaluator in Step 1. Arguments can be made that this perspective should be narrowly focused on transportation impacts only or should include broader impacts. This report does not indicate which perspective should be chosen for a particular project or organization; however, Table 13 may assist evaluators with making such a decision.

Table 11. Summary of Volumes and Mainline Speeds for Route 1 (Cosner's Corner Case Study)

Scenario: Route 1	Annual Change (%)	Measure of Effectiveness	2003	2010	2015
Base case (no stand-alone project)	6.2	ADT (veh/day), both ways[a]	28,680[h]	43,740[h]	59,130
	12.0	AM Peak (veh/hr), one way[b]	701[h]	1,545[h]	2,717
	-6.5	AM Speed (mph)[c]	43.26	37.14	26.59
	7.0	AM Travel time (min)[d]	0.83	0.97	1.35
	12.4	PM Peak (veh/hr), one way[e]	1,073[h]	2,429[h]	4,354
	-10.6	PM Speed (mph)[c]	40.97	29.09	15.72
	11.8	PM Travel time (min)[d]	0.88	1.24	2.29
	4.7	Off Peak (veh/hr), one way[f]	898[h]	1,278[h]	1,607
	-1.4	Off Peak Speed (mph)[c]	42.15	39.40	36.59
	1.4	Off Peak Travel time (min)[d]	0.85	0.91	0.98
With stand-alone project	9.0	ADT (veh/day), both ways[a]	28,680[h]	52,590[h]	81,095
	10.2	AM Peak (veh/hr), one way[b]	701	1,382	2,244
	-2.3	AM Speed (mph)[g]	43.26	42.00	37.57
	2.4	AM Travel time (min)[d]	0.83	0.86	0.96
	14.4	PM Peak (veh/hr), one way[e]	1,073[h]	2,753[h]	5,396
	-9.6	PM Speed (mph)[g]	40.97	34.52	20.02
	10.6	PM Travel time (min)[d]	0.88	1.04	1.80
	8.2	Off Peak (veh/hr), one way[f]	898[h]	1,583[h]	2,350
	-1.9	Off Peak Speed (mph)[g]	42.15	41.10	36.95
	2.0	Off Peak Travel time (min)[d]	0.85	0.88	0.97

[a] Average daily traffic (24-hr volume).

[b] Hourly volume during AM peak hour.

[c] Based on the formula $\text{Speed} = 45/[1 + 0.71(\text{hourly volume}/2{,}750)^{2.1}]$.

[d] Based on a length of 0.6 mi.

[e] Hourly volume during PM peak hour.

[f] Hourly volume during an off peak hour, estimated as (1/2ADT – AM Peak Volume – PM Peak Volume)/(14).

[g] Based on the formula $\text{Speed} = 45/[1 + 0.71(\text{hourly volume}/4125)^{2.1}]$.

[h] Value was given, not derived, from the traffic impact analysis.

Table 12. Summary of Assumptions for Cosner's Corner Stand-Alone Project

Data Element	Assumption
Truck percentage	0%
Free flow speed for Route 1	45 mph
Ultimate (LOS E) capacity for Route 1	1,375 veh/hr
Workdays per year	250
Traffic volumes for 2003 and 2010	Varies based on information from Silver Companies (n.d.) and a report for the Silver Companies by Wells & Associates (2003). Data are given in Table 11.
Traffic volumes after 2010	Based on a growth rate of 1.06 per annum without development and 1.09 with development. Data are given in Table 11.
Volume in typical off-peak hour	The sum of traffic volumes from all off-peak hours divided by 14.

Table 13. Considerations for Selecting Evaluator's Perspective in Step 1

Evaluator May Choose to Focus Exclusively on Transportation Impacts If	Evaluator May Choose to Address Broader Set of Non-Transportation Impacts If
The evaluator's organization has a stated mission of focusing on transportation impacts	The evaluator's organization has a stated mission of considering broader, not just transportation, impacts
Another organization or entity will address non-transportation impacts	No other organization or entity will address these non-transportation impacts
The evaluator's expertise is limited to transportation impacts	The evaluator has expertise or access to resources to address non-transportation impacts
The evaluator, or the evaluator's organization, does not have credibility outside the domain of transportation	The evaluator, or the evaluator's organization, has credibility with external stakeholders with respect to consideration of non-transportation impacts
Non-transportation impacts are addressed at some other point during project development	Failure to consider non-transportation impacts at this point in project development may mean that such impacts are never addressed

