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3.6 INDIRECT AND CUMULATIVE IMPACTS

3.6.1 Introduction

The National Environmental Policy Act (NEPA) requires major federal actions to consider the relationship between short-term uses and long-term productivity of the environment. The 1978 CEQ regulations for NEPA established means for considering these impacts by defining three types of effects: direct, indirect and cumulative. Direct effects are those that are caused by the actions and occur at the same time and place. Indirect effects are those caused by the action but occur later in time and/or farther removed in distance but are reasonably foreseeable. Cumulative impacts are those which result from the sum of incremental effects when added to past, present and reasonably foreseeable actions.

Amendments occurred in July 2020 (85 Federal Register 43375) which attempted to simplify and clarify the policy by merging terminology in reference to indirect and cumulative effects. The term cumulative was eliminated and the definition of indirect effects was adjusted to "…changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance…." (CEQ 2020 – 40 CFR 1508.1).

In October of 2021, notification was released (85 Federal Register 43375), and the agency is reviewing the changes to the definitions and is anticipated to restore some of the prior language. Regardless of whether the original language or the 2020 revisions are in effect, evaluation of reasonably foreseeable effects is the primary goal of this section. The 2020 revisions did not eliminate consideration of cumulative effects. Rather, it instructed the NEPA preparer to increase focus on causal relationships in terms of incremental effects. The terminology used for cumulative effects will follow the 1978 definitions which were in effect at the time of the July, 2019 Notice of Intent (NOI) for this project.

The impacts of other federal, state and private actions with the No-Build Alternative for the Mid-States Corridor are included in the impacts of reasonably foreseeable future actions of others not associated with the Mid-States Corridor. An example of a reasonably foreseeable action would be an announced industrial development not connected to the project. The industrial development, while not associated with the Mid-States Corridor, would be a reasonably foreseeable future action.

The assessment of cumulative impacts is required by the CEQ Regulations. The regulations ensure that the proposed Mid-States Corridor and other federal, state and private actions will be evaluated with regard to cumulative impacts. This document summarizes the analysis of indirect and cumulative impacts. Details are provided in **Appendix F – Cumulative Impacts Baseline Trends**, **Appendix G – Cumulative Impacts Technical Report** and **Appendix Q – Cumulative Impacts Calculation Appendix**.

3.6.2 Methodology

The methodology for determining the cumulative impacts of the proposed Mid-States Corridor project is discussed in detail in Appendix G. The technical report gives the details of the 11-step process for conducting the cumulative impacts analysis. These 11 steps include:

1. Identify the significant cumulative effects issues associated with the Mid-States Corridor.
2. Establish the geographic scope for the analysis.
3. Establish the time frame for the analysis.
4. Identify other actions affecting the resources, ecosystems and human communities of concern.
5. Characterize the resources, ecosystems and human communities identified in scoping and explain how they have historically changed.
6. Characterize the stresses affecting these resources, ecosystems and human communities and their relation to regulatory thresholds.
7. Define a baseline condition for these resources, ecosystems and human communities.
8. Identify the important cause and effect relationships between human activities and resources, impacts and human communities.
9. Determine the magnitude and significance of cumulative effects by identifying the changes as a result of the Mid-States Corridor.
10. Modify or add alternatives to avoid, minimize or mitigate significant cumulative effects.
11. Monitor the cumulative effects of the alternatives and provide documentation.

The 11-step process was developed in accordance with "*Considering Cumulative Effects Under the National Environmental Policy Act*" (Council on Environmental Quality, 1997). The Project's Geographic Information System (GIS) and the economic and transportation models were used to calculate the direct and indirect impacts of Mid-States Corridor alternatives.

The Transportation Economic Development Impact System (TREDIS) model forecasted economic development in the Study Area due to the Mid-States Corridor. The TREDIS model analyzes economic geographic relationships and economic response factors such as cost and access changes and labor market and income factors to forecast potential impacts of a new transportation project. A feedback loop to the traffic model from the TREDIS model is used to estimate the conversion of induced population and employment into forecasts for indirect impacts.

The combination of these improvements – the Mid-States Corridor, the feedback loop and land use estimates – represent a significant step beyond the usual practice for modeling planned transportation improvements. The models forecasted effects in the year 2045 to document the impacts on air quality, noise, indirect land use and traffic to predict potential incremental impacts to resources within the Mid-States Corridor Study Area.

