

4.18 INDIRECT EFFECTS

Sections 4.18 and 4.19 discuss findings of the Indirect (4.18) and Cumulative Impacts (4.19) assessment. In compliance with the National Environmental Policy Act (NEPA) and the President's Council on Environmental Quality (CEQ) regulations (40 CFR 1508.25 (c)), the potential indirect effects and cumulative impacts are examined along with the direct impacts of the 2026 No-Build Alternative, the TSM Alternative, and the CBAs. The purpose of the indirect and cumulative impact assessment is to ensure that federal actions consider the full range of potential environmental consequences. When assessing the indirect impacts and cumulative effects of a proposed action, it is important to effectively identify the potential consequences of human activities on the natural and built environment.

Direct, indirect, and cumulative impacts are assessed for this project in accordance with the following definitions provided in the Council on Environmental Quality (CEQ) regulations:

- Direct impacts are “caused by the action and occur at the same time and place” (40 CFR 1508.8);
- Indirect impacts are “caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable”. Indirect effects are synonymous with secondary effects and “may include growth inducing effects and other effects related to potential changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems” (40 CFR 1508.8); and
- Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions” (40 CFR 1508.7).

The indirect and cumulative impact analysis for this project has been developed according to the guidance presented in the 1997 Council on Environmental Quality publication, Considering Cumulative Effects; the U.S. Environmental Protection Agency (EPA) publication, Consideration of Cumulative Impacts in EPA Review of NEPA Documents (May 1999); and the FHWA’s 1992 Position Paper and 1996 handbook on Community Impact Assessment. Additional case studies, theoretical assumptions, and evaluation methods used in this analysis are stated within the *Indirect and Cumulative Impacts Technical Report*.

4.18.1 Indirect Land Use Impacts

As current research suggests, accessibility is the key factor in assessing the potential impact of a transportation project on land use. When a transportation project makes it easier to access certain locations, “these places become more attractive to more or different types of development. However, improving accessibility does not guarantee that land use change will follow.” (*Land Use Impacts of Transportation: A Guidebook*) This indirect land use analysis considered induced development at interchange areas as well as the potential for sprawl development throughout the study area.

Because counties and incorporated areas have jurisdiction over land use, the land use plans and regulations and the economic development plans of localities were the primary basis for determining the future land use for the No-Build/TSM and CBA alternatives. However, local plans were not prepared with the CBAs in mind; therefore, analysis was conducted to estimate possible levels of interchange development, taking into account the local context and the results of interviews with local officials. The findings were reviewed by local officials.

Changes in planned land use are not expected under either the 2026 No-Build or the TSM Alternative. It is assumed that approved projects and land uses will develop as planned. However, the increasing travel-time delays could hinder the planned economic development along the Route 460 corridor. Travel times from Petersburg to Suffolk are anticipated to increase by 8 minutes (11 percent) between 2000 and 2026.

4.18.1.1 Potential Development at Interchange Areas

The CBAs will affect accessibility by physically changing access (i.e. providing new interchange and intersection locations) and lowering regional travel times between Petersburg and Suffolk. The application of an empirically-based framework (i.e., Hartgen model) for interchange area development lends consistency and objectivity to the indirect land use impact analysis, while the extent of local coordination maintains the focus of the analysis on local jurisdiction decision-making. The Hartgen model correlates development factors to estimate the potential level for development at rural interchanges on limited access highways (Hartgen, 1992). This model, coupled with information provided by local officials, was used to identify land use changes attributable to the CBAs. As noted in Hartgen's model, the likelihood of an interchange or intersection area experiencing changes in land use is based on a number of factors, including:

1. Traffic volumes on the proposed alternative and crossroad;
2. Population of the nearest and surrounding communities;
3. Distance to major urban centers;
4. Distance between interchanges;
5. Current land use; and
6. Site factors at the interchange or intersection (availability of water and sewer, planned land uses, local land use policies, visibility, environmental constraints).

Based on these factors and information provided by local officials, it is possible to estimate the likely type of development that can be anticipated at each interchange area. Impacts were assessed for each of the CBA interchange areas. A zone of potential influence having a one-mile radius (2,000 acres) around each interchange was considered for indirect land use impacts. In this analysis, this area is referred to as the interchange area, which is synonymous with CEQ's project impact zone. Based on the rural nature of this area and local areas' varying expectations for growth, not all interchange areas were anticipated to have indirect land use changes.

For those interchange areas projected to alter future development patterns, a GIS review of existing land uses and comprehensive land use planning within each interchange area identified the amount of developable land available to accommodate the anticipated development. It was assumed that the scale of the potential development would be similar in magnitude to existing and planned development within the study area. Acres of potential development were projected based on existing land use densities and reviewed by local officials. The potential acreage of potential development was hand-allocated to the appropriate interchange area. The likelihood of impacts to sensitive resources from potential development was assessed based on the amount of land consumed by new development relative to the amount of available, developable land in the interchange areas.

As shown in Figure 4.18-1 to Figure 4.18-3, all CBAs have the potential to induce land use changes when compared to the 2026 No-Build and TSM Alternatives. The potential for development and associated land use changes would occur as follows:

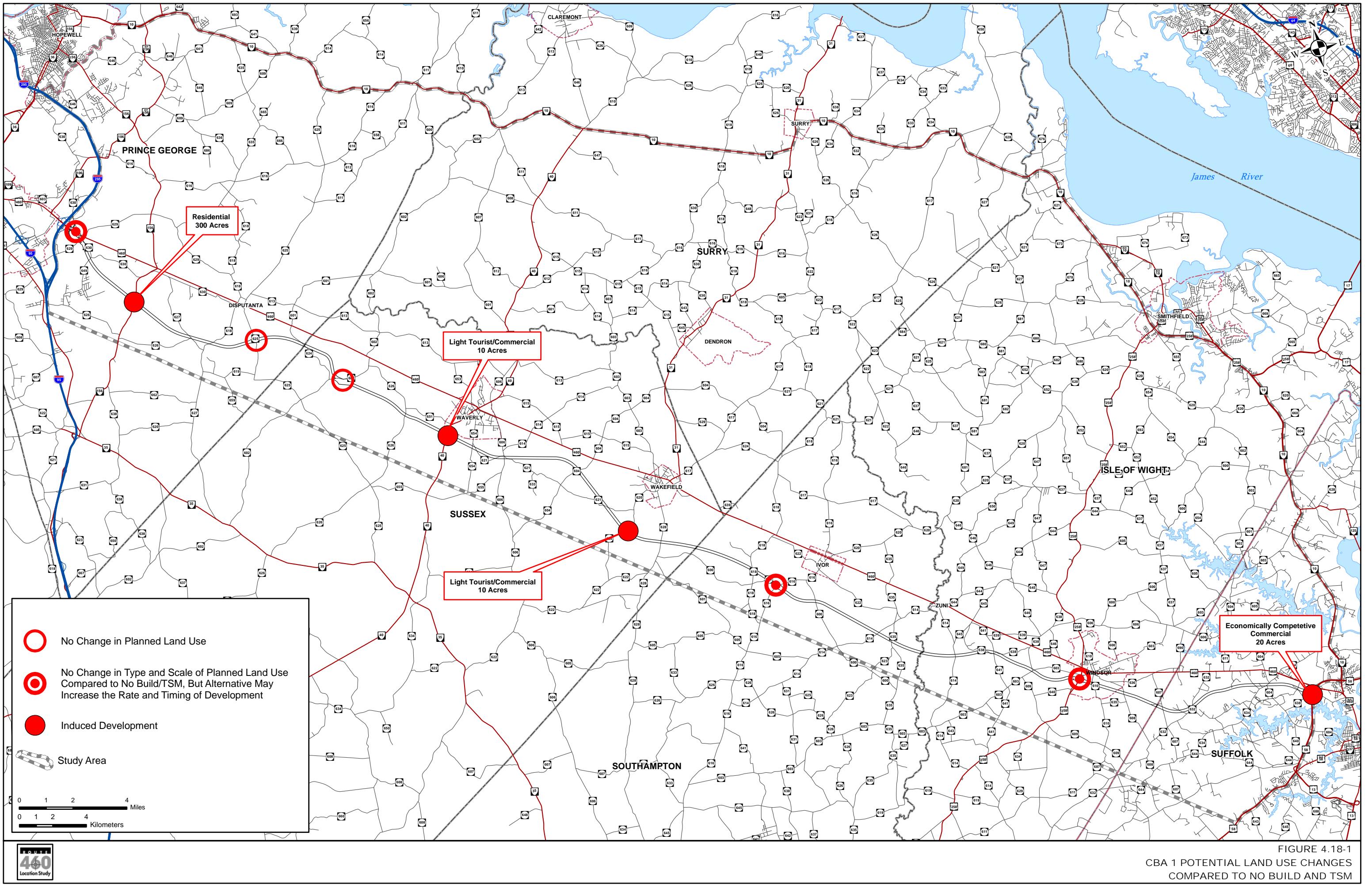
- CBA 1 - Of the nine interchange locations, four have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 156 in Prince George County, Route 40 in Waverly, Route 620 in Wakefield, and Route 58 bypass in Suffolk for a total of 340 acres.
- CBA 2 – Of the 19 interchange and intersection locations, four have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 40 in Waverly, Route 620 in Ivor, Route 460 at the Isle of Wight/Suffolk line, and Route 58 bypass in Suffolk for a total of 50 acres.

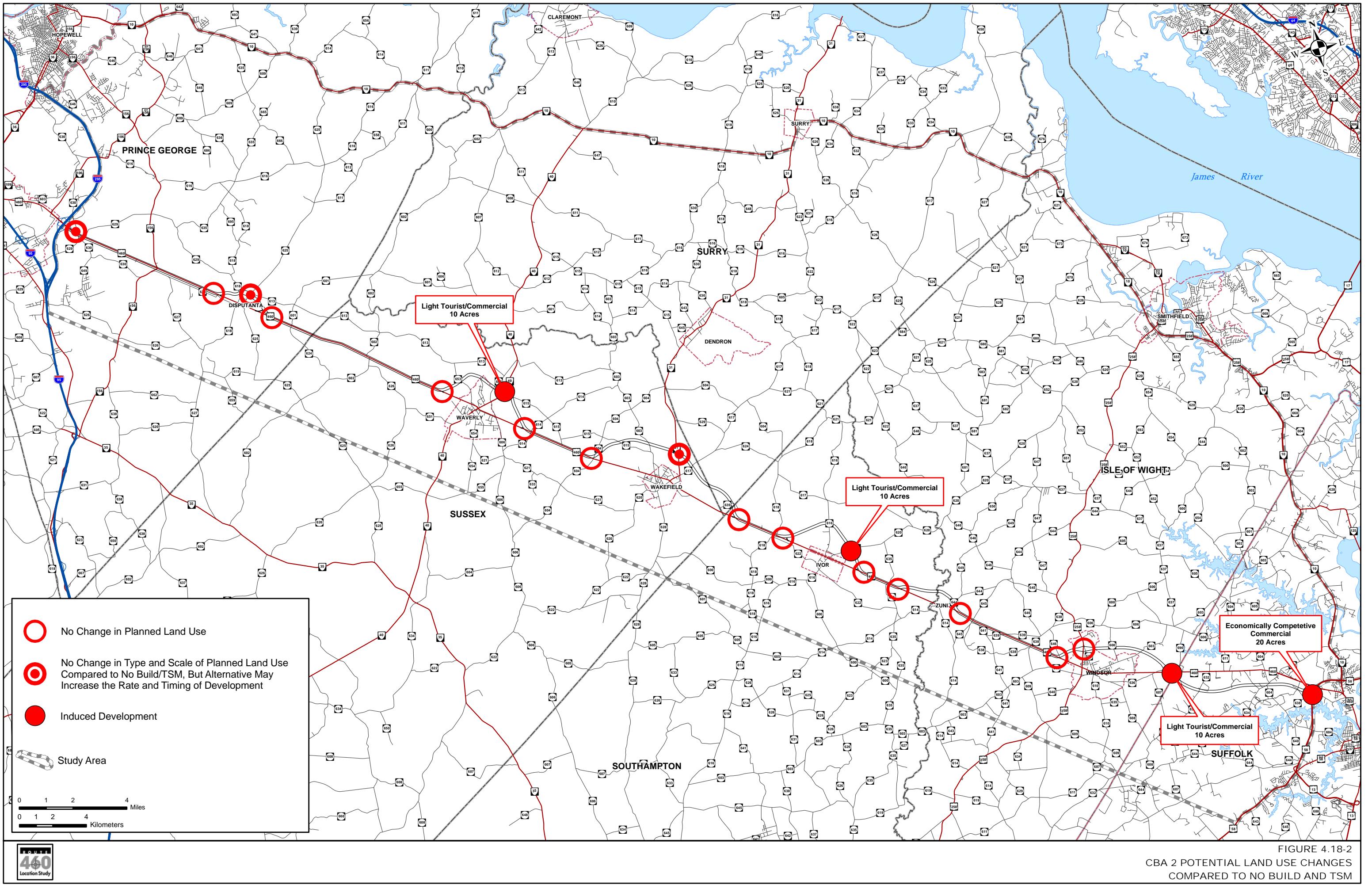
- CBA 3 – Of the nine interchange locations, seven have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 156 in Prince George County, Route 40 in Waverly, Route 31 in Wakefield, Route 620 in Ivor, Route 258 in Windsor, Route 460 at the Isle of Wight/Suffolk line, and Route 58 bypass in Suffolk for a total of 380 acres.

