



MID-STATES CORRIDOR

APPENDIX H – FOREST IMPACT ANALYSIS

Mid-States Corridor Tier 1 Environmental Impact Statement

Prepared for
Indiana Department of Transportation
Mid-States Regional Development Authority

December 8, 2021

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FOREST IMPACTS DETAILED ANALYSIS

Introduction

The purpose of this section is to provide additional data, graphics, and analyses regarding the potential forest impacts by the project alternatives. While the summary table, Tables 3.21-1 and 3.21-2 in Volume 1, Section 3.21.3 provide an overview of potential direct and core forest impacts for each alternative by range, the tables in this appendix present impacts of the extended alternative sections, variations, and facility types. Because the freeway facility type has been removed from consideration, this analysis will not include discussion of this type. Because no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated, this analysis calculates no impacts to these areas and excludes them from discussion in the analysis.

Impact discussion includes consideration of general (total) forest impacts and 'core' forest impacts. A program was proposed in 1990 by the National Fish and Wildlife Foundation to conserve habitat used by migratory birds which breed in North America but overwinter in the tropics (Finch, 1991). The initiative was proposed due to the observed decline in migratory bird populations nationwide. Research indicated the decline of many of these species is associated with the loss of stable interior forest habitat. Studies conducted in Wisconsin found that the presence of core area was a better predictor of species presence than total area for a subset of neotropical migrants (Temple, 1986). The value of core area is complex and varies by species; however, it is an important factor to evaluate in consideration to forest impacts.

Forest impacts include all forests in the National Land Cover Database (NLCD) land use dataset regardless of type or wetland status. Forested wetlands are analyzed in more detail in Chapter 3.18. Forest impacts will duplicate some forests discussed in the wetlands chapter; however, the impacts of the two chapters are NOT additive. The distribution of forests in the study area is depicted in **Figure 1**.

Alternatives B, C, M, and O have one centerline with two working alignments to reflect two possible facility types, Super-2 or expressway. Expressway facilities generally require more right-of-way (ROW) than Super-2 facilities, and thus will have more impacts for the same centerline location.

Alternative P has two bypass options consisting of an east and west Loogootee bypass, which causes it to have the greatest range of impacts. The two Loogootee bypass option centerlines each have two facility type working alignments, expressway and Super-2. **Table 1** shows the comparison of length and area of these new alignments, centerlines, and variations.



