

TASK 06

DEMAND FOR SERVICE TECHNICAL MEMO

PREPARED BY: AECOM

FEBRUARY 13, 2017



SMITHGROUP JJR . AECOM . BERGMANN ASSOCIATES . QUANDEL CONSULTANTS

NORTH↑
SOUTH↓
COMMUTER RAIL

North-South Commuter Rail Feasibility Study

Task 6: Demand for Service Technical Memo

Table of Contents

1. INTRODUCTION AND EXECUTIVE SUMMARY	3
2. METHODOLOGY	8
3. SERVICE PLANNING ASSUMPTIONS	14
4. STOPS MODEL RESULTS	20
5. RANGE OF FORECASTS AND SUMMARY	39

APPENDIX I: STOPS MODEL RUNS FOR OPTIONS 1, 2 AND 3

APPENDIX II: NORTH-SOUTH COMMUTER RAIL MARKET ANALYSIS

1. INTRODUCTION AND EXECUTIVE SUMMARY

The Ann Arbor Area Transportation Authority (AAATA) is assessing the market potential for the North-South Commuter Rail Line (WALLY), a proposed 27-mile long commuter rail line with several stops connecting Ann Arbor and Howell, MI. The North-South Commuter Rail is envisioned to provide an additional transit option for travel to Ann Arbor from areas north of town and improve mobility along the US-23 highway corridor.

As part of the evaluation of North-South Commuter Rail, AECOM developed ridership forecasts for six options:

- Option 1: Full Service
- Option 2: Full Service without Barton Drive Station
- Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations
- Option 4: Minimum Operating Configuration (MOC) with Whitmore Lake and Barton Drive Stations
- Option 5A: Shuttle Service (one train set) with Whitmore Lake/Barton Drive/Ann Arbor stations
- Option 5B: Shuttle Service (two train sets) with Whitmore Lake/Barton Drive/Ann Arbor stations

For the current year (2015), between 800 and 1,840 average weekday boardings are forecast on the line, depending on the option. For the forecast year (2040) between 1,100 and 2,419 average weekday boardings are forecast. Table 1 summarizes the forecasts.

Table 1: Ridership Forecasts by Option: Years 2015 and 2040

Option	Project Trips	2015 Mode Share (AM and PM peak)	Mode Share (Avg. Weekday)	Project Trips	2040 Mode Share (AM and PM peak)	Mode Share (Avg. Weekday)
1 Full Service	1,840	8%	3%	2,346	10%	4%
2 Full Service without Barton Drive Station	1,190	7%	3%	1,540	8%	3%
3 Starter Service	1,170	6%	3%	1,500	8%	3%
4 MOC	800	4%	2%	1,100	6%	3%
5A Shuttle Service (one train set)	1,346	8%	3%	1,956	10%	4%
5B Shuttle Service (two train sets)	1,674	8%	3%	2,419	10%	4%

Note: Mode share was calculated for the districts of Howell, Genoa, and Whitmore Lake. For the AM and PM peaks the total transit trips were divided by the total of home-based work trips in the three selected districts. The home-based work trips are factored by 43.27%; this number is based on Census Transportation Planning Package (CTPP) 2000 data and the percentage of workers in those districts that leave for work between 7 and 9 am, to be consistent with the Simplified Trips-on-Project Software (STOPS) model. It is not commuter rail trips divided by total trips in the district.

This technical memorandum describes the:

- Ridership forecasting methodology used
- Service planning assumptions used for each option
- Raw results from the STOPS model
- A range of forecasts

An independent travel market assessment was completed by the Southeast Michigan Council of Governments (SEMCOG) and is presented in Appendix II.

Table 2 summarizes the assumptions, stations, and estimated daily ridership for each of the four options in 2015 and 2040.

Table 2: N-S Rail Feasibility Study: Options Analysis for STOPS Demand Estimation

Option Name		Assumptions for this option						Estimated Daily Ridership (Boardings)		
		Factored CTPP Data Used?	Howell	Genoa	Hamburg	Whitmore	Barton	Ann Arbor	Year	
			2015	2040						
1) Full Service	Stations included in this option (• = yes); (◦ = distributor bus service also provided)	Yes	•	•	•	•	◦	◦	1,840	2,346
	Parking provided at this station (• = yes)		•	•	•	•	◦			
	Average minutes of auto travel times to Ann Arbor from District containing this station:		37	36	35	35	24	-		
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):						5	10		
	Minutes of rail travel times reduced from each station to account for "free fares":		10	10	10	10	10	10		
2) Full Service without Barton Drive Station	Stations included in this option (• = yes); (◦ = distributor bus service also provided)	Yes	•	•	•	•		◦	1,190	1,540
	Parking provided at this station (• = yes)		•	•	•	•				
	Average minutes of auto travel times to Ann Arbor from the District containing this station:		37	36	35	35		-		
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):							10		
	Minutes of rail travel times reduced from each station to account for "free fares":		10	10	10	10		10		

Assumptions for this option							Estimated Daily Ridership (Boardings)			
Option Name		Factored CTPP Data Used?	Howell	Genoa	Hamburg	Whitmore	Ann Arbor	Year		
								2015	2040	
3) "Starter Service"	Stations included in this option (• = yes); (◦ = distributor bus service also provided)	Yes	•			•	◦	1,170	1,500	
	Parking provided at this station (• = yes)		•			•				
	Average minutes of auto travel times to Ann Arbor from District containing this station:		37			35	-			
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):	Yes					10	800	1,100	
	Minutes of rail travel times reduced from each station to account for "free fares":		10			10	10			
4) Minimum Operating Configuration	Stations included in this option (• = yes); (◦ = distributor bus service also provided)					•	◦			
	Parking provided at this station (• = yes)					•				
	Average minutes of auto travel times to Ann Arbor from District containing this station:					35	24			
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):					5				
	Minutes of rail travel times reduced from each station to account for "free fares":				10	10				

		Assumptions for this option						Estimated Daily Ridership (Boardings)		
Option Name		Factored CTPP Data Used?	Howell	Genoa	Hamburg	Whitmore	Barton	Ann Arbor	2015	2040
5A) Shuttle Service (one train set)	Stations included in this option (● = yes); (○ = distributor bus service also provided)	No				●	○	○	1,343	1,956
	Parking provided at this station (● = yes)					●	○	○		
	Average minutes of auto travel times to Ann Arbor from District containing this station:					35	24			
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):						5	10		
	Minutes of rail travel times reduced from each station to account for "free fares":									
5B) Shuttle Service (two train sets)	Stations included in this option (● = yes); (○ = distributor bus service also provided)	No				●	○	○	1,676	2,419
	Parking provided at this station (● = yes)					●	○	○		
	Average minutes of auto travel times to Ann Arbor from District containing this station:					35	24			
	Minutes of auto travel times increased from each station to account for "terminal times" (i.e. parking search or shuttle bus):						5	10		
	Minutes of rail travel times reduced from each station to account for "free fares":									

2. METHODOLOGY

AECOM used the Federal Transit Administration's (FTA) Simplified Trips-on-Project Software (STOPS) tool to forecast ridership. AECOM used STOPS version 1.50, which is the most current STOPS version as of October 2015.

STOPS relies upon the following input data to forecast ridership:

- Census Transportation Planning Package (CTPP) Journey-to-Work data to describe travel patterns in project areas. CTPP Journey-to-Work data depicts home-to-work flows in an area (i.e., not all types of trips, such as non-home based trips), and STOPS factors these flows to represent both home-based work trips and home-based non-work trips. STOPS characterizes non-home-based travel based upon ratios of home based travel.
- Zone-to-zone highway travel times and distances (typically from regional travel models) to represent the local highway network.
- Transit service plans in General Transit Feed Specification (GTFS) format to represent the local transit network.
- Regional population and employment forecasts from SEMCOG to represent demographic growth in a geographical area. STOPS uses the demographic forecasts to scale the year 2000 CTPP data to predicted future-year travel flows.

STOPS allows users to specify various parameters that help 1) understand the propensity to use transit in a metropolitan area and 2) assess unmeasured effects associated with a proposed investment. "Unmeasured effects" is an FTA term that describes attributes of the service that cannot be directly measured in terms of travel times (i.e. rail "bias"). For unmeasured effects the FTA recommended visibility factor 1.0 was applied. Visibility of heavy rail is set as 1.0 in this version of STOPS. Previously light rail and commuter rail service was coded with 0.5. In STOPS Version 1.50, only streetcars or BRT routes are coded with a visibility factor of under 1.0.

In addition, the following were used to validate STOPS to local conditions:

- STOPS allows users to specify the number of weekday unlinked bus and rail trips of the various transit services in the model setup. The combined number of average weekday unlinked transit trips for AAATA and The University of Michigan (UM) in 2013 was 51,089.
- STOPS creates districts for calibration and growth-factor geography. Several districts were created across areas within a 25-mile radius of the proposed North-South commuter rail stations. These districts define the UM and University of Michigan Medical Center (UMMC) campuses (see the "UMICH" district), the Ann Arbor area (not including UM/UMMC), and areas

surrounding the North-South rail line north of Ann Arbor which include Whitmore Lake, Genoa and Howell. The district system and all North-South station locations are shown in Figure 1 on the next page.

AECOM assembled the relevant CTPP and GTFS files, highway travel times, and demographic data. GTFS files were obtained for both AAATA and UM transit services. AAATA GTFS files were modified to include North-South commuter rail service and new bus connector services, which vary by option. The addition of the North-South service and corresponding bus connector services is the basis for the option forecasts. Highway travel times and demographic forecasts were obtained from SEMCOG.

