EXHIBIT A

BASELINE ENVIRONMENTAL CONSULTING

2 February 2023
22204-01

Ellison Folk
Shute, Mihaly & Weinberger LLP
396 Hayes Street
San Francisco, CA 94102-4421

Subject: Review of Idaho-Maryland Mine Project, Final Environmental Impact Report, SCH# 2020070378

Dear Ms. Folk:

In February 2022, Baseline Environmental Consulting (Baseline) peer reviewed the Draft Environmental Impact Report (DEIR) for the proposed Idaho-Maryland Mine Project (project) and prepared a comment letter that identified flaws in the analysis used to support the significance determinations for air quality and greenhouse gas (GHG) emissions (as well as other topics). Baseline has reviewed the Air Quality and GHG Emissions sections of the Final Environmental Impact Report (FEIR) for the proposed project. Based on our review of the revisions and responses to comments presented in the FEIR, we have identified flaws that remain in the overall CEQA analysis. The specific concerns identified in our review of the air quality and GHG sections of the FEIR are described in detail below.

Comment GRP 21-122: Underestimated Emissions from Off-Site Haul Truck Trips

Baseline previously prepared a comment for the DEIR (FEIR comment GRP 21-122) regarding the inadequate analysis of criteria air pollutant and GHG emissions from haul trucks transporting waste rock and mine tailings to various destinations over the lifetime of the project. The DEIR air quality analysis assumed that waste rock and mine tailings would be used as engineered fill at the following locations over time:

- Years 2022–2026: Fill placement at the Centennial Industrial Site;
- Years 2027–2032: Fill placement at the Brunswick Industrial Site; and
- Years 2033–2102: Fill placement at off-site locations.

The air quality and GHG analysis in the DEIR assumed that remediation of the Centennial Industrial Site would be completed and approved by the DTSC prior to the opening year. However, since remediation of the Centennial Industrial Site is not included as part of the CEQA analysis for the project, there is no assurance that remediation of the site will be completed prior to the opening year of the project or within the lifetime of the project. The DEIR acknowledged this on page 3-26, stating that “if the remediation of the Centennial Industrial

Site, currently under DTSC oversight, is not complete upon commencement of mining, in which case engineered fill would be placed at the Brunswick Industrial Site and/or transported off-site to be utilized in local and regional construction markets."

As Baseline previously commented (FEIR comment GRP-122), the DEIR should have analyzed the worst-case scenario for estimating emissions from haul trucks transporting engineered fill, which would be to assume trucks may need to haul the engineered fill to off-site locations about 60 miles away in the opening year (2022). Baseline prepared an updated analysis of the project's daily nitrogen oxide (NOx) emissions in the opening year related to haul trucks transporting engineered fill to the off-site locations instead of the Centennial Industrial Site. Based on the updated analysis, the project would generate about 193 pounds per day of NOx, which would exceed the Northern Sierra Air Quality Management District's (NSAQMD's) Level C threshold of significance of 136 pounds per day. This would result in a significant and unavoidable impact if emissions are not mitigated below the NSAQMD's Level C threshold.

In response to comment GRP 21-122, page 2-957 of the FEIR states that "if the Centennial site were not available, fill placement would take place initially at the Brunswick site rather than being hauled to local and regional construction projects." Based on this assumption, the FEIR states that emissions from haul trucks transporting engineered fill to the more distance off-site locations would not occur before 2027, after placement of engineered fill at the Brunswick site is completed. According to the FEIR response to comment, the project's total NOx emissions in 2027 would be about 125 pounds per day, which is below NSAQMD's Level C threshold of significance of 136 pounds per day (page 2-958 of FEIR).

However, the FEIR did not provide any revisions to the Project Description or other chapters of the DEIR explicitly stating that engineered fill will not be transported to off-site locations prior 2027. The current language in the Project Description clearly states that if the Centennial Industrial Site were not available, then "engineered fill would be placed at the Brunswick Industrial Site and/or transported off-site" (page 3-26 of DEIR). Because there is no explicit requirement preventing the project from transporting fill to off-site locations prior 2027, the FEIR has failed to analyze the worst-case scenario for the project's criteria air pollutant and GHG emissions.

Aside from failing to analyze the worst-case scenario, Baseline acknowledges that Master Response 4 of the FEIR attempts to address the air quality and GHG emission concerns associated with haul trucks traveling to off-site locations. As stated on page 2-10 of the FEIR, "the applicant has agreed to a condition of approval that would require the applicant to use electric trucks for any offsite sale or transport of waste rock or sand tailings from the Brunswick site (other than to the Centennial Site) if such transport occurs prior to 2033." The purpose of this condition of approval (referred to as "COA 4") is to ensure the project would not have greater air quality and GHG emissions impacts than analyzed under the DEIR if the Centennial

Site is not available for placement of engineered fill. Baseline appreciates that the applicant has adopted COA 4 with the intent to address the potentially significant air quality and GHG emissions impacts not properly analyzed in the DEIR. However, there is currently limited commercial availability for electric-powered haul trucks. According to the California Air Resources Board's Advanced Clean Trucks regulation, only about 5% of the heavy-duty trucks that will be manufactured in California in 2024 will be zero-emission vehicles (i.e., battery electric or hydrogen fuel cell electric). Also, the FEIR does not address the need to install charging infrastructure for heavy-duty trucks at the project site. While COA 4 was incorporated into the project with good intentions, the FEIR fails to evaluate the feasibility of implementing COA 4. Therefore, the assumption that 100 percent of the project's heavy-duty trucks used for transporting engineered fill to off-site locations prior to 2033 will be electric is unsubstantiated.

Comments GRP 21-123 and GRP 21-124: Incomplete Evaluation of Applicant Proposed Measures and Mitigation Measures

Baseline previously prepared a comment (FEIR comment GRP 21-123) about the need to incorporate the applicant proposed measures (APMs) related to air quality and GHG emissions into the project design to ensure they are implemented. In response to comment GRP 21-123 (and others), the FEIR revised the Project Description in the DEIR to include the following APMs:

- APM-AQ-1: Exhaust Emission Controls
- APM-AQ-2: Surface Fugitive Dust Controls

Baseline acknowledges and appreciates that the requested revisions were made to ensure the APMs are implemented. However, the FEIR also revised the following sentence in the Air Quality chapter of the DEIR (page 2-182 of FEIR): "The emission data presented in Table 4.3-17 (i.e., unmitigated emissions) reflect the reductions that would occur with<u>out</u> implementation of APM-AQ-1 and APM-AQ-2." This statement is not true. According to page 50 of Appendix E.1 of the DEIR, the unmitigated criteria air pollutant emissions summarized in Table 4.3-17 includes implementation of APM-AQ-1 and APM-AQ-2. In other words, Table 4.3-17 of the DEIR summarizes the project's mitigated emissions with APM-AQ-1 and APM-AQ-2 instead of the unmitigated emissions.

As Baseline previously commented (GRP 21-123), the DEIR should have been revised to disclose the project's unmitigated emissions without implementation of the APMs and evaluate the effectiveness of the APMs to reduce the project's air quality impacts. Similarly, Baseline commented (GRP 21-124) that the DEIR analysis should have been updated to identify and evaluate feasible mitigation measures that would reduce the project's criteria air pollutant emissions during operation. In response, the FEIR incorporated APM-AQ-1 and APM-AQ-2 into the Project Description, which requires the use of Tier 4 final engines for all off-road equipment and dust control measures during project operation. However, the FEIR did not evaluate the effectiveness of APM-AQ-1 and APM-AQ-2 to reduce the project's unmitigated emissions.

According to Table 4.3-17 of the DEIR, it appears that emissions of NOx from off-road equipment (about 6.7 pounds per day) after implementing APM-AQ-1 accounts for about 7% of the project's total NOx emissions (100.2 pounds per day) during operation in 2022. Because the unmitigated NOx emissions without APM-AQ-1 have not been disclosed, it's not clear what level of reduction in NOx emissions is achieved by implementing APM-AQ-1. According to Table 4.3-17 of the DEIR, operation of on-road vehicles and emergency generator testing would account for about 46% and 19% of the project's NOx emissions in 2022, but the FEIR does not evaluate potential mitigation measures such as increasing electric vehicle charging infrastructure or using battery-powered emergency generators to reduce NOx emissions from these sources. As a result, the FEIR failed to evaluate and disclose the effectiveness of implementing the APMs or other potential mitigation measures to reduce the project's air quality impacts during operation.

Comments GRP 21-125 and 21-126: Unsubstantiated Health Risk Assessment

Baseline previously prepared comments for the DEIR (FEIR comments GRP 21-125 and 21-126) about the inadequacy of the supporting documentation for the project's air quality health risk assessment (HRA). The DEIR did not include documentation of the individual health-risk contributions from up to 25 emission sources during each phase of project construction and operation. In addition, no graphics were provided to show the location of the modeled emission sources, sensitive receptors, and results of the air dispersion modeling. As a result, there was no reasonable method for the public or decision makers to review the validity of the HRA findings and evaluate the effectiveness of proposed Mitigation Measure 4.3-1(b).

According to the HRA, the estimated unmitigated cancer risk at the maximally exposed individual resident (MEIR) was reported to be 10.4 in a million, which is above the threshold of significance (10.0 in a million). With implementation of higher-tier engines during construction, as required by Mitigation Measure 4.3-1(b), the DEIR estimated that the project would result in an incremental cancer risk of 7.6 in one million. This 27% reduction in cancer risk is surprising, because Mitigation Measure 4.3-1(b) only reduces emissions during 1 year of construction and does not reduce any of the other emission sources over the 80 years of operation. However, there is no way to review the validity of the HRA results and effectiveness of Mitigation Measure 4.3-1(b) because the results of the HRA analysis are poorly documented and non-existent in some cases.

In partial response to comments GRP 21-122 and 21-123, a Health Risk Memorandum was attached to the Final EIR as Appendix K that included health risk isopleths and sensitive receptor locations, which helps to clarify some of missing HRA documentation in the DEIR. The

FEIR also provided a summary table of health risks in response to comments GRP 21-122 and 21-123 (see **Table 1** below). This information was not included in the Air Quality chapter or Appendix E.1 of the DEIR. Table 4.3-21 *Project-Related Health Risk Results* of the DEIR should have been revised to disclose this information to the public.

Table 1. Calculated Cancer Risks at the MEIR

Activity	Cancer Risk per million Mitigated	Cancer Risk per million Unmitigated
Construction - Asbestos in Dust	3.7	3.7
Construction - Diesel Exhaust	1.2	4.1
Operations - Asbestos in Dust	1.8	1.8
Operations - Diesel Exhaust	0.6	0.6
Operations - Arsenic in Dust	0.3	0.3
Total	7.6	10.4

Note: MEIR = maximally exposed individual resident.
Source: Page 2-942 of FEIR

The HRA was based on a 30-year exposure scenario. As summarized in **Table 2** below, the project would generate about 8.60 tons of diesel exhaust on-site from offroad equipment and on-road vehicles over a 30-year period. Implementation of Mitigation Measure 4.3-1(b) during construction in 2021 would reduce the project's total diesel exhaust emissions over the 30-year period by about 2% to 8.41 tons. This is a relatively minor reduction in the project's total on-site diesel exhaust emissions. However, according to **Table 1**, implementation of Mitigation Measure 4.3-1(b) would reduce the project's overall cancer risk by about 27%, which does not seem to correlate with the project's 2% reduction in diesel exhaust over the 30-year period. It appears that the cancer risk associated with diesel exhaust during project operations from 2022 to 2050 has been substantially underestimated.

The FEIR fails to provide an explanation for how a 27% reduction in cancer risk can be achieved by implementing Mitigation Measure 4.3-1(b). To verify the results of the HRA, the public would need to know the emission rates used for each modeled source for each year of construction and operation from 2021 to 2050, as well as the location of each source. This level of information is not documented Appendix E.1 of the DEIR or Appendix K of the FEIR.

Table 2. Annual On-Site Diesel Exhaust Emissions

Year	Unmitigated Diesel Exhaust Emissions (tons)	Mitigated Diesel Exhaust Emissions (tons)	% Reduction
2021	0.32	0.13	59%
2022	0.36	0.36	0%
2023	0.36	0.36	0%
2024	0.36	0.36	0%
2025	0.36	0.36	0%
2026	0.36	0.36	0%
2027	0.42	0.42	0%
2028	0.42	0.42	0%
2029	0.42	0.42	0%
2030	0.42	0.42	0%
2031	0.42	0.42	0%
2032	0.42	0.42	0%
2033	0.22	0.22	0%
2034	0.22	0.22	0%
2035	0.22	0.22	0%
2036	0.22	0.22	0%
2037	0.22	0.22	0%
2038	0.22	0.22	0%
2039	0.22	0.22	0%
2040	0.22	0.22	0%
2041	0.22	0.22	0%
2042	0.22	0.22	0%
2043	0.22	0.22	0%
2044	0.22	0.22	0%
2045	0.22	0.22	0%
2046	0.22	0.22	0%
2047	0.22	0.22	0%
2048	0.22	0.22	0%
2049	0.22	0.22	0%
2050	0.22	0.22	0%
TOTAL	**8.60**	**8.41**	**2%**

Note: Based on PM10 emissions from offroad equipment and on-road vehicles reported in Appendix E.1 pages 114-119.

Comment GRP 21-127: Unsubstantiated GHG Threshold of Significance

Baseline previously prepared a comment (FEIR comment GRP 21-127) about the DEIR failing to provide justification for using an annual GHG threshold of significance of 10,000 metric tons of carbon dioxide equivalents (MTCO2e) to demonstrate how the project would achieve the statewide GHG reductions goals for 2030 and beyond over the proposed 80-year lifetime of the mining permit.

In response to the comment GRP 21-127 (and others), page 2-116 of the FEIR provides the following explanation:

> *As a basis for choosing 10,000 MT CO2e as the threshold of significance for operational GHG emissions, the DEIR provided the following reasoning: "For operations, because the project is an industrial project that includes stationary sources (i.e., diesel generators used for emergency power), the project's GHG emissions were compared to the 10,000 MT CO2e per year quantitative threshold, which, as described above, is used by SMAQMD, PCAPCD, BAAQMD, and SCAQMD for industrial and/or stationary source emissions of GHGs. The substantial evidence for this GHG emissions threshold is based on the expert opinion of various California air districts, which have applied the 10,000 MT CO2e per year threshold in numerous CEQA documents where those air districts are the lead agency." (DEIR, p. 4.3-43.)*

Based on the California Supreme Court findings for *Center for Biological Diversity v. Department of Fish & Wildlife* (2015) (62 Cal.4th 204), a project's GHG emissions should be evaluated based on its effect on California's efforts to meet its long-term climate goals. As the Supreme Court held in that case, a project that would be consistent with meeting those goals can be found to have a less-than-significant impact on climate change under CEQA. If a project would contribute its "fair share" of what will be required to achieve those long-term climate goals, then a reviewing agency can find that the impact will not be significant because the project will help to solve the problem of global climate change (62 Cal.4th 220–223).

In accordance with Executive Order B-55-18, California is committed to achieving carbon neutrality by 2045. The 10,000 MTCO2e threshold used in the FEIR has no correlation to the State's carbon neutrality goal for 2045. As Baseline previously commented, the other air districts originally adopted the 10,000 MTCO2e threshold to achieve the 2020 statewide GHG goal under California Assembly Bill 32. The Bay Area Air Quality Management District (BAAQMD), which is referenced above, is in the process of considering an updated GHG threshold for industrial projects to address California's long-term GHG goals such as carbon neutrality by 2045.[1] In effect, the FEIR has blindly applied a GHG threshold of 10,000 MTCO2e

[1] Bay Area Air Quality Management District (BAAQMD), Air District Update to CEQA Thresholds of Significance for Greenhouse Gases; Public Workshop. December 9, 2021.

per year adopted by other air districts without understanding the justifications each air district had for originally adopting the threshold. The FEIR should be able to reference specific supporting documentation provided by these air districts to justify how the threshold would help the project achieve California's long-term GHG goals. As a result, the FEIR analysis of project impacts from GHG emissions remains inadequate.

Conclusions

Based on our review of the FEIR, many of the previous comments on the DEIR have not been resolved and the overall analysis related to air quality and GHG emissions is inadequate.

Sincerely,

Patrick Sutton,
Principal Environmental Engineer

Patrick Sutton, P.E.

BASELINE ENVIRONMENTAL CONSULTING

Principal Environmental Engineer

Areas of Expertise

Air Quality, GHGs, Noise, Hazardous Materials, Geology, and Hydrology

Education

M.S., Civil and Environmental Engineering, University of California – Davis

B.S., Environmental Science, Dickinson College

Registration

Professional Engineer No. 13609 (RI)

Years of Experience

19 Years

Patrick Sutton is an environmental engineer who specializes in the assessment of hazardous materials released into the environment. Mr. Sutton prepares technical reports in support of environmental review, such as Phase I/II Environmental Site Investigations, Air Quality Reports, Greenhouse Gas (GHG) Reduction Plans, and Health Risk Assessments. He has prepared numerous CEQA/NEPA evaluations for air quality, GHGs, geology, hazardous materials, and water quality related to residential, commercial, and industrial projects, as well as large infrastructure developments. His proficiency in a wide range of modeling software (AERMOD, CalEEMod, RCEM, CT-EMFAC) as well as relational databases, GIS, and graphics design allows him to thoroughly and efficiently assess and mitigate environmental concerns.

For mixed-use development projects, Mr. Sutton has prepared health risk assessments for sensitive receptors exposed to toxic air contaminants based on air dispersion modeling. He has also prepared GHG Reduction Plans to demonstrate how projects can comply with State and/or local GHG reduction goals. For large highway infrastructure improvement projects, Mr. Sutton has prepared air quality and hazardous materials technical reports in accordance with Caltrans requirements. Air quality assessments include the evaluation of criteria air pollutants, mobile source air toxics, and GHG emissions to support environmental review of the project under CEQA/NEPA and to determine conformity with the State Implementation Plan. Hazardous materials investigations include sampling and statistically analysis of aerially-deposited lead adjacent to highway corridors.

Project Experience

Oakland Downtown Specific Plan EIR. Prepared a program- and project-level Air Quality and GHG Emissions analysis. Developed a mitigation measure with performance standards to ensure GHG emissions from future projects comply with the Citywide 2030 GHG reduction target.

I-680 Express Lanes from SR 84 to Alcosta Boulevard Project. Prepared Initial Site Assessment and Preliminary Site Investigation to evaluate contaminants of potential concern in soil and groundwater. Prepared Air Quality Report to determine the project's conformity to federal air quality regulations and to support environmental review of the project under CEQA and NEPA.

Altamont Corridor Expressway (ACE/Forward) Project EIR/EIS. Prepared a program- and project-level Hazardous Materials analysis for over 120 miles of railroad corridor from San Jose to Merced. Hazardous materials concerns, such as release sites, petroleum pipelines, agricultural pesticides, and nearby school sites were evaluated in GIS.

Stonegate Residential Subdivision EIR. Prepared a project-level Hydrology and Water Quality analysis for a residential development located within the 100-year floodplain. The proposed project included modifications to existing levees and flood channels.

BART Silicon Valley Extension Project. Prepared Initial Site Assessment and Hazardous Materials EIS/EIR section for extending 6 miles of proposed BART service through the Cities of San Jose and Santa Clara.

EXHIBIT B

ECONOMIC IMPACT OF THE PROPOSED IDAHO-MARYLAND MINE PROJECT

15 NOVEMBER 2022

Prepared for:

County of Nevada

Prepared by:

Robert D. Niehaus, Inc.

ECONOMIC IMPACT OF THE
PROPOSED IDAHO-MARYLAND MINE PROJECT

Prepared for:

County of Nevada
950 Maidu Avenue
Nevada City, CA 95959
Phone: 530-265-1218

Prepared by:

Robert D. Niehaus, Inc.
140 East Carrillo Street
Santa Barbara, CA 93101
(805) 962-0611

RDN Project Number 320

15 November 2022

EXECUTIVE SUMMARY

This report, prepared for Nevada County by Robert D. Niehaus, Inc. (RDN), presents results of the economic and fiscal impact analysis of the proposed Idaho-Maryland Mine project (proposed project). The proposed project would reinitiate underground mining and gold mineralization processing in Nevada County, which would result in costs and benefits to the local community. This study evaluates potential costs and benefits of the proposed project in Nevada County. Potential costs include increased need for public services, while potential benefits include increased economic activity, employment, wages, and tax revenue. This study also assesses whether operation of the proposed project may indirectly impact local property values. Although this study assumes the project proponent, Rise Grass Valley (RGV), would construct and operate the proposed project, the impacts would remain the same if another operator were to purchase the mine because the new operator would be subject to the same constraints, conditions, and requirements.

The County is responsible for processing and reviewing RGV's application for consideration by decision-makers, including the Nevada County Planning Commission and Board of Supervisors. Understanding both costs and benefits of the proposed project and how they relate to one another is important for helping decision-makers, as well as the public and other stakeholders, better understand the economic implications of the proposed project for the local community. This study aims to provide a clearer picture of the proposed project's potential economic and fiscal effects to the local community, including anticipated costs and benefits of the proposed project in Nevada County. This study, in combination with the Draft Environmental Impact Report (EIR), provides valuable information about the potential impacts of the proposed project to help inform the decision-making process.

This study evaluates the anticipated economic and fiscal impacts of the proposed project to local businesses, residential property values, utility providers, public services, tax revenues, and the County General Fund. Given the uncertainty regarding the mine's production and resulting economic impact, these results require careful interpretation. Although this study includes information about the economic impacts of the proposed project during multiple phases—construction, ramp up, and ongoing operation—the most critical impacts are those related to ongoing operation. Therefore, this summary focuses on the impact of ongoing project operation to businesses, residents, utility providers, government agencies, and special districts in Nevada County.

The results of this economic and fiscal impact analysis are summarized below. This analysis assumes the proposed project would operate as proposed by the applicant and documented in the project description in the Draft EIR, and the applicant's projections for employment, payroll, and operational expenditures on goods and services provided for this study are accurate. This report presents all dollar figures in constant (inflation-adjusted) 2022 dollars.

Economic Impact from Proposed Project Spending

- RGV provided estimated annual payroll expenditures for the proposed project, which are expected to total $38.1 million for 312 jobs, including 213 local hires and 99 non-local hires, for an average $122,000 in total compensation (i.e., wages plus benefits) per job.

- RDN adjusted RGV's estimated local annual operational expenditures on goods and services based on known industry dynamics of local versus non-local spending. The revised annual operational expenditures total $5.0 million. This estimate is $7.5 million lower than RGV's original estimate of $12.5 million.

- Full operation of the proposed project would result in yearly output of $202.8 million in Nevada County. The community impact, which considers the portion of output that would be generated by RGV spending and benefits the local community, would be $61.1 million.

- During full operation, the proposed project would directly employ 312 workers and the proposed project's operational expenditures on goods and services would support an additional 163 indirect and induced jobs at local businesses.

- Operation of the proposed project would result in yearly labor income of approximately $45.4 million: $38.1 million from jobs working directly for the mine (direct jobs), $2.2 million from jobs in supporting industries (indirect jobs), and $5.1 million from jobs in industries that serve residents (induced jobs).

Impact to Local Property Values

- RDN performed extensive research and analysis and found no conclusive evidence to assert that the proposed project would have a significant impact on local property values.

- An extensive literature review did not identify any studies that focused specifically on property value impacts of a modern, underground mineral mine.

- A rigorous analysis of three mines determined to be viable case study locations did not find a statistically significant impact on nearby residential property values.

- A survey of licensed real estate professionals in Nevada County indicates that most respondents believe that the proposed project would result in a large and permanent negative impact on local property values. This result is coupled with their opinion that the Draft EIR significantly understates the significance of the proposed project's environmental impacts.

Impacts to Utilities, Public Services, and the General Fund

- The County provides public services that would be affected by the proposed project and associated increase in population. Certain costs would be covered by mitigation through the project's conditions of approval. Costs to the County not covered by mitigation are primarily associated with law enforcement and emergency services, which expect increases in costs related to heightened traffic on local roads and associated vehicle accidents.

- RGV's mineral property tax accounts for a sizable portion of the impact to the County's tax revenue. Mineral property taxes would be based on the amount of gold reserves that are available and economically viable, which is currently unknown. Given this uncertainty, RDN estimates that the tax revenue on mineral properties going to the County General Fund would be between $141,000 and $742,000 in the first year of full production. This value would decrease over time if mineral properties were reduced during operation without the discovery of additional reserves.

- During full operation, the proposed project would result in approximately $881,000 in estimated annual tax revenue from property, sales, and other taxes due to indirect and induced effects from

RGV spending, with $147,000 of this revenue going to the Nevada County General Fund.

- This study estimates a range for the net fiscal impact of the proposed project to the Nevada County General Fund. The high-end estimate is $763,000 in the first year of full operation, declining gradually to somewhere between $760,000 and $741,000 per year for as long as the mine is fully operational and continues discovering new reserves at the projected rate of extraction. The low-end estimate is $163,000 in the first year of full operation before declining over an eight-year productive life of the mine to somewhere between $22,000 and $17,000 per year after exhausting mineral reserves.

TABLE OF CONTENTS

1. INTRODUCTION

Rise Grass Valley (RGV), a private company, is applying to construct and operate the Idaho-Maryland Mine Project (proposed project), which would reinitiate underground mining and gold mineralization processing in Nevada County. The County is responsible for processing and reviewing the application for consideration by decision-makers, including the Nevada County Planning Commission and Board of Supervisors. In order to provide a clearer picture of the proposed project's potential effects to the local community, the County contracted with Robert D. Niehaus, Inc. (RDN) to perform this economic impact analysis. The study was performed concurrently with the environmental review process and, in combination with the Draft Environmental Impact Report (EIR), provides valuable information about the potential impacts of the proposed project to help inform the decision-making process.

This study evaluates the proposed project based on the assumption that it would operate as proposed by the applicant and documented in the project description in the Draft EIR. Any concerns about the potential for the proposed project to result in environmental impacts above or below those discussed in the Draft EIR should be addressed as part of the California Environmental Quality Act (CEQA) process. This study assumes RGV constructs and operates the proposed project. If another mine operator were to purchase the mine and assume responsibility for the project, they would be subject to the same constraints, conditions, and requirements. Therefore, the expected economic impact would remain the same.

Construction and operation of the proposed project would result in costs and benefits to the local community as a result of new mining activity. These activities would provide financial benefits to the community by increasing economic activity and supporting new jobs. However, they could also result in adverse environmental effects, such as increased traffic volumes, noise levels, and visual impacts, making the surrounding area a less desirable place to live or visit. In the event the proposed project resulted in substantial long-term adverse effects, these effects could translate to indirect financial costs in the form of reduced property values and County tax revenues.

Understanding both costs and benefits of the proposed project and how they relate to one another is important for helping decision-makers, as well as the public and other stakeholders, better understand the economic implications of the proposed project to the local community. This study provides quantitative analysis of the measurable economic impacts, including estimated impacts to output, local jobs, and property values, as well as qualitative analysis of other financial costs and benefits that cannot be precisely measured, such as potential impacts to existing local businesses that are not captured in the aggregated data. The conclusion of this study includes a summary of the costs relative to the benefits of the proposed project to help provide an understanding of the overall economic effects of the project.

The following sections of this report include:

- **Section 2: Proposed Project Summary** – This section provides an overview of the proposed project, including key project components that affect the economic and fiscal impact analysis.
- **Section 3: Economic Impact from Proposed Project Spending** – This section evaluates the estimated payroll and expenditures, and resulting output, employment, and labor income that construction and operation of the proposed project would generate in Nevada County.
- **Section 4: Impact to Local Property Values** – This section provides an analysis of how similar

projects have impacted property values and discusses the potential impact of the proposed project to property values in Nevada County; this section also includes the results of an opinion survey that asked local Realtors® to estimate the potential impacts.

- **Section 5: Impacts to Utilities, Public Services, and the General Fund** – This section summarizes anticipated fiscal impacts to utility providers, public services, tax revenues, and the County General Fund.

2. PROPOSED PROJECT SUMMARY

The proposed project would reinitiate underground mining and gold mineralization processing for the Idaho-Maryland Mine over an 80-year permit period, with proposed operation occurring 24 hours a day, 7 days a week during full operations. It includes underground mining within the 2,585 subsurface acres to which the applicant retains mineral rights and above-ground activities at two properties comprising approximately 175 acres in unincorporated western Nevada County: the Brunswick and Centennial industrial sites. The proposed project would construct and operate above-ground mineral processing and water treatment facilities at the Brunswick Industrial Site and place engineered fill at both industrial sites for the first five years of the project. Once these sites have reached their specified capacity for engineered fill, this material would be trucked out of the area for disposal elsewhere. For a detailed description of the proposed project, refer to *Section 3: Project Description* of the Draft EIR.

This section provides a summary of the primary project components that affect the economic impact analysis, including the proposed project's schedule, estimated level of gold production, and anticipated increase in vehicle and truck trips on local roadways, which would increase needs and associated costs for public law enforcement and emergency services. Another key component is the proposed project's local spending on project operation, including both payroll and expenditures on goods and services, which is discussed in *Section 3.1: Project Payroll and Expenditures*.

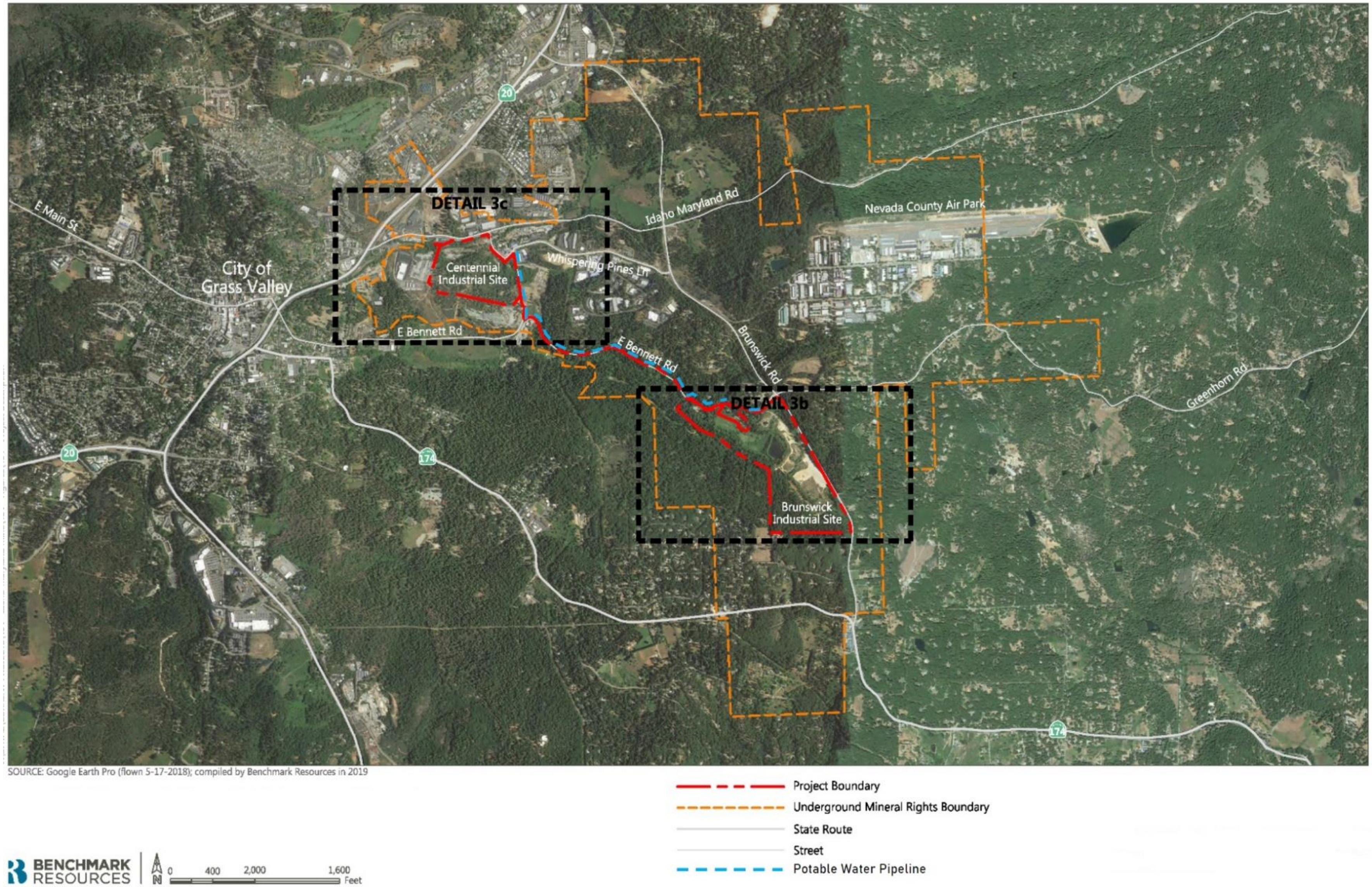
2.1 Project Location and Description

The proposed project's underground mining and above-ground mineral processing activities would occur on the Brunswick Industrial Site, which is located on approximately 119 acres immediately southwest of the East Bennett Road and Brunswick Road intersection. The site is currently located in unincorporated Nevada County, though the northern portion is also within the City of Grass Valley's long-term sphere of influence. This means the City could someday annex the northern portion of the site into their incorporated city boundary. The property is an industrial site with several historic mine shaft entrances, including the Brunswick and Union Hill shafts, which are currently covered. The property was more recently used for a sawmill that operated into the early 2000s. Surrounding properties include low-density residences to the north, west, south, and east, industrial uses to the north, open space to the west and south, and South Fork Wolf Creek to the west.

During the first five years of mining operation, the proposed project would place engineered fill at the Centennial Industrial Site, which is located on approximately 56 acres southwest of the Idaho Maryland Road and Centennial Drive intersection and is entirely within unincorporated Nevada County and the City of Grass Valley's long-term sphere of influence. The site is located immediately adjacent to the City of Grass Valley, with the western, northern, and part of the eastern property lines located along the city's boundary. The site is designated for light industrial uses and was previously used to deposit mine tailings. Development is not currently permitted on the majority of this site due to unstable soils and contamination, but RGV is performing voluntary cleanup of the site. Cleanup efforts are a separate project and are not part of the proposed project. Uses that surround the Centennial Industrial Site include commercial uses to the north, west, and east, and industrial uses to the north, south, and east.

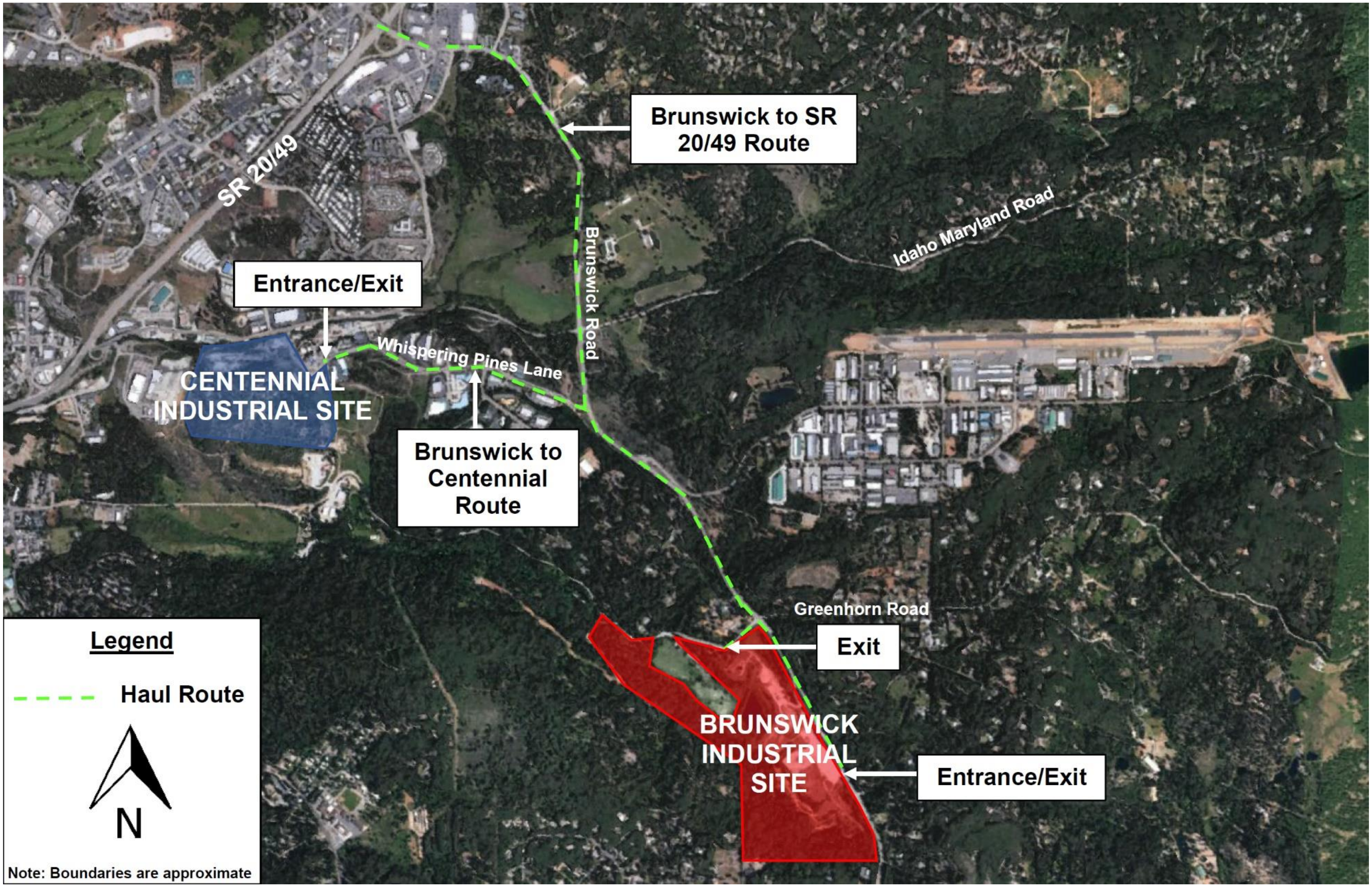
Figure 2-1 provides an overview of the project area, depicting the location of the project sites and the underground mineral rights boundary. No underground mining activity would occur in the first 500 feet of the surface except at access points on the project site. Figure 2-2 maps the proposed haul routes for transporting material to and from the project sites.

Figure 2-1. Project Location



Source: Draft EIR

Figure 2-2. Proposed Haul Routes

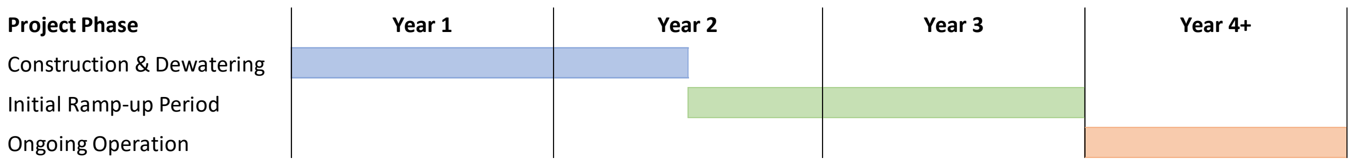


Source: Draft EIR

2.2 Key Project Components

The anticipated schedule for the proposed project includes 18 months of above-ground construction and mine dewatering, 18 months of initial ramp up, and then full ongoing project operation. The construction phase includes the construction of above-ground facilities and the initial dewatering of mine shafts. The ramp-up phase includes underground construction, employee training, mill commissioning, initial mining, and ramp-up to full production and workforce. Once these phases are complete, the project would be in its full operation phase, which would continue for as long as the mine is active, up to the 80-year permit period. Figure 2-3 displays the projected schedule for the proposed project.

Figure 2-3 Proposed Project Schedule



This study uses estimates of the proposed project's mineral extraction schedule and annual mineral production, based on data provided by RGV. RGV provided information about underground gold mining operations with similar throughputs to the proposed project and similar reserve grades to historic production at the Idaho-Maryland Mine. These mines maintain approximately 5 to 11 years of mineral reserves with an average of 8 years, meaning that they extract their known reserves over an eight-year period as they continue to explore and discover additional reserves. The 2021 economic impact report commissioned by RGV projected annual mineral production of the Idaho-Maryland Mine would be 108,400 ounces of gold per year based on an estimated 365,000 tons of annual gold mineralization and the assumption that mineralization grades are at historic levels achieved before mine closure (Applied Economics LLC 2021). Based on this information, this study assumes the proposed project would maintain eight years of mineral reserves and produce 108,400 ounces of gold per year.

The proposed project would increase traffic in the area from workers commuting to their jobs and from new truck trips associated with project operation, which would impact long-term costs to law enforcement and emergency services. During full operation, the Brunswick Industrial Site would generate a maximum of 174 employee trips per day, while the Centennial Industrial Site would generate a maximum of 4 employee trips per day. In addition to employee traffic, the maximum number of two-way truck trips is 118 trucks completing 236 total daily trips, one inbound and one outbound. The proposed haul routes go from the Brunswick Industrial Site to the Centennial Industrial Site on Brunswick Road and Whispering Pines Lane or off-site locations on SR49, depending on the location used for engineered fill. The roadways most heavily impacted by the haul routes are Brunswick Road between E. Bennett Road and Project Driveway; Brunswick Road between E. Bennett Road and Whispering Pines Lane; Brunswick Road between SR 49 and Whispering Pines Lane; E. Bennett Road between Project Driveway and Brunswick Road; Whispering Pines Lane between Brunswick Road and Crown Point Circle; and Whispering Pines Lane between Crown Point Circle and the Centennial Industrial Site.

3. ECONOMIC IMPACT FROM PROPOSED PROJECT SPENDING

This section estimates the economic impacts in Nevada County from construction and operation of the proposed project if it were to operate at its anticipated capacity. The proposed project would increase economic activity and support new jobs due to local spending and employment associated with initial construction and ongoing mining activities. This new spending and employment would have spillover effects to local businesses and residents as RGV purchases goods and services from other businesses in the county, which in turn spend some portion of this money and potentially employ additional county residents. In addition to this activity, workers supported directly and indirectly by the proposed project would spend money at local businesses, such as shops and restaurants, resulting in additional economic activity and jobs.

RDN recognizes that aggregate economic effects do not fully account for impacts to existing individual businesses in the area because the proposed project would impact businesses differently. For example, a local truck repair shop may get additional business repairing trucks used by the mining operation, while a local restaurant with outdoor seating along the transportation corridor may suffer reduced patronage due to the degraded atmosphere from traffic and noise. This study considers these impacts by incorporating feedback obtained through stakeholder interviews to better understand potential project impacts that are not captured in the aggregated data.

This analysis evaluates the short-term and long-term impact of the proposed project. The construction and ramp-up phases of the proposed project would result in short-term economic impacts. The proposed project schedule includes 18 months of construction and 18 months of initial ramp up. Impacts from these phases would be short-term, as they are expected to last only for the duration of construction and ramp-up activity. Economic impacts from ongoing operation of the proposed project are expected to continue as long as the project operates at its anticipated capacity. These impacts are therefore considered long-term impacts that continue for the life of the project. This analysis evaluates the economic impacts in the following periods:

Year 1: Construction (above-ground)
Year 2: Construction (above ground), dewatering and initial ramp up
Year 3: Ramp up to full operation
Year 4+: Annual ongoing operation

This report adjusts all dollar figures for inflation in order to present them in today's dollars. Therefore, the proposed project's expenses, revenues, and economic impacts for each year are presented in constant 2022 dollars. In the case of ongoing annual expenses and revenues, the amounts of these cash flows appear unchanged over time because this study assumes these cash flows would escalate at the projected rate of inflation, and then deflates them by the same projected rate of inflation to bring them into today's dollars. For example, assume the proposed project purchases 100 hard hats each year. If the cost for 100 hard hats is $10,000 in 2022 and inflation is 3.0 percent, the cost would be $10,300 in 2023, $10,609 in 2024, etc. Once these costs are deflated to constant 2022 dollars using a rate of 3.0 percent, they would be $10,000 in 2022, 2023, 2024, and every future year of the project.

3.1 Project Payroll and Expenditures

This study uses anticipated employment and payroll expenditures based on data provided by RGV. The proposed project would employ 63 workers during the construction and dewatering phase, 121 workers during the initial ramp-up period, and 312 workers during full ongoing operation. During the construction phase, 52 of the 63 workers would perform construction work related to the proposed project's above-ground infrastructure and mine dewatering. RDN estimates that the remaining 11 workers would perform construction work related to the potable water pipeline and other conveyance infrastructure needed to provide water from Nevada Irrigation District (NID) to up to 30 residential properties currently on wells along 1.25 miles of East Bennett Road. This estimate is based on average construction costs provided by NID.

Table 3-1 presents anticipated workforce, average annual compensation (i.e., wages plus benefits), and total payroll during full operations. The majority of construction workers would be contractors rather than direct employees of RGV. The 121 workers for the ramp-up period represents the average employment across the 18-month project phase, during which employment would consistently grow. During full operation, the proposed project would employ 312 full-time workers with a total annual payroll of $38.1 million. RGV projects they would hire 213 of these workers locally and recruit 99 workers from outside the county (RGV, 2021).

Table 3-1. Projected Workforce and Annual Average Compensation and Payroll by Category

Job Category	Total Jobs	*Local Hires*	*Non-Local Hires*	Average Compensation	Total Payroll[1]
Underground Mine	156	*98*	*58*	$123,000	$19,188,000
Mineral Processing	36	*36*	*0*	$108,000	$3,888,000
Trades	34	*26*	*8*	$126,000	$4,284,000
Labor – Underground	17	*17*	*0*	$89,000	$1,513,000
Geology, Engineering, and Environmental	28	*14*	*14*	$130,000	$3,640,000
Accountants, Administration, and Security	16	*16*	*0*	$110,000	$1,760,000
Surface equipment operators	6	*6*	*0*	$99,000	$594,000
Managers and Supervisors	19	*0*	*19*	$172,000	$3,268,000
Total or Weighted Average[2]	**312**	***213***	***99***	**$122,000**	**$38,135,000**

[1] Total payroll in millions

[2] Numbers may not sum due to rounding

RGV projects the average compensation including wages and benefits for their 312 employees would be $122,000 per year. This includes employees that are hired locally and from outside the area. Based on the average compensation by job category, the 213 employees hired locally would have an average compensation of $117,000 per year and the 99 employees hired from outside the County would have an average compensation of $134,000 per year. The difference in average compensation for local and non-local hires is primarily driven by the 19 non-local employees RGV expects to hire for manager and supervisor positions, which have a projected average compensation of $172,000 per year. The weighted average compensation for all employees excluding managers and supervisors would be $119,000 per year.

Table 3-2 presents anticipated annual local operational expenditures on goods and services, including RGV's initial estimates and RDN's adjustments.

Table 3-2. Annual Local Operational Expenditures on Goods and Services by Category

Expenditure Category	RGV Estimate	RDN Adjustment	Revised Estimate
Office, Administration, & Miscellaneous	$1,232,000	-	$1,232,000
Engineering, Environmental, and Professional Services	$360,000	-	$360,000
Facility and Road Operation and Maintenance[1]	$457,000	$24,000	$481,000
Electric Power and Fuel	$7,918,000	($7,442,000)	$476,000
Equipment Maintenance and Repair	$210,000	-	$210,000
Operating Supplies	$1,327,000	-	$1,327,000
Transportation and Deliveries	$368,000	-	$368,000
Lodging and Local Transportation	$639,000	($128,000)	$511,000
Total[2]	**$12,511,000**	**($7,546,000)**	**$4,965,000**

[1] RDN adjusted this category by deducting $12,000 for internet expenses and adding $36,000 for water expenditures
[2] Numbers may not sum due to rounding

The proposed project's anticipated local operational expenditures on goods and services (i.e., those that would occur within the county) are $5.0 million. RGV provided initial expenditures estimates and RDN adjusted them based on the dynamics of specific industries. RDN excluded expenditures to utility companies that are headquartered outside of the local area because these expenditures would not substantially affect local economic activity and employment. In the case of electrical expenditures to Pacific Gas and Electricity (PG&E), payments to their customer service office in Nevada City would be routed to PG&E's headquarters, and the amount of the payments routed through this office would not affect its operation in terms of costs or employment. Additionally, although much of the electricity used in the project area is generated locally and delivered by electrical infrastructure built and maintained by local workers, an increase in local demand would not necessarily increase the amount of electricity generated locally or the amount of ongoing infrastructure maintenance activity. The power grid is a dynamic system that is managed across the state, and new demand in one area may be served by any number of generation facilities throughout the state.

RDN also adjusted anticipated local expenditures for taxis, rental cars, and airport shuttles. The closest major airport is located outside of Nevada County, so some of these expenditures would likely occur outside the local area. Finally, RDN adjusted expenditure data to account for the cost of water RGV would purchase from NID to serve up to 30 residential properties currently on wells along East Bennett Road.

3.2 Input-Output Methodology and Inputs

This analysis evaluates the economic impact of the proposed project in Nevada County using IMPLAN, a widely recognized economic modeling software platform commonly used in the planning community. The key component of the IMPLAN platform is an input-output (I-O) model containing accounting tables that trace the linkages of interindustry purchases and sales in a specific region. The model uses these linkages to calculate the impacts per dollar of spending on jobs, income, and additional expenditures in one industry on the overall economy of the study region. For more information on the IMPLAN modeling process, visit IMPLAN.com.

This study presents the potential direct, indirect, induced, and total economic impacts of the proposed project in Nevada County in terms of output, employment, and labor income. These impacts include:

- **Direct Impacts**: The proposed project would draw dollars into the local area, some of which RGV would use to pay for supplies, services, and labor from local businesses. The direct impacts of the proposed project include the output of the mine, which is the market value of all goods and services produced by the mine, jobs working directly for the mine, and the labor income associated with those jobs. Construction activities would also draw dollars into the area, stimulating the local economy and producing output in the form of new buildings and infrastructure.

- **Indirect Impacts**: Indirect impacts include output, jobs, and labor income at businesses supported by (1) RGV's procurement spending, i.e., purchases of goods and services used in the course of business, and (2) local expenditures by supplying industries responding to demand from the sectors where these initial expenditures occur. An example of an indirect impact is increased employment and spending by a local firm providing services to RGV. For example, suppose RGV hires ABC Maintenance to repair some machinery. ABC Maintenance then purchases parts from a local wholesaler to perform the work. RGV's expenditures to ABC Maintenance, the jobs at ABC Maintenance supported by this spending, and the resulting increased sales of parts and associated employment are all indirect impacts of RGV's operational expenditures.

- **Induced Impacts**: Employees of RGV, as well as employees of businesses directly and indirectly impacted by RGV's expenditures, would spend a portion of their income in Nevada County. Local spending by these employees and the employment and labor income it supports are induced impacts. Examples of induced impacts include output, employment, and labor income at businesses such as retail stores, gas stations, banks, restaurants, and service companies that supply goods and services to workers and their families.

- **Total Impacts**: The total impacts are the sum of all direct, indirect, and induced impacts.

The proposed project's spending on construction and operation, including payroll and procurement of goods and services, would drive the economic impacts of the project. This analysis relies on employment, payroll, and local spending estimates based on data provided by RGV and reviewed and adjusted by RDN. Refer to *Section 3.1: Project Payroll and Expenditures* for details regarding these estimates. The proposed project's expenditures include:

1. **Construction Expenditures:** RGV would pay for construction of above-ground facilities, initial dewatering of the mine, and construction of underground water pipelines and associated infrastructure. Construction of the proposed project would occur over 18 months and require an estimated 52 workers for above-ground facilities and dewatering, and 11 workers for underground water pipelines. RGV was not able to provide estimated costs for construction of above-ground facilities and dewatering, so RDN used the IMPLAN model to translate the number of construction workers to the estimated costs associated with that level of employment. RDN obtained the estimated cost of construction for underground pipelines and associated infrastructure from NID.

