APPENDIX E: RIDERSHIP & REVENUE FORECASTS AND OPERATING & MAINTENANCE COSTS

RIDERSHIP AND REVENUE FORECASTS

The information in this appendix includes the updated ridership analysis that was completed to forecast future ridership demands for the Chicago-Detroit/Pontiac Intercity Passenger Rail Corridor Program. The updated analysis was completed by the Program Team in 2014 to update preliminary demand forecasts for the 2025, 2035, 2045, and 2055 planning horizon years to identify the appropriate service scenario. The updated analysis is based on previous studies that were completed for the MWRRS Plan. To develop these forecasts the Program Team assembled data from existing sources to address the full range of route alternatives. Key issues considered by the Program Team included the geographic detail (e.g. analysis zones) needed to distinguish among alignment/station alternatives and the areas impacted by the proposed service. Key sources of travel data included data developed from previous studies, Amtrak ridership, FAA passenger data, other national data, the Volpe Center's inter-regional auto trip model, and Michigan, Indiana, and Illinois statewide model data.

The Program Team completed a series of Stated Preference Surveys in the fall of 2012 as well as used socioeconomic data and forecasts to estimate market growth throughout the Program Corridor market. Three key measures used in the model include population/households, employment, and personal income. Data and forecasts provided by each state DOT were used in Michigan, Indiana, and Illinois. These data sources were supplemented by national economic data (Woods & Poole) and forecasts prepared by appropriate sources.

Current service characteristics provided the Program Team with key independent variables required for mode choice modeling and developing the base year calibration. The major mode specification characteristics used in the model included line haul travel time, access/egress time, travel cost, and frequency of service. Key inputs were refined and updated based on highway network and service data obtained from: service data developed by previous forecasting efforts completed by the Program Partners; Michigan, Indiana, and Illinois statewide highway network and service data; published timetables (air, rail, etc.); average auto costs (based on latest data and estimates for fuel prices and other operating costs); and published fares (or average yields).

Once all the new inputs and data identified above were assembled, the ridership model was reviewed and adjusted as needed to match existing conditions. This entailed applying the ridership model to the existing conditions and adjusting it so that it accurately forecasts the actual current ridership volumes. The results of this analysis are presented in rest of this appendix.

Prepared for:

MDOT
Michigan Department of Transportation

Chicago-Detroit/Pontiac Passenger Rail Corridor Investment Plan Alternatives Identification and Evaluation

Prepared by:

TEMS

Transportation Economics & Management Systems, Inc.

1 MARKET ANALYSIS

1.1 OVERVIEW OF EXISTING TRAVEL MARKET

The Michigan passenger rail system consists of three corridors, namely the Chicago-Detroit/Pontiac corridor, the Chicago-Grand Rapids corridor, and the Chicago-Battle Creek-Port Huron corridor. It is one of the busiest passenger rail systems in the Midwest region, and the Chicago-Detroit/Pontiac corridor is the most important corridor in Michigan. The state of Michigan has 83 counties, the US Census Bureau estimated that the population of the state was 9.88 million in 2012. Michigan hosts a large number of finance and business services, manufacturing facilities, universities, military bases, and research and high-tech industry. The Bureau of Economic Analysis data shows that the state had nearly five million jobs and per capita income was $26,367 in 2012. The Bureau of Economic Analysis data and Woods & Poole Economics projections indicate that Michigan's demographic and economic growth will continue over the next several decades, the population is projected to be 10.85 million in 2040, employment will be 5.67 million in 2040, and per capita income is projected to be $42,237 in 2040 in 2012 dollars.

The Michigan passenger rail corridors have a high level of business and commuter travel between its urban areas together with significant social and tourist travel. The total annual intercity trips in the corridors are estimated to be 138.6 million in 2012.

Exhibit 1-1 shows the current Michigan intercity passenger rail system. The mainline runs from Chicago to Detroit and Pontiac, it has three daily round trips. In addition, there are two branch lines: Chicago to Grand Rapids with one daily round trip and Chicago to Battle Creek and Port Huron with one daily round trip. The passenger rail system serves 22 Michigan communities: New Buffalo, Niles, Dowagiac, Kalamazoo, Battle Creek, Albion, Jackson, Ann Arbor, Dearborn, Detroit, Royal Oak, Birmingham, Pontiac, East Lansing, Durand, Flint, Lapeer, Port Huron, St. Joseph-Benton Harbor, Bangor, Holland, and Grand Rapids. The passenger rail system also serves Chicago in Illinois, and Hammond-Whiting and Michigan City in Indiana.

The total ridership in these corridors in 2012 was 792,769, with 495,277 riders in the Chicago-Detroit/Pontiac Corridor, 109,501 riders in the Chicago-Grand Rapids (Holland) Corridor and 187,991 riders in the Chicago-Battle Creek-Port Huron Corridor.

Exhibit 1-1: Michigan's Intercity Passenger Rail System

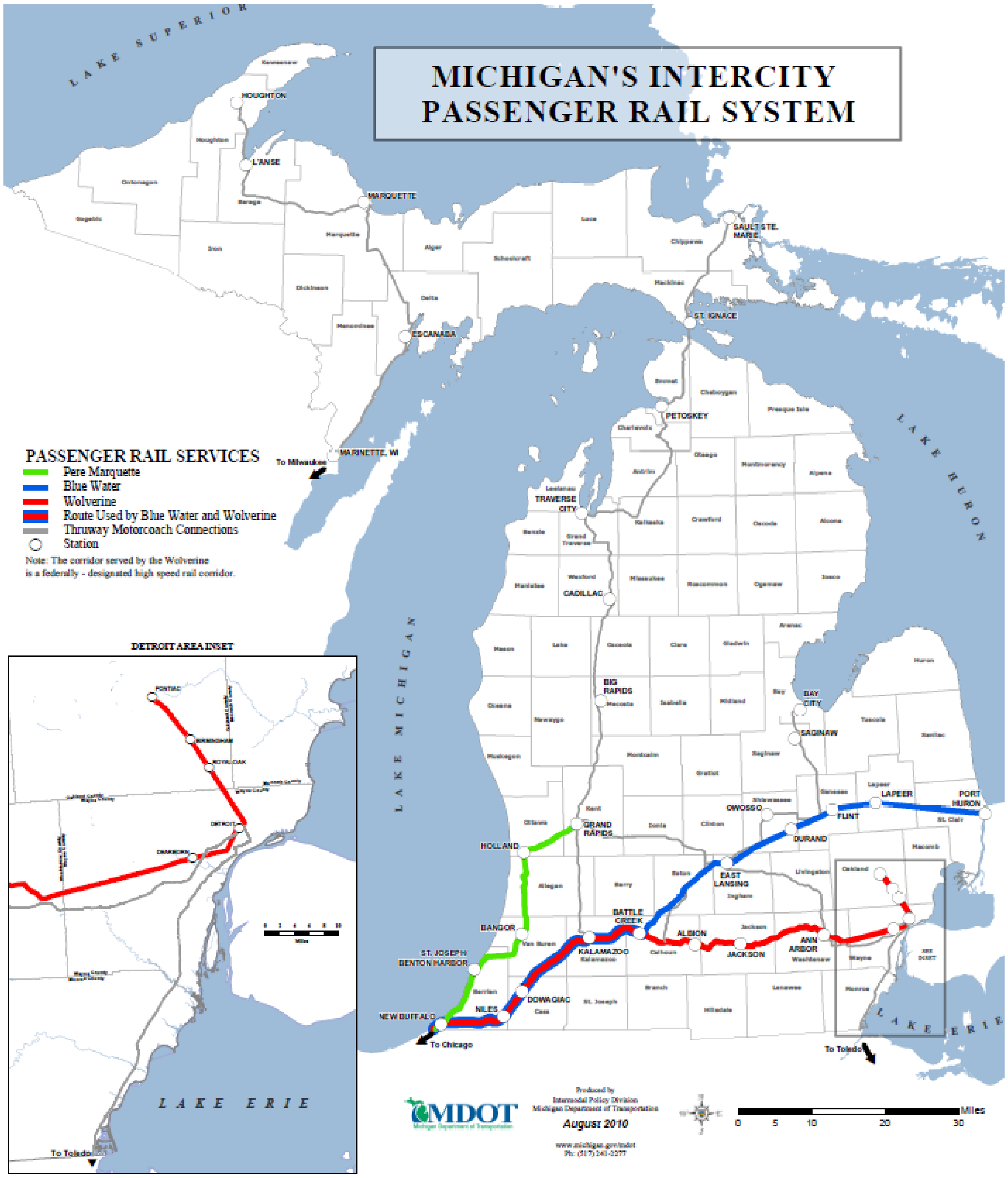
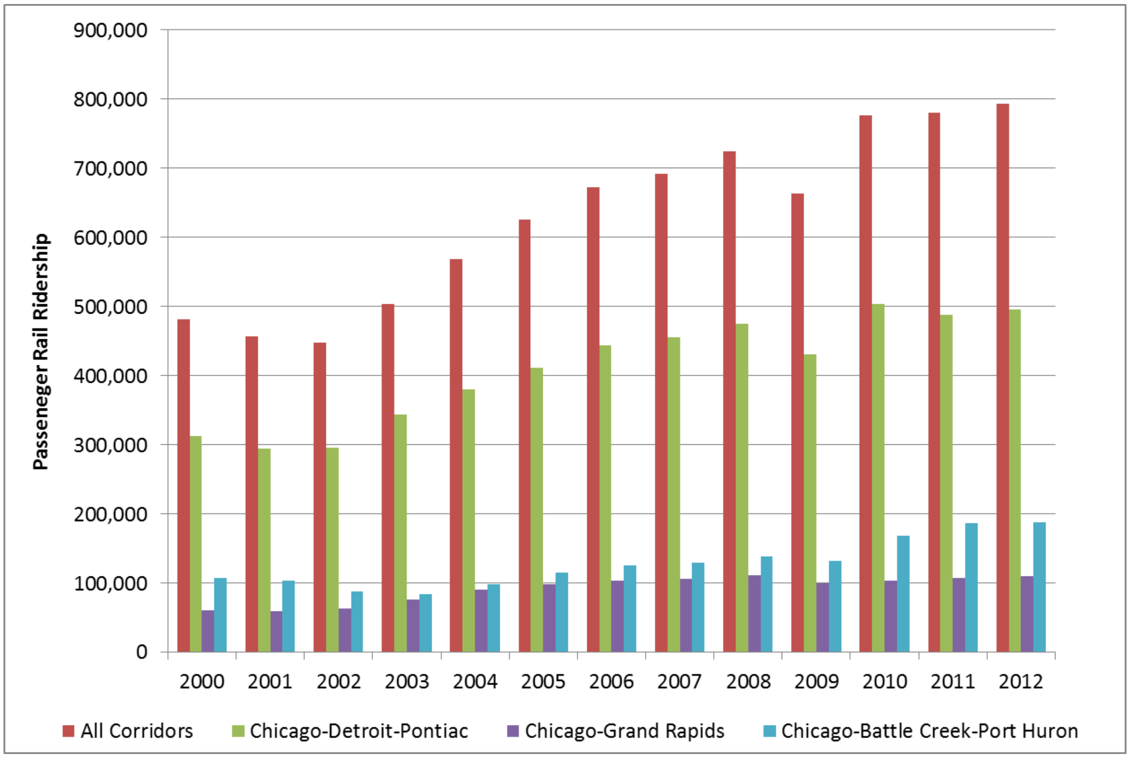


Exhibit 1-2 shows the historical Michigan rail ridership data from 2000 to 2012. The data indicates a trend of passenger rail travel growth in Michigan. The passenger rail travel decreases occurring in 2001 and 2009 were due to economic recessions where ridership drops were seen nationwide. It can be seen that the rail ridership increases from 481,223 in 2000 to 792,769 in 2012, a 64.7 percent increase or an average annual growth of 4.25 percent.

Exhibit 1-2: Historical Michigan Rail Travel Data



1.2 BASIC STRUCTURE OF THE COMPASS™ TRAVEL MARKET FORECAST MODEL

For the purpose of this study ridership and revenue forecast will be made using the COMPASS™ Travel Demand Model. The COMPASS™ Multimodal Demand Forecasting Model is a flexible demand forecasting tool used to compare and evaluate alternative passenger rail network and service scenarios. It is particularly useful in assessing the introduction or expansion of public transportation modes such as air, bus or high-speed rail into markets. Exhibit 1-3 shows the structure and working process of the COMPASS™ Model. As shown, the inputs to the COMPASS™ Model are base and proposed transportation networks, base and projected socioeconomic data, value of time and value of frequency from Stated Preference surveys, and base year travel data obtained from government agencies and transportation service operators.

The COMPASS™ Model structure incorporates two principal models: a Total Demand Model and a Hierarchical Modal Split Model. These two models are calibrated separately. In each case, the models are calibrated for origin-destination trip making in the study area. The Total Demand Model provides a mechanism for replicating and forecasting the total travel market. The total number of trips between any two zones for all modes of travel is a function of (1) the socioeconomic characteristics of the two zones and (2) the travel opportunities provided by the overall transportation system that exists (or will exist) between the two zones. Typical socioeconomic variables include population, employment and income. The quality of the transportation system is measured in terms of total travel time and travel cost by all modes, and the induced demand is estimated by considering the change in quality of travel offered by all modes.

The role of the COMPASS™ Modal Split Model is to estimate relative modal shares of travel given the estimation of the total market by the Total Demand Model. The relative modal shares are derived by comparing the relative levels of service (as estimated by generalized costs) offered by each of the travel modes. Three levels of binary choice were used in this study (see Exhibit 1-4). The first level separates rail services from bus services. The second level of the hierarchy separates air travel, the fastest and most expensive mode of travel, from surface modes of rail and bus services. The third level separates auto travel with its perceived spontaneous frequency, low access/egress times, and highly personalized characteristics, from public modes (i.e., air, rail and bus). The model forecasts changes in riders, revenue and market share based on changes travel time, frequency and cost for each mode as measured by the generalized costs for each mode. A more detailed description of the COMPASS™ Model is given in Appendix 2.

Exhibit 1-3: Structure of the COMPASS™ Model

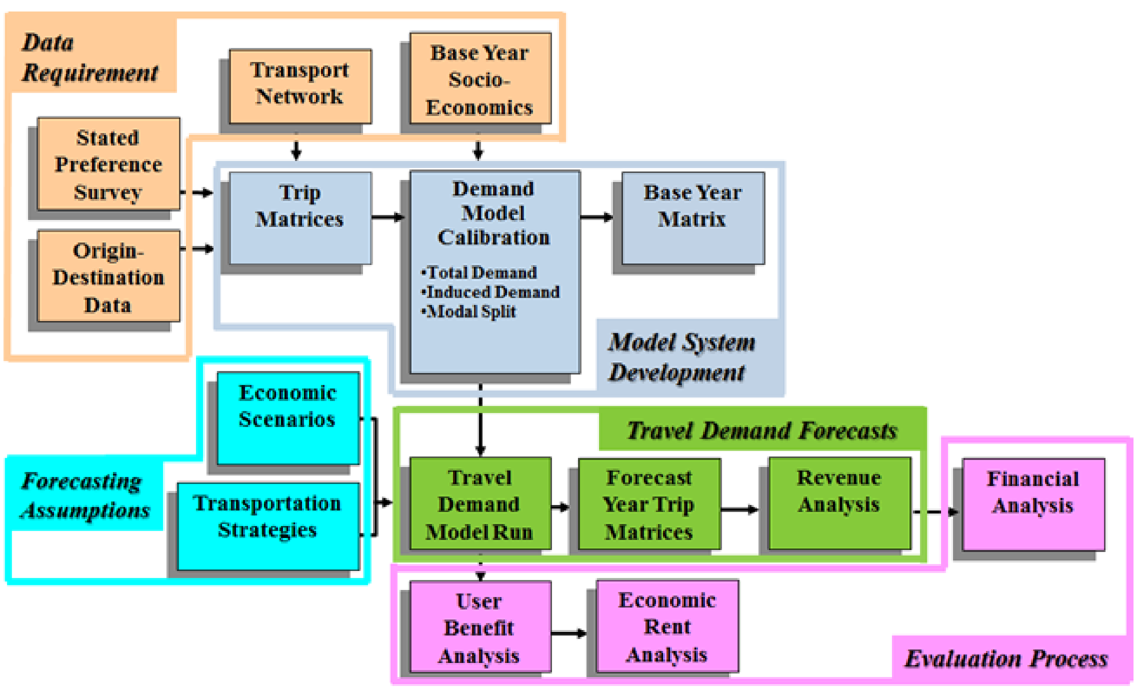
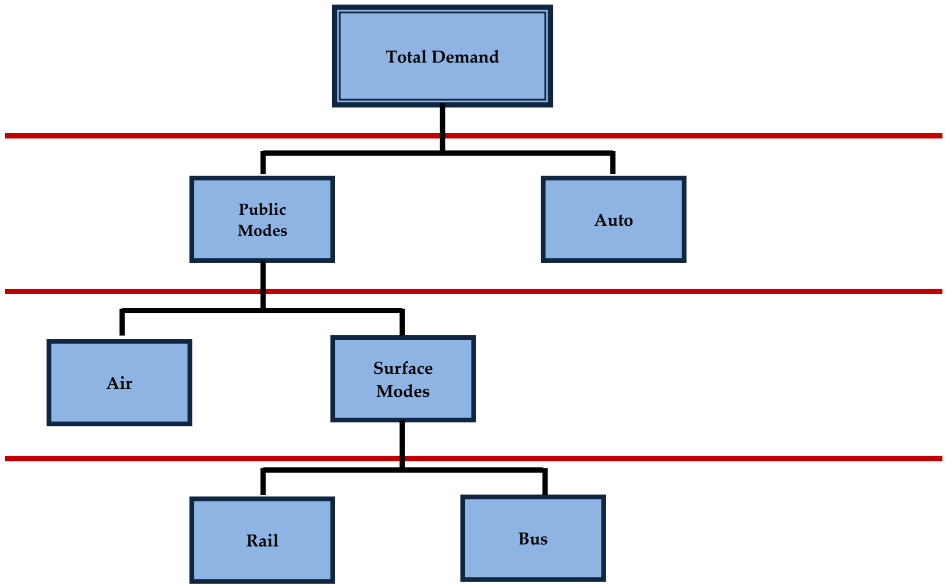


Exhibit 1-4: Hierarchical Structure of the Modal Split Model



A key element in evaluating passenger rail service is the comprehensive assessment of the travel market in the corridor under study, and how well the passenger rail service might perform in that market. For the purpose of this study, this assessment was accomplished using the following process –

- Building the zone system that enables more detailed analysis of the origin-destination travel market and the development of base year and future socioeconomic data for each zone.
- Compiling information on the service levels (times, fares, frequency, costs) in the corridor for auto, air, bus, and the proposed passenger rail travel.
- Identifying and quantifying factors that influence travel choices, including values of time, frequency and access/egress time.
- Developing strategies that quantify how travel conditions will change, including future gas price, future vehicle fuel efficiency improvement, and highway congestion.
- Developing and calibrating total travel demand and modal split models for travel demand forecasting.
- Forecasting travel, including total demand and modal shares.

The following sections document the modeling process and the forecasting results.

1.3 Zone Definition

The zone system provides a representation of the market areas among which travel occurs from origins to destinations. For intercity passenger rail planning, most rural zones can be represented by larger areas. However, where it is important to identify more refined trip origins and destinations in urban areas, finer zones are used. The travel demand model forecasts the total number of trip origins and destinations by mode and by zone pair. Because the MWRRI developed an integrated rail network for the Midwest, a zone system is needed that incorporates all the corridors of MWRRI. To meet this need, a 595-zone system was developed for the Midwest study area based on aggregation of the 2010 census tracts and traffic analysis zones (TAZs) of local transportation planning agencies. Exhibit 1-5 shows the zone system for the Midwest study area. Exhibit 1-6 shows the zones in the Chicago-Detroit/Pontiac corridor area.

Exhibit 1-5: Midwest Study Area Zone System

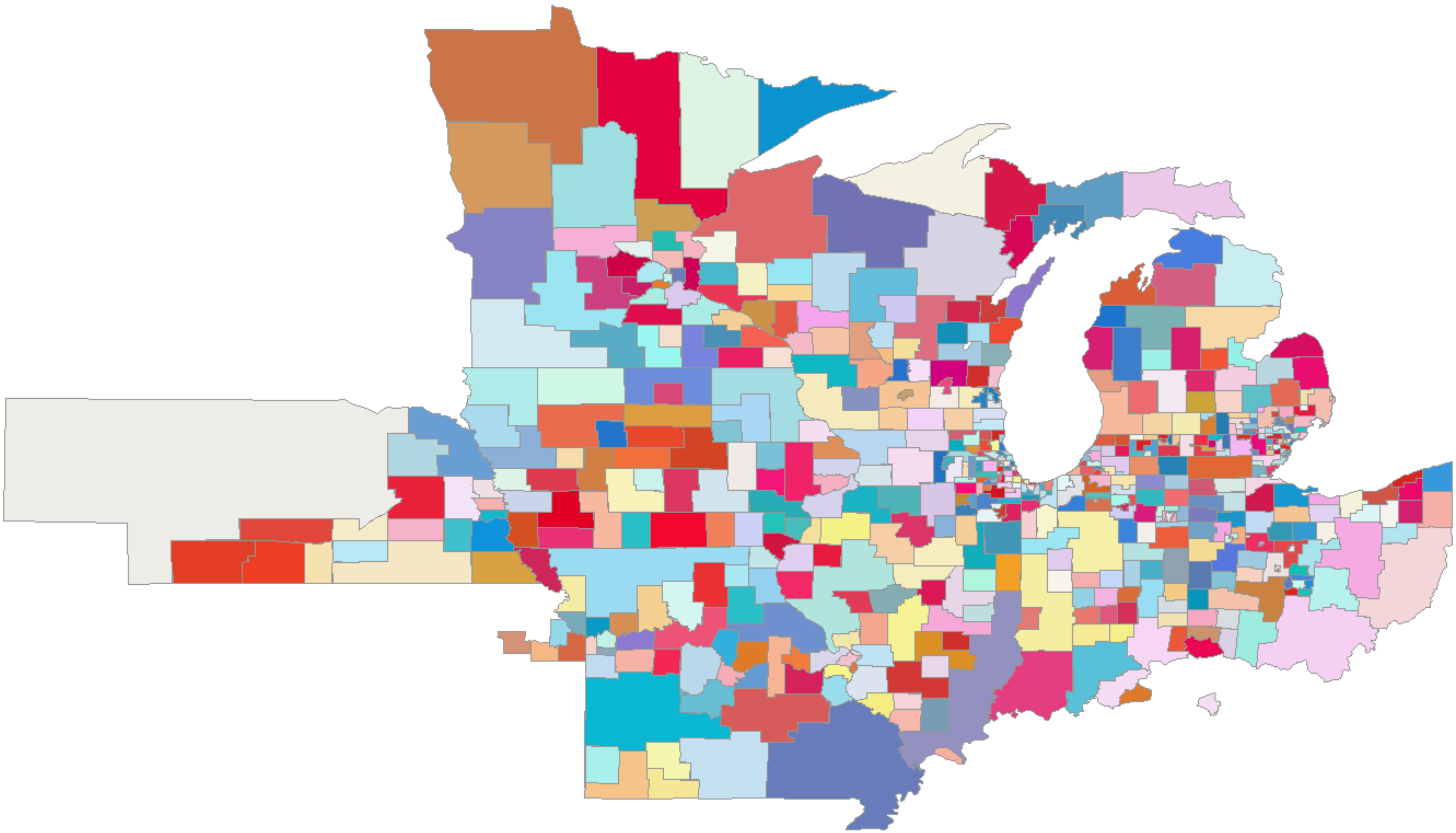
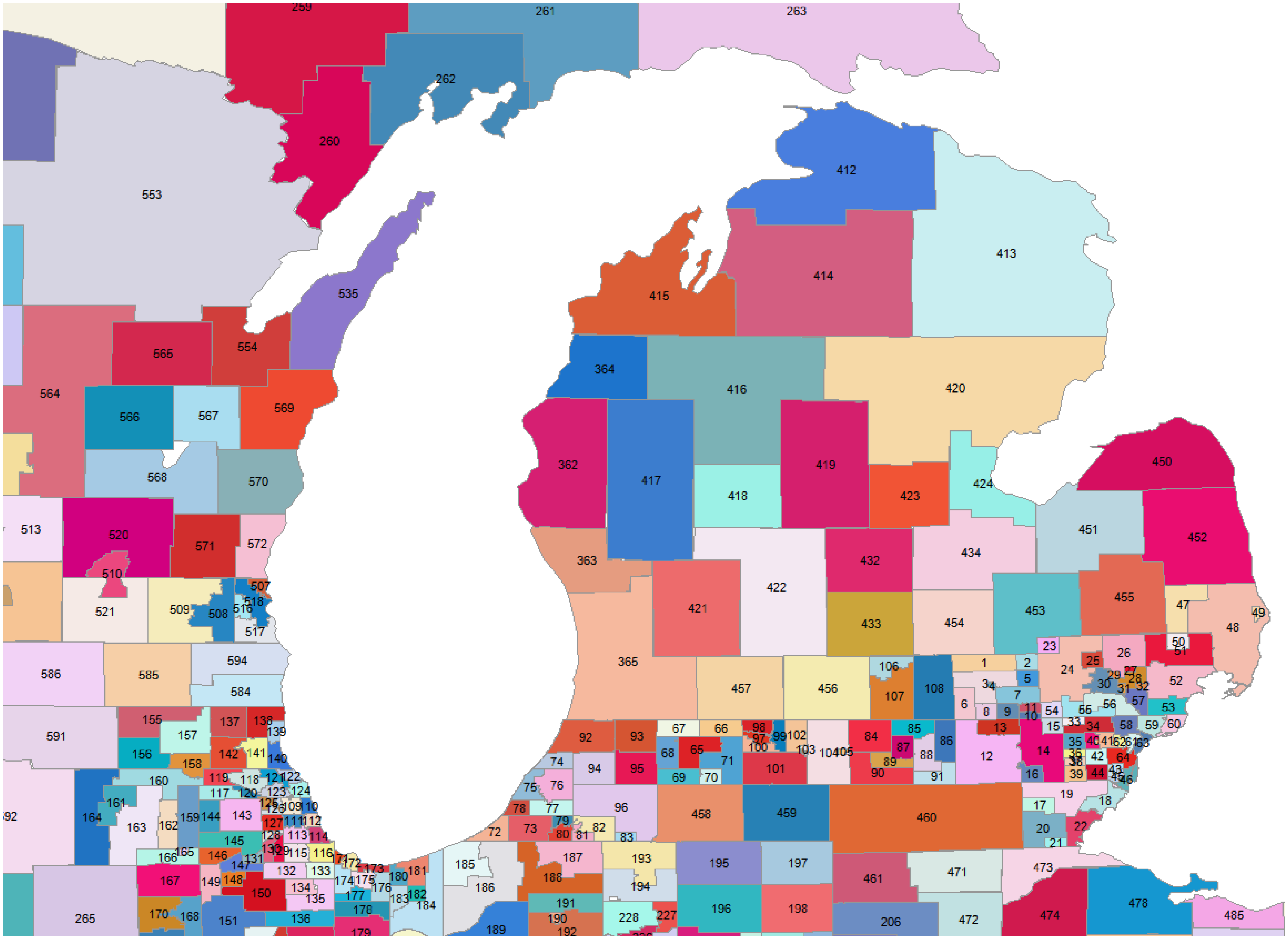


Exhibit 1-6: Chicago-Detroit/Pontiac Corridor Area Zones



1.4 Socioeconomic Baseline and Projections

The travel demand forecasting model requires base year estimates and future growth forecasts of three socioeconomic variables of population, employment and per capita income for each of the zones in the study area. A socioeconomic database was established for the base year (2012) and for each of the forecast years (2015-2050). The data was developed at five-year intervals using the most recent data from the following sources:

- U.S. Census Bureau
- Woods & Poole Economics
- U.S. Bureau of Economic Analysis
- Michigan Department of Transportation
- Southeast Michigan Council of Governments
- Region 2 Planning Commission
- Tri-County Regional Planning Commission
- Battle Creek Area Transportation Study
- Kalamazoo Area Transportation Study
- Southwest Michigan Commission
- Chicago Metropolitan Agency for Planning

Exhibit 1-7 shows the base year and projected socioeconomic data for Michigan. According to the data developed from these sources, the population of Michigan will increase from 9.88 million in 2012 to 11.42 million in 2055, the total employment of the study area will increase from 4.84 million to 6.14 million in 2055, and per capita income will increase from $26,367 in 2012 to $54,442 in 2055 in 2012 dollars.

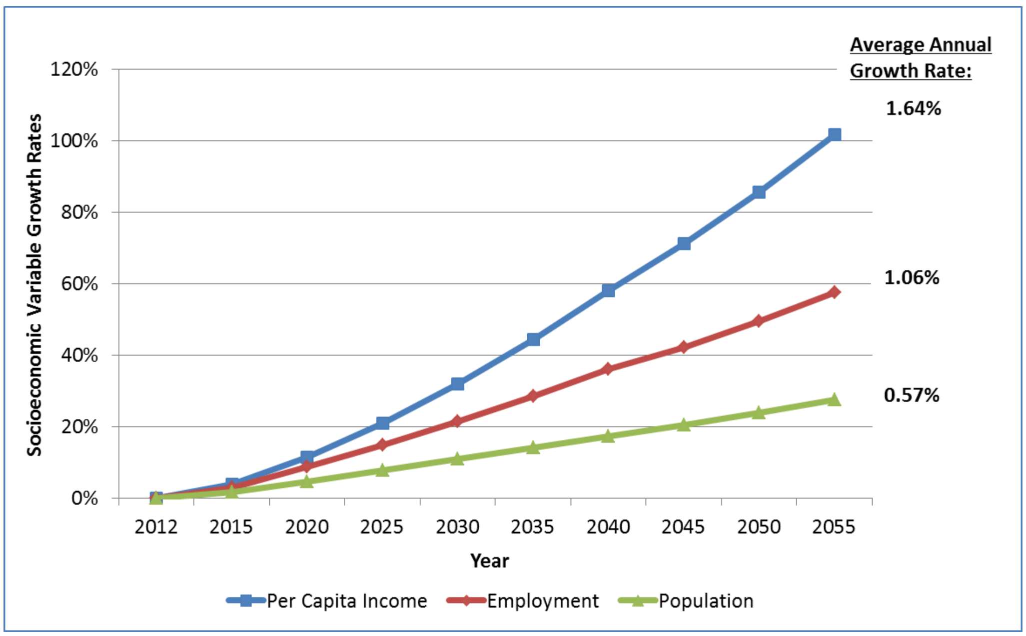
Exhibit 1-7: Michigan Base and Projected Socioeconomic Data

Year	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
Population	9,883,360	9,978,825	10,146,370	10,321,439	10,498,203	10,677,246	10,858,363	11,038,972	11,224,963	11,424,044
Employment	4,835,847	4,911,835	5,051,450	5,197,107	5,349,613	5,510,194	5,677,699	5,815,870	5,971,332	6,138,396
Per Capita Income (2012$)	26,367	27,519	29,583	32,101	35,051	38,433	42,237	45,909	49,902	54,442

Exhibit 1-8 shows the socioeconomic growth projections for the study area. The exhibit shows that there is higher growth of employment and income than population. Furthermore, travel increases are historically strongly correlated to increases in employment and income, in addition to changes in population. Therefore, travel in the corridor is likely to continue to increase faster than the population growth rates, as changes in employment and income outpace population growth, and stimulate more demand for traveling.

The exhibits in this section show the aggregate socioeconomic projection for the whole study area. It should be noted that in applying socioeconomic projections to the model, separate projections were made for each individual zone using the data from the listed sources. Therefore, the socioeconomic projections for different zones are likely to be different and thus may lead to different future travel sub-market projections. A full description of socioeconomic data of each zone can be found in the Appendix 1.

Exhibit 1-8: Study Area Socioeconomic Data Growth Rates



1.5 Existing Travel Modes

In transportation analysis, travel desirability/utility is measured in terms of travel cost and travel time. These variables are incorporated into the basic transportation network elements that provide by mode the connections from any origin zone to any destination zone. Correct representation of the existing and proposed travel services is vital for accurate travel forecasting. Basic network elements are called nodes and links. Each travel mode consists of a database comprised of zones and stations that are represented by nodes, and existing connections or links between them in the study area. Each node and link is assigned a set of travel attributes (time and cost). The network data assembled for the study included the following attributes for all the zone pairs.

For public travel modes (air, rail, bus) –

- Access/egress times and costs (e.g., travel time to a station, time/cost of parking, time walking from a station, etc.)
- Waiting at terminal and delay times
- In-vehicle travel times
- Number of interchanges and connection times
- Fares
- Frequency of service

For private mode (auto) –

- Travel time, including rest time
- Travel cost (vehicle operating cost)
- Tolls
- Parking Cost
- Vehicle occupancy

The transportation travel attribute or service data of different modes available in the study corridor were obtained from a variety of sources and coded into the COMPASS™ networks as inputs to the demand model. The major sources are as follows.

The highway network was developed to reflect the major highway segments within the study area. The sources for building the highway network in the study area are as follows –

- State and Local Departments of Transportation highway databases
- The Bureau of Transportation Statistics HPMS (Highway Performance Monitoring System) database

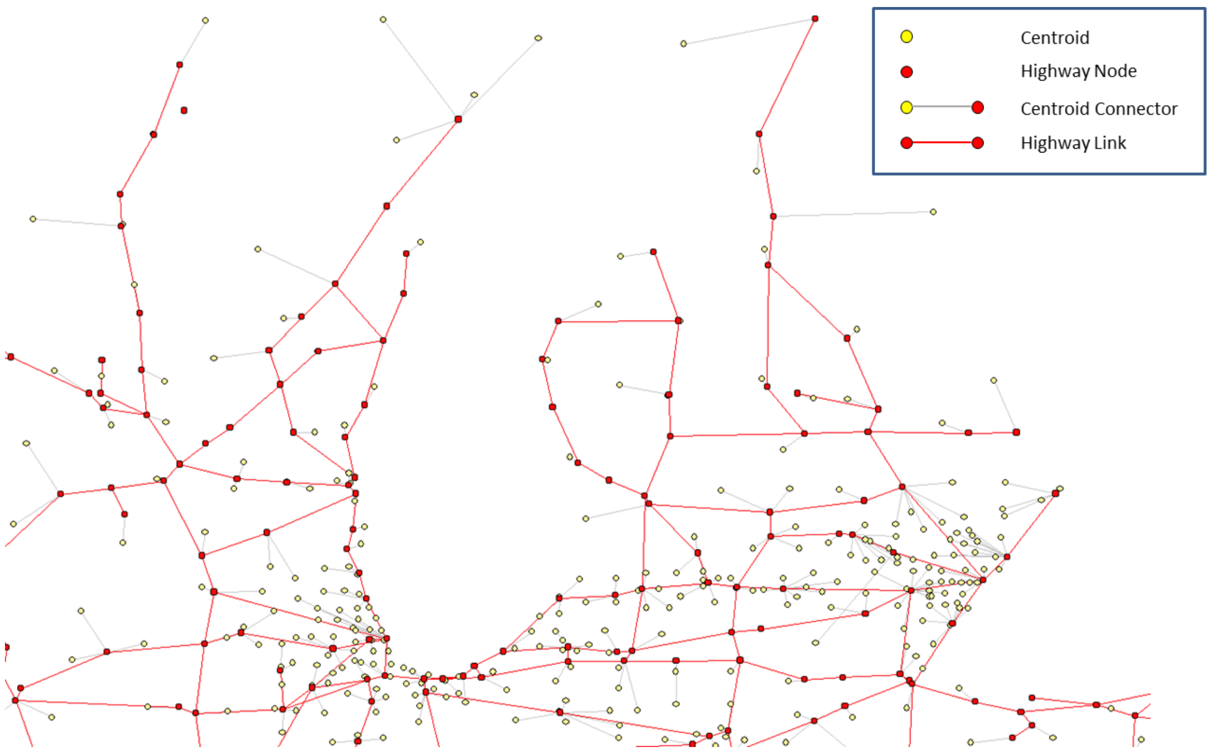
The main roads included in the highway network are shown in Exhibit 1-9.

