APPENDIX CC

INDIRECT IMPACT ANALYSIS

ANALYSIS OF INDIRECT IMPACTS

The analysis of indirect impacts in the FEIS for I-69 Sections 1, 2 and 3 determined that all induced growth (growth attributable to that Section of I-69, which would not occur in the absence of the project) would impact existing agricultural or "other" land, as defined in the Year 2001 National Land Cover Data (NLCD) set.[1] As documented in Section 5.24.1 of this EIS, the I-69 EISs includes the following NLCD categories under "agricultural or other land":

- Cultivated Crops
- Pasture/Hay
- Grassland/Herbaceous
- Shrub/Scrub
- Barren Land (Rock/Sand/Clay)

Table 1 shows the breakdown of land use for all TAZs in Gibson, Pike and Daviess counties for which induced growth is forecasted for the projects in Sections 1 through 3.

TABLE 1 - DEVELOPABLE LAND BREAKDOWN, TAZs IN GIBSON, PIKE AND DAVIESS COUNTIES WITH INDUCED GROWTH								
		TAZs with Induced Development - Acreages/% Breakdown in County						
County	**Source**	**Developed**	**Unusable**	**Ag/Other in Floodplain**	**Available Ag/Other**	**Forest in Floodplain**	**Available Forest**	**Total TAZ Acres**
Gibson	Section 1 FEIS, Table 5.24-1	320	12	26	2,151	22	489	3,020
		11%	0%	1%	71%	1%	16%	
Pike	Section 2 FEIS, Table 5.24-1	870	7	150	4,481	49	1,095	6,652
		13%	0%	2%	67%	1%	16%	
Daviess	Section 3 FEIS, Table 5.24-1	1,097	3	18	7,054	11	1,012	9,195
		12%	0%	0%	77%	0%	11%	
Total, Gibson, Pike & Daviess counties		***2,287***	***22***	***194***	***13,686***	***82***	***2,596***	***18,867***
		12%	***0%***	***1%***	***73%***	***0%***	***14%***	
Ratio, Available Ag/Other Land to Available Forest Land					5.27			

Table 1 illustrates that in the TAZs in these counties which are forecasted to have induced growth due to I-69, available agricultural or other "open" land heavily predominates, by comparison to forested acreage. Nearly three-quarters of ***all*** land in these TAZs is open (non-

[1] National Land Cover Data (NLCD) is a land-cover data set for the United States. It is produced by the Multi-Resolution Land Characteristics Consortium (MRLC), made up of federal government agencies. The agencies which participated in the formulation of the 2001 National Land Cover Data include U.S. Environmental Protection Agency; U.S. Department of Commerce (National Oceanic and Atmospheric Administration); National Aeronautic and Space Administration; U.S. Department of the Interior (Bureau of Land Management, National Park Service, Fish and Wildlife Service, Office of Surface Mining Reclamation and Enforcement, and U.S. Geological Survey); and U.S. Department of Agriculture (Forest Service and Natural Resources Conservation Service). It is the best available source for comprehensive land use data for the United States. A 2006 update is under preparation, but not yet available for use. For additional information about the MRLC or NLCD, see http://www.epa.gov/mrlc/

forested) land suitable for development. Non-forested open land suitable for development is over 5 times more prevalent than forested land which also is suitable for development.

Section 4 (Monroe and Greene counties) is much more heavily forested than Sections 1 through 3. The assumption that forested land would not be impacted by indirect development is not applicable to Section 4. Table 2 shows the same breakdown of land use in the 51 TAZs in Greene County and 4 TAZs in Monroe County which are forecasted to receive induced development due to I-69, and which are analyzed as part of the Section 4 project.

TABLE 2 - DEVELOPABLE LAND BREAKDOWN, TAZs IN GREENE AND MONROE COUNTIES WITH INDUCED GROWTH								
		TAZs with Induced Development - Acreages/% Breakdown in County						
County	Source	Developed	Unusable	Ag/Other in Floodplain	Available Ag/Other	Forest in Floodplain	Available Forest	Total TAZ Acres
Greene (51 TAZs)	Section 4 DEIS, Table 5.24-1	2,434	19	607	17,993	1,553	50,438	73,044
		3%	0%	1%	25%	2%	69%	
Monroe (4 TAZs)		127	-	32	282	35	302	778
		16%	0%	4%	36%	4%	39%	
Total, Greene and Monroe counties		***2,561***	***19***	***639***	***18,275***	***1,588***	***50,740***	73,822
		3%	0%	1%	25%	2%	69%	
Ratio, Available Ag/Other Land to Available Forest Land					0.36			
Note: Monroe County totals include only those TAZs which are part of the Section 4 project.								