Overall, the likelihood for potential land use changes would be greatest under CBAs 1 and 3 and, somewhat lesser under CBA 2. Interchange area potential development is discussed in detail in the Indirect and Cumulative Technical Report. Potential levels of interchange related development identified in Figure 4.18-1 to Figure 4.18-3 include:

- No change in planned land use – land use is the same as the 2026 No-Build land use conditions.
- No change in the type and scale of planned land use compared to No-Build, but alternative may increase the rate and timing of development.
- Residential – residential development at scale and density currently allowed by local plans.
- Light tourist/commercial – consists of 10 acres of development at the interchange area, may include one or more gas stations and/or a fast food restaurant.
- Economically competitive – consists of 20 acres of development at the interchange area, may include two to four gas stations and one to two fast food restaurants.

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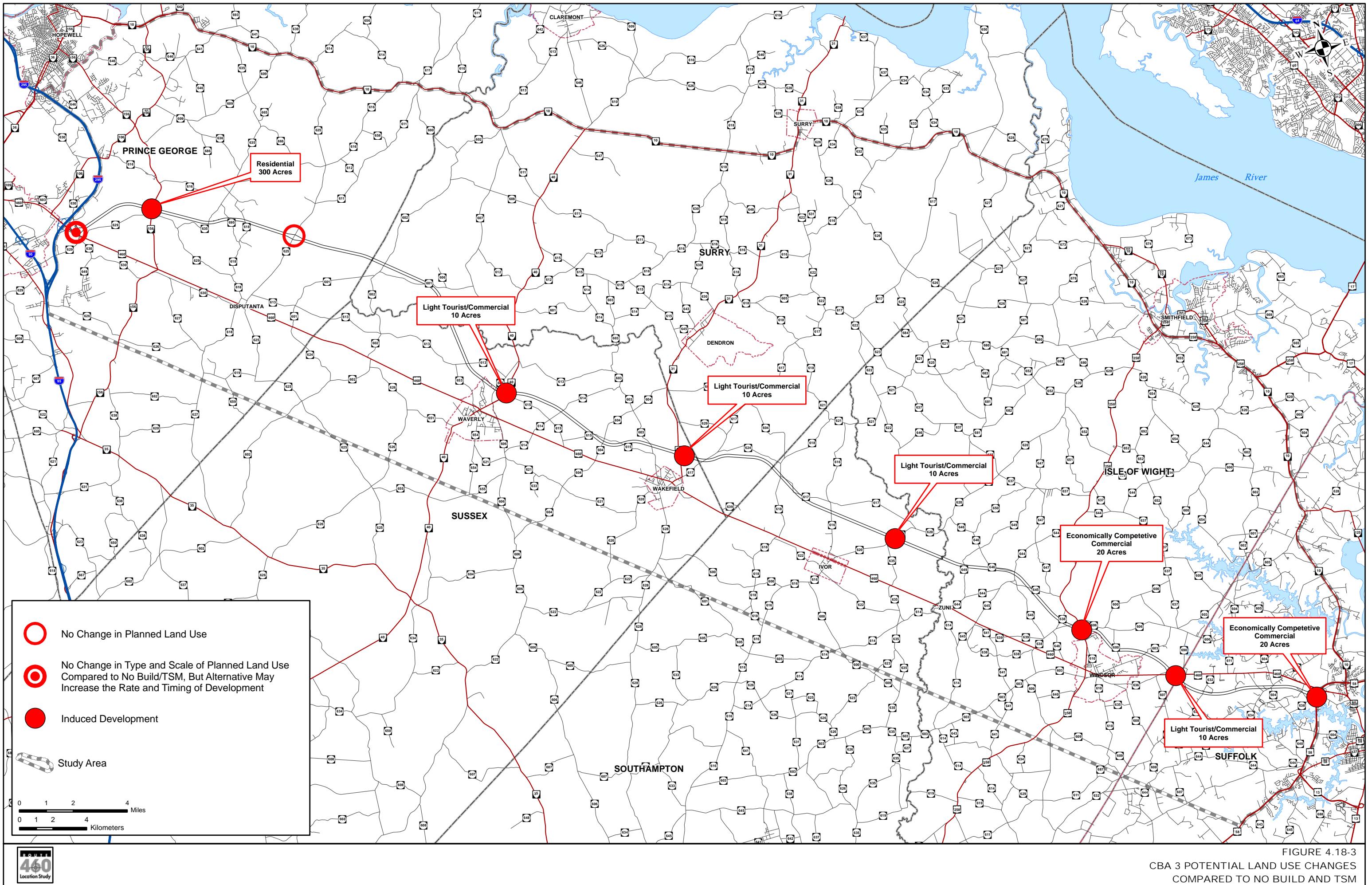


FIGURE 4.18-3
CBA 3 POTENTIAL LAND USE CHANGES
COMPARED TO NO BUILD AND TSM

4.18.1.2 Land Use Changes beyond Interchange Areas

An increasing rate of conversion of land to residential uses may also occur beyond the proposed interchange locations. These land use changes beyond the existing suburban development would likely be the cumulative result of regional population growth, market trends, and travel time savings.

For this analysis, this potential indirect land use impact is termed “sprawl development” and is defined as new low-density residential development in existing rural areas. Existing commuting patterns reveal that Prince George residents mainly commute to employment centers west of the study area, while Isle of Wight, Suffolk, and Surry residents are commuting to major employment centers east or northeast of the study area. In order for areas further to the interior of the Route 460 corridor (i.e., Waverly, Wakefield, and Ivor) to become instantly attractive for these same commuter-sheds upon construction of a CBA, travel times would need to decrease relative to the 2026 No-Build condition sufficiently to offset the increased distance from the employment centers. If this were to occur, it would suggest a dramatic change in residential development pressures could occur with the CBA(s).

Based on an analysis of commuting patterns, land use plans, and existing and planned development patterns, the eastern and western commuter-sheds for the 2026 No Build Alternative were identified. Travel times with the CBAs from each interchange along the corridor were compared to the No-Build travel times. According to the travel time analysis, the travel time savings of the CBAs would not draw the interior counties’ interchanges into the commuter sheds, therefore, the development pressures for sprawl development in the study area are not expected to be great.

However, suburban and exurban development patterns elsewhere in the state, such as Stafford and Fauquier Counties in northern Virginia, suggest that some residential development will eventually reach beyond the existing commuter-sheds, and the travel time savings of the CBAs will make this somewhat more likely to occur. Development and its impacts will, however, also depend on local actions including planning regulations and the provision of infrastructure. Sprawl development impacts cannot be measured, but based on local coordination and existing comprehensive plans, the lack of impetus from travel time savings, and the modest population growth rates expected in the interior of the study area (less than 0.5 percent annually), sprawl development effects are anticipated to be minor in extent.

4.18.1.3 Summary of Indirect Land Use Changes

Adequate developable land is located within each one-mile interchange area to absorb the acres of anticipated potential development. CBAs 1 and 3 would result in the greatest amount of indirect land use impacts as a result of the conversion of an additional 340 and 380 acres, respectively. CBA 2 would result in the conversion of 50 acres of agricultural and forestlands. The effect of these additional land use impacts to agricultural and forestland will be discussed in further detail in Sections 4.18.4 and 4.18.5.

4.18.2 Indirect Social Impacts

This analysis considers different factors that have the potential to affect social interaction and stability in the seven communities along Route 460 in the study area. The direct and indirect community impacts considered include: displacements, safety, travel patterns and accessibility, economic impacts, and indirect change to land use in the seven communities.

Based on the relative severity of the five factors identified above, and considering existing levels of community cohesion, a rating of low, low-moderate, moderate, or high is identified for each community. Social adaptation can be both negative and positive; but the main concern is the sustainability of the community as a whole. In general, these social impacts are considered low in communities with no displacements, no new traffic patterns, and no land use changes at interchange areas. Conversely, communities experiencing considerable changes with regard to these factors would be expected to have a moderate or high indirect social impact.

4.18.2.1 2026 No-Build and TSM Alternatives

The No-Build and TSM Alternatives would not result in any displacements or changes in local travel patterns. Currently, Route 460 bisects the communities of Disputanta, Waverly, Wakefield, Ivor, Zuni, and Kings Fork. Current traffic levels and lack of consistent shoulder limit bicycle and pedestrian mobility along Route 460 in each community. Future traffic increases, which include increases in truck traffic could further limit bicycle and pedestrian mobility and increase the degree to which Route 460 bisects the communities. By the year 2026, average daily traffic volumes for the No-Build and TSM Alternatives are projected to increase between 34 and 70 percent over existing volumes.

The national average for truck traffic on rural arterial highways is 10 percent (FHWA, 1996). In contrast, the percentage of truck traffic on Route 460 ranges from 18 to 30 percent under existing conditions and will increase to a range of 30 to 37 percent in 2026 with the No Build and TSM Alternatives. Due to the high percent of truck traffic, high travel speeds, and a lack of protected turning movements, residents have noted throughout the public involvement process their concerns with regard to safety when crossing or turning on Route 460. Local services such as emergency service response, mail delivery, and school bus routes are also sensitive to these increases in traffic and truck volumes.