Exhibit 1-9: Major Roads in the COMPASS™ Highway Network

Road Name	Road Description
Interstate-80	Chicago to Toledo
Interstate-90	Chicago to Toledo
Interstate-94	Chicago to Detroit
Interstate-75	Toledo to Saginaw
Interstate-96	Detroit-Grand Rapids
Interstate-69	Indianapolis-Sarnia

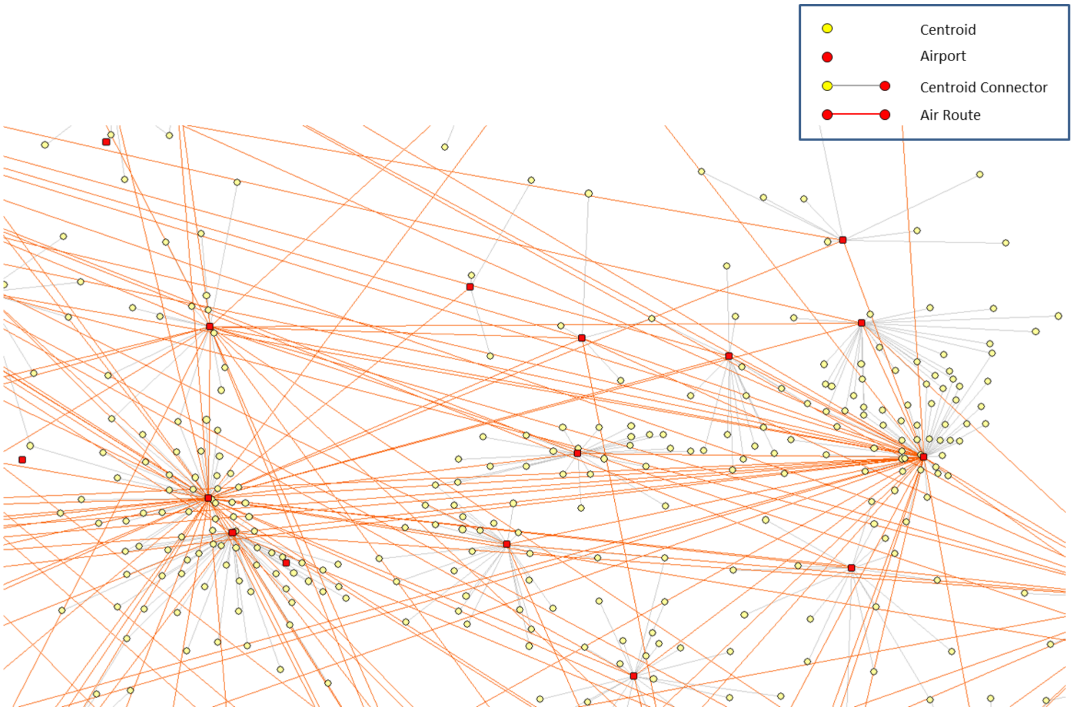
The highway network of the corridor area coded in COMPASS™ is shown in Exhibit 1-10. Two networks were developed: one for business travel, one for nonbusiness (commuter, social, tourist and etc.) travel.

Exhibit 1-10: COMPASS™ Highway Network for the Corridor Area



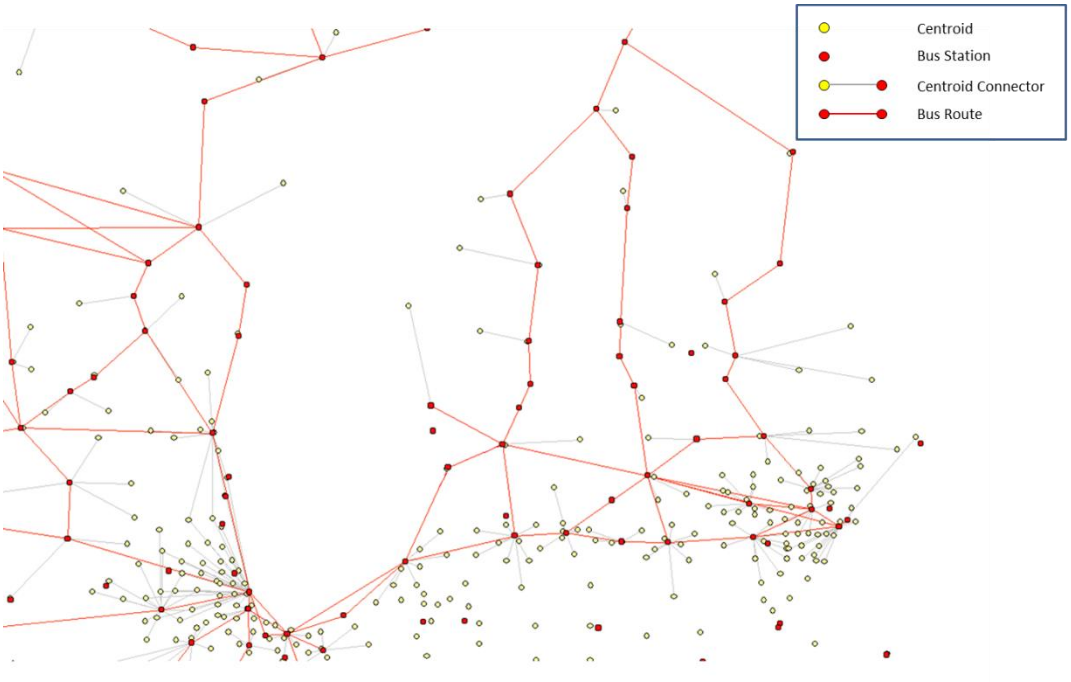
United Airlines, Delta, US Airways, and American Airlines serve the Chicago-Detroit/Pontiac corridor air market. Air network attributes contain a range of variables that include time and distance between airports, airfares, and connection times. Travel times, frequencies and fares were derived from official airport websites, websites of the airlines serving airports in the study area, and the BTS 10% sample of airline tickets. Exhibit 1-11 shows the air network of the corridor area coded in COMPASS™. Again, two networks were developed: one for business travel, one for nonbusiness travel.

Exhibit 1-11: COMPASS™ Air Network for the Corridor Area



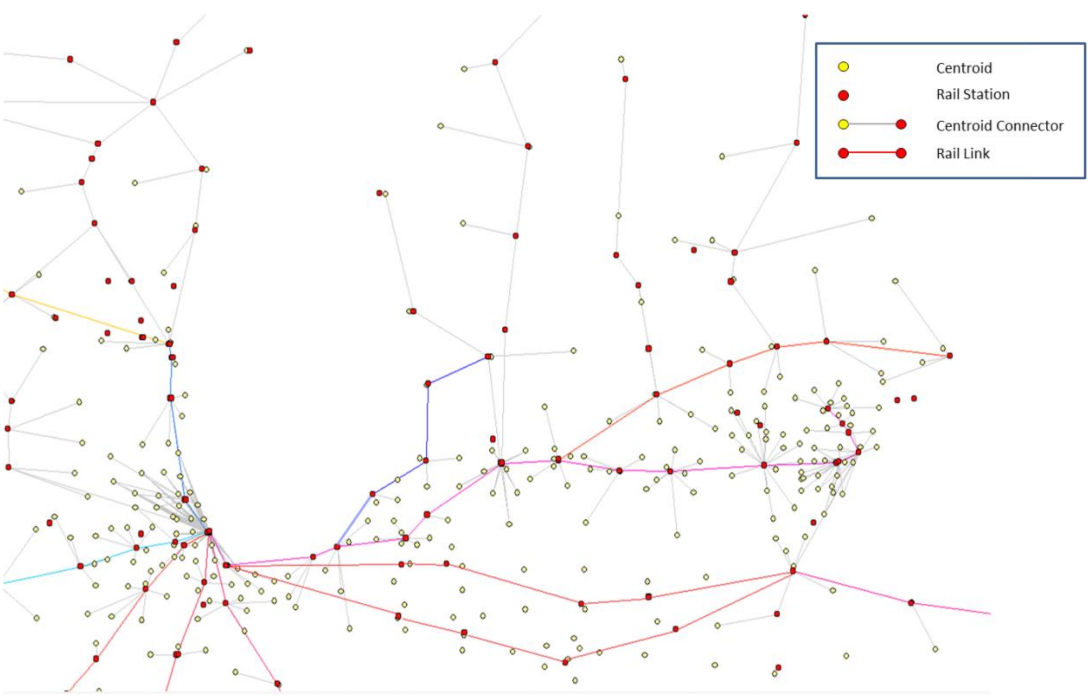
Bus travel data of travel time, fares, and frequencies, were obtained from official schedules of Greyhound, MegaBus, Indian Trails, and Lamers operators. Exhibit 1-12 shows the bus network of the corridor area coded in COMPASS™. Again, two networks (business, nonbusiness) were developed.

Exhibit 1-12: COMPASS™ Bus Network for the Corridor Area



Passenger rail travel data of travel time, fares, and frequencies, were obtained from official schedules of Amtrak. Exhibit 1-13 shows the passenger rail network of the corridor area coded in COMPASS™. Two networks were developed for both business and nonbusiness forms of travel.

Exhibit 1-13: COMPASS™ Passenger Rail Network for the Corridor Area



1.6 Origin–Destination Trip Database

The multi-modal intercity travel analyses model requires the collection of base year 2012 origin-destination (O-D) trip data describing annual personal trips between zone pairs. For each O-D zone pair, the annual personal trips are identified by mode (auto, air, and bus) and by trip purpose (Business and Non-Business). Because the goal of the study is to evaluate intercity travel, the O-D data collected for the model reflects travel between zones (i.e., between counties, neighboring states and major urban areas) rather than within zones.

TEMS extracted, aggregated and validated data from a number of sources in order to estimate base travel between origin-destination pairs in the study area. The data sources for the origin-destination trips in the study are –

- Michigan Department of Transportation
- Southeast Michigan Council of Governments
- Region 2 Planning Commission
- Tri-County Regional Planning Commission
- Battle Creek Area Transportation Study
- Kalamazoo Area Transportation Study
- Southwest Michigan Commission
- Chicago Metropolitan Agency for Planning
- Bureau of Transportation Statistics 10% Ticket Sample
- TEMS 2012 SP Survey
- Midwest Regional Rail Initiative Study (2004)

The travel demand forecast model requires the base trip information for all modes between each zone pair. In some cases this can be achieved directly from the data sources, while in other cases the data providers only have origin-destination trip information at an aggregated level (e.g., AADT data, station-to-station trip and station volume data). Where that is the case, a data enhancement process of trip simulation and access/egress simulation needed to be conducted to estimate the zone-to-zone trip volume. The data enhancement process is shown in Exhibit 1-14.

For the auto mode, the quality of the origin-destination trip data was validated by comparing it to AADTs and traffic counts on major highways and adjustments have been made when necessary. For public travel modes, the origin-destination trip data was validated by examining station volumes and segment loadings.

Exhibit 1-14: Zone-to-Zone Origin-Destination Trip Matrix Generation and Validation

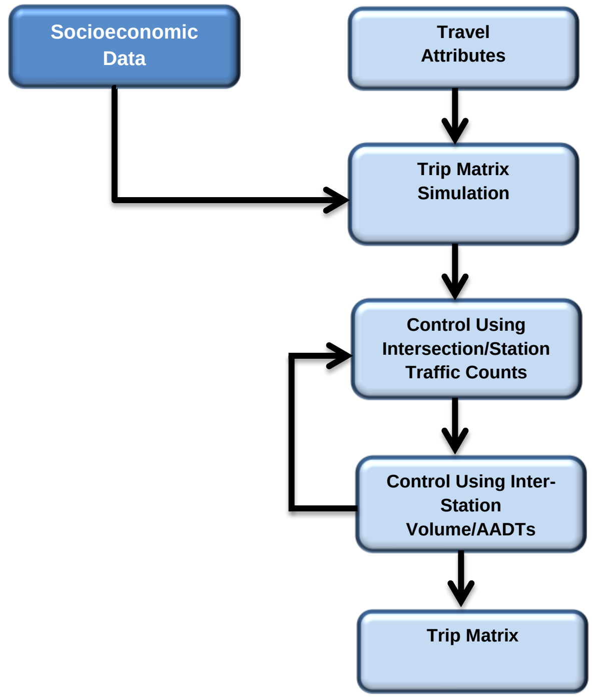
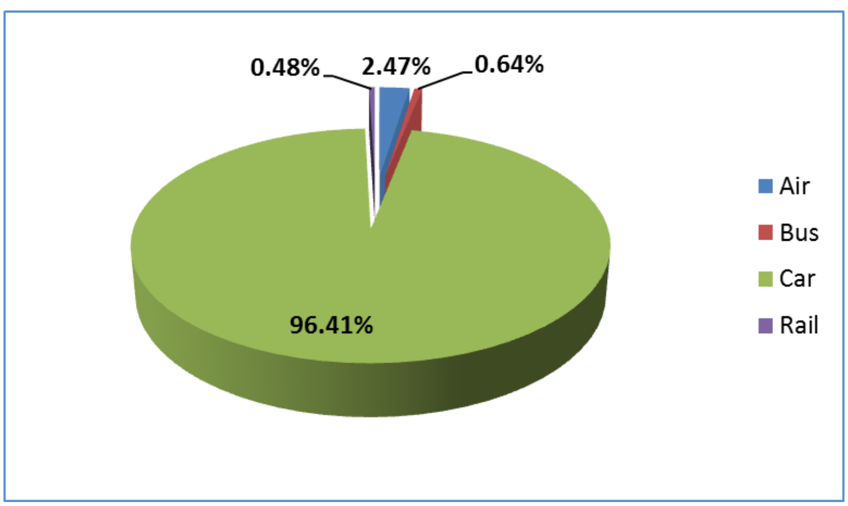


Exhibit 1-15 shows the base Chicago-Detroit/Pontiac corridor 2012 travel market share of rail, air, bus, and auto modes. It can be seen that auto mode dominates the travel market with more than 96 percent of market share. Public modes have less than four percent of travel market share.

Exhibit 1-15: 2012 Base Chicago-Detroit/Pontiac Corridor Travel Market Share by Mode



1.7 Stated Preference Survey

The Stated Preference Analysis was based on results from a broad range of collected stated preference survey forms. Stated Preference Survey method uses a quota sampling approach as a fast and effective way of gathering consumer information on the importance of different travel decisions. This includes such issues as how travelers value travel time (for auto and transit modes) and how they value frequency of service and access time (for transit modes). A quota survey, as opposed to a random survey or a focus group study, is particularly effective in ensuring that all the important travel attributes are measured for the whole population at minimum cost. The quota survey, which has been widely adopted for public opinion surveys, is based on the development of representative “quotas” of the traveling public. The TEMS analysis requires that, two sets of data be collected: (1) the data that define the “travel behavior” quota and (2) the data that define the “personal profile” quota for the individuals surveyed. This allows the data to be stratified by such factors as trip length, income, and group size, and for the results to be applied to the total population of travelers.

This section describes the stated preference survey process including the methodology used, sample size, survey forms, target locations, and dates of survey deployment along with survey results and analysis.

1.7.1 Survey Process

The essence of the stated preference technique is to ask people making trips in the corridor to make a series of trade-off choices based on different combinations of travel time, frequency and cost. Stated preference analysis has been used extensively by TEMS to assess new travel options relating to time, fares, frequency, comfort and reliability for rail, air, and bus services. Tests of the technique in a series of before and after evaluations in North America have produced exceedingly good results. In particular, these tests found that the use of "abstract mode" questions in conjunction with "trade-off analysis" produced reliable results.

Three specific trade-offs were analyzed and used for this study:

- Choices between travel time and travel costs to derive incremental Values of Time for all modes
- Choices between headway times (frequency of service) and travel costs to derive incremental Values of Frequency for transit modes (air, bus and rail).
- Choice between access/egress time (for example, travel time between home and railway station)and associated costs to derive incremental Values of Access for transit modes (air, bus and rail)

One part of the survey contains revealed preference questions while the other part contains questions that aim on defining the travel behavior of the surveyed individuals. The revealed preference questions which are the profile data collected from the surveys are used in conjunction with origin-destination and census data to ensure that the stated preference survey can be effectively expanded to properly represent the total population. The collected travel behavior data provides the critical component of the factors needed to estimate the generalized cost of travel.

Generalized cost of travel between two zones estimates the impact of improvements in the transportation system on the overall level of trip making. Generalized cost is typically defined in travel time (i.e., minutes) rather than cost (i.e., dollars). Costs are converted to time by applying appropriate conversion factors, as shown in Equation 1. The generalized cost (GC) of travel between zones *i* and *j* for mode *m* and trip purpose *p* is defined as follows:

Equation 1:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH}{VOT_{mp} * F_{ijm}}$$

Where,

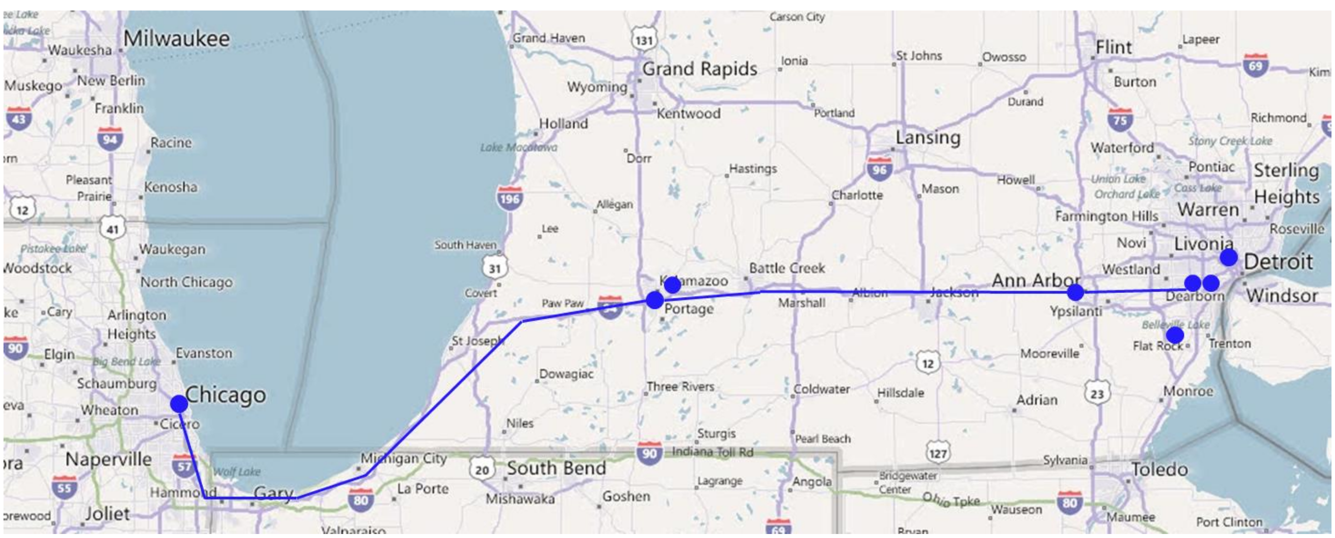
TT_{ijm}	=	Travel Time between zones *i* and *j* for mode *m* (in-vehicle time + station wait time + connection time + access/egress time), with waiting, connect and access/egress time multiplied by a factor (waiting and connect time factors is 1.8, access/egress factors were determined by VOA/VOT ratios from the SP survey) to account for the additional disutility felt by travelers for these activities.
TC_{ijmp}	=	Travel Cost between zones *i* and *j* for mode *m* and trip purpose *p* (fare + access/egress cost for public modes, operating costs for auto)
VOT_{mp}	=	Value of Time for mode *m* and trip purpose *p*
VOF_{mp}	=	Value of Frequency for mode *m* and trip purpose *p*
F_{ijm}	=	Frequency in departures per week between zones *i* and *j* for mode *m*
OH	=	Operating hours per week (sum of daily operating hours between the first and last service of the day)

Value of time is the amount of money (dollars/hour) an individual is willing to pay to save a specified amount of travel time, the value of frequency is the amount of money (dollars/hour) an individual is willing to pay to reduce the time between departures when traveling on public transportation, and the value of access is the amount of money (dollars/hour) an individual is willing to pay for reducing access time to a mode (e.g. the airport, HSR station, railroad station, bus station) to gain easier access to someplace (e.g., an airport). Access/Egress time is weighted higher than in-vehicle time in generalized costs calculation, and its weight is derived from value of time and value of access. Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found from previous studies.

In terms of the size of the survey for each of the quota groups identified - usually up to 8 primary groups. It has been shown that a sample as small as 30 individuals[1] is statistically significant to analyze the behavioral difference between groups. These primary groups are based on 4 mode groups - auto and transit (that includes air, rail and bus) to 2 purpose groups business and non-business. To improve statistical reliability, TEMS typically seeks 40 to 100 respondents per quota. This means that between 320 and 800 surveys are needed for a stated preference survey analysis. The 1,500-2,000 surveys were set as a goal for this survey.

A very important part of the survey process is to identify the desirable survey locations. Exhibit 1-16 shows the Stated Preference Survey locations map covering Chicago, Kalamazoo, Ann Arbor, Dearborn, and Detroit including Detroit Metropolitan Wayne County Airport. The surveys were conducted both electronically and also in the field. The main aim of the surveys was to target all 8 quota groups (i.e., Business, Nonbusiness trip purposes for auto, air, rail and bus users).

Exhibit 1-16: Survey Locations



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[1] Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). Hillsdale, NJ: Erlbaum.

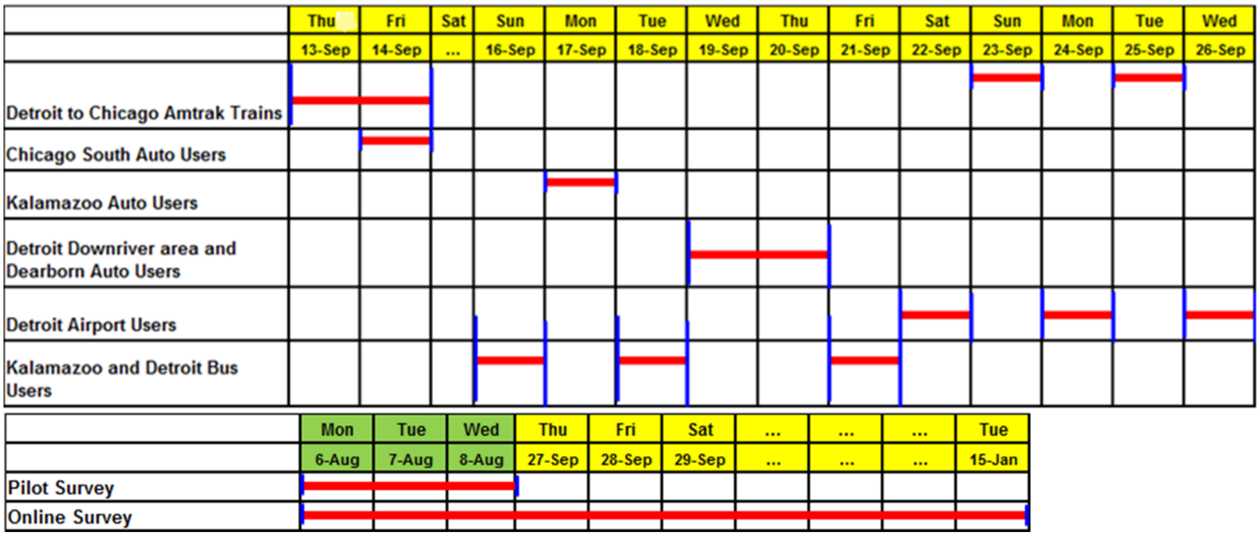
The field Stated Preference Survey captured:

- Rail Users: With the help of Amtrak officials approval, a survey was conducted on the trains running between Chicago, Kalamazoo, and Ann Arbor;
- Auto Users: With the help of the Illinois and Michigan Department of Motor Vehicles authority, a survey was conducted at their facilities located at Chicago, Kalamazoo, and Detroit. Patrons were interviewed at these facilities by approaching only those who were seated and were waiting to be called;
- Air Mode Users: With the help of Detroit Metropolitan Wayne County Airport Authority, the air travelers were interviewed at the baggage claim areas, lobby and outside the security clearance areas;
- Bus Users: With the help of Greyhound, Megabus, Indian Trails and Michigan Flyers officials, bus passengers were interviewed in Kalamazoo and Detroit including Detroit Metropolitan Wayne County Airport.
- All Four Mode Users: With the help of Public and Private Organizations such as Chamber of Commerce's at Chicago, Lansing, Kalamazoo, Ann Arbor, and Michigan City, IN, University of Notre Dame (South Bend, IN), Ann Arbor University (Ann Arbor, MI), and Northwestern University (Kalamazoo, MI), online survey responses were collected from individuals located in Detroit- Chicago corridor area.

Pilot surveys were also conducted prior to actual field and online surveys to test the survey questionnaire. This provided a validation of the survey Average and helped the scaling of the stated preference questions so that respondents did "trade" time and cost when filling in the survey forms. Minor adjustments to wording of questions and format were made to improve the user understanding of the forms.

Field and online survey deployment are shown in Exhibit 1-17. The field survey was conducted in September 2012 with interviews between September 13, 2012 and September 26, 2012. The online survey was conducted between August, 2012 and January, 2013. TEMS collected 1,916 surveys achieving the target range.

Exhibit 1-17: On-Site Survey Team Actual Deployment & Online Survey



1.7.2 Survey Results and Analysis

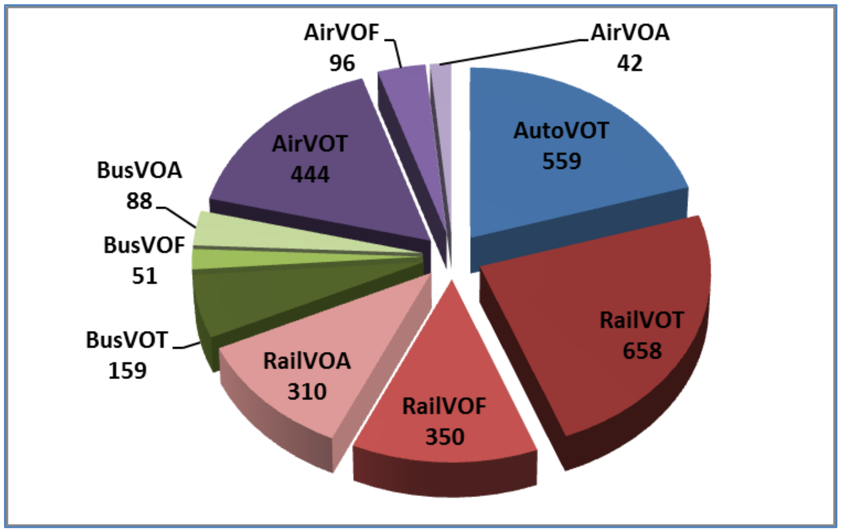
TEMS collected 1,916 surveys, reaching high end of total target (2,000) as shown in Exhibit 1-18. Each mode has collected more than 80 responses which is minimum target set by TEMS. Except bus, all the other modes have collected more than 200 responses which is high end target set by TEMS.

Exhibit 1-18: Actual Survey Count per Mode

Location	Field + Online Count (Actual)
Amtrak Train	670
Air	465
Auto	564
Bus	170
Sub Total	**1869**
Pilot Surveys	47
Total (include pilot surveys)	**1916**

Behavioral attributes reflect the behavior of the respondent when travel conditions change. For the purpose of this study, stated preference surveys collected the information necessary to identify the Value of Time (VOT)[2] for all travelers, the Value of Frequency (VOF)[3] and the Value of Access (VOA)[4]. There were separate forms for each mode and questions were unique for VOT, VOF and VOA. Exhibit 1-19 shows that a total of VOT, VOF and VOA responses for all modes were 2,757.

Exhibit 1-19: VOT, VOF, VOA Counts per Mode[5]



The responses captured by the revealed part of the questionnaire, show that 22% from business travelers and 78% responses are from nonbusiness travelers for all modes as shown in Exhibit 1-20. These nonbusiness travel purposes include commuting, traveling to/from school, vacations, shopping, visiting friends and etc.

[2] Value of Time (VOT) is the amount of money (dollars/hour) an individual is willing to pay to save a specified amount of travel time.

[3] Value of Frequency (VOF) is the amount of money (dollars/hour) an individual is willing to pay to reduce the time between departures when traveling on public transportation.

[4] Value of Access (VOA) is the amount of money (dollars/hour) an individual is willing to pay for the improved access time to a mode (e.g. the airport, HSR station, railroad station, bus station) to gain easier access to someplace (like airport).

[5] This total count of VOT, VOF and VOA per mode equals 2,757 and these counts are not equal to total survey counts as each transit respondent (most of them) filed out two stated preference questionnaires.

Exhibit 1-20: Purpose of Travel Responses

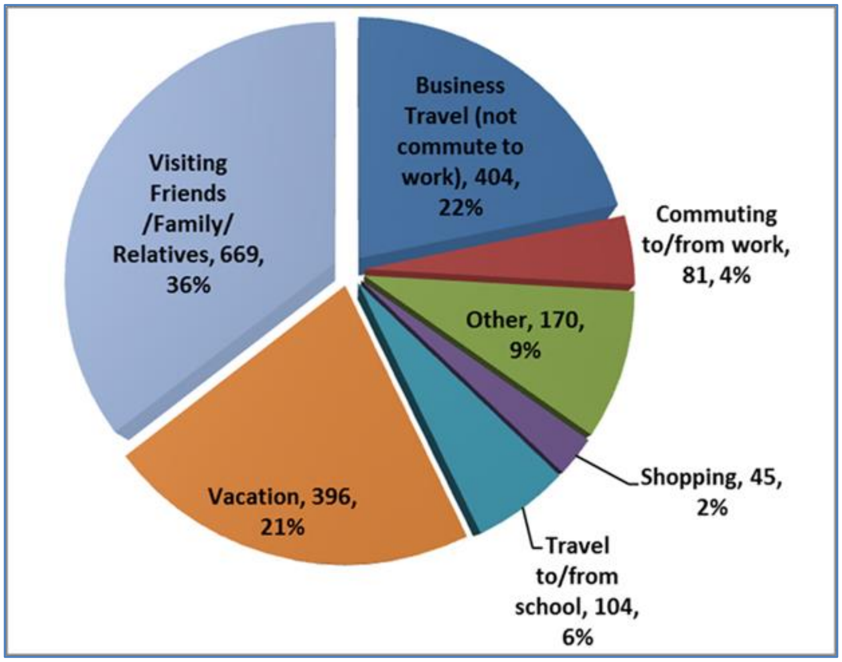
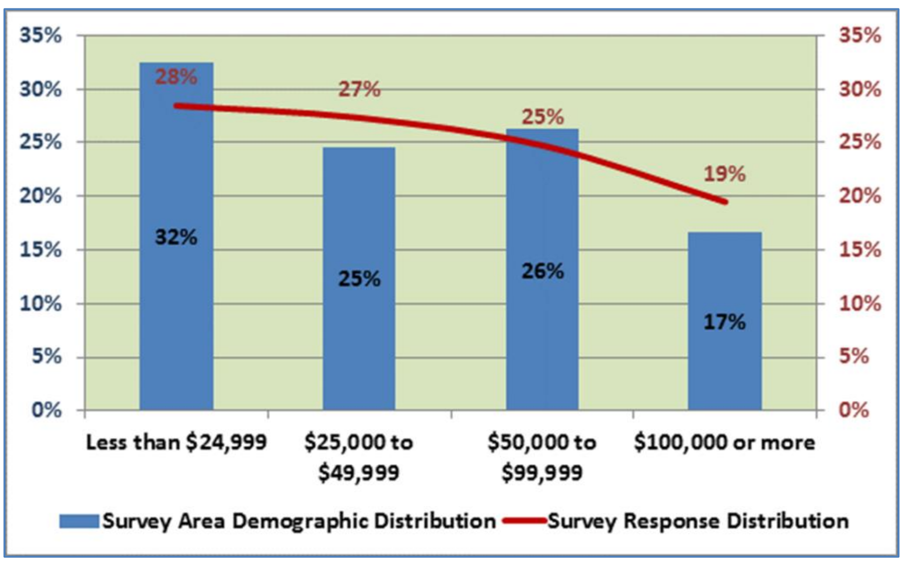


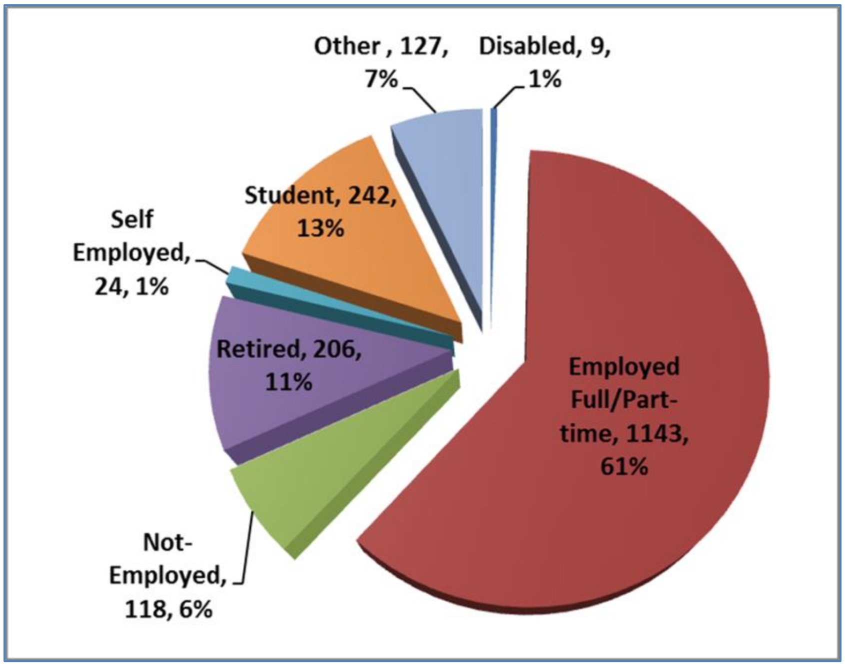
Exhibit 1-21 illustrates distribution of average number of household by income groups along the survey study area corridor in comparison with statistical and survey data. It is seen in the Exhibit 1-6 that survey responses closely follows most of the demographic distribution. This also shows that the survey responses are effectively represented, and the margin of error is only ±4%.

Exhibit 1-21: Distribution of Average Number of Households by Income



The employment type responses from the survey as shown in Exhibit 1-22 says that 61% of the responses are from employed individuals, 11% are from retired individuals, 13% are from students, 6% are from unemployed individuals, and the rest are from self-employed, disabled and other employment categories.

Exhibit 1-22 Employment Type Responses



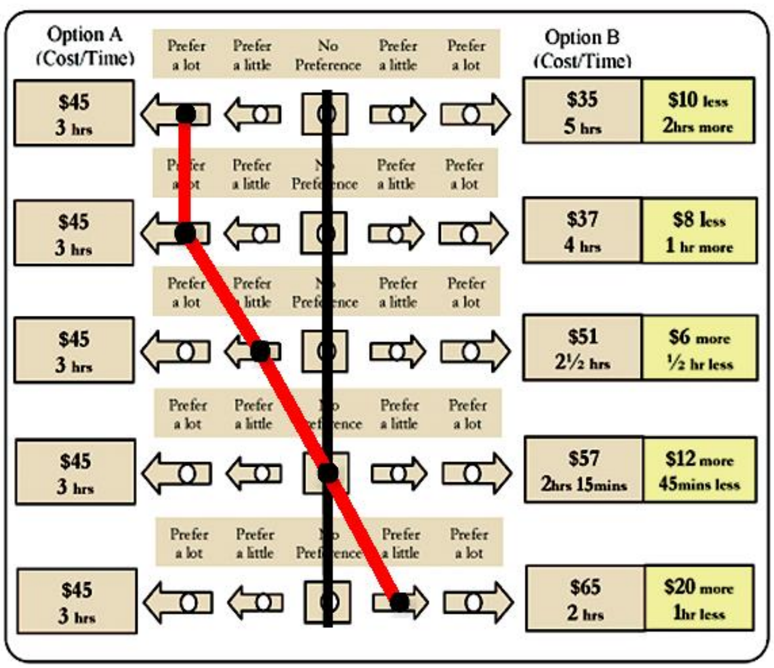
Each of these three variables (VOT, VOF and VOA) has been analyzed using the "trade-off' method. The Trade-Off Analysis identifies how individuals choose between time and money in selecting travel options. Two trade-off analysis methods, Binary Logit Method and Direct Comparison Method, were employed to analyze the Attitudinal Survey Data and determine Values of Time (VOT's), Values of Frequency (VOF's), and Values of Access (VOA's).

