APPENDIX 3.18-A: RIMS II MODELING DETAILS

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Summary of Findings

This appendix presents the results of the Regional Input-Output Modeling System (RIMS II) modeling analysis supporting the analysis presented in Section 3.18, Regional Growth. Overall, this study finds that development and operation of the California High-Speed Rail (HSR) System in the San Jose to Central Valley Wye Project Extent (project extent or project) would have a positive economic effect on the regional resource study area (RSA) composed of Santa Clara, San Benito, and Merced Counties. The results reported herein are those obtained at the time the analysis was completed and reflect the estimates of costs, projected construction schedule and other modeling inputs for the project available at that time, including those provided in Appendix 6-A, San Jose to Merced Project Section: PEPD Record Set Capital Cost Estimate Report, July 2019.

The estimate of total economic effect, including direct and multiplier effects from the construction phase, is approximately $7.33 billion to $10.43 billion in this region, depending on the project alternative, measured in constant 2018 dollars. Alternative 3 would yield the highest regional economic impact, roughly 42 percent greater than Alternative 4, which would have the lowest cost and employment impact. The estimate for direct spending for construction labor and materials ranges from $5.21 billion to $7.42 billion, and the remaining spending represents indirect spending on labor and materials by companies in the supply chain for construction (e.g., wholesalers of concrete or lessors of construction equipment), as well as induced spending in industries required to serve the households of construction and indirect labor workers (e.g., retail, entertainment, healthcare). During the peak year of construction (2024), direct spending is estimated to support between 5,110 and 7,990 construction-related job-years,[1] depending on the project alternative.

By 2040, the ongoing project operations would support an estimated $210 million per year in economic activity within the regional economy. Again, this economic activity would represent direct spending by the California High-Speed Rail Authority (Authority) on labor and materials for operations and maintenance, as well as indirect spending by supply-chain industries and induced spending in household-serving industries. Phase I project operations are projected to support 1,110 jobs annually in the RSA, including 600 workers directly employed by the Authority or its vendors. Spending and employment associated with operations would not vary substantially among the project alternatives because of similar guideway lengths and the same number of stations and types of maintenance facilities.

Analysis Framework and Approach

The economic impacts calculated and reported in this appendix are directly linked to spending attributable to the project and are considered using the accepted economic metrics of economic output, employment, and employee compensation. Project-related expenditures on goods and services from within the regional economy would create a multiplier effect as local and regional businesses that supply inputs to production generate successive rounds of spending. Employment supported by HSR would also generate a multiplier effect through household spending in the regional economy.

Input-Output Analysis Overview

Input-Output (I/O) analysis is based on the concept that industries in a geographic region are interdependent and thus the total contribution of any one establishment's activity is larger than its individual (direct) output or employment. Consequently, an establishment's economic activity has a multiplier effect that generates successive rounds of spending and output in other economic sectors within a particular region. For example, construction firms purchase goods from producers, who in turn purchase raw materials from suppliers. Thus, an increase or decrease in

[1] One job-year is equivalent to one job held by one person over one year's duration.

the demand for construction supplies would stimulate an increase or decrease in output and employment in interdependent secondary industries.

Regional economic impact analysis and I/O models in particular provide a means to quantify economic effects stemming from a particular industry or economic activity. I/O models produce quantitative estimates of the magnitude of regional economic activity resulting from some initial activity. I/O models rely on economic multipliers that mathematically represent the relationship between the initial change in one sector of the economy and the effect of that change on employment, income, economic output, and value added in other regional industries. These economic data provide a quantitative estimate of the magnitude of shifts in jobs and revenues within a regional economy.