4.18.2.2 Candidate Build Alternatives

Table 4.18-1 summarizes the direct and indirect factors that influence social interaction and stability under each CBA. The adverse social impacts of the CBAs include displacements and / or introduction of new impediments to non-vehicular traffic. The positive impacts include improved access for emergency vehicles, reduced travel times, and increases in local employment. Additional social impacts that cause change that may ultimately be either positive or negative include “bypass effects” that will cause change in local business districts and indirect land use impacts at interchanges that will change community dynamics. As illustrated in Figure 4.18-4 through Figure 4.18-6, all three CBAs have similar indirect social impacts with two exceptions:

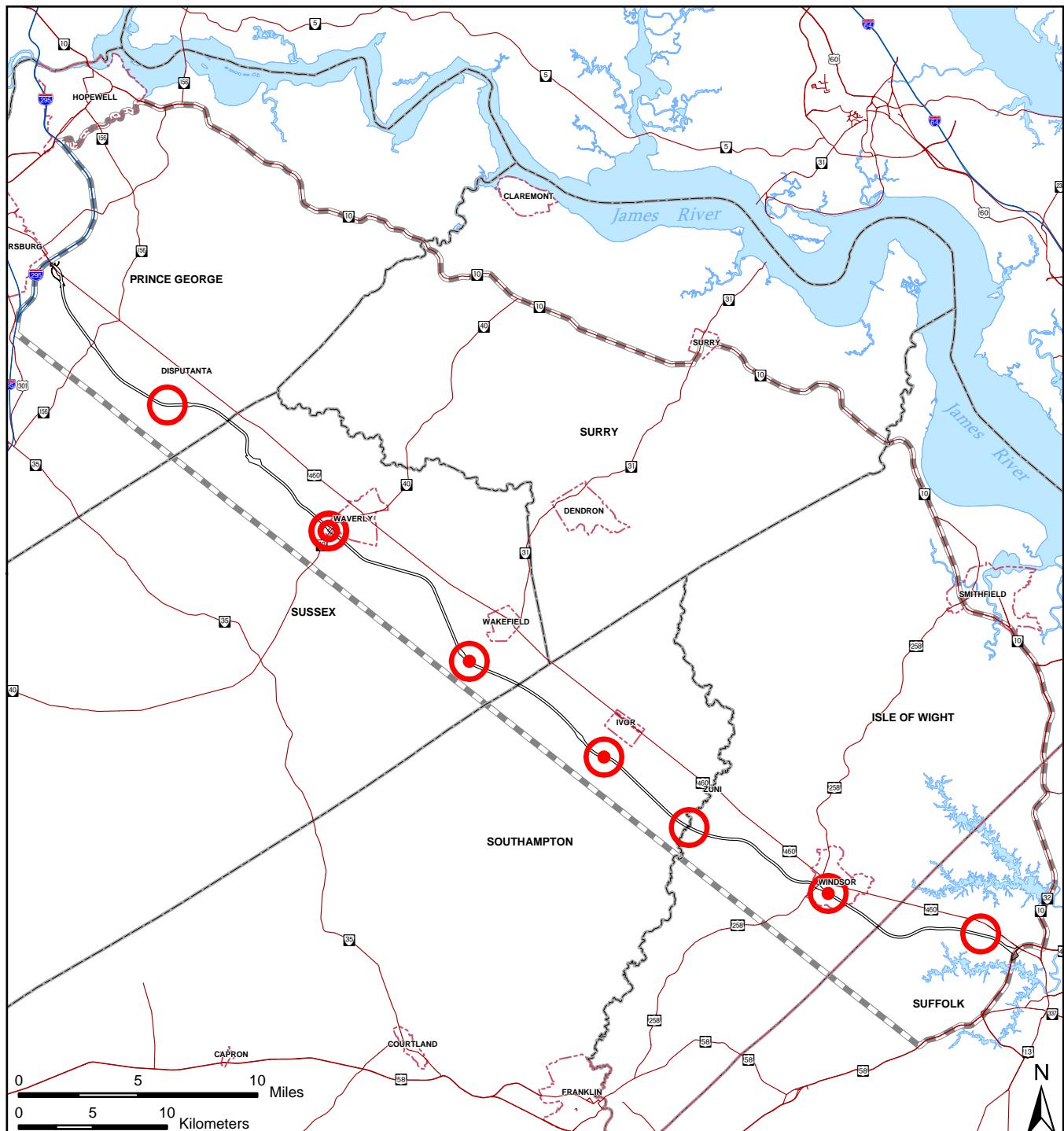
- CBA 1 would result in moderate changes to levels of community cohesion in Waverly.
- CBA 2 would result in low-moderate changes in community cohesion in Zuni.

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**Table 4.18-1
SUMMARY OF SOCIAL EFFECTS**

Community	CBA 1		CBA 2		CBA3	
	Impact to Community Cohesion	Basis for Impact	Impact to Community Cohesion	Basis for Impact	Change in Community Cohesion	Basis for Impact
Disputanta	Low	No negative impacts; minimal change in land use dynamics	Low	No negative impacts; minimal change in land use dynamics	Low	No negative impacts; minimal change in land use dynamics
Waverly	Moderate	Displacements (12), increased traffic on Route 40, potential development at interchange	Low-Moderate	Potential development use at interchange	Low-Moderate	Potential development use at interchanges
Wakefield	Low-Moderate	Potential development at interchanges	Low-Moderate	Increased traffic on Route 31, possible effects to rate/timing of planned land use near interchange	Low-Moderate	Increased traffic on Route 31, potential development at interchange
Ivor	Low-Moderate	Possible effects to rate/timing of planned land use near interchange	Low-Moderate	Potential development at interchange	Low-Moderate	Potential development at interchanges
Zuni	Low	No negative impacts; minimal change in land use dynamics	Low-Moderate	Displacements (4), proximity impacts	Low	No negative impacts; minimal change in land use dynamics
Windsor	Low-Moderate	Displacements (2), increased traffic on Route 258; possible effects to rate/timing of development near interchange	Low-Moderate	Displacements (8), increased traffic on Route 258	Low-Moderate	Increased traffic on Route 258, Potential development at interchange
Kings Fork	Low	Displacements (2-3)	Low	Displacements (2-3)	Low	Displacements (2-3)

Source: Parsons Brinkerhoff and Michael Baker Jr. 2005



- Low
- Low - Moderate
- TargetException Moderate
- Study Area



FIGURE 4.18-4
CBA 1 INDIRECT SOCIAL IMPACTS TO COMMUNITIES

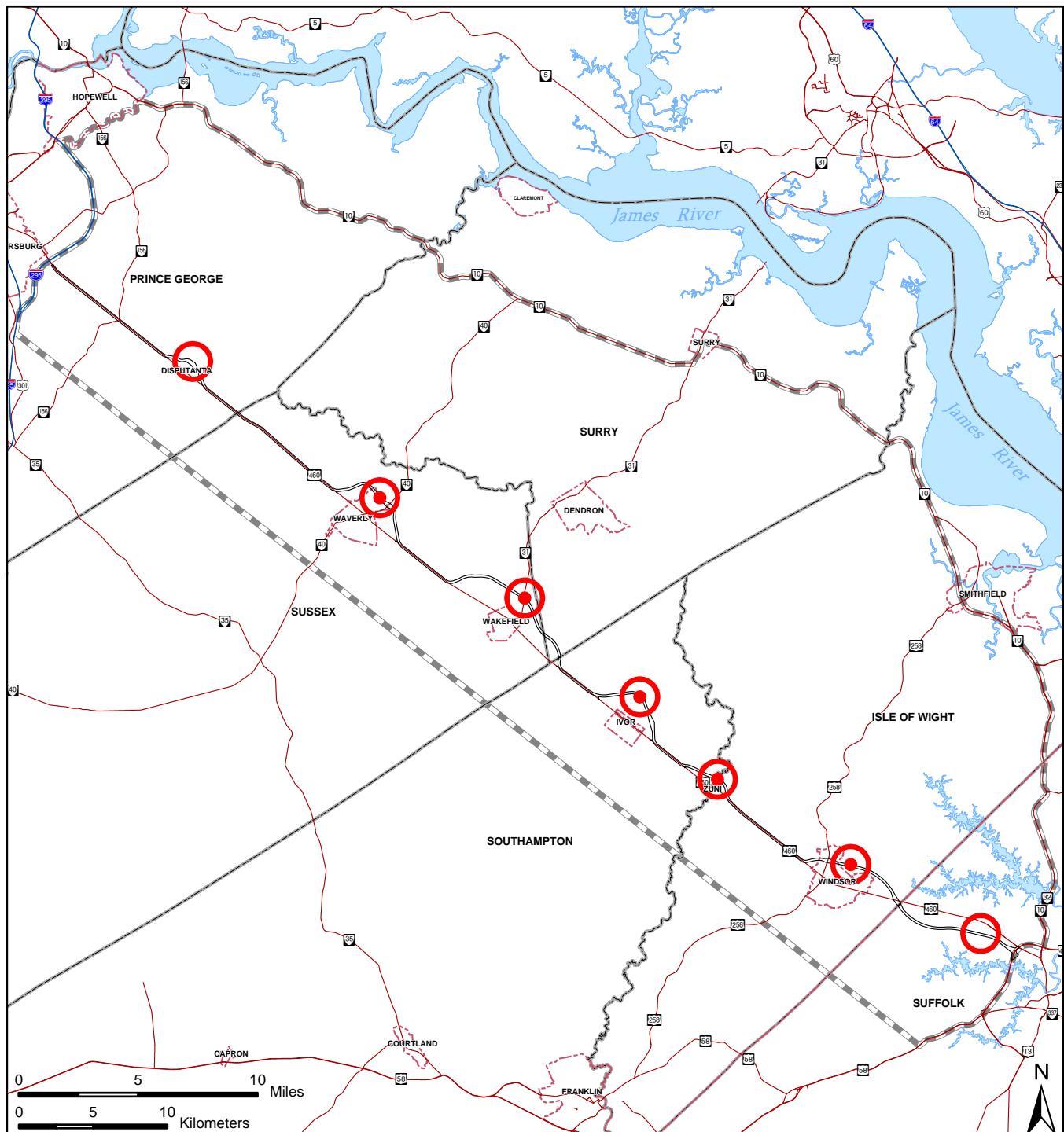
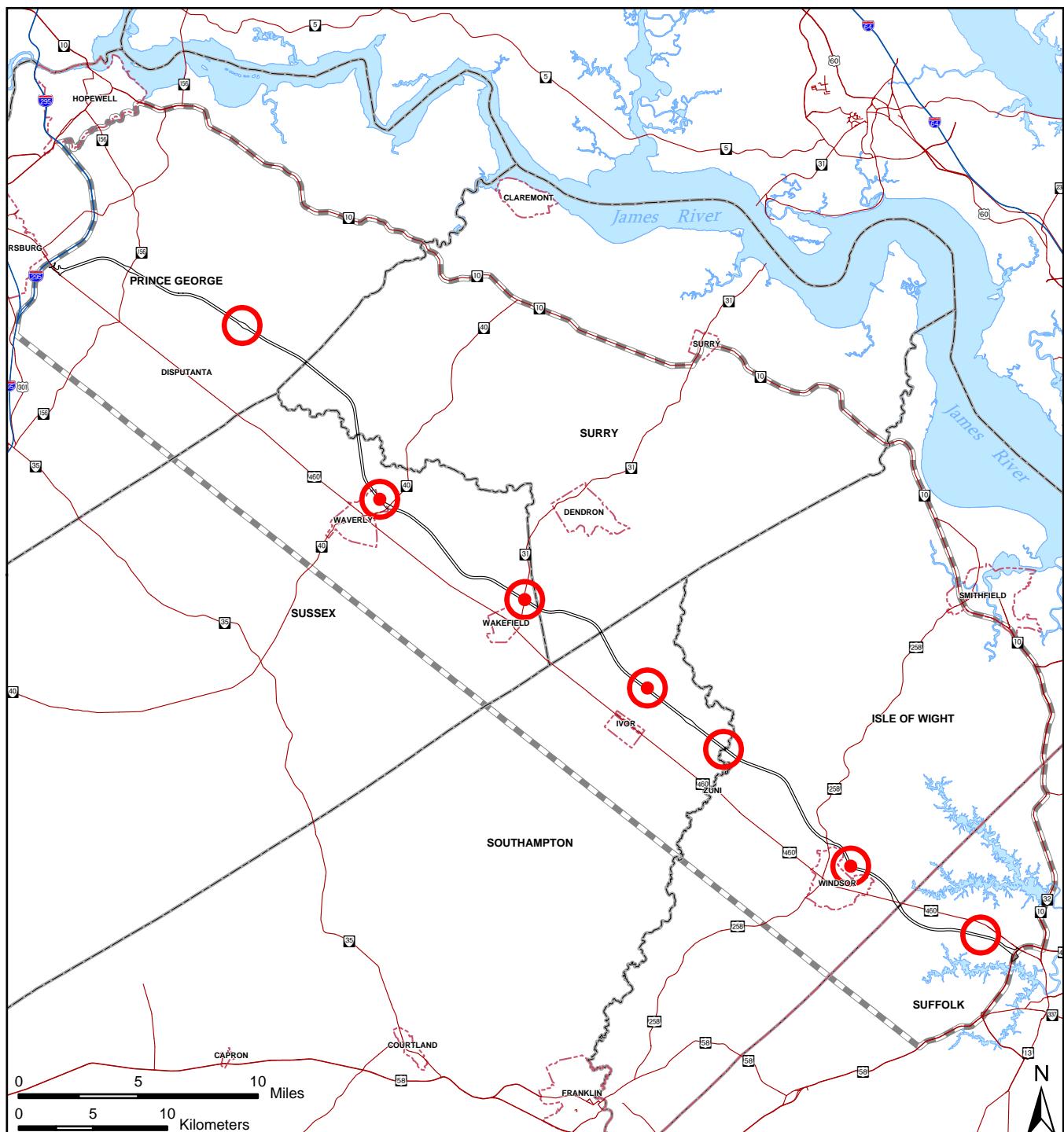