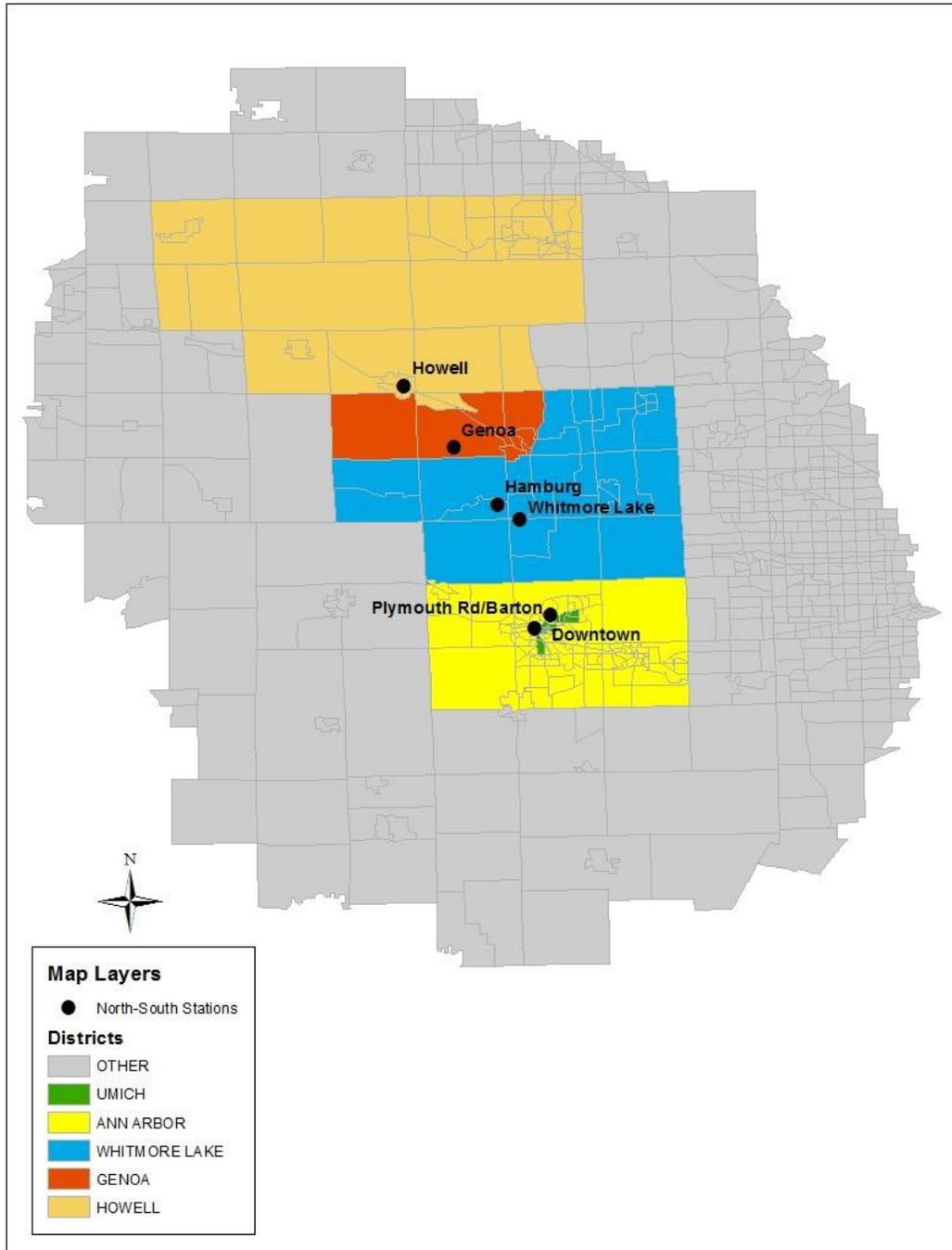
Other aspects that could affect ridership in the North-South corridor were also considered. AECOM examined the zone-to-zone highway distances and travel times, both of which reflect travel between origins and destinations. The travel times represent in-vehicle travel time on highways and do not include “terminal times” that simulate extra time to find parking and/or access a final destination. Travelers headed to a UM campus destination often need extra time to search for parking and/or take a shuttle bus to their final destination. AECOM modeled this extra time by adding additional travel time to the highway travel times for travel to or from UM and UMMC area zones. As a result, terminal times of 5-minutes and 10-minutes, a standard industry assumption in modeling, were added to the highway travel times for select zones (Table 2). Bus assumptions from bus-connector service to and from downtown are presented as Tables 5 and 7 in Section 3, Service Planning Assumptions.

Another aspect that could affect ridership is a proposed free or discounted service offered by The University of Michigan to the UM community during the first three years of service. While STOPS accounts for major components in typical travel demand models (e.g., trip patterns, highway networks, and transit networks), the STOPS model does not include elements used in other models. For example, STOPS does not directly account for transit fares or parking costs, which AECOM has represented in this study by including additional travel impedance (time) to stations or parking lots. Since fares cannot be accounted for in the STOPS model, a 10 minute travel time reduction was assumed in the MOC and carried over to the other options to account for the proposed free or discounted service.

The results of auto travel times to Ann Arbor from each District reflect an average of travel time from different points within each district to Ann Arbor station. The calculations were done using highway travel times from the SEMCOG model, and reflect a very slight decrease from the outermost districts at Howell to Barton just outside of Ann Arbor. The slight decrease in travel time can be explained by the accessibility and quality of road options available for automobile travelers from different districts. A likely traveler from the Howell District has convenient and easy access to I-96 and RUS-23. While being the most distant from Ann Arbor station, this means travelers from the Howell District would travel primarily on high speed routes with few traffic stops, lowering their overall average time of travel. Conversely, the map in Figure 1 shows that districts containing Genoa and Hamburg are geographically large and also stretch far from the main automobile corridor while having more likely travelers. While some travelers in these districts enjoy much faster travel to Ann Arbor as one would expect from their

closer proximity to Ann Arbor, other likely travelers in the outskirts of the districts must travel along smaller arterials with lower speeds of travel before they reach the main I-96/US-23 corridor. As a result, despite these districts being closer to Ann Arbor than Howell District, the overall average travel time is higher relative to what might otherwise be expected.

Figure 1: Ann Arbor Area Districts defined by STOPS model with North-South Station Locations



The current highway travel times and distances do not account for the proposed changes to US-23, envisioned in the Michigan Department of Transportation's Active Traffic Management (ATM) project. At this time the ATM project has not been added to SEMCOG's regional travel model. The proposed changes could possibly improve highway travel times between areas north of Ann Arbor and downtown Ann Arbor, which likely would reduce the relative attractiveness of North-South within the STOPS model.

STOPS simplifies model development and the travel forecasting process by making use of data that may be obtained quickly and easily, such as CTPP Journey-to-Work (JtW) data and GTFS files. STOPS includes representations of highway and transit networks and uses CTPP data to represent travel patterns. STOPS looks at both work and non-work travel. Non-work travel is estimated by using regional factors.

AECOM examined the differences between CTPP Journey-to-Work data used by STOPS and recent UM/UMMC employee home-to-work travel data. AECOM received aggregated 2014 data from UM about the home zip codes of faculty and staff of UM and UMMC and compared this data with the CTPP Journey-to-Work flows. CTPP flows are comparable to the University of Michigan employee home-to-work data, yet CTPP flows are approximately 50 percent less than the UM Medical Center employee home-to-work flows (for workers commuting from north of Ann Arbor to the UMMC campus area). The UMMC employee data shows that 2,750 workers travel from north of Ann Arbor to the UMMC campus area, whereas CTPP Journey-to-Work data shows only 1,770 workers make similar trips. The ratio of the UMMC employee flows to the corresponding CTPP flows is 1.55.

Because of the differences between the CTPP data and the UMMC employee data, AECOM evaluated two versions of the model using a different Journey-to-Work table. In the first version, the existing CTPP Journey-to-Work table was used without any modification. In the second version, AECOM modified the existing CTPP Journey-to-Work table to reflect the home-to-work flows in the UMMC employee data. AECOM identified and factored records in the CTPP data that represented travel patterns found in the UMMC employee data (e.g., an employee commuting from Howell to UMMC); these records were scaled up by a factor of 1.55 (as described above) in order to resemble the UMMC employee total and better reflect travel patterns in the area. Options 1, 2 and 3 were run with both sets of data. Option 4, (the Minimum Operating Configuration), used "Original CTPP Data" with a blended scenario to represent free/discounted fares. Options 5A and 5B were also run with Original CTPP data sets. However, the factor was later applied to mimic the effects of the factored CTPP data and create an upper bound forecast for options 4, 5A & 5B. In the forecast results section, the tables for the factored CTPP data are shown (except Options 5A & 5B which were run with original CTPP data). The original CTPP data tables can be found in Appendix I.

Table 3 shows total district to district trips from the STOPS model. Note that there is not necessarily a direct correlation between a district and the stations it contains. In other words, districts can contribute trips to multiple stations. The total trips do not change significantly between the two versions of CTPP

data. The majority of trips made between the “other” districts, and trips in the Ann Arbor district comprise a significant portion of the total trips. These trips remain consistent between all four service options.