3.6.3 Analysis

The following sections highlight each of the 11 steps and discusses the results of the cumulative impacts. Detailed information and analysis are provided in **Appendix G** and **Appendix Q**.

3.6.3.1 Identify the significant cumulative effects issues associated with the Mid-States Corridor

For the proposed Mid-States Corridor, five major resources, ecosystems and human communities were identified to analyze cumulative impacts. These resources are farmland, forests, wetlands, streams and karst features.

3.6.3.2 Establish the geographic scope for the analysis

The geographic scope of the cumulative impacts analysis is the Study Area, which is comprised of Crawford, Daviess, Dubois, Greene, Lawrence, Martin, Monroe, Orange, Perry, Pike, Spencer and Warrick counties. The geographic scope of analysis was adjusted appropriately to the type of resource being analyzed for impacts. For example, potential impairments to water quality in streams considered pollutant inputs separately by watersheds within the Study Area.

3.6.3.3 Establish the time frame for the analysis

The time period studied for this impacts analysis includes past years to present day, and impacts were forecasted to the year 2045. The year 2045 was selected as it represents the limits of reasonably foreseeable projections.

3.6.3.4 Identify other actions affecting the resources, ecosystems and human communities of concern

The major projects identified as other actions to be considered include the following list. Detailed information related to each action is included in **Appendix G**.

- **Coal to Diesel Plant in Dale**: This plant is being developed near Dale at the I-65/US 231 interchange.
- **Washington Convention Center**: This is being developed near the I-69 interchange with US 50.
- **Huntingburg Solar Field**: This is being developed on agricultural land near Huntingburg.
- **Lehigh Cement Plant Expansion**: This is an expansion of the existing Lehigh Cement plant in Mitchell.
- **Loogootee Trail System**: This project provides for construction of a multi-use trail connecting West Boggs Park to Loogootee.
- **Milwaukee Road Trail**: This extends an existing 10.9 mile multi-use trail from Williams to Indian Springs.
- **State Road 54 Added Travel Lanes**: INDOT is constructing new added travel lanes on approximately 11 miles of SR 54 west of SR 43.
- **State Road 37 Added Travel Lanes**: INDOT is constructing new added travel lanes and turn lanes to SR 37 at John Williams Blvd. in Bedford.
- **Lincoln Boyhood-Santa Claus Discovery Trail**: The town of Santa Claus is constructing a bike/pedestrian trail in Santa Claus extending to the intersection of SR 162 and SR 245.
- **Eastside Trail in Santa Claus, IN**: The town of Santa Claus is constructing a multi-use trail to connect Ray Yellig Trail to the American Discovery Trail.
- **Warrick Trail**: Warrick County plans to extend the Warrick Trail, a multi-use trail, between Vann Road and Oak Grove Road.

3.6.3.5 Characterize the resources, ecosystems and human communities identified in scoping and explain how they have historically changed

Baseline reports on farmland, forests, wetlands, streams and karst features in the Study Area have been completed and can be found in **Appendix F**. In summary, this analysis found that within the Study Area:

- **Farmland**: Farmland use in the Study Area between 1974 and 2017 declined from approximately 1,750,000 to 1,420,000 acres (a 19 percent decline). The decline of farmland in the Study Area is not an equivalent of farmland irretrievably lost. The trends driving the agricultural sector are diverse and specific to a given area. For example, loss of farmland surrounding the greater Indianapolis area is driven substantially by population growth and conversion of land use from rural to urban settings. For the Mid-States Corridor, the predominant reduction of farmland is driven by removal of marginal soils from row crop production. While urban development primarily in Dubois County has resulted in some loss, the majority of lands within the Study Area removed from agricultural production generally remain undeveloped or converted to timberland.
- **Forests**: Forest lands were evaluated in detail for the period between 1986 and 2019 but longer-term data were considered for context. Forested land in Indiana reached a low in the 1960s falling below four million acres. Changes in public sentiment, property taxation incentives and farming practices contributed to substantial increases of land set aside as forest or fallowed and allowed to reforest between the 1960s and 1990s. Statewide, the amount of forested land is nearly five million acres currently. The Study Area contains some of the densest areas of forest in the state. The combined 12 counties had a three percent increase in forest between 1986 and 2019; however, annual data varied greatly within the counties influenced by timber harvest and reforestation rates.
- **Wetlands**: Evaluation for historical conditions of wetlands was conducted qualitatively. Remote sensing data related to wetlands is updated by federal agencies every two to five years for the National Wetland Inventory (NWI) and National Land Cover Dataset (NLCD). However, changes in methodology and level of detail between sample years prevent the direct analysis between years of data without substantial effort to normalize the datasets to evaluate discrete localized trends. Forested wetlands account for approximately 82 percent of the wetland type within the Study Area. On a national level, wetlands have historically exhibited a decreasing trend. The state of Indiana was estimated to have converted approximately 4.7 million acres of wetlands to non-wetland lands for agriculture use and urban development by the 1980s. Broad land use trends in the Study Area since the 1980s have seen the steady conversion of farmland to non-farmland use. For this reason, it is anticipated that the Study Area has seen level or slight increases in wetland acreage. This is at variance with trends of wetland loss statewide. NLCD data was used for reference only and not for quantitative analysis. With this caveat,2001 and 2016 published estimates of wetland acreage in the Study Area trended upward. Significant reclassification of land cover types and methodologies prevents a precise numerical comparison.
- **Streams**: A total of 41,300 miles of streams are present in the Study Area. Canals and ditches compose a portion of these streams, but no actions were identified where significant changes to stream morphology have occurred in the recent past. Such actions would include new major segments of channelization or in-stream dam construction. This lack of significant change in stream morphology is expected in the future. Regarding water quality, review of the 303(d) list identified impaired stream segments throughout the Study Area. Further review of various watershed plans identified historically consistent issues related to the various impairments. Most impairments were found to be associated with agricultural sources. No impairments observed were associated with a roadway transportation source.

- **Karst Features**: Karst is a geologic formation, and the presence or absence of the underlying lithology which creates karst features is consistent over time. Identification of exposed karst features such as sinkholes, springs, and cave entrances may change, but these do not change the risk associated with being within a karst region. The eastern portion of the Study Area contains the underlying limestone lithology and the densest volume of karst.

3.6.3.6 Characterize the stresses affecting these resources, ecosystems and human communities and their relation to regulatory thresholds

Stresses to the resources of concern were reviewed to determine if known issues are present in the Study Area. Items such as land use or population changes were considered. A summary of these stressors are as follows:

- **Farmland.** Stressors to agriculture can occur from several sources, including but not limited to urbanization, changes in commodity prices and costs of farming inputs, soil health and weather. The amount of agricultural land in every county of the Study Area has been decreasing steadily for decades. However, farm productivity has been steadily increasing as technological innovations have improved yields year-over-year. Farming has transitioned to a more industrialized sector with fewer and larger farming operations. Marginal soils produce smaller yields which has shifted the economic decisions for row crop production. The steady decline of total farmland aligns with consolidation around properties with prime farmland soils and distance from/access to ports. The Study Area is not experiencing an issue of irretrievable loss of farmland, rather a conversion or fallowing of land to other uses. Urbanization is not a significant issue in the Study Area.

- **Forests.** Stressors to forested land include conversion to urban or residential settings, transportation corridors, unmanaged timber harvests and agricultural use. Statewide, the volume of forested lands has been increasing at various rates since the 1960s. The Study Area contains some of the counties with the most forest cover in Indiana. The annual survey data collected in this Study Area by the U.S. Forest Service (USFS) has identified ongoing fluctuations in the rate of reforestation and conversion to non-forest habitat over time. For the Study Area as a whole, forest acreage is trending upward. There has been a downward trend in Warrick and Perry counties. Review of stressors on forest acreage must consider the commercial, timber and sporting value of forest, as well as its ecological value. Maintaining sections of old growth forest and large contiguous blocks of forest land are important to ecosystems. Forest fragmentation reduces wildlife corridors and availability of core forest habitat, which can be crucial to the life cycles of various species.