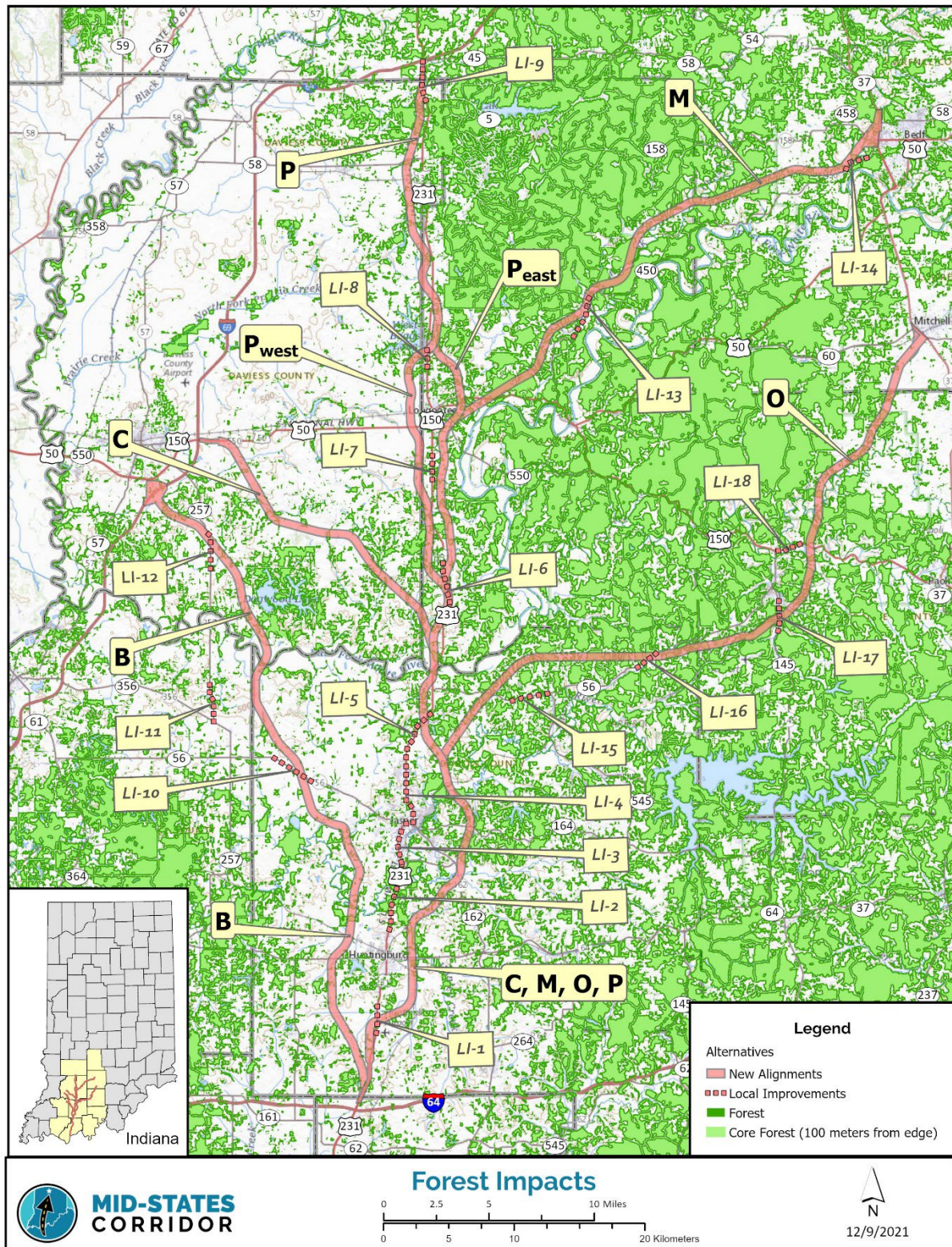
TABLE 1: WORKING ALIGNMENT AREA AND DISTANCE

Routes*			Section 2		Section 3		Total Alternative	
Name	Facility Type	Alignment ID	ROW (Acres)	Centerline (Miles)	ROW (Acres)	Centerline (Miles)	Total ROW (Acres)	Centerline (Miles)
B	Expressway	B2	1,152	23	1,096	10	2,248	33
	Super-2	B3	915	23	1,027	10	1,941	33
C	Expressway	C2E	1,243	23	889	17	2,132	40
	Super-2	C3E	897	23	731	17	1,628	40
M	Expressway	M2E	1,242	23	3,210	57	4,453	80
	Super-2	M3E	897	23	2,794	57	3,691	80
O	Expressway	O2E	1,222	23	2,121	59	3,343	82
	Super-2	O3E	941	23	1,834	60	2,775	82
P	Expressway	P2Ee	1,243	23	1,599	31	2,842	54
	Super-2	P3Ee	897	23	1,299	31	2,196	54
	Expressway	P2Ew	1,243	23	1,516	31	2,759	54
	Super-2	P3Ew	897	23	1,209	31	2,105	54

**This table presents only the areas associated new alignment; associated local improvements are excluded from these totals. See Table 12 for additives to determine total impact of each alternative.*