Table 3: District-to-District Summaries of Average Weekday Trips by All Modes – All Options

Average Weekday Person Trips (All Trips) - Using Factored CTPP Data

Origin District	Year 2015							Destination District	Year 2040						
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER
HOWEL	302	2,136	14,434	29,733	117,117	18,963	182,684	HOWEL	381	2,777	18,368	39,751	151,316	23,684	236,276
GENOA	829	3,482	30,800	60,603	29,733	16,207	141,652	GENOA	1,052	4,535	40,412	84,395	39,751	20,531	190,676
WHTMR	17,877	33,391	145,866	30,800	14,434	96,393	338,761	WHTMR	21,333	40,662	183,293	40,412	18,368	115,496	419,563
ANNAR	182,745	938,810	33,391	3,482	2,136	168,782	1,329,345	ANNAR	220,622	1,153,063	40,662	4,535	2,777	198,978	1,620,636
UMICH	99,117	182,745	17,877	829	302	20,307	321,176	UMICH	115,855	220,622	21,333	1,052	381	23,011	382,252
OTHER	20,307	168,782	96,393	16,207	18,963	4,028,278	4,348,928	OTHER	23,011	198,978	115,496	20,531	23,684	4,385,226	4,766,926
TOTAL	321,176	1,329,345	338,761	141,652	182,684	4,348,928	6,662,545	TOTAL	382,252	1,620,636	419,563	190,676	236,276	4,766,926	7,616,328

3. SERVICE PLANNING ASSUMPTIONS

The service planning assumptions at the time the STOPS model runs were prepared for the four options are described below.

- Option 1: Full Service
- Option 2: Full Service without Barton Drive Station
- Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations
- Option 4: Minimum Operating Configuration (MOC) with Whitmore Lake and Barton Drive Stations
- Option 5A: Shuttle Service (one train set) with Whitmore Lake/Barton Drive/Ann Arbor stations
- Option 5B: Shuttle Service (two train sets) with Whitmore Lake/Barton Drive/Ann Arbor stations

Option 1: Full Service

The full-service configuration, Option 1, consists of six stations from Howell to downtown Ann Arbor with four morning trains and four evening trains. The morning schedule used in the GTFS files is shown below in Table 4.

Table 4: North-South AM Train Departure Times by Station – Option 1: Full Service

Station	Train 1	Train 2	Train 3	Train 4
Howell	6:00	6:30	7:00	7:30
Genoa	6:13	6:43	7:13	7:43
Hamburg	6:24	6:54	7:24	7:54
Whitmore Lake	6:31	7:01	7:31	8:01
Barton Drive	6:46	7:16	7:46	8:16
Ann Arbor	6:52	7:22	7:52	8:22

Source: Quandel Consultants

Five new connecting bus routes were introduced to connect the North-South Barton Drive Station to the surrounding Ann Arbor area, and these routes were added to the AAATA build GTFS files for both the Full Service option, MOC, Whitmore Lake/Barton Drive/Ann Arbor (one train set) option, and the Whitmore Lake/Barton Drive/Ann Arbor (two train sets) option (Options 1, 4, 5A and 5B). The connecting bus services are based on bus service specifications provided by AAATA. Connector buses are modeled to depart from Barton Drive Station four minutes after the arrival of a North-South train.

Descriptions of the added bus routes, including the bus stops along the routes, are documented in Table 5 below.

Table 5: AAATA North-South Bus Connectors at Barton Drive Station (Options 1,4, 5A and 5B)

Route	Route Description & Route Bus Stops
Route 1	Plymouth to Maiden Lane, to E. Medical Center Dr. to Observatory to Ann to Zina Pitcher Place, to Catherine to Glen
STOPS	<ul style="list-style-type: none"> · E. Medical Center Dr. @ Taubman · E. Medical Center Dr. @ CMHC · Ann @ Simpson Memorial Institute · Zina Pitcher @ Ann (Kresge)
Route 2	Plymouth to Broadway to Beakes, to Fifth Ave. to Huron to Fletcher to N. University
STOPS	<ul style="list-style-type: none"> · Fifth Ave. @ Detroit (Kerrytown) · Huron @ Fifth (downtown) · Huron @ State · Fletcher @ Washington (Rackham) · CC Little Bldg (main UM bus stop)
Route 3	Plymouth to Broadway to Beakes to Fifth Ave. to William to State
STOPS	<ul style="list-style-type: none"> · Broadway @ Swift (Lowertown) · Fifth Ave. @ Ann (City Hall) · Fifth Ave. @ William (Blake Transit Center) · William @ Thompson
	State @ North University (Diag)
Route 4	Plymouth to Maiden Lane to Fuller to Glen to Huron to Fletcher to North University
STOPS	<ul style="list-style-type: none"> · Maiden Lane @ Nielsen Ct. · Glen @ Catherine · Fletcher @ Washington (Rackham)
	CC Little Bldg (main UM bus stop)
Route 5	Plymouth to Murfin to Bonisteel to Beal to VA to Beal to Hayward, to Hubbard to Huron Pkwy (assumes bus can go eastbound on Plymouth from station stop
STOPS	<ul style="list-style-type: none"> · Murfin @ Hayward · Bonisteel @ Murfin · Bonisteel @ Beal · VA Medical Center · Beal @ Hayward

Source: AAATA

Option 2: Full Service without Barton Drive Station

The second option is based on the full-service alternative, with the removal of the Barton Drive Station in the north part of Ann Arbor. Similar to the full service option, there are four trains in the morning, and the schedule is shown below in Table 6. Instead of connecting bus service at Barton Drive Station (as in the MOC and full-service options), new connecting bus service at Ann Arbor Station, provided by AAATA, was added. These routes connect Ann Arbor Station to the UM Central Campus, UM Medical Center, and UM North Campus. This connecting bus service shown in Table 7 is also applicable for the “Starter” service option, described in the next section.

Table 6: North-South AM Train Departure Times by Station – Option 2: Full Service without Barton Drive Station

Station	Train 1	Train 2	Train 3	Train 4
Howell	6:00	6:30	7:00	7:30
Genoa	6:13	6:43	7:13	7:43
Hamburg	6:24	6:54	7:24	7:54
Whitmore Lake	6:31	7:01	7:31	8:01
Ann Arbor	6:49	7:19	7:49	8:19

Source: Quandel Consultants

Table 7: North-South Bus Connectors at Ann Arbor Station (Options 2 and 3)

Route	Route Description & Route Bus Stops
Route UMMC1	Ann Arbor Station to U-M Central Campus & Medical Center Route <ul style="list-style-type: none"> · First & Liberty (Downtown Rail Station) · Blake Transit Center · Central Campus Transit · Center Mott Hospital · Taubman Center · Cancer Center
Route UMMC2	Ann Arbor Station to U-M Medical Center & Central Campus Route <ul style="list-style-type: none"> · First & Liberty (Downtown Rail Station) · Huron & Fourth Ave · Cancer Center · Taubman Center · Mott Hospital · Central Campus Transit Center
Route UM North	Ann Arbor Station to U-M North Campus Route <ul style="list-style-type: none"> · First & Liberty (Downtown Rail Station) · Pierpoint Commons · First & Liberty (Downtown Rail Station)

Source: AAATA

Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations

This option is based upon the full-service configuration with a limited number of stations. The only stations in this scenario are located at Howell, Whitmore Lake, and Ann Arbor, with Genoa, Hamburg, and Barton Drive stations removed. There are four trains in the morning that depart on half hour intervals: The schedule is shown below in Table 8. Similar to the full service option without Barton Drive Station, the bus service is modified so that the buses depart the Ann Arbor Station five minutes after the arrival of a North-South train, and an additional bus is added from Ann Arbor Station to the UM North Campus.

Table 8: North-South AM Train Departure Times by Station – Option 3: “Starter” Service

Station	Train 1	Train 2	Train 3	Train 4
Howell	6:00	6:30	7:00	7:30
Whitmore Lake	6:26	6:56	7:26	7:56
Ann Arbor	6:44	7:14	7:44	8:14

Source: Quandel Consultants

Option 4: Minimum Operating Configuration (MOC) with Whitmore Lake and Barton Drive Stations

The minimum operating configuration only has two stops: Whitmore Lake and Barton Drive. The four morning trips are shown in Table 9 below. The rail in-vehicle travel time between the stations was specified as 18 minutes, and seven North-South trains (four southbound and three northbound) in the morning were included in the service plan as shown in Tables 9 and 10 below. AECOM represented the existing and future-year no-build transit service by using current AAATA and University of Michigan (UM) GTFS files, which represent transit service in the Ann Arbor area as it exists today.

For the purpose of MOC option evaluation, AECOM developed two different STOPS model runs. The first run uses STOPS native defaults that assume a typical regional fare policy for commuter rail. The second run simulates the effects of a free transit fare in order to mimic the proposal to offer free or discounted service to the UM community during the first three years of service. Although the STOPS model does not account for fares directly, in-vehicle travel time (IVTT) can be adjusted to simulate the effect of discounted fares. In the second model run, the rail IVTT between Whitmore Lake Station and Barton Drive Station was reduced from 18 minutes to 8 minutes to account for the discounted fare. Because a portion of the market may receive a free fare (i.e., the UM community), AECOM developed a routine to “blend” together the results from the base condition and free-fare condition in order to develop forecasts for the MOC. If a trip began or ended in the UM district riders are counted as receiving a free fare. The free fare scenario was only considered for the MOC option. The numbers for Options 1-3 were based on the free fare percentage from the MOC option. The CTPP data used in this option is the original data; forecasts were adjusted post-model run to account for the factored CTPP data.

