# Appendix D
# Vehicle Trip and Emission Calculations

## D.1    Vehicle Trip Calculations

Use the following table to determine the number of daily vehicle trips generated by a project.

**Table D.1 Estimating Vehicular Trips**

| Land Use(s) | Size | Trip Rate[1] | Daily Vehicle Trips |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| Total Daily Vehicle Trips |  |  |  |
| [1] Refer to Table D-2 for appropriate daily average trip rates. | | | |

- Itemize each land use associated with a project in the first column.
- List the size of each land use.
  **Note:** Typically, residential projects are listed by number of dwelling units, while non-residential projects are reported by gross square footage, expressed as 1000s of square feet. For example, a 50,000 square foot project would be recorded in the table above as 50.
- Transfer the appropriate trip generation rates for each land use from Table D.2.
  **Note:** If additional trip generation rates are needed, refer to the Institute of Transportation Engineers (ITE) *Trip Generation Handbook – 6th Edition.*
- Multiply the size of each land use by its trip generation rate to determine the number of daily vehicle trips generated by each land use.
- Add trip totals for each land use to determine a project's total daily vehicle trips.

## D.2    Vehicle Emission Calculations

### Table D.2 Trip Generation Rates for Various Land Uses

| LAND USE | UNIT OF MEASURE | TRIP RATE | LAND USE | UNIT OF MEASURE | TRIP RATE |
|---|---|---|---|---|---|
| **Port and Terminal** | | | **Office** | | |
| Aviation Airport | Av. Flts/day | 1.98 | General Office | 1000 GSF | 15.00* |
| Truck Terminal | Acre | 62.48 | Corp. Headquarters Bldg. | 1000 GSF | 6.27 |
| **Industrial** | | | Medical Office Bldg. | 1000 GSF | 25.91 |
| Light Industrial | 1000 GSF | 5.26 | Office Park | 1000 GSF | 8.50 |
| Industrial Park | 1000 GSF | 5.44 | Research Center | 1000 GSF | 5.93 |
| Manufacturing | 1000 GSF | 3.05 | Business Park | 1000 GSF | 10.89 |
| Warehousing | 1000 GSF | 3.77 | **Medical** | | |
| Mini Warehouse | 1000 GSF | 2.45 | Hospital | 1000 GSF | 15.25 |
| **Residential** | | | **Retail** | | |
| Single Family D.U. | DU | 9.53 | Building & Lumber Store | 1000 GSF | 28.80 |
| Apartment | DU | 6.29 | Special Retail Center | 1000 GLA | 37.97 |
| Res. Condominium | DU | 5.69 | Discount Store | 1000 GSF | 70.56 |
| Mobile Home Park | DU | 4.77 | Hardware/Paint Store | 1000 GSF | 58.23 |
| Planned Unit Dev. | DU | 6.96 | Garden Center | 1000 GSF | 44.51 |
| **Lodging** | | | Shopping Center | 1000 GLA | 82.00* |
| Hotel | Room | 8.93 | Quality Restaurant | 1000 GSF | 92.55 |
| Motel | Room | 5.63 | High-Turnover Restaurant | 1000 GSF | 158.37 |
| **Recreational** | | | Fast Food w/ Drive-Thru | 1000 GSF | 623.19 |
| Golf Course | Acre Acre | 8.18 | Fast Food w/o Drive-Thru | 1000 GSF | 778.18 |
| Racquet Club | 1000 GSF | 17.14 | New Cars Sales | 1000 GSF | 38.72 |
| **Institutional** | | | Supermarket | 1000 GSF | 172.02 |
| Elementary School | 1000 GSF | 10.72 | Convenience Market (24 hr) | 1000 GSF | 758.79 |
| High School | 1000 GSF | 10.90 | Furniture Store | 1000 GSF | 4.67 |
| Church | 1000 GSF | 13.28 | **Services** | | |
| Day Care Center | 1000 GSF | 58.33 | Walk-In Bank | 1000 GSF | 109.44 |
| Library | 1000 GSF | 39.75 | Drive-In Bank | 1000 GSF | 201.56 |
| GSF = Gross Square Feet;  GLA = Gross Leasable Area;  D.U. = Dwelling Unit<br>Note: Trip Rate based on a daily average calculated over one week.<br>Source: Institute of Transportation Engineers. <u>Trip Generation</u> – 6th Edition, 1997 | | | | | |