In the Comparison Method, the trade-off choices made by individuals are ranked in descending or ascending (VOT, VOF or VOA) order, along with the individual's choice between time and money and the degree of preference the individual had for that specific trade-off choice. As shown in Exhibit 1-8 and 1-9, VOT is shown in ascending order from $5/hour to 20$/hour and the degree of preference is measured by preference scale stated as "Prefer a lot", "Prefer a little" and "No Preference" toward option A or option B . The individual's VOT, VOF or VOA is then determined by identifying the point of inflection, or the point at which an individual changes from spending more time to save money or preferring to spend more money to save time in making a given journey. The Comparison Method provides a clear and detailed understanding of how travelers react to the series of binary choice trade-off questions. Once the individual trade-off values are determined, the results are averaged to give overall population values.

The Binary Logit Method applies a logit curve to calculate the coefficients of the time and cost variables. The individual's VOT, VOF or VOA is derived as the ratio of time and cost coefficients. This method is a less subjective and more rigorous process than the Comparison Method. However, the statistical rigidity of the Binary Logit Method frequently provides less understanding of travel behavior and gives less analytic ability to interpret behavior effectively. Furthermore, because this method cannot incorporate the results for individuals who do not make a trade-off (preferring time or money options consistently over the whole range of trade-off choices), the Binary Logit Method can only be used at an aggregate level.

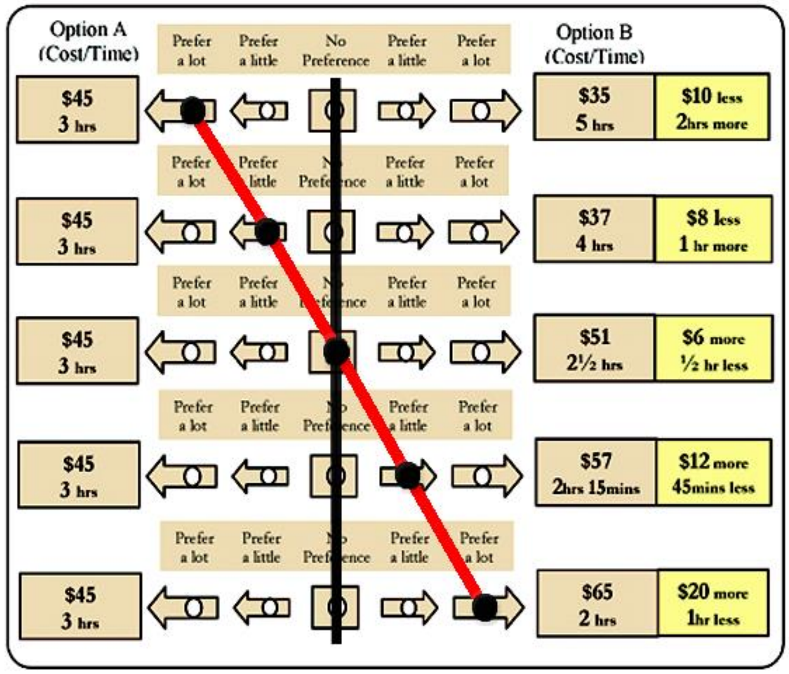
Exhibit 1-23 and 1-24 provides an example of the respondent's trading behavior and illustrates how VOT is calculated using 'trade-off' method. Exhibit 1-11 provides an example of the respondent's non trading behavior[6]. The VOT is calculated for the 'neutral point' located in the intersection between the line indicating 'no preference' and the line connecting the points indicated by the respondent. As seen in Exhibit 1-8 the neutral point or no preference line is located at the fourth row indicating that the respondent is willing to spend $12 more for 45 minutes less. This implies the respondent is willing to spend $16 more for one hour of time saving. Thus, the respondent has a VOT value of $16 per hour.

Exhibit 1-23: VOT calculation based on "Trade-Off" Method: "Trading Behavior"- Example #1



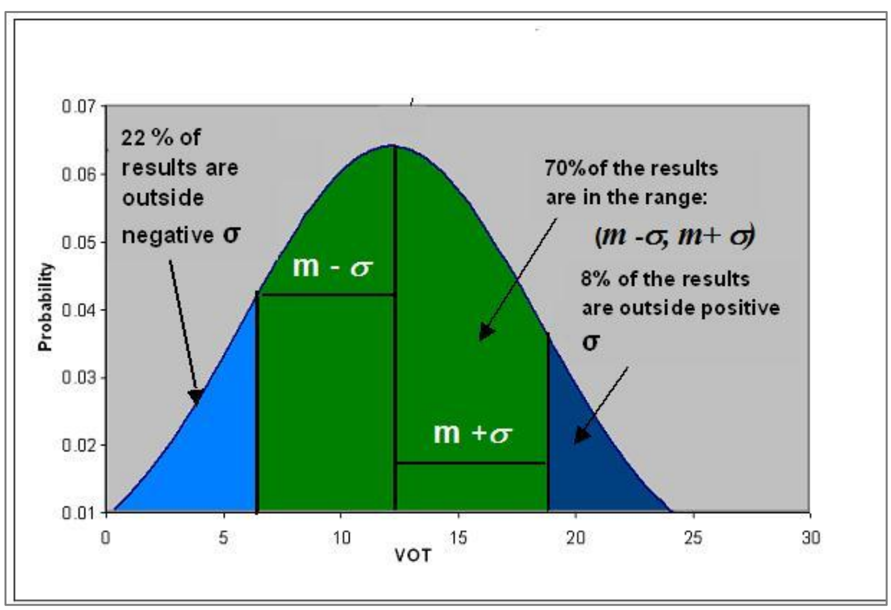
[6] These examples (Exhibit 1-8, 1-9, and 1-11) are drawn from previous TEMS Stated Preference Surveys, and are designed to show how travelers 'trade-off' or 'do not trade-off' between time and cost options.

Exhibit 1-24: VOT calculation based on "Trade-Off" Method: "Trading Behavior" - Example # 2



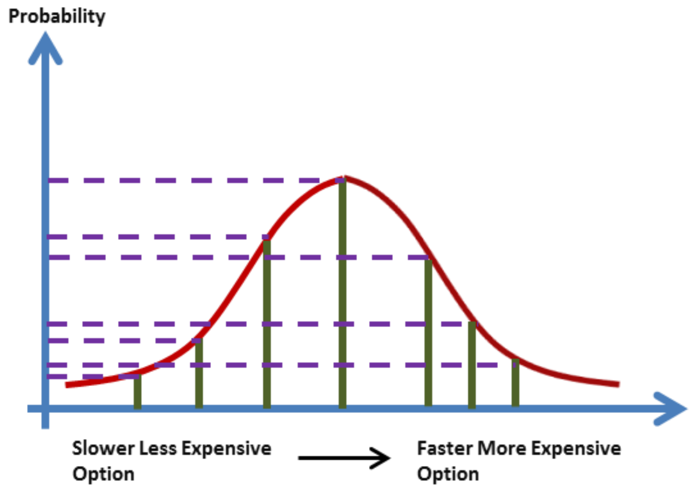
Not all survey respondents illustrated perfect trading behavior (similar to those shown in Exhibit 1-23 or 1-24). For the data collected, about 30% of the respondents were identified as 'non-traders'. This is shown in Exhibit 1-25, where the 30% (i.e. 22% of very low values of time and 8% of very high values of time) non-traders refer to the individuals with either very high values of time or very low values of time. The survey is intended to obtain VOT's mainly from the 70% in the middle (i.e., one standard deviation) with weighted non-traders, which is illustrated in Exhibit 1-26. One of 30% non-trading behavior examples is shown in Exhibit 1-27.

Exhibit 1-25: Distribution of the Non Respondent Error in the Trade-off Analysis of the Collected Survey Data[7]



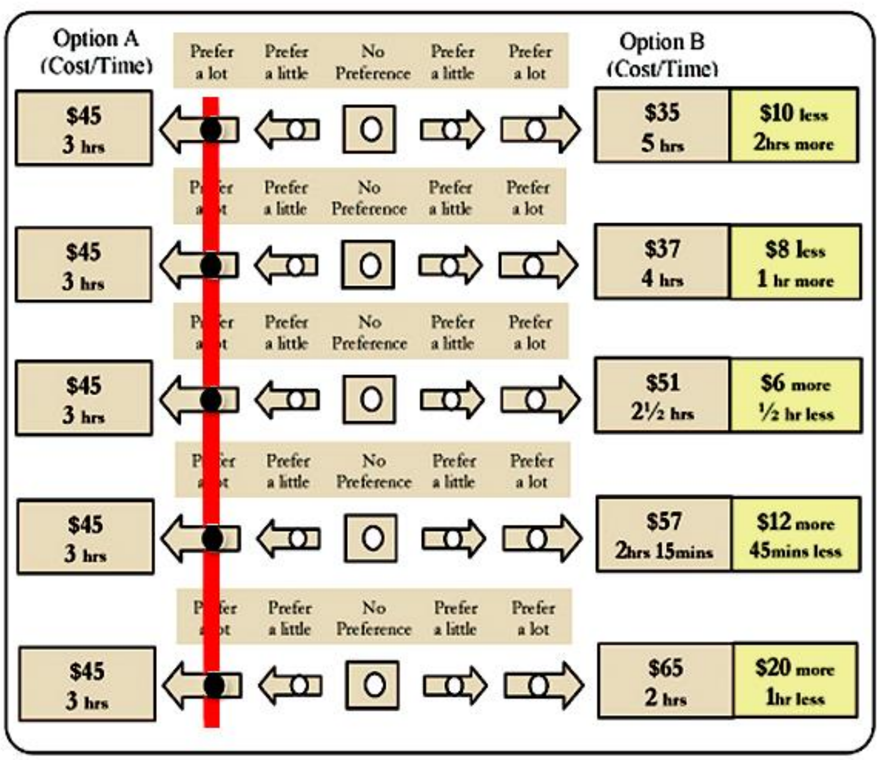
[7] Normal distribution with one standard deviation above the mean.

Exhibit 1-26: Probability Distribution of VOT



VOT calculated based on the example shown in Exhibit 1-27 is assumed to be $45 for three hours ($15 per hour) or less as there is no trading, and the individual is showing a preference to spend time rather than money.

Exhibit 1-27: VOT calculation based on "'Trade-Off" Method: "Non Trading Behavior"



The Stated Preference Survey results of VOT, VOF and VOA calculated for four modes (auto, rail, bus, and air) and two types of purpose (business and nonbusiness) are presented in Exhibits 1-28 through 1-30. Based on the calculations, the following observations were made:

- The hierarchical order of VOT is higher for air access, rail, auto and then bus users, which is the typical trend;
- Business trips have larger VOT, VOF and VOA values than nonbusiness trips;
- The VOT, VOF and VOA values are consistent with those of previous studies (e.g., Bay Bridge Travel Survey, 2006, Rocky Mountain Rail Authority (RMRA), 2008) after adjusting to 2012 dollars for similar trip length.

Exhibit 1-28 VOT values by Mode and Purpose of Travel ($2012/hour)

Value of Time VOT	Business	Nonbusiness
Auto	$27.49	$24.79
Bus	$20.43	$15.05
Rail	$39.20	$28.05
Air Access	$49.43	$39.28

Exhibit 1-29: VOF values by Mode and Purpose of Travel ($2012/hour)

Value of Frequency VOF	Business	Nonbusiness
Bus	$5.32	$5.28
Rail	$10.44	$8.83
Air Access	$25.60	$18.41

Exhibit 1-30: VOA values by Mode and Purpose of Travel ($2012/hour)

Value of Access VOA	Business	Nonbusiness
Bus	$27.87	$25.68
Rail	$53.92	$35.90
Air Access	$58.81	$46.82

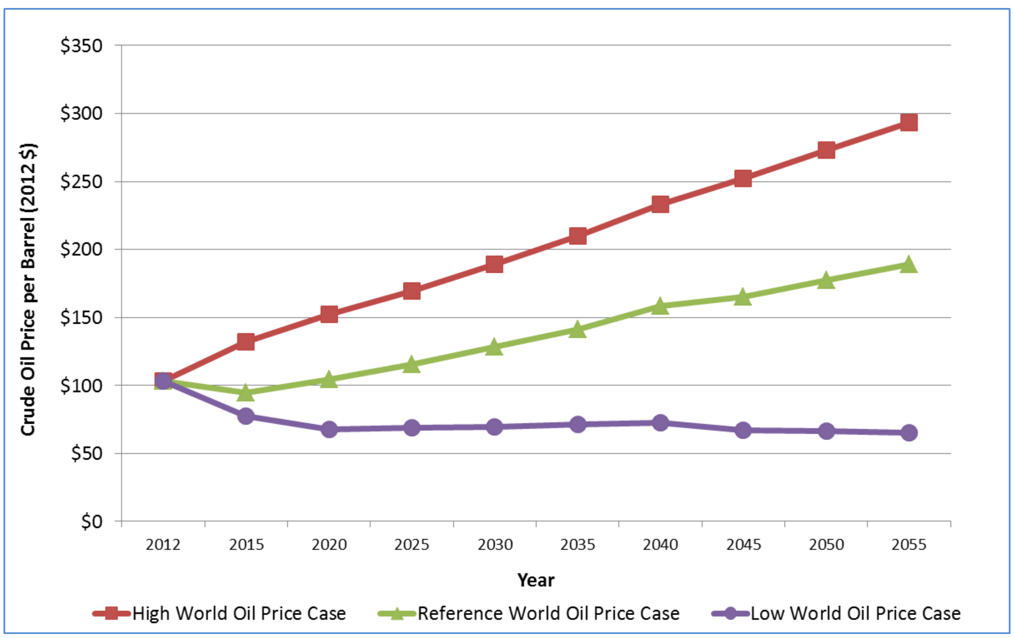
1.8 Future Travel Market Strategies

1.8.1 Fuel Price Forecasts

An important factor in the future attractiveness of passenger rail is fuel price. Exhibit 1-31 shows the Energy Information Agency (EIA)[8] projection of crude oil prices for three oil price cases, namely high world oil price case that is aggressive oil price forecast, reference world oil price case that is moderate and is also known as the central case forecast, and the conservative low world oil price case. In this study, the reference case oil price projection was used to estimate transportation cost in future travel market. EIA projects oil price to 2035, the oil price projections after 2035 were estimated based on historical prices and EIA projections. The EIA reference case forecast suggests that crude oil prices are expected to be $104 per barrel (2012$) in 2020 and will remain at that high level and will increase to $142 per barrel (2012$) in 2035.

EIA has also developed a future retail gasoline price forecast, which is shown in Exhibit 1-32. The implication of this is a reference case gasoline price of $3.39 per gallon (2012$) in 2020, with a high case price of $5.02 per gallon and a low case price of $2.67 per gallon. Since 2012 annual average gas price of Midwest region is about $3.6[9] per gallon in a weak economy environment, $4~5 per gallon once the economy starts to grow again seems likely.

Exhibit 1-31: Crude Oil Price Forecast by EIA

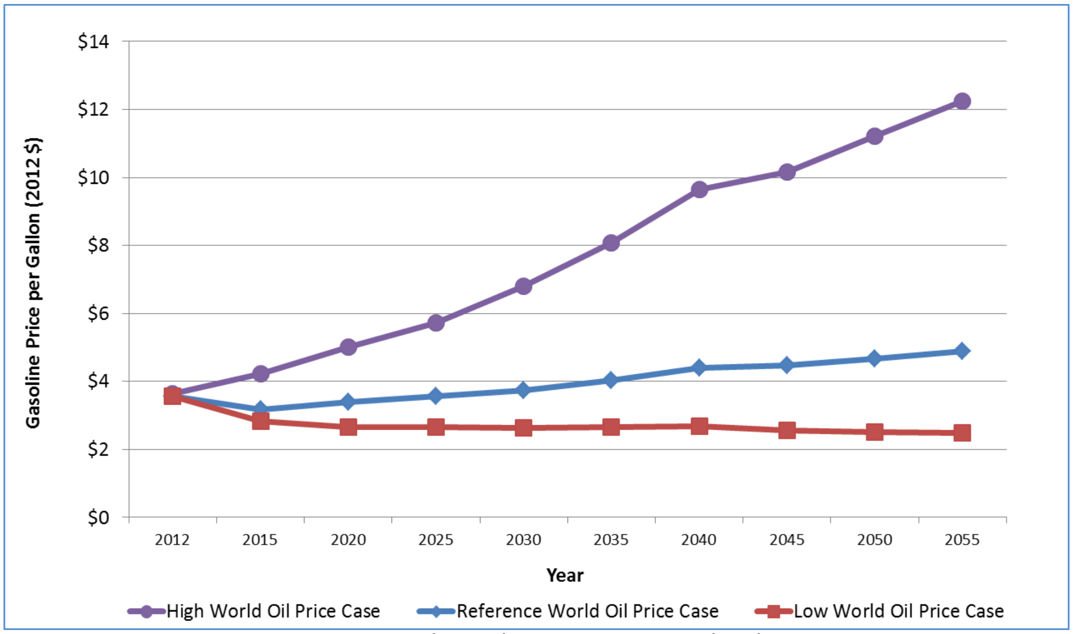


*EIA projections go to 2040, projections beyond 2040 were extrapolated

[8] EIA periodically updates historical and projected oil prices at www.eia.gov/forecasts/aeo/tables_ref.cfm

[9] Weekly Retail Gasoline and Diesel Prices from EIA http://www.eia.gov/dnav/pet/pet_pri_gnd_a_epmr_pte_dpgal_a.htm

Exhibit 1-32: U.S. Retail Gasoline Prices Forecast by EIA

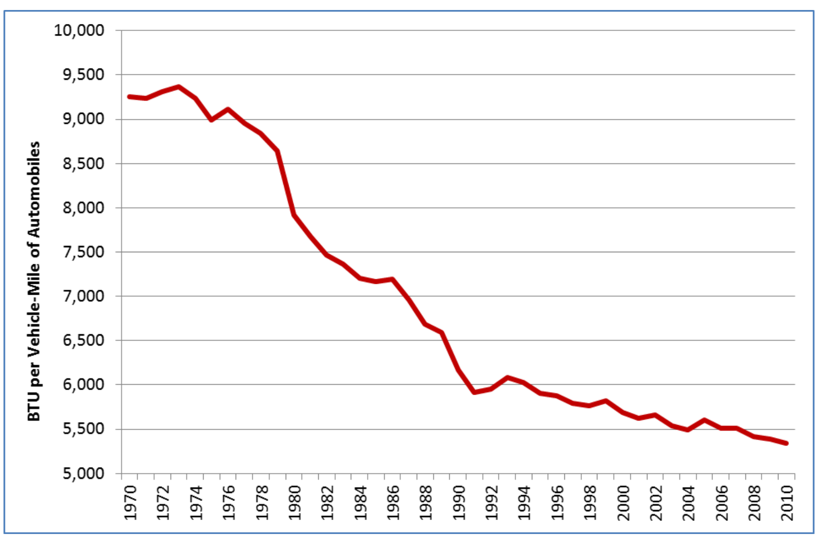


*EIA projections go to 2040, projections beyond 2040 were extrapolated

1.8.2 Vehicle Fuel Efficiency Forecasts

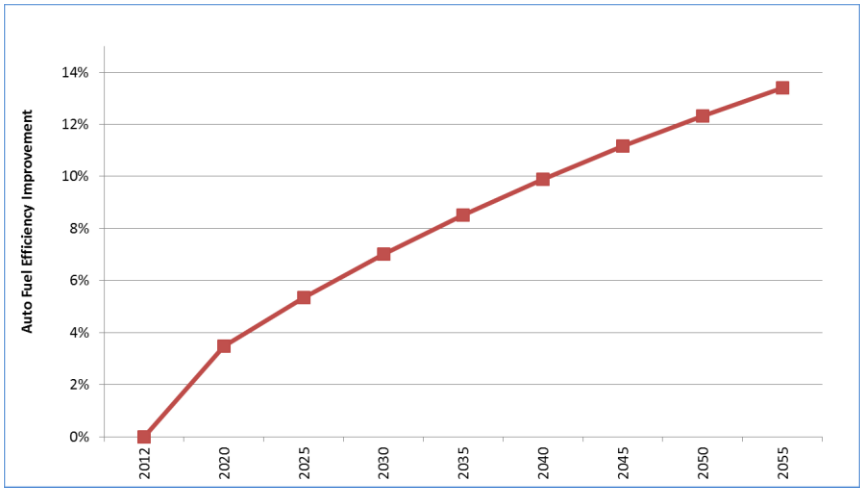
Future improvement in automobile technology is likely to reduce the impact of high gas prices on automobile fuel cost with better fuel efficiency. The Oak Ridge National Laboratory (ORNL) Center for Transportation Analysis (CTA) historical automobile highway energy intensities data has the historical Btu (British thermal unit) per vehicle-mile data for automobiles since 1970 as show in Exhibit 1-33.

Exhibit 1-33: ORNL Historical Highway Automobile Energy Intensities Data



From Exhibit 1-34 it can be seen that automobile fuel efficiency has been improving gradually during the past few decades but the improvement has slowed down in recent years. Future automobile fuel efficiency improvement that was projected and shown in Exhibit 1-34 was based on the historical automobile fuel efficiency data. It shows that the automobile fleet fuel efficiency is expected to improve by nearly 13 percent by 2055.

Exhibit 1-34: Auto Fuel Efficiency Improvement Projections



1.8.3 HIGHWAY TRAFFIC CONGESTION

The average annual travel time growth in the corridor was estimated with the projected highway traffic volume data and the BPR (Bureau of Public Roads) function that can be used to calculate travel time growth with increased traffic volumes:

$$T_f = T_b * [1 + \alpha * \left(\frac{V}{C}\right)^{\beta}]$$

where

T_f is future travel time,

T_b is highway Average travel time,

V is traffic volume,

C is highway Average capacity,

α is a calibrated coefficient (0.56),

β is a calibrated coefficient (3.6).

The capacity and projected highway link volumes are derived from the Michigan Statewide Model (2010 version), which is provided by Michigan Department of Transportation. Historic volume data are obtained from Illinois Department of Transportation, Michigan Department of Transportation and 2012 Annual Urban Mobility Report from Transportation Institute of Texas A&M University. Exhibit 1-35 shows the projected travel time growths in 2035 for three major city pairs in the study area due to increasing highway traffic volumes.

Exhibit 1-35: Highway Travel Time Projections for Three City Pairs

	2012 Travel Time	2035 Projected Travel Time
Ann Arbor, MI – Detroit, MI	43 Min	49 Min
Chicago, IL –Kalamazoo, MI	2 Hour 9 Min	2 Hour 17Min
Chicago, IL – Detroit, MI	4 Hour 15 Min	4 Hour 29 Min

The projected travel times in Exhibit 1-20 were calculated with by computing travel time on each segment of the highway route between two cities. The key assumptions are as follows:

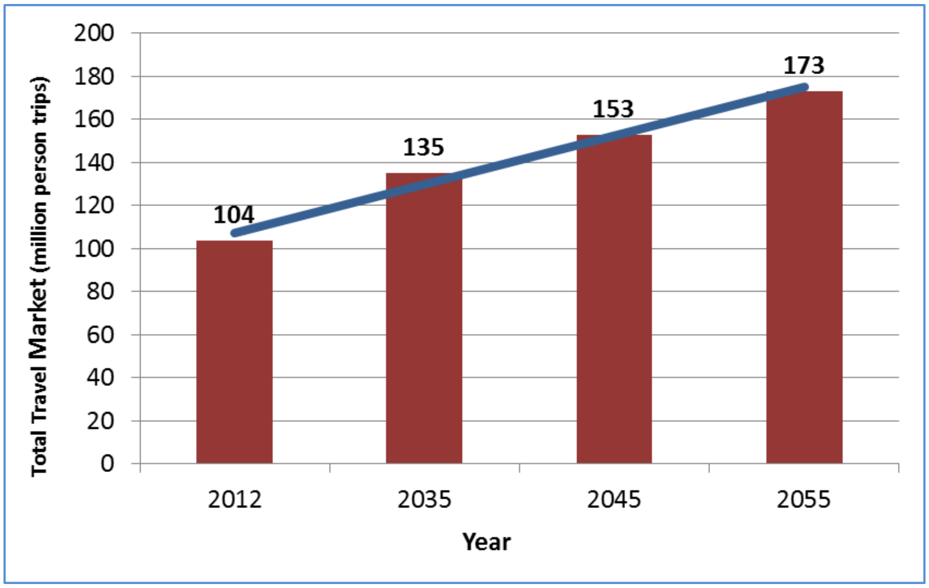
- $\alpha = 0.56$
- $\beta = 3.6$

For example, the highway links between Chicago and Detroit have seen a traffic volume increase from 5.7 million of vehicle miles travelled (VMT) per day to 6.0 million VMT per day from 2008 to 2035. By applying the BPR function while assuming same route is used between these two cities in the future, it can be calculated that travel time on this highway segment will increase by 0.24% per year with the BPR function.

1.9 Chicago-Detroit/Pontiac Corridor Total Travel Market Demand Forecast

This section presents the Chicago-Detroit/Pontiac corridor total travel demand forecast as result of applying the *COMPASS*™ total demand model. Exhibit 1-36 shows the Chicago-Detroit/Pontiac corridor total travel demand forecasts for 2035, 2045, and 2055. It can be seen that the Chicago-Detroit/Pontiac corridor travel demand will increase to 135 million in 2035, to 153 million in 2045, and increases to 173 million in 2055. The average annual corridor travel market growth rate is 1.2 percent, which is in line with the socioeconomic growth within the travel market.

Exhibit 1-36: Chicago-Detroit/Pontiac Corridor Total Travel Demand Forecast (million)



1.10 Chicago-Detroit/Pontiac Corridor Passenger Rail Forecast Results

Exhibit 1-37 gives the four passenger rail scenarios that were studied with TEMS COMPASS™ ridership and revenue forecasting program. The "Base" scenario is the current Chicago-Detroit/Pontiac rail service that has three daily round trips (DRT) and travel time from Chicago to Pontiac is six hours and forty minutes. In addition, the "Base" scenario uses the current fuel price and highway travel time in the forecasts. Therefore, it produces the baseline passenger rail demand forecast by assuming that the current travel market conditions will continue in the future. "Scenario 1" has three DRTs and travel time from Chicago to Pontiac is shortened by one hour by infrastructure improvements to become five hours and forty minutes. "Scenario 2" has six DRTs and travel time from Chicago to Pontiac is the same as that of "Scenario 1". "Full Build" has 10 DRTs and travel time from Chicago to Pontiac is five hours and sixteen minutes. Each of the build "scenarios" also considers projected congestions and increase energy prices.

Exhibit 1-37: Passenger Rail Service Scenarios

Scenario	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)
Base (Current Travel Market Conditions)	3	46	6:40
Scenario 1 (3 DRTs and Improved Travel Time)	3	55	5:40
Scenario 2 (6 DRTs and Improved Travel Time)	6	55	5:40
Full Build (10 DRTs and Improved Travel Time)	10 (7 to Pontiac)	58	5:16

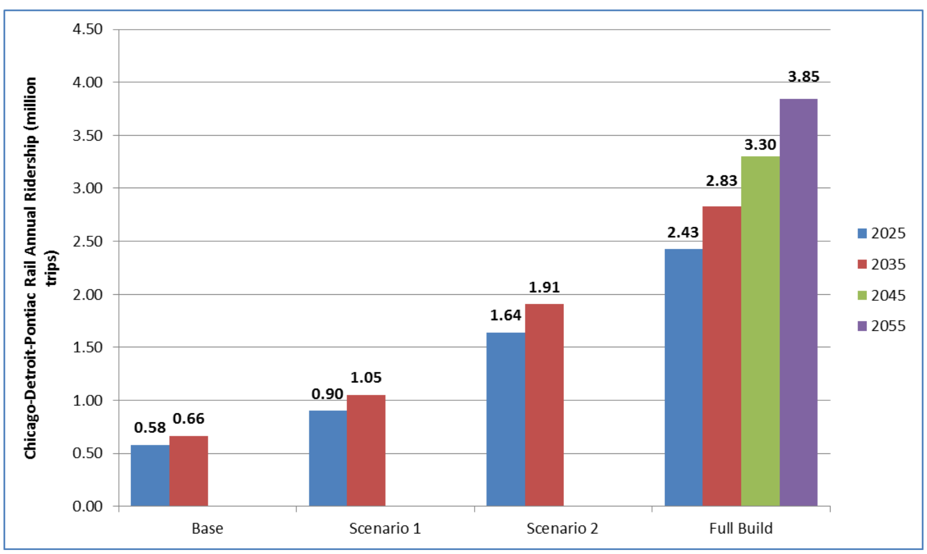
Exhibit 1-38 shows the ten forecasts produced for the four scenarios. Forecasts were made for 2025 and 2035 for the “Base”, “Scenario 1”, and “Scenario 2” scenarios; for the “Full Build” scenario forecasts were done for 2025, 2035, 2045, and 2055.

Exhibit 1-38: Demand Forecasts for Passenger Rail Service Scenarios

Scenario	2025	2035	2045	2055
Base (Current Travel Market Conditions)	√	√		
Scenario 1 (3 DRTs and Improved Travel Time)	√	√		
Scenario 2 (6 DRTs and Improved Travel Time)	√	√		
Full Build (10 DRTs and Improved Travel Time)	√	√	√	√

The passenger rail ridership for each scenario and year is shown in Exhibit 1-39. It can be seen that in the “Base” scenario rail ridership will be 0.58 million in 2025 and becomes 0.66 million in 2035, this is the baseline rail ridership forecast if today’s travel market characteristics including fuel price and highway travel time remain the same in the future, so all incremental ridership comes only from socioeconomic growth. “Scenario 1” will have 0.9 million rail trips in 2025 and 1.05 million in 2035, the increase in rail ridership is due to improved travel time and inclusion of fuel price and highway congestion in the demand forecast model. “Scenario 2” will have 1.64 and 1.91 million trips in 2025 and 2035. The incremental rail ridership compared to “Scenario 1” comes from improved train frequency and more convenient schedule. The “Full Build” scenario which has 10 DRTs and fastest speed will have 2.43 million trips in 2025, 2.83 million in 2035, 3.3 million in 2045, and 3.85 million in 2055.

Exhibit 1-39: Chicago-Detroit/Pontiac Corridor Ridership Forecast (annual million trips)



The passenger rail revenue forecast is shown in Exhibit 1-40. It can be seen that revenues increase strongly as both travel speed and frequency increase.

Exhibit 1-40: Chicago-Detroit/Pontiac Corridor Revenue Forecast (annual million 2013$)

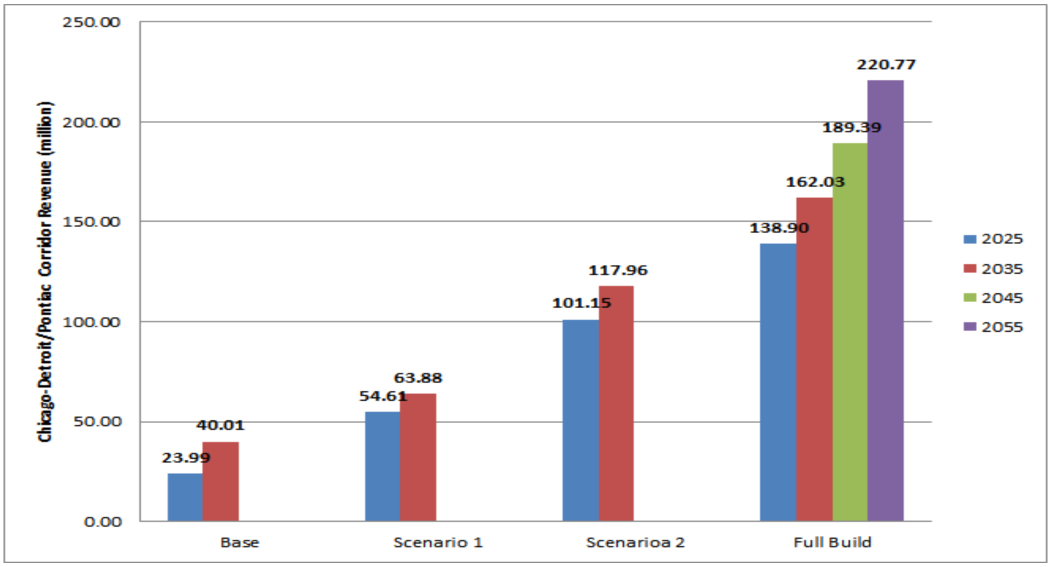
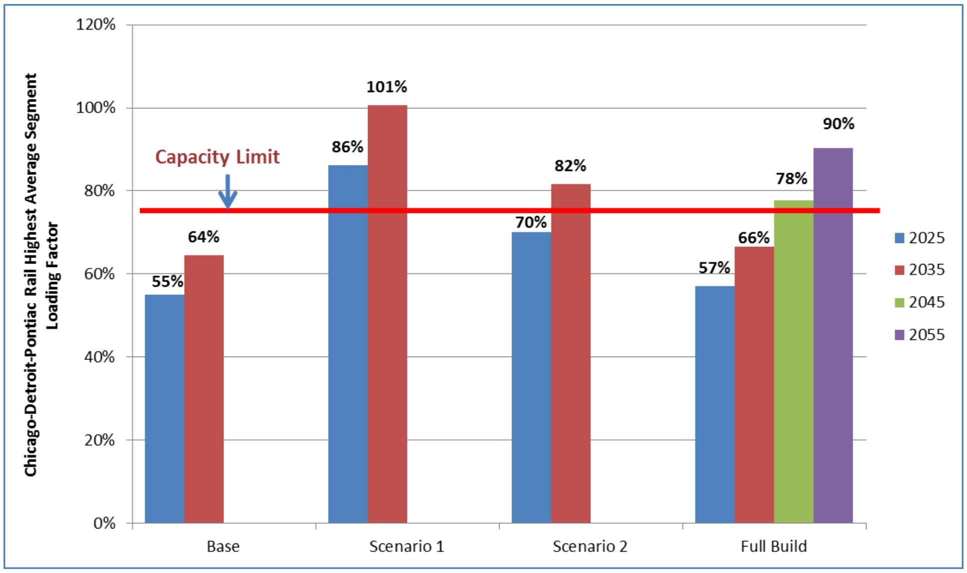


Exhibit 1-41 shows the highest average segment (stop to stop) loading factor in the Chicago-Detroit/Pontiac corridor. Given a train size of 460 seats, it can be seen that the "Base" scenario has the highest average segment loading factors of 55% and 65% in 2025 and 2035. 'Scenario 1" will have 86% and 101% highest average segment loading factors in 2025 and 2035 if improved travel time, fuel price projections, and highway congestions are included in the forecast. Historical data shows that passenger rail services with average segment loading factor higher than 75% cannot guarantee that all passengers can have a seat during peak operation hours if there is no reservation system available. If there is a reservation system the highest allowable average segment loading factor would be 80% to 84%. Since there is no reservation system proposed for train operations, it is necessary to implement "Scenario 2" in 2025 which in order to reduce the highest average segment loading factor to 70%. However again in 2035, the highest average segment loading factor for "Scenario 2" will reach 82%, 7% higher than the seat capacity limit in peak hours. Therefore, there is a need to increase train frequency to the "Full Build" scenario in 2035 to provide satisfactory seat capacity in the Chicago-Detroit/Pontiac corridor. If "Full Build" scenario can be implemented in 2035, the highest average segment loading factor in the corridor will be 66%, which is below the seat capacity limit. However the highest average segment loading factor in the corridor will reach 78% in 2045, and in 2055 it will be 90%, this indicates that an even more frequent passenger rail service will be needed in the late stage of the Chicago-Detroit/Pontiac passenger rail project's life span.

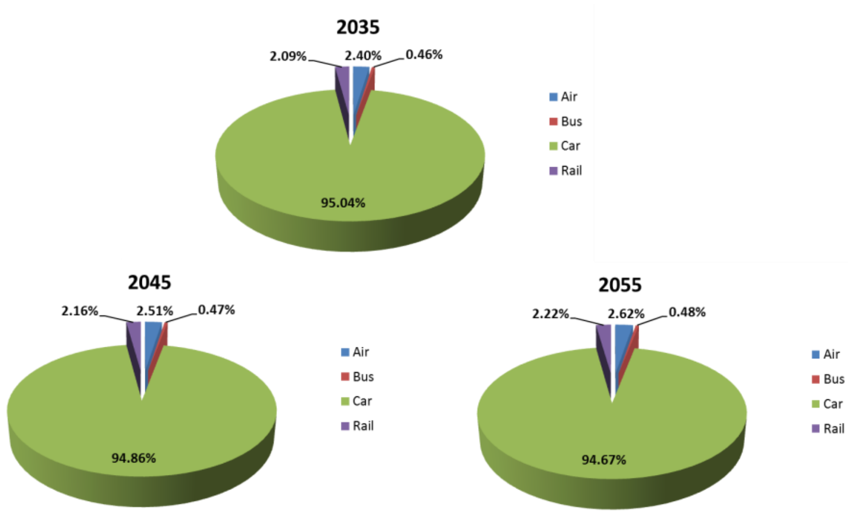
Detailed rail travel demand forecast results for the ten runs are available in the Appendix 3.

