

California High-Speed Rail Authority

Bakersfield to Palmdale Project Section

Draft Project Environmental Impact Report/Environmental Impact Statement

Appendix 3.18-A: Regional Growth Methodology Memorandum

January 2020



The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

APPENDIX 3.18-A: REGIONAL GROWTH METHODOLOGY MEMORANDUM

This appendix describes the methodologies and presents the results of the analysis of employment effects related to high-speed rail (HSR) project spending on short-term construction and long-term operation and maintenance of the HSR project improvements in the Bakersfield to Palmdale Project Section (B-P), including the B-P Build Alternatives, the César E. Chávez National Monument Design Option (CCNM Design Option), the Refined CCNM Design Option, the portion of the Fresno to Bakersfield Locally Generated Alternative (F-B LGA) alignment from the intersection of 34th Street and L Street to Oswell Street, the Bakersfield and Palmdale stations, and maintenance facilities. Maintenance facilities include the light maintenance facility (LMF), maintenance of way facility (MOWF), and maintenance of infrastructure siding facilities (MOIS). The analysis evaluates these effects in the two-county region, or resource study area (RSA) comprising Kern and Los Angeles counties. This appendix supports the analysis presented in Section 3.18, Regional Growth, and details the methodology for using the Regional Input-Output Modeling System (RIMS) II multipliers from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) to estimate these effects.

Overview of Input-Output Analysis

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 associated output and employment in other economic sectors in 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 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 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.

This analysis uses I/O analysis to evaluate the total effect of HSR project spending on the regional economy in terms of employment based on the initial economic input associated with HSR 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 HSR activities within the regional economy.

This analysis measures economic significance in terms of employment, and uses the following terminology to discuss employment effects:

- **Employment:** Equivalent to jobs, a headcount that includes part-time and full-time workers.

- **Annual job years:** A combined measure of total jobs and the duration of those jobs. One annual job year is defined as equivalent to one job held by one person for one year.

RIMS II Multipliers

This analysis relies on RIMS II multipliers acquired from the BEA to measure the economic effects of spending in the RSA associated with construction and operation of the proposed improvements within the Bakersfield to Palmdale Project Section (BEA 2013).¹ RIMS II multipliers are based on national I-O relationships that are adjusted to account for local supply conditions. These adjustments account for the fact that local industries often do not supply all of the intermediate inputs needed to produce the region's output. Industries must purchase some intermediate inputs from suppliers outside the region. These purchases are often called leakages because they represent money that no longer circulates in the local economy. In terms of this analysis, an example of leakage is HSR project spending on construction supplies from companies located outside the RSA.

RIMS II multipliers are available at the county level and were, therefore, obtained for the two-county RSA and are specific to the regional economy composed of Kern and Los Angeles counties. The multipliers were acquired from the BEA in November 2015, and were the most current available at the time of this analysis, that is, those based on 2007 national input-output data and 2013 regional data (BEA 2015). 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 BEA. Industry Aggregation 7 (NAICS Industry Sector 23), Construction, multipliers are most directly relevant to the construction phase and Industry Aggregation 33 (NAICS Industry Sector 482), Rail transportation, multipliers are most directly relevant to the operations and maintenance phase of the HSR project.

Type II multipliers were used for this analysis because these multipliers capture direct, indirect, and induced economic effects by considering the economic effect of industry and household expenditures (BEA 2013). Unlike Type I multipliers, which account for only direct and indirect effects, Type II multipliers include the induced effects associated with the spending of earnings by labor (households) in a region. Type II multipliers were used in this analysis because induced jobs were of interest for this study.

The analysis uses RIMS II Type II annual regional economic final-demand and direct-effect multipliers to estimate employment effects in terms of the total number of jobs in the RSA that would be created during construction and operation of the proposed improvements within the Bakersfield to Palmdale Project Section, including direct, indirect, and induced jobs. Final-demand employment multipliers provide the total number of local jobs created per million-dollar change in final demand (in this case per million dollars in HSR project spending in the RSA), while direct-effect employment multipliers provide the total number of local jobs created per additional direct job created in the final-demand industry. The final-demand and direct-effect multipliers that are relevant to this regional growth analysis are included in Table 3.18-A-1.

