APPENDIX F: QUARRY AND BALLAST MEMORANDA

F.1 INTRODUCTION

Construction of the California High-Speed Rail (HSR) Project would require ballast material to support the laying of track. This memorandum describes the analysis performed to determine: (1) the potential amount of railroad ballast material available from California quarries for the Burbank to Los Angeles Project Section of the California HSR Project; and (2) pollutant emissions associated with hauling the materials to the project sites.

The Burbank to Los Angeles Project Section is approximately 14 miles long and is expected to require approximately 246,000 cubic yards of ballast material and sub-ballast material (hereafter referred to as ballast material). Construction of the segment would require large amounts of excavation in certain locations. It is possible that some of the excavated material would be suitable for ballast; however, this analysis assumes all new material would be obtained.

This analysis assumes that the total amount of ballast material required for the Burbank to Los Angeles Project Section would be available from quarries within the South Coast Air Basin.

F.2 QUARRIES EVALUATED

A list of all active quarries in Los Angeles County was obtained from the California Department of Conservation, Office of Mine Reclamation's interactive web map.[1] Quarries were filtered for those supplying a primary commodity that could potentially be used for ballast material. At least three quarries were capable of supplying ballast material for the project. It was assumed that the least number of quarries would be used for efficiency; therefore, one quarry with the largest acreage nearest to the project vicinity was selected for this analysis.

Quarries with 200 or more acres of permitted area are considered to be of sufficient size to effectively serve project demand.[2] The quarry selected for this analysis is the Irwindale Quarry, located in Irwindale, California. This quarry has a permitted area of greater than 200 acres and therefore would serve project demand effectively based on the expected amount of ballast that would be required.

Table F-1 summarizes the results of the quarry evaluation.

F.3 METHODOLOGY FOR ESTIMATING POLLUTANT EMISSIONS FROM HAULING BALLAST TO THE PROJECT SITE

The actual hauling scenario during construction (including which quarries would provide ballast material, how much material would be provided by each quarry, and a variety of other factors) is uncertain. To develop emission estimates, one scenario was developed for hauling ballast emissions from the quarry as listed in Table F-1.

Table F-1 Quarry Information

Quarry Name	Distance to Project Site (miles)[1]	Acres Disturbed[2]	Acres Permitted[3]
Irwindale Quarry	27	458	484

Source: California Department of Conservation, Office of Mine Reclamation 2016

1 Distance to Project Site represents the distance from the quarry to the nearest segment of the Burbank to Los Angeles Project Section.

2 Acres Disturbed is the number of acres disturbed by the mine.

3 Acres Permitted is the number of acres permitted for mining disturbance issued by the lead agency.

[1] California Department of Conservation, Office of Mine Reclamation. 2016. *Mines on Line Interactive Map*. http://maps.conservation.ca.gov/mol/index.html (accessed March 7, 2017)

[2] URS/HMM/Arup Joint Venture. 2011. *Estimated Emissions from Hauling Ballast Material – Merced to Fresno and Fresno to Bakersfield Sections of the California High-Speed Train Project*. July 21, 2011.

Emissions were calculated using the following equation:

$$Annual\ emissions\left(\frac{tons}{year}\right)=\left(\frac{cubic\ yards}{year}\right)\times\left(\frac{trip}{cubic\ yards}\right)\times\left(\frac{miles}{trip}\right)\times\left(\frac{grams\ pollutant}{mile}\right)\times\left(\frac{tons}{gram}\right)$$

To calculate the annual volumes of material required for the Burbank to Los Angeles Project Section, it was assumed that construction would take place over 3.5 years. Daily emissions were calculated by assuming that the annual material requirements would be hauled by trucks that would operate 260 days per year. The truck haul capacity was assumed to be 20 cubic yards.

Emissions were calculated using year 2020 emission factors. Year 2020 would be the first year that ballast is required for the project. Emission factors for that year are the most conservative within the project schedule because they are expected to decrease each year as vehicle technology improves.

Table F-2 provides the emission factors used in the Burbank to Los Angeles Project Section analysis. Truck emission factors were obtained from EMFAC2014 and based on the T7 Single Construction Truck vehicle category.

Table F-2 Ballast Hauling Emission Factors

Emission Source	Emission Factors						
	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Haul Trucks (grams/mile) [1]	0.043	0.186	3.392	0.014	0.018	0.017	1,474.80

Sources: EMFAC2014
CO = carbon monoxide
NO_X = nitrogen oxides
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compounds

Emissions were calculated by multiplying the emission factor by the distance traveled and the amount of material hauled per trip. Emissions for the following pollutants were calculated:

- Carbon monoxide (CO)
- Nitrogen oxides (NO_X)
- Particulate matter smaller than or equal to 2.5 microns in diameter ($PM_{2.5}$)
- Particulate matter smaller than or equal to 10 microns in diameter (PM_{10})
- Sulfur dioxide (SO_2)
- Volatile organic compounds (VOC)
- Carbon dioxide (CO_2)

F.4 ESTIMATED POLLUTANT EMISSIONS FROM HAULING BALLAST TO THE PROJECT SITE

With the entire project requiring a total of approximately 246,000 cubic yards of ballast material, approximately 70,000 cubic yards of ballast material would be supplied annually.

Table F-3 shows the annual emissions from ballast hauling from the quarry to the project site in the South Coast Air Basin.

Table F-3 Annual Emissions from Ballast Hauling through the South Coast Air Basin/South Coast Air Quality Management District, Burbank to Los Angeles Project Section

Air Basin / Air Quality Management District	Emissions (tons/year)						
	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC	CO_2
South Coast Air Basin / South Coast Air Quality Management District	0.04	0.71	0.00	0.00	0.00	0.01	307.81

CO = carbon monoxide
CO_2 = carbon dioxide
NO_X = nitrogen oxides
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compounds

Table F-4 Daily Emissions from Ballast Hauling through the South Coast Air Basin/South Coast Air Quality Management District, Burbank to Los Angeles Project Section

Air Basin / Air Quality Management District	Emissions (pounds/day)						
	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC	CO_2
South Coast Air Basin / South Coast Air Quality Management District	0.30	5.45	0.03	0.03	0.02	0.07	2,367.78

CO = carbon monoxide
CO_2 = carbon dioxide
NO_X = oxides of nitrogen
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compounds

F.5 REFERENCES

California Department of Conservation, Office of Mine Reclamation. 2016. *Mines on Line Interactive Map*. http://maps.conservation.ca.gov/mol/mol-app.html (accessed March 7, 2017).

URS/HMM/Arup Joint Venture. 2011. *Estimated Emissions from Hauling Ballast Material—Merced to Fresno and Fresno to Bakersfield Sections of the California High-Speed Train Project*. July 21, 2011.

This page intentionally left blank