Partial List of Sources Demonstrating the Link Between Vehicle Miles Traveled and Loss of Water Clarity and Quality in Lake Tahoe
(reverse chronological order)

State Water Resources Control Board, Nevada Division of Environmental Protection. (2024) *Lake Tahoe TMDL 2024 Performance Report: Guiding Efforts to Restore Lake Tahoe's Historic Clarity*, p. 2. https://clarity.laketahoeinfo.org/FileResource/DisplayResourceAsEmbeddedPDF/2942c291-08ea-47a9-b74b-b7255fafd829

- Report noting that the TMDL strategy to improve Lake Tahoe clarity and quality "relies on the Tahoe Regional Planning Agency's (TRPA) air quality and transportation management plan to reduce nitrogen deposition from vehicle emissions."

Tahoe Regional Planning Agency. (2024) Lake Tahoe Info Lake Clarity Tracker, Atmospheric Deposition. https://clarity.laketahoeinfo.org/Results/Detail/AtmosphericDeposition

- Noting that "The strategy for reducing nitrogen generated in-basin as emissions [in order to improve Lake clarity] relies on the Tahoe Regional Planning Agency's (TRPA) 2012 air quality and transportation management plan, which aims to reduce vehicle miles travelled in the Tahoe Basin."

Tahoe Regional Planning Agency. (Amended 2024) *Threshold Standards and Regional Plan*, pp. 2-38, 2-43. https://www.trpa.gov/wp-content/uploads/Adopted-Regional-Plan.pdf

- Water quality policies aimed at reducing vehicle use, stating: "There is evidence that atmospheric sources of nitrogen and entrained dust may be a major contributor of nutrients to Lake Tahoe, and that local emissions of oxides of nitrogen and entrained dust, primarily from automobiles, account for most of these atmospheric inputs."

U.C. Davis Tahoe Environmental Research Center, One Health Institute (Prepared for: Nevada Division of Environmental Protection). (2023) *To Sink or Swim: A Snapshot Evaluation of the Fate and Types of Microplastics in Lake Tahoe*, p. 36. https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/LakeTahoe%20Microplastics%20Report_Final_20230302.pdf

- Research demonstrating large volume of microplastics pollution in Lake Tahoe and the connection with vehicle miles traveled (VMT). "There is currently no treatment system for stormwater in the Tahoe Basin prior to it flowing into the

lake potentially contributing to a large microplastic load from a range of sources such as trash, rubber tire wear and road paint. Microplastics deposited by atmospheric deposition may also be a contributor."

U.C. Davis Tahoe Environmental Research Center. (2022) *Atmospheric Pollutant Deposition: Monitoring Nitrogen and Phosphorus Deposition at the Mid-Lake Station of Lake Tahoe*, p. 5. https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/TERC%202021%20Task%202%20MIDLAKE%20AD%20Report%20FINAL.pdf

- Report providing monitoring data and noting that "[m]otor vehicle emissions are thought to be the largest contributor to atmospheric nitrogen pollutants in the [Tahoe] basin." Report attributes spikes in data to smoke deposition from wildfires.

U.C. Davis Tahoe Environmental Research Center. (2022) *Training Manual, Chapter 4: Environmental Problems Facing Lake Tahoe*, pp. 2, 23, 26. https://tahoe.ucdavis.edu/docents

- Manual explaining that "excessive automobile use degrades air quality and contributes to the decline in Tahoe's clarity" due to motor vehicles' contribution to fine sediment, nitrogen, phosphorous, and microplastics.

Tahoe Regional Planning Agency. (2021) Staff Report Re Threshold Update, p. 10. https://www.trpa.gov/wp-content/uploads/Agenda-Item-No-VII.A-VMT_RTP_PIA-Staff-Report-with-attachments.pdf

- Staff report regarding the change to an efficiency metric for VMT, noting that "[d]uring peak times of visitation, Tahoe's roads clog with traffic and parking demands exceed capacity at recreation sites. This seasonal influx of motorists has consequences for the environment, for local communities and their mobility, *and for air and water quality*." (Emphasis added.)

Heidt, A. (2020) *Lake Tahoe's pristine legacy threatened by microplastics*. UC Santa Cruz Science Notes

- Study found microplastics in all six Lake Tahoe sample locations, as well as in Tahoe area snowmelt. Scientist discovered "215 pieces of microplastic per liter of snowmelt." Study noted that "microplastics can [] include craggy castoffs of tire rubber."