The analysis begins with an estimate of the initial economic input associated with project expenditures on capital investment and operations in the regional economy. These initial inputs are referred to as the direct effect. Next the I/O model quantifies the impacts associated with the multiplier effects that result from that initial economic input. Multiplier effects include indirect or induced effects. Indirect effects represent economic impacts on suppliers while induced effects represent economic impacts on household income and spending. In this report, direct, indirect, and induced effects are defined as follows:

- **Direct effect**—The economic value of the initial input of spending into the economy made by the Authority
- **Indirect effect—**The economic value of "upstream" industry-to-industry transactions that supply inputs to the production of goods and services consumed by the Authority
- **Induced effect—**The economic value of labor income that recirculates in the economy as a result of the initial expenditures made by the Authority
- **Total impact**—The sum of the direct, indirect, and induced effects. The total impact measures the overall impact of project activities within the regional economy

This analysis measures economic significance using common economic metrics, including employment, employee compensation, economic output, and job-year as defined below:

- **Employment**—Equivalent to jobs, a headcount that includes part-time and full-time workers.
- **Employee compensation**—Payments to labor in the form of income (i.e., wages and salaries) and fringe benefits paid by the employer (e.g., health insurance), as well as proprietor income.
- **Economic output**—Economic activity, calculated as production value including intermediate inputs (i.e., the goods and services used in the production of final products). Output includes spending on employee compensation as well as the production value of each intermediate input, such as equipment, supplies, insurance, rents, utilities, communication services, printing, and other goods and services.
- **Job-years**—A combined measure of total jobs and the length of time of those jobs. One job-year is defined as equivalent to one job held by one person over one year's duration. As an example, one job held by one worker for three years would constitute three job-years; three jobs held by three workers for one year's duration would also constitute three job-years.

It should be noted that a portion of the impacts reported in this analysis may not be entirely net new. For example, it is plausible that the State of California would have spent a portion of its HSR budget on other projects elsewhere in the state if the HSR project did not occur.

RIMS II Multipliers

To measure the economic effects of the project in the RSA, this I/O analysis relies on RIMS II multipliers acquired from the U.S. Bureau of Economic Analysis (BEA 2013). The multipliers are the most current available at the time the analysis was conducted, that is, those based on 2007 national input-output data and 2016 regional data. The multipliers were acquired from the Bureau

on October 12, 2018, and are specific to the regional economy composed of Santa Clara, San Benito, and Merced Counties. The multipliers are produced as tables organized both by selected detailed industries, as defined under the North American Industry Classification System (NAICS), and by NAICS industry aggregations or sectors, as defined by the U.S. Bureau of Economic Analysis.

RIMS II multipliers in two industry aggregations are most directly relevant to the construction phase and the operations and maintenance phase of the project. For the construction phase, Industry Aggregation #7 Construction (NAICS Industry Sector 23) multipliers are the most generally applicable to local construction cost estimates for RSA, and are shown in Table 1.

Table 1 RIMS II Multipliers Relevant to Project Construction in the Resource Study Area

Industry	Multiplier					
	Final Demand				Direct Effect	
	Output[1] (dollars)	Earnings[2] (dollars)	Employment[3] (jobs)	Value-Added[4] (dollars)	Earnings[5] (dollars)	Employment[6] (jobs)
7. Construction	1.4061	0.3586	6.3204	0.7725	1.3591	1.5117

Source: BEA 2018

[1] Represents the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

[2] 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 industry corresponding to the entry.

[3] Represents the total change in number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry corresponding to the entry. Because the employment multipliers are based on 2016 data, the output delivered to final demand should be in 2016 dollars.

[4] Represents the total dollar change in value added that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

[5] Represents the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the entry.

[6] Represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

Note: Multipliers are based on the 2007 Benchmark Input-Output Table for the Nation and 2016 regional data.

For the operations and maintenance phase, Industry Aggregation 33 Rail Transportation (NAICS Industry Sector 482) multipliers are the most generally applicable to operations and maintenance (O&M) cost estimates for the RSA. These multipliers are shown in Table 2.

Dollar inputs for analysis models using RIMS II multipliers should be indexed to the same year as the multipliers applied. Analysts used Construction Cost Index developed for the Authority's *2016 Business Plan Capital Cost Basis of Estimate Report* (Authority 2016) to adjust the capital and construction cost estimates for this analysis, which were provided in 2018 dollars (Authority 2019), to the 2016 dollars pertinent to the RIMS II multipliers.. An inflation factor of 2.25 percent per annum is assumed to pertain between Fiscal Year 2016/2017 and Fiscal Year 2024/2025 for the Construction Cost Index, and has been applied as necessary to convert 2018 dollars to 2016 dollars for analysis and to use 2018 dollars for uniform reporting.

