Appendix D.4

Economics Impact Analysis Technical Report

BALTIMORE-WASHINGTON, D.C. SUPERCONDUCTING MAGLEV PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND SECTION 4(f) EVALUATION

U.S. Department of Transportation
Federal Railroad Administration

MARYLAND DEPARTMENT OF TRANSPORTATION

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Appendix D.4A Introduction

This technical memorandum describes the social and economic impacts that would occur with implementation of the Superconducting Magnetic Levitation Project (SCMAGLEV Project) Project's Build Alternatives (with respect to the No Build Alternative) within the Washington-Baltimore-Arlington, DC-MD-VA-WV-PA Combined Statistical Area (CSA). This technical memorandum is structured to describe the economic impacts as they occur over the implementation timeline starting with construction of the Project, progressing to system operation, and ending with the market's reaction to the new transportation investment. The Federal Railroad Administration (FRA) finds that all Build Alternatives would generate near-term economic impacts during the construction period, which ends by 2029. The FRA assumes that the first full year of operations would begin in 2030;[1] and economic operations and market response outcomes focus on full build-out conditions in the horizon year 2045.

The technical memorandum is organized as follows:

- Section 2 describes the regulatory context;
- Section 3 describes the affected environment;
- Section 4 describes the methodology and findings for assessing the environmental consequences associated with the Build Alternatives, including construction, revenue loss from construction activity, fiscal impacts from property acquisitions, operation and maintenance, travel market impacts, property premium impacts, potential for agglomeration and productivity impacts, labor markets impacts, and
- Section 5 presents potential mitigation measures that could be taken for future selected Build Alternatives.

Appendix D.4B Regulatory Context and Methodology

D.4B.1 Regulatory Context

In accordance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., the Council on Environmental Quality (CEQ) regulations, 40 C.F.R. Parts 1500 1508, and the Federal Rail Administration's (FRA) Procedures for Considering Environmental Impacts, 64 Fed. Reg. 28545 (May 26, 1999) FRA assessed the impacts on the socioeconomic environment, including the number and kind of available jobs, impacts on commerce, including existing business districts, metropolitan areas, and

[1] The Baltimore-Washington SCMAGLEV Project Construction Planning Memorandum (WSP, Revision 2, May 14, 2020) states that the SCMAGLEV will open at the end of 2029; therefore this section assumes that the first full year of operations would be 2030.

impacts on local government services and revenues. For a discussion on community impacts, please see Section 4.04 on Neighborhoods in the DEIS.

National and local economies are not subject to regulation by any Federal agency. Rather, investments and policies are set in an effort to influence, but not dictate, market outcomes indirectly through economic policy decisions, land use regulation, and spatially-targeted incentives to spur and focus growth.

Multiple Federal agencies, however, provide guidance on economic factors to be used when conducting economic assessments. Applicable guidance documents at the time of the analysis, listed in **Table D.4-1**, will be considered in the socioeconomics and economic impacts evaluation for the SCMAGLEV Project.

Table D.4-1: Federal Agency Guidance on Economic Impacts Assessment

Federal Agency	Guidance Document	Description
Office of the Secretary of Transportation (OST), U.S. DOT	▪ Memorandum on Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses (2016) ▪ Memorandum on Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis, September 28, 2011 ▪ 2015 BTS Motor Vehicle Safety Data Table 2-17, ▪ Benefit-Cost Analysis Guidance for Discretionary Grant Program (January 2020): https://www.transportation.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf	Issues and regularly updates guidance on the values to be used to monetize changes in travel time and safety to be used in project assessments. These values are regularly applied in all of the modal agencies' assessments.
National Highway Traffic Safety Administration, U.S. DOT	▪ Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, Table VIII-16, "Economic Values Used for Benefits Computations (2010 dollars)" ▪ FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13: http://www.fhwa.dot.gov/policy/hcas/addendum.cfm	Provides guidance on assessing emissions factors.
Office of Management and Budget, Executive Office of the President	▪ OMB Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" (10/29/1992) ▪ OMB Circular A-4, "Development of Regulatory Analysis: Section E. Identifying and Measuring Benefits and Costs (September 17, 2003).	The Office of Management and Budget has provided guidance on the discount rates to be used in benefit cost analyses and the general approach to identify benefits and costs. Although this is described in the context of doing a benefit cost analysis, the discount rates are relevant for discounting the streams of earnings associated with phased implementation of the Build Alternatives.

Federal Agency	Guidance Document	Description
Executive Office of the President	▪ Executive Order 12893 (Principles for Federal Infrastructure Investments, 59 FR 4233)	Provides guidance on the analysis framework to apply.
House of Representatives	▪ Conference Report of the Committee of Conference on H.R. 3", July 28, 2005. https://www.congress.gov/congressional-report/109th-congress/house-report/203	The Safe, Accountable, Flexible, Efficient Transportation Equity Act: : A Legacy for Users (SAFETEA-LU) act authorizes a total of $90 million for magnetic levitation train deployment for FY2005-FY2009 (Section 1307; the authorization is in Section 1101(a)(18)). That is more than the $60 million in contract authority provided for maglev deployment under TEA-21 (TEA-21 also authorized an additional $950 million for this program that was never appropriated)
Multiple Federal Agencies (Interagency Working Group)	▪ Interagency Working Group on Social Cost of Carbon, United States Government, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013; revised August 2016), page 25, Table A1 "Annual SCC Values: 2010-2050 (2007$/metric ton CO2)" ▪ MOVEs 2010a Emission Rates from New Start/Small Start Guidance	Provides guidance on assessing carbon impact factors; this is the source recommended in U.S. DOT's guidance for the BUILD program.

Sources: Compiled by AECOM

FRA has not published guidance for SCMAGLEV projects; however, FRA guidance for conventional passenger rail offers some indication of the benefit types of interest.

D.4B.2 Methodology

FRA's economic analysis describes the economic impacts for the Build Alternatives that result from the following:

Short-term construction impacts – Added jobs and earnings during the construction period. Added jobs and earnings would provide a boost to the economy.

Using the Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System (RIMS II) Series 2018 multipliers, FRA estimates jobs and earnings impacts (direct, indirect, and induced) resulting from construction of the Build Alternatives.

The construction activities will also generate negative impacts known as social costs. Two major parties that would incur these costs are the travelers and business

community in the affected area. Due to road disruptions, travelers will experience travel delays while businesses are expected to see various levels of revenue losses or even business closures depending on the type of service they offer.

Long-term operation and maintenance impacts, and travel market impacts – Added jobs and earnings associated with SCMAGLEV operations when SCMAGLEV services are implemented. FRA calculates the direct, indirect, and induced jobs and earnings impacts of the operation and maintenance (O&M) activities for the Washington-Baltimore-Arlington, DC-MD-VA-WV-PA CSA using BEA RIMS II Series 2018 multipliers.

In addition, this section includes travel market impacts that include value of changes in user benefits, reliability, safety, induced ridership, congestion, pavement cost, air quality, and the revenue of publicly-provided rail service (Amtrak and Maryland Area Regional Commuter-MARC). The SCMAGLEV service would provide benefits to users and nonusers that result from increases in mobility and reduced vehicle (auto) miles traveled (VMT), bus passenger miles traveled (PMT) and regional commuter rail PMT. FRA estimates a change in these operational benefits between the No Build Alternative to the Build Alternatives. The impacts (positive and negative) are monetized using outputs from the travel demand model, values of time, operating costs associated with auto, bus and regional commuter rail travel, and economic values of accidents and emissions consistent with U.S. Department of Transportation (DOT) guidance.

Long-term market response to SCMAGLEV service – Changes in property value as a result of changes in transportation connectivity and accessibility within the metropolitan area, and minor negative impacts around the selected trainset maintenance facility (TMF). These impacts are measured in terms of a property premium (discount) for parcels around the Build Alternatives' stations and selected TMF. The likelihood of Transit-Oriented Development (TOD) is intensified with the addition of this mode at station locations. There is also the potential for agglomeration[2] and labor market impacts.

Construction of the SCMAGLEV Project requires the acquisition of some existing properties and possible changes in the properties' tax treatment in Baltimore City, Baltimore County, Anne Arundel County, Prince George's County and Washington, D.C. Any sizeable tax revenue loss may affect the ability to provide government services in the affected jurisdictions. Using parcel data from the latest Assessor's Offices for Maryland and District of Columbia, FRA identifies the existing use of the "to be" acquired properties and whether part of each property or the full property would be acquired to estimate the potential property acquisition impacts. For a discussion on the

[2] Agglomeration impacts occur when the concentration of firms and employees facilitates the exchange of ideas and knowledge in the host market, fostering growth and productivity. To the degree that the SCMAGLEV reduces the effective distance between knowledge industries, the potential for agglomeration economies rises. The economic connections between Washington, D.C. and Baltimore would intensify, allowing the two metropolitan economies to increasingly compete in the global economy with a larger footprint.

community impacts, please see the discussion in Section 4.04 Neighborhoods of the DEIS.

The SCMAGLEV Project would have both a positive and negative impact on revenues, potentially impacting the local government services that rely on them. The increased accessibility of some properties would result in an increase in property values and therefore property taxes, while property acquisitions and losses of revenues by competing systems would result in a reduction of revenues. The net change in revenues would therefore impact the availability and scale of public services.

Appendix D.4C SCMAGLEV Project Affected Environment

The affected environment for the economic analysis is Washington-Baltimore-Arlington, defined as the DC-MD-VA-WV-PA CSA, with a particular focus on the Baltimore and Washington, D.C. Metropolitan Statistical Areas (MSAs); the borders of the affected environment used in this analysis differ from the SCMAGLEV Study Area defined in the Purpose and Need as interconnections in the economy would foster economic impacts beyond the physical corridor. The existing conditions analysis looked at the definition of metropolitan areas and how are the connected, the current and historical commuting flows, the migration flows and the associated earnings, the housing markets, and the market synergies among the studied areas.

The SCMAGLEV Project connects the two largest urban anchors within the combined statistical area. Understanding the economic impacts thus begins with an assessment of how the two urban centers are currently linked and how these economic nodes either compete or complement one another.

D.4C.1 Population and Employment Trends

The SCMAGLEV Project connects the two largest urban anchors within the Washington-Baltimore-Arlington, DC-MD-VA-WV-PA CSA, the fourth largest in the United States with nearly 10 million residents as of 2018 (**Figure D.4-1**). The CSA is comprised of the Washington, D.C. and Baltimore MSAs, as well as five other smaller urban areas including the Hagerstown-Martinsburg, MD-WV MSA, Chambersburg-Waynesboro, PA MSA, Winchester, VA-WV MSA, California-Lexington Park MSA and the Easton, MD micropolitan statistical area. The Washington-Arlington-Alexandria MSA (referred to as the Washington, D.C. MSA) is centered on Washington, D.C. and includes five counties in Maryland, eleven counties and six independent cities in Virginia, and one county in West Virginia. The counties that could be considered as Washington, D.C. inner suburbs are Montgomery County and Prince George's County in Maryland, and Arlington County, City of Alexandria, Fairfax County, and the cities of Fairfax and Falls Church in Virginia. The Baltimore-Columbia-Towson MSA (referred to as Baltimore MSA) is centered on Baltimore City and six counties nearby, including Anne Arundel County, Baltimore County, Carroll County, Harford County, Howard

County, and Queen Anne's County. Defined by proximity to Baltimore City, the MSA's inner suburbs are Baltimore County, Anne Arundel County and Howard County. The fast and reliable exchange of passengers between the two urban cores, accommodated by the Project, would reinforce the existing economic integration between Washington, D.C. and Baltimore City.[3]

These two urban areas are approximately 40 miles apart. The anticipated SCMAGLEV services are estimated to reduce travel times by 8 to 27 minutes of travel time savings depending on the trip purpose and length under each of the Build Alternatives.[4]

The Washington-Baltimore-Arlington CSA has a population of over 9 million (2018 estimate), making it the fourth largest in the United States. Over 6.5 million people are working-age, defined as between the age of 15 and 64, accounting for 67.7 percent of the total population. (**Table D.4-2**).

The composition of the CSA is determined by grouping metropolitan or micropolitan statistical areas that have an employment interchange measure of at least 15. The employment interchange measure is a measure of ties between two adjacent entities, and is calculated by adding the following:

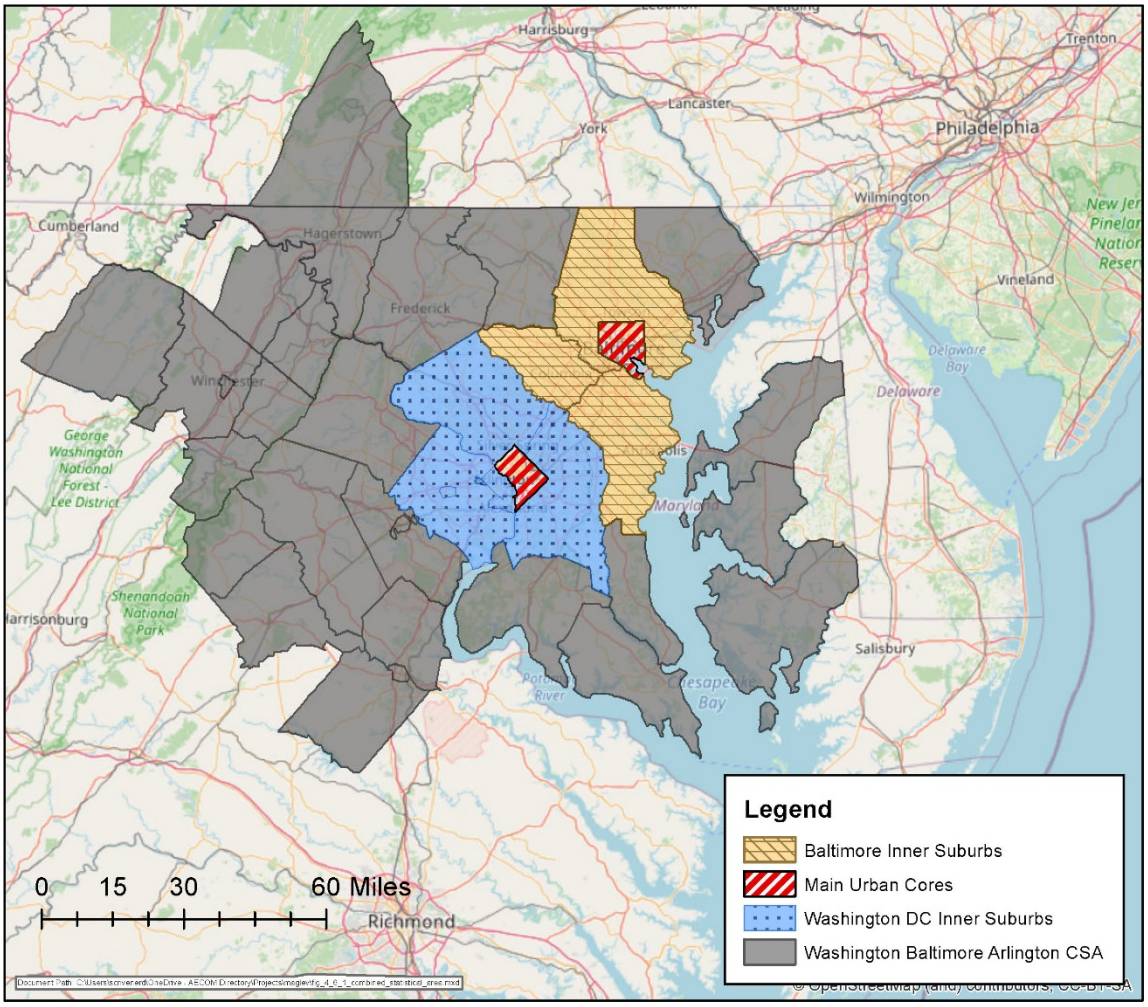
- Percentage of workers living in the smaller entity who work in the larger entity, plus
- Percentage of employment in the smaller entity accounted for by workers who live in the larger entity

In particular, the two larger MSAs in the studied CSA are the Washington-Arlington-Alexandria MSA and the Baltimore-Columbia-Towson MSA. The two MSAs combined have a population of approximately 8.9 million people accounting for 92.4 percent of the CSA's 9.7 million residents.

[3] A CSA is a grouping of areas that have a significant amount of employment interchange. The Washington-Baltimore-Arlington, DC-MD-VA-WV-PA CSA comprises six metropolitan areas and two micropolitan areas across four states and the District of Columbia. Metropolitan and micropolitan areas are comprised of counties. Metropolitan statistical areas, by definition, are areas that have "at least one urbanized area of 50,000 or more in population, plus adjacent territory that has a high degree of social and economic integration with the core." Micropolitan statistical areas are defined as area that have at least one urban cluster with a population of between 10,000 and 50,000 and "adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties."

[4] Baltimore-Washington SCMAGLEV Project Draft Ridership Report. 2.2 Document Travel Demand. Revision 0, 2018-06-29, page 51.

Figure D.4-1: Washington-Baltimore-Arlington Combined Statistical Area (2012)



Source: US Department of Commerce Economics and Statistical Administration U.S. Census Bureau, 2012 Economic Census. https://www2.census.gov/geo/maps/econ/ec2012/csa/EC2012_330M200US548M.pdf

Table D.4-2: Washington-Baltimore-Arlington Area Population (2018)

Metropolitan/Micropolitan Statistical Area	Population	Working Age Population (15-64)		Non-Working Age Population	
Metropolitan Areas					
Baltimore-Columbia-Towson, MD Metro Area	2,793,250	1,870,005	66.9%	923,245	33.1%
California-Lexington Park, MD Metro Area	111,531	75,164	67.4%	36,367	32.6%
Chambersburg-Waynesboro, PA Metro Area	153,751	96,176	62.6%	57,575	37.4%
Hagerstown-Martinsburg, MD-WV Metro Area	263,306	173,151	65.8%	90,155	34.2%
Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area	6,138,382	4,197,610	68.4%	1,940,772	31.6%
Winchester, VA-WV Metro Area	136,305	88,139	64.7%	48,166	35.3%
Micropolitan Areas					

Metropolitan/Micropolitan Statistical Area	Population	Working Age Population (15-64)		Non-Working Age Population	
Cambridge, MD	32,261	19,995	62.0%	12,266	38.0%
Easton, MD	37,211	21,248	57.1%	15,963	42.9%
Total	**9,665,997**	**6,541,488**	**67.7%**	**3,124,509**	**32.3%**

Source: American Community Survey data (2018 5-year estimates).

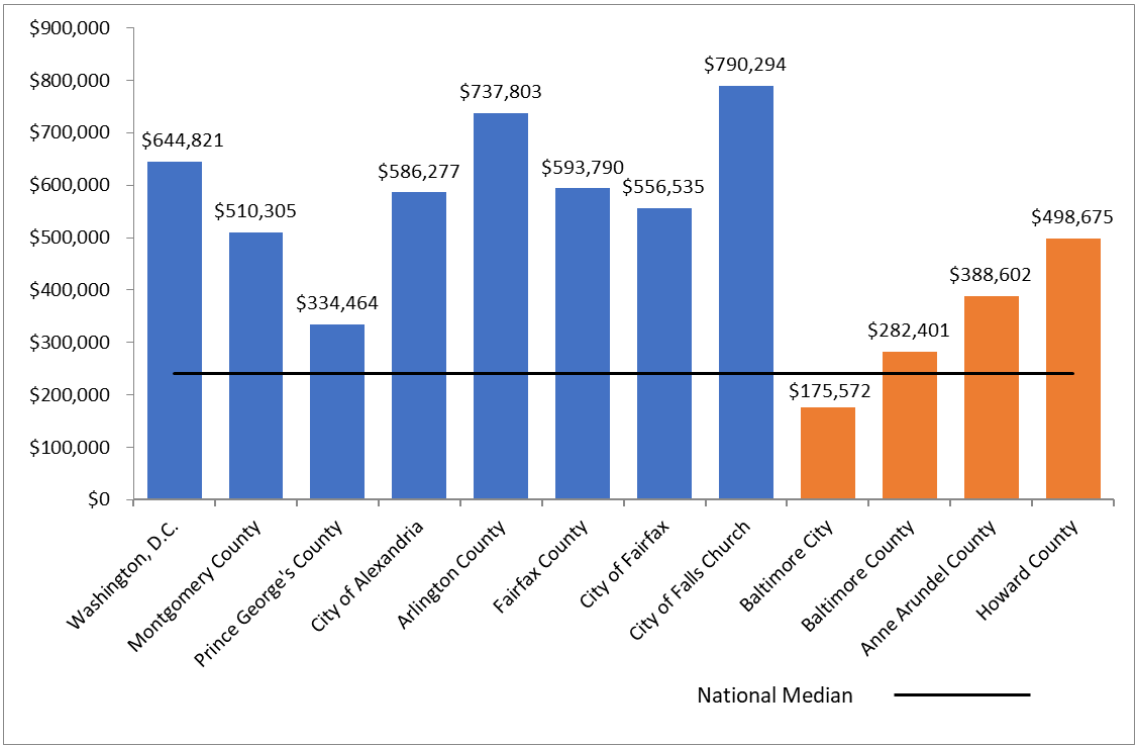
D.4C.2 Relative Housing Affordability

Washington, D.C. and Baltimore have different housing markets. Counties comprising the Washington, D.C. MSA (shown in blue in **Figure D.4-2**) have median home values[5] that are substantially above the national median value[6] of $241,300 (2019 Q4 estimate) and rank among some of the most expensive housing markets in the country.[7] Counties comprising the Baltimore MSA (shown in orange in Figure 2) have median home values that are substantially lower, and in some cases below the national median (such as the case of Baltimore City). **Figure D.4-2** shows the median home values for the two MSA's center cities and inner suburbs.

With inner suburbs in the Washington, D.C. MSA (except Prince George's County) having median home values greater than median home values in every suburb in the Baltimore MSA, Baltimore presents a much more affordable housing market than the Washington, D.C. MSA. The relative housing affordability between the Baltimore MSA and Washington, D.C. MSA is driven by a number of factors, including the state of the labor markets income levels, and the availability of housing.

[5] Median home values were estimated for each county studied. Home values represent the value of all homes (not the home sale value). Source: National Association of Realtors.
[6] Median home value is the home value in the middle of the data set after arranging all the home values from low to high. The median home value, then, represents the figure at which half of the properties in the area are valued at a higher price and other half at a lower price.
[7] National Association of Realtors, Median Home Value, Q4 2019. https://www.nar.realtor/research-and-statistics/housing-statistics/county-median-home-prices-and-monthly-mortgage-payment

Figure D.4-2: Median Home Value for Washington, D.C., Baltimore City and Inner Suburbs by County (2019, Q4)



Source: National Association of Realtors, Median Home Value, Q4 2019.

With median prices well above the national average, many households are "priced out"[8] of rental and owner-occupied housing near the District core and major suburban employment centers—Tysons Corner and Alexandria, for example. In addition, high land prices and construction costs deter the development of multifamily rental properties marketed to lower—middle income households near these employment centers. The development economics favors higher-end condos and one- to two-bedroom apartments in these areas. When evaluating the ratio of median house price to median income in two MSA's, as of 2018 Baltimore MSA has a lower ratio than Washington, D.C. MSA, indicating better affordability of housing.[9] With limited rental and owner-occupied housing choices in their segment of the Washington, D.C. MSA market, lower-middle income households would seek more affordable opportunities away from the employment centers and in urban areas undergoing revitalization such as Baltimore. Depending on the cost per ticket, fast and frequent transportation such as that envisioned for the Build Alternatives could allow households to select a more affordable Baltimore housing location but still work in the higher-cost employment centers, facilitating the employment interchange and intensifying the economic linkage between Baltimore and Washington, D.C. Today, 12.8 percent of Baltimore MSA workers

[8] Priced Out: Persistence of the Workforce Housing Gap in the Washington, D.C., Metro Area, Urban Land Institute, 2009.
[9] The State of the Nation's Housing 2019, Harvard Joint Center for Housing Studies of Harvard University, 2019. Page 3 Figure 2. https://www.jchs.harvard.edu/sites/default/files/Harvard_JCHS_State_of_the_Nations_Housing_2019.pdf

commute to the Washington, D.C. MSA and 6.8 percent of Washington, D.C. MSA workers commute to Baltimore MSA.[10]

There is a disparity between income levels among Washington, D.C., Baltimore City and both MSA's inner suburbs. Median household income in the Washington, D.C. MSA is approximately $102,180, while in the Baltimore MSA median household income is approximately $80,470. **Figure D.4-3** shows the median household income by county for the two MSA's. Median house prices are also higher in the Washington, D.C. MSA compared with those in Baltimore MSA by as much as $600,000 depending on the jurisdictions.

As seen in **Figure D.4-3** above, the trend observed for incomes is similar to what is seen for home values in the two MSA's, with nearly all jurisdictions in Washington, D.C. MSA (shown in blue) having higher median household incomes than jurisdictions in the Baltimore MSA (shown in orange).