Tahoe Regional Planning Agency. (2020) *Regional Transportation Plan (RTP) and Sustainable Communities Strategy*, at pp. 16, 21

- TRPA adopted this document in its role as the Metropolitan Planning Organization (MPO) and the California Regional Transportation Planning Agency (RTPA) for the region. In it, TRPA explains describes its approach to meeting its environmental goals for the Lake as follows: "A transportation system that provides alternatives to driving can help preserve Tahoe's environment by reducing GHG and roadway runoff into the lake. Assessing projects for vehicle miles traveled (VMT) and mitigating those impacts is part of TRPA's and California jurisdictions' development review." It also explains that the "RTP plus federal and state vehicle emissions standards contribute to the Tahoe TMDL program goals *to reduce nitrogen loading to the atmosphere from mobile sources*." (emphasis added).

Mejia, J., et al., Desert Research Institute Division of Atmospheric Sciences (Prepared for the Tahoe Science Advisory Council Threshold Update 2017-18). (Rev. 2019) *Final Report: Vehicle Miles Traveled Review*. https://www.researchgate.net/publication/352555818_Final_report_Vehicle_Miles_Traveled_Review

- Study conducts a one week simulation and utilizes a numeric modeling system based on the Weather Research and Forecasting (WRF) model coupled to the Community Multiscale Air Quality (CMAQ) model. Preliminary results from the demonstration study find that nitrogen (NOx) and road dust deposition into Lake Tahoe have decreased proportionally to a reduction in VMT.

Tahoe Regional Planning Agency. (2019) Staff Report Re VMT Threshold Update https://www.trpa.gov/wp-content/uploads/documents/archive/1.-Agenda-Item-V.A-2019_8-28_RPIC_Staff-Report-VMT_V3.pdf

- Explaining that, "[w]hile the work plan to update the VMT threshold standard focuses on identifying appropriate measures and targets for the concerns more salient today, *it does not mean that TRPA is moving away from VMT as a measure. Reducing VMT will remain a central focus of TRPA's Regional Plan, and transportation and air quality programs*." (Emphases added.)

Rinke, N. et al., Office of the Attorney General of California. (2016) Letter to Placer County re Squaw Valley [now Palisades Tahoe] Specific Plan Environmental Impact Report, pp. 3-5.

- "The significant increase in traffic within the basin [from the Project] will have direct impact on the air and water quality of Lake Tahoe. Increased vehicular use

generates significant amounts of dust and leads to nitrogen deposition in the lake, which in turn causes algae growth that threatens the clarity of the lake."

Marshall, J., Tahoe Regional Planning Agency. (2015) Letter to Placer County re Draft Environmental Impact Report for Village at [Palisades Tahoe] Specific Plan, p. 2. https://www.placer.ca.gov/DocumentCenter/View/7915/Tahoe-Regional-Planning-Agency-Responses-PDF

- "By proposing to increase the bedbase and attractions at the Village at Squaw Valley [now Palisades Tahoe], the SVSP [now VPTSP], if implemented without adequate mitigation, would significantly affect Lake Tahoe's physical environment through increased vehicle trips into, and the amount of vehicle miles traveled within, the Tahoe Basin."

State Water Resources Control Board Lahontan Region. (2014) *Lake Tahoe Nearshore Water Quality Protection Plan: Report to the Legislature*, pp. 8, 11. https://cawaterlibrary.net/wp-content/uploads/2017/09/tahoenearshoreplan1114.pdf

- Report to Legislature explaining that "Updated [Regional Plan] policies . . . promoting the reduction of vehicle miles traveled are all important elements for nearshore water quality protection."

VanCuren, R., et al. (2012) *Air pollution in the shore zone of a Large Alpine Lake – 1 – Road dust and urban aerosols at Lake Tahoe, California–Nevada*, Atmospheric Environment, volume 46, pp. 607-617. DOI: 10.1016/j.atmosenv.2009.12.001

- Research paper identifying methodology for calculating atmospheric deposition in Lake Tahoe and concluding "that road dust is a major component of aerosols around Lake Tahoe, and that strong gradients in dust loading occur as functions of location, land use [and] traffic activity".