FIGURE 1: FOREST AND CORE FOREST IDENTIFICATION



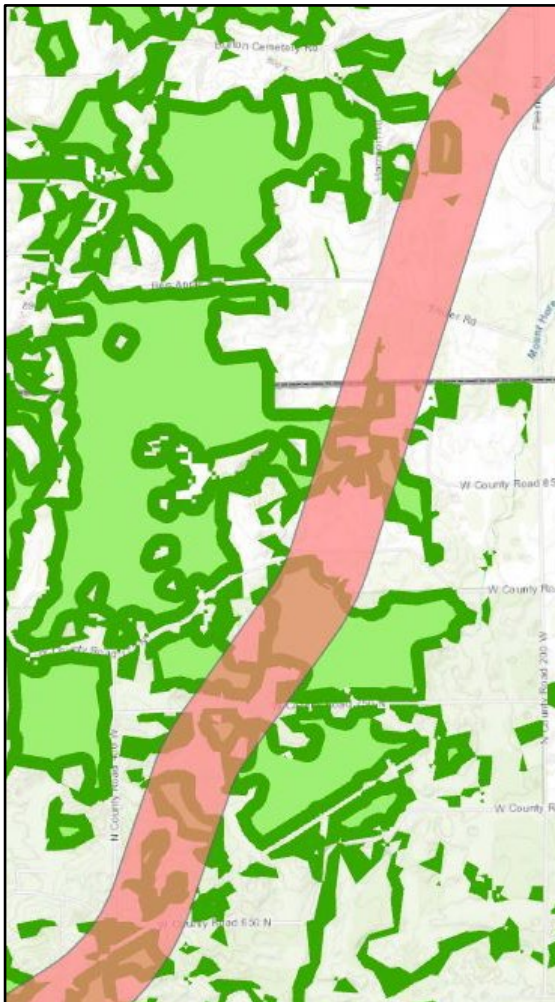


Methodology

Core Forest

Core Forest analysis is complex and requires an understanding of terms and context. The NLCD GIS data was used to create a single forest dataset (a single layer not subdivided into forest types). This layer was then updated with aeriels and used as the baseline for analysis. Limitations are present with the use of this data as it has a 30-meter resolution which produces a coarse boundary. Additionally, it was classified with unsupervised algorithms from satellite photography. This combination serves to reduce the accuracy and the layer should only be considered a generalization, sufficiently representing large areas of resource, but not suitable for high accuracy delineation and calculations. Despite these limitations, equal analysis across all alternatives using this methodology provides a fair comparison to establish comparison for the magnitude of impacts between alternatives. Tier 2 studies will likely require a better resolution data source with field verification of forests for more detailed and accurate studies.

FIGURE 2: EXAMPLE OF CORE FOREST OUTPUT



The light green areas within the dark green bands represent the core forest areas of the forest blocks

Core forest is defined as interior forest that is a least one acre in size and is 100 meters inside the edge of the forest around it. Using this definition, the forest base layer polygons were buffered inside their boundaries by 100 meters, creating a core forest base layer (**Figure 2**). This data is referred to as “existing core forest”. To analyze the effect of build alternatives both directly and from fragmentation, the forest base layer was recreated with the alternative ROWs erased away and the core buffers recreated as if forests within the alignments had been removed. This data is referred to as “remaining core forests”.

This analysis was performed both for existing and build alternatives to create the comparison. Loss of core forest can occur either by an alignment directly bisecting the core area or indirectly from an alignment shifting the 100-meter boundary area. The volume of core forest calculated as impacts included both scenarios as the analysis recalculated the boundary zones. To provide context to the existing landscape, the acres of total loss for core forest was divided by the existing core forest acres to get the percentage of the area core forest lost in a build scenario for each alternative.

Resource Analysis

Alternative B

Alternative B is unique that it has almost no overlap with any other alternative in Sections 2 or 3 as it is the only alignment with a western corridor around Huntingburg and Jasper. Negligible overlap is present where the alternatives separate from US 231 at the southern start of section 2. As a result, the comparison of forest impacts of Alternative B does not need to consider areas of common alignment. The totals of Alternative B fairly represent this alternative as an independent area (**Table 2**).

Alternative B has the least percentage of existing forest in the alignment ROWs and the least forest impact of any alternative. Alternative B crosses ecoregions with flat to rolling topography and deep soils which result in much of the ROW land use already converted for development, agriculture, or coal extraction.

Section 3 is similar in total ROW acreage to Section 2 despite being half as long (**Table 1**). The area of Section 3 near I-69 accounts for more than half of the impacts. This is the result of the presence of more major streams and floodplains, including the East Fork White River, Aikman Creek, and Veale Creek.

As expected, the expressway facility has a slightly higher impact to forest than Super-2 due to its larger ROW and larger connections to state roads. Section 2 has 17 more acres of forest impact in expressway than Super-2, while Section 3 has 18 more acres, for a total of 35 more acres of impact in the expressway facility alignment as compared to the Super-2 facility alignment.