Table 2 RIMS II Multipliers Relevant to Project Operations and Maintenance in the Resource Study Area

Industry	Multiplier					
	Final Demand				Direct Effect	
	Output[1] (dollars)	Earnings[2] (dollars)	Employment[3] (jobs)	Value-Added[4] (dollars)	Earnings[5] (dollars)	Employment[6] (jobs)
33. Rail Transportation	1.3389	0.2602	3.5442	0.7250	1.4597	1.8531

Source: BEA 2018

[1] Represents the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

[2] 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 industry corresponding to the entry.

[3] Represents the total change in number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry corresponding to the entry. Because the employment multipliers are based on 2016 data, the output delivered to final demand should be in 2016 dollars.

[4] Represents the total dollar change in value added that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

[5] Represents the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the entry.

[6] Represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

Note: Multipliers are based on the 2007 Benchmark Input-Output Table for the Nation and 2016 regional data

Construction Cost Estimates

In addition to RIMS II data, this analysis relies on detailed capital cost estimates. Capital cost estimates for RIMS II modeling were assembled from data provided in the capital cost estimates for the four project alternatives. These sources itemize costs using the Authority's refinement of the Federal Railroad Administration's (FRA) standard cost categories, which establish a consistent format for the reporting, estimating, and managing capital costs.[2]

As shown in Table 3, the project alternatives are estimated to have total capital costs ranging from approximately $16.48 billion to $23.31 billion (2018$), including the costs of right-of-way and land acquisitions, but excluding the cost of HSR trains (train sets, support and maintenance vehicles, and parts), and finance charges. These exclusions are not anticipated to have a significant effect on regional job creation or system-wide costs. The development budget analyzed for the regional economic impacts reflects the total construction costs. These construction costs include "hard" development costs, but exclude the costs of right-of-way and land acquisitions and further exclude professional services as many or most of the design, administrative, consulting, monitoring, and accounting services may be conducted outside of the RSA.

The hard costs include all aspects of construction, including site work, track construction, bridge construction, maintenance facility development, and other construction requirements. These estimated total construction costs range from $12.71 billion to $18.09 billion (2018$), depending on the project alternative. The total capital cost estimates include unallocated contingency budgets that are about 3.8 percent of the sum of all other costs for Alternatives 1, 2, and 3 and about 3.7 percent of all other costs for Alternative 4. The same ratios of unallocated contingency costs, have been assumed in calculations of total construction costs and local construction costs, by project alternative.

[2] The *San Jose to Merced Project Section: PEPD Record Set Capital Cost Estimate Report* provides estimates capital costs for the project section alternatives (Appendix 6-A). These capital cost estimates are limited to SCC groups 10 to 60, and 80 to 90, which include most of the SCC cost categories directly related to the labor and materials involved in construction of the rail system and support facilities. Total construction costs for the project section correspond to cost estimates for SCC Groups 10 to 60 and a share of Group 90 Costs, and exclude 40.07-Right-of-Way Purchase and Land Costs.

Local construction costs are estimates of the development budget expenditures within the three-county RSA of Santa Clara, San Benito, and Merced Counties. For a project of the scale and specialized requirements of the HSR, a substantial amount of manufacturing and fabrication of the system's construction components would likely occur outside of the RSA. The amount of project-related manufacturing and fabrication that occurs within the RSA, and the amount of money spent within the RSA to hire construction workers, is calculated as portions of the local construction costs. For the project, the overall local percentage capture ratio has been estimated at 41 percent of total construction costs.[3] The estimated local construction costs thus range from $5.21 billion to $7.42 billion (2018$), depending on the project alternative. The great majority of those costs are for the guideway construction, with the small remainder for the construction of the station and maintenance facilities.

Construction of the project's guideway, stations, and maintenance facilities is planned for the years 2022 through 2028, with 2024 identified as the peak year of construction activity. As shown in Table 4, this construction schedule has been used to spread the estimated local construction costs for the project alternatives based on general anticipated expenditures associated with construction activities.