Exhibit 1-41: Chicago-Detroit/Pontiac Corridor Segment Loading Factors Forecast



The Chicago-Detroit/Pontiac corridor transportation mode market share forecasts for the "Full Build" scenario are shown in Exhibit 1-42. The auto mode continues to demonstrate its dominance in the corridor maintaining a market share above 90 percent from 2035 to 2055. Rail market share will increase from 2.09 percent in 2035, to 2.16 percent in 2045, and will reach 2.22 percent in 2055. Air market share will be 2.40 percent to 2.62 percent in the corridor, and the market share growth is due to increased congestion and fuel prices. Bus market share will remain at 0.45 to 0.48 percent.

Exhibit 1-42: Chicago-Detroit/Pontiac Corridor "Full Build" Travel Market Share Forecast



The purpose split of the rail ridership for Chicago-Detroit/Pontiac corridor "Full Build" scenario as illustrated in Exhibit 1-43 shows that percentage of each trip purposes of rail travel. The Non-Business trips account for about 67 to 68 percent of the overall rail travel market, the Business trips account for about 32 to 33 percent.

Exhibit 1-43: Chicago-Detroit/Pontiac Corridor "Full Build" Rail Trip Purpose Forecast

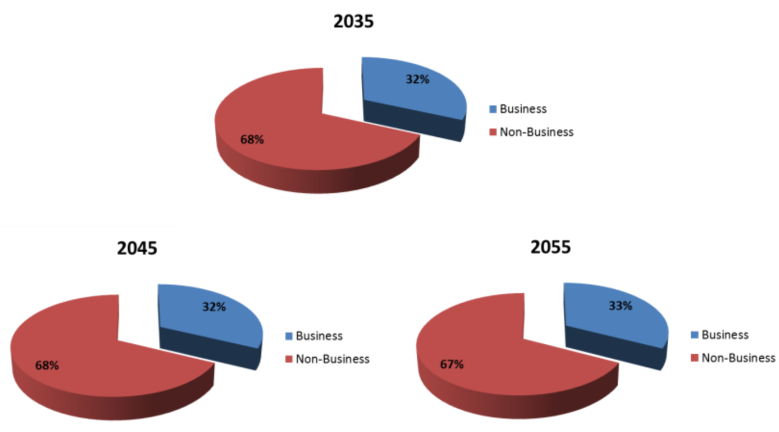


Exhibit 1-44 illustrates the sources of the rail trips for the Chicago-Detroit/Pontiac corridor "Full Build" scenario in 2035. The trips diverted from other modes are the most important source of rail trips, which accounts for 70.6 percent of overall rail travel market. Induced travel demand in the corridor as result of the new passenger rail service is 6.2 percent of the rail travel market. As for the diverted trips from other modes, 54.1 percent trips are from auto mode, but the auto driving still dominates future travel market, this is because auto driving has a strong base in the current Michigan corridors.

Exhibit 1-44: Chicago-Detroit/Pontiac Corridor "Full Build" Rail Trip Sources Forecast

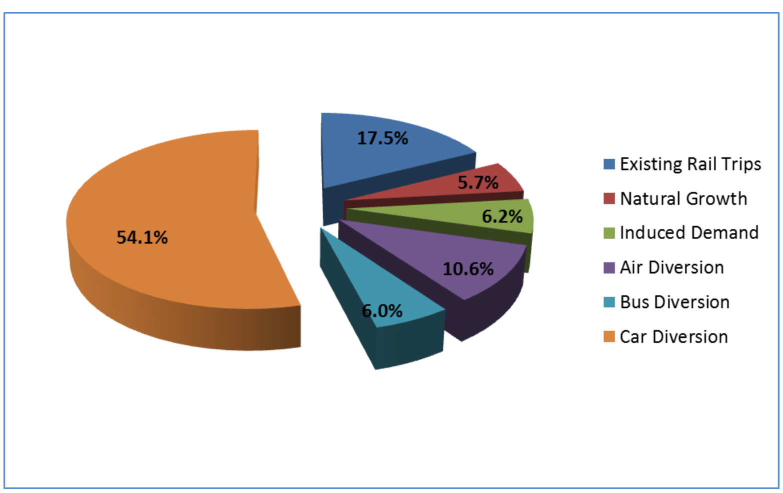


Exhibit 1-45 shows the contributing factors of the increased passenger rail ridership for Chicago-Detroit/Pontiac corridor "Full Build" scenario in 2035. It can be seen that levels-of-service improvement of passenger rail accounts for 53 percent of the total rail ridership, and gas price and highway congestion increases account for 23 percent of rail ridership

Exhibit 1-45: Chicago-Detroit/Pontiac Corridor "Full Build" Contributing Factors of Rail Trips

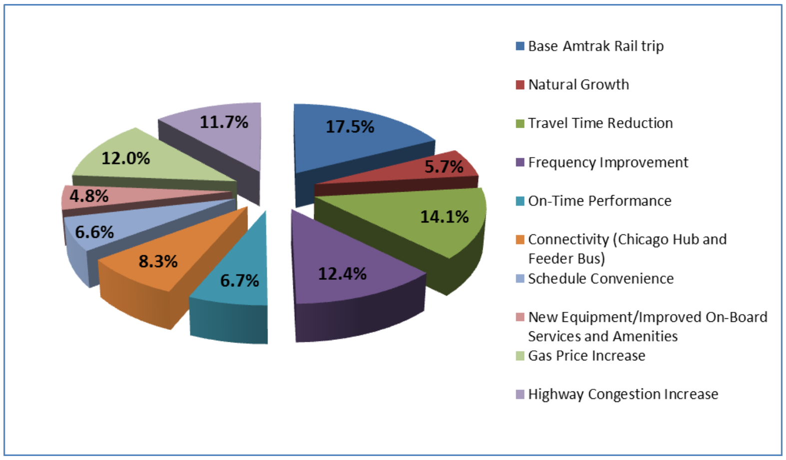


Exhibit 1-46 shows the comparison of 2030 Chicago-Detroit/Pontiac corridor "Full Build" scenario forecast with previous studies. The rail trips rates (trips per 10,000 persons per day) are listed and it can be seen that the rail trip rate of Chicago-Detroit/Pontiac corridor is similar to that of Chicago-St. Louis corridor. This is due to the similarities of socioeconomics and rail proposals in each corridor. The forecast results are much lower than the high-speed rail options developed for other corridors. The rail trip rate forecast for Chicago-Detroit/Pontiac corridor is 30 to 40 percent of the Northeast corridor 125MPH to 150MPH forecast, 50 percent of the Georgia 130MPH passenger rail forecast, 75 percent of the Hampton Roads 130MPH passenger rail forecast. The difference is due to the higher speeds and frequency of train service in other corridors, and in Georgia and Hampton Roads case, the buildup of a dedicated right-of-way. Also the Northeast corridor has much higher socioeconomics.

Exhibit 1-46: 2035 Forecast Comparison with Previous Studies

	2030 Chicago-Detroit/Pontiac (110 MPH)	2030 NEC Master Plan NYC-DC Northeast Regional[1]	2030 NEC Master Plan NYC-DC Northeast Regional and Aclea[1]	2030 Chicago-St. Louis 110MPH[2]	2030 Georgia 130MPH[3]	2030 Hampton Roads 130[4]
Rail Trip Rate (trips per 10,000	5.3	13.3	18.9	5.4	10.3	7.1

persons per day)						

[1] The Northeast Corridor Infrastructure Master Plan, The NEC Master Plan Working Group, 2010
[2] Chicago to St. Louis 110 MPH EIS, 2003
[3] Atlanta to Charlotte Passenger Rail Corridor EIS, Steer Davies Gleave, 2013
[4] Hampton Roads Passenger Rail Vision Plan Alternatives Analysis, TEMS, 2014

Exhibits 1-47 and 1-48 show the apples-to-apples comparison of the forecast results with those from the High-Speed Ground Transportation for America (HSGTA 1997) study. It is shown that the forecast of this study is slightly lower than the HSGTA study. It is 15 percent lower than the 90 MPH forecast and 4 percent lower than the 110 MPH forecast from the HSGTA study once the different assumptions between the studies are accounted for.

Exhibit 1-47: Apples-to-Apples Comparison with High-Speed Ground Transportation for America (1997) Chicago-Detroit Corridor 90 MPH Forecast

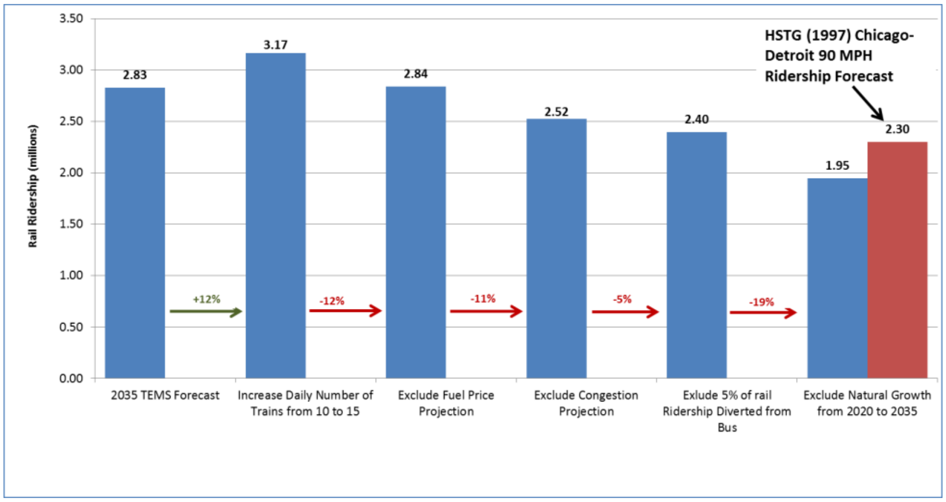
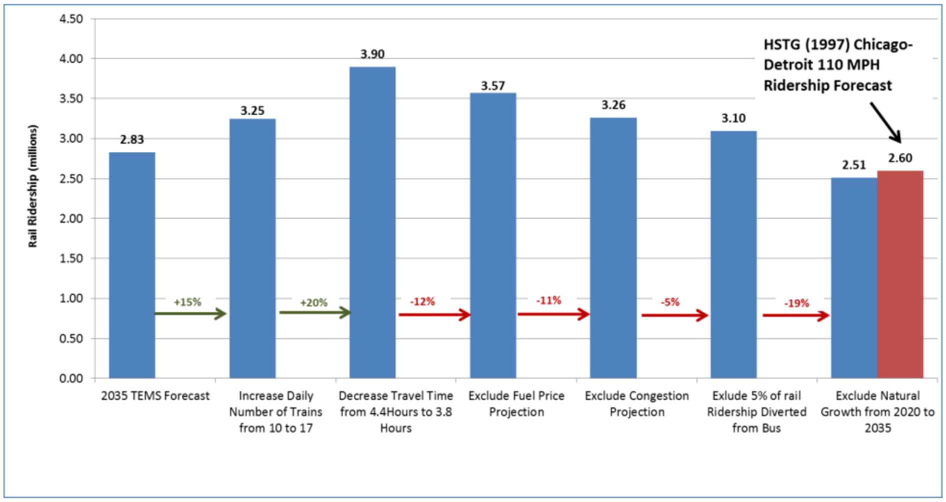


Exhibit 1-48: Apples-to-Apples Comparison with High-Speed Ground Transportation for America (1997) Chicago-Detroit Corridor 110 MPH Forecast



1.11 PASSENGER RAIL FORECAST SENSITIVITY ANALYSIS

The travel demand model was use to forecast the passenger rail ridership and revenue under various future socioeconomic growth rates, future fuel prices scenarios, and future highway congestion increases.

Exhibit 1-49 shows the rail ridership changes by assuming different socioeconomic growth rates. It is shown that if the annual socioeconomic growth rate from base year 2012 to forecast year 2035 is lowered by 10 percent, the rail ridership will decrease by 2.9 percent and if the growth rate is increased by 10 percent, the rail ridership will increase by 3 percent. Exhibit 1-50 shows that the rail revenue will decrease by 3 percent if the annual socioeconomic growth rate is lowered by 10 percent and the rail revenue will increase by 3.1 percent if the annual socioeconomic growth rate is increase by 10 percent.

Exhibit 1-49: 2035 Rail Ridership Changes under Various Socioeconomic Growth Scenarios

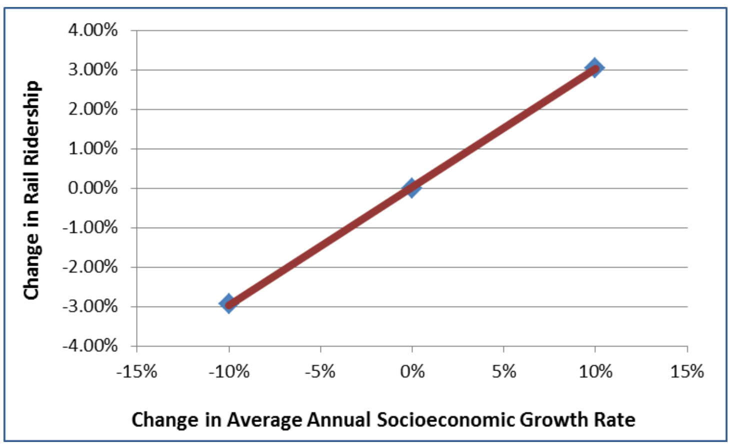


Exhibit 1-50: 2035 Rail Revenue Changes under Various Socioeconomic Growth Scenarios

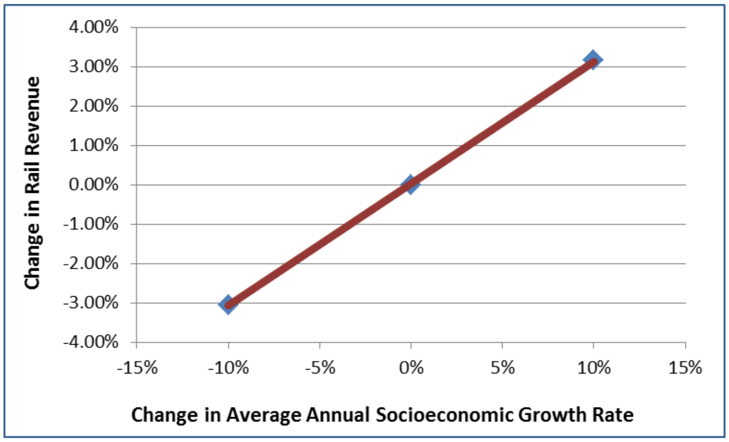


Exhibit 1-51 shows the rail ridership changes by assuming different fuel price scenarios. It is shown that if the fuel price is lowered by 34 percent, which is EIA's low world oil price projection, the rail ridership will decrease by 4 percent and if the fuel price is increased by 101 percent, which is EIA's high world oil price projection, the rail ridership will increase by 14.5 percent. Exhibit 1-52 shows that if the fuel price is lowered by 34 percent, the rail revenue will decrease by 4.5 percent and if the fuel price is increased by 101 percent, the rail revenue will increase by 16 percent.

Exhibit 1-51: 2035 Rail Ridership Changes under Various Fuel Price Scenarios

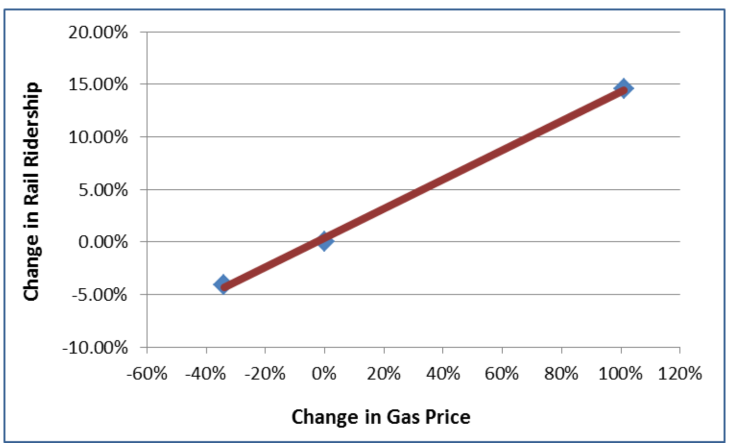


Exhibit 1-52: 2035 Rail Revenue Changes under Various Fuel Price Scenarios

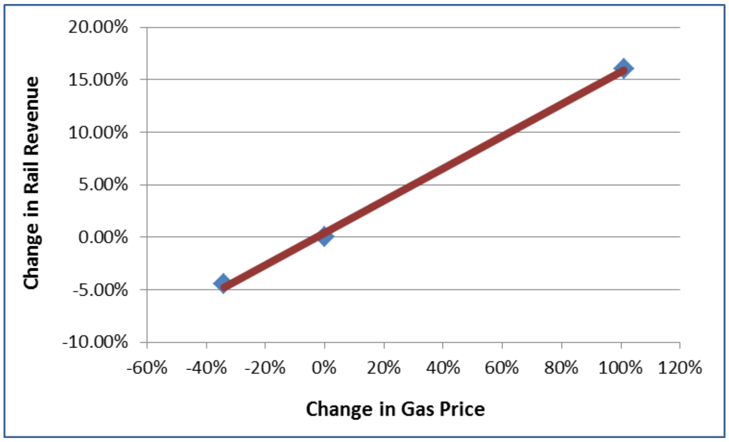


Exhibit 1-53 shows the rail ridership changes by assuming different highway congestion growth scenarios. It is shown that if the highway congestion growth is lowered by 10 percent, the rail ridership will decrease by 1.1 percent and if the highway congestion growth is increased by 10 percent, the rail ridership will increase by 1.2 percent. Exhibit 1-54 shows that if the highway congestion growth is lowered by 10 percent, the rail revenue will decrease by 1.2 percent and if the highway congestion growth is increased by 10 percent, the rail revenue will increase by 1.3 percent.

Exhibit 1-53: 2035 Rail Ridership Changes under Various Highway Congestion Growth Scenarios

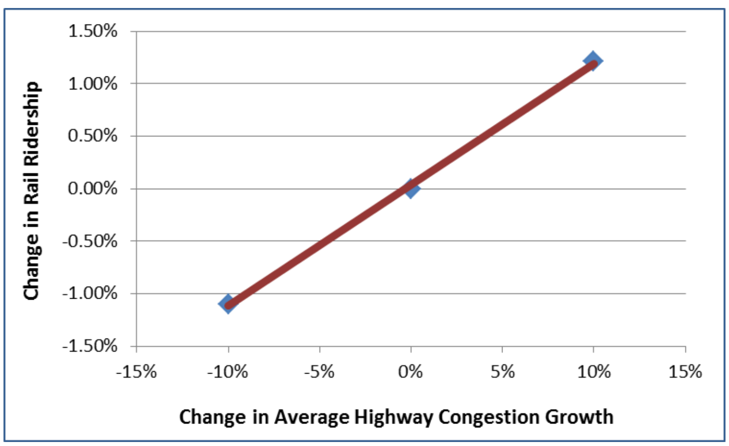


Exhibit 1-54: 2035 Rail Revenue Changes under Various Highway Congestion Growth Scenarios

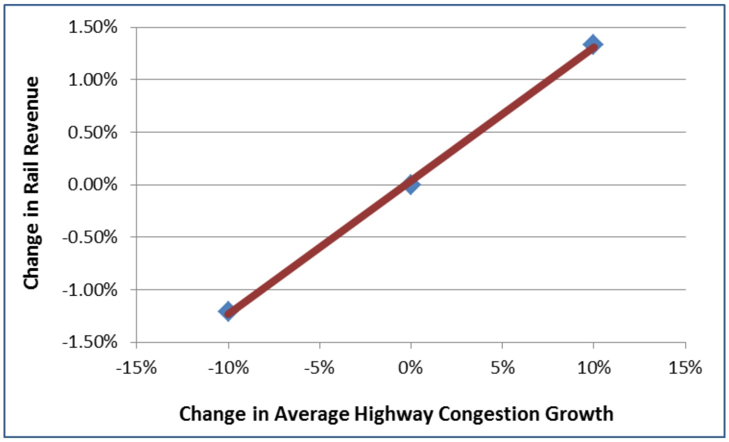
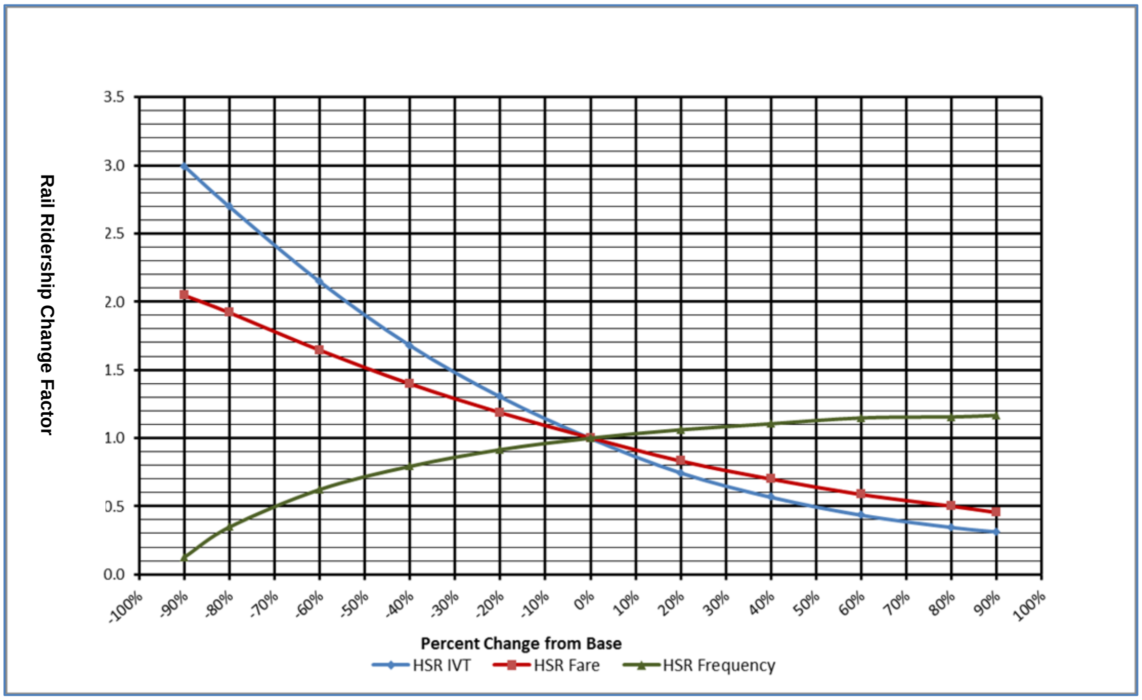


Exhibit 1-55 shows the elasticity of the Chicago-Detroit/Pontiac corridor passenger rail ridership forecast to important passenger rail services factors including in-vehicle travel time, train frequency, and fare. It can be seen that passenger rail ridership elasticity against in-vehicle travel time is 1.2 when in-vehicle travel time changes by 10 percent, which means that a 10 percent change in rail in-vehicle travel time will result in 12 percent change in passenger rail ridership. The travel time elasticity includes such factors as service reliability and schedule convenience as well as travel time itself. The in-vehicle time elasticity increases gradually as change in in-vehicle time increases, when in-vehicle travel time changes by 30 percent, the change in passenger rail ridership is 50 percent. For rail frequency, a 10 percent change in rail frequency results in 2.5 percent change in rail ridership and a 30 percent change in rail frequency result in 10 percent change in rail ridership, thus gives an elasticity of 0.25 to 0.3. For fare elasticity, when rail fare changes by 10 percent, the rail ridership will change by 8 percent, and when fare changes by 30 percent, rail ridership changes by 30 percent. This is due to the fact that the analysis optimized fare and has elasticity close to 1.0.

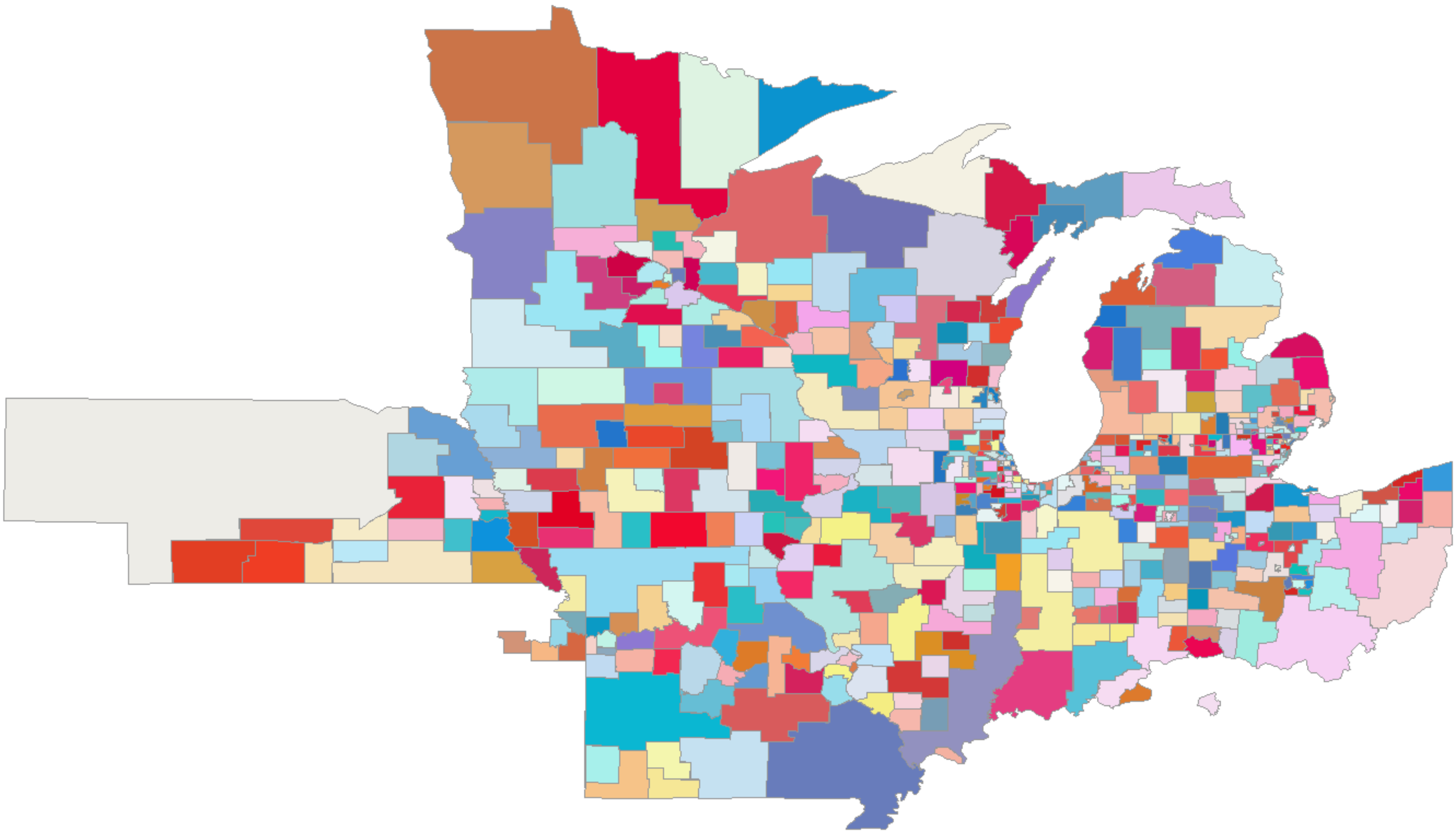
Exhibit 1-55: Chicago-Detroit/Pontiac Corridor Passenger Rail Ridership Forecast Elasticity


Rail Ridership Change Factor
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-100% -90% -80% -70% -60% -50% -40% -30% -20% -10% 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Percent Change from Base
HSR IVT
HSR Fare
HSR Frequency

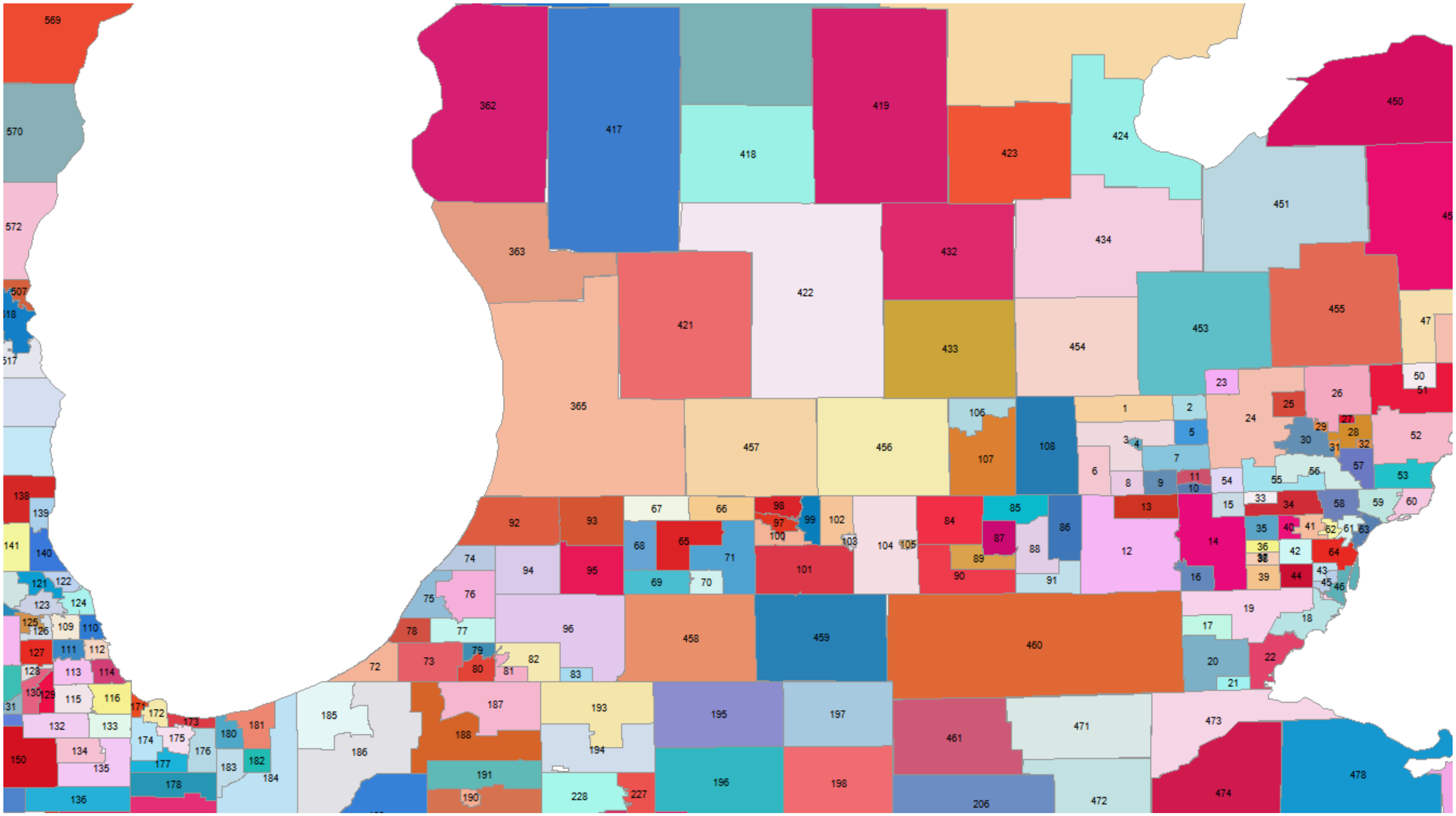
TECHNICAL APPENDIX

1. ZONE SYSTEM AND SOCIOECONOMIC DATA

THE STUDY AREA IS DIVIDED INTO 595 ZONES:



THE MICHIGAN PASSENGER RAIL CORRIDOR ZONES:



1.1 Michigan Population Data and Forecasts

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
1	1	Fowlerville, MI	18,781	19,135	19,741	20,367	21,012	21,677	22,364	23,072	23,803	24,556
2	2	Fenton, MI	6,356	6,430	6,557	6,686	6,817	6,951	7,088	7,227	7,369	7,514
3	3	Howell, MI	21,197	21,811	22,874	23,989	25,158	26,384	27,671	29,019	30,434	31,917
4	4	Howell, MI	5,600	5,647	5,726	5,806	5,888	5,971	6,055	6,140	6,226	6,313
5	5	Howell, MI	27,183	27,521	28,093	28,678	29,275	29,884	30,506	31,141	31,789	32,450
6	6	Pinckney, MI	18,506	18,774	19,230	19,698	20,176	20,667	21,169	21,683	22,210	22,750
7	7	Brighton, MI	36,905	37,090	37,400	37,713	38,029	38,348	38,669	38,993	39,319	39,648
8	8	Pinckney, MI	4,394	4,424	4,474	4,525	4,576	4,628	4,681	4,734	4,788	4,843
9	9	Brighton, MI	24,976	24,995	25,027	25,060	25,092	25,124	25,156	25,189	25,221	25,253
10	10	Whitmore Lake, MI	9,775	9,826	9,913	9,999	10,087	10,175	10,265	10,354	10,445	10,537
11	11	Brighton, MI	7,593	7,612	7,645	7,678	7,711	7,744	7,777	7,810	7,843	7,877
12	12	Chelsea, MI	43,829	45,125	47,372	49,730	52,206	54,805	57,533	60,397	63,404	66,560
13	13	Dexter, MI	30,419	30,673	31,102	31,536	31,976	32,423	32,876	33,335	33,801	34,273
14	14	Ann Arbor, MI	244,693	245,825	247,722	249,634	251,561	253,503	255,460	257,431	259,419	261,421
15	15	Northville TWP, MI	6,285	6,418	6,648	6,885	7,131	7,386	7,650	7,923	8,206	8,499
16	16	Milan, MI	20,288	20,727	21,481	22,262	23,072	23,911	24,781	25,682	26,616	27,584
17	17	Dundee, MI	6,814	7,009	7,346	7,699	8,069	8,457	8,864	9,290	9,736	10,204

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
18	18	Monroe, MI	27,973	28,293	28,835	29,388	29,951	30,524	31,109	31,705	32,312	32,931
19	19	Milan, MI	27,461	27,765	28,281	28,806	29,340	29,885	30,440	31,005	31,581	32,167
20	20	Lambertville, MI	17,608	17,783	18,079	18,379	18,685	18,995	19,311	19,631	19,958	20,289
21	21	Lambertville, MI	27,066	27,331	27,780	28,236	28,699	29,170	29,648	30,135	30,629	31,132
22	22	Monroe, MI	45,172	45,358	45,672	45,987	46,304	46,624	46,946	47,270	47,597	47,925
23	23	Holly, MI	11,291	11,514	11,896	12,290	12,697	13,118	13,553	14,003	14,467	14,946
24	24	White Lake, MI	177,487	180,198	184,807	189,535	194,383	199,355	204,455	209,685	215,048	220,549
25	25	Clarkston, MI	44,774	45,170	45,838	46,516	47,204	47,902	48,610	49,329	50,059	50,799
26	26	Lake Orion, MI	89,229	91,118	94,356	97,710	101,182	104,778	108,502	112,358	116,352	120,487
27	27	Rochester, MI	16,275	16,431	16,695	16,963	17,235	17,512	17,793	18,078	18,368	18,663
28	28	Rochester, MI	81,562	83,206	86,019	88,928	91,935	95,043	98,257	101,579	105,013	108,564
29	29	Pontiac, MI	12,346	12,408	12,513	12,618	12,725	12,832	12,940	13,050	13,160	13,271
30	30	Waterford, MI	136,601	137,196	138,194	139,199	140,212	141,232	142,259	143,294	144,336	145,386
31	31	Pontiac, MI	13,262	13,142	12,944	12,748	12,556	12,367	12,180	11,996	11,815	11,637
32	32	Troy, MI	11,225	11,235	11,253	11,270	11,288	11,305	11,323	11,340	11,358	11,375
33	33	Northville TWP, MI	28,841	29,579	30,850	32,176	33,559	35,001	36,505	38,074	39,710	41,417
34	34	Livonia, MI	155,297	155,210	155,065	154,920	154,775	154,631	154,486	154,342	154,198	154,053