2. **Payroll Expenditures:** RGV projects they would spend $38.1 million per year employing 312 workers at the mine during full operation. Refer to Table 3-1 in *Section 3.1: Project Payroll and Expenditures* for a breakdown of anticipated workforce, average annual compensation, and total payroll. During the 18-month ramp-up period, RGV projects they would employ an average of 121 workers. This analysis assumes the same average pay for these workers as for those that would be employed during full operations.

3. **Operational Expenditures on Goods and Services**: RGV would procure a portion of the goods and services necessary to support the proposed project's operation from businesses located in Nevada County. Annual expenditures during full operation of the proposed project would be approximately $5.0 million per year. Refer to Table 3-2 in *Section 3.1: Project Payroll and Expenditures* for a breakdown of anticipated local operational expenditures on goods and services, including RGV's initial estimates and RDN's adjustments. This analysis accounts for the industry-level effects of the proposed project's operational spending based on the major industry codes for these expenditures, as defined by the North American Industry Classification System (NAICS). For the ramp-up period, this analysis scales down anticipated operational expenditures proportionally to the anticipated level of employment during the ramp-up period relative to full operations.

3.3 Output, Jobs, and Labor Income

Total output represents the amount of money that would circulate in the economy as a result of the proposed project's activity and includes the multiplier effect that is generated by the portion of each dollar that gets re-spent locally. In this analysis, direct output represents the value of everything that would be produced by RGV, including the new facilities and infrastructure they would build during the construction phase, and the minerals they would mine, process, and sell to the market during the ramp-up and full operation phases. Indirect output includes RGV's initial spending on procurement of goods and services and the successive rounds of spending that would occur at businesses across multiple sectors. Induced output includes all of the spending by RGV employees and employees at businesses supported directly and indirectly by RGV spending. The total output is the sum of direct, indirect, and induced output. Indirect and induced impacts relative to the total impact represent the multiplier effect of RGV's direct output.

Because much of the total output would be related to RGV's profit, this analysis also estimates a "community impact." Impacts to the local community include the multiplier effect from RGV's output (i.e., the sum of indirect and induced output), the value of RGV's newly constructed facilities and infrastructure, and RGV's payroll spending to local residents.

Table 3-3 presents the proposed project's estimated direct, indirect, induced, and total impact in terms of output for each year of the construction and ramp-up period, and for ongoing operation. It also provides the economic multiplier, multiplier effect, and the community impact for each of these periods.

Table 3-3. Annual Output (in millions; 2022 dollars)

Type of Impact	Year 1	Year 2	Year 3	Year 4+
Direct	$10.1	$13.5	$69.7	$179.8
Indirect	$2.7	$2.6	$2.4	$6.1
Induced	$2.4	$4.5	$6.6	$16.9
Total[1]	**$15.2**	**$20.6**	**$78.6**	**$202.8**
Multiplier	*1.51*	*1.52*	*1.13*	*1.13*
Multiplier Effect	$5.1	$7.1	$8.9	$23.0
Community Impact[3]	**$15.2**	**$20.6**	**$23.7**	**$61.1**

[1] Number may not sum due to rounding

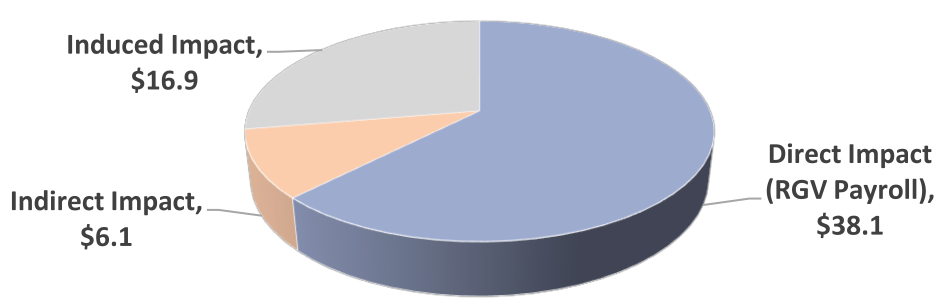
[2] The multiplier effect is equivalent to the sum of indirect and induced impacts

[3] The community impact represents indirect and induced effects, the value of constructed infrastructure, and RGV's payroll spending

The total economic impact of expenditures by the proposed project would increase each year during the construction and ramp-up period and reach approximately $202.8 million per year of output during full operation. The proposed project's direct impact is the annual output produced by mining activity, estimated at $179.8 million based on RGV's projected production of 108,400 ounces of gold per year and the current three-year average price of gold of $1,659 per ounce. Of these funds, RGV would spend approximately $5.0 million on procurement of local goods and services to support their operations, which would generate an indirect economic impact of $6.1 million. These impacts would accrue to businesses where RGV initially spends these funds as well as to those businesses' supply chains. In addition to direct and indirect impacts, the proposed project would generate an induced impact of $16.9 million due to household spending by RGV employees and employees of the businesses supported directly or indirectly by RGV's operational spending.

This analysis estimates that the portion of the total economic activity that would impact the local community during full project operation would be $61.1 million per year. The IMPLAN analysis generated an economic multiplier for the proposed project in Nevada County of 1.13, which indicates that each dollar worth of output generated by the proposed project would support an additional 13 cents of indirect and induced output, i.e., economic activity, in Nevada County due to local and successive rounds of spending. Therefore, the multiplier effect would result in $23.0 million of output. This, in combination with RGV's local payroll spending of $38.1 million, comprises the total community impact of $61.1 million per year. Figure 3-1 shows the community impact during full operation by impact type.

Figure 3-1. Annual Community Impact during Full Operation by Impact Type (in millions; 2022 dollars)



Output during the construction and ramp-up periods would be $15.2 million in Year 1, $20.6 million in Year 2, and $78.6 million in Year 3. The community impacts in Year 1 and Year 2 are equal to the total output because RGV's expenditures would go toward construction of local infrastructure, development of the mine, and mill commissioning, all of which produce value locally. This analysis assumes the mine would begin mining and processing minerals in Year 3 and would therefore start generating output in the form of RGV revenue in that year. The estimated community impact in Year 3 is $23.7 million in output.

Operation of the proposed project would generate local jobs and associated labor income, including direct jobs working for the mine, indirect jobs working for businesses supported by RGV's operational expenditures, and induced jobs working for businesses that supply goods and services to workers and their families. All direct jobs working for the mine would be full-time positions and each count as one job in the following analysis. However, this analysis estimates the employment impact in terms of the total number of jobs, per the IMPLAN methodology, rather than full-time equivalent jobs. This means that two part-time indirect or induced jobs would count as two jobs rather than one. Labor income includes the combined cost of total payroll paid to employees (e.g., wages and salaries, benefits, and payroll taxes) and payments received by self-employed individuals and unincorporated business owners.

Table 3-4 presents the proposed project's estimated direct, indirect, induced, and total impact in terms of jobs and labor income for each year of the construction and ramp-up period, and for ongoing operation.

Table 3-4. Annual Employment and Labor Income

Type of Impact	Year 1	Year 2	Year 3	Year 4+
Employment (in number of jobs)				
Direct	63.0	93.0	121.0	312.0
Indirect	17.6	19.2	20.4	52.6
Induced	15.8	29.6	42.8	110.4
Total[1]	**96.3**	**141.8**	**184.2**	**475.0**
Labor Income (in millions; 2022 dollars)				
Direct	$4.5	$9.7	$14.8	$38.1
Indirect	$0.7	$0.8	$0.8	$2.2
Induced	$0.7	$1.4	$2.0	$5.1
Total[1]	**$5.9**	**$11.9**	**$17.6**	**$45.4**

[1] Number may not sum due to rounding

Ongoing operation of the proposed project would support an estimated 475 jobs and $45.4 million in labor income in Nevada County annually. This includes 312 jobs working directly for RGV, all of which would be full-time positions. The remaining 163 jobs would be a mix of full-time and part-time jobs working for businesses supported directly and indirectly by RGV expenditures and associated household spending. Based on RGV's projected payroll spending of $38.1 million, average annual compensation for their workers would be $122,000. Estimated income for the indirect and induced jobs amounts to $7.3 million, which equates to average annual compensation of $44,000 for these jobs.

Many of the direct, indirect, and induced expenditures that would occur as a result of the proposed project would also generate local tax payments. RDN evaluated the total tax effects from project spending in Nevada County that would accrue to all taxing entities in the county, as well as the amount of tax dollars that would accrue to the County's General Fund. Refer to *Section 5.3: Tax Revenue,* for the results of this tax analysis.

3.4 Impacts to Commercial Industries

Operation of the proposed project and associated indirect and induced spending would impact hundreds of industries in Nevada County.

Table 3-5 displays the top 12 industries that would be impacted by operation of the proposed project in terms of output, employment, and labor income.

Table 3-5. Industries with Largest Impact in terms of Output, Employment, and Labor Income

Industry	Direct	Indirect	Induced	Total[1]
Output				
Gold Ore Mining	$179,800,000	$1,000	$1,000	$179,802,000
Retail Sales	$0	$667,000	$1,880,000	$2,547,000
Wholesale Suppliers	$0	$1,373,000	$886,000	$2,259,000
Healthcare Services	$0	$0	$1,837,000	$1,837,000
Real Estate Services	$0	$243,000	$927,000	$1,171,000
Restaurants and Drinking Places	$0	$31,000	$1,048,000	$1,080,000
Financial Services	$0	$34,000	$813,000	$847,000
Local Government Enterprises	$0	$116,000	$623,000	$739,000
Services to Buildings and Landscaping	$0	$434,000	$136,000	$571,000
Insurance Providers and Related Activity	$0	$54,000	$511,000	$566,000
Truck Transportation	$0	$380,000	$38,000	$418,000
Hotels and Motels	$0	$411,000	$0	$412,000
Employment				
Gold Ore Mining	312.0	0.0	0.0	312.0
Retail Sales	0.0	6.7	16.7	23.4
Restaurants and Drinking Places	0.0	0.5	13.1	13.5
Healthcare Services	0.0	0.0	13.0	13.0
Wholesale Suppliers	0.0	5.1	5.0	10.1
Dry-Cleaning and Laundry Services	0.0	6.6	0.6	7.2
Services to Buildings and Landscaping	0.0	5.0	1.5	6.5
Real Estate Services	0.0	1.3	4.6	5.9
Individual and Family Services	0.0	0.0	5.9	5.9
Financial Services	0.0	0.2	4.5	4.7
Hotels and Motels	0.0	4.6	0.0	4.6
Transit and Ground Passenger Transportation	0.0	3.6	0.8	4.3
Labor Income				
Gold Ore Mining	$38,135,000	$0	$0	$38,135,000
Healthcare Services	$0	$0	$1,036,000	$1,036,000
Retail Sales	$0	$313,000	$718,000	$1,030,000
Restaurants and Drinking Places	$0	$15,000	$436,000	$451,000
Local Government Enterprises	$0	$62,000	$225,000	$287,000
Dry-Cleaning and Laundry Services	$0	$243,000	$21,000	$264,000
Services to Buildings and Landscaping	$0	$188,000	$62,000	$250,000
Automotive Repair and Maintenance	$0	$19,000	$223,000	$242,000
Financial Services	$0	$9,000	$196,000	$205,000
Hotels and Motels	$0	$187,000	$0	$187,000
Wholesale Suppliers	$0	$98,000	$83,000	$180,000
Truck Transportation	$0	$157,000	$16,000	$173,000

[1] Numbers may not sum due to rounding. Dollar figures presented in 2022 dollars and rounded to thousands.

The total direct economic impact of proposed project operation would be the $179.8 million of output, 312 jobs, and $38.1 million of labor income produced by RGV in the Gold Ore Mining sector, while the indirect and induced impacts would be the resulting rounds of spending that occur at businesses across multiple sectors. The industry with the largest indirect and induced impacts in terms of output and employment would be Retail Sales. RGV and supporting industry expenditures as well as local household spending would drive these impacts. The industry with the largest indirect and induced impacts in terms of labor income would be Healthcare Services, with this impact entirely driven by household spending. The reason the 13 jobs in Healthcare Services would result in more labor income than the 23 jobs in Retail Sales is that jobs in this sector have higher average wages and weekly hours (Bureau of Labor Statistics, 2022).

RGV and supporting industry expenditures, i.e., those that contribute to indirect impacts, would have the largest impact in terms of output in the Wholesale Suppliers, Retail Sales, and Services to Buildings and Landscaping sectors. The impact of industry spending would outweigh that of household spending in the Wholesale Supplier sector (60.8 percent versus 39.2 percent), while the reverse is true in the Retail Sales sector (26.2 percent versus 73.8 percent). This finding is in line with general spending patterns of businesses and households, with both of these types of buyers making purchases from both types of sellers, with businesses generally purchasing supplies from wholesalers and households generally purchasing goods from retailers. The output impact to the Services to Buildings and Landscaping sector would be primarily driven by RGV and supporting industry expenditures, which would make up 76.0 percent of the total impact in this industry.

The economic impacts from RGV and supporting industry expenditures in terms of jobs and labor income are generally in line with those for output, with a couple of exceptions. Although industry rather than household spending supports the majority of output in the Wholesale Supplier sector, employment and labor income supported by each type of buyer is relatively equal. This finding implies that more staff is required relative to total sales volume at wholesale suppliers that serve households rather than businesses. Another exception is the Dry-Cleaning and Laundry Services sector, which would not be in the top 12 industries in terms of output but would grow by seven jobs and $264,000 in labor income. RGV projects they would have high costs for laundry services ($183,000 per year), which would be the primary driver of this impact.

The induced impacts of proposed project operation are greater than the indirect impacts, with $16.9 million versus $6.1 million in output (refer to Table 3-3 in *Section 3.3: Output, Jobs, and Labor Income*), as much of the household spending occurs locally. This spending impacts a wide variety of household-supporting industries, with the top industries in terms of output being Retail Sales, Healthcare Services, and Restaurants and Drinking Places. These three industries would also experience the highest indirect impacts in terms of employment and labor income.

3.5 Impacts to Existing Local Businesses

RDN understands that the proposed mining operations may impact individual local businesses in a variety of ways. While the IMPLAN analysis captures the aggregate anticipated economic impact, it does not capture the differences in how existing local businesses may be impacted. To better understand potential impacts to these businesses, RDN reached out to local business organizations and owners and other representatives at individual businesses to conduct brief interviews.

RDN and the County developed an initial list of local businesses to contact based on their proximity to the project site and transportation corridors, and then refined and expanded the list based on stakeholder input from MineWatch and local business organizations. RDN spoke to representatives at business organizations about the impacts they anticipate could occur as a result of the proposed project to local businesses, public services, and real estate. During these interviews, RDN also requested recommendations for specific local businesses or types of businesses that should be included in the stakeholder interviews. RDN then interviewed representatives at individual local businesses about their general operations and anticipated impacts to their business from the proposed project.

RDN spoke with representatives of MineWatch and four business organizations: Nevada City Chamber of Commerce, Greater Grass Valley Chamber of Commerce, Nevada County Economic Resource Council, and Sierra Business Council. Given the controversial nature of the proposed project, representatives from a couple of these organizations largely declined to comment because their organizations are not taking a position on the proposed project. Representatives from the remaining organizations had mixed responses.

Generally speaking, these organizations indicated that the new economic activity generated by the proposed project could support new businesses in the area, but potential environmental effects could adversely affect other local businesses. Even if the proposed project does not have substantial negative environmental impacts, the perception of such impacts may negatively affect the tourism industry, as people may choose not to visit the area if they believe it has been negatively impacted by mining activity. Another concern is the size of the local workforce. Local businesses are already competing for talent and labor; introducing additional high-paying jobs would likely make it harder for local businesses to meet their hiring needs.

After interviewing organizations, RDN reached out to representatives at 24 individual businesses in Nevada County, of which 8 agreed to an interview, 6 declined to participate, and 10 did not respond to our messages. Similar to our experience with business organizations, many of the business representatives who chose not to participate cited the contentious nature of the proposed project as their reason for declining. Even among the business representatives who responded to our questions, there was a general sense of hesitancy to participate in the interview and responses were often guarded.

Of those business owners and representatives that spoke with RDN about the proposed project, their anticipated impacts varied. Some business representatives anticipate little to no change in business revenue but expressed concern over how potential environmental impacts, namely water quality, might impact their business's operations. Others expect that the proposed mining operation would likely benefit their businesses. When asked about the effect of the proposed mine on the economy more generally (beyond their specific business), responses echoed those from the business organizations. Their responses varied, with some expecting that the mine would facilitate new economic activity in Nevada County and others articulating concerns about labor shortages. While the sample size and response rate limit the ability to quantify or draw broader conclusions, the variance in responses highlights the variety and complexity of potential impacts that the proposed mine may have on existing local businesses.

4. IMPACT TO LOCAL PROPERTY VALUES

RDN researched the potential impacts of re-opening the Idaho Maryland Mine on local residential property values. This research consisted of (1) a literature review, (2) a case study analysis, and (3) a survey of real estate professionals that work in western Nevada County. This section details our research methodologies and findings.

4.1 Literature Review Summary

Although there is an extensive body of literature about the potential spillover effects of adverse environmental impacts on home prices, there are relatively few rigorous, well-executed studies that focus specifically on mining and its impact on home prices, and these studies cover a range of mining operations and locations. As a result, our thorough review of the academic literature did not yield any significant research on the impact to home values of mines that closely resemble the proposed project. Most studies focus on more visibly impactful activities, such as open pit mining or other major industrial activities, rather than underground mineral mining. Please see *Section 7: References* for a complete list of papers RDN reviewed for this study and *Appendix A—Literature Review: Impacts of Mining and Industrial Activities on Home Values* for a summary of results for the studies RDN found most relevant to the proposed project.

Table 4-1 summarizes the findings of the key studies identified in RDN's literature review based on the type of site, study area, and direction and magnitude of the impact. The literature presents a wide range of impacts from mining and other industrial activities on property values, from a positive impact of 3.8 percent for home sales within two kilometers of industrial sites in the Netherlands to a negative impact of up to 17.2 percent on rental prices in Chilean cities where new mines opened. For the studies RDN reviewed, the distance of measurable impacts ranged from 0.3 miles away for general hazardous waste sites to 10 miles away for open pit rock mines.

Table 4-1: Summary of Key Study Findings

Author(s)	Site Type	Impact Area	Impact on Residential Property Values
Bakker (2021)	Industrial sites	2 kilometers (1.2 miles)	Premium of 4% for homes near an industrial site (i.e., homes cost more closer to the site)
Boxall, Chan, and McMillan (2005)	Natural gas facilities	4 kilometers (2.5 miles)	4% to 8% decline in value for homes near natural gas facilities
Brasington and Hite (2005)	General environmental hazards	Not applicable; study estimates a distance-to-hazard price elasticity	3% increase in home prices when distance from the nearest environmental hazard increases by 10%
Currie, et al. (2015)	Toxic plants	1 mile	11% decline in home prices within a half mile of a source of toxic air emissions; negative impact may remain even after closure of the source of pollution

Author(s)	Site Type	Impact Area	Impact on Residential Property Values
Davis (2011)	Power plants	2 miles	Reduction between 3% and 7% for homes near power plants
Fitzpatrick and Parmeter (2021)	Coal mining	2.3 kilometers (1.4 miles)	15.5% decline in value for homes near coal mining
Ford and Seals (2018)	Rock quarries	In some specifications they estimate elasticities, so they do not use a specific distance; in other specifications they use 2 miles	Finds no compelling statistical evidence that either the anticipation of, or the ongoing operation of, rock quarries negatively impact home prices
Kiel and McClain (1995)	Incinerator Plant	Not applicable; study estimates a distance-to-hazard price elasticity over a 28-square-mile area	Home prices increased by 1.7% per mile away from the plant during construction, 3.2% per mile during early operation, and 2.7% per mile after four years of continued activity
Malikov, Sun, and Hite (2017)	Rock mining	10 miles for near-zero effect (effects dissipate with distance)	2.3% to 5.1% reduction per mile closer to rock mining activity
Muehlenbachs, Spiller, and Timmins (2015)	Shale gas	1.5 kilometers (0.9 miles)	Reductions in value between 10% and 17% for homes near shale gas development
Neelawala, Wilson, and Athukorala (2012)	Mining of different resources	4 kilometers (2.5 miles)	6% to 7% increase in willingness to pay per kilometer of distance from mine/smelting operation
Rivera (2020)	Mining of different resources	Not applicable; study evaluates city-level data	10% to 17% reduction in rents in cities with new mine openings
Taylor, Phaneuf, and Liu (2016)	Contaminated and clean commercial/ industrial sites	Home impacted by a contaminated site if within 0.5 miles, and by a clean site if within 0.3 miles	Proximity to clean sites reduces neighboring home values by 2.5%; proximity to a contaminated site reduces values by about 8%; remediation of a contaminated site increases values by as much as 5%

4.2 Case Study Analysis

Given that existing academic research does not specifically address impacts to property values from underground gold mining activities and shows a range of impacts by the type of activity and size of impact area, RDN performed a case study analysis to estimate the impacts of similar mining operations on property values. The steps of this analysis include searching for existing mines that are reasonably comparable to the proposed project, acquiring real estate transaction data for continuous periods during which the comparable mines switched from a period of extended closure to full operation, selecting an appropriate methodology for evaluating impacts of these operations to property values, and performing the analysis.

Site Selection

To identify potential case study mines, RDN searched records from two public databases that catalog active and inactive or abandoned mines in the U.S.: the Mine Safety and Health Administration's (MSHA) Mine Data Retrieval System (MDRS) and the U.S. Geological Survey's (USGS) Mineral Resource Data System (MRDS). MSHA's MDRS online database contains information on over 31,500 mines, including location, type, mineral, operational status, operator, and quarterly employment data. While the MSHA data include information from 1983 to present, the bulk data files available for public download only go back to 2000. (Data for 1983 to 1999 is accessible through the web interface for individual mines.) USGS MRDS records go back much further and include historical information on the type of workings and mineral deposits for over 300,000 locations. Unfortunately, many of the USGS's database records are also incomplete and/or out of date. Where needed, RDN supplemented our research with internet searches for news articles, press releases, and financial documents on candidate mines' operational histories. Our screening criteria considered the following factors:

Mine Status –*When did the mine open and, if it has since closed, when did it close? If the mine was intermittently open, were there periods of inactivity during which the community believed the mine would close permanently?* Ideally, the mine will have opened in an area where mining has not previously occurred or where the existing mine has either been abandoned or inactive long enough that the community was uncertain whether the mine would re-open. Due to the lack of bulk data from MSHA MDRS before 2000, we restricted our search to mines that opened or re-opened in 2000 or later. Compared to the proposed project, we assume older mines are less likely to have used the same mining processes or be subject to the same environmental standards during their early operation. Similarly, real estate data providers are more likely to have parcel-level information available for recent periods versus older periods.

Mine Material – *What are the mine's primary products? Are the mine's extraction processes and environmental impacts similar to those of the proposed Idaho-Maryland Mine Project?* Ideally, the mine should use similar mining extraction processes as the proposed project and output similar waste products. Thus, the mined material should ideally be gold or other metal as opposed to coal or other non-metals.

Mine's Proximity to Residential Areas – *How many people live within one, five, and ten miles? Are there any other significant commercial or industrial activities nearby which could interfere with an analysis of the mine's impacts?* The mine must be close enough to a residential area that the mine could conceivably impact nearby property values. Areas with large populations close to the mine are preferable to areas with smaller populations. They will most likely contain more real estate transactions for the period of interest and thus a larger dataset available for analysis. Our literature review included studies with an impact radius that ranged from 0.3 miles to 10 miles, with most using an impact radius of between 1 mile and 2.5 miles. It is also important that the area have a sizable population close to the mine but outside the impact radius to act as a control group.

Mine Type – *Is the mine (1) a surface or open-pit mine, (2) an underground mine, (3) a hybrid surface and underground mine, or (4) an in-situ mine?* Ideally, the mine should be an underground mine so as to match the proposed project. Research shows that the potentially adverse environmental spillover effects of underground mines are typically lower than those of similarly sized surface mines.

Using the search criteria above, RDN filtered the MSHA dataset down to about a dozen candidates, then determined the total population and housing units within one, five, and ten miles as of the 2000, 2010, and 2020 censuses. After a holistic review of each mine's characteristics, operational histories, and surrounding population, RDN chose three mines to use as case studies: the Haile Gold Mine in Lancaster County, SC; the Coy Mine in Jefferson County, TN; and the Lincoln Mine in Amador County, CA.

The final step in our preparation for the case study analysis was to acquire residential sales transactions and property characteristics for surrounding parcels. RDN investigated several potential sources for these data, including public data available from County Assessor's Offices and Zillow, and licensed data available from third-party sellers, including ATTOM Data Solutions, CoreLogic, and ParcelQuest. We ultimately purchased data from CoreLogic. In consideration of budget constraints, we limited the scope of our purchase to parcels partially or wholly located in ZIP codes within five miles of each case study mine. We also limited our purchase of sales transactions to 11-year periods during which the mines ramped up production after an extended closure. These periods were 2010-2020 for the Haile Gold Mine, 2004-2014 for the Coy Mine, and 2009-2019 for the Lincoln Mine. Of course, not all parcels in the study area necessarily sold during these periods. For parcels that only sold before or after the requested periods, the CoreLogic data still includes the most recent sales price. To validate and supplement the CoreLogic data, RDN manually collected historical sales prices from Zillow for a random sample of properties located at various distances from each mine. This supplementary data collection was particularly helpful for increasing our sample size of observations for the Haile Gold Mine.

Case Study Mines

Haile Gold Mine

The Haile Gold Mine is a surface gold mining operation located in Lancaster County, South Carolina. The closest town to the Haile Gold Mine is Kershaw, South Carolina, which is approximately four miles away. According to the decennial censuses, the population within 10 miles of the mine increased from 15,233 in 2000, to 16,564 in 2010, and 17,253 in 2020.

The mine is currently owned and operated by Haile Gold Mine, Inc., a subsidiary of OceanaGold, a global mining company. The mine initially opened in 1827 before closing in the early 1900s; it was then periodically mined for the rest of the century. More recently, MSHA records indicate the mine was inactive from December 2002 until November 2011, when the mine changed back to active status. However, the mine operator did not receive all the necessary permits to commence new construction and operations until October 2014. The mine then ramped up employment and operations, pouring its first gold in January 2017.

Table 4-2 presents summary statistics for single-family homes sold within 10 miles of the mine, broken down into two periods: before and after the mine re-opened. For purposes of this study, we are using 2016Q3 as the opening period. As show in the table, the real average sales price and price per square foot (in constant 2022 dollars) grew after the mine re-opened. However, this does not mean there is a causal relationship between increases in sales prices and the mine opening, which could be attributed to confounding factors.

Table 4-2: Summary Statistics for Home Sales within 10 Miles of Haile Gold Mine, Before and After Opening (2016Q3)

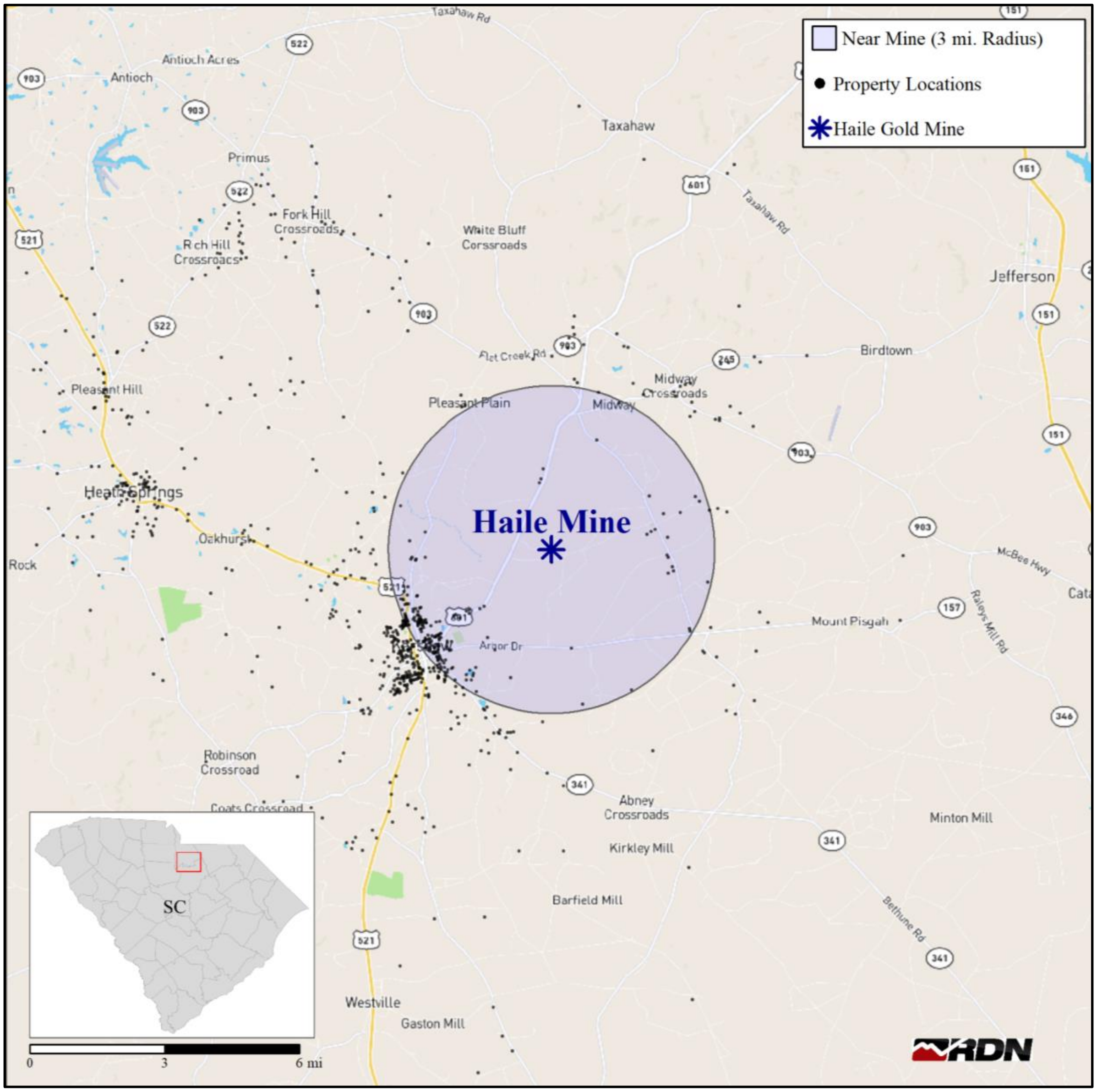
Variable	(n=622) Before Opening 2002Q1-2016Q2	(n=497) After Opening 2016Q3-2022Q1	Change
Sale Price (Adj.)	$96,032	$111,284	***$15,252
Price per Square Foot (Adj.)	$56.68	$68.98	***$11.15
Age (Sale Date – Year Built)	38	37	(1)
Square Footage (Home)	1,614	1,585	(29)
Square Footage (Land)	120,804	175,570	*54,766
Population Density (Pop./sq mi)	319	315	(4)
Distance to Nearest School (miles)	1.48	1.40	(0.08)

*Notes: *** p < 0.001; ** p < 0.01; * p < 0.05. All values are average estimates for properties within 10 miles of the mine. The opening of the mine is defined as 2016Q3. All prices in constant 2022 dollars.*

Sources: CoreLogic, 2022; Zillow, 2022; ESRI, 2022; and RDN estimates prepared for this study.

For the purpose of our analysis, we consider properties within three miles of the Haile Gold Mine as "near" the mine and all other properties are "far" from the mine. We chose this radius for the impact area because it is within the range of distances used in the literature and results in a similar number of observations that are inside or outside the impact area in our hedonic regression analysis. All else equal, having similar sample sizes in each area (i.e., near and far from the mine) increases the statistical power of their comparison. This means we are more likely to detect the effect, if any, that the mine has had on nearby property values relative to a dataset with the same total sample size but with fewer observations in one area and more in the other. Figure 4-1 maps the Haile Gold Mine, the impact area, and the locations of property sales observed over the case study period.

Figure 4-1: Residential Property Sales Near and Far from Haile Gold Mine, Lancaster County, SC, 2002-2022



Coy Mine

The Coy Mine is an underground zinc mine located in Jefferson County, Tennessee; it is one of three East Tennessee Mines, the others being the Immel Mine and the Young Mine. The population within 10 miles of the Coy Mine was 52,190 in 2000, 59,356 in 2010, and 63,042 in 2020. Asarco purchased the site in the 1960s and operated the Coy Mine until 2001. Press releases indicate the mine closed at the tail end of 2001 following the U.S. recession and a steep fall in the price of zinc. The mine remained closed for several years before briefly re-opening in 2007 under new owner Glencore. The current owner, Nyrstar, completed its purchase of the mine in 2009 and resumed operations, reaching full capacity by 2010Q4.

Table 4-3 presents summary statistics for single-family homes sold within 10 miles of the Coy Mine, classified into two periods: before and after the mine re-opened. For purposes of this study, we set 2009Q3 as the period for mine re-opening. Though the mine was active from 2007 to 2008, it appears the current owner, Nystar, significantly ramped up production after they acquired the mine in 2009. As show in the table, the real average sales price and price per square foot (in constant 2022 dollars) fell after the mine re-opened. However, this does not mean there is a causal relationship between decreases in sales prices and the mine opening, which could be attributed to confounding factors. To establish a causal relationship, we must also analyze the marginal change in prices for impacted homes and non-impacted homes at different stages of the mine's operation.

Table 4-3: Summary Statistics for Home Sales within 10 Miles of Coy Mine, Before and After Opening (2009Q3)

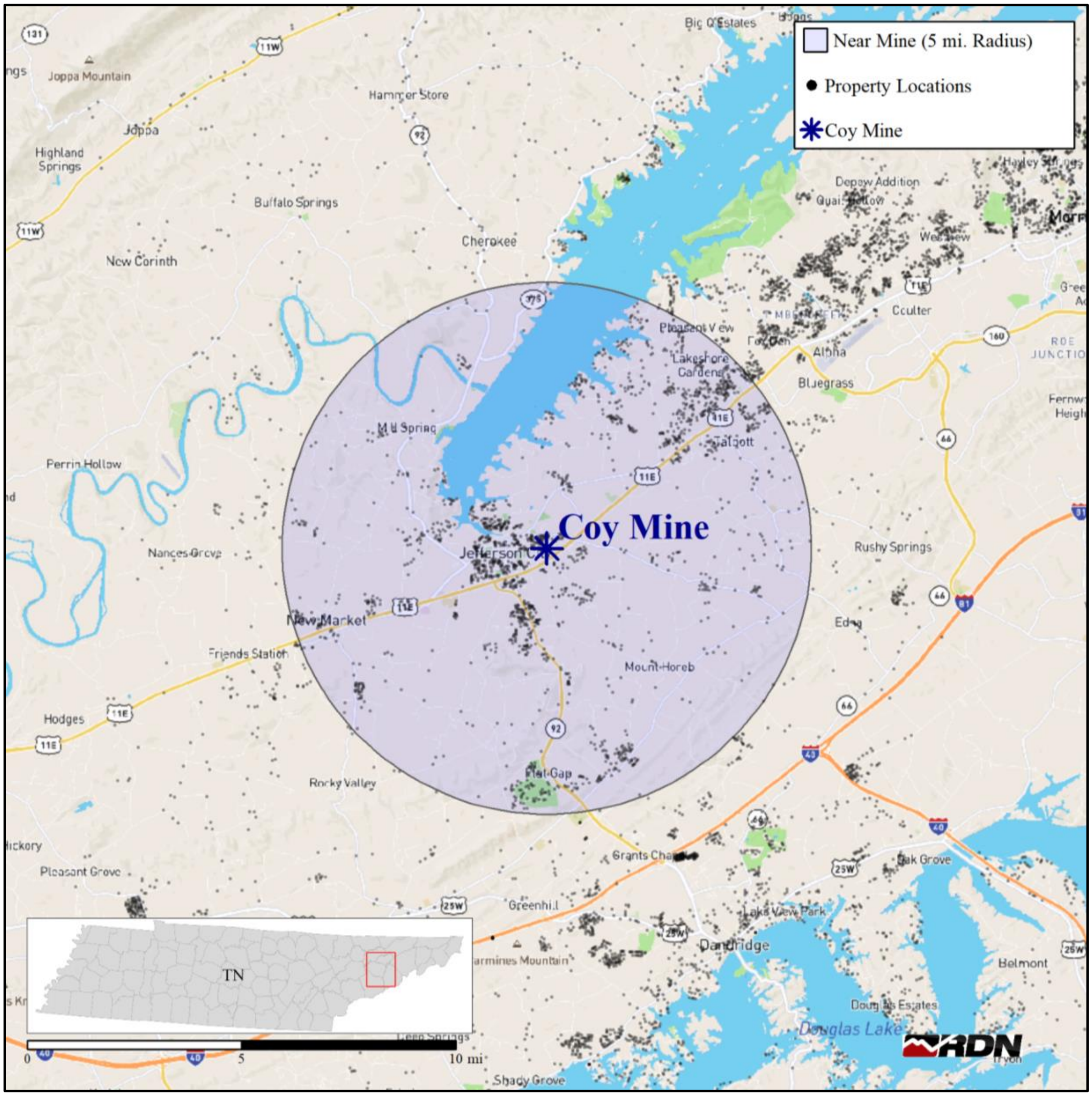
Variable	(n=4,594) Before Opening 2002Q1-2009Q2	(n=3,683) After Opening 2009Q3-2022Q1	Change
Sale Price (Adj.)	$194,928	$170,966	***($23,962)
Price per Square Foot (Adj.)	$108.32	$94.12	***($14.20)
Age (Sale Date – Year Built)	11	16	***5
Square Footage (Home)	1,810	1,811	1
Square Footage (Land)	46,220	45,727	(493)
Population Density (Pop./sq mi)	538	566	**28
Distance to Nearest School (mi.)	2.83	2.83	0

*Notes: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. All values are average estimates for properties within 10 miles of the mine. The opening of the mine is defined as 2009Q3. All prices in constant 2022 dollars.*

Sources: CoreLogic, 2022; Zillow, 2022; ESRI, 2022; and RDN estimates prepared for this study.

For the purpose of our analysis, properties within five miles of the Coy Mine are "near" the mine and all other properties are "far" from the mine. We chose this radius for the impact area because it is within the range of distances used in the literature (albeit at the upper end) and results in a similar number of observations that are "near" and "far" from the mine in our hedonic regression analysis, which increases the statistical power of their comparison. Figure 4-2 maps the Coy Mine, the impact area, and the locations of property sales observed between 2002 and 2022.

Figure 4-2: Coy Mine Impact Area and Residential Property Sales, Jefferson County, TN, 2002-2022



Lincoln Mine

The Lincoln Mine is an underground gold mine in Amador County, California that was first established in 1851. The closest town to the Lincoln Mine is Sutter Creek, California, which is approximately 1.4 miles away. The population within 10 miles of the mine, retrieved from decennial census data for 2000, 2010, and 2020, were 26,397, 28,964, and 30,536, respectively. According to MSHA data, the Lincoln Mine was abandoned from at least 1999 to July 2012, when "intermittent" operation began under then owner, Sutter Gold. A February 2013 news article from ABC7 describe the mine as "weeks away from starting full-scale mining," but the company ran into financial and equipment issues that delayed production. The mine was put on care and maintenance in 2014 until the current owner, Seduli Sutter Operations, purchased the mine in 2020 and resumed operations, pouring its first gold in 2022.

Table 4-4 presents summary statistics for single-family homes sold within 10 miles of the Lincoln mine from before the mine re-opened and after the mine re-opened. For purposes of this study, we define the "mine opening" period as 2016Q3. As shown in the table, the real average sales price and price per square foot (in constant 2022 dollars) grew after the mine re-opened. However, this does not by itself indicate any causal relationship between homes sales prices and the mine opening. To establish a causal relationship, we must also analyze the marginal change in prices for impacted homes and non-impacted homes at different stages of the mine's operation.

Table 4-4: Summary Statistics for Home Sales within 10 Miles of Lincoln Mine, Before and After Opening

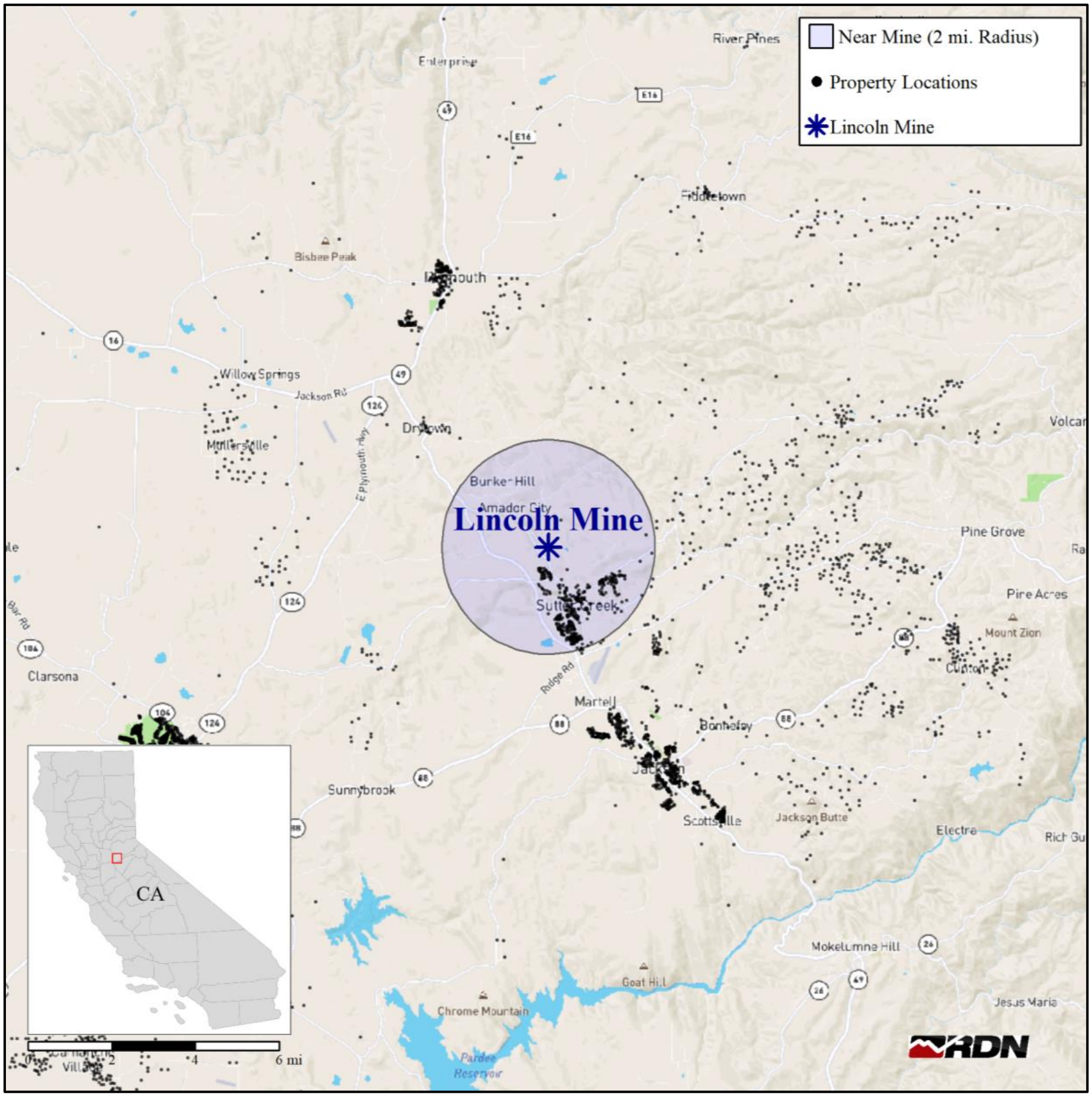
Variable	(n=1,598) Before Opening 2001Q1-2013Q1	(n=2,609) After Opening 2013Q2-2022Q1	Change
Sale Price (Adj.)	$324,172	$383,363	***$59,190
Price per Square Foot (Adj.)	$182.82	$224.32	***$41.50
Age (Sale Date – Year Built)	28	34	***6
Square Footage (Home)	1,738	1,785	*47
Square Footage (Land)	59,025	72,948	**13,923
Population Density (Pop./sq mi)	683	679	(4)
Distance to Nearest School (mi.)	0.92	0.98	**0.06

*Notes: *** p < 0.001; ** p < 0.01; * p < 0.05. All values are average estimates for properties within 10 miles of the mine. The opening of the mine is defined as 2013Q2. All prices in constant 2022 dollars.*

Sources: CoreLogic, 2022; Zillow, 2022; ESRI, 2022; and RDN estimates prepared for this study.

For the purpose of our analysis, properties within two miles of the Lincoln Mine are "near" the mine and all other properties are "far" from the mine. We chose this radius as the impact area because it is within the range of distances used in the literature and results in a similar number of observations that are inside or outside the impact area in our hedonic regression analysis, which increases the statistical power of our analysis. Figure 4-3 maps the Lincoln Mine, the impact area, and the locations of property sales observed between 2001 and 2022.

Figure 4-3: Lincoln Mine Impact Area and Residential Property Sales, Amador County, CA, 2001-2022



Case Study Methodologies

While the existing literature does not specifically address impacts to property values from underground mining, the same methodologies used to estimate the impacts of other activities on residential home prices are generally applicable. For a discussion of methodological approaches that may be used to estimate impacts of mining and other activities to property values, see *Appendix B—Literature Review: Methodologies for Estimating Impacts on Home Values*. The methodologies used for this case study analysis are summarized below.

Hedonic Pricing Multi-Event Analysis

Impacts on home values from an activity may vary based on the homes' distance from the activity and the stage of the activity. Using a hedonic pricing multi-event approach, RDN estimated whether, on average, the distance from a mine is associated with any premium or penalty on home values for the case-study locations. We do this at three different stages for each mine: pre-operation, ramp up, and an ongoing operation. Data used for the case study analysis includes property and location attributes. Table 4-5 includes a summary of the variables used for the analysis.

Table 4-5: Summary of Case Study Dataset Variables

Variable	Description
Mine Name	Designates if the property is near to the Haile Gold Mine, Coy Mine, or Lincoln Mine
Sale Amount	Transaction value of home (constant 2022Q1USD)
Sale Date	Date of transaction
Home Square Footage	Size of livable space in the home (square feet)
Age	Age of the home (years)
Population Density	Population density surrounding the home
Distance to Nearest School	Straight-line distance to the nearest school (miles)
Distance to Mine	Straight-line distance to the nearest mine (miles)

In order to define the development and operation stages for each of the three case study mines, RDN reviewed a combination of historical mine status and employment data from MSHA and, when available online, historical news articles about the development and operational status of the mines. This analysis considers mines to be inactive during periods the mine's status is recorded by MSHA as "abandoned" or "non-producing," or if the mine's status is "active" but the mine is not producing and does not show any significant employment. Non-producing mines are those where production has not yet begun or has ceased, but some minimal work occurs, such as safety inspections. Abandoned mines are those that are not only closed, but also no party is actively monitoring or maintaining the site. A mine can become active again when the existing or new operator decides to resume operations. This often requires a transition period of construction, capital improvements, and hiring and training before the mine reaches full operational capacity.

RDN selected dates that best align with the following definitions of the various stages of development and operation:

- **Pre-operation Phase**: this is the period during which a prospective mine operator is working on obtaining project approval and necessary permits; during this period the general public learns about the upcoming project.
- **Ramp-up Phase**: this period includes construction activities, equipment procurement and upgrades, workforce training, and ramp up of mining activities to full operation; the mine begins operating (i.e., producing) part-way through this phase.
- **Ongoing Operation Phase**: this period includes ongoing full operation of the mine.

Table 4-6 summarizes the periods RDN selected for each mine's pre-operation, ramp-up, and ongoing operation phases.

Table 4-6: Quarterly Periods by Phase of Operation, Case Study Mines

Mine Name	Pre-operation	Ramp-up	Ongoing
Haile Gold Mine	2002Q1 - 2014Q3	2014Q4 - 2020Q3 (Mine open: 2016Q3)	2020Q4 – 2022Q2
Coy Mine	2002Q1 - 2006Q3	2006Q4 - 2013Q3 (Mine open: 2009Q3)	2013Q4 - 2022Q2
Lincoln Mine	2001Q1 - 2011Q3	2011Q4 - 2017Q2 (Mine open: 2013Q2)	2017Q3 - 2022Q2

Once all stages were defined for each mine, we pooled the data for each stage and performed statistical analyses to examine the relationship between a mine's location and phase of operation and the location and characteristics of homes sold in the surrounding area. Specifically, in each stage, we regressed the natural logarithm of the constant-dollar sale price on a variable measuring the straight-line distance to the mine in miles, our main variable of interest, and a set of additional covariates/control variables. Because we use the natural logarithm of the sale price, the coefficient on the distance-to-mine variable can be interpreted approximately as the percent change in the value of a home associated with an increase of one mile in the distance from the mine.

Fixed-Effects Difference-in-Differences Analysis

To further investigate whether the opening of the case study mines impacted home values in their respective areas, and whether any impact varied by proximity to the mines, we analyze whether, on average, home prices in the counties where the mines are located changed as a result of the mines opening and commencing normal operations. Further, we estimate whether homes considered to be near the mine experienced different impacts than other homes.

The fixed-effects difference-in-differences analysis uses two operational statuses: mine closed and mine open. This is different from the hedonic pricing multi-event analysis, which included three phases. For this binary indicator, RDN selected the quarter when the mine appears to have commenced or re-commenced production (i.e., mineral extraction), as opposed to exploratory drilling and mine construction leading up to operations. This date occurs part-way into the ramp-up phase, after construction and equipment procurement or upgrades. Based on available data, the dates at which the case study mines began operation were 2016Q3 for the Haile Gold Mine, 2009Q3 for the Coy Mine, and 2013Q2 for the Lincoln Mine (refer to Table 4-6).

For each mine location, RDN calculated an average quarterly price for homes classified as near or far from the mine using a large set of alternative distances as the cutoff point for being considered near the mine. These distances ranged from half a mile up to ten miles. For each mine, RDN then found which cutoff distance resulted in the largest number of same-quarter near-and-far averages. Under certain cutoff distances and periods, some counties only had home sales either near or far from the mine, but not both. In order to ensure the fixed effects regression has appropriate overlap of sales across groups (near and far) for each mine, we defined the cutoff as the distance that results in the largest number of same-quarter near-and-far averages. The resulting cutoff distances are three miles for the Haile Gold Mine, five miles for the Coy Mine, and two miles for the Lincoln Mine.

Once we determined the distances for each mine and created near/far indicators in each data set, we pooled the data for all three case study areas. We then regressed the natural logarithm of the constant-dollar sale price on key indicators: (1) *Mine Open*, for if the sale occurred while the mine was operating normally, and (2) an interaction term, *Mine Open*Near Mine*, for if the mine was operational during the sale and the property is close to the mine. Note that for any individual property its proximity to the mine does not vary over time (nor does its building area or land area). In the fixed effects model, it is impossible to estimate the impact of being near the mine, regardless of mine operation status, because the fixed effects already control for each property's unique physical characteristics. The main coefficients of interest in the fixed effects model are the coefficients for the indicators. The coefficient for *Mine Open* indicates the overall effect of the mine operating on all homes, whereas the coefficient for *Mine Open*Near Mine* indicates any additional effect of the mine operating on homes "near" the mine, specifically.

