D.07 - Transit Feasibility Analysis

Alexandria

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Madison County Council of Governments

TRANSIT FEASIBILITY ANALYSIS

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PREPARED FOR:
MADISON COUNTY COUNCIL OF GOVERNMENTS

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1.0 INTRODUCTION

RSG coordinated with the Madison County Council of Governments (MCCOG) to conduct a feasibility analysis of a proposed commuter transit connection between downtown Anderson, IN and downtown Indianapolis, IN. This study offers a preliminary indication of potential ridership within the Anderson Metropolitan Planning Area (MPA), and forecasts potential ridership utilizing scenarios developed as part of the 2045 InMotion Metropolitan Transportation Plan (MTP).

While the results of this study are not adequate to support a Federal Transit Administration capital grant application, it does provide necessary insight to indicate whether further, more detailed study of expanded commuter service is warranted. This study leverages a stated-preference survey add-on from the 2014 Heartland in Motion Household Travel Survey, and expands on initial work conducted in 2014 to provide more detailed analysis of the components that impact potential riders of a new commuter service connection. Additionally, the analysis leverages big data origin-destination flows between the Anderson MPA developed for the regional travel demand model, as well as hypothetical highway and transit times.

Working within the constraints of the design of the 2014 stated-preference survey, RSG analyzed potential ridership for express bus service and commuter rail service.

Additionally, two 2045 development scenarios from the MTP were included in the analysis to gauge how ridership is anticipated to evolve over 30 years from the 2015 base year:

1. Status Quo

Maintains historical development patterns and trends within the MPA, and functions as the baseline forecast scenario.

2. Investing in Place

Focuses on the redevelopment of existing downtown areas in the MPA, and anticipates additional growth from the Indianapolis region into the MPA.

2.0 METHODOLOGY

The methodology used to develop baseline ridership shares for express bus and commuter rail service estimated a multinomial logit model (MNL) leveraging the stated preference survey add-on from the 2014 Heartland in Motion Transportation Study. The model is applied using sample enumeration to a weighted survey dataset of one-way trips from 7 origin zones in the MPA to 2 destination zones in Marion County.

Multinomial logit model

A simple choice model was chosen over more complex specifications due to the limitations of the stated-preference design, and sampling constraints for observed trips versus hypothetical trips that respondents were asked to completed from the 2014 household travel survey.

FIGURE 1: MODE LIST

Mode Name	Description
Car	Person trip using vehicle
Express Bus	Person trip using proposed express bus service
Commuter Rail	Person trip using proposed commuter rail service

$$P_{i,n} = \frac{e^{V_{i,n}}}{\sum_{j=1}^{J} e^{V_{j,n}}}$$

Where:

$P_{i,n}$: Probability of person n choosing alternative i (out of j = 1,…,J)

$V_{i,n}$: Systematic component of the utility for alternative i for person n

FIGURE 2: MODEL SPECIFICATION

Mode	Specification
Car	asc_car * 1 + b_tt * drivetime + b_cost * drivecost + b_pcost * parkingcost
Express Bus	b_tt * bustime + b_cost * buscost + b_headway * busfrequency
Commuter Rail	asc_rail * 1 + b_tt *railtime + b_cost * railcost + b_headway * railfrequency

FIGURE 3: MNL CHOICE MODEL ESTIMATION RESULTS

Name	Units	Variable	Value	T-test
Drive mode constant	(0,1)	asc_car	0.9781	10.14
Express bus mode constant	(0,1)	asc_bus	0.0000	
Commuter rail mode constant	(0,1)	asc_rail	0.8982	19.34
Sensitivity to travel time	Minutes	b_tt	-0.0192	-8.36
Sensitivity to headway	Minutes between transit	b_headway	-0.0181	-12.04
Sensitivity to cost	Dollars	b_cost	-0.1141	-8.11
Sensitivity to parking costs	Dollars	b_pcost	-0.2321	-10.74
Income- cost elasticity	NA	b_cost	-0.0757	-0.45

Figure 3 shows the MNL choice model estimation results. The variables have the expected sign and generally show strong statistical significance.

Value of time was calculated using the income cost elasticity variable in Figure 4 and was found to be generally reasonable for income categories.

FIGURE 4: VALUE OF TIME

Income category	Value of Time
Under $25,000	$9.07
$25,000 to $49,999	$9.86
$50,000 to $74,999	$10.24
$75,000 or more	$10.69
Median	$10.07

The MNL model was compared to similar existing commuter systems that include both express bus and commuter rail in Minnesota and Tennessee in Figure 5 and Figure 6. The share and aggregate ridership of the proposed commuter service to similar regions was found to be reasonable.