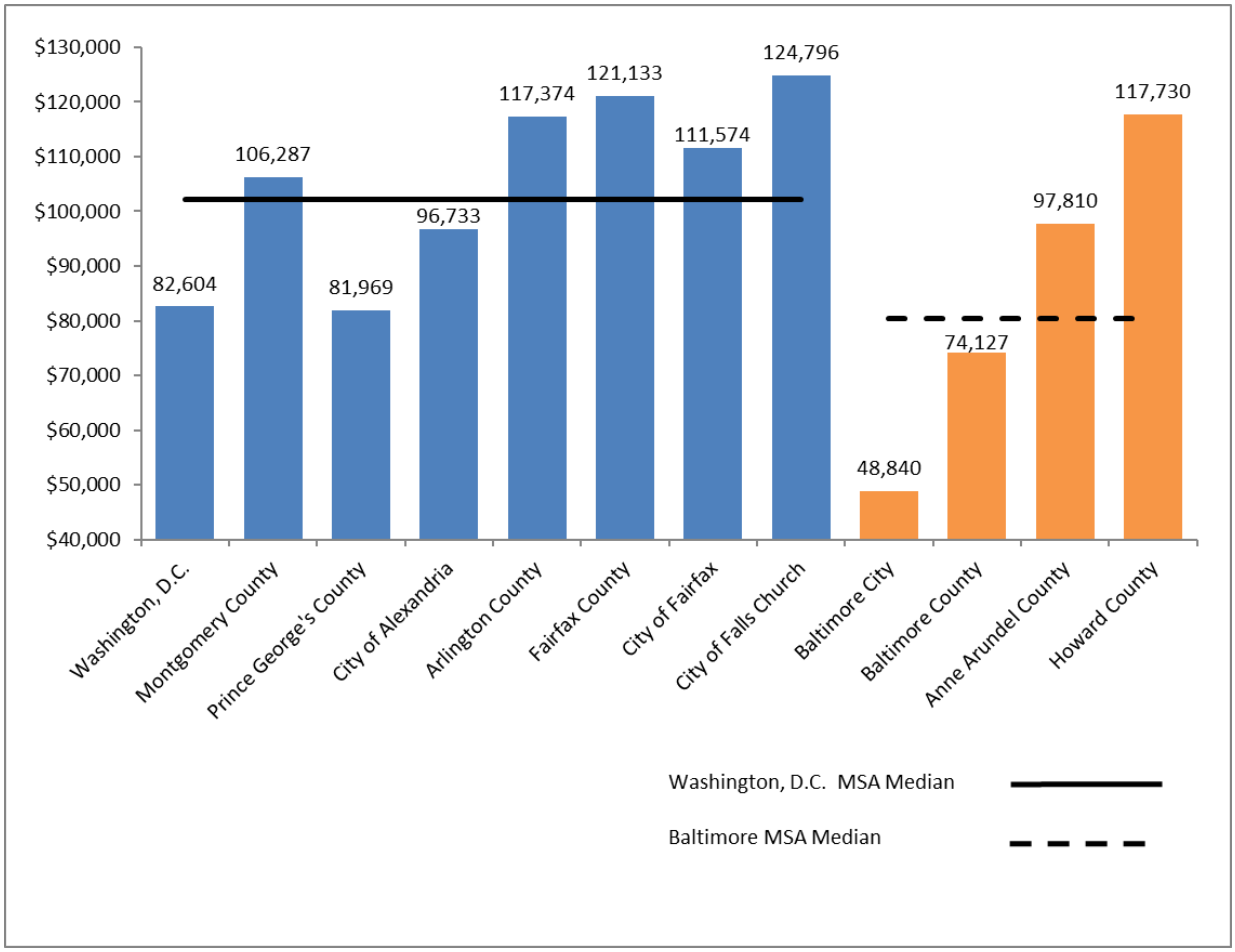
There is significant migration of people between the two MSA's. Examining IRS migration data from 2010 to 2018, which tracks the changes in addresses of tax returns filed from year to year shows that thousands of people/households move between the two MSA's every year, and that Washington, D.C. and Baltimore City, the cores of the MSA's, attracting a substantial portion of those households from the other MSA. **Table D.4-3** shows the migration patterns between the inner suburbs of the Washington, D.C. and Baltimore MSA's averaged over the last five years. Baltimore is the largest destination of Washington, D.C. out-migration, and Washington, D.C is the largest destination of Baltimore out-migration. Between 2010 and 2018, over 36 percent of all households that moved from the Washington, D.C. MSA, relocated in Baltimore MSA based on the most recent data available at this level of geography. Similarly, of all households that moved from Baltimore over the same period, over 52 percent relocated to the Washington, D.C. MSA.

As seen in the tables above, on average, over 10,200 filings/households moved from Washington, D.C. and inner suburbs of the Washington, D.C. MSA to Baltimore City and inner suburbs of the Baltimore MSA each year. Of these, nearly 1,900 of them have moved to Baltimore City, specifically. Prince George's County was the largest origin for Baltimore MSA migrant households, accounting for 4,900 (17.85 percent). On average, approximately 420 households moved each year over the past eight years from Washington, D.C. to Baltimore City—core to core.

Conversely, approximately 8,500 filings/households have moved each year from Baltimore City and inner suburbs of the Baltimore MSA to Washington, D.C. and inner suburbs of the Washington, D.C. MSA, on average over the same five-year period. Of these, approximately 1,200 of them have moved to Washington, D.C. specifically.

[10] LEHD, https://onthemap.ces.census.gov/

Figure D.4-3: Median Household Income for Washington, D.C., Baltimore City and Inner Suburbs by County (2018)



Source: U.S. Census Bureau

Table D.4-3: Migration Patterns between the Center Cities and Inner Suburbs of Washington, D.C. and Baltimore MSA's (2010-2018 average)

	Moved to Baltimore MSA		Moved to Baltimore City	
	Number Returns	Percentage of All Who Moved	Number Returns	Percentage of All Who Moved
Washington, D.C. MSA – City and Inner Suburbs	**10,276**	**36.71%**	**1,884**	**6.76%**
District of Columbia	969	3.31%	419	1.43%
Montgomery County	3,023	10.04%	576	1.91%
Prince George's County	4,901	17.85%	586	2.14%
City of Alexandria	228	1.83%	47	0.38%
Arlington County	317	1.78%	97	0.54%
Fairfax County	838	1.90%	159	0.36%
Fairfax City	-	0.00%	-	0.00%

	Moved to Baltimore MSA		Moved to Baltimore City	
	Number Returns	Percentage of All Who Moved	Number Returns	Percentage of All Who Moved
Falls Church	-	0.00%	-	0.00%
	Moved to Washington, D.C. MSA		Moved to Washington, D.C.	
Baltimore MSA – City and Inner Suburbs	**8,356**	**52.18%**	**1,180**	**6.63%**
Baltimore City	1,649	7.97%	563	2.72%
Baltimore County	1,571	6.82%	173	0.75%
Anne Arundel County	2,925	16.65%	274	1.56%
Howard County	2,210	20.75%	170	1.60%

Source: AECOM analysis, IRS migration data (https://www.irs.gov/statistics/soi-tax-stats-migration-data).
Note: Assumes that migration trends seen with tax return filings are representative of those seen with households.

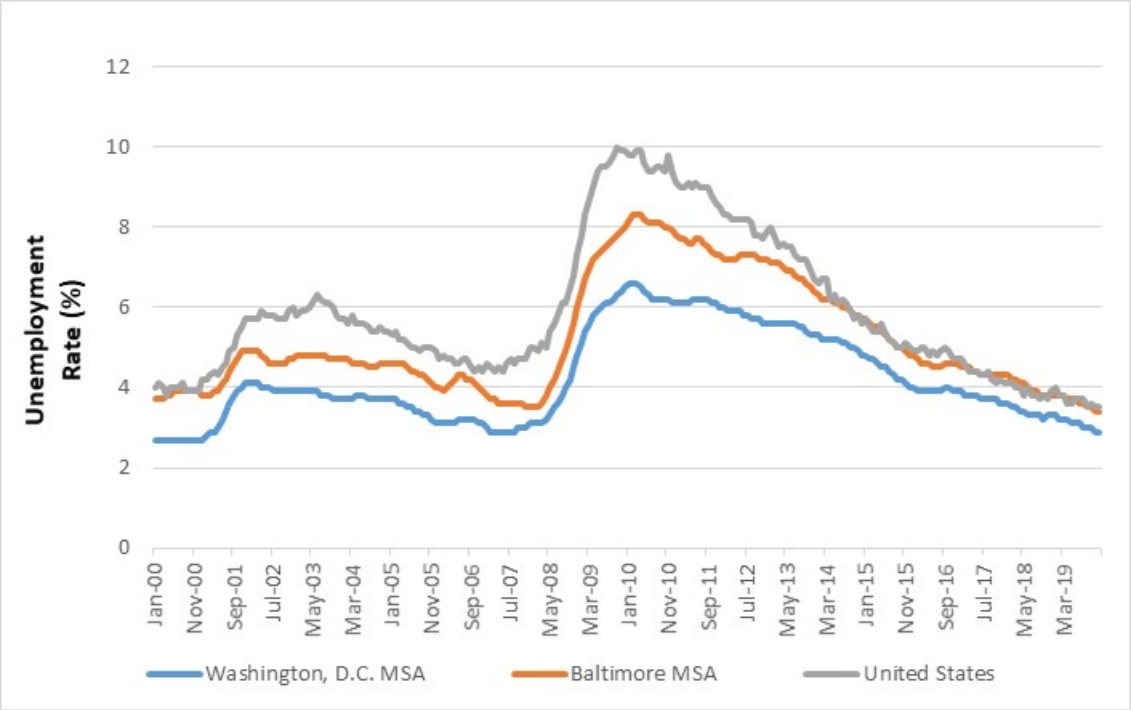
D.4C.2.1.1 Market Synergies

Washington, D.C. ranks 20th in the United States in terms of population size; the city had a population of approximately 705,749 in 2019 (est.).[11] Baltimore is the largest city in Maryland and the 30th-most populated city in the United States with approximately 593,490 people in 2019 (estimate). In terms of gross domestic product, Washington, D.C. MSA economy is 2.65 times of Baltimore MSA economy. In 2018 the Baltimore MSA reported a real gross domestic product (GDP) of $201,989 million ranking 19th among all the United States MSA's; while the Washington, D.C. MSA with a real GDP of $534,823 million ranked 5th.[12] The average real GDP for MSAs across the United States is approximately $47,431 million (in 2018 dollars).

Both Washington, D.C. and Baltimore MSA's have a better than average labor market, with unemployment rates for both MSA's historically being below the national average. **Figure D.4-4** shows the unemployment rates for the two MSA's, as well as the nationwide rate for comparison. Baltimore MSA unemployment rate is on average 1.0 percent lower than the national average and, of the two MSA's, Washington, D.C. MSA tends to have a more favorable unemployment rate of the two, generally being as much as a percentage point lower than that of Baltimore MSA.

[11] US Census Quick Facts https://www.census.gov/quickfacts/fact/table/baltimorecitymaryland,DC,US/PST045219
[12] Bureau of Economic Analysis. 2018. https://apps.bea.gov/iTable/iTable.cfm?reqid=99&step=1#reqid=99&step=1&isuri=1

Figure D.4-4: Washington, D.C. and Baltimore MSA's Unemployment Rates (2000-2019)



Source: US Bureau of Labor Statistics.

The Washington, D.C. and Baltimore MSA's share multiple transport systems by air and land.

By air, the region is served by major three airports, which collectively have originated approximately 25.0 million trips in 2017 (**Table D.4-4**). The three major airports are:

- Baltimore–Washington International Thurgood Marshall Airport is the closest airport to Baltimore City and, in 2017, accounted by 30.9 percent of total originations in the area. Most of its originations (nearly 62.6 percent) are passengers from the Baltimore MSA.
- Ronald Reagan Washington National Airport is located in Arlington County, Virginia and is the closest to Washington, D.C. Nearly 41.2 percent of the city's originations are from Ronald Reagan. Nearly 97.6 percent of trips originated from this airport are by people who live in the Washington, D.C MSA.
- Washington Dulles International Airport is in Chantilly, Virginia and is the region's main international airport. Around 7 million passengers originate their trips at Washington Dulles and 95.2 percent of those originations are passengers from the Washington, D.C. MSA.

Table D.4-4: Air Passenger Originations Airport Access Mode by MSA (2017)

	BWI Marshall	Ronald Reagan Washington National	Washington Dulles International
Washington, D.C. MSA	**33.8%**	**97.6%**	**95.2%**
District of Columbia	6.2%	38.2%	14.6%
Montgomery County	11.0%	9.8%	13.2%
Prince George's County	6.5%	7.7%	3.4%
City of Alexandria	0.7%	6.7%	3.6%
Arlington County	1.6%	15.8%	7.7%
Fairfax County	3.1%	13.9%	34.9%
Other Counties	4.7%	5.4%	17.9%
Baltimore MSA	**62.6%**	**1.6%**	**2.9%**
Baltimore City	14.9%	0.3%	0.5%
Baltimore County	9.4%	0.1%	0.4%
Anne Arundel County	22.7%	0.3%	0.5%
Howard County	9.1%	0.9%	1.0%
Other Counties	6.6%	0.1%	0.4%
Other MSAs	**3.6%**	**0.9%**	**1.9%**
Total Originations	7,723,337	10,280,422	6,960,611
% Originations Total	30.9%	41.2%	27.9%

Source: Washington-Baltimore Region Air Passenger Survey 2017. https://www.mwcog.org/assets/1/28/07062018_-_Item_9_-_Report_-_Washington-Baltimore_Regional_Air_Passenger_Survey_-_2017_General_Findings.pdf

By land, the region is connected by extensive rail and road networks. Multiple rail and transit systems operate in the region, including Amtrak, Washington Metro, Virginia Railway Express, MARC Train, Baltimore Metro and Baltimore Light Rail. By road, the region relies on an extensive highway and U.S./state route system to access the region's main markets. Among the main U.S. interstates, Washington, D.C.-Baltimore is linked by I-95, Baltimore-Washington Parkway, I-495 (District of Columbia Beltway) and I-695 (Baltimore Beltway). U.S. Route 1 also connects Washington, D.C. and Baltimore.

The economies of Washington, D.C. and Baltimore MSA's specialize in certain industries, with the cities of Washington, D.C. and Baltimore serving as each MSA respective employment hub. To determine the types of industries that are dominant in the region, Location Quotients for industries in Washington, D.C. and Baltimore City were calculated. The Location Quotient (LQ) is a measure of the concentration of employment in a local economy as compared to that of the reference economy at a particular time. An LQ will be greater than 1 for a local economy with a comparative advantage in an economic sector (i.e. an exporter), while it will be less than 1 for a local area with a weakness in that sector (i.e. an importer). If an LQ is 1.1, it can be expected that the local economy has 10 percent more concentration within that industry than the United States as a whole at that time. To calculate the LQ, average annual employment data for 3-digit North American Industry Classification System (NAICS) industry

classifications from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages data was analyzed for 2019.[13]

Table D.4-5 shows the industries that are more concentrated relative to the nationwide average, in either Washington, D.C. or Baltimore City. This higher-than-average concentration indicates that the host economy (Washington, D.C. or Baltimore City) produces more of that industry's output than needed for local consumption—that is, it "exports" those services to the rest of the country and/or other countries. These industries are the ones that anchor the host economy.

Washington, D.C. has a high concentration of employment in several industries. The top five LQ in 2019 are in space research and technology (12.31), administration of economic programs (11.93), membership associations and organizations (8.59), national security and international affairs (8.04) and community and housing program administration (7.24), and. All five industries have an LQ higher than 6.5, indicating that the concentration is more than six times greater than the national average. Employment in the Washington, D.C. inner suburbs concentrates on space research and technology (15.71), national security and international affairs (5.85), and administration of economic programs (4.58).

Baltimore City also offers high concentration of employment in several industries, including administration of human resource programs (6.62), administration of economic programs (3.30), hospitals (3.15), and administration of environmental programs (2.95), justice, public order and safety activities (2.71). The top five industries have an LQ of 2.5 or higher. Baltimore City inner suburbs top LQs in 2019 are administration of human resource programs (3.02), and national security and international affairs (2.21).

Based on the concentrations of particular industries in Washington, D.C. and Baltimore City, there are opportunities for collaboration and exchange among many of the industries in the two economies.

Table D.4-5: Dominant Industries for Washington, D.C., Baltimore City and Inner Suburbs and their Location Quotients (2019)

NAICS Code	Industry	Washington, D.C.	Washington, D.C. Inner Suburbs	Baltimore City	Baltimore City Inner Suburbs
221	Utilities	0.49	0.37	1.70	0.12
238	Specialty trade contractors	0.34	1.01	0.61	1.51
448	Clothing and clothing accessories stores	0.43	1.05	0.42	1.51
481	Air transportation	0.03	1.52	0.00	2.04
487	Scenic and sightseeing transportation	3.34	0.00	0.00	0.67
488	Support activities for	0.07	0.37	1.53	1.02

[13] The North American Industry Classification System is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

NAICS Code	Industry	Washington, D.C.	Washington, D.C. Inner Suburbs	Baltimore City	Baltimore City Inner Suburbs
	transportation				
493	Warehousing and storage	0.00	0.31	2.60	0.43
511	Publishing industries, except internet	1.64	1.28	1.40	0.71
515	Broadcasting, except internet	4.08	0.82	0.93	0.88
517	Telecommunications	0.44	1.57	0.49	1.13
518	Data processing, hosting and related services	0.68	2.52	0.27	0.48
519	Other information services	3.41	0.72	0.32	0.46
523	Securities, commodity contracts, investments	0.82	0.81	2.12	1.50
533	Lessors of nonfinancial intangible assets	0.04	0.63	0.00	1.80
541	Professional and technical services	2.60	3.16	1.01	1.70
611	Educational services	0.74	0.45	1.68	0.80
622	Hospitals	0.91	0.33	3.15	0.43
711	Performing arts and spectator sports	2.52	0.63	1.85	0.42
712	Museums, historical sites, zoos, and parks	5.04	0.94	2.04	0.17
721	Accommodation	1.51	0.96	0.67	0.66
813	Membership associations and organizations	8.59	2.20	1.40	0.87
814	Private households	3.23	3.11	0.73	0.79
921	Executive, legislative and general government	2.42	0.64	0.57	0.19
922	Justice, public order, and safety activities	4.59	0.85	2.71	0.78
923	Administration of human resource programs	3.52	4.05	6.62	3.02
924	Administration of environmental programs	4.11	0.80	2.95	0.12
925	Community and housing program administration	7.24	0.36	0.35	0.00
926	Administration of economic programs	11.93	4.58	3.30	1.98
927	Space research and technology	12.31	15.71	0.00	0.00
928	National security and international affairs	8.04	5.85	0.44	2.21

Source: AECOM analysis, U.S. Bureau of Labor Statistics. Note: Darker blue means more concentrated industry. Only industries with an LQ over 1.5 are displayed.

Appendix D.4D Environmental Consequences

FRA evaluated the economic consequences within the SCMAGLEV Project Affected Environment defined above of the No Build Alternative and Build Alternatives. Anticipated short-term and long-term impacts to the regional economy, including direct and indirect impacts, were identified. FRA provided a qualitative and quantitative analysis when applicable.

D.4D.1 No Build Alternative

Under the No Build Alternative, the Project would not be built. Therefore, short-term construction impacts would not occur, neither would long-term operation and maintenance impacts, nor long-term market response impacts. However, other planned and funded transportation projects will continue to be implemented in the area and have economic impacts such as construction and operation and maintenance impacts, and market responses.

D.4D.2 Build Alternatives

FRA's analysis assumes that transportation network improvements included in the No Build Alternative are also included in the Build Alternatives. Therefore, this section focuses only on the additional incremental economic impacts attributable to the Build Alternatives (i.e., the differences between the future conditions under the No Build Alternative and the future conditions under implementation of the Build Alternatives).

FRA's analysis compares the environmental consequences of the Project's Build Alternatives to the No Build Alternative, and quantifies where possible for opening year 2030 and future year 2045 (**Table D.4-6** and **Table D.4-7**). When the analysis cannot quantify the environmental consequences, they are discussed qualitatively.

Table D.4-6: Summary of Potential Environmental Consequences of the Build Alternatives During the Construction Period (Temporary)

Build Alternatives	Total Employment (job-years)	Total Earnings (2018$ million)	Annual Business Revenue Loss Impacts due to Construction, Low-High Range (2018$ million)
Alignment J			
J-01	166,000	$9,060	$(18.9) - $(241.2)
J-02	161,000	$8,810	$(18.5) - $(233.5)
J-03	161,000	$8,810	$(18.5) - $(233.5)
J-04	187,000	$10,240	$(26.0) - $(311.4)
J-05	183,000	$9,990	$(25.6) - $(303.6)
J-06	183,000	$9,990	$(25.6) - $(303.6)
Alignment J1			

Build Alternatives	Total Employment (job-years)	Total Earnings (2018$ million)	Annual Business Revenue Loss Impacts due to Construction, Low-High Range (2018$ million)
J1-01	174,000	$9,510	$(18.9) - $(241.2)
J1-02	169,000	$9,250	$(18.5) - $(233.5)
J1-03	169,000	$9,250	$(18.5) - $(233.5)
J1-04	195,000	$10,680	$(26.0) - $(311.4)
J1-05	191,000	$10,430	$(25.6) - $(303.6)
J1-06	191,000	$10,430	$(25.6) - $(303.6)

Source: AECOM analysis

D.4D.2.1 Short-Term (Temporary) Construction Impacts

Construction of the SCMAGLEV Project would support the local economy through the hiring of construction personnel, renting or purchasing construction equipment, and procurement of construction materials for the duration of the construction period, affecting the local labor and manufacturing markets. Construction is scheduled to begin January 2022 and finish by the end of 2029.[14] During construction, specialized labor from throughout the region would be engaged, leading to an increase in employment. In addition, construction related goods would be purchased, much of which would come from the region. These activities would provide direct, indirect, and induced impacts for the local economy:

- Direct impact – Includes the impacts on industries that are directly purchased to build the Project, including control equipment and construction.
- Indirect impact – Includes the impacts on supporting industries that supply goods and services to the direct impact industries. This includes workers in industries that supply equipment parts, steel, concrete, wood, and other raw materials that are needed for building guideways and station facilities.
- Induced impact – Includes the impact of direct and indirect workers spending their income on consumer goods and services such as food, shelter, clothing, recreation, and personal services.

Using the Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System (RIMS II) Series 2018 multipliers, this section estimates jobs and earnings impacts resulting from construction of the Build Alternatives. The multipliers are constructed to reflect the economic structure of economies of Washington-Baltimore-Arlington CSA. The multipliers are applied to the estimated construction cost. The RIMS Type II multipliers used in this memorandum represent the most updated version available at the time this analysis was prepared.

[14] Baltimore-Washington SCMAGLEV Project Construction Planning Memorandum, Revision 2, May 14, 2020, WSP

Table D.4-7: Summary of Potential Environmental Consequences of the Build Alternatives (Recurring, 2018$ million)

Option	Operations and Maintenance		Travel Time Savings (User Benefits)		Travel Cost Savings (Penalty)		Emissions		Safety		Pavement		Congestion		Induced Ridership		Reliability		Revenue Impact (Penalty)		Property Premium		Parcel Acquisitions Tax Impact
	Direct Employment (job-years)	Total Earnings	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045	Property Premium	Tax Impact	
Alignment J																							
J-01	130	$24.3	$462.3	$617.7	$(552.6)	$(704.2)	$1.8	$2.0	$75.2	$103.7	$0.4	$0.6	$31.1	$42.9	$13.3	$19.0	$19.8	$25.8	$(23.2)	$(29.1)	$1,113.3	$13.7	$(5.517)
J-02	130	$24.7																			$1,112.7	$13.7	$(5.187)
J-03	130	$24.6																			$1,112.6	$13.7	$(5.188)
J-04	140	$25.8	$519.7	$696.6	$(607.5)	$(773.7)	$2.1	$2.3	$83.4	$115.2	$0.5	$0.6	$34.5	$47.7	$15.3	$22.3	$21.9	$28.5	$(24.8)	$(31.1)	$1,356.3	$16.5	$(4.538)
J-05	140	$26.2																			$1,355.7	$16.5	$(4.215)
J-06	140	$26.0																			$1,355.6	$16.5	$(4.216)
Alignment J1																							
J1-01	140	$25.9	$462.3	$617.7	$(552.6)	$(704.2)	$1.8	$2.0	$75.2	$103.7	$0.4	$0.6	$31.1	$42.9	$13.3	$19.0	$19.8	$25.8	$(23.2)	$(29.1)	$1,113.3	$13.7	$(5.468)
J1-02	130	$25.1																			$1,112.7	$13.7	$(5.097)
J1-03	130	$24.8																			$1,112.6	$13.7	$(5.097)
J1-04	150	$27.4	$519.7	$696.6	$(607.5)	$(773.7)	$2.1	$2.3	$83.4	$115.2	$0.5	$0.6	$34.5	$47.7	$15.3	$22.3	$21.9	$28.5	$(24.8)	$(31.1)	$1,356.3	$16.5	$(4.497)
J1-05	140	$26.6																			$1,355.7	$16.5	$(4.125)
J1-06	140	$26.3																			$1,355.6	$16.5	$(4.125)

Source: AECOM analysis
Note: Items shown in red text and parenthesis represent cost losses either as increases in costs or lost funds.

Table D.4-8 shows the breakdown of SCMAGLEV capital costs in 2018 dollars. The construction infrastructure and professional services values served as the basis for estimating construction spending impacts. Contingency was allocated to construction and professional services categories based on each category's share of the total non-contingency costs.[15, 16] It is assumed that vehicles would be manufactured outside of the Washington-Baltimore-Arlington CSA. Therefore, vehicles, in addition to Right-of-Way (ROW), are excluded from the total costs for the purposes of assessing economic impacts to the affected environment. There are currently two alignments identified, Build Alternatives J and J1. Additionally, there are four possible station pairs per alignment yielding four combinations per alignment. The two stations in Baltimore, Maryland are Cherry Hill and Camden Yards Stations; and the station in Washington, D.C. is the Mount Vernon Square (MVS) entrance. An additional station would be built at BWI Marshall Airport independently of the selected alignment or the selected station pair. Each alignment's station pair option includes the capital cost for building one trainset maintenance facility (TMF) (MD 198, BARC Airstrip or BARC West). Construction cost for one TMF is $280 million for MD 198 and $80 million for BARC Airstrip or BARC West, excluding professional services and contingency. Professional services were calculated as 30 percent of construction cost; Contingency of 20 percent was applied to both construction and professional services. Including professional services and contingency construction cost per TMF is $436.8 million for MD 198 and $124.8 million for BARC Airstrip or BARC West. The yard and yard track capital costs at TMF MD 198, TMF BARC Airstrip and TMF BARC West would be similar.

In order to isolate the potential economic impacts of the SCMAGLEV Project to the affected environment, it is necessary to distinguish those resources that are new to the economy and that would not be invested in affected counties but for the Project, from those that would still be spent in the region with similar economic impacts (e.g., funds that would be allocated to other transportation construction projects in the region). Only those impacts from new regional inflows of funding would create new employment in the affected environment. Impacts from existing funding sources would support employment in the Washington-Baltimore-Arlington CSA but not generate a net change from the baseline. At this stage of planning, the funding sources have not been finalized; as a result, the study assumes 100 percent of funding comes from outside the region. Thus, the analysis applies the full Project cost, which represents the maximum construction impact.