- **Wetlands.** Stressors to wetlands in the Study Area are predominantly from human alterations to hydrology. These include ditching, installation of underground drain tiles, construction of levees and dams, urbanization and redirecting stormwater runoff. The Study Area is predominantly rural. Urbanization is highly localized and not a significant stressor on wetland acreage. The hydrologic alterations from major channelization, ditching and dam and levee construction for agricultural lands occurred decades ago. Localized ditching and installation of underground drain tiles continues on active farmland, but the trend has been for more farmland in the Study Area to be removed from production, which reduces this stressor.

- **Streams.** Stressors to streams are from similar sources as wetlands. Channelization, ditching, installation of drain tiles, construction of dams and levees and land use changes all can have effects on the stream morphology and water quality. As noted with wetlands, the landscape level alterations to streams were completed decades ago, the stream systems have been in an adaptive phase since. Pollutants, either as point sources or as non-point sources from stormwater runoff, are the primary stressors on water quality. These include discharges from point sources such as wastewater treatment facilities or non-point sources such as E. coli. and excess nutrients from agricultural lands. The Study Area contains a number of former surface mines that have created a limited amount of legacy pollutants, such as heavy metals in segments of streams, that can persist in the environment.

- **Karst Features.** Similar to streams, stressors to karst can be considered from the perspective of a physical effect and a water quality effect. A physical effect would be the closure or modification of an existing cave entrance or modification of a sinkhole. An effect on water quality would be the introduction of a pollutant source into a karst environment that contaminates the groundwater and sensitive habitat within the underground features. Of the two stressors, the risks to water quality are greater. Sources of pollutants may include point or non-point sources, including accidental releases of hazardous waste.

3.6.3.7 Define a baseline condition for the resources, ecosystems and human communities

The baseline condition identifies the forecasted effects of the No-Build Alternative within the Study Area if the Mid-States Corridor is not built. The time frame selected is 2045. This analysis forecasts the impacts to these major resources, ecosystems and human communities over this period.

- **Farmland**. This resource is forecasted to decrease an additional 23 percent in the Study Area, to approximately 1,080,000 acres, by 2045. The predominant reduction of farmland is driven by removal of marginal soils from row crop production. Most of the lands within the Study Area being removed from agricultural production remain undeveloped and are not being lost to urbanization.

- **Forest**. Forecasting the acreage of forests in the Study Area is partially connected to the trends observed in farmland. The Study Area is in a rural setting and located in an ecological region containing some of the state's highest concentrations of forest. Changes in property taxation (incentives) and changes in farming practices have contributed to increases of land set aside as forest or fallowed and allowed to reforest. The annual variations present within the counties in the Study Area regarding timber clearing and reforestation prevent a predictable level of growth, but the trend is for a net gain of forest by 2045 for the region. On a county level, some may exhibit losses in a given year or for several years.

- **Wetlands.** As noted in the historical trend analysis, remote sensing data related to wetlands was unable to be used to generate a meaningful quantitative prediction. Forested wetlands accounted for approximately 82 percent of the wetland type within the Study Area. Agricultural lands on marginal grounds, which include low-lying fields in floodplains, are predicted to be converted to other land uses through the forecast year (2045). Although no quantitative measurement was able to be generated, it is anticipated there will be a minor upward trend in emergent and forested wetlands during the forecast period.

- **Streams.** No other actions were identified which would cause a substantive morphological change to any higher order streams within the major watersheds of the Study Area. Such actions would include major segments of channelization, levee creation or dam construction. Additionally, all projects impacting a waterway are required to be permitted, and conditions associated with these permits require offsetting mitigation actions to maintain channel stability. No substantive change in length of streambeds is forecasted. Review of the 303(d) list identified impaired stream segments throughout the Study Area; however, none of the impairments were associated with transportation related sources. The impairments were predominantly associated with agricultural sources and many of the watersheds in the Study Area have approved Total Maximum Daily Loading (TMDL) and Watershed Management Plans (WMP). The implementation of these and future watershed plans in combination with the predicted reduction of farmland and increase of forest land during the forecast period indicate that water quality should trend upward.