[3] The analysis assumed local construction expenditures in the RSA would equal about 41 percent of total construction costs, based on review of U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) historical data for the RSA, California and the nation and upon analysts' professional judgement. Total construction costs correspond to cost estimates for SCC Groups 10 to 60 and a share of Group 90 Costs, and exclude costs for 40.07-Right-of-Way Purchase and Land Costs.

Table 3 Project Alternatives' Costs by Standard Cost Category (2018$[4])

Standard Cost Category[1]/Alternative	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	Total Capital Costs	Total Construction Costs	Total Capital Costs	Total Construction Costs	Total Capital Costs	Total Construction Costs	Total Capital Costs	Total Construction Costs
10 track structures & track[2]	$13,271,520,000	$13,271,520,000	$9,865,455,000	$9,865,455,000	$13,473,346,000	$13,473,346,000	$8,678,042,000	$8,678,042,000
20 Stations, terminals, intermodal[3]	$830,279,000	$830,279,000	$819,713,000	$819,713,000	$873,691,000	$873,691,000	$698,399,000	$698,399,000
30 Support facilities: yards, shops, administrative buildings	$240,091,000	$240,091,000	$240,091,000	$240,091,000	$281,953,000	$281,953,000	$262,779,000	$262,779,000
40 Sitework, existing improvements	$4,111,065,000	$1,623,830,000	$5,798,280,000	$2,581,723,000	$4,065,164,000	$1,816,182,000	$3,282,675,000	$1,633,274,000
50 Communications & signaling	$362,257,000	$362,257,000	$347,835,000	$347,835,000	$352,090,000	$352,090,000	$387,038,000	$387,038,000
60 Electric traction	$645,328,000	$645,328,000	$672,801,000	$672,801,000	$641,774,000	$641,774,000	$597,759,000	$597,759,000
70 Vehicles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80 Professional services	$2,710,861,000	$0	$2,306,446,000	$0	$2,777,205,000	$0	$1,981,346,000	$0
90 Unallocated contingency	$836,614,000	$640,469,000	$762,569,000	$552,517,000	$844,168,000	$655,301,000	$590,574,000	$455,615,000
100 Finance charges	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total costs[1]	$23,008,015,000	$17,613,775,000	$20,813,189,000	$15,080,135,000	$23,309,392,000	$18,094,338,000	$16,478,610,000	$12,712,905,000
Local construction costs[2,3]		$7,221,648,000		$6,182,855,000		$7,418,679,000		$5,212,291,000

Sources: Authority 2018
N/A = Not applicable
SCC = standard cost category
[1] Capital Cost estimates are exclusive of costs for Standard Cost Categories (SCC) 70-Vehicles and 100-Finance Charges. Construction Cost estimates are exclusive of costs for SCC 40.07-Right-of-Way Purchase and Land Costs .
[2] Cost estimates for SCC Categories 10, 40, 50, and 60 plus proportional share of SCC Category 90-Unallocated Contingency is assumed to be track construction costs. Cost estimates for SCC Categories 20–30 plus proportional share of SCC Category 90 assumed to be station and maintenance facility construction costs.
[3] Local Construction Expenditures assumed as 41 percent of total construction costs.
[4] The Construction Cost Index (CCI) developed for the Authority's 2016 Business Plan Capital Cost Basis of Estimate Report (Authority 2016) has been applied to adjust capital and construction cost estimates for the project, which were provided in 2018 dollars, to the 2016 dollars pertinent to the RIMS II multipliers. The CCI inflation factor of 2.25 percent per annum is assumed to pertain between Fiscal Year 2016/2017 and Fiscal Year 2024/2025 for the Construction Cost Index, and has been applied to convert 2018 dollars to 2016 dollars for RIMS II modeling, and to convert RIMS II model outputs in 2016 dollars to 2018 dollars for uniform reporting.