[15] Contingency of 20 percent was applied to both construction and professional services. The analysis applied the average percentage contingency between 10 percent and 30 percent mentioned in the 2006 SANDAG MAGLEV Study. SANDAG MAGLEV Study Phase 1. Final Report. March 17, 2006. Page 35. Accessed: https://www.sandag.org/programs/transportation/comprehensive_transportation_projects/Maglev/2006_maglev_reduced.pdf

[16] Professional services include architectural engineering, project management, and planning services. They were calculated as 25 percent of construction cost. The 2006 SANDAG MAGLEV Study identifies the Project elements of the professional services estimated on the basis a percentage of certain cost categories.
SANDAG MAGLEV Study Phase 1. Final Report. March 17, 2006. Page 92.

Table D.4-8: Capital Costs for SCMAGLEV by Build Alternatives (2018$ thousand)

Build Alternatives	Alternative Full Name	Alignment	Stations				TMF			Total Capital Cost
			MVS	BWI Marshall Airport	Cherry Hill	Camden Yards	MD 198	BARC Airstrip	BARC West	
Alignment J										
J-01	Build Alternatives J Cherry Hill MD 198	$9,441,712	$1,907,226	$1,474,452	$968,711	-	$436,800	-	-	$14,228,899
J-02	Build Alternatives J Cherry Hill BARC Airstrip	$9,357,472	$1,907,226	$1,474,452	$968,711	-	-	$124,800	-	$13,832,659
J-03	Build Alternatives J Cherry Hill BARC West	$9,357,472	$1,907,226	$1,474,452	$968,711	-	-	-	$124,800	$13,832,659
J-04	Build Alternatives J Camden MD 198	$10,002,858	$1,907,226	$1,474,452	-	$2,254,452	$436,800	-	-	$16,075,787
J-05	Build Alternatives J Camden BARC Airstrip	$9,918,618	$1,907,226	$1,474,452	-	$2,254,452	-	$124,800	-	$15,679,547
J-06	Build Alternatives J Camden BARC West	$9,918,618	$1,907,226	$1,474,452	-	$2,254,452	-	-	$124,800	$15,679,547
Alignment J1										
J1-01	Build Alternatives J1 Cherry Hill MD 198	$10,137,276	$1,907,226	$1,474,452	$968,711		$436,800			$14,924,464
J1-02	Build	$10,047,420	$1,907,226	$1,474,452	$968,711			$124,800		$14,522,608

Build Alternatives	Alternative Full Name	Alignment	Stations				TMF			Total Capital Cost
			MVS	BWI Marshall Airport	Cherry Hill	Camden Yards	MD 198	BARC Airstrip	BARC West	
	Alternatives J1 Cherry Hill BARC Airstrip									
J1-03	Build Alternatives J1 Cherry Hill BARC West	$10,047,420	$1,907,226	$1,474,452	$968,711				$124,800	$14,522,608
J1-04	Build Alternatives J1 Camden MD 198	$10,699,073	$1,907,226	$1,474,452		$2,254,452	$436,800			$16,772,002
J1-05	Build Alternatives J1 Camden BARC Airstrip	$10,608,749	$1,907,226	$1,474,452		$2,254,452		$124,800		$16,369,678
J1-06	Build Alternatives J1 Camden BARC West	$10,608,749	$1,907,226	$1,474,452		$2,254,452			$124,800	$16,369,678

Source: WSP.
Note: MVS stands for Mount Vernon Square entrance; TMF stands for trainset maintenance facility.

Construction of the Project represents significant capital investment in the Washington-Baltimore-Arlington CSA; therefore, impacts are estimated for the Washington-Baltimore-Arlington CSA to capture the full impact of the construction of the initiative.

In the RIMS Type II employment multipliers, the final demand employment multiplier represents the total change in number of jobs that occurs in all industries for each $1 million of output (in 2018$) delivered to final demand by the construction industry. For example, based on the multipliers in Table 9, every $1 million spent on construction goods and services in the Washington-Baltimore-Arlington CSA yields 11.5781 job-year. The employment impacts are expressed in job-years, which are defined as one job for one person for one year. For example, three job-years are equal to three people doing a job for one year, or one person performing one job for three years.

The construction of the Build Alternatives (versus the No Build Alternative) results also in earnings impacts to the Washington-Baltimore-Arlington CSA for both the construction and professional services industries. The final demand earnings multiplier represents the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the construction industry. For example, based on the multipliers in **Table D.4-9**, every $1 delivered to final demand by the construction industry in the Washington-Baltimore-Arlington CSA yields $0.605 of earnings for households employed.

Table D.4-9: Washington-Baltimore-Arlington CSA Employment and Earnings Multipliers for Construction and Professional Services

Construction Multipliers	Employment (number of jobs)	Earnings (2018$)	Industry
Construction	11.5781	$0.605	Construction
Professional services	11.9746	$0.7435	Professional, scientific, and technical services

Source: 2018 RIMS Type II
Notes: Table 2-5, Final-demand Employment /3/ (number of jobs), Final-demand Earnings /2/ (dollars)

The economic impacts in terms of job-year from the construction of the Project are shown in **Table D.4-10** and they are separated into construction and professional services jobs for each of the proposed Build Alternatives. Jobs are shown in job-years (i.e. one job year is one job for one person over one year).

Total construction employment[17] impacts positively across alignments and options would range between 161,000 job-years and 195,000 job-years (one job year is one job for one person over one year).

Additionally, the economic impacts in terms of earnings from the construction of the Project are shown in **Table D.4-11**, separated into construction and professional services earnings shown in 2018 dollars.

[17] Inclusive of the construction and professional services industries.

Total earnings would be between $8.8 billion and $10.6 billion. The average annual total jobs would be between 161,000 and 195,000 over the construction period. Average direct jobs per year, limited only to the construction industry, range between over 8,700 to over 10,560, representing between 2.7 percent and 3.3 percent of the CSA's construction[18] employment. This is not enough to cause inflationary pressures in the market by itself. If there are other large infrastructure projects planned for the same time horizon, the region could see pressure on construction costs or difficulty finding workers. Option 04 for Build Alternatives J1 offers the largest employment and earnings impacts, an estimated additional 10,560 direct construction jobs per year during the construction period.

The Project has the potential to impact construction employment positively in the region; as a result, construction hiring for the Project may affect construction schedules of other projects in the region.

D.4D.2.2 Short-Term (Temporary) Travel and Business Community Impacts from Construction

There are impacts associated with construction in cities that affect the life of the surrounding communities and beyond. These impacts are also known as social costs.[19] These costs refer to the monetary equivalent of consumed resources, loss of income and loss of enjoyment experienced by parties not engaged in the construction contractual agreement.[20]

The SCMAGLEV's construction will cause travel disruptions as street lanes and sidewalks are closed, as parking space is reduced, as commercial establishments become less visible from the street, and as noise and dust levels in the vicinity of the building activity rise. There are two main types of construction impacts, defined by the groups who are most directly affected—traveler impacts and business community impacts.

Traveler Impacts. These are measured in terms of the travel delay cost and loss of reliability experienced by travelers in the corridor as they wait in queues or take detours because available travel lanes and sidewalks are reduced or closed to accommodate construction.[21]

[18] 2018 ACS 5-yr estimate for total construction employment for the CSA.
[19] Tolga Celik, Saeed Kamali, and Yusuf Arayici. 2017. "Social Cost in Construction Projects." Environmental Impact Assessment Review, Volume 64, May 2017, pages 77-86. https://www.sciencedirect.com/science/article/abs/pii/S0195925516303419
[20] Andrew Gilchrist, and Erez N. Allouche. 2005. "Quantification of social costs associated with construction projects: state-of-the-art review." Tunneling and Underground Space Technology, Volume 20, Issue 1, January 2005, pages 89-104. https://www.sciencedirect.com/science/article/abs/pii/S088677980400286X
[21] Social costs take many forms including increased time and travel distance, reduced reliability, noise inconvenience, accelerated deterioration of secondary roads, increased pollutants from idling cars, increased vehicle operating cost, reduced accessibility, increased safety concerns; and under extreme circumstances residents' relocations.

Table D.4-10: Washington-Baltimore-Arlington CSA Construction and Professional Services Impacts in Terms of Job-Year

Build Alternatives	Construction Cost ($ million)	Construction Employment Multiplier (job-years/$ million)	Construction Jobs (job-years)	Professional Services Costs ($ million)	Professional Services Employment Multiplier (job-years/$ million)	Professional Services Jobs (job-years)	Total Jobs (job-years)
Alignment J							
J-01	$10,950	11.5781	127,000	$3,280	11.9746	39,000	166,000
J-02	$10,640		123,000	$3,190		38,000	161,000
J-03	$10,640		123,000	$3,190		38,000	161,000
J-04	$12,370		143,000	$3,710		44,000	187,000
J-05	$12,060		140,000	$3,620		43,000	183,000
J-06	$12,060		140,000	$3,620		43,000	183,000
Alignment J1							
J1-01	$11,480	11.5781	133,000	$3,440	11.9746	41,000	174,000
J1-02	$11,170		129,000	$3,350		40,000	169,000
J1-03	$11,170		129,000	$3,350		40,000	169,000
J1-04	$12,900		149,000	$3,870		46,000	195,000
J1-05	$12,590		146,000	$3,780		45,000	191,000
J1-06	$12,590		146,000	$3,780		45,000	191,000

Source: AECOM analysis; Note: Employment multipliers were developed based on 2018$. Estimates rounded to the nearest thousand.

Table D.4-11: Washington-Baltimore-Arlington CSA Construction and Professional Services Impacts in Terms of Earnings (2018$ million)

Build Alternatives	Construction Cost ($ million)	Construction Earnings Multiplier (earnings/$ million cost)	Construction Earnings ($ million)	Professional Services Costs ($ million)	Professional Services Earnings Multiplier (earnings/$ million cost)	Professional Services Earnings ($ million)	Total Earnings ($ million)
Alignment J							
J-01	$10,950	0.605	$6,620	$3,280	0.7435	$2,440	$9,060
J-02	$10,640		$6,440	$3,190		$2,370	$8,810
J-03	$10,640		$6,440	$3,190		$2,370	$8,810
J-04	$12,370		$7,480	$3,710		$2,760	$10,240
J-05	$12,060		$7,300	$3,620		$2,690	$9,990
J-06	$12,060		$7,300	$3,620		$2,690	$9,990
Alignment J1							
J1-01	$11,480	0.605	$6,950	$3,440	0.7435	$2,560	$9,510
J1-02	$11,170		$6,760	$3,350		$2,490	$9,250
J1-03	$11,170		$6,760	$3,350		$2,490	$9,250
J1-04	$12,900		$7,810	$3,870		$2,880	$10,680
J1-05	$12,590		$7,620	$3,780		$2,810	$10,430
J1-06	$12,590		$7,620	$3,780		$2,810	$10,430

Source: AECOM analysis.

Business Community Impacts. These are measured in terms of lost sales and/or closures as travelers avoid the area to avoid the travel snarls and difficulty accessing businesses in close proximity to the construction activity. Some businesses may need to re-schedule deliveries if construction activity makes it difficult for trucks to access the facility. For complementary discussion on community impacts, please see Section 4.4 Neighborhoods.

In short, the economic impacts of infrastructure construction and repair projects must consider not only commuters and residents, but also businesses' level of economic activity.[22] In Charlottesville, Virginia, an article in the local newspaper quoted a coffeehouse owner as saying he had lost customers and was cutting staff; other businesses' sales have dropped by 40 percent during the U.S. Route 250 bypass construction.[23] A study about the construction impact of a light rail system in the Rainier Valley in Seattle, Washington found that the number of business licenses between the pre- and post-construction period decreased by 13 percent.[24] The City of Portland, Maine, and the Portland Water District conducted a business case evaluation to select among storage alternatives. One primary area identified was the impacts to businesses located along project roads, including one that would dig a trench in the existing roadway of a commercial corridor to install pipes. The study estimated that lost sales would range between 0 percent to 70 percent depending on business type and construction scenario.[25] These examples illustrate that impacts on businesses associated with construction could be significant.

There is limited literature and no standard methodology that focuses on quantifying the social costs associated with the impacts that results from construction.[26, 27] For the SCMAGLEV Project, FRA forecasted that during the construction period, the main intersections around the proposed stations[28] would face similar or worse levels of service (i.e. higher seconds of delay per vehicle) than under the No Build Alternative. Around Mount Vernon Square station, FRA estimated that vehicles could be delayed up to 12 minutes in one intersection due to construction activity for the SCMAGLEV Project. At Camden Yards station and Cherry Hill station, delays at intersections could be up to 5 minutes and 4 minutes per vehicle, respectively. These estimated delays would have an impact on commuters and residents by increasing travel times and commutes. (see Section 4.02 Transportation in the DEIS)

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[22] Diane Marie Dube. 2013-2014. "Prepare, Survive, and Thrive: A Lawyer's Guide to Advising Business Clients Facing Construction Disruption." 22 J. Affordable Housing & Community Development Law 345. https://heinonline.org/HOL/LandingPage?handle=hein.journals/jrlaff22&div=28&id=&page=

[23] Scott Beyer. 2014. "How to Keep Construction from Killing Businesses." Governning.com, July 2014 https://www.governing.com/columns/urban-notebook/gov-when-public-works-projects-kill-business.html

[24] Alexandre Krieg. 2009. "The Impact of Light Rail Construction on Neighborhood Business activity in the Rainer Valley, Seattle, Washington." University of Florida. http://etd.fcla.edu/UF/UFE0041284/krieg_a.pdf

[25] AECOM and Sebago Technics. 2018. "Back Cove South CSO Storage Conduit and Tank Alternatives: Business Case Evaluation Report of Findings." January. Prepared for the City of Portland Department of Public Works.

[26] Wen-Der Yu, and Shao-Sgun Lo. 2007. "Time-dependent construction social costs model." Construction Management and Economics, 23:3, pages 327-337. https://www.tandfonline.com/doi/abs/10.1080/01446190500040281

[27] Amir Ibrahim, Omar El-Anwar, and Mohamed Marzouk. 2018. "Socioeconomic impact assessment of highly dense-urban construction projects." Automation in Construction, Volume 92, August 2018, pages 230-241 https://www.sciencedirect.com/science/article/abs/pii/S0926580516304514

[28] Travel impacts at BWI Marshall Airport were not estimated.

Additionally, FRA estimated quantitatively the social impacts associated with station and TMF construction activities linked to businesses revenue loss.[29]

D.4D.2.2.1 Revenue Loss for Impacted Businesses

The construction of the SCMAGLEV Project would impact business revenues within a ¼-mile radius of the stations and TMFs due to lane closures, traffic delays, and limited accessibility. The details of the construction period and duration at individual sites are yet determined; however, business revenue impacts are assumed to be temporary for the duration of construction. Due to the construction period and duration uncertainty, the estimated revenue loss values are reported on an annual basis.

In order to estimate the potential revenue impacts of businesses around the proposed stations and TMFs of the SCMAGLEV Project, records for businesses in the zip codes within the ¼-mile radius buffers were collected from the AtoZdatabases.[30, 31] This analysis assumes that the businesses within the ¼-mile radius buffer of each potential station or TMF are impacted by construction as drivers or pedestrians would likely need to navigate the construction site to access these businesses or parking nearby; this is consistent with the ¼-mile radius buffer being the typical transit walk shed. [32]

Following the ¼-mile radius buffer clip, the AtoZdatabases list of businesses was further refined based on the North American Industry Classification System (NAICS) code. Up to 10 six-digit NAICS codes are listed for each entry in the AtoZdatabases; the first two NAICS codes (i.e. the primary business definition) were used in this analysis based on the first two digits. The businesses that would be most impacted by construction are assumed to fall into four NAICS codes:

- Retail Trade (44 and 45)
- Arts, Entertainment, and Recreation (71)
- Accommodations and Food Services (72)

These industries are believed to be most impacted because the ability to make comparable transactions—purchase groceries or a coffee for example—elsewhere in the community is greatest. By contrast, professional services transactions are less likely to be tempered as people are less willing to change dentists, lawyers or hair stylists once they have found a professional with whom they are comfortable. They are more willing to accept the travel inconvenience to visit the dentist that makes them comfortable and knows them.

[29] Business revenue losses at BWI Marshall Airport due to construction are assumed to be negligible and are therefore not quantitatively estimated.
[30] AtoZdatabases, https://www.atozdatabases.com/
[31] List of ZIP codes downloaded by station and by TMF - Mount Vernon Square Station Zip Codes: 20001, 20002, 20005, 20036; Camden Yards Station Zip Codes: 21201, 21202, 21217, 21222, 21225, 21230, 21298; Cherry Hill Station Zip Codes: 21225, 21230; TMF BARC West and TMF BARC Airstrip Zip Codes: 20705, 20708; MD 198 TMF Zip Codes: 20724, 20755
[32] Federal Highway Administration. 2013. “Chapter 4: Actions to Increase the Safety of Pedestrians Accessing Transit,” January 31. https://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/ch4.cfm

Because the database reports total corporate revenues, the potential list of affected businesses was further refined to exclude corporate franchise locations, as applicable. This means that the estimates provided below exclude losses to the neighborhood Starbucks or Walgreens for example, making the losses conservative. The final list included business revenues if the employment at the location was equal to the corporate employment, or if no corporate employment was provided. The list of relevant businesses was reviewed for reasonableness based on the NAICS codes, revenues, employees, and business names. **Table D.4-12** summarizes the number of business by NAICS code in the study area. It is noted that businesses outside of the ¼-mile radius buffer of each potential station or TMF, and other industries than the four listed above could be impacted. For these reasons, this analysis gives a conservative estimate of the overall revenue impacts on businesses in the affected area due to construction.

Table D.4-12: Number of Businesses Impacted by NAICS Code

NAICS	Stations			TMF		
	Camden Yards	Cherry Hill	Mount Vernon Square	MD 198	BARC West	BARC Airstrip
Retail Trade (44-45)	69	4	68	3	NA	NA
Arts, Entertainment, and Recreation (71)	18	1	27	0		
Accommodations and Food Services (72)	94	4	131	2		
Total	**181**	**9**	**226**	**5**	**0**	**0**

Source: AECOM analysis

Based on findings from the AECOM and Sebago Technics (2018) study, a range of impacts on revenues was applied. The low and high percentages of revenues impacted are shown in **Table D.4-13** by NAICS code. These percentages were applied to the 2019 revenue[33] of each business impacted by the construction of the SCMAGLEV Project.

Table D.4-13: Range of Revenues Impacted by NAICS Code in Percentage

NAICS	Low	High
44-45	2	50
71	4	40
72	7	70

Source: AECOM and Sebago Technics. 2018. "Back Cove South CSO Storage Conduit and Tank Alternatives: Business Case Evaluation Report of Findings." January. Prepared for City of Portland Dept. of Public Works.

The potential impacts on business revenues by NAICS code, station and TMF are shown in **Table D.4-14** for the low and high estimates, respectively, deflated to 2018 dollars. These results are on an annual basis and assume the businesses would experience similar revenues to the 2019 revenues in the future. Notably, these impacts on revenues in the affected areas may be canceled out by increased sales outside of

[33] Note that all records in the AtoZdatabases do not contain 2019 revenue data.

the affected area, resulting in no net change to the region in terms of jobs, GDP, and tax revenues. However, the impact on the affected areas may be significant and long-term particularly in the cases of businesses that operate on large volumes and low margins. For some of this type of business, the loss of revenue may result in permanent closure.

Table D.4-14: Low and High Estimates of Annual Revenue Loss Impact by NAICS Code and Station/TMF, thousands of 2018 dollars

NAICS	Percentage Applied	Station			TMF		
		Camden Yards	Cherry Hill	Mount Vernon Square	MD 198	BARC West	BARC Airstrip
Low Estimate of Annual Revenue							
44-45	2%	$420	$1,430	$1,790	$260	NA	NA
71	4%	$1,910	$0	$1,180	$0		
72	7%	$5,300	$130	$14,010	$130		
TOTAL		**$7,630**	**$1,560**	**$16,980**	**$390**	--	--
High Estimate of Annual Revenue							
44-45	50%	$35,050	$35,730	$44,570	$6,450	NA	NA
71	40%	$19,110	$0	$11,800	$0		
72	70%	$53,000	$1,280	$140,090	$1,320		
TOTAL		**$107,160**	**$37,010**	**$196,460**	**$7,770**	--	--

Source: AECOM analysis. Note: NAICS codes are Retail Trade (44 and 45), Arts, Entertainment, and Recreation (71) and Accommodations and Food Services (72).

The construction impact on business revenue losses around Mount Vernon Square Station would range between $17 million and $196 million per year. The accommodation and food services industry accounts for 70-80 percent of the construction impact. This is due the proximity to a large number of restaurants and other retail in the central business district of Washington, D.C. Near the Mount Vernon Square Station, FRA identified 226 businesses with the potential to be impacted from construction.[34]

At Camden Yards Station, the losses to business revenue losses ranges from nearly $8 million to $107 million per year for the 181 potentially impacted businesses.[35] The accommodation and food services industry accounts for 50-70 percent of the impacts around the Camden Yards Station. The revenue losses around Cherry Hill Station range between $2 million and $37 million per year due to a lower concentration of retail activities in the immediate station area; FRA identified only nine businesses in the

[34] At Mount Vernon Square Station, there would be 68 Retail Trade (44 and 45), 27 Arts, Entertainment, and Recreation (71), and 131 Accommodations and Food Services (72) businesses potentially impacted in the station area.
[35] At Camden Yards Station, there would be 69 Retail Trade (44 and 45), 18 Arts, Entertainment, and Recreation (71), and 94 Accommodations and Food Services (72) businesses potentially impacted in the station area.

station area with the potential to be affected during construction with one retail business contributing nearly 90 percent of the impact.[36]

The impacts of construction on the TMF located at MD 198 would result in a loss of business revenues of $390,000 to $8 million per year. There are five businesses with the potential to be impacted from construction near the MD 198 TMF.[37] There are no businesses in the four NAICS categories within ¼-mile radius buffer of the TMF BARC West, and no businesses at all within the ¼-mile radius buffer of the TMF BARC Airstrip. Therefore, there would be no construction impacts on business revenues around TMF BARC West and TMF BARC Airstrip locations.

D.4D.2.3 Long-Term (Recurring) Operation and Maintenance Impacts

Implementation of the SCMAGLEV service would support jobs and earnings as a result of ongoing operations and maintenance (O&M) expenditures to run the service. These impacts are recurring annual impacts that would continue through the life of the service. Operating and maintaining the service for the Build Alternatives would expand payrolls in each year service is operated. The O&M hiring associated with the Build Alternatives represents the direct impacts within the CSA. The earnings of these newly hired sector employees would translate into a proportional increase in consumer demand as these workers purchase goods and services in the region. A further increase of new employment across a variety of industrial sectors and occupational categories is expected as employers hire to meet this increase in local consumer demand. This impact represents the Project's potential induced impact. Finally, the hiring created due to the provision of supplies to the SCMAGLEV system represents the Project's indirect impacts.

Table D.4-15 presents the annual O&M costs estimated on a mile basis that are applied to estimate the anticipated total employment impacts from the SCMAGLEV service. The O&M impacts do not consider any reduction in operating hours in competing services on auto, taxi/TNC, bus and rail operations in the Build Alternatives compared to the No Build Alternative. The O&M estimates were derived based on the estimated O&M cost of SCMAGLEV service between Washington, D.C. and Baltimore sourced from 2005 Report to Congress - Costs and Benefits of Magnetic Levitation and inflated to 2018 dollars applying the GPD deflator.[38] The 2005 Report to Congress annual provides O&M estimates that reflect the staffing plan, fringe benefits, material costs for maintaining the vehicles and guideway, utility costs for vehicle propulsion and station light and air conditioning, insurance, and administrative costs; it excludes the O&M cost of maintaining the TMF.

[36] At Cherry Hill Station, there would be four Retail Trade (44 and 45), one Arts, Entertainment, and Recreation (71), and four Accommodations and Food Services (72) businesses potentially impacted in the station area.
[37] At MD 198 TMF, there would be three Retail Trade (44 and 45), zero Arts, Entertainment, and Recreation (71), and two Accommodations and Food Services (72) businesses potentially impacted in the TMF area.
[38] Federal Railroad Administration. Report to Congress - Costs and Benefits of Magnetic Levitation, FRA, September 2005 https://www.fra.dot.gov/Elib/Document/1176

Table D.4-15: SCMAGLEV Estimated Annual Operation and Maintenance Cost by Build Alternative

Build Alternative	Annual O&M Costs (2018$ Thousand)	Route Length (miles)
Alignment J		
J-01	$59,998	34.97
J-02	$61,064	35.59
J-03	$60,664	35.36
J-04	$63,665	37.11
J-05	$64,731	37.73
J-06	$64,331	37.50
Alignment J1		
J-01	$64,069	37.34
J-02	$62,038	36.16
J-03	$61,323	35.74
J-04	$67,734	39.48
J-05	$65,703	38.30
J-06	$64,989	37.88

Source: Federal Railroad Administration. Report to Congress - Costs and Benefits of Magnetic Levitation, FRA, September 2005. Inflated to 2018 dollars using direct capital - nondefense or GDP (chained) price index. Note: Approximately annual SCMAGLEV O&M track cost per mile is $1.7 million. O&M costs and impacts related to maintaining the TMF are not included.

This analysis assumes that funding for O&M would be provided through private funds and a mix of government funds and project-generated funds, such as fares and potentially advertising revenues. Although these funds could include local sources, this represents spending that would not take place but for the implementation of service. The expansion of transit service associated with the Build Alternatives represents an expansion of economic activity in the Washington-Baltimore-Arlington CSA and thus generates recurring net economic impacts.

As with construction impacts, this section calculates direct, indirect, and induced impacts of the O&M impacts for the Washington-Baltimore-Arlington CSA using RIMS II Series 2018 multipliers (as they were the latest available at the time of the analysis). The multipliers would be applied to the estimated O&M cost. These are recurring impacts that continue over time for as long as the service is in operations.

Table D.4-16 presents the multipliers used in the analysis for the O&M expenditures in Washington-Baltimore-Arlington CSA. Multipliers for “Rail transportation” were applied to the O&M cost for the SCMAGLEV service. As SCMAGLEV is not an industry in the United States at present, a SCMAGLEV multiplier was not available. Rail transportation was the closest substitute.