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
35	35	Canton, MI	55,188	56,178	57,867	59,606	61,398	63,244	65,145	67,104	69,121	71,199
36	36	Belleville, MI	32,970	33,817	35,278	36,801	38,390	40,048	41,777	43,581	45,463	47,426
37	37	Belleville, MI	11,064	11,332	11,794	12,275	12,775	13,295	13,837	14,400	14,987	15,597
38	38	Belleville, MI	10,833	11,075	11,490	11,921	12,368	12,831	13,312	13,811	14,329	14,866
39	39	Belleville, MI	3,965	4,008	4,079	4,152	4,226	4,302	4,379	4,457	4,536	4,617
40	40	Westland, MI	91,060	91,039	91,005	90,971	90,938	90,904	90,870	90,836	90,802	90,768
41	41	Garden City, MI	108,275	108,040	107,650	107,261	106,874	106,488	106,103	105,720	105,339	104,958
42	42	Romulus, MI	16,849	17,187	17,767	18,366	18,985	19,625	20,287	20,971	21,678	22,409
43	43	Romulus, MI	40,478	40,984	41,842	42,718	43,612	44,525	45,457	46,408	47,380	48,371
44	44	Carleton, MI	21,166	22,009	23,489	25,069	26,755	28,554	30,474	32,523	34,710	37,045
45	45	Flat Rock, MI	34,581	35,528	37,163	38,874	40,664	42,536	44,494	46,542	48,685	50,926
46	46	Trenton, MI	40,311	40,567	40,997	41,432	41,871	42,315	42,763	43,217	43,675	44,138
47	47	Capac, MI	12,008	12,124	12,320	12,519	12,721	12,927	13,136	13,348	13,564	13,783
48	48	St Clair, MI	133,093	134,545	137,000	139,500	142,045	144,637	147,276	149,964	152,700	155,486
49	49	Port Huron, MI	18,035	18,422	19,087	19,776	20,489	21,228	21,994	22,788	23,610	24,462
50	50	Romeo, MI	5,451	5,609	5,882	6,169	6,470	6,786	7,116	7,464	7,828	8,209
51	51	Romeo, MI	41,793	43,519	46,555	49,803	53,278	56,995	60,972	65,226	69,777	74,645
52	52	Macomb, MI	506,345	512,553	523,070	533,803	544,756	555,934	567,341	578,982	590,862	602,986
53	53	Roseville, MI	287,599	286,849	285,602	284,361	283,125	281,895	280,670	279,451	278,236	277,027

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
54	54	South Lyon, MI	25,312	26,169	27,661	29,238	30,906	32,668	34,531	36,500	38,581	40,782
55	55	Farmington, MI	123,781	125,196	127,590	130,029	132,516	135,050	137,632	140,264	142,946	145,680
56	56	Southfield, MI	288,556	290,431	293,584	296,771	299,993	303,249	306,541	309,869	313,232	316,633
57	57	Clawson, MI	172,103	172,023	171,890	171,757	171,625	171,492	171,360	171,228	171,095	170,963
58	58	Detroit, MI	289,780	284,803	276,697	268,821	261,170	253,737	246,515	239,498	232,682	226,059
59	59	Hamtramck, MI	285,138	280,409	272,700	265,203	257,912	250,822	243,927	237,221	230,700	224,357
60	60	Detroit, MI	200,020	196,945	191,925	187,033	182,265	177,619	173,092	168,680	164,380	160,190
61	61	Dearborn, MI	73,717	73,346	72,731	72,122	71,517	70,918	70,324	69,735	69,151	68,571
62	62	Dearborn, MI	68,195	68,637	69,381	70,133	70,892	71,661	72,437	73,222	74,015	74,817
63	63	Detroit, MI	93,632	91,809	88,850	85,986	83,214	80,532	77,936	75,424	72,993	70,640
64	64	Southgate, MI	137,538	136,999	136,105	135,217	134,335	133,459	132,588	131,724	130,864	130,011
65	65	Kalamazoo, MI	181,304	183,759	185,508	187,809	190,697	194,174	196,528	199,273	202,018	204,702
66	66	Richland, MI	12,174	12,339	12,525	12,708	12,918	13,090	13,281	13,469	13,657	13,851
67	67	Kalamazoo, MI	14,639	14,726	14,837	14,957	15,088	15,230	15,329	15,449	15,568	15,682
68	68	Kalamazoo, MI	17,803	18,337	19,154	20,216	21,487	23,021	23,626	24,655	25,684	26,639
69	69	Vicksburg, MI	12,042	12,245	12,459	12,675	12,893	12,376	12,863	12,986	13,110	13,364
70	70	Vicksburg, MI	2,402	2,419	2,442	2,472	2,504	2,543	2,562	2,590	2,618	2,644

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
71	71	Galesburg, MI	10,578	10,660	10,799	10,973	11,229	11,525	11,615	11,801	11,987	12,146
72	72	Union Pier, MI	9,743	9,719	9,691	9,673	9,657	9,641	9,627	9,593	9,570	9,547
73	73	Buchanan, MI	8,445	8,424	8,400	8,384	8,370	8,356	8,344	8,315	8,295	8,275
74	74	Watervliet, MI	14,865	14,828	14,785	14,758	14,733	14,709	14,688	14,635	14,601	14,565
75	75	Benton Harbor, MI	59,451	59,305	59,132	59,022	58,924	58,826	58,743	58,533	58,395	58,252
76	76	Benton Harbor, MI	9,435	9,412	9,385	9,367	9,352	9,336	9,323	9,290	9,268	9,245
77	77	Buchanan, MI	13,341	13,308	13,269	13,245	13,223	13,201	13,182	13,135	13,104	13,072
78	78	Bridgman, MI	6,807	6,790	6,771	6,758	6,747	6,736	6,726	6,702	6,686	6,670
79	79	Niles, MI	3,109	3,102	3,093	3,087	3,082	3,077	3,072	3,061	3,054	3,047
80	80	Niles, MI	30,365	30,290	30,202	30,146	30,095	30,045	30,003	29,896	29,825	29,752
81	81	Niles, MI	10,372	10,554	10,868	11,193	11,520	11,846	12,174	12,483	12,803	13,140
82	82	Niles, MI	21,746	22,127	22,787	23,469	24,153	24,837	25,525	26,173	26,845	27,549
83	83	Elkhart, IN	0	0	0	0	0	0	0	0	0	0
84	84	Albion, MI	8,891	8,921	8,982	9,052	9,123	9,193	9,265	9,321	9,387	9,452
85	85	Pleasant Lake, MI	13,903	13,951	14,046	14,155	14,266	14,376	14,489	14,577	14,679	14,781
86	86	Grass Lake, MI	7,622	7,649	7,701	7,760	7,821	7,882	7,944	7,992	8,048	8,104
87	87	Jackson, MI	65,572	65,798	66,247	66,760	67,283	67,802	68,335	68,749	69,231	69,713

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
88	88	Jackson, MI	23,986	24,069	24,233	24,421	24,612	24,802	24,997	25,148	25,324	25,501
89	89	Jackson, MI	14,520	14,570	14,669	14,783	14,899	15,014	15,132	15,223	15,330	15,437
90	90	Jackson, MI	12,523	12,566	12,652	12,750	12,850	12,949	13,050	13,129	13,221	13,314
91	91	Brooklyn, MI	12,525	12,568	12,654	12,752	12,852	12,951	13,053	13,132	13,224	13,316
92	92	Covert, MI	23,956	24,096	24,332	24,571	24,812	25,055	25,300	25,548	25,798	26,051
93	93	Paw Paw, MI	14,533	14,958	15,694	16,466	17,276	18,126	19,017	19,953	20,934	21,964
94	94	Paw Paw, MI	12,299	12,462	12,738	13,021	13,309	13,604	13,905	14,214	14,529	14,850
95	95	Paw Paw, MI	25,999	26,810	28,220	29,703	31,265	32,908	34,638	36,459	38,376	40,394
96	96	Jones, MI	20,305	20,520	20,885	21,256	21,633	22,018	22,409	22,807	23,212	23,624
97	97	Battle Creek, MI	62,643	62,834	63,152	63,472	63,665	64,714	64,782	65,180	65,578	65,868
98	98	Battle Creek, MI	16,632	16,774	17,013	17,256	17,309	17,521	17,740	17,932	18,123	18,329
99	99	Battle Creek, MI	13,806	14,054	14,477	14,913	15,315	15,814	16,212	16,644	17,076	17,518
100	100	Battle Creek, MI	18,280	18,413	18,635	18,860	19,063	19,469	19,631	19,876	20,122	20,344
101	101	Athens, MI	8,574	9,012	9,791	10,637	10,958	11,459	12,268	12,908	13,548	14,326
102	102	Marshall, MI	2,382	2,448	2,563	2,683	2,808	2,940	3,077	3,221	3,372	3,530
103	103	Marshall, MI	3,757	3,791	3,848	3,906	3,965	4,025	4,086	4,148	4,210	4,274
104	104	Albion, MI	6,413	6,536	6,745	6,961	7,184	7,414	7,652	7,897	8,150	8,411
105	105	Albion, MI	3,752	3,749	3,744	3,738	3,733	3,728	3,723	3,718	3,713	3,708

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
106	106	East Lansing, MI	206,271	207,160	208,870	210,787	212,732	214,666	216,643	218,244	220,060	221,888
107	107	Mason, MI	48,551	48,760	49,163	49,614	50,072	50,527	50,992	51,369	51,797	52,227
108	108	Williamston, MI	25,007	25,115	25,323	25,555	25,791	26,025	26,265	26,459	26,679	26,901
109	258	Bruce Crossing, MI	82,226	82,236	82,442	82,700	82,928	83,109	83,313	83,495	83,692	83,887
110	259	Ishpeming, MI	93,040	93,497	94,481	95,537	96,568	97,551	98,568	99,518	100,507	101,512
111	260	Bark River, MI	23,878	23,900	23,994	24,104	24,207	24,297	24,395	24,480	24,573	24,666
112	261	Munising, MI	17,989	18,046	18,186	18,339	18,484	18,622	18,767	18,899	19,038	19,179
113	262	Rapid River, MI	36,945	37,069	37,360	37,680	37,990	38,280	38,582	38,862	39,155	39,451
114	263	Newberry, MI	56,150	56,409	56,973	57,581	58,173	58,738	59,321	59,866	60,434	61,009
115	362	Ludington, MI	55,386	56,072	57,337	58,642	59,929	61,185	62,456	63,705	64,969	66,282
116	363	Muskegon, MI	171,988	173,279	175,796	178,416	180,956	183,383	185,846	188,331	190,813	193,356
117	364	Brethren, MI	24,587	24,621	24,740	24,879	25,014	25,140	25,275	25,383	25,506	25,629
118	365	Holland, MI	386,057	405,659	438,753	472,252	505,692	538,937	572,385	605,327	638,545	675,683
119	412	Petoskey, MI	86,660	90,460	96,962	103,593	110,246	116,890	123,609	130,043	136,626	143,919
120	413	Alpena, MI	72,422	73,487	75,386	77,311	79,185	80,991	82,798	84,702	86,561	88,501
121	414	Frederic, MI	79,610	81,519	84,841	88,207	91,531	94,795	98,071	101,385	104,684	108,204
122	415	Lake Ann, MI	126,701	128,436	131,608	134,881	138,116	141,282	144,491	147,624	150,803	154,117

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
123	416	Cadillac, MI	71,287	72,208	73,903	75,657	77,386	79,080	80,797	82,470	84,169	85,937
124	417	Bitely, MI	61,211	63,754	68,083	72,471	76,847	81,192	85,564	89,871	94,215	99,004
125	418	Big Rapids, MI	43,089	43,836	45,169	46,533	47,881	49,200	50,533	51,856	53,187	54,586
126	419	Clare, MI	100,833	101,016	101,564	102,191	102,789	103,338	103,919	104,432	104,985	105,540
127	420	West Branch, MI	113,496	114,617	116,748	118,965	121,151	123,277	125,442	127,534	129,669	131,873
128	421	Grand Rapids, MI	612,587	632,054	665,596	699,660	733,548	767,087	800,862	834,218	867,817	904,252
129	422	Ionia, MI	127,889	130,059	133,939	137,907	141,825	145,665	149,539	153,389	157,258	161,324
130	423	Sanford, MI	83,223	83,352	83,766	84,243	84,696	85,110	85,552	85,935	86,353	86,771
131	424	Midland, MI	106,939	106,671	106,477	106,360	106,208	106,001	105,824	105,595	105,399	105,199
132	432	Ithaca, MI	42,244	42,265	42,401	42,570	42,725	42,859	43,007	43,128	43,265	43,402
133	433	St Johns, MI	76,554	78,928	82,981	87,117	91,268	95,417	99,589	103,599	107,700	112,136
134	434	Saginaw, MI	198,418	197,809	197,261	196,854	196,380	195,806	195,285	194,674	194,120	193,561
135	450	Bad Axe, MI	32,860	32,861	32,941	33,046	33,140	33,218	33,306	33,375	33,455	33,535
136	451	Caro, MI	55,540	55,813	56,402	57,036	57,657	58,252	58,867	59,435	60,030	60,635
137	452	Sandusky, MI	43,027	43,411	44,153	44,934	45,704	46,456	47,227	47,952	48,702	49,474
138	453	Flint, MI	422,669	422,745	423,881	425,336	426,663	427,783	429,035	430,024	431,171	432,306
139	454	Owosso, MI	70,480	70,868	71,684	72,558	73,414	74,240	75,091	75,879	76,704	77,543
140	455	Lapeer, MI	89,004	90,949	94,395	97,934	101,464	104,965	108,517	111,916	115,397	119,100

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
141	456	Charlotte, MI	108,702	110,926	114,759	118,705	122,670	126,632	130,622	134,394	138,289	142,409
142	457	Hastings, MI	59,779	61,398	64,210	67,071	69,911	72,718	75,544	78,340	81,154	84,179
143	458	3 Rivers MI,	61,244	61,719	62,648	63,618	64,564	65,473	66,398	67,312	68,234	69,180
144	459	Coldwater, MI	45,250	45,793	46,794	47,824	48,834	49,815	50,806	51,798	52,791	53,822
145	460	Hudson, MI	146,175	147,025	148,796	150,686	152,541	154,330	156,176	157,888	159,676	161,498

1.2 Michigan Employment Data and Forecasts

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
1	1	Fowlerville, MI	1,124	1,179	1,278	1,385	1,501	1,627	1,764	1,912	2,072	2,246
2	2	Fenton, MI	116	124	138	154	171	191	213	238	265	295
3	3	Howell, MI	8,485	8,741	9,185	9,651	10,141	10,656	11,198	11,766	12,364	12,992
4	4	Howell, MI	7,632	7,769	8,003	8,243	8,491	8,747	9,010	9,281	9,560	9,847
5	5	Howell, MI	10,537	10,864	11,433	12,031	12,660	13,323	14,020	14,753	15,525	16,338
6	6	Pinckney, MI	7,499	7,696	8,035	8,389	8,758	9,144	9,547	9,967	10,406	10,865
7	7	Brighton, MI	22,679	23,205	24,110	25,049	26,026	27,040	28,094	29,188	30,326	31,508
8	8	Pinckney, MI	614	615	616	618	619	620	621	623	624	625
9	9	Brighton, MI	4,296	4,438	4,685	4,946	5,222	5,512	5,819	6,143	6,485	6,846
10	10	Whitmore Lake, MI	3,872	4,030	4,309	4,606	4,925	5,265	5,628	6,017	6,432	6,877
11	11	Brighton, MI	5,022	5,165	5,411	5,670	5,941	6,224	6,522	6,833	7,160	7,502
12	12	Chelsea, MI	18,750	19,050	19,561	20,086	20,625	21,179	21,747	22,331	22,930	23,545
13	13	Dexter, MI	8,104	8,260	8,528	8,803	9,088	9,382	9,685	9,998	10,322	10,655
14	14	Ann Arbor, MI	203,741	207,866	214,927	222,228	229,777	237,583	245,653	253,998	262,626	271,548
15	15	Northville TWP, MI	552	579	626	678	733	793	858	928	1,004	1,086
16	16	Milan, MI	11,297	11,529	11,926	12,337	12,761	13,200	13,655	14,125	14,611	15,114
17	17	Dundee, MI	3,657	3,703	3,781	3,861	3,942	4,025	4,110	4,197	4,285	4,376

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
18	18	Monroe, MI	8,660	8,777	8,977	9,181	9,390	9,604	9,823	10,046	10,275	10,509
19	19	Milan, MI	5,428	5,499	5,621	5,746	5,873	6,003	6,135	6,271	6,410	6,552
20	20	Lambertville, MI	3,026	3,073	3,152	3,234	3,318	3,404	3,493	3,584	3,677	3,772
21	21	Lambertville, MI	6,197	6,272	6,397	6,526	6,656	6,790	6,926	7,065	7,206	7,351
22	22	Monroe, MI	26,781	27,032	27,457	27,888	28,325	28,770	29,222	29,680	30,146	30,619
23	23	Holly, MI	3,402	3,568	3,863	4,182	4,528	4,902	5,307	5,746	6,221	6,735
24	24	White Lake, MI	57,144	58,468	60,744	63,108	65,564	68,116	70,767	73,521	76,383	79,356
25	25	Clarkston, MI	7,307	7,583	8,068	8,583	9,132	9,715	10,336	10,996	11,699	12,446
26	26	Lake Orion, MI	40,853	41,980	43,928	45,967	48,100	50,332	52,667	55,111	57,668	60,344
27	27	Rochester, MI	3,968	4,106	4,346	4,600	4,869	5,153	5,454	5,773	6,110	6,468
28	28	Rochester, MI	86,858	88,561	91,474	94,483	97,590	100,800	104,116	107,540	111,078	114,731
29	29	Pontiac, MI	4,624	4,726	4,900	5,081	5,269	5,464	5,666	5,875	6,092	6,317
30	30	Waterford, MI	96,852	97,645	98,982	100,337	101,710	103,102	104,513	105,944	107,394	108,864
31	31	Pontiac, MI	8,605	8,782	9,086	9,401	9,727	10,064	10,412	10,773	11,146	11,532
32	32	Troy, MI	6,443	6,474	6,527	6,580	6,634	6,688	6,742	6,797	6,853	6,908
33	33	Northville TWP, MI	9,539	9,582	9,654	9,727	9,800	9,873	9,948	10,022	10,098	10,174
34	34	Livonia, MI	123,545	123,617	123,739	123,860	123,981	124,103	124,225	124,346	124,468	124,590
35	35	Canton, MI	16,699	17,080	17,736	18,417	19,124	19,858	20,621	21,412	22,234	23,088
36	36	Belleville, MI	10,638	10,621	10,592	10,564	10,535	10,507	10,478	10,450	10,422	10,394

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
37	37	Belleville, MI	5,898	5,934	5,995	6,057	6,119	6,182	6,246	6,310	6,374	6,440
38	38	Belleville, MI	784	792	805	819	833	847	862	877	892	907
39	39	Belleville, MI	587	626	696	775	862	959	1,068	1,188	1,322	1,471
40	40	Westland, MI	35,121	35,228	35,407	35,587	35,768	35,950	36,133	36,317	36,502	36,687
41	41	Garden City, MI	25,812	25,992	26,295	26,602	26,912	27,226	27,544	27,865	28,190	28,519
42	42	Romulus, MI	34,299	34,617	35,152	35,696	36,248	36,808	37,377	37,955	38,542	39,138
43	43	Romulus, MI	19,323	19,573	19,997	20,431	20,873	21,326	21,788	22,260	22,742	23,235
44	44	Carleton, MI	8,455	8,529	8,654	8,781	8,910	9,041	9,173	9,308	9,445	9,583
45	45	Flat Rock, MI	14,746	14,738	14,725	14,712	14,699	14,686	14,674	14,661	14,648	14,635
46	46	Trenton, MI	11,435	11,511	11,639	11,769	11,900	12,033	12,167	12,303	12,440	12,579
47	47	Capac, MI	2,503	2,585	2,728	2,878	3,037	3,205	3,381	3,568	3,764	3,972
48	48	St Clair, MI	55,721	56,476	57,756	59,066	60,405	61,775	63,176	64,608	66,073	67,571
49	49	Port Huron, MI	3,281	3,399	3,605	3,823	4,055	4,301	4,561	4,838	5,131	5,442
50	50	Romeo, MI	1,714	1,770	1,867	1,970	2,078	2,192	2,313	2,440	2,574	2,715
51	51	Romeo, MI	14,039	14,372	14,943	15,538	16,156	16,799	17,467	18,162	18,884	19,636
52	52	Macomb, MI	187,928	189,982	193,455	196,991	200,592	204,259	207,993	211,795	215,667	219,609
53	53	Roseville, MI	167,812	168,337	169,216	170,099	170,987	171,879	172,777	173,678	174,585	175,496
54	54	South Lyon, MI	8,107	8,511	9,231	10,012	10,859	11,777	12,773	13,854	15,025	16,296
55	55	Farmington, MI	118,725	120,298	122,966	125,693	128,480	131,329	134,242	137,218	140,261	143,372
56	56	Southfield, MI	237,430	239,201	242,184	245,204	248,261	251,356	254,490	257,663	260,876	264,129

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
57	57	Clawson, MI	167,098	168,472	170,789	173,138	175,518	177,932	180,379	182,859	185,374	187,923
58	58	Detroit, MI	58,134	57,611	56,750	55,901	55,066	54,242	53,431	52,632	51,846	51,070
59	59	Hamtramck, MI	216,818	215,604	213,597	211,607	209,637	207,685	205,751	203,835	201,936	200,056
60	60	Detroit, MI	60,278	60,010	59,567	59,126	58,690	58,256	57,825	57,398	56,974	56,553
61	61	Dearborn, MI	47,614	47,693	47,825	47,957	48,090	48,223	48,357	48,490	48,625	48,759
62	62	Dearborn, MI	72,381	72,111	71,663	71,218	70,776	70,337	69,900	69,466	69,035	68,606
63	63	Detroit, MI	41,797	41,387	40,714	40,052	39,401	38,760	38,129	37,509	36,899	36,299
64	64	Southgate, MI	53,899	53,858	53,791	53,723	53,655	53,588	53,521	53,453	53,386	53,319
65	65	Kalamazoo, MI	112,913	114,144	117,773	121,014	125,066	129,483	132,139	135,613	139,087	142,444
66	66	Richland, MI	4,456	4,520	4,677	4,827	5,008	5,225	5,342	5,502	5,662	5,816
67	67	Kalamazoo, MI	2,308	2,316	2,392	2,451	2,509	2,572	2,622	2,679	2,736	2,793
68	68	Kalamazoo, MI	7,461	7,547	7,771	7,984	8,224	8,513	8,683	8,904	9,124	9,338
69	69	Vicksburg, MI	3,730	3,745	3,841	3,909	3,994	4,090	4,149	4,224	4,300	4,372
70	70	Vicksburg, MI	771	768	783	795	804	818	823	833	842	850
71	71	Galesburg, MI	10,521	10,528	10,724	10,851	11,013	11,185	11,293	11,433	11,572	11,704
72	72	Union Pier, MI	5,627	5,661	5,729	5,799	5,873	5,952	6,035	6,125	6,207	6,295
73	73	Buchanan, MI	2,391	2,406	2,435	2,465	2,496	2,530	2,565	2,603	2,638	2,675
74	74	Watervliet, MI	5,047	5,078	5,138	5,202	5,268	5,339	5,414	5,494	5,568	5,646
75	75	Benton Harbor, MI	42,437	42,694	43,206	43,738	44,298	44,891	45,520	46,193	46,817	47,477
76	76	Benton Harbor, MI	3,549	3,571	3,613	3,658	3,705	3,754	3,807	3,863	3,915	3,970

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
77	77	Buchanan, MI	6,539	6,579	6,658	6,740	6,826	6,918	7,014	7,118	7,214	7,316
78	78	Bridgman, MI	3,376	3,396	3,437	3,480	3,524	3,571	3,621	3,675	3,724	3,777
79	79	Niles, MI	1,216	1,223	1,238	1,253	1,269	1,286	1,304	1,324	1,341	1,360
80	80	Niles, MI	13,566	13,649	13,812	13,982	14,161	14,351	14,552	14,767	14,966	15,177
81	81	Niles, MI	1,182	1,204	1,245	1,288	1,334	1,384	1,438	1,473	1,518	1,566
82	82	Niles, MI	4,463	4,545	4,699	4,862	5,035	5,223	5,427	5,561	5,730	5,910
83	83	Elkhart, IN	0	0	0	0	0	0	0	0	0	0
84	84	Albion, MI	1,751	1,763	1,782	1,801	1,819	1,836	1,853	1,875	1,894	1,913
85	85	Pleasant Lake, MI	1,509	1,520	1,537	1,553	1,568	1,583	1,598	1,616	1,633	1,649
86	86	Grass Lake, MI	1,894	1,907	1,928	1,948	1,968	1,987	2,005	2,028	2,048	2,070
87	87	Jackson, MI	44,034	44,351	44,833	45,302	45,759	46,196	46,613	47,157	47,634	48,123
88	88	Jackson, MI	7,519	7,573	7,655	7,735	7,813	7,888	7,959	8,052	8,133	8,217
89	89	Jackson, MI	7,921	7,978	8,065	8,149	8,231	8,310	8,385	8,483	8,568	8,656
90	90	Jackson, MI	2,372	2,389	2,415	2,441	2,465	2,489	2,511	2,541	2,566	2,593
91	91	Brooklyn, MI	3,079	3,101	3,135	3,168	3,200	3,230	3,260	3,298	3,331	3,365
92	92	Covert, MI	9,451	9,509	9,606	9,704	9,804	9,904	10,006	10,108	10,212	10,317
93	93	Paw Paw, MI	2,537	2,557	2,590	2,624	2,659	2,693	2,729	2,765	2,801	2,838
94	94	Paw Paw, MI	3,247	3,275	3,322	3,370	3,418	3,467	3,516	3,566	3,617	3,669
95	95	Paw Paw, MI	12,292	12,650	13,270	13,920	14,602	15,318	16,069	16,856	17,682	18,548
96	96	Jones, MI	9,387	9,471	9,613	9,756	9,902	10,051	10,201	10,354	10,509	10,666

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
97	97	Battle Creek, MI	30,526	30,856	31,413	31,980	32,176	32,378	32,993	33,413	33,833	34,332
98	98	Battle Creek, MI	1,763	1,882	2,098	2,339	2,372	2,409	2,658	2,808	2,958	3,167
99	99	Battle Creek, MI	3,473	3,651	3,970	4,316	4,370	4,431	4,795	5,017	5,239	5,539
100	100	Battle Creek, MI	17,735	18,111	18,757	19,425	19,954	20,578	21,216	21,835	22,453	23,115
101	101	Athens, MI	617	628	646	665	674	683	703	718	732	750
102	102	Marshall, MI	1,537	1,556	1,586	1,618	1,649	1,682	1,715	1,749	1,784	1,819
103	103	Marshall, MI	4,567	4,616	4,699	4,784	4,871	4,959	5,048	5,140	5,233	5,327
104	104	Albion, MI	3,338	3,339	3,339	3,340	3,340	3,341	3,341	3,342	3,342	3,343
105	105	Albion, MI	2,887	2,935	3,016	3,099	3,184	3,272	3,362	3,454	3,549	3,647
106	106	East Lansing, MI	169,271	173,553	180,593	187,640	194,690	201,734	208,772	215,475	222,392	229,738
107	107	Mason, MI	21,544	22,089	22,985	23,882	24,779	25,675	26,571	27,424	28,305	29,240
108	108	Williamston, MI	7,141	7,322	7,619	7,916	8,214	8,511	8,808	9,091	9,382	9,692
109	258	Bruce Crossing, MI	32,711	32,972	34,714	36,529	38,430	40,412	42,486	43,788	45,518	47,360
110	259	Ishpeming, MI	39,494	40,243	42,235	44,260	46,312	48,393	50,506	52,263	54,223	56,319
111	260	Bark River, MI	10,765	10,745	10,970	11,200	11,440	11,692	11,956	12,097	12,307	12,520
112	261	Munising, MI	5,345	5,387	5,618	5,848	6,077	6,300	6,525	6,711	6,923	7,143
113	262	Rapid River, MI	15,661	16,093	16,917	17,757	18,616	19,489	20,381	21,161	22,001	22,908
114	263	Newberry, MI	19,180	19,408	20,404	21,418	22,447	23,489	24,551	25,359	26,315	27,331
115	362	Ludington, MI	23,606	24,129	25,265	26,424	27,610	28,818	30,075	31,106	32,254	33,489

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
116	363	Muskegon, MI	62,371	63,194	64,710	66,390	68,263	70,356	72,705	73,994	75,798	77,703
117	364	Brethren, MI	8,667	8,658	8,924	9,185	9,450	9,711	9,971	10,157	10,390	10,626
118	365	Holland, MI	177,301	187,711	203,853	221,391	240,419	261,032	283,320	298,504	317,116	338,370
119	412	Petoskey, MI	38,312	40,107	44,345	48,965	53,976	59,418	65,304	68,851	73,590	79,028
120	413	Alpena, MI	26,591	26,646	27,439	28,185	28,893	29,579	30,218	30,832	31,486	32,149
121	414	Frederic, MI	32,168	32,782	34,838	36,989	39,245	41,615	44,123	45,786	47,899	50,198
122	415	Lake Ann, MI	52,793	53,672	56,426	59,227	62,079	64,982	67,928	70,278	72,971	75,846
123	416	Cadillac, MI	28,902	29,615	31,216	32,876	34,595	36,373	38,226	39,657	41,310	43,100
124	417	Bitely, MI	23,253	24,026	25,688	27,494	29,454	31,600	33,924	35,338	37,211	39,295
125	418	Big Rapids, MI	17,201	17,473	18,396	19,353	20,340	21,364	22,425	23,187	24,114	25,107
126	419	Clare, MI	42,750	43,304	45,132	46,959	48,789	50,642	52,519	54,066	55,807	57,643
127	420	West Branch, MI	37,496	38,112	39,777	41,476	43,221	45,037	46,924	48,348	50,019	51,799
128	421	Grand Rapids, MI	291,909	305,453	324,525	344,167	364,354	385,073	406,297	425,914	446,211	468,677
129	422	Ionia, MI	51,941	53,409	55,936	58,760	61,934	65,510	69,550	71,711	74,778	78,151
130	423	Sanford, MI	37,614	38,699	39,961	41,320	42,772	44,325	45,985	47,324	48,799	50,388
131	424	Midland, MI	48,135	48,667	49,535	50,460	51,453	52,506	53,633	54,454	55,424	56,432
132	432	Ithaca, MI	17,188	17,336	17,601	17,868	18,130	18,396	18,659	18,919	19,182	19,451
133	433	St Johns, MI	30,417	31,921	34,662	37,774	41,336	45,430	50,165	52,217	55,581	59,446
134	434	Saginaw, MI	81,429	83,503	86,569	90,089	94,166	98,914	104,474	107,058	111,044	115,410
135	450	Bad Axe, MI	13,576	13,720	13,994	14,283	14,594	14,942	15,334	15,565	15,872	16,195

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
136	451	Caro, MI	22,842	22,659	22,811	22,974	23,151	23,347	23,566	23,571	23,696	23,814
137	452	Sandusky, MI	17,217	17,323	17,632	17,943	18,257	18,572	18,893	19,161	19,460	19,765
138	453	Flint, MI	165,074	165,873	170,108	174,991	180,494	186,595	193,285	196,278	201,208	206,330
139	454	Owosso, MI	30,390	30,412	30,739	31,077	31,441	31,826	32,237	32,460	32,786	33,112
140	455	Lapeer, MI	37,761	38,497	40,025	41,527	43,000	44,446	45,871	47,327	48,779	50,316
141	456	Charlotte, MI	42,534	44,110	46,737	49,425	52,172	54,965	57,804	60,319	63,006	65,940
142	457	Hastings, MI	27,250	28,038	29,233	30,449	31,675	32,904	34,139	35,365	36,593	37,913
143	458	3 Rivers MI,	25,155	25,968	26,692	27,397	28,083	28,756	29,427	30,331	31,094	31,915
144	459	Coldwater, MI	18,124	18,443	19,326	20,216	21,121	22,039	22,968	23,739	24,602	25,521
145	460	Hudson, MI	63,495	63,894	65,045	66,264	67,557	68,942	70,417	71,360	72,580	73,835

1.3 Michigan per Capita Income Data and Forecasts (2012 US$)

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
1	1	Fowlerville, MI	26,445	27,132	28,447	30,011	31,824	33,875	35,835	37,805	39,882	42,112
2	2	Fenton, MI	33,371	34,239	35,898	37,871	40,159	42,748	45,221	47,707	50,328	53,143
3	3	Howell, MI	30,639	31,435	32,959	34,771	36,871	39,248	41,519	43,801	46,208	48,792
4	4	Howell, MI	23,541	24,152	25,323	26,715	28,329	30,155	31,900	33,653	35,502	37,488
5	5	Howell, MI	32,641	33,490	35,113	37,043	39,281	41,813	44,232	46,663	49,227	51,980
6	6	Pinckney, MI	26,571	27,262	28,583	30,154	31,976	34,037	36,007	37,986	40,073	42,314
7	7	Brighton, MI	36,241	37,183	38,985	41,128	43,613	46,424	49,110	51,809	54,656	57,713
8	8	Pinckney, MI	33,691	34,567	36,242	38,235	40,545	43,158	45,655	48,164	50,811	53,653
9	9	Brighton, MI	36,221	37,163	38,964	41,106	43,589	46,399	49,084	51,781	54,627	57,681
10	10	Whitmore Lake, MI	33,095	33,955	35,601	37,558	39,827	42,394	44,847	47,312	49,912	52,703
11	11	Brighton, MI	35,240	36,156	37,909	39,993	42,409	45,143	47,754	50,379	53,147	56,119
12	12	Chelsea, MI	39,512	41,285	44,502	48,510	53,224	58,610	64,241	70,002	76,280	83,283
13	13	Dexter, MI	42,575	44,485	47,951	52,271	57,350	63,154	69,221	75,429	82,193	89,739
14	14	Ann Arbor, MI	32,222	33,667	36,290	39,559	43,404	47,796	52,388	57,086	62,205	67,916
15	15	Northville TWP, MI	33,246	34,738	37,444	40,817	44,784	49,315	54,054	58,901	64,183	70,075
16	16	Milan, MI	33,630	35,138	37,876	41,288	45,300	49,884	54,677	59,581	64,924	70,884
17	17	Dundee, MI	24,289	25,127	26,430	28,014	29,874	32,001	34,244	36,398	38,688	41,214
18	18	Monroe, MI	25,674	26,560	27,937	29,612	31,577	33,826	36,197	38,474	40,894	43,565

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
19	19	Milan, MI	27,000	27,932	29,379	31,141	33,208	35,573	38,065	40,460	43,006	45,814
20	20	Lambertville, MI	27,350	28,294	29,761	31,545	33,639	36,034	38,559	40,985	43,564	46,409
21	21	Lambertville, MI	30,149	31,190	32,806	34,773	37,081	39,722	42,506	45,180	48,022	51,158
22	22	Monroe, MI	25,415	26,292	27,655	29,313	31,259	33,485	35,831	38,085	40,482	43,125
23	23	Holly, MI	27,999	29,277	31,960	35,262	39,162	43,670	48,801	53,801	59,315	65,688
24	24	White Lake, MI	33,340	34,862	38,056	41,989	46,632	52,001	58,110	64,065	70,630	78,219
25	25	Clarkston, MI	36,039	37,684	41,137	45,388	50,407	56,211	62,814	69,251	76,348	84,552
26	26	Lake Orion, MI	37,558	39,273	42,871	47,301	52,533	58,581	65,462	72,171	79,567	88,116
27	27	Rochester, MI	46,192	48,301	52,727	58,175	64,609	72,047	80,511	88,762	97,858	108,373
28	28	Rochester, MI	41,028	42,901	46,832	51,671	57,386	63,993	71,510	78,838	86,917	96,257
29	29	Pontiac, MI	18,232	19,065	20,812	22,962	25,502	28,438	31,778	35,035	38,625	42,775
30	30	Waterford, MI	35,439	37,057	40,452	44,632	49,568	55,275	61,769	68,099	75,077	83,144
31	31	Pontiac, MI	59,284	61,991	67,671	74,663	82,920	92,467	103,330	113,918	125,592	139,088
32	32	Troy, MI	40,380	42,223	46,092	50,855	56,479	62,981	70,380	77,592	85,544	94,736
33	33	Northville TWP, MI	53,055	56,066	60,919	66,773	73,620	81,499	91,331	100,600	110,809	122,759
34	34	Livonia, MI	33,076	34,953	37,979	41,628	45,897	50,809	56,939	62,717	69,082	76,531
35	35	Canton, MI	35,016	37,003	40,206	44,069	48,589	53,788	60,278	66,395	73,133	81,019
36	36	Belleville, MI	28,686	30,314	32,938	36,103	39,805	44,065	49,381	54,393	59,913	66,373
37	37	Belleville, MI	35,841	37,875	41,153	45,107	49,733	55,055	61,698	67,959	74,856	82,928
38	38	Belleville, MI	32,886	34,752	37,760	41,388	45,633	50,516	56,611	62,356	68,684	76,091