Results

Table 4-7 summarizes the regression results of both the multi-event hedonic regressions (Columns 1-3) and the fixed effects difference-in-difference regression (Column 4).

Table 4-7: Regression Analysis Results

	(1) Pre-operation	(2) Ramp up	(3) Ongoing	(4) Fixed Effects
Intercept	11.4405 ***	12.1788 ***	11.7750 ***	9.9694 ***
	(0.7274)	(0.3212)	(0.2133)	(0.4472)
Distance to Mine	-0.0108 ***	-0.0122 ***	-0.0117 **	
	(0.0029)	(0.0021)	(0.0037)	
Mine Open				-0.0108
				(0.0279)
Mine Open*Near Mine				0.0089
				(0.0423)
Building Area	0.0004 ***	0.0001 ***	0.0004 ***	
	(0.0000)	(0.0000)	(0.0000)	
Land Area	-0.0000 ***	0.0000 ***	0.0000 *	
	(0.0000)	(0.0000)	(0.0000)	
Age	-0.0200 ***	-0.0278 ***	-0.0168 ***	-0.0757 **
	(0.0015)	(0.0010)	(0.0014)	(0.0255)
Age Squared	0.0001 ***	0.0002 ***	0.0001 ***	0.0003 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)
Population Density	-0.0001 ***	-0.0002 ***	-0.0002 ***	0.0005
	(0.0000)	(0.0000)	(0.0000)	(0.0003)
Observations	5,367	10,803	2,803	11,666
Adjusted R-squared	0.4697	0.4057	0.6132	0.5898

Notes: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. Columns 1 through 3 include mine and sale-date fixed effects, and controls for distance to nearest school. Column 4 includes a linear control variable for time.

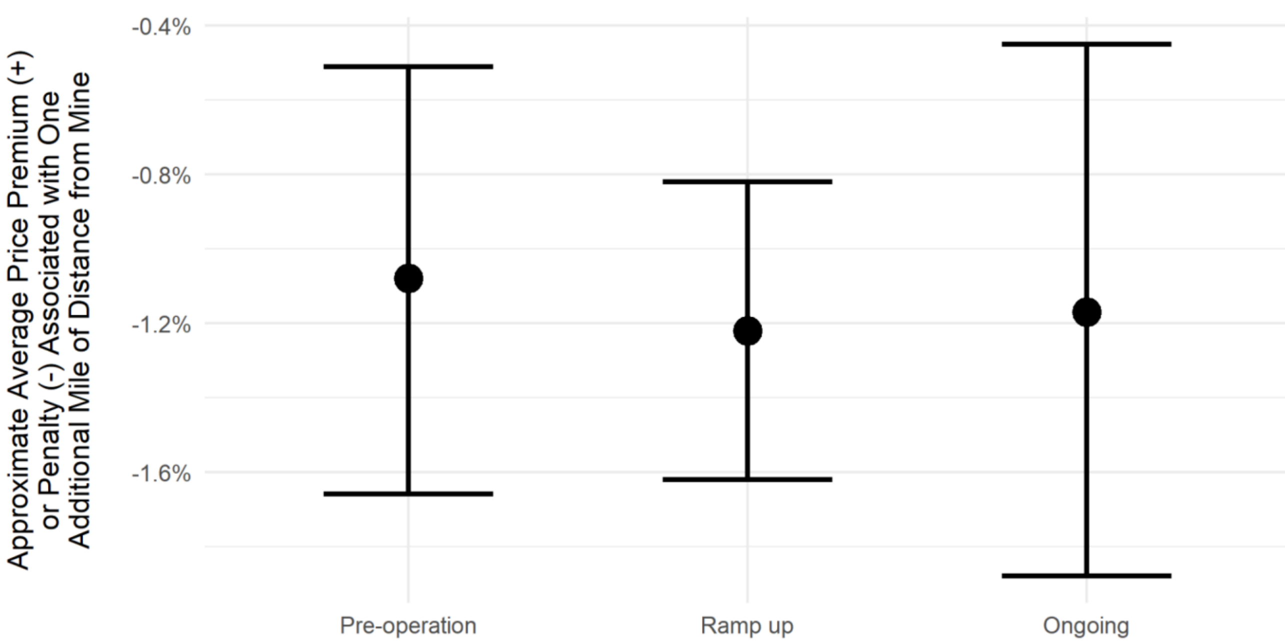
Hedonic Pricing Multi-Event Analysis

Columns 1 through 3 in Table 4-7 display the results of the hedonic pricing multi-event analysis. In all three columns, the coefficient on the distance-to-mine variable can be interpreted approximately as the percent change in the value of a home associated with an increase of one mile in the distance from the mine. The results of the analysis indicate that in our case study areas, throughout all three stages, distance from the mine results in a penalty, or negative premium, on home values at a rate of approximately one percent per additional mile of distance. That is, controlling for observable characteristics, prices for homes closer to the mines are on average higher than for homes further away, with the price decreasing approximately one percent for every additional mile of distance from the mines.

Importantly, the coefficients on the distance-to-mine variable are stable across the three different stages, suggesting that any price premiums observed before the mine is fully approved and permitted are still observed during the ramp-up stage as well as the ongoing operation phase, which occurs after some of the uncertainty about the mines' spillover effects should have subsided.

Figure 4-4 displays the estimated home-value impacts of an increase of one mile in distance from the mines, with the corresponding 95 percent confidence intervals for the point estimates for all three stages. The clear overlap of the confidence intervals indicate that these estimates are indistinguishable from one another. That is, as indicated, we estimate that the impact is stable across time, suggesting that operations at the mines did not significantly change any pre-existing distance premiums or penalties.

Figure 4-4: Average Price Premium or Penalty associated with One Additional Mile from Case Study Mines

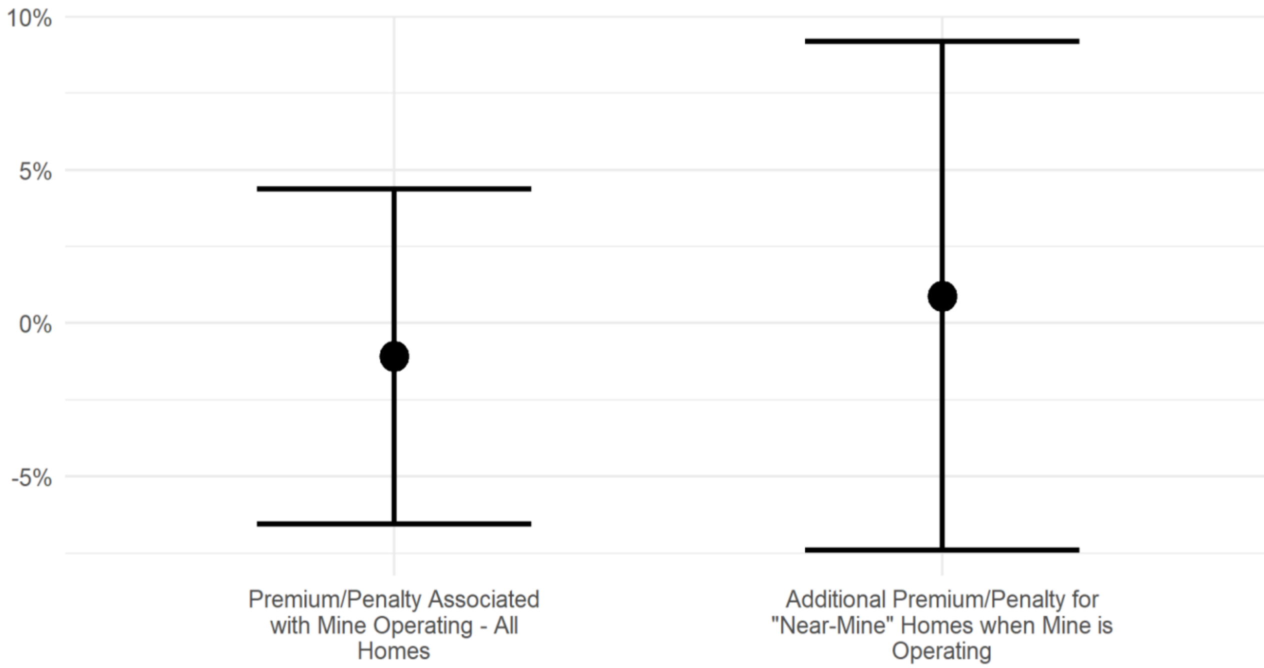


Fixed-Effects Difference-in-Differences Analysis

Column 4 in Table 4-7 displays the results of the fixed-effects difference-in-differences estimation. The small and negative coefficient on the *Mine Open* indicator variable is not statistically significant at the 95 percent level. What this means is that, at the chosen confidence level, the estimated effect is indistinguishable from a zero effect. The estimate and confidence interval on the left-hand side of Figure 4-5 displays this graphically, namely, that while the point estimate (which is a sample estimate) is approximately -1.0 percent, we are 95 percent confident that the true population parameter is between roughly -5.0 percent and +5.0 percent.

The coefficient on the *Mine Open*Near Mine* indicator variable is also statistically insignificant at the 95 percent level. Similar to the Mine Open indicator, what this means is that we are 95 percent confident that the true population parameter falls in a range that includes both positive and negative values. At the chosen confidence level, then, we cannot rule out that homes near the mine when the mine starts operating are not impacted, negatively nor positively, by the mine's operation. This is shown graphically on the right-hand side estimate and confidence interval in Figure 4-5.

Figure 4-5: Average Price Premium or Penalty associated with Location relative to Case Study Mines



Summary of Findings

Overall, the results of the regression analysis do not indicate a significant effect of comparable underground mining operations on property values. This result is consistent for both specifications; the first looking at the impact of distance to the mine as a continuous variable across different periods of operation and the second estimating if homes considered to be near the mine experienced different impacts than other properties. This impact is on aggregate, meaning that, on average, property values are not expected to be significantly impacted. However, this result is not an indication of a mine's impact on individual properties. For instance, certain homes may experience a reduction in value due to noise pollution, while others are sold at a premium due to increased demand for housing by workers of the mine and other households that move to the area for supporting jobs.

In addition to the results discussed above, RDN conducted several other analyses and specifications to account for biases in the selection of periods of operations, distances used to classify homes as near or far, and confounding variables. We also conducted sensitivity analyses to different model specifications by using spatial regression models that incorporate the location effects of surrounding properties, meaning that the sales price of a home could be partially impacted by the sale price of a home on the same street or block. All analyses pointed to the same conclusion that mining operations similar to the proposed project have not significantly impacted the home values of surrounding properties.

4.3 Survey of Local Real Estate Professionals

RDN assumes that real estate industry professionals based in western Nevada County have a better-than-average understanding of the major factors that determine home prices in the area. Because they work directly with prospective home buyers and sellers, they should also be attuned to the reasons why their clients want to buy or sell a property and how much clients think the properties are worth. As explained by Kiel and McClain (1995) and Taylor, Phaneuf, and Liu (2016), market expectations, speculation, and uncertainty can have a significant impact on property values. Real estate market participants assess value based on imperfect information, not only about the present, but also about what may or may not happen in the future.

RDN conducted several scoping interviews with local real estate professionals to understand local expectations for the Idaho-Maryland Mine's impacts to property values, if any. Following these interviews, RDN designed and distributed an online survey to 362 Realtors® based in western Nevada County. The survey prompted respondents to quantify and explain the magnitude and duration of the proposed project's impacts to property values for various areas. The following section summarizes the results of RDN's interviews and survey (the survey form is attached in *Appendix C—Realtor Survey*).

Scoping Interviews

Phone interviews were conducted with contacts selected from a list of local real estate industry professionals collected by RDN and reviewed by the County. This list includes Realtors®, brokers, general contractors, and rental property managers. Out of the approximately 30 contacts that RDN called, 11 agreed to an interview. Of the remaining 19 contacts, most simply did not answer or did not return RDN's voicemails. However, similar to our interviews with some business organizations, several contacts declined to be interviewed because they did not want to comment on what they perceive to be a controversial project despite assurances that their responses would be confidential.

Several interviewees said they do not expect that the mine would have any significant impact on property values. One respondent expects a moderate increase in sales prices and total sales due to the anticipated increase in population and jobs. Most interviewees, however, expect that the proposed project would negatively impact local property values. According to these respondents, Nevada County is a gateway to outdoor recreation and has long been a draw for retirees moving from the Bay Area or Los Angeles in search of a slower pace. Younger families have also been moving to the area, a trend that accelerated during the COVID-19 epidemic due to the proliferation of flexible work-from-home policies and people's increased desire for more space. A common thread between these groups is that many place a high value on natural spaces and resources. Thus, local preferences may be less accepting of large industrial or commercial developments as compared to communities in more developed areas. To support this notion, three real estate brokers interviewed for this study claimed they had first-hand experience with buyers who walked away from a potential sale due to concerns about the proposed project's environmental effects on the property. Though the homes ultimately sold, they either sold at lower prices or spent more days on the market than they otherwise would. According to one broker, information about the mine is one of the required disclosures when selling homes nearby.

RDN asked interviewees to explain the reasons why the proposed project would impact property values. While many cited the anticipated increases in traffic and noise along the proposed truck haul routes, the primary concern of those who expect large negative impacts is the possible draining or contamination of local wells and other water resources. Two interviewees specifically noted the case of the San Juan

Ridge Mine, located 7.5 miles north of Nevada City. In 1995, miners inadvertently drilled into an aquifer, flooding the mine. Ultimately, the accident drained and contaminated a dozen local wells (San Juan Ridge Taxpayers Assocation 2022). The EIR for the mine had not anticipated the possibility of such significant levels of flooding or its impact on local water resources. Some now see the Draft EIR for the Idaho-Maryland Mine within the context of the San Juan Ridge Mine and fear a similar outcome.

Some of the real estate professionals that RDN interviewed indicated that local fears about the mine's environmental impacts are likely overstated. Nonetheless, they acknowledged, the perceived increase in risk would impact local home sales, at least temporarily. Two interviewees opined that if the mine continued to operate without incident, eventually the risk premiums for the affected properties would subside and their values would recover. The exception would be properties directly next to or up to a few blocks from the truck haul routes, which most interviewees agreed would be negatively impacted due to the anticipated increase in traffic and noise.

Survey Population and Distribution

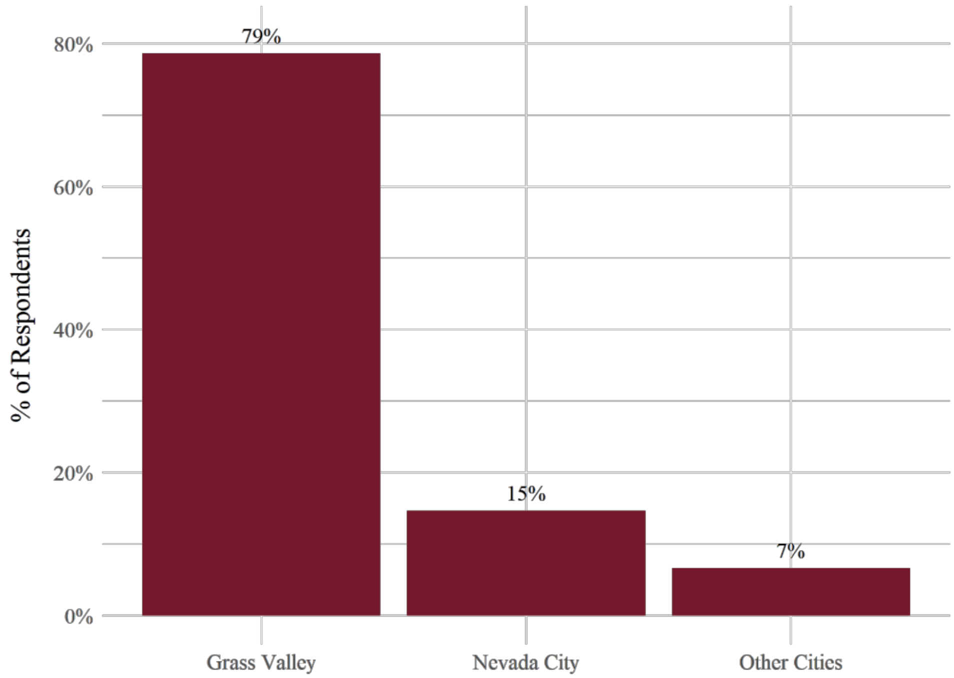
RDN collected office and email address information for 362 Realtors® who operate in western Nevada County by cross-referencing searches on Realtor.com with company websites and other sources. We decided to limit our survey to licensed Realtors® as a quality control measure, given that the broader real estate industry includes personnel with a wide range of experience and specialties. We distributed the online survey through the SurveyMonkey platform on 27 June 2022 using personalized email invitations. Reminder emails were sent to non-respondents on 30 June and 7 July. The survey closed on 9 July. Each email invitation included a unique survey URL linked to a specific respondent. To protect the integrity of the survey, we recorded only the first response from each unique URL.

RDN received a total of 75 responses from 362 potential respondents, which represents a 21 percent response rate. Of the 75 respondents, 87 percent fully completed the survey and the remaining 13 percent skipped one or more questions. Respondents were asked about their familiarity with the proposed project and the Draft EIR, as well as various questions related to their expectations regarding the project's impact to local property values. The following section summarizes the survey results for each and reflects only the aggregated opinions of those who volunteered to respond. It is important to note that that the opinions of those who responded to the survey may differ from those who did not respond to the survey.

Survey Results by Question

Figure 4-6 shows the distribution of respondents by city based on their office location as determined by RDN. The majority of respondents are based in Grass Valley (79 percent) or Nevada City (15 percent). Approximately 54 percent of respondents also indicated that they have 10 or more years of experience as a licensed real estate professional in Nevada County.

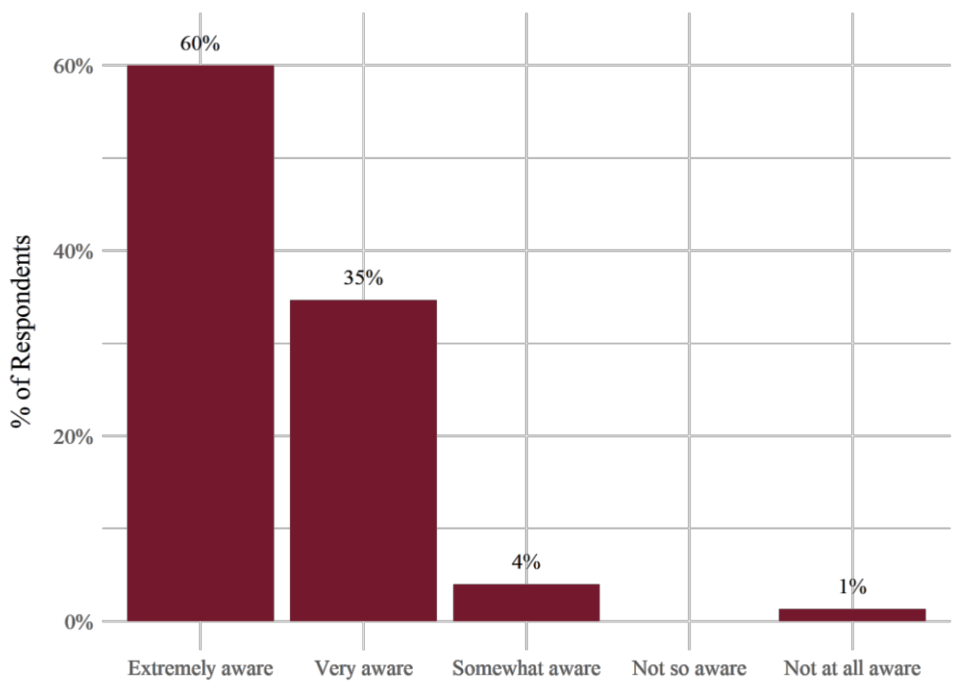
Figure 4-6. Respondents by City of Main Office



Note: numbers may not sum to 100 percent due to rounding.

Figure 4-7 displays respondents' self-reported level of awareness of the proposal to re-open the Idaho-Maryland Mine. A majority of respondents, 60 percent, reported being "extremely aware" of the proposed project, with 93 percent being at least "very" aware.

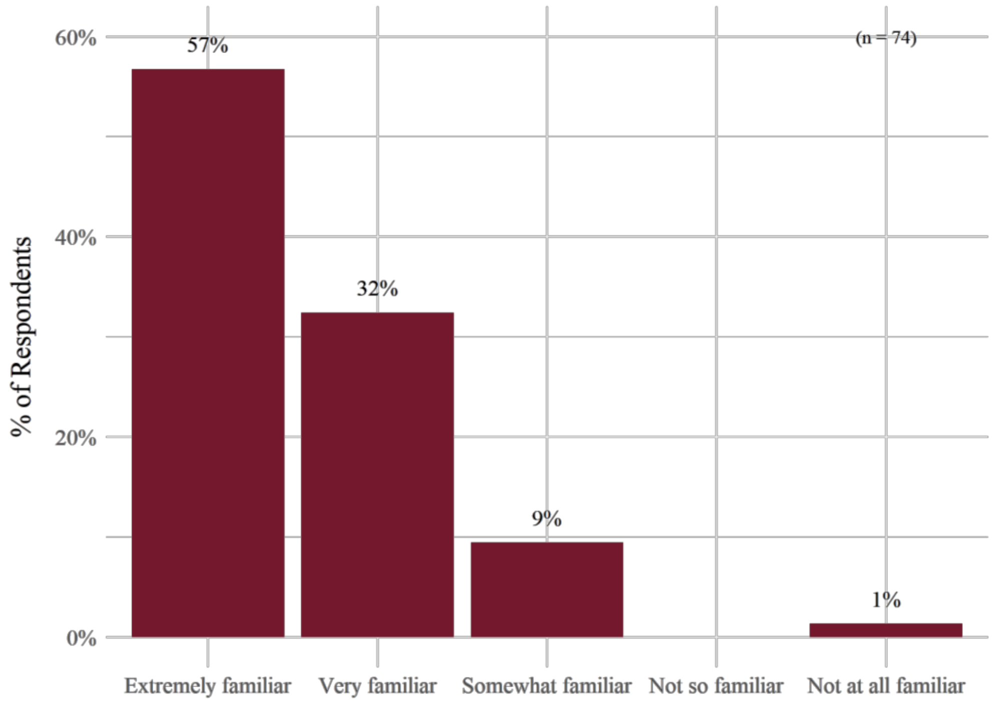
Figure 4-7. Are you aware of the proposal to re-open the Idaho-Maryland Mine?



Note: numbers may not sum to 100 percent due to rounding.

The majority of respondents also indicated that they are familiar with the project area (Figure 4-8).

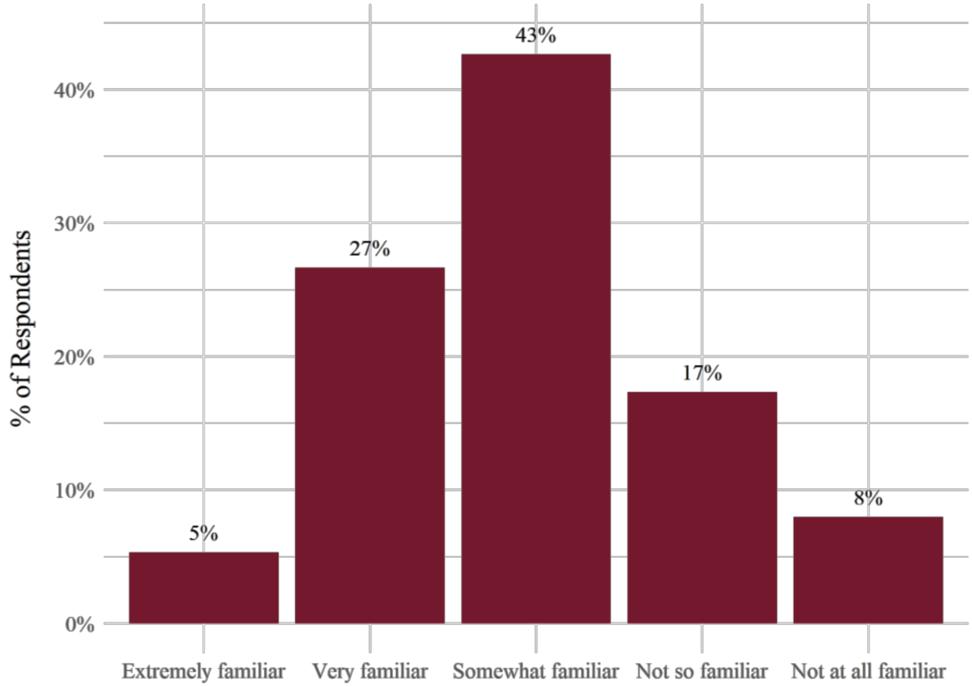
Figure 4-8. How familiar are you with the area around the proposed Idaho-Maryland Mine Project sites?



Note: numbers may not sum to 100 percent due to rounding.

Survey respondents were asked about their familiarity with the findings of the Draft EIR. Figure 4-9 summarizes this distribution, which indicates that 68 percent of respondents are at most "somewhat familiar" with the document, including 25 percent that are "not so familiar" or "not at all familiar." In contrast, 27 percent of respondents indicated that they are "very familiar" with the Draft EIR and only 5 percent said they are "extremely familiar." In contrast, approximately 60 percent of respondents said they were "extremely familiar" with the proposal to re-open the mine (Figure 4-7). Comparing these results, we can surmise that many people who are familiar with the proposed project are not familiar with the findings of the Draft EIR and are likely getting their information about the mine from other sources. As discussed in *Section 4.1: Literature Review*, the environmental impact of a site or speculation regarding its potential impacts can influence nearby property values.

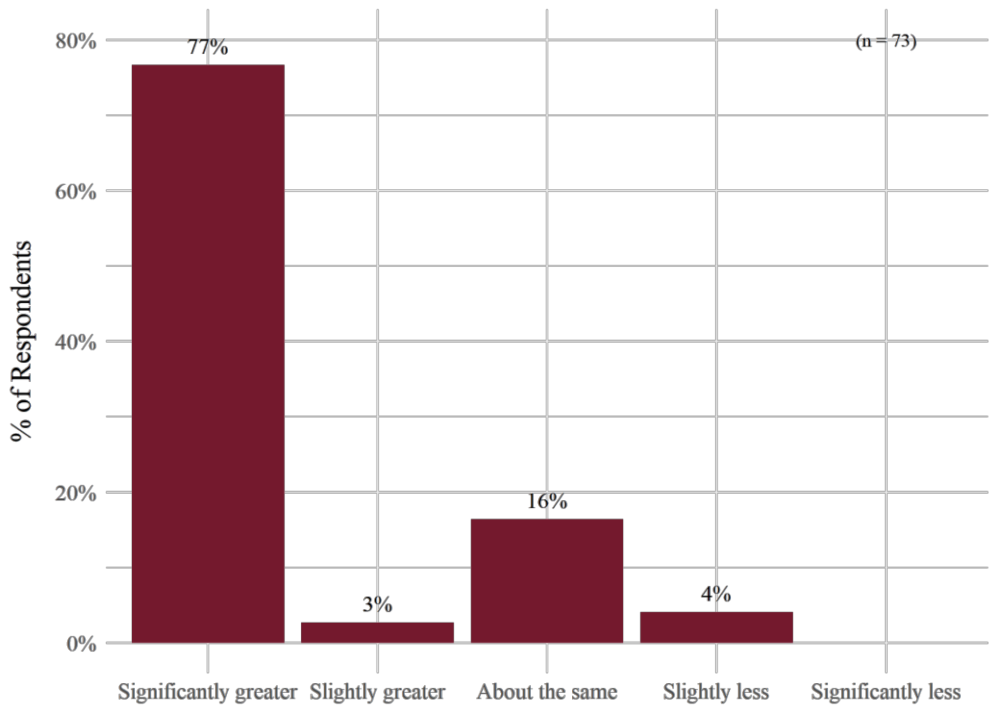
Figure 4-9. How familiar are you with the findings of the Draft Environmental Impact Report (EIR) on the Idaho-Maryland Mine Project?



Note: numbers may not sum to 100 percent due to rounding.

Respondents were also asked whether they believe the Draft EIR understates or overstates the environmental impacts of the proposed project. Figure 4-10 summarizes respondents' expectations relative to the document's findings. Approximately 77 percent of respondents speculate that the environmental impacts would be significantly greater than what is reported in the Draft EIR. This is a curious result given that only 32 percent of respondents claim to be "very familiar" or "extremely familiar" with the findings of the Draft EIR; it implies that many respondents may be forming their opinions on the Draft EIR based on secondary sources, which highlights the importance of these sources in shaping public perceptions of the Draft EIR and the proposed project.

Figure 4-10. Responses Summary: Do you believe the environmental impacts would be greater than or less than those stated in the Draft EIR?

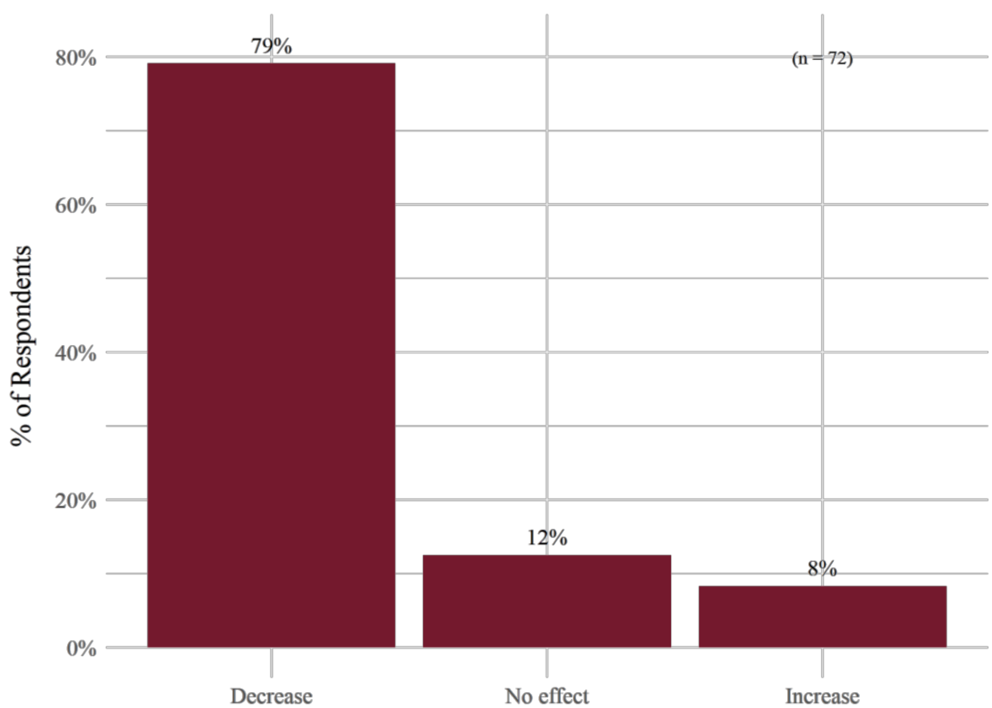


Note: numbers may not sum to 100 percent due to rounding.

The objective of RDN's literature review and case study analysis is to isolate the marginal effect of the proposed project on local property values while controlling for other factors. RDN similarly asked survey respondents to estimate the marginal impact that the proposed project would have on property values based on their local experience, assuming all other factors are held constant. Figure 4-11 reports the proportion of respondents that believe the mine would, on average, cause property values in Nevada County to increase, decrease, or neither (no effect).

Approximately 79 percent of respondents expect property values in Nevada County to decline if the Idaho-Maryland Mine re-opens. Only eight percent of respondents expect property values would increase. The remaining 12 percent do not expect the mine to impact property values. Of participants that included a written comment explaining their opinion, the most cited factor was the risk to water resources, which was mentioned by 37 percent of respondents. There is a strong presence of opinion that if water supply is impacted by the mine's activity, either by dewatering or pollutant run-off, property values would drop significantly. Increases in traffic and noise pollution were mentioned by 32 percent and 31 percent of respondents, respectively, as other causes for declines in property values. All respondents that expect increases in property values cited the increase in jobs and economic activity associated with the proposed project.

Figure 4-11. What would be the overall effect of the Project on the market value of residential properties in Nevada County?

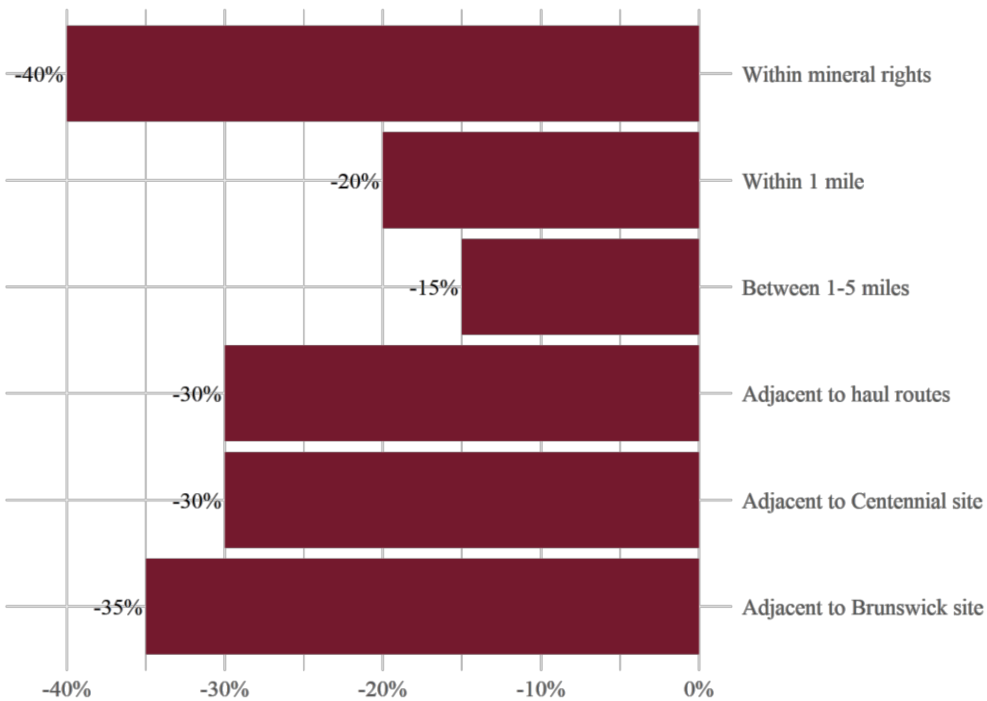


Note: numbers may not sum to 100 percent due to rounding.

RDN surveyed how real estate professionals expected property values to change in different areas near the mine, including properties on the proposed project's planned haul routes, near the Brunswick and Centennial sites, within the project's mineral rights boundary, within one mile of the project sites (e.g., Grass Valley), and between one and five miles of the project sites (e.g., Nevada City). When asked about specific areas, respondents overwhelmingly expect property values would decrease to some degree, with over 90 percent of respondents expecting some level of decrease in all defined impact areas.

Figure 4-12 summarizes the median estimated impact for the defined areas. The largest median decrease in property value is for properties within RGV's mineral rights boundary. (Note that the survey included reference maps of the proposed project's mineral rights boundary and hauling routes.)

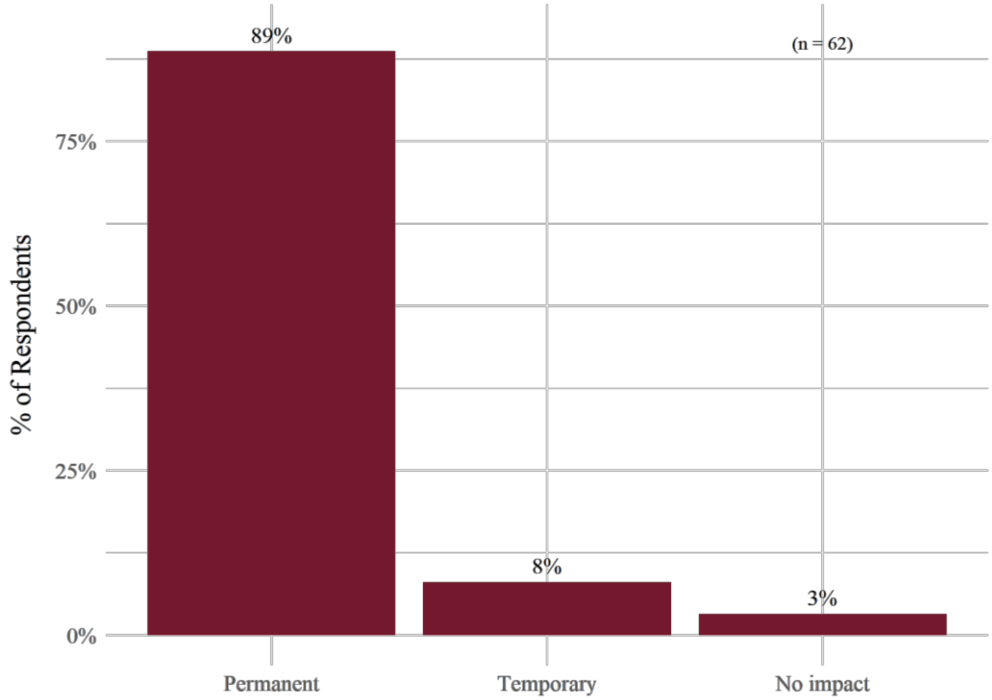
Figure 4-12. On average, how much do you believe residential property values in the following areas would change due to the Idaho-Maryland Mine Project?



Note: Reported numbers present the median, or middle, value of responses for each area.

Respondents were also asked whether they believe the anticipated change in property values caused by the proposed project would be temporary, permanent, or not applicable because they do not believe the mine would impact property values. Figure 4-13 charts the proportion of respondents who selected each answer choice. Overall, 89 percent of respondents expect that the proposed project would have a permanent impact on property values, whether positive or negative. However, of those who indicated the impact would be negative, 94 percent of respondents also indicated that the negative impact would be permanent.

Figure 4-13. In your opinion, do you expect the mine's impacts on property values would be temporary or permanent?



Note: numbers may not sum to 100 percent due to rounding.

For the final question of the survey, respondents were prompted to comment on why they believed the impacts would be temporary or permanent. Similar to previous comments, those who believe the impact would be negative and permanent cited degradation of water sources, increased traffic, and increased noise. In particular, respondents believe that damage to water resources would persist beyond the operational lifecycle of the mine. Consistent with their belief that the Draft EIR understates the environmental impacts, many respondents also believe that irreparable damage to water resources would permanently lower residential property values. Additionally, some respondents commented that these issues (traffic, noise, and potential well water contamination or depletion) would need to be disclosed to potential homebuyers, which would lower those properties' values to some extent regardless of whether these issues are ever realized.

Summary of Survey Results

The results of the Realtor® survey mirrored RDN's one-on-one interviews with local real estate professionals. If the proposed project moves forward, most respondents believe that home prices in nearby areas would decline. The estimated magnitude of the decline varies by area. The median expected change in property value ranged from -15 percent for properties between one and five miles away from the mine up to -40 percent for properties located within RGV's mineral rights' boundary. Respondents indicated that the negative impact would largely be the result of potential adverse environmental impacts to water quality and the increase in traffic and noise associated with the planned truck hauling routes.

Not all respondents expect that the proposed project would have a negative impact. Approximately 20 percent of respondents said that the proposed project would either have no impact or a positive impact on property values in Nevada County. Most of these respondents cited the increased economic activity and jobs associated with the mine. Additionally, others noted that the haul route was already a busy road that potential buyers would already have accounted for in home purchases in the area.

The environmental concerns mentioned in our interviews and survey are discussed in the findings of the Draft EIR. However, respondents to the survey do not think that the Draft EIR adequately assesses the impacts of the proposed project. This result highlights the potential impact of market speculation on property values. Market speculation, or stigma, is discussed by Kiel and Williams (2007) as having a potential impact on property values that is highly dependent on the site in question. The results of the survey indicate that the expectations and public sentiment regarding the proposed project differ from the actual outcomes for those mines presented in the case study analysis.

4.4 Conclusion

Our review of the relevant literature found many studies on the environmental spillover effects of industrial developments on property values. Although most of these studies find net negative impacts on property values, none of them focus on the property value impacts from opening or reopening a modern, underground mineral mine. This limits our ability to use existing studies to draw conclusions about the likely impacts of the proposed project, as the environmental impacts of open pit or surface mines are generally considered more severe than those of underground mines. Additionally, new industrial sites in the United States, and especially in California, must comply with more stringent environmental safety requirements than some of the sites studied in the literature. According to the Draft EIR, the proposed project would implement mitigation measures that would reduce most of the potentially significant environmental impacts to an acceptable level. The long-term significant and unavoidable impacts that would remain relate to degraded views of the project site from public vantage points and traffic impacts at the Brunswick Road/SR 174 intersection.

RDN also performed interviews with real estate professionals and a survey of licensed Realtors® to better understand potential impacts of the proposed project to property values. The survey results indicate that most respondents believe that the proposed project would have large and permanent negative impacts, though the level of impact varies by area. Overall, the median respondent believes that the proposed project would cause an average 40 percent reduction in home values for properties located within RGV’s mineral rights boundary. In contrast, the median respondent believes homes located farther away (1 to 5 miles) would see an average 15 percent reduction. In the case of the survey, almost all respondents who believe that the proposed project would have large negative impacts on property values also believe that the Draft EIR substantially understates the significance of its environmental impacts. Respondents were particularly concerned about permanent damage to local water resources. In contrast, the scope of this study is to evaluate the economic impacts of the proposed project assuming it operates as proposed by the applicant and documented in the project description in the Draft EIR. The Draft EIR indicates that most of the potentially significant environmental impacts would be mitigated such that the impact would be “Less than Significant,” including potential impacts to water resources.

Given the lack of existing studies on the property value impacts of sites that are comparable to the proposed project, and that survey data is largely influenced by perceptions of the proposed project impacts rather than those defined in the Draft EIR, RDN performed our own study of modern mines in the United States that are reasonably similar to the proposed project. We identified three mines as viable case study locations, then acquired and analyzed residential sales transactions for parcels near these locations over periods when the mines were both non-operational and operational. Overall, our analyses indicate that opening or recommissioning the selected mines did not have a statistically significant impact on nearby residential property values during the periods studied. Confidence intervals around the impact estimates, which are generally small, include both negative and positive values, and therefore contain the value of zero. A general interpretation of confidence intervals that contain zero is that, at the chosen confidence level, it is not possible to rule out the hypothesis that there is no effect (that the effect may in fact be zero).

As part of this analysis RDN planned to evaluate the total impact to property values and associated property taxes based on the anticipated average change in property values associated with the proposed project. Of the three types of research RDN performed for this analysis–the literature review, real estate industry survey, and case study analysis–the case study analysis strikes the balance of being the most robust and readily applicable for evaluating the proposed project. Therefore, RDN uses the results of the case study analysis to evaluate the proposed project. However, the results of the case study analysis are inconclusive regarding the magnitude, and even the direction, of any potential impacts. Because the results do not allow us to rule out the possibility that the operation of the mines in the case studies had no effect on surrounding property values, RDN is unable to rule out that this would also be the case for the proposed project. Accordingly, we do not estimate any anticipated average change in property values associated with the proposed project. This is not to say that we have certainty that the proposed project will not impact property values (positively or negatively), but rather that we do not have enough certainty to exclude the possibility of the project having no impact.

5. IMPACTS TO UTILITIES, PUBLIC SERVICES, AND THE GENERAL FUND

RDN conducted an analysis to estimate the impact of proposed project operations on utility providers, public services, and the County's General Fund. This analysis considers the ability of public providers to serve the proposed project's utility needs; potential increased costs to County departments that provide law enforcement, emergency, and administrative services; and potential impacts to public services provided by other jurisdictions and special districts. To understand the total fiscal impact of proposed project operations to the County's General Fund, this analysis evaluates anticipated costs to County departments and compares them to the estimated tax revenue associated with the proposed project.

5.1 Utility Providers

The proposed project would result in new demand for electricity, potable water, and waste disposal services to serve the project itself, new residents in the area, and households that switch from well water to municipal water supplied by the Nevada Irrigation District (NID). RDN conducted interviews with representatives at Pacific Gas and Electric (PG&E), NID, and Waste Management regarding the potential impacts to their services.

PG&E provides electrical service to almost the entire population of Nevada County and would serve the proposed project. Per the Draft EIR, operation of the proposed project would require an estimated total connected load of approximately 10 megawatts (MW), with a net load of approximately 6 MW. Although this would greatly increase electrical service demand in the area, PG&E would adjust their services to accommodate the change. PG&E operates a dynamic power grid that serves much of the State of California by transporting power from generation facilities to consumer. Through this system, PG&E would serve the increased demand for power from facilities throughout the state. Although the proposed project would require construction of onsite poles and a substation, it would not result in the need for substantial new infrastructure on public land that does not currently support PG&E infrastructure. Therefore, it likely would not change the amount of franchise taxes PG&E pays for the use of public land. Given PG&E is a private company with the capacity to serve the proposed project's electrical needs and that their franchise tax burden would not change, this activity would not financially affect the County.

NID is a multi-county water agency that provides water service to over 100,000 customers, including 700 in the Wolf Creek Area (i.e., the project area). According to the Draft EIR, the proposed project would increase water supplies by depositing an additional 1,000 acre feet of treated water into the Wolf Creek System, resulting in a net positive impact to water supply. Based on this finding and current supplies, NID has sufficient capacity to serve both the proposed project and an additional 30 residential properties along East Bennett Road that may transition from wells to their system. Although the Draft EIR finds the proposed project would not impact any additional wells, NID submitted comments on the Draft EIR suggesting that the County require RGV to supply a $14 million bond to ensure that costs for new pipelines and connection fees would be covered if the proposed project impacts any additional wells. Based on the findings of the Draft EIR and current conditions, NID has sufficient water supply to accommodate the proposed project and this activity would not financially affect the County.

Waste Management provides waste disposal services in the project area and would serve any new residents that move to the area. The proposed project would manage their own waste disposal and would not impact this service. Waste Management currently serves 44,000 residential properties in Nevada County, including 8,000 in the City of Grass Valley and 2,000 in Nevada City. Given the small projected increase in new households, Waste Management would be able to absorb the additional demand from new residents without a substantial change to their service. Waste Management is a private company and changes to their service would not affect County finances.

5.2 Public Services

Operation of the proposed project involves industrial activities, including increased truck traffic, that may result in the need for additional public services, including law enforcement and emergency services. The costs for some of these services would be covered by funding provided by RGV through mitigation, while the rest would be supported by public funds. The proposed project would also draw new residents to the area to work at the mine and in jobs supported indirectly by the proposed project's local expenditures on payroll, supplies, and services. This additional population may also increase the need for public services. This section provides a discussion of anticipated impacts to public services provided by the County and other jurisdictions and special districts. The discussion of impacts to County departments also includes estimated costs for maintaining the existing level of service.

RDN conducted interviews with representatives at law enforcement agencies, fire districts, and County and city departments in Nevada County to understand each organization's anticipated changes in costs and employment related to (1) operation of the proposed project and (2) the anticipated increase in population. For these interviews, RDN directed stakeholders to consider the proposed project and potential impacts as presented in the Draft EIR when evaluating ways in which these operations could directly impact their agency or department. For impacts related to anticipated population growth, RDN inquired about potential impacts to the agency or department and whether costs would likely increase proportionally with population growth.

This analysis assumes the local population would grow by 240 residents, as presented in the Draft EIR. The Draft EIR estimates 99 workers would move to the area to work in the mine, each representing a new household. Since the average household size in Nevada County is 2.4 people, these new workers would result in approximately 240 new residents when accounting for family members that would move with them. When interviewing County and city departments, law enforcement agencies, and emergency services, RDN directed them to consider a population increase of 240 residents distributed in the areas surrounding the project site. Table 5-1 summarizes the estimated increase in population that would result from the proposed project in each jurisdiction.

Table 5-1. Projected Population Increase

Jurisdiction	Population[1]	New Residents	Percent of New Residents
Unincorporated Western Nevada County	67,506	191	80%
City of Grass Valley	14,016	40	17%
Nevada City	3,152	9	4%
Other (unimpacted) regions	14,743	0	0%
Total Nevada County	**99,417**	**240**	**100%**

[1] *Population estimates from 2020 decennial census*

Law enforcement agencies and emergency service providers indicated that operation of the proposed project would likely increase the need for their services. The primary factor that would drive this need is the projected increase in truck traffic on local roadways that would likely result in more vehicle accidents and associated calls to service. The anticipated increase in population would also result in additional vehicles on the roadways, particularly during commute hours, which may also increase the need for law enforcement and emergency services. The costs for these agencies to maintain their existing levels of service while serving additional residents would likely increase proportionally to the increase in population in their service areas.

Most County and city departments expect little to no impact to their employment or annual operating expenses as a result of the proposed project. In most cases, they anticipate either (1) direct impacts from operation of the mine would be minimal and would not increase costs, or (2) the proposed project's mitigation measures would cover anticipated cost increases. In these cases, this analysis assumes there would be no impact to the County's General Fund. Some of these organizations cited potential increases in costs related to new residents moving to the area but generally concluded that 240 new residents would not substantially change their costs or employment. In these cases, RDN estimated the potential cost increase for County departments based on their current service population and budget.

County Departments

The County provides a variety of public services, many of which would be affected by the proposed project and associated increase in population. This section summarizes potential impacts during full operation of the proposed project to these services and estimates the resulting public costs to maintain these services at the existing level. Increased costs to these services that are not covered through mitigation measures or other fees would impact the County's General Fund.

The County Sheriff's Office provides law enforcement and coroner services, which include responding to calls for service in their service area and operating the coroner unit and County jail. This department anticipates the proposed project would result in additional calls for service due to increased traffic on local roads and associated vehicle accidents and deaths, as well other impacts related to new residents moving into the area. These additional service needs would increase the department's operational costs. The specific impact would be dependent on factors that are not entirely known, such as the character of new residents drawn to the area. The Sheriff's Office operates the County jail, which has high costs for each inmate (approximately $110,000 per year). To provide a general estimate of agency costs, this analysis assumes new residents drawn to the area by the proposed project have a similar incarceration rate to that of the existing County population. Given the anticipated need for increased services from the Sheriff's Office, this analysis assumes the department's operating costs would increase proportionally to the anticipated increase in population in unincorporated Western Nevada County.

The County provides disaster response services though their Office of Emergency Services (OES). In the case of large emergencies, OES manages the Emergency Operation Center, coordinates emergency response across agencies, and provides logistics and assistance to public agencies. OES expects the impact to their department to be minimal, assuming the mine complies with safety protocols and there are no unforeseen ancillary effects. The department would continue to provide services to the entire county, including new residents that move to the area as a result of the proposed project. Therefore, this analysis assumes the department's operating costs would increase proportionally to the anticipated increase in population in the county.

The primary County departments that would experience direct effects from the proposed project include Public Works, which is responsible for maintaining local roadways, and Planning, which is the primary department responsible for ensuring RGV complies with the conditions of project approval, including implementation of the mitigation measures from the EIR process. Representatives from these departments indicated that anticipated costs associated with operation of the mine are being taken into consideration during the project approval process and would be covered through the proposed project's conditions of approval. These conditions include initial one-time payments toward roadway improvements as well as ongoing tonnage fees to cover the cost of roadway maintenance associated with the proposed project's trucking activity. RGV would also be required to reimburse the County for staff hours dedicated to monitoring the project's compliance with building codes and mitigation measures. Therefore, RGV would cover all of the direct costs to the Public Works and Planning departments related to the proposed project. These funds would be deposited to and withdrawn from the County's General Fund, thereby increasing the annual budget by the same amount as the increased cost. Therefore, the total impact to the General Fund associated with these public services would be $0.