Table D.4-16: Washington-Baltimore-Arlington CSA Employment and Earnings Multipliers for Rail Transportation

O&M Multipliers	Employment (number of jobs)	Earnings (2018$)	Industry
Rail transportation	6.4232	$0.4048	Rail transportation

Source: RIMS II Type II. Note: Final-demand Employment /Table 2-3/ (number of jobs), Final-demand Earnings /Table 2-2/ (dollars)

The interpretation of the RIMS II Type II employment multipliers used in the analysis is as follows. The final demand employment multiplier represents the total change in number of jobs that occurs in all industries for each $1 million of output (in 2018$) delivered to final demand by the rail transportation industry. For example, based on the multipliers in **Table D.4-16**, every $1 million delivered to final demand by the rail transportation industry in Washington-Baltimore-Arlington CSA yields 6.4232 jobs in all industries. The employment impacts are expressed in job-years, which are defined as one full-time job for one person for one year.

The final demand earnings multiplier represents the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the rail transportation industry. Based on the multipliers shown in Table 16, every $1 delivered to final demand by the rail transportation industry in Washington-Baltimore-Arlington CSA yields $0.4048 of earnings for households employed by all industries.

The annual economic impacts for Build Alternatives in terms of job-years and earnings from the operation and maintenance of the project are shown in **Table D.4-17**. Jobs are shown in job-years (i.e. one job year is equal to one job for one person over one year). For the Washington-Baltimore-Arlington CSA, operation and maintenance would result in between 390 and 440 total jobs annually, and between $24.3 and $27.4 million in earnings.

Table D.4-17: Washington-Baltimore-Arlington CSA Operating and Maintenance Impacts in Terms of Jobs and Earnings by Build Alternative

Build Alternatives	Annual O&M Costs (2018$ Thousand)	O&M Employment Multiplier (job-years/$ million)	Direct Annual O&M Employment (job-years)	Total Annual O&M Employment (job-years)	O&M Earnings Multiplier (earnings/$ million cost)	Total Annual O&M Earnings (2018$ Thousand)
Alignment J						
J-01	$59,998	6.4232	130	390	0.4048	$24,287
J-02	$61,064		130	390		$24,719
J-03	$60,664		130	390		$24,557
J-04	$63,665		140	410		$25,772
J-05	$64,731		140	420		$26,203
J-06	$64,331		140	410		$26,041

Build Alternatives	Annual O&M Costs (2018$ Thousand)	O&M Employment Multiplier (job-years/$ million)	Direct Annual O&M Employment (job-years)	Total Annual O&M Employment (job-years)	O&M Earnings Multiplier (earnings/$ million cost)	Total Annual O&M Earnings (2018$ Thousand)
Alignment J1						
J1-01	$64,069	6.4232	140	410	0.4048	$25,935
J1-02	$62,038		130	400		$25,113
J1-03	$61,323		130	390		$24,824
J1-04	$67,734		150	440		$27,419
J1-05	$65,703		140	420		$26,597
J1-06	$64,989		140	420		$26,308

Source: AECOM analysis

D.4D.2.4 Long-Term (Recurring) Travel Market Impacts

The availability of the SCMAGLEV option would change the travel patterns in the CSA. These changes include the net change in user benefits, increased reliability relative to other modes, increased safety, induced ridership savings, avoidance of congestion, pavement savings, reduced emissions, and reduced revenue for publicly-provided regional commuter rail service as riders on these modes divert to SCMAGLEV. This analysis of travel market impacts quantifies how travel-related costs would change as a result of the Build Alternatives in the opening and horizon years, 2030 and 2045. This analysis distinguishes impact results for riders traveling to Cherry Hill Station and Camden Yards Station.

The SCMAGLEV service would provide benefits to users and nonusers that result from increases in mobility and reduced vehicle (auto) miles traveled (VMT), bus passenger miles traveled (PMT) and regional commuter rail PMT. The analysis estimates the change in these operational benefits from the No Build Alternative to the Build Alternatives. The region benefits in total, because transportation services are enhanced compared to the No Build Alternative. The impacts (positive and negative) are monetized using outputs from the travel demand model, values of time, operating costs associated with auto, bus and regional commuter rail travel, and economic values of accidents and emissions consistent with U.S. Department of Transportation (DOT) guidance.[39] The ridership demand forecast models assume locations at Mount Vernon Square, BWI Marshall Airport, Cherry Hill Station and Camden Yards Station.

D.4D.2.4.1 Monetized Value for Changes in Travel Time

With the implementation of improvements under the Build Alternatives, mobility and connectivity for the overall Washington-Baltimore-Arlington CSA would be enhanced, thereby accommodating and encouraging future ridership growth. This section describes the travel time impacts associated with the Build Alternatives.

[39] Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2020).

The availability of the SCMAGLEV service results in travel time savings for the region as a whole compared to the No Build Alternative. Comparing the No Build and Build Alternatives' values of travel time results in the net change in the value of travel time for the Build Alternatives relative to other modes. Multiplying the annual travel time savings by the value of time for personal and business travel results in the total value of net travel time savings for the Build Alternatives in 2030 and 2045. The value of time for personal travel in 2018 dollars is $15.20 per hour, while the value of time for business travel is valued at $27.10 per hour. Positive values indicate travel time savings where users experience a shorter average trip in the Build Alternatives than the No Build Alternative; negative values indicate that travelers would lose time from the introduction of the new service to the region's transportation network. These savings are monetized using U.S. DOT factors.

Table D.4-18 summarizes the annual travel time savings estimated in the Ridership Data Request and the Ridership Supplement Memorandum. [40, 41] **Table D.4-19** presents SCMAGLEV ridership percentage by market segment and by airport/non-airport trip percentage in the future estimated in the final ridership report.[42] Applying the market segment percentages to the travel time savings, and multiplying the estimates by the travel time values provides monetary values for travel time savings. The SCMAGLEV ridership data estimates annual travel time savings for two generic Build Alternatives depending on which station in Baltimore is analyzed and versus the No Build Alternative.

Table D.4-18: Annual Travel Time Savings by Year (in hours)

Commute Pair	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Washington, D.C.-Baltimore	21,003,586	27,606,825	23,613,732	31,133,083
Washington, D.C.-BWI Marshall Airport	1,758,358	2,741,589	1,976,872	3,091,776
Baltimore-BWI Marshall Airport	2,707,478	3,589,649	3,043,940	4,048,160
Total	**25,469,422**	**33,938,062**	**28,634,545**	**38,273,018**

Source: SCMAGLEV Ridership Data Request, July 27, 2020; Table 7, SCMAGLEV Ridership Supplement, December 10, 2018

Table D.4-19: 2050 SCMAGLEV Ridership by Market Segment

Market Segment	Percent of Total Ridership	Percent of Non-Airport Ridership	Percent of Airport Ridership
Commute	25.4%	30%	-
Business	15.4%	18%	-
Non-Business	44.6%	52%	-

[40] SCMAGLEV Ridership Data Request, July 27, 2020
[41] SCMAGLEV Ridership Supplement, December 10, 2018, Memorandum
[42] 2050 SCMAGLEV By Market Segment. Baltimore-Washington SCMAGLEV Project Final Ridership Report, November 8, 2018

Market Segment	Percent of Total Ridership	Percent of Non-Airport Ridership	Percent of Airport Ridership
Airport Business	8.2%	-	57%
Airport Non-Business	6.3%	-	43%
Total	**100%**	**100%**	**100%**

Source: Figure 7-6, SCMAGLEV Final Ridership Report, November 8, 2018

Travel time savings reflects the "door-to-door" time, and therefore includes transfer and wait times out-of-vehicle as well as in-vehicle time. There are three possible commute pairs: Washington, D.C. and Baltimore; Washington, D.C. and BWI Marshall Airport, and BWI Marshall Airport and Baltimore. Also, there are three types of travelers; the ones traveling for business, the ones traveling for non-business activities, and the ones commuting to work. The annual change in hours by market pair and by travel purpose, and value of travel time is shown in **Table D.4-20**. In 2030 the total annual travel time savings associated with Cherry Hill Station is $462.3 million, and in 2045 total annual travel time savings would be $617.7 million. In 2030 the total annual travel time savings associated with Camden Yards Station is $519.7 million, and in 2045 total annual travel time savings would be $696.6 million.

Table D.4-20: Annual Travel Time Savings by Year (2018$ million)

Commute Pair / Type of Commute	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Washington, D.C. - Baltimore	**$364.3**	**$478.9**	**$409.6**	**$540.0**
Business	$102.6	$134.9	$115.4	$152.1
Commute	$95.0	$124.8	$106.8	$140.7
Non-Business	$166.7	$219.1	$187.4	$247.1
Washington, D.C. - BWI Marshall Airport	**$38.6**	**$60.1**	**$43.4**	**$67.8**
Business	$26.9	$42.0	$30.3	$47.4
Non-Business	$11.6	$18.1	$13.1	$20.4
BWI Marshall Airport - Baltimore	**$59.4**	**$78.7**	**$66.8**	**$88.8**
Business	$41.5	$55.0	$46.6	$62.0
Non-Business	$17.9	$23.7	$20.1	$26.7
Total	**$462.3**	**$617.7**	**$519.7**	**$696.6**

Source: AECOM analysis

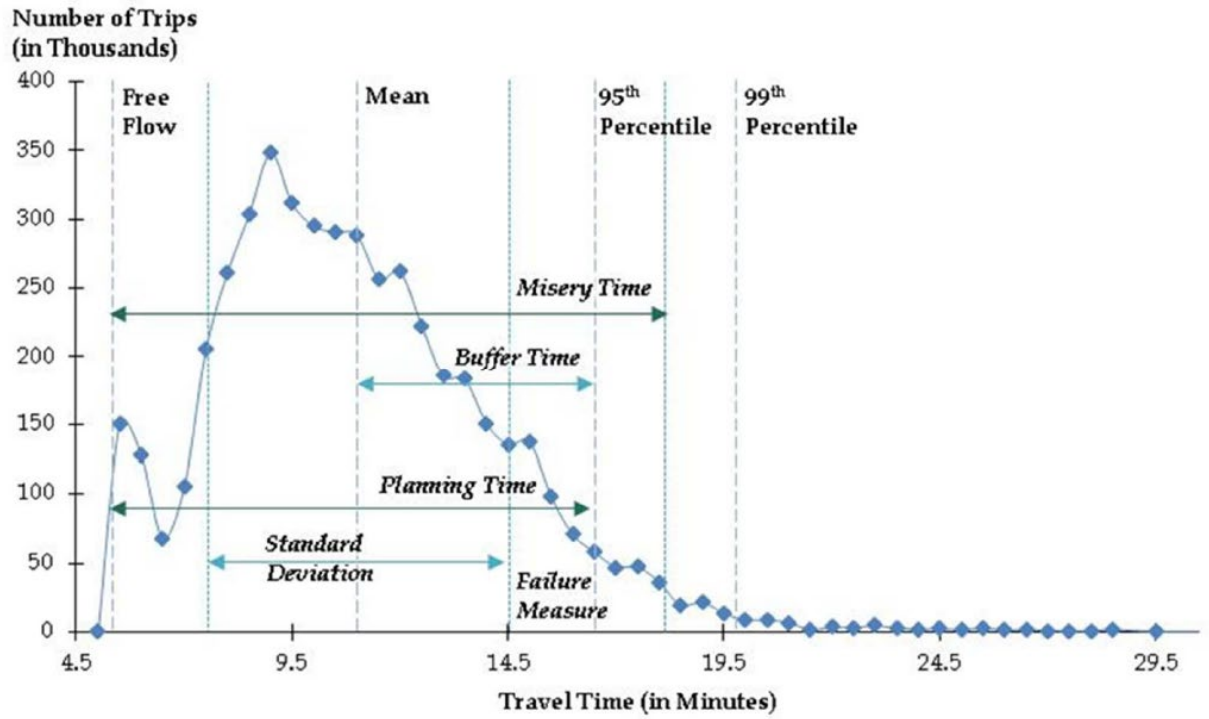
D.4D.2.4.2 Value for Change in Reliability

In addition to time savings, travelers also value reliability of travel time. Reliability is the level of certainty with respect to travel time and congestion, and is a statistical measure

calculated by applying the standard deviation of travel time.[43,44,45] There are several reliability metrics that can be estimated, such as planning time, buffer time, and misery time, represented in **Figure D.4-5** below. This section focuses on buffer time, described as the time auto drivers, taxi/TNC bus riders, and rail riders must factor in order to be on time to their destination.

Buffer time is the additional time allocated by travelers during their trip planning to compensate for delays caused by events. For auto and bus travelers the primary events impacting buffer time are traffic jams caused by accidents or congestion, highway maintenance and construction, or difficulty parking. For rail travelers the primary events impacting buffer time are unscheduled train delays and overcrowded cars. The amount of buffer time travelers allocate is a personal decision dependent upon the perceived reliability of the transportation mode and the importance of reaching the planned destination when scheduled.

Figure D.4-5: The Travel Time Distribution is the Basis for Defining Reliability Metrics



Source: Cambridge Systematics et al. Analytical Procedures for Determining the Impacts of Reliability Mitigation Strategies. SHRP 2 L03. Transportation Research Board of the National Academies, Washington, D.C. 2013.

[43] Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highways User-Cost Estimation (1999). Accessed: http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_431.pdf
[44] Improving Our Understanding of How Highway Congestion and Pricing Affect Travel Demand. SHRP 2 Report S2-C04-RW-1. Accessed: http://www.trb.org/Publications/Blurbs/168141.aspx
[45] Application of Bus Only Lanes in Downtown Washington, D.C.: Concurrent versus Contra-flow Bus Lanes (2015). Accessed: http://amonline.trb.org/trb60693-2016-1.2807374/t020-1.2818429/286-1.2819353/16-1551-1.2816148/16-1551-1.2985012?qr=1

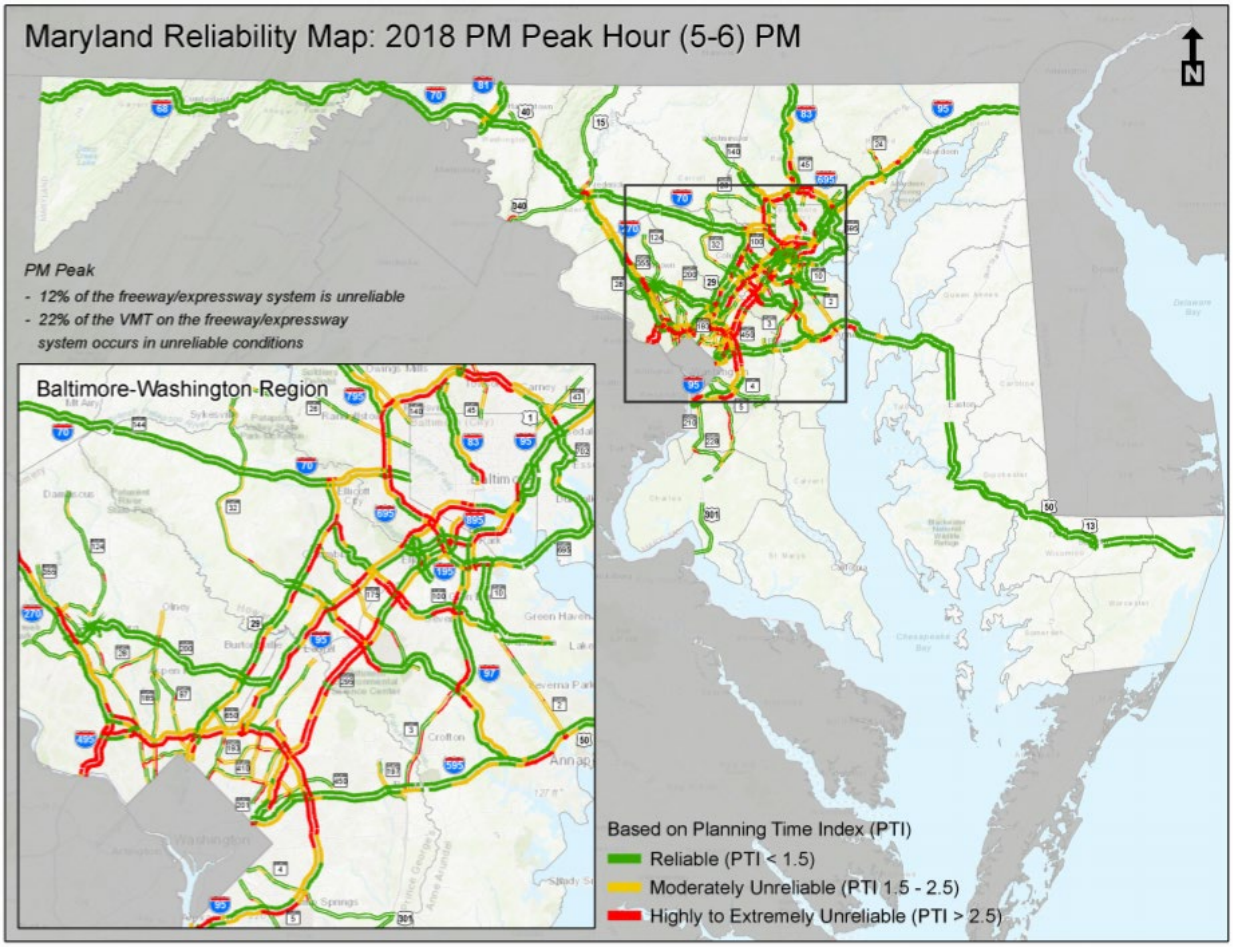
As a new mode, passengers would need to judge the reliability of SCMAGLEV relative to other transportation modes before reducing buffer time. However, based on its performance in other countries, it is anticipated that SCMAGLEV travelers would begin to reduce their buffer time. Buffer time is estimated for travelers diverted from current highway and rail transportation modes. The 2018 JR-Central annual report states that in 2017 their Maglev trains reported an average delayed time of 0.7 minutes per train in service, which is nearly zero delay.[46] This buffer time reduction would not apply to induced travel since those riders would have not taken the trip without SCMAGLEV. The current free-flow travel time for both highway and rail travel between Washington, D.C. and Baltimore is approximately one hour. The travel time varies based upon time of travel and direction of travel. INRIX calculated that in 2019 the annual hours lost in congestion (on top of the free flow travel time) in Washington, D.C. were 124 hours per driver while in Baltimore the measure was at 84 hours. Washington, D.C. and Baltimore rank 24th and 59th, respectively, among 979 cities ranked in the world.[47] The closer the ranking to one, the worse is the level of congestion. The Amtrak Acela and MARC commuter rail systems publish annual reliability statistics on the performance. Amtrak Acela averages 72 percent to 91 percent[48] and MARC averages 87 percent to 93 percent[49] on-time performance during the past several years.

Given the uncertainties, the analysis assumes a corridor wide buffer time reduction of five minutes per trip soon after the SCMAGLEV system starts operating. This is a conservative estimated of the amount of time SCMAGLEV rider would reduce their buffer time once the SCMAGLEV system is established as a highly reliable transportation mode. Reliability on the Baltimore-Washington Parkway varies with time, but as the figure below indicates, it can be highly variable with a planning time index (PTI) value of over 1.5 for many segments. (**Figure D.4-6**)

The value of time for all purposes in 2018 dollars, equaling to $16.60 per hour, is used in this analysis. **Table D.4-21** presents the reliability impact from the diversions to SCMAGLEV by mode and the buffer time reduction multiplied the average value of time. The estimated reliability impact for SCMAGLEV associated with Cherry Hill Station would be $19.8 million in 2030 and $25.8 million in 2045, all in 2018 dollars. The estimated reliability impact for SCMAGLEV associated with Camden Yards Station would be $21.9 million in 2030 and $28.5 million in 2045, all in 2018 dollars.

[46] 2018 JR-Central Annual Report. Page 18. Accessed https://global.jr-central.co.jp/en/company/ir/annualreport/_pdf/annualreport2018.pdf
[47] INRIX Scorecard 2019. Accessed http://inrix.com/scorecard/
[48] Federal Railway Administration, 2019. Quarterly Report on the Performance and Service Quality of Intercity Passenger Train Operations. Table 6. Accessed https://railroads.dot.gov/elibrary/quarterly-report-performance-and-service-quality-intercity-passenger-train-operations-q3-1
[49] MDOT MTA Performance Improvement Data. Accessed https://www.mta.maryland.gov/performance-improvement

Figure D.4-6: Baltimore-Washington Region Freeway/Expressway Congestion Map PM Peak Hour (5PM-6PM)



Source: 2019 Maryland State Highway Mobility Report, Page 47. Accessed https://www.roads.maryland.gov/OPPEN/2019_mobility_report.pdf

Table D.4-21: Reliability Impact by Year

	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Diversions by Mode (x 1,000)				
Automobile	11,380	14,877	12,610	16,480
Bus	253.107	309.733	263.229	320.005
Taxi/TNC	582.217	860.551	681.976	1009.282
Highway Dependent	12,216	16,048	13,555	17,810
Rail	2,123	2,610	2,261	2,769
Total	14,339	18,658	15,816	20,579
Buffer Time Reduction per Trip (minutes)	5	5	5	5
Total Buffer Time (minutes)	71,692,705	93,288,845	79,078,890	102,892,765

	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Total Buffer Time (hours)	1,194,878	1,554,814	1,317,982	1,714,879
Travel Time Value (2018$ hour)	$16.60	$16.60	$16.60	$16.60
Buffer Time Impact (2018$)	$19,834,982	$25,809,914	$21,878,493	$28,466,998

Source: AECOM analysis

D.4D.2.4.3 Monetized Value for Changes in Travel Cost

User benefits, used to calculate the travel time savings, take into consideration the travel cost estimates under the Build Alternative, and within these numbers, it is important to note that SCMAGLEV riders are trading off time savings for higher travel costs. Nevertheless, this section estimated the travel costs savings borne by SCMAGLEV riders, which would be negative.

Travel cost savings are savings incurred by passengers that divert from auto, taxi/transportation network company (TNC), bus and rail in the No Build Alternative to SCMAGLEV in the Build Alternatives in 2030 and 2045. The travel cost savings take into account the net change in vehicle operating costs from USDOT BCA guidance, parking fee costs, toll fee costs, and taxi/TCN/bus/commuter rail fares for trips diverted to SCMAGLEV from auto, taxi/TNC, bus and rail.

Auto Travel Cost Savings Assumptions

The Ridership Supplement memorandum estimates annual auto VMT avoided for a common Build Alternatives versus the No Build Alternative (**Table D.4-22**). The auto vehicle operating costs are calculated by multiplying the avoided auto VMT and $0.41 cost per mile in 2018 dollars.[50]

Table D.4-22: Annual Auto VMT Savings (in 000s)

Year	Cherry Hill	Camden Yards
2030	284,919	316,108
2045	393,149	436,566

Source: SCMAGLEV Ridership Data Request, July 27, 2020

Parking fees are assumed to be an average of $30 per round-trip and are applied to all auto trips between Washington, D.C. and Baltimore because the major employment centers have parking garages that require daily payment either by the hour or as a portion of the employee's paycheck.[51] The average parking cost assumed at the airport for Washington, D.C. and Baltimore travelers was $43 per round trip. Parking cost at the airport was calculated multiplying the maximum daily/long-term parking fees, the

[50] Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2020)
[51] 2050 SCMAGLEV By Market Segment. Baltimore-Washington SCMAGLEV Project Draft Final Ridership Report, June 29, 2018.

percentage of daily/long-term parking usage, and the average parking days as presented in **Table D.4-23**. Toll fees are assumed to be an average of $8 per trip.[52] The study assumes that 24.0 percent of auto drivers would use toll lanes.[53] Parking fee and toll fee avoided are applied to auto trips that would divert to SCMAGLEV.

Table D.4-23: BWI Marshall Airport Parking Cost Assumptions

Parking Type	Maximum Fee (1)	Percentage (2)	Av. Days for Washington, D.C. Travelers (2)	Av. Days for Baltimore Travelers (2)
Daily	$12	50.9%	1.5	1.5
Long-Term	$8	49.1%	9.0	9.0

Sources: (1) BWI Marshall Airport website. (2) Air Travelers in America Findings of a Survey Conducted by Ipsos, 2018. Slide 12. Accessed: http://airlines.org/wp-content/uploads/2018/02/A4A-AirTravelSurvey-20Feb2018-FINAL.pdf

Mode Diversions

The 2030 and 2045 annual diversions from each mode (including auto, rail, bus and taxi/TNC) are estimated in the Ridership Supplement memorandum and summarized in **Table D.4-25**. Multiplying annual diversions to SCMAGLEV with the fare assumptions would estimate the net total travel cost savings by mode. Diversion at opening year and future year by segment were calculated based on the annual ridership by segment recorded in the SCMAGLEV Ridership Supplement (December 10, 2018). **Table D.4-24** summarizes the percentage of total annual diversions by segment.

Table D.4-24: Ridership Diversion Percentage Assumptions by Segment

Segment	Auto	Rail	Bus	Taxi/TNC
Opening Year				
Washington, D.C. – Baltimore	92	88	72	0
BWI Marshall Airport – Baltimore	4	5	6	68
Washington, D.C. – BWI Marshal Airport	4	7	22	32
Future Year				
Washington, D.C. – Baltimore	92	87	68	0
BWI Marshall Airport – Baltimore	4	5	6	64
Washington, D.C. – BWI Marshal Airport	4	8	26	36

Sources: Tables 8 and 9, SCMAGLEV Ridership Supplement, December 10, 2018.

As shown in **Table D.4-25**, to calculate the diversions from auto and taxi/TNC to SCMAGLEV, the analysis applies different auto occupancy rates by each market segment presented in **Table D.4-26**.

[52] Ibid.
[53] MTA 2017 Traffic and Toll Revenue Forecast Update (Legacy Facilities). November. Accessed https://mdta.maryland.gov/sites/default/files/Files/Financial_Forecast/LEGACY_FACILITIES_FULL_FINAL_REPORT.pdf

Table D.4-25: Annual Diversions to SCMAGLEV by Mode

Segment	Auto	Rail	Bus	Taxi/TNC
Cherry Hill Station				
2030				
Washington, D.C. – Baltimore	10,486,098	1,879,084	182,355	0
BWI Marshall Airport – Baltimore	444,677	99,752	16,356	394,013
Washington, D.C. – BWI Marshal Airport	449,692	143,915	54,395	188,204
2045				
Washington, D.C. – Baltimore	13,621,026	2,268,291	209,921	0
BWI Marshall Airport – Baltimore	575,457	126,581	19,957	547,496
Washington, D.C. – BWI Marshal Airport	680,798	215,333	79,855	313,055
Camden Yards Station				
2030				
Washington, D.C. – Baltimore	11,618,545	2,001,528	189,648	0
BWI Marshall Airport – Baltimore	492,700	106,252	17,010	461,525
Washington, D.C. – BWI Marshal Airport	498,256	153,292	56,571	220,451
2045				
Washington, D.C. – Baltimore	15,088,769	2,406,176	216,883	0
BWI Marshall Airport – Baltimore	637,465	134,275	20,619	642,121
Washington, D.C. – BWI Marshal Airport	754,158	228,422	82,503	367,161

Sources: SCMAGLEV Ridership Data Request, July 27, 2020; Tables 8 and 9, SCMAGLEV Ridership Supplement, December 10, 2018.