FIGURE 5: AGGREGATE ONE-WAY TRAVELERS COMPARISON SYSTEMS

Name	Total Travelers	Transit	Express Bus	Rail
Shelborne County, MN to Minneapolis, MN	3265	565	60	505
Wilson County, MN to Nashville	22950	465	100	365

FIGURE 6: MODE SHARE OF ONE-WAY TRAVELERS COMPARISON SYSTEMS

Name	Transit	Express Bus	Rail
Shelborne County, MN to Minneapolis, MN	17.30%	1.84%	15.47%
Wilson County, MN to Nashville	2.03%	0.44%	1.59%
Average of both systems	9.57%	1.14%	8.53%

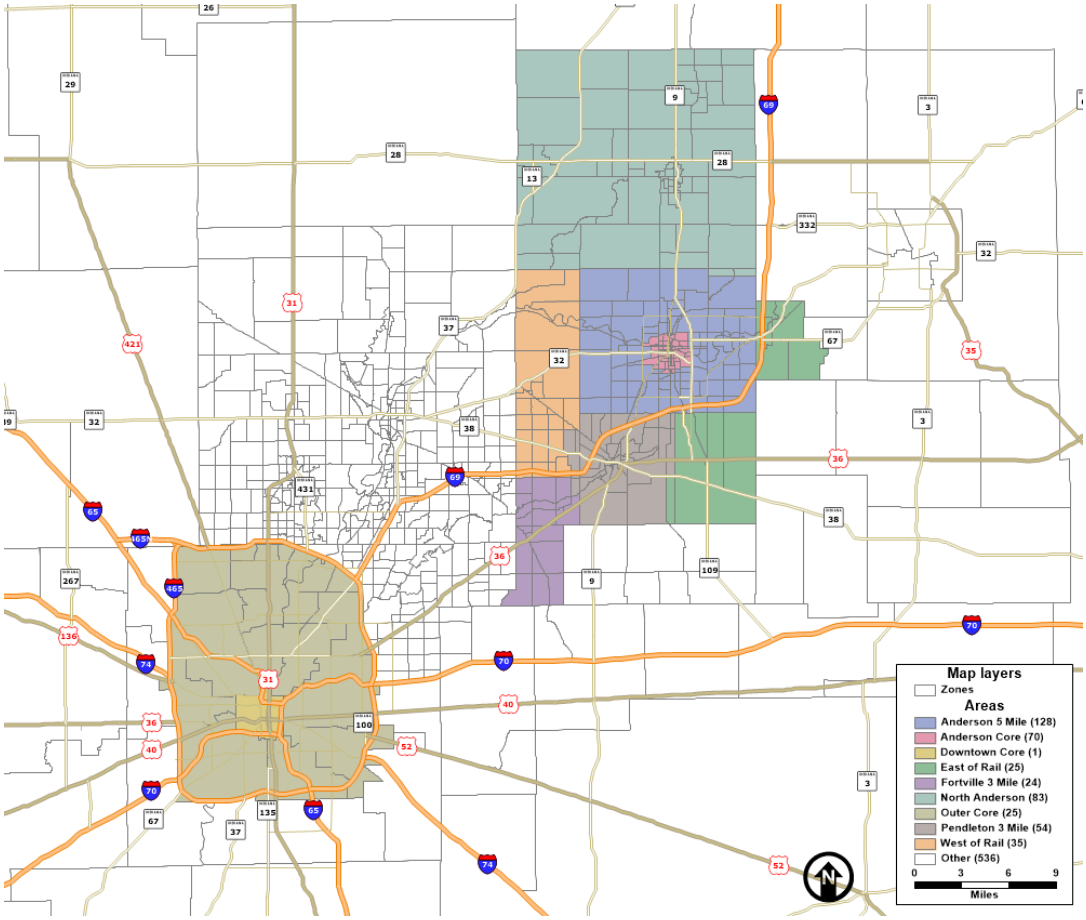
Weighted sample enumeration

The MNL choice model was applied using sample-enumeration that is weighted to subarea population to expand the survey dataset to the population, and is calibrated to the total one-way travelers from the Anderson MPA to the Indianapolis catchment areas using expanded LBS data. The sample enumeration simulator utilizes the reported google drive time from the original stated-preference survey utilizing reported home location in the 2014 Heartland In Motion Transportation Study.

Access to express bus and commuter rail stations utilizes the drive time from the origin zone to the station zone. Egress times assume a minimum of 5 minute walk time from Union Station or the Carson Transit Center for travelers who do not leave the downtown Indianapolis catchment. For travelers who have a destination outside of the downtown Indianapolis core, a transfer time of 15 minutes plus the transit time to their destination is used. Where the total in-vehicle transit time, plus transfer time, plus egress time was unreasonable in comparison to the anticipated drive time, express bus and commuter rail was made unavailable as a choice selection to keep mode shares to the outer Indianapolis catchment area reasonable.