The Public Works and Planning departments anticipate that increased costs related to an increase in population would either be negligible or covered by impact fees. An increase of 240 residents in the County represents a 0.2 percent increase in the population, which would not substantially affect department services. Additionally, if any new homes were constructed to accommodate the increase in population, these projects would be required to pay impact and permitting fees, which help support these departments' activities. Therefore, the increased population would not affect these departments such that they impact the County's General Fund.

The County's Transit Division and Housing and Community Services Department expect little to no impact to their annual budget from the proposed project. The project site is not currently served by public transit, and therefore the Transit Division does not anticipate any change to its operating costs. The Housing and Community Services Department anticipates a minimal increase in costs attributed to new residents, however, the department receives a minority of its funding from General Funds, with the majority sourced from grants. Therefore, the associated impact to the General Fund would be minimal.

Table 5-2 summarizes the estimated public cost impacts to County agencies and departments (i.e., those supported by the County General Fund). Departments with no anticipated cost increase or with all anticipated costs covered by mitigation reflect a $0 impact. For each department that expects a cost increase due to new residents associated with the mine, RDN used their latest annual budget and the county's population to calculate the per person budget and then multiplied it by the total projected population increase in the county.

Table 5-2. Annual Costs to County General Fund (rounded to thousands)

Agency/Department	Estimated Public Cost[1]
Nevada County Sheriff's Office	$141,000
Nevada County Office of Emergency Services	$8,000
Public Works (includes Solid Waste)[2]	$0
Planning Department[2]	$0
Transit Division[3]	$0
Housing & Community Services (County Funds)[3]	$0
Total Annual Impact to County General Fund	**$150,000**

[1] Numbers in 2022 dollars; numbers may not sum due to rounding
[2] Anticipated costs are covered by project mitigation
[3] Anticipated costs are below $500 per year
Source: Stakeholder interviews and calculations by RDN

City Departments and Special Districts

RDN conducted interviews with representatives at additional public agencies and special districts to understand their anticipated impacts associated with the proposed project at full operation. This section provides a discussion summarizing these impacts. Increased costs to the following departments and organizations would not impact the County's General Fund.

The law enforcement agencies that provide services to the areas surrounding the project site expect that the anticipated increase in population associated with the proposed project would increase the need for traffic enforcement and response to calls for services, thereby increasing their operating costs. The daytime population in the City of Grass Valley exceeds the residential population because the city serves as an economic hub that supports workers that commute into the city from other areas. Although the proposed project would primarily result in the reverse effect since the project site is located outside the city, the Grass Valley Police Department would support new residents of the city, mine workers commuting through the city to access the project site, and commuters coming to the city for jobs supported indirectly by project operation. Nevada City is located farther from the project site, so the Nevada City Police Department would primarily service new residents that move to the city. The California Highway Patrol (CHP) Grass Valley Area also expects a slight increase in calls for service to serve new residents. For each of these departments, the total cost for providing service would likely increase proportionally to the increase in population in their service area.

The fire districts that provide services to areas surrounding the project site expect additional costs related to the anticipated increase in population associated with the proposed project. The Ophir Hill Fire Department is responsible for fire protection services to the project site and surrounding area, and therefore anticipates increased service costs and staffing needs associated with the proposed project and associated population increase. However, the project's mitigation would cover these increased costs by funding three full-time firefighters for the life of the project and the purchase of a new fire engine for the district. The Nevada County Consolidated Fire District anticipates the impact to their budget directly related to the proposed project would be minimal because the primarily impacted roadways are not in their jurisdiction. However, the district may receive additional calls for aid from neighboring districts as well as increased costs associated with new residents. The Grass Valley Fire District (GVFD) expects increased service needs related to increased truck traffic and related traffic incidents, which may also result in a need for additional staff. The Nevada City Fire District, which has a contract with GVFD for services, expects a similar impact. With the exception of Ophir Hill Fire Department, whose service cost increase would be covered by mitigation, service costs for local fire districts would likely increase proportionally to the increase in their service populations.

The City of Grass Valley expects the proposed project would not increase annual costs for their Community Development Department but would substantially impact their Public Works Department. Representatives at the City cited concerns about increased traffic congestion necessitating intersection and roadway improvements and heavy truck traffic heightening pavement maintenance needs. The City also anticipates the need for new residential development to support population growth. Although development fees typically cover a portion of development support, other costs such as unallocated staff time, associated support for necessary improvement projects, and ongoing service costs would require additional staff or consultants. The proposed project would pay development impact fees to the City to help cover costs associated with specific intersection and roadway improvements. However, these one-time fees do not account for costs associated with ongoing pavement maintenance. The City estimates ongoing annual costs to be $120,000 for a full-time engineer and $50,000 for a maintenance worker.

RDN made multiple attempts to contact the Grass Valley and Union Hill school districts but were unable to reach representatives who could answer questions about the potential fiscal impacts of the proposed project and associated population increase to their districts. According to the Draft EIR, schools in the project area have experienced declining enrollment and are projected to experience continued reductions. Based on 2019-2020 enrollment numbers, the primary and secondary school districts serving this portion of the County have capacity to accommodate the anticipated number of additional students. These districts would receive additional funding from the state based on these new students. The vast majority of funding for these districts is from the state, though approximately seven percent of their budget is locally funded through property taxes.

5.3 Tax Revenue

Tax revenue from property, sales, and other taxes paid by RGV and associated with the proposed project's local spending and related economic growth would benefit local jurisdictions and special districts in the county. This revenue includes property taxes on land, improvements, and mineral property paid directly by RGV; sales and other taxes paid by RGV; and property, sales, and other taxes paid by local businesses and residents supported by RGV's local expenditures.

RGV's mineral property tax would represent a large portion of anticipated tax revenue and depend on the value of the proposed project's mineral property, which is currently undetermined. Therefore, this analysis includes assumptions about the mine's anticipated production in order to provide a range of the potential impact of the proposed project on local tax revenue. The assumptions used to develop this estimate are described below.

This section presents estimates of the total tax revenue the proposed project would generate for local agencies, including the County and cities and special districts in the county. It also breaks out the portion of this revenue that would be allocated to the County in order to estimate the total impact of the proposed project to the County General Fund. The remaining tax revenue would be allocated to cities and special districts in the county.

Rise Grass Valley Property Taxes

RGV currently pays property tax on the two project sites and would pay additional taxes for any improvements (e.g., buildings) on these sites once they are completed. RGV would also pay property tax on their mineral reserves (i.e., property) at the time they begin extracting this material.

Land and Improvements

Property owners pay taxes based on the assessed value of a property, including the land and any improvements, such as utility services or buildings. The assessed values of the existing Brunswick and Centennial properties are based on the fair market values (sales price accepted) assigned to the parcels at the time of their acquisition in 2017 and 2018, respectively. Per California law, the assessed value has increased by either the CPI or two percent, whichever is lower, each year since. Based on a two percent increase from last year, the assessed values for 2022/2023 are $2.9 million for the Brunswick property and $1.3 million for the Centennial property.

RGV currently pays property taxes for the Brunswick and Centennial properties and would continue to pay them throughout their ownership of these properties. These taxes are based on the one percent tax levy authorized under Proposition 13 and any additional voter-approved debt or special taxes associated with the service areas in which each property lies. The County receives approximately 13.8 percent of all Proposition 13 taxes paid in the County, with the remaining portion going to other jurisdictions and special districts. Because voter-approved debt and special taxes do not affect the County General Fund, they are not included in this analysis.

Table 5-3 summarizes the assessed values for RGV properties, the associated Proposition 13 property taxes, and the portion of these taxes that would go to the County General Fund. The property tax for RGV's existing properties is $43,000, with $6,000 of this revenue going to the County.

Table 5-3. Property Tax from Existing Properties in 2022/2023 (rounded to thousands)[1,2]

Property	Assessed Value	Prop 13 Tax	County Tax Revenue
Brunswick Industrial Site	$2,936,000	$29,000	$4,000
Centennial Industrial Site	$1,326,000	$13,000	$2,000
Total	**$4,261,000**	**$43,000**	**$6,000**

[1] Numbers in 2022 dollars

[2] Numbers may not sum due to rounding

Upon completing construction of proposed improvements and facilities on the Brunswick Industrial Site, RGV would pay property tax on these improvements as well. According to the proposed schedule, this would occur 18 months after initiation of the proposed project. Because RGV was not able to provide anticipated construction costs, RDN estimated the value of these improvements based on the IMPLAN analysis output associated with 52 construction workers over the course of 18 months (refer to *Section 2.1: Project Location and Description*). The estimated value of site improvements, which represents the assessed value, is $12.5 million. The proposed improvements at the Brunswick site would thus result in additional estimated property tax of $125,000, with $17,000 of this revenue going to the County.

Mineral Properties

Upon commencing mineral extraction, RGV would also begin paying property taxes on the assessed value of their "proved reserves" of gold, which is the measured volume and weight of gold that is economically mineable. The process for assessing mineral property is detailed in the Assessors' Handbook Section 560 (California State Board of Equalization 1997). This process involves categorizing mines as investment properties that may be purchased and sold for the possibility of generating future income. Therefore, the County uses an income approach to assess mineral property values. This approach considers the aggregate present worth of the property's future net income when assessing the property's current value for tax purposes. This approach is complex and sensitive to the information included in the appraisal. RDN's analysis takes a simplified method to estimating the mine's expected cash flow. An in-depth assessment would require detailed financial information and current mineral exploration data beyond what is currently available.

In order to account for mining being a high-risk industry, mineral property in California is generally assessed using a high discount rate for estimating the current value of future cash flows. Per discussions with the Nevada County Assessor and her staff, in order to establish a specific discount rate and define other factors that would affect the mineral property assessment for the proposed project, they would work closely with the California State Board of Equalization. Based on discount rates used for other projects in the county and for high-risk projects in neighboring counties, they estimated they would apply a discount rate around 15 to 19 percent to assess RGV's mineral property since the proposed project would be a high-risk venture. They indicated the base year for mineral property assessments is generally the first year of full production since ramp-up costs often outweigh revenue during the ramp-up period. Based on this information, this study uses 17 percent as the discount rate and Year 4 of the proposed project (i.e., the first year of full production) as the base year to provide a general estimate of the anticipated mineral property value and associated taxes for the proposed project.

The assessed value of the proved reserves would be based on the price of gold, anticipated production schedule, and amount of proved reserves. This analysis uses the three-year rolling-average price of gold as of January 1, 2022, which is $1,659 per ounce. RGV provided production data for four comparable underground gold mining operations that have similar throughputs to the proposed project and similar reserve grades to historic production at the Idaho-Maryland Mine. These mines maintain approximately 5 to 11 years of reserves with an average of 8 years. Therefore, this analysis assumes the mine extracts proved reserves over eight years. RGV does not have any proved reserves because they are currently in the process of performing the exploration work to quantify these resources. Therefore, this analysis provides the potential tax impact for a range of proved reserves by providing a high-end and low-end estimate.

The high-end estimate uses projected annual production of 108,400 ounces of gold per year and assumes the mine continually maintains eight years of reserves. This projected annual production was obtained from the 2021 economic impact report commissioned by RGV (Applied Economics LLC 2021). Based on these assumptions, the initial proved reserves would be 876,200 ounces of gold. This scenario assumes additional proved reserves are discovered and assessed each year in the same amount as was extracted that year. In reality, mine production and discovery of proved reserves would not be this consistent. However, this approach helps estimate the average effects that would occur if RGV continually discovers new reserves, as they currently anticipate.

Table 5-4 shows the net present value calculation for the estimated mineral property value for the high-end scenario in the base year (i.e., first year of full production).

Table 5-4. Base Year Mineral Property Value Assessment – High-end Scenario (in millions of 2022 dollars)

Year[1]	Yearly Production	Revenue	Expenses[2]	Net Income	Present Value[3]
4	108,400	$179.8	$68.3	$111.5	$111.5
5	108,400	$179.8	$68.3	$111.5	$94.5
6	108,400	$179.8	$68.3	$111.5	$80.1
7	108,400	$179.8	$68.3	$111.5	$67.9
8	108,400	$179.8	$68.3	$111.5	$57.5
9	108,400	$179.8	$68.3	$111.5	$48.8
10	108,400	$179.8	$68.3	$111.5	$41.3
11	108,400	$179.8	$68.3	$111.5	$35.0
Total[4]	**867,200**	**$1,438.4**	**$546.1**	**$892.3**	**$536.7**

[1] Analysis uses Year 4 of the proposed project (i.e., first year of full production) as the base year
[2] Annual expenses during full operation were provided by RGV
[3] Applies a discount rate of 17% to account for the high risk associated with the mining industry
[4] Numbers may not sum due to rounding

Under this scenario, the estimated assessed value would be approximately $536.7 million, resulting in $5.4 million in Proposition 13 property taxes, with $0.7 million going to the County General Fund in the first year of full operation. Although the mineral reserves would be depleted each year, this scenario assumes RGV continually discovers and establishes additional proved reserves, which would be assessed and taxed by the County. This new mineral property would be assessed according to the California State Board of Equalization terms for “new construction,” which includes any addition to land or improvements. Generally speaking, as reserves decline, property taxes decline, and as more proved reserves are established, property taxes increase. Because this scenario assumes the mine establishes proved reserves in the same amount as the material they mine each year, keeping the price of gold constant, the assessed value and resulting taxes would remain the same as well. This effect is reflected in the yearly high-end mineral property tax estimates provided in *Section 5.4: Nevada County General Fund*.

This analysis establishes a low-end estimate based on historic proved reserves and the assumption that the mine would not discover any additional reserves. The Emgold Mining Corporation produced the last reported measured reserves for the Idaho-Maryland Mine in November 2002, which they estimated as 212,000 ounces of gold. Therefore, the low-end estimate assumes the mine produces 26,500 ounces of gold per year over approximately eight years. Under this scenario, the proved reserves would be depleted by 26,500 ounces per year until none are remaining.

Table 5-5 shows the net present value calculation for the estimated mineral property value for the low-end scenario in the base year (i.e., first year of full production) .

Table 5-5. Base Year Mineral Property Value Assessment – Low-end Scenario (in millions of 2022 dollars)

Year[1]	Yearly Production	Revenue	Expenses[2]	Net Income	Present Value[3]
4	26,500	$44.0	$16.7	$27.3	$27.3
5	26,500	$44.0	$16.7	$27.3	$20.8
6	26,500	$44.0	$16.7	$27.3	$15.9
7	26,500	$44.0	$16.7	$27.3	$12.1
8	26,500	$44.0	$16.7	$27.3	$9.3
9	26,500	$44.0	$16.7	$27.3	$7.1
10	26,500	$44.0	$16.7	$27.3	$5.4
11	26,500	$44.0	$16.7	$27.3	$4.1
Total[4]	**212,000**	**$351.6**	**$133.5**	**$218.1**	**$101.9**

[1] Analysis uses Year 4 of the proposed project (i.e., first year of full production) as the base year
[2] Annual expenses provided by RGV scaled by yearly production for this estimate relative to that for the high-end estimate
[3] Applies a discount rate of 17% to account for the high risk associated with the mining industry
[4] Numbers may not sum due to rounding

The estimated assessed value in the base year would be approximately $101.9 million under the low-end scenario. Based on this valuation, the associated Proposition 13 property tax would be $1.0 million, with $0.1 million going to the County General Fund in the first year of full operation. Because this scenario assumes the mine does not discover any additional reserves, the remaining mineral property is reduced after each year of operation. Therefore, the assessed value and associated property taxes would decline each year. These declines are reflected in the yearly low-end mineral property tax estimates provided in *Section 5.4: Nevada County General Fund*.

Tax Revenue from Increased Economic Activity

RGV's local spending on payroll and purchases of goods and services would generate increased economic activity, which would increase local tax revenue. RGV's payroll and local operational spending would support direct and indirect jobs in the area. The employees that fill these jobs would spend a portion of their income on property, sales, and other taxes, some of which would be allocated to the County's General Fund. Additionally, RGV's local spending would generate sales tax revenue. This study used the IMPLAN model to estimate the total property, sales, and other tax revenue associated with the indirect and induced impacts generated by the proposed project's local spending. Refer to *Section 3.1: Project Payroll and Expenditures* for a description of the methodology used for this analysis.

Table 5-6 shows the estimated property, sales, and other tax revenue that would be generated in the county and the portion that would be allocated to the County's General Fund due to indirect and induced impacts of the proposed project.

Table 5-6. Property, Sales, and Other Taxes Generated by Local Spending (rounded to thousands)[1]

Type of Tax	Year 1	Year 2	Year 3	Year 4+
All Agencies and Districts in Nevada County				
Property Tax	$20,000	$105,000	$187,000	$483,000
Sales Tax	$13,000	$69,000	$123,000	$318,000
Other Tax	$3,000	$17,000	$31,000	$80,000
Total Tax Revenue[2]	**$37,000**	**$191,000**	**$342,000**	**$881,000**
Nevada County General Fund				
Property Tax	$3,000	$14,000	$24,000	$63,000
Sales Tax	$3,000	$13,000	$23,000	$60,000
Other Tax	$1,000	$5,000	$9,000	$24,000
Total Tax Revenue[2]	**$6,000**	**$32,000**	**$57,000**	**$147,000**

[1] Numbers in 2022 dollars
[2] Totals may not sum due to rounding
Source: IMPLAN Analysis by RDN

The proposed project's spending on payroll and operational expenses during full operation would generate an estimated $881,000 per year in tax revenue to local agencies and districts, including local governments and fire protection, school, and other special districts. The portion of these funds that would be allocated to the County's General Fund is approximately $147,000 per year.

Summary of Tax Revenue

Table 5-7 presents the total estimated tax effect of the proposed project in Year 4, which is the first year it would be fully operational. These estimates account for the high-end and low-end scenarios, with the low-end estimates assuming the proposed project would operate at a reduced capacity. This summary scales down tax revenue resulting from increased economic activity under the low-end scenario to account for fewer people moving to the area and lower employment and operational spending by RGV.

Table 5-7. Estimated Tax Revenue in the First Year of Full Operation (rounded to thousands)[1]

	Total Tax Revenue		County Tax Revenue	
	Low	High	Low	High
Property Taxes Paid by RGV				
Assessed Property	$46,000	$46,000	$6,000	$6,000
Improvements (new facilities)	$125,000	$125,000	$17,000	$17,000
Mineral Property	$1,019,000	$5,367,000	$141,000	$742,000
Taxes from Increased Economic Activity				
Property Tax	$118,000	$483,000	$15,000	$63,000
Sales Tax	$78,000	$318,000	$15,000	$60,000
Other Taxes	$19,000	$80,000	$6,000	$24,000
Total[2]	**$1,405,000**	**$6,418,000**	**$200,000**	**$912,000**

[1] Numbers in 2022 dollars
[2] Totals may not sum due to rounding

The total estimated tax effect in the first year of full operation is $1.4 to $6.4 million to local agencies and districts, including local governments and fire protection, schools, and other special districts. The County General Fund would receive a portion of these tax receipts, amounting to $200,000 to $912,000.

5.4 Nevada County General Fund

Operation of the proposed project would impact the Nevada County General Fund by increasing costs to some county services while also increasing the County's tax revenue. RGV's mineral property tax represents a sizable portion of the potential General Fund revenue. However, this analysis cannot provide a specific estimate for this revenue because the amount of gold reserves that are available and economically viable is unknown. This analysis, therefore, considers a range of potential impacts by evaluating the high-end and low-end scenarios outlined in *Section 5.3:Tax Revenue*.

Based on the estimated public costs and tax revenues, the anticipated net fiscal impact to the Nevada County General Fund of either the high-end or low-end scenario would be negative in Years 1 and 2 and positive from Year 3 onward through the productive life of the mine. Under the high-end scenario, the estimated net fiscal impact would be $763,000 in Year 4, which would be the first year of full operations, and decline to somewhere between $760,000 and $741,000 per year for as long as the mine continues to discover and produce approximately 108,400 ounces of gold per year, up to the 80-year permit period. At the time when the mine's reserves and productivity start to decline, the associated costs and revenues to the County General Fund would also decline.

Under the low-end scenario, the net fiscal impact would be approximately $163,000 in Year 4, and then decline through the eight-year productive life of the mine. Because all reserves would be exhausted by the end of Year 11, this analysis assumes the mine would suspend operations in Year 12 and public costs and benefits would no longer accrue, with the exception of tax revenue associated with the property and improvements. Although the property would likely change ownership sometime after the mine's closure, the new assessment value and resulting tax revenue accruing to the County General Fund would reflect the value of any improvements that remain on the property (e.g., industrial buildings, roadways, etc.).

Table 5-8 and Table 5-9 present the estimated costs and revenues to the County General Fund that would result from the proposed project under the high-end and low-end scenarios, respectively. All values are adjusted to reflect current (2022) dollar values using historic and projected Consumer Price Index for all Urban Consumers (CPI-U) data from the Congressional Budget Office. These tables follow the anticipated project schedule, with construction and initial ramp-up occurring in Years 1-3 and full operation commencing in Year 4. Many of the costs and tax revenues in the table remain the same each year because they are reported in constant 2022 dollars. For the low-end scenario, this analysis scales down public costs and tax revenue resulting from increased economic activity to account for fewer people moving to the area and lower employment and operational spending by RGV. In both scenarios, construction workers were treated as new temporary residents who would increase public costs during the construction period since it is currently unknown if they would be hired locally or from outside the county.

Table 5-8. High-End Estimate of Fiscal Impacts from Proposed Project Operation on the County General Fund[1]

Year[2]	1	2	3	4	5	6	7	8	9	10	11	12+[6]
Annual Public Costs[3]												
Sheriff's Office	$37,000	$47,000	$55,000	$141,000	$141,000	$141,000	$141,000	$141,000	$141,000	$141,000	$141,000	$141,000
Office of Emergency Services	$2,000	$3,000	$3,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
Total Cost	**$39,000**	**$49,000**	**$58,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$150,000**
Annual Tax Revenue												
Property Taxes Paid by RGV												
Assessed Property[4]	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000 to $4,000
Improvements[4]	-	$9,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000 to $13,000
Mineral Property[5]	-	-	-	$742,000	$742,000	$742,000	$742,000	$742,000	$742,000	$742,000	$742,000	$742,000
Taxes from Increased Economic Activity												
Property Tax[4]	$3,000	$14,000	$24,000	$63,000	$62,000	$62,000	$62,000	$62,000	$61,000	$61,000	$61,000	$61,000 to $46,000
Sales Tax	$3,000	$13,000	$23,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Other Taxes	$1,000	$5,000	$9,000	$24,000	$24,000	$24,000	$24,000	$24,000	$24,000	$24,000	$24,000	$24,000
Total Revenue	**$12,000**	**$46,000**	**$80,000**	**$912,000**	**$912,000**	**$912,000**	**$911,000**	**$911,000**	**$911,000**	**$910,000**	**$910,000**	**$910,000 to $890,000**
Net Revenue or Cost												
High-End Estimate	**($27,000)**	**($3,000)**	**$22,000**	**$763,000**	**$762,000**	**$762,000**	**$762,000**	**$761,000**	**$761,000**	**$761,000**	**$760,000**	**$760,000 to $741,000**

[1] Numbers presented in 2022 dollars rounded to thousands; totals may not sum due to rounding
[2] Based on the anticipated project schedule, construction and initial ramp-up would occur in Years 1-3 and full operation would start in Year 4; Year 1 = FY 2023/2024
[3] The Public Works, Planning, and Housing and Community Services departments do not anticipate substantial costs that would impact the General Fund
[4] Property assessments are capped at a 2.0% increase each year, so tax revenue may not increase proportionally to inflation; therefore, this analysis shows a gradual decline over time
[5] The high-end mineral property value is based on extraction of 108,400 ounces of gold per year, continual discovery of new reserves (maintaining 8 years), and an average price of $1,659
[6] The 12+ column presents costs and revenues for as long as the mine continues to discover and produce approximately 108,400 ounces of gold per year, up to the 80-year permit period

Table 5-9. Low-End Estimate of Fiscal Impacts from Proposed Project Operation on the County General Fund[1]

Year[2]	1	2	3	4	5	6	7	8	9	10	11	12+[7]
Annual Public Costs[3,4]												
Sheriff's Office	$37,000	$26,000	$13,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	-
Office of Emergency Services	$2,000	$1,000	$1,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	-
Total Cost	**$39,000**	**$27,000**	**$14,000**	**$37,000**	**$37,000**	**$37,000**	**$37,000**	**$37,000**	**$37,000**	**$37,000**	**$37,000**	**-**
Annual Tax Revenue												
Property Taxes Paid by RGV												
Assessed Property[5]	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000 to $4,000
Improvements[5]	-	$9,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000 to $13,000
Mineral Property[6]	-	-	-	$141,000	$123,000	$105,000	$87,000	$69,000	$52,000	$34,000	$17,000	-
Taxes from Increased Economic Activity												
Property Tax[5]	$3,000	$3,320	$5,937	$15,306	$15,246	$15,186	$15,126	$15,067	$15,007	$14,948	$14,890	-
Sales Tax	$3,000	$3,204	$5,729	$14,771	$14,771	$14,771	$14,771	$14,771	$14,771	$14,771	$14,771	-
Other Taxes	$1,000	$1,284	$2,297	$5,921	$5,921	$5,921	$5,921	$5,921	$5,921	$5,921	$5,921	-
Total Revenue	**$12,000**	**$22,000**	**$37,000**	**$200,000**	**$182,000**	**$164,000**	**$146,000**	**$128,000**	**$110,000**	**$93,000**	**$75,000**	**$22,000 to $17,000**
Net Revenue or Cost												
Low-End Estimate	**($27,000)**	**($5,000)**	**$23,000**	**$163,000**	**$145,000**	**$127,000**	**$109,000**	**$91,000**	**$74,000**	**$56,000**	**$39,000**	**$22,000 to $17,000**

[1] Numbers presented in 2022 dollars rounded to thousands; totals may not sum due to rounding
[2] Based on the anticipated project schedule, construction and initial ramp-up would occur in Years 1-3 and full operation would start in Year 4; Year 1 = FY 2023/2024
[3] The Public Works, Planning, and Housing and Community Services departments do not anticipate substantial costs that would impact the General Fund
[4] Anticipated costs for 240 new residents were scaled down by production under the low-end relative to the high-end estimate to account for the commensurate reduction in jobs
[5] Property assessments are capped at a 2.0% increase each year, so tax revenue may not increase proportionally to inflation; therefore, this analysis shows a gradual decline over time
[6] The low-end mineral property value is based on proved reserves of 212,000 ounces of gold, an extraction period of 8 years, average gold price of $1659, and no additional reserves
[7] The 12+ column presents costs and revenues following the 8-year productive life of the mine, which amounts to the tax revenue associated with the property and improvements

6. SUMMARY OF IMPACTS

This study evaluates the total economic impact of the proposed project and its anticipated impact to industries, residential property values, utility providers, public services, tax revenues, and the County General Fund. Given the uncertainty regarding the mine's production and resulting economic impact, these results require careful interpretation.

Although this study includes information about the economic impacts of the proposed project during multiple phases—construction, ramp up, and ongoing operation—the most critical impacts are those related to ongoing operation. These impacts are critical because they would be long term, lasting for the operational period of the proposed mining operations, up to the 80-year permit period. Therefore, this summary focuses on ongoing project operation.

Based on the assumption that the proposed project would operate as proposed by the applicant and documented in the project description in the Draft EIR, and that the projections for employment, payroll, and operational expenditures on goods and services that are presented in this study are accurate, the proposed project's anticipated long-term annual effects include the following:

- **Output**: The proposed project would generate total annual output of $202.8 million in Nevada County. This includes the direct impact of an estimated $179.8 million in revenue by RGV and $23.0 million in increased economic activity at local businesses (i.e., indirect and induced impacts) due to the multiplier effect. The portion of this impact that would affect the local community are the indirect and induced impacts and RGV's payroll spending, which combined total $61.1 million.

- **Employment and Labor Income**: The proposed project would directly employ an estimated 312 workers and generate an additional 163 indirect and induced jobs at local businesses, thereby supporting 475 local jobs. Total anticipated labor income includes RGV's anticipated payroll of $38.1 million and $7.3 million in indirect and induced labor income, for a total of $45.4 million. All employment and labor income would be local effects.

- **Commercial Businesses**: RGV expenditures on payroll and procurement of goods and services would increase economic activity at local businesses, with the largest impacts in terms of output occurring in the Retail Sales, Wholesale Suppliers, and Healthcare Services sectors. In terms of employment and labor income, the largest impacts would occur in the Retail Sales, Restaurants and Drinking Places, and Healthcare Services sectors.

- **Property Values:** RDN performed an extensive case study analysis of mining operations similar to the proposed project. The results of this analysis are inconclusive regarding the magnitude and direction of impacts to nearby property values. Thus, RDN is unable to rule out the possibility that the proposed project would have no effect on property values in Nevada County. Accordingly, we do not estimate any anticipated aggregate impact to property values associated with the proposed project.

- **Utility Providers**: The proposed project would result in new demand for electricity from PG&E, potable water from NID, and waste disposal services from Waste Management to serve the project itself, new residents in the area, and households that switch from well water to municipal water. These utility providers confirmed that they would be able to accommodate these changes in demand and this activity would not financially impact the County.

- **Public Services and Costs**: The proposed project and associated increase in local population would increase demand and associated costs for public services, particularly law enforcement and emergency services due to the likely increase in vehicle accidents resulting from increased traffic. The estimated cost increase for County departments is $150,000 per year.

- **Tax Revenue**: The proposed project would result in tax revenue from property, sales, and other taxes paid by RGV and associated with the project's local spending and related economic growth. RGV's mineral property tax represents a sizable portion of potential tax revenue generated by the proposed project but cannot be precisely estimated because the amount of economically viable gold reserves is unknown. Using a range based on a low-end and high-end scenario, the anticipated tax effects in the first year of full operation would be $1.4 to $6.4 million to local agencies and districts, including local governments and fire protection, school, and other special districts, with $200,000 to $912,000 of these tax receipts going to the County General Fund.

- **County General Fund**: Based on the estimated public costs and tax revenues, the estimated net fiscal impact to the Nevada County General Fund of the high-end scenario, which assumes ongoing discovery of new gold reserves, is $763,000 per year in the first year of full operation, declining gradually to somewhere between $760,000 and $741,000 per year for as long as the mine is fully operational and continues discovering new reserves at the same rate. Under the low-end scenario, the net fiscal impact would be $163,000 in the first year of full operation, and then gradually decline over an eight-year productive life of the mine to somewhere between $22,000 and $17,000 per year after exhausting mineral reserves.

7. REFERENCES

Affuso, Ermanno, Caudill, S. B., Mixon, F. G., & Starnes, K. W. (2019). Is Airport Proximity an Amenity or Disamenity? An Empirical Investigation Based on House Prices. *Land Economics*, 391-408.

Anstine, J. (2003). Property Values in a Low Populated Area when Dual Noxious Facilities are Present. *Growth and Change*, 345-358.

Applied Economics LLC. (2021). *Economic Impacts of the Idaho-Maryland Mine on Nevada County.* Phoenix.

Backhouse, T. (2018, August 6th). *Features.* Retrieved from Mortgage Finance Gazette: https://www.mortgagefinancegazette.com/features/beware-dangers-past-mining-activity-06-08-2018/

Bakker, R. (2021). Does the development of industrial sites influence the price of residential properties? *Masters Thesis*. Groningen, Netherlands: Rijksuniversiteit Groningen.

Barkey, P. M., & Polzin, P. E. (2012). *The Impact of Otter Creek Coal Development on the Montana Economy.* Missoula: Bureau of Business and Economic Research.

Bell, R. (1998). The Impact of Detrimental Conditions on Property Values. *The Appraisal Journal*, 380-391.

Boxall, P. C., Chan, W. H., & McMillan, M. L. (2005). The Impact of Oil and Natural Gas Facilities on Rural Residential Property Values: A Spatial Hedonic Anlysis. *Resource and Energy Economics*, 248-269.

Braden, J. B., Feng, X., & Won, D. (2011). Waste Sites and Property Values: A Meta-Analysis. *Environmental Resource Economics*, 175-201.

Brasington, D. M., & Hite, D. (2005). Demand of Environmental Quality: A Spacial Hedonic Analysis. *Regional Science and Urban Economics*, 57-82.

Bratcher, C. (2022, May 11). Sergeant, California Highway Patrol. (B. Bradbury, Interviewer)

Bureau of Labor Statistics. (2022, July 31). Retrieved from Current Employment Statistics, Earnings and Hours of Production and Nonsupervisory Employees: https://www.bls.gov/iag/tgs/iag65.htm

Buttron, M. (2022, May 26). Fire Chief, Grass Valley Fire District. (B. Bradbury, Interviewer)

California State Board of Equalization. (2015). *Assessors' Handbook Section 560, Assessment of Mining Properties.* Sacramento.

California State Board of Equalization. (2022). *Property Tax Rules, Division 1, Chapter 4, Article 4, Rule 469. Mining Properties.*

Carruthers, J. I., & Clark, D. E. (2010). Valuing Environmental Quality: A Space-based Strategy. *Journal of Regional Science*, 801-832.

Carvalho, F. P. (2017). Mining Industry and Sustainable Development: Time for a Change. *Food And Energy Security*, 61-77.

Case, K. E., & Shiller, R. J. (1987). Prices of Single Family Homes Since 1970: New Indexes for Four Cities. *New England Economic Review*, 45-56.

Choate, R. (2022, June 22). Nevada County Housing and Community Services. (B. Bradbury, Interviewer)

Chuhan-Pole, P., Dabalen, A., Kotsadam, A., Sanoh, A., & Tolonen, A. (2015). *The Local Socioeconomic Effects of Gold Mining: Evidence from Ghana.* Washington, DC: World Bank Group.

Clay, K., Lewis, J., & Severnini, E. (2016). *Canary in a Coal Mine: Infant Mortality, Property Values, and Tradeoffs Associated with Mid-20th Century Air Pollution.* Cambridge: National Bureau of Economic Research.

CoreLogic. (2022, April). Property characteristics and sales prices histories for residential parcels in ZIP codes within 5 miles of the Haile Gold Mine (2010-2020), Coy Mine (2004-2014), and Lincoln Mine (2009-2019). Irvine, CA.

County of Nevada. (2021). *2021-22 Ad Valorem Distribution.* Retrieved from https://www.nevadacountyca.gov/ArchiveCenter/ViewFile/Item/1314

County of Nevada. (2022). *Adopted Budget, FY 2022-2023.*

County of Nevada. (2022). *Direct Charge Code Summary.*

County of Santa Clara. (2006). *Demistifying the California Property Tax Apportionment System, A Step-by-Step Guide through the AB 8 Process.*

CRIRSCO. (2012, October). *Committee for Mineral Reserves International Reporting Standards, Standard Definitions.* Retrieved from https://www.crirsco.com/docs/CRIRSCO_standard_definitions_oct2012.pdf

Currie, J., Davis, L., Greenstone, M., & Walker, R. (2015). Environmental Health Risks and Housing Values: Evidence from 1,600 Toxic Plant Openings and Closings. *American Econonomics Review*, 678-709.

Davis, L. W. (2011). The effect of power plants on local housing values and rents. *Review of Economics and Statistics 93 (4)*, 1391-1402.

Deaton, B. J., & Hoehn, J. P. (2002). *The Effect of Hazardous Waste Sites on Property Values in Zones of High Industrial Activity; A Hedonic Approach.* Long Beach: Agricultural and Applied Economics Association.

EPA, U. (2009). *Challenges in Applying Property Value Studies to Assess the Benefits of the Superfund Program.* Washington, DC: Office of Superfund Remediation and Technology Innovation.

Fitzpatrick, L. G., & Parmeter, C. F. (2021). Data-Driven Estimation of Treatment Buffers in Hedonic Analysis: An Examination of Surface Coal Mines. *Land Economics*, 528-547.

Fitzpatrick, L., & Parmeter, C. (2016, August 9). Coal Mines and Property Values. *Presentation*. United States.

Ford, G. S., & Alan, S. R. (2018). *Quarry Operations and Property Values: Revisiting Old and Investigating New Empirical Evidence.* Washington, DC: Phoenix Center for Advance Legal adn Economic Public Policy Studies.

Foss, B. (2022, June 2). Planning Director, County of Nevada. (B. Bradbury, Interviewer)

Friedt, F. L., & Cohen, J. P. (2021). Perception vs. reality: The aviation noise complaint effect on home prices. *Transportation Research Part D: Transport and Environment 100: 103011*.

Frisman, P. (2006). *Impact of Open Space on Property Values.* Hartford: Conneticut Office of Legislative Research.

Gamper-Rabindran, S., Mastromonaco, R., & Timmins, C. (2011). *Valuing the Benefits of Superfund Site Remediation: Three Approaches to Measuring Localized Exernalities.* Cambridge: National Bureau of Economic Research.

Gopalakrishnan, S., & Klaiber, H. A. (2013). Is the Shale Energy Boom a Bust for Nearby Residents? Evidence from Housing Values in Pennsylvania. *American Journal of Agricultural Economics 96 (1)*, 43-66.

Grayson, S. (2022, May 19). City Manager, Nevada City. (B. Bradbury, Interviewer)

Greenstone, M., & Gallagher, J. (2008). Does Hazardous Waste Matter? Evidence for the Housing Market and the Superfund Program. *The Quarterly Journal of Economics*, 951-1003.

Guignet, D., Heberling, M., Papenfus, M., Griot, O., & Holland, B. (2019). *Property Values and Water Quality: A Nationwide Meta-analysis adn the Implications for Benefit Transfer.* Washington, DC: National Center for Environmental Economics, EPA.

Henry, C. (2016). *Transit Oriented Development Study for the Detroit People Mover.* Detroit: Detroit Transporation Corporation.

Herath, S., & Maier, G. (2010). The Hedonic Price Method in Real Estate and Housing Market Research: A Review of the Literature. *WU Vienna University of Economics and Business*.

Horne, S. (2022, March 18). Nevada County Assessor. (B. Bradbury, Interviewer)

Johnson, S. (2022, April 27). Deputy Chief, City of Grass Valley Police Department. (B. Bradbury, Interviewer)

Jones, B. (2022, May 31). Engineer, City of Grass Valley. (B. Bradbury, Interviewer)

Kiel, K. A., & McClain, K. T. (1995). House Prices during Siting Decision Stages: The Case of an Incinerator from Rumor through Operation. *Journal of Environmental Economics and Management*.

Kiel, K. A., & Williams, M. (2007). The Impact of Superfund Sites on Local Property Values: Are all Sites the Same? *Journal of Urban Economics*, 170-192.

Kleinhans, R. (2022, May 2). Chief Financial Officer, Nevada County Sheriff's Office. (B. Bradbury, Interviewer)

Lancaster, K. J. (1966). A New Approach to Consumer Theory. *Journal of Political Economy 74*, 132-157.

Last, T. (2022, June 8). Community Development Director, City of Grass Valley. (B. Bradbury, Interviewer)

Linden, L., & Rockoff, J. E. (2008). Estimates of the Impact of Crime Risk on Property Values from Megan's Laws. *American Economic Review 98 (3)*, 1103-1127.

Malikov, A., Sun, Y., & Hite, D. (2017, November 6). *The Value-Undermining Effects of Rock Mining on Nearby Residential Property: A Semiparametric Spatial Quantile Autoregression.* Retrieved from SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3064867

Malpezzi, S. (2003). Hedonic Pricing Models: A Selective and Applied Review. *Housing economics and public policy*, 67-89.

Maxwell Stamp. (2015). *The Social and Economic Impacts of Gold Mining.* London: World Gold Council.

McMahan, T. (2022, May 4). Fire Marshal, Nevada County Consolidated Fire District. (B. Bradbury, Interviewer)

Mettler, E. (2022, June 28). Nevada County Housing and Community Services. (B. Bradbury, Interviewer)

Mine Safety and Health Administration. (2022). *Mine Data Retrieval System*. Retrieved from https://www.msha.gov/mine-data-retrieval-system

Mittal, A. K. (2011, July 14). Abandoned Mines: Information on the Number of Hardrock Mines, Cost of Cleanup, and Value of Financial Assurances. *Government Accoutability Office*. Washington, DC: GAO.

Monson, M. (2009). Valuation Using Hedonic Pricing Models. *Cornell Real Estate Review 7*, 62-73.

Muehlenbachs, L., Spiller, E., & Timmins, C. (2015). The Housing Market Impacts of Shale Gas Development. *American Economic Review 105 (12)*, 3633-3659.

Neelawala, P., Wilson, C., & Athukorala, W. (2012). The Impact of Mining and Smelting Activities on Property Values: A Study of Mount Isa City, Queensland, Australia. *Agricultural and Resource Economics*, 60-78.

Nguyen, N., Boruff, B., & Tonts, M. (2018). Fool's Gold: Understanding Social, Economic and Environmental Impacts from Gold Mining in Quang Nam Province, Vietnam. *Sustainability*, 1-22.

Osborn, S. (2015). *Directory of Active Metal and Industrial Mineral Underground Mines in the United States in 2015.* Reston: United States Geological Survey.

Ozdenerol, E., Huang, Y., Javadnejad, F., & Antipova, A. (2015). The Impact of Traffic Noise on Housing Values. *Journal of Real Estate Practice and Education*, 35-53.

Raney Planning & Management, Inc. (2021). *Idaho-Maryland Mine Project, Draft Environmental Impact Report.* Sacramento.

Reichert, A. K. (1997). Impact of a Toxic Waste Superfund Site on Property Values. *The Appraisal Journal*, 381-392.

Rise Grass Valley, Inc. (2021). *Idano-Maryland Mine Project, Employment Details.*

Rivera, N. M. (2020). Is Mining an Environmental Disamenity? Evidence from Resource Extraction Site Openings. *Environmental and Resource Economics 75 (3)*, 485-528.

Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy (University of Chicago Press) 82 (1)*, 34-55.

Rothenberger, R. (2022, May 11). Fire Chiet, Ophir Hill Fire Protection District. (B. Bradbury, Interviewer)

Salter, M. (2022, March 18). Nevada County Auditor-Controller. (B. Bradbury, Interviewer)

San Juan Ridge Taxpayers Assocation. (2022, July). *A Brief History of the San Juan Ridge Mine*. Retrieved from San Juan Ridge Taxpayers Assocation Website: https://www.sjrtaxpayers.org/history/

Scales, S. (2022, May 11). Program Manager, Nevada County Office of Emergency Services. (B. Bradbury, Interviewer)

Singh, M. M. (2009). *Study of Mineral Production with Reference to the Rosemont Copper Project.* Phoenix: Arizona Department of Mines & Mineral Resources.

Stock, J. H. (2018, August 6). U.S. Forest Service (USFS) Environmental Assessment (EA) on Proposed 20-year Mineral Leasing Withdrawal in Superior National Forest. *Letter*. Cambridge, MA, United States: Harvard University, Department of Economics.

Sun, Bixuan. (2013, April 12). An Econometric Analysis of the Effect of Mining on Local Real Estate Values. *Presentation*. LSa Crosse, Wisconsin, United States: National Conference on Undergraduate Research.

Taylor, L., Phaneuf, D., & Xiangping, L. (2016). Disentangling property value impacts of environmental contamination from locally undesirable land uses: Implications for measuring post-cleanup stigma. *Journal of Urban Economics*, 85-98.

Tillotson, T. (2022, May 31). Community Development Agency Director, County of Nevada. (B. Bradbury, Interviewer)

United States Environmental Protection Agency. (2000, September). How Can a Superfund Site Affect My Property? Answers to Frequently Asked Questions. *Superfund Today*. Washington, DC: US EPA.

United States Geological Survey. (2011). *Mineral Resources Data System*. Retrieved from https://mrdata.usgs.gov/mrds/

Williams, A. M. (2011). *The Impact of Surface Coal Mining on Residential Property Values: A Hedonic Price Analysis.* Knoxville: University of Tennessee, Chancellor's Honors Program Projects.

Williams, G. (2017). Comparison of Social Costs of Underground and Open-Cast Coal Mining. *IAIA17 Conference Proceedings* (p. 7). Montreal: International Association for Impact Assessment.

Williamson, J. M., Thurston, H. W., & Heberling, M. T. (2008). Valuing Acid Mine Drainage Remediation in West Virginia: A Hedonic Modeling Approact. *The Annal of Regional Science*, 987-999.

Zillow. (2022, June). *Sales price histories for addresses of select parcels in ZIP codes within 5 miles of the Haile Gold Mine, Coy Mine, and Lincoln Mine*. Retrieved from https://www.zillow.com

APPENDIX A—LITERATURE REVIEW: IMPACTS OF MINING AND INDUSTRIAL ACTIVITIES ON HOME VALUES

There is an extensive body of literature about the potential spillover effects of adverse environmental impacts on home prices. As an example, a 2011 meta-analysis focusing on the effect of waste sites on nearby home prices found 70 articles (Braden, Feng and Won 2011). Studies have also evaluated a wide range of other types of sites broadly considered to have a negative impact on home prices, including airports (Affuso, et al. 2019; Friedt and Cohen 2021), shale energy extraction operations (Gopalakrishnan and Klaiber 2013; Muehlenbachs, Spiller and Timmins 2015), power plants (Davis 2011), and crime hotspots (Linden and Rockoff 2008).

Focusing specifically on mining and its impact on home prices, there are relatively few rigorous, well-executed studies, and these studies cover a range of mining operations and locations. Williams (2011) and Fitzpatrick and Parmeter (2021) study the impacts of surface coal mines; Neelawala, Wilson, and Athukorala (2012) study the impact of mining and smelting on home prices in Queensland, Australia, where the production consists of lead, copper, silver, and zinc; Malikov, Sun, and Hite (2017) study the impacts of rock mining; while Ford and Seals (2018) focus on the operation of quarries. A 2020 article by Rivera explores the impact of mineral mining on rental prices in Chile.

However, our review of the academic literature did not yield any significant research on the impact to home values of mines that closely resemble the proposed project. Most studies focus on more visibly impactful activities, such as open pit mining or other major industrial activities, rather than underground mineral mining. The following discussion summarizes the results of those studies that RDN found most relevant to the proposed project. Please see *Section 7: References* of the main report for the complete list of papers RDN reviewed for this study.

Studies on the Impacts of Mining and Drilling Sites

RDN reviewed several studies on the impacts of mining or drilling operations on local property values. Ford and Seals (2018), using a variety of methods and examining multiple study areas in the United States, conclude that rock quarries do not have a statistically significant impact on nearby residential home prices. However, this study appears to be one of the few exceptions. Most studies that examine mining or similar operations, including coal mining, rock quarries, and shale gas drilling, conclude that the activity had a negative, statistically significant impact on nearby residential home values. Fitzpatrick and Parmeter (2021) examined surface coal mines in two Appalachian counties, reporting a 15.5 percent decrease in home value when the home is within 2.3 kilometers of an active mine. Malikov, Sun, and Hite (2017) estimated the impact of surface rock mining on home prices in Delaware County, Ohio. For homes within 10 miles of rock mining activity, they observed a 2.3 to 5.1 percent reduction in home price per mile closer to the mine, which they associate with elevated noise and dust levels from dynamite blasting and increased truck traffic.

Muehlenbachs, Spiller, and Timmins (2015) studied shale gas development in Pennsylvania and found a 9.9 to 16.5 percent reduction in home prices within 1.5 kilometers of shale gas drilling operations compared to homes further away. Noting the heated debate surrounding the potential for water contamination from shale gas development, the authors also found that nearby homes with wells saw large negative impacts while homes with piped water exhibited small positive impacts. Neelawala, Wilson, and Athukorala (2012) examined the impact of mining and smelting related pollution in

Australia, finding that homebuyers within four kilometers were willing to pay approximately AUS $13,947 more for each kilometer the home was farther away from the pollution source.

Lastly, Rivera (2020) used data on thousands of mines in Chile to estimate that cities where new mines opened between 2011 and 2016 exhibited 10.4 to 17.2 percent lower rental prices relative to cities that did not have any new mine openings, depending on the model specification. However, the results vary under different robustness checks, including a comparison of open pit versus underground mine openings. Controlling for other factors, the author found that new open pit mine openings exhibited over twice as large negative impacts to rent than new underground mine openings across several model specifications.

Studies on the Impacts of other Heavy Industry Sites

The vast majority of studies focusing on other industrial activities, such as incineration plants, power plants, and natural gas facilities, find the impact to residential home values is negative. An exception to these findings comes from Bakker (2021), who examined the impacts of industrial site development on home values in the Netherlands. The main result shows that homes within two kilometers of one of several industrial sites sold for an average 3.8 percent higher price after the sites were developed as compared to homes within the same radius that sold before site development and homes sold post-development but further away. However, in a sensitivity analysis that looked at only heavy industrial sites (e.g., large manufacturing parks), this positive impact was smaller and not statistically significant. Similarly, reducing the impact radius from 2 to 1.6 kilometers also yielded non-significant impacts. Kiel and Williams (2007), who examined changes in property values around 57 Superfund sites in the U.S., also found mixed results. Overall, 32 Superfund sites did not appear to have any statistically significant impact on the value of nearby homes, whereas 7 were associated with higher property values closer to the site, and the remaining 18 were associated with lower property values closer to the site. These results suggest that the magnitude and direction of an industrial project's impact on home values depends on both the particular characteristics of the industrial project and the characteristics of the surrounding area.

Despite the aforementioned exceptions, most industrial activities studied in the literature were found to negatively impact nearby residential property values. Boxall, Chan, and McMillan (2005) concluded that there is an approximately four to eight percent decline in property value in rural residential homes that are located within four kilometers of oil and gas facilities in Central Alberta, Canada. Brasington and Hite (2005) estimate that homes in U.S. metropolitan areas decrease in price by 0.03 percent for every 1.0 percent closer they are to the nearest perceived hazard (abandoned factories, landfills, etc.). Currie, et al. (2015) examined the opening and closing of 1,600 industrial plants in the United States, observing a 9.6 to 10.7 percent decline in home prices within 0.5 miles of toxic air emissions after a plant opens. Davis (2011) estimated that U.S. neighborhoods within 2 miles of a power plant had 4.1 to 7.1 percent lower sales prices than homes in comparable areas without power plants. Additionally, the magnitude of the difference was directly related to the size of the plants.

Using a similar methodology to other studies but including information about proximity to commercial and industrial sites, Taylor, Phaneuf, and Liu (2016) determined that proximity to an uncontaminated site reduces neighboring home values by 2.5 percent within 0.3 miles, while proximity to a site contaminated by hazardous waste reduces values by approximately 7.9 percent within 0.5 miles. Lastly, Kiel and McClain (1995) estimated changes in nearby home prices during various stages of the opening of an incinerator plant in Massachusetts. Relative to the average sales price for the area, they found that home prices increased by 1.7 percent per mile away from the plant during construction, 3.2 percent per mile during early operation, and 2.7 percent per mile after four years of continued activity. Results from these last two studies suggest that uncertainty and risk aversion play a role in sites' impacts on local home values. A project that is perceived to have negative environmental impacts can cause decreases in home values even when there is no evidence of environmental contamination.

Summary Results of Key Studies

Table A-1 summarizes the findings of the key studies identified in RDN's literature review based on the type of site, the study area, and the direction and magnitude of the impact. The literature presents a wide range of impacts, from a positive impact of 3.8 percent for home sales within two kilometers of industrial sites in the Netherlands to a negative impact of up to 17.2 percent on rental prices in Chilean cities where new mines opened. For the studies RDN reviewed, the distance of measurable impacts ranged from 0.3 miles away for general hazardous waste sites to 10 miles away for open pit rock mines.