- **Karst.** Surface indications of karst include cave entrances, springs, sinkholes and sinking stream basins. The Study Area is located within a karst region. The highest concentrations of the underlying geology producing karst features are in Crawford, Greene, Lawrence, Monroe and Orange counties. Karst is a

geologic formation, and the presence or absence of karst will not vary over time. The number of exposed features such as sinkholes may vary over time. A key concern regarding karst features is their sensitivity to groundwater contamination. The analysis considered whether land use activities in karst areas during the forecast period were likely to increase or decrease risks to groundwater contamination. The trend for farmland reduction will result in the reduction of non-point pollutant sources, but the areas of the Study Area with the most karst resources tend to have the least farmland. No substantive changes to land use were identified. Thus, risk to groundwater quality is predicted to remain consistent, with no upward or downward trend.

3.6.3.8 Identify the important cause and effect relationships between human activities and resources, impacts and human communities

The five resources of concern considered in this analysis are farmland, forests, wetlands, streams and karst features. The analysis identified causal factors for all five which can influence future trends against the background of baseline trends. Drivers for these trends are interconnected, but ultimately can be traced back to socioeconomic circumstances. The region has experienced population growth between 1900-2020, with Monroe, Warrick, Dubois and Lawrence counties the primary growth centers. Crawford, Martin, Perry and Spencer counties each have experienced a steady decline in population while population in Daviess, Greene, Pike and Orange counties has been relatively steady. The largest growth period for the region was between 1950-2000. During this period only Martin and Pike counties experienced population loss. The period between 2000-2020 showed a change from the prior 50 years. During this period half of the Study Area counties had population declines. Currently (2020 data) shows the 12-county Study Area with a population of approximately 448,000. More than half of this population is in Monroe, Lawrence and Warrick counties.

Following national trends, population growth in the Study Area has typically occurred around major regional population centers with smaller communities declining. Farming has historically been a primary economic driver for the Midwest. While farming will remain a key economic driver, this sector has become industrialized and shifted from a high number of producers with low commodity volume to a low number of producers with high commodity volume. Innovations in equipment and technology have maintained consistent year-over-year improvements in productivity. The most profitable activities are cultivation of row crops on prime farmland soils. As productivity increases, crop production increases and drives down the commodity prices. Technology has provided improvements, but the cost of equipment associated with the technological gains has required larger farming operations to support the asset investment. These combinations have served to consolidate farms and shift the price point for planting lands with marginal soils. Between 1960 and 2015 the total number of farmers in the U.S. fell by half while the average farm size grew significantly.

The Study Area was historically forested with those lands cleared for agricultural purposes as settlement occurred. A substantial portion of the soils in the Study Area are not prime farmland on relatively small plots. The historical and forecasted trends for further reduction of agricultural lands fit within this profile. Alternatively, the price for timber has steadily increased. Allowing marginal grounds to reforest provides other financial opportunities for landowners including tax incentives, hunting leases and eventual timber harvest.

Each of these resources are connected socioeconomically in the following ways:

- **Agriculture**. Farms are reducing in size as individual operations are becoming larger and consolidating around properties with prime farmland soils. Marginal lands are being converted to other uses and taken out of production. As less opportunities are available for smaller operators, population movement for employment is incentivized, and rural areas become ‘more rural’. The net effect is the reduction of agricultural lands.

- **Forest**. The consolidation of farming operations away from historically forested lands incentivizes either the active planting or allowing natural succession to reforest lands formerly in row crop production. The net effect is the opportunity for the increase in forested lands.
- **Wetlands**. Many agricultural lands in the Study Area are on active or formerly active floodplains. Some land no longer is a floodplain due to the construction of levees to protect the land from flooding. The floodplain areas typically were modified and require various management activities to provide proper drainage to use in row crop production. As these areas are removed from production, the maintenance activities are stopped and the opportunity for hydric conditions to return increase. The reduction in active farms and employment opportunities outside of regional metropolitan centers remove the threat of residential development or other urbanization actions. The net effect is the opportunity for increases in wetlands.
- **Streams**. The Study Area is in a low population density setting with limited potential for urbanization activities. The rural setting has limited manufacturing/industrial point sources for pollutants. Farming operations are currently providing the dominant non-point pollutant sources. Reductions in farming activity, removal of marginal grounds from production and the corresponding potential for an increase in forest land and wetlands reduce the non-point source pollutant loads. The net effect is the opportunity for an increase in water quality of surface water runoff reaching the receiving streams.
- **Karst**. This resource is highly sensitive to surface water runoff infiltrating and polluting groundwater. Identical to streams, the opportunity for improvement of surface water runoff is positive overall; however, the risks for a specific incident of accidental release of pollutants to any single karst feature remains consistent.