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
39	39	Belleville, MI	24,591	25,987	28,236	30,949	34,123	37,775	42,332	46,628	51,360	56,899
40	40	Westland, MI	25,352	26,790	29,109	31,906	35,179	38,943	43,642	48,070	52,949	58,659
41	41	Garden City, MI	23,242	24,561	26,687	29,251	32,251	35,702	40,010	44,070	48,543	53,777
42	42	Romulus, MI	21,115	22,313	24,244	26,574	29,299	32,435	36,348	40,037	44,100	48,855
43	43	Romulus, MI	28,251	29,854	32,438	35,555	39,201	43,396	48,632	53,567	59,003	65,366
44	44	Carleton, MI	26,678	28,192	30,632	33,575	37,019	40,980	45,925	50,585	55,719	61,727
45	45	Flat Rock, MI	27,496	29,056	31,571	34,605	38,154	42,236	47,332	52,136	57,427	63,619
46	46	Trenton, MI	32,633	34,484	37,469	41,069	45,281	50,127	56,175	61,876	68,155	75,505
47	47	Capac, MI	21,832	22,659	24,124	25,880	27,927	30,266	32,788	35,232	37,859	40,792
48	48	St Clair, MI	24,041	24,951	26,565	28,498	30,752	33,328	36,105	38,797	41,689	44,919
49	49	Port Huron, MI	27,898	28,955	30,827	33,071	35,686	38,676	41,898	45,022	48,379	52,126
50	50	Romeo, MI	29,018	30,229	32,306	34,849	37,851	41,316	45,265	48,969	52,975	57,551
51	51	Romeo, MI	28,626	29,821	31,869	34,379	37,340	40,758	44,654	48,307	52,260	56,774
52	52	Macomb, MI	29,533	30,766	32,879	35,468	38,523	42,050	46,069	49,838	53,916	58,573
53	53	Roseville, MI	24,159	25,167	26,896	29,014	31,513	34,398	37,685	40,769	44,104	47,914
54	54	South Lyon, MI	32,625	34,115	37,241	41,089	45,633	50,887	56,864	62,692	69,116	76,543
55	55	Farmington, MI	37,585	39,301	42,902	47,335	52,571	58,623	65,510	72,223	79,624	88,180
56	56	Southfield, MI	44,532	46,565	50,832	56,084	62,287	69,458	77,617	85,571	94,340	104,477
57	57	Clawson, MI	35,018	36,617	39,972	44,103	48,980	54,619	61,036	67,291	74,186	82,158
58	58	Detroit, MI	17,291	18,272	19,854	21,761	23,993	26,561	29,765	32,786	36,113	40,008

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
59	59	Hamtramck, MI	14,587	15,414	16,748	18,358	20,240	22,406	25,110	27,658	30,465	33,750
60	60	Detroit, MI	24,701	26,103	28,362	31,088	34,276	37,944	42,522	46,837	51,590	57,154
61	61	Dearborn, MI	15,161	16,021	17,408	19,080	21,037	23,288	26,098	28,747	31,664	35,078
62	62	Dearborn, MI	29,632	31,313	34,024	37,293	41,118	45,518	51,009	56,186	61,888	68,562
63	63	Detroit, MI	14,350	15,164	16,477	18,060	19,912	22,043	24,702	27,209	29,970	33,202
64	64	Southgate, MI	23,797	25,147	27,324	29,950	33,021	36,555	40,965	45,122	49,702	55,061
65	65	Kalamazoo, MI	24,097	24,932	26,298	28,019	30,042	32,347	34,788	37,124	39,617	42,386
66	66	Richland, MI	36,617	37,887	39,963	42,577	45,652	49,155	52,864	56,413	60,201	64,410
67	67	Kalamazoo, MI	28,042	29,014	30,604	32,606	34,961	37,643	40,484	43,202	46,103	49,326
68	68	Kalamazoo, MI	31,774	32,875	34,677	36,945	39,613	42,652	45,871	48,951	52,238	55,890
69	69	Vicksburg, MI	31,135	32,214	33,979	36,202	38,817	41,795	44,949	47,967	51,187	54,766
70	70	Vicksburg, MI	26,745	27,672	29,189	31,098	33,344	35,902	38,612	41,204	43,971	47,045
71	71	Galesburg, MI	26,977	27,912	29,441	31,367	33,633	36,213	38,945	41,560	44,351	47,451
72	72	Union Pier, MI	33,633	35,130	37,086	39,488	42,291	45,478	49,110	52,563	56,257	60,391
73	73	Buchanan, MI	24,426	25,513	26,934	28,678	30,714	33,029	35,667	38,174	40,857	43,859
74	74	Watervliet, MI	21,657	22,621	23,881	25,427	27,233	29,285	31,624	33,847	36,226	38,888
75	75	Benton Harbor, MI	29,329	30,634	32,340	34,435	36,879	39,658	42,826	45,836	49,058	52,663
76	76	Benton Harbor, MI	18,927	19,770	20,871	22,223	23,800	25,594	27,638	29,581	31,660	33,986
77	77	Buchanan, MI	21,875	22,848	24,121	25,683	27,506	29,579	31,941	34,186	36,589	39,278
78	78	Bridgman, MI	30,729	32,097	33,885	36,079	38,640	41,552	44,871	48,025	51,401	55,178

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
79	79	Niles, MI	20,858	21,786	23,000	24,489	26,227	28,204	30,457	32,597	34,889	37,452
80	80	Niles, MI	20,269	21,114	22,271	23,682	25,325	27,190	29,287	31,281	33,411	35,787
81	81	Niles, MI	25,566	26,631	28,091	29,870	31,943	34,295	36,941	39,456	42,143	45,139
82	82	Niles, MI	27,443	28,191	29,699	31,463	33,495	35,793	38,194	40,478	42,898	45,568
83	83	Elkhart, IN	20,670	21,233	22,369	23,697	25,228	26,958	28,767	30,487	32,310	34,321
84	84	Albion, MI	23,876	24,850	26,024	27,499	29,239	31,229	33,480	35,578	37,808	40,296
85	85	Pleasant Lake, MI	24,816	25,830	27,050	28,583	30,391	32,459	34,799	36,980	39,298	41,884
86	86	Grass Lake, MI	31,850	33,151	34,717	36,684	39,005	41,659	44,662	47,461	50,436	53,755
87	87	Jackson, MI	18,202	18,945	19,840	20,964	22,290	23,807	25,523	27,123	28,823	30,720
88	88	Jackson, MI	23,473	24,431	25,586	27,036	28,746	30,702	32,915	34,978	37,170	39,616
89	89	Jackson, MI	29,296	30,492	31,933	33,743	35,878	38,319	41,081	43,656	46,392	49,445
90	90	Jackson, MI	26,054	27,118	28,399	30,009	31,907	34,079	36,535	38,825	41,258	43,973
91	91	Brooklyn, MI	26,837	27,933	29,253	30,911	32,866	35,103	37,633	39,992	42,498	45,295
92	92	Covert, MI	22,159	22,794	24,255	25,999	28,010	30,281	32,681	34,977	37,435	40,177
93	93	Paw Paw, MI	23,969	24,656	26,237	28,123	30,298	32,754	35,351	37,834	40,492	43,459
94	94	Paw Paw, MI	19,603	20,165	21,458	23,001	24,779	26,788	28,912	30,943	33,117	35,543
95	95	Paw Paw, MI	23,681	24,360	25,922	27,785	29,934	32,361	34,926	37,380	40,006	42,937
96	96	Jones, MI	23,556	24,198	25,492	27,006	28,750	30,722	32,783	34,744	36,821	39,113
97	97	Battle Creek, MI	18,134	18,998	20,186	21,630	23,302	25,186	27,312	29,392	31,632	34,128
98	98	Battle Creek, MI	23,135	24,237	25,753	27,595	29,727	32,131	34,843	37,497	40,354	43,539

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
99	99	Battle Creek, MI	27,058	28,347	30,120	32,274	34,768	37,580	40,751	43,856	47,197	50,922
100	100	Battle Creek, MI	28,632	29,997	31,873	34,153	36,791	39,767	43,123	46,408	49,944	53,885
101	101	Athens, MI	27,363	28,667	30,459	32,638	35,160	38,004	41,211	44,350	47,729	51,496
102	102	Marshall, MI	23,659	24,786	26,336	28,220	30,401	32,859	35,632	38,347	41,269	44,525
103	103	Marshall, MI	30,568	32,025	34,028	36,462	39,279	42,456	46,038	49,546	53,321	57,529
104	104	Albion, MI	19,945	20,895	22,202	23,790	25,628	27,701	30,039	32,327	34,790	37,536
105	105	Albion, MI	17,322	18,148	19,283	20,662	22,258	24,059	26,089	28,077	30,216	32,600
106	106	East Lansing, MI	23,236	24,582	26,177	28,107	30,306	32,737	35,473	38,304	41,360	44,712
107	107	Mason, MI	31,500	33,324	35,487	38,103	41,084	44,379	48,090	51,927	56,070	60,615
108	108	Williamston, MI	31,231	33,039	35,184	37,778	40,733	44,000	47,679	51,483	55,590	60,097
109	258	Bruce Crossing, MI	20,218	20,709	22,478	24,606	27,069	29,875	33,081	36,006	39,190	42,901
110	259	Ishpeming, MI	23,868	24,730	26,517	28,645	31,069	33,765	36,769	39,671	42,801	46,322
111	260	Bark River, MI	22,560	23,562	25,263	27,294	29,627	32,265	35,240	38,143	41,286	44,822
112	261	Munising, MI	20,619	21,455	23,248	25,369	27,800	30,532	33,570	36,572	39,842	43,538
113	262	Rapid River, MI	23,014	24,218	26,170	28,477	31,113	34,064	37,336	40,701	44,370	48,457
114	263	Newberry, MI	20,816	21,163	22,774	24,697	26,889	29,350	32,109	34,578	37,237	40,311
115	362	Ludington, MI	21,558	22,415	24,052	25,983	28,187	30,658	33,306	35,966	38,838	42,024
116	363	Muskegon, MI	20,155	20,970	22,109	23,506	25,140	27,001	29,079	31,047	33,148	35,494
117	364	Brethren, MI	22,739	23,308	24,985	27,044	29,419	32,119	35,188	37,948	40,925	44,368
118	365	Holland, MI	25,168	26,065	27,889	30,149	32,822	35,912	39,029	42,153	45,528	49,274

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
119	412	Petoskey, MI	27,601	28,291	30,218	32,675	35,600	38,974	42,394	45,662	49,182	53,148
120	413	Alpena, MI	21,670	22,215	23,714	25,549	27,684	30,118	32,767	35,202	37,818	40,799
121	414	Frederic, MI	23,060	23,657	25,275	27,274	29,628	32,329	35,209	37,890	40,775	44,055
122	415	Lake Ann, MI	27,078	27,920	29,812	32,131	34,808	37,810	41,064	44,165	47,501	51,254
123	416	Cadillac, MI	20,306	21,154	22,779	24,707	26,920	29,410	32,102	34,805	37,737	41,007
124	417	Bitely, MI	20,900	21,434	22,876	24,660	26,762	29,186	31,653	34,016	36,554	39,403
125	418	Big Rapids, MI	19,939	20,426	21,692	23,199	24,916	26,829	28,848	30,762	32,803	35,077
126	419	Clare, MI	19,223	19,991	21,426	23,102	24,989	27,071	29,408	31,705	34,181	36,944
127	420	West Branch, MI	21,114	21,811	23,502	25,533	27,882	30,554	33,496	36,304	39,348	42,810
128	421	Grand Rapids, MI	26,438	27,684	29,598	31,992	34,834	38,121	41,570	45,057	48,836	53,040
129	422	Ionia, MI	20,121	20,945	22,153	23,639	25,392	27,418	29,639	31,757	34,027	36,566
130	423	Sanford, MI	30,399	31,450	33,401	35,862	38,784	42,148	45,990	49,462	53,196	57,488
131	424	Midland, MI	24,431	25,336	26,984	29,046	31,488	34,303	37,567	40,524	43,713	47,393
132	432	Ithaca, MI	19,302	20,156	21,466	23,023	24,797	26,787	29,031	31,225	33,584	36,213
133	433	St Johns, MI	28,197	28,817	30,749	33,080	35,858	39,125	42,591	45,733	49,106	52,969
134	434	Saginaw, MI	23,110	24,056	25,564	27,436	29,632	32,132	35,081	37,776	40,678	44,005
135	450	Bad Axe, MI	22,164	22,805	24,364	26,254	28,443	30,927	33,749	36,314	39,074	42,241
136	451	Caro, MI	21,086	21,590	22,905	24,488	26,329	28,430	30,782	32,871	35,103	37,659
137	452	Sandusky, MI	20,691	21,236	22,588	24,203	26,076	28,211	30,561	32,708	35,006	37,616
138	453	Flint, MI	23,405	24,229	25,888	27,950	30,387	33,193	36,428	39,367	42,542	46,211

Zone Index	Compass Model ID	Zone Description	2012	2015	2020	2025	2030	2035	2040	2045	2050	2055
139	454	Owosso, MI	23,522	24,450	25,962	27,772	29,879	32,283	34,978	37,530	40,269	43,348
140	455	Lapeer, MI	25,161	26,045	27,527	29,227	31,150	33,288	35,466	37,698	40,071	42,627
141	456	Charlotte, MI	27,209	28,223	30,036	32,166	34,597	37,316	40,071	42,915	45,962	49,268
142	457	Hastings, MI	25,734	26,451	28,174	30,337	32,907	35,880	39,044	41,981	45,139	48,729
143	458	3 Rivers MI,	21,418	22,275	23,797	25,600	27,658	29,958	32,450	34,928	37,596	40,552
144	459	Coldwater, MI	20,173	20,935	22,265	23,866	25,716	27,784	30,061	32,260	34,620	37,254
145	460	Hudson, MI	22,543	23,387	24,637	26,146	27,896	29,879	32,104	34,192	36,415	38,897

2 COMPASS™ MODEL

The COMPASS™ Model System is a flexible multimodal demand-forecasting tool that provides comparative evaluations of alternative socioeconomic and network scenarios. It also allows input variables to be modified to test the sensitivity of demand to various parameters such as elasticities, values of time, and values of frequency. This section describes in detail the model methodology and process used in the study.

2.1 DESCRIPTION OF THE COMPASS™ MODEL SYSTEM

The COMPASS™ model is structured on two principal models: Total Demand Model and Hierarchical Modal Split Model. For this study, these two models were calibrated separately for two trip purposes, which are Business and Non-Business. For each market segment, the models were calibrated on base year origin-destination trip data, existing network characteristics and base year socioeconomic data.

Since the models were calibrated on the base year data, when applying the models for forecasting, an incremental approach known as the “pivot point” method is used. By applying model growth rates to the base data observations, the “pivot point” method is able to preserve the unique travel flows present in the base data that are not captured by the model variables. Details on how this method is implemented are described below.

2.2 TOTAL DEMAND MODEL

The Total Demand Model, shown in Equation 1, provides a mechanism for assessing overall growth in the travel market.

Equation 1:

$$T_{ijp} = e^{\beta_{0p}}(SE_{ijp})^{\beta_{1p}}e^{\beta_{2p}U_{ijp}}$$

Where,

T_{ijp} = Number of trips between zones *i* and *j* for trip purpose *p*

SE_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p*

U_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p*

$\beta_{0p}, \beta_{1p}, \beta_{2p}$ = Coefficients for trip purpose *p*

Equation 1, the total number of trips between any two zones for all modes of travel, segmented by trip purpose, is a function of the socioeconomic characteristics of the zones and the total utility of the transportation system that exists between the two zones. For this study, trip purposes include Business and Non-Business. The socioeconomic characteristics consist of population, employment and average income. The utility function provides a measure of the quality of the transportation system in terms of the times, costs, reliability and level of service provided by all modes for a given trip purpose. The Total Demand Model equation may be interpreted as meaning that travel between zones will increase as socioeconomic factors such as population and income rise or as the utility (or quality) of the transportation system is improved by providing new facilities and services that reduce travel times and/or costs. The Total Demand Model can therefore be used to evaluate the effect of changes in both socioeconomic and travel characteristics on the total demand for travel.

2.2.1 SOCIOECONOMIC VARIABLES

The socioeconomic variables in the Total Demand Model show the impact of economic growth on travel demand. The COMPASS™ Model System, in line with most intercity modeling systems, uses three variables (population, employment, and average income) to represent the socioeconomic characteristics of a zone. Different combinations were tested in the calibration process and it was found, as is typically found elsewhere, that the most reasonable and statistically stable relationships consists of the following formulations:

Trip Purpose	***Socioeconomic Variable***
Business	$E_i E_j (I_i + I_j) / 2$
Non-Business	$(P_i E_j + P_j E_i) / 2 \ (I_i + I_j) / 2$

The Business formulation consists of a product of employment in the origin zone, employment in the destination zone, and the average income of the two zones. Since business trips are usually made between places of work, the presence of employment in the formulation is reasonable. While the income factor is correlated to the type of employment, higher income levels generate more Business trips. The Non-Business formulation consists of all socioeconomic factors, this is because commuter trips are between homes and places of work, which are closely related to population and employment, and income factor is related to the wealth of the origin zone and the type of employment in the destination zone, leisure and social trip are correlated to population in the origin zone and destination zone and the average income of the two zones.

2.2.2 Travel Utility

Estimates of travel utility for a transportation network are generated as a function of generalized cost (GC), as shown in Equation 2:

Equation 2:

$$U_{ijp} = f(GC_{ijp})$$

where,

GC_{ijp} = Generalized Cost of travel between zones *i* and *j* for trip purpose *p*

Because the generalized cost variable is used to estimate the impact of improvements in the transportation system on the overall level of trip making, it needs to incorporate all the key attributes that affect an individual's decision to make trips. For the public modes (i.e., rail and bus), the generalized cost of travel includes all aspects of travel time (access, egress, in-vehicle times), travel cost (fares), and schedule convenience (frequency of service, convenience of arrival/departure times). For auto travel, full average cost of operating a car is used for Business, while only the marginal cost is used for Commuter and Other trips. In addition, tolls and parking charges are used where appropriate.

The generalized cost of travel is typically defined in travel time (i.e., minutes) rather than dollars. Costs are converted to time by applying appropriate conversion factors, as shown in Equation 3. The generalized cost (GC) of travel between zones *i* and *j* for mode m and trip purpose p is calculated as follows:

Equation 3:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH}{VOT_{mp} * F_{ijm}}$$

Where,

TT_{ijm}	=	Travel Time between zones *i* and *j* for mode *m* (in-vehicle time + station wait time + connection time + access/egress time), with waiting, connect and access/egress time multiplied by a factor (waiting and connect time factors is 1.8, access/egress factors were determined by VOA/VOT ratios from the SP survey) to account for the additional disutility felt by travelers for these activities.
TC_{ijmp}	=	Travel Cost between zones *i* and *j* for mode *m* and trip purpose *p* (fare + access/egress cost for public modes, operating costs for auto)
VOT_{mp}	=	Value of Time for mode *m* and trip purpose *p*
VOF_{mp}	=	Value of Frequency for mode *m* and trip purpose *p*
F_{ijm}	=	Frequency in departures per week between zones *i* and *j* for mode *m*
OH	=	Operating hours per week (sum of daily operating hours between the first and last service of the day)

Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found from previous studies. Wait times are weighted 70 percent higher than in-vehicle time.

Similarly, access/egress time has a higher disutility than in-vehicle time. Access time tends to be more stressful for the traveler than in-vehicle time because of the uncertainty created by trying to catch the flight or train. Based on previous work, access time is weighted 80 percent higher for rail and bus travel.

The third term in the generalized cost function converts the frequency attribute into time units. Operating hours divided by frequency is a measure of the headway or time between departures. Tradeoffs are made in the stated preference surveys resulting in the value of frequencies on this measure. Although there may appear to some double counting because the station wait time in the first term of the generalized cost function is included in this headway measure, it is not the headway time itself that is being added to the generalized cost. The third term represents the impact of perceived frequency valuations on generalized cost. TEMS has found it very effective to measure this impact as a function of the headway.

2.2.3 Calibration of the Total Demand Model

In order to calibrate the Total Demand Model, the coefficients are estimated using linear regression techniques. Equation 1, the equation for the Total Demand Model, is transformed by taking the natural logarithm of both sides, as shown in Equation 4:

Equation 4:

$$\log(T_{ijp}) = \beta_{0p} + \beta_{1p}\log(SE_{ijp}) + \beta_{2p}(U_{ijp})$$

Equation 4 provides the linear specification of the model necessary for regression analysis.

The segmentation of the database by trip purpose resulted in two sets of models. The results of the calibration for the Total Demand Models are displayed in Exhibit 1.

Exhibit 1: Total Demand Model Coefficients (1)

Business $\log(T_{ij}) = -9.575 + 0.530 \log(SE_{ij}) + 0.624\, U_{ij}$ $R^2=0.87$

(-194) (21) (613)

where $U_{ij} = \log[\exp(-2.480+0.979U_{Public}) + \exp(-0.005\ GC_{Auto})]$

Other $\log(T_{ij}) = -9.623 + 0.447 \log(SE_{ij}) + 0.711\, U_{ij}$ $R^2=0.92$

(-130) (252) (725)

where $U_{ij} = \log[\exp(-3.796+0.971U_{Public}) + \exp(-0.005\ GC_{Auto})]$

(1) *t-statistics are given in parentheses.*

In evaluating the validity of a statistical calibration, there are two key statistical measures: t-statistics and R^2. The *t*-statistics are a measure of the significance of the model's coefficients; values of 1.95 and above are considered "good" and imply that the variable has significant explanatory power in estimating the level of trips. R^2 is a statistical measure of the "goodness of fit" of the model to the data; any data point that deviates from the model will reduce this measure. It has a range from 0 to a perfect 1, with 0.3 and above considered "good" for large data sets. Based on these two measures, the total demand calibrations are good. The *t*-statistics are high, aided by the large size of the data set. The R^2 values imply good fits of the equations to the data.

As shown in Exhibit 1, the socioeconomic elasticity values for the Total Demand Model are 0.53 and 0.36 for business and non-business trips, meaning that each one percent growth in the socioeconomic term generates approximately a 0.53 and 0.36 percent growth in the total business and non-business travel market respectively.

The coefficient on the utility term is not strictly elasticity, but it can be considered an approximation. The utility term is related to the scale of the generalized costs, for example, utility elasticity can be high if the absolute value of transportation utility improvement is significant. This is not untypical when new transportation systems are built. In these cases, a 20 percent reduction in utility is not unusual and may impact more heavily on longer origin-destination pairs than shorter origin-destination pairs.

2.2.4 Incremental Form of the Total Demand Model

The calibrated Total Demand Models could be used to estimate the total travel market for any zone pair using the population, employment, per household income, and the total utility of all the modes. However, there would be significant differences between estimated and observed levels of trip making for many zone pairs despite the good fit of the models to the data. To preserve the unique travel patterns contained in the base data, the incremental approach or "pivot point" method is used for forecasting. In the incremental approach, the base travel data assembled in the database are used as pivot points, and forecasts are made by applying trends to the base data. The total demand equation as described in Equation 1 can be rewritten into the following incremental form that can be used for forecasting (Equation 5):

Equation 5:

$$\frac{T_{ijp}^{\;f}}{T_{ijp}^{\;b}} = \left(\frac{SE_{ijp}^{\;f}}{SE_{ijp}^{\;b}}\right)^{\beta_{1p}} \exp(\beta_{2p}\,(U_{ijp}^{\;f} - U_{ijp}^{\;b}))$$

Where,

T^{f}_{ijp} = Number of Trips between zones *i* and *j* for trip purpose *p* in forecast year *f*

T^{f}_{ijp} = Number of Trips between zones *i* and *j* for trip purpose *p* in base year *b*

SE^{f}_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p* in forecast year *f*

SE^{b}_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p* in base year *b*

U^{f}_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p* in forecast year *f*

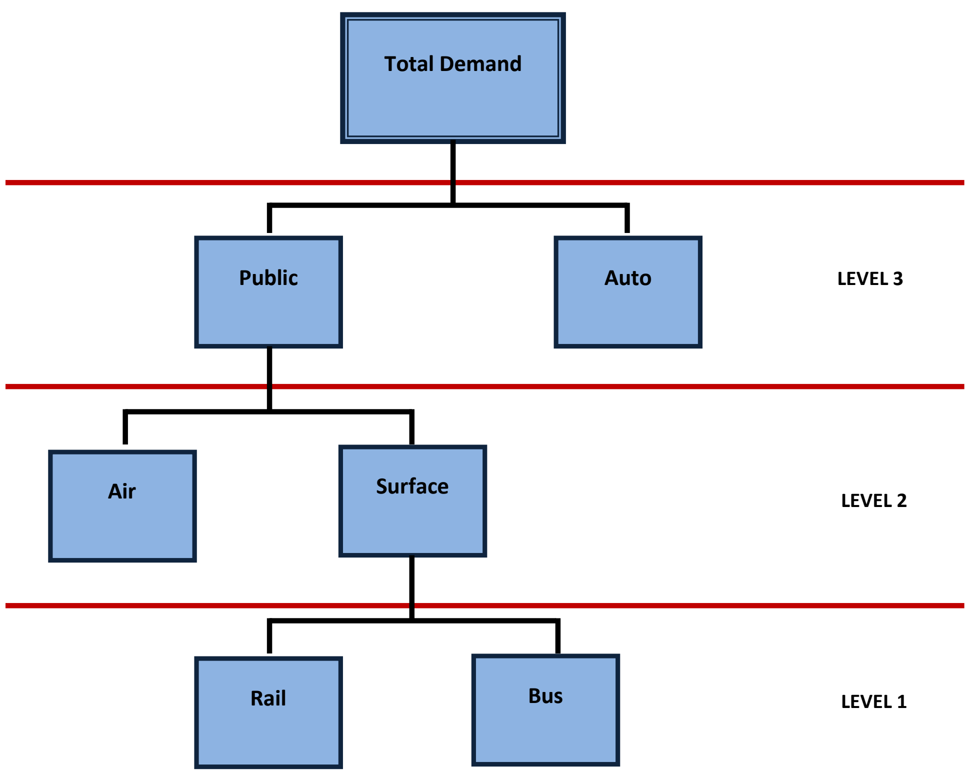
U^{b}_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p* in base year *b*

In the incremental form, the constant term disappears and only the elasticities are important.

2.3 Hierarchical Modal Split Model

The role of the Hierarchical Modal Split Model is to estimate relative modal shares, given the Total Demand Model estimate of the total market that consists of different travel modes available to travelers. The relative modal shares are derived by comparing the relative levels of service offered by each of the travel modes. The COMPASS™ Hierarchical Modal Split Model uses a nested logit structure, which has been adapted to model the interurban modal choices available in the study area. The hierarchical modal split model is shown in Exhibit 2.

Exhibit 2: Hierarchical Structure of the Modal Split Model

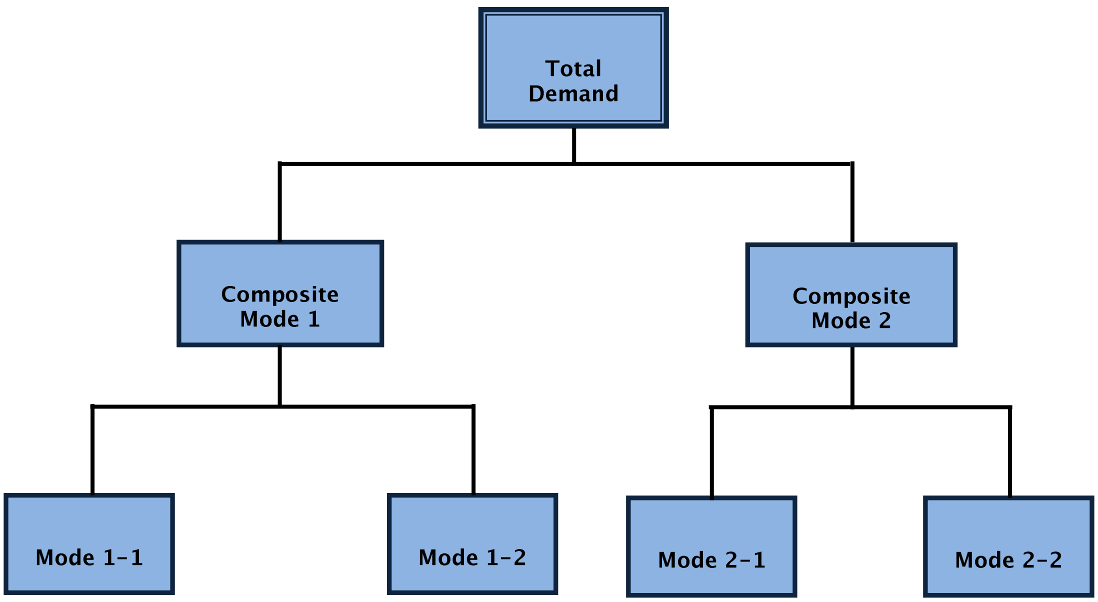


The main feature of the Hierarchical Modal Split Model structure is the increasing commonality of travel characteristics as the structure descends. The upper level of the hierarchy separates private auto travel – with its spontaneous frequency, low access/egress times, low costs and highly personalized characteristics – from the public modes. The lower separates Maglev – a faster and more comfortable public mode from Transit, which provides slower conventional rail and bus services within the corridor.

2.3.1 Background of the Hierarchical Modal Split Theory

The modal split models used by TEMS derived from the standard nested logit model. Exhibit 3 shows a typical two-level standard nested model. In the nested model shown in Exhibit 3, there are four travel modes that are grouped into two composite modes, namely, Composite Mode 1 and Composite Mode 2.

Exhibit 3: A Typical Standard Nested Logit Model



Each travel mode in the above model has a utility function of U_j, j = 1, 2, 3, 4. To assess modal split behavior, the logsum utility function, which is derived from travel utility theory, has been adopted for the composite modes in the model. As the modal split hierarchy ascends, the logsum utility values are derived by combining the utility of lower-level modes. The composite utility is calculated by

$$U_{N_k} = \alpha_{N_k} + \beta_{N_k} \log \sum_{i \in N_k} \exp(\rho U_i) \qquad (1)$$

where

N_k is composite mode k in the modal split model,

i is the travel mode in each nest,

U_i is the utility of each travel mode in the nest,

ρ is the nesting coefficient.

The probability that composite mode *k* is chosen by a traveler is given by

$$P(N_k) = \frac{\exp(U_{N_k} / \rho)}{\sum_{N_i \in N} \exp(U_{N_i} / \rho)} \quad (2)$$

The probability of mode *i* in composite mode *k* being chosen is

$$P_{N_k}(i) = \frac{\exp(\rho U_i)}{\sum_{j \in N_k} \exp(\rho U_j)} \quad (3)$$

A key feature of these models is a use of utility. Typically in transportation modeling, the utility of travel between zones *i* and *j* by mode *m* for purpose *p* is a function of all the components of travel time, travel cost, terminal wait time and cost, parking cost, etc. This is measured by generalized cost developed for each origin-destination zone pair on a mode and purpose basis. In the model application, the utility for each mode is estimated by calibrating a utility function against the revealed base year mode choice and generalized cost.

Using logsum functions, the generalized cost is then transformed into a composite utility for the composite mode (e.g. Public modes in Exhibit 2). This is then used at the next level of the hierarchy to compare the next most similar mode choice (e.g. in Exhibit 2, Public mode is compared with Auto mode).

2.3.2 Calibration of the Hierarchical Modal Split Model

Working from the lower level of the hierarchy to the upper level, the first analysis is that of the Rail mode versus the Bus mode. As shown in Exhibit 4, the model was effectively calibrated for the two trip purposes, with reasonable parameters and R^2 and *t* values. All the coefficients have the correct signs such that demand increases or decreases in the correct direction as travel times or costs are increased or decreased, and all the coefficients appear to be reasonable in terms of the size of their impact.

Exhibit 4: Rail versus Bus Modal Split Model Coefficients (1)

Business	log(PRail/PBus)	=	3.697	-	0.013 GCRail	+	0.010 GCBus	R2=0.70
			(84)		(-303)		(322)	
Other	log(PRail/PBus)	=	2.326	-	0.006 GCRail	+	0.005 GCBus	R2=0.75
			(108)		(-309)		(377)	

(1) *t-statistics are given in parentheses.*

The coefficients for the upper levels of the hierarchy of Surface mode versus Air mode and Public versus Auto mode are given in Exhibits 5 and 6 respectively. The utility of the composite modes is obtained by deriving the logsum of the utilities of lower level modes from the model. The model calibrations for both trip purposes are statistically significant, with good R^2 and *t* values, and reasonable coefficients.

Exhibit 5: Surface versus Air Modal Split Model Coefficients (1)

Business	log(PSurface/PAir)	=	-5.972	+	0.979 USurf	+	0.009 GCAir	R2=0.80
			(-147)		(425)		(222)	
	where USurf = log[exp(3.697-0.013GCRail) + exp(-0.010 GCBus)]							
Other	log(PSurface/PAir)	=	-3.179	+	0.981 USurf	+	0.005 GCAir	R2=0.79
			(-85)		(137)		(63)	
	where USurf = log[exp(2.326-0.006GCRail) + exp(-0.005 GCBus)]							

(1) *t-statistics are given in parentheses.*

Exhibit 6: Public versus Auto Modal Split Model Coefficients (1)

Business	log(PPublic/PAuto)	=	-2.480	+	0.979 UPublic	+	0.005 GCAuto	R2=0.90
			(-190)		(384)		(203)	
	where UPublic = log[exp(-5.972+0.979USurface) + exp(-0.009 GCAir)]							
Other	log(PPublic/PAuto)	=	-3.796	+	0.971 UPublic	+	0.006 GCAuto	R2=0.88
			(-210)		(266)		(326)	
	where UPublic = log[exp(-3.179+0.981USurface) + exp(-0.005 GCAir)]							

(1) *t-statistics are given in parentheses.*

2.3.3 Incremental Form of the Modal Split Model

Using the same reasoning as previously described, the modal split models are applied incrementally to the base data rather than imposing the model estimated modal shares. Different regions of the corridor may have certain biases toward one form of travel over another and these differences cannot be captured with a single model for the entire system. Using the “pivot point” method, many of these differences can be retained. To apply the modal split models incrementally, the following reformulation of the hierarchical modal split models is used (Equation 6):

Equation 6:

$$\frac{\left(\frac{P_A^f}{P_B^f}\right)}{\left(\frac{P_A^b}{P_B^b}\right)} = e^{\beta(GC_A^f - GC_B^b) + \gamma(GC_B^f - GC_B^b)}$$

For hierarchical modal split models that involve composite utilities instead of generalized costs, the composite utilities would be used in the above formula in place of generalized costs. Once again, the constant term is not used and the drivers for modal shifts are changed in generalized cost from base conditions.

Another consequence of the pivot point method is that it prevents possible extreme modal changes from current trip-making levels as a result of the calibrated modal split model, thus that avoid over- or under- estimating future demand for each mode.

2.4 Induced Demand Model

Induced demand refers to changes in travel demand related to improvements in a transportation system, as opposed to changes in socioeconomic factors that contribute to growth in demand. The quality or utility of the transportation system is measured in terms of total travel time, travel cost, and worth of travel by all modes for a given trip purpose. The induced demand model used the increased utility resulting from system changes to estimate the amount of new (latent) demand that will result from the implementation of the new system adjustments. The model works simultaneously with the mode split model coefficients to determine the magnitude of the modal induced demand based on the total utility changes in the system. It should be noted that the model will also forecast a reduction in trips if the quality of travel falls due to increased congestions, higher car operating costs, or increased tolls. The utility function is acting like a demand curve increasing or decreasing travel based on changes in price (utility) for travel. It assumes travel is a normal good and subject to the laws of supply and demand.