Table A-1: Summary of Key Study Findings

Author(s)	Site Type	Impact Area	Impact on Residential Property Values
Bakker (2021)	Industrial sites	2 kilometers (1.2 miles)	Premium of 4% for homes near an industrial site (i.e., homes cost more closer to the site)
Boxall, Chan, and McMillan (2005)	Natural gas facilities	4 kilometers (2.5 miles)	4% to 8% decline in value for homes near natural gas facilities
Brasington and Hite (2005)	General environmental hazards	Not applicable; study estimates a distance-to-hazard price elasticity	3% increase in home prices when distance from the nearest environmental hazard increases by 10%
Currie, et al. (2015)	Toxic plants	1 mile	11% decline in home prices within a half mile of a source of toxic air emissions; negative impact may remain even after closure of the source of pollution
Davis (2011)	Power plants	2 miles	Reduction between 3% and 7% for homes near power plants
Fitzpatrick and Parmeter (2021)	Coal mining	2.3 kilometers (1.4 miles)	15.5% decline in value for homes near coal mining
Ford and Seals (2018)	Rock quarries	In some specifications they estimate elasticities, so they do not use a specific distance; in other specifications they use	Finds no compelling statistical evidence that either the anticipation of, or the ongoing operation of, rock quarries negatively impact home prices

Author(s)	Site Type	Impact Area	Impact on Residential Property Values
		2 miles	
Kiel and McClain (1995)	Incinerator Plant	Not applicable; study estimates a distance-to-hazard price elasticity over a 28-square-mile area	Home prices increased by 1.7% per mile away from the plant during construction, 3.2% per mile during early operation, and 2.7% per mile after four years of continued activity
Malikov, Sun, and Hite (2017)	Rock mining	10 miles for near-zero effect (effects dissipate with distance)	2.3% to 5.1% reduction per mile closer to rock mining activity
Muehlenbachs, Spiller, and Timmins (2015)	Shale gas	1.5 kilometers (0.9 miles)	Reductions in value between 10% and 17% for homes near shale gas development
Neelawala, Wilson, and Athukorala (2012)	Mining of different resources	4 kilometers (2.5 miles)	6% to 7% increase in willingness to pay per kilometer of distance from mine/smelting operation
Rivera (2020)	Mining of different resources	Not applicable; study evaluates city-level data	10% to 17% reduction in rents in cities with new mine openings
Taylor, Phaneuf, and Liu (2016)	Contaminated and clean commercial/ industrial sites	Home impacted by a contaminated site if within 0.5 miles, and by a clean site if within 0.3 miles	Proximity to clean sites reduces neighboring home values by 2.5%; proximity to a contaminated site reduces values by about 8%; remediation of a contaminated site increases values by as much as 5%

APPENDIX B—LITERATURE REVIEW: METHODOLOGIES FOR ESTIMATING IMPACTS ON HOME VALUES

Establishing the factors that determine the prices of goods is challenging, especially in industries like residential real estate that are competitive (many buyers and sellers) but where the products are differentiated (each home being a unique product). Ultimately, prices represent the intersection of supply and demand for these goods. Both supply and demand can change at the same time, making it difficult to identify the specific determinants of observed prices. Despite these limitations, well-established methodologies exist for estimating the relationship between residential home values and their various determinants. The following sections discuss the primary methodologies used in the literature to estimate the impact of adverse environmental spillovers on residential home values.

Pricing Methods

Hedonic Pricing Method

The hedonic pricing method, based on the work of Lancaster (1966) and Rosen (1974), refers to the idea that a product's overall sale price is determined by adding up the value of all aspects or characteristics of that product. This methodology can be used to evaluate how specific aspects or characteristics of a good affect the price.

Real estate markets are often competitive with differentiated products, so they are a prime area in which to use hedonic pricing models. As Monson (2009) explains, one can think of a property as a collection of goods that determine its overall value. Home characteristics that are commonly used for this approach include, among others, property attributes (e.g., age of the home, square footage) and locational attributes (e.g., distance to amenities, such as the nearest school). Data from many real estate transactions, such as those found on sites like Zillow, can be used to estimate the value of each of these home attributes, which can in turn be used to predict total transaction prices.

A review of the literature using hedonic pricing in real estate markets revealed that this methodology is used extensively for many applications, including as a method to develop measures of environmental quality based on proximity to desirable or undesirable environmental features (Malpezzi 2003). A number of the papers in RDN's literature review used hedonic pricing models for this purpose, including estimating the impact of mining on housing prices in Queensland, Australia (Neelawala, Wilson and Athukorala 2012), and the impacts of traffic noise on housing values (Ozdenerol, et al. 2015).

The key feature of the hedonic pricing method is that home prices can be partially determined by the absence or presence of certain characteristics if the value of those characteristics can be estimated. Studies that use this approach to estimate impacts of some activity or industry often use distance to an activity (e.g., distance to a mine) or a discrete near-or-far classification as a characteristic for which the value can be estimated.

Repeated Sales Price Method

An alternative approach to estimate residential home value changes is the construction of repeated sales prices indices. This method looks at the difference in sale prices of the same home over time to assess how prices change, assuming characteristics of the home do not change between sales. A well-known example of this is the widely published set of Case-Shiller indices, based on the work of Case and Shiller (1987). Repeated sales price indices are best suited for estimating changes in prices rather than estimating price levels. Also, they do not provide estimates of the value of the characteristics or features of homes. Nevertheless, since this methodology does not require detailed lists of home characteristics, it avoids biases related to omitting some important variable(s) from the estimation, which can be an issue in the hedonic pricing methodology (Malpezzi 2003). Using the repeated sales methodology, it is possible to compare price changes for homes defined as "near" the activity and price changes for homes that are "far" from the activity.

Methodological Improvements to Pricing Methods

Fixed Effects Model

The repeated sales methodology described earlier can be seen as a specific case of more general fixed effects models. In the context of estimating residential property values, fixed effects are variables that do not change over time for individual homes. These variables include attributes like building square footage or lot size, which can reasonably be assumed to remain constant throughout a home's lifespan. Fixed effects estimation allows a model to implicitly control for characteristics that are, when available, explicitly considered in a hedonic pricing approach , and isolate the impact of characteristics that change over time (e.g., specific market conditions). Fixed effects estimation has the additional advantage of accounting for unobserved characteristics that do not change over time. Currie, et al. (2015) uses a fixed effects model for this purpose to control for time-invariant characteristics of properties.

Difference-in-Differences Model

As Ford and Seals explain (2018), both hedonic pricing and repeated sales methods used for estimating potential impacts of a mine or other activity can suffer from selection bias, which broadly refers to any bias introduced by data that are not properly randomly selected. The reason is that, generally, the location of a mine is not chosen randomly. Factors that determine where mining or other activity takes place may also cause differences in home prices. Ideally, a study that seeks to estimate the impact of a particular activity should compare price differences between the areas believed to be impacted relative to other areas, both before the activity is in place and once the activity exists. Comparing the differences before and after allows for estimation of the causal effect of the activity on price differences. This methodology is generally known as difference-in-differences.

In their analysis of the impact of quarry operations on home prices, Ford and Seals (2018) address selection bias issues by combining hedonic pricing with a difference-in-differences approach. Effectively, this evaluates whether the hedonic price of being near a quarry before the quarry is operating is different from this same hedonic price when the quarry is operating. Other recent studies that use a combination of hedonic pricing and difference-in-differences include estimates of the impacts on home prices of environmental contamination (Taylor, Phaneuf, and Liu 2016), industrial site development (Bakker 2021), and estimates of the impact to rental prices in Chile from mining operations (Rivera 2020). Currie, et al. (2015) use a difference-in-differences approach to estimate the impact on housing values from exposure to environmental health risks. They are able to use this approach because their home sales transaction data covers periods and geographies in which a number of toxic plants open and/or close.

Similarly, a difference-in-differences approach can be combined with a repeated sales price method to identify causal relationships between a mine and changes in home prices. This approach offers the advantage of not requiring a rich dataset in terms of housing characteristics, though it relies on the assumption of constant-quality of the housing units included in the analytical sample. Currie, et al. (2015) use this approach as a robustness check in their evaluation of home price impacts from exposure to environmental health risks. Similarly, Taylor, Phaneuf, and Liu (2016) complement their analysis of the impact of environmental contamination with estimates combining a repeated sales method with difference-in-differences.

Key Definitions

Impact Area Definition

A common consideration in evaluating the impact that the presence of an industry or activity has on real estate prices is defining the potentially impacted area. Fitzpatrick and Parmeter (2021) indicate that this often comes down to judgment by the analyst and that different definitions of the impact area may lead to different results.

To test the sensitivity of results to the definition of near and far areas, researchers often perform their analysis using different boundaries, where the boundaries may be set based on different criteria. Currie, et al. (2015) use U.S. Environmental Protection Agency data on hazardous air pollution and find that pollution levels fall quickly as distance from the polluting plant increases, with most pollutants being detectable only within one mile of a plant. This informs their use of radii of half a mile and one mile for classifying homes as near or far from a plant in the two specifications they use, with the comparison groups being homes between half a mile and one mile or between one mile and two miles from a plant, respectively.

Taylor, Phaneuf, and Liu (2016) prepare a first set of estimates using intervals of distance (bins) to determine the maximum distance at which homes may be impacted by their proximity to a hazardous waste site that is either contaminated or uncontaminated (clean). They use the evidence from these estimates to classify homes that are within half a mile of a contaminated site as being near the contaminated site and homes that are within one third of a mile of a clean site as being near the clean site. Using a somewhat similar approach, Bakker (2021) prepares a first set of estimates to determine a target distance for the impact of industrial sites, but rather than using distance bins, he uses a continuous distance variable, and finally settles on a model specification that defines being near a site as a distance of up to two kilometers.

Concerns about the arbitrary nature of defining impact areas have prompted research that attempts to provide more flexible ways of estimating impacts as well as more robust methods for determining what an impact area should be. Malikov, Sun, and Hite (2017) estimate the effect of rock mining on home prices using a methodology that does not require pre-specifying a distance threshold and that allows estimation of effects that dissipate with distance in a non-linear way. Fitzpatrick and Parmeter (2021) provide another alternative that focuses on determining optimal "treatment buffers" in hedonic models.

Multi-Event Definition

Another consideration explored by Kiel and McClain (1995) is that the impact of undesirable activities or land uses may not be constant through all stages of a project. Their study estimated the effect on property values of the construction and operation of an incinerator in North Andover, Massachusetts, from 1974 to 1992 through five stages of the project: (1) pre-rumor, (2) rumor, (3) construction, (4) online, and (5) ongoing operation. Their results indicated that real estate prices near the incinerator declined once construction, or a "ramp up" in activity, began. This finding indicates that undesirable activities can influence home buyers and sellers in the local community even before operations commence, based only on expectations of adverse environmental or other impacts.

Kiel and McClain also considered an adjustment period, dubbed "ongoing operation," after which sufficient knowledge of the adverse impact should be known and real estate prices are no longer impacted by uncertainty about the plant's impacts. The inclusion of this period assumes that a significant contributor to the change in property values is the expectation of negative consequences, even if those consequences never materialize. Taylor, Phaneuf, and Liu (2016) support this notion by concluding that property values decrease near both contaminated and uncontaminated hazardous waste sites, indicating that the risk of future contamination is a consideration for homebuyers. A general use of the multi-event approach is limited by the difficulty of defining cutoff dates that determine the stages of the process. Kiel and McClain (1995) rely on local newspaper articles and contracts to specify key dates. Alternatives for determining cutoff dates may include using employment or production.

APPENDIX C—REALTOR SURVEY

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Purpose of this Survey

Robert D. Niehaus, Inc. (RDN) is an economic consulting firm. We have been hired by Nevada County to conduct an independent study of the economic impacts of the proposed Idaho-Maryland Mine Project near Grass Valley, CA.

We are surveying local real estate professionals to better understand their perspectives on how the Project would affect local property values. The following survey is 10 questions and takes an estimated five to eight (5-8) minutes to complete.

We understand that the Idaho-Maryland Mine Project is controversial. Project proponents emphasize its anticipated benefits, including local jobs, operational spending, and tax revenues. Project opponents emphasize its anticipated costs, including adverse impacts on the local environment and residents' quality of life.

This survey is completely confidential; RDN will anonymize and aggregate your response with others when we report our findings. The raw data will not be shared with anyone outside of RDN's project team. For questions or technical support, please contact us at survey@rdniehaus.com. Please press "NEXT" to continue.

RDN

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Your Experience and Familiarity with the Project

1. How many years of experience do you have working as a licensed real estate professional in Nevada County?

- ◯ 0-2 Years
- ◯ 3-5 Years
- ◯ 6-9 Years
- ◯ 10+ Years

2. Are you aware of the proposal to re-open the Idaho-Maryland Mine?

- ◯ Extremely aware
- ◯ Very aware
- ◯ Somewhat aware
- ◯ Not so aware
- ◯ Not at all aware

3. How familiar are you with the area around the proposed Idaho-Maryland Mine Project sites?

- ◯ Extremely familiar
- ◯ Very familiar
- ◯ Somewhat familiar
- ◯ Not so familiar
- ◯ Not at all familiar

4. How familiar are you with the findings of the Draft Environmental Impact Report (EIR) on the Idaho-Maryland Mine Project?

- ◯ Extremely familiar
- ◯ Very familiar
- ◯ Somewhat familiar
- ◯ Not so familiar
- ◯ Not at all familiar

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Draft EIR Findings

5. Summary of Draft EIR Findings (from Nevada County Planning Department): "The EIR identifies significant impacts for the following California Environmental Quality Act (CEQA) environmental topic areas: Aesthetics; Air Quality and Greenhouse Gas Emissions; Biological Resources; Cultural and Tribal Cultural Resources; Geology and Soils; Hazards and Hazardous Materials; Hydrology and Water Quality; Noise and Vibration; Transportation; and Wildfire.

However, the EIR includes mitigation measures that would reduce project impacts related to Air Quality and Greenhouse Gas Emissions; Biological Resources; Cultural and Tribal Cultural Resources; Geology and Soils; Hazards and Hazardous Materials; Hydrology and Water Quality; Noise and Vibration (off-site haul truck traffic noise; operational noise and vibration); Transportation (hazards related to construction traffic); and Wildfire to less-than-significant levels.

The EIR determined that the project would have certain impacts to Aesthetics; Noise (temporary construction noise along East Bennett Road); and Transportation (e.g., intersections) that would remain significant and unavoidable even after implementation of the feasible mitigation measures set forth in the EIR."

Do you believe the environmental impacts would be greater than or less than those stated in the Draft EIR?

- ◯ Significantly greater
- ◯ Slightly greater
- ◯ About the same
- ◯ Slightly less
- ◯ Significantly less

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Overall Impact

6. There are many factors that affect property values, but we want to estimate the "marginal effect" of the Idaho-Maryland Mine Project specifically, i.e. how the Project would affect property values assuming all other factors are held constant.

In your professional opinion, what would be the overall effect of the Project on the market value of residential properties in Nevada County? Would it cause a net INCREASE or DECREASE in property values?

- ◯ Increase
- ◯ Decrease
- ◯ No effect

7. Please help us understand why you selected the answer above:

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Location and Size of Impacts

8. On average, how much do you believe residential property values in the following areas would change due to the Idaho-Maryland Mine Project?

For each area, select the percent (%) change in the first column and "Increase" or "Decrease" in the second column. For reference, please scroll down to see maps from the Draft EIR.

	% Change	Increase or Decrease
Properties adjacent to the Project's haul routes		
Properties adjacent to the Project's Brunswick site		
Properties adjacent to the Project's Centennial site		
Properties under which the Project has mineral rights		
Properties within 1 mile of Project sites, excluding those in the areas above (e.g., Grass Valley)		
Properties between 1 and 5 miles of Project sites (e.g., Nevada City)		

Figure 3-13
Project Haul Routes

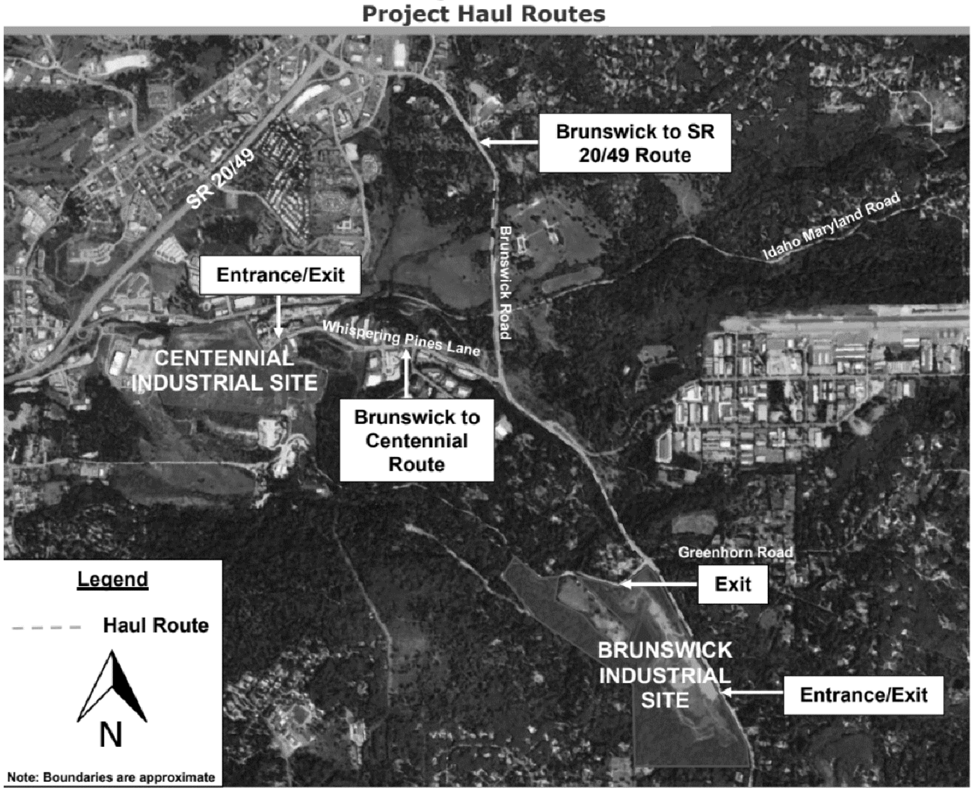
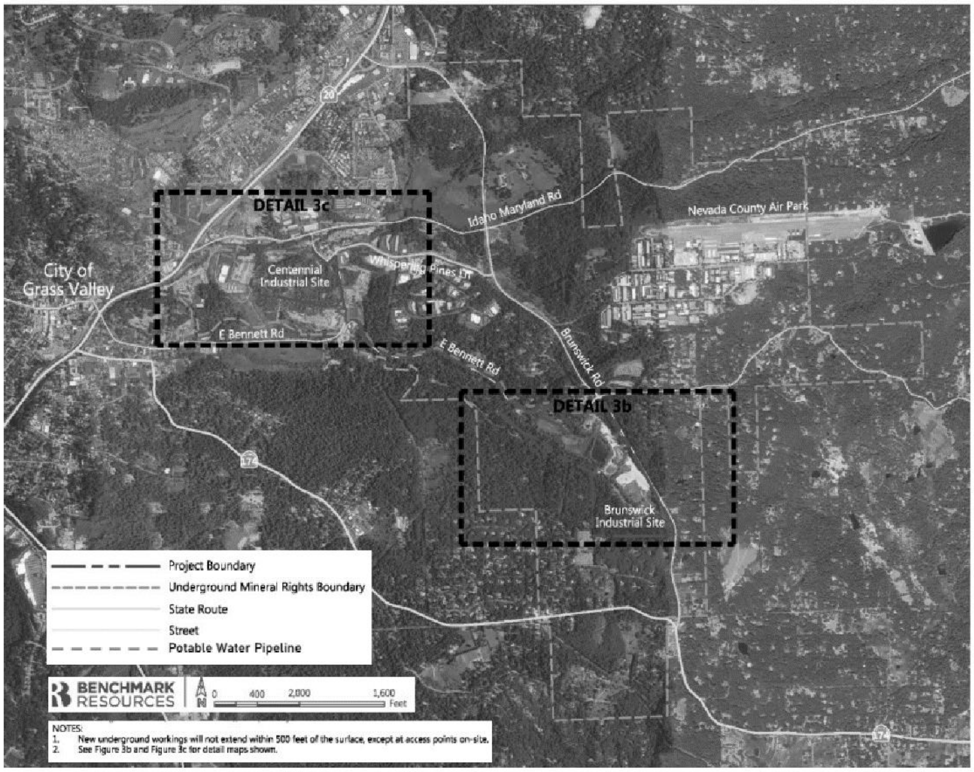


Figure 3-2
Project Location Map - Overview



RDN

Projected Impacts of the Idaho-Maryland Mine on Local Property Values

Duration of Impacts

9. In your opinion, do you expect the mine's impacts on property values would be TEMPORARY or PERMANENT?

- ◯ TEMPORARY, i.e. during construction or ramp-up of operations only
- ◯ PERMANENT, i.e. for as long as mine is active or longer
- ◯ No impact on property values

10. Please briefly explain what factors you are considering in your assessment of the location and duration of the Idaho-Maryland Mine Project's impacts on property values.

EXHIBIT C

1981 - 2010

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1981-2010 Normals (~3 KB)

1971 - 2000

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1971-2000 Normals (~3 KB)

1961 - 1990

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1961-1990 Normals (~3 KB)

Period of Record

- Station Metadata
- Station Metadata Graphics

General Climate Summary Tables
- Temperature
- Precipitation
- Heating Degree Days
- Cooling Degree Days
- Growing Degree Days

Temperature
- Daily Extremes and Averages
- Spring 'Freeze' Probabilities
- Fall 'Freeze' Probabilities
- 'Freeze Free' Probabilities
- Monthly Temperature Listings
  - Average
  - Average Maximum
  - Average Minimum
  - Extreme Maximum
  - Extreme Minimum

Precipitation
- Monthly Average
- Daily Extreme and Average
- Daily Average
- Precipitation Probability by Duration.
- Precipitation Probability by Quantity.
- Monthly Precipitation Listings
  - Monthly Totals
  - Daily Extreme

Snowfall
- Daily Extreme and Average
- Daily Average
- Monthly Snowfall Listings
  - Monthly Totals

Snowdepth
- Daily Extreme and Average
- Daily Average

Heating Degree Days
- Daily Average
- Monthly HDD Listings
  - Monthly Totals(*)

Cooling Degree Days
- Daily Average
- Monthly CDD Listings
  - Monthly Totals(*)

Growing Degree Days
- Monthly GDD Listings
  - Monthly Total Base 40 (*)
  - Monthly Total Base 50 (*)

Period of Record Data Tables
- Daily Summary Stats (~55 KB)
- Monthly Tabular data (~2 KB)

Daily Data
  - Graph and Lister (*)
  - Lister (*)

Western Regional Climate Center, wrcc@dri.edu

GRASS VALLEY NO. 2, CA

Total of Precipitation (Inches)

(043573)

File last updated on February 16, 2023
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1966	-----z	-----z	-----z	-----z	-----z	-----z	-----z	-----z	-----z	0.00	14.91	8.77	23.68 i
1967	18.10	1.09	9.82	8.66	0.74	2.39	0.00	0.00	0.50	2.30	5.01	6.53	55.14
1968	10.66	8.47	4.26	0.61	1.05	0.30	0.01	0.98	0.00 a	4.08	7.84	10.71	48.97
1969	25.02	14.95	2.91	4.93	0.00	0.30	0.01	0.00	0.00	3.14	3.17	15.91	70.34
1970	21.76	4.11	5.38	0.93	0.10	1.35	0.00	0.00	0.00	2.46	12.14	16.77	65.00
1971	5.37	0.98	8.75	2.51	2.56	0.78	0.00	0.08	0.96	0.87	4.36	11.26	38.48
1972	4.22	6.79	1.64	4.63	0.64	0.46	0.00	0.00	2.53	2.73	10.82	8.25	42.71
1973	18.01	11.94	7.31	0.24	0.74	0.07	0.00	0.00	1.38	4.77	21.29	12.49	78.24
1974	9.74	4.75	15.73	5.25	0.15	0.36	3.82	0.08	0.00	2.40	2.94	4.41	49.63
1975	4.75	16.41	11.57	5.25	0.59	0.53	0.09	1.19	0.02	7.87	3.55	2.84	54.66
1976	0.77	4.22	2.84	2.48	0.00	0.10	0.00	2.34	1.06	0.11	2.02	0.57	16.51
1977	3.75	3.97	2.82	0.33	3.49	0.00	0.07	0.15	1.20	0.39	5.42	12.47	34.06
1978	21.23	8.28	10.79	8.38	0.53	0.10	0.00	0.00	2.98	0.00	6.40	2.06	60.75
1979	10.74	12.07	8.01	2.70	2.01	0.00	0.30	0.04	0.05	6.22	5.06	8.07	55.27
1980	15.21	15.34	4.24	3.07	2.07	0.99	0.86	0.00	0.00	0.65	1.78	4.08	48.29
1981	10.97	3.09	8.89	1.56	1.10	0.01	0.00	0.00	1.42	5.92	17.11	16.21	66.28
1982	9.83	8.09	13.42	8.34	0.10	0.66	0.03	0.04	3.39	7.13	12.00	10.99	74.02
1983	9.99	14.26	20.78	6.44	1.22	0.41	0.03	0.07	2.05	2.11	19.23	17.83	94.42
1984	0.34	7.19	4.60	3.51	1.40	0.76	0.00	0.62	0.12	4.92	11.58	2.95	37.99
1985	1.52	6.25	8.97	0.61	0.07	0.37	0.02	0.10	1.87	1.78	10.74	4.99	37.29
1986	8.75	25.45	11.16	1.83	1.19	0.00	0.00	0.00	5.87	0.12	1.12	2.16	57.65
1987	6.04	6.90	8.70	0.65	0.14	0.06	0.03	0.00	0.00	1.91	3.30	12.39	40.12
1988	8.74	0.38	1.92	5.30	1.66	0.80	0.00	0.00	0.02	0.00	13.59	6.35	38.76
1989	3.58	4.02	20.81	2.68	0.48	0.43	0.00	0.94	3.41	5.20	4.09	0.00	45.64
1990	9.93	5.58	3.68	2.02	7.04	0.03	0.00	0.00	0.48	0.96	1.56	2.25	33.53
1991	1.02	4.16	20.15	2.17	2.72	1.66	0.00	0.14	0.02	4.67	3.53	4.66	44.90
1992	3.52	14.33	5.09	2.33	0.00	1.73	0.00	0.00	0.04	4.37	0.97	14.09	46.47
1993	17.81	10.38	6.32	3.14	2.13	2.01	0.00	0.09	0.00	2.12	3.77	7.80	55.57
1994	2.93	8.46	1.49	4.63	1.73	0.15	0.00	0.00	0.21	1.03	9.83	11.53	41.99
1995	25.22	0.80	23.45	6.38	4.97	2.77	0.00	0.00	0.00	0.00	0.60	13.22	77.41
1996	13.06	14.08	4.54	8.31	7.54	0.11	0.00	0.03	0.34	2.36	8.13	27.81	86.31
1997	23.60	0.78	2.32	1.78	0.91	1.78	0.00	0.71	0.47	3.42	9.25	4.77	49.79
1998	19.54	19.83	5.30	5.69	7.85	0.42	0.00	0.00	1.53	0.91	10.62	6.16	77.85
1999	11.19	16.20	5.14	2.85	0.82	0.15	0.00	0.07	0.00	2.13	5.58	1.68	45.81
2000	14.38	21.26	4.76	2.63	3.18	0.65	0.00	0.00	1.64	4.70	1.83	2.24	57.27
2001	5.84	8.13	3.66	3.63	0.00	0.28	0.00	0.00	0.42	1.94	7.58	16.28	47.76
2002	5.56	5.29	8.38	1.41	2.26	0.00	0.00	0.00	0.00	0.00	6.10	19.86	48.86
2003	4.09	3.22	6.34	10.21	2.56	0.00	0.00	1.97	0.03	0.24	4.07	15.41	48.14
2004	6.57	10.39	1.85	1.13	0.28	0.00	0.00	0.00	0.41	6.66	3.82	10.60	41.71
2005	8.03	5.26	10.12	3.82	8.07	2.10	0.00	0.00	0.48	1.27	3.89 c	26.73	69.77
2006	8.83	6.85	16.02	12.62	1.33 c	0.00	0.00 e	0.00	0.00	0.45	3.65 c	9.35	59.10
2007	1.15	14.15	1.34 d	3.46 c	1.64	0.30	0.17 e	0.00	1.50	4.13	1.51	10.06	39.41
2008	9.95	7.16	1.43	0.45	0.42	0.00	0.00	0.00	0.00	1.91	4.88	6.61	32.81
2009	3.12	11.11 a	6.50	1.61	5.53	0.74	0.00	0.00	0.13	3.14	2.02	6.89	40.79
2010	11.23	6.35	4.72	9.08	3.17	0.08	0.00	0.04	0.00	8.58	8.63	17.70	69.58
2011	2.80	7.02	19.60	2.53 a	3.53	2.41	0.00	0.00	0.00	4.20	1.99	0.17	44.25
2012	7.37	4.11	17.86	8.79	0.41	1.73	0.03	0.05	0.00	2.97	12.52	18.05	73.89
2013	1.45	1.01	3.15	2.37	1.10	1.95	0.00	0.01	2.61	0.39	1.89	0.57	16.50
2014	1.49	14.86	9.60	3.38	0.72	0.00	0.02	0.06	0.87	1.61	5.25	14.87	52.73
2015	0.11	5.86	1.01	2.99	0.09	0.18	0.04	0.00	0.09	0.70	5.73	12.30	29.10
2016	15.05	1.87 a	16.62	2.17	1.21	0.04	0.00	0.00	0.00	10.29	7.19	13.35	67.79
2017	25.93	22.66	6.65	8.86	0.35	0.50	0.00	0.01	0.14	1.04 b	12.76	1.06	79.96
2018	9.72	0.75	15.93	6.27	0.43	0.00	0.00	0.00	0.00	0.92	8.38	4.72	47.12
2019	13.10	21.93	8.17	2.89	5.37	0.36	0.00	0.00	2.31	0.04	1.68	11.54	67.39
2020	5.36	0.00	7.23	4.69	4.40	0.03	0.00	0.02	0.00	0.00	4.40	4.37	30.50
2021	7.15	3.88	4.54	0.10	0.00	0.00	0.00	0.00	0.44 a	14.93	2.70	16.56	50.30
2022	1.70	0.13	1.49	6.53	0.26	1.14	0.00	0.00	1.49	0.00	5.28	19.23	37.25
2023	18.88	1.23 l	-----z	-----z	-----z	-----z	-----z	-----z	-----z	-----z	-----z	-----z	18.88 k
Period of Record Statistics													
MEAN	9.57	8.34	8.03	3.96	1.86	0.62	0.10	0.18	0.79	2.79	6.51	9.68	52.18
S.D.	7.10	6.39	5.90	2.91	2.14	0.76	0.52	0.46	1.18	2.95	4.79	6.59	16.70
SKEW	0.72	0.82	0.98	0.90	1.55	1.31	6.74	3.29	2.04	1.74	1.12	0.55	0.32
MAX	25.93	25.45	23.45	12.62	8.07	2.77	3.82	2.34	5.87	14.93	21.29	27.81	94.42
MIN	0.11	0.00	1.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	16.50
YRS	57	56	56	56	56	56	56	56	56	57	57	57	56

EXHIBIT D

ADVERTISEMENT

NEWS ENVIRONMENT

Common tire chemical implicated in mysterious deaths of at-risk salmon

Coho salmon in urban streams have been dying in the U.S. Pacific Northwest

3 DEC 2020 • BY ERIK STOKSTAD

Particles that erode from tires wash into streams used by coho salmon. KEVIN SCHAFER/GETTY IMAGES

SHARE:

For decades, something in urban streams has been killing coho salmon in the U.S. Pacific Northwest. Even after Seattle began to restore salmon habitat in the 1990s, up to 90% of the adults migrating up certain streams to spawn would suddenly die after rainstorms. Researchers suspected the killer was washing off nearby roads, but couldn't identify it. "This was a serious mystery," says Edward Kolodziej, an environmental engineer at the University of Washington's (UW's) Tacoma and Seattle campuses.

Online today in *Science*, researchers led by Kolodziej report the primary culprit comes from a chemical widely used to protect tires from ozone, a reactive atmospheric gas. The toxicant, called 6PPD-quinone, leaches out of the particles that tires shed onto pavement. Even small doses killed coho salmon in the lab. "It's a brilliant piece of work," says Miriam Diamond, an environmental chemist at the University of Toronto. "They've done a tremendous job at sleuthing out a very challenging problem."

Manufacturers annually produce some 3.1 billion tires worldwide. Tire rubber is a complex mixture of chemicals, and companies closely guard their formulations. Because tire particles are a common component of water pollution, researchers have been examining how they affect aquatic life.

SIGN UP FOR NEWS FROM SCIENCE DAILY HEADLINES

Get more great content like this delivered right to you!

SIGN UP ›

After Kolodziej arrived at UW's Center for Urban Waters in 2014, he joined the effort to solve the coho salmon mystery. The group created a mixture of particles from nine tires—some bought new, others provided by two undergraduates who moonlight as mechanics—to mimic what might wash off typical highways. They found several thousand unidentified chemicals in the mixture. Postdoc Zhenyu Tian spent more than 2 years narrowing down the list, separating the molecules based on their electrical charge and other properties. By May 2019, he had narrowed the focus to about 50 unknown chemicals, and then further work revealed the chemical formula of a prime suspect. "If you're looking for an unexplained toxicant that's killing fish, we had the perfect instruments and expertise," Kolodziej recalls.

But what was it? A 2019 report from the Environmental Protection Agency on chemicals in recycled tires mentioned 6PPD, which has a similar formula. The final clue was buried in an industry report from 1983, which contained the exact formula of 6PPD-quinone, the molecule created when 6PPD reacts with ozone. The team synthesized 6PPD-quinone and found it was highly lethal to coho salmon.

Now, the team is working to understand how the chemical kills fish. Kolodziej and colleagues say other species of fish should also be evaluated for sensitivity. Because you can't buy the molecule, Kolodziej's team is making it. "My lab might even be the only place that actually has this," he says.

ADVERTISEMENT

The researchers suspect the compound is present on busy roads everywhere. They've found it washes off pavement and into streams in Los Angeles and San Francisco, for example. The simplest solution might be for tire manufacturers to switch to an environmentally benign alternative. But Sarah Amick, vice president of environment, health, safety, and sustainability at the U.S. Tire Manufacturers Association, says it's too early to discuss alternatives. "It's important that additional research be done to validate and verify these results."

Another way to protect salmon is to filter stormwater through soil, but installing enough infiltration basins to treat road runoff before it reaches spawning streams would be very expensive, says co-author Jenifer McIntyre, an ecotoxicologist at Washington State University's Puyallup Research and Extension Center. In the meantime, Kolodziej says he "can't walk along a street without staring at all the skid marks," thinking about tire chemicals, and "wondering what's there."

doi: 10.5555/article.2484311

RELEVANT TAGS:

ENVIRONMENT

PLANTS & ANIMALS

ABOUT THE AUTHOR

Erik Stokstad

Author

Erik Stokstad is a reporter at *Science*, covering environmental issues.

EXHIBIT E

Dozens of tires litter the mouth of Rodeo Creek, on San Pablo Bay's south shore. These tires are a likely source of 6PPD-quinone, which is toxic to fish. (Photo by Kate Golden)

Nature News

A Nasty Salmon-Killing Tire Chemical Is in Bay Waterways. Can It Be Cleaned Up?

6PPD-quinone comes from a long-used chemical that will be hard to replace in tires. But 'green infrastructure' may help stop it from entering our waters.

by Kate Raphael

March 2, 2023

When Heidi Petty began cleaning up Rodeo Creek nearly two decades ago, she pulled seventeen shopping carts out of the waterway, which runs from western Contra Costa County into San Pablo Bay. Since then, she has extracted mattresses, chairs, fake Christmas trees, a golf club, and a wig. But despite her efforts to clean up this creek-turned-dumping-ground, one particularly noxious type of trash keeps coming: tires. Parts of this urban watershed contain a mess of whole tires, mired in the mud like a monstrous serpent.

"There seems to be a pretty solid theme of using creeks as a disposal for highly toxic things," says Petty, the watershed program manager at the Contra Costa Resource Conservation District. "And tires are hard to get rid of."

Trouble is, they're not just eyesores but likely fish-killers. As tires break down, they release a cocktail of chemicals that leach into the water in creeks all over the Bay Area—which in turn empty into the broader San Francisco Bay. Most pollutants have more subtle impacts on wildlife. But now we have a new—or rather, newly identified—pollutant to worry about: 6PPD-quinone (aka 6PPD-q). This chemical is formed when 6PPD, a chemical long added to tires to prevent degradation, reacts with ozone in the atmosphere. In the past few years, researchers have learned it is lethal to steelhead trout, coho salmon, and chinook salmon; it kills cohos even at very low concentrations. Now, regulators and environmentalists are working to manage 6PPD-q pollution, to protect already imperiled local steelhead trout populations.

Many of the tires at Rodeo Creek's mouth appear to have been there a while. Nearby is a relatively out-of-sight easy access point for those with items to dump. (Photo by Kate Golden)

. . .

A 20-year mystery, solved

Scientists published the first research identifying 6PPD-q in late 2020, but researchers at the National Oceanic and Atmospheric Administration (NOAA) have been observing its effects on coho salmon for decades. 6PPD, its precursor, was first used in tires in the mid-1960s and was in widespread use by the 1970s, according to the U.S. Tire Manufacturers Association.

In the early 2000s, Barb French, a NOAA research chemist, was surveying fish in Puget Sound streams. She observed that when salmon returned to their natal streams to spawn, they grew disoriented. "They'd swim in circles and sideways through the water," French says. They splayed their fins and gaped their mouths, then died in a few hours. It shocked French. Having just returned from the ocean, these salmon were at a point in their life cycle when they should have been strong.

"That then led to 20 years of research to figure out the needle in the haystack of what was killing these fish," said French's colleague Nat Scholz, NOAA's ecotoxicology program manager.

French, Scholz, and their team linked the fish kills to roadway runoff, but they did not know which chemical was responsible. Stormwater is a complicated soup—and many chemicals used in tires are proprietary secrets, guarded by manufacturers. "You can't measure a lot of things in the stormwater if you don't know what they are," French says. Finally, at the end of 2020, another team led by Zhenyu Tian, then at the Tacoma, Washington-based Center for Urban Waters, separated urban stormwater into its components and identified the culprit of the fish kills: 6PPD-q.

Once French knew what was killing the coho salmon, she and her team began investigating how the chemical affected other fish. She and her colleagues exposed different types of salmonids to undiluted stormwater containing 6PPD-q. Steelhead trout and chinook salmon were susceptible to the chemical, exhibiting the same suite of symptoms French had seen among the coho salmon in the Pacific Northwest, though they were not as acutely vulnerable as cohos: In French's study, up to 42 percent of steelhead and 13 percent of the chinooks exposed to the stormwater died within two days, while over 90 percent of the cohos died.

A coho in its brilliant red spawning getup. Cohos haven't been seen in the Bay since the mid-to-late 1980s, but they still have North Bay spawning sites, including in Lagunitas Creek and the Russian River. Cohos have proved to be the most vulnerable to 6PPD-q. (Bureau of Land Management, CC-BY-2.0 via **Flickr**)

. . .

6PPD-q is here

Since steelhead and chinooks are both native to Bay Area waterways, scientists at the San Francisco Estuary Institute began testing for the chemical in streams and watersheds in and around the San Francisco Bay in late 2018, as part of the research efforts led by Zhenyu Tian.

"We've found quite high concentrations of 6PPD-quinone in our waterways," says Ezra Miller, a scientist at the institute, an independent scientific nonprofit that assesses and improves the Bay's health.

In an area as heavily urbanized and car-centric as the Bay Area, 6PPD-q is likely ubiquitous. Rodeo Creek runs beneath a "hub of freeways, overpasses, and underpasses, (built) with very little concern for wildlife," Petty says. In addition to the 6PPD-q that all those whole tires likely leach into the creek, the chemical also makes its way into watersheds via the small particles that tires slough off whenever they are rolling.

Rodeo Creek once teemed with fish, molluscs, and aquatic plants. But a series of construction projects destroyed the fish habitat: the creek was channelized, widened and lined with concrete, to prevent flooding in Rodeo; small dams called drop structures were added in an effort to slow erosion; and railroad construction diverted the creek's path.

"We're kind of working around bad infrastructure from a long time ago," says Petty. Today, Rodeo Creek's fish have completely disappeared.

It's a story that has played out for streams across the state.

. . .

Steelhead here 'face extinction'

To distribute water to California's Central Valley, the state built many dams, destroying salmon and trout habitat, as well as their migration routes. Climate change is warming waters and changing streamflows, making life harder for these coldwater fish. California steelhead trout and other salmonid populations have been declining for a long time, according to Peter Moyle, researcher and UC Davis fisheries professor emeritus.

The Bay's steelhead are part of a distinct population of fish that is federally listed as threatened and "face extinction in the next 100 years" unless there are "significant investments in monitoring, habitat restoration, and water management," according to a **2017 report** Moyle coauthored.

Pollution plays a role in the decline of these fish, explained Moyle, but the extent of its influence is hard to tease out.

The Center for Ecosystem Management and Restoration, an organization dedicated to rehabilitating California's streams until it closed its doors at the end of 2016, documented steelhead populations in many creeks neighboring Rodeo, including Pinole, San Pablo, and Walnut Creeks in Contra Costa County, and Codornices, San Lorenzo, and Alameda Creeks in Alameda County. And, according to Miller, testing of area creeks has shown that concentrations of 6PPD-q sometimes exceed its LC50 for coho salmon. (LC50 is a term used by toxicologists—the "LC" means "lethal concentration"—that refers to the chemical concentration expected to kill half of exposed individuals in a group.)

Coho salmon appear to be more vulnerable to 6PPD-q than steelhead. But based on the data collected by the SFEI, Miller says Bay Area levels of 6PPD-q are potentially high enough to harm steelhead, too.

Coastal rainbow trout (*Oncorhynchus mykiss*, subspecies *irideus*) like this one, caught south of San Jose in October 2022, are the same species as steelhead. Steelhead, like salmon, spend time at sea, while rainbow trout live their lives entirely in fresh water. (Photo by prickly_sculpin via **iNaturalist**, CC-BY-NC)

. . .

Human health effects? Unknown.

In places where 6PPD-q is present at not-quite-fatal levels, the chemical may still have nasty sublethal effects scientists are only beginning to investigate. "It doesn't matter if they live, if they can't reproduce, if they can't eat, if they can't swim away from predators," says French.

Researchers are also studying whether 6PPD-q can be passed up the food chain to other predatory fish. "This particular compound looks to be metabolized in fish," says Scholz. That means that even if the compound harms or kills the fish, it most likely does not accumulate in their bodies, where it could harm other organisms that consume them—like people.

Humans are exposed to 6PPD and 6PPD-q, but scientists do not fully understand the mechanism through which 6PPD-q kills fish, let alone how the compound affects human health. 6PPD-q has not been found in drinking water, says Ezra Miller of the SFEI, as far as they know. "But that may be because we haven't been looking for it," they add. Scientists have found both 6PPD and 6PPD-q in the urine of adults and children in South China. Miller suspects the main exposure route in humans is via inhalation of very small tire particles, rather than through water, but more research is needed.

. . .

An American avocet feeds avidly at the mouth of Rodeo Creek, working around one of the many tires mired in the muck. (Photo by Kate Golden)

. . .

Chemical alternatives are a ways off

In May of 2022, the California Department of Toxic Substances Control initiated the process of designating 6PPD as a “priority product,” which would force tire manufacturers to disclose their use of 6PPD and begin research to find safer alternatives for use in tires.

PPDs, the class of chemicals including 6PPD, were first developed by the U.S. government. “One of the biggest pushes for an improvement in durability for rubber happened between World War II and the Korean War,” says Jamie McNutt, Director of Regulatory Science at the US Tire Manufacturers Association, or USTMA. US military officials found the tires on their combat vehicles had degraded since WWII, and in preparation for conflict in Korea, they developed PPD chemistry to fight tire degradation.

The chemistry worked exceptionally well, and 6PPD is now used in every consumer tire McNutt is aware of. “If you look at a tire, you think it’s just one big black ball of rubber,” says McNutt, but in actuality “it’s a multiple-layered composite product,” she says. And every layer except the innermost lining contains 6PPD. The chemical is essential in preventing the outermost layer of tire from cracking, but it also protects inner layers from oxidation that could lead to tire failure.

Tire manufacturers say they were unaware of the breakdown product 6PPD-quinone’s presence in the environment—and its impact on fish—until Zhenyu Tian’s research was published in 2020. Since then, the USTMA has advocated for analyses of alternative products to replace 6PPD, partnered with researchers to address data gaps around 6PPD-q, and invested in mitigation efforts to remove polluted stormwater, according to Sarah Amick, a USTMA senior vice president of environment, health and safety, and a senior counsel.

Tire manufacturing is complex. All the materials must work together and meet high standards for road safety. Finding an alternative for a chemical as essential and widely used as 6PPD represents a huge challenge that will likely take a long time. While tire manufacturers know how to test for performance, safety testing for toxicity is less well-defined. “Even if we had a material identified as an alternative, we do not know how to test it for safer toxicity,” says McNutt.

Until there’s a safer chemical alternative, scientists and engineers say, we must treat the stormwater itself. And once car tire particles, and the 6PPD-q in them, enter the environment, they may be extremely difficult to remove. Tiny tire particles can travel far from the roads where they originated, and once they reach creeks and larger bodies of water, there are no effective methods of filtering them from the water. How long 6PPD-q sticks around is still unknown.

But there are solutions.

. . .

Trap it!

One solution is to collect the tire particles and their pollutants before they reach waterways.

Soil filtration columns are cylinders of dirt designed to trap pollutants contained in urban stormwater as it passes through so that only clean, filtered water enters the environment. These types of green infrastructure projects **have effectively removed** 6PPD-q from urban stormwater, in research conducted by French's NOAA colleagues and other scientists.

Some of the 6PPD-q problem could be mitigated by green infrastructure projects already under way in the Bay Area that were designed to deal with old foes like mercury, copper, and polychlorinated biphenyls.

"We are steadily increasing the number of green stormwater infrastructure facilities, such as bioretention facilities," also known as rain gardens, wrote Terry Fashing, Oakland's watershed and stormwater program manager, in an email.

In the Rodeo Creek watershed, Heidi Petty is planning to install a "living levee" in an effort to remove pollutants like 6PPD-q and prepare to bring fish back into the creek. Typical levees usually incorporate a steep slope toward the water, with concrete or other human-made walls that leave no habitat for aquatic life. Petty aims to build a gradual slope and repopulate the area with native plants like eelgrass. "We're just basically recreating what should be there," says Petty. This type of living levee also creates a wetland further upland that can also filter out pollutants like 6PPD-q.

Eventually, Petty hopes to reintroduce steelhead back into the creek. It's not just about salmon. If the water can be made clean enough for sensitive salmonids to live in it, other species will benefit, too.

Petty is hopeful. She imagines a future restored tidal marsh at Rodeo's mouth similar to what existed centuries ago: The garbage is gone. Native aquatic plants like eelgrass attenuate the force of oncoming waves and prevent erosion. Oyster reefs filter out pollutants. The air is a soundscape of bird calls from clapper rails and terns, their stomachs free of plastic and pieces of tire. The steelhead return, their silvery bodies catching the glint of the sun.

About the Author

Kate Raphael
Kate Raphael is a reporter based in Berkeley. She covers toxics, climate change, and health. She grew up in Indiana, then spent eight years in New England before moving to the Bay Area to attend the UC Berkeley School of Journalism, where she is a current student. Her favorite way to enjoy the nature around her is through trail running, and you can often find her in the Berkeley Hills.

ALSO ON **BAY NATURE**

First Long-Tailed Weasel Since the …
10 months ago • 2 comments
The sighting excites biologists, and suggests the potential for more wild …

The Backyard Monarchs of the …
8 months ago • 3 comments
At almost every stage of life, the butterflies are threatened by climate …

A Possible Outbreak of Canine …
a year ago • 1 comment
A fox looks sick in the Presidio, and Animal Care and Control reports …

Brickyard Cove, a New East Bay Park …
9 months ago • 1 comment
Brickyard Cove in Berkeley is the crown jewel of McLaughlin Eastshore …

What Happens When Large Animals Die …
9 months ago • 1 comment
Large carcasses can't just be wiped up. What are the other options?

How Different Wetlands Fight …
a year ago • 2 comments
Wetlands breathe in carbon dioxide, but can breathe out methane.

EXHIBIT F

Environmental Science & Technology LETTERS
pubs.acs.org/journal/estlcu
Letter

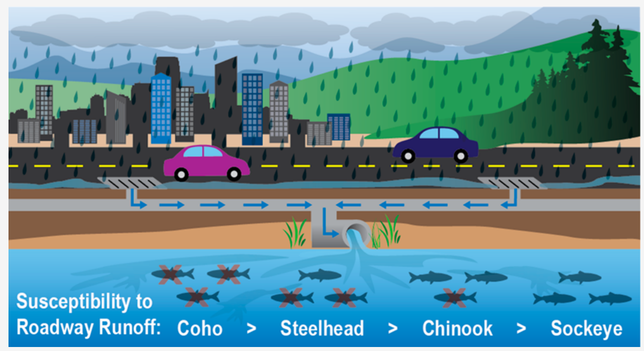
Urban Roadway Runoff Is Lethal to Juvenile Coho, Steelhead, and Chinook Salmonids, But Not Congeneric Sockeye

B. F. French, D. H. Baldwin, J. Cameron, J. Prat, K. King, J. W. Davis, J. K. McIntyre, and N. L. Scholz*

Cite This: *Environ. Sci. Technol. Lett.* 2022, 9, 733–738
Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

Downloaded via 52.39.49.65 on March 16, 2023 at 15:25:10 (UTC).
See https://pubs.acs.org/sharingguidelines for options on how to legitimately share published articles.



ABSTRACT: We compared the sensitivity of closely related Pacific salmon and steelhead (*Oncorhynchus* spp.) to untreated urban stormwater runoff across three storm events. Juvenile coho, sockeye, steelhead, and Chinook were exposed for 24 h to untreated urban runoff and then transferred to clean water for 48 h. As anticipated from previous studies, coho were highly susceptible to runoff toxicity, with cumulative mortality rates ranging from 92%–100% across the three storms. By contrast, juvenile sockeye were unaffected (100% survival), and cumulative mortality rates were intermediate for steelhead (4%–42%) and Chinook (0%–13%). Furthermore, coho died rapidly following the onset of stormwater exposure (generally <4 h), whereas mortality in Chinook and steelhead was delayed by 1–2 days. Similar to previous findings for coho, steelhead and Chinook did not recover when transferred to clean water. Lastly, significant mortality occurred in coho even when roadway runoff was diluted by 95% in clean water. Our findings extend the urban runoff mortality syndrome in salmonids and point to a near-term need for sublethal studies in steelhead and Chinook to more precisely understand stormwater risks to threatened species recovery efforts in the western United States.