¹ BEA does not endorse any resulting estimates and/or conclusions about the economic impact of a proposed change on an area.

Table 3.18-A-1 RIMS II Type II Multipliers Relevant to the Regional Growth Analysis

Industry	Final-Demand Employment Multiplier ¹	Direct-Effect Employment Multiplier ²
Industry Aggregation 7, Construction	10.9433	1.9576
Industry Aggregation 33 Rail Transportation	6.314	3.0721

Sources: BEA 2015.

¹ Represents the total change in number of jobs in all industries per million dollars of output in the industry corresponding to the entry. Because the employment multipliers are based on 2013 data, the output delivered to final demand should be in 2013 dollars.

² Represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

This analysis also uses final-demand multipliers to calculate the number of direct jobs in the RSA in the in the final-demand industry. The final-demand employment multipliers provide the total number of jobs, and do not provide a breakout of the number of direct jobs in the final-demand industry. The number of direct jobs in the final-demand industry can be calculated in two steps. First, for the final-demand industry, divide the final-demand employment multiplier by the direct-effect employment multiplier. The result is the ratio of the number of jobs per million dollars of output for the final-demand industry. Second, multiply this ratio by the final-demand change to obtain the change in jobs in the final-demand industry.

The RIMS II Type II final-demand and direct-effect employment multipliers include only employment effects in the RSA and do not account for economic effects that would occur outside this area. Therefore, use of these multipliers does not account for external economic effects and associated employment since it excludes effects that would occur outside of the RSA yet would benefit the state of California as a whole. Therefore, the employment effects from the proposed improvements within the Bakersfield to Palmdale Project Section estimated in this analysis would be less than total employment effect to the state of California.

Although HSR project spending would increase economic activity in the region, 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. These potential effects are not captured in this analysis.

Short-Term Construction Employment Effects Methodology

This section presents the methodology used to develop estimates for the number of short-term jobs that the proposed improvements within the Bakersfield to Palmdale Project Section would create as a result of construction spending in the RSA, and presents the result of this analysis. The methodology for estimating short-term job creation is based on the *Project Level Environmental Methodology Guidelines, Version 5.09* (Authority and FRA 2017) and the December 2013 RIMS II user guide (BEA 2013).

Construction of the proposed improvements within the Bakersfield to Palmdale Project Section would result in short-term direct construction jobs and additional indirect and induced jobs. Direct employment refers to the jobs created to construct the project and primarily involves jobs created in the construction sector. Indirect employment refers to the jobs created in existing businesses in the region (e.g., material and equipment suppliers) that provide goods and services to project construction. Induced employment refers to jobs created in new or existing businesses (e.g., retail stores, gas stations, banks, restaurants, service companies) that supply goods and services to workers and their families.

This analysis estimates employment effects from construction of the proposed improvements within the Bakersfield to Palmdale Project Section based on the total construction spending estimate for each of the B-P Build Alternatives and design options. This analysis sought to estimate the effects that would occur in the RSA as a result of construction of each of the B-P Build Alternatives and design options, and thus spending in the following the Federal Railroad Administration's (FRA) Standard Cost Categories (Authority and FRA 2019):

- 10: track structures and track
- 20: stations, terminals, intermodal
- 30: support facilities: yards, shops, administrative buildings
- 40: site work, right-of-way, land, existing improvements
- 50: communications and signaling
- 60: electric traction
- 80: professional services
- 90: Unallocated Contingency

This methodology uses only construction costs, and excludes costs for right-of-way acquisition, final design, and program implementation (e.g., train vehicles) because those costs would not measurably affect employment in the RSA. Right-of-way acquisition costs are included in Category 40, site work, right-of-way, land, existing improvements, so the portion attributed specifically to right-of-way acquisition was subtracted out of the Category 40 costs for this analysis. The construction spending estimates include the cost to construct all proposed improvements within the Bakersfield to Palmdale Project Section, including the Bakersfield and Palmdale stations, alignment alternatives or design options between the stations, and maintenance facilities.