A map of the origin and destination subarea catchments used in the analysis is contained in Figure 7.

FIGURE 7: SUBAREA CATCHMENTS



3.0 ANALYSIS

RSG coordinated with MCCOG staff to identify routes for commuter rail and express bus service, and proposed stations within the limitations of the stated preference design. The proposed commuter rail line in Figure 8 would utilize the existing CSX corridor between Downtown Anderson and Union Station in Downtown Indianapolis, with 3 intermediate stops in Pendleton, Fortville, and Lawrence. The proposed express bus route in Figure 9 would utilize the existing roadway network connecting between Downtown Anderson and the Carson Transit Center in Downtown Indianapolis, with 1 intermediate stop in McCordsville.

FIGURE 8: PROPOSED COMMUTER RAIL LINE

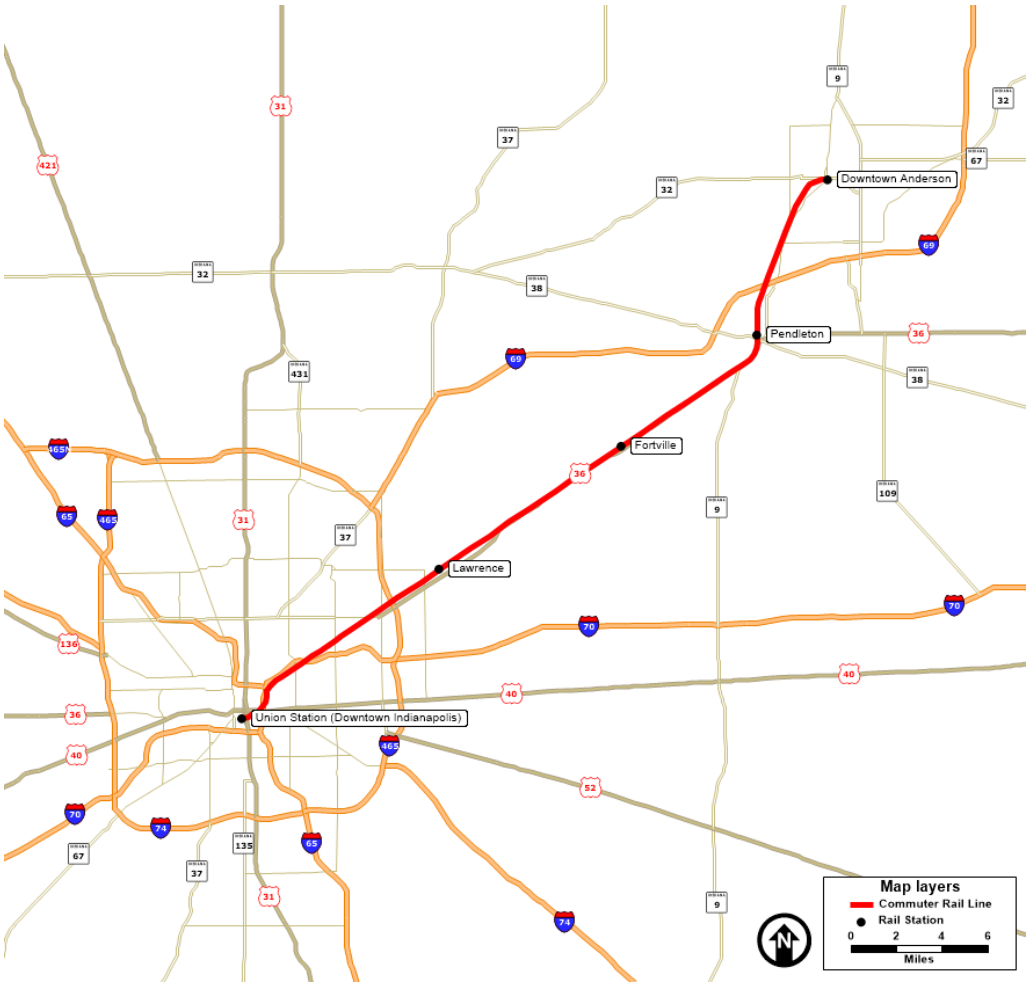
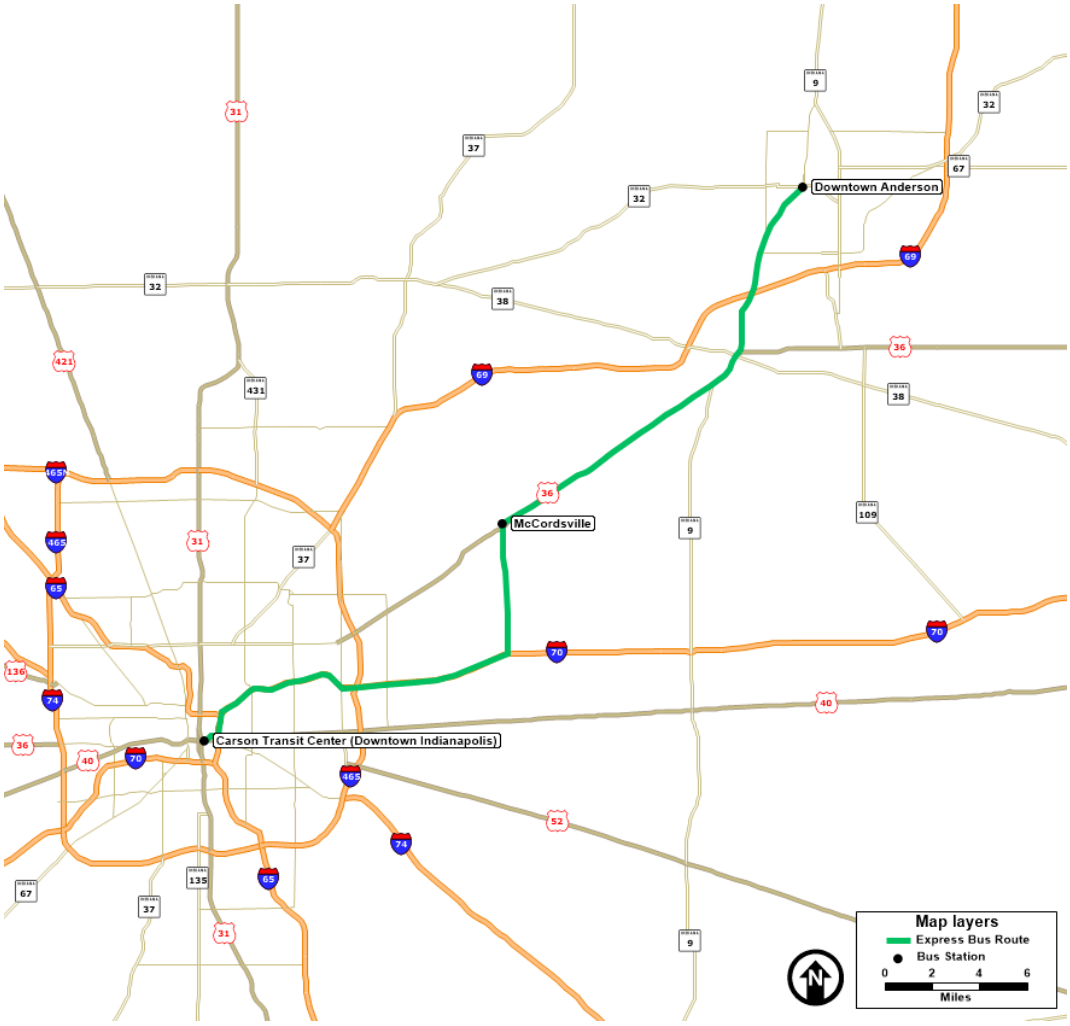