Table 9: Southbound AM North-South Trains – Option 4: MOC

Station	Train 1	Train 3	Train 5	Train 7
Whitmore Lake	5:30	6:16	7:07	7:53
Barton Drive	5:48	6:34	7:25	8:11
Ann Arbor Layover	5 min	5 min	5 min	

Source: Quandel Consultants

Table 10: Northbound AM North-South Trains – Option 4: MOC

Station	Train 2	Train 4	Train 6
Barton Drive	5:53	6:39	7:30
Whitmore Lake	5:48	6:34	7:48
Whitmore Lake Layover	5 min	10 min	5 min

Source: Quandel Consultants

Option 5A: Shuttle Service (one train set) with Whitmore Lake/Barton Drive/Ann Arbor Stations

The one train set option consists of three stations from Whitmore Lake to downtown Ann Arbor with four AM southbound and 4 PM northbound trains, and three AM northbound and three PM southbound trains. The service has roughly one hour peak headways. The in vehicle travel time is 20 min Southbound and 21 min Northbound. The rail travel times were used as per the schedule and were not discounted for free fares. The morning schedule used in the GTFS files is shown below in Table 11 and 12.

Table 11: Southbound North-South AM Train Departure Times by Station – Option 5A: Shuttle Service (one train set)

Station	Train 1	Train 2	Train 3	Train 4
Whitmore Lake	5:22	6:23	7:29	8:30
Barton Drive	5:37	6:38	7:44	8:45
Ann Arbor	5:42	6:43	7:49	8:50

Source: Quandel Consultants

Table 12: Northbound North-South AM Train Departure Times by Station – Option 5A: Shuttle Service (one train set)

Station	Train 1	Train 2	Train 3
Ann Arbor	7:59	6:53	5:52
Barton Drive	8:06	7:00	5:59
Whitmore Lake	8:20	7:14	6:13

Source: Quandel Consultants

Similar to Option 1, connecting bus routes to Barton Drive station were added to the GTFS files. Table 5 describes the included bus services.

Option 5B: Shuttle Service (two train sets) with Whitmore Lake/Barton Drive/Ann Arbor Stations

The two train set option consists of three stations from Whitmore Lake to downtown Ann Arbor with four AM southbound and 4 PM northbound trains, and two AM northbound and two PM southbound trains. The service has roughly half hour peak headways. The in vehicle travel time is 20 min Southbound and 26 min northbound. The travel times were not discounted for free fares. The morning schedule used in the GTFS files is shown below in Table 13 and 14.

Table 13: Southbound AM Train Departure Times by Station – Option 5B: Shuttle Service (two train sets)

Station	Train 1	Train 2	Train 3	Train 4
Whitmore Lake	6:30	7:05	7:39	8:15
Barton Drive	6:45	7:20	7:54	8:30
Ann Arbor	6:50	7:25	7:59	8:35

Source: Quandel Consultants

Table 14: Southbound AM Train Departure Times by Station – Option 5B: Shuttle Service (two train sets)

Station	Train 1	Train 2
Ann Arbor	7:00	7:35
Barton Drive	7:07	7:42
Whitmore Lake	7:26	8:01

Source: Quandel Consultants

Similar to Option 1, connecting bus routes to Barton Drive station were added to the GTFS files. Table 5 describes the included bus services.

4. STOPS MODEL RESULTS

This section summarizes STOPS model results using the assumptions outlined in Section 3 for the four options evaluated. Further analysis of the results including a range of forecasts is presented in Section 5.

Option 1: Full-Service

The following ridership results in Table 15 represent district-to-district summaries for the STOPS model with factored CTPP data. The districts in the summaries correspond to the district system shown in Figure 1. The factored CTPP data shows average weekday trips from the STOPS model as 1,654 linked trips in 2015 and 2,345 in 2040. A linked trip captures an entire journey as one trip, even if there is a transfer. Results from the original CTPP scenario can be found in Appendix I.

All trips, as shown in Table 15, either begin or end in the UM or Ann Arbor districts. District information is presented in geographical order, outbound from Ann Arbor for destinations. The largest travel market is between the Whitmore Lake district and UM district: This is based upon the level of district, not station attractiveness. Each district's corresponding station can be found in Figure 1. Some trips are also made between the UM and Ann Arbor districts, which reflects the option's attractiveness within the STOPS model compared to other travel options for short-distance trips between north Ann Arbor and areas west and southwest of the main UM campus. Between these areas, the in-vehicle travel time on Option 1 is much lower than local bus service and is comparable to highway travel times. Given that STOPS does not consider transit fares and that North-South has a relatively low in-vehicle travel time, North-South is an attractive option for these short-distance trips from north Ann Arbor to downtown areas. The attractiveness of North-South also results in some intra-district trips for the UM and Ann Arbor districts that are very similar to the trips made between the UM and Ann Arbor.

Table 15: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 1: Full Service

Average Weekday Project Trips - Using Factored CTPP Data

Origin District	Year 2015							Destination District	Year 2040							
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER		TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER
HOWEL	7	16	0	0	0	0	0	22	HOWEL	11	23	0	0	0	0	34
GENOA	15	11	0	0	0	0	0	26	GENOA	22	17	0	0	0	0	39
WHTMR	275	93	0	0	0	0	0	368	WHTMR	411	131	0	0	0	0	541
ANNAR	126	160	93	11	16	61	467	ANNAR	168	211	131	17	23	80	629	
UMICH	72	126	275	15	7	109	603	UMICH	88	168	411	22	11	162	861	
OTHER	109	61	0	0	0	0	170	OTHER	162	80	0	0	0	0	242	
TOTAL	603	467	368	26	22	170	1,654	TOTAL	861	629	541	39	34	242	2,345	

Table 16 below shows average weekday station boardings by access mode. The label “XFER” refers to transfers made between local transit and North-South trains. The labels “KNR” and “PNR” refer to “Kiss and Ride” and “Park and Ride,” respectively. Stations on the northern half of the rail line are dependent on auto access, and the highest demand for park-and-ride facilities occurs at Whitmore Lake Station. The number of North-South riders who access the Ann Arbor Station by walking is greater when considering the factored CTPP data. The “WALK” column could also include biking; stops does not differentiate between the two.

Table 16: Station Boardings by Access Mode Using Factored CTPP Data – Option 1: Full Service

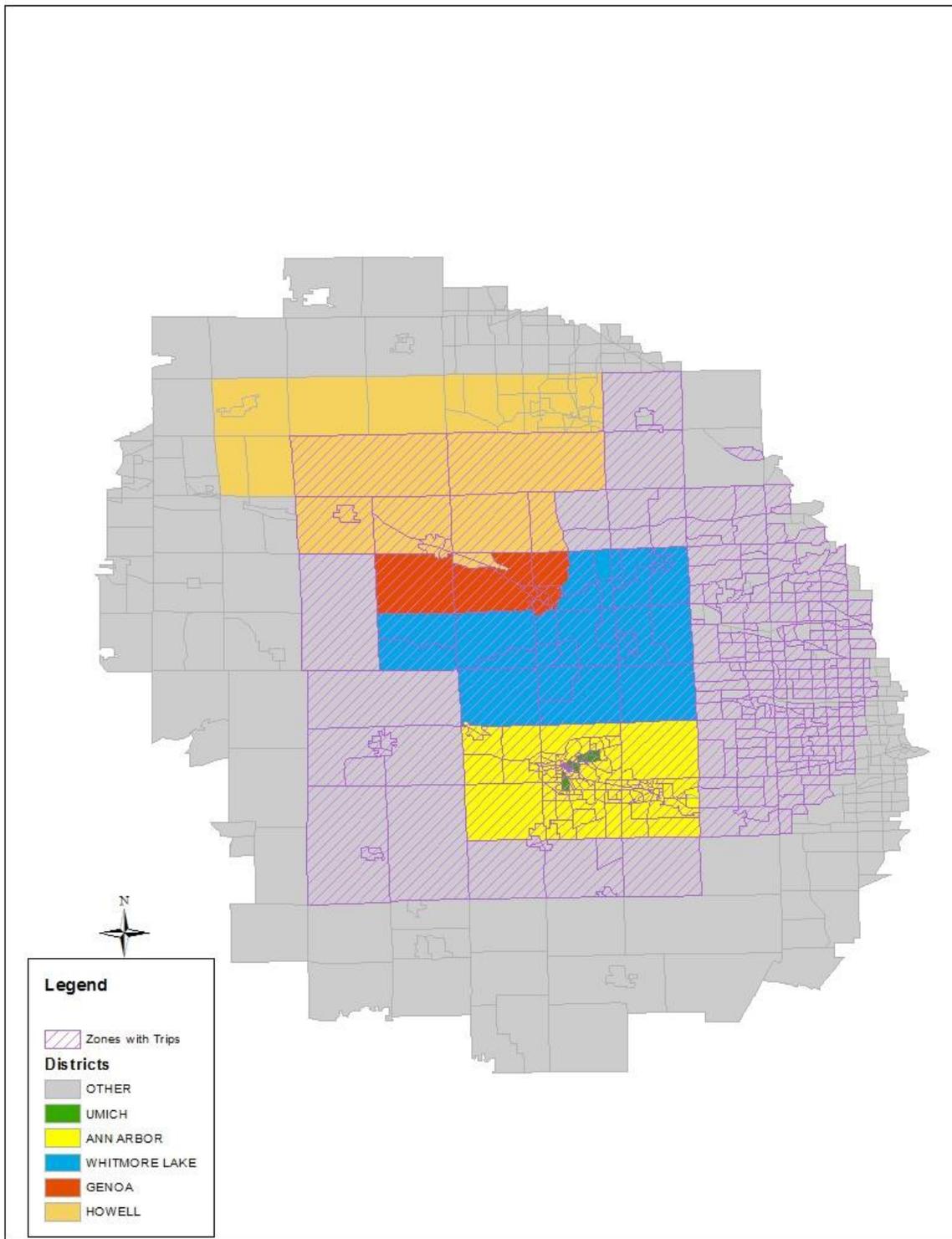
Station	<u>Year 2015</u>					<u>Year 2040</u>				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	9	3	10	0	22	12	4	17	0	33
Genoa	0	4	12	0	16	0	6	19	0	25
Hamburg	0	7	0	0	7	0	10	0	0	10
Whitmore Lake	0	226	414	0	640	0	293	632	0	925
Barton Drive	268	3	0	123	394	387	4	0	188	579
Ann Arbor	477	1	16	80	574	641	2	21	110	774
Total	754	244	452	203	1,653	1,040	319	689	298	2,346