KEYWORDS: *urbanization, stormwater, endangered species, Oncorhynchus, microplastics, 6PPD-quinone, urban runoff mortality syndrome, tire wear particles*

INTRODUCTION

Recent advances in analytical methods have made it increasingly possible to fractionate urban stormwater runoff into individual and identifiable toxic components. These efforts have yielded several chemicals of emerging concern (CECs) that are derived primarily from vehicle tires and therefore ubiquitous in roadway runoff.[1,2] Many are essentially unknown to ecotoxicology despite an apparent prevalence in the environment[3,4] and rapid mobilization in stormwater runoff.[5−7] One such CEC is *N*-(1,3-dimethylbutyl)-*N*′-phenyl-*p*-phenylenediamine (6PPD), an antiozonant added during the manufacture of tires to help prevent tread degradation. Ozone abiotically converts 6PPD into 6PPD-quinone, as well as other transformation products.[8]

For the past two decades, researchers in the Pacific Northwest of the United States (U.S.) have been studying a severe urban runoff mortality syndrome in coho salmon (*Oncorhynchus kisutch*). This forensic investigation eventually led to the discovery of 6PPD-quinone (6PPD-q) as the primary causal agent in the urban runoff mortality phenomenon.[4] Recurring, stormwater-driven dieoffs pose a significant threat to the near-term and long-term conservation of wild coho populations,[9] several of which are currently managed under the U.S. Endangered Species Act (ESA). The conservation implications for ESA-listed salmon are considerable, given high rates of premature death (up to 90% or more) among adult coho returning to spawn in urban watersheds, as documented in field surveys across multiple years in Puget Sound and elsewhere.[10,11]

At present, uncertainty around the extent to which roadway runoff toxicants, including 6PPD-q and other tire antioxidant/antiozonant transformation products, impact aquatic taxa beyond coho is spurring a global effort in ecotoxicology.[3,12,20] Although environmental health data are limited, there appears to be variation in vulnerability to roadway runoff even among closely related species of Pacific salmon belonging to the genus *Oncorhynchus*. This is evident from recent studies, wherein adult coho and chum (*O. keta*) were exposed to urban runoff or tire leachate, with high mortality observed in coho but not chum.[13,14] These differences in survival were consistent with observations from field surveys that previously documented

Received: July 8, 2022
Revised: July 28, 2022
Accepted: July 28, 2022
Published: August 24, 2022

ACS Publications
© 2022 The Authors. Published by American Chemical Society

high rates of premature spawner mortality in coho but not chum in restored urban catchments.[10] However, the vulnerability of other Pacific salmonids to urban roadway runoff, including sockeye (*O. nerka*), Chinook (*O. tshawytscha*), and steelhead (ocean-going rainbow trout; *O. mykiss*), has not been determined. In the context of the ESA, this represents a major information gap, particularly for stream-type Chinook and steelhead that spend proportionately more time in freshwater habitats as juveniles, where they are more likely to be exposed to runoff from the transportation grid. Moreover, relative to coho, ESA-listed Chinook and steelhead populations encompass a much wider range of river basins in the western U.S., particularly in California (see www.fisheries.noaa.gov/species-directory/threatened-endangered for current ESA range designations).

It was recently shown that juvenile coho, in addition to spawning adults, are highly susceptible to the mortality syndrome.[15] Salmonids other than coho, including *O. mykiss*, also appear vulnerable.[12] In the present study, we extended these earlier observations by coexposing juvenile coho, sockeye, Chinook, and steelhead to runoff collected during multiple rain events. We focused on small subyearlings (coho, sockeye, Chinook) as well as larger age 1+ juveniles (coho, steelhead), and used coho as a positive control for the baseline toxicity of untreated stormwater (i.e., as confirmation of the mortality syndrome). Our study had three primary objectives: (1) determine whether ESA-listed species other than coho are vulnerable to acutely lethal stormwater toxicity, (2) evaluate the time course for mortality across species and whether affected fish recover in clean water, and (3) assess the role of dilution as a factor influencing survival, using juvenile coho as an indicator species.

■ MATERIALS AND METHODS

Urban Roadway Runoff Collection and Transport. Urban stormwater was collected from downspouts draining a short section of elevated urban arterial (west-bound onramp to State Route 520 from Montlake Boulevard in Seattle, Washington). Runoff from six storms was collected at different times of the year in 2018 (August 26, October 25, and December 17) and 2019 (March 12, March 25, and April 4). During each storm event, runoff was filtered through a fiberglass window screen to remove coarse debris and collected in 900 L or 1325 L stainless steel collection totes (Custom Metalcraft Inc., Springfield MO) for subsequent transport at ambient temperature to the Washington State University Research and Extension Center in Puyallup (WSU-P). Juvenile salmonid exposures were initiated within 24 h of each storm event. Note that 6PPD-q levels in runoff from this location have been previously measured across nine storms in 2017−2019,[4,19] including the October and December collection events used here in 2018; all storms contained 6PPD-q at concentrations expected to be lethal to juvenile coho (Table S3).

Juvenile Salmon and Steelhead. Juvenile coho, sockeye, and Chinook salmon as well as an ocean-migrating stock of *O. mykiss* (hereafter referred to as steelhead) were obtained from local hatcheries, held in a recirculating freshwater system at WSU-P on a 12:12 h dark:light cycle, and fed daily with commercial fish food (BioVita, Bio-Oregon). Fish rearing water consisted of municipal water treated with reverse osmosis and adjusted to pH 7.6 and a conductivity of 1500 μS/cm, then passed through a bead filter, UV reactor, bioreactor, and chiller. Sockeye prefer cooler waters (8 °C optimum), and thus exposure temperatures were maintained at 5.0−10.3 °C for the cross-species vulnerability experiments involving sockeye and the three other salmonids. For the dilution experiments (coho only), temperatures ranged from 10.0 to 12.1 °C. Fish sizes and water quality measurements for all experiments are described in the Supporting Information (Tables S3 and S4); experimental protocols were approved by Washington State University's Institutional Animal Care and Use Committee.

Stormwater Exposures to Assess Species-Specific Sensitivity. For the multispecies comparisons, replicate groups of juvenile salmonids were exposed to undiluted roadway runoff (100% stormwater) for 24 h following each of the three 2019 storm events and then transferred to clean (rearing) water for an additional 48 h (Table S1). Coho served as positive controls for the urban mortality syndrome in side-by-side exposures using subyearlings (coho, sockeye, and Chinook) and larger age 1+ salmonids (coho and steelhead). We selected an ocean-migrating stock of *O. mykiss* to differentiate the steelhead life history from domesticated, freshwater-resident strains of rainbow trout.

Static exposures were carried out in 35 L glass aquaria containing either 30 L of clean water or 100% stormwater. For the smaller fish (subyearling coho, Chinook, and sockeye), 9−10 fish were placed in each of the three replicate exposure tanks. For the larger (age 1+) coho and steelhead, n = 6 fish were placed in each of four replicate exposure tanks. A few fish escaped into the surrounding water bath and were excluded (Table S1).

Exposure tanks were supplied with air stones for oxygenation (>10 mg/L) and placed in flow-through water baths with chillers to maintain temperatures. Across all three storms, mortality was monitored throughout exposure periods at regular intervals (2, 4, 8, and 24 h). Final reported mortality counts included moribund fish that did not react to gentle prodding and were removed and euthanized with MS-222 (400 mg/L) followed by severing the spinal cord.

All fish surviving the 24 h exposure were transferred to larger (57 L) tanks containing clean water for a 48 h depuration. For the smaller fish (subyearling coho, Chinook, and sockeye), individuals were removed from the three replicate exposure tanks and grouped into a single depuration tank with a maximum number of 30 fish per tank. For the larger age 1+ coho and steelhead, fish from individual exposure tanks were divided evenly into two depuration tanks (n = 12 maximum per tank, to adjust for larger fish). Moribund and dead fish were monitored and removed midway through depuration (48 h) and at the end of depuration (72 h).

Stormwater Exposures to Assess the Influence of Dilution on the Mortality Syndrome. To evaluate dilution, juvenile coho were exposed to a graded stormwater concentration series for 24 h following three storms in 2018 (Table S2). Juvenile coho (age 1+; Table S4) were placed in static exposure chambers as described above. Glass aquaria (35 L) were filled with either 30 L of clean water or urban stormwater diluted to 25%, 11.2%, 5%, 2.2%, or 1% with clean water. For the August and December storms, individual fish (n = 8, adjusted for size) were placed in each of three replicate tanks per concentration. For the October storm, a mechanical failure (chiller) necessitated a shift in experimental design, whereby n = 10 fish were exposed in each of the two replicate

https://doi.org/10.1021/acs.estlett.2c00467
Environ. Sci. Technol. Lett. 2022, 9, 733−738

tanks per dilution. Mortality was enumerated as described above.

Statistical Analyses. Statistical analyses were developed using R (https://www.r-project.org/) and RStudio (https://www.rstudio.com). Mortality was calculated in proportion to the total number of individuals across all tanks within a given treatment (e.g., exposure, species, time, and/or dilution; see data in Tables S1 and S2). For each observed proportion, the 95% confidence interval was calculated using the BinomCI function from the DescTools R package with the "modified Wilson" method to account for proportions near 0 and 1 (presented as percentages in Figure 1). Differences among treatments were determined by comparing confidence intervals around the observed proportions.

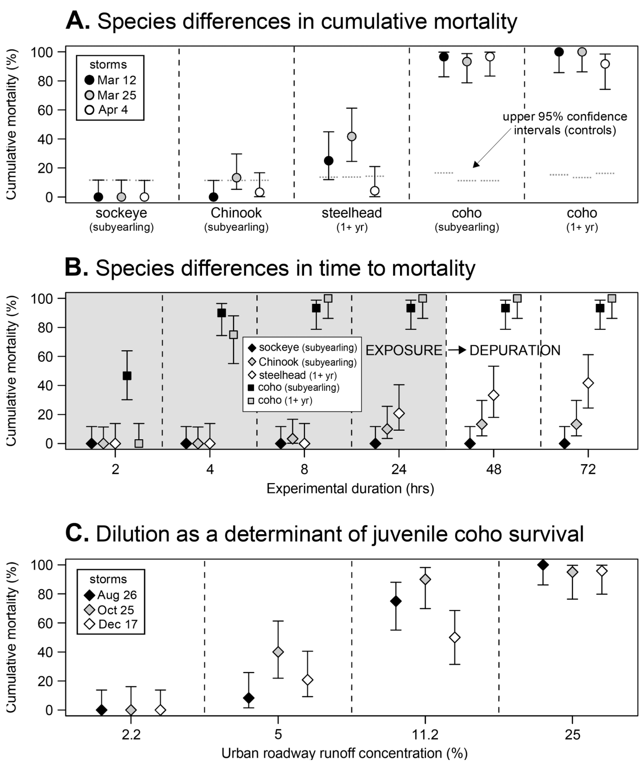


Figure 1. Cumulative mortality (% and 95% confidence interval) of juvenile Pacific salmonids exposed to urban roadway runoff. (A) Species differences across three storms following 24 h exposure and 48 h depuration. Upper 95% confidence intervals of controls are shown as dotted lines. (B) Species differences in mortality over time for a single storm (March 25) after 24 h exposure (gray shaded area) and 48 h depuration (unshaded area). (C) Mortality in coho (1+ yr) exposed for 24 h to different dilutions of roadway runoff over three storms. No mortality was observed in controls. (A–C) Data from all control and exposed fish are shown in Tables S1 and S2. Fish age is noted as subyearlings or 1+ yrs.

RESULTS AND DISCUSSION

Varying Mortality in Response to Untreated Stormwater Across Salmonid Species. Juvenile sockeye, Chinook, and steelhead, as well as two size classes of juvenile coho (positive controls), were exposed to untreated roadway runoff from three separate storm events (Figure 1A). As anticipated from earlier studies,[4,15,16] subyearling and larger (age 1+) coho were highly susceptible to toxic runoff, as evidenced by >90% cumulative mortality (Figure 1A; right-most panels) across all three 2019 storms. Conversely, all juvenile sockeye survived 24 h exposures to runoff, irrespective of the storm, similar to previous observations of 100% survival for chum.[13,14] The response of juvenile Chinook was less consistent, with only modest mortality in response to the second (March 25) storm. Steelhead were intermediate between sockeye (no deaths) and coho (almost no survivors), with proportionately higher mortality for the first and second storms (Figure 1A).

Species-Specific Timelines for the Mortality Syndrome. Among Pacific salmonids, the stormwater mortality phenomenon has primarily been studied in coho, where the progression of the syndrome—from asymptomatic fish to visible distress (disorientation, loss of equilibrium) to death—occurs over a span of a few hours in fish exposed to 100% stormwater. In accord with earlier published results,[15] juvenile coho began dying soon during exposure (2−4 h), with near-maximal cumulative mortality within 8 h (Figure 1B; stormwater exposure window in shaded panels at left). Relative to coho (positive controls), the progressions of symptoms in Chinook and steelhead were qualitatively the same (surface swimming and gaping, loss of equilibrium) albeit with a delayed onset and a longer window for mortality thereafter, with fish generally dying toward the end of the 24 h exposure or after subsequent transfer to clean water. Hence, similar to coho,[15] the distress syndrome in Chinook and steelhead appears irreversible.

Influence of Dilution on Coho Survival. Our sourcing of stormwater from an urban arterial with high traffic volume (relatively concentrated runoff) is well suited for studies of green infrastructure effectiveness[16,17] but is less representative of exposure conditions in salmon habitats where stormwater is diluted by receiving waters. To evaluate the influence of dilution on survival, juvenile coho were exposed to runoff from three separate storm events for 24 h, at concentrations ranging from 1% to 25%. Mixtures containing 5% or more stormwater were generally lethal to juvenile coho (Figure 1C). Note that the upper end of the exposure range (25% runoff diluted in clean water) was chosen based on maximal coho lethality in pilot experiments; untreated surface runoff is likely to represent more than 25% of receiving surface water volumes in many urban watersheds.

Implications. In the U.S. Pacific Northwest, the urban runoff mortality phenomenon has been studied intensively for the past two decades, with a primary focus on adult coho returning from the ocean to spawn in urbanized Puget Sound watersheds.[10,18] Wild coho populations are unlikely to withstand the high rates of dying spawners previously and consistently documented in urban stream reach surveys.[9] The mortality syndrome was subsequently extended to juvenile coho,[15] which enabled relatively high-throughput testing of stormwater fractions and set the stage for the eventual discovery of 6PPD-q as the causative agent.[4] Because the parent compound (6PPD) and other chemicals similar in structure and function are ubiquitous in motor vehicle tires worldwide, there has been an expanding effort to identify other fish species at risk from exposure to untreated roadway runoff. Our current findings extend the urban runoff mortality phenomenon to steelhead and Chinook but with phenotypic nuances in severity (less) and time course (longer) relative to coho. Nevertheless, the characteristics of the syndrome in coho exposed to roadway runoff (e.g., the present study; Chow et al.[15]) or 6PPD-q alone (e.g., Tian et al.[4]) are the same,

https://doi.org/10.1021/acs.estlett.2c00467
Environ. Sci. Technol. Lett. 2022, 9, 733−738

implying a common underlying mechanism. The discussion that follows therefore hypothesizes that the coho, steelhead, and Chinook toxicity observed here was caused by 6PPD-q across the different stormwater collections, an assumption further supported by recent findings for *O. mykiss*.[12] For context, coho are exceptionally sensitive to 6PPD-q toxicity, with lethality (LC50) in response to exposure concentrations less than 0.1 parts per billion.[19] In the present study, 6PPD-q levels were likely to have exceeded this acute lethality threshold for coho across all storms by an order of magnitude. This is supported by published 6PPD-q measurements in runoff from the same source (SR520 elevated bridge) across nine separate rain events in 2017−2019,[4,19] including the October and December stormwaters collected for the dilution experiments in Figure 1C (Table S3).

Our current findings are the first demonstration of urban runoff-driven mortality in Chinook, and our sockeye results reinforce what are apparently stark differences in vulnerability across closely related salmonids. For example, whereas coho (*O. kisutch*) are highly sensitive,[19] several field and laboratory studies have shown that congeneric chum salmon (*O. keta*) are not.[10,13] Similar to chum, zebrafish (*Danio rerio*) and medaka (*Oryzias latipes*) appear relatively insensitive to 6PPD-q,[20,21] along with Arctic char (*Salvelinus alpinus*) and white sturgeon (*Acipenser transmontanus*).[12] Conversely, Brinkmann et al.[12] recently showed that brook trout (*Salvelinus fontinalis*), like coho, are also highly sensitive to the acutely lethal toxicity of 6PPD-q. Intriguingly, in the same study, the time to death for rainbow trout (*O. mykiss*) was intermediate, with mortality occurring over a more protracted timeline of a few days. On the basis of these initial findings, the Salmonidae appear to sort into roughly three categories of vulnerability to 6PPD-q acute toxicity: high (coho salmon and brook trout), low (chum and sockeye salmon, Arctic char), and intermediate (steelhead/rainbow trout, Chinook salmon).

In the context of threatened species management, the recent *O. mykiss* results are particularly noteworthy. In addition to being a model test organism in aquatic toxicology, rainbow trout are an important aquaculture species for recreational fishing.[22] In the western United States, several distinct population segments (or evolutionarily significant units) of ocean-migrating *O. mykiss* (steelhead) are currently listed for protection under the U.S. Endangered Species Act (ESA). Accordingly, freshwater and estuarine habitats critical for steelhead conservation and recovery have been designated across major metropolitan areas in the coastal and interior regions of California, Oregon, and Washington. The overlap between these recovery domains and the expanding transportation grid, at the watershed and basin scales, is extensive. The ESA requires that federal natural resource managers consider the impacts of federal actions on listed species, and stormwater contaminants (e.g., 6PPD-q) represent a habitat factor that was largely unknown to science when steelhead were listed.

For *O. mykiss*, the initial evidence suggests that life history plasticity (i.e., freshwater residence vs ocean migration) is not a determinant of susceptibility, albeit premised on two important assumptions: (1) Variation in genetics or husbandry/culture practices between the *O. mykiss* stocks used here and those sourced for Brinkmann et al.[12] did not influence observed toxicity, and (2) 6PPD-q was the causative agent for *O. mykiss* deaths here, thus facilitating a direct comparison of mortality across the two studies. Irrespective, more work is needed—particularly experimental designs that consider phenotypic and genetic differences across wild steelhead stocks. The intermediate and delayed nature of the mortality syndrome in steelhead and Chinook (relative to coho) also raises the potential significance of sublethal toxicity. The recent discovery of 6PPD-q should expedite functional studies of neurobehavioral and cardiorespiratory dysregulation, to match the consistently dominant features of the distress phenotype (e.g., surface swimming and gaping, loss of orientation and equilibrium).

Our findings also directly address the potential role of dilution in receiving waters, as a conventional management strategy for reducing toxic impacts to aquatic communities. Recent laboratory study designs[14−17] have used urban runoff from a relatively intensively trafficked arterial, in part as a strategy to establish a clear baseline of toxicity in fish and invertebrates prior to green infrastructure treatments to evaluate pollutant removal and improved organismal health. While this approach was useful for challenging bioinfiltration soil systems,[16,17] exposures to undiluted arterial roadway runoff are not necessarily representative of receiving water quality conditions in large rivers or lakes or in habitats downstream from a site-specific stormwater discharge. Field surveys have consistently demonstrated high rates of coho spawner mortality across all urban watersheds where the phenomenon has been studied closely.[11] Therefore, a protective role for dilution has (to date) seemed unlikely, given these indirect lines of evidence.[10,11] Consistent with this, arterial runoff was acutely lethal to juvenile coho salmon, even when diluted in 95% clean water. Additional factors working against "dilution as the solution" to the urban runoff mortality syndrome include the ubiquitous and diffuse nature of stormwater inputs to salmon habitats (e.g., serial and repeated discharges along migration corridors), ongoing climate change (i.e., reduced receiving water volumes), and the possibility of sublethal toxicity at the lower end of the dilution exposure range examined here. To address these factors, future studies can focus on a few related chemicals (antiozonants and associated transformation products, as opposed to whole urban runoff), using an extensive and established set of tools for studying cardiorespiratory and neurobehavioral toxicity in fish (e.g., Blair et al.[23]). These studies are needed to more precisely define sublethal toxicity thresholds in ESA-listed steelhead and Chinook and to better understand what appear to be striking sensitivity differences across closely related species of salmon, trout, and char.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acs.estlett.2c00467.

Table S1: All data for the species comparison exposure studies. Table S2: All data collected for the exposure studies evaluating dilution effect. Table S3: Storm information and water quality measurements. Table S4: Information related to the fish such as age, size, and hatchery of origin. (XLSX)

■ AUTHOR INFORMATION

Corresponding Author

N. L. Scholz − *Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric*

https://doi.org/10.1021/acs.estlett.2c00467
Environ. Sci. Technol. Lett. 2022, 9, 733−738

Administration, Seattle, Washington 98112, United States; orcid.org/0000-0001-6207-0272;
Email: nathaniel.scholz@noaa.gov

Authors

B. F. French − *Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Seattle, Washington 98112, United States;* orcid.org/0000-0002-2358-9044

D. H. Baldwin − *Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Seattle, Washington 98115, United States*

J. Cameron − *Saltwater Inc, under contract to Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Seattle, Washington 98112, United States*

J. Prat − *School of the Environment, Puyallup Research and Extension Center, Washington State University, Puyallup, Washington 98371, United States*

K. King − *Environmental Contaminants Program, United States Fish and Wildlife Service, Lacey, Washington 98503, United States*

J. W. Davis − *Environmental Contaminants Program, United States Fish and Wildlife Service, Lacey, Washington 98503, United States*

J. K. McIntyre − *School of the Environment, Puyallup Research and Extension Center, Washington State University, Puyallup, Washington 98371, United States;* orcid.org/0000-0003-3480-7083

Complete contact information is available at:
https://pubs.acs.org/10.1021/acs.estlett.2c00467

Notes

The authors declare no competing financial interest.

■ ACKNOWLEDGMENTS

This effort was supported by federal funding for Puget Sound recovery (EPA Interagency Agreement DW-014092437301). Washington State University was also supported by the Alice C. Tyler Trust, the Governor of Washington State, McIntire-Stennis Grant #NI19MSCFRXXXG034, accession #1015288 from the USDA National Institute of Food and Agriculture, and Seattle Public Utilities. We thank Emma Mudrock and Jill Wetzel for assistance with animal husbandry and conducting the exposures. Fish were generously provided by the Washington Department of Fish & Wildlife and the Puyallup Tribe. Additional assistance was provided by Chelsea Mitchell, Stephanie Blair, Lane Maguire, Ben Leonard, Michelle Chow, Jana Labenia, and Julann Spromberg. Our thanks to Su Kim for creating the graphic embedded in the abstract. Findings and conclusions herein are those of the authors and do not necessarily represent the views of the sponsoring organizations.

■ REFERENCES

(1) Tian, Z.; Peter, K. T.; Gipe, A. D.; Zhao, H.; Hou, F.; Wark, D. A.; Khangaonkar, T.; Kolodziej, E. P.; James, C. A. Suspect and Nontarget Screening for Contaminants of Emerging Concern in an Urban Estuary. *Environ. Sci. Technol.* **2020**, *54* (2), 889−901.

(2) Du, B.; Lofton, J. M.; Peter, K. T.; Gipe, A. D.; James, C. A.; McIntyre, J. K.; Scholz, N. L.; Baker, J. E.; Kolodziej, E. P. Development of Suspect and Non-target Screening Methods for Detection of Organi c Contaminants in Highway Runoff and Fish Tissue with High-resolution Time-of-flight Mass Spectrometry. *Environmental Science: Processes & Impacts* **2017**, *19* (9), 1185−1196.

(3) Peter, K. T.; Lundin, J. I.; Wu, C.; Feist, B. E.; Tian, Z.; Cameron, J. R.; Scholz, N. L.; Kolodziej, E. P. Characterizing the Chemical Profile of Biological Decline in Stormwater-Impacted Urban Watersheds. *Environ. Sci. Technol.* **2022**, *56* (5), 3159−3169.

(4) Tian, Z.; Zhao, H.; Peter, K. T.; Gonzalez, M.; Wetzel, J.; Wu, C.; Hu, X.; Prat, J.; Mudrock, E.; Hettinger, R.; Cortina, A. E.; Biswas, R. G.; Kock, F. V. C.; Soong, R.; Jenne, A.; Du, B.; Hou, F.; He, H.; Lundeen, R.; Gilbreath, A.; Sutton, R.; Scholz, N. L.; Davis, J. W.; Dodd, M. C.; Simpson, A.; McIntyre, J. K.; Kolodziej, E. P. A Ubiquitous Tire Rubber-derived Chemical Induces Acute Mortality in Coho Salmon. *Science* **2021**, *371* (6525), 185−189.

(5) Peter, K. T.; Hou, F.; Tian, Z.; Wu, C.; Goehring, M.; Liu, F.; Kolodziej, E. P. More Than a First Flush: Urban Creek Storm Hydrographs Demonstrate Broad Contaminant Pollutographs. *Environ. Sci. Technol.* **2020**, *54* (10), 6152−6165.

(6) Rauert, C.; Charlton, N.; Okoffo, E. D.; Stanton, R. S.; Agua, A. R.; Pirrung, M. C.; Thomas, K. V. Concentrations of Tire Additive Chemicals and Tire Road Wear Particles in an Australian Urban Tributary. *Environ. Sci. Technol.* **2022**, *56* (4), 2421−2431.

(7) Johannessen, C.; Helm, P.; Lashuk, B.; Yargeau, V.; Metcalfe, C. D. The Tire Wear Compounds 6PPD-Quinone and 1,3-Diphenylguanidine in an Urban Watershed. *Arch. Environ. Contam. Toxicol.* **2022**, *82* (2), 171−179.

(8) Seiwert, B.; Nihemaiti, M.; Troussier, M.; Weyrauch, S.; Reemtsma, T. Abiotic Oxidative Transformation of 6-PPD and 6-PPD Quinone from Tires and Occurrence of their Products in Snow from Urban Roads and in Municipal Wastewater. *Water Res.* **2022**, *212*, 118122.

(9) Spromberg, J. A.; Scholz, N. L. Estimating the Future Decline of Wild Coho Salmon Populations Resulting from Early Spawner Die-offs in Urbanizing Watersheds of the Pacific Northwest, USA. *Integrated Environmental Assessment and Management* **2011**, *7* (4), 648−656.

(10) Scholz, N. L.; Myers, M. S.; McCarthy, S. G.; Labenia, J. S.; McIntyre, J. K.; Ylitalo, G. M.; Rhodes, L. D.; Laetz, C. A.; Stehr, C. M.; French, B. L.; McMillan, B.; Wilson, D.; Reed, L.; Lynch, K. D.; Damm, S.; Davis, J. W.; Collier, T. K. Recurrent Die-Offs of Adult Coho Salmon Returning to Spawn in Puget Sound Lowland Urban Streams. *PLoS One* **2011**, *6* (12), e28013.

(11) Feist, B. E.; Buhle, E. R.; Baldwin, D. H.; Spromberg, J. A.; Damm, S. E.; Davis, J. W.; Scholz, N. L. Roads to Ruin: Conservation Threats to a Sentinel Species across an Urban Gradient. *Ecological Applications* **2017**, *27* (8), 2382−2396.

(12) Brinkmann, M.; Montgomery, D.; Selinger, S.; Miller, J. G. P.; Stock, E.; Alcaraz, A. J.; Challis, J. K.; Weber, L.; Janz, D.; Hecker, M.; Wiseman, S. Acute Toxicity of the Tire Rubber-Derived Chemical 6PPD-quinone to Four Fishes of Commercial, Cultural, and Ecological Importance. *Environmental Science & Technology Letters* **2022**, *9*, 333−338.

(13) McIntyre, J. K.; Prat, J.; Cameron, J.; Wetzel, J.; Mudrock, E.; Peter, K. T.; Tian, Z.; Mackenzie, C.; Lundin, J.; Stark, J. D.; King, K.; Davis, J. W.; Kolodziej, E. P.; Scholz, N. L. Treading Water: Tire Wear Particle Leachate Recreates an Urban Runoff Mortality Syndrome in Coho but Not Chum Salmon. *Environ. Sci. Technol.* **2021**, *55* (17), 11767−11774.

(14) McIntyre, J. K.; Lundin, J. I.; Cameron, J. R.; Chow, M. I.; Davis, J. W.; Incardona, J. P.; Scholz, N. L. Interspecies Variation in the Susceptibility of Adult Pacific Salmon to Toxic Urban Stormwater Runoff. *Environ. Pollut.* **2018**, *238*, 196−203.

(15) Chow, M. I.; Lundin, J. I.; Mitchell, C. J.; Davis, J. W.; Young, G.; Scholz, N. L.; McIntyre, J. K. An Urban Stormwater Runoff Mortality Syndrome in Juvenile Coho Salmon. *Aquatic Toxicology* **2019**, *214*, 105231.

(16) McIntyre, J. K.; Davis, J. W.; Hinman, C.; Macneale, K. H.; Anulacion, B. F.; Scholz, N. L.; Stark, J. D. Soil Bioretention Protects Juvenile Salmon and their Prey from the Toxic Impacts of Urban Stormwater Runoff. *Chemosphere* **2015**, *132*, 213−219.

https://doi.org/10.1021/acs.estlett.2c00467
Environ. Sci. Technol. Lett. 2022, 9, 733−738

(17) Spromberg, J. A.; Baldwin, D. H.; Damm, S. E.; McIntyre, J. K.; Huff, M.; Sloan, C. A.; Anulacion, B. F.; Davis, J. W.; Scholz, N. L. Coho Salmon Spawner Mortality in Western US Urban Watersheds: Bioinfiltration Prevents Lethal Storm Water Impacts. *Journal of Applied Ecology* **2016**, *53* (2), 398−407.
(18) McCarthy, S. G.; Incardona, J.; Scholz, N. Coastal Storms, Toxic Runoff, and the Sustainable Conservation of Fish and Fiisheries. *American Fisheries Society Symposium* **2008**, *64*, 7−27.
(19) Tian, Z.; Gonzalez, M.; Rideout, C. A.; Zhao, H. N.; Hu, X.; Wetzel, J.; Mudrock, E.; James, C. A.; McIntyre, J. K.; Kolodziej, E. P. 6PPD-Quinone: Revised Toxicity Assessment and Quantification with a Commercial Standard. *Environmental Science & Technology Letters* **2022**, *9* (2), 140−146.
(20) Hiki, K.; Asahina, K.; Kato, K.; Yamagishi, T.; Omagari, R.; Iwasaki, Y.; Watanabe, H.; Yamamoto, H. Acute Toxicity of a Tire Rubber-Derived Chemical, 6PPD Quinone, to Freshwater Fish and Crustacean Species. *Environmental Science & Technology Letters* **2021**, *8* (9), 779−784.
(21) Varshney, S.; Gora, A. H.; Siriyappagouder, P.; Kiron, V.; Olsvik, P. A. Toxicological Effects of 6PPD and 6PPD Quinone in Zebrafish Larvae. *Journal of Hazardous Materials* **2022**, *424*, 127623.
(22) Barnes, M. E.; Whelan, G. E. Visitor Policies and Practices at Public Trout and Salmon Hatcheries in North America. *Fisheries* **2004**, *29* (10), 16−21.
(23) Blair, S. I.; Barlow, C. H.; McIntyre, J. K. Acute Cerebrovascular Effects in Juvenile Coho Salmon Exposed to Roadway Runoff. *Canadian Journal of Fisheries and Aquatic Sciences* **2021**, *78* (2), 103−109.

Recommended by ACS

The Tire-Derived Chemical 6PPD-quinone Is Lethally Toxic to the White-Spotted Char *Salvelinus leucomaenis pluvius* but Not to Two Other Salmonid Species

Kyoshiro Hiki and Hiroshi Yamamoto
NOVEMBER 07, 2022
ENVIRONMENTAL SCIENCE & TECHNOLOGY LETTERS
READ

Low Levels of Contaminants Stimulate Harmful Algal Organisms and Enrich Their Toxins

Evgenios Agathokleous, Edward J. Calabrese, *et al.*
AUGUST 13, 2022
ENVIRONMENTAL SCIENCE & TECHNOLOGY
READ

Influence of Life-History Parameters on Persistent Organic Pollutant Concentrations in Blubber of Eastern North Pacific Gray Whales (*Eschrichtius robustus*)

Kia R. R. Hayes, Céline A. J. Godard-Codding, *et al.*
NOVEMBER 08, 2022
ENVIRONMENTAL SCIENCE & TECHNOLOGY
READ

Widening the Lens on UV Filters: Newfound Ubiquity of Triazine UV Filters in Breast Milk from South China and Implications for Augmented "Cocktail" Exposure in Infants

Yuying Sun, Lixi Zeng, *et al.*
SEPTEMBER 12, 2022
ENVIRONMENTAL SCIENCE & TECHNOLOGY LETTERS
READ

Get More Suggestions >

EXHIBIT G

Downloaded via Zhenyu Tian on January 16, 2022 at 19:26:29 (UTC).
See https://pubs.acs.org/sharingguidelines for options on how to legitimately share published articles.

Environmental Science & Technology LETTERS

pubs.acs.org/journal/estlcu

Letter

6PPD-Quinone: Revised Toxicity Assessment and Quantification with a Commercial Standard

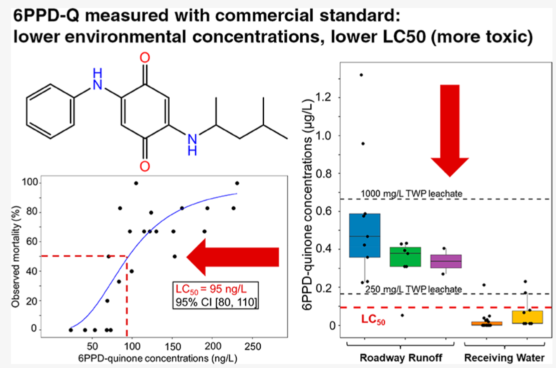
Zhenyu Tian,* Melissa Gonzalez, Craig A. Rideout, Haoqi Nina Zhao, Ximin Hu, Jill Wetzel, Emma Mudrock, C. Andrew James, Jenifer K. McIntyre, and Edward P. Kolodziej*

Cite This: https://doi.org/10.1021/acs.estlett.1c00910

Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: Stormwater exposure can cause acute mortality of coho salmon (*Oncorhynchus kisutch*), and 6PPD-quinone (6PPD-Q) was identified as the primary causal toxicant. Commercial standards of 6PPD-Q recently became available; their analysis highlighted a systematic high bias in prior reporting concerning 6PPD-Q. A 6PPD-Q commercial standard was used to re-confirm toxicity estimates in juvenile coho salmon and develop a liquid chromatography-tandem mass spectrometry analytical method for quantification. Peak area responses of the commercial standard were ~15 times higher than those of in-house standards, and the updated LC_{50} value (95 ng/L) was ~8.3-fold lower than that previously reported. These data support prior relative comparisons of the occurrence and toxicity while confirming the substantial lethality of 6PPD-Q. While environmental concentrations are expected to be lower, 6PPD-Q also was more toxic than previously calculated and should be categorized as a "very highly toxic" pollutant for aquatic organisms. Isotope dilution-tandem mass spectrometry methods enabled accurate quantification (limits of quantification of <10 ng/L) within environmental samples.



■ INTRODUCTION

Stormwater runoff is an important contaminant transport pathway in rapidly urbanizing areas,[1] and the complex mixtures of stormwater contaminants often substantially degrade receiving water quality.[2,3] While heavy metals and polycyclic aromatic hydrocarbons have long been regulated pollutants in stormwater, recent studies have reported numerous emerging organic contaminants such as various pesticides, pharmaceuticals, plasticizers, and vehicle and tire rubber-related contaminants.[4−7] Such contaminants can impact aquatic organisms; one compelling example is the stormwater-linked urban runoff mortality syndrome (URMS) of coho salmon (*Oncorhynchus kisutch*) in the Pacific Northwest (USA). Every autumn, recurrent acute mortality occurs when adult coho salmon return to near-urban creeks to spawn.[8] Across sub-basins, mortality rates were most correlated with road density and traffic intensity.[9,10]

While investigating URMS, we previously identified 6PPD-quinone {6PPD-Q; 2-anilino-5-[(4-methylpentan-2-yl)amino]-cyclohexa-2,5-diene-1,4-dione}, an ozonation product of 6PPD, as the primary causal toxicant for long-standing observations of coho mortality.[11] Exposure experiments demonstrated acute toxicity at trace levels (LC_{50} of 0.8 μg/L), and retrospective analysis confirmed detection within roadway runoff and receiving waters, including during URMS events. Because the parent antioxidant compound 6PPD is ubiquitous in tire rubbers, 6PPD-Q would be expected to occur widely in roadway-impacted environments globally, although the hazards of its exposure and toxicity to humans and other organisms remain mostly unknown. Recent studies have confirmed the occurrence of 6PPD-Q in surface waters,[12,13] dusts,[14,15] and fine particulates.[16] Therefore, its potential toxicological effects and ubiquitous occurrence merit monitoring of 6PPD-Q to understand its environmental fate and enable management.

As a newly discovered transformation product, the toxicological experiments and quantification reported by Tian et al.[11] used our own 6PPD-Q standards purified from ozone synthesis and tire wear particle leachate (see the Supporting Information). Recently, a commercial standard and an isotope-labeled standard (D5-6PPD-Q) became available. During analysis, we observed a substantially higher (~15-fold) peak area response of the commercial 6PPD-Q standard versus those of our in-house standards (Figure S1). This observation implied a systematic high bias to the environmental and

Received: November 11, 2021
Revised: January 3, 2022
Accepted: January 5, 2022

© XXXX American Chemical Society

exposure concentrations we reported previously.[11] The lower responses of in-house standards could be caused by the limited solubility or sorption of 6PPD-Q, and we also are investigating possible oxidative polymerization and solid formation within our in-house stocks as potential fate outcomes for quinones.

To correct for potential inaccuracy in previous 6PPD-Q reporting due to the lower purity and/or performance of our in-house standards, we repeated our exposures to juvenile coho salmon with the commercial standard and revised our measured environmental concentrations. We also developed an isotope dilution analytical method based upon liquid chromatography-tandem mass spectrometry (LC-MS/MS). Using these improved quantitative methods, these data represent a timely communication of our current knowledge of the toxicity and expected environmental concentrations of 6PPD-Q.

■ MATERIALS AND METHODS

Chemicals. Commercial standards of 6PPD-Q (10 mg, 98.8% purity, solid) and D5-6PPD-Q (solution in acetonitrile, 100 mg/L) were purchased from HPC (Atlanta, GA). Methanol (LCMS grade), ethanol (absolute, 200 proof), and formic acid (HPLC grade) were purchased from Fisher Scientific. Deionized water (18 MΩ-cm) was generated by a Milli-Q Ultrapure Water System. The 6PPD-Q stock solution (stored at −20 °C) was made by dissolving 5 mg of the HPC standard in 50 mL of ethanol.

Coho Salmon and Exposure Experiments. Juvenile coho salmon used for exposures were obtained courtesy of the Puyallup Tribe of Indians, from the same stock (Diru Creek) and cohort (now age 1+, 30−64 g) as in the previous study.[11] Fish were reared at Washington State University's Puyallup Research and Extension Center on a 12 h:12 h light:dark cycle in a custom recirculating water system and fed commercial food (Biovita, Bio-Oregon, Oregon, WA). Fish system water was dechlorinated municipal water treated by reverse osmosis to Type 3 (>4 MΩ-cm, <0.25 μS/cm) in a RiOs 200 purification system (Millipore Sigma) and then reconstituted with buffered Instant Ocean (Blacksburg, VA) salts to pH ∼7.6 and 1300 μS/cm conductivity at 10−13 °C. Experiments conformed to Experimental Protocol 04860-002, approved by Washington State University's Institutional Animal Care and Use Committee.

For exposures, glass aquaria were randomly placed in recirculating water baths to control temperature. Static aerated exposures were prepared by diluting various volumes of the 6PPD-Q stock solution in 10 mL of ethanol (350−1400 ng/mL), which was then mixed with 70 L of system water; negative controls were pure ethanol (10 mL). Solvent:exposure water ratios matched those of Tian et al.[11] Solutions and negative controls were made within 24 h of exposure. Larger exposure volumes (70 L) and fewer fish per aquarium ($N = 6$) were used here to accommodate the larger fish (30 L with 8−10 fish per aquarium used previously[11]). In two range-finding experiments (0.16−4.0 μg/L and 20−200 ng/L), five concentrations were tested, with five or six fish per concentration. To determine LC_{50}, six concentrations of 6PPD-Q and a negative control were tested. Exposures were repeated in triplicate (batches 1−3, across 3 weeks). Including 30 fish in the second range finding and 108 fish in the three definitive experiments, 138 fish contributed to dose−response exposures (Table S1; controls not included). Four fish jumped out of aquaria during exposures, so 134 fish contributed to the dose−response curve. In all aquaria, safe conditions of temperature (10−13 °C), conductivity (1170−1370 μS/cm), pH (7.6−8.0), and dissolved oxygen (>98% saturation) were verified before fish were transferred. Just prior to the introduction of fish, 1 L of exposure water was sampled from each aquarium, stored on ice or refrigerated, and extracted within 24 h for analysis. For all exposures, mortality rates were recorded at 24 h. Dose−response curves were calculated in R 3.6.2 using a two-parameter log−logistic model in the *drc* package.

Analytical Method. For quantification, duplicates of 200 mL of exposure water from each aquarium (corresponding to one concentration) were spiked with 5 ng of D5-6PPD-Q (100 ng/mL, 0.05 mL) as the internal standard, mixed, and equilibrated (20 min) before extraction. Solid phase extraction (SPE) used Oasis HLB cartridges (6 mL, 200 mg) (see the Supporting Information for details). Eluents were concentrated under a gentle nitrogen flow and volumized to 1 mL for analysis.

Quantification used an Agilent 1290 (Santa Clara, CA) Infinity ultra-high-performance liquid chromatograph (UHPLC) coupled to an Agilent 6460A triple-quadrupole mass spectrometer. Detection used electrospray ionization (ESI+) and multiple-reaction monitoring (MRM) modes. 6PPD-Q concentrations were estimated from a seven-point calibration curve [0.025−50 μg/L (Figure S2)] with D5-6PPD-Q as the isotopic internal standard (25 μg/L, identical to the concentrations of sample extracts). Detailed parameters and method information can be found in Tables S2 and S3 and the text of the Supporting Information.

Quality Assurance/Quality Control. Negative controls were included in batches 1−3 of definitive exposures for LC_{50} determination; all coho salmon ($N = 18$) survived negative controls. Negative controls were processed in a manner identical to that of dosed samples, and additional SPE method blanks were included by extracting and analyzing 200 mL of DI water using identical methods. After laboratory materials (e.g., rubber stoppers) with potential to generate background signals had been screened and removed, 6PPD-Q was not detected above the limit of detection in blanks. Intraday/interday precisions were determined by comparing 2.5 μg/L standard responses multiple ($N \geq 3$) times across one analytical batch or in batches across different dates. All exposure water samples were extracted in duplicate, and then measured and nominal concentrations were compared.

Matrix spikes were performed by spiking 6PPD-Q (5 and 50 ng/L) into Miller Creek (47°27′2.2″N, 122°20′44″W; Burien, WA) baseflow and DI water samples. Absolute recoveries were 58−95%; relative recoveries were 89−116% for the spikes (details in the Supporting Information). The limits of detection (LOD) and quantification (LOQ) were determined as the lowest concentrations giving signal:noise (S:N) ratios of 3 and 10, respectively. The instrumental LOD and LOQ were calculated from low-concentration 6PPD-Q standards (0.025 and 0.1 μg/L), and the method LOD and LOQ (reflecting the mass concentration via SPE) were calculated from spiked creek water samples.

■ RESULTS AND DISCUSSION

Peak Area Response and Toxicity Confirmation. Upon receipt, we first compared the commercial standard (HPC) to our in-house standard[11] across the same nominal concentration range and observed an unexpected difference between

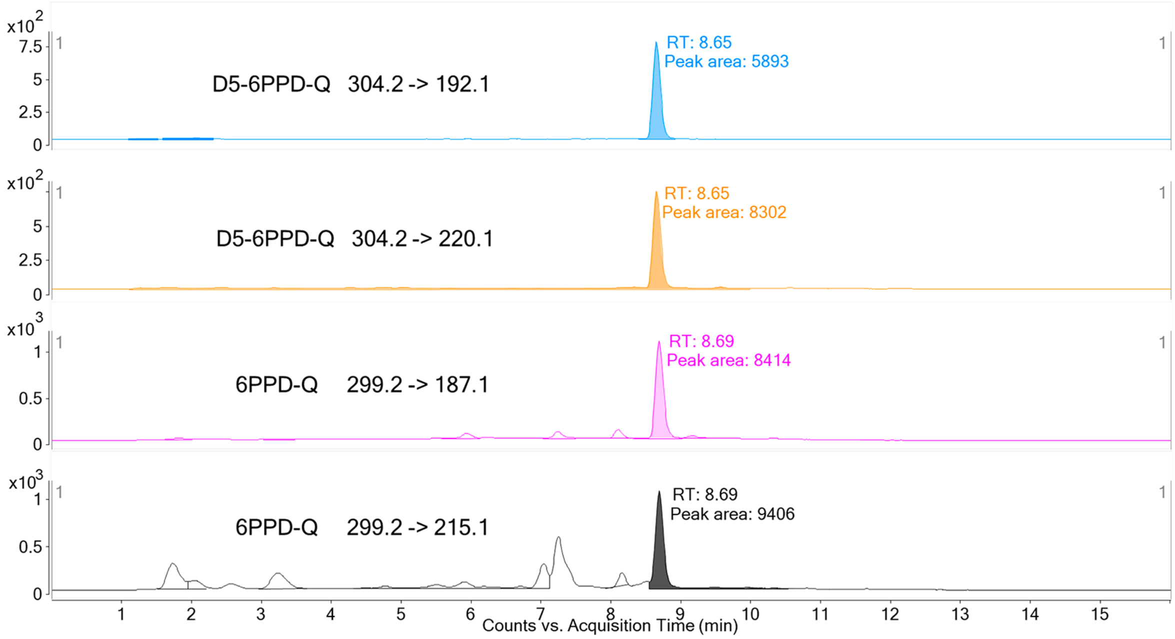


Figure 1. Chromatograms of 6PPD-Q in a stormwater-impacted creek measured by HPLC-MS/MS in MRM mode (measured concentration of 48 ng/L). The top two transitions were the quantitative and qualitative ions of D5-6PPD-Q (internal standard, spiked at 25 ng/L), and the bottom two transitions were the quantitative and qualitative ions of 6PPD-Q. RT, retention time.

the peak area responses of the two calibration curves (Figure S1). The peak area difference was confirmed on both qTOF-HRMS (~15-fold) and MS/MS (~18-fold) instrument platforms, with slight differences caused by the different sensitivities and/or linear ranges of the two instruments. Meanwhile, at identical nominal concentrations, the red/magenta color of the commercial standard solution was visually more intense than that of in-house standards. Ultraviolet−visible spectrophotometry also indicated substantially reduced absorbance for the in-house stock solutions versus the commercial standard stocks at key diagnostic wavelengths [e.g., 360 nm (Supporting Information and Figure S3)].

We then evaluated the toxicity of the commercial 6PPD-Q standard to juvenile coho salmon through two range-finding exposures. Our first exposure utilized a wide nominal concentration range (0.16−4.0 μg/L) that included our previously reported LC_{50} value (0.8 μg/L, derived from exposures using in-house stocks). Observed mortality rates were 100% (five of five) at 0.8, 1.8, and 4.0 μg/L, while four of five coho salmon died at 0.16 and 0.36 μg/L. Notably, coho salmon in the 4.0 μg/L aquarium were symptomatic in ~40 min and all perished in <2 h, which is faster than any of our prior observations. Another exposure series (0.02−0.2 μg/L) demonstrated 100% mortality (six of six) at 0.2 μg/L 6PPD-Q, 67% (four of six) at 0.1 μg/L, and 0% (zero of six) at 0.02, 0.04, and 0.06 μg/L. These results confirmed the substantial toxicity of 6PPD-Q for coho salmon but also indicated that our previous observations with in-house standards had systematically underestimated toxicity.

On the basis of mass spectrometry and these preliminary exposures, we concluded that the 6PPD-Q masses of our in-house standards were lower than we expected. In considering various options for mass loss, we most suspected that we had inadvertently formed a solid precipitate or similar impurity not detected by LC-HRMS or NMR during the end stages of our 6PPD-Q purification or handling processes. The reduced responses of in-house 6PPD-Q might be caused by lower than expected solubility and sorption losses to some filter and system materials; quinones also can undergo many interesting reaction types such as oxidative polymerization and other complexations.[18−20] Although we continue to investigate potential loss mechanisms, we cannot yet conclusively explain this mass loss. On the basis of our experience, while noting the potential for redox-active quinones to exhibit some complex and uncommon fate mechanisms, we caution other investigators to carefully track 6PPD-Q stability and recovery (e.g., peak area response, validated against commercial standards, measured vs nominal concentrations[21]) over time and under experimental conditions. Further research should characterize the fate and stability of 6PPD-Q under a broad range of conditions.

Quantification Method. To improve quantification accuracy, we developed an isotope dilution analytical method using the commercial standard and an isotopic internal standard (D5-6PPD-Q). Using high-performance LC-MS/MS detection, we evaluated transitions of both native and deuterated 6PPD-Q standards (Figure S4), optimized the instrumental parameters to improve sensitivity, and validated performance with environmental samples. These studies indicated that the complex matrix in stormwater and roadway runoff was the primary challenge to analytical performance, with matrix suppression at large extraction volumes (e.g., 1 L) sometimes completely suppressing 6PPD-Q detection.[11] Matrix dilution and reduced extraction (or injection) volumes mitigated matrix suppression and tended to improve performance; thus, we used 200 mL extraction volumes to optimize sensitivity. For location-specific stormwater or roadway runoff sampling, we recommend adjusting extraction volumes in response to observed matrix suppression or sample compositions. Spiking concentrations of the isotopic standard (25 ng/L in samples, 5 μg/L in extracts) were adjusted to reflect

https://doi.org/10.1021/acs.estlett.1c00910
Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

expected environmental concentrations while maintaining sufficient sensitivity.

Chromatograms of 6PPD-Q and D5-6PPD-Q in a creek stormwater sample are shown (Figure 1). With optimized parameters (Table S2), the instrument limit of quantification was 0.16 pg on column (31 ng/L in solutions). When applied to analysis of baseflow and stormwater samples in receiving water, method limits of quantification were 2.5 and 5.1 ng/L, respectively. In comparison with our original semiquantification method using LC-qTOF-HRMS,[11] the improved sensitivity came from the more specific MS/MS transitions used for quantification, an optimized processing procedure, the increased detector linear range, and higher standard purity. Spike recovery trials indicated 89−116% relative recovery of 6PPD-Q in creek samples and <3% intraday and interday variation. Given the highly toxic nature of 6PPD-Q and often trace (<100 ng/L) environmental concentrations present in runoff-impacted receiving waters, sensitive, accurate, and robust methods will be needed to maintain performance even at concentrations of ≤10 ng/L.

