BALTIMORE-WASHINGTON SCMAGLEV PROJECT

RIDERSHIP DATA REQUEST

REVISION: 1

DATE: MAY 6, 2020

(Response to data requests #6, 7, 18, 19, 20, 21, 22 and 23)

BWRR

BALTIMORE-WASHINGTON RAPID RAIL

BALTIMORE-WASHINGTON SCMAGLEV PROJECT

RIDERSHIP DATA REQUEST

4.3 PRELIMINARY ENGINEERING

REVISION: 1

DATE: MAY 6, 2020

LOUIS BERGER

Your ref.:

TABLE OF CONTENTS

TABLES

FIGURES

NOTES/REVISIONS FOR VERSION CONTROL

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1. INTRODUCTION

This memo first provides a general overview of the methodology Louis Berger used to forecast SCMAGLEV ridership between Baltimore and Washington for BWRR.

2. RIDERSHIP METHODOLOGY

Louis Berger forecasted annual ridership demand between Baltimore, BWI, and Washington DC under two Baltimore station location scenarios: (1) Cherry Hill, which is the station location assumed in the base forecast; and (2) Camden Yards.

The key elements of the study were as follows:

— MODEL DEVELOPMENT: The ridership demand forecasts were prepared according to best practices in travel demand forecasting for intercity passenger rail as recommended by the Federal Railroad Administration (FRA). Key work activities included: (1) extensive primary data collection to understand willingness to pay for travel time savings and for travel time reliability by residents and visitors currently traveling in the Baltimore-Washington corridor; (2) a comprehensive review of existing data sources to establish base year levels of travel demand and origin/destination patterns; and (3) a critical assessment of economic growth projections to establish a reasonable level for the overall increase in travel demand that will occur in the study area.

— DATA SOURCES: Throughout the modeling process, Louis Berger coordinated with the two Metropolitan Planning Organizations (MPO) covering the study area - the Baltimore Metropolitan Council (BMC) and Metropolitan Washington Council of Governments (MWCOG). In addition to third-party (i.e., Woods & Poole) economic demographic forecasts, Louis Berger reviewed population and employment forecasts developed by the two MPOs. The methods and preliminary results were presented at a workshop at the BMC headquarters on June 13, 2018 that was attended by BMC and MWCOG along with other stakeholders (i.e. MEDCO, MDOT, and AECOM).