TABLE 2: ALTERNATIVE B FOREST IMPACTS

Alternative*			Section 2		Section 3		Total	
Name	Facility	Alignment ID	Forest (acres)	% Section Forested	Forest (acres)	% Section Forested	Forest (acres)	% Forested
B	Expressway Super-2	B2	131	9%	216	19%	347	14%
		B3	114	10%	198	19%	312	14%
*Includes impacts from the route and local improvements								

Of the forest directly lost in the working ROW, three percent is core habitat. While twice the amount of forest overall occurs in Section 3, the majority of core forest impacts is in Section 2 (**Table 3**), associated with forests near the Patoka River. In Section 3, the core areas affected are associated with Veale Creek.

Two core forest blocks will be removed completely. While Alternative B experiences less new impact to core forest because its existing forest is already largely converted and fragmented, these may be locally important due to the distance from other core forest areas. In section 3, total core forest impacts result in the loss of 22% of the core forest currently existing in the Section 3 ROW area.



TABLE 3: ALTERNATIVE B CORE FOREST IMPACTS

Alternative B						
Variation	Existing Core Forest Connected to the Working Alignment (Acres)	Remaining Core Forest After Action and Edge Refinement (Acres)	Direct Take of Core Forest (Acres)	Total Loss of Core Forest (Acres)	% Loss of Core Forest from Existing Core Forest	Loss of Core Forest (Block Count)
Section 2						
B2 Expressway	338	309	11	28	8%	2
B3 Super-2	338	310	9	29	9%	2
Section 3						
B2 Expressway	53	41	2	12	23%	0
B3 Super-2	53	42	2	11	21%	0
Total						
B2 Expressway	391	350	13	42	11%	2
B3 Super-2	391	352	10	39	10%	2

Alternative C

Alternatives C, M, P, and the majority of Alternative O share the same ROW throughout Section 2; however, Alternative C has more direct forest impacts within Section 2 in comparison. The Section 2 eastern bypass of Jasper and Huntingburg (Alternatives C, M, P, and O) passes through the Southern Bottomlands natural region with a number of forested river floodplains. It is also on the edge of the Crawford Upland natural region, which has more topographic relief and less conversion of forests to other uses. A sizable area of forest is impacted between SR 162 and SR 164 by this alternative.

Section 3, beginning at the Eastern Fork of the White River, turns west toward Washington, traversing the Glaciated natural region, which has been largely converted to agricultural use, and therefore has fewer forest impacts. Alternative C Section 3 crosses less floodplain area with less floodplain forest than Alternative B, and as a result has lower Section 3 expressway impacts in comparison. However, the higher impacts of Section 2 make the overall Alternative C forest impacts 1.5 times larger than Alternative B.

As expected, the expressway facility has greater impacts due to its wider ROW and larger connections at existing road crossings. Most of the difference between the expressway and Super-2 forest impacts occurs within Section 2 (**Table 4**), where more forest is prevalent.



TABLE 4: ALTERNATIVE C FOREST IMPACTS

Alternative*			Section 2		Section 3		Total	
Name	Facility	Alignment ID	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Forested
C	Expressway Super-2	C2	380	25%	176	20%	556	23%
		C3	281	24%	143	20%	424	22%
*Includes impacts from the route and local improvements								

Of all forest lost to direct take in Alternative C, 12 percent is core forest habitat. Consistent with the characterization of forests in Alternative C, 89 percent of the available core forest habitat connected to the working alignment ROW is in Section 2 and accounts for the majority of impacts. Impacts include the complete loss of seven core blocks. However, these impacts comprise only 0.5 percent of the core forest available in the area. In Section 2, notable areas of impact include the fragmentation of a large contiguous forest between SR 162 and SR 164, and the complete removal of a sizable core habitat in the area of Little Creek near Haysville.

The expressway facility core forest loss was attributed to approximately 50 percent direct take and 50 percent fragmentation. The Super-2 facility has fragmentation accounting for more core forest loss with 40 percent direct take loss and 60 percent fragmentation loss.

In Section 3, the impact is less, but represents a much larger percentage (19-21 percent) of the core habitat available than Alternative B (Table 5).