The land use in these TAZs is nearly the reverse of that in Gibson, Pike and Daviess counties. Here, more than two-thirds of ***all*** land in these TAZs is forested land suitable for development. By comparison, only one-quarter of all land in these TAZs is open (non-forested) land suitable for development. Forested land suitable for development is nearly three times as prevalent as open (non-forested) land suitable for development.

In the Section 3 FEIS, there were 12 TAZs in Greene County (in the vicinity of the US 231 interchange) which were considered in its analysis of indirect impacts. The Section 3 FEIS stated that there would be no induced development which would impact forested acreage in these TAZs. The discussion which follows illustrates that for this portion of Greene County, this conclusion is reasonable.

In these 12 TAZs, 25 acres of induced development was forecasted by 2030. This development was heavily concentrated in 3 TAZs (2800514, 2803203, and 2803204). Twenty-two (22) of the 25 acres of induced development is forecasted to occur in these three TAZs. Table 3 shows the breakdown of land use in these three TAZs. They have more open (non-forested) land suitable for development than forested land. However, the amount of open land is only marginally greater than the amount of forested land.

TABLE 3 - DEVELOPABLE LAND BREAKDOWN, US 231 TAZs IN GREENE COUNTY WITH INDUCED GROWTH							
County	**Developed**	**Unusable**	**Ag/Other in Floodplain**	**Available Ag/Other**	**Forest in Floodplain**	**Available Forest**	**Total TAZ Acres**
2800514	32	0	0	130	0	12	174
	18%	0%	0%	75%	0%	7%	
2803203	41	0	0	162	0	260	463
	9%	0%	0%	35%	0%	56%	
2803204	17	0	12	46	5	15	95
	18%	0%	13%	48%	5%	16%	
Total - US 231 TAZs	***90***	***-***	***12***	***338***	***5***	***287***	***732***
	12%	***0%***	***2%***	***46%***	***1%***	***39%***	
Ratio, Available Ag/Other Land to Available Forest Land					1.18		
Note: These 3 TAZs are forecasted to have 88% of induced growth of Greene County TAZs near US 231 interchange (22 of 25 acres)							

The remaining 9 TAZs (of the 12 Greene County TAZs located near the US 231 interchange) were forecasted to have 1 added household (in 7 of the 9 TAZs) or 2 added households (in 2 of the 9 TAZs). These added households have a forecasted impact per TAZ of 0.3 acres (1 household) or 0.5 acres (2 households). These impacts are negligible, and there is ample open land in these TAZs to accommodate this development.

To reaffirm that forest impacts due to induced development would be negligible in these three Greene County TAZs near US 231 (which are forecasted to have nearly all the induced growth in this part of Greene County), the development in these three TAZs was reviewed during the ten year period between 1998 and 2008. ArcMap Geographic Information Systems (GIS) software was used in the analysis. Year 1998 aerial photographs were compared to Year 2008 aerial photographs in order to identify land use changes due to development. "Development" included houses or other buildings, driveways, barns, roads, ponds, parking areas, mining, or tree clearing. Development activities were digitized into a shapefile for each TAZ. Development was categorized by the land use observed in the 1998 aerial photo as impacting either "forest" or "other." Year 2005 aerial photographs were also consulted because they were taken "leaf off" (when no leaves are on trees), while the 2008 aerial photos were taken "leaf on." Land use often was easier to discern in the "leaf off" photos. However, the 2008 aerial photographs were the ultimate authority for assessing development.

The total acreage of development between 1998 and 2008 was calculated for each TAZ using ArcMap software. The amount of this acreage which occurred to forested land also was calculated. Using these calculations, the amount and percentage of development which occurred on forested land was calculated for each TAZ. These results are shown in Table 4.