FIGURE 4.18-5
CBA 2 INDIRECT SOCIAL IMPACTS TO COMMUNITIES



- Low
- Low - Moderate
- Moderate
- Study Area



FIGURE 4.18-6
CBA 3 INDIRECT SOCIAL IMPACTS TO COMMUNITIES

4.18.3 Indirect Economic Impacts

Indirect economic impacts include the economic effects from potential land use changes, bypassing communities, and benefits of travel time savings to industrial developments in the study area. The analysis assumes that the traffic on Route 460 and any CBAs is a major determinant of the location of some businesses. This analysis considers the likely employment impacts that would result from different traffic levels along Route 460 as well as the employment changes in from potential land use changes in interchange areas, and the general extent to which those impacts may be offsetting.

Due to the speculative nature of predicting employment losses and gains, the analysis of indirect employment impacts is mainly qualitative, with general quantitative results that enable comparisons. The analysis is based on existing and planned land use and the indirect land use impact analysis. The analysis of the economic effects to bypassed communities relies on empirical research reported in transportation literature and application of that research to the travel time and bypass characteristics of the CBAs relative to each bypassed community.

The No-Build and TSM alternatives would not bypass the existing business districts along Route 460, nor would development at new-location interchanges occur. The maintenance and growth of traffic levels along Route 460 would support existing and future automobile-based businesses. However, the high levels of truck traffic and high traffic volumes by 2026 could discourage the development of non-automobile-dependent businesses due to access and safety concerns by motorists and pedestrians. Average daily traffic volumes for these two alternatives increase between 34 to 70 percent over existing volumes. With an increase in traffic volumes on Route 460 comes an increasing percentage of truck traffic, ranging from a 6 to an 11 percent increase over current truck volumes. On rural arterial highways like Route 460, the national average for truck volumes is 10 percent (FHWA). Under the No-Build and TSM Alternatives, the truck volumes would range from 30 to 37 percent of total traffic. With this substantial volume of truck traffic passing through the downtowns of communities along Route 460, access to local businesses will become more difficult, the visibility of local businesses will be reduced, and noise levels will increase.

Travel times under the No-Build and TSM Alternatives would also increase. Between Petersburg and Suffolk, travel times would increase by 11 percent (8 minutes) over the existing condition. This increased travel time places an increasing burden on commuting workers, the delivery of goods and services, and the desirability of the Route 460 corridor for development purposes.

4.18.3.1 Indirect Economic Benefits of the CBAs

Indirect economic benefits of the CBAs include development of businesses at new interchange areas, as described under indirect land use impacts, and travel time savings for industrial areas with access to the CBA. The indirect economic benefits of the CBAs in terms of the number of interchanges with induced commercial development and the number of industrial areas with improved access are as follows:

- CBA 1 – Three interchanges and five industrial areas.
- CBA 2 – Four interchanges and five industrial areas.
- CBA 3 – Six interchanges and three industrial areas.

The interchange areas are discussed in more detail in 4.18.1.1 and the planned industrial areas are described in more detail in 4.19.2. A negative consequence of the economic benefits in interchange areas could be the failure of businesses in existing business districts along Route 460 to remain profitable when traffic levels decline. This is discussed in the following section. However, total traffic on Route 460 and the CBAs is higher with the CBAs than it is with the No Build Alternative, which suggests that there will be a net increase in economic opportunities for automobile-dependent businesses with the CBAs. Overall, the benefits to existing and planned employment and industrial areas would be maximized under

CBAs 1 and 3 because they are on new alignment, are limited access via interchanges, and provide for the safe, free-flow of traffic at much higher speeds.

4.18.3.2 Bypass Effects of the CBAs

To determine the potential impacts to communities bypassed by either CBA 1, 2, or 3, it was necessary to establish criteria and general assumptions. An extensive literature review of analyses of small town bypasses was conducted for this study. The general findings of the literature review are best summarized by Weisbrod:

The many highway bypass studies carried out around the country provide a generally consistent story. They indicate new highways bypassing the central business district of a community are seldom devastating or the savior of the area. The locational shift in traffic can cause some existing businesses to close up or relocate, but it can also create some new business opportunities. Net economic impacts on the broader community are usually relatively small (negative or positive). Downtown business districts having a strong identity as a destination for visitors or for local shoppers are the ones most likely to be strengthened due to the reduction in traffic delays through their centers. However, there is also a broad perception that adequate signage to the bypassed business center is an important need (and concern) for ensuring its continued success.

Across the case studies, some positive and negative factors are common. The positive benefits of bypassing downtown areas commonly include the removal of heavy truck traffic from central areas and the opening up of additional industrial sites along the new route, thus attracting new investment from outside the region. The negative impacts sometimes include increases in sprawled, low density commercial and residential development that entail additional environmental and infrastructure costs.

In general, the degree to which bypassed communities are affected is best reflected in the following categories: travel time savings, reduction in overall traffic volumes and percentage of truck traffic, accessibility to or distance from the new bypass interchange to a community's downtown area, and type of businesses within each bypassed community's downtown area.

Travel Time Savings

Travel time savings for CBA 1 or 3, from Petersburg to Suffolk, would be approximately 21 minutes (26 percent) compared to the No-Build Alternative. Under CBA 2, this savings would be approximately 10 minutes (12 percent). Existing at-grade intersections along Route 460, many of which are signalized, are maintained under CBA 2. As a result, travel time savings would not be as great as they would be for CBA 1 or 3. Workers commuting from any of the six bypassed communities would benefit the most from the travel time savings afforded under CBA 1 or 3. One of the adverse impacts associated with travel time savings is that CBA 1, 2, or 3 could facilitate the shift of local shoppers from the smaller local communities to the larger urban centers. However, as noted in the literature review, business districts having a strong identity as a destination for visitors or for local shoppers are the ones most likely to be strengthened due to the reduction in traffic delays through their centers.

Reduction in Traffic Volumes and Truck Traffic

Reducing traffic volumes through a community's downtown area creates both positive and negative impacts. The quality of life through the bypassed downtown area is improved substantially as congestion and vehicular noise are reduced, visibility and safety improved, and accessibility to local businesses and services is greatly improved. However, travel-oriented businesses such as gas stations, truck stops, motels, fast-food restaurants, and tourist-oriented shops could suffer from the shift in travel patterns and reduction in traffic passing by their respective businesses. On Route 460 through the downtown areas of Disputanta, Waverly, Wakefield, Ivor, Zuni, and Windsor, overall average daily traffic (ADT) volumes under the No-Build Alternative would be between 14,400 to 19,500. The CBAs would substantially

reduce traffic volumes on existing Route 460 through the bypassed downtown areas relative to the No-Build Alternative:

- Under CBA 1, existing Route 460 would have an ADT of 1,500 to 4,500 (76 to 90 percent reduction in ADT),
- Under CBA 2, existing Route 460 would have an ADT of 1,500 to 4,500 (73 to 90 percent reduction in ADT), and
- Under CBA 3, existing Route 460 would have an ADT of 1,400 to 8,000 (49 to 90 percent reduction in ADT).

The percentage of truck traffic on existing Route 460 in the downtowns of bypassed communities would be between 7 and 9 percent of total traffic volumes with all CBAs compared to 30 to 37 percent under the No-Build Alternative. The national average for truck traffic on similar rural arterials is 10 percent.

Accessibility to Downtown Areas via Bypass

A distance of approximately 1 to 1.5 miles is assumed to be the threshold for whether a traveler on the bypass would exit onto a secondary road in order to obtain goods and services in the nearby town. As shown in Table 4.18-2, all of the proposed interchanges under CBA 2 are within this range. Given the proximity of the bypassed communities from the bypass, it is more likely that travelers on CBA 2 would travel into the downtown area to obtain goods and services. Under CBA 1 or 3, the farther the bypass interchange is from the downtown area, the more likely it is that through-traffic would continue to the next exit that offers goods and services within this 1 to 1.5 mile range. Two interchanges in each of CBA 1 and 3 are greater than two miles from the bypassed community. A detailed analysis of potential land use changes and the likelihood of new interchange areas being developed is provided in Indirect Effects and Cumulative Impacts Technical Report. CBA 1 has three interchange areas with potential commercial development, while CBA 2 has four areas and CBA 3 has six.

**Table 4.18-2
DISTANCE OF BYPASS INTERCHANGE TO ROUTE 460 IN DOWNTOWN AREA**

BYPASSED COMMUNITY	CBA 1	CBA 2	CBA 3
Disputanta	1.5 miles	0.5 mile	3.3 miles
Waverly	1.6 miles	1.2 miles	1.2 miles
Wakefield	2.9 miles	1.3 miles	1.3 miles
Ivor	2.3 miles	0.9 mile	2.5 miles
Zuni*	---	---	---
Windsor	0.5 miles	0.8 mile	1.5 miles

* No interchange access would be provided to Zuni via CBA 1, 2, or 3. However, CBA 2 would provide at-grade intersections on existing Route 460 at the western and eastern sides of Zuni.

Summary of Bypass Effects

The CBAs are anticipated to have similar bypass effects to existing downtown businesses on the basis of changes in traffic levels. CBA 3 would have the most new, competing commercial development areas at interchanges, while CBA 1 would have the least. The distance of the bypass interchanges to the existing downtown areas is small enough at all interchanges with CBA 2 to infer that drivers would visit the downtown areas from the bypasses. With CBAs 1 and 3, there are two interchanges where this distance

exceeds the assumed threshold of through-travelers' willingness to venture into downtown areas for goods and services.