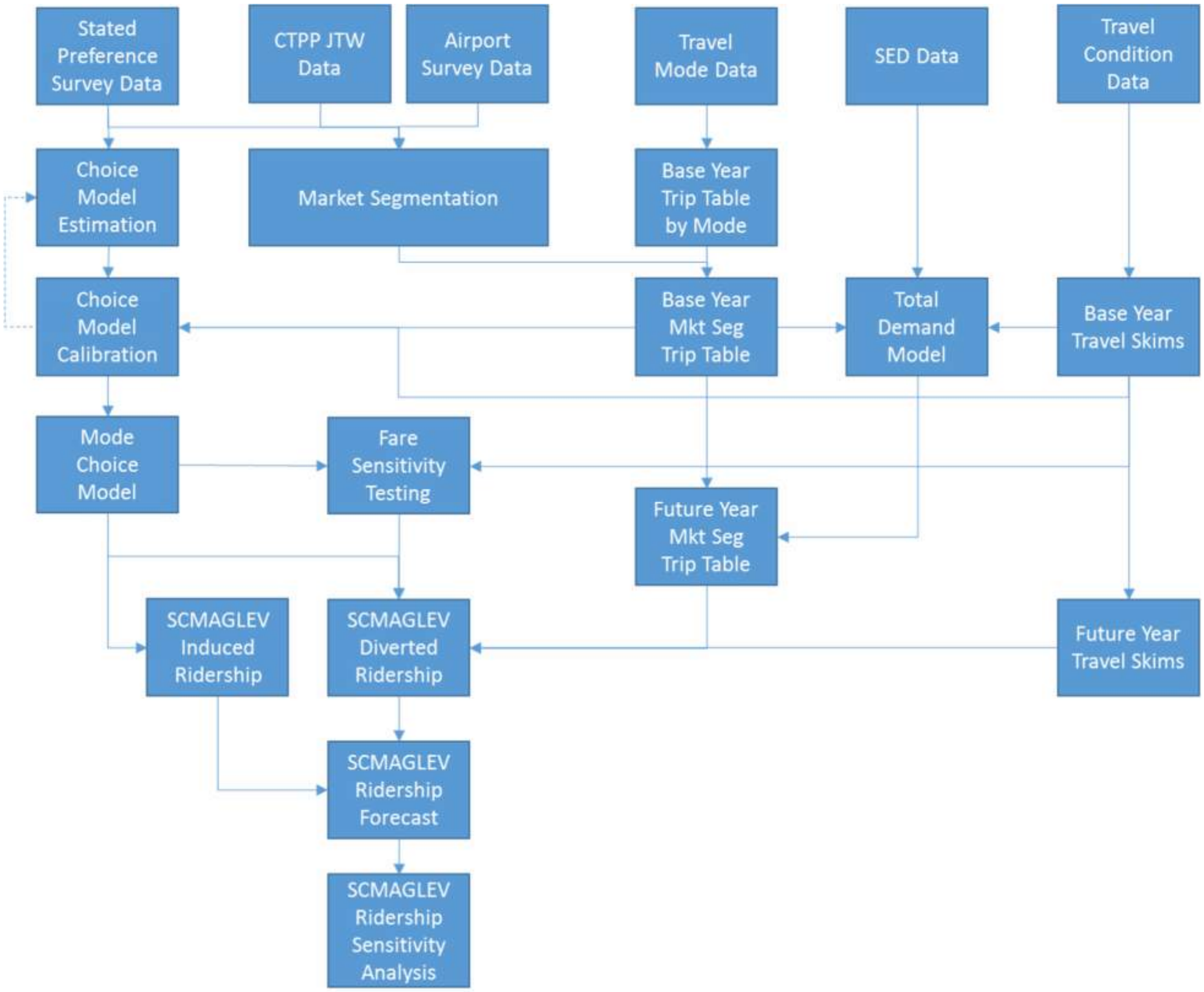
CRITICAL MODEL REVIEW: A peer review process using independent experts reviewed the forecasting assumptions and procedures. (b) (4) [redacted]

2.1 MODELING APPROACH

Figure 1 provides a high-level schematic overview of the process that was used to generate the SCMAGLEV ridership estimates contained in this report. The methodological approach underpinning this study was designed to reflect the state-of-the-practice as described in the High-Speed Intercity Passenger Rail (HSIPR) Best Practices documents.[1]

[1] Steer Davies Gleave, HSIPR Best Practices: Ridership and Revenue Forecasting, Prepared for the Office of the Inspector General, 2011

Figure 1. Methodological Overview



The interlinked processes presented in the figure can be summarized in four broad work streams briefly described below:

— **Data collection** is further segmented into three broad categories.

(1) **Socioeconomic and demographic (SED) data** that provides the basis for understanding rates of current trip generation (production and attraction) as well as growth in future trip generation rates.

(2) **Travel mode data** that provides an indication of the addressable travel market size through the triangulation of several data sources supplying information on trip volumes by mode.

(3) **Travel condition data** providing information on the levels of service (LOS) by mode for use in understanding current and future mode choice.

— **Trip table development** is a key component of the forecasting process as it defines the scope of the potential ridership. This phase of the study can be further decomposed into four discrete tasks:

(1) **Base year trip table development** that proceeds from the travel mode data collection exercise to define the volume of trips between the various city pairs of interest to this study.

(2) **Market segmentation** of the trip table that breaks down the estimated volume of trips according to several different categories that may drive mode choice decisions such as trip purpose, household income, time-of-day, etc.

(3) **Total demand model estimation** based on currently observed correlations between local socioeconomic conditions, and patterns of trip generation and distribution.

(4) **Future year trip table development** using the total demand model to develop future forecasts of overall travel demand market growth by travel market.

— **Primary market research** is a critical component of the overall ridership demand forecasting effort is further segmented into two distinct efforts:

(1) **Stated preference (SP) survey** that collects data on the potential travel market information including existing travel patterns and travel characteristics of each respondent. The hypothetical choice tasks presented to respondents are then used as the basis for developing mode choice models through model estimation and calibration procedures.

