

ATTACHMENT A – Public Comment Draft 7/13/16

To the August 2016 Supplement to Nevada’s 2012 Revision to the Nevada State Implementation Plan for Carbon Monoxide: Updated Limited Maintenance Plan for the Nevada Side of the Lake Tahoe Basin.

Mobile Source Emissions Inventory and Future Year Projections for the 2012 Lake Tahoe Basin Carbon Monoxide Limited Maintenance Plan

1. Introduction

The U.S. Environmental Protection Agency requires that an annual carbon monoxide (CO) season emissions inventory for 2011 and a projected inventory for 2024 be included as part of the second 10-year CO Limited Maintenance Plan (LMP) for the Nevada side of the Lake Tahoe Basin (Basin).

Mobile sources account for the vast majority of CO emissions in the Basin. The Nevada Division of Environmental Protection’s (NDEP) initial 10-year maintenance plan included an emissions inventory for onroad and nonroad mobile sources; therefore, the NDEP is providing a similar inventory for the second 10-year CO LMP.

2. Seasonal Adjustment Factor

Data from the National Emissions Inventory (NEI) is used as a starting point for the 2011 Basin CO emissions inventory. The NEI provides annual emissions for both onroad and nonroad source categories at the county level. The county level emissions are apportioned to the Basin based on the ratio of AVMT or population in the Basin versus the totals from the three counties that the Nevada side of the Basin resides in¹. Annual emissions for the onroad and nonroad sources do not reflect the emission rates during the CO season; so, the NEI emissions are scaled to match CO season emissions using two Seasonal Adjustment Factors (SAF).

The SAF are calculated by taking the Basin-wide onroad and nonroad seasonal emissions from the NDEP’s 2001 emissions inventory² and dividing each one by the corresponding 2002 NEI annual onroad and nonroad Basin-apportioned emissions.

$$\text{Onroad SAF} = \left(\frac{2001 \text{ Onroad Annual CO Season Emissions}}{2002 \text{ Onroad Annual Basin apportioned NEI Emissions}} \right)$$

$$1.824 = \left(\frac{5,832 \text{ tons of CO}}{3,197 \text{ tons of CO}} \right)$$

$$\text{Nonroad SAF} = \left(\frac{2001 \text{ Nonroad Annual CO Season Emissions}}{2002 \text{ Nonroad Annual Basin apportioned NEI Emissions}} \right)$$

¹ Sections 3 and 4 further describe the methodology used to apportion emissions to the Basin.

² The 2001 emissions inventory was included with the “Carbon Monoxide Redesignation Request and Limited Maintenance Plan for the Nevada Side of the Lake Tahoe Basin” that was submitted to the USEPA in October 2003.

$$0.241 = \left(\frac{374 \text{ tons of CO}}{1,554 \text{ tons of CO}} \right)$$

3. Onroad CO Emissions Inventory

For the 2011 onroad emissions inventory, countywide Annual Vehicle Miles Traveled (AVMT) data is collected from the Nevada Department of Transportation’s (Nevada DOT) Annual Vehicle Miles of Travel Report.³ AVMT for the Basin is calculated as the sum of the arterial and nonarterial (collectors and local roads) AVMT; there are no freeways or ramps in the Basin. The arterial AVMT is calculated by multiplying the Annual Average Daily Traffic⁴ counts from the Nevada DOT times the road length for each arterial road segment. The AVMT for the nonarterial roads are assumed to be 10.8 percent of the arterial AVMT. This assumption relies on the assumptions used in the NDEP’s 2001 emissions inventory prepared for the first 10-year LMP.

$$\text{Arterial AVMT} = \text{AADT mi/day} \cdot \frac{\text{Days}}{\text{Year}} \cdot \text{Section Length mi}$$

$$\text{Total AVMT} = \text{Arterial AVMT} + 10.8\% \cdot \text{Arterial AVMT}$$

Tahoe Basin - Total AVMT by County					
County	2001	2002	2005	2008	2011
Carson City	10,293,298	10,035,965	10,293,298	9,461,374	9,435,523
Douglas	101,914,091	100,893,856	98,568,761	88,496,348	96,578,327
Washoe	59,230,051	58,553,218	56,058,881	57,255,201	55,971,930
Total	171,437,440	169,483,039	164,920,939	155,212,922	161,985,780