Given that all six of the bypassed communities have some sort of highway-related business, such businesses would likely experience a short-term decline in revenues due to the shift of through-traffic. The towns of Waverly, Wakefield, and Windsor have the greatest number of highway-related businesses. Therefore, these towns could be the most adversely affected in this regard. However, these towns are also the largest of the communities along the Route 460 corridor and are more self-sufficient than communities such as Disputanta, Ivor, and Zuni. This self-sufficiency and local support of these highway-related businesses could offset the reduction in through-traffic business. With the shifting of traffic to CBA 1, 2, or 3, access to businesses in the downtown areas would become easier and more convenient.

4.18.4 Indirect Farmlands Impacts

Indirect impacts to farmlands include farmland fragmentation and impacts to farmland from potential development. The No-Build and TSM Alternatives would not include roadway on new location. Therefore, farmland fragmentation impacts would not occur with these alternatives. Potential development is not anticipated with the No-Build or TSM Alternative. The No-Build and TSM Alternatives would not affect the economic sustainability of agriculture within the study area.

Farmland fragmentation is assumed to have the potential to occur where an alternative is proposed on new location in agricultural areas. Where the roadway is proposed to be widened in place, agricultural acres may be impacted but no new fragmentation of farmland would occur. Therefore, CBAs 1 and 3 have the potential to fragment farmland anywhere that they pass through agricultural areas, whereas CBA 2 has the potential for these impacts only in the area of the bypasses. Therefore, CBA 2 would be expected to have the least indirect impacts to farmland fragmentation and CBA 1 and CBA 3 would be expected to have higher farmland fragmentation impacts because the scale of their new location impacts on agricultural land is similar.

Impacts to agricultural and forestal districts have been minimized in the proposed CBA alignments; therefore, indirect impacts to farmlands have already been minimized to some degree. During final design, the parcel-level impacts to farms will be minimized, which will further reduce farmland fragmentation. If a CBA is selected, any uneconomic remnants of land that would be created by the selected alternative would be purchased during right-of-way acquisition.

Additional indirect impacts to agricultural land will occur where indirect land use change take place on and displaces agricultural land use. The CBAs are estimated to have the following indirect impacts to agricultural land in interchange areas:

- CBA 1 – 115 acres
- CBA 2 – 30 acres
- CBA 3 – 150 acres

The interchange area at CBA 1 includes 40 acres of land within the Knoxville District Agricultural and Forestal Districts. As long as this land remains within the district, it will not be developed for more intensive land uses. In addition to zoning restrictions, should localities want to limit potential development at associated interchange areas and preserve agricultural land uses, they can consider supporting or encouraging agricultural and forestal districts to preserve and protect open spaces, forested areas, and agricultural lands.

The potential for these impacts in combination with direct project impacts and the past, present and future actions in the study area to impact the sustainability of agriculture is assessed in Table 4.19-4.

4.18.5 Indirect Terrestrial Communities, Habitat, and Biodiversity impacts

For purposes of this assessment, forestland is used as the primary indicator of terrestrial wildlife habitat and biodiversity. Indirect impacts evaluated in this analysis include incremental habitat loss, forest fragmentation, and resulting effects upon regional biodiversity. As reported in the *Natural Resources Technical Report*, uplands within certain portions of the study area are so highly fragmented that they afford limited contribution with respect to wildlife corridors; however, riparian corridors and a number of headwater areas in the western portion of the study area have been less disturbed and presently serve as components of several prominent wildlife corridors within the region.

The No-Build and TSM alternatives would result in some indirect impacts to wildlife habitat, but these effects would occur within or adjacent to the existing de-forested corridor and are expected to be negligible.

CBA 1 would result in the conversion of 225 acres of forestland uses as a result of indirect land use impacts near interchanges; this acreage is less than 0.1 percent of the forestland in the study area. None of the CBA 1 interchanges or potential development would bisect a wildlife corridor or affect a BRANK area.

CBA 2 would result in the conversion of 20 acres of forestland uses as a result of indirect land use impacts in interchange areas, which is less than 0.01 percent of forestland in the study area. CBA 2 would affect neither wildlife corridors nor BRANK areas in the interchange areas that are anticipated to have potential development impacts.

CBA 3 would result in 230 acres of converted forestland as a result of indirect land use impacts at interchange areas. This is less than 0.1 percent of the forestland in the study area. While one CBA 3 interchange (Route 625 near Disputanta) is in the vicinity of a wildlife crossing and BRANK area, no change in future land use is anticipated to occur at this interchange as a result of CBA 3.

4.18.6 Indirect Impacts to Waters of the U.S., Including Wetlands, and Associated Aquatic habitat

Indirect impacts to navigable waterways, streams, ponds, and wetlands may occur as a result of indirect land use impacts or downstream effects from the direct impacts of project alternatives. The severity of these impacts along with appropriate mitigation measures will be regulated by state and federal permitting processes that will minimize impacts from the proposed roadway project. State, federal, and additional local regulations would apply to most indirect land use changes. Regulatory permit programs and agencies that will serve to regulate the degree and extent of future indirect impacts include: the Virginia Pollutant Discharge Elimination System (VPDES), the Virginia Water Protection Permit (VWPP), Section 404 of the Clean Water Act of 1977, and the Virginia Marine Resources Commission (VMRC).

If individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) required encroachment upon wetlands or streams, such encroachments can be expected to be relatively minor in extent and severity. The No-Build and TSM Alternatives would not resolve any existing stormwater management problems or bring existing stormwater treatment facilities along the Route 460 corridor up to current standards.

CBA 1 and CBA 3 would have comparable levels of indirect impacts to waters of the U.S and associated habitat as a result of indirect land use impacts. Indirect land use impacts are anticipated to impact 340 acres with CBA 1 and 380 acres with CBA 2. However, wetland impacts in these development areas would be expected to be minimal due to the avoidance and minimization requirements of wetland regulations as well as the ample availability of non-jurisdictional developable land. CBA 2 would impact fewer acres (50) as a result of potential development, and the same results with regard to indirect impact minimization would occur with CBA 2 as were described for CBAs 1 and 3.

As detailed in the *Natural Resources Technical Report*, CBA 3 has the greatest quantity of wetland and stream crossing impacts, followed by CBA 1. CBA 2 has the least impacts to these resources. Indirect impacts associated with these encroachments, such as pollutant loading, thermal and sedimentation effects at stream crossings, streambed erosion, effects to downstream aquatic habitat, and impacts to

downstream wetland hydrology, would be minimized by the use of best management practices during construction and the collection and retention of storm water according to best management practices and as required by VDEQ. Indirect impacts to stream beds and aquatic habitat located downstream of streams crossed by a CBA would be mitigated through restoration of disturbed stream banks/substrate and land surfaces immediately following construction and through provision of storm water management facilities designed to address both water quantity and water quality. In addition to having fewer crossings and encroachments on waters of the U.S., CBA 2 would provide a beneficial indirect impact along the existing Route 460 corridor by affording the opportunity to improve any deficient stormwater management facilities and reduce pollutant loading in streams currently crossed by Route 460.

4.18.7 Indirect Impacts to Water Quality from Indirect land use changes

Indirect impacts to water quality could occur as a result of the increases in impervious surface from development that could be induced by a project alternative. A quantitative analysis of impervious surface increases for direct and indirect project impacts as well as planned future actions is presented in Section 4.19.5.

Individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) may require increases in impervious surface. However, these increases would be relatively minor in extent and severity.

CBA 1 and CBA 3 would have comparable levels of indirect impacts to water quality as a result of potential development. The increased impervious surface associated with potential development (94 acres of impervious surface and 128 acres, respectively) would increase stormwater runoff; however, certain design criteria associated with this development would be governed by VDEQ permits in that they would be required to follow best management practices (BMP) for stormwater retention and treatment and erosion/siltation control. CBA 2 would result in 42 acres of additional impervious surface as a result of potential development, but the same minimization of impacts through permitting requirements would be anticipated.

4.18.8 Indirect Impacts to Floodplains

Development in floodplains is governed by federal and state statutes through the Virginia Department of Conservation and Recreation (VDCR) Floodplain Management Program and by local Flood Insurance Programs administered by localities and overseen by FEMA.

If individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) required encroachment within floodplains or regulated floodways, such encroachments would be relatively minor in extent and severity. Indirect impacts to floodplains and floodways would be negligible for all CBAs as a result of floodplain regulations and VDOT's bridge design standards. Regulatory restrictions and performance standards set forth in local floodplain ordinances and FEMA regulations would apply to potential development. Therefore, no indirect impacts to floodplains are anticipated to occur with this project.

4.18.9 Indirect Impacts to Threatened and Endangered Species

Federally-listed threatened or endangered species in the study area include the bald eagle, the red-cockaded woodpecker, and the piping plover. Indirect impacts to these species could occur if the project's indirect land use impacts were anticipated to occur in the vicinity of these species' habitats. However, indirect land use impacts are limited to the areas around interchanges of the CBAs, and none of these species' habitats exist in these areas. Therefore, no indirect impacts to federally-listed threatened and endangered species are anticipated to occur with this project.

4.18.10 Indirect Noise Impacts

Indirect land use impacts would change the patterns of traffic both on Route 460 and in adjacent activity areas. Indirect noise impacts could occur where new activity areas are created, if the nature or intensity of such areas were anticipated to add to local sound levels. According to the indirect land use impact analysis, the No-Build and TSM alternatives would not create any new activity areas. The new activity areas (i.e., commercial development) with the CBAs would be small in scale – no larger than 20 acres in size and consisting of gas stations, restaurants and small tourist-related businesses. The level of economic activity anticipated is directly related to the anticipated traffic levels of the CBA and cross-roads, which were considered in the direct noise impact analysis. Based on the indirect land use analysis, the type and scale businesses in new activity centers would not be expected to contribute substantially to increased noise in the interchange areas beyond that of the projected traffic.

4.18.11 Indirect Air Quality Impacts

Regional air quality conformity analysis considers the projected increases in regional population and employment, which are included in the non-attainment regions' travel demand models. The two non-attainment regions are the Richmond-Petersburg region at the west end of the project and the Hampton Roads region at the east end of the project. The indirect land use impacts of the CBAs and any net increase in employment, with associated travel, would not necessarily be included in the regional air quality conformity analysis. However, the Route 460 Location Study is included in the conformity analysis for these regions, so the only incremental impact for air quality would be the indirect land use changes. The majority of CBA land use impacts would occur at the ends of the project that are within these non-attainment areas. This includes 300 acres of low-density residential development in Prince George County with CBAs 1 and 3, as well as 20-30 acres of commercial development at the eastern end of the project with all three CBAs. These impacts are insignificant when one considers that the Richmond-Petersburg region has a population of approximately one million and the Hampton Roads region has approximately 750,000 jobs. The minute proportion of regional development that would be increased by the project's indirect land use impacts is not anticipated to affect air quality conformity in either non-attainment region.

4.18.12 Indirect impacts to Cultural Resources

Unlike streams and jurisdictional lands, cultural resources may be encroached upon or displaced, through private land transactions, where indirect land use impacts occur. Thus, the indirect impact analysis to cultural resources focuses on the presence of National Register listed or eligible sites in the areas where potential development is anticipated to occur.

- CBA 1 – The interchange with Route 620 south of Wakefield is anticipated to have 10 acres of commercial development. This is in the vicinity of the Wakefield Sportsmen's Club (DHR 091-5058). This is the location of the annual "Shad Planking" political event.
- CBA 2 – At the Isle of Wight County/Suffolk City line, 10 acres of commercial development are anticipated to be induced by a new interchange. This is in the vicinity of Saunders House (DHR 046-0006).
- CBA 3 – The interchange noted for CBA 2 is also part of CBA 3. In addition, at the new interchange on Route 620 north of Ivor is anticipated to have 10 acres of induced commercial development, Oak Grove (DHR 087-0014) is located in the vicinity of this interchange.