Judgment Is Required When Presenting the Results

Two considerations governed how the results of the methodology should be presented. First, the analytical methods used—such as the queuing theory shown in Eqs. 1 through 5, the trip generation rates based on the literature (ITE, 2003), or the sketch planning methods for determining intersection capacity (Martin and McGuckin, 1998)—provide an order of magnitude estimate that does not fully predict traveler behavior. For example, if the information in Table 6, which estimated total vehicle delay on Route 17, is considered, it is unlikely that motorists would continue to use that route if the delays approached the values shown for 2015; rather, motorists will take other routes. Thus, the information from Table 6 that is applicable at the planning level of analysis is that the stand-alone project will increase delay compared to the delay that would result without this project. By itself, the exact amount of delay forecast for 2015, is not germane to the analysis.

The second consideration is that not all impacts should be quantified, especially if data are unavailable, as was the case with Table 8, which showed the pedestrian crash risk for each alternative. The utility of this table is that it offers strategies for minimizing the risk of a pedestrian injury. For example, with the first alternative of providing a grade-separated overpass, a design choice that would reduce the risk of pedestrians not using the overpass would be (1) to have a moderate rather than steep slope for accessing the overpass, and (2) to design the sidewalk such that it is separated from the roadway and leads directly to the overpass, thereby making the overpass choice more appealing.

The Methodology Is Iterative

Although eight steps are given, the application of the methodology is iterative in practice. This is partly because of how performance measures are selected. Generally it is easy to identify a large number of performance measures in Step 5 only to find that a subset of them are directly relevant to the evaluation when they are computed in Steps 6 and 7. It is also possible to overlook some metrics in Step 5, as was the case with pedestrian non-compliance in the Eagle

Harbor case study. The original iteration did not consider non-compliance; it was later found that this risk should be noted.

Yet it is Steps 2 and 3 that also lead to the methodology being iterative. The sources of policy guidance—especially if they include technical design manuals—may in some cases be identified after the performance measures have been identified. For example, referring again to the initial application of the Eagle Harbor case study, one additional source of policy guidance in Step 2—walking speeds for children (Gates et al., 2006)—was identified after pedestrian trip generators in Step 6 were found to include activities that would necessarily involve a large proportion of children.

Finally, the iterative nature of the methodology is influenced by the data available. Several of the techniques lend themselves to using initial default assumptions from the literature that can be modified based on the results obtained from a field visit. Pedestrian gap analysis, delay in a traffic queue, and even costs for infrastructure are all examples of situations where approximate data may be obtained from the literature and then better data may be obtained by visiting the project site. The extent to which such data were sought largely influences whether the desired 40-hour timeframe for analysis will be met. More than 40 person-hours were required by the investigators to complete the case studies because they spent a substantial amount of time considering how to perform analyses that were later excluded from the study as a result of narrowing the scope of the study. For example, the investigators initially considered ways of estimating the impact of the Cosner's Corner project on the economy (in Steps 6 and 7) because one of the performance measures selected (in Step 5) had been economic impacts. However, further discussions led to a refinement of Step 5 to be just those performance measures discussed previously; thus, an economic analysis was no longer necessary.

The Analytical Techniques Are Found in Planning References and Engineering References

As the methodology is applied in a planning context, it is appropriate that several of the techniques employed were found in planning-related literature, such as trip generation rates, speed/volume delay curves, and the maximum number of vehicles that can be accommodated by an at-grade intersection (ITE, 2003; Martin and McGuckin, 1998; Meyer and Miller, 2001). However, the evaluation methodology also borrowed approaches that are traditionally in the domain of traffic engineering and operations, such as delay experienced by vehicles in a queue and pedestrian walking speeds (Garber and Hoel, 2002; Gates et al., 2006; Gerlough and Huber, 1975).

Application of these methods was preferred to the use of software in order to keep the analysis timeframe relatively close to the desired 40 hours. For example, during the Eagle Harbor case study, the investigators suggested using microscopic simulation software to determine the queue length as a function of signal timing. The steering committee indicated their preference to avoid such software. Instead, simple queuing analysis based on the arrival rate of vehicles and the amount of red time was used to determine the length of the queue.

CONCLUSIONS

1. *Stand-alone projects are identified as such not by their funding source or by what they are meant to accomplish but by the fact that they originate from outside the standard transportation planning process.* A stand-alone project may be formally defined as any project that requires an ad-hoc decision on the part of state, regional, or local government without the benefit of firm policy guidance that otherwise clearly indicates what decision should be made. This research identified 22 different stand-alone projects in Virginia with diverse objectives such as providing new infrastructure, making an operational change to the highway system, and changing how future growth is estimated.