Table D.4-26: Auto Occupancy Rate by Market Segment

Market Segment	Auto Occupancy Rate
Commute	1.10
Business	1.38
Non-Business	2.12
Airport Business	2.07
Airport Non-Business	2.16

Source: Table 4, SCMAGLEV Ridership Supplement, December 10, 2018.

Fare Assumptions

The fare costs of each one-way rail, bus and SCMAGLEV trip between Washington, D.C., BWI Marshall Airport and Baltimore are presented in **Table D.4-27**.

Table D.4-27: Fare Assumptions per Trip (2018$)

Mode	Washington, D.C. – Baltimore	Washington, D.C. – BWI Marshall Airport	BWI Marshall Airport – Baltimore
Rail*	$10	$9	$6
Bus	$14	$11	$2
Taxi/TNC**	$75	$63	$29
SCMAGLEV	$60	$45***	$27

Sources: 2050 SCMAGLEV By Market Segment. Baltimore-Washington SCMAGLEV Project Draft Final Ridership Report, June 29, 2018; SCMAGLEV Ridership Report Revenue and Operations Estimates Addendum, October 27, 2018; Amtrak website; Taxirefinder.com
Note: *Rail includes a weighted average based on 2017 ridership of Amtrak Acela, Amtrak regional rail and MARC commuter rail fares. **The travel demand model assumes people would not select the taxi/TNC option when making rounds trips between Washington, D.C. and Baltimore. *** Washington, D.C. to BWI Marshall Airport SCMAGLEV ticket is calculated by share of mileage between the Washington, D.C. to Baltimore.

Net Travel Cost Savings

Compared to the No Build Alternative, between 285 million and 316 million auto VMT are avoided in 2030, and 393 million or 437 million auto VMT are avoided in 2045 (depending on selected Baltimore station) if any of the Build Alternatives are constructed. When the auto VMT avoided per Build Alternatives is multiplied by the average auto operating cost per mile, the annual vehicle cost avoided is calculated. Those savings jointly with the parking fee and toll fee savings would be approximately $229.1 million and $254.0 million in 2030, and $308.3 million and $341.9 million in 2045 per Build Alternative. Since the diverted rider has a fare cost associated with each transit trip, the SCMAGLEV fares (once adjusted for auto occupancy rates) are subtracted from the vehicle costs avoided, parking fee and toll fee savings, resulting in auto travel cost savings under each Build Alternatives compared to the No Build Alternative. The net extra cost associated with SCMAGLEV use for travelers that divert is estimated to be between $432.3 million and $478.8 million in 2030, and $555.2 million and $614.6 million in 2045. Those travelers that divert are willing to pay more for the time savings, reliability, and amenities of the new mode (**Table D.4-28**).

In addition to auto travel cost savings, there are bus, rail and taxi/TNC related travel cost savings from diversions to SCMAGLEV. The difference in fares between existing modes and SCMAGLEV is taken into account to calculate the total net savings (cost). Despite diversions, the number of taxis/TNCs, buses or trains would not decrease once the SCMAGLEV is operational; therefore, the analysis maintains constant their vehicle operating costs.

Table D.4-28: Net Travel Cost Savings (2018$ million)

Cost Description	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
From auto to SCMAGLEV				
Annual vehicle cost avoided (savings)	$116.8	$161.2	$129.6	$179.0
Parking fee cost avoided (savings)	$99.9	$130.9	$110.7	$145.0
Toll fee cost avoided (savings)	$12.4	$16.2	$13.7	$17.9
SCMAGLEV annual fare cost	$(661.4)	$(863.4)	$(732.8)	$(956.5)
Net auto to SCMAGLEV travel cost	$(432.3)	$(555.2)	$(478.8)	$(614.6)
From bus to SCMAGLEV				
Net bus to SCMAGLEV travel cost	$(10.6)	$(12.9)	$(11.1)	$(13.3)
From rail to SCMAGLEV				
Net rail to SCMAGLEV travel cost	$(101.4)	$(124.1)	$(108.0)	$(131.6)
From taxi/TNC to SCMAGLEV				
Net taxi/TNC to SCMAGLEV travel cost	$(8.2)	$(12.1)	$(9.6)	$(14.2)
Total	**$(552.6)**	**$(704.2)**	**$(607.5)**	**$(773.7)**

Source: AECOM analysis.
Note: Items shown in red text and parentheses represent cost losses.

If Cherry Hill Station is selected, the net travel cost savings for the Build Alternatives would be $(552.6) million in 2030 and $(704.2) million in 2045. If Camden Yards Station is selected, the net travel cost savings for the Build Alternatives would be $(604.5) million in 2030 and $(773.7) million in 2045.

D.4D.2.4.4 Monetized Value for Induced Ridership

As reported in the July 27, 2020 ridership report data, the travel demand model estimated that 15-17 percent of the total ridership between the Washington, D.C. and Baltimore market pair, and 34-41 percent of the total ridership between the Washington, D.C. and BWI Marshall Airport market pair are induced riders, or those that would not otherwise take the trip. Because there is economic value to taking a trip, the value of new trips that would not have been made but for the availability of the SCMAGLEV service is assessed.[54] It is estimated that induced riders save half of the auto variable costs per mile following guidance for assessing induced travel. Multiplying the average VMT avoided by the number of diverted riders and half of the auto variable cost per mile results in the induced rider benefit. The total induced user benefit would be between $13.3 million in 2030 and $19.0 million in 2045 if Cherry Hill Station is selected. The total induced user benefit would be $15.3 million in 2030 and $22.3 million in 2045 if Camden Yards Station is selected. (**Table D.4-29**)

[54] Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2020), https://www.transportation.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf

Table D.4-29: Induced Ridership by Year

Item	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Total Induced Ridership	2,718,370	3,709,469	3,144,844	4,360,099
Baltimore – Washington, D.C.	2,156,069	3,036,581	2,494,326	3,569,188
Washington, D.C. – BWI Marshall Airport	562,301	672,888	650,518	790,911
Diverted Ridership (Auto/Taxi)	11,962,684	15,737,832	13,291,477	17,489,675
Total Auto Vehicle Miles Travelled (VMT)	284,918,509	393,149,002	316,108,014	436,566,324
VMT per Diverted Rider	23.82	24.98	23.78	24.96
Auto Operating Costs Avoided per Diverted Rider (2018$)	$9.77	$10.24	$9.75	$10.23
User Benefit per Induced Rider (2018$)	$4.88	$5.12	$4.88	$5.12
Total Induced User Benefit (2018$)	$13,272,553	$18,996,688	$15,332,580	$22,310,983

Source: SCMAGLEV Ridership Data Request, July 27, 2020; Tables 1, 8 and 9, SCMAGLEV Ridership Supplement, December 10, 2018. AECOM analysis.

D.4D.2.4.5 Monetized Value for Changes in Congestion Savings

As drivers divert to SCMAGLEV, congestion is reduced for those that remain on the corridor's roads. This marginal reduction of congestion has value. The FHWA Cost Allocation Study, 2000 Addendum estimates the marginal congestion costs per VMT to be 7.70 cents (2000$) for auto and 24.48 cents (2000$) for 4-axle trucks, both on urban interstate, as shown in **Table D.4-30**. The analysis assumes all trips are on urban interstates.[55] The GDP non-defense capital deflator has been used to convert 2000 dollars into 2018 dollars.

Table D.4-30: Marginal Congestion and Crash Costs from Additional Vehicle Use (cents/vehicle-mile)

Vehicle Class/ Highway Class	Auto/Urban Interstate		40 kip 4-axle S.U. Truck/Urban Interstate	
	2000$	2018$	2000$	2018$
Congestion	¢7.70	¢10.89	¢24.48	¢34.62

Source: FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13. Accessed: http://www.fhwa.dot.gov/policy/hcas/addendum.cfm.

Applying the marginal congestion costs to the annual change in auto and large vehicles (such as buses and trucks) VMT yields the marginal congestion costs avoided for the Build Alternatives. The analysis assumes an average of 40 passengers per 12-year bus to convert annual bus PMT avoided to annual bus VMT avoided.[56] Total congestion savings for the Build Alternatives in 2030 and 2045 would result in $31.1 million and

[55] The Baltimore-Washington Parkway is not an interstate highway, but it is access control. Thus, the analysis classifies it as interstate, instead of rural.
[56] FTA (2007), Useful Life of Transit Buses and Vans, page 10. Accessed https://www.transitwiki.org/TransitWiki/images/6/64/Useful_Life_of_Buses.pdf

$42.9 million respectively if Cherry Hill Station is selected. Total congestion savings for the Build Alternatives in 2030 and 2045 would result in $34.5 million and $47.7 million respectively if Camden Yards Station is selected. **Table D.4-31** summarizes total congestion savings in 2030 and 2045 in 2018 dollars.

Table D.4-31: Congestion Savings

Year	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Auto Vehicle Miles Travelled (VMT) Avoided	284,918,509	393,149,002	316,108,014	436,566,324
Bus VMT Avoided	271,883	336,335	283,435	349,531
Congestion Savings (2018$ million)	$31.1	$42.9	$34.5	$47.7

Source: AECOM analysis

D.4D.2.4.6 Monetized Value for Changes in Pavement Savings

The reduction in auto and bus VMT from the No Build to Build Alternatives reduces the wear and tear on the pavement in the roadways and reduces the marginal cost of pavement. The total pavement savings are calculated by multiplying the VMT avoided by the external cost of pavement from additional automobile/bus use. The FHWA Cost Allocation Study, 2000 Addendum estimates the marginal pavement costs per VMT to be 0.10 cents (2000$) for autos and 3.1 cents (2000$) for large vehicle (such as buses and trucks), as shown in **Table D.4-32**. The analysis assumes all trips are on urban interstates. The GDP non-defense capital deflator has been used to convert 2000 dollars into 2018 dollars.

Table D.4-32: Pavement Costs from Additional Vehicle Use (cents/vehicle-mile)

Vehicle Class/ Highway Class	Auto/Urban Interstate		40 kip 4-axle S.U. Truck/Urban Interstate	
	2000$	2018$	2000$	2018$
Pavement	¢0.10	¢0.14	¢3.1	¢4.38

Source: FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13. Accessed: http://www.fhwa.dot.gov/policy/hcas/addendum.cfm.

Table D.4-33 describes the pavement savings in 2030 and 2045 by multiplying auto and bus VMT avoided and the external cost of pavement from additional automobile use on urban interstates. Total pavement savings for the Build Alternatives if Cherry Hill Station is selected would result in $415,000 and $571,000 in 2030 and 2045 respectively in 2018 dollars. Total pavement savings for the Build Alternatives if Camden Yards Station is selected would result in $460,000 and $633,000 in 2030 and 2045 respectively in 2018 dollars.

Table D.4-33: Pavement Savings by Year

	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Auto Vehicle Miles Travelled (VMT) Avoided	284,918,509	393,149,002	316,108,014	436,566,324
Bus VMT Avoided	271,883	336,335	283,435	349,531
Auto Pavement Savings (2018$)	$402,977	$556,054	$447,090	$617,461
Bus Pavement Savings (2018$)	$11,921	$14,747	$12,427	$15,325
Pavement Savings (2018$)	$414,898	$570,800	$459,517	$632,787

Source: AECOM analysis

D.4D.2.4.7 Monetized Value for Changes in Safety for SCMAGLEV Riders

SCMAGLEV provides an alternative to using congested roads and improves safety for travelers who divert from auto and bus travel while increasing the accessibility for the area's populations to jobs, education, and recreational opportunities. Access to SCMAGLEV would result in auto and bus VMT saved with SCMAGLEV users no longer using autos and buses for some trips in the Build Alternatives compared to the No Build Alternative. This reduces the likelihood of crashes and associated deaths, injuries, and property damage because SCMAGLEV is a safer mode than auto and bus. There is only one record of a MAGLEV train collision in September 2006 in Germany, killing 23 people and injuring 10 people.[57] It is important to mention that the MAGLEV train that crashed was a different technology than the SCMAGLEV proposed between Washington, D.C. and Baltimore. Therefore, this analysis assumes very small zero (i.e. nearly zero) probability of a SCMAGLEV train collision or derailments.

To estimate the reduction in these accidents by severity, the change in auto and bus VMT is multiplied by fatal, injury and property damage only (PDO) national crash rates. The auto crash rates for fatalities and injured persons are found in the 2018 crash national statistics,[58] while the bus crash rates for fatalities and injured persons are found in the 2017 large truck and bus crash national facts.[59]

PDO crashes are based on the average share of fatal, injury, and PDO crashes over 2016-2018 that result in PDO from the same sources. In total, 70.0 percent of auto crashes and 77.2 percent of bus crashes would result in PDO; these shares are held constant throughout the analysis period. These crash rates are shown in **Table D.4-34**.

[57] BBC News article, "Deadly Crash on German Monorail", September 22, 2006. Accessed: http://news.bbc.co.uk/2/hi/europe/5370564.stm
[58] U.S. DOT, NHTSA. Traffic Safety Facts Annual Report Tables. https://cdan.nhtsa.gov/tsftables/tsfar.htm
[59] U.S. DOT. Federal Motor Carrier Safety Administration Analysis Division. "Large Truck and Bus Crash Facts 2017." May 2019. https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/data-and-statistics/461861/ltcbf-2017-final-5-6-2019.pdf

Table D.4-34: Accident Rates

Type of Accident	Unit	Rate
Auto		
Fatalities	Per 100,000,000 VMT	1.13
Injured Persons	Per 100,000,000 VMT	84.00
Property Damage Only	Percent of auto crashes	70.00%
Bus		
Fatalities	Per 100,000,000 VMT	1.81
Injured Persons	Per 100,000,000 VMT	178.48
Property Damage Only	Percent of bus crashes	77.22%

Source: U.S. DOT, NHTSA. Traffic Safety Facts Annual Report Tables. https://cdan.nhtsa.gov/tsftables/tsfar.htm , U.S. DOT. Federal Motor Carrier Safety Administration Analysis Division. "Large Truck and Bus Crash Facts 2017." May 2019. https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/data-and-statistics/461861/ltcbf-2017-final-5-6-2019.pdf

Applying crash reduction factors to the auto and bus VMT avoided results in estimates of annual fatalities and injuries avoided. The value of auto accidents avoided is estimated by applying the value of a statistical life (VSL) as published by the U.S. DOT. The VSL applied in this analysis are summarized in **Table D.4-35**.

Table D.4-35: Value of Accidents Avoided (2018$ millions)

Type of Accident	Value
K- Killed	$9,600,000
U - Injured (severity unknown)	$174,000
PDO per vehicle	$4,400

Source: Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2020)

Safety savings are calculated by applying crash reduction factors to the auto and bus VMT avoided and multiplying by the value of accidents avoided in **Table D.4-36**. The annual accidents avoided by auto and bus and the related cost savings for the Build Alternatives is summarized in **Table D.4-37**. If Cherry Hill Station is selected, under the Build Alternatives, there would be $75.2 million of safety savings in 2030 and $103.7 million in 2045. If Camden Yards Station is selected, under the Build Alternatives, there would be $83.4 million of safety savings in 2030 and $115.2 million in 2045.

Table D.4-36: Annual Auto and Bus Accidents Avoided by MAIS Type

Type of Accident	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Auto VMT Avoided	284,918,509	393,149,002	316,108,014	436,566,324
Reduced Fatalities -- Auto	3.2	4.4	3.6	4.9
Reduced Injuries -- Auto	239.3	330.2	265.5	366.7
Reduced PDO -- Auto	566.1	781.1	628.0	867.4
Bus VMT Avoided	271,882.9	336,334.6	283,435.2	349,530.5
Reduced Fatalities -- Bus	0.0	0.0	0.0	0.0
Reduced Injuries -- Bus	0.5	0.6	0.5	0.6
Reduced PDO -- Bus	1.7	2.1	1.7	2.1
Reduced Fatalities – Auto & Bus	**3.2**	**4.4**	**3.6**	**4.9**
Reduced Injuries – Auto & Bus	**239.8**	**330.8**	**266.0**	**367.3**
Reduced PDO – Auto & Bus	**567.7**	**783.2**	**629.8**	**869.5**

Source: AECOM analysis

Table D.4-37: Cost Savings of Accidents Avoided (2018$)

Type of Accident	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Fatalities	$30,955,307	$42,707,374	$34,340,756	$47,419,583
Injuries	$41,728,124	$57,567,109	$46,290,370	$63,917,082
PDO	$2,498,064	$3,445,947	$2,771,033	$3,825,855
Total Safety Benefits (2018$)	**$75,181,495**	**$103,720,430**	**$83,402,159**	**$115,162,521**

Source: AECOM analysis

D.4D.2.4.8 Monetized Value for Air Quality Gains to SCMAGLEV

The change in auto and bus VMT under the Build Alternatives translates to changes in emissions compared to the No Build Alternative. With auto and bus VMT being removed from the area, the auto and bus emissions are decreasing. Offsetting these, generating the electricity to power the SCMAGLEV incurs in pollution emission. The net emission impacts are calculated next.

Reduction in Auto and Bus Emissions

MOVES 2010a emissions rates for autos and buses for carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM2.5), volatile organic compound (VOC), and carbon dioxide (CO2) are applied to the changes in VMT to estimate the pollutant emissions. Despite diversions from rail, the number of commuter and intercity trains is not projected to decrease once the SCMAGLEV is operational; therefore, the analysis assumes no changes in emissions for trains. **Table D.4-38** displays the air quality emissions factors applied in 2030 and 2045.

Table D.4-38: MOVEs 2010a Emission Rates (grams per VMT)

Mode	CO	NOx	PM2.5	VOC	CO2
2030 Automobile	11.46	0.28	0.01	0.27	434
2045 Automobile	10.26	0.2	0.01	0.21	397
2030 Bus – Diesel	3.26	2.08	0.09	0.24	2854
2045 Bus – Diesel	2.89	1.14	0.03	0.16	2721

Source: Moves 2010a, page 22. Accessed:
http://www.scag.ca.gov/Documents/NSSSFinalPolicyGuidanceAug2013.pdf

The emission rates in grams per mile from **Table D.4-38** are multiplied by the appropriate conversion factor to calculate short tons per mile for each pollutant type, except for carbon dioxide which is in metric tons per U.S. DOT guidance. The tons of emissions per VMT are multiplied by the annual change in auto VMT. The operation of SCMAGLEV results in no emissions, while auto and bus emissions are reduced from fewer VMT. As a result, the tons of auto and bus emissions are multiplied by the economic value of the emissions damage cost from National Highway Traffic Safety Administration guidance as shown in **Table D.4-39**. Because the economic value of carbon dioxide changes over time, the values in 2030 and 2045 are applied.

Table D.4-39: Value of Emissions

Emission Type	2018$
Per short ton	
Carbon Monoxide (CO)	$0
Nitrogen Oxides (NOx)	$8,600
Particulate Matter (PM2.5)	$387,300
Volatile Organic Compounds (VOC)	$2,100
Per metric ton	
Carbon Dioxide (CO2) in 2030	$1
Carbon Dioxide (CO2) in 2045	$2

Source: Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2020)

The overall emissions impact is positive for the Build Alternatives since auto and bus diversions are savings. **Table D.4-40** shows the value of emissions of the Build Alternatives compared to the No Build Alternative for 2030 and 2045. Under the Build Alternatives, if Cherry Hills Station is selected, the emissions savings would total $2.3 million in 2030 and $2.9 million in 2045; if Camden Yards Station is selected, the emissions savings would total $2.5 million in 2030 and $3.3 million in 2045.

Table D.4-40: Auto and Bus Emission Savings (2018$)

Emission Type	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Carbon Monoxide (CO)	$0	$0	$0	$0
Nitrogen Oxides (NOx)	$761,639	$749,035	$844,655	$831,496
Particulate Matter (PM2.5)	$1,226,835	$1,682,759	$1,360,435	$1,868,288
Volatile Organic Compounds (VOC)	$178,228	$191,242	$197,728	$212,353
Subtotal	$2,166,702	$2,623,037	$2,402,818	$2,912,137
Carbon Dioxide (CO2)	$124,431	$313,991	$138,000	$348,536
Mode Shift Emissions Impact	$2,291,133	$2,937,028	$2,540,818	$3,260,673

Source: AECOM analysis

SCMAGLEV Electric Power Emission Calculations

Emissions rates vary by state as reported by the United States Environmental Protection Agency (EPA) for carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) since they are emitted directly through the combustion of fuels in different types of equipment. **Table D.4-41** displays the output emission rates by state.

Table D.4-41: State Output Emission Rates (lb./MWh)

Emission Rate	Washington, D.C.	Maryland
Carbon Dioxide (CO2)	438.874	835.748
Methane (CH4)	0.022	0.081
Nitrous Oxide (N2O)	0.002	0.011

Source: EPA; Table 3. State Output Emission Rates (eGRID2018). Accessed: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

The emission rates in pounds per MWh from **Table D.4-41** are multiplied by the appropriate conversion factors to calculate carbon dioxide in metric tons for Washington, D.C. and Maryland. Then, each emission of CH4 and N2O is multiplied by the respective global warming potential (GWP) to calculate CO2 -equivalent emissions. The GWPs are 25 for CH4 and 298 for N2O, from the Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report (AR4), 2007.[60]

The metric tons of emissions for Washington, D.C. and Maryland are multiplied by the annual power consumption for SCMAGLEV, including energy needed at train stations, ancillary facilities, TFM and maintenance of way (MOW) facilities (**Table D.4-42**).

[60] Releasing 1 kilograms (kg) of CH4 into the atmosphere is about equivalent to releasing 25 kg of CO2, and releasing 1 kg of N2O into the atmosphere is about equivalent to releasing 298 kg of CO2.

Table D.4-42: Total Annual System Consumption (MWh/year)

Use	MWh/year
SCMAGLEV Train	644,644
Train Stations	315,360
Ancillary facilities	81,505
TMF and MOW Facilities	220,000
Total	**1,261,509**

Source: Section 4.19 Energy of the SCMAGLEV DEIS

SCMAGLEV would consume nearly 1,261,500 MWh per year in total, which would be consumed approximately 8 percent in Washington, D.C. and 92 percent in Maryland.[61] Finally, the metric tons of emissions are multiplied by the economic value of the emissions damage cost suggested by U.S. DOT as shown in **Table D.4-43**. Because the economic value of carbon dioxide changes over time, the values in 2030 and 2045 are applied. Under the Build Alternatives, the SCMAGLEV emissions if Cherry Hill Station is selected, would be $459.4 thousand in 2030 and $918.7 thousand in 2045; if Camden Yards Station is selected, the SCMAGLEV emissions would be $460.4 thousand in 2030 and $920.7 thousand in 2045.

Table D.4-43: SCMAGLEV Total Emission

	Unit	Total			
Annual Power Consumption	MWh	1,262,000			
		Cherry Hill		Camden Yards	
	Unit	Washington, D.C.	Maryland	Washington, D.C.	Maryland
Power Supply	%	8.4	91.6	7.9	92.1
	MWh	105,763	1,156,237	100,322	1,161,678
Carbon Dioxide-Equivalent Emissions	Metric Ton/MWh	0.1991	0.3791	0.1991	0.3791
Total Carbon Dioxide-Equivalent Emissions	Metric Ton	21,054	438,319	19,971	440,382
	Unit	2030	2045	2030	2045
Carbon Dioxide (CO2)	Per Metric Ton, 2018$	$1.00	$2.00	$1.00	$2.00
Total SCMAGLEV Emissions	2018$	$459,373	$918,747	$460,353	$920,706

Source: AECOM analysis

Net Emission Savings

Table D.4-44 presents the net emission savings from subtracting SCMAGLEV power generation emissions for the emission savings. The net results are a saving of approximately $1.8 million in 2030 and $2.0 million in 2045, if Cherry Hill Station is

[61] Energy service area map. Accessed: https://oasisenergy.com/maryland/

selected; and approximately $2.1 million in 2030 and $2.3 million in 2045, if Camden Yards Station is selected.

Table D.4-44: Net Emission Savings (2018$)

	Cherry Hill		Camden Yards	
	2030	2045	2030	2045
Auto and Bus Emission Saving	$2,291,132	$2,937,027	$2,540,818	$3,260,672
SCMAGLEV Emission Cost	$459,373	$918,747	$460,353	$920,706
Total	**$1,831,759**	**$2,018,280**	**$2,080,465**	**$2,339,967**

Source: AECOM analysis

D.4D.2.4.9 Impact on The Revenue of Publicly-Provided Rail Service (Amtrak and MARC)

The impact of SCMAGLEV on the three existing passenger rail systems serving the Washington, D.C.-Baltimore Corridor is dependent upon the number of riders that switch from each system. There are three rail systems that could be impacted; the Amtrak Acela, Amtrak regional rail, and the MARC commuter rail system. The fares for these systems vary from $5-$8 one-way for MARC, to $16-$17 for the Amtrak Northeast Regional, to a median fare of $26-$52 for the Amtrak Acela. The Amtrak Acela provides higher speed rail service from Washington, D.C. to Boston, Massachusetts and most of the Amtrak Acela riders originating in Washington, D.C. are traveling to destinations beyond Baltimore. The SCMAGLEV Final Ridership Report dated November 2018 estimates that 98,528 Amtrak Acela riders annually board or alight in Washington, D.C. or Baltimore, and there are approximately 16 Amtrak Acela trains between Washington, D.C. and Baltimore on weekdays.

The MARC Penn Line travels between Washington, D.C. and Perryville Maryland which is 36 miles northeast of Baltimore. The MARC Camden Line travels between Washington, D.C. and Camden Station in Baltimore. The MARC Penn Line has seven stops and the MARC Camden Line has ten stops between Washington, D.C. and Baltimore.

The revenue estimates for the MARC commuter train are based upon annual MARC ridership and the $8 one-way fare for travel between Washington, D.C. and Baltimore, the $5 between Baltimore Penn Station and BWI Marshall Airport and $7 between BWI Marshall Airport and Washington, D.C. The fare chart was last updated in 2015. The MTA issues weekly and monthly passes for MARC transit which lowers the per trip cost based upon the number of trips pass holders take per month. The MARC lines are operated by MTA. The revenue for MARC is not available at the MTA website but MTA published the percentage of operating costs recovered by fares for MARC.
Table D.4-45 shows the ridership, fare and estimated revenue in 2018 for the three Washington, D.C. - Baltimore rail systems.