The potential impact areas are 1-mile in radius around the CBA interchanges. GIS analysis indicates that ample developable land is available for the 10 acres of development anticipated at these sites without encroaching upon the historic sites. Also, this development could require development approvals from local government, and effects to historic properties could be considered during this process. The decisions of landowners will also factor into the preservation of these historic sites.

4.19 CUMULATIVE IMPACTS

In accordance with CEQ guidance, the cumulative effects analysis was limited through the NEPA scoping process to effects that can be evaluated meaningfully and that are of concern to resource agencies, local officials, and/or the public. Issues of concerns evaluated in the cumulative effects analysis include:

- Impacts to historically diminishing farmlands;
- Economic impacts to communities;
- Impacts to water quality and aquatic habitat;
- Impacts to already-fragmented forested lands, affecting terrestrial communities and habitat; and
- Impacts to wetlands

The existing and future No-Build land use scenarios assumed for this project are considered the cumulative baseline condition. The direct and indirect impacts of the proposed CBAs, when added to impacts of other past, present, or future actions, were assessed to identify the cumulative effects to resources of concern and the incremental impact of the proposed project. Cumulative project impacts were quantified in GIS or qualitatively discussed for each issue of concern.

Evaluation of cumulative impacts was completed in by first identifying past, present, and reasonably foreseeable future actions.

Team members then reviewed the long-term productivity or sustainability of resources potentially affected by the Route 460 project and other planned actions to identify the incremental effects of the proposed project.

4.19.1 Past and Present Actions

Past and present actions affecting the resources, ecosystems, and human communities of concern include:

Period: 1900 – 1950s

- Towns of Windsor and Wakefield incorporated – 1902
- Development of large-scale agricultural processing industries based on peanuts, pork processing, and paper products (e.g., Smithfield Foods -1936, Union Camp/International Paper - 1937, Planters Peanuts – 1906.)
- Development of Fort Lee in Prince George County – 1917 – quartermaster and logistics training disciplines.
- Development of I-64 – From Hampton Roads to Richmond, completed between 1957 and 1968
- Development of I-95 – 1958

Period: 1960 – 1980s

- Development of Surry Nuclear Power plant (Virginia Electric and Power Company (VEPCO) – now Dominion Power) – 1973
- City of Suffolk merged with Nansemond County - 1974
- Norfolk Southern ceased passenger rail service between Petersburg and Suffolk in the early 1970's
- Food Lion distribution Center established in Prince George County

Period: 1990 - Present

- Development of I-295 in Prince George – 1992
- Development of I-664 in Suffolk – Construction started 1979 and ended in 1992 with completion of the Monitor-Merrimack Memorial Bridge-Tunnel.
- Boundary adjustment to the Town of Windsor, increasing land area from 653 acres to 2,578 acres July 2001.
- Development of Prince George's SouthPoint Industrial Park – 2000 - ongoing
- Atlantic Waste Landfill – Sussex County – Permitted in 1993 (landfill expected to be full in 2006)
- Sussex I and II State Prisons – over 2,400 prisoners, security levels 4 and 5, opened 1998-1999
- Preservation of Piney Grove Preserve (Nature Conservancy) – 1998. Piney Grove harbors Virginia's last breeding population of red-cockaded woodpeckers.
- Hurricane Isabel – September 2003

4.19.2 Other Major Future Actions:

Through review of existing plans and coordination activities, major planned actions in or affecting the study area were identified. Most of the development information was provided by local planning and economic development officials. Table 4.19-1, Table 4.19-2, and Table 4.19-3 show the major, future actions and the location and timing of these actions. Table 4.19-1 identifies transportation projects, Table 4.19-2 presents commercial development and Table 4.19-3 presents residential development. All of the developments in Table 4.19-2 and Table 4.19-3 were directly considered in the cumulative impact analysis as reasonably foreseeable future development that will occur with or without the proposed improvements to Route 460. The projects in Table 4.19-1 were evaluated with regard to planning status and were not found to be reasonably foreseeable for the reasons described in the table. The developments in Table 4.19-2 and Table 4.19-3 are presented graphically in Figure 4.19-1 by the numbers indicated in the left-hand column of each table.

**Table 4.19-1
FUTURE MAJOR TRANSPORTATION PROJECTS**

Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
Route 258 Bypass	VDOT	Isle of Wight County	Identified as a needed, long-term roadway improvement in county's comprehensive plan. However, it is not included in VDOT's 6-Year Transportation Improvement Plan nor is it included in the Hampton Roads PDC's 2030 Constrained Long-Range Plan.
Passenger Rail	VDRPT	Richmond – Hampton Roads	Richmond/Hampton Roads Passenger Rail Study pending. Preliminary alignment alternatives in two corridors (Route 460 and I-64) are under consideration. As a preferred alternative has not been selected, this project is not incorporated in this cumulative analysis. Additionally, the alternative selected would not make a discernable difference to the traffic forecasts for the CBAs.
Eastern Virginia Airport	Virginia Department of Aviation	Surry, Isle of Wight, or Suffolk	Virginia Department of Aviation was investigating the possibility of constructing a regional super airport or additional airport in one of these localities. However, this new airport is not included in the Department of Aviation's long-range plan.

Source: Michael Baker Jr., Inc. 2005

Table 4.19-2
FUTURE MAJOR COMMERCIAL DEVELOPMENT ACTIONS

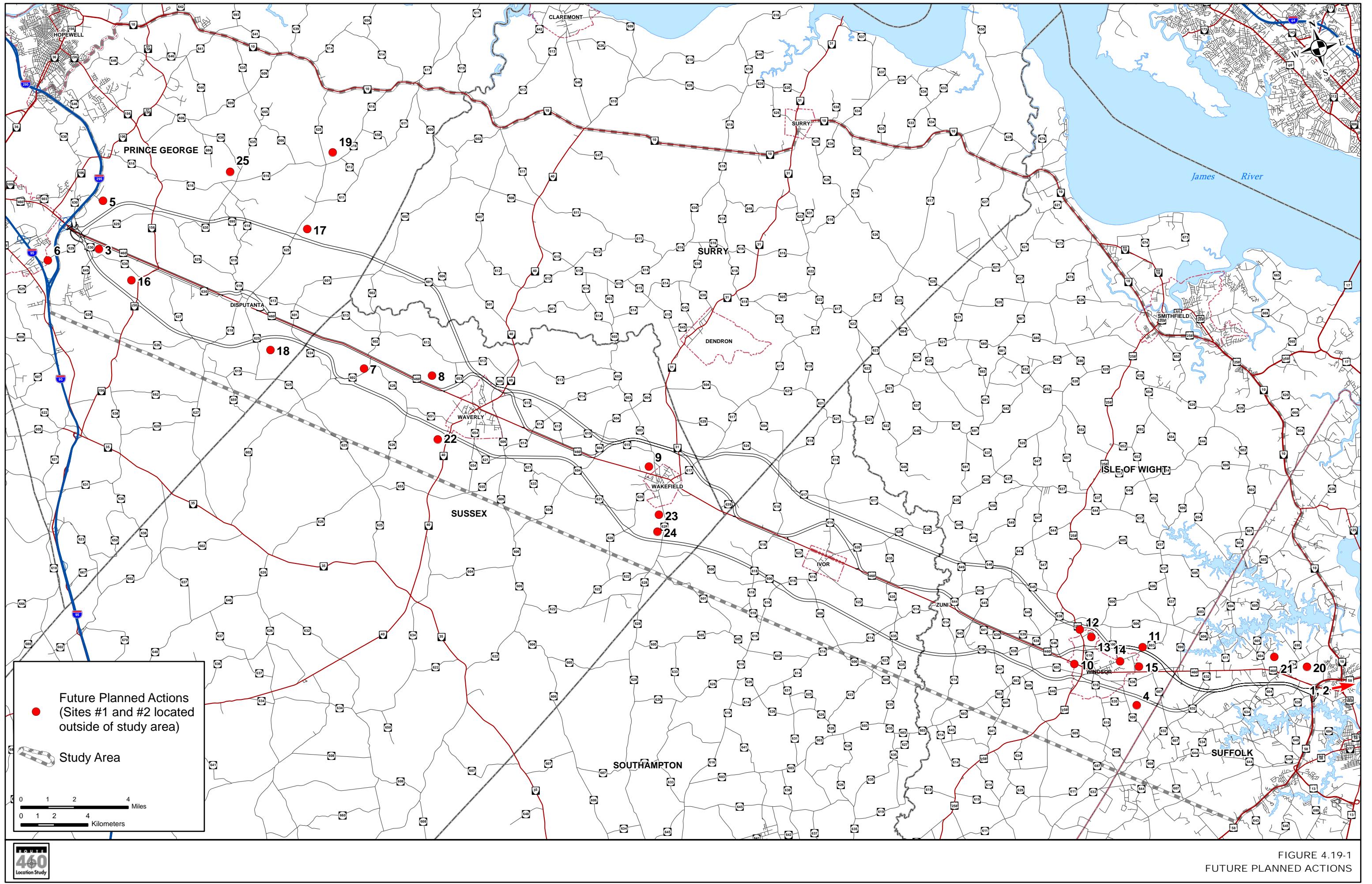
No.	Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
1	New container terminal	A.P. Moller / Maersk Group (APM Terminals North America, Inc.)	Portsmouth on the west side of the Elizabeth River.	Anticipated completion 2007
2	New container terminal	Port of Virginia	East side of Craney Island in Portsmouth.	EIS pending – due December 2005. Facility is located outside the study area. Projected increases in port activity are included in the traffic analysis for this EIS. The Port Authority is proposing improvements and expansion to accommodate the more than 16 million tons of general cargo by the year 2010.
3	New Intermodal Facility – Norfolk Southern South Central Virginia Intermodal Terminal	Norfolk Southern Railroad	New Bohemia, Prince George County	Shipping/warehouse development on approximately 22 acres bounded by Lamore Drive, Norfolk Southern railroad tracks. Facility is anticipated to serve 200 trucks per day in the first phase and, may expand to accommodate approximately 500 trucks daily.
4	Development of Norfolk Southern property	Norfolk Southern Railroad / Isle of Wight County	East and west of Windsor in Isle of Wight County	Norfolk Southern property east of Windsor is 1,600-acre undeveloped tract; one of largest tracts on East Coast. Very desirable property since the tract has rail access and is reasonably accessible to ports. It is assumed to be developed as an inland port facility with multimodal industrial park by 2026 with an anticipated 5,600 jobs created (assumes all jobs are automated and that it is all warehouse type of development).
5	Southpoint Industrial Park – Build-out	Private Developers and Prince George County	Prince George County, adjacent to I-295 and Route 460	1,800 acre industrial park for light manufacturing and distribution. Anticipate build-out in 5 to 10 years.
6	Moving Southside Regional Medical Center to Reves Road	Petersburg Hospital Company, LLC	Prince George County	Plans to relocate Southside Regional Medical Center and add two operating rooms. The current facility is a 408-bed acute care medical center with two professional schools.
7	Five Forks Energy Power Plant	Dominion Virginia Power	Sussex County, along Norfolk Southern rail line, on the north side of Route 602 and south of Route 460	Potential location of a cogeneration power plant. Size of parcel approximately 1,000 acres. If cogeneration power plant is not developed, this site remains a prime location for other industrial development due to rail access.
8	Regional Industrial Park	Town of Waverly and Sussex County	Old Waverly Airport along Route 460	Proposed industrial park on approximately 171 acres.
9	Expansion of the Town of Wakefield	Town of Wakefield	West of town along Route 460	Annexation of land planned in next 2-3 years
10	Strip Shopping Center	Private	Windsor, between railroad tracks and Route 460	Proposed 30,000 square feet retail and fast food restaurant with 15 to 20 commercial units and a fast food establishment. Total area approximately 2.5 acres
11	Retail Development	Private	Windsor, along Route 460 near Food Lion	Proposed commercial development on 21 acres with 50,000 square feet of retail space.