The CO emissions from the NEI are apportioned to the Basin using the ratio of the AVMT within the Basin to the sum of countywide AVMT for the three counties. The sum of the 2011 NEI onroad CO emissions for the three counties is multiplied by this ratio to yield the total, annual, Basin-apportioned onroad CO emissions.

$$\text{NEI Basin Apportioned Emissions} = (\text{Total NEI 3 County Emissions}) \cdot \left(\frac{\text{Basin AVMT}}{\text{Total 3 County AVMT}} \right)$$

$$2,482 \text{ Tons CO} = (61,741 \text{ Tons CO}) \cdot \left(\frac{161,985,905 \text{ AVMT}}{4,028,911,195 \text{ AVMT}} \right)$$

The annual NEI Basin-apportioned onroad emissions are then multiplied by the onroad SAF to convert the emissions to the annual CO season onroad inventory for 2011.

$$\text{Annual CO Season Onroad Emissions} = (\text{2011 NEI Basin Apportioned Emissions} \cdot \text{Onroad SAF})$$

³ The AVMT data is from the Nevada DOT website (https://www.nevadadot.com/About_NDOT/NDOT_Divisions/Planning/Roadway_Systems/Annual_Vehicle_Miles_of_Travel.aspx) as amended based on email correspondence between NDEP staff, Andrew Tucker, and Nevada DOT staff, Steve Jackson.

⁴ AADT data is from the Nevada DOT Traffic Records Information Access (TRINA) web application (<http://apps.nevadadot.com/Trina/>).

$$4529 \text{ Tons CO} = (2,482 \text{ Tons CO} \cdot 1.824)$$

The same methodology is used to develop onroad inventories for 2002, 2005 and 2008. These additional inventories provide points by which trends in the emissions can be identified.

Tahoe Basin - Onroad CO Emissions (tpy)					
Inventory Year	2001	2002	2005	2008	2011
Annual CO Season Emissions	5,832	5,832	5,766	3,496	4,529

4. Nonroad CO Emissions Inventory

The nonroad CO emissions inventory is developed using a similar methodology to the onroad inventory, except that it uses population instead of AVMT to apportion NEI emissions to the Basin.

Data from the 2000 and 2010 U.S. Census are used to determine the population for the Basin and the populations for the three counties. The populations of the Basin and the three counties are assumed to have changed linearly between 2000 and 2010. Without a second point to reference, the 2011 population is assumed to be the same as in 2010. The Census data is then used to calculate the fraction of the three-county population residing within the Basin. The three-county nonroad emissions from the NEI are multiplied by the fraction of the population residing in the Basin, resulting in the annual, Basin-apportioned NEI nonroad CO emissions.

$$NEI \text{ Basin Apportioned Emissions} = (Total \text{ NEI } 3 \text{ County Emissions}) \cdot \left(\frac{Basin \text{ Population}}{Total \text{ } 3 \text{ County Population}} \right)$$

$$862 \text{ Tons CO} = (30,039 \text{ Tons CO}) \cdot \left(\frac{15,042 \text{ Residents}}{523,679 \text{ Residents}} \right)$$

Tahoe Basin Population by County		
County	2000 Tahoe Basin Pop.	2010 Tahoe Basin Pop.
Carson City ⁵	525	553
Douglas	5,853	5,402
Washoe	9,952	9,087
Total	16,330	15,042
% of County Pop.	3.77%	2.87%

The annual NEI Basin-apportioned nonroad emissions are then multiplied by the nonroad SAF to calculate the annual CO season nonroad inventory for 2011.

$$Annual \text{ CO Season Nonroad Emissions} = (2011 \text{ NEI Basin Apportioned Emissions} \cdot Nonroad \text{ SAF})$$

⁵ The population of Carson City County that resides within the Basin is zero according to the 2000 and 2010 Census. The 2001 emissions inventory assumed that 1% of the population of Carson City County contributes to the nonroad inventory for the Basin. The same assumption was used for the 2011 inventory.

$$208 \text{ Tons CO} = (862 \text{ Tons CO} \cdot 0.241)$$

Inventories for the nonroad source category are developed for 2002, 2005, 2008, and 2011. Again, the additional inventories provide data points by which trends in emissions can be identified and which act to inform the reference point for future-year projections.