(2) **Model estimation processes** develop mathematical algorithms describing observed mode choice behavior of hypothetical choice tasks. Resulting market-segmented models of mode choice are used to derive rates of diversion from existing modes of travel.

— **SCMAGLEV ridership forecasting** comprised three distinct phases listed below:

(1) **Fare sensitivity testing** evaluating the various ranges of potential SCMAGLEV fares and resulting ridership demand responses.

(2) **SCMAGLEV base case ridership forecasts** estimating two sources of ridership that pivot off fare sensitivity analysis:

(a) Diverted ridership

(b) Induced ridership

(3) Sensitivity tests to evaluate forecast uncertainty and areas of forecast risk.

2.2 TRAVEL DEMAND MODEL

The ridership analysis was conducted using a travel demand model based on available regional data and customized specifically to analyze intercity trips within the study area. Key features of the travel demand model framework are noted below:

— To support the engineering and environmental analyses, Louis Berger developed a model of average daily travel for four daily time periods with distinct characteristics for intercity travel: Morning (AM) 6:00am to 9:00am; Midday (MD) 9:00am to 4:00pm; Evening (PM) 4:00pm to 7:00pm; and Overnight (NT) 7:00pm to 6:00am.

— Average daily ridership estimates were converted to annual estimates through the application of an annualization factors that differed by trip purpose, e.g., commuter, airport-related, business, non-business, to account for differences in the mix of weekday and weekend travel patterns for each type of trip.

— To facilitate the collection of travel data a study area was set to correspond to the boundaries of the MWCOG and BMC regional planning jurisdictions. To establish reasonable limits for the market area for intercity travel to be served by SCMAGLEV stations, a catchment area of a 25-mile boundary around each of the three proposed stations was first delineated. Within the Baltimore/Washington region, the 25-mile zone was further refined to reflect what was considered a reasonable catchment area for short distance trips within those respective larger areas.

— Louis Berger assembled a comprehensive accounting of the current level of intercity trips from MPO surveys and models, transit agency data, airport data, and mobile phone O/D data. Given the catchment area delineation, the total volume of travel in 2017 that constitutes the market for SCMAGLEV is over 117 million person trips annually.

— Louis Berger conducted an analysis by travel mode to determine the growth in the total volume of trips into the future. The analysis drew upon data from MPO demographic and economic forecasts, transit agency data, airport data, and third-party economic data sources. The overall level of growth in intercity trips in the study areas was estimated at 0.93% compound average annual growth from 2017 through 2050.

— Using the findings of the SP survey on trip characteristics, traveler characteristics, mode choice preferences and willingness to pay, Louis Berger conducted a discrete choice analysis to estimate mode choice models representing the existing travel market and future market with the inclusion of SCMAGLEV. (b) (4)

— The mode choice model was developed with a nested structure (b) (4)

— The implied value of time resulting from the discrete choice analysis is consistent with USDOT guidelines and the household income profile of the study area.

3. SPECIFIC DATA

3.1 SCMAGLEV FARE STRUCTURE AND REVENUES

A sensitivity analysis was conducted on a range of fares as the first step in establishing the SCMAGLEV ridership demand forecast. A varied set of fares ranging between $27.00 and $81.00 depending on trip purpose and travel distance was used to generate a base case ridership demand forecast assuming station locations at Cherry Hill (Baltimore), BWI and Mount Vernon Square (Washington). (b) (4) [redacted].

(b) (4) [redacted]

The sensitivity analyses in the Baltimore-Washington Final Ridership Report were developed at the recommendation of the independent peer review panel to test the utility and functioning of the ridership model from replacing input derived from the stated-preference survey and other best practice research with inputs that represent possible occurrences.

(b) (4) [redacted]

Comparative Modes of Transportation

As part of the analysis, comparative modes of transportation were examined to validate and benchmark the range of ticket pricing expected to be offered by SCMAGLEV service.

Amtrak - Ticket pricing was reviewed for current Amtrak Acela Business Class fares between Washington and Baltimore, wherein the Business Class is the basic class of service on Acela trains. Acela fares were obtained from Amtrak's website through monitoring of two-week advance purchase pricing for weekday travel during the week of March 15-20, 2018. Two-week advanced fares were obtained to avoid fluctuations in fares, typically upward, on or just prior to the actual day of travel. Published Acela fares during that week ranged between $44 and $68 per ticket with the median of $52 per ticket.