Source: Michael Baker Jr., Inc. 2005

Table 4.19-3
FUTURE MAJOR COMMUNITY AND RESIDENTIAL DEVELOPMENT

No.	Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
12	Church	Private	Windsor	10-acre site for new church
13	Single Family Residential	Private	Windsor	Second phase of Windsor Woods Subdivision. Additional 52 units to be built.
14	Single Family Residential	Private	Windsor, along Route 603	Proposed Holland Meadows subdivision with 100-units.
15	Single Family Residential	Private	Isle of Wight County near Route 460 and the Cost Plus Distribution Center	Proposed 200 unit subdivision (1 unit per 5 acres). Total acreage likely to be 1,000 acres
16	Single Family Residential	Private	Prince George County near Route 156	Lamar Drive subdivision with 24 units.
17	Single Family Residential	Private	Prince George County near Route 625 north of Route 460	60 acre parcel (12 units on 5 acres each) Arwood Road. 125 acre Warwick Acres (24 lots at 5 acres each)
18	Single Family Residential	Private	Prince George County near Route 625 south of Route 460	500 acre parcel (150 units) for residential development.
19	Single Family Residential	Private	Prince George County along Route 611	235 acre Pleasant Grove Estates (47 lots at 5 acres each)
20	Single Family Residential	Private	City of Suffolk, Kings Fork Road to Route 460	382 units at Kings Fork Farms (approximately 400 acres)
21	Expansion of Retirement Community	Private	City of Suffolk, near Lake Prince	Lake Prince Retirement Community expanding with additional 60 to 70 residential lots (approximately 70 acres)
22	Single Family Residential	Private	Sussex County, along Route 40	Waverly Meadows Subdivision on approximately 18 acres (70 units on ¼ acre lots)
23	Single Family Residential	Private	Sussex County, along Route 617	3 acre development with 10 units on ¼ acre lots
24	Single Family Residential	Private	Sussex County, along Route 628	Drumwright Mill Subdivision. 500 lot subdivision with lot size varying from ¼ to 5 acres. Planned urban development (PUD) with golf course.
25	Single Family Residential	Private	Prince George County, along Routes 635 & 636	24 units at Centennial Acres 24 units at Centennial/Lawyers Road

Source: Michael Baker Jr., Inc. 2005



4.19.3 Cumulative Farmland Impacts

Cumulative impacts to agricultural lands may result from the conversion of agricultural lands from the proposed project, potential development, and private actions. The cumulative impacts to farmlands will occur as a result of 1) direct project impacts, 2) the project's indirect land use impacts in interchange areas, and 3) other planned actions. Cumulative impacts cannot be directly estimated for actively farmed parcels due to lack of GIS information. However, impacts to land classified as agricultural serves as a proxy. This classification includes cropland and pasture, confined feeding operations and "other" agricultural land.

A GIS analysis of the location of agricultural land uses and agricultural/forestal districts was compared to the location of indirect land use changes. As discussed in Section 4.18.1, each 2,000-acre interchange area was reviewed for the amount and type of developable land. Anticipated land use changes were allocated to available land, outside of agricultural and forestal districts, based on the assumption that, accessible, agricultural land would develop first, followed by accessible forested non-wetland acres. In every case, these two land types were more than sufficient to absorb the projected development.

Reasonably foreseeable future actions within the study area from Table 4.19-2 and Table 4.19-3 were reviewed, and wherever possible, acres were estimated for the development. For the other planned actions, many of the sites are not identified at a parcel level or within large parcels, so a worst-case scenario of farmland impacts was assessed.

Based on the land use impact analysis in the *Land Use, Parklands, and Farmlands Technical Report*, 30.4 percent of the study area (144,671 acres) is in agricultural land use. Historically, the study area has been predominantly rural, and while some residential and industrial developments have reduced the agricultural land in the study area, these developments are small in number and generally small in scale. The future No Build scenario, or baseline, for farmland impacts includes the impacts of planned actions, including industrial, commercial and residential development. The analysis accounted for all planned developments within the study area. These planned actions are estimated to consume an additional 8,600 acres of land in a worst case scenario. If all of this land were agricultural, that would consume six percent of the agricultural land in the study area.

Direct agricultural land use impacts range from the conversion of 517 acres to 707 acres in the Design Corridor of the CBAs. Indirect land use changes to agricultural land uses are estimated to result in the conversion of an additional 115 acres with CBA 1, 30 acres with CBA 2, and 150 acres with CBA 3. Total direct and indirect impacts would account for less than 0.5 percent of total agricultural land uses in the study area with the Design Corridors of CBAs 1 and 2 and less than 0.6 percent with the Design Corridor of CBA 3.

Thus, the project-related impacts to agricultural land are estimated to consume up to one percent of agricultural land. The worst case scenario for total cumulative effects to agricultural land is estimated to be less than seven percent of all agricultural land in the study area. Given the scale of these impacts, cumulative impacts to this resource do not appear to be sufficiently extensive to threaten its sustainability.

Additionally, local programs and policies provide incentives to preserve agricultural lands. These include Agricultural and Forestal Districts and a rural economic development manager on staff in Isle of Wight County and a growth management policy in the City of Suffolk.

Table 4.19-4
DIRECT AND INDIRECT FARMLAND IMPACTS

Alternative		Direct Agricultural Impacts (acres)	Indirect Agricultural Impacts (acres)	Total Direct and Indirect Agricultural Impacts (acres)	Percent of Agricultural Land in Study Area
CBA 1	Planning Corridor	965	115	1,080	0.75%
	Design Corridor	517	115	632	0.44%
CBA 2	Planning Corridor	1237	30	1,267	0.88%
	Design Corridor	557	30	587	0.41%
CBA 3	Planning Corridor	1229	150	1,379	0.95%
	Design Corridor	707	150	857	0.59%

Source: Parsons Brinckerhoff and Michael Baker Jr. 2005

4.19.4 Economic Impacts to Communities

Economic conditions in the study area vary – past and present actions include both economic growth and isolated economic decline. The future economic setting without the proposed project would include economic growth at planned industrial parks and at port terminals. This growth would bring more jobs to study area residents, but also would add truck traffic to the existing Route 460 facility, exacerbating concerns such as safety and local pedestrian movement that pose difficulties for local business districts. Other economic forces in the study area include the trend towards “big box” retail which, while not evident within most of the study corridor today, nevertheless threatens local business districts from the locations where this development does occur at the east and west ends of the study area and beyond. The economic future for study area communities is therefore a mixture of good and bad without the proposed improvements to Route 460.

Table 4.19-5 presents the collective economic impact findings from direct and indirect impacts of the CBAs. The direct impacts are explained in detail in the *Right of Way and Relocation Technical Report* and the *Socioeconomic Technical Report*. These findings show that negative direct impacts in the form of job losses and lost property tax revenues will generally be offset with indirect impacts from commercial growth at interchange areas and enhanced attractiveness to planned industrial areas as a result of travel time savings. However, a concern voiced by communities along the corridor is the continued sustainability of existing downtown areas once they are bypassed. This issue is addressed in Section 4.18.3 Indirect Economic Impacts, and the analysis finds that the bypass effects also have both positive and negative impacts to communities. The opportunity created by the reduction in traffic in business districts and the proximity to the improved Route 460 interchanges can actually enhance the economic sustainability of the towns.

From a cumulative standpoint, the communities will face economic challenges with or without the proposed improvements to Route 460. However, the opportunity for economic benefits appears greater with the CBAs because of the travel time savings to industries and the potential for bypassed

communities to create more attractive and sustainable downtown business districts than would be possible if truck traffic remained on the existing route.

**Table 4.19-5
ESTIMATED ECONOMIC EFFECTS OF THE CBAS**

Locality Direct	Employment Lost¹	Direct Loss of Property Tax Revenues¹	Location and Degree of Potential Commercial Development	Existing and Planned Industrial Areas Benefiting from Improved Accessibility
CBA 1				
Prince George County	10 jobs	\$32,762	No commercial development anticipated, but induced residential development would occur at Route 156	Southpoint Industrial Park Planned Norfolk Southern facility
Sussex County	0	\$9,150	Potential for light tourist / commercial services at the interchange areas in Waverly and Wakefield	Existing and planned industrial development along Route 602 Town of Waverly's industrial area on Route 40
Surry County	0	\$0	None anticipated	None anticipated
Southampton County	0	\$2,608	None anticipated	None anticipated
Isle of Wight	0	\$22,993	None anticipated	Town of Wakefield's industrial zoned area on Route 258
City of Suffolk	0	\$13,182	Potential for economically competitive development at Route 58 Bypass area	None anticipated
Total CBA 1	10 jobs	\$80,695	Three Locations Of Induced Commercial Development	Five industrial areas with improved access
CBA 2				
Prince George County	80 jobs	\$32,294	None anticipated	Southpoint Industrial Park Planned Norfolk Southern facility
Sussex County	<10	\$7,177	Potential for light tourist / commercial services at the interchange area in Waverly	Planned Regional Industrial Park (airport site)
Surry County	0	\$445	None anticipated	None anticipated
Southampton County	0	\$7,502	Potential for light tourist / commercial services at the interchange area in Ivor	None anticipated
Isle of Wight	0	\$26,933	Potential for light tourist / commercial services at the interchange area east of Windsor	Shirley T. Holland Industrial Park Planned development of Norfolk Southern parcel (1,600 acres)
City of Suffolk	0	\$18,063	Potential for economically competitive development at Route 58 Bypass area	None anticipated

Locality Direct	Employment Lost ¹	Direct Loss of Property Tax Revenues ¹	Location and Degree of Potential Commercial Development	Existing and Planned Industrial Areas Benefiting from Improved Accessibility
Total CBA 2	90 jobs	\$92,414	Four locations of induced commercial development	Five Industrial Areas With Improved Access
CBA 3				
Prince George County	0	\$16,971	No commercial development anticipated, but induced residential development would occur at Route 156	Planned Norfolk Southern facility
Sussex County	0	\$3,515	Potential for light tourist / commercial services at the interchange areas in Waverly and Wakefield	None anticipated
Surry County	0	\$2,756	None anticipated	None anticipated
Southampton County	0	\$3,023	Potential for light tourist / commercial services at the interchange area in Ivor	None anticipated
Isle of Wight	0	\$13,101	Potential for economically competitive development on Route 258 in Windsor Potential for light tourist / commercial services at the interchange area east of Windsor	Shirley T. Holland Industrial Park Planned development of Norfolk Southern parcel (1,600 acres)
City of Suffolk	0	\$18,063	Potential for economically competitive development at Route 58 Bypass area	None anticipated
Total CBA 3	0	\$57,430	Five Locations Of Induced Commercial Development	Three Industrial Areas With Improved Access

¹Design Corridor estimates are shown for comparison purposes

Source: Michael Baker Jr., 2005

4.19.5 Cumulative Impacts to Water Quality and Aquatic Habitat

Due to its very nature, assessing cumulative impacts to water quality and aquatic habitat is a complex and highly speculative undertaking. Notwithstanding, this analysis focuses on an important variable related to water quality that can be assessed using the methods described below—impervious surface. Increases in impervious surface relative to natural areas in the study area are assumed to be an indicator of cumulative impacts to water quality.