Table 17 summarizes the AAATA North-South bus connector boardings for the 2015 and 2040 forecasts. The boardings for the North-South bus connectors are the same for both sets of CTPP data. Descriptions of the bus connector routes are provided in Table 5. As a check on coding Figure 2 shows the zones (shaded) in the STOPS model that contain rail trips in this option.

Table 17: Connector Bus Boardings – Option 1: Full Service

STOPS Model Boardings		
Route Name	Year 2015	Year 2040
Route 1	1	2
Route 2	71	90
Route 3	37	48
Route 4	80	95
Route 5	5	6
Total Weekday Boardings	194	241

Figure 2: Zones with Rail Trips for Option 1: Full Service



Option 2: Full Service without Barton Drive Station

Table 18 represents the district-to-district summaries of average weekday trips for the factored CTPP data. The districts are shown in Figure 1. With the factored CTPP data, the ridership is about 100-150 linked trips higher than the non-factored data, increasing from 1,077 trips in 2015 to 1,532 trips in 2040. The forecast results for the original CTPP data can be found in Appendix I. The trips are highest in the UM, Ann Arbor and Whitmore Lake districts in both scenarios. Compared to the full-service ridership forecasts presented in the prior section, exclusion of the Barton Drive Station results in approximately 40 percent fewer trips.

Table 18: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 2: Full Service without Barton Drive Station

Average Weekday Project Trips - Using Factored CTPP Data

Origin District	Year 2015							Destination District	Year 2040						
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER		TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL
HOWEL	6	14	0	0	0	0	20	HOWEL	10	21	0	0	0	0	30
GENOA	13	10	0	0	0	0	22	GENOA	19	15	0	0	0	0	34
WHTMR	201	83	0	0	0	0	283	WHTMR	292	117	0	0	0	0	409
ANNAR	48	63	83	10	14	51	268	ANNAR	65	85	117	15	21	69	371
UMICH	11	48	201	13	6	79	356	UMICH	12	65	292	19	10	112	509
OTHER	79	51	0	0	0	0	130	OTHER	112	69	0	0	0	0	180
TOTAL	356	268	283	22	20	130	1,077	TOTAL	509	371	409	34	30	180	1,532

Table 19 below shows average weekday station boardings by access mode for Option 2. As noted previously, the label “XFER” refers to transfers made between local transit and North-South trains. The labels “KNR” and “PNR” refer to “Kiss and Ride” and “Park and Ride,” respectively. Similar to the full-service scenario, stations on the northern half of the rail line are dependent on auto access, and the highest demand for park-and-ride facilities occurs at Whitmore Lake Station. Similarly, the number of North-South riders who access the Ann Arbor Station by walking is greater when considering the factored CTPP data.

In the full-service scenario, the majority of the boardings at the Barton Drive Station were made by walking, with the rest as transfers. With the elimination of the station in this option, the walk boardings do not seem to be diverted to another station, although the transfer boardings at the Ann Arbor Station increase greatly in this option for both sets of CTPP data in both years.

Table 19: Station Boardings by Access Mode Using Factored CTPP Data – Option 2: Full Service without Barton Drive Station

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	8	2	8	0	18	11	3	14	0	28
Genoa	0	3	10	0	13	0	5	16	0	21
Hamburg	0	11	35	0	46	0	15	53	0	69
Whitmore Lake	0	183	279	0	461	0	236	414	0	650
Ann Arbor	358	0	0	181	539	492	0	0	276	768
Total	365	200	331	181	1,077	503	260	497	276	1,536

Table 20 shows the weekday ridership along the three new connector routes in the 2015 opening year and 2040 build year. Route descriptions for the three bus connector routes are provided in Table 7. In 2040, weekday ridership is projected to be around 400 along the routes.

Table 20: Connector Bus Boardings – Option 2: Full Service without Barton Drive Station

Route Name	Year 2015	Year 2040
UMMC 1	38	55
UMMC 2	149	224
UM North	43	101
Total Weekday Boardings	230	380

Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations

The ridership forecasts for the “Starter” service option are presented in Table 21. The only stations in this option are Howell, Whitmore Lake, and Ann Arbor. Similar to Option 2, Full Service without the Barton Drive Station, the bus service is modified so that the buses depart the Ann Arbor Station five minutes after the arrival of a North-South train, and an additional bus is added from Ann Arbor Station to the UM North Campus. The bus service is presented in Table 7.

Table 21 shows the district-to-district summaries of average weekday trips for the factored CTPP data; information from the original CTPP data scenario can be found in Appendix I. The districts are shown in Figure 1. The total average weekday North-South ridership is forecasted to increase from 1,060 trips in 2015 to 1,504 trips in 2040. The overall ridership numbers are similar to Option 2, Full Service without Barton Drive Station.

Compared to the full service ridership forecasts presented in the prior section, exclusion of the three stations (Genoa, Hamburg, and Barton Drive) results in about a 35 to 40 percent reduction in trips. These differences are the same in both the base and forecast years.

Table 21: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 3: “Starter” Service

Average Weekday North-South Project Trips - Using Factored CTPP Data

Origin District	<u>Year 2015</u>							Destination District	<u>Year 2040</u>						
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL		UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL
District								District							
HOWEL	6	15	0	0	0	0	21	HOWEL	10	22	0	0	0	0	32
GENOA	11	9	0	0	0	0	20	GENOA	17	14	0	0	0	0	31
WHTMR	201	79	0	0	0	0	280	WHTMR	292	112	0	0	0	0	404
ANNAR	49	58	79	9	15	48	257	ANNAR	67	78	112	14	22	64	356
UMICH	10	49	201	11	6	80	356	UMICH	11	67	292	17	10	112	508
OTHER	80	48	0	0	0	0	127	OTHER	112	64	0	0	0	0	176
TOTAL	356	257	280	20	21	127	1,060	TOTAL	508	356	404	31	32	176	1,504

Table 22 shows average weekday station boardings by access mode. The label “XFER” refers to transfers made between local transit and North-South trains. The labels “KNR” and “PNR” refer to “Kiss and Ride” and “Park and Ride,” respectively.

Similar to the full-service configuration, stations on the northern half of the rail line are dependent on auto access, and the highest demand for park-and-ride facilities occurs at Whitmore Lake Station. The parking demand at Whitmore Lake Station is greater when using the factored CTPP data compared to the parking demand in the original CTPP data. Similarly, the number of North-South riders who access Ann Arbor Station by walking is greater when considering the factored CTPP data.

Table 22: Station Boardings by Access Mode Using Factored CTPP Data – Option 3: “Starter” Service

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	8	4	12	0	23	11	5	19	0	36
Whitmore Lake	0	192	314	0	506	0	248	468	0	717
Ann Arbor	344	0	0	185	529	472	0	0	280	752
Total	352	195	326	185	1,059	484	253	488	280	1,505

In the Full Service scenario, the majority of the boardings at the Barton Drive Station were made by walking, with the rest as transfers. The Hamburg Station was primarily accessed by kiss-and-ride, and the Genoa Station was accessed by park-and-ride, with a small number of kiss-and-ride boardings. With the elimination of these stations in this option, it appears as if many of the riders could be choosing not to use the system altogether, as total boardings at Howell and Whitmore Lake do not increase from the Full Service scenario. Similar to the full service option without Barton Drive Station, the Ann Arbor boardings increase, particularly in the transfer mode.

Table 23 shows weekday boardings along the three new connector bus routes in the 2015 and the 2040 forecast. Boardings on these three routes are generally lower than in Option 2, Full Service without Barton Drive Station.

Table 23: Connector Bus Boardings– Option 3: “Starter” Service

Route Name	Year 2015	Year 2040
UMMC 1	87	130
UMMC 2	55	74
UM North	36	73
Total Weekday Boardings	178	277

Option 4: Minimum Operating Configuration (MOC)

The 2015 and 2040 MOC ridership forecasts are shown in Table 24. Forecasts are provided for both the base model run and the model run that includes the free fare condition described in the previous section. AECOM blended the ridership results from the two model runs to create a final “blended” forecast for 2015 and 2040. For trips that begin or end in the University of Michigan district (“UMICH”), the blended forecasts use the ridership results from the model run with the free fare. For trips that begin and end outside of the UMICH district, the blended forecasts use the ridership results from the base model run.