Updated Dose−Response Curve. To update the dose−response curve and LC_{50} estimate with the commercial standard, we performed additional 6PPD-Q exposures on juvenile coho salmon. Exposure concentrations were quantified using the LC-MS/MS analytical method; Table S1 reports nominal concentrations, measured concentrations, and mortality details. From the updated dose−response curve (Figure 2),

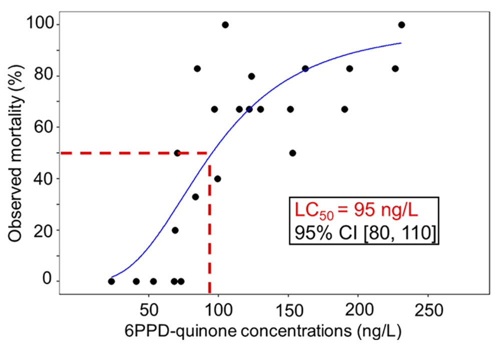


Figure 2. Dose−response curves for 24 h juvenile coho salmon exposures using the commercial HPC 6PPD-Q standard (N = 134 fish). All negative control fish survived and did not show any symptoms (N = 24; six in range finding and 18 in definitive exposure). Curves were fitted to a two-parameter logistic model. CI, confidence interval.

an LC_{50} of 95 ng/L was estimated for 6PPD-Q [95% confidence interval (CI [80, 110])]. This result was substantially lower than our previous result (790 ng/L, 95% CI [630, 960]) estimated from our in-house standards and was consistent with more dilute 6PPD-Q stock solutions. This ∼8.3-fold difference in the LC_{50} is a combined result of the peak area response (∼15-fold) and the 6PPD-Q recovery without internal standard normalization (60−70%).

Environmental Significance. The commercial standard analysis exposed a systematic high bias to our previously reported environmental concentrations and toxicity assessment for 6PPD-Q. Therefore, while *relative* comparisons between environmental concentrations and the LC_{50} in our previous work remain valid[11] (all retrospective analysis and dose−response curves were based on the same standard and quantification method), *absolute* concentrations should be revised lower on the basis of our current knowledge of the peak area response for 6PPD-Q. In general, the environmental concentrations and LC_{50} values for coho salmon should be approximately 1 order of magnitude lower than we previously reported.[11,17,22]

To illustrate the updated LC_{50} and observed environmental concentrations, we revised our previous occurrence data[11] while including additional 6PPD-Q data reported recently (Figure 3). Consistent with previous results, 6PPD-Q concentrations in almost all roadway runoff samples exceeded the LC_{50} for coho salmon and concentrations in runoff-impacted receiving waters, including storms where acute mortality occurred, were again near or above the LC_{50}. We note that environmental concentration data in Figure 3B, derived from archived sample extracts,[11] still employ semi-quantification without isotopic standard correction as an inherent aspect of retrospective analysis. Because they are not recovery-corrected, these data likely still underestimate actual concentrations by ∼30−40%. With isotope dilution normalization, more stormwater samples would be expected to contain concentrations above the LC_{50}. Overall, these results re-confirm the lethality of 6PPD-Q to coho salmon and the substantial capability for mortality outcomes at environmentally relevant concentrations.

Since the initial identification, additional reports of 6PPD-Q occurrence[13−15,23] have confirmed its ubiquity in roadway-impacted environments at reported concentrations up to the low microgram per liter range. Because rubber products like tires, including end-of-life applications in recycled and repurposed materials, are ubiquitous in modern society, continued documentation of 6PPD-Q in various environmental compartments (e.g., soil, air, and biological tissues) is expected. As demonstrated by our quantitative difficulties, accurately characterizing previously unknown contaminants, especially unintentionally produced transformation products that lack commercial standards, remains a challenging and yet critical task for environmental researchers. The updated LC_{50} (95 ng/L) suggests that 6PPD-Q is among the most toxic chemicals known for aquatic organisms, at least to coho salmon.[21] Compared directly to pollutants categorized as "very highly toxic" to sensitive aquatic organisms (mortality at <100 ppb, Table 1, rationale in the Supporting Information), the LC_{50} for coho salmon (mortality at ∼0.1 ppb) places 6PPD-Q among a very small group of pollutants, mostly organophosphate or organochlorine pesticides, with acute toxicity expectations at tens of nanograms per liter.

Many pressing knowledge gaps remain with respect to the environmental fate, transport, and toxicological implications of 6PPD-Q in tire rubber-impacted environments. Aspects of quinone stability and fate, representing contaminant structures less commonly considered and documented in environmental fields, are clearly both analytically and environmentally important to understand. The mechanisms of toxicity of 6PPD-Q to coho salmon need to be characterized, while its toxicity, both acute and sublethal, to additional organisms needs to be broadly evaluated, including insights into mechanisms of species-specific sensitivities.[21,22] Critically, 6PPD-Q reminds us that many synthetic chemicals do not simply disappear upon environmental release; we should be especially careful with chemicals like antioxidants that may have toxic properties[24] and are also designed to react. The lifetime mass balance of 6PPD, 6PPD-Q, and related chemicals in rubber tires that are subject to widespread environmental

https://doi.org/10.1021/acs.estlett.1c00910
Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

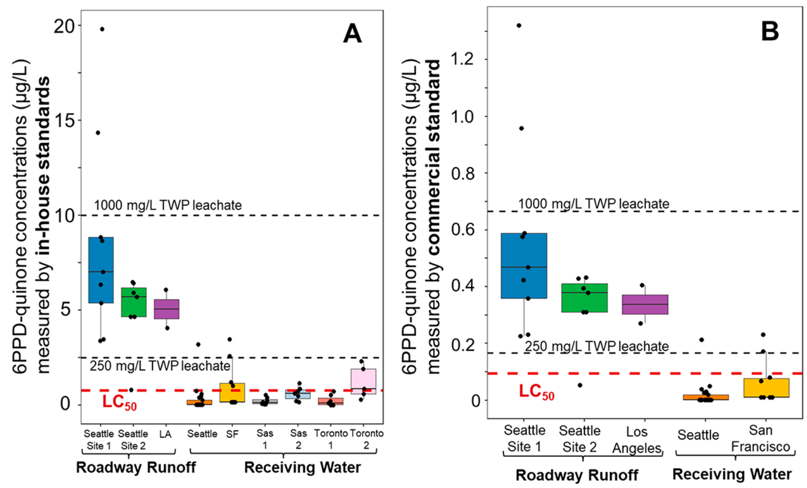


Figure 3. 6PPD-Q environmental concentrations and toxicity estimates derived from different standards. (A) 6PPD-Q concentrations estimated using in-house standards. Data for Seattle, San Francisco, and Los Angeles were taken from ref 11. Sas 1 and Sas 2 were snowmelt and surface water samples from Saskatoon, Canada, reported in ref 12. Toronto 1 and Toronto 2 were surface waters from Toronto, Canada, reported in refs 13 and 23. (B) Updated 6PPD-Q concentrations and toxicity thresholds estimated using a commercial standard (HPC), reflecting data reported in ref 11. The updated concentrations are based on retrospective UPLC-qTOF analysis of archived sample extracts, divided by a factor of 15 (qTOF peak area difference between the in-house and commercial 6PPD-Q standards). 6PPD-Q was quantified in roadway runoff and runoff-impacted receiving waters. Each symbol corresponds to duplicate or triplicate samples; boxes represent first and third quartiles. For comparison, the 95 ng/L LC_{50} value for juvenile coho salmon and detected 6PPD-quinone levels in 250 and 1000 mg/L TWP leachate are included. Modified from ref 11 with permission from AAAS.

Table 1. Comparison of the Toxicity of 6PPD-Q to Coho Salmon with Those of the Most Toxic Chemicals for Which the U.S. Environmental Protection Agency Has Established Aquatic Life Criteria[a]

chemical class	name	most sensitive species	LC_{50} (ppb)	95% CI	ref	CMC (ppb)	EPA document
OP	parathion	*Orconectes nais*	0.04	0.01−0.2	25	0.065	EPA 440/5-86-007
quinone	6PPD-Q	*O. kisutch*	0.10	0.08−0.11	this study	not available	not available
OC	mirex	*Procambaris blandingi*	0.10	not reported	26	0.001	EPA 440/5-86-001
OP	guthion	*Gammarus fasciatus*	0.10	0.073−0.014	25	0.01	EPA 440/5-86-001
OP	chlorpyrifos	*Gammarus lacustris*	0.11	not reported	27	0.083	EPA 440/5-86-005
OC	endrin	*Perca flavescens*	0.15	0.12−0.18	28	0.086	EPA 820-B-96-001
OC	4,4′-DDT	*O. nais*	0.18	0.12−0.30	25	1.1	EPA 440/5-80-038
OP	diazinon	*Ceriodaphia dubia*	0.25	not reported	29	0.17	EPA-822-R-05-006
metal	cadmium	*Oncorhynchus mykiss*	0.35	not reported	30	1.8	EPA-820-R-16-002
OC	methoxychlor	*O. nais*	0.50	0.25−1.8	25	0.03	EPA 440/5-86-001
OC	dieldrin	*Pteronarcella badia*	0.50	0.37−0.67	28	0.24	EPA 820-B-96-001
OP	malathion	*G. fasciatus*	0.76	0.63−0.92	25	0.1	EPA 440/5-86-001
OC	toxaphene	*Ictalurus punctatus*	0.8	0.5−1.2	31	0.73	EPA 440/5-86-006

[a]The rationale for the toxicity comparison can be found in SI text. Abbreviations: OP, organophosphate; OC, organochlorine; CMC, criterion maximum concentration; CI, confidence interval.

dispersal should also be thoroughly characterized to advance the safe use, disposal, and recycling of these materials as we work toward more environmentally benign and sustainable consumer products.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acs.estlett.1c00910.

> Details on the use of in-house standards, water extraction, instrumental methods and parameters, ultraviolet−visible measurement, toxicity comparison rationale, nominal and measured exposure concentrations of 6PPD-Q, chromatograms, mass spectra, and standard calibration curves (PDF)

■ AUTHOR INFORMATION

Corresponding Authors

Zhenyu Tian − *Center for Urban Waters, Tacoma, Washington 98421, United States; Interdisciplinary Arts and Sciences, University of Washington Tacoma, Tacoma, Washington 98421, United States;* orcid.org/0000-0002-7491-7028; Email: z.tian@northeastern.edu

Edward P. Kolodziej − *Center for Urban Waters, Tacoma, Washington 98421, United States; Interdisciplinary Arts and Sciences, University of Washington Tacoma, Tacoma, Washington 98421, United States; Department of Civil and Environmental Engineering, University of Washington, Seattle, Washington 98195, United States;* orcid.org/0000-0002-7968-4198; Email: koloj@uw.edu

Authors

Melissa Gonzalez – *Center for Urban Waters, Tacoma, Washington 98421, United States; Interdisciplinary Arts and Sciences, University of Washington Tacoma, Tacoma, Washington 98421, United States*

Craig A. Rideout – *Center for Urban Waters, Tacoma, Washington 98421, United States; Interdisciplinary Arts and Sciences, University of Washington Tacoma, Tacoma, Washington 98421, United States*

Haoqi Nina Zhao – *Department of Civil and Environmental Engineering, University of Washington, Seattle, Washington 98195, United States;* orcid.org/0000-0003-3908-630X

Ximin Hu – *Department of Civil and Environmental Engineering, University of Washington, Seattle, Washington 98195, United States;* orcid.org/0000-0001-8107-5968

Jill Wetzel – *Washington Stormwater Center, Puyallup Research & Extension Center (PREC), Puyallup, Washington 98371, United States*

Emma Mudrock – *Washington Stormwater Center, Puyallup Research & Extension Center (PREC), Puyallup, Washington 98371, United States*

C. Andrew James – *Center for Urban Waters, Tacoma, Washington 98421, United States*

Jenifer K. McIntyre – *Washington Stormwater Center, Puyallup Research & Extension Center (PREC), Puyallup, Washington 98371, United States; School of the Environment, Washington State University, Puyallup Research & Extension Center (PREC), Puyallup, Washington 98371, United States;* orcid.org/0000-0003-3480-7083

Complete contact information is available at:
https://pubs.acs.org/10.1021/acs.estlett.1c00910

Notes

The authors declare no competing financial interest.

■ ACKNOWLEDGMENTS

This work was funded by the U.S. Environmental Protection Agency under Assistance Agreement PC-01J18101 with the Washington State Department of Ecology and National Science Foundation Grant 1803240 (CBET). The authors thank the Puyallup Tribe of Indians for providing coho salmon.

■ REFERENCES

(1) Masoner, J. R.; Kolpin, D. W.; Cozzarelli, I. M.; Barber, L. B.; Burden, D. S.; Foreman, W. T.; Forshay, K. J.; Furlong, E. T.; Groves, J. F.; Hladik, M. L.; et al. Urban stormwater: An overlooked pathway of extensive mixed contaminants to surface and groundwaters in the United States. *Environ. Sci. Technol.* **2019**, *53* (17), 10070–10081.

(2) Spahr, S.; Teixidó, M.; Sedlak, D. L.; Luthy, R. G. Hydrophilic trace organic contaminants in urban stormwater: occurrence, toxicological relevance, and the need to enhance green stormwater infrastructure. *Environ. Sci. Water Res. Technol.* **2020**, *6* (1), 15–44.

(3) Zgheib, S.; Moilleron, R.; Chebbo, G. Priority pollutants in urban stormwater: Part 1–Case of separate storm sewers. *Water Res.* **2012**, *46* (20), 6683–6692.

(4) Burant, A.; Selbig, W.; Furlong, E. T.; Higgins, C. P. Trace organic contaminants in urban runoff: Associations with urban land-use. *Environ. Pollut.* **2018**, *242*, 2068–2077.

(5) Peter, K. T.; Tian, Z.; Wu, C.; Lin, P.; White, S.; Du, B.; McIntyre, J. K.; Scholz, N. L.; Kolodziej, E. P. Using high-resolution mass spectrometry to identify organic contaminants linked to urban stormwater mortality syndrome in coho salmon. *Environ. Sci. Technol.* **2018**, *52* (18), 10317–10327.

(6) Seiwert, B.; Klöckner, P.; Wagner, S.; Reemtsma, T. Source-related smart suspect screening in the aqueous environment: search for tire-derived persistent and mobile trace organic contaminants in surface waters. *Anal. Bioanal. Chem.* **2020**, *412* (20), 4909–4919.

(7) Wolfand, J. M.; Seller, C.; Bell, C. D.; Cho, Y.-M.; Oetjen, K.; Hogue, T. S.; Luthy, R. G. Occurrence of urban-use pesticides and management with enhanced stormwater control measures at the watershed scale. *Environ. Sci. Technol.* **2019**, *53* (7), 3634–3644.

(8) Scholz, N. L.; Myers, M. S.; McCarthy, S. G.; Labenia, J. S.; McIntyre, J. K.; Ylitalo, G. M.; Rhodes, L. D.; Laetz, C. A.; Stehr, C. M.; French, B. L.; McMillan, B.; Wilson, D.; Reed, L.; Lynch, K. D.; Damm, S.; Davis, J. W.; Collier, T. K. Recurrent die-offs of adult coho salmon returning to spawn in Puget Sound lowland urban streams. *PLoS One* **2011**, *6* (12), No. e28013.

(9) Chow, M. I.; Lundin, J. I.; Mitchell, C. J.; Davis, J. W.; Young, G.; Scholz, N. L.; McIntyre, J. K. An urban stormwater runoff mortality syndrome in juvenile coho salmon. *Aquat. Toxicol.* **2019**, *214*, 105231.

(10) Feist, B. E.; Buhle, E. R.; Baldwin, D. H.; Spromberg, J. A.; Damm, S. E.; Davis, J. W.; Scholz, N. L. Roads to ruin: conservation threats to a sentinel species across an urban gradient. *Ecol. Appl.* **2017**, *27* (8), 2382–2396.

(11) Tian, Z.; Zhao, H.; Peter, K. T.; Gonzalez, M.; Wetzel, J.; Wu, C.; Hu, X.; Prat, J.; Mudrock, E.; Hettinger, R.; et al. A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. *Science* **2021**, *371* (6525), 185–189.

(12) Challis, J.; Popick, H.; Prajapati, S.; Harder, P.; Giesy, J.; McPhedran, K.; Brinkmann, M. Occurrences of Tire Rubber-Derived Contaminants in Cold-Climate Urban Runoff. *Environ. Sci. Technol. Lett.* **2021**, *8*, 961–967.

(13) Johannessen, C.; Helm, P.; Metcalfe, C. D. Detection of selected tire wear compounds in urban receiving waters. *Environ. Pollut.* **2021**, *287*, 117659.

(14) Klöckner, P.; Seiwert, B.; Weyrauch, S.; Escher, B. I.; Reemtsma, T.; Wagner, S. Comprehensive characterization of tire and road wear particles in highway tunnel road dust by use of size and density fractionation. *Chemosphere* **2021**, *279*, 130530.

(15) Huang, W.; Shi, Y.; Huang, J.; Deng, C.; Tang, S.; Liu, X.; Chen, D. Occurrence of Substituted p-Phenylenediamine Antioxidants in Dusts. *Environ. Sci. Technol. Lett.* **2021**, *8* (5), 381–385.

(16) Zhang, Y.; Xu, C.; Zhang, W.; Qi, Z.; Song, Y.; Zhu, L.; Dong, C.; Chen, J.; Cai, Z. p-Phenylenediamine Antioxidants in PM2.5: The Underestimated Urban Air Pollutants. *Environ. Sci. Technol.* **2021**, DOI: 10.1021/acs.est.1c04500.

(17) Hou, F.; Tian, Z.; Peter, K. T.; Wu, C.; Gipe, A. D.; Zhao, H.; Alegria, E. A.; Liu, F.; Kolodziej, E. P. Quantification of organic contaminants in urban stormwater by isotope dilution and liquid chromatography-tandem mass spectrometry. *Anal. Bioanal. Chem.* **2019**, *411* (29), 7791–7806.

(18) Madkour, T. M. Chemistry of Polymerization Products of p-Benzoquinone. 13 C NMR and Molecular Dynamics Study. *Polym. J.* **1997**, *29* (8), 670–677.

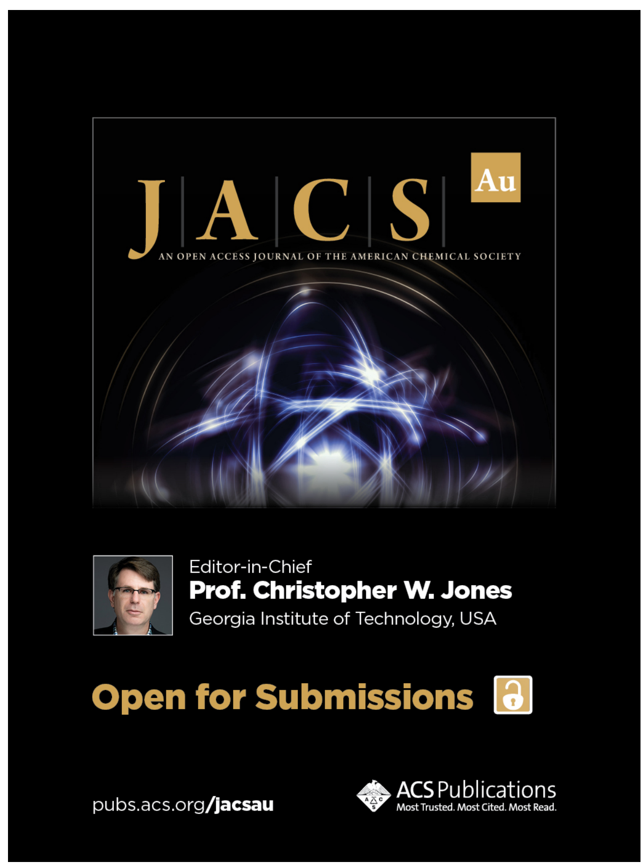
(19) Sadykh-Zade, S.; Ragimov, A.; Suleimanova, S.; Liogon'Kii, V. The polymerization of quinones in an alkaline medium and the structure of the resulting polymers. *Polym. Sci. USSR* **1972**, *14* (6), 1395–1403.

(20) Sabaa, M. W.; Madkour, T. M.; Yassin, A. A. Polymerization products of p-Benzoquinone as bound antioxidants for styrene-butadiene rubber: Part I—Preparation of quinone polymers. *Polym. Degrad. Stab.* **1988**, *22* (3), 195–203.

(21) Hiki, K.; Asahina, K.; Kato, K.; Yamagishi, T.; Omagari, R.; Iwasaki, Y.; Watanabe, H.; Yamamoto, H. Acute Toxicity of a Tire Rubber-Derived Chemical, 6PPD Quinone, to Freshwater Fish and Crustacean Species. *Environ. Sci. Technol. Lett.* **2021**, *8* (9), 779–784.

(22) McIntyre, J. K.; Prat, J.; Cameron, J.; Wetzel, J.; Mudrock, E.; Peter, K. T.; Tian, Z.; Mackenzie, C.; Lundin, J.; Stark, J. D.; et al. Treading Water: Tire Wear Particle Leachate Recreates an Urban Runoff Mortality Syndrome in Coho but Not Chum Salmon. *Environ. Sci. Technol.* **2021**, *55* (17), 11767–11774.

(23) Johannessen, C.; Helm, P.; Lashuk, B.; Yargeau, V.; Metcalfe, C. D. The Tire Wear Compounds 6PPD-Quinone and 1, 3-Diphenylguanidine in an Urban Watershed. *Arch. Environ. Contam. Toxicol.* **2021**, 1−9.
(24) OSPAR Commission. 4-(Dimethylbutylamino) diphenylamine (6PPD). *Hazardous Substances Series*, 2006.
(25) Sanders, H. O. *Toxicity of some insecticides to four species of malacostracan crustaceans*; U.S. Department of the Interior, Fish and Wildlife Service, 1972; Vol. *66*.
(26) Ludke, J. L.; Finley, M.; Lusk, C. Toxicity of mirex to crayfish, Procambarus blandingi. *Bull. Environ. Contam. Toxicol.* **1971**, *6* (1), 89−96.
(27) Sanders, H. O. *Toxicity of pesticides to the crustacean Gammarus lacustris*; U.S. Fish and Wildlife Service, 1969.
(28) Mayer, F. L.; Ellersieck, M. R. *Manual of acute toxicity: interpretation and data base for 410 chemicals and 66 species of freshwater animals*; U.S. Department of the Interior, Fish and Wildlife Service, 1986.
(29) Norberg-King, T. J. Toxicity Data on Diazinon, Aniline, 2,4-Dimethylphenol. In Memo to C. Stephan; U.S. Environmental Protection Agency: Duluth, MN, and Superior, WI, 1987.
(30) Mebane, C. A.; Dillon, F. S.; Hennessy, D. P. Acute toxicity of cadmium, lead, zinc, and their mixtures to stream-resident fish and invertebrates. *Environ. Toxicol. Chem.* **2012**, *31* (6), 1334−1348.
(31) Johnson, W. W.; Julin, A. M. *Acute toxicity of toxaphene to fathead minnows, channel catfish, and bluegills*; Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, 1980.



https://doi.org/10.1021/acs.estlett.1c00910
Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

EXHIBIT H

Chemosphere 132 (2015) 213–219

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Soil bioretention protects juvenile salmon and their prey from the toxic impacts of urban stormwater runoff

J.K. McIntyre [a,*], J.W. Davis [b], C. Hinman [a], K.H. Macneale [c], B.F. Anulacion [c], N.L. Scholz [c], J.D. Stark [a]

[a] Washington State University, Puyallup Research and Extension Center, Puyallup, WA, USA
[b] U.S. Fish & Wildlife Service, Washington Fish and Wildlife Office, Lacey, WA, USA
[c] National Ocean and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA, USA

HIGHLIGHTS

- Characterized the chemistry and toxicity of highway runoff from six storm events.
- Highway runoff caused lethal and sublethal toxicity in juvenile salmon and their prey.
- We treated highway runoff via infiltration through a bioretention soil media (BSM).
- BSM was 60% sand: 15% compost: 15% shredded bark: 10% water treatment residuals.
- Bioretention treatment of runoff prevented all mortality and sublethal toxicity.

ARTICLE INFO

Article history:
Received 15 October 2014
Received in revised form 11 December 2014
Accepted 12 December 2014
Available online 6 January 2015

Handling Editor: A. Gies

Keywords:
Green infrastructure
Bioretention treatment
Urban runoff
Aquatic toxicology
Juvenile coho salmon
Mayfly nymphs

ABSTRACT

Green stormwater infrastructure (GSI), or low impact development, encompasses a diverse and expanding portfolio of strategies to reduce the impacts of stormwater runoff on natural systems. Benchmarks for GSI success are usually framed in terms of hydrology and water chemistry, with reduced flow and loadings of toxic chemical contaminants as primary metrics. Despite the central goal of protecting aquatic species abundance and diversity, the effectiveness of GSI treatments in maintaining diverse assemblages of sensitive aquatic taxa has not been widely evaluated. In the present study we characterized the baseline toxicity of untreated urban runoff from a highway in Seattle, WA, across six storm events. For all storms, first flush runoff was toxic to the daphniid *Ceriodaphnia dubia*, causing up to 100% mortality or impairing reproduction among survivors. We then evaluated whether soil media used in bioretention, a conventional GSI method, could reduce or eliminate toxicity to juvenile coho salmon (*Oncorhynchus kisutch*) as well as their macroinvertebrate prey, including cultured *C. dubia* and wild-collected mayfly nymphs (*Baetis* spp.). Untreated highway runoff was generally lethal to salmon and invertebrates, and this acute mortality was eliminated when the runoff was filtered through soil media in bioretention columns. Soil treatment also protected against sublethal reproductive toxicity in *C. dubia*. Thus, a relatively inexpensive GSI technology can be highly effective at reversing the acutely lethal and sublethal effects of urban runoff on multiple aquatic species.
© 2014 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Polluted stormwater runoff is one of the most important threats to water quality in the developed and developing world. Green stormwater infrastructure (GSI), also known as low-impact development, encompasses a set of evolving technologies designed to mimic the hydrologic and filtration capacity of undeveloped landscapes. Examples include green roofs, bioretention systems, and permeable pavement (Dietz, 2007; Ahiablame et al., 2012). The overarching aim of GSI is to slow, spread, and infiltrate stormwater runoff in the urban environment, thereby improving water quality and reducing risks to public safety from flooding and combined sewer overflows. In urbanized areas of the United States, the National Pollutant Discharge Elimination System (NPDES) regulates the release of potentially toxic stormwater runoff. To meet permit requirements, municipalities are increasingly incorporating the use of GSI to reduce runoff pollution to waterways (US EPA, 2010).

Urban runoff impacts the hydrology, geomorphology, and thermal regime of urban streams (Paul and Meyer, 2001; Sheeder et al., 2002; Konrad et al., 2005; Kinouchi et al., 2007). Runoff also trans-

* Corresponding author.
E-mail address: jen.mcintyre@wsu.edu (J.K. McIntyre).

http://dx.doi.org/10.1016/j.chemosphere.2014.12.052
0045-6535/© 2014 The Authors. Published by Elsevier Ltd.
This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

ports chemical contaminants to receiving waters, many of which are toxic to fish (Skinner et al., 1999; Kayhanian et al., 2008; Corsi et al., 2010), invertebrates (Hall and Anderson, 1988; Marsalek et al., 1999; Kayhanian et al., 2008; Corsi et al., 2010), and aquatic plants (Kayhanian et al., 2008). Field assessments have helped disaggregate the impacts of stormwater quantity and quality on stream taxa. This includes, for example, the role of water quality in the recurrent die-offs of adult coho salmon returning to spawn in urban watersheds in western North America (Scholz et al., 2011). More generally, however, it remains difficult to attribute poor indices of biological integrity to degraded water quality versus other known and important drivers of the urban stream syndrome such as increased flow volume and rates (Roy et al., 2003; Morgan and Cushman, 2005; Walsh et al., 2005, 2007).

The identification of inexpensive, scalable GSI technologies that improve water quality and protect or restore aquatic communities is a key goal in the evolving science of stormwater management. The conventional metrics for success are typically reduced surface flows (DeBusk et al., 2011) and contaminant removal, including metals (Davis et al., 2003) and polycyclic aromatic hydrocarbons (PAHs) (LeFevre et al., 2012). Water quality treatment through physical filtration, sorption, and other soil chemistry mechanisms is a common GSI tenet, and green roofs, rain gardens, and bioretention planters are all examples of GSI practices that use soil mixes of different compositions as treatment media. Moreover, soil mixes may or may not be planted with vegetation to further extract excess nutrients or other pollutants (Hunt et al., 2012). The capacity for soil systems to retain or adsorb toxics in runoff is well established. For example, high removal efficiencies have been documented for metals (Davis et al., 2009), PAHs (DiBlasi et al., 2009), oil (Chapman and Horner, 2010), pesticides (Zhang et al., 2010), and nutrients (Davis et al., 2006). By contrast, the effectiveness of soil bioretention mechanisms as a means to reduce or eliminate adverse health effects to aquatic species has not been widely studied.

Here we characterized the toxicity of first flush runoff collected from an urban arterial in Seattle (Washington, USA) across six distinct storm events. This source of stormwater contains pollutants that are typical for roadways with a relatively high motor vehicle traffic volume year-round. Baseline toxicity was measured in terms of the survival and reproductive success of the cladoceran *Ceriodaphnia dubia* – a common model invertebrate in toxicology. For the final storm, we assessed the effectiveness of one GSI technique by filtering highway runoff through large experimental bioretention columns. In addition to survival and reproduction in *C. dubia*, we monitored the survival of juvenile coho salmon (*Oncorhynchus kisutch*) and wild mayfly nymphs (*Baetis* spp.) exposed to GSI-treated and untreated stormwater. Salmon are a keystone species of temperate coastal regions and mayfly nymphs are an important prey item for juvenile salmon as well as many other species.

2. Methods

2.1. Highway runoff collection

Stormwater was collected during six distinct storms between August 2011 and September 2012, following antecedent dry periods (ADP) of 5–50 d. Runoff was captured at NOAA's Northwest Fisheries Science Center (NWFSC; Seattle, WA, USA) from downspouts draining a busy elevated urban highway (annual average daily traffic = 94000 vehicles in 2011, 67000 in 2012; WA DOT, 2012). A diverter (Rain Harvesting, AquaBarrel, Gaithersburg, MD, USA) collected the first flush into glass carboys. Coarse detritus was pre-filtered with fiberglass window screen to prevent clogging the intake. Runoff from each storm event was frozen (−20 °C) within 4 h of collection, a procedure that did not alter the toxicity of samples (McIntyre et al., 2014).

The sixth storm (September 2012) was a source of stormwater runoff for the bioretention treatment. Collected runoff (250 L) was transported on ice from Seattle to the Washington State University Research and Extension Center in Puyallup, WA (WSU-P). A larger volume of runoff could not be collected due to the small size of the storm (0.3 mm). The collected sample was therefore diluted to a total volume of 410 L with rainwater collected at WSU-P to achieve sufficient volume for juvenile coho salmon exposures. For experiments with salmon, the runoff (untreated and treated) was used on the day of collection. For experiments with macroinvertebrates, treated and untreated runoff samples were stored in amber glass bottles at −20 °C and thawed at room temperature on the day of use. Carboys were scrubbed with hot water and rinsed with acetone and methylene chloride between storm events.

2.2. Bioretention treatment

Runoff collected during the September 2012 storm event was filtered through experimental soil columns at WSU-P as previously described (McIntyre et al., 2014). Briefly, the stormwater was transferred from glass collection carboys to a high-density polyethylene cistern for homogenization. Pre-treatment runoff was then sampled, and the remaining water in the cistern was filtered through 12 soil bioretention columns (22 L each) at a rate of 0.058 mm s^{-1}. Each column (36 cm diameter) contained a 61 cm deep mixture of 60% sand, 15% compost, 15% shredded bark, and 10% drinking water treatment residuals (City of Anacortes, WA) overlying a 30-cm deep gravel aggregate drainage layer (Palmer et al., 2013). Half of the columns were planted in November 2011 with the sedge *Carex flacca*, while the other half had no plants (Fig. 1). Treated effluent (19 L from each column) was composited by treatment into glass aquaria prior to water sample collection, resulting in three replicates of each water treatment: untreated runoff (Runoff), bioretention with soil only (No Plants), and bioretention with both soil and plants (Plants). An additional three aquaria were filled with WSU-P fish lab water (described below) as a negative control ('Control'). Exposure waters for each

Fig. 1. The two sets of bioretention columns used to filter runoff from the September 2012 storm event. All columns contain a mixed layer of bioretention soil medium overlying a gravel aggregate drainage layer. The columns on the left are planted with *Carex flacca*.

treatment were collected and chemically analyzed as previously reported (McIntyre et al., 2014). Additionally, water chemistry for the Control treatment (juvenile coho and *Baetis* tests) is described in Table S1, Figs. S1, and S2. Within each treatment, composite samples across triplicate aquaria were frozen at −20 °C in amber glass bottles for subsequent biological analyses with *C. dubia* and *Baetis* spp. The remaining water in each aquarium was used immediately for juvenile coho exposures.

2.3. Baseline toxicity of untreated stormwater to C. dubia

To assess the toxicity of untreated highway runoff across multiple storms, cladocerans (*C. dubia)* were cultured at WSU-P as previously described (Deardorff and Stark, 2009). Exposures to runoff or reconstituted de-ionized water (controls) were carried out in glass beakers maintained in an environmental chamber (25 °C; 50% relative humidity; 18:6 h light:dark photoperiod). For exposures lasting 48 h, 10 neonates (<24 h old) were placed in each of four replicates of 30 mL, fed 0.2 mL of food solution at test onset to improve control survival, and counted at 48 h. The significance of *C. dubia* 48 h replicate survival relative to unexposed controls was determined by *t*-test for each runoff event. Reproductive success was measured following longer (7 d) exposures. For each of the five storms, 10 neonates were placed in each of four replicates of 100 mL and received 1 mL of food solution daily. On day 7, the survival of females and the number of offspring per replicate were counted relative to controls. Statistical significance was determined using multivariate general linear models (GLM) with numbers of adults and neonates per adult as dependent variables. All statistics were performed with SPSS v. 21 software (IBM) with an $\alpha = 0.05$. Individuals were added in groups of ten to each treatment by replicate number (i.e., Control 1, Exposed 1, Control 2, Exposed 2, etc.) and were assessed in the same order.

2.4. Toxicity to invertebrates and juvenile salmon pre- and post-soil infiltration

The survival and reproductive success of cladocerans before and after infiltration of stormwater through bioretention columns was assessed using runoff from the September 2012 storm event and significance tested by ANOVA (48 h survival) and multivariate GLM (7 d survival and neonates per adult) with Dunnett post hoc tests. One neonate (<24 h) was placed in each of ten 50 mL glass beakers containing 30 mL of solution and fed 0.2 mL of food solution daily as per U.S. Environmental Protection Agency guidelines for reproductive toxicity testing (U.S. EPA, 2002a). Neonate survival and reproduction was monitored daily for 7 d. Control replicates met minimum survival, brood number, and offspring counts (U.S. EPA, 2002a).

Wild mayfly nymphs, an important source of prey for juvenile salmon, were collected from the protected and nearly pristine Cedar River near Landsburg, WA. Live benthic macroinvertebrates were capture by kicknet and transported in aerated river water to WSU-P. Individual mayflies (*Baetis* spp.) were isolated and placed in groups of 10 in each of six replicate chambers by replicate number (i.e. Control 1, Exposed 1, Control 2, Exposed 2, etc). Chambers consisted of 250 mL Erlenmeyer flasks lined with clean river stones and containing 100 mL of exposure solution. Each flask was capped and fitted with an aeration tube. Flasks were suspended in a cold water bath at 13 °C on a 12:12 light:dark regime. Surviving individuals were counted at 48 h, and replicate survival relative to controls was analyzed by one-way ANOVA with a Dunnett post hoc. Error bars in all figures are one standard error (SE) of the mean unless noted as standard deviation (SD).

Juvenile coho salmon were obtained from the hatchery facility at the NWFSC (Seattle, WA) and maintained at WSU-P in flow-through circular fiberglass tanks supplied with dechlorinated city water at 13 °C on a 12:12 light:dark regime. The subyearling coho ($\bar{x}$, SD: length = 70, 10 mm; weight = 2.8, 1.2 g) were exposed to untreated and treated stormwater (or hatchery control water) in 35-L glass aquaria supplied with an airstone and maintained at 13 °C using a water bath. Aquaria were randomly assigned to water baths. Per U.S. Environmental Protection Agency guidelines for acute toxicity testing (U.S. EPA, 2002b), ten coho were sequentially placed in each aquarium. The pH and dissolved oxygen (DO) measurements at the outset of each test were within a normal range for maintaining healthy juvenile coho (pH = 7.16–7.85, DO = 7.36–9.13 mg L^{-1}).

Dissolved oxygen levels in both the untreated and treated runoff declined over the first 12 h to <6 mg L^{-1}. By this time, 100% of the juvenile coho exposed to untreated runoff had died (vs. 0% in the treated runoff). We therefore placed a new set of live fish in the untreated exposure aquaria and increased aeration in all aquaria. Dissolved oxygen, measured daily, remained within the recommended range for the remainder of the 96 h test (DO = 7.89–10.10 mg L^{-1} at test termination). Survival was monitored daily. Surviving coho were euthanized after 96 h in MS-222. Individual lengths and weights were measured and bile was collected by puncturing the gall bladder with a solvent-rinsed scalpel. Bile was stored at −20 °C until analysis for PAH metabolites at NWFSC (Seattle, WA) using high performance liquid chromatography with fluorescence detection (HPLC-F) (Yanagida et al., 2012), as detailed in Supporting Information (Text S1). Due to the small volume of bile per fish, triplicate samples could only be acquired for one treatment (Plants). Bile from the remaining fish was composited into one replicate per treatment. These unique values (No Plants and Control) for each PAH metabolite (naphthalene, phenanthrene, pyrene, benzo[a]pyrene) were compared to a range of 3 ∗ SD (standard deviation) of the mean values for Plants. Because 3 ∗ SD should encompass 99% of the actual distribution, values beyond this range were assumed to be from a different distribution. Gill tissue, sampled with Teflon scissors and plastic forceps, was composited across replicates in plastic Whirl-paks and stored at −20 °C until metals analysis at Trace Elements Research Laboratory (College Station, TX) by ICP-MS, as detailed in Supporting Information (Text S2). Differences in metal concentration among treatments were analyzed by multivariate GLM.

3. Ethics Statement

Juvenile coho salmon were maintained and euthanized following protocol #00435-001 approved by the Institutional Animal Care and Use Committee at Washington State University. Mayflies were collected under a scientific collection permit issued by the Washington State Department of Fish and Wildlife (Permit #12-250). Humane euthanization was not employed prior to the end of the study because mortality was an important endpoint for each test. Animals were monitored daily. Surviving animals were euthanized at the end of each study by MS-222 overdose (coho salmon), submersion in 80% ethanol (mayfly nymphs), or freezing (*C. dubia*). A total of 150 coho salmon were used, 240 mayflies, and 790 *C. dubia*.

4. Results

4.1. Biological effectiveness of bioretention: macroinvertebrates

Highway runoff caused acute mortality (Fig. 2) and reproductive impairment (Fig. 3) in *C. dubia*. At the end of the 48-h exposure, mortality was significant for five of the six storms (Fig. 2); specifically August 2011 ($t(4) = 7.0$, $p = 0.002$), October 2011

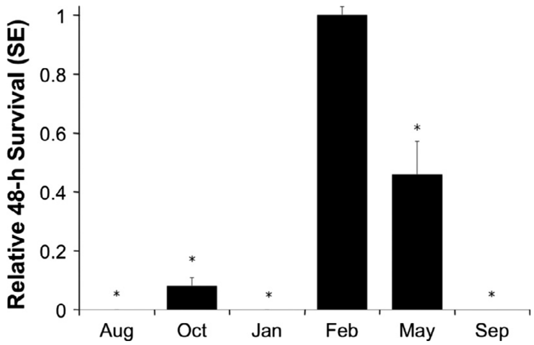


Fig. 2. Survival of *C. dubia* following 48-h exposure to first flush highway runoff relative to control survival for each storm event tested. Asterisks indicate runoff exposures that significantly affected survival relative to controls.

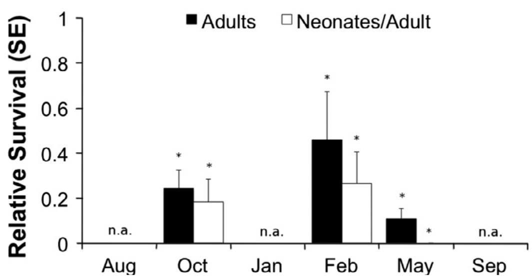


Fig. 3. Survival and reproductive impairment for *C. dubia* following 7-d exposure to highway runoff relative to control values for each storm event tested. Survival and reproduction were impaired following exposure to all runoff samples. n.a. indicates runoff that caused 100% mortality before *C. dubia* reached reproductive maturity.

(t(6) = 10.752, $p < 0.001$), January 2012 (t(6) = 12.333, $p < 0.001$), May 2012 (t(6) = 3.922, $p = 0.008$), and September 2012 (t(6) = undefined; 100% mortality in runoff vs. 0% mortality in controls), but not February 2012 (t(6) = 0, $p = 1.000$). For storms with survival beyond 48 h, the 7 d test indicated mortality was significant after 7 d in all remaining untreated runoff (Fig. 3); specifically October 2011 (F(1,1) = 78.400, $p < 0.001$), February 2012 (F(1,1) = 6.316, $p = 0.046$), and May 2012 (F(1,1) = 289.00, $p < 0.001$). For the August 2011 event (48 h survival assessment), mortality declined from 100% in the fresh sample to 0% after cold storage (4 °C) in the dark for 7 d. Untreated September 2012 highway runoff was also acutely lethal to wild mayflies (82% mortality; Fig. 4).

Reproduction of *C. dubia* was impaired after 7-d exposure for all runoff events (Fig. 3). No neonates were produced when stormwater treatments resulted in 0% female survival (August 2011, January 2012, September 2012 runoff), but in exposures with

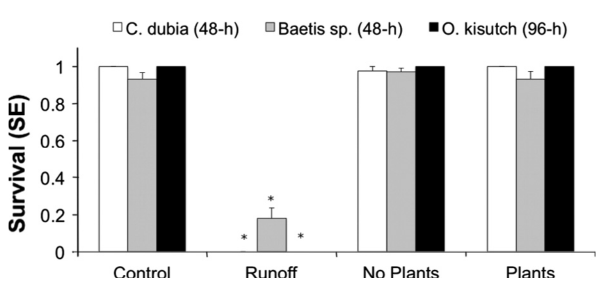


Fig. 4. Survival of three test organisms exposed to control water, untreated September 2012 runoff, runoff treated with bioretention without plants (No Plants), and runoff treated with bioretention with plants (Plants). Asterisks indicate survival significantly lower than control. Error bars are ± one standard error of the mean.

surviving females, significantly fewer offspring were produced per female in runoff compared to control water (October 2011 (F(1,1) = 62.837, $p = 0.001$), February 2012 (F(1,1) = 16.435, $p = 0.007$), and May 2012 (F(1,1) = 30.082, $p = 0.002$).

For daphniids and mayflies, treatment with bioretention (with or without plants) conferred complete protection against the lethal toxicity of stormwater runoff, with survival rates that were not significantly different from controls (Fig. 4). Although *C. dubia* neonate production in bioretention-treated waters initially lagged behind controls (Fig. 5), production was not significantly different from controls by the end of 7 d (F(3,39) = 37.674) for daphniids exposed to treated runoff in bioretention with plants (Dunnett post hoc, $p = 0.980$) or without plants ($p = 0.949$).

4.2. Biological effectiveness of bioretention: juvenile salmon

Untreated highway runoff was acutely lethal to juvenile coho salmon (*O. kisutch*), with 100% mortality occurring within 12 h of exposure, with or without dissolved oxygen supplementation. As with the macroinvertebrates, treatment of runoff through the bioretention soil medium prevented mortality (Fig. 4).

Because coho salmon exposed to untreated runoff did not survive to test termination, bile was not collected for analysis of PAH exposure. The bile metabolites measured in surviving salmon from the post-filtration treatments (96-h exposures) were modestly higher than controls, as indicated by being more than 3 SD of the mean (Fig. 6). This indicates that PAHs were still bioavailable in the water passing through the soil columns. The presence of plants in the soil columns reduced the naphthalene-equivalent

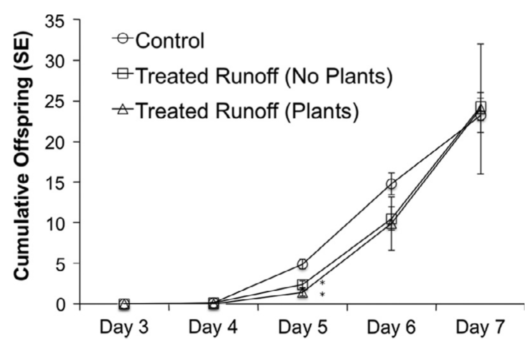


Fig. 5. Cumulative neonate count during the 7-d exposure of *C. dubia* to September 2012 runoff treated with bioretention compared with controls. Neonate production began on Day 4, was significantly lower on Day 5 for treated water exposures, but was not different among treatments by the end of the test period.

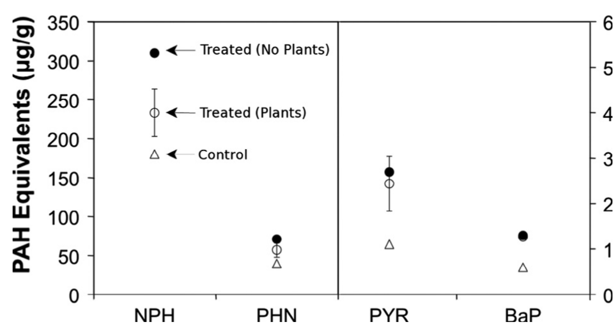


Fig. 6. Biliary metabolites of PAHs in juvenile coho salmon at the end of the 96-h exposure to control water or runoff treated with bioretention, with and without plants. Equivalents of PAHs are for napthalene (NPH), phenanthrene (PHN), pyrene (PYR), and benzo(*a*)pyrene (B*a*P). The error bars on the 'Plants' treatment are ±3 ∗ SD of the mean for the three replicates. Control and 'No Plants' are composite samples of all replicates for those treatments.

Table 1
Mean metal concentrations (mg/kg wet weight) in triplicate samples of gills of juvenile coho salmon exposed to control water or highway runoff treated with bioretention, without plants or with plants.

Mean	Zn	Cu	Cd	Ni	Pb
Control	340	4.473	1.527	<0.502[a]	<0.502
No Plants	383	4.805	2.160	<0.508	<0.508
Plants	320	3.840	1.540	<0.502	<0.502
Std. Dev.[b]					
Control	43	0.568	0.208	n.a.[c]	n.a.
No Plants	13	0.445	0.085	n.a.	n.a.
Plants	47	1.039	0.693	n.a.	n.a.

[a] '<' Indicates value less than detection limit.
[b] One standard deviation of the mean.
[c] Not applicable since below detection limit.

and phenanthrene-equivalent PAH metabolites in coho bile relative to the treatment without plants whereas levels of pyrene and benzo(*a*)pyrene equivalents in coho bile, while higher than controls, were not different among the two bioretention treatments (Fig. 6). The concentration of PAHs in treatment waters was not different among bioretention-treated and control waters (Fig. S1). Metal content of juvenile coho gills was not significantly different ($F(2,8) = 1.439–0.084$, $p = 0.321–0.920$) among controls and fish exposed to runoff treated with bioretention, with or without plants (Table 1), despite large differences in metal concentration among treatment waters (Fig. S2).

5. Discussion

Bioretention is a non-proprietary, relatively inexpensive, and readily transferable green infrastructure approach for treating polluted runoff. Here we have assessed the extent to which soil infiltration prevented adverse ecological impacts in the form of lethal and sublethal toxicity to juvenile coho salmon and their invertebrate prey. For the most part, untreated runoff was highly toxic to all species tested. Conversely, stormwater filtered through bioretention columns was strikingly less harmful to coho, mayflies, and cladocerans. We also found that bioretention treatment reversed reproductive impairment in *C. dubia*, a sensitive sublethal indicator of urban stormwater quality (Ireland et al., 1996; Marsalek et al., 1999; Kayhanian et al., 2008; Corsi et al., 2010; McQueen et al., 2010). We found no additional ameliorating effect of plants on aquatic species survival or reproduction, in part because the soil treatment alone was so effective. Overall, these results demonstrate that bioretention can achieve a central aim of green stormwater infrastructure; namely, preventing harm to aquatic animals.

Highway runoff collected for this study contained a suite of contaminants typical of high-use roads (Shinya et al., 2000), including elevated metals, PAHs, and organic matter (McIntyre et al., 2014). Filtration through the soil columns reduced metals by 30–99%, PAHs to levels at or below detection (>92%), and organic matter by over 40% (McIntyre et al., 2014). Tissue concentrations of metals in the gills of juvenile coho salmon exposed to treated runoff and unexposed controls were not significantly different, suggesting that the metals in the post-treatment exposure waters were biologically unavailable. The bioavailability of metals to aquatic animals is determined to a large extent by the presence of dissolved organic matter which sequesters metal ions (Santore et al., 2001; McIntyre et al., 2008; Linbo et al., 2009). For example, whereas dissolved copper is acutely toxic to peripheral sensory neurons in the lateral line of larval zebrafish (*Danio rerio*) at low dissolved organic carbon concentrations (IC50 = 11.5 ppb copper at 0.1 ppm DOC), it becomes much less toxic with relatively modest increases in DOC (IC50 = 50.3 ppb copper at 4.3 ppm DOC) (Linbo et al., 2009). Untreated highway runoff can have very high levels of DOC (37–400 ppm; McIntyre et al., 2014). Although bioretention treatment reduced metals and DOC, the DOC remaining in the effluent was evidently sufficient to prevent metal accumulation in the juvenile coho gill. Thus metals in these highway runoff samples do not appear to be a significant contributor to toxicity, before (McIntyre et al., 2014) or after soil infiltration.

Storing runoff at 4 °C for 7 d eliminated acute mortality in *C. dubia*. We previously found that this storage period resulted in a very significant reduction in PAHs, likely due to microbial degradation (McIntyre et al., 2014). This suggests that organic contaminants are necessary or perhaps even sufficient to cause the mortality observed from exposure to highway runoff. Organic contaminants (vs. metals alone) were also suspected of causing lethal and sublethal effects observed in zebrafish exposed to untreated highway runoff (McIntyre et al., 2014), and have previously been implicated in studies attempting to identify the putative toxicants in urban runoff (McQueen et al., 2010).

Although asymptomatic, juvenile coho salmon exposed to treated runoff had measurably elevated levels of PAH metabolites in their bile relative to controls. Thus, although PAH levels were at or below detection limits in both the treated and control water samples, a small amount of PAHs likely passed through, or were generated by, the soil columns. The concentrations of PAHs in fish bile are commonly higher than in water; e.g., in past studies comparing PAH levels in the bile of caged fish and co-located passive sampling devices relative to surrounding surface waters (Verweij et al., 2004). Although the levels of PAH metabolites were slightly higher in coho exposed to treated runoff relative to controls, the phenanthrene-equivalents in the bile of these fish were at or below the threshold concentrations for harm in juvenile salmonids (Meador et al., 2008). This reflects the exceptional sensitivity of common biomarkers for diagnosing PAH exposure in fish, including bile chemistry and the upregulation of detoxification pathways involving CYP1a and related metabolic enzymes (Lee and Anderson, 2005).