TABLE 5: ALTERNATIVE C CORE FOREST IMPACTS

Alternative C						
Variation	Existing Core Forest Connected to the Working Alignment (Acres)	Remaining Core Forest After Action and Edge Refinement (Acres)	Direct Take of Core Forest (Acres)	Total Loss of Core Forest (Acres)	% Loss of Core Forest from Existing Core Forest	Loss of Core Forest (Block Count)
Section 2						
C Expressway	603	501	45	103	17%	6
C Super-2	603	510	30	93	15%	6
Section 3						
C Expressway	76	36	22	40	53%	1
C Super-2	76	39	20	37	49%	1
Total						
C Expressway	679	537	67	143	21%	7
C Super-2	679	549	50	130	19%	7



Alternative P

Alternative P has the same alignment as Alternative C and Alternative M for Section 2. The discussion regarding Section 2 impacts of Alternative C applies also to Alternative P. Section 3 contains the differences in these alternatives for comparison. Alternative P Section 3 has two bypass variations compared for forest impacts (**Table 6**). The expressway alignment taking an east bypass around Loogootee has the highest forest impacts in Alternative P Section 3. The alignments taking a west bypass around Loogootee have roughly 100 acres less impacts. The two bypass options follow the same alignment except where they split to bypass Loogootee from CR 800 S in the south to east of West Boggs Lake in the north. These non-overlapping sections comprise roughly 12 miles of Section 3 measuring 500 – 650 acres, or 23 percent of the total alternative for each alternative. Differences between the two bypass options occur in these independent sections.

Both bypass options traverse scattered forests, with the east bypass crossing more floodplain forests. Much of the larger forest impact of the eastern bypass is in areas associated with Haw Creek, Friends Creek, West Boggs Creek, and the drainages of the East Fork of the White River. Consistent with the observations of all alternatives, expressway variations impact 107 - 130 acres more forest than Super-2 variations due to the wider ROW and larger connections.

The Alternative P variations impact a large block of contiguous forest associated with First Creek, at the northern end of the alternative; and include forest impacts to the Gantz Woods Nature Preserve managed by The Nature Conservancy.

TABLE 6: ALTERNATIVE P FOREST IMPACTS

Alternative*			Section 2		Section 3		Total	
Name	Facility	Alignment ID	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Forested
P	Expressway	P2east	380	25%	542	32%	923	29%
	Super-2	P3east	281	24%	455	32%	737	25%
	Expressway	P2west	380	25%	411	25%	791	29%
	Super-2	P3west	281	24%	348	26%	629	25%
*Includes impacts from the route and local improvements								

The majority of the core forest impacts occur in Section 3 (60-72 percent). Section 2 impacts are identical to Alternative C and M, and the same for all Alternative P variations. Notable areas of impact include the fragmentation of a large contiguous forest between SR 162 and SR 164, and the complete removal of a sizable core habitat in the area of Little Creek near Haysville.

Similar to the trends in forest impacts, core forest impacts are roughly 100 acres more in the Alternative P eastern bypass options (**Table 7**). All alternatives impact a core area just north of the East Fork White River. The independent segment containing only the western bypass alignments impact one large core forest south of West Boggs Lake. The independent segment with only the eastern bypass alignments impact two large core forests, one near Haw Creek, and one complex near the White River south of US 50. The four bypass variations impact a large, contiguous core forest associated with First Creek at the northern end of the alternative. Differences in core forest impacts between facility types, expressway



and Super-2, are very small. Core forest losses are attributed to 40-45 percent direct loss and 55-60 percent fragmentation loss.

TABLE 7: ALTERNATIVE P CORE FOREST IMPACTS

Alternative P						
Variations	Existing Core Forest Connected to the Working Alignment (Acres)	Remaining Core Forest After Action and Edge Refinement (Acres)	Direct Take of Core Forest (Acres)	Total Loss of Core Forest (Acres)	% Loss of Core Forest from Existing Core Forest	Loss of Core Forest (Block Count)
Section 2						
P Expressway East	603	501	45	102	17%	6
P Super-2 East	603	501	30	93	15%	6
P Expressway West	603	510	45	102	17%	6
P Super-2 West	603	510	30	93	15%	6
Section 3						
P Expressway East	1073	820	114	253	24%	4
P Super-2 East	1073	834	100	239	22%	4
P Expressway West	863	710	66	153	18%	1
P Super-2 West	863	721	62	142	16%	1
Total						
P Expressway East	1676	1,321	160	355	21%	10
P Super-2 East	1676	1,344	130	332	20%	10
P Expressway West	1466	1,211	111	255	17%	7
P Super-2 West	1466	1,231	92	235	16%	7