FIGURE 9: PROPOSED EXPRESS BUS ROUTE



Forecast model inputs

The forecast model requires inputs for fare, in-vehicle time, headway, drive cost, and parking cost contained in Figures 10 through 12. For the purposes of this analysis, future year scenarios assumed the same 2015 dollars used in the base to hold the relative transportation costs constant in future years. Additional comparative study would be necessary to determine any expected real cost to transportation beyond inflation in forecast years, and how this might impact ridership beyond 2015.

FIGURE 10: EXPRESS BUS INPUTS

Station	One-way fare	In-Vehicle Time (minutes)	Headway (minutes between buses)
Anderson	$6.00	70	60
McCordsville	$3.00	35	60

FIGURE 11: COMMUTER RAIL INPUTS

Station	One-way fare	In-Vehicle Time (minutes)	Headway (minutes between buses)
Anderson	$12.00	60	60
Pendleton	$10.00	45	60
Fortville	$8.00	30	60

FIGURE 12: DRIVE INPUTS

Drive cost (cost per trip)	Parking cost (cost per hour)
$3.00	$3.50

Forecast growth rates were applied on the 7 origin zones based off projections developed for the MTP for the 2045 Status Quo scenario and the 2045 Investing in place scenario in Figure 13. Drive time increases between the MPA origin zones and Indianapolis destination zones were assigned based off expected increases in AM travel time in the inbound to Indianapolis direction derived from the travel demand model for both 2045 scenarios in Figure 14.