Table 4 Project Alternatives' Costs by Construction Year (2018$)

Alternative / Cost	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Capital costs [1]	$23,008,015,000	$20,813,189,000	$23,309,392,000	$16,478,610,000
Total construction costs [2]	$17,613,775,000	$15,080,135,000	$18,094,338,000	$12,712,905,000
Local construction costs [3]	$7,221,648,000	$6,182,855,000	$7,418,679,000	$5,212,291,000
Local construction costs during 2022	$1,009,965,000	$860,581,000	$981,296,000	$750,117,000
Local construction costs during 2023	$1,500,862,000	$1,262,451,000	$1,553,870,000	$1,036,101,000
Local construction costs during 2024 (peak year)	$1,927,656,000	$1,613,336,000	$1,998,840,000	$1,278,919,000
Local construction costs during 2025	$1,429,269,000	$1,182,656,000	$1,472,046,000	$1,039,469,000
Local construction costs during 2026	$634,992,000	$544,982,000	$645,479,000	$461,283,000
Local construction costs during 2027	$556,152,000	$580,173,000	$597,838,000	$527,295,000
Local construction costs during 2028	$162,750,000	$138,676,000	$169,310,000	$119,108,000

Sources: Authority 2017c, 2018
[1] Capital Cost estimates are exclusive of costs for Standard Cost Categories (SCC) 70-Vehicles and 100-Finance Charges. Construction Cost estimates are exclusive of costs for SCC 40.07-Right-of-Way Purchase and Land Costs.
[2] Cost estimates for SCC Categories 10, 40, 50, and 60 plus a proportional share of SCC Category 90-Unallocated Contingency is assumed to be track construction costs. Cost estimates for SCC Categories 20–30 plus a proportional share of SCC Category 90 assumed to be stations and maintenance facility construction costs.
[3] Local construction assumed equal to 41% of total construction.

Economic Impacts from Construction

This analysis assumes that approximately 41 percent of the total construction expenditures for the project would be made in the regional economy; that is, in the three-county RSA. As shown in Table 5, the direct employment for construction is projected at between 5,110 and 7,990 jobs in the peak year 2024 depending on the project alternative. Table 5 presents the estimated total one-time economic impact of construction of the project on the RSA.

Table 5 Total One-Time Economic Impact of Construction (2018$)

Alternative/Sector	Output (2018$)[1]	Employment (Job-Years)[1]	Employee Compensation (2018$)[1]
Alternative 1			
Direct impact	$7,221,648,000	28,880	$1,905,440,000
Indirect/induced impact	$2,932,711,000	14,780	$684,243,000
Total impact	$10,154,359,000	43,660	$2,589,683,000
2024 Peak year direct jobs	N/A	7,710	N/A
2024 Peak year direct, indirect and induced jobs	N/A	11,650	N/A
Alternative 2			
Direct impact	$6,182,855,000	24,730	$1,631,353,000
Indirect/induced impact	$2,510,858,000	12,650	$585,819,000
Total impact	$8,693,713,000	37,380	$2,217,172,000
2024 Peak year direct jobs	N/A	6,450	N/A
2024 Peak year direct, indirect and induced jobs	N/A	9,750	N/A

Alternative/Sector	Output (2018$)[1]	Employment (Job-Years)[1]	Employee Compensation (2018$)[1]
Alternative 3			
Direct impact	$7,418,679,000	29,670	$1,957,426,000
Indirect/induced impact	$3,012,725,000	15,180	$702,912,000
Total impact	$10,431,404,000	44,850	$2,660,338,000
2024 Peak year direct jobs	N/A	7,990	N/A
2024 Peak year direct, indirect and induced jobs	N/A	12,080	N/A
Alternative 4			
Direct impact	$5,212,291,000	20,840	$1,375,269,000
Indirect/induced impact	$2,116,711,000	10,670	$493,859,000
Total impact	$7,329,002,000	31,510	$1,869,128,000
2024 Peak year direct jobs	N/A	5,110	N/A
2024 Peak year direct, indirect and induced jobs	N/A	7,730	N/A

Sources: Authority 2018, 2019 2017b; BEA 2018
[1] All numbers have been rounded to the nearest 1,000 for output and employee compensation and to the nearest 10 for employment.
N/A = Not applicable.