2. *Stand-alone projects may yield positive or negative results.* Beneficial results have included improved access management for an arterial facility, developer-funded facilities coupled with land use changes sought by a locale, and greater local and state cooperation at a specific site. Adverse results have included greater delay attributable to the addition of access points and the taking of land that could otherwise be used for a transportation improvement.

3. *An eight-step methodology developed to evaluate stand-alone proposals offers three benefits: a rationale for accepting or rejecting a stand-alone proposal, an assessment of the alternatives, and documentation of the process used to reach a decision.* In some cases (see Table 8), no decision is clearly the best, and thus the benefits and disadvantages of each alternative are the greatest utility of the methodology.

4. *The methodology may be applied in about 40 hours depending on the data available, the level of accuracy desired, and the number of performance measures selected.* For each case study, the sources of policy guidance, the identification of performance measures, and the supporting analysis can be achieved within the 40-hour timeframe if the evaluator has ready access to these data, can make reasonable assumptions where the data are missing, and can focus on the appropriate performance measures in Step 5 on the first iteration.

RECOMMENDATIONS

1. *VDOT district planners should consider the eight-step methodology developed in this study for situations where stand-alone projects must be assessed and thus no other policy guidance is available*. Situations where this is likely to occur include regions where jurisdictions have different visions for how an area should develop and locations where proffers are being used to increase transportation infrastructure.

2. *If accepted by VDOT district planners, the methodology should be shared with other planning partners*. These partners are primarily city and county planners but may include planning district commission (PDC) staff to the extent that such PDCs are involved with evaluating stand-alone projects. Sharing this methodology with staff outside VDOT may require four types of technical assistance from either practitioners, researchers, or both.

- *Identifying examples of evaluations where the evaluator's perspective was that of a community planner in Step 1.* The two case studies took the perspective of a transportation planner, which may be appropriate for a strict focus on transportation. For evaluators, such as county planners, who might evaluate a broad set of impacts, such as economic development and community cohesion, additional examples are appropriate.

- *Developing a toolbox of analytical techniques used to estimate the performance measures in Steps 6 and 7.* The techniques used in the case studies focused on pedestrian crossing treatments and arterial traffic operations, but additional sketch planning techniques related to mode choice are appropriate. This toolbox might take the form of a one-page list of rules (e.g., assume a single detached dwelling unit generates 10 trips per day), or it might take the form of a more detailed training packet that uses examples such as the queuing procedures in Eqs. 8 and 9.

- *Identifying methods for obtaining data from diverse sources to support the computations in Steps 6 and 7.* These methods might include existing data sources, such as the Statewide Planning System (SPS), and techniques for estimating projections at a specific site, such as volume growth rates.

- *Developing ways to incorporate the summary of impacts in Step 8 into the standard planning process.* If stand-alone projects become a large component of a region's transportation program, then an appropriate response should be to enable such a process to incorporate stand-alone projects. There may be ways to use the findings from Step 8 to influence this process so that future stand-alone projects need not be separate from the standard planning process. For example, with the second case study, a longer term response might be to develop guidance for routinely considering pedestrian safety as part of the development of a county's local plan, such that the need for pedestrian crossings is evaluated as part of land use planning. Accordingly, there may be experiences in other states that merit examination should stand-alone projects become more common in the future.

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APPENDIX A

INTERVIEW QUESTIONS

1. Over the past five years, have any "stand-alone" projects been initiated or proposed in your district? These include the following:

    - proffered project
    - developer's initiative to improve access to their individual project
    - county's requirement with rezoning or site plan application
    - county-led bond project
    - PPTA proposal
    - VDOT-recommended major project
    - formal procedures used to prioritize short-term projects.

2. When you are consulted for advice on stand-alone projects, what time frame are you given? (For example, many counties require proffer review in 60 days or less.)

3. Have there been instances where these "stand-alone" projects resulted in a conflict

    - While developing the long range plan?
    - After long range plan improvements were implemented?

4. Have there been cases where stand-alone projects were detrimental to the long term transportation network?

5. If you answered "Yes" to question 1, and "No" to question 2, then what steps have proven helpful for evaluating stand-alone projects?