FIGURE 13: 2045 SCENARIO SUBAREA GROWTH RATES (TIMES BASE TRIPS)

Subarea	Status Quo Growth Rate	Investing in Place Growth Rate
Anderson core	1.05	1.25
Anderson 5 mile	1.07	1.07
Pendleton 3 mile	1.25	1.41
Fortville 3 mile	1.56	2.09
North of Anderson	1.00	1.03
West CSX corridor	1.44	2.24
East of CSX corridor	1.64	0.95

FIGURE 14: 2045 SCENARIO CONGESTION INCREASES

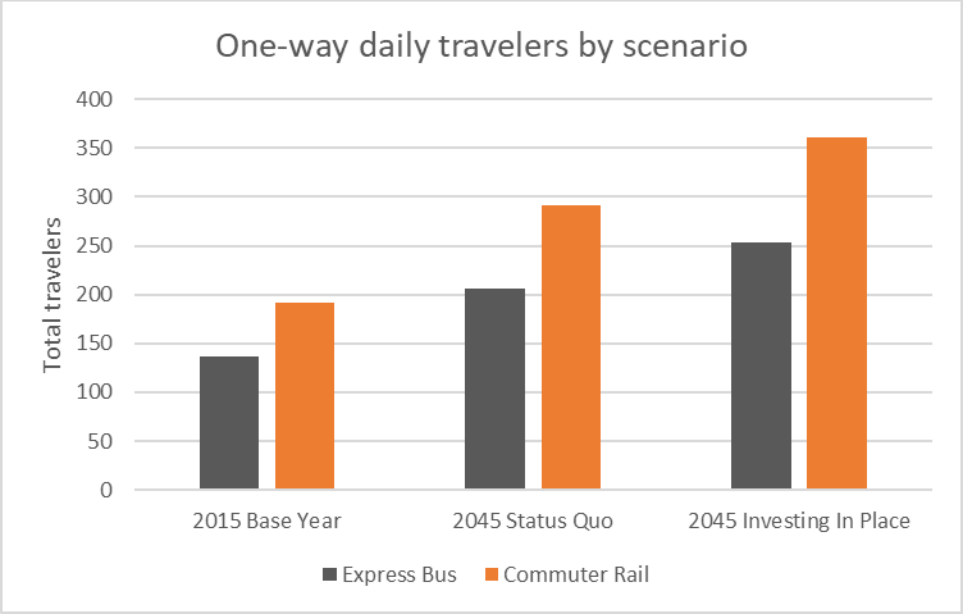
	Status Quo	Investing in Place
Congestion increase	1.20	1.27

Scenario comparison

RSG analyzed 3 scenarios to forecast potential ridership for both commuter services in the base year of 2015, and two 2045 forecast scenarios. Figures 15 through 21 contain summary results from the sample-enumeration simulator for each scenario that was analyzed. For the base condition scenario, there are a total of 5,216 observed trips between the Anderson MPA and the Indianapolis catchment areas. The drive mode constitutes the largest aggregate share of one-way daily travelers at 4,887. Commuter rail and Express bus travelers are similar in their aggregate shares of one-way daily travelers at 197 and 137, respectively.

Figure 15 contains a comparison of one-way daily travelers by each scenario. The 2045 status quo scenario increases total travelers between the Anderson MPA and Indianapolis catchment to 6,601, while the 2045 investing in place scenario increases total travelers to 7,413. Both 2045 scenarios significantly increase forecasted ridership, primarily through aggregate population growth in the region. A comparison to the investing in place scenario to the status quo scenario indicates that the former results in over 1.5 times more potential one-way travelers than the status quo scenario.

FIGURE 15: 2045 ONE WAY DAILY TRAVELERS BY SCENARIO



A comparison of one-way travelers by origin zone is contained in Figures 16 through 18. Most potential travelers prefer commuter rail across all origin zones in the MPA. However, there are important distinctions between Anderson core, and more rural areas north of Anderson, and outside of the Fortville and Pendleton subareas where the choice between express bus and commuter rail is not as apparent. Additionally, in both 2045 scenarios the travelers in the Anderson core prefer express bus over commuter rail.

Subarea origin zones closer to Indianapolis comprise the bulk of potential ridership for both modes and for all scenarios. The 5-mile Anderson subarea, Pendleton, and Fortville origin zones compromise nearly 76% of all 2015 one-way daily travelers for express bus, and 79% of all one-way travelers for commuter rail. In both 2045 scenarios, these 3 subareas consist of between 75% and 80% of all potential riders of either express bus or commuter rail. In all scenarios, the Fortville 3-mile subarea is the largest share of all potential travelers for either mode. While almost every subarea prefers commuter rail over express bus, the Fortville subarea consistently has the largest preference for commuter rail than other subareas within the MPA.