Use Table D.3, below, to calculate long-term vehicular emissions of a project or short-term construction employee trip emissions.  Calculate emissions for the year closest to the build-out year of the project.  Larger, phased projects may require multiple calculations.  Complete Table D.3 for each year of analysis.

**Table D.3 Vehicle Emissions Calculation**

| Year of Analysis _____<br><br>Total Daily<br>Vehicle Trips (Table D.1) _____ | Emissions<br>(Pounds/Day) | | | |
|---|---|---|---|---|
| | ROG | NO$_X$ | PM$_{10}$ | CO |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total Vehicular Emissions | | | | |

- Enter the year of analysis (the build-out year of the project or phase of larger projects).
- Transfer the total daily vehicle trips from Table D.1 (or from Table 4.7 in Chapter 4: *Construction Worker Trip Generation).*
- Use Table D.4 to estimate the amount of emissions generated by daily trips (use the corresponding year of analysis).  (Rows from emission tables can be transferred to rows of Table D.1.)
- Add pollutant values for each column as necessary to determine total vehicular emissions. Transfer vehicular emission totals to line two of Table 10: Long-Term Emissions.  If estimating Phase II Construction employee trip emissions, transfer totals to line one of Table 5:  Short Term Phase II Emissions.

**Table D.4 Lookup Table for Construction Worker Trip Emissions (Lbs.)**
**Years 2000, 2005, 2010, 2015**

| | Year 2000 | | | | Year 2005 | | | |
|---|---|---|---|---|---|---|---|---|
| Trips | ROG | NOx | PM$_{10}$ | CO | ROG | NOx | PM$_{10}$ | CO |
| 1 | 0.04 | 0.04 | 0.001 | 0.38 | 0.03 | 0.02 | 0.001 | 0.21 |
| 10 | 0.44 | 0.35 | 0.012 | 3.78 | 0.26 | 0.19 | 0.012 | 2.10 |
| 100 | 4.38 | 3.55 | 0.116 | 37.79 | 2.56 | 1.93 | 0.117 | 20.96 |
| 1000 | 43.82 | 35.47 | 1.164 | 377.88 | 25.62 | 19.29 | 1.173 | 209.56 |
| 10000 | 438.21 | 354.67 | 11.640 | 3778.84 | 256.23 | 192.91 | 11.727 | 2095.57 |
| | | | | | | | | |
| | Year 2010 | | | | Year 2015 | | | |
| Trips | ROG | NOx | PM$_{10}$ | CO | ROG | NOx | PM$_{10}$ | CO |
| 1 | 0.02 | 0.01 | 0.001 | 0.12 | 0.01 | 0.01 | 0.001 | 0.08 |
| 10 | 0.16 | 0.11 | 0.011 | 1.25 | 0.10 | 0.07 | 0.012 | 0.75 |
| 100 | 1.59 | 1.13 | 0.113 | 12.46 | 1.03 | 0.66 | 0.119 | 7.55 |
| 1000 | 15.85 | 11.25 | 1.125 | 124.62 | 10.31 | 6.64 | 1.191 | 75.49 |
| 10000 | 158.53 | 112.50 | 11.250 | 1246.23 | 103.07 | 66.42 | 11.910 | 754.92 |

Source: California Air Resources Board, EMFAC2000, version 2.02.
Runs performed for El Dorado County, Mountain Counties Air Basin, using weighted fleet mix of light-duty autos, light-duty trucks, and medium-duty vehicles, annual average emission rates, and a10-mile one-way trip.
Use linear interpolation or extrapolation if actual number of trips is different from numbers shown. Use linear interpolation for intervening years.