Consideration of Overlapping HSR Project Section Construction Schedules and Construction Worker Commute Sheds

The project is just one of several HSR project sections expected to be constructed within a relatively short timeframe and in relative proximity. The RSA for the project includes Santa Clara County, which is also one of the counties in the RSA for the San Francisco to San Jose Project. The San Francisco to San Jose Project Section construction period (2021–2025) is anticipated to overlap the construction period anticipated for this project (2022–2028). The Central Valley Wye Project also has a construction period (2019–2023) that is anticipated to partially overlap the construction period anticipated for this project (2022–2028). Construction workers experienced on any of these adjacent project sections would provide valuable labor resources for the others, and the estimated daily commute sheds for the different project sections would also overlap. Approximately 55,300 (or 55 percent) of the 100,400 employed residents who were primarily employed as construction workers in 2017 and living within the 90-minute commute shed for the San Francisco to San Jose Project Section were also residing within the commute shed for this project. Approximately 5,630 (or about 10 percent) of the 54,900 employed residents who were primarily employed as construction workers in 2017 and living within the 90-minute commute shed for the Central Valley Wye Project were also residing within the commute shed for this project. (U.S. Census Bureau 2019a, 2019b; Attachment 1 to this appendix).

Economic Impacts from Operations

The analysis of operations is based on data obtained from the Authority, including estimated system-wide operating and maintenance costs (Authority 2017a). In addition, the analysis relied on detailed program data to allocate costs to the project.[4] Specifically, the analysis used

[4] Project route miles within Santa Clara, San Benito, and Merced Counties were estimated using the length of the midline of Alternatives 1, 2, 3 and 4 (per GIS shapefile set: JM_SingleCenterline_AllAlts_ZipFinal_20181008.zip) The length of the alternatives' midline may differ from route miles for the individual alternatives and from the project mileage estimates in the Authority's *2018 Business Plan Capital Cost Basis of Estimate Report* (Authority 2018a).

personnel estimates and route miles as the primary metric through which operations costs are allocated from HSR system-wide totals to specific HSR project sections.

In 2040, the Authority anticipates that the total operating budget for the Phase I system will be approximately $874 million (2015$ millions) (Authority 2017a). Total operating and maintenance (O&M) staffing for the entire Phase I system in 2040 is projected by the Authority at 3,540 jobs (Authority 2017c). The number of staff associated with each project section will ultimately depend on final decisions regarding the locations of the maintenance facilities, the operation and control center, and the California High-Speed Rail Headquarters. Interim estimates of the San Jose to Central Valley Wye project O&M staffing in 2040 used in this analysis is 600 jobs or about 17 percent of the Phase I estimate for total jobs systemwide, based on a pro-rata allocation of the systemwide O&M jobs by ratio of the project's centerline route miles to total route miles systemwide (Authority 2018).

The same ratio of the project's centerline route miles to total route miles systemwide is applied to allocate Phase 1 O&M cost estimates to the individual Phase 1 project sections.[5] About $147 million (2015$), or about 17 percent of the projected operating budget, is estimated for the San Jose to Central Valley Wye project. The operations expenses include regional spending on employee compensation and goods and services. The operations and maintenance employment would include train operations, dispatching, maintenance of equipment, track, and systems, station and train cleaning, and general and administrative positions associated with the tracks, stations in San Jose and Gilroy and rail yards and maintenance facilities. Other operating budget costs would involve commercial activities, insurance, and contingency funds. No heavy maintenance facilities are proposed for the project.

Analysts used the Construction Cost Index developed for the Authority's 2016 Business Plan Capital Cost Basis of Estimate Report (Authority 2016) to adjust operations and maintenance expense estimates made in 2015 dollars to the 2016 dollars pertinent to the RIMS II multipliers described previously. An inflation factor of 2.00 percent per annum is assumed to pertain between Fiscal Year 2015/2016 to Fiscal Year 2016/2017 in the Construction Cost Index, and has been applied as necessary to convert 2015 dollars to 2016 dollars for analysis.