The toxic impacts of urban runoff on aquatic species are often particularly severe during the first flush of a storm (Marsalek et al., 1999; Kayhanian et al., 2008; McQueen et al., 2010; Mayer et al., 2011). As anticipated from previous studies, the first flush from the storms assessed here killed most or all of the fish and invertebrates. Contaminant concentrations in the first flush may be 20-fold higher than the corresponding event mean concentration (EMC) derived from integrated sampling across an entire runoff event (e.g., Shinya et al., 2000). Although EMCs are a conventional metric in stormwater science, toxicity studies based on EMC values often report little or no biological response (Kayhanian et al., 2008). Future GSI effectiveness studies should focus on peak contaminant concentrations in the first flush to minimize underestimates of baseline toxicity and maximize the likelihood of detecting differences in pre- and post-treatment water quality.

Our present results notwithstanding, several important questions specific to the effectiveness of green stormwater infrastructure remain. In the case of bioretention, for example, these include the relative influence of different soil compositions (Carpenter and Hallam, 2010), the influence of biota (particularly plants and microbes; Endreny et al., 2012; LeFevre et al., 2012; Barrett et al., 2013; Palmer et al., 2013), and performance consistency between laboratory and field installations (Carpenter and Hallam, 2010). Another practical consideration, from the perspective of real-world maintenance, is the performance of bioretention systems on a timescale of month to years. Initial long-term effectiveness studies, while limited in number, indicate that metals removal persists on a timescale of decades (Ingvertsen et al., 2012; Paus et al., 2014). While more work is needed in the above areas, our current findings provide preliminary evidence of the biological effectiveness of GSI technology, using metrics that could be expanded to include additional species and endpoints (e.g., endocrine disruption or behavioral changes in fish). Framing effectiveness in terms of aquatic animal health is a relatively novel approach to validating GSI technologies, and our initial findings suggest considerable promise for the success of these types of mitigation methods.

In closing, this and previous studies highlight the considerable hazard that untreated urban runoff poses for aquatic species in receiving waters. In the urban environment, there are often important constraints on the amount of land available for treating stormwater. As a small footprint and relatively inexpensive mitigation technology, the soil columns used here prevented lethal and sublethal toxicity to juvenile coho salmon and their invertebrate prey in response to runoff from a section of densely used four-lane highway. With appropriate scaling (e.g., the installation of sequential bioretention systems along transportation corridors), it may be possible to considerably reduce the harmful toxic impacts of this type of urban runoff.

Acknowledgements

We thank the many volunteers who made the bioretention test possible including Julann Spromberg, Richard Edmunds, Mary Jean Willis, Lyndal Johnson, Kate Macneale, Alisan Beck, Tiffany Linbo, and Tanya Swarts. This research project received agency funding from the U.S. National Oceanic and Atmospheric Administration (Coastal Storms Program), the U.S. Fish and Wildlife Service National Contaminants Program, and the U.S. Environmental Protection Agency Region 10. Additional funding was supplied by a Russell Family Foundation grant to JDS (13k-3780-4759). The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. Findings and conclusions herein are those of the authors and do not necessarily represent the views of the sponsoring organizations.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.chemosphere.2014.12.052.

References

Ahiablame, L.M., Engel, B.A., Chaubey, I., 2012. Effectiveness of low impact development practices: literature review and suggestions for future research. Water Air Soil Poll. 223, 4253–4273.
Barrett, M.E., Limouzin, M., Lawler, D.F., 2013. Effects of media and plant selection on biofiltration performance. J. Environ. Eng.-ASCE 139, 462–470.
Carpenter, D.D., Hallam, L., 2010. Influence of planting soil mix characteristics on bioretention cell design and performance. J. Hydrol. Eng. 15, 404–416.
Chapman, C., Horner, R.R., 2010. Performance assessment of a street-drainage bioretention system. Water Environ. Res. 82, 109–119.
Corsi, S.R., Graczyk, D.J., Geis, S.W., Booth, N.L., Richards, K.D., 2010. A fresh look at road salt: aquatic toxicity and water quality impacts on local, regional, and national scales. Environ. Sci. Technol. 44, 7376–7382.
Davis, A.P., Shokouhian, M., Sharma, H., Minami, C., Winogradoff, D., 2003. Water quality improvement through bioretention: lead, copper, and zinc removal. Water Environ. Res. 75, 73–82.
Davis, A.P., Shokouhian, M., Sharma, H., Minami, C., 2006. Water quality improvement through bioretention media: nitrogen and phosphorus removal. Water Environ. Res. 78, 284–293.
Davis, A.P., Hunt, W.F., Traver, R.G., Clar, M., 2009. Bioretention technology: overview of current practice and future needs. J. Environ. Eng.-ASCE 135, 109–117.
Deardorff, A.D., Stark, J.D., 2009. Acute toxicity and hazard assessment of spinosad and r-11 to three cladoceran species and coho salmon. Bull. Environ. Contam. Toxicol. 82, 549–553.
DeBusk, K.M., Hunt, W.F., Line, D.E., 2011. Bioretention outflow: does it mimic nonurban watershed shallow interflow? J. Hydrol. Eng. 16, 274–279.
DiBlasi, C.J., Li, H., Davis, A.P., Ghosh, U., 2009. Removal and fate of polycyclic aromatic hydrocarbon pollutants in an urban stormwater bioretention facility. Environ. Sci. Technol. 43, 494–502.
Dietz, M.E., 2007. Low impact development practices: a review of current research and recommendations for future directions. Water Air Soil Poll. 186, 351–363.
Endreny, T., Burke, D.J., Burchhardt, K.M., Fabian, M.W., Kretzer, A.M., 2012. Bioretention column study of bacteria community response to salt-enriched artificial stormwater. J. Environ. Qual. 41, 1951–1959.
Hall, K.J., Anderson, B.C., 1988. The toxicity and chemical composition of urban stormwater runoff. Can. J. Civil Eng. 15, 98–106.
Hunt, W.F., Davis, A.P., Traver, R.G., 2012. Meeting hydrologic and water quality goals through targeted bioretention design. J. Environ. Eng. 138, 698–707.
Ingvertsen, S.T., Cederkvist, K., Regent, Y., Sommer, H., Magid, J., et al., 2012. Assessment of existing roadside swales with engineered filter soil: I. Characterization and lifetime expectancy. J. Environ. Qual. 41, 1960–1969.
Ireland, D.S., Burton, G.A., Hess, G.G., 1996. In situ toxicity evaluations of turbidity and photoinduction of polycyclic aromatic hydrocarbons. Environ. Toxicol. Chem. 15, 574–581.
Kayhanian, M., Stransky, C., Bay, S., Lau, S.L., Stenstrom, M.K., 2008. Toxicity of urban highway runoff with respect to storm duration. Sci. Total. Environ. 389, 386–406.
Kinouchi, T., Yagi, H., Miyamoto, M., 2007. Increase in stream temperature related to anthropogenic heat input from urban wastewater. J. Hydrol. 335, 78–88.
Konrad, C.P., Booth, D.B., Burges, S.J., 2005. Effects of urban development in the Puget lowland, Washington, on interannual streamflow patterns: consequences for channel form and streambed disturbance. Water Resour. Res., 41.
Lee, R.F., Anderson, J.W., 2005. Significance of cytochrome p450 system responses and levels of bile fluorescent aromatic compounds in marine wildlife following oil spills. Mar. Pollut. Bull. 50, 705–723.
LeFevre, G.H., Hozalski, R.M., Novak, P.J., 2012. The role of biodegradation in limiting the accumulation of petroleum hydrocarbons in raingarden soils. Water Res. 46, 6753–6762.
Linbo, T.L., Baldwin, D.H., McIntyre, J.K., Scholz, N.L., 2009. Effects of water hardness, alkalinity, and dissolved organic carbon on the toxicity of copper to the lateral line of developing fish. Environ. Toxicol. Chem. 28, 1455–1461.
Marsalek, J., Rochfort, Q., Brownlee, B., Mayer, T., Servos, M., 1999. An exploratory study of urban runoff toxicity. Water Sci. Technol. 39, 33–39.
Mayer, T., Rochfort, Q., Marsalek, J., Parrott, J., Servos, M., et al., 2011. Environmental characterization of surface runoff from three highway sites in southern Ontario, Canada: 2. Toxicology. Water Qual. Res. J. Can. 46, 121–136.
McIntyre, J.K., Baldwin, D.H., Meador, J.P., Scholz, N.L., 2008. Chemosensory deprivation in juvenile coho salmon exposed to dissolved copper under varying water chemistry conditions. Environ. Sci. Technol. 42, 1352–1358.
McIntyre, J.K., Davis, J.W., Incardona, J., Anulacion, B.F., Stark, J.D., et al., 2014. Zebrafish and clean water technology: assessing soil bioretention as a protective treatment for toxic urban runoff. Sci. Total Environ. 500–501, 173–180.
McQueen, A.D., Johnson, B.M., Rodgers, J.H., English, W.R., 2010. Campus parking lot stormwater runoff: physicochemical analyses and toxicity tests using *Ceriodaphnia dubia* and *Pimephales promelas*. Chemosphere 79, 561–569.
Meador, J.P., Buzitis, J., Bravo, C.F., 2008. Using fluorescent aromatic compounds in bile from juvenile salmonids to predict exposure to polycyclic aromatic hydrocarbons. Environ. Toxicol. Chem. 27, 845–853.
Morgan, R.P., Cushman, S.E., 2005. Urbanization effects on stream fish assemblages in Maryland, USA. J. N. Am. Benthol. Soc. 24, 643–655.
Palmer, E.T., Poor, C.J., Hinman, C., Stark, J.D., 2013. Nitrate and phosphate removal through enhanced bioretention media: mesocosm study. Water Environ. Res. 85, 823–832.
Paul, M.J., Meyer, J.L., 2001. Streams in the urban landscape. Annu. Rev. Ecol. Syst. 32, 333–365.
Paus, K.H., Morgan, J., Gulliver, J.S., Leiknes, T., Hozalski, R.M., 2014. Assessment of the hydraulic and toxic metal removal capacities of bioretention cells after 2–8 years of service. Water Air Soil Poll., 225.
Roy, A.H., Rosemond, A.D., Paul, M.J., Leigh, D.S., Wallace, J.B., 2003. Stream macroinvertebrate response to catchment urbanisation (Georgia, USA). Freshwat. Biol. 48, 329–346.
Santore, R.C., Di Toro, D.M., Paquin, P.R., Allen, H.E., Meyer, J.S., 2001. Biotic ligand model of the acute toxicity of metals. 2. Application to acute copper toxicity in freshwater fish and *Daphnia*. Environ. Toxicol. Chem. 20, 2397–2402.
Scholz, N.L., Myers, M.S., McCarthy, S.G., Labenia, J.S., McIntyre, JK., et al., 2011. Recurrent die-offs of adult coho salmon returning to spawn in puget sound lowland urban streams. PLoS1 6, 1–12.
Sheeder, S.A., Ross, J.D., Carlson, T.N., 2002. Dual urban and rural hydrograph signals in three small watersheds. J. Am. Water Resour. Assoc. 38, 1027–1040.
Shinya, M., Tsuchinaga, T., Kitano, M., Yamada, Y., Ishikawa, M., 2000. Characterization of heavy metals and polycyclic aromatic hydrocarbons in urban highway runoff. Water Sci. Technol. 42, 201–208.
Skinner, L., de Peyster, A., Schiff, K., 1999. Developmental effects of urban storm water in medaka (*Oryzias latipes*) and inland silverside (*Menidia beryllina*). Arch. Environ. Contam. Toxicol. 37, 227–235.
U.S. EPA, 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms.
U.S. EPA, 2002. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms.
U.S. EPA, 2010. Green infrastructure case studies: municipal policies for managing sormwater with green infrastructure. In: Office of Wetlands Oceans and Watersheds, EPA-841-F-10-004. pp. 70.
Verweij, F., Booij, K., Satumalay, K., van der Molen, N., van der Oost, R., 2004. Assessment of bioavailable PAH, PCB and OCP concentrations in water, using

semipermeable membrane devices (spmds), sediments and caged carp. Chemosphere 54, 1675–1689.
WA DOT (2012) Annual traffic report. Washington State Department of Transportation. <http://www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm>.
Walsh, C.J., Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M., et al., 2005. The urban stream syndrome: current knowledge and the search for a cure. J. N. Am. Benthol. Soc. 24, 706–723.
Walsh, C.J., Waller, K.A., Gehling, J., Mac Nally, R., 2007. Riverine invertebrate assemblages are degraded more by catchment urbanisation than by riparian deforestation. Freshwat. Biol. 52, 574–587.
Yanagida, G.K., Anulacion, B.F., Bolton, J.L., Boyd, D., Lomax, D.P., et al., 2012. Polycyclic aromatic hydrocarbons and risk to threatened and endangered Chinook salmon in the lower Columbia River estuary. Arch. Environ. Contam. Toxicol. 62, 282–295.
Zhang, X.Y., Liu, X.M., Zhang, M.H., Dahlgren, R.A., Eitzel, M., 2010. A review of vegetated buffers and a meta-analysis of their mitigation efficacy in reducing nonpoint source pollution. J. Environ. Qual. 39, 76–84.

EXHIBIT I

NEVADA COUNTY, CALIFORNIA

NOTICE OF AVAILABILITY FOR PUBLIC REVIEW AND NOTICE OF INTENT TO ADOPT A PROPOSED MITIGATED NEGATIVE DECLARATION FOR THE LAKE WILDWOOD TENNIS FACILITY LIGHTING EXPANSION PROJECT (PLN22-0008; AAP22-0001; VAR22-0004; EIS22-0008)

TO:

Department of Public Works – Pat Perkins
Building Department
Environmental Health Department
CEO – Alison Lehman
Commissioner Mastrodonato, District IV
Supervisor Hoek, District IV
Tyler Barrington, Principal Planner
County Counsel*
COB – Jeff Thorsby
Penn Valley Fire Protection District
Penn Valley Community Foundation
LAFCO
PG&E
Federation of Neighborhoods
Northern Sierra Air Quality Management District
Property Owners w/in 300-Feet
Fire Protection Planner – Scott Eckman
Sierra Nevada Group/Sierra Club
Penn Valley Municipal Advisory Committee
Kevin Johnston
Native American Heritage Commission
Maureen Collins
Shingle Springs Band of Miwok Indians
Nevada City Rancheria Nisenan Tribe
Tsi Akim Maidu
United Auburn Indian Community
General Plan Defense Fund
CA Native Plant Society - Redbud
Kevin Johnston
Bear Yuba Land Trust
California State Clearinghouse
Laborers Pacific Southwest

**receives full report, others receive NOA/NOI only with report available online.*

Date: July 22, 2022

Prepared by:
Matt Kelley, Senior Planner
Nevada County Planning Department
950 Maidu Avenue, Suite 170
Nevada City, CA 95959
(530) 265-1423
Email: matt.kelley@nevadacountyca.gov

File Number(s): PLN22-0008; AAP22-0001; VAR22-0004; EIS22-0008

Assessor's Parcel Number: 031-450-001

Applicant/Owner:
Lake Wildwood Association
Bryan Cox, General Manager
11255 Cottontail Way
Penn Valley, CA 95946

Representative:
Nelson Engineering
Kevin J. Nelson
14028 Camas Court
Penn Valley, CA 95946

Zoning Districts: Single-Family Residential (R1 – Planned Development (PD)

General Plan Designation: Planned Residential Community (PRC)

Lake Wildwood Tennis Facility Lighting Expansion
PLN22-0008; AAP22-0001; VAR22-0004; EIS22-0008

Project Location: 12960 Thistle Loop, Penn Valley. Further located east of Pleasant Valley Road and north of the intersection of Wildflower Drive and Pleasant Valley Road within the Lake Wildwood Subdivision in unincorporated Western Nevada County.

Project Description: The project is an application for an Amendment to Approved Use Permit U92-09 for the installation of 32 lights within four existing tennis courts located within the Lake Wildwood Subdivision Tennis Facility to allow nighttime tennis play from dusk until 10:00 P.M. for Lake Wildwood Association members. As proposed some of the light poles would have two lights installed, resulting in 32 lights distributed between 24 light poles. Due to the requirements of championship tennis play, along with matching the height of the existing lights, which are located at the Commadore Park tennis courts, located within Lake Wildwood; the light poles are proposed at a height of 20 feet tall, which would exceed the height limitation of 15 feet established by Section L-II 4.2.8 of the Nevada County Land Use and Development Code. Therefore, the project is being processed with a Variance to the light pole height restrictions.

PUBLIC REVIEW: As a Lead agency in accordance with CEQA, Nevada County is distributing the Draft Initial Study / Mitigated Negative Declaration (IS/MND) to interested public and regulatory authorities for review and comment for a period of 32-days. Nevada County is inviting comments and concerns regarding the IS/MND during the public comment period spanning **July 22, 2022 to August 22, 2022 at 5:00 p.m.** Final action on the proposed MND will be taken by the Nevada County Planning Commission after the completion of the public review period at a duly noticed public hearing.

DOCUMENT AVAILABILITY: The Draft Initial Study / Mitigated Negative Declaration is available for review on Nevada County's Website at https://www.nevadacountyca.gov/994/Environmental-Documents. Hardcopies may be reviewed at the Nevada County Planning Department, 950 Maidu Avenue, Suite 170, Nevada City, CA 95959.

Written comments should be sent to the following address: Matt Kelley, Senior Planner, Nevada County Planning Department, 950 Maidu Avenue, Suite 170, Nevada City, CA 95959 - Phone: 530-264-1423 - Email: matt.kelley@nevadacountyca.gov; on or before **August 22, 2022 at 5:00 p.m.**

Pursuant to the State of California Public Resources Code and the "Guidelines for Implementation of the California Environmental Quality Act of 1970," as amended to date, a Draft Mitigated Negative Declaration has been prepared because no substantial evidence exists, as indicated in the attached Initial Study, that the proposed project may have a significant environmental effect that is not mitigated to a level of less than significance.

Prepared by:

Matt Kelley, Senior Planner

7/22/22
Date

NEVADA COUNTY, CALIFORNIA
INITIAL STUDY

To:

Building Department
Department of Public Works – Pat Perkins
Environmental Health
CEO – Alison Lehman
Commissioner Mastrodonato, District IV
Supervisor Hoek, District IV
Tyler Barrington, Principal Planner
County Counsel
COB – Jeff Thorsby
Penn Valley Fire Protection District
Penn Valley Community Foundation
LAFCO
PG&E
Federation of Neighborhoods
Northern Sierra Air Quality Management District
Property Owners w/in 300-Feet
Fire Protection Planner – Scott Eckman
Sierra Nevada Group/Sierra Club
Penn Valley Municipal Advisory Committee
Kevin Johnston
Native American Heritage Commission
Maureen Collins
Shingle Springs Band of Miwok Indians
Nevada City Rancheria Nisenan Tribe
Tsi Akim Maidu
United Auburn Indian Community
General Plan Defense Fund
CA Native Plant Society - Redbud
Kevin Johnston
Bear Yuba Land Trust
California State Clearinghouse
Laborers Pacific Southwest

Date: July 22, 2022

Prepared by:
Matt Kelley, Senior Planner
Nevada County Planning Department
950 Maidu Avenue, Suite 170
Nevada City, CA 95959
(530) 265-1423
Email: matt.kelley@co.nevada.ca.us

File Number(s): PLN22-0008, AAP22-0001, VAR22-0004; EIS22-0008

Assessor Parcel Number: 031-450-001

Applicant/Owner:
Lake Wildwood Association
Bryan Cox, General Manager
11255 Cottontail Way
Penn Valley, CA 95946

Representative:
Nelson Engineering
Kevin J. Nelson
14028 Camas Court
Penn Valley, CA 95946

Zoning District: Single-Family Residential (R1) – Planned Development (PD)

General Plan Designation: Planned Residential Community (PRC)

Project Location: 12960 Thistle Loop, Penn Valley. Further located east of Pleasant Valley Road and north of the intersection of Wildflower Drive and Pleasant Valley Road within the Lake Wildwood Subdivision in unincorporated Western Nevada County.

Project Description: The project is an application for an Amendment to Approved Use Permit U92-09 for the installation of 32 lights within four existing tennis courts located within the Lake Wildwood Subdivision Tennis Facility to allow nighttime tennis play from dusk until 10:00 P.M. for Lake Wildwood Association members. As proposed some of the light poles would have two lights installed, resulting in 32 lights distributed between 24 light poles. Due to the requirements of championship tennis play, along with matching the height of the existing lights, which are located at the Commadore Park tennis courts, located within Lake Wildwood; the light poles are proposed at a height of 20 feet tall, which would exceed the height limitation of 15 feet established by Section L-II 4.2.8 of the Nevada County Land Use and Development Code. Therefore, the project is being processed with a Variance to the light pole height restrictions.

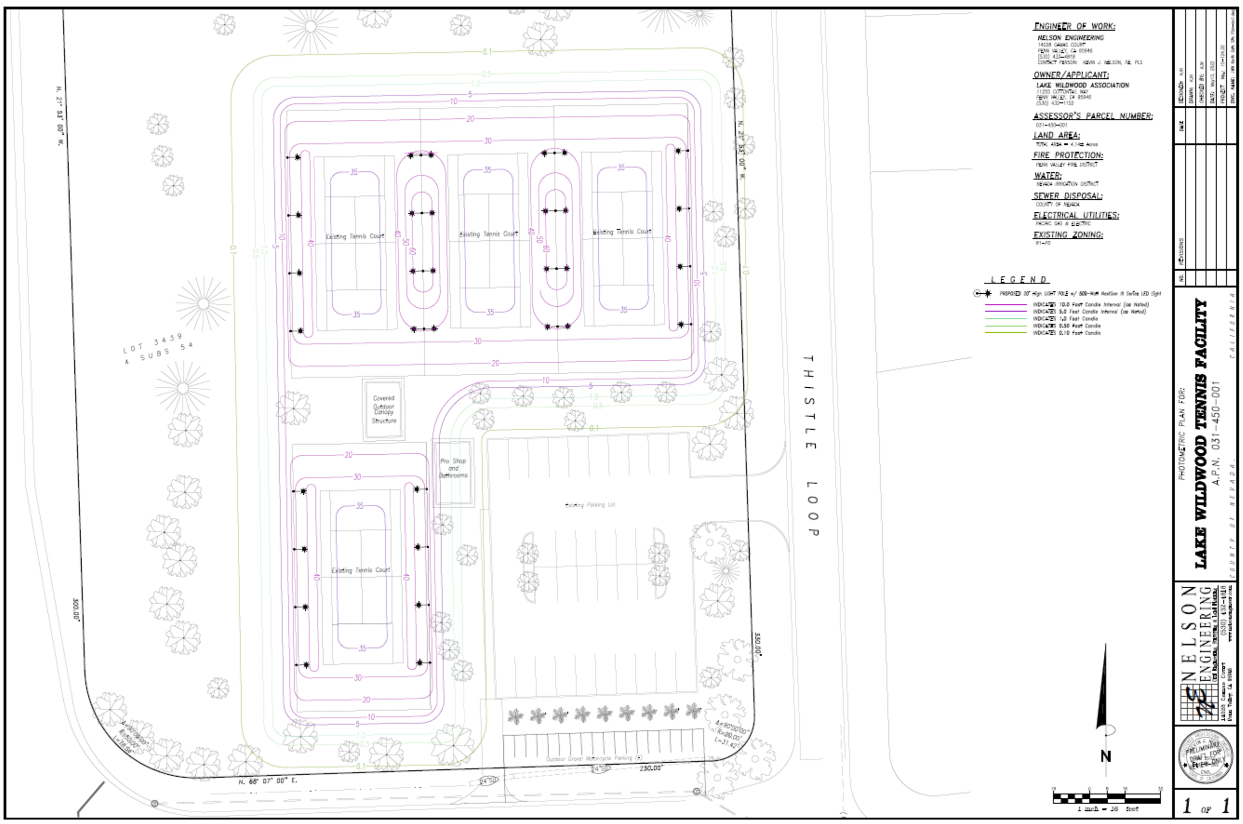


Figure 1 - Site Plan

Project Site and Surrounding Land Uses: The parcel is located in the unincorporated part of Western Nevada County at 12960 Thistle Loop (Assessor Parcel Number 031-450-001) within the Lake Wildwood Subdivision. The project area is proposed to be within the four existing northern tennis courts, which are located along Thistle Loop and north of the northern entrance gate at the Lake Wildwood Tennis facility.

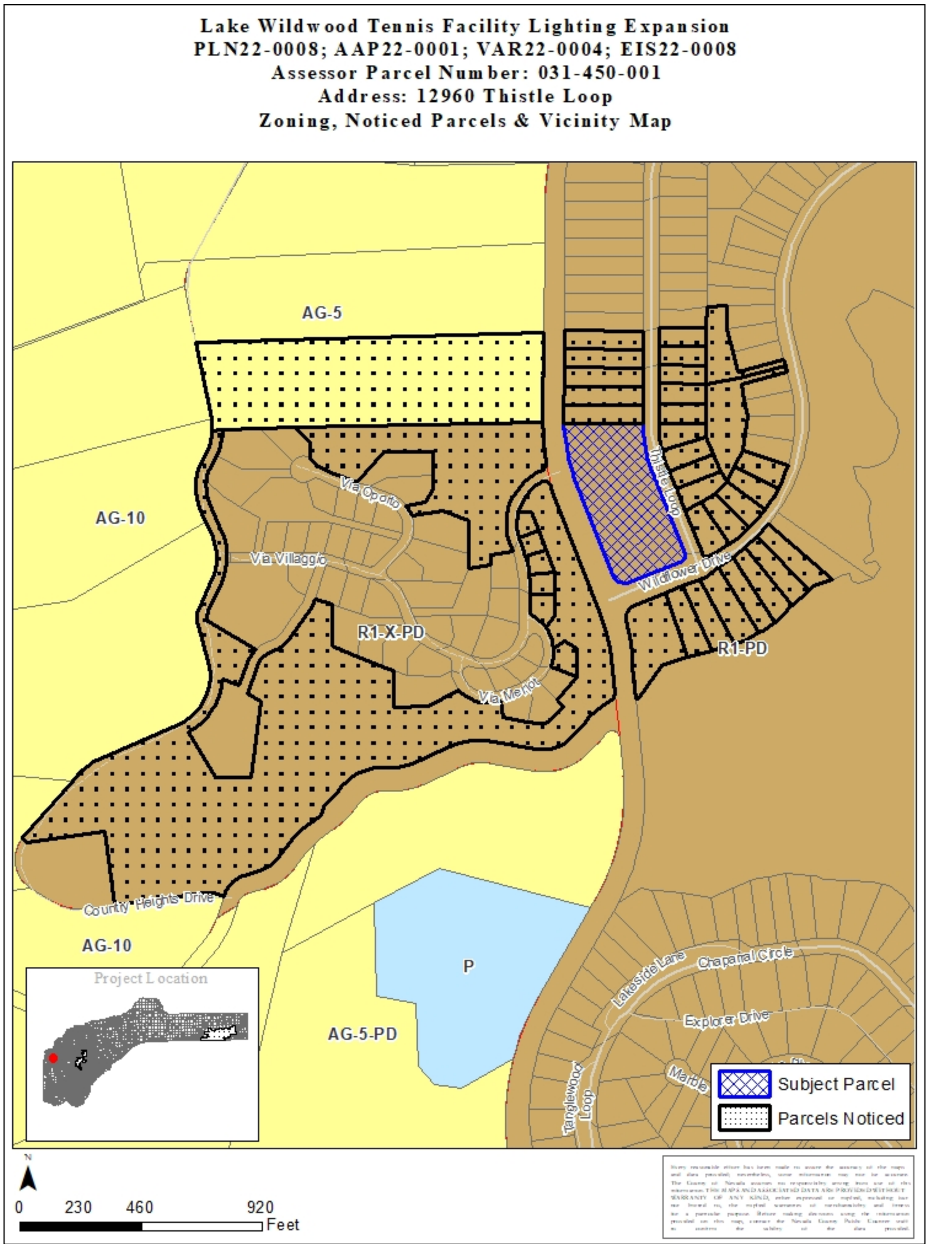


Figure 2 - Vicinity Map

The subject parcel is zoned Single-Family Residential (R-1) with Planned Development (PD) combining district. The subject parcel contains the existing Lake Wildwood Tennis Facility that is open to Association members and is developed with four tennis courts, a tennis Pro-Shop and off-street parking area with 31 off-street parking spaces. The surrounding parcels, which are located north and east, are developed with existing single-family residences. The northern-gated entrance to Lake Wildwood is located south of the Tennis Facility.

Other Permits, Which May Be Necessary: Based on initial comments received, the following permits may be required from the designated agencies:

1. Building Permits- Nevada County Building Department

Relationship to Other Projects: U92-09 approved the development of the tennis facility, which included four tennis courts, an approximately 480-square-foot pro-shop and associated off-street parking. The project is proposing the addition of 32 lights mounted on 24 light poles which would be 20 feet tall, to allow tennis play from dusk until 10:00 P.M.

This analysis does not intend to "reopen" the environmental review of the approved Mitigation Negative Declaration for the Use Permit (U92-09). The aforementioned documents can be viewed at the Nevada County Planning Department Office located at 950 Maidu Avenue, Suite 170, Nevada City, California 95959. This environmental assessment is intended to be a tiered document pursuant to the California Environmental Quality Act Guidelines Section 2109(b) and shall use both new information and existing information provided with the existing permits. As previously mentioned, the project includes a Variance to Zoning Regulations. Pursuant to Section 15305(a) of the CEQA Guidelines, a Variance is typically categorically exempt from environmental review.

Tribal Consultation: Have California Native American Tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code Section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

California Native American Tribes with ancestral land within the project area were routed the project during distribution. The California Native American Tribes will be sent a Notice of Availability for Public Review and Notice of Intent to Adopt a Mitigated Negative Declaration for this project, which will allow the California Native American Tribes the opportunity to comment on the analysis of environmental impacts. Mitigation has been included in Sections 5 and 18 of this initial study to address a plan for further consultation, if needed.

SUMMARY OF IMPACTS and PROPOSED MITIGATION MEASURES

Environmental Factors Potentially Affected:
All of the following environmental factors have been considered. Those environmental factors checked below would be potentially affected by this project, involving at least one impact that is "Less Than Significant with Mitigation" as indicated by the checklist on the following pages.

__	1. Aesthetics	__	2. Agriculture / Forestry Resources	✓	3. Air Quality
__	4. Biological Resources	✓	5. Cultural Resources	__	6. Energy
✓	7. Geology / Soils	__	8 Greenhouse Gas Emissions	__	9. Hazards / Hazardous Materials
__	10. Hydrology / Water Quality	__	11. Land Use / Planning	__	12. Mineral Resources
✓	13. Noise	__	14. Population / Housing	__	15. Public Services
__	16. Recreation	__	17. Transportation	✓	18. Tribal Cultural Resources
✓	19. Utilities / Service Systems	__	20. Wildfire	✓	21. Mandatory Findings of Significance

Summary of Impacts and Recommended Mitigation Measures:

3. **AIR QUALITY:** To offset potentially adverse air quality impacts associated with the project activities, the following mitigation measures shall be required:

Mitigation Measure 3A: Implement dust control measures. Prior to the approval of any Grading or Building Permits, to reduce short-term construction impacts, all future development permits shall comply with the following standards to the satisfaction of the Northern Sierra Air Quality Management District, which shall be noted on all grading and improvement plans and shall be included in project bidding documents:

1. The applicant shall implement all dust control measures in a timely manner during all phases of project development and construction.

2 All material excavated, stockpiled or graded shall be sufficiently watered, treated or converted to prevent fugitive dust form leaving the property boundaries and causing a public nuisance or a violation of an ambient air standard. Watering should occur at least twice daily, with complete site coverage.

3. All areas (including unpaved roads) with vehicle traffic shall be watered or have dust palliative applied as necessary for regular stabilization of dust emissions.

Would the proposed project:	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact	Reference Source (Appendix A)
b. Conflict with existing zoning for agricultural use or conflict with a Williamson Act contract?				✓	A, 18
c. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resource Code section 12220(g)), timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?				✓	A, L, 18
d. Result in the loss of forest land or conversion of forest land to non-forest use?				✓	L, 18
e. Involve other changes in the existing environment, which due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?				✓	A, L, 7

Impact Discussion:

2a-e: The site is designated as "Urban & Built-Up Land" by the Farmland Mapping and Monitoring Program and would thus will not convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance. The proposed project would not involve other changes in the existing environment which could result in conversion of Farmland to a non-agricultural use. The project site is not subject to a Williamson Act contract, and it is not located within a Timberland Production Zone and will not result in the rezoning of forest land. Thus, as outlined above the proposed project is anticipated to have ***no impact*** on agricultural resources

Mitigation: **None required.**

3. <u>AIR QUALITY</u>

Existing Setting:

Nevada County is located in the Mountain Counties Air Basin. The overall air quality in Nevada County has improved over the past decade, largely due to vehicles becoming cleaner. State and Federal air quality standards have been established for specific "criteria" air pollutants including ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter. In addition, there are State standards for visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. State standards are called California Ambient Air Quality Standards (CAAQS) and federal standards are called National Ambient Air Quality Standards (NAAQS). NAAQS are composed of health-based primary standards and welfare-based secondary standards.

Western Nevada County is classified as a Serious Nonattainment Area for the 2008 ozone NAAQS and Moderate Nonattainment for the 2015 ozone NAAQS. It is also Nonattainment for the ozone CAAQS. The area is also Marginal Nonattainment for the 2008 ozone NAAQS and is Nonattainment for the ozone CAAQS. Most of western Nevada County's ozone is transported to the area by wind from the Sacramento area and, to a lesser extent, the San Francisco Bay Area. Ozone is created by the interaction of Nitrogen Oxides and Reactive Organic Gases (also known as Volatile Organic Compounds) in the presence of sunlight, especially when the temperature is high. Ozone is mainly a summertime problem, with the highest concentrations generally observed in July and August, especially in the late afternoon and evening hours.

Nevada County is also Nonattainment for the PM10 CAAQS, but Unclassified for the PM10 NAAQS due to lack of available recent data. The number after "PM" refers to maximum particle size in microns. PM10 is a mixture of dust, combustion particles (smoke) and aerosols, whereas PM2.5 is mostly smoke and aerosol particles. PM2.5 sources include woodstoves and fireplaces, vehicle engines, wildfires and open burning. PM10 sources include the PM2.5 plus dust, such as from surface disturbances, road sand, vehicle tires, and leaf blowers. Some pollen and mold spores are also included in PM10, but most are larger than 10 microns. All of Nevada County is Unclassifiable/Attainment for the PM2.5 NAAQS and Unclassified for the PM2.5 CAAQS (US Environmental Protection Agency, 2015).

Ultramafic rock and its altered form, serpentine rock (or serpentinite), both typically contain asbestos, a cancer-causing agent. Ultramafic rock and serpentine are likely to exist in several areas of western Nevada County; however, the area of the project site is not mapped as an area that is likely to contain natural occurrences of asbestos (California Department of Conservation, 2000). A Biological Inventory of the project site also found that no serpentine or gabbro-derived soils in the Aiken loam and Aiken cobbly loam soils series are mapped near the project area (Dunn, 2021).

Please see Section 8 of this Initial Study for a discussion on project impacts related to Greenhouse Gas Emission.

Would the proposed project:	**Potentially Significant Impact**	**Less Than Significant with Mitigation**	**Less Than Significant Impact**	**No Impact**	**Reference Source (Appendix A)**
a. Conflict with or obstruct implementation of the applicable air quality plan.				✓	A,G
b. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable federal or state ambient air quality standard?		✓			A,G
c. Expose sensitive receptors to substantial pollutant concentrations?		✓			A,G,L
d. Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?		✓			A,G
e. Generate substantial smoke ash or dust?		✓			A,G

Impact Discussion:

3a: Nevada County's General Plan, Chapter 14 Air Quality Element, contains numerous policies to protect air quality in Nevada County. With the exception of General Plan Air Quality Element Policy 14.7A, which requires compliance with Northern Sierra Air Quality Management District Rule 226, the Nevada County General Plan Air Quality Element policies are intended to apply to development that generates new residents or new employees. The addition of lights to the existing Lake Wildwood Tennis Facility would not create any new residents or employees. By assessing air pollution and emissions associated with the proposed project and recommending mitigation measures based on Thresholds of Significance established by the Northern Sierra Air Quality Management District (NSAQMD), the project as proposed would comply with Northern Sierra Air Quality Management District regulations. In addition, the project has been mitigated, as discussed below to be complaint with the NSAQMD construction guidelines in compliance with Rule 226, which is related to the control of dust emissions as required by Mitigation Measure 3A. In addition, based on the County's review of the NSAQMD Rules and Guidelines for Assessing and Mitigation

Air Quality Impacts of Land Use Projects, it appears several of the objectives of the NSAQMD regulations are achieved through the application of mitigation measures provided below and due to the size and type of the project, the minimization of heavy equipment idling times as required by Mitigation Measure 3B, the use of alternative methods to open burning for vegetation disposal, and the compliance with Asbestos Airborne Toxic Control Measures.

Therefore, given the above discussion, the project itself will not violate any established policies or standards for the protection of air quality nor would it conflict with or obstruct implementation of any quality plan, therefore there is ***no impact***.

3b-e: Western Nevada County is in non-attainment for the Federal 8-hour ozone standard, and the entirety of Nevada County is in non-attainment for the State 1- and 8-hour ozone standards and PM10 standards. While most of the ozone in the County is transported from urban areas to the southwest, PM10 sources primarily come from within the County. PM10 violations in winter are largely due to wood smoke from the use of woodstoves and fireplaces, while summer and fall violations often occur during forest fires or periods of open burning. The proposed project would result in a temporary but incrementally small net increase in pollutants due to minor land disturbance and construction vehicle and equipment emissions related to the installation of the 24 light poles and trenching for underground electrical. Additionally, the construction of the project would entail some ground disturbance, which would be relatively small in nature due to the scope of the proposed project. Although this amount of disturbance would not result in the need for a Dust Control Permit, Mitigation Measure 3A to minimize dust emissions is recommended to reduce dust impacts in a way commensurate with the amount of grading being proposed. Reasonable precautions may include watering vehicle traffic areas, as well as any stockpiled material, and limiting traffic speeds. Such methods will be required to be noted on the improvement plans prior to approval.

Short-term project construction activities have the potential of generating dust and impacting the local ambient air quality with grading and excavation, vegetation removal, and construction activities from site preparation, the installation of underground utilities, and associated light poles. If improperly managed or controlled, and depending upon the time of year and air conditions, the construction activities associated with this project may have the potential to produce off-site dust impacts. The Northern Sierra Air Quality Management District (NSAQMD) therefore recommends mitigation during the construction phase of this project including Mitigation Measure 3B requiring that diesel construction equipment not be idled for more than 5 minutes to prevent smoke and ozone precursors.

Serpentine soils and ultramafic rock are not mapped on the project site, pursuant to the Northern Sierra Air Quality Management District and the National Geologic Map Database provided by the United States Geologic Service. However, although unlikely, there is always the potential to encounter these soil types during grading activities. According to the NSAQMD, ultramafic rock typically contains asbestos, a cancer-causing agent. Disturbance of this rock and nearby soil during project construction can result in the release of microscopic cancer-causing asbestos fibers into the air, resulting in potential health and safety hazards. Health risks related to project grading would be reduced by the incorporation of Mitigation Measure 3C, which would require compliance with the Asbestos Airborne Toxic Control Measure (ACTM) for construction.

The mitigation measures recommended above will minimize the potential adverse impacts associated with construction and operational emissions to a level that is ***less than significant with mitigation***.

Mitigation: To offset potentially adverse air quality impacts associated with the project activities, the following mitigation measures shall be required:

Mitigation Measure 3A: Implement dust control measures. Prior to the approval of any Grading or Building Permits, to reduce short-term construction impacts, all future development permits shall comply with the following standards to the satisfaction of the Northern Sierra Air Quality Management District, which shall be noted on all grading and improvement plans and shall be included in project bidding documents:

1. The applicant shall implement all dust control measures in a timely manner during all phases of project development and construction.

2 All material excavated, stockpiled or graded shall be sufficiently watered, treated or converted to prevent fugitive dust form leaving the property boundaries and causing a public nuisance or a violation of an ambient air standard. Watering should occur at least twice daily, with complete site coverage.

3. All areas (including unpaved roads) with vehicle traffic shall be watered or have dust palliative applied as necessary for regular stabilization of dust emissions.

4. All land clearing, grading, earth moving, or excavation activities on a project shall be suspended as necessary to prevent excessive windblown dust when winds are expected to exceed 20 mph.

5. All on-site vehicle traffic shall be limited to a speed of 15 mph on unpaved roads.

6. All inactive disturbed portions of the development site shall be covered, seeded or watered until a suitable cover is established. Alternatively, the applicant shall be responsible for applying non-toxic soil stabilizers to all inactive construction areas.

7. All material transported off-site shall be either sufficiently watered or securely covered to prevent public nuisance.

Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

Mitigation Measure 3B: Minimize Construction Equipment Idling. In order to reduce emissions from construction equipment, the applicant shall include the following standard note on all Grading Plans, Site Plans or Improvement Plans: "During construction, the contractor shall minimize idling time to a maximum of 5 minutes for all diesel-powered equipment. Signs shall be posted in the designated queuing areas of the construction site to remind off-road equipment operators that idling is limited to a maximum of 5 minutes. Idling of construction-related equipment and construction related vehicles is not recommended within 1,000 feet of any sensitive receptor."
Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Planning Department approval of Grading Permits or Building Permits / Complaint driven*
Responsible Agencies: *Planning and Building Department, Code Compliance Division*

Mitigation Measure 3C: Comply with the Asbestos Airborne Toxic Control Measure (ACTM) for construction. If serpentine, ultramafic rock, or naturally occurring asbestos is discovered during construction or grading, the Northern Sierra Air Quality Management District shall be notified no later than the following business day and specific requirements contained in Section 93105 of Title 17 of the California Code of Regulations shall be strictly complied with. This measure shall be included as a note on all grading and improvement plans.
Timing: *Prior to issuance of the grading permits and improvement plans and during grading activity*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

4. BIOLOGICAL RESOURCES

Existing Setting: The subject property is currently used for the Lake Wildwood Tennis Facility and contains four existing tennis courts, a Tennis Pro Shop and associated off-street parking spaces. The proposed tennis court lights and poles would be located within the existing tennis courts. There are no stream or riparian areas within the project site or adjacent to it. Furthermore, the project applicant has verified that no trees would be removed for the installation of the light poles.

Would the proposed project:	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact	Reference Source (Appendix A)
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			✓		K,19, 25
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?			✓		A, K, L,19,22
c. Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				✓	A, K, L,19,29
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?			✓		A, 19
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?			✓		A,19
f. Conflict with the provisions of an adopted Habitat Conservation Plan, or other approved local, regional, or state habitat conservation plan?				✓	A,19
g. Introduce any factors (light, fencing, noise, human presence and/or domesticated animals) which could hinder the normal activities of wildlife?			✓		A,19

EXHIBIT J

NEVADA COUNTY, CALIFORNIA
NOTICE OF AVAILABILITY FOR PUBLIC REVIEW AND NOTICE OF INTENT TO ADOPT A PROPOSED MITIGATED NEGATIVE DECLARATION

TO:

Building Department
Public Works – Kevin Nelson, Pat Perkins
Environmental Health
CEO – Alison Lehman
Commissioner Greeno
Supervisor Hardy Bullock, District V
Principal Planner, Tyler Barrington
COB – Jeff Thorsby
Truckee Fire Protection District
Caltrans Highways
Fire Protection Planner
Lahontan Water Quality Control Board
Pacific Gas & Electric
Liberty Utilities
Washoe Tribe
Nevada City Rancheria Nisenan Tribe
T'si Akim Maidu
United Auburn Indian Community
Shingle Springs Band of Miwok Indians
Donner Summit Association
Donner Summit Historical Society
Sierra Watch
South Yuba River Citizen League
California Native Plant Society – Redbud
Laborers Pacific Southwest
Bear Yuba Land Trust
General Plan Defense Fund
Mountain Area Preservation Fund
Donner Summit Public Utility District
Military Training Route Operator – David Bell

Date: July 5, 2022

File Number(s): PLN22-0092, AAP22-0002, EIS22-0007, VAR22-0003

Applicant: Bill Clark – Auburn Ski Club
P.O. Box 729
Soda Springs, CA 95728

Project Location: 19749 Boreal Ridge Road, Soda Springs, CA 95728. The project site is located near the western edge of the Boreal parking lot near the Auburn Ski Club Nordic Center in unincorporated Eastern Nevada County, off of Interstate 80.

Project Description: An Amendment to Approved Use Permit U89-039 to install 40 light poles along the 2-kilometer lower loop of an existing 10-kilometer cross-county skiing trail system and to allow nighttime skiing from dusk until 8:00 P.M. on Wednesday through Saturday nights from early November through March at the Auburn Ski Club Nordic Center. Some of the light poles will have two lights installed, resulting in a total of 48 lights distributed between the 40 poles. Due to the high levels of snow on Boreal Ridge during the winter, the light poles are proposed to be 40 feet tall which exceeds the height limitation of 15 feet established by Section L-II 4.2.8 of the Nevada County Land Use and Development Code. Therefore, the project is being processed with a variance to the light pole height restrictions.

PUBLIC REVIEW: As a lead agency, in accordance with CEQA, Nevada County is distributing the Draft Initial Study/Mitigated Negative Declaration IS/MND to interested public and regulatory authorities for review and comment for a period of 31-days. Nevada County is inviting comments and concerns regarding the IS/MND during the public review period spanning **July 8, 2022 to August 8, 2022 at 5:00 p.m.** Final action on the proposed MND will be taken by the Nevada County Zoning Administrator after the completion of the public review period at a duly noticed public hearing.

DOCUMENT AVAILABILITY: The Draft Initial Study/Mitigated Negative Declaration is available for review on Nevada County's website at https://www.mynevadacounty.com/994/Environmental-Documents. Hardcopies may be reviewed at the Nevada County Planning Department, 950 Maidu Avenue, Suite 170, Nevada City, CA 95959.

Written comments should be sent to the following address: David Nicholas, Assistant Planner, Nevada County Planning Department, 950 Maidu Avenue Suite 170, Nevada City, CA 95959 - Email: david.nicholas@co.nevada.ca.us; on or before **August 8, 2022 at 5:00 p.m.**

Pursuant to the State of California Public Resources Code and the "Guidelines for Implementation of the California Environmental Quality Act of 1970," as amended to date, a Draft Mitigated Negative Declaration has been prepared because no substantial evidence exists, as indicated in the attached Initial Study, that the proposed project may have a significant environmental effect that is not mitigated to a level of less than significance.

Prepared by:

David Nicholas [signature]
David Nicholas, Assistant Planner

7-5-2022
Date

NEVADA COUNTY, CALIFORNIA
INITIAL STUDY

To:

Building Department	Nevada City Rancheria Nisenan Tribe
Public Works – Kevin Nelson, Pat Perkins	T'si Akim Maidu
Environmental Health	United Auburn Indian Community
CEO – Alison Lehman	Shingle Springs Band of Miwok Indians
Commissioner Greeno	Donner Summit Association
Supervisor Hardy Bullock, District V	Donner Summit Historical Society
Principal Planner, Tyler Barrington	Sierra Watch
COB – Jeff Thorsby	South Yuba River Citizen League
Truckee Fire Protection District	California Native Plant Society – Redbud
Caltrans Highways	Laborers Pacific Southwest
Fire Protection Planner	Bear Yuba Land Trust
Lahontan Water Quality Control Board	General Plan Defense Fund
Pacific Gas & Electric	Mountain Area Preservation Fund
Liberty Utilities	Donner Summit Public Utility District
Washoe Tribe	Military Training Route Operator – David Bell

Date: July 5, 2022

Prepared by: David Nicholas, Assistant Planner
Nevada County Planning Department
950 Maidu Avenue, Suite 170
Nevada City, CA 95959
(530) 265-1257
Email: david.nicholas@co.nevada.ca.us

File Number(s): PLN22-0092, AAP22-0002, EIS22-0007, VAR22-0003

Assessor Parcel Number: 047-450-004

Applicant/Owner: Bill Clark
Auburn Ski Club, Inc
P.O. Box 729
Soda Springs, CA 95728

Zoning District: Forest-40 (FR), Recreation (REC)

General Plan Designation: FOR-40, REC

Project Location: 19749 Boreal Ridge Road, Soda Springs, CA 95728. The project site is located near the western edge of the Boreal parking lot near the Auburn Ski Club Nordic Center in unincorporated Eastern Nevada County, off of Interstate 80.

Project Description: An Amendment to Approved Use Permits U89-039 to install 40 light poles along the 2-kilometer lower loop of an existing 10-kilometer cross-county skiing trail system and to allow nighttime skiing from dusk until 8:00 P.M. on Wednesday through Saturday nights from early November through March at the Auburn Ski Club Nordic Center. Some of the light poles will have two lights installed, resulting in a total of 48 lights distributed between the 40 poles. Due to the high levels of snow on Boreal Ridge during the winter, the light poles are proposed to be 40 feet tall which exceeds the height limitation of 15 feet established by Section L-II 4.2.8 of the Nevada County Land Use and Development Code. Therefore, the project is being processed with a variance to the light pole height restrictions.

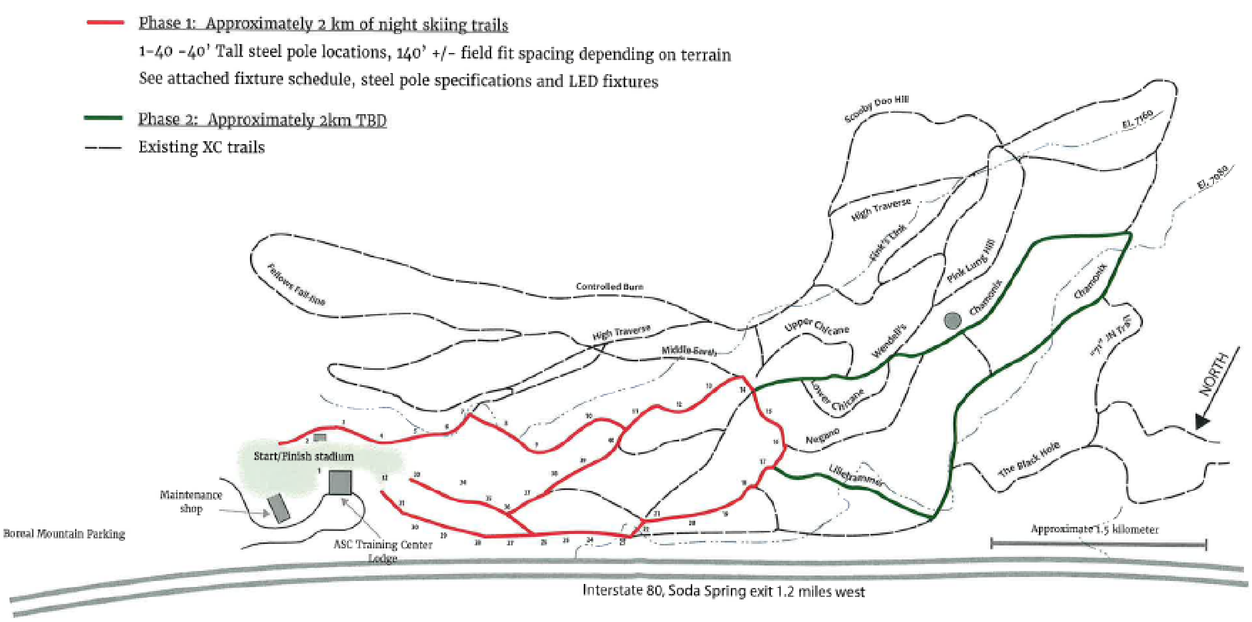