Tahoe Basin - Nonroad CO Emissions (tpy)					
Inventory Year	2001	2002	2005	2008	2011
Annual CO Season Emissions	375	375	323	252	208

5. Future Year Projections

The Tahoe Regional Planning Agency (TRPA) provided the NDEP with population projections and data from a travel demand model.⁶ TRPA used the travel demand model to estimate Daily Vehicle Miles Traveled (DVMT) for 2010 and to project DVMT for 2020 for five different development scenarios in the Lake Tahoe Basin. DVMT is converted to AVMT for 2010 and 2020 by multiplying the DVMT by the number of days in the year.

The travel demand model was run for both the Nevada and California sections of the Lake Tahoe Basin. The model was validated for the entirety of the Basin, based on the 2010 Regional Transportation Plan Guidelines from the California Transportation Commission. The model significantly over estimates the 2010 Annual Average Daily Traffic (AADT) for Nevada road segments, when compared to the AADT measured by Nevada DOT traffic recorders. Therefore, it is not appropriate to use the absolute magnitude of the 2020-projected Nevada AVMT. Nevertheless, because TRPA maintains control over development in the Lake Tahoe Basin, the underlying assumptions used by TRPA to estimate future development and the change in AVMT remain valid. As such, the relative change in AVMT between the base year of 2010 and the projected year can be used to project the estimated onroad emissions from 2011 to 2024. This approach assumes a constant CO emissions-to-AVMT ratio over the years even though the fleet characteristics, which are from the California Air Resource Board’s EMFAC2011 model, indicate a slightly more efficient fleet in 2020.

The five different development scenarios that TRPA modeled result in five different AVMT values. The NDEP projects a range of onroad emissions based on the relative change in AVMT between 2010 and 2020 for TRPA’s least conservative (LC) and most conservative (MC) AVMT projections. The relative change in both scenarios is converted to an annual AVMT rate-of-change factor as,

$$AVMT_{Change} = \frac{\left(\frac{VMT_{2020}}{VMT_{2010}} - 1\right)}{(2020 - 2010)}$$

The calculation of the annual change in AVMT for the least conservative scenario is,

⁶ Development of a Regional Greenhouse Gas Emissions Inventory for the Lake Tahoe Basin, E. Pollard, S. Reid and J. Stillely, Sonoma Technology, Inc. for the California Tahoe Conservancy. May 10, 2012.

$$-0.23\%_{LC} = \frac{\frac{141,905,787 \text{ VMT}}{146,196,553 \text{ VMT}} - 1}{2020 - 2010}$$

And the calculation of the annual change in AVMT for the most conservative scenario is,

$$0.95\%_{MC} = \frac{\frac{164,301,349 \text{ VMT}}{146,196,553 \text{ VMT}} - 1}{2020 - 2010}$$

Then, both rates of change are applied to the 2011 annual Basin-apportioned CO season emissions for the 13 year period until 2024.⁷ The results are added to the 2011 Basin-adjusted CO emissions, resulting in the projected range of 2024 annual CO emissions.

$$\begin{aligned} \text{Onroad Projected Emissions}_{2024} &= \text{AVMT}_{\text{change}} \cdot (2024 - 2011) \cdot \text{Emissions}_{\text{Basin},2011}^{\text{onroad}} + \text{Emissions}_{\text{Basin},2011}^{\text{onroad}} \\ 4,396 \text{ Tons CO}_{LC} &= -0.23\%_{LC} \cdot (2024 - 2011) \cdot 4,529 \text{ Tons CO} + 4,529 \text{ Tons CO} \\ 5,089 \text{ Tons CO}_{MC} &= 0.95\%_{MC} \cdot (2024 - 2011) \cdot 4,529 \text{ Tons CO} + 4,529 \text{ Tons CO} \end{aligned}$$

The emissions projections for the nonroad sources are estimated using population from the 2010 U.S. Census and the TRPA population projections. The relative population changes from the least and most conservative projections are used to calculate the annual rate of change as,

$$\text{Population}_{\text{change}} = \frac{\frac{\text{Population}_{2020}}{\text{Population}_{2010}} - 1}{2020 - 2010}$$

The calculation of the annual change in population for the least conservative scenario is,

$$-1.08\%_{LC} = \frac{\frac{13,423 \text{ Residents}}{15,042 \text{ Residents}} - 1}{2020 - 2010}$$

And the calculation of the annual change in population for the most conservative scenario is,