FIGURE 16: ONE-WAY TRAVELERS BY ORIGIN ZONE (2015 BASE)

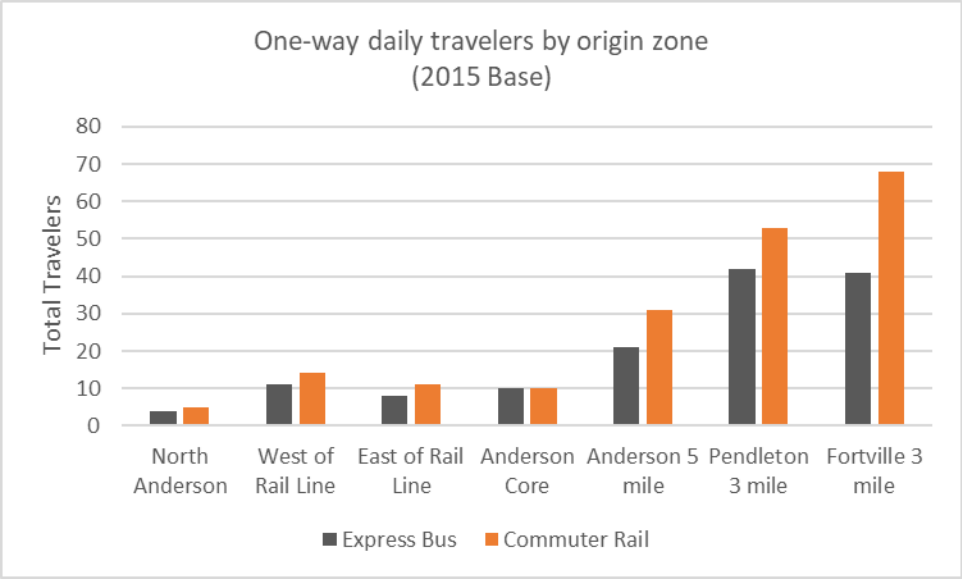


FIGURE 17: ONE-WAY TRAVELERS BY ORIGIN ZONE (2045 STATUS QUO)

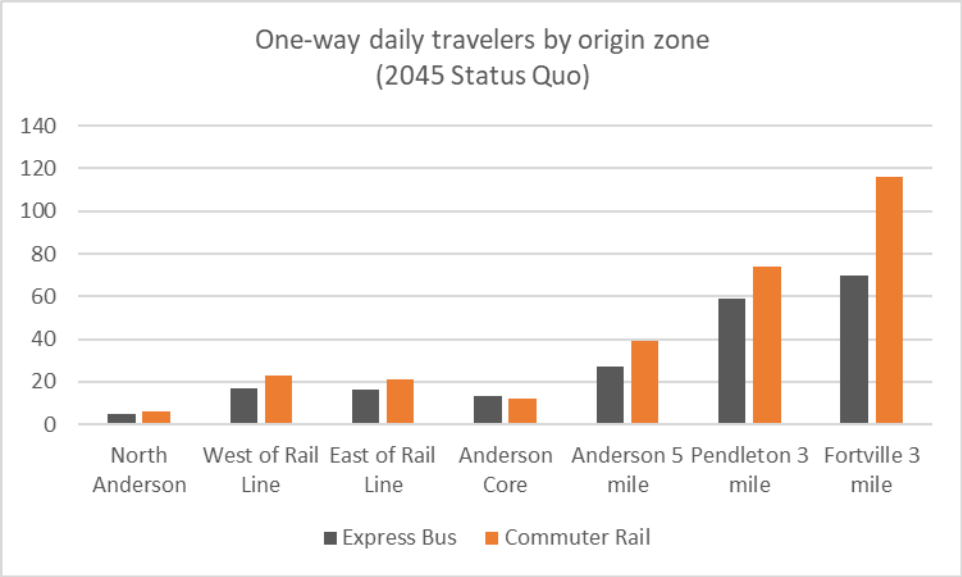


FIGURE 18: ONE-WAY TRAVELERS BY ORIGIN ZONE (2045 INVESTING IN PLACE)