Alternative M

Alternative M is one of the longest alternatives and has the largest forest impact of any alternative (**Table 8**). Alternative M shares all of Section 2 with Alternative C and Alternative P, and shares roughly 12 of its 57 miles in Section 3 with Alternative P (from the East Fork White River to Loogootee). The discussion regarding Section 2 impacts of Alternative C applies also to Alternative M. Alternative M Section 3 is located in the forested Crawford Upland and Escarpment natural regions. The rugged topography and thin karst region soils makes the land less suitable for development and agriculture, meaning it is less likely to be converted to other land uses. Approximately 60 percent of Alternative M, Section 3 is forested. Roughly 85 percent of the Alternative M forest impacts occur in Section 3. As expected, the expressway variation has a larger impact due to a wider ROW design (14 percent). Alternative M impacts roughly 650 acres of forest in a tract of the Martin State Forest near Bear Hill Road and Indian Creek.



TABLE 8: ALTERNATIVE M FOREST IMPACTS

Alternative*			Section 2		Section 3		Total	
Name	Facility	Alignment ID	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Forested
M	Expressway	M2	380	25%	1,931	57%	2,311	47%
	Super-2	M3	281	24%	1,713	58%	1,994	48%
*Includes impacts from the route and local improvements								

The forest impacts of Alternative M are comprised of 25 percent core forest habitat. Section 2 core forest impacts are the same as those for Alternative C and Alternative P. Comparing the alternative sections, 90 percent of the impacts to core forest occur in Section 3, a similar trend to forest impacts at large. The expressway option impacts 7 percent more core forest than the Super-2 option, due to larger ROWs. Roughly half the core forest loss is from direct take, and half from fragmentation. The loss of core forest reduces core areas along the alternative by 24 percent (**Table 9**). The forest impacts to the Martin State Forest are core forest impacts which fragment a large block of core habitat into three pieces.

TABLE 9: ALTERNATIVE M CORE FOREST IMPACTS

Alternative M						
Variations	Existing Core Forest Connected to the Working Alignment (Acres)	Remaining Core Forest After Action and Edge Refinement (Acres)	Direct Take of Core Forest (Acres)	Total Loss of Core Forest (Acres)	% Loss of Core Forest from Existing Core Forest	Loss of Core Forest (Block Count)
Section 2						
M Expressway	603	501	45	103	17%	6
M Super-2	603	510	30	93	15%	6
Section 3						
M Expressway	4,263	3,164	528	1,100	26%	12
M Super-2	4,263	3,232	453	1,031	24%	12
Total						
M Expressway	4,867	3,664	573	1,202	25%	18
M Super-2	4,867	3,746	484	1,124	23%	18

Alternative O

Although Alternative O, located in the forested Crawford Upland and Escarpment, is the longest alternative, it has the second largest forest impacts (**Table 10**). It affects 400 – 550 less forested acres than Alternative M. Alternative O shares 78 percent of Section 2 with Alternatives C, M, and P from I-64 to CR E 400 N, where it then branches off to the east toward SR 56.



Alternative O Section 2 has 323 - 403 acres of forest impacts, of which 97-112 acres occur within Alternative O Section 2 alignments that do not duplicate any other alternative. Alternative O Section 3 has 75 - 78 percent of the forest impacts of Alternative O. The Section 3 working ROWs are 61 - 65 percent forested. The expressway alignment has 10 percent greater impacts than the Super-2 alignment due to a slightly wider ROW in certain areas. Although the two facility options have different designs for connecting to SR 37, these differences do not affect forest impact totals as they occur in an already developed area where little tree cover is present.