2.5 References

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3 Chicago–Detroit/Pontiac Corridor Passenger Rail Demand Forecast Results

3.1 Base (Current Travel Market Conditions) Passenger Rail Forecast Results

Passenger Rail Forecast Results

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Annual Ridership (million trips)	Annual Revenue (million 2013$)	Annual Passenger Miles (million miles)	Annual Train Miles (million miles)
2025	3	46	6:40	0.58	$23.99	120.68	0.67
2035	3	46	6:40	0.66	$40.01	141.21	0.67

Annual Passenger Rail Incremental Ridership

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Natural Growth (million trips)
2025	3	46	6:40	0.08
2035	3	46	6:40	0.16

Annual Passenger Rail Station Volumes

Station	2025 Annual Station Volume (thousand ONs and OFFs)	2035 Annual Station Volume (thousand ONs and OFFs)
Chicago Union Station, IL	483	561
Northwest Indiana, IN	8	10
Michigan City, IN	3	4
New Buffalo, MI	15	16
Niles, MI	13	14
Dowagiac, MI	5	5
Kalamazoo, MI	77	83
Battle Creek, MI	47	55
Albion, MI	2	2
Jackson, MI	31	33
Ann Arbor, MI	178	209
Dearborn, MI	120	139
Detroit, MI	72	82
Royal Oak, MI	53	63
Birmingham, MI	31	36
Pontiac, MI	16	17

Annual Passenger Rail Segment Loadings

Station Link	2025 Annual Segment Loading (million trips)	2035 Annual Segment Loading (million trips)
Chicago Union Station, IL-Hammond-	0.48	0.56
Northwest Indiana, IN-Michigan City, IN	0.55	0.65
Michigan City, IN-New Buffalo, MI	0.55	0.65
New Buffalo, MI-Niles, MI	0.54	0.63
Niles, MI-Dowagiac, MI	0.53	0.63
Dowagiac, MI-Kalamazoo, MI	0.53	0.62
Kalamazoo, MI-Battle Creek, MI	0.46	0.54
Battle Creek, MI-Albion, MI	0.42	0.49
Albion, MI-Jackson, MI	0.42	0.49
Jackson, MI-Ann Arbor, MI	0.40	0.47
Ann Arbor, MI-Dearborn, MI	0.26	0.30
Dearborn, MI-Detroit, MI	0.14	0.16
Detroit, MI-Royal Oak, MI	0.10	0.12
Royal Oak, MI-Birmingham, MI	0.04	0.05
Birmingham, MI-Pontiac, MI	0.02	0.02

Passenger Rail Segment Loading Factors

Station Link	2025 Segment Loading Factor	2035 Segment Loading Factor
Chicago Union Station, IL-Hammond-	48%	56%
Northwest Indiana, IN-Michigan City, IN	55%	64%
Michigan City, IN-New Buffalo, MI	55%	64%
New Buffalo, MI-Niles, MI	53%	62%
Niles, MI-Dowagiac, MI	53%	62%
Dowagiac, MI-Kalamazoo, MI	52%	61%
Kalamazoo, MI-Battle Creek, MI	46%	54%
Battle Creek, MI-Albion, MI	42%	49%
Albion, MI-Jackson, MI	42%	49%
Jackson, MI-Ann Arbor, MI	40%	46%
Ann Arbor, MI-Dearborn, MI	26%	30%
Dearborn, MI-Detroit, MI	14%	16%
Detroit, MI-Royal Oak, MI	10%	11%
Royal Oak, MI-Birmingham, MI	4%	5%
Birmingham, MI-Pontiac, MI	1%	2%

3.2 Scenario 1 (3 DRTs and Improved Travel Time) Passenger Rail Forecast Results

Passenger Rail Forecast Results

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Annual Ridership (million trips)	Annual Revenue (million 2013$)	Annual Passenger Miles (million miles)	Annual Train Miles (million miles)
2025	3	55	5:40	0.90	$54.61	193.64	0.67
2035	3	55	5:40	1.05	$63.88	225.77	0.67

Annual Passenger Rail Incremental Ridership

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Diverted from Auto (million trips)	Diverted from Air (million trips)	Diverted from Bus (million trips)	Natural Growth (million trips)	New Induced (million trips)	Total Increment (million trips)
2025	3	55	5:40	0.26	0.03	0.02	0.08	0.02	0.41
2035	3	55	5:40	0.31	0.03	0.02	0.16	0.02	0.55

Annual Passenger Rail Station Volumes

Station	2025 Annual Station Volume (thousand ONs and OFFs)	2035 Annual Station Volume (thousand ONs and OFFs)
Chicago Union Station, IL	747	875
Northwest Indiana, IN	12	14
Michigan City, IN	5	6
New Buffalo, MI	34	38
Niles, MI	19	22
Dowagiac, MI	7	9
Kalamazoo, MI	92	107
Battle Creek, MI	72	84
Albion, MI	3	3
Jackson, MI	36	41
Ann Arbor, MI	365	425
Dearborn, MI	189	218
Detroit, MI	99	113
Royal Oak, MI	73	85
Birmingham, MI	40	46
Pontiac, MI	19	23

Annual Passenger Rail Segment Loadings

Station Link	2025 Annual Segment Loading (million trips)	2035 Annual Segment Loading (million trips)
Chicago Union Station, IL-Hammond-Whiting, IN	0.76	0.88
Northwest Indiana, IN-Michigan City, IN	0.87	1.01
Michigan City, IN-New Buffalo, MI	0.87	1.01
New Buffalo, MI-Niles, MI	0.82	0.96
Niles, MI-Dowagiac, MI	0.81	0.95
Dowagiac, MI-Kalamazoo, MI	0.80	0.94
Kalamazoo, MI-Battle Creek, MI	0.75	0.88
Battle Creek, MI-Albion, MI	0.70	0.82
Albion, MI-Jackson, MI	0.70	0.82
Jackson, MI-Ann Arbor, MI	0.68	0.79
Ann Arbor, MI-Dearborn, MI	0.42	0.48
Dearborn, MI-Detroit, MI	0.23	0.26
Detroit, MI-Royal Oak, MI	0.13	0.15
Royal Oak, MI-Birmingham, MI	0.06	0.07
Birmingham, MI-Pontiac, MI	0.02	0.02

Passenger Rail Segment Loading Factors

Station Link	2025 Annual Segment Loading Factor	2035 Annual Segment Loading Factor
Chicago Union Station, IL-Hammond-	0.75	0.87
Northwest Indiana, IN-Michigan City, IN	0.87	1.01
Michigan City, IN-New Buffalo, MI	0.87	1.01
New Buffalo, MI-Niles, MI	0.82	0.96
Niles, MI-Dowagiac, MI	0.81	0.95
Dowagiac, MI-Kalamazoo, MI	0.80	0.94
Kalamazoo, MI-Battle Creek, MI	0.75	0.88
Battle Creek, MI-Albion, MI	0.70	0.82
Albion, MI-Jackson, MI	0.70	0.82
Jackson, MI-Ann Arbor, MI	0.68	0.79
Ann Arbor, MI-Dearborn, MI	0.42	0.48
Dearborn, MI-Detroit, MI	0.23	0.26
Detroit, MI-Royal Oak, MI	0.13	0.15
Royal Oak, MI-Birmingham, MI	0.06	0.07
Birmingham, MI-Pontiac, MI	0.02	0.02

3.3 Scenario 2 (6 DRTs and Improved Travel Time) Passenger Rail Forecast Results

Passenger Rail Forecast Results

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Annual Ridership (million trips)	Annual Revenue (million 2013$)	Annual Passenger Miles (million miles)	Annual Train Miles (million miles)
2025	6	55	5:40	1.64	$101.15	346.28	1.35
2035	6	55	5:40	1.91	$117.96	402.79	1.35

Annual Passenger Rail Incremental Ridership

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Diverted from Auto (million trips)	Diverted from Air (million trips)	Diverted from Bus (million trips)	Natural Growth (million trips)	New Induced (million trips)	Total Increment (million trips)
2025	6	55	5:40	0.69	0.19	0.09	0.08	0.09	1.14
2035	6	55	5:40	0.82	0.22	0.11	0.16	0.11	1.41

Annual Passenger Rail Station Volumes

Station	2025 Annual Station Volume (thousand ONs and OFFs)	2035 Annual Station Volume (thousand ONs and OFFs)
Chicago Union Station, IL	1,262	1,470
Northwest Indiana, IN	23	27
Michigan City, IN	10	12
New Buffalo, MI	30	35
Niles, MI	22	25
Dowagiac, MI	7	8
Kalamazoo, MI	139	167
Battle Creek, MI	107	126
Albion, MI	6	7
Jackson, MI	112	128
Ann Arbor, MI	622	725
Dearborn, MI	325	375
Detroit, MI	268	307
Royal Oak, MI	163	190
Birmingham, MI	108	125
Pontiac, MI	73	87

Passenger Annual Rail Segment Loadings

Station Link	2025 Annual Segment Loading (million trips)	2035 Annual Segment Loading (million trips)
Chicago Union Station, IL-Hammond-Whiting, IN	1.26	1.47
Northwest Indiana, IN-Michigan City, IN	1.41	1.65
Michigan City, IN-New Buffalo, MI	1.41	1.65
New Buffalo, MI-Niles, MI	1.35	1.57
Niles, MI-Dowagiac, MI	1.35	1.57
Dowagiac, MI-Kalamazoo, MI	1.34	1.56
Kalamazoo, MI-Battle Creek, MI	1.35	1.58
Battle Creek, MI-Albion, MI	1.33	1.55
Albion, MI-Jackson, MI	1.33	1.54
Jackson, MI-Ann Arbor, MI	1.29	1.49
Ann Arbor, MI-Dearborn, MI	0.88	1.01
Dearborn, MI-Detroit, MI	0.56	0.64
Detroit, MI-Royal Oak, MI	0.34	0.40
Royal Oak, MI-Birmingham, MI	0.18	0.21
Birmingham, MI-Pontiac, MI	0.07	0.09

Passenger Rail Segment Loading Factors

Station Link	2025 Segment Loading Factor	2035 Segment Loading Factor
Chicago Union Station, IL-Hammond-Whiting, IN	63%	73%
Northwest Indiana, IN-Michigan City, IN	70%	82%
Michigan City, IN-New Buffalo, MI	70%	82%
New Buffalo, MI-Niles, MI	67%	78%
Niles, MI-Dowagiac, MI	67%	78%
Dowagiac, MI-Kalamazoo, MI	66%	77%
Kalamazoo, MI-Battle Creek, MI	67%	78%
Battle Creek, MI-Albion, MI	66%	77%
Albion, MI-Jackson, MI	66%	77%
Jackson, MI-Ann Arbor, MI	64%	74%
Ann Arbor, MI-Dearborn, MI	43%	50%
Dearborn, MI-Detroit, MI	28%	32%
Detroit, MI-Royal Oak, MI	17%	20%
Royal Oak, MI-Birmingham, MI	9%	11%
Birmingham, MI-Pontiac, MI	4%	4%

3.4 Full Build (10 DRTs and Improved Travel Time) Passenger Rail Forecast Results

Passenger Rail Forecast Results

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Annual Ridership (million trips)	Annual Revenue (million 2013$)	Annual Passenger Miles (million miles)	Annual Train Miles (million miles)
2025	10 (7 to Pontiac)	58	5:16	2.43	$138.90	465.29	1.95
2035	10 (7 to Pontiac)	58	5:16	2.83	$162.03	541.52	1.95
2045	10 (7 to Pontiac)	58	5:16	3.30	$189.39	631.67	1.95
2055	10 (7 to Pontiac)	58	5:16	3.85	$220.77	734.86	1.95

Annual Passenger Rail Incremental Ridership

Year	Daily Round Trips (DRT)	Average Speed (miles/hour)	Run Time (hr:mm) (Chicago-Pontiac)	Diverted from Auto (million trips)	Diverted from Air (million trips)	Diverted from Bus (million trips)	Natural Growth (million trips)	New Induced (million trips)	Total Increment (million trips)
2025	10 (7 to Pontiac)	58	5:16	1.30	0.26	0.14	0.08	0.15	1.93
2035	10 (7 to Pontiac)	58	5:16	1.53	0.30	0.17	0.16	0.18	2.33
2045	10 (7 to Pontiac)	58	5:16	1.80	0.35	0.20	0.25	0.21	2.81
2055	10 (7 to Pontiac)	58	5:16	2.11	0.40	0.23	0.36	0.25	3.35

Annual Passenger Rail Station Volumes

Station	2025 Annual Station Volume (thousand ONs and OFFs)	2035 Annual Station Volume (thousand ONs and OFFs)	2045 Annual Station Volume (thousand ONs and OFFs)	2055 Annual Station Volume (thousand ONs and OFFs)
Chicago Union Station, IL	1,672	1,946	2,271	2,644
Northwest Indiana, IN	35	41	47	55
Michigan City, IN	19	23	27	33
New Buffalo, MI	70	81	94	108
Niles, MI	79	91	107	124
Dowagiac, MI	17	19	23	27
Kalamazoo, MI	476	566	673	797
Battle Creek, MI	268	312	367	429
Albion, MI	10	12	14	16
Jackson, MI	155	179	208	240
Ann Arbor, MI	830	969	1,134	1,323
Dearborn, MI	418	483	560	647
Detroit, MI	384	440	507	582
Royal Oak, MI	199	231	268	311
Birmingham, MI	130	151	176	204
Pontiac, MI	90	108	129	154

Annual Passenger Rail Segment Loadings

Station Link	2025 Annual Segment Loading (million trips)	2035 Annual Segment Loading (million trips)	2045 Annual Segment Loading (million trips)	2055 Annual Segment Loading (million trips)
Chicago Union Station, IL-Hammond-Whiting, IN	1.67	1.95	2.27	2.64
Northwest Indiana, IN-Michigan City, IN	1.92	2.23	2.35	3.04
Michigan City, IN-New Buffalo, MI	1.91	2.23	2.34	3.03
New Buffalo, MI-Niles, MI	1.83	2.13	2.24	2.90
Niles, MI-Dowagiac, MI	1.82	2.11	2.22	2.87
Dowagiac, MI-Kalamazoo, MI	1.80	2.10	2.20	2.84
Kalamazoo, MI-Battle Creek, MI	1.91	2.23	2.35	3.04
Battle Creek, MI-Albion, MI	1.83	2.13	2.48	2.89
Albion, MI-Jackson, MI	1.82	2.12	2.48	2.88
Jackson, MI-Ann Arbor, MI	1.73	2.01	2.35	2.73
Ann Arbor, MI-Dearborn, MI	1.20	1.39	1.62	1.87
Dearborn, MI-Detroit, MI	0.79	0.92	1.07	1.24
Detroit, MI-Royal Oak, MI	0.42	0.49	0.57	0.67
Royal Oak, MI-Birmingham, MI	0.22	0.26	0.30	0.36
Birmingham, MI-Pontiac, MI	0.09	0.11	0.13	0.15

Passenger Rail Segment Loading Factors

Station Link	2025 Segment Loading Factor	2035 Segment Loading Factor	2045 Segment Loading Factor	2055 Segment Loading Factor
Chicago Union Station, IL-Hammond-Whiting, IN	50%	58%	68%	79%
Northwest Indiana, IN-Michigan City, IN	57%	66%	70%	90%
Michigan City, IN-New Buffalo, MI	57%	66%	70%	90%
New Buffalo, MI-Niles, MI	54%	63%	67%	86%
Niles, MI-Dowagiac, MI	54%	63%	66%	86%
Dowagiac, MI-Kalamazoo, MI	54%	62%	66%	85%
Kalamazoo, MI-Battle Creek, MI	57%	66%	70%	90%
Battle Creek, MI-Albion, MI	54%	63%	74%	86%
Albion, MI-Jackson, MI	54%	63%	74%	86%
Jackson, MI-Ann Arbor, MI	51%	60%	70%	81%
Ann Arbor, MI-Dearborn, MI	36%	41%	48%	56%
Dearborn, MI-Detroit, MI	24%	27%	32%	37%
Detroit, MI-Royal Oak, MI	12%	15%	17%	20%
Royal Oak, MI-Birmingham, MI	7%	8%	9%	11%
Birmingham, MI-Pontiac, MI	3%	3%	4%	5%

GreatLakesRail.org

Chicago – Detroit / Pontiac Passenger Rail Corridor Program

Technical Memorandum

OPERATIONS AND MAINTENANCE COSTS

AUGUST 28, 2014

U.S. Department of Transportation
Federal Railroad Administration

MDOT
Michigan Department of Transportation

Indiana Department of Transportation

Illinois Department of Transportation

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1 PURPOSE OF THIS TECHNICAL MEMORANDUM

The purpose of this technical memorandum is to describe the process used to develop the Operating and Maintenance (O&M) costs for the Chicago-Detroit / Pontiac Passenger Rail Corridor Program (the Program). This document describes the operating scenarios for the No Build Alternative and Build Alternative, the methodology for calculating the O&M costs, and the O&M cost estimates for the No Build and Build Alternatives.

2 BACKGROUND

The States of Michigan, Indiana, and Illinois are active partners in jointly improving passenger rail services between Chicago and Detroit / Pontiac through the Chicago-Detroit / Pontiac Passenger Rail Corridor Program. The states are working on improving the infrastructure to accommodate up to 10 daily round trips between Chicago and Detroit with seven daily round trips between Detroit and Pontiac, Michigan operating at speeds up to 110 mph.

2.1 Existing Service

Amtrak currently operates passenger rail service between Chicago Union Station and Michigan on three routes. Amtrak operates three round trips per day between Chicago and Pontiac, which is known as the Wolverine Service. Wolverine trains take approximately 6 hours 30 minutes to travel approximately 300 miles between Chicago and Pontiac, at an average speed of 47 mph. The Wolverine schedules are shown in Figure 1. In addition, Amtrak operates one round trip per day on the Pere Marquette route (Chicago – Holland – Grand Rapids) and one round trip per day on the Blue Water route (Chicago – Battle Creek – Port Huron). For the purposes of this EIS the Pere Marquette and the Blue Water are considered feeder routes and the O&M costs, ridership and revenue for these connecting routes are not included in this analysis of O&M costs for the Chicago-Detroit/Pontiac Corridor.

The State of Michigan provides operating subsidies for this service according to the requirements of Section 209 of the Passenger Rail Infrastructure and Investment Act of 2008 (PRIIA)[1] This law requires Amtrak to develop and implement a single, nationwide standardized methodology for establishing and allocating the operating and capital costs among the states and Amtrak for all routes that are less than 750 miles long.

[1] *Passenger Rail Investment and Improvement Act of 2008. Public Law No. 110-432, Division B, enacted Oct. 16, 2008,*

Figure 1: Current Amtrak Wolverine Schedule

EASTBOUND

Station	Miles	Ar/Dp	Train Number 350	352	354
CHICAGO IL	0.0	Dp	7 00A	12 50P	6 00P
Hammond-Whiting IN	16.0	Dp	7 29A	1 19P	
Michigan City IN	52.8	Dp		1 58P	7 01P
New Buffalo	62.9	Dp	9 17A	3 09P	8 12P
Niles MI	89.8	Dp	9 47A	3 33P	8 35P
Dowagiac MI	102.3	Dp	9 57A		
Kalamazoo MI	138.3	Dp	10 45A	4 18P	9 20P
Battle Creek MI	161.0	Dp	11 17A	4 50P	9 57P
Albion MI	185.6	Dp		5 18P	
Jackson MI	206.5	Dp	12 08P	5 34P	10 47P
Ann Arbor MI	243.5	Dp	12 55P	6 26P	11 30P
Dearborn MI	273.5	Dp	1 25P	6 56P	12 01A
DETROIT MI	282.7	Ar	1 54P	7 23P	12 28A
DETROIT MI	282.7	Dp			
Royal Oak MI	292.8	Dp	2 18P	7 47P	12 52A
Birmingham MI	297.1	Dp	2 26P	7 54P	12 59A
PONTIAC MI	305.4	Ar	2 53P	8 22P	1 29A

WESTBOUND

Station	Miles	Dp/Ar	Train Number 351	353	355
PONTIAC, MICH.	0.0	Dp	5 00A	10 35A	5 40P
Birmingham, Mich.	8.3	Dp	5 13A	10 49A	5 53P
Royal Oak, Mich.	12.6	Dp	5 20A	10 57A	6 00P
DETROIT, MICH.	22.7	Ar	5 40A	11 17A	6 20P
DETROIT, MICH.	22.7	Dp	5 43A	11 20A	6 23P
Dearborn, Mich.	31.9	Dp	6 06A	11 43A	6 45P
Ann Arbor, Mich.	61.9	Dp	6 41A	12 17P	7 21P
Jackson, Mich.	98.9	Dp	7 23A	12 58P	8 01P
Albion, Mich.	119.8	Dp		1 21P	
Battle Creek, Mich.	144.4	Dp	8 17A	1 54P	8 55P
Kalamazoo, Mich.	167.1	Dp	8 50A	2 25P	9 26P
Dowagiac, Mich.	203.1	Dp			9 51P
Niles, Mich.	215.6	Dp		2 58P	10 03P
New Buffalo, Mich.	242.5	Dp		3 28P	10 24P
Michigan City, Ind.	252.6	Dp			9 34P
Hammond-Whiting IN	289.4	Dp		3 20P	10 18P
CHICAGO ,ILL.	305.4	Ar	10 12A	4 08P	11 07P

Source: Amtrak Schedule Effective May 19, 2014

2.2 Funded Capital Improvements Included in the No Build Alternative

Near-term service improvements intended to improve the intercity rail passenger's experience will be implemented along the Corridor under the No Build condition. This section describes those improvements that are committed by the Program Partners and are in various phases of delivery. The improvements that are funded are considered to be a part of the No Build Alternative. Non-funded projects (i.e., projects that do not have full construction funding in place) are not included in the Committed Project Lists. Operations modeling completed for the Program assume that these improvements are implemented. These projects will occur independently, with or without implementation of the Build Alternatives. The detailed list of these projects is provided in Appendix B of the Draft Environmental Impact Statement.

2.2.1 Illinois Projects

The No Build Alternative in Illinois consists of the continuation of the existing passenger rail service on the existing trackage with the current level of maintenance and no appreciable change to current track configuration or operations.

The Chicago Region Environmental and Transportation Efficiency Program (CREATE) is a partnership between U.S. DOT, the State of Illinois, City of Chicago, Metra, Amtrak, Association of American Railroads, Belt Railway of Chicago, BNSF Railway, Canadian Pacific Railway, Canadian National Railway, CSX Transportation, Indiana Harbor Belt Railroad, Norfolk Southern Corporation, and Union Pacific Railroad that is focused on investing in critically needed improvements to increase the efficiency of the region's passenger and freight rail infrastructure in the Chicago area. Fully funded CREATE projects will provide improvements on several of the alternative routes into Chicago that are being considered. These projects are listed in Appendix B of the DEIS.

Improvements to support the Chicago to St. Louis High Speed Rail service are also currently underway. As a result of that project's 2004 Record of Decision (ROD), the Chicago to St. Louis corridor was selected by the FRA for $1.1-billion of corridor improvements between Dwight, Illinois and St. Louis. These improvements include upgraded track built and maintained to 110 miles per hour standards, siding and crossovers, grade crossing surfaces, signals and warning system, stations, and new higher-speed passenger trains. A Tier 1 EIS for the full build-out and routing between Chicago and Dwight, Illinois was completed, and the ROD was signed in December 2012.

In March 2013, FRA recommended that the State of Illinois lead a multi-state procurement of 35 new next-generation locomotives and 130 bi-level rail cars to be funded by the U.S. Department of Transportation. Procurement of Midwest Train Equipment Fleet will modernize train equipment within Illinois, Michigan, Missouri, California, and Washington and enable passenger rail service to operate higher speeds.

The only major committed roadway project that will add new capacity in Illinois that is under construction and will affect the movement of freight and, to a lesser degree, the movement of passengers between Chicago and Detroit/Pontiac is the addition of a new interchange connecting Interstates 294 and 57 on the Tri-State Tollway in the south suburbs near Harvey, Illinois.

2.2.2 Indiana Projects

There are a number of planned and programmed rail improvements included in the No Build within Indiana and they are listed individually in Appendix B. Most of these improvements are included in the Indiana Gateway Project, which began construction in 2013. As part of FRA's High-Speed Intercity Passenger Rail Program (HSIPR), Indiana was the recipient of a $71.4-million grant for the construction of eight separate improvements along the congested railroad segment from Porter, Indiana west to the Illinois state line. Seven of the improvements will be on track owned by NS and the eighth will be on Amtrak's Michigan line at Porter, Indiana. The work will include crossover tracks and related signal improvements, and additional sidings.

There are currently no major roadway projects that will add new capacity to the transportation system within the La Porte INDOT District that are expected to significantly affect travel between Chicago and Detroit/Pontiac.

2.2.3 Michigan Projects

Under the No Build scenario, Amtrak's Wolverine Service will continue to operate on the existing Amtrak route within Michigan. From the Michigan/Indiana state line to Kalamazoo, Michigan, passenger trains currently run at speeds up to 110 mph, and will continue to do so in this section of the Corridor. Between Kalamazoo and Dearborn, Michigan, MDOT has purchased the 135-mile section of track previously owned by NS, and has secured federal funding for rail improvements in this section of the Corridor that would allow speeds up to 110 mph. The rail improvements between Kalamazoo and Dearborn, Michigan include track rehabilitation, replacement of track ties, turnouts, and ballast, curve modifications and installation of ITCS (Defined in Footnote #20) and Active Warning Systems at all crossings.

In Detroit, a new connection track between Conrail Shared Assets Operations (CSAO) Michigan Line and CN Shoreline Subdivision trackage at West Detroit Junction has been funded. Improvements will separate freight and passenger service in this area, therefore reducing conflicts and improving intercity passenger service reliability.

Recent investments have been made at four different station locations in Michigan. Improvements at the Battle Creek Station included renovation of the station's interior lobby, bathrooms, ticketing areas and offices, lighting, signage, and bringing the facility into compliance with the Americans with Disabilities Act (ADA). The interior improvements along with the refurbishment to the exterior façade and installation of new exterior lighting were completed in June 2012. Pontiac, Michigan also constructed a new 4,500 square foot intermodal station that officially opened in August 2011. Construction of a new 16,000 square foot Dearborn Intermodal Passenger Rail Station has also been funded and is expected to be completed in early 2014, while construction of the new Troy Multi-Modal Transit Center is anticipated to provide a new 2,000 square foot intermodal station for the City of Troy, Michigan.

There are no major roadway projects that would add significant capacity to the transportation network programmed within or near the Corridor in Berrien, Van Buren, Cass, Kalamazoo, Calhoun, Jackson, Washtenaw, Wayne or Oakland counties.

3 OPERATING SCENARIOS

3.1 No Build Alternative Operating Scenario

The No Build Alternative for this analysis is the current frequency of Wolverine service being operated by Amtrak (three round trips a day between Chicago and Pontiac). The No Build Alternative assumes that all of the currently funded projects described in Section 2.2 have been constructed and that maximum speeds between Porter, Indiana and Dearborn, Michigan are 110 mph. As a result the end-to-end travel times have been significantly reduced.

Figure 2: No Build Alternative Schedule

EASTBOUND

Station	Miles	Ar/Dp	Train Number		
			350	352	354
CHICAGO IL	0.0	Dp	7 20A	12 50P	6 00P
Hammond-Whiting IN	16.0	Dp	7 47A	1 17P	
Michigan City IN	52.8	Dp		1 57P	7 00P
New Buffalo	62.9	Dp	9 37A	3 09P	8 12P
Niles MI	89.8	Dp	10 07A	3 33P	8 35P
Dowagiac MI	102.3	Dp	10 17A		
Kalamazoo MI	138.3	Dp	10 55A	4 08P	9 10P
Battle Creek MI	161.0	Dp	11 18A	4 31P	9 33P
Albion MI	185.6	Dp		4 54P	
Jackson MI	206.5	Dp	11 59A	5 15P	10 15P
Ann Arbor MI	243.5	Dp	12 33P	5 49P	10 49P
Dearborn MI	273.5	Dp	12 59P	6 16P	11 16P
DETROIT MI	282.7	Ar	1 21P	6 38P	11 38P
DETROIT MI	282.7	Dp	1 24P	6 41P	11 41P
Royal Oak MI	292.8	Dp	1 42P	6 59P	11 59P
Birmingham MI	297.1	Dp	1 49P	7 06P	12 06A
PONTIAC MI	305.4	Ar	2 26P	7 43P	12 43A

WESTBOUND

Station	Miles	Dp/Ar	Train Number		
			351	353	355
PONTIAC, MICH.	0.0	Dp	6 32A	9 42A	6 22P
Birmingham, Mich.	8.3	Dp	6 45A	9 56A	6 35P
Royal Oak, Mich.	12.6	Dp	6 52A	10 04A	6 42P
DETROIT, MICH.	22.7	Ar	7 15A	10 27A	7 05P
DETROIT, MICH.	22.7	Dp	7 18A	10 30A	7 08P
Dearborn, Mich.	31.9	Dp	7 26A	10 38A	7 15P
Ann Arbor, Mich.	61.9	Dp	7 55A	11 07A	7 43P
Jackson, Mich.	98.9	Dp	8 27A	11 39A	8 15P
Albion, Mich.	119.8	Dp		11 56A	
Battle Creek, Mich.	144.4	Dp	9 10A	12 24P	8 57P
Kalamazoo, Mich.	167.1	Dp	9 35A	12 49P	9 21P
Dowagiac, Mich.	203.1	Dp			9 46P
Niles, Mich.	215.6	Dp		1 12P	9 58P
New Buffalo, Mich.	242.5	Dp		1 42P	10 19P
Michigan City, Ind.	252.6	Dp			
Hammond-Whiting IN	289.4	Dp			
CHICAGO ,ILL.	305.4	Ar	10 44A	2 19P	10 49P

Source: RTC Generated No Build Schedule (8-26-2013). HDR, Inc.

3.2 Interim Service Operating Scenario

Annual operating and maintenance costs have been estimated for the first full year of service (2035) of implementation of six round trips per day interim service. The operating plan assumes that the full set of capital improvements identified for the Full Build Alternative (see Section 3.3), which allow increased speed and frequencies. Key elements of the operating plan include:

- The rail network will be upgraded to allow for passenger train speeds up to110 mph. Capacity enhancements will also be made to minimize conflicts between passenger and freight trains.
- The total number of daily round trips between Chicago and Detroit/Pontiac will increase from the current three to six daily round trips between Chicago and Pontiac. A schedule for this service has been developed and is included in Figure 3.

Service frequencies for branch line services (Pere Marquette between Kalamazoo and Grand Rapids, Michigan and Blue Water between Battle Creek and Port Huron, Michigan) will remain at their current levels of one trip per day. The O&M costs, ridership and revenue for these connecting routes are not included in this analysis of O&M costs for the interim service level.

Figure 3: Interim Service Schedule - 2025

EASTBOUND

Station	Miles	Travel Times	Ar/Dp	Train Number						
				702	704	706	708	710	712	714
CHICAGO Ill.	0.0	0:00	Dp		6 00A	9 20A	12 00P	5 35P	6 00P	7 00P
Suburban near Gary, Ind,	16.0	0:18	Dp		6 27A		12 27P	6 02P		7 27P
Michigan City, Ind.	52.8	0:53	Dp				1 07P	6 42P		8 07P
New Buffalo, Mich.	62.9	1:02	Dp		8 19A	11 37A	2 19P	7 54P	8 19P	9 19P
Niles, Mich.	89.8	1:22	Dp		8 42A	12 00A	2 43P	8 17P	8 42P	9 42P
Dowagiac, Mich.	102.3	1:32	Dp		8 52A	12 10P		8 27P		9 52P
Kalamazoo, Mich.	138.3	2:01	Dp	5 56A	9 21A	12 39P	3 18P	8 56P	9 21P	10 21P
Battle Creek, Mich.	161.0	2:28	Dp	6 23A	9 48A	1 06P	3 45P	9 23P	9 48P	10 48P
Albion, Mich.	185.6	2:51	Dp	6 36A			4 08P			
Jackson, Mich.	206.5	3:11	Dp	7 06A	10 31A	1 49P	4 28P		10 31P	11 31P
Ann Arbor, Mich.	243.5	3:44	Dp	7 39A	11 04A	2 22P	5 01P		11 04P	12 04A
Dearborn, Mich.	273.5	4:09	Dp	8 04A	11 29A	2 47P	5 26P		11 29P	12 29A
DETROIT, MICH.	282.7	4:24	Ar	8 19A	11 44A	3 02P	5 41P		11 44P	12 44A
DETROIT, MICH.	282.7	4:27	Dp	8 22A	11 47A	3 05P	5 44P		11 47P	12 47A
Royal Oak, Mich.	292.8	4:51	Dp	8 43A	12 08P	3 26P	6 05P		12 08A	1 08A
Birmingham, Mich.	297.1	4:58	Dp	8 50A	12 15P	3 33P	6 12P		12 15A	1 15A
PONTIAC, MICH.	305.4	5:16	Ar	9 18A	12 43P	4 01P	6 40P		12 43A	1 43A

WESTBOUND

Station	Travel Times	Miles	Dp/Ar	Train Number						
				701	703	705	707	709	711	713
PONTIAC, MICH.	0:00	0.0	Dp		4 00A	6 32A	9 51A	1 30P	4 52P	7 20P
Birmingham, Mich.	0:13	8.3	Dp		4 13A	6 45A	10 04A	1 43P	5 05P	7 33P
Royal Oak, Mich.	0:20	12.6	Dp		4 20A	6 52A	10 11A	1 50P	5 12P	7 40P
DETROIT, MICH.	0:40	22.7	Ar		4 40A	7 12A	10 26A	2 10P	5 32P	8 00P
DETROIT, MICH.	0:43	22.7	Dp		4 43A	7 15A	10 29A	2 13P	5 35P	8 03P
Dearborn, Mich.	0:54	31.9	Dp		4 57A	7 26A	10 40A	2 24P	5 46P	8 14P
Ann Arbor, Mich.	1:24	61.9	Dp		5 27A	7 56A	11 10A	2 54P	6 16P	8 44P
Jackson, Mich.	1:55	98.9	Dp		5 58A	8 27A	11 41A	3 25P	6 47P	9 15P
Albion, Mich.	2:13	119.8	Dp			8 45A	11 59A		7 05P	9 33P
Battle Creek, Mich.	2:40	144.4	Dp	5 43A	6 43A	9 12A	12 26P	4 10P	7 32P	10 00P
Kalamazoo, Mich.	3:01	167.1	Dp	6 11A	7 11A	9 40A	12 54P	4 38P	8 00P	10 29P
Dowagiac, Mich.	3:29	203.1	Dp	6 36A			1 19P			10 53P
Niles, Mich.	3:42	215.6	Dp	6 49A	7 49A		1 32P	5 16P		11 06P
New Buffalo, Mich.	4:01	242.5	Dp	7 10A	8 10A		1 53P	5 37P		11 27P
Michigan City, Ind.	4:10	252.6	Dp	6 20A			1 03P			10 37P
Suburban near Gary, IN	4:44	289.4	Dp	6 54A			1 37P			11 11P
CHICAGO ,ILL.	5:06	305.4	Ar	7 35A	8 35A	10 47A	2 18P	5 02P		11 52P

Source: Michigan Department of Transportation

3.3 Full Build Alternative Operating Scenario

Annual operating and maintenance costs have been estimated for the first full year of service implementation to occur in 2035. The operating plan is based on the recommended capital improvements to the corridor which allow increased speed and frequencies. Key elements of the operating plan include:

- The rail network will be upgraded to allow for passenger train speeds up to110 mph. Capacity enhancements will also be made to minimize conflicts between passenger and freight trains.
- The total number of daily round trips between Chicago and Detroit/Pontiac will increase from the current three to ten daily round trips between Chicago and Detroit with seven daily round trips between Detroit and Pontiac, Michigan. A schedule for this service has been developed and is included in Figure 2.
- Service frequencies for branch line services (Pere Marquette between Kalamazoo and Grand Rapids, Michigan and Blue Water between Battle Creek and Port Huron, Michigan) are increased to four trips per day. The O&M costs, ridership and revenue for these connecting routes are not included in this analysis of O&M costs for the Chicago-Detroit/Pontiac Corridor.