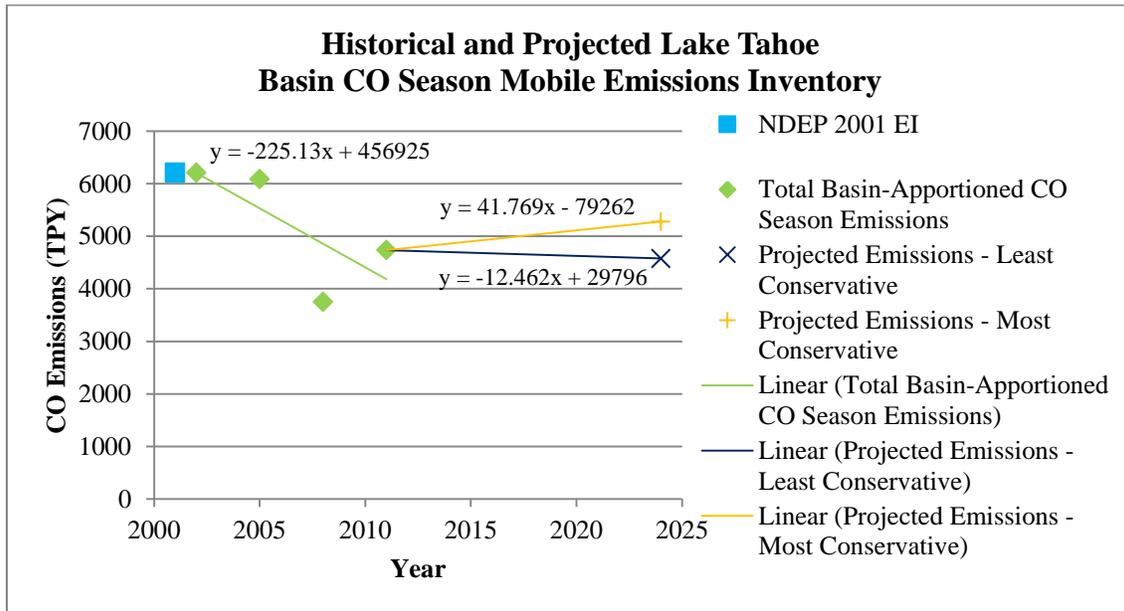
$$-0.62\%_{MC} = \frac{\frac{14,115 \text{ Residents}}{15,042 \text{ Residents}} - 1}{2020 - 2010}$$

Then, both rates of change are applied over the 2011 to 2024 period and added to the 2011 annual Basin-apportioned CO season emissions to provide a projected range of emissions for nonroad sources in 2024.

$$\begin{aligned} \text{Nonroad Projected Emissions}_{2024} &= \text{Population}_{\text{change}} \cdot (2024 - 2011) \cdot \text{Emissions}_{\text{Basin},2011}^{\text{nonroad}} + \text{Emissions}_{\text{Basin},2011}^{\text{nonroad}} \\ 179 \text{ Tons CO}_{LC} &= -1.08\%_{LC} \cdot (2024 - 2011) \cdot 208 \text{ Tons CO} + 208 \text{ Tons CO} \\ 191 \text{ Tons CO}_{MC} &= -0.62\%_{MC} \cdot (2024 - 2011) \cdot 208 \text{ Tons CO} + 208 \text{ Tons CO} \end{aligned}$$

⁷ Note: Reported 2011 CO emissions are above the trend line, making the 2024 projected emissions more conservative, i.e., higher than what the trend would project.

The 2024 projected emissions inventory range falls between the sum of the onroad and nonroad emissions for the least conservative development scenario and the sum of the onroad and nonroad emissions for the most conservative development scenario. The final emissions inventory is a range of projected emissions which fall between the least and most conservative scenarios. The graph below shows the downward trend in the total emissions from both onroad and nonroad sources in the Basin, along with the projected range of emissions for 2024.



The table below displays the annual CO season emissions for each NEI year and the projected emissions from both the most conservative and least conservative scenarios. The inventory shows that the emissions in 2011 are 23 percent lower than in 2001. Annual emissions in 2024 are projected to be between 13 percent and 25 percent lower than the 2001 emissions.

Tahoe Basin CO Season Mobile Emissions Inventory (tpy)							
Year	2001	2002	2005	2008	2011	2024 _{LC}	2024 _{MC}
Onroad Emissions	5,832	5,832	5,766	3,496	4,529	4,396	5,089
Nonroad Emissions	375	375	323	252	207	178	190
Total Emissions	6,207	6,207	6,089	3,748	4,736	4,574	5,279

Key: LC = least conservative; MC = most conservative.