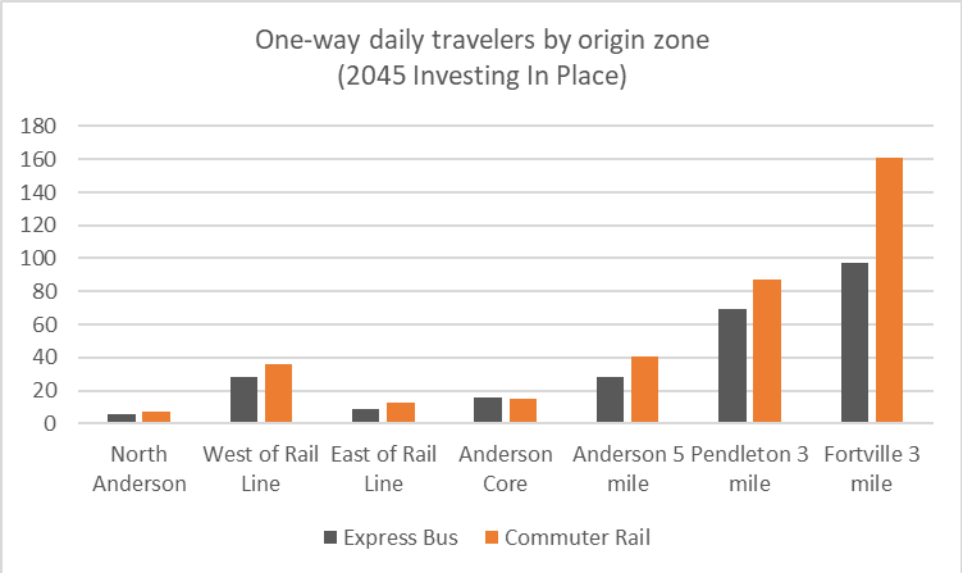


FIGURE 19: 2015 BASE YEAR SCENARIO (EXISTING CONDITIONS)

Mode	Daily Travelers - One Way		Annual Weekday Travelers - Both Directions	
Car	4,887	93.7%	2,540,991	93.7%
Express Bus	137	2.6%	71,434	2.6%
Commuter Rail	192	3.7%	99,740	3.7%

Destination Zone	Car	Express Bus	Commuter Rail	Total trips
Central Indianapolis	748	102	145	994
Outer Indianapolis	4,139	36	47	4,221
Total	*4,887*	*137*	*192*	*5,216*
Central Indianapolis	75.2%	10.2%	14.6%	
Outer Indianapolis	98.0%	0.8%	1.1%	
Total	*93.7%*	*2.6%*	*3.7%*	

Origin Zone	Car	Express Bus	Commuter Rail	Total trips
North of Anderson	295	4	5	305
West of the Rail Line	277	11	14	302
East of the Rail Line	381	8	11	401
Anderson Core	501	10	10	521
Anderson 5 mile	1,510	21	31	1,562
Pendleton 3 mile	968	42	53	1,062
Fortville 3 mile	954	41	68	1,063
Total	*4,887*	*137*	*192*	*5,216*
North of Anderson	96.8%	1.4%	1.8%	
West of the Rail Line	91.8%	3.6%	4.6%	
East of the Rail Line	95.1%	2.1%	2.8%	
Anderson Core	96.1%	2.0%	1.9%	
Anderson 5 mile	96.7%	1.4%	2.0%	
Pendleton 3 mile	91.1%	3.9%	5.0%	
Fortville 3 mile	89.8%	3.8%	6.4%	
Total	*93.7%*	*2.6%*	*3.7%*	

FIGURE 20: 2045 STATUS QUO SCENARIO

Mode	Daily Travelers - One Way		Annual Weekday Travelers - Both Directions	
Car	6,103	92.5%	3,173,449	92.5%
Express Bus	206	3.1%	107,342	3.1%
Commuter Rail	292	4.4%	151,740	4.4%

Destination Zone	Car	Express Bus	Commuter Rail	Total trips
Central Indianapolis	923	152	219	1,294
Outer Indianapolis	5,179	54	73	5,307
Total	6,103	206	292	6,601
Central Indianapolis	71.4%	11.8%	16.9%	
Outer Indianapolis	97.6%	1.0%	1.4%	
Total	92.5%	3.1%	4.4%	

Origin Zone	Car	Express Bus	Commuter Rail	Total trips
North of Anderson	293	5	6	305
West of the Rail Line	395	17	23	434
East of the Rail Line	620	16	21	657
Anderson Core	522	13	12	547
Anderson 5 mile	1,606	27	39	1,672
Pendleton 3 mile	1,195	59	74	1,328
Fortville 3 mile	1,472	70	116	1,658
Total	6,103	206	292	6,601
North of Anderson	96.2%	1.7%	2.1%	
West of the Rail Line	90.8%	4.0%	5.2%	
East of the Rail Line	94.4%	2.4%	3.3%	
Anderson Core	95.4%	2.3%	2.2%	
Anderson 5 mile	96.1%	1.6%	2.3%	
Pendleton 3 mile	90.0%	4.4%	5.6%	
Fortville 3 mile	88.8%	4.2%	7.0%	
Total	92.5%	3.1%	4.4%	