Approximately 600 O&M jobs are estimated as direct impacts of the project as part of Phase 1 operations, which is forecast to create approximately 3,540 permanent O&M jobs system-wide by 2040 (Authority 2017a). The direct O&M jobs would include train operations and dispatching, infrastructure and equipment maintenance, station and train cleaning, ticketing and other commercial activities, and administration. Approximately 510 additional permanent jobs are estimated for the RSA, as indirect and induced impacts of the direct O&M employment and expenditures. The indirect and induced jobs would include additional employment supporting, servicing, or supplying train operation, administration and dispatching, infrastructure and equipment maintenance, station and train cleaning, ticketing and other commercial activities, and other occupations, such as security, operations of concessions, provision of goods and services to riders entering and leaving the HSR system.

The total direct, indirect and induced annual employment impact of operations and maintenance would be 1,110 jobs. Table 6 shows the estimated total recurring economic impact of project operations. Most of the anticipated occupations for these project O&M jobs would be in service sectors of the economy. The California Employment Development Department (CEDD) estimated 515,600 service jobs in the RSA in 2015; California Department of Transportation (Caltrans) projects 717,280 service jobs in the RSA by 2040 (Caltrans 2015). The addition of 1,110 O&M-related service jobs would represent increments of only about 0.22 percent and 0.15 percent of the existing (2015) and future (2040) estimates of the No Project Alternative service-sector

[5] Analysts used O&M Phase I 2040 Medium Cost Scenario estimates (Authority 2017a) in conjunction with estimates of route miles by project section (Authority 2018a). The Construction Cost Index developed for the Authority's 2016 Business Plan Capital Cost Basis of Estimate Report (Authority 2016) to adjust the operating cost estimates for this analysis, which were provided in 2015 dollars (Authority 2017a), to the 2016 dollars pertinent to the RIMS II multipliers and for RIMS II calculations.

employment in the RSA. The California Employment Development Department and Caltrans projections of total employment for the RSA are 1,125,900 jobs (2015) and 1,387,360 jobs (2040), respectively. The addition of 1,110 O& M-related jobs would represent increments of about 0.10 percent and 0.08 percent of the existing (2015) and future (2040) estimates of No Project Alternative total employment in the RSA.

Table 6 Total Recurring Economic Impact of Stabilized Project Operations (2018$)

Sector	Output (2018$) [1]	Employment (Job-Years) [2]	Employee Compensation (2018$)
Direct impact	$157,212,900	600	$42,599,400
Indirect/induced impact	$53,279,500	510	$19,582,900
Total impact	$210,492,400	1,110	$62,182,300

Sources: Authority 2017a; BEA 2018
[1] Direct output is based on the project's estimated $147 million (2015$) share, based on proportional route miles, of the estimated annual systemwide operations and maintenance costs under the O&M Phase I 2040 Medium Cost Scenario. The project's Phase 1 direct operations and maintenance jobs are estimated at about 600 of approximately 3,540 total jobs systemwide in 2040.
[2]. Calculated by application of RIMS II Direct Effect Employment Multipliers for Industry Aggregation 33 Rail Transportation

In aggregate, as shown in Table 7, direct, indirect and induced employment gains associated with operations and maintenance of the HSR system would represent a very small addition to the expected growth in the entire RSA—less than 0.1 percent more total employment by 2040 than projected under the No Project Alternative.

Table 7 Operations-Related Employment Growth

Region	Year 2015 Existing	No Project Alternative 2015–2040 Growth	No Project Alternative 2040 Baseline Forecast	Project Phase I O&M Direct, Indirect & Induced Growth	Project Total O&M Growth Inducement
RSA	1,125,900	261,500	1,387,400	1,110	0.08%

Sources: CEDD 2016; CDOF 2016; Authority 2017a, 2017c.
CEDD = California Employment Development Department
CDOF = California Department of Finance
O&M = operations and maintenance
HSR = High-Speed Rail
RSA = resource study area
[1] Regional O&M direct employment is projected at about 1,110 by 2040, based on the project extent's approximate share of systemwide route miles and Authority 2017a.

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