Table D.4-45: 2017 Rail Ridership and Revenue (2018$)

	Amtrak Acela	Amtrak Regional	MARC Commuter	Total Rail
Washington, D.C. – Baltimore				
2017 Ridership	98,529	273,045	2,737,761	3,109,335
Fare per one-way ticket (2018$)	$52	$17	$8	
Baseline Revenue (2018$)	$5,123,508	$4,553,437	$21,080,760	$30,757,705
Washington, D.C. – BWI Marshall Airport				
2017 Ridership	36,006	99,780	162,943	298,729
Fare per one-way ticket (2018$)	$41	$17	$7	
Baseline Revenue (2018$)	$1,483,475	$1,663,982	$1,091,718	$4,239,175
Baltimore – BWI Marshall Airport				
2017 Ridership	13,296	36,846	60,170	110,312
Fare per one-way ticket (2018$)	$26	$16	$5	
Baseline Revenue (2018$)	$339,118	$578,318	$288,816	$1,206,251

Source: Table 3-10, SCMAGLEV Final Ridership Report, November 8, 2018; SCMAGLEV Ridership Report Revenue and Operations Estimates Addendum, October 25, 2018; AECOM analysis.

Table D.4-46 shows the growth in rail ridership between 2017 and 2030, and between 2017 and 2045 based upon the compound adjusted growth rate.

Table D.4-46: Ridership Forecasted Growth

CARG for Commuter Riders	13-year Growth	28-year Growth
1.0086	1.117755	1.270957

Source: Table 3-13, SCMAGLEV Final Ridership Report, November 8, 2018

Table D.4-47 displays the ridership and revenue for the three rail systems in 2030 and the forecasted revenue loss resulting from passenger diversions to SCMAGLEV. The ridership estimate with SCMAGLEV in 2030 is based upon a 57.3 percent diversion of riders from each of the three rail lines to SCMAGLEV if Cherry Hill Station is selected, and 61.3 percent diversion of riders from each of the three rail lines to SCMAGLEV if Camden Yards Station is selected. In 2030, Amtrak Acela, Amtrak regional rail, and the MARC commuter rail system are expected to accumulate a revenue loss of $23.2 million annually at full build out if Cherry Hill Station is selected, and a revenue loss of $24.8 million annually at full build out if Camden Yards Station is selected.

Table D.4-47: 2030 Rail Ridership and Revenue Loss (2018$)

	Amtrak Acela	Amtrak Regional	MARC Commuter	Total Rail
Cherry Hill				
Washington, D.C. – Baltimore				
Riders without SCMAGLEV	110,131	305,197	3,060,145	3,475,474
Fare per one-way ticket	$52	$17	$8	
Baseline Revenue	$5,726,825	$5,089,626	$23,563,120	$34,379,571
Riders with SCMAGLEV	47,008	130,269	1,306,173	1,483,450
Revenue with SCMAGLEV	$2,444,403	$2,172,424	$10,057,536	$14,674,363
Revenue Loss (1)	$3,282,423	$2,917,202	$13,505,584	$19,705,208
Washington, D.C. – BWI Marshall				
Riders without SCMAGLEV	40,246	111,530	182,130	333,906
Fare per one-way ticket	$41	$17	$7	
Baseline Revenue	$1,658,162	$1,859,924	$1,220,273	$4,738,358
Riders with SCMAGLEV	17,178	47,605	77,739	142,522
Revenue with SCMAGLEV	$707,759	$793,878	$520,854	$2,022,491
Revenue Loss (2)	$950,402	$1,066,045	$699,419	$2,715,867
Baltimore – BWI Marshall				
Riders without SCMAGLEV	14,862	41,185	67,255	123,302
Fare per one-way ticket	$26	$16	$5	
Baseline Revenue	$379,050	$646,417	$322,825	$1,348,293
Riders with SCMAGLEV	6,343	17,579	28,707	52,629
Revenue with SCMAGLEV	$161,792	$275,913	$137,793	$575,497
Revenue Loss (3)	$217,259	$370,505	$185,033	$772,796
Total Revenue Loss (1+2+3)	$(4,450,084)	$(4,353,752)	$(14,390,036)	$(23,193,872)
Camden Yards				
Washington, D.C. – Baltimore				
Riders without SCMAGLEV	110,131	305,197	3,060,145	3,475,474
Fare per one-way ticket	$52	$17	$8	$-
Baseline Revenue	$5,726,825	$5,089,626	$23,563,120	$34,379,571
Riders with SCMAGLEV	42,584	118,010	1,183,259	1,343,853
Revenue with SCMAGLEV	$2,214,377	$1,967,993	$9,111,092	$13,293,461
Revenue Loss (1)	$(3,512,448)	$(3,121,633)	$(14,452,028)	$(21,086,110)
Washington, D.C. – BWI Marshall				
Riders without SCMAGLEV	40,246	111,530	182,130	333,906
Fare per one-way ticket	$41	$17	$7	$-
Baseline Revenue	$1,658,162	$1,859,924	$1,220,273	$4,738,358
Riders with SCMAGLEV	15,562	43,125	70,424	129,110
Revenue with SCMAGLEV	$641,157	$719,172	$471,840	$1,832,169
Revenue Loss (2)	$(1,017,005)	$(1,140,752)	$(748,433)	$(2,906,189)
Baltimore – BWI Marshall				
Riders without SCMAGLEV	14,862	41,185	67,255	123,302

	Amtrak Acela	Amtrak Regional	MARC Commuter	Total Rail
Fare per one-way ticket	$26	$16	$5	$-
Baseline Revenue	$379,050	$646,417	$322,825	$1,348,293
Riders with SCMAGLEV	5,747	15,925	26,005	47,677
Revenue with SCMAGLEV	$146,566	$249,949	$124,826	$521,341
Revenue Loss (3)	$(232,484)	$(396,469)	$(197,999)	$(826,952)
Total Revenue Loss (1+2+3)	$(4,761,937)	$(4,658,854)	$(15,398,461)	$(24,819,251)

Source: AECOM analysis

Table D.4-48 shows the ridership and revenue forecast for the three rail systems in 2045, the last year of the ridership forecast in the Ridership Report. The ridership estimate with SCMAGLEV in 2045 shown is based upon a 63.2 percent diversion of riders from each of the three rail lines to SCMAGLEV, if Cherry Hill Station is selected, and 67.5 percent diversion of riders from each of the three rail lines to SCMAGLEV if Camden Yards Station is selected. May note that the loss is applied equally, but the percentages could come disproportionally from one rail service. In 2045, Amtrak Acela, Amtrak regional rail, and the MARC commuter rail system are expected to accumulate a revenue loss of $29.1 million annually at full build out if Cherry Hill Station is selected, and a revenue loss of $31.1 million annually at full build out if Camden Yards Station is selected.

The projected loses, however, could be offset if the reduction in passengers using MARC and Amtrak rail services results in additional capacity that allows for induced rail ridership by attracting commuters from auto and buses. If there would be no additional demand, then the revenue loss would not be reduced, and the services would run at a lower utilization.

Table D.4-48: 2045 Rail Ridership and Revenue Loss (2018$)

	Amtrak Acela	Amtrak Regional	MARC Commuter	Total Rail
Cherry Hill				
Washington, D.C. – Baltimore				
Riders without SCMAGLEV	125,226	347,029	3,479,578	3,951,832
Fare per one-way ticket	$52	$17	$8	--
Baseline Revenue	$6,511,760	$5,787,224	$26,792,747	$39,091,732
Riders with SCMAGLEV	46,132	127,842	1,281,844	1,455,819
Revenue with SCMAGLEV	$2,398,873	$2,131,960	$9,870,202	$14,401,036
Revenue Loss (1)	$(4,112,888)	$(3,655,264)	$(16,922,545)	$(24,690,696)
Washington, D.C. – BWI Marshall				
Riders without SCMAGLEV	45,762	126,816	207,094	379,672
Fare per one-way ticket	$41	$17	$7	--
Baseline Revenue	$1,885,434	$2,114,850	$1,387,527	$5,387,811
Riders with SCMAGLEV	16,858	46,718	76,291	139,868
Revenue with SCMAGLEV	$694,577	$779,091	$511,152	$1,984,820

	Amtrak Acela	Amtrak Regional	MARC Commuter	Total Rail
Revenue Loss (2)	$(1,190,857)	$(1,335,759)	$(876,375)	$(3,402,991)
Baltimore – BWI Marshall				
Riders without SCMAGLEV	16,899	46,830	76,474	140,202
Fare per one-way ticket	$26	$16	$5	--
Baseline Revenue	$431,004	$735,017	$367,073	$1,533,094
Riders with SCMAGLEV	6,225	17,252	28,172	51,649
Revenue with SCMAGLEV	$158,778	$270,774	$135,226	$564,778
Revenue Loss (3)	$(272,226)	$(464,244)	$(231,847)	$(968,316)
Total Revenue Loss (1+2+3)	$(5,575,971)	$(5,455,266)	$(18,030,766)	$(29,062,003)
Camden Yards				
Washington, D.C. – Baltimore				
Riders without SCMAGLEV	125,226	347,029	3,479,578	3,951,832
Fare per one-way ticket	$52	$17	$8	--
Baseline Revenue	$6,511,760	$5,787,224	$26,792,747	$39,091,732
Riders with SCMAGLEV	40,719	112,842	1,131,443	1,285,005
Revenue with SCMAGLEV	$2,117,408	$1,881,813	$8,712,113	$12,711,335
Revenue Loss (1)	$(4,394,352)	$(3,905,411)	$(18,080,634)	$(26,380,397)
Washington, D.C. – BWI Marshall				
Riders without SCMAGLEV	45,762	126,816	207,094	379,672
Fare per one-way ticket	$41	$17	$7	--
Baseline Revenue	$1,885,434	$2,114,850	$1,387,527	$5,387,811
Riders with SCMAGLEV	14,880	41,236	67,340	123,457
Revenue with SCMAGLEV	$613,081	$687,679	$451,178	$1,751,937
Revenue Loss (2)	$(1,272,353)	$(1,427,171)	$(936,349)	$(3,635,874)
Baltimore – BWI Marshall				
Riders without SCMAGLEV	16,899	46,830	76,474	140,202
Fare per one-way ticket	$26	$16	$5	--
Baseline Revenue	$431,004	$735,017	$367,073	$1,533,094
Riders with SCMAGLEV	5,495	15,227	24,867	45,589
Revenue with SCMAGLEV	$140,148	$239,003	$119,360	$498,511
Revenue Loss (3)	$(290,856)	$(496,014)	$(247,713)	$(1,034,583)
Total Revenue Loss (1+2+3)	$(5,957,561)	$(5,828,596)	$(19,264,697)	$(31,050,854)

Source: AECOM analysis

D.4D.2.5 Long-Term (Recurring) Market Reponses

Over time, the market would respond to the availability of the SCMAGLEV service. There are four elements to the market response; property premium,[62] fiscal impacts from acquisitions, agglomeration economies,[63] and labor market impacts.

D.4D.2.5.1 Property Premium

SCMAGLEV provides the properties surrounding station entrances with improved access to Washington, D.C. and Baltimore regional economy. Regional access is impacted most for those areas within walking distance of a station, generally approximated as being within ½-mile radius of a station. As many businesses and people often desire to be closer to transportation access, residents and commercial enterprises would be willing to pay a premium for locations proximate to SCMAGLEV.. Empirical research on the economic impact of transit access and the value of walkable community centers indicates that there are often positive impacts on property values associated with such investments.

Parcel record shapefiles obtained from Washington, D.C. and Maryland provide assessments of property values for parcels within a ¼-mile and ½-mile radius of the proposed transit stations. A property premium based on empirical research on property value outcomes in other locations is applied to the base parcel values. Studies have shown that an increase in property values near transit lines can range from 2 percent to over 167 percent, depending on the property type, transit mode, and proximity.[64]

For this analysis, the premium applied varies from station to station, depending on the level of development and existing availability of transportation infrastructure. The analysis assumes no changes in property premium in the ½-mile radius around the BWI Marshall Airport station as it is largely surrounded by airport functions. As **Figure D.4-7** shows, Mount Vernon Square and Camden Yards Stations are located in heavily developed downtowns and a variety of land uses, while the Cherry Hill Station is located in a less densely developed location with fewer existing transit options. Therefore, it is assumed that properties around Cherry Hill Station would experience a greater property premium than properties around Camden Yards and Mount Vernon Square Stations. The premium applied to properties around Cherry Hill Station is sourced from a study on an intercity passenger train service between New Orleans and Baton Rouge, and amounted to 8.5 percent for the first ¼-mile radius from a station, and 4 percent for the area between ¼-mile and ½-mile radii of a station.[65] For Mount Vernon Square and

[62] Property premium is the increase in property value resulting from improved access to local economic opportunities (e.g. better transit access to business center)
[63] Agglomeration economies are the benefits that come when firms and people locate near one another together in cities and industrial clusters. These benefits come from transport cost savings, as well as knowledge spillovers. E. L. Glaser (February 2010). Agglomeration Economics. The University of Chicago Press. Accessed at https://www.nber.org/chapters/c7977.pdf.
[64] Center for Transit-Oriented Development, Capturing the Value of Transit, November 2008, page 10. Accessed: http://www.reconnectingamerica.org/assets/Uploads/ctodvalcapture110508v2.pdf
[65] Baton Rouge – New Orleans Intercity Passenger Rail Summary Report, December 2010, page 8.27. Accessed: http://www.norpc.org/assets/pdf-documents/studies-and-plans/BR-NO_Pass_Rail-Vol-1_2010.pdf

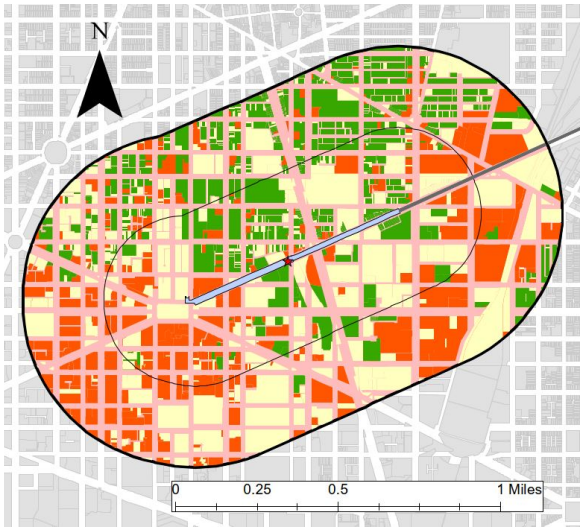
Camden Yards Stations, a property premium of 4 percent is applied for the first ¼ -mile radius from a station, and 2 percent for the area between ¼-mile and ½-mile radii of a station.

This analysis conservatively applies to existing properties only, and does not predict higher or denser uses (i.e., existing houses would not be torn down and replaced with condo buildings). It is assumed that these land gains are realized over a two-year period between 2028 (in anticipation of opening) and 2030 as the system comes into operation and the market responds to its availability.

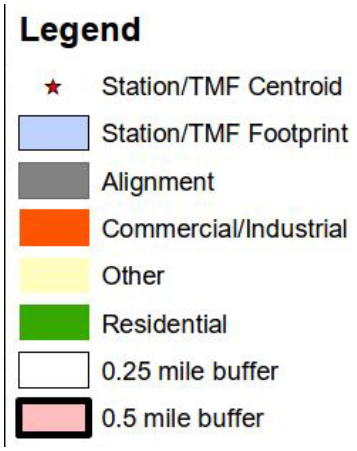
The appraised value of properties within a ½-mile radius of a station in the Build Alternatives amounted to a value of over $49 billion (based on 2020 assessed values, discounted to 2018 dollars) for Washington, D.C., and Baltimore City. The impacted properties were identified by buffering ¼-mile and ½-mile radii around planned station locations. **Table D.4-49** displays the property premium around each station.

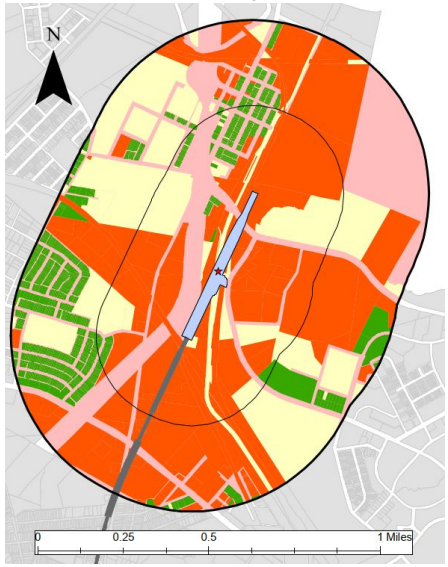
The increase in property values immediately adjacent to the Build Alternatives' stations results in an increase in the tax base for Washington, D.C., Maryland, and Baltimore City, which translates into an increase in the annual property tax revenues received by the district, state, and city. An estimate of the potential increase in annual property tax revenues associated with existing properties (does not include any new development or large-scale redevelopment projects in the corridor) is also presented in **Table D.4-49**.

Figure D.4-7: Property Types around Potential Stations

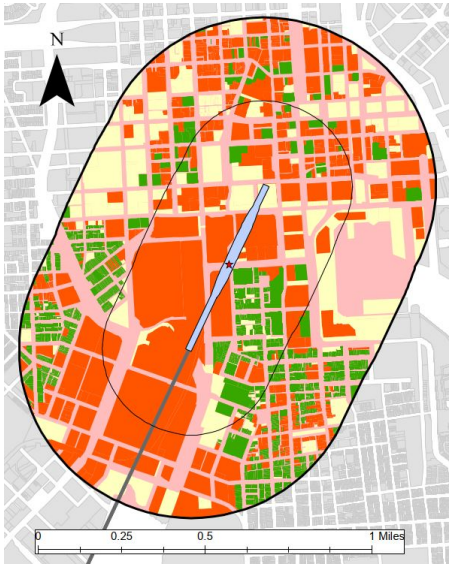


Mount Vernon Square Station





Cherry Hill Station



Camden Yards Station

Source: AECOM analysis

Table D.4-49: Property Premium and Annual Tax Revenue Impact around Proposed SCMAGLEV Stations (2018$, thousand)

Station	Residential	Commercial	Other	Total
Mount Vernon Square Station (Washington, D.C.)				
Quarter-Mile Radius				
Assessed Value	$3,212,770	$7,705,160	$3,462,670	$14,380,600
Property Premium	$128,510	$308,210	$138,510	$575,220
Tax Revenue from Premium	$860	$5,290	$610	$6,760
Half-Mile Radius (Contains Quarter-Mile Radius Totals)				
Assessed Value	$6,976,060	$25,622,020	$8,793,390	$41,391,480
Property Premium	$203,780	$666,540	$245,120	$1,115,440
Tax Revenue from Premium	$1,350	$10,970	$1,120	$13,440
Cherry Hill Station (Baltimore)				
Quarter-Mile Radius				
Assessed Value	$16,200	$51,280	$28,450	$95,930
Property Premium	$1,380	$4,360	$2,420	$8,150
Tax Revenue from Premium	$30	$100	$0	$140
Half-Mile Radius (Contains Quarter-Mile Radius Totals)				
Assessed Value	$75,500	$105,780	$51,550	$232,830
Property Premium	$3,750	$6,540	$3,340	$13,630
Tax Revenue from Premium	$90	$150	$0	$240
Camden Yards Station (Baltimore)				
Quarter-Mile Radius				
Assessed Value	$928,770	$2,165,410	$550,290	$3,644,480
Property Premium	$37,150	$86,620	$22,010	$145,780
Tax Revenue from Premium	$830	$1,440	$10	$2,280
Half-Mile Radius (Contains Quarter-Mile Radius Totals)				
Assessed Value	$1,959,170	$3,524,160	$3,021,820	$8,505,150
Property Premium	$57,760	$113,790	$71,440	$242,990
Tax Revenue from Premium	$1,270	$1,790	$20	$3,080

Source: AECOM analysis

In addition to stations, the TMF would store the SCMAGLEV rolling stock (i.e. transit vehicle such as SCMAGLEV cars, as well as vehicles used to support the SCMAGLEV services) and would house rounds the clock operations and maintenance services. Externalities such as noise and vibrations that would be present at these facilities would have an impact on values of surrounding properties. However, judging by the planned locations of these maintenance facilities, the likely impact would be small. As seen in **Figure D.4-8**, TMF BARC Airstrip and TMF BARC West have a few residential developments nearby. TMF BARC Airstrip and TMF BARC West are located in the vicinities of government owned lands, which are exempt on property taxes; therefore, any impact on property value would not translate in tax collection impacts for the region.

TMF MD 198 is in an area that lacks dense development, thus minimizing the impact on existing properties.

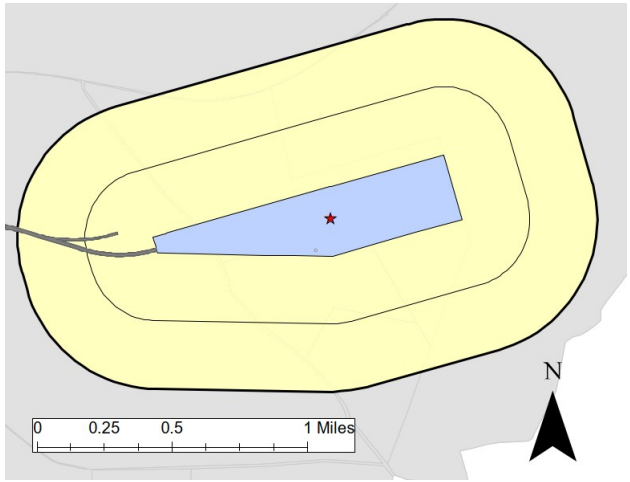
Based on the aforementioned findings, it is assumed that a property premium of -1 (negative one) percent would affect all properties within ½- mile of each TMF alternative. The real impact may be larger than -1 percent at TMF MD 198, however the property tax revenue lost at 5 percent is still insignificant. Moreover, it may be possible to mitigate the disturbance with a second wall. **Table D.4-50** shows the estimated change in property value and property tax revenue by TMF alternative. The annual tax revenue impact around TMF BARC West is estimated to be negative $7,000, while the revenue impact around TMF MD 198 is estimated to be negative $19,000. Since the TMF BARC Airstrip is currently on exempt properties, the estimated annual tax revenue impact is zero.

Table D.4-50: Property Premium Impact of TMF BARC Airstrip, TMF BARC West and TMF MD 198 (2018$)

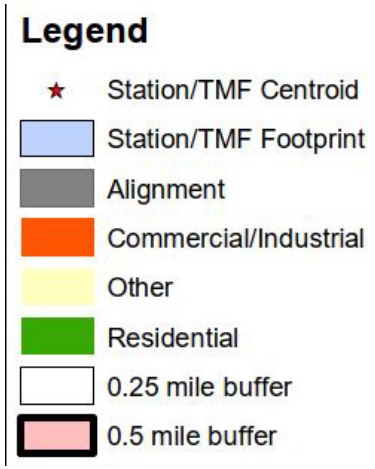
Transit Maintenance Facility	Total Value	Total Taxable Value	Estimated Change in Property Value	Estimated Change in Property Tax Revenue*
BARC Airstrip	$276,948,000	$0	$(2,769,000)	$0
BARC West	$281,579,000	$46,171,000	$(2,816,000)	$(7,000)
MD 198	$211,498,000	$177,748,000	$(2,115,000)	$(19,000)

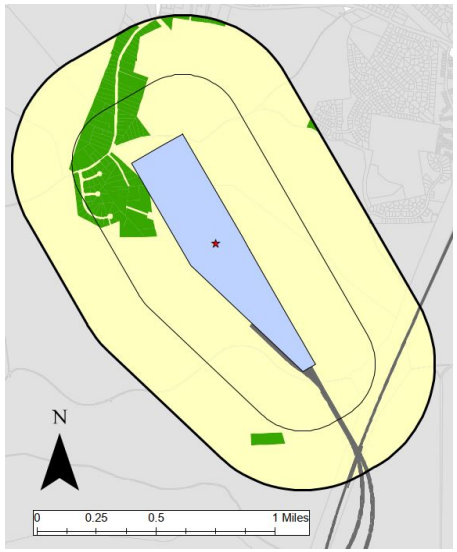
Source: AECOM analysis
Note: *Estimated tax revenue loss for TMF BARC Airstrip and TMF BARC West include the State of Maryland and Prince George's County property taxes, while TMF MD 198 includes the State of Maryland and Anne Arundel County property taxes. Items shown in red text and parenthesis represent cost losses as lost funds.

Figure D.4-8: Property Types around TMF BARC Airstrip, TMF BARC West and TFM MD 198

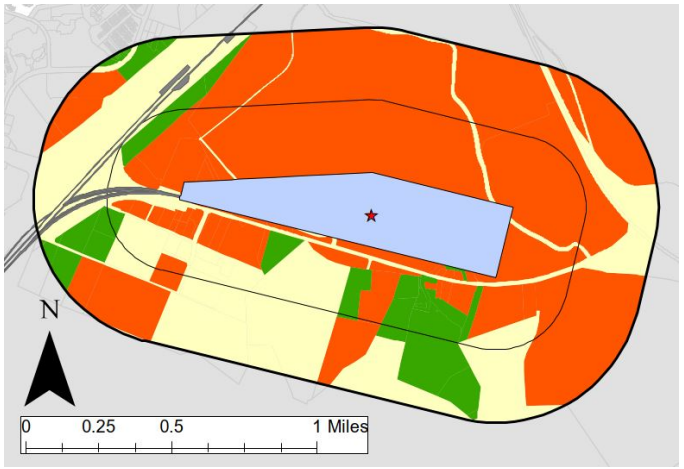


TMF BARC Airstrip





TMF BARC West



TMF MD 198

Source: AECOM analysis

Collectively, the property premium impact from the project would be between $1.13 billion and $1.36 billion. This represents a wealth impact for the property owners near the stations. **Table D.4-51** shows the property premium impact by option.