6. A city planner noted that it is difficult to obtain right of way (ROW) years in advance of project design because of the EIS process, with the contention being that selecting ROW presupposes a specific alignment. Thus, it is difficult to coordinate stand-alone projects absent an agreement on a specific alignment. Has this issue affected your county's use of proffers?

7. Which counties in your district, if any, would you recommend that we interview?

8. Are there land use instruments that counties desire but which are not permitted (or are too administratively cumbersome to implement) in Virginia? Examples include adequate public facilities ordinances, split-rate tax districts, site impact fees, or revenue sharing agreements.

APPENDIX B

DETAILS OF METHODOLOGY FOR EVALUATING STAND-ALONE PROJECTS

Stand-alone projects, defined as those projects that did not originate within the transportation planning process and those projects for which formal guidance is not available, may provide several benefits, such as allowing privately funded infrastructure to be built or enabling the state to make an operational change sought by a city, county, or region. Stand-alone projects may have adverse consequences, however, such as a loss of land that will be necessary for future improvements. The following eight-step methodology was developed to assist decision makers with their decision to accept, reject, or modify a proposed stand-alone project.

Step 1: Define the Evaluator's Perspective and Horizon Year

Define Evaluator's Perspective

The evaluator's perspective depends on the goals of the organization the evaluator represents. For example, a county planner may elect to address a variety of non-transportation issues, such as community cohesion, noise, and impacts on property values. By contrast, a state transportation planner may take the position that such non-transportation issues are the exclusive consideration of the county and thus the state planner's role is to identify improvements that will accommodate traffic generated at the site. (These are examples only; the investigators do not purport to know the proper perspective of a county or state planner. Table 13 may assist readers in choosing a perspective for a particular organization or project.)

The importance of choosing the evaluator's perspective is essential because it affects the remaining steps of the process, such as Step 3 (where sources of policy guidance are sought) and Step 5 (where performance measures are chosen).

Determine Horizon Year

The administrative regulations that implement Chapter 527 of § 15.2-2222.1 of the *Code of Virginia* (24 VAC 30-155) (VDOT, 2007) suggest that the horizon year should be *either* 6 years into the future *or* the buildout year, *whichever is later, although this horizon may be modified by VDOT in consultation with the county* (VDOT, 2006). The horizon year should be chosen such that (1) there can be some reasonable degree of confidence in the forecasts, and (2) the adverse impacts of a project are evident. To meet the first condition, it is generally preferable to have a horizon year that is as close to the present as possible. To meet the second condition, especially for facilities that are currently under capacity and not expected to be over capacity for a few years, it may be necessary to have a horizon year that is several years into the future. Although the examples herein used a single horizon year, there may be instances where different horizon years are used to assess both short and longer term consequences or to perform sensitivity analyses.)

Step 2: Identify the Potential Problem Created by the Stand-Alone Project

Identify the Stand-Alone Project

Stand-alone projects are not necessarily immediately evident. For example, a rezoning request may not necessarily be a stand-alone project if the county had envisioned in its long-range plan (LRP) that a rezoning would be sought at a particular location (and thus a proffer could be extracted from the developer). Alternatively, if the comprehensive plan does not have sufficient detail, judgment may be required to determine whether the proposed project is indeed a stand-alone project. Thus, the evaluator should consider the source of the project and potential problems caused by the project to determine whether it is truly a "stand-alone" project.

Stand-alone projects may arise from any of eight situations:

1. developer's proffer in a developer-initiated re-zoning request
2. developer's initiative to improve access to his or her individual project
3. county's requirement with rezoning or site plan application
4. county-led bond project
5. a proposal under the Public-Private Transportation Act
6. VDOT-recommended major project
7. formal procedures used to prioritize short-term projects
8. initiative by a locality.

A project that falls within one of these eight categories is not necessarily a stand-alone project. Two common characteristics of stand-alone projects are that a decision on the project must be made without having explicit policy guidance and that the project poses a significant change to the transportation system. Such changes may result in one or more potential problems: (1) the project conflicts with the local comprehensive plan; (2) the project allocates right of way (ROW) ineffectively; (3) the project limits funding for future projects; or (4) the project precludes, complicates, or negates another improvement.

Collect Background Information

Background information includes impacts the project will have on the area, speed limits, pavement types, number of lanes, land use in the area, demographics, and economic data gathered in the area of the stand-alone project. For example, a given project may bring more development to the area, may increase capacity on the road network, and may impede another project from being completed.