VanCuren, R., et al. (2012) *Aerosol generation and circulation in the shore zone of a Large Alpine lake – 2 – Aerosol distributions over Lake Tahoe, CA*, Atmospheric Environment, volume 46, pp. 631-644. https://doi.org/10.1016/j.atmosenv.2009.08.049

- Collected data "indicate that anthropogenic pollutants, especially road dust and combustion products, are commonly produced along the [Lake Tahoe] shoreline."

State Water Resources Control Board, Nevada Division of Environmental Protection. (2010) *Final Lake Tahoe Total Maximum Daily Load (TMDL) Report*, pp. 3-1, 7-8, 9-3, 11-11, 11-12, 16-5.

https://www.waterboards.ca.gov/lahontan/water_issues/programs/tmdl/lake_tahoe/docs/tmdl_rpt_nov2010.pdf

- "Motor vehicles, including cars, buses, trucks, boats, and airplanes are primary sources of atmospheric nitrogen." Mobile sources contribute to pollution of Lake Tahoe through both atmospheric deposition of nitrogen, as well as by contributing fine sediment and phosphorus. Reduction in VMT/vehicle trips is identified as a "Implementation Action[] to Meet the Clarity Challenge and Achieve the TMDL."

Prigden, A., Tahoe Daily Tribune. *Vehicles Impact Lake Tahoe Clarity*. (2007) https://www.tahoedailytribune.com/news/vehicles-impact-lake-tahoe-clarity/

- Article summarizing UC Davis research study findings that VMT greatly contributes to the loss of Lake Tahoe water clarity and quality. It stated "the solution [is] simply to get cars off the road."

California Air Resources Board, California Environmental Protection Agency. (2006) *Lake Tahoe Atmospheric Deposition Study*. https://www.waterboards.ca.gov/rwqcb6/water_issues/programs/tmdl/lake_tahoe/docs/peer_review/carb2006.pdf

- Comprehensive research study quantifying the contribution of atmospheric deposition to the nitrogen (N), phosphorus (P), and particulate matter (PM) loading of Lake Tahoe, which play a large role in the loss of Lake clarity. Motor vehicles are identified as a major contributor of these pollutants.

Gertler, A.W. et al. (2006) *Local air pollutants threaten Lake Tahoe's clarity.* California Agriculture 60(2):53-58. https://ucanr.edu/repository/fileAccessPublic.cfm?fn=ca6002p53-169072.pdf

- Study noting the high impact of in-basin emissions on Lake Tahoe. "The highest levels of ozone and nitric acid in August coincide with traffic-related high emissions of nitrogen oxides and volatile organic compounds (VOC), high temperatures and solar radiation — all factors promoting the generation of these photochemically produced air pollutants." Study results "imply that the majority of phosphorus deposition in the Tahoe Basin can be attributed to local sources from roadway sanding and salting in winter, local soils in summer and vehicle exhaust."

Kuhns, H. et al., Desert Research Institute (2004) DRI Lake Tahoe Source Characterization Study: Final Report, pp. i, ii, 1-1. https://www.researchgate.net/publication/228921959_DRI_Lake_Tahoe_source_characterization_study_Final_report

- "To improve water clarity, a comprehensive knowledge of the pollutants entering the lake through dry deposition, wet deposition, runoff, etc. is needed. This report addresses the local emissions of air pollutants in the Lake Tahoe Basin from sources that are likely to be the largest contributors to dry deposition in the lake." "Measurements indicated that the between 40% to 90% of PM mass emissions from motor vehicles are composed of road dust material (i.e. silicon, aluminum, iron, and organic carbon). Road dust entrainment may be the dominant source of coarse organic carbon PM. The application of brine solution as a deicer on the roads produced downwind coarse particle (PM10 –PM2.5) source profiles that were enriched with both sodium (21%) and chloride (22%). Motor vehicle exhaust was composed of organic (54%) and elemental carbon (15%), resulting in an elemental to total carbon ratio of 0.23. This is approximately a factor of two higher than the ratio observed in wood smoke." "The CARB emission estimates derived from the EMFAC model were 2 to 10 times greater than the measured on-road exhaust emissions based on estimated fuel consumption." Further study is needed to refine the source data.