3.6.3.9 Determine the magnitude and significance of cumulative effects by identifying the changes as a result of the Mid-States Corridor

Forecasted direct and indirect impacts of the Mid-States Corridor are calculated as changes to the No-Build Alternative. Incremental "other actions" were evaluated and added to the direct and indirect impacts to calculate the reasonably foreseeable cumulative effects. These were reviewed to determine whether these effects are significant, either as beneficial or adverse. The impacts were calculated using GIS and the economic and transportation planning modeling combination. Tables detailing these calculations can be found in **Appendix Q**. Traffic Analysis Zones (TAZs) were used to analyze the potential indirect impacts from induced growth caused by the Mid-States Corridor. These cumulative impacts can be found in **Table 3.6-1** and summarized as:

- **Farmland.** Direct impacts ranged from approximately 1,100 acres from Alternatives C and O, to 1,800 from B, M and P. Very minimal acreage was estimated to be lost as a result from induced growth from any of the alternatives. Alternatives B, C, M, and O each had less than 10 acres of indirect impacts; Alternative P had the most indirect impacts but yielded only a range of 14-17 acres. Incremental impacts from Other Projects were estimated at 1,000 acres and were applied consistently to all alternatives. The cumulative impacts ranged from near 2,100 to 3,000 acres of impacts with Alternatives C and O performing similarly and Alternatives B, M and P performing similarly. The forecast for farmland in the Study Area is to be reduced by an additional 300,000 acres by 2045; the cumulative impacts for farmland are not significant in relationship to effects of the Mid-States Corridor.
- **Forests.** Direct impacts ranged from approximately 300 acres from Alternative B to nearly 2,300 acres from Alternative M. Very minimal acreage was estimated to be lost as a result from induced growth from any of the alternatives. Alternatives B, C, M and O each had five or less acres of indirect impacts, and Alternative P only had approximately 10 acres. Incremental impacts from Other Projects were estimated to impact an additional 150 acres of forest. These were applied consistently to all alternatives. The cumulative impacts ranged from near 500 to 2,400 acres of impacts with alternatives ranging from least to greatest impacts

in the order of B, C, P, O and M. The forecast for forest land in the Study Area could not be quantified but was projected to increase for the region. The direct impacts far exceed indirect impacts and the impacts of Other Projects. Alternative M and O have greatest acreage impacts. This metric may be less important in comparing them from the other alternatives than the impacts they have on core forests and the value of certain impacted forest areas to protected species along their routes. See discussion regarding (core forests in **Section 3.21**. The cumulative effects for forests do not generate significantly more impacts than the direct impacts.

- **Wetlands.** Direct impacts ranged from approximately 40 acres from Alternative P to more than 100 acres for Alternative M. No wetland impacts were attributed to indirect effects. Incremental impacts from Other Projects were estimated at less than 10 acres. These were applied consistently to all alternatives. Alternative P has the potential to have the fewest wetland impacts but performs similarly to Alternatives O and C. Alternative B has the potential to impact between 83-91 acres while Alternative M may impact 105-118 acres. The forecast for trends in wetlands acreage in the Study Area could not be quantified. Wetland acreage has the potential to increase along floodplains where marginal agricultural lands are removed from production and drainage maintenance is reduced on those properties. Regulatory requirements in Indiana will require mitigation for direct impacts to wetlands as part of any selected Build Alternative. This action will generate an offset for the direct impacts caused by the Mid-State Corridor. The cumulative impacts for wetlands are not significant in relationship to the Mid-States Corridor.