TABLE 4 - 1998 - 2008 DEVELOPMENT IN US 231 TAZs IN GREENE COUNTY						
TAZ	Growth, 1998 - 2008					Forecasted 2030 Induced Growth (Acres)
	Acres			Percentage		
	Forest	Agriculture	Total	Forest	Agriculture	
2800514	0	0	0	N/A	N/A	5.5
2803203	0.6	4.9	5.5	11%	89%	11.1
2803204	0	0.1	0.1	0%	100%	5.5
Total	***0.6***	***5.0***	***5.6***	***11%***	***89%***	***22.1***

Nearly all the actual development over the last 10 years (89%) occurred in non-forested areas; only 0.6 acres (11%) impacted forested land. Essentially all of this development occurred in TAZ 2803203, in which 56% of land (260 acres) is forested land suitable for development; by comparison, 35% of land (162 acres) is open land suitable for development (see Table 3). In the other TAZs in this vicinity in which significant amounts of induced development is forecasted, the amount of open land suitable for development is many times the amount of forested land suitable for development.

For the analysis of indirect impacts in Section 4, the Greene County TAZs in the vicinity of the US 231 interchange are assumed to have negligible indirect impacts to forested land, based on the analysis described above. This is consistent with how these TAZs were treated in the indirect impact analysis in the Section 3 FEIS.

A similar GIS analysis was performed for a representative sampling of the remaining 39 (of the total of 51) TAZs in Greene County and 4 TAZs in Monroe County which are associated with Section 4 and forecasted to have induced growth

Ten (10) of the 43 remaining Traffic Analysis Zones (TAZs) predicted to experience growth as a result of the I-69 Section 4 project were reviewed for development during the ten year period from 1998 and 2008. This represents approximately one-quarter of the remaining TAZs in Section 4. Eight (8) of the TAZs are located in Greene County and two (2) are located in Monroe County. TAZs targeted for this analysis included:

- TAZs along the proposed I-69 corridor
- TAZs forecasted to have higher levels of induced growth
- Heavily forested TAZs were targeted for the analysis.

Appendix A shows a map of the TAZs studied in this analysis.

The total acreages of development were calculated for each TAZ using the ArcMap software. The acreages of 1998 forest land that was developed in 2008 were also calculated. Based on these numbers, the percentage of development that occurred on 1998 forested land was then

calculated for each TAZ. Table 5 shows the total acreages of development from 1998-2008, the acreages of 1998 forest land, and the percentage of the development that occurred on forest land. It also shows the land uses in each TAZ from the NLCD. Land use categories are as presented in Tables 1 – 4; the category "Not Available" is land not available for development, which includes developed land, land in floodplains, and land which is otherwise unusable for development.

The average percentage of development (unweighted) that occurred on year 1998 forest land for each TAZ was 31%. The total development (all TAZs) and percentage of development that occurred on year 1998 forest land was 36%. Based on these percentages and in order to be conservative, for the purposes of this analysis **40%** of the indirect and cumulative development acreages in the remaining 43 TAZs in Section 4 will be allocated to forest land impacts.

Induced growth forecasted for the indirect impacts analysis is broken down by induced household (residential) growth and induced employment (commercial) growth. This forest analysis did not differentiate between the two types of development. The majority of the land use changes observed between 1998 and 2008 were due to residential development. Induced commercial development is anticipated to occur on land that is more easily developed such as flat, dry, agricultural land. However, the same percentage (40%) was applied to both types of development due to the very small sample size of commercial development during the survey period and to maintain a conservative approach to determining forest impacts.

TABLE 5. SUMMARY OF DEVELOPMENT AND FOREST IMPACTS IN SELECT SECTION 4 TAZS (EXCLUDING THOSE NEAR US 231 INTERCHANGE) BETWEEN 1998-2008

	NCLD Acreages				1998 - 2008 Development Acreage				
TAZ #	Total	Available Forest	Available Ag/Open	Not Available	Total Acres Developed	Forested Acres Developed	% Development in Forest	% Development in Ag/Open	Available Ag/Open
2800605	1822	1407	368	47	3.16	0.07	2%	98%	20%
2802702	3410	2930	290	190	11.02	0.6	5%	95%	9%
2801502	1160	1060	83	17	0.22	0.22	100%	0%	7%
5300721	238	46	152	40	4.55	0	0%	100%	64%
2800806	1838	1121	629	88	37.42	2.81	8%	92%	34%
2800804	1750	1282	334	134	9.92	1.65	17%	83%	19%
2801503	2109	1732	290	87	101.18	38.36	38%	62%	14%
2801504	2395	1874	406	115	71.04	35.61	50%	50%	17%
5300728	416	215	77	124	27.16	18.55	68%	32%	19%
2800906	3288	2413	670	205	20	4.93	25%	75%	20%
				Total	285.67	102.8	36%		
				Average of TAZ Percentages (unweighted)			31%		

Table 5 shows that only after available Ag/Other land at less than 20% of total TAZ land cover that a meaningful percentage of development is in forested land.