FIGURE 21: 2045 INVESTING IN PLACE SCENARIO

Mode	Daily Travelers - One Way		Annual Weekday Travelers - Both Directions	
Car	6,798	91.7%	3,535,001	91.7%
Express Bus	254	3.4%	131,869	3.4%
Commuter Rail	361	4.9%	187,674	4.9%

Destination Zone	Car	Express Bus	Commuter Rail	Total trips
Central Indianapolis	1,027	183	264	1,475
Outer Indianapolis	5,771	71	96	5,938
Total	6,798	254	361	7,413
Central Indianapolis	69.7%	12.4%	17.9%	
Outer Indianapolis	97.2%	1.2%	1.6%	
Total	91.7%	3.4%	4.9%	

Origin Zone	Car	Express Bus	Commuter Rail	Total trips
North of Anderson	301	6	7	314
West of the Rail Line	611	28	36	676
East of the Rail Line	358	9	13	381
Anderson Core	620	16	15	652
Anderson 5 mile	1,603	28	41	1,672
Pendleton 3 mile	1,341	69	87	1,498
Fortville 3 mile	1,963	97	161	2,221
Total	6,798	254	361	7,413
North of Anderson	96.0%	1.8%	2.2%	
West of the Rail Line	90.5%	4.1%	5.4%	
East of the Rail Line	94.1%	2.5%	3.4%	
Anderson Core	95.2%	2.5%	2.3%	
Anderson 5 mile	95.9%	1.7%	2.4%	
Pendleton 3 mile	89.6%	4.6%	5.8%	
Fortville 3 mile	88.4%	4.4%	7.2%	
Total	91.7%	3.4%	4.9%	

4.0 CONCLUSIONS AND RECOMMENDED STEPS

The 2015 base year forecast of potential commuter service riders indicates relatively low potential ridership in the Anderson MPA for commuter rail and express bus, respectively. As expected, 2045 scenarios significantly increase potential ridership of both commuter rail and express bus. The investing in place scenario results in the largest increase in potential commuter service travelers within the MPA. This increase in potential ridership is primarily attributed to uniform expected increases in population in both scenarios, where the Investing in Place scenario expects larger increases in population. The average increase in population for the Status Quo scenario is nearly 29%, whereas the expected increase in the Investing in Place scenario is nearly 43%. Additionally, some increase is attributed to higher population projections between core areas in the Anderson core, Anderson 5 Mile, Pendleton 3 mile, and Fortville 3 mile areas which represent higher concentrations of eligible choice riders, and riders who are in closer proximity of anticipated stations or stops. On average, these higher density core locations increase by nearly 23% in the Status Quo scenario and by nearly 46% in the Investing in Place scenario. In general, it can be expected that the more people who reside closer to a station or stop will utilize a potential mass transit service than those who reside further from it, supporting the notion that more compact, dense areas around planned transit service result in communities that are “transit ready”. However, some caution should be exercised in this notion, communities that are dense and compact must also have populations with trip making behavior that have logical origins and destinations that can be realistically served by a proposed transit service, and while at the same time provide a competitive alternative to automobiles for eligible travelers.

Calibration of the mode-choice model was conducted by comparing the share, and aggregate daily one-way ridership using CTPP and Census Journey to Work data in Minnesota and Tennessee. In these instances, while it's encouraging to note that the forecasted potential ridership in the Anderson MPA is similar to other areas, caution should be used when comparing actual ridership to projected ridership because of “new mode” bias in the stated preference design where respondents have a tendency to favor new transportation choices over ones that exist in surveys.

A key limitation of the stated-preference design from the 2014 Heartland in Motion Transportation Study is that the survey did not include sampling of potential riders outside of the Anderson MPA in Lawrence, McCordsville, and Fishers who would in all likelihood also use this service. As a result of this design limitation, the application of the choice model does not include potential travelers from any of these communities. Additionally, the 2014 Heartland in Motion Study did not sample enough actual daily commuters between the MPA and the Downtown Indianapolis core. As a result, respondents who reported any trip within a 30-day period were included in the survey and necessary to achieve a statistically valid model estimation- this as an additional source of optimism bias that is “hard baked” into this analysis.

If MCCOG continues to study new commuter service in the region, a new stated-preference survey will be necessary that samples from observed travelers with Downtown Indianapolis destinations along the entire proposed route of the commuter service outside of the Anderson MPA. Additionally, MCCOG should refine additional details of how either express bus or commuter rail would operate, this should include, at a minimum:

- Refinement of in-vehicle travel times on rail or road network
- Refinement of operational hours and headways
- Refinement of commuter service access/egress options
- Inclusion of additional amenities that may attract choice riders

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