TABLE 10: ALTERNATIVE O FOREST IMPACTS

Alternative*			Section 2		Section 3		Total	
Name	Facility	Alignment ID	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Section Forested	Total Forest (acres)	% Forested
O	Expressway	O2	403	27%	1,353	61%	1,756	47%
	Super-2	O3	323	27%	1,265	65%	1,588	50%

**Includes impacts from the route and local improvements*

The forest impacts associated with Alternative O consist of 29 percent core forest habitat. Section 2 core forest impacts are the same as those for Alternative C, M and P south of CR E 400N. In the remaining four miles of Alternative O Section 2, the only notable core forest is just southwest of SR 56. Section 3 contains 89 percent of the impacts to core forest habitat, while Section 3 contains 77 - 80 percent of all forest in the alternative. The expressway option impacts 4 percent more core forest than the Super-2 option, due to a slightly larger ROW. Roughly half the core forest loss is from direct take, and half is from fragmentation. The loss of core forest reduces core areas along the alternative by 22 - 23 percent. (Table 11).

TABLE 11: ALTERNATIVE O CORE FOREST IMPACTS

Alternative O						
Variations	Existing Core Forest Connected to the Working Alignment (Acres)	Remaining Core Forest After Action and Edge Refinement (Acres)	Direct Take of Core Forest (Acres)	Total Loss of Core Forest (Acres)	Loss of Core Forest (% of Core Forest in the Area)	Loss of Core Forest (Block Count)
Section 2						
O Expressway	647	528	50	119	18%	4
O Super-2	647	540	42	107	17%	4
Section 3						
O Expressway	3,950	3,025	459	926	23%	12
O Super-2	3,950	3,049	427	902	23%	12
Total						
O Expressway	4,597	3,552	509	1,045	23%	16
O Super-2	4,597	3,588	468	1,009	22%	16



Local Improvements

Direct forest loss and total core forest loss within the ROW of the alignments' local improvements are presented in **Table 12**. Local Improvement 2 has notably higher impacts compared to other locations for both direct and core forest impacts. Local Improvement 6 also has higher direct impacts compared to other locations.

TABLE 12: LOCAL IMPROVEMENT FOREST IMPACTS

Local Improvements*				Forest Impacts (Acres)	
LI-#	Existing Road	Alternatives	Section	Direct Forest Impacts	Core Forest Loss
LI-1	US 231	B, C, M, O, P	2	10	0
LI-2	US 231	B, C, M, O, P	2	229	5
LI-3	US 231	B, C, M, O, P	2	1	0
LI-4	US 231	C, M, O, P	2	0	0
LI-5	US 231	C, M, O, P	2	44	1
LI-6	US 231	M, P	3	171	0
LI-7	US 231	M, P	3	11	0
LI-8	US 231	P	3	7	0
LI-9	US 231	P	3	10	0
LI-10	SR 56	B	2	5	0
LI-11	SR 257	B	2	7	0.4
LI-12	SR 257	B	3	2	0.3
LI-13	SR 450	M	3	47	1
LI-14	SR 450	M	3	37	2
LI-15	SR 56	O	3	19	0
LI-16	SR 56	O	3	16	0
LI-17	SR 145	O	3	11	0
LI-18	US 150	O	3	5	0

* Local Improvements are associated with the alternative and do not change for variations within alternatives.

Summary

Alternative B has the lowest forest and core forest impacts. Alternative C is the next lowest. Section 3 of these alternatives occur in a landscape where most forest land has already been converted to other uses. The primary difference in the amount of impact between Alternative B and C is attributed to Section 2, which traverses very different landscapes. Alternative B Section 2 is an area that is mostly agricultural, while Alternative C crosses more floodplain forest and forest uplands. Northwestern Family alternatives have few impacts on core forests.

Preferred Alternative P has total forest impacts that are the median of all the alternative impact values. Its Section 2 impacts are identical to those of Alternative C and M. Alternative P has total impacts 200 -



350 acres higher than Alternative C, but 1250 – 1500 acres less than Alternative M. Alternative P variations impact one large area of core forest just south of I-69 near Crane / First Creek.

The Northeastern Family, Alternatives M and O, are 50 percent forested in Section 3 which is twice the percentage of other alternatives. Forest impacts for Alternative M and Alternative O are three to eight times higher than other alternatives. These alternatives occur in the Crawford Upland and Escarpment, where steep topography and shallow soils has reduced conversion for development and farming. Alternatives M and O are 82 miles long in Sections 2 and 3. They are the longest in the study area by more than 30 miles, with the next longest being Alternative P at 55 miles. Alternatives M and O impact many large blocks of core forest, which accounts for 22 - 29 percent of the total forest loss in the alternative.