This analysis assumes that construction spending would occur throughout the construction period, and would follow a standard S-shaped spending curve based on a normal distribution, which assumes that spending increases steadily to a peak at the mid-point of the construction and then decreases symmetrically until construction is completed. At the time this analysis was prepared, the construction period was estimated to commence in March 2018 and end in June 2025, with peak construction activity occurring in 2021. Although the specific dates have changed, this estimate is representative of the expected duration of construction activities. The estimate for the total number of jobs that would be created at the peak of construction would be similar for any construction period of the same duration, regardless of the commencement date. The estimated construction costs by year for each of the B-P Build Alternatives are presented in Table 3.18-A-2. The total construction spending for the two design options (CCNM Design Option and Refined CCNM Design Option) are shown in Table 3.18-A-3. The costs for these design options would be incurred while construction is occurring for the alignments associated with the design options which are in the Keene area. Therefore only the total costs are shown for the design option. These costs would be in addition to the costs for each alternative.

Table 3.18-A-2 Construction Spending by Alternative (2016\$ in Millions)¹

Alternative	2018	2019	2020	2021	2022	2023	2024	2025	Total
Alternative 1	\$831.7	\$1,681.2	\$2,677.6	\$3,277.3	\$3,063.3	\$2,190.8	\$1,214.6	\$329.9	\$15,266.3
Alternative 2	\$830.3	\$1,678.2	\$2,672.8	\$3,271.4	\$3,057.9	\$2,186.9	\$1,212.4	\$329.3	\$15,239.1
Alternative 3	\$869.6	\$1,757.8	\$2,799.5	\$3,426.5	\$3,202.8	\$2,290.6	\$1,269.9	\$344.9	\$15,961.6
Alternative 5	\$829.9	\$1,677.4	\$2,671.5	\$3,269.8	\$3,056.4	\$2,185.8	\$1,211.8	\$329.1	\$15,231.7

Source: Authority 2019a.

¹ Includes costs from Bakersfield Station to Palmdale Station, including the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswald Street and Avenue O to Spruce Court in Palmdale, the Bakersfield and Palmdale stations, and the maintenance facilities.

Table 3.18-A-3 Construction Spending by Design Option (2016\$ in Millions)

Alternative	Total
CCNM Design Option	+\$42.7
Refined CCNM Design Option	+\$492.9

Source: Authority 2019a.

Numbers reflect changes brought by the addition of the CCNM Design Option or Refined CCNM Design Option to any of the B-P Build Alternatives.

This analysis estimates the direct, indirect, and induced employment effects that would occur from the proposed improvements within the Bakersfield to Palmdale Project Section by applying the RIMS II Type II final-demand multiplier for the construction industry for the two-county RSA to the construction spending estimates. As the most recent set of RIMS II Type II multipliers are from 2013, construction spending estimates were converted from 2016 dollars to 2013 dollars for use with these multipliers using the Consumer Price Index for All Urban Consumers from the U.S. Bureau of Labor Statistics (2017). The RIMS II Type II multipliers were then applied to obtain the number of jobs (direct, indirect, and induced) created per million dollars of project expenditure. The result of this analysis generates the total number of jobs that would be created, including part-time and full-time jobs.

Not all construction spending would occur locally in Kern and Los Angeles counties, as construction of the HSR project would use materials from outside of the RSA (e.g., concrete sections of the guideway, track sections, and quarry materials). However, RIMS II Type II multipliers account for expenditures that would likely occur outside the RSA, referred to as leakage, and therefore the RIMS II Type II multipliers were applied to the entire construction cost estimate for each of the B-P Build Alternatives and design options. This analysis uses Industry Aggregation 7, Construction, to represent the construction industry. The final-demand multiplier for this industry is 10.9433, indicating that 10.9433 jobs would be created for every one million dollars in project spending. The number of these jobs that would be direct jobs was broken out by using the direct-effect multiplier for the two-county RSA for Industry Aggregation 7, Construction. The direct-effect multiplier for this industry is 1.9576, indicating that a total of 1.9576 jobs would be created for every direct job created in this industry.