Ridership is projected to increase from 718 daily trips in 2015 to 1,099 daily trips in 2040, with about half of the daily trips made between the Whitmore Lake district and the UMICH or Ann Arbor districts. Another ten percent of daily trips are made between the Genoa or Howell districts and the UMICH or Ann Arbor districts. Some trips also are forecasted to begin or end outside of the North-South rail corridor in the “OTHER” district.

Table 24: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 4: Minimum Operating Configuration

Average Weekday North-South Project Trips - Base Model Run

Origin District	Year 2015							Destination District	Year 2040							
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL
HOWEL	5	5	0	0	0	0	0	9	HOWEL	9	7	0	0	0	0	16
GENOA	18	5	0	0	0	0	0	23	GENOA	33	8	0	0	0	0	40
WHTMR	101	42	0	0	0	0	0	142	WHTMR	172	58	0	0	0	0	230
ANNAR	39	42	42	5	5	28	0	160	ANNAR	58	55	58	8	7	37	222
UMICH	7	39	101	18	5	62	0	231	UMICH	8	58	172	33	9	95	375
OTHER	62	28	0	0	0	0	0	90	OTHER	95	37	0	0	0	0	132
TOTAL	231	160	142	23	9	90	0	654	TOTAL	375	222	230	40	16	132	1,014

Average Weekday North-South Project Trips - Model Run with Free Fares

Origin District	Year 2015							Destination District	Year 2040							
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL
HOWEL	6	5	0	0	0	0	0	11	HOWEL	12	8	0	0	0	0	19
GENOA	19	6	0	0	0	0	0	25	GENOA	34	9	0	0	0	0	42
WHTMR	121	49	0	0	0	0	0	170	WHTMR	202	68	0	0	0	0	269
ANNAR	44	47	49	6	5	32	0	183	ANNAR	64	62	68	9	8	41	250
UMICH	9	44	121	19	6	65	0	264	UMICH	10	64	202	34	12	97	417
OTHER	65	32	0	0	0	0	0	97	OTHER	97	41	0	0	0	0	138
TOTAL	264	183	170	25	11	97	0	748	TOTAL	417	250	269	42	19	138	1,135

Average Weekday North-South Project Trips – Blended

Origin District	Year 2015							Destination District	Year 2040						
	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER		TOTAL	District	UMICH	ANNAR	WHTMR	GENOA	HOWEL
HOWEL	6	5	0	0	0	0	11	HOWEL	12	7	0	0	0	0	19
GENOA	19	5	0	0	0	0	24	GENOA	34	8	0	0	0	0	41
WHTMR	121	42	0	0	0	0	163	WHTMR	202	58	0	0	0	0	259
ANNAR	44	42	42	5	5	28	165	ANNAR	64	55	58	8	7	37	228
UMICH	9	44	121	19	6	65	264	UMICH	10	64	202	34	12	97	417
OTHER	65	28	0	0	0	0	93	OTHER	97	37	0	0	0	0	134
TOTAL	264	165	163	24	11	93	718	TOTAL	417	228	259	41	19	134	1,097

Table 25 shows the number of average weekday station boardings by access mode for 2015 and 2040. These results are from the blended forecasts to assist in modelling the free fares, as explained above. The number of riders who park and ride at the Whitmore Lake Station is forecasted to increase from 200 in 2015 to 341 in 2040. The number of riders who access Barton Drive Station by local transit is forecasted to increase from 336 in 2015 to 496 in 2040. The label “XFER” refers to transfers made between local transit and North-South trains. The labels “KNR” and “PNR” refer to “Kiss and Ride” and “Park and Ride,” respectively.

Table 25: Station Boardings by Access Mode – Option 4: Minimum Operational Configuration

<u>Year 2015</u>					
STATION	WALK	KNR	PNR	XFER	TOTAL
Whitmore Lake	0	159	200	0	359
Barton Drive	23	0	0	336	359
<u>Year 2040</u>					
STATION	WALK	KNR	PNR	XFER	TOTAL
Whitmore Lake	0	208	341	0	549
Barton Drive	53	0	0	496	548

Table 26 shows the forecasted weekday bus boardings for the North-South connector bus routes that provide transit service from Barton Drive Station to the surrounding Ann Arbor area. Connector bus route descriptions are provided in Table 5. Route 1 is forecasted to serve the most riders relative to the other four connector routes, and overall connector bus ridership is forecasted to grow from 451 boardings in 2015 to 651 boardings in 2040. Because the overall route ridership is greater than the number of transit transfers made at Barton Drive Station, the ridership forecasts suggest the connector bus routes will transport some riders who do not use the North-South train service.

Table 26: Connector Bus Routes – Option 4: Minimum Operational Configuration

Route Name	Year 2015	Year 2040
Route 1	161	260
Route 2	69	92
Route 3	64	87
Route 4	100	125
Route 5	56	87
Total Weekday Boardings	451	651

Option 5A: Shuttle Service (one train set) with Whitmore Lake/Barton Drive/Ann Arbor Stations

As can be seen in the previous option runs, the Whitmore Lake station did not have any walk access boardings as the station was over 1.7 miles away from the zone centroid, and hence STOPS was considering it as 'not walk accessible'. For the Option 5A and Option 5B runs, the station location was changed slightly closer to centroid to enable 'walk' access. This is more a work around to have walk access trips at Whitmore Lake station. This change does not have impact on boardings at other stations. Table 27 represents the district –to –district summaries for the average weekday trips for the Original CTPP data. Figure 1 shows the district system used in the model.

Table 27: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 5A: Shuttle Service (one train set)

Average Weekday North-South Project Trips - Using Original CTPP Data

Origin District	Year 2015							Destination District	Year 2040						
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL		District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER
HOWEL	7	6	0	0	0	0	12	HOWEL	12	9	0	0	0	0	20
GENOA	22	8	0	0	0	0	30	GENOA	37	13	0	0	0	0	50
WHTMR	194	88	0	0	0	0	281	WHTMR	297	121	0	0	0	0	418
ANNAR	131	115	88	8	6	46	393	ANNAR	189	155	121	13	9	61	547
UMICH	44	131	194	22	7	94	491	UMICH	56	189	297	37	12	136	726
OTHER	94	46	0	0	0	0	140	OTHER	136	61	0	0	0	0	196
TOTAL	491	393	281	30	12	140	1,346	TOTAL	726	547	418	50	20	196	1,956

Table 28 below shows the average weekday station boardings by access mode for Option 5A. As noted previously, the labels “KNR” and “PNR” refer to ‘Kiss and Ride’ and ‘Park and Ride’ respectively, and “XFER” refers to transfers between local transit and North-South trains. The STOPS model predicts average weekday boardings of 1,242 for the year 2015 and 1,832 for the year 2040. Stations away from downtown, Whitmore Lake, are dependent on auto access and stations close to downtown have more walk access trips.

Table 28: Station Boardings by Access Mode Using Original CTPP Data – Option 5A: Shuttle Service (one train set)

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Whitmore Lake	52	192	302	0	546	66	251	486	0	803
Barton Drive	261	2	0	120	383	382	2	0	191	575
Ann Arbor	315	7	38	54	414	430	9	65	74	578
Total	628	201	340	174	1,343	878	262	551	265	1,956

Table 29 shows the weekday ridership along the new connector routes. Table 5 provides the route descriptions for the five bus routes. The model predicts 153 boardings in year 2015 and 205 boardings for the year 2040.

Table 29: Connector bus boardings– Option 5A: Shuttle Service (one train set)

STOPS Model Boardings		
Route Name	Year 2015	Year 2040
Route 1	1	2
Route 2	63	95
Route 3	36	45
Route 4	30	35
Route 5	23	28
Total Weekday Boardings	153	205

Option 5B: Shuttle Service (two train sets) with Whitmore Lake/Barton Drive/Ann Arbor Stations

Option 5B has roughly 30 minute peak headways, better than the one hour headway for Option 5A. Hence the two train set option has higher boardings compared to the one train set option. As mentioned before the Whitmore station location was changed slightly closer to centroid to enable ‘walk’ access. Table 30 represents the district –to –district summaries for the average weekday trips for the Original CTPP data. Figure 1 shows the district system used in the model.

Table 30: District-to-District Summaries of Average Weekday Linked Trips on Project by North-South Rail – Option 5B: Shuttle Service (two train sets)

Average Weekday North-South Project Trips - Using Original CTPP Data

Origin District	Year 2015							Destination District	Year 2040						
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL		District	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER
HOWEL	9	8	0	0	0	0	17	HOWEL	16	12	0	0	0	0	28
GENOA	32	10	0	0	0	0	42	GENOA	55	15	0	0	0	0	69
WHTMR	209	110	0	0	0	0	319	WHTMR	324	152	0	0	0	0	475
ANNAR	184	156	110	10	8	59	526	ANNAR	258	210	152	15	12	77	723
UMICH	59	184	209	32	9	111	603	UMICH	75	258	324	55	16	161	887
OTHER	111	59	0	0	0	0	169	OTHER	161	77	0	0	0	0	238
TOTAL	603	526	319	42	17	169	1,674	TOTAL	887	723	475	69	28	238	2,419

Table 31 below shows the average weekday station boardings by access mode for Option 6. As noted previously, the labels “KNR” and “PNR” refer to ‘Kiss and Ride’ and ‘Park and Ride’ respectively, and “XFER” refers to transfers between local transit and North-South trains. Unlike Option1, this option has two AM Northbound and two PM southbound trips. The STOPS model predicts average weekday boardings of 1,676 for the year 2015 and 2,419 for the year 2040. This is higher compared to the Option 1. Similar to Option 5, auto access seems to be the most preferred for stations away from downtown, Whitmore Lake, while walk access is more preferred for stations closer to downtown.