Step 3: Compare Relevant Policy Guidance with the Proposed Project

Determine Relevant Sources of Policy Guidance

Possible sources of policy include county comprehensive plans, an MPO's constrained LRP, a region's subarea plan, VDOT's Six-Year Improvement Program (SYIP), the state's multimodal LRP (such as VTrans2025 [Commonwealth of Virginia, 2004]), access management plans for a specific corridor, and published design practices such as the AASHTO "Green Book" (American Association of State Highway and Transportation Officials, 2004).

Compare Proposed Stand-Alone Improvement with Policy Guidance

After outlining the aspects of the stand-alone project, the relevant sources of policy guidance should be reviewed to determine if they will affect the project. It is also important to take note of other projects being planned for the area that may directly impact or be impacted by the project.

If no policy guidance is available, the evaluator should create a set of possible long-term strategies based on the goals of the organization. These strategies may then be used during Steps 6 and 7.

Specify the Roles and Responsibilities of Involved Parties

Each of the parties involved in the stand-alone project, such as VDOT, developers, and city or county government representatives, should be identified. Then, the role of each member in project development, such as his or her stance on the project's advancement and the responsibility with regard to the completion of the project, should be specified. A table, similar to Table B1, may be completed to show the involvement of each party.

The role of each party is also a reflection of the perspective chosen in Step 1. For example, for the county planner in the last row of Table B1, the improvements that are recommended as a result of the county's LRP (CLRP) have probably been designed as a system; thus the transportation system may perform poorly if only some recommendations from the CLRP are implemented. Thus, the county planner might be concerned with stand-alone projects that obstruct improvements anticipated in the CLRP.

Table B1. Possible Agreements Among Involved Parties

Party	Role in Project	Chief Concern
VDOT	Will maintain project after completion	Not in SYIP
Developer	Pay for project	Need project completed quickly for access to property
County	Approve project	Address congestion needs

Step 4: Identify Future Transportation Improvements Impacted by the Stand-Alone Project

There are several ways that another improvement may be impacted by a stand-alone project:

- the physically impedes the improvement (e.g., through taking needed ROW)
- the project takes money that otherwise would have been spent on the improvement

- the project increases or decreases the need for the other project (e.g., the stand-alone project increases congestion on a secondary road already over capacity).

Sources of information on the impacted projects include documentation identified in Step 3 and verbal comments. Impacted projects may have been only conceptualized but not planned (e.g., discussed in a planning meeting but not documented in the local plan), planned but not programmed (e.g., in the CLRP but not in the SYIP), or already in the transportation program. For example, if the local plan denotes that an interchange should be built at a particular location but the proposed stand-alone project uses that ROW for a minor arterial road, the interchange would be impacted by the stand-alone proposal and would merit further evaluation.

Step 5: Establish Appropriate Performance Measures

Stand-alone projects may have three broad types of impacts:

1. *social impacts* in the areas of accessibility, community cohesion, traffic noise, air quality, visual quality, and other health or environmental effects

2. *economic impacts* in the areas of property values, job creation, job access, increased tax base, income levels, or other facets of economic development

3. *user impacts* in the areas of travel time, pedestrian or motorist safety, cost, and range of feasible transportation modes.

The perspective of the evaluator in Step 1 should guide which impacts are assessed. For example, if the evaluator focused only on transportation impacts in Step 1, the social and economic impacts would not be included in the evaluation. Rather, the user impacts would be the focus. If the perspective of the evaluator was to assess a broader set of impacts, sample performance measures representing some of these impacts might be examined. An example of such a performance measure, applied to the case of the Cosner's Corner project, is shown in Table B2.

Table B2. Noise Levels for Route 1 (Example Performance Measure for Cosner's Corner Project)

Scenario	**Noise Levels (dBA)**[a]			**Mainline Travel Speeds (PM Peak)**[b]		
	2003	**2010**	**2015**	**2003**	**2010**	**2015**
Base case	66.6	66.4	65.5	41	29[c]	16
Stand-alone project	67.1	68.4	67.6[d]	41	35	20

[a] Assumes an observer 50 ft away, A-weighted decibels, and speeds as shown with volumes estimated by the authors. Calculations based on lookup tables from FHWA's Traffic Noise Model (TNM), Version 2.5 (FHWA, 2005)

[b] Calculations reflect mainline speeds only and do not include intersection delay.

[c] Calculations based on volume-delay curves given in the literature (Martin and McGuckin, 1998). For example, the 2010 base case PM peak hourly volume is estimated as 2,429 veh/hr and thus the speed is estimated as $45/[1 + 0.71(\text{hourly volume}/2750)^{2.1}] = 29.0869 \approx 29$ mph.