- **Streams**. Direct impacts ranged from approximately 23 miles of stream channel from Alternative C to 45 miles for Alternative M. No stream impacts were attributed to indirect effects. Incremental impacts from Other Projects were estimated to be less than two miles of stream channel. These were applied consistently to all alternatives. Impacts to length of stream channel from least to greatest were attributed to Alternatives C, B, P, O and M. Under current regulatory requirements, channelization or other physical modification of waterways will not be allowed without demonstrating the appropriate length, slope and channel shape proposed will maintain stream stability. Proper Best Management Practices must also be deployed during construction to prevent construction sediments from entering the waterways. Some physical disturbance to the streams will occur and some additional sedimentation may be released during storm events during the construction phases, but these impacts are not anticipated to produce a cumulative degradation of water quality to any of the existing 303(d) streams. Regarding the broader water quality of the Study Area, it is forecasted to have farmland removed from production, for forest land to increase, and numerous watershed management/improvement projects to be implemented. These actions should reduce non-point pollutant loads and result in a positive trend for water quality across much of the Study Area. The cumulative impacts for streams are not significant in relationship to the Mid-States Corridor.

- **Karst.** Direct impacts ranged from zero to nearly 100 karst features. Karst areas are limited to the eastern side of the Study Area, and are generally confined to the portions of Alternatives O and M after they continue to the east from their shared alignment with Alternatives C and P. Alternative B is the westernmost alignment and has one karst feature associated with it, a sinkhole. This sinkhole is located outside of karst lithology. No karst impacts were attributed to indirect effects. Incremental impacts from Other Projects were not associated with any specific karst features but were estimated to affect 10 acres of karst. These were applied consistently to all alternatives. The cumulative impacts for karst are not significant in relationship to the Mid-States Corridor.

3.6.3.10 Modify or add alternatives to avoid, minimize, or mitigate significant cumulative impacts

While no significant cumulative impacts have been identified associated with the project, efforts to avoid and minimize impacts to resources of concern have been incorporated throughout the development of alternatives. Refinement of this process will occur throughout this and subsequent Tier 2 NEPA studies and post-NEPA design. These efforts are discussed in the respective resource sections of **Chapter 3** as well as **Chapter 5 – Comparison of Alternatives** and **Chapter 6 – Mitigation and Commitments**. A summary of avoidance and minimization is as follows:

- **Farmland**. Agricultural impacts are not limited to the physical footprint of a roadway project. Alternatives must consider maintaining access for equipment and machinery, maximizing perpendicular crossings to reduce creating point rows, evaluating for landlocked and uneconomic remnants and minimizing conversion of prime farmland soils. Each of these considerations were made in balance with avoidance of other resources within the Study Area. Land use plans and potential areas of induced growth were evaluated to consider access management plans to minimize agricultural impacts. Other Projects were evaluated to determine if the incremental actions would produce significant cumulative impacts. None of the incremental actions were identified as having the potential to produce significant cumulative effects. No specific mitigation was developed for farmland.
- **Forest**. Land cover data and remote sensing techniques were used to develop an inventory of contiguous blocks of forest which had the probability of behaving as core forest habitat. Areas of core forest were avoided to the extent practicable in balance with avoiding other resources. Indirect impacts will be minimized by limiting access points within forested blocks. Other Projects were evaluated to determine if the incremental actions would produce significant cumulative impacts. None of the incremental actions were identified as having the potential to produce significant cumulative effects. Consideration of forest mitigation will be determined in consultation with USFWS during formal consultation on protected species.
- **Wetlands**. Land cover data and wetlands inventory data were used to identify potential locations of wetlands. Wetland areas were avoided to the extent practicable in balance with avoidance of other resources. Indirect impacts will be minimized by limiting access points in or near wetland areas. Other Projects were evaluated to determine if the incremental actions would produce significant cumulative impacts. None of the incremental actions were identified as having the potential to produce significant cumulative effects. Consideration of mitigation will occur during the Tier 2 NEPA studies and during the Clean Water Act Section 404/401 permitting process.
- **Streams**. Hydrographic data were used to identify the locations of potential waterways. Stream channels were avoided to the extent practicable in balance with avoidance of other resources. Where avoidance wasn't practicable, alignments were oriented to impact the channel as close to a perpendicular angle as possible, with stream relocations minimized. Indirect impacts will be minimized by limiting access points in or near stream channels. Other Projects were evaluated to determine if the incremental actions would produce significant cumulative impacts. None of the incremental actions were identified as having the potential to produce significant cumulative effects. Mitigation plans will be developed during the Tier 2 NEPA studies where a detailed compensatory mitigation plan for impacted streams will completed as part of the Clean Water Act Section 404/401 permitting process.
- **Karst**. Lithology and resource agency data were used to identify areas of potential karst and known karst features. Karst features were avoided to the extent practicable in balance with avoidance of other resources. Indirect impacts will be minimized by limiting access points in or near karst features. Other Projects were evaluated to determine if the incremental actions would produce significant cumulative impacts. None of the incremental actions were identified as having the potential to produce significant cumulative effects.