Increases in impervious surfaces resulting from development can affect the physical and chemical characteristics of streams, potentially altering aquatic habitat. If not effectively attenuated through use of BMPs, increases in impervious surface can increase runoff volume, which in turn can lead to erosion, stream widening, and incision, as well as increased contributions of pollutants (particularly sediment) to surface waters. Increases in concentrations of these pollutants in surface water can result in disruption of life processes for aquatic organisms, can be toxic to aquatic life, or can decrease habitat suitability.

According to empirical research, when impervious surface cover exceeds ten percent within a given watershed, negative effects on in-stream habitat are typically observed; at 25 percent, the watershed becomes severely degraded (Center for Watershed Protection, 2003). These thresholds are based on

areas where much of the development occurred before existing stormwater management practices were in place. Therefore, these thresholds would be higher in areas developed using these practices.

While the study area appears to be below the 10 percent threshold based on analysis that follows, it is nevertheless the case that past actions have caused extensive degradation of water quality in the study area. As detailed in the *Water Quality Technical Report*, extensive portions of the Blackwater River and numerous aquatic systems in the study area are considered impaired on the basis of fecal coliform, sediments, and other pollutants. These impairments are related to agricultural runoff, intensive livestock operations, and sanitation-related issues rather than impervious surfaces based on the extent of fecal coliform impairments.

Increases in impervious surface relative to natural areas in the study area are assumed to be indicators of cumulative impacts to water quality. However, the amount of impaired waters in the study area suggests that stormwater management for any amount of development will be important to the future water quality in the study area.

In existing conditions, natural areas represented between 92 to 100 percent of the four watersheds. This demonstrates the vastness of natural land uses relative to the built environment. Negative impacts to stream habitat are not anticipated in existing conditions due to the level of impervious surface within each watershed. However, as noted above, there are extensive portions of the Blackwater River and numerous swamps that currently are impaired waters for a variety of reasons.

Reasonably foreseeable future actions within the study area identified in Table 4.19-2 and Table 4.19-3 were disaggregated according to watershed. Wherever possible, acres were estimated for the development and assigned a ratio of impervious surface based on planned land use. These other planned actions are estimated to consume an additional 8,600 acres of land resulting in an addition of approximately 2,300 acres of impervious surface in the Blackwater River watershed, 1,900 acres in the Nansemond River watershed, and 400 acres in the Nottoway River watershed. No major projects were identified for the Lower James River watershed within the study area. All of these watersheds would have less than 10 percent impervious surfaces within the planned future developments (Table 4.19-6). Thus, the future baseline condition without the proposed Route 460 improvements would fall below the most conservative threshold that indicates degradation of aquatic habitat. However, the waters impaired by pollutants in the current condition would be sensitive to any development impacts. The permitting process discussed in the indirect impact analysis in Sections 4.18.6 and 4.18.7 serve to protect the receiving waters from any further impairment.

As noted in Table 4.19-7, all three CBAs have similar direct and indirect impacts to water quality on the basis of the levels of impervious surface in the Blackwater River and Nansemond River watersheds. As CBA 1 is the only alternative to affect the Nottoway River watershed, it is the only one to result in impervious surface changes in that watershed. The direct and indirect impacts of CBA 1 increase the percent of impervious coverage from 0.9 percent to 1.3 percent in the Blackwater River watershed, from 2.5 percent to 3.0 percent in the Nansemond River watershed, and from 0.2 percent to 1.4 percent in the Nottoway River Watershed. The direct and indirect impacts of CBA 2 increase the percent of impervious coverage from 0.9 percent to 1.2 percent in the Blackwater River watershed and from 2.5 percent to 3.1 percent in the Nansemond River watershed. The direct and indirect impacts of CBA 3 increase the percent of impervious coverage from 0.9 percent to 1.4 percent in the Blackwater River watershed and from 2.5 percent to 3.0 percent in the Nansemond River watershed.

As noted in Table 4.19-8, the direct and indirect impacts of each CBA in addition to the land use conversions associated with other major actions would result in similar changes to impervious surface in the Lower James River, Blackwater River, and Nansemond River watershed. As previously noted, CBA 1 is the only alternative to affect the Nottoway River watershed and results in higher cumulative changes to impervious surface area when compared to CBAs 2 and 3.

**Table 4.19-6
EXISTING AND PROJECTED IMPERVIOUS SURFACE COVERAGE IN THE STUDY AREA BY WATERSHED**

	Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
Existing Impervious Surface Coverage (acres)	514	2,703	1,626	16
Existing Impervious Surface Coverage (percent of watershed in study area)	0.5%	0.9%	2.5%	0.2%
Impervious Surface Coverage of Planned Actions (acres)	0	2,300	1,900	400
Impervious Surface Coverage of Planned Actions (percent of watershed in study area)	0	0.7%	2.9%	3.9%

Source: Michael Baker Jr., 2005.

**Table 4.19-7
DIRECT AND INDIRECT IMPACTS TO IMPERVIOUS SURFACE COVERAGE IN THE STUDY AREA BY WATERSHED**

	Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
CBA 1 (acres)	0	1,333	307	125
CBA 1 (percent of watershed in study area)	0%	0.4%	0.5%	1.2%
CBA 2 (acres)	0	898	367	0
CBA 2 (percent of watershed in study area)	0%	0.3%	0.6%	0.0%
CBA 3 (acres)	0	1,510	293	0
CBA 3 (percent of watershed in study area)	0%	0.5%	0.5%	0.0%

Source: Michael Baker Jr., 2005.

Table 4.19-8
CUMULATIVE IMPACTS TO IMPERVIOUS SURFACE COVERAGE IN THE STUDY AREA BY WATERSHED

	Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
CBA 1 (acres)	514	6,312	3,802	517
CBA 1 (percent of watershed in study area)	0.5%	2.0%	5.9%	5.0%
CBA 2 (acres)	514	5,876	3,862	391
CBA 2 (percent of watershed in study area)	0.5%	1.9%	6.0%	3.8%
CBA 3 (acres)	514	6,489	3,788	391
CBA 3 (percent of watershed in study area)	0.5%	2.1%	5.9%	3.8%

Source: Michael Baker Jr., 2005.

Increased volumes of stormwater resulting from any additional infrastructure or impervious surfaces does not necessarily translate into worse water quality in receiving waters when appropriate best management practices are employed. As noted in the *Water Quality Technical Report* and *Natural Resources Technical Report*, with implementation of appropriate mitigation measures and best management practices (BMPs), the construction and operation of a CBA is not expected to result in measurable degradation of water quality or affect changes to regional water quality. The cumulative amounts of impervious surface in all three CBAs are well below the threshold of 10 percent and, as such, no negative cumulative effects to aquatic habitat are anticipated.

4.19.6 Cumulative Impacts to Terrestrial Communities and Habitat

The cumulative impacts to forestlands would occur as a result of 1) direct project impacts, 2) the project's indirect land use impacts in interchange areas, and 3) other planned actions. The analysis assumes that potential development associated with the CBAs and other planned actions that are not identified at the parcel level would convert agricultural or forestland uses to developed uses. The amount of agricultural land use conversion versus forestland conversion depends on its location and availability within each interchange area. It was assumed that agricultural lands were slightly more attractive as potential development locations than forestlands. For the other planned actions, many of the sites are not identified at a parcel level or within large parcels, so a worst-case scenario of forestland impacts was assessed.

The majority of the forestlands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, residential and commercial development. Based on the land use impact analysis in the *Land Use, Parklands, and Farmlands Technical Report*, 61.8 percent of the study area (294,671 acres) is in forestland use.

Direct and indirect forest impacts are presented in Table 4.19-9. Direct forestland use impacts range from the conversion of 599 acres to 1,140 acres in the Design Corridor of the CBAs. Total direct and indirect

impacts would account for less than 0.5 percent of total forestland uses in the study area with the Design Corridors of CBAs 1 and 3 and 0.2 percent with the Design Corridor of CBA 2. The project's direct and indirect impacts, at worst, would be 2,409 acres, which comprises 0.82 percent of the forestland in the study area (Planning Corridor of CBA 1). The *Natural Resources Technical Report* identifies the areas where direct impacts would occur in riparian corridors or key biodiversity areas, and the indirect impacts on these areas are discussed in 4.18.5.

Other planned actions, independent of the proposed project, are estimated to consume an additional 8,600 acres of land. If all of this land were forested, that would consume three percent of the total forestland in the study area. Because the forested areas are highly fragmented in the base condition, the areas most sensitive to habitat impacts are the riparian corridors that enable mobility and large contiguous forest tracts having a high rating for biodiversity. Comparing Figure 4.19-1 to the prominent wildlife corridors and the biodiversity-ranked communities, the areas that may be affected in the future baseline (No-Build) condition include development sites along Route 625 north of Disputanta (actions 17-19) and the Warwick Swamp area (action 7).

In summary, the project-related impacts to forestland are estimated to consume up to one percent of forestland, and the worst case scenario for total cumulative effects to forestland is estimated to be less than four percent of all forestland. The majority of forested areas are not high quality with regard to species mobility and biodiversity; and the known important sites for wildlife movement and biodiversity do not appear to be generally at risk as a result of cumulative impacts. Mitigation for impacts to terrestrial habitat are detailed in the *Natural Resources Technical Report*.

**Table 4.19-9
FOREST IMPACTS TO TERRESTRIAL NATURAL COMMUNITIES**

Alternative		Direct Forest Impacts (Acres)	Indirect Forest Impacts (Acres)	Total Direct and Indirect Forest Impacts (Acres)	Percent of Forestland in Study Area
CBA 1	Planning Corridor	2,184	225	2,409	0.82%
	Design Corridor	1,140	225	1,365	0.46%
CBA 2	Planning Corridor	1,370	20	1,390	0.47%
	Design Corridor	599	20	619	0.21%
CBA 3	Planning Corridor	1,931	230	2,161	0.73%
	Design Corridor	998	230	1,228	0.42%

Source: Parsons Brinckerhoff and Michael Baker Jr.

4.19.7 Cumulative Impacts to Wetlands

Historically, the wetlands in the study area have been drained and filled extensively for agriculture and other land uses. Given that wetlands are widespread in the study area, locations of future development are only generally identified, and indirect land use impacts also are only generally identified, a quantitative analysis of cumulative wetland impacts is not feasible. Instead, this section provides a qualitative assessment of cumulative wetland effects in light of current wetland regulations.

The regulatory processes governing wetlands are discussed in the *Natural Resources Technical Report*. Commercial and industrial development, as well as planned subdivision-style residential development, will be governed by these processes to prevent the loss of wetlands. Therefore, small-scale and individual lot residential development is the type of development that is most likely to cause unmitigated wetland impacts through use of nationwide permits. In the future baseline or No-Build condition, these impacts will occur throughout the corridor, but are not expected to be widespread based on population forecasts

of less than 0.5 percent in Southampton, Surry and Sussex counties and less than one percent per year in Prince George County. Chesapeake Bay regulations (adopted by each study area locality by ordinance) as well as separate, Suffolk and Isle-of-Wight County land use regulations incorporate additional measures to protect sensitive lands beyond that regulated strictly by VWPP and COE wetland permits.

In contrast to the general residential development that will occur in the baseline scenario, the direct and indirect wetland impacts of the CBAs would be subject to regulations requiring avoidance, minimization, and mitigation of wetland impacts. Thus, the net future wetland impacts with and without the proposed action are assumed to be virtually the same and are not anticipated to threaten the sustainability or function of wetland systems in the study area.

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