[d] Noise levels were not substantively affected by the stand-alone project. For example, during the evening peak hour, Route 1 noise levels were estimated as 65.5 dBA without the project and 67.6 dBA with the project—a difference of 2.1 dBA. Typically, the field measurement error is within 3 dBA.

Step 6: Evaluate the Impacts of the Stand-Alone Project Over the Horizon Period

Based on the performance measures identified in Step 5, the evaluator should choose methods to evaluate these impacts over the horizon identified in Step 1, assuming that the project will be built and that the projects improvements identified in Step 4 are not built. Methods in the literature (Forkenbrock and Weisbrod, 2001; Institute of Transportation Engineers [ITE], 2006) can be used to analyze quantifiable and non-quantifiable impacts, as shown in Table B3. The particular method chosen depends on the time available to perform the level of analysis and the level of accuracy required. For example, it most likely will not be possible to analyze all impacts in Table B3 within 40 hours.

Table B3. Social and Economic Impacts and Corresponding Evaluation Techniques

Impact	Evaluation Technique	Explanation of Technique
Accessibility	Interviews/ surveys	Interviews and surveys can be used to ask focus group or affected people about transportation needs, purposes of trips, what they think are acceptable user costs (including travel time) for the trips, and transportation choices available to them or that they would like to be available to them.
	Gravity models	Gravity models use information on all available origins and destinations within given area to forecast trips. Calculating changes in travel time for different types of trips can measure accessibility in area.
Community cohesion	Interviews/ surveys	Collecting first-hand information from people who live in area can give valuable insight into networking structure and social patterns of community. interviews can help determine how people will view new transportation investment and how it will affect their networking structure.
	Maps	Maps and GIS images can be used to show how project will affect current transportation system and link origins and destinations. Maps and aerial photos can show alternatives to proposed project.
Economic development	Market studies	Market studies show changes in business sales based on changes in market size; mainly useful when transportation impact causes change to size of market share area.
	Expert interviews	Interviews of experts such as local government officials and other business leaders can be used to determine how transportation project will influence economic development. Experts can share opinions on how transportation project may bring more business to area or hinder growth.
Safety	National data analysis	Based on data collected on geometry of road, prediction can be made involving estimated number of crashes that may occur if certain transportation project is completed. Prediction can be compared to national data and/or assigned monetary value to represent change in crashes.
	Bicycle safety index	Data on geometry of roadway, pavement characteristics, and details about number of lanes and lane widths are input into an equation, called the bicycle safety index. Value calculated as the BSI can be translated into classification such as excellent, good, fair, or poor with corresponding description of road's bicycling conditions.
Traffic noise	TNMLook Tables	TNMLook Tables (FHWA, 2005) estimate noise values for simple highway scenarios based on information such as whether road has barrier wall, type of terrain around road, and speeds on road.
Visual quality	Preference surveys	Residents can express visual tastes for certain designs and concepts to gauge what aspects should be integrated into new transportation projects in area.
	Analogous case studies	Numerous alternative designs with explanations about effects after they were built are shown to focus groups. Comparing different cases allows groups to decide what features they like best and least.

Step 7: Evaluate the Impacts of Not Building the Stand-Alone Project Over the Horizon Period

The last analytical step is to determine the impacts that would occur if the stand-alone project is not built and if the improvements it otherwise obstructs are built. The performance measures and evaluation techniques should be consistent with those used in Step 6, and it may be helpful to combine the results of Steps 6 and 7 when presenting the results of the analysis. If a specific year that an obstructed improvement is scheduled to be built is not available, this should be considered when choosing the horizon year in Step 1. The results from this evaluation will be used in Step 8 to compare the stand-alone project build scenario to the alternatives.

Step 8: Summarize the Impacts With and Without the Project

The last step of the methodology is to summarize the results in such a way that an informed decision regarding the proposed project's acceptance, rejection, or modification can be made. The impacts of building the stand-alone project found in Step 6 should be contrasted with the impacts of the alternative solutions computed in Step 7. In addition, the evaluator should summarize the impacts of the project based on the policy information reviewed in Step 3.

In practice, a table identifying the advantages and disadvantages of the stand-alone project relative to the do-nothing case should be presented. The table alone will not indicate what course of action the decision maker should select, but it should include the quality of the discussion concerning the evaluator's decision with respect to the project.

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