Figure 4: Full Build 2035 Schedule

EASTBOUND

Station	Miles	Travel Times	Ar/Dp	Train Number 700	702	704	706	708	710	712	714	716	718	720	722
CHICAGO Ill.	0.0	0:00	Dp			6 00A	7 00A	8 00A	10 00A	11 00A	12 00P	5 35P	6 00P	6 35P	7 35P
Suburban near Gary, Ind,	16.0	0:18	Dp					8 18A		11 18A		5 53P		6 53P	7 53P
Michigan City, Ind.	52.8	0:53	Dp							11 53A		6 28P		7 28P	8 28P
New Buffalo, Mich.	62.9	1:02	Dp					10 02A	12 02P	1 02P		7 37P	8 02P	8 37P	9 37P
Niles, Mich.	89.8	1:22	Dp					10 22A	12 22P	1 22P		7 57P	8 22P	8 57P	9 57P
Dowagiac, Mich.	102.3	1:32	Dp					10 32A	12 32P	1 32P		8 07P		9 07P	10 07P
Kalamazoo, Mich.	138.3	2:01	Dp	6 01A	7 01A	8 40A	9 40A	11 01A	1 01P	2 01P	2 40P	8 36P	9 01P	9 36P	10 36P
Battle Creek, Mich.	161.0	2:28	Dp	6 28A	7 28A		10 03A	11 28A	1 28P	2 28P		9 03P	9 28P	10 03P	11 03P
Albion, Mich.	185.6	2:51	Dp	6 41A	7 41A					2 51P					
Jackson, Mich.	206.5	3:11	Dp	7 11A	8 11A			12 11A	2 11P	3 11P			10 11P	10 46P	
Ann Arbor, Mich.	243.5	3:44	Dp	7 44A	8 44A	10 06A	11 10A	12 44A	2 44P	3 44P	4 06P		10 44P	11 19P	
Dearborn, Mich.	273.5	4:09	Dp	8 09A	9 09A	10 31A	11 35A	1 09A	3 09P	4 09P	4 31P		11 09P	11 44P	
DETROIT, MICH.	282.7	4:24	Ar	8 24A	9 24A	10 46A	11 50A	1 24A	3 24P	4 24P	4 46P		11 24P	11 59P	
DETROIT, MICH.	282.7	4:27	Dp	8 27A			11 53A	1 27A	3 27P	4 27P	4 49P		11 27P		
Royal Oak, Mich.	292.8	4:51	Dp	8 51A			12 17P	1 51A	3 51P	4 51P	5 13P		11 51P		
Birmingham, Mich.	297.1	4:58	Dp	8 58A			12 24P	1 58A	3 58P	4 58P	5 20P		11 58P		
PONTIAC, MICH.	305.4	5:16	Ar	9 16A			12 42P	2 16P	4 16P	5 16P	5 38P		12 16A		

WESTBOUND

Station	Travel Times	Miles	Dp/Ar	Train Number 701	703	705	707	709	711	713	715	717	719	721	723
PONTIAC, MICH.	0:00	0.0	Dp		4 03A	4 33A			9 46A	2 53P	3 35P			6 52P	7 20P
Birmingham, Mich.	0:13	8.3	Dp		4 16A	4 46A			9 59A	3 06P	3 48P			7 05P	7 33P
Royal Oak, Mich.	0:20	12.6	Dp		4 23A	4 53A			10 06A	3 13P	3 55P			7 12P	7 40P
DETROIT, MICH.	0:40	22.7	Ar		4 43A	5 13A			10 26A	3 33P	4 15P			7 32	8 00P
DETROIT, MICH.	0:43	22.7	Dp		4 46A	5 16A		7 15A	10 29A	3 36P	4 18P	5 05P	5 35P	7 35P	8 03P
Dearborn, Mich.	0:54	31.9	Dp		4 57A	5 27A		7 26A	10 40A	3 47P	4 29P	5 16P	5 46P	7 46P	8 14P
Ann Arbor, Mich.	1:24	61.9	Dp		5 27A	5 57A		7 56A	11 10A	4 17P	4 59P	5 46P	6 16P	8 16P	8 44P
Jackson, Mich.	1:55	98.9	Dp		5 58A	6 28A		8 27A	11 41A	4 48P			6 47P	8 47P	9 15P
Albion, Mich.	2:13	119.8	Dp					8 45A	11 59A				7 05P		9 33P
Battle Creek, Mich.	2:40	144.4	Dp	5 43A	6 43A		7 43A	9 12A	12 26P	5 33P	6 06P		7 32P	9 32P	10 00P
Kalamazoo, Mich.	3:01	167.1	Dp	6 11A	7 11A	7 41A	8 11A	9 40A	12 54P	6 01P	6 29P	7 11P	8 00P	10 00P	10 29P
Dowagiac, Mich.	3:29	203.1	Dp	6 36A			8 36A		1 19P						10 53P
Niles, Mich.	3:42	215.6	Dp	6 49A	7 42A		8 49A		1 32P	6 39P					11 06P
New Buffalo, Mich.	4:01	242.5	Dp	7 10A	8 03A		9 10A		1 53P	7 00P					11 27P
Michigan City, Ind.	4:10	252.6	Dp	6 19A			8 19A		1 02P						10 36P
Suburban near Gary, IN	4:44	289.4	Dp	6 53A			8 53A		1 36P						11 10P
CHICAGO ,ILL.	5:06	305.4	Ar	7 15A	8 10A	8 21A	9 15A	10 20A	1 58P	7 05P	7 09P	7 51P			11 32P

Source: Michigan Department of Transportation

4 OPERATING AND MAINTENANCE COSTS CALCULATION METHODOLOGY

Operating and maintenance costs have been developed from unit costs used in conjunction with the service units developed in the operating plan to project total costs. Unit costs were developed primarily from the costs provided by Amtrak for the FY 2014 Wolverine train operations[2]. The unit cost estimates were developed by Amtrak's Performance Tracking (APT) system in compliance with the PRIIA Section 209 Cost Methodology Policy. Each cost category is driven by the operating data that is most appropriate for that type of expense. For example, the costs for train crews and on-board service labor are driven by total train hours, the cost for fuel is driven by total train miles and the costs for track maintenance are driven by total track miles. The cost drivers used for each cost category are shown in Table 1 below.

Table 1: Operating Cost Categories and Primary Cost Drivers

Cost Driver	Cost Category
Track Miles	• Maintenance of Way – Track and Signals
Train Miles	• Maintenance of Equipment • Fuel • Police and Security
Train Hours	• On Board Service Labor and Support • Train and Engine Crew Labor • Train and Engine Overhead and Support
Passenger Miles	• Insurance • Passenger Inconvenience
Unit Trips	• Yard Operations
Ridership	• Sales and Marketing • Commissions • Information and Reservations
Fixed Costs	• Stations • General Administration

The No Build Alternative assumes that the current level of Wolverine service – three daily round trips – will remain in place. The O&M costs for the No Build Alternative are therefore calculated based on the current year (FY2014) cost estimates provided by Amtrak in 2013.

[2] *Appendix II. Michigan State-Supported Service. Section 209 Services Operating Pricing. Amtrak FY 2014. Provided by Michigan Department of Transportation, July, 2014.*

4.1 Cost Expense Categories

The costs have been calculated for several major cost categories for each of the components of service operations. A description of the components of each of these expense categories is provided below.

4.1.1 Maintenance of Way

The capital improvement plan for the corridor calls for an upgrade of tracks to allow for passenger train operations at speeds up to110 mph. In order to operate at this speed, all tracks must be maintained in compliance with the Federal Railroad Administration's Class 6 track standards. This is a significantly higher standard of maintenance than is currently in place on the corridor. With the exception of the Amtrak-owned section of track between Porter, Indiana and Kalamazoo, Michigan, the tracks are currently maintained at FRA Class 4 standards, which allow for a maximum passenger train speed of 79 mph.

The annual cost of maintaining a mile of track to FRA Class 6 standards is estimated to be $58,438. Two sources for this cost item have been identified. The Chicago – St. Louis Tier I Draft Environmental Impact Statement[3] assumes a track maintenance cost of $48,000 per track mile per year (2011 dollars). Inflating this estimate to 2013 dollars gives a cost of $52,283 per mile per year. The Draft Atlanta to Charlotte Passenger Rail Corridor Investment Plan[4] uses a methodology developed by Zeta –Tech for the FRA to calculate a 2013 cost of $58,438 per mile per year for Class 6 track.[5] The higher cost per track mile figure (developed for the Charlotte to Atlanta Corridor) is used in this report as the more conservative estimate.

The capital plan identifies numerous improvements that will need to be made to accommodate the higher speed passenger rail service. With all of these improvements in place, approximately 101 miles of the 305 mile long corridor will be double tracked, so a total of 406 miles of track will need to be maintained. With the exception of short sections of track in the urban areas on either end of the corridor where speeds will be restricted and Class 4 is sufficient, this track will be maintained to Class 6 standards when service is fully implemented. Ultimately a portion of this cost may be shared by other passenger and freight users of the corridor, but for the purposes of this estimate all track maintenance costs have been included in the Chicago-Detroit/Pontiac Corridor O&M Costs.

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[3] *Chicago – St. Louis Tier I Draft Environmental Impact Statement. Illinois Department of Transportation and Federal Railroad Administration, 2012.*

[4] *Draft Atlanta to Charlotte Passenger Rail Corridor Investment Plan. Georgia Department of Transportation and the Federal Railroad Administration. May 2014*

[5] *Federal Railroad Administration. Technical Monograph: Estimating Maintenance Costs for mixed High Speed Passenger and Freight Rail Corridors. August 2004.*

4.1.2 Maintenance of Equipment

The annual costs for equipment, labor and facilities related to the maintenance of the locomotives and passenger cars is included in this expense category. The operating plans for the interim and full build-out assume that new high speed rail locomotives and passenger cars will be purchased for exclusive use on this Corridor. All of this equipment is new, and there is no data available on the actual costs of maintaining this equipment. However, it is reasonable to expect that the costs of maintaining this equipment will be comparable to the costs of maintaining the current Amtrak fleet in use on the corridor. Therefore the unit costs utilized in the Amtrak 2014 Wolverine O&M cost estimates are used to develop the maintenance of equipment costs for all of the scenarios analyzed. These costs are calculated on a per train mile basis.

4.1.3 Operations and Transportation

This cost category includes both the train and engine crew labor and the on-board service labor required to operate the rail service. Also included in this category are materials and supplies, overhead and management expenses and the costs of moving trains in and out of storage yards. These costs are calculated using 2014 Wolverine unit costs, with the cost driver being the total number of train hours. The exception is Yard Operations, where the Cost Driver is Unit Trips where a "Unit" is the number of coaches and locomotives on a train. For example a typical trainset of 6 coaches and 2 locomotives is 8 units.

4.1.4 Fuel

It is assumed that each train will be powered by two high horsepower diesel-electric locomotives specifically designed for high speed operations and that meet all current federal emissions standards. An average consumption rate of 2.42 gallons per mile was estimated based upon other studies conducted across the nation. Assuming a diesel fuel cost of $3.90 a gallon in 2013 dollars, this translates into a cost of $9.44 per train mile.

4.1.5 Sales and Marketing

This category includes the cost of marketing and advertising the rail service in order to attract passengers. Also included in this category is the Corridor's share of the cost of the national information and reservations network. The unit costs for these items are calculated from the Amtrak 2014 Wolverine cost estimates. The cost driver for these expense categories is annual ridership.

4.1.6 Stations

The proposed schedule for each alternative includes stops at 16 stations in Illinois, Indiana and Michigan. This includes 15 existing stations and one new suburban station in a location in northwest Indiana.

Four stations will be manned and served solely by the Chicago – Detroit/Pontiac Corridor trains:

1. Ann Arbor
2. Detroit
3. Jackson
4. Dearborn

Three manned stations will be shared with trains operating on the Pere Marquette and/or Blue Water routes:

1. Niles
2. Kalamazoo
3. Battle Creek

Eight of these stations will be unmanned. Some of these unmanned stations will also be served by the Pere Marquette and/or Blue Water trains:

1. Northwest Indiana[6]
2. Michigan City
3. New Buffalo
4. Dowagiac
5. Albion
6. Royal Oak
7. Birmingham
8. Pontiac

Chicago Union Station is a major regional hub station that is served by numerous Amtrak long distance and regional trains as well as by Metra commuter trains. Amtrak currently allocates costs to the Wolverine service based on its portion of use of the station.

Costs have been projected for each type of station based on previous Wolverine charges and other national studies. With the large increases in ridership that are projected in 2035 it is anticipated that usage and thus O&M costs will increase significantly. The costs used for the interim and full build-out O&M is twice the average cost per station that were identified in the detailed Amtrak 2011 Section 209 Wolverine Route cost estimates.

[6] An exact location of a suburban station in Northwest Indiana has not yet been identified and will be the subject of future studies. The current Amtrak station at Hammond/Whiting is unmanned. Depending on the location and projected demand, this could end up being a manned station.

4.1.7 General and Administrative

This category includes the Corridor's share of general administration and liability insurance. Also included is the cost of "passenger inconvenience," which includes payments for replacement tickets and alternative transportation necessitated by service delays.

The unit costs for Insurance and Passenger Inconvenience are calculated from the rates provided by Amtrak for the Wolverine service for 2014. The General Administration costs are expressed as a percentage of total O&M cost. The 9.0% percent General Administration rate was calculated from an analysis of several current Amtrak routes and from estimated O&M costs for proposed services.

4.1.8 Capital Equipment Overhaul

When Amtrak calculates the cost of providing service on the Wolverine corridor, it calculates a cost of utilizing their current fleet of locomotives and coaches. In this calculation, Michigan is charged for the Wolverine's portion of the cost of major overhauls for all of the vehicles used in service in the Midwest. These costs are based on Amtrak's annual program of major equipment overhauls.

The No Build Alternative, the Interim Service Scenario and Build Alternative all assume that new coaches and high speed locomotives will be purchased to provide service in the corridor. The long term cost of major capital overhaul has been calculated on a train mile basis using the Amtrak 2014 Wolverine cost estimates.

4.1.9 Police, Security and Environmental Safety

This category includes the cost of keeping the rail operations safe and secure, including the provision of railroad police, security services and the prevention and remediation of environmental impacts. The Unit Costs for these items were developed from the Amtrak 2014 Wolverine Cost Estimates. The Cost Driver for these line items is train miles.

4.2 Key Annual Operating Statistics

Key annual operating statistics for the current Amtrak service (2013) No Build Alternative (2035), the Interim Service Scenario (2025) and the Build Alternative (2035) have been calculated based on the current and proposed service scenarios and ridership projections. These statistics are shown in Table 2.

Table 2: Key Operating Statistics

Operating Statistics	Current Amtrak Service (2013)	No Build Alternative (2035)	Interim Service (2025)	Full Build Alternative (2035)
Ridership	509,100	1,050,000	1,640,000	2,830,000
Passenger Revenue	$19,398,853	$63,880,000	$99,690,000	$162,030,000
Service Frequencies	3 Round Trips/Day	3 Round Trips/Day	6 Round Trips/Day	10 Round Trips/Day (Chi-Det) 7 Round Trips/Day (Det-Pon)
Corridor Length in Miles	305	305	305	305
Track Miles	376	387	387	406
Train Miles	674,272	668,826	1,354,223	2,212,849
Train Hours	14,272	12,398	25,678	35,058
Unit Trips	15,330	15,330	40,880	70,080
Number of Stations	16	16	16	16
Passenger Miles	105,448,566	225,770,000	346,280,000	541,520,000

5 OPERATING AND COST ESTIMATES

Using the methodology described above, O&M costs have been calculated for both the No Build and the Build Alternatives and for the Interim Service Scenario for the Chicago – Detroit/Pontiac Passenger Rail Corridor. The No Build Alternative maintains the current frequency of service (three round trips per day), but assumes that all of the currently funded improvements are in place in 2035. The Interim Service O&M costs are for the first full year of operations of 6 round trips per day in 2025. The Build Alternative O&M costs are for the assumed first full year of operation (2035) of the proposed service of ten daily round trips between Chicago and Detroit with seven daily round trips from Detroit to Pontiac, Michigan operating at a maximum speed of 110 mph. All costs are shown in 2013 dollars.

5.1 No Build Alternative (2035)

The total annual operating and maintenance costs are shown in Table 3 below. The cost drivers and unit costs are listed, as well as a brief description of the source for each cost item. The No Build Alternative cost estimates assumes that MDOT-owned equipment will be used to operate the service. No equipment lease costs are included in the Capital line item. The cost for periodic major overhauls of these coaches and locomotives is included in the Maintenance of Equipment line item.

Table 3: No Build Alternative Operating and Maintenance Costs

Cost Category	Cost Driver	Units	Unit Cost	Annual Cost	Data Source/Comments
Maintenance of Way					
MoW Track & Signal - Class 4	Track Miles	158	$48,468	$7,657,944	Costs from 2013 ATL-CLT ADR
MoW Track & Signal - Class 6	Track Miles	229	$58,438	$13,382,302	Costs from 2013 ATL-CLT ADR
Subtotal		*387*		$21,040,246	
Maintenance of Equipment					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Maintenance of Equipment	Train Miles	668,826	$8.90	$5,950,000	Unit Cost From Wolverine FY2014
MoE Supervision, Training & Support	Train Miles	668,826	$2.41	$1,612,000	Unit Cost From Wolverine FY2014
MoE Yard Operations	Train Miles	668,826	$0.31	$208,000	Unit Cost From Wolverine FY2014
Subtotal				$7,770,000	
Operations-Transportation					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
On Board Service Labor and Support	Train Hours	12,398	$80.93	$1,003,328	Unit Cost From Wolverine FY2014
Commissary Provisions and Management	Train Hours	12,398	$62.36	$773,127	Unit Cost From Wolverine FY2014
Train & Engine Crew Labor	Train Hours	12,398	$410.52	$5,089,609	Unit Cost From Wolverine FY2014
Yard Operations	Unit Trips	15,330	$39.20	$601,000	Unit Cost From Wolverine FY2014
T&E Overhead & Operations Mgmt	Train Hours	12,398	$124.79	$1,547,123	Unit Cost From Wolverine FY2014
Subtotal				$9,014,188	
Fuel					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Fuel	Total Train Miles	668,826	$9.44	$6,312,380	Unit Cost From Wolverine FY2014
Subtotal				$6,312,380	
Sales & Marketing					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Marketing and Sales	Ridership	1,050,000	$1.57	$1,645,846	Actual Wolverine Ridership FY2013
Commissions	Ridership	1,050,000	$0.82	$860,047	Actual Wolverine Ridership FY2013
Information & Reservations	Ridership	1,050,000	$2.25	$2,366,000	Actual Wolverine Ridership FY2013
Subtotal				$4,871,893	
Stations					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Manned Stations - Route	Each	4	$850,000	$3,400,000	Ann Arbor, Detroit, Jackson, Dearborn
Shared Stations - Route	Each	3	$600,000	$1,800,000	Battle Creek, Niles, Kalamazoo
Unmanned Stations	Each	8	$10,000	$80,000	Hammond, MI City, New Buffalo, Dowagiac, Albion, Royal Oak, Birmingham, Pontiac
Chicago Union Station - Shared	Each	1	$3,000,000	$3,000,000	Share of Total Amtrak CUS Costs
Subtotal				$8,280,000	
General & Administrative					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
General and Administration	Share of all	$62,279,706	9.0%	$5,605,174	Unit Cost From Wolverine FY2014
Insurance	Train Miles	668,826	$1.262	$844,000	Unit Cost From Wolverine FY2014
Passenger Inconvenience	Total Passengers	1,050,000	$0.079	$83,000	Actual Wolverine Ridership FY2013
Subtotal				$6,532,174	
Capital Equipment Overhaul					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Equipment Overhaul - Coaches	Lump sum	1	$2,078,000	$2,078,000	Wolverine FY2014 Equipment
EquipmentOverhaul - Locomotives	Lump sum	1	$1,205,000	$1,205,000	Wolverine FY2014 Equipment
Subtotal				*$3,283,000*	
Police, Security & Environmental/Safety					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Police	Train Miles	668,826	$0.35	$234,000	Unit Cost From Wolverine FY2014
Security Strategy & Special Ops	Train Miles	668,826	$0.82	$547,000	Unit Cost From Wolverine FY2014
Subtotal				$781,000	
TOTAL:					
Total				$67,884,880	
Cost per Train Mile		668,826		$101.50	
OPERATING REVENUE					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Passenger Revenue	Ridership	1,050,000	$60.84	$63,880,000	TEMS Demand Model

5.2 Interim Service (2025)

The total annual operating and maintenance costs for the first year of operation (2025) of the interim service level of 6 round trips per day are shown in Table 4. Since it is assumed that the equipment serving this corridor will be owned by the State of Michigan, no equipment lease costs are included in the Capital line item. The cost for periodic major overhauls of these coaches and locomotives is included in the Maintenance of Equipment line item.

5.3 Full Build Alternative (2035)

The total annual operating and maintenance costs for the first year of operation (2035) of the full build-out alternative are shown in Table 5. Since it is assumed that the equipment serving this corridor will be owned by the State of Michigan, no equipment lease costs are included in the Capital line item. The cost for periodic major overhauls of these coaches and locomotives is included in the Maintenance of Equipment line item.

Table 4: Interim Service (2025) Operating and Maintenance Costs

Cost Category	Cost Driver	Units	Unit Cost	Annual Cost	Data Source/Comments
Maintenance of Way					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost(2013 Dolla**	**Data Source/Comments**
MoW Track & Signal - Class 4	Track Miles	158	$48,468	$7,657,944	Costs from 2013 ATL-CLT ADR
MoW Track & Signal - Class 6	Track Miles	229	$58,438	$13,382,302	Costs from 2013 ATL-CLT ADR
Subtotal				$21,040,246	
Maintenance of Equipment					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Maintenance of Equipment	Train Miles	1,354,223	$8.90	$12,047,419	Unit Cost From Wolverine FY2014 plus additional charge for equipment overhauls
MoE Supervision, Training & Support	Train Miles	1,354,223	$2.41	$3,263,939	Unit Cost From Wolverine FY2014
MoE Yard Operations	Train Miles	1,354,223	$0.31	$421,153	Unit Cost From Wolverine FY2014
Subtotal				$15,732,511	
Operations-Transportation					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
On Board Service Labor and Support	Train Hours	24,644	$93.16	$2,295,832	Unit Cost From Wolverine FY2014
Commissary Provisions and Management	Train Hours	24,644	$71.79	$1,769,082	Unit Cost From Wolverine FY2014
Train & Engine Crew Labor	Train Hours	24,644	$472.58	$11,646,128	Unit Cost From Wolverine FY2014
Yard Operations	Unit Trips	40,880	$39.20	$1,602,667	Unit Cost From Wolverine FY2014
T&E Overhead & Operations Mgmt	Train Hours	24,644	$143.65	$3,540,153	Unit Cost From Wolverine FY2014
Subtotal				$20,853,861	
Fuel					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Fuel	Train Miles	1,354,223	$9.44	$12,781,157	From Atlanta to Charlotte Study
Subtotal				$12,781,157	
Sales & Marketing					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Marketing and Sales	Ridership	1,640,000	$1.57	$2,570,654	Unit Cost From Wolverine FY2014
Commissions	Ridership	1,640,000	$0.82	$1,343,312	Unit Cost From Wolverine FY2014
Information & Reservations	Ridership	1,640,000	$2.25	$3,695,467	Unit Cost From Wolverine FY2014
Subtotal				$7,609,432	
Stations					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Manned Stations - Route	Each	4	$850,000	$3,400,000	Ann Arbor, Detroit, Jackson, Dearborn
Shared Stations - Route	Each	3	$600,000	$1,800,000	Battle Creek, Niles, Kalamazoo
Unmanned Stations	Each	8	$10,000	$80,000	Hammond, MI City, New Buffalo, Dowagiac, Albion, Royal Oak, Birmingham, Pontiac
Chicago Union Station - Shared	Each	1	$3,000,000	$3,000,000	Share of Total Amtrak CUS Costs
Subtotal				$8,280,000	
General & Administrative					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
General Administration	Share of all	$99,501,122	9.0%	$8,955,101	Average of existing and proposed services
Insurance	Passenger Miles	346,280,000	$0.014	$4,847,920	Unit Cost From Wolverine FY2014
Passenger Inconvenience	Passenger Miles	346,280,000	$0.000	$127,303	Unit Cost From Wolverine FY2014
Subtotal				$13,930,324	
Capital Equipment Overhaul					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Equipment Overhaul - Coaches	Train Miles	1,354,223	$3.11	$4,207,485	MDOT-Owned Equipment
EquipmentOverhaul - Locomotives	Train Miles	1,354,223	$1.80	$2,439,855	MDOT-Owned Equipment
Subtotal				$6,647,340	
Police, Security & Environmental/Safety					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Police	Train Miles	1,354,223	$0.35	$473,798	Unit Cost From Wolverine FY2014
Security Strategy & Special Ops	Train Miles	1,354,223	$0.82	$1,107,553	Unit Cost From Wolverine FY2014
Subtotal				$1,581,350	
TOTAL:					
Total				$108,456,223	
Cost per Train Mile		1,354,223		$80.09	
OPERATING REVENUE					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Revenue**	**Data Source/Comments**
Passenger Revenue	Ridership	1,640,000	$61.68	$101,150,000	TEMS Demand Model

Table 5: Full Build Alternative (2035) Operating and Maintenance Costs

Cost Category	Cost Driver	Units	Unit Cost	Annual Cost(2013 Dolla	Data Source/Comments
Maintenance of Way					
MoW Track & Signal - Class 4	Track Miles	53	$48,468	$2,568,804	Costs from 2013 ATL-CLT ADR
MoW Track & Signal - Class 6	Track Miles	353	$58,438	$20,628,614	Costs from 2013 ATL-CLT ADR
Subtotal				$23,197,418	
Maintenance of Equipment					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Maintenance of Equipment	Train Miles	2,212,849	$8.90	$19,685,915	Unit Cost From Wolverine FY2014 plus additional charge for equipment overhauls
MoE Supervision, Training & Support	Train Miles	2,212,849	$2.41	$5,333,394	Unit Cost From Wolverine FY2014
MoE Yard Operations	Train Miles	2,212,849	$0.31	$688,180	Unit Cost From Wolverine FY2014
Subtotal				$25,707,489	
Operations-Transportation					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
On Board Service Labor and Support	Train Hours	35,058	$93.16	$3,266,077	Unit Cost From Wolverine FY2014
Commissary Provisions and Management	Train Hours	35,058	$71.79	$2,516,717	Unit Cost From Wolverine FY2014
Train & Engine Crew Labor	Train Hours	35,058	$472.58	$16,567,918	Unit Cost From Wolverine FY2014
Yard Operations	Unit Trips	70,080	$39.20	$2,747,429	Unit Cost From Wolverine FY2014
T&E Overhead & Operations Mgmt	Train Hours	35,058	$143.65	$5,036,263	Unit Cost From Wolverine FY2014
Subtotal				$30,134,404	
Fuel					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Fuel	Train Miles	2,212,849	$9.44	$20,884,869	From Atlanta to Charlotte Study
Subtotal				$20,884,869	
Sales & Marketing					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Marketing and Sales	Ridership	2,830,000	$1.57	$4,435,946	Unit Cost From Wolverine FY2014
Commissions	Ridership	2,830,000	$0.82	$2,318,032	Unit Cost From Wolverine FY2014
Information & Reservations	Ridership	2,830,000	$2.25	$6,376,933	Unit Cost From Wolverine FY2014
Subtotal				$13,130,911	
Stations					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Manned Stations - Route	Each	4	$850,000	$3,400,000	Ann Arbor, Detroit, Jackson, Dearborn
Shared Stations - Route	Each	3	$600,000	$1,800,000	Battle Creek, Niles, Kalamazoo
Unmanned Stations	Each	8	$10,000	$80,000	Hammond, MI City, New Buffalo, Dowagiac, Albion, Royal Oak, Birmingham, Pontiac
Chicago Union Station - Shared	Each	1	$3,000,000	$3,000,000	Share of Total Amtrak CUS Costs
Subtotal				$8,280,000	
General & Administrative					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
General Administration	Share of all	$142,561,425	9.0%	$12,830,528	Average of existing and proposed services
Insurance	Passenger Miles	541,520,000	$0.014	$7,581,280	Unit Cost From Wolverine FY2014
Passenger Inconvenience	Passenger Miles	541,520,000	$0.000	$199,079	Unit Cost From Wolverine FY2014
Subtotal				$20,610,888	
Capital Equipment Overhaul					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Equipment Overhaul - Coaches	Train Miles	2,212,849	$3.11	$6,875,182	MDOT-Owned Equipment
EquipmentOverhaul - Locomotives	Train Miles	2,212,849	$1.80	$3,986,811	MDOT-Owned Equipment
Subtotal				*$10,861,993*	
Police, Security & Environmental/Safety					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Cost**	**Data Source/Comments**
Police	Train Miles	2,212,849	$0.35	$774,202	Unit Cost From Wolverine FY2014
Security Strategy & Special Ops	Train Miles	2,212,849	$0.82	$1,809,781	Unit Cost From Wolverine FY2014
Subtotal				$2,583,983	
TOTAL:					
Total				$155,391,954	
Cost per Train Mile		2,212,849		$70.22	
OPERATING REVENUE					
Cost Category	**Cost Driver**	**Units**	**Unit Cost**	**Annual Revenue**	**Data Source/Comments**
Passenger Revenue	Ridership	2,830,000	$57.25	$162,030,000	TEMS Demand Model

5.4 Comparison of Operating and Maintenance Costs

This technical memorandum provides operating and maintenance cost estimates for three service scenarios for the Chicago – Detroit/Pontiac Passenger Rail Corridor Program. The major costs for the three scenarios are shown in Table 6. The No Build Alternative includes the current level of service, but it also includes significant upgrades in the speed and capacity of the rail corridor as the result of the completion of projects that are fully funded and expected to be in place by the year 2017.

The 2035 No Build Alternative O&M costs are almost twice the current Amtrak operating budget, which is projected to be $36.9 million in 2014. This increase in cost is due primarily to Maintenance of Way costs which will be required to maintain the track between Porter, Indiana and Dearborn, Michigan to FRA Class 6 standards. Ridership and revenue are also projected to increase substantially, primarily as a result of the reduction of trip travel times resulting from continuous 110 mph operations. This alternative shows an operating deficit of approximately $4.0 million. Figure 5 shows the breakdown of costs by category for the No Build Alternative.

Table 6: Comparison of Service Alternative Operating and Maintenance Costs by Major Cost Categories

Cost Item	No Build Alternative (2035)		Interim Service Scenario (2025)		Build Alternative (2035)	
	Cost	% of Total	Cost	% of Total	Cost	% of Total
Maintenance of Way	$21,000,000	30.9%	$21,000,000	19.4%	$23,200,000	14.9%
Maintenance of Equipment	$7,800,000	11.5%	$15,700,000	14.5%	$25,700,000	16.5%
Ops-Transportation	$9,000,000	13.3%	$20,900,000	19.3%	$30,100,000	19.4%
Fuel	$6,300,000	9.3%	$12,800,000	11.8%	$20,900,000	13.4%
Sales & Marketing	$4,900,000	7.2%	$7,600,000	7.0%	$13,100,000	8.4%
Stations	$8,300,000	12.2%	$8,300,000	7.7%	$8,300,000	5.3%
General & Administrative	$6,500,000	9.6%	$13,900,000	12.8%	$20,600,000	13.3%
Capital Equipment Overhaul	$3,300,000	4.9%	$6,600,000	6.1%	$10,900,000	7.0%
Police, Security & Safety	$800,000	1.2%	$1,600,000	1.5%	$2,600,000	1.7%
TOTAL	$67,900,000	100.0%	$108,400,000	100.0%	$155,400,000	100.0%
PROJECTED REVENUE	$63,900,000		$101,200,000		$162,000,000	
OPERATING RATIO	94.1%		93.4%		104.2%	

The Interim Service Scenario includes 6 round trips per day operating on the same infrastructure that is included in the No Build Alternative. This scenario is an intermediate phase in 2025 towards implementing the full Build Alternative. All of the rail infrastructure improvements included in the No Build Alternative are assumed to be in place for this interim service scenario. Because the amount of service provided has doubled as compared to the No Build Alternative, costs associated with train miles and train hours have increased substantially. This includes the categories of Ops-Transportation (on-board labor), Maintenance of Equipment and Fuel. Since the infrastructure improvements in the Interim Service Scenario are the same as those in the No Build Alternative, the Maintenance of Way costs are identical. This alternative shows an operating deficit of approximately $7.3 million. Figure 6 shows the breakdown of costs by category for the Interim Service Scenario.

The Build Alternative includes all of the improvements necessary to allow 10 round trips per day on the corridor. This includes substantial improvements to the South of the Lake section between Chicago, Illinois and Porter, Indiana, a 10-mile section of double track on the Amtrak territory near Niles, Michigan, and double tracking the entire segment between Dearborn, Michigan and Pontiac, Michigan. This increases the amount of Class 6 track in the corridor and increases Maintenance of Way Costs. The frequency of service and ridership increase over the No Build Alternative, so costs associated with train hours, train miles and ridership all also show substantial increases. This scenario shows an operating surplus of approximately $6.6 million. Figure 7 shows the breakdown of costs by category for the Build Alternative.

Figure 5: No Build Alternative Cost Categories Percent of Total

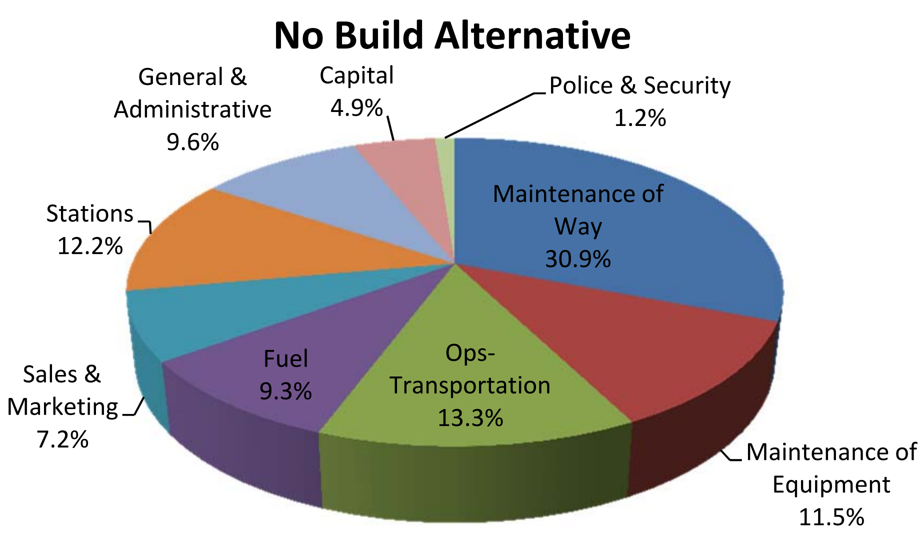

Figure 6: Interim Service Scenario Cost Categories Percent of Total

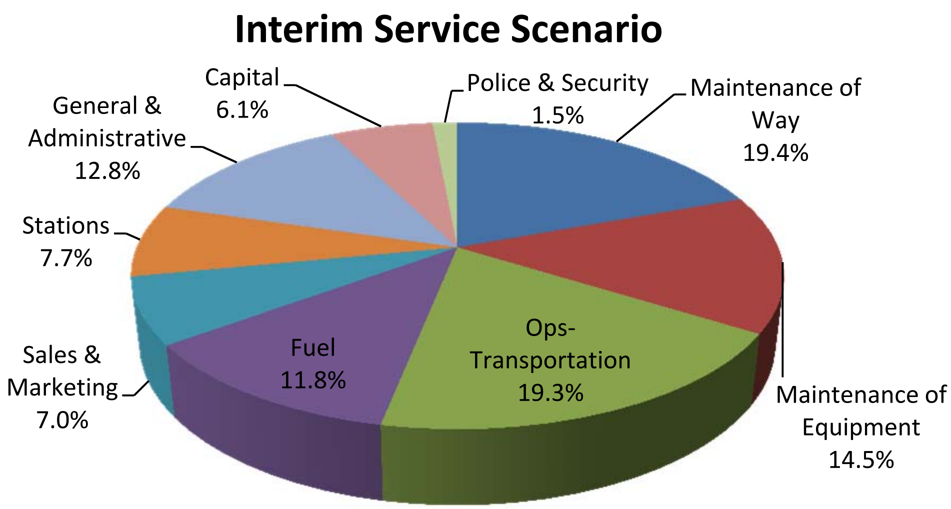

Figure 7: Full Build Alternative Cost Categories Percent of Total