Table D.4-51: Property Premium Impact by Alternatives (2018$ millions)

Option	Align-ment	Stations				TMF			Total Property Premium
		MVS	BWI	Cherry Hill	Camden Yards	MD 198	BARC Airstrip	BARC West	
Alignment J									
J-01	$0.0	$1,115.4	$0.0	$13.6	-	$(2.1)	-	-	$1,127.0
J-02	$0.0	$1,115.4	$0.0	$13.6	-	-	$(2.8)	-	$1,126.3
J-03	$0.0	$1,115.4	$0.0	$13.6	-	-	-	$(2.8)	$1,126.3
J-04	$0.0	$1,115.4	$0.0	-	$243.0	$(2.1)	-	-	$1,356.3
J-05	$0.0	$1,115.4	$0.0	-	$243.0	-	$(2.8)	-	$1,355.7
J-06	$0.0	$1,115.4	$0.0	-	$243.0	-	-	$(2.8)	$1,355.6
Alignment J1									
J1-01	$0.0	$1,115.4	$0.0	$13.6	-	$(2.1)	-	-	$1,127.0
J1-02	$0.0	$1,115.4	$0.0	$13.6	-	-	$(2.8)	-	$1,126.3
J1-03	$0.0	$1,115.4	$0.0	$13.6	-	-	-	$(2.8)	$1,126.3
J1-04	$0.0	$1,115.4	$0.0	-	$243.0	$(2.1)	-	-	$1,356.3
J1-05	$0.0	$1,115.4	$0.0	-	$243.0	-	$(2.8)	-	$1,355.7
J1-06	$0.0	$1,115.4	$0.0	-	$243.0	-	-	$(2.8)	$1,355.6

Source: AECOM analysis.
Note: Items shown in red text and parenthesis represent cost losses as lost funds.

Collectively, the impact on tax revenue from the property premium is estimated to be between $13.7 million and $16.5 million per year. **Table D.4-52** shows the tax revenue impact of property premium by option.

Table D.4-52: Tax Revenue from Property Premium by Alternatives (2018$ thousands)

Option	Align-ment	Stations				TMF			Total Tax
		MVS	BWI	Cherry Hill	Camden Yards	MD 198	BARC Airstrip	BARC West	
Alignment J									
J-01	$0	$13,440	$0	$240	-	$(19)	-	-	$13,661
J-02	$0	$13,440	$0	$240	-	-	$0	-	$13,680
J-03	$0	$13,440	$0	$240	-	-	-	$(7)	$13,673
J-04	$0	$13,440	$0	-	$3,080	$(19)	-	-	$16,501
J-05	$0	$13,440	$0	-	$3,080	-	$0	-	$16,520
J-06	$0	$13,440	$0	-	$3,080	-	-	$(7)	$16,513
Alignment J1									
J1-01	$0	$13,440	$0	$240	-	$(19)	-	-	$13,661

Option	Align-ment	Stations				TMF			Total Tax
		MVS	BWI	Cherry Hill	Camden Yards	MD 198	BARC Airstrip	BARC West	
J1-02	$0	$13,440	$0	$240	-	-	$0	-	$13,680
J1-03	$0	$13,440	$0	$240	-	-	-	$(7)	$13,673
J1-04	$0	$13,440	$0	-	$3,080	$(19)	-	-	$16,501
J1-05	$0	$13,440	$0	-	$3,080	-	$0	-	$16,520
J1-06	$0	$13,440	$0	-	$3,080	-	-	$(7)	$16,513

Source: AECOM analysis
Note: Items shown in red text and parenthesis represent cost losses as lost funds.

The difference among the Build Alternatives options is not large, with all Build Alternatives generating material benefits in terms of property premium and the tax revenue generated from it.

There is also the potential for Transit-Oriented Development (TOD) around Cherry Hill Station (in the Westport area) and may be intensified in the Mount Vernon Square and Camden Yards Station areas, which is different from the property premium impact analysis mentioned above. TOD considers the potential for new development, while the property premium impact considers the potential for existing properties to gain value. The new SCMAGLEV stations represent new access points to the larger region transportation network, making them attractive for new or intensified development. Studies of this market response have found that the magnitude of new development varies widely with local conditions such as zoning, mix of business and non-business travelers, ability to assemble parcels, and other neighborhood amenities.[66,67] While some of the development around the station may be new to the local economy, some of the development around the station could be simply a transfer from another location in the same market attracted by the new station's access. As an example, development that was already slated for the Brooklyn or Westport neighborhoods in Baltimore in might shift to Cherry Hill if the SCMAGLEV system were constructed with a terminus there. The development would still within Baltimore; it is simply moving to the SCMAGLEV station to take advantage of the accessibility provided by the SCMAGLEV station. The magnitude of change in TOD activity attributable to the SCMAGLEV has not been estimated as it depends on many factors beyond the scope of this assessment, such as zoning, ability to assemble land, support infrastructure, among other factors.

Potential Gentrification and Displacement Impacts

Triggered by the SCMAGLEV investment, the Baltimore and Washington, D.C. economies would be much more accessible to one another—a quick trip downtown to downtown—faster than most residents' commutes today. This would allow some workers in Washington, D.C. to locate in Baltimore where housing costs are much

[66] Center for Transit-Oriented Development, Capturing the Value of Transit, November 2008, page 10. Accessed: http://www.reconnectingamerica.org/assets/Uploads/ctodvalcapture110508v2.pdf
[67] Baton Rouge – New Orleans Intercity Passenger Rail Summary Report, December 2010, page 8.27. Accessed: http://www.norpc.org/assets/pdf-documents/studies-and-plans/BR-NO_Pass_Rail-Vol-1_2010.pdf

lower. This would increase demand for Baltimore housing in areas readily accessible to the SCMAGLEV stations and drive up housing costs. This cause of neighborhood ascent is understood as "gentrification," the influx of middle or upper income residents to the neighborhood, drawn by low and appreciating house prices, a desire for urban amenities and lifestyle, and accommodated by improvements in negative social conditions such as crime or poor schools.

For those who own the affected housing stock, these price increases would serve as a wealth effect—an existing asset would become more valuable. For renters, however, the impacts are far less favorable as rents would increase and building owners would have increasing incentives to redevelop at a higher density or to convert the apartments to condos. Renters would eventually find the higher rents unaffordable and relocate to other neighborhoods—effectively displaced. The literature on gentrification and displacement largely relies on qualitative analysis—comparatively few studies have quantitatively modeled the process of neighborhood ascent and even fewer have formally assessed causation.[68] As a result, this discussion considers the gentrification issue qualitatively with an emphasis on mitigation.

A 2001 study of the gentrification issue identified the following predictive factors: a) high rate of renters, b) ease of access to job centers, c) high and increasing levels of metropolitan congestion, d) high architectural value, e) comparatively low housing values, f) high job growth, g) constrained housing supply, h) large rent gap, i) urban amenities, j) targeted public sector policies (e.g., tax incentives, public housing revitalization, construction of transit facilities, disposition of city owned properties, code enforcement, etc.), and k) growing preference for urban amenities.[69]

As noted in the discussion of existing conditions, many of these factors are now or would be present with the construction of the SCMAGLEV system. These include: a high rate of renters (in some neighborhoods), ease of access to job centers, rising congestion in the Baltimore-Washington metro area, low housing values in Baltimore neighborhoods, a large rent gap between Baltimore City and Washington, D.C., construction of transportation infrastructure, and urban amenities. Thus, it is reasonable to expect that many Baltimore neighborhoods would experience gentrification and resident households may feel pressure to relocate.

Of note, Baltimore City is already experiencing gentrification even without the availability of the SCMAGLEV system. The National Community Reinvestment Coalition periodically conducts studies of urban gentrification. The Coalition's study concluded that Baltimore City was one of the U.S. cities most affected by gentrification between 2000 and 2013. In a follow up study that examined the 2013-2017 time period, the impact of gentrification had lessened, highlighting that these neighborhood processes

[68] A working paper by Miriam Zuk, Ariel H. Bierbaum, Karen Chapple, Karolina Gorska, Anastasia Loukaitou-Sideris, Paul Ong, and Trevor Thomas entitled "Gentrification, Displacement and the Role of Public Investment: A Literature Review," March 3, 2015 offers a comprehensive overview of the issues and qualitative analysis to date. Available at https://www.urbandisplacement.org/sites/default/files/images/displacement_lit_review_final.pdf

[69] Kennedy, Maureen, and Paul Leonard. 2001. Dealing with Neighborhood Change: A Primer on Gentrification and Policy Choices. The Brookings Institution and PolicyLink.

vary in their intensity over time.[70] It is likely that SCMAGLEV operation would intensify gentrification and displacement pressures. For complementary qualitative discussion on potential gentrification impacts, please see Section 4.4 Neighborhoods and Section 4.5 Environmental Justice.F

D.4D.2.5.2 Fiscal and Social Impact from Acquisitions

Property tax revenues are an important funding source for Baltimore City, Baltimore County, Anne Arundel County, Prince George's County and Washington, D.C. to meet their operating, debt service, and capital obligations. Construction of the SCMAGLEV requires the acquisition of some existing properties and possible changes in the properties' tax treatment in these jurisdictions.

The annual tax revenue associated with potential property acquisitions due to ROW purchases, displacement, and relocation is determined by first identifying the actual properties required for the project. The property acquisitions that would be required under the Build Alternatives are identified using GIS mapping and the preliminary engineering ROW plans.

Using parcel data from the latest Assessor's Offices for Maryland and District of Columbia, this section identifies the existing use of the "to be" acquired properties and whether part of each property or the full property would be acquired. If assessor's data are not in 2018 dollars, the analysis converts the values to 2018 dollars by applying the GDP non-defense capital deflator.

Quantifying the quantity and size of land acquired allows us to derive the associated lost or gained tax revenue (if any) for the local counties. The percentage of each property parcel that is acquired for the project is provided for the analysis. For acquisitions of greater than 33 percent, it is assumed that the existing improvement (or structure) on the property would be impacted by full ROW acquisition. Therefore, the entire value of the existing improvement (or structure) is removed and the acquisition percentage is applied to the land value.

The assessed value of the acquisitions required for each alternative and the tax rates for each city and county are used for the purpose of estimating the annual property tax revenues lost or gained due to these acquisitions by city. The assessed value of each property prior to and after the acquisition is estimated to derive the pre-acquisition and post-acquisition taxable value for each property and serves as the basis for calculating the tax revenue from these properties pre- and post-acquisition. The difference between the pre- and post-acquisition property values amounts to the taxable value removed from the tax base. Similarly, the difference between pre- and post-acquisition tax revenue amounts to the tax revenue lost because of the Project (negative tax revenue

[70] National Community Reinvestment Coalition.2019. "Shifting Neighborhoods: Gentrification and cultural displacement in American cities," Jason Richardson, Bruce Mitchell, and Juan Franco. Accessed at: https://ncrc.org/gentrification/

impact). **Table D.4-53** and **Table D.4-54** show the property acquisition impacts for each of the propose Build Alternatives.

Table D.4-53: SCMAGLEV Fiscal Acquisition Impacts for Build Alternatives J (2018$)

Jurisdiction*	Property Value Impact	Tax Impact	Percent of Tax Revenue (County and City)	Percent of Tax Revenue (MD only)
Alignment J				
Option J-01				
Anne Arundel County	$35,649,000	$(477,000)	0.062%	0.013%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$21,106,000	$(127,000)	0.013%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$352,647,000	$(5,517,000)	-	-
Option J-02				
Anne Arundel County	$12,915,000	$(148,000)	0.019%	0.011%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$69,724,000	$(127,000)	0.013%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$378,532,000	$(5,187,000)	-	-
Option J-03				
Anne Arundel County	$12,915,000	$(148,000)	0.019%	0.011%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$35,593,000	$(129,000)	0.013%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$344,400,000	$(5,188,000)	-	-
Option J-04				
Anne Arundel County	$35,649,000	$(477,000)	0.062%	0.008%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$20,731,000	$(121,000)	0.012%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$483,721,000	$(4,538,000)	-	-
Option J-05				
Anne Arundel County	$12,915,000	$(148,000)	0.019%	0.005%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$69,724,000	$(127,000)	0.013%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$509,980,000	$(4,215,000)	-	-
Option J-06				
Anne Arundel County	$12,915,000	$(148,000)	0.019%	0.005%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$35,593,000	$(129,000)	0.013%	

Jurisdiction*	Property Value Impact	Tax Impact	Percent of Tax Revenue (County and City)	Percent of Tax Revenue (MD only)
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$475,848,000	$(4,216,000)	-	-

Note: Maryland county impacts include tax impacts to city within the county limits, where applicable. Items shown in red text and parenthesis represent cost losses as lost funds.

Table D.4-54: SCMAGLEV Fiscal Acquisition Impacts for Build Alternatives J1 (2018$)

Jurisdiction*	Property Value Impact	Tax Impact	Percent of Tax Revenue (County and City)	Percent of Tax Revenue (MD only)
Alignment J1				
Option J1-01				
Anne Arundel County	$56,835,000	$(501,000)	0.065%	0.013%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$15,120,000	$(56,000)	0.006%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$367,848,000	$(5,468,000)	-	-
Option J1-02				
Anne Arundel County	$11,935,000	$(144,000)	0.019%	0.010%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$61,472,000	$(41,000)	0.004%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$369,301,000	$(5,097,000)	-	-
Option J1-03				
Anne Arundel County	$11,935,000	$(144,000)	0.019%	0.010%
Baltimore City	$56,563,000	$(1,201,000)	0.121%	
Baltimore County	$11,729,000	$(142,000)	0.013%	
Prince George's County	$27,641,000	$(41,000)	0.004%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$335,470,000	$(5,097,000)	-	-
Option J1-04				
Anne Arundel County	$56,835,000	$(501,000)	0.065%	0.007%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$15,120,000	$(56,000)	0.006%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$499,296,000	$(4,497,000)	-	-
Option J1-05				
Anne Arundel County	$11,935,000	$(144,000)	0.019%	0.004%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$61,472,000	$(41,000)	0.004%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$500,749,000	$(4,125,000)	-	-

Jurisdiction*	Property Value Impact	Tax Impact	Percent of Tax Revenue (County and City)	Percent of Tax Revenue (MD only)
Option J1-06				
Anne Arundel County	$11,935,000	$(144,000)	0.019%	0.004%
Baltimore City	$188,012,000	$(230,000)	0.023%	
Baltimore County	$11,728,000	$(142,000)	0.013%	
Prince George's County	$27,641,000	$(41,000)	0.004%	
Washington, D.C.	$227,601,000	$(3,568,000)	0.133%	-
Total Impact	$466,918,000	$(4,125,000)	-	-

Note: Maryland county impacts include tax impacts to city within the county limits, where applicable. Items shown in red text and parenthesis represent cost losses as lost funds.

Across all Build Alternatives, the expected negative tax impact to the jurisdictions would be minimal, amounting less than 0.2 percent for any of the jurisdictions. The magnitude of the tax base loss is less than one year's average annual rate of growth in the tax base. This would not result in any impact to the jurisdictions' abilities to provide public resources and maintain assets.

If Federal funding is used or the government's power of eminent domain is used to overcome involuntary acquisitions, the ROW acquisition and relocation assistance program would be conducted in accordance with the Uniform Relocation Assistance and Real Properties Acquisition Policies Act of 1970, as amended (42 USC § 4601 *et seq.)*, commonly known as the Uniform Relocation Act. This act identifies the process, procedures, and timeframe for ROW acquisition and relocation of affected residents or businesses. The requirements of the Uniform Relocation Act apply whenever a project uses Federal dollars in any phase of a project. In addition, the states receiving Federal-aid funding from the Highway Trust Fund are required to maintain (updated every five years) a manual outlining their ROW policies and procedures as outlined in Title 23 CFR.

Although SCMAGLEV would be owned and operated by a private entity, and thus taxed, the tax base loss analysis was completed as there are several uncertainties concerning its taxation. In November 2015, the Project Sponsor, Baltimore-Washington Rapid Rail/The Northeast Maglev (BWRR/TNEM),[71] received a railroad franchise by the Maryland Public Service Commission.[72] The franchise tax in Maryland is typically calculated on a percentage of the revenues derived from sales of the utility company to customers in the service area or territory. The franchise tax is applied to public service companies[73] such as gas, electric, and telephone for the privilege of doing business in Maryland. The franchise tax is calculated in part as a percentage (2 percent) of the

[71] The Project Sponsor, BWRR/TNEM, is registered as a Domestic LLC, with Business Code 20 (Entities Other Than Corporations). Accessed: https://www.marylandtaxes.gov/business/income/tax-information.php
[72] "Baltimore Washington Rapid Rail and The Northeast Maglev Announce Approval of Railroad Franchise Request by the Maryland Public Service Commission" announcement, November 17, 2015. Accessed: https://bwrapidrail.com/wp-content/uploads/2017/01/20151117-TNEM-BWRR-Baltimore-Washington-Rapid-Rail-and-The-Northeast-Maglev-Announce-Approval-of-Railroad-Franchise-Request-by-the-Maryland-Public-Service-Commission.pdf
[73] A "public service company" is an entity engaged in telephone business in the State or engaged in the transmission, distribution, or delivery of electricity or gas in Maryland. Maryland Code Tax-General §8-401-417.

gross receipts derived from businesses in Maryland.[74] Since Washington, D.C. does not currently have laws that describe how the Project Sponsor would be taxed, the analysis does not include the tax revenue that jurisdictions would receive from the SCMAGLEV.

There are also social impacts from the acquisitions. Residents may require relocation to accommodate the Project. There have been 2,597 listings (single-family and townhomes) in Baltimore City over 24 months ending in July 21, 2020. In the District, the active listings was 803 over the 24 months ending in July 21, 2020.[75] Forecasts are not publicly available. Private property owners could be compensated at market value for land and would be eligible for additional benefits.

As for renters, the Department of Housing and Urban Development (HUD) considers anything under a 6 percent rental vacancy rate as a "tight" rental market (i.e., replacement rental housing may be difficult to locate). The overall rental vacancy rate, which includes single-family homes and apartments, in Washington, D.C. and Baltimore City were 7.5 percent and 13.5 percent respectively.[76]

The three largest real estate research firms that monitor the Baltimore MSA market, REIS, the United States Commercial Real Estate Services (CBRE), and Costar Group, Inc, project that overall multifamily vacancies will range between 4 percent and 7 percent between 2020 and 2022.[77] By contrast, in the Washington, D.C. MSA multifamily market, the vacancy rate is expected to range between 4 percent and 6 percent over the period between 2020 and 2022, and 4 percent to 7 percent between 2020 and 2023.[78] In the year of 2019, there were 4,963 and 1,994 multifamily housing opportunities created in Washington, D.C. and Baltimore City respectively, with 13,900 and 5,373 respectively under construction and more planned over the next three years,[79] all looking to accommodate perspective residents in the area.

While residential relocations are sensitive because they may alter households' school and commute patterns, FRA also anticipates commercial acquisitions as a result of the Project (see Section 4.03 Land Use and Zoning in the DEIS). None of the acquisitions along the SCMAGLEV alignments are sufficiently unique in its commercial activity that the business could not find comparable building, resource, and transportation access elsewhere in the same jurisdiction. Both the Washington, D.C. MSA and Baltimore MSA markets have active retail, office, and warehouse sectors and could readily accommodate the change in commercial address.

As illustrated in **Table D.4-55**, for the six options under Build Alternatives J, the number of residential parcels (including single and multifamily) impacted ranges from 15 (Option

[74] State of Maryland, Public Utility Valuation and Franchise Tax Unit. Accessed https://dat.maryland.gov/businesses/Pages/franchise-and-public-utilities.aspx
[75] Zillow Homes. researched July 21, 2020. https://www.zillow.com/homes/
[76] HUD Comprehensive Housing Market Analysis. Washington, D.C. vacancy rate was reported on July 1, 2018; Baltimore City vacancy rate was reported on June 1, 2018.
[77] Multifamily Metro Outlook: Baltimore Winter 2019. Fannie Mae 2018. 2022 projection was the latest number reported.
[78] Multifamily Metro Outlook: Washington Spring 2019. Fannie Mae 2019.
[79] Trends in the Mid-Atlantic Multifamily Market. CBRE 2020

J-04) to 20 (Options J-02, J-03); the number of commercial parcels impacted ranges from 127 (Options J-05, J-06) to 188 (Option J-01); the number of industrial parcels impacted ranges from 17 (Options J-04, J-05, J-06) to 60 (Options J-01, J-02, J-03). For the six options under Build Alternatives J1 (see and **Table D.4-56**), the number of residential parcels (including single and multifamily) impacted ranges from 18 (Option J1-04) to 31 (Options J1-02, J1-03); the number of commercial parcels impacted ranges from 123 (Options J1-05, J1-06) to 185 (Option J1-01); the number of industrial parcels impacted ranges from 13 (Options J1-04, J1-05, J1-06) to 56 (Options J1-01, J1-02, J1-03).

Table D.4-55: Impacted Acreage and Parcel Counts by Land Use for Build Alternatives J

Land Use	Anne Arundel County		Baltimore City		Baltimore County		Prince George's County		Washington, D.C.		Total	
	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels
Alignment J												
Option J-01												
Single Family	0.9	7	0.0	3	0.0	0	3.7	5	0.0	2	4.6	17
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	15.9	29	96.3	37	0.0	5	9.0	8	82.1	109	203.2	188
Industrial	33.0	24	33.8	27	27.2	5	0.0	0	5.8	4	99.8	60
Other	241.6	27	60.7	20	0.2	2	48.9	12	341.5	26	692.9	87
Total Impact	**291.4**	**87**	**190.8**	**87**	**27.4**	**12**	**61.6**	**25**	**429.4**	**143**	**1,000.5**	**354**
Option J-02												
Single Family	0.9	7	0.0	3	0.0	0	3.7	6	0.0	2	4.6	18
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.9	20	96.3	37	0.0	5	9.0	8	82.1	109	195.2	179
Industrial	33.0	24	33.8	27	27.2	5	0.0	0	6.0	4	100.0	60
Other	90.6	20	60.7	20	0.2	2	273.1	16	341.5	26	766.0	84
Total Impact	**132.4**	**71**	**190.8**	**87**	**27.4**	**12**	**285.7**	**30**	**429.6**	**143**	**1,065.8**	**343**
Option J-03												
Single Family	0.9	7	0.0	3	0.0	0	3.7	6	0.0	2	4.6	18
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.9	20	96.3	37	0.0	5	9.0	8	82.1	109	195.2	179
Industrial	33.0	24	33.8	27	27.2	5	0.0	0	6.0	4	100.0	60
Other	90.6	20	60.7	20	0.2	2	225.9	19	341.5	26	718.9	87
Total Impact	**132.4**	**71**	**190.8**	**87**	**27.4**	**12**	**238.6**	**33**	**429.6**	**143**	**1,018.7**	**346**
Option J-04												
Single Family	0.9	5	0.0	1	0.0	0	3.7	5	0.0	2	4.6	13
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2

Land Use	Anne Arundel County		Baltimore City		Baltimore County		Prince George's County		Washington, D.C.		Total	
	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels
Commercial	15.2	13	15.0	6	0.0	0	8.8	6	82.1	109	121.1	134
Industrial	32.4	7	0.7	2	27.2	4	0.0	0	5.8	4	66.1	17
Other	241.6	27	28.2	19	0.2	2	48.8	12	341.5	26	660.2	86
Total Impact	**290.1**	**52**	**43.9**	**28**	**27.4**	**6**	**61.3**	**23**	**429.4**	**143**	**852.1**	**252**
Option J-05												
Single Family	0.9	5	0.0	1	0.0	0	3.7	6	0.0	2	4.6	14
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.2	4	15.0	6	0.0	0	9.0	8	82.1	109	113.3	127
Industrial	32.4	7	0.7	2	27.2	4	0.0	0	6.0	4	66.3	17
Other	90.6	20	28.2	19	0.2	2	273.1	16	341.5	26	733.6	83
Total Impact	**131.1**	**36**	**43.9**	**28**	**27.4**	**6**	**285.7**	**30**	**429.6**	**143**	**917.7**	**243**
Option J-06												
Single Family	0.9	5	0.0	1	0.0	0	3.7	6	0.0	2	4.6	14
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.2	4	15.0	6	0.0	0	9.0	8	82.1	109	113.3	127
Industrial	32.4	7	0.7	2	27.2	4	0.0	0	6.0	4	66.3	17
Other	90.6	20	28.2	19	0.2	2	225.9	19	341.5	26	686.4	86
Total Impact	**131.1**	**36**	**43.9**	**28**	**27.4**	**6**	**238.6**	**33**	**429.6**	**143**	**870.6**	**246**

Note: Parcel counts exclude any parcels for which land use information was not available.