The listing below ranks the TAZs from Table 5 by the percentage of land cover which is agricultural or other open land available for development.

5300721 - 64% of available land Ag/Open - 100% of development on open/ag land.
2800806 - 34% of available land Ag/Open - 92% of development on open/ag land.
2800605 - 20% of available land Ag/Open - 98% of development on open/ag land.
2800906 - 20% of available land Ag/ Open - 75% of development on open/ag land.
2800804 - 19% of available land Ag/Open - 83% of development on open/ag land.
5300728 - 19% of available land Ag/Open - 32% of development on open/ag land.
2801504 - 17% of available land Ag/Open - 50% of development on open/ag land.
2801503 - 14% of available land Ag/Open - 62% of development on open/ag land.
2802702 - 9% of available land Ag/Open - 95% of development on open/ag land.
2801502 - 7% of available land Ag/Open - 0% of development on open/ag land.

Three of the four TAZs which have at least 20% of land cover in agricultural or other open land (available for development) have nearly all (92 – 100%) development occurring on this land type. The fourth TAZ in this category (2800906) has 75% of development occurring on this land type. Five of the six TAZs with less than 20% of land cover in agricultural or other open land (available for development) have 0 – 83% of development occurring on this land type. The sixth TAZ in this category (2802702) has 95% of development occurring on this land type.

While there are many factors which are considered in deciding where to develop land for homes and businesses, there is a consistent overall trend observed that there is no meaningful use of forest for development until the available agricultural or other open land is less than 20% of all land available. This illustrates that the conservative nature of the estimate provided above, that 40% of *all* indirect impacts in Greene County (other than those near the US 231 interchange) are to forested land. The data shown above suggest that there would be a reasonable case for requiring a 75% - 80% "threshold" of forest cover before there are any meaningful indirect impacts to forest. However, specifying a 40% allocation of indirect impacts to forest in ***all*** TAZs (away from the US 231 area) is a reasonable and conservative percentage which accounts for all indirect impacts to forest.

ANALYSIS OF NO-BUILD IMPACTS IN BLOOMINGTON

In the environs of Bloomington, there are 87 TAZs which are “fully developed” in the Base Year (2000). This means that the Year 2001 NCLD data set shows all acres of landcover as “developed land” (either developed, open space; developed, low intensity; developed, medium intensity; or developed, high intensity). 78 of these 87 TAZs are forecasted to have growth in households and/or employment in the forecast year (2030) No Build scenario. Applying the acreage ratios used for Monroe County (4.82 households/acre and 17.8 jobs/acre) to forecasted increases in population and employment in these TAZs would result in 622 acres of impacts to

open land. However, there is no open land in these TAZs. For these TAZs, these forecasts indicate that these added households and jobs will be accommodated on land which already is classified as "developed" having a higher level of development. For example, in some cases a strip shopping area could be replaced by a two- or three-story office building, or larger housing lots could be divided to accommodate additional housing units. Accordingly, when calculations are made in Chapter 5.24 of the acreage impacts of growth in the "no build" case, these 622 acres should not be included in the forecast.

Likewise, there are an additional 55 TAZs which have some available undeveloped land in the 2001 NLCD data set, but where applying these acreage ratios would use all remaining undeveloped land without accommodating all forecasted growth. In these 55 TAZs, applying the acreage ratios cited above would result in forecasted impacts which would use 585 more open acres than is available in these TAZs.

Accordingly, Table 5.24-4 in this EIS (which shows forecasted land use changes in the 2030 "No Build" case) deducts 1,207 acres (622+585 = 1,207) from the estimated no-build impacts to open land which do not account for constraints in availability of open land in certain TAZs. This is a conservative assumption, since it assumes that ***all*** open acreage in the 55 TAZs with some undeveloped land would be impacted before existing developed land would be used at a higher level of development.