Ridesharing Services (Uber and Lyft) - Ride sharing continues to increase in popularity and has become a common mode of transportation, especially for the Millennial generation and business and non-business travelers. Uber and Lyft are the leaders in this market segment and fares were obtained during peak and off-peak hours for travel between the segment pairs based on fare ranges published on the providers' websites (uberestimate.com/prices/ and lyft.com/fare-estimate) during March 2018 and October 2018. Ride Sharing fares between the SCMAGLEV operating segments fell into the ranges outlined in Table 1.

Table 1. Ride-Sharing Services Sample Fare Ranges

	Peak Fares	Off-Peak Hour Fares
Baltimore to Washington	$70-$79	$59-$69
Baltimore to BWI	$28-$29	$22-$24
BWI to Washington DC	$60-$66	$50-$52

Traditional Private Car Services (Cab & Private Car Services) - Traditional car services between the segments were also reviewed. Both public cab services and private car service fares were obtained from general (taxifarefinder.com) and specific taxi and private car company websites during peak and off-peak hours for travel between the segment pairs during March 2018 and October 2018. Fares for these services between the SCMAGLEV operating segments fell into the ranges outlined in Table 2 below.

Table 2. Traditional Private Car Services Sample Fare Ranges

	Peak Fares	Off-Peak Hour Fares
Baltimore to Washington	$100-$125	$89-$118
Baltimore to BWI	$58-$60	$32-$54
BWI to Washington DC	$84-$106	$73-$99

Fare Range Estimate pending Final Preferred Alignment Decision and Costing Analysis

Based on the methods of transportation listed in the prior section and taking into account the significant improvement in services offered through shorter connection times and dramatically reduced travel times, preliminary average ticket costs would fall into a range of $40-$80 depending on time of travel, capacity constraints and location combinations. (b) (4) [redacted]

(b) (4) [redacted]

- [redacted]
- [redacted]
- [redacted]

(b) (4)

[redacted]

3.2 TRAVEL TIME SAVINGS

The travel time savings were estimated by subtracting the aggregated travel time in the Build Alternative from the aggregated travel time in the No Build Alternative. The aggregated travel time in the Build and No Build Alternatives includes travel time for all Baltimore-Washington segments: Baltimore-BWI and BWI- Washington.

The estimate was developed with the project's travel demand model for two scenarios that are defined based on the location of the Baltimore station (Cherry Hill or Camden Yards).

Table 3. Annual Hours of Travel Time Savings by Station Location Scenario ((b) (4) [redacted] 2045)

	Cherry Hill	Camden Yards
(b) (4) [redacted]		
2045	33,938,062	38,273,018

3.3 VEHICLE MILES TRAVELED AND PASSENGER MILES TRAVELED

The reduction in annual vehicle miles traveled were estimated by subtracting the VMT in the Build Alternative from VMT in the No Build Alternative. The VMT in the Build and No Build Alternatives includes the travel time for all Baltimore-Washington segments: Baltimore-BWI and BWI- Washington.

The estimate was developed with the project's travel demand model for the two station location scenarios

Table 4. Annual VMT Savings by Station Location Scenario ((b) (4) 2045)

Year	Scenario	VMT No Build	VMT Build	VMT savings
(b) (4)				
2045	Cherry Hill	3,775,499,269	3,382,350,267	393,149,002
(b) (4)				
2045	Camden Yards	3,775,499,269	3,338,932,945	436,566,324

The reduction in annual bus and rail passenger miles traveled were estimated by subtracting the bus and rail PMT in the Build Alternative from the bus and rail PMT in the No Build Alternative. The PMT in the Build and No Build Alternatives includes the travel time for all Baltimore-Washington segments: Baltimore-BWI and BWI- Washington.