Table 31: Station Boardings by Access Mode Using Original CTPP Data – Option 5B: Shuttle Service (two train sets)

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Whitmore Lake	52	230	368	0	650	66	300	589	0	955
Barton Drive	371	3	0	77	451	547	3	0	125	675
Ann Arbor	412	13	61	89	575	558	15	95	121	789
Total	835	246	429	166	1,676	1,171	318	684	246	2,419

Table 32 shows the weekday ridership along the new connector routes. Table 5 provides the route descriptions for the five bus routes. The model predicts 154 boardings in year 2015 and 208 boardings for the year 2040.

Table 32: Connector bus boardings– Option 5B: Shuttle Service (two train sets)

STOPS Model Boardings		
Route Name	Year 2015	Year 2040
Route 1	1	2
Route 2	64	98
Route 3	36	45
Route 4	30	35
Route 5	23	28
Total Weekday Boardings	154	208

5. RANGE OF FORECASTS AND SUMMARY

The six service options examined in this memorandum include full service, full service with the removal of Barton Drive Station, “Starter” service with Howell, Whitmore Lake and Ann Arbor Stations, the Minimum Operating Configuration and Shuttle Service with one and two train sets. Since the options evolved over time and in some cases different input assumptions were used at the time each STOPS run was completed an attempt was made to range the forecasts using a consistent “umbrella” set of assumptions. Ranges of forecasts that take differing inputs into account are considered “good practice” by the Federal Transit Administration during New Starts Project Development and so an early look at such a range is beneficial.

Table 33 shows the range of trips on the project in 2015 and 2040. The lower bound considers the original CTPP data and assumes full fares for all riders. The upper bound is calculated using the factored CTPP data and free fares for the University of Michigan community. For Options 1, 2, and 3, the free fare ridership numbers were calculated by applying a factor for trips to and from the UMICH district based on the free-fare scenario modeled in Option 4. The differences between the upper bound and lower bound are about 150-300 riders for each option in both 2015 and 2040.

Table 33: Range of Forecasts for Options 1-5B

Option	Year 2015		Year 2040	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
1 Full Service	1,590	1,840	2,290	2,570
2 Full Service without Barton Drive Station	970	1,190	1,410	1,670
3 “Starter” Service	970	1,170	1,410	1,640
4 MOC	650	800	1,010	1,190
5A Shuttle Service (one train set)	1,300	1,500	1,910	2,140
5B Shuttle Service (two train sets)	1,610	1,870	2,420	2,650

Note: Option 4 (MOC), 5A and 5B were not modeled using the factored CTPP data; a post-model adjustment factor was applied to the numbers in the table to mimic the effects of the factored CTPP data.

For the purposes of evaluating options, the upper bound value for 2015 and “midpoint” for 2040 are used. These are shown in Table 33. In addition, the rail mode share of eligible person trips is presented in Table 34. The mode shares were calculated for the districts of Genoa, Howell and Whitmore Lake. The total transit trips were divided by the total of home-based work trips in the districts that the STOPS model shows to be using the commuter rail system. The home-based work trips are factored by 43.27 percent; this number is based on CTPP 2000 data and the percentage of workers in those districts that

leave for work between 7 and 9 am, to be consistent with the STOPS model. STOPS estimated trips for an average weekday peak period factor developed by offsetting the time of arrival at work from the source CTPP dataset by one hour to account for commute times. While “closer in” trips may have an offset of less than an hour, this high level assumption is adequate for developing peak factors.

Table 34: Mode Share Summary by Option, Years 2015 and 2040

Option	Project Trips	2015 Mode Share (AM and PM peak)	Mode Share (Avg. Weekday)	Project Trips	2040 Mode Share (AM and PM peak)	Mode Share (Avg. Weekday)
1 Full Service	1,840	8%	3%	2,346	10%	4%
2 Full Service, removal of Plymouth/Barton Road	1,190	7%	3%	1,540	8%	3%
3 Starter Service	1,170	6%	3%	1,500	8%	3%
4 MOC	800	4%	2%	1,100	6%	3%
5A Shuttle Service (one train set)	1,346	8%	3%	1,956	10%	4%
5B Shuttle Service (two train sets)	1,674	8%	3%	2,419	10%	4%

SEMCOG developed a market analysis with their travel forecasting model for years 2035 (2035 RDF) and a 2010 (2010 RDF) base year. The results of the SEMCOG market analysis are presented in Appendix II. Since SEMCOG’s trip distribution data and procedures are more recent than the Year 2000 CTPP Journey to Work (JtW) flows in the STOPS model AECOM analyzed potential station boardings for Option 1 by reallocating the STOPS model results with SEMCOG’s distribution. Table 35 shows the station boarding estimates using the SEMCOG distribution. This represents a slightly different distribution from that forecast by stops (Table 16). However, the overall number of boardings is not that different.

Table 35: Station Boardings by Station – Option 1: Full Service, reallocated with SEMCOG distribution

Station	Year 2015	Year 2040
Howell	95	124
Genoa	59	77
Hamburg	164	213
Whitmore Lake	444	578
Barton Drive	439	579
Ann Arbor	639	774
Total	1,840	2,346

Source: AECOM

References

1. Ann Arbor Area Transportation Authority. "North-South Commuter Rail". Accessed April 6, 2015. Retrieved from <http://www.theride.org/AboutUs/Initiatives/NorthSouthCommuterRail>
2. Federal Transit Administration. "An Overview of STOPS". Accessed on August 17, 2015. Retrieved from <http://www.fta.dot.gov/documents/STOPS.overview-web-final.pdf>
3. National Transit Database 2013 Transit Agency Profile. "Ann Arbor Area Transportation Authority". Accessed April 6, 2015. Retrieved from http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2013/agency_profiles/5050.pdf
4. National Transit Database 2013 Transit Agency Profile. "The University of Michigan Parking and Transportation Services". Accessed April 6, 2015. Retrieved from http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2013/agency_profiles/5151.pdf

APPENDIX I: STOPS MODEL RUNS FOR OPTIONS 1, 2 AND 3

Appendix I contains additional tables created from the STOPS model runs for Options 1, 2 and 3. The tables in the Appendix contain the information from the “original” CTPP STOPS model runs; the main body of this report contains the information created from the STOPS models where the factored CTPP data was used. All of these tables were sourced from STOPS model outputs.

List of Tables in this section:

Table 36 – District-to-District Summaries of Average Weekday Trips by All Modes – All Options

Table 37 – District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 1: Full Service

Table 38 – Station Boardings by Access Mode – Option 1: Full Service

Table 39 – District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 2: Full Service without Barton Drive Station

Table 40 – Station Boardings by Access Mode – Option 2: Full Service without Barton Drive Station

Table 41 – Connector Bus Boardings – Option 2: Full Service without Barton Drive Station

Table 42 – District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations

Table 43 – Station Boardings by Access Mode – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations

Table 44 – Connector Bus Boardings – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations

Table 36: District-to-District Summaries of Average Weekday Trips by All Modes – All options

Average Weekday Person Trips (Original CTPP Data)

Origin District	Year 2015							Year 2040							
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	
District								District							
HOWEL	520	2,136	14,445	29,697	117,046	18,958	182,801	HOWEL	663	2,776	18,385	39,709	151,218	23,680	236,430
GENOA	1,394	3,479	30,826	60,508	29,697	16,195	142,097	GENOA	1,773	4,533	40,458	84,283	39,709	20,523	191,279
WHTMR	10,077	33,444	146,168	30,826	14,445	96,500	331,459	WHTMR	11,979	40,678	183,620	40,458	18,385	115,566	410,685
ANNAR	182,417	938,810	33,444	3,479	2,136	168,781	1,329,065	ANNAR	220,089	1,153,194	40,678	4,533	2,776	198,986	1,620,255
UMICH	98,123	182,417	10,077	1,394	520	20,235	312,765	UMICH	114,630	220,089	11,979	1,773	663	22,921	372,054
OTHER	20,235	168,781	96,500	16,195	18,958	4,028,298	4,348,965	OTHER	22,921	198,986	115,566	20,523	23,680	4,385,318	4,766,994
TOTAL	312,765	1,329,065	331,459	142,097	182,801	4,348,965	6,647,151	TOTAL	372,054	1,620,255	410,685	191,279	236,430	4,766,994	7,597,696

Table 37: District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 1: Full Service (Original CTPP Data)

Origin District	Year 2015							Year 2040							
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL	
District								District							
HOWEL	16	16	0	0	0	0	32	HOWEL	28	23	0	0	0	0	51
GENOA	36	11	0	0	0	0	47	GENOA	60	17	0	0	0	0	77
WHTMR	214	93	0	0	0	0	307	WHTMR	336	131	0	0	0	0	466
ANNAR	125	160	93	11	16	61	466	ANNAR	167	211	131	17	23	80	628
UMICH	71	125	214	36	16	108	569	UMICH	88	167	336	60	28	159	836
OTHER	108	61	0	0	0	0	169	OTHER	159	80	0	0	0	0	238
TOTAL	569	466	307	47	32	169	1,588	TOTAL	836	628	466	77	51	238	2,294