Alternative P, the Preferred Alternative, does not occur within areas of karst. No mitigation for karst is anticipated; however, further detailed studies will occur during Tier 2.

3.6.3.11 Monitor the cumulative effects of the alternatives and provide documentation

This analysis has determined that there will be no significant indirect or cumulative impacts to key resources. Accordingly, no monitoring system is anticipated for these resources. It should be noted that some mitigation commitments detailed in **Chapter 6 – Mitigation and Commitments** will provide for ongoing monitoring of resources associated with commitments.

3.6.4 Summary

The impacts to farmland, forests, wetlands, streams and karst are presented as ranges in **Table 3.6-1**. Each alternative has multiple facility types under consideration. In addition, Alternative P has east and west bypass options around Loogootee. The results of this cumulative impacts analysis indicate that Alternatives B and C would have the lowest cumulative impacts, while Alternatives M and O would have the highest. Alternative P, the Preferred Alternative, has midrange impacts. It also has the potential for the smallest impacts to wetlands. The analysis found no significant indirect or cumulative impacts associated with Alternative P.

Cumulative Impacts*						
Resource Impacts**		B	C	M	O	P
Farmland	Direct (Acres)	1,517-1,764	1,082-1,408	1,465-1,857	1,091-1,381	1,354-1,832
	Indirect	3	5	9	4	14-17
	Mitigation	153 - 171	80 - 105	167 - 200	80 - 102	64 - 107
	Other Projects	1,000	1,000	1,000	1,000	1,000
	Cumulative	**2,673-2,938**	**2,167-2,518**	**2,641-3,066**	**2,175-2,487**	**2,432-2,956**
Forests	Direct (Acres)	306-341	408-536	1,973-2,284	1,572-1,734	613-902
	Indirect	1	1	5	3	8-11
	Mitigation	–	–	–	–	–
	Other Projects	150	150	150	150	150
	Cumulative	**457-492**	**559-687**	**2,128-2,439**	**1,725-1,887**	**771-1,063**
Wetlands	Direct (Acres)	76-84	46-56	98-111	46-55	39-56
	Indirect	0	0	0	0	0
	Mitigation	+186-204	+110-135	+202-235	+113-134	+100-141
	Other Projects	7	7	7	7	7
	Cumulative	**83-91 (impact) +103-113 (offset)**	**53-63 (impact) +57-72 (offset)**	**105-118 (impact) +97-117 (offset)**	**53-52 (impact) +60-72 (offset)**	**46-63 (impact) +54-78 (offset)**
Streams	Direct (Ln Ft)***	145,000-168,900	120,300-152,100	238,300-279,600	182,000-209,700	158,488-207,875
	Indirect	0	0	0	0	0
	Mitigation	BMPs	BMPs	BMPs	BMPs	BMPs
	Other Projects	7,000	7,000	7,000	7,000	7000
	Cumulative	**152,000-175,900**	**127,300-159,100**	**245,300-286,600**	**189,000-216,700**	**165,488-214,875**
Karst	Direct (#)	1	–	92-94	52-70	–
	Direct (Acres)	–	–	474-484	313-465	–
	Indirect (#)	NA	NA	NA	NA	NA
	Indirect (Acres)	NA	NA	NA	NA	NA
	Other Projects (acres)	10	10	10	10	10
	Cumulative (#)	**1**	**–**	**92-94**	**52-70**	**–**
	Cumulative (Acres)	**10**	**10**	**484-494**	**323-475**	**10**

* Tier 1 Alternative impacts are reported in ranges including all the local improvements, facility types and bypass variations.

** Projected impacts to resources by 2045 for the No-Build Alternative derived from Baseline Trend Analysis.

***Denotes estimated linear feet where modification of existing channel would occur but assumes no significant loss of stream length.

Table 3.6-1: Cumulative Impacts by Alternative