Table D.4-56: Impacted Acreage and Parcel Counts by Land Use for Build Alternatives J1

Land Use	Anne Arundel County		Baltimore City		Baltimore County		Prince George's County		Washington, D.C.		Total	
	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels
Alignment J1												
Option J1-01												
Single Family	0.9	7	0.0	3	0.0	0	4.2	8	0.0	2	5.2	20
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	16.9	28	96.3	37	0.0	5	6.0	6	82.1	109	201.3	185
Industrial	30.2	21	33.8	27	27.2	5	0.0	1	0.0	2	91.3	56
Other	808.5	27	60.7	20	0.2	2	84.1	23	342.4	25	1,295.8	97
Total Impact	**856.6**	**83**	**190.8**	**87**	**27.4**	**12**	**94.3**	**38**	**424.5**	**140**	**1,593.5**	**360**
Option J1-02												
Single Family	0.9	7	0.0	3	0.0	0	4.5	17	0.0	2	5.5	29
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.9	18	96.3	37	0.0	5	5.2	6	82.1	109	191.4	175
Industrial	30.2	21	33.8	27	27.2	5	0.0	1	0.0	2	91.3	56
Other	67.8	16	60.7	20	0.2	2	294.1	33	342.3	25	765.1	96
Total Impact	**106.8**	**62**	**190.8**	**87**	**27.4**	**12**	**303.9**	**57**	**424.4**	**140**	**1,053.3**	**358**
Option J1-03												
Single Family	0.9	7	0.0	3	0.0	0	4.5	17	0.0	2	5.5	29
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.9	18	96.3	37	0.0	5	5.2	6	82.1	109	191.4	175
Industrial	30.2	21	33.8	27	27.2	5	0.0	1	0.0	2	91.3	56
Other	67.8	16	60.7	20	0.2	2	249.9	31	342.3	25	720.8	94
Total Impact	**106.8**	**62**	**190.8**	**87**	**27.4**	**12**	**259.7**	**55**	**424.4**	**140**	**1,009.0**	**356**
Option J1-04												
Single Family	0.9	5	0.0	1	0.0	0	4.2	8	0.0	2	5.2	16
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2

Land Use	Anne Arundel County		Baltimore City		Baltimore County		Prince George's County		Washington, D.C.		Total	
	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels	Acres	Number of Parcels
Commercial	16.3	12	15.0	6	0.0	0	6.0	6	82.1	109	119.3	133
Industrial	29.6	4	0.7	2	27.2	4	0.0	1	0.0	2	57.6	13
Other	808.5	27	28.2	19	0.2	2	84.1	23	342.4	25	1,263.3	96
Total Impact	**855.3**	**48**	**43.9**	**28**	**27.4**	**6**	**94.3**	**38**	**424.5**	**140**	**1,445.4**	**260**
Option J1-05												
Single Family	0.9	5	0.0	1	0.0	0	4.5	17	0.0	2	5.5	25
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.2	2	15.0	6	0.0	0	5.2	6	82.1	109	109.5	123
Industrial	29.6	4	0.7	2	27.2	4	0.0	1	0.0	2	57.6	13
Other	67.8	16	28.2	19	0.2	2	294.1	33	342.3	25	732.6	95
Total Impact	**105.6**	**27**	**43.9**	**28**	**27.4**	**6**	**303.9**	**57**	**424.4**	**140**	**905.1**	**258**
Option J1-06												
Single Family	0.9	5	0.0	1	0.0	0	4.5	17	0.0	2	5.5	25
Multifamily	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	2
Commercial	7.2	2	15.0	6	0.0	0	5.2	6	82.1	109	109.5	123
Industrial	29.6	4	0.7	2	27.2	4	0.0	1	0.0	2	57.6	13
Other	67.8	16	28.2	19	0.2	2	249.9	31	342.3	25	688.4	93
Total Impact	**105.6**	**27**	**43.9**	**28**	**27.4**	**6**	**259.7**	**55**	**424.4**	**140**	**860.9**	**256**

Note: Parcel counts exclude any parcels for which land use information was not available

D.4D.2.5.3 Agglomeration Economies

Agglomeration impacts occur when the concentration of firms and employees facilitates the exchange of ideas and knowledge in the host market, fostering growth and productivity. To the degree that the SCMAGLEV reduces the effective distance between knowledge industries, the potential for agglomeration economies to occur arises. The economic connections between Washington, D.C. and Baltimore would intensify, allowing the two metropolitan economies to increasingly compete in the global economy with a larger coordinated footprint. Therefore, it is important to understand which industries employ the largest number of people in Washington, D.C., Baltimore City and the inner suburbs. Both areas boast high skilled-industries, however the industries themselves differ.

As shown in **Table D.4-57**, the economy of Washington, D.C. is dominated by professional and technical services and membership associations and organizations categories, which collectively make up 186,000 jobs, or a quarter of all jobs in the city. The Washington, D.C. inner suburbs concentrate manly on professional and technical services (20.6 percent of total workforce).

Table D.4-57: Top Industries in Washington, D.C. and Inner Suburbs (2019)

Rank	Industry	Number of People Employed	Percent of Total Workforce
Washington, D.C.			
1	Professional and technical services	125,163	16.95%
2	Membership associations and organizations	60,634	8.21%
3	Food services and drinking places	55,814	7.56%
4	Administrative and support services	46,826	6.34%
5	Educational services	46,588	6.31%
Other		403,476	54.63%
Total		738,501	100%
Washington, D.C. Inner Suburbs (excl. D.C.)			
1	Professional and technical services	319,410	20.60%
2	Food services and drinking places	120,269	7.76%
3	Administrative and support services	105,019	6.77%
4	Ambulatory health care services	86,146	5.56%
5	Educational services	59,788	3.86%
Other		859,788	55.46%
Total		1,550,420	100%

Source: U.S. Bureau of Labor Statistics.

Once a predominantly industrial town, Baltimore now focuses on providing services (**Table D.4-58**). The economy of the Baltimore City is dominated by educational services and hospitals categories, which make up nearly 30 percent (i.e. 95,000 employees) of all jobs in the city. The Baltimore city inner suburbs concentrate on professional and technical services, food services and drinking places, and

administrative and support services, accounting for more than 205,000 employees (i.e. 27.1 percent of the labor force). It is unclear how SCMAGLEV would change or shift the job markets in the Washington, D.C. and Baltimore economies. However, the Project is anticipated to have an overall positive impact on job growth in the region.

Table D.4-58: Top Industries in Baltimore City and Inner Suburbs (2019)

Rank	Industry	Number of People Employed	Percent of Total Workforce
Baltimore City			
1	Educational services	48,502	14.47%
2	Hospitals	46,727	13.94%
3	Administrative and support services	22,148	6.61%
4	Professional and technical services	22,127	6.60%
5	Food services and drinking places	19,689	5.87%
Other		175,943	52.50%
Total		335,136	100.00%
Baltimore City Inner Suburbs (excl. Baltimore City)			
1	Professional and technical services	83,840	11.05%
2	Food services and drinking places	65,190	8.60%
3	Administrative and support services	56,497	7.45%
4	Educational services	52,368	6.90%
5	Ambulatory health care services	51,540	6.80%
Other		449,022	59.20%
Total		758,457	100%

Source: U.S. Bureau of Labor Statistics.

As each Build Alternative has the same travel time and trip cost, the potential for agglomeration economies and productivity impacts is positive and equal across all Build Alternatives. Agglomeration economies are a beneficial impact; they support the productivity of an economy's firms and thus the region's economic competitiveness. As described by Dr. Larry Summers (Harvard economist and former Chief Economist of the World Bank and former director of the National Economic Council) in the 2017 Brookings Institution symposium, "Infrastructure permits, in substantial part, larger interchange and reduces impactive distances, thereby facilitating trade and agglomeration, … in a world where private capital, private companies and ideas are increasingly mobile, a nation's infrastructure is "distinctively local and distinctively defining of its strength."[80]

The impact of telecommuting on agglomeration varies, depending on whether workers telecommute 100 percent of the time or split their time between work and telecommuting. If employees work from home 100 percent of the time, this diminishes the potential for agglomeration economies given the current urban structure. If the urban

[80] Anna Malinovskaya and David Wessel. "Larry Summers v. Edward Glaeser: Two Harvard economists debate increased infrastructure investments," Wednesday, January 18, 2017. Accessed August 6, 2019 https://www.brookings.edu/blog/up-front/2017/01/18/larry-summers-v-edward-glaeser-two-harvard-economists-debate-increased-infrastructure-investments/

structure evolves over time such that telecommuting households who no longer incur commuting costs now move to the urban center as they can afford a higher cost home (and work) location, the potential for agglomeration may increase as home-based workers meet for informal social and business gatherings where ideas can be exchanged. By contrast, if employees work from home two to three days a week and travel to an office location for the balance of their time, telecommuting may support agglomeration economies as it eases congestion and thereby facilitates the movement of people within the metropolitan area and the associated exchange of ideas and opportunities—supporting trade and agglomeration as outlined in the 2017 Brookings remarks cited.

D.4D.2.5.4 Labor Market Impacts

The Washington, D.C. and Baltimore metropolitan areas also differ by size in terms of job opportunities. There are nearly 3.4 million jobs in Washington, D.C. MSA compared with nearly 1.4 million jobs in the Baltimore MSA. Comparing just the core areas that would be connected via the Build Alternatives, the District of Columbia has 798,400 jobs compared with 373,400 jobs in Baltimore City.[81]

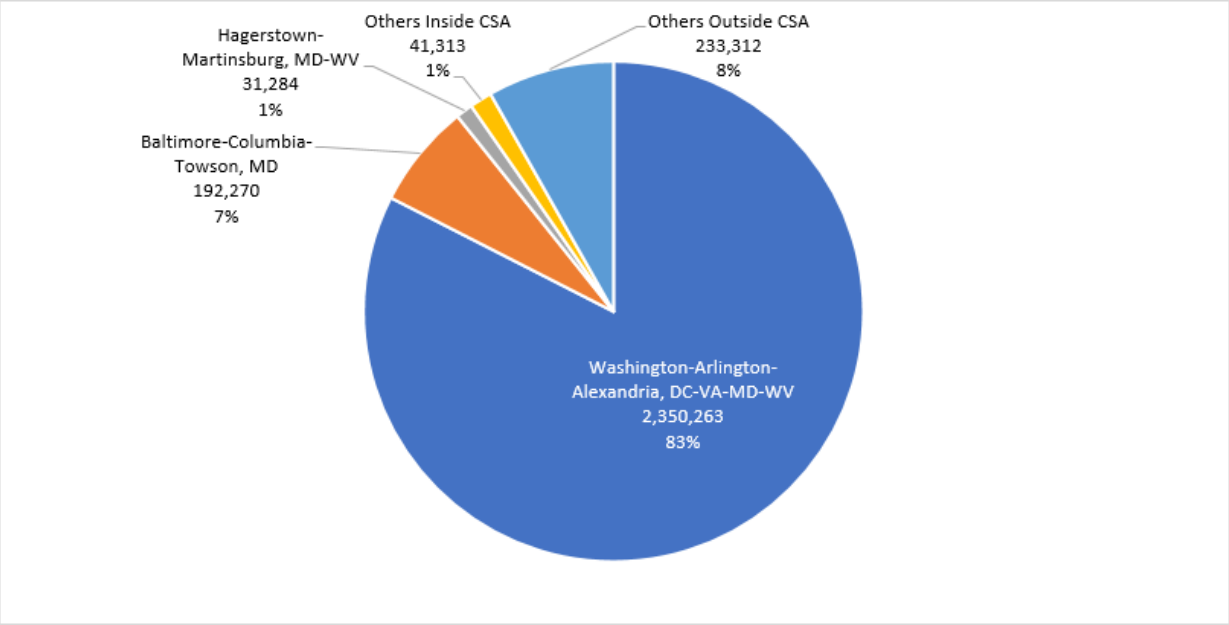
Labor market impacts occur when travel improvements increase the number of job opportunities available to workers and workers available to firms. When this occurs, firms and workers are able to select jobs and employees that more closely match the exact job requirements or worker skills than they might in a small market with more limited options. Given the projected travel times associated with the Build Alternative, the range of opportunities within a 30- to 45-minute travel shed would increase substantially for many workers and open the pool of available applicants to employers.

While the number of job opportunities would increase, the labor market impact it two-fold. Some workers would find jobs and transition from unemployment to employment. Some workers would find better jobs than they have currently as they now face a large selection of job opportunities. In this instance, underemployed workers would find jobs that better fit their skills with an associated increase in labor productivity and earnings. Both impacts are positive and would not require mitigation.

Substantial commuting linkages exist within the Washington-Baltimore-Arlington CSA. The Washington, D.C. MSA and Baltimore MSA are the two largest employment centers in the CSA, attracting a substantial portion of the labor force from adjacent metropolitan and micropolitan statistical areas. However, the largest commuting flows in the CSA occur between the Washington, D.C. MSA and Baltimore MSA. **Figure D.4-9** and **Figure D.4-10** show the origin of commuters to Washington, D.C. MSA and Baltimore MSA.

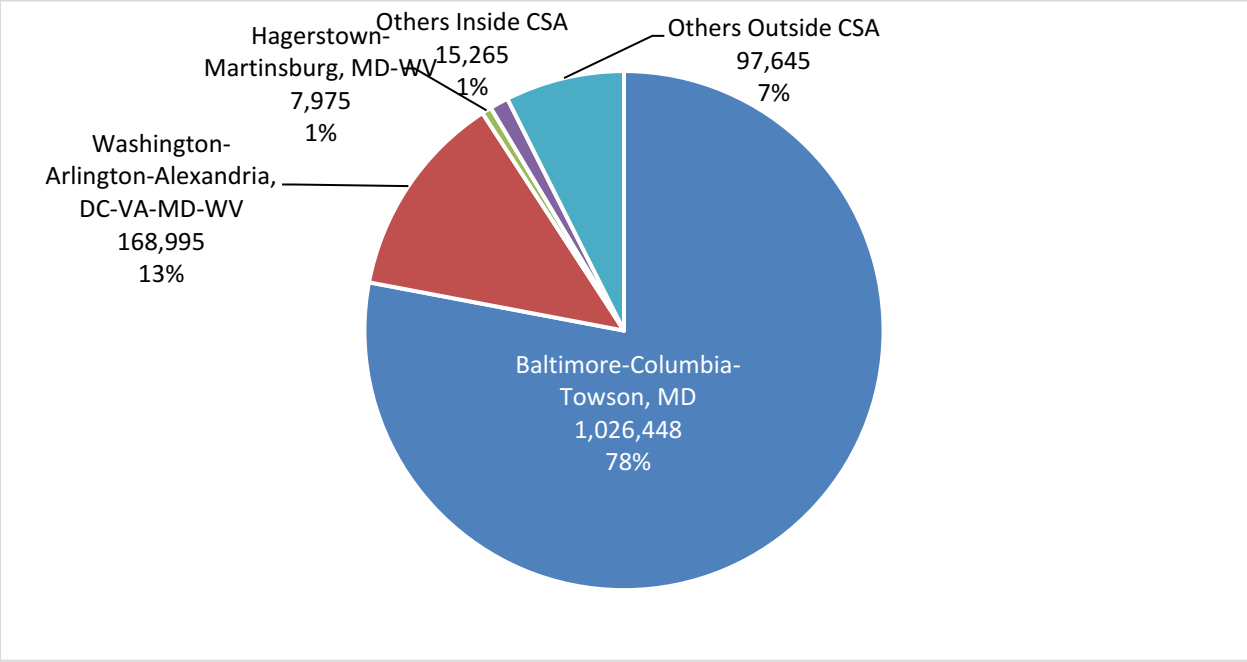
[81] Bureau of Labor Statistics. Employment statistics shown as 2019 annual average.

Figure D.4-9: Origin of Commuters to Washington, D.C. MSA (2017)



Source: Longitudinal Employer-Household Dynamics (LEHD) database, https://onthemap.ces.census.gov/

Figure D.4-10: Origin of Commuters to Baltimore MSA (2017)



Source: LEHD, https://onthemap.ces.census.gov/

While lower housing cost exists in the Baltimore MSA, the Washington, D.C. MSA provides generally higher wages and a larger pool of job opportunities. The different economic benefits provided by each market create incentives to live in one market and commute to the other. In total, approximately 3 million people work in the Washington,

D.C. MSA, and another 1.3 million work in the Baltimore MSA. While the majority of each MSA's commuters live in the same MSA as they work in (83 percent in Washington, D.C. MSA and 78 percent in Baltimore MSA), a significant number of people commute between the two MSA's. Over 192,000 workers, or 7 percent of total commuters to Washington, D.C. MSA, commute from Baltimore MSA; and over 160,000 workers, or 13 percent of total commuters to Baltimore MSA, commute from Washington, D.C. MSA. These percentages provide the best estimate of the labor exchange between the two markets under the No Build Alternative and underscore the potential for greater economic integration between the two economies if the travel time between the two were meaningfully reduced.

As each Build Alternative has the same travel time and cost, each Build Alternative has the same propensity to foster labor market impacts. Because trips would be faster and more reliable, it is anticipated that there would be greater commuting between the two markets under each of the Build Alternatives.

The expected average fare for SCMAGLEV would be $60 per one-way trip; however it could vary between $27 and $80[82] per one-way trip suggesting that higher income workers would be the most likely to use SCMAGLEV for commuting. Workers that do not commute to the office 5 days a week, but rather telecommute could also be potential users of the service. With telecommuting approved for a growing share of Washington, D.C. employers, such policies would reduce the fare's impact on household commute budgets and make SCMAGLEV an option for more commuters.[83] Those who telecommute may select SCMAGLEV as their main means of transportation when they have to go to the office as it would be faster and more reliable than other public transportation options.

There is a significant spread in travel costs per mile in the Washington, D.C.- Baltimore corridor. At the lowest cost, a MARC trip costs 19 cents per mile and takes just over an hour. At the highest cost of modes active in the corridor, an Acela trip costs $1.30 per mile or seven times the cost of a MARC trip. The higher cost saves the travelers about 30 minutes—the Acela trip takes just 32 minutes. Travelers deciding among the various modes operating in the current Washington, D.C.- Baltimore corridor regularly trade off time for travel cost where the range between the lowest and highest cost is large—the top cost is approximately seven times the lowest fare. **Table D.4-59** summarizes the travel times and cost per mile for the active modes in the corridor.

[82] SCMAGLEV Project Ridership Data Request, May 6, 2020.
[83] In the Washington, D.C. MSA, telework continues a steady upward trend observed since 2007, with more than one million regional teleworkers in 2019. Source: CommuterConnections. "2019 State of the Commute Report from the Metropolitan Washington Region." June 2020. Accessed: https://www.mwcog.org/file.aspx?D=%2b0qv8i2f8F2I1MILGLYfWp1CaYuFlZ5rwb5Ug4gcoTQ%3d&A=%2bkIjc%2fnIQiqtav9hkV%2b7cN%2fnZ1nVfMkbtPLYAPGMWIU%3d

Table D.4-59: Travel Time and Cost per Mile by Mode in the Washington, D.C.-Baltimore Corridor

Mode	Travel Time (mins)	Distance (miles)	Travel Cost (2018$)	Cost per Mile (2018$/mile)
Acela	32	40	$52.00	$ 1.30
MARC	65	40	$7.70	$ 0.19
Amtrak	41	40	$16.68	$ 0.42
Auto	55	39.6	$16.24	$ 0.41
Bus	70	39.6	$14.11	$ 0.36

Source: Data collected for the economics assessment of the MAGLEV project.
Note: There are no direct commercial flights between Washington, D.C. and Baltimore. Calculations assume 15-minute travel time for SCMAGLEV.

Understanding the estimated average SCMAGLEV fare, the monthly travel cost would be very high for commuting five days a week by SCMAGLEV. However, with the greater prevalence of people working from home, many travelers will select going into the office fewer times per day, reducing the amount of household budget absorbed by commuting.

Appendix D.4E Potential Mitigation Strategies

D.4E.1 Short Term Operational Strategies

D.4E.1.1 Construction Impacts

Construction would have temporary impacts on commercial and industrial businesses, particularly those near or adjacent to construction sites. Sidewalk space might be taken temporarily for station and alignment construction, thereby reducing business access. Business impacts could include reduced visibility of commercial signs and businesses. These construction impacts could in turn produce minor economic impacts to commercial establishments.

There are a number of minimization strategies and mitigation measures the Project Sponsor would undertake to temper these impacts. Some of the strategies include:

- Coordinate with individual businesses to identify business usage, delivery, and shipping patterns, as well as critical times of the day or year for business activities to aid in developing Worksite Traffic Control Plans and to ensure that critical business activities are not disrupted.
- Develop, fund, and maintain a telephone hotline during construction and one or more SCMAGLEV Field Offices with staff to address community issues and concerns as they arise. Office could be open from 9am-5pm weekdays and any weekends when work occurs. Schedule to be developed prior to construction. The office would provide a physical location where information pertaining to construction can be exchanged. Ensure that all potentially affected persons know the name and telephone number(s) of public affairs staff that they can contact if needed.

- Participate in local events to promote awareness of the Project.
- Notify property owners, businesses, and residences of major construction activities (e.g., utility relocation/disruption and milestones; re-routing of delivery trucks).
- Provide literature to public and news media, schedule promotional displays, participate in community committees, and make presentations, as needed, about the Project.
- Coordinate business outreach programs and implement promotions for businesses most affected by the construction.
- Whenever possible, develop detours for any road or sidewalks to be closed during construction. Post signs (in appropriate languages) alerting pedestrians, bicycles, and vehicles of road and sidewalk closures and detours. Ensure pedestrian detours are accessible to seniors and disabled persons. Develop Worksite Traffic Control Plans in conjunction with the county and municipal departments of transportation to accommodate automobile and pedestrian traffic.
- Maintain access to community facilities affected by construction activities.
- Provide early notification to emergency service providers of any road closures or detours.
- Develop a community outreach plan to notify local communities of construction schedules, road and sidewalk closures, and detours. Coordinate with local communities during preparation of traffic management plans to minimize potential construction impacts to community resources and special events. Consider limiting construction activities during special events.
- Develop a construction mitigation plan with community input to address construction impacts. Determine truck hauling routes and schedules that would minimize impacts on sensitive uses in all parts of the Project area.
- Engage with businesses in the study area, particularly when developing the construction phasing schedules, to ensure accessibility for customers and suppliers in order to reduce revenue losses.
- During construction, provide temporary replacement or shared parking as needed to absorb the loss of parking due to acquisitions. Temporary parking could be added by constructing surface lots on nearby vacant parcel or restriping nearby streets to allow diagonal curb parking.
- Erect barriers and provide security personnel during construction to minimize trespassing and vandalism. Barriers could be enhanced with artwork and attractive design features where possible.
- Forewarn the public of any anticipated road closures or detours due to construction activity.

Additionally, since the Project would have the potential to affect construction employment in the region, a thoughtful procurement process and construction schedule

needs to be prepared. In the case that there are other ongoing regional projects, the Project could be scheduled after coordination with those projects.

D.4E.1.2 ROW Acquisition Impacts

As noted in Section 4.2.2, project implementation would require some property acquisition but the expected loss in associated tax revenues is less than 0.2 percent and would not damage jurisdictions' ability to provide public services.

Relocation resources would be available to all residential and business relocations without discrimination. If the Project is funded with Federal dollars, the Uniform Relocation Act requires that all replacement housing would be decent, safe, and sanitary.[84] Funded by the Department of Housing and Urban Development (HUD), advisory service, payment for moving expenses and replacement housing assistance will be provided to eligible personnel, for both residents and businesses.

Both the Washington, D.C. and Baltimore single-family (detached, attached and condo) housing markets are robust; the historical performance of the housing market suggests that the mix of new and existing homes on the market would allow homeowners to find a replacement dwelling in the same MSA. A key consideration for residential mitigation is providing homeowners who may want to stay in their same neighborhood/school district sufficient time to find a suitable listing within this narrower search area. For those willing to change neighborhoods, multiple options are expected to be available based on the market's recent history. Private residential property owners could be compensated at market value for land to be acquired by the Project and would be eligible for additional benefits.[85] As discussed in the fiscal and social impact section , overall, the Washington, D.C. and Baltimore rental markets do not qualify as "tight" rental markets under the HUD thresholds.

For businesses, advisory service, along with Payment for Moving and Reestablishment Expenses could be provided.[86] Depending on individuals' choice, the amount of assistance will vary based on the actual moving expense or a fixed amount of $1,000-$40,000. A business may also be eligible for a Payment for Reestablishment Expenses, up to $25,000, if choosing to be paid the amount of their actual expense. In addition, businesses could be provided with current information on available replacement locations that meet their needs, or the option to discuss their preferred replacement location with their local agency. In Maryland, this assistance is offered through The Maryland Community Development Block Grant Program (CDBG).

[84] U.S. Department of Housing and Urban Development, Office of Community Planning and Development. "Relocation Assistance to Tenants Displaced from Their Homes". https://www.hud.gov/sites/documents/tenadisp.pdf
[85] The amount of assistance on rental or purchase of housing will be based on the difference in costs of the current and replacement home, and a time period of 42 months.
[86] U.S. Department of Housing and Urban Development, Office of Community Planning and Development. U.S. Department of Housing. "Relocation Assistance to Displaced Businesses, Non-Profit Organizations and Farms." https://www.hud.gov/sites/documents/1043CPD.PDF

D.4E.2 Long-Term Operational Strategies

D.4E.2.1 Operational Impacts

No negative impact on the region's economy have been identified in this analysis; no mitigation would be required as a consequence.

D.4E.2.2 Tax Base Impacts

Around the selected stations, property values would increase, and therefore the tax base in Washington, D.C. and Baltimore City would increase. However negative property impacts around the selected TMF would reduce the tax base in Anne Arundel County or Prince George's County. The state of Maryland and Washington, D.C. would experience a net increase in the tax base due to property premium. Parcel acquisitions would also have a negative impact on the affected jurisdictions reducing the entire tax base value less than 0.2 percent.

Positive property premium impacts linked to the new stations would temper the negative tax base impacts due to property acquisitions in Washington, D.C. and Baltimore City. However, there are a number of mitigation measures that Anne Arundel County or Prince George's County would need to undertake to lessen the negative property premium impacts related to the TMF and the reduction of the tax base due to parcel acquisitions. These mitigations could include sound walls and landscaping to buffer the neighborhood from the visual and noise impacts, controlling access to minimize traffic impacts on the surrounding area, and selection of a physical design that minimizes the footprint and its proximity to affected parcels. Project Sponsor would coordinate with the affected jurisdictions to reduce the negative impacts.

D.4E.2.3 Gentrification Impacts

As gentrification is already present in the Baltimore area's economy and could be intensified by construction of the SCMAGLEV system, mitigation measures should be considered. Understanding that displacement is caused by outside factors beyond the household's control that cause housing to no longer be affordable, best practices in mitigating the displacement effects of gentrification focus on keeping households engaged and aware of local trends and managing the price effects to maintain a stock of affordable housing. Illustrative measures might include: [87]

- Robust community outreach to those most affected by displacement—prioritizing them in the planning, implementation, and on-going monitoring of displacement and mitigation efforts.
- Vulnerable neighborhoods should be engaged early in the SCMAGLEV development process to partner in the development of the mitigation strategy.

[87] Adapted from "Case Studies of Local Efforts to Mitigate Displacement in Gentrifying Neighborhoods" The Uprooted Project, University of Texas At Austin. Accessed https://sites.utexas.edu/gentrificationproject/files/2018/10/part3.pdf

- Temper market pressures where possible using community land trusts, long-term affordability restrictions, and nonprofit and public ownership of land.
- Consider creating special districts where rent increases are limited or redevelopment is permitted only with the creation of a specified amount of affordable housing.

D.4E.2.4 Development Impacts

No negative impacts on the local economy have been identified; potential economic development would be subject to existing or revised land use controls and policies and thus be consistent with local objectives and the vision for the corridor. No mitigation would be required as a consequence.

Appendix D.4F Next Steps

As part of the Final Environmental Impact Statement (FEIS), the Project Sponsor will continue to refine the SCMAGLEV Project design. Once a Preferred Alternative is identified, FRA will highlight in this section the short-term and long-term impacts associated with the selected alternative. The Project Sponsor will continue to coordinate with local governments and Federal government agencies the mitigation strategy of the proposed Project impacts.