Table 38: Station Boardings by Access Mode – Option 1: Full Service (Original CTPP Data)

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	10	3	13	0	26	14	4	22	0	40
Genoa	0	7	25	0	32	0	9	44	0	53
Hamburg	0	13	0	0	13	0	17	0	0	17
Whitmore Lake	0	214	368	0	582	0	277	581	0	858
Barton Drive	290	3	0	120	413	431	4	0	187	622
Ann Arbor	429	1	16	76	522	579	2	21	103	705
Total	729	241	422	196	1,588	1,024	313	668	290	2,295

Table 39: District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 2: Full Service without Barton Drive Station (Original CTPP Data)

Origin District	Year 2015							Destination District	Year 2040						
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL		UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL
District								District							
HOWEL	11	14	0	0	0	0	25	HOWEL	18	21	0	0	0	0	39
GENOA	22	10	0	0	0	0	32	GENOA	37	15	0	0	0	0	52
WHTMR	134	83	0	0	0	0	216	WHTMR	207	117	0	0	0	0	324
ANNAR	47	63	83	10	14	51	267	ANNAR	65	85	117	15	21	69	371
UMICH	10	47	134	22	11	77	300	UMICH	12	65	207	37	18	109	447
OTHER	77	51	0	0	0	0	128	OTHER	109	69	0	0	0	0	177
TOTAL	300	267	216	32	25	128	966	TOTAL	447	371	324	52	39	177	1,408

Table 40: Station Boardings by Access Mode – Option 2: Full Service without Barton Drive Station (Original CTPP Data)

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	8	2	9	0	20	12	3	16	0	31
Genoa	0	5	15	0	20	0	7	26	0	34
Hamburg	0	15	51	0	65	0	20	79	0	99
Whitmore Lake	0	170	208	0	378	0	221	321	0	541
Ann Arbor	296	0	0	188	484	413	0	0	292	705
Total	304	192	283	188	967	424	251	442	292	1,410

Table 41: Connector Bus Boardings – Option 2: Full Service without Barton Drive Station (Original CTPP Data)

Route Name	Year 2015	Year 2040
UMMC 1	51	78
UMMC 2	152	229
UM North	42	101
Total Weekday Boardings	245	408

Table 42: District-to-District Summaries of Average Weekday Linked Trips by North-South Rail – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations (Original CTPP Data)

Origin District	Year 2015							Destination District	Year 2040						
	UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL		UMICH	ANNAR	WHTMR	GENOA	HOWEL	OTHER	TOTAL
HOWEL	12	15	0	0	0	0	26	HOWEL	20	22	0	0	0	0	41
GENOA	20	9	0	0	0	0	29	GENOA	33	14	0	0	0	0	47
WHTMR	142	79	0	0	0	0	221	WHTMR	219	113	0	0	0	0	331
ANNAR	49	58	79	9	15	48	257	ANNAR	67	78	113	14	22	64	356
UMICH	10	49	142	20	12	79	310	UMICH	11	67	219	33	20	110	459
OTHER	79	48	0	0	0	0	126	OTHER	110	64	0	0	0	0	174
TOTAL	310	257	221	29	26	126	968	TOTAL	459	356	331	47	41	174	1,407

Table 43: Station Boardings by Access Mode – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations (Original CTPP Data)

Station	Year 2015					Year 2040				
	WALK	KNR	PNR	XFER	TOTAL	WALK	KNR	PNR	XFER	TOTAL
Howell	9	4	16	0	29	12	6	27	0	45
Whitmore Lake	0	186	269	0	455	0	241	417	0	658
Ann Arbor	285	0	0	199	483	397	0	0	306	703
Total	293	190	285	199	967	409	247	444	306	1,406

Table 44: Connector Bus Boardings – Option 3: “Starter” Service with Howell, Whitmore Lake and Ann Arbor Stations (Original CTPP Data)

Route Name	Year 2015	Year 2040
UMMC 1	127	202
UMMC 2	57	78
UM North	36	73
Total Weekday Boardings	220	353

APPENDIX II: NORTH-SOUTH COMMUTER RAIL MARKET ANALYSIS

MEMO

Southeast Michigan Council of Governments

1001 Woodward Avenue, Suite 1400

Detroit, Michigan 48226

(313) 961-4266

DATE: February 1, 2016
TO: Project File
FROM: Saima Masud, Li-yang Feng, Jilan Chen, Brian Pawlik and Alex Bourgeau
SUBJECT: North-South Commuter Rail Market Analysis

SEMCOG is in the process of updating its travel demand forecast model from version E6 to E7. As part of this update, staff is reviewing and testing the current mode choice model performance in E6 for various transit modes, including Bus Rapid Transit and Commuter Rail.

Meanwhile, technical assistance was requested from the North South Commuter Rail feasibility study project team on ridership estimation. A preliminary ridership analysis was performed using the E6C+ model version built for 2040 Regional Transportation Plan. The model produced initial ridership estimation; however, due to limited resources corridor level model calibration was not performed.

As an alternative, a market based analysis approach was explored to provide a preliminary reference for ridership projections on the North-South Line.

This memo describes the background and observations of this market analysis, where some of the travel model output was also used.

Model Assumptions and Catchment Areas:

The analysis was performed with two model years, 2010 and 2035. The base year 2010 model was developed with 2040 Regional Development Forecast (RDF) with model version E6C+; whereas the future year 2035 model utilized 2035 RDF (Model Version E5). The reason for using year 2035 model was that N-S (WALLY) line was already included in both the travel model network and the RTP plan for that model run.

The first step of this process was to measure the market size or catchment area (Traffic Analysis Zones) by station. In order to define the catchment area for each stop, a model tool with select link like procedure was utilized. We selected four park and ride (PnR) stop locations (Howell, Genoa, Hamburg, Whitmore Lake) to estimate potential ridership, since the majority of the total ridership for N-S rail is expected to be in drive-access mode.

The resulting matrices from select link approach identified origin zones and destination parking lots for transit trips based on travel time, fare structure, parking impedances, etc.

A few manual adjustments were made to remove zones with very low probability of using the transit line. For each of the four PnR stop locations, we then had a trip catchment area.

Another assumption is that the catchment area for drive access covers the walk access area.

The N-S Rail line is the only transit line for areas north of Ann Arbor, trips to parking lots are assumed to be in-bound to Ann Arbor destinations.

Ridership Estimation:

Once the catchment areas were defined, the travel-model-estimated daily home-based work trips (commute) were aggregated from each catchment area to Ann Arbor zones (area roughly bounded by freeways). Please note that in the SEMCOG region, the peak period (defined as a sum of AM and PM peaks) work travel is about 60% of the daily travel.

In order to find the potential transit market, a transit mode share of 3% and 5% was applied to the total commute trips. This is based on known mode shares for the AAATA (5%) and other corridors in the region. This corridor has unique characteristics in the region and a higher mode share could be expected, but for technical modeling purposes known numbers were used.

Tables 1 and 2 shows total daily work trips, and potential transit market (5% and 3% mode shares) from these catchment areas to Ann Arbor from the model for 2010 and 2035 respectively.

Table 1: Daily Work Trips to and from Ann Arbor (Model Version E6C+, Year 2010)

Catchment Areas	# Zones In Catchment	Daily Work trips	5% of Work Travel	3% of Work Travel
Howell	40	3,018	151	91
Genoa	15	1,875	94	56
Hamburg	14	5,175	259	155
Whitmore	172	14,030	702	421
Total	241	24,098	1,205	723

Table 2: Daily Work Trips to and from Ann Arbor (Model Version E5, Year 2035)

Catchment Areas	# Zones In Catchment	Daily Work trips	5% of Work Travel	3% of Work Travel
Howell	42	4,360	218	131
Genoa	34	3,868	193	116
Hamburg	17	7,005	350	210
Whitmore	155	17,120	856	514
Total	248	32,354	1,618	971

Buffer Analysis on University of Michigan Employees:

As an additional reference, SEMCOG performed a buffer analysis using observed data of University of Michigan (U-M) employee residence zip codes, gathered from the University’s transportation department.

Table 3 looks at U-M employees in the station buffer areas. Unlike the previous tables, this represents one-way trips. For comparison, it results in 442 total trips (to work and back home).

We believe the U-M employees represent about 1/3 of total Ann Arbor employment, although this has not been confirmed by either the University or WATS. This was analyzed to get a sense of using actual work trips as opposed to model estimates.

Table 3: Daily Work Trips to the U-M

Station	Zip Codes	Total Employees	5% of Employees	Percent of Total Employees
Genoa	1	575	29	13.0
Hamburg	3	802	40	18.1
Howell	3	747	37	16.9
Howell-outregion	5	130	7	2.9
Howell-Total	8	877	44	20
Whitmore Lake	11	2,062	103	46.6
Whitmore Lake-outregion	7	107	5	2.4
Whitmore Lake-Total	18	2169	108	49
Total	30	4,423	221	100

Source: University of Michigan, 2015.

Summary of Findings

As a supplemental analysis to the “Ridership Forecasts for North-South Commuter Rail Feasibility Study”, SEMCOG staff performed PnR location based ridership analysis using Select Link analysis tools and catchment area conception. Market share based transit model share assumption was used.

Due to the nature of analysis, certain limitations of this analysis need to be considered. These estimates could provide a general reference for the project sketch planning, and by no means are the substitute for an in-depth transit alternatives study.