The estimate was developed with the project's travel demand model for the two station location scenarios

Table 5a. Annual Rail PMT Savings by Station Location Scenario ((b) (4) 2045)

Year	Scenario	Rail PMT No Build	Rail PMT Build	Rail PMT Saved
(b) (4)				
2045	Cherry Hill	195,220,004	92,883,450	102,336,553
(b) (4)				
2045	Camden Yards	195,220,004	85,880,077	109,339,927

Table 5b. Annual Bus PMT Savings by Station Location Scenario ((b) (4) 2045)

Year	Scenario	Bus PMT No Build	Bus PMT Build	Bus PMT Saved
(b) (4)				
2045	Cherry Hill	24,638,267	11,184,884	13,453,383
(b) (4)				
2045	Camden Yards	24,638,267	10,657,047	13,981,220

3.4 DIVERSIONS BY MODE

The diversions by mode to Maglev was estimated with the project's travel demand model for each of the two station location scenarios. The diversions shown represent the diversions for all Baltimore-Washington segments: Baltimore-BWI and BWI-Washington.

Table 6. Annual Diversion (Person Trips) by Mode by Station Location Scenario ((b) (4) 2045)

Station Location Scenario	(b) (4)	2045 Cherry Hill	(b) (4)	2045 Cherry Hill
Diverted from Auto	(b) (4)	14,877,281	(b) (4)	16,480,393
Diverted from Rail		2,610,204		2,768,873
Diverted from Bus		309,733		320,005
Diverted from Taxi/Rideshare		860,551		1,009,282

3.5 (b) (4)

(b) (4)

(b) (4)

3.6 RIDERSHIP INCLUDING DIVERSIONS BY MODE

The ridership was estimated with the project's travel demand model for each of the two station location scenarios. The ridership and diversions shown represent all Baltimore-Washington segments: Baltimore-BWI and BWI-Washington

Table 8. SCMAGLEV Annual Ridership by Source by Station Location Scenario ((b) (4) 2045)

	(b) (4)	2045 Cherry Hill	(b) (4)	2045 Camden Yards
Diverted from Auto	(b) (4)	14,877,281	(b) (4)	16,480,393
Diverted from Rail		2,610,204		2,768,873
Diverted from Bus		309,733		320,005
Diverted from Taxi/Rideshare		860,551		1,009,282
Total Diversions		18,657,769		20,578,554
Induced Ridership		3,709,469		4,360,099
Total Ridership		22,367,238		24,938,652

The Cherry Hill station analysis in the base model assumed no change in transportation access to Cherry Hill from such major Baltimore destinations as Downtown, Inner Harbor, and Harbor East. Subsequent analysis estimated that the provision of a dedicated and frequent shuttle bus service and the extension of water taxi service to Cherry Hill would increase overall ridership with a Cherry Hill Station to a level within 3 to 8 percent of a Camden Yards station depending on the levels of access serving Cherry Hill. In addition, a Camden Yards Station would contribute to substantially higher capital and operating costs for the SCMAGLEV system when compared with a Cherry Hill Station. Such higher costs would need to be recovered through fare revenues, necessitating a higher fare relative to that of Cherry Hill. A higher fare at a Camden Yards Station would negate any locational advantage that Camden Yards has over Cherry Hill.

3.7 STATION ACCESS AND EGRESS TRIPS

The station access and egress trips were estimated with the project's travel demand model for each of the two station location scenarios

Table 9. Station Access Mode Split for Cherry Hill Station Location Scenario (2045)

	Access	
Origin Station	(b) (4)	Total
Cherry Hill		19,205
BWI Airport		17,549
Mt. Vernon		33,315
Cherry Hill		100%
BWI Airport		100%
Mt. Vernon		100%

Table 10. Station Egress Mode Split for Cherry Hill Station Location Scenario (2045)

	Egress	
Destination Station	(b) (4)	Total
Cherry Hill		19,205
BWI Airport		17,549
Mt. Vernon		33,315
Cherry Hill		100%
BWI Airport		100%
Mt. Vernon		100%

Table 11. Station Access Mode Split for Camden Hill Station Location Scenario (2045)

	Access	
Origin Station	(b) (4)	Total
Camden Yards		23,271
BWI Airport		17,649
Mt. Vernon		36,844
Camden Yards		100%
BWI Airport		100%
Mt. Vernon		100%

Table 12. Station Egress Mode Split for Camden Hill Station Location Scenario (2045)

	Egress	
Destination Station	(b) (4)	Total
Camden Yards		23,271
BWI Airport		17,649
Mt. Vernon		36,844
Camden Yards		100%
BWI Airport		100%
Mt. Vernon		100%