The employment multipliers measure the total change in the number of local jobs, including full- and part-time jobs, and do not represent full-time equivalent (FTE) employment. This analysis uses the ratio of FTE to total employment to calculate the employment effect in terms of FTE. Data for FTE employment versus total employees (part- and full-time) is not available for individual regions, but it is available at the national level in BEA's National Income and Product Accounts (NIPA). Therefore, the conversion of total jobs to FTE employment is based on the assumption that the national average proportion of FTE employment to total jobs is representative of the ratio in the RSA. Based on NIPA data from 2008 through 2017, the average ratio of FTE to total jobs is 0.960 for the construction industry (BEA 2019a, 2019b). Based on this ratio, the estimates for the number of jobs that would be created by construction spending for the B-P Build Alternatives and design options were converted to annual job years, with each annual job year representing one person fully employed for one year. The total direct, indirect, and induced employment estimates for each of the B-P Build Alternatives are shown in Table 3.18-A-4. The total construction jobs for the two design options (CCNM Design Option and Refined CCNM Design Option) are shown in Table 3.18-A-5. The jobs for these design options would be created while construction is occurring for the alignments associated with the design options which are in the Keene area. Therefore only the total jobs are shown for the design option. These jobs would be in addition to the jobs for each alternative.

Table 3.18-A-4 Employment Effects during Construction (in annual job years)¹

Employment	2018	2019	2020	2021	2022	2023	2024	2025	Total
Alternative 1									
Direct	4,300	8,700	13,900	17,000	15,900	11,400	6,300	1,700	79,200
Indirect and Induced	4,100	8,300	13,300	16,300	15,200	10,900	6,000	1,600	75,700
Total	8,400	17,000	27,200	33,300	31,100	22,300	12,300	3,300	157,900
Alternative 2									
Direct	4,300	8,700	13,900	17,000	15,800	11,300	6,300	1,700	79,000
Indirect and Induced	4,100	8,300	13,300	16,200	15,200	10,900	6,000	1,600	75,600
Total	8,400	17,000	27,200	33,200	31,000	22,200	12,300	3,300	154,600
Alternative 3									
Direct	4,500	9,100	14,500	17,800	16,600	11,900	6,600	1,800	82,800
Indirect and Induced	4,300	8,700	13,900	17,000	15,900	11,400	6,300	1,700	79,200
Total	8,800	17,800	28,400	34,800	32,500	23,300	12,900	3,500	162,000
Alternative 5									
Direct	4,300	8,700	13,800	16,900	15,800	11,300	6,300	1,700	78,800
Indirect and Induced	4,100	8,300	13,300	16,200	15,200	10,800	6,000	1,600	75,500
Total	8,400	17,000	27,100	33,100	31,000	22,100	12,300	3,300	154,300

Sources: Results from BEA RIMS II multiplier analysis using data from the following sources: Authority 2019a, BEA 2015, and U.S. Bureau of Labor Statistics 2017.

¹ Includes costs from Bakersfield Station to Palmdale Station, including the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street and Avenue O to Spruce Court in Palmdale, the Bakersfield and Palmdale stations, and the maintenance facilities.

Table 3.18-A-5 Employment Effects during Construction (in annual job years)

Employment	Total
CCNM Design Option	
Direct	200
Indirect and Induced	200
Total	400
Refined CCNM Design Option	
Direct	2,600
Indirect and Induced	2,400
Total	5,000

Sources: Results from BEA RIMS II multiplier analysis using data from the following sources: Authority 2019a, BEA 2015, and U.S. Bureau of Labor Statistics 2017.

Numbers reflect changes brought by the addition of the CCNM Design Option or Refined CCNM Design Option to any of the B-P Build Alternatives

For the B-P Build Alternatives evaluated, project expenditures would result in the creation of an estimated 78,800 to 82,800 direct and 75,500 to 79,200 indirect and induced annual job years, for a total of 154,300 to 162,000 annual job years in the RSA, depending on the B-P Build Alternative that is selected. During the peak period of construction, an estimated 16,900 to 17,800 direct and

16,200 to 17,000 indirect and induced jobs, for a total of 33,100 to 34,800 jobs would be supported.