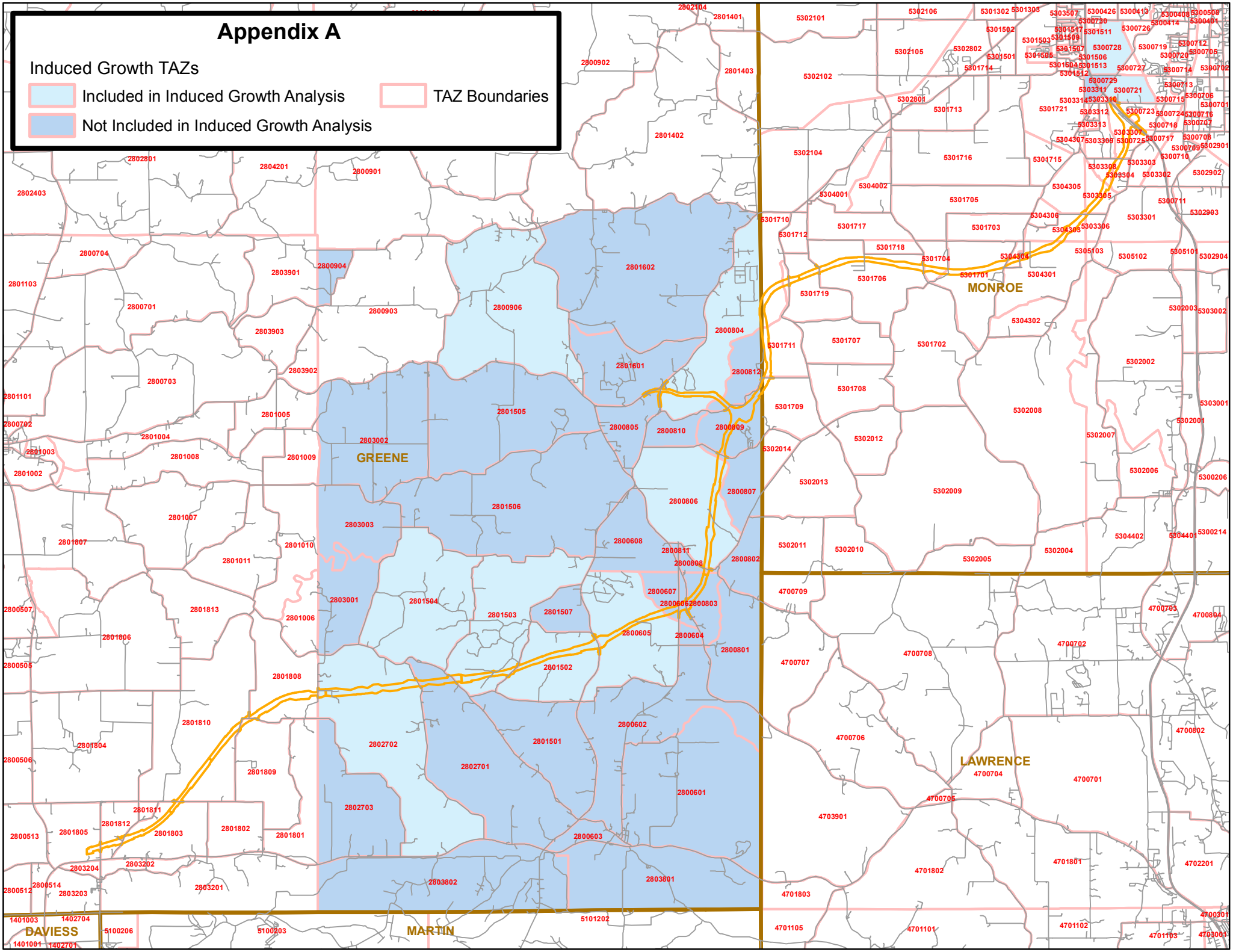
<u>List of Appendices</u>
Appendix A – Map of Section 4 TAZs

Appendix A - Map of Section 4 TAZs

Appendix A

Induced Growth TAZs

Included in Induced Growth Analysis

Not Included in Induced Growth Analysis

TAZ Boundaries