Alternative 3 would create the greatest number of jobs during the construction period, at 162,000 annual job years in the RSA when considering direct, indirect, and induced jobs. Alternatives 1 and 2 would follow, resulting in the creation of 157,900 and 154,600 annual job years, respectively. Alternative 5 would result in the smallest number of jobs, as it would create 154,300 annual job years.

The CCNM Design Option would add 400 annual job years and the Refined CCNM Design Option would add 5,000 annual job years to any of the B-P Build Alternatives jobs estimates shown in Table 3.18-A-4.

Long-Term Operation Growth Effects Methodology

This section describes the methodology that was used to calculate long-term employment growth that could occur due to operation of the HSR project in the Bakersfield to Palmdale Project Section, which includes operation of the B-P Build Alternatives or design options, the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street, the Bakersfield and Palmdale stations, and maintenance facilities. This employment growth includes direct long-term jobs for HSR staff that operate and maintain the system as well as indirect and induced long-term jobs at local businesses supported by local expenditures by the HSR project and their staff and families. Given long-term growth effects are related to operation of the HSR project in the Bakersfield to Palmdale Project Section, and the B-P Build Alternatives are similar in length and include the same number of stations and maintenance facilities, employment effects are regional in nature and do not vary by B-P Build Alternative. This analysis of long-term, operations-induced growth focuses on the two-county RSA and determines how operation of the HSR project in the Bakersfield to Palmdale Project Section could influence projected regional employment, either directly or indirectly. The process for estimating long-term job creation follows the methodology described in the *Project Level Environmental Methodology Guidelines, Version 5.09* (Authority and FRA 2017).

This analysis uses employment forecasts from the May 2019 *Revised High-Speed Rail Operating and Maintenance Staffing Projections for Use in EIR/EIS Project-Level Analysis* memorandum (Authority 2019b) to estimate direct employment, and the RIMS II Type II multipliers for the RSA to calculate estimated indirect and induced employment. This analysis estimates the number of direct jobs associated with operation and maintenance of the HSR project in the Bakersfield to Palmdale Project Section based on the number of jobs forecasted under implementation of full Phase 1 operation of the HSR system. Jobs associated with station operations, training cleaning, and maintenance of equipment and infrastructure are based on the specific facilities that would be located in the RSA (i.e., the Bakersfield and Palmdale stations, LMF, MOWF, and MOIS facilities). There are no jobs associated with train operation and dispatching because these jobs would be located predominantly at San Francisco and Los Angeles stations at the operation and control center, which would be located outside of the RSA. Although the majority of general and administrative staff would be located at the operation and control center, some would be located in the RSA. Table 3.18-A-6 summarizes direct jobs associated with operation and maintenance of the proposed improvements within the Bakersfield to Palmdale Project Section.

Table 3.18-A-6 Direct Operation and Maintenance Jobs

Staffing Category	Direct Jobs in the RSA
Station Operations and Train Cleaning	50
Maintenance of Equipment and Infrastructure	98
Train Operations and Dispatching	0
General and Administrative	20
Total	168

Source: Authority 2019b.

This analysis estimates the number of indirect and induced jobs based on the number of direct jobs by applying the RIMS II Type II direct-effect employment multiplier for Category 33, Rail Transportation, for the RSA to the number of direct jobs associated with operating the HSR project in the Bakersfield to Palmdale Project Section. The direct-effect multiplier is 3.0721, indicating there are a total of 3.0721 jobs associated with each direct job in the rail transportation industry. As such, operation of the HSR project in the Bakersfield to Palmdale Project Section would result in an increase of about 168 direct jobs and 348 indirect and induced jobs for a total of approximately 516 jobs.

References

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- . 2015. *Regional Input-Output Modeling System (RIMS II) Type II Multipliers, 2007 U.S. Benchmark I-O data and 2013 Regional Data*. November 2015.
- . 2019a. Table 6.4D. Full-Time and Part-Time Employees by Industry (accessed February 2019).
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- U.S. Bureau of Labor Statistics. 2017. *CPI Detailed Report, Data for December 2016*. (Table 24. Historical Consumer Price Index for All Urban Consumers (CPI-U): U. S. city average, all items) (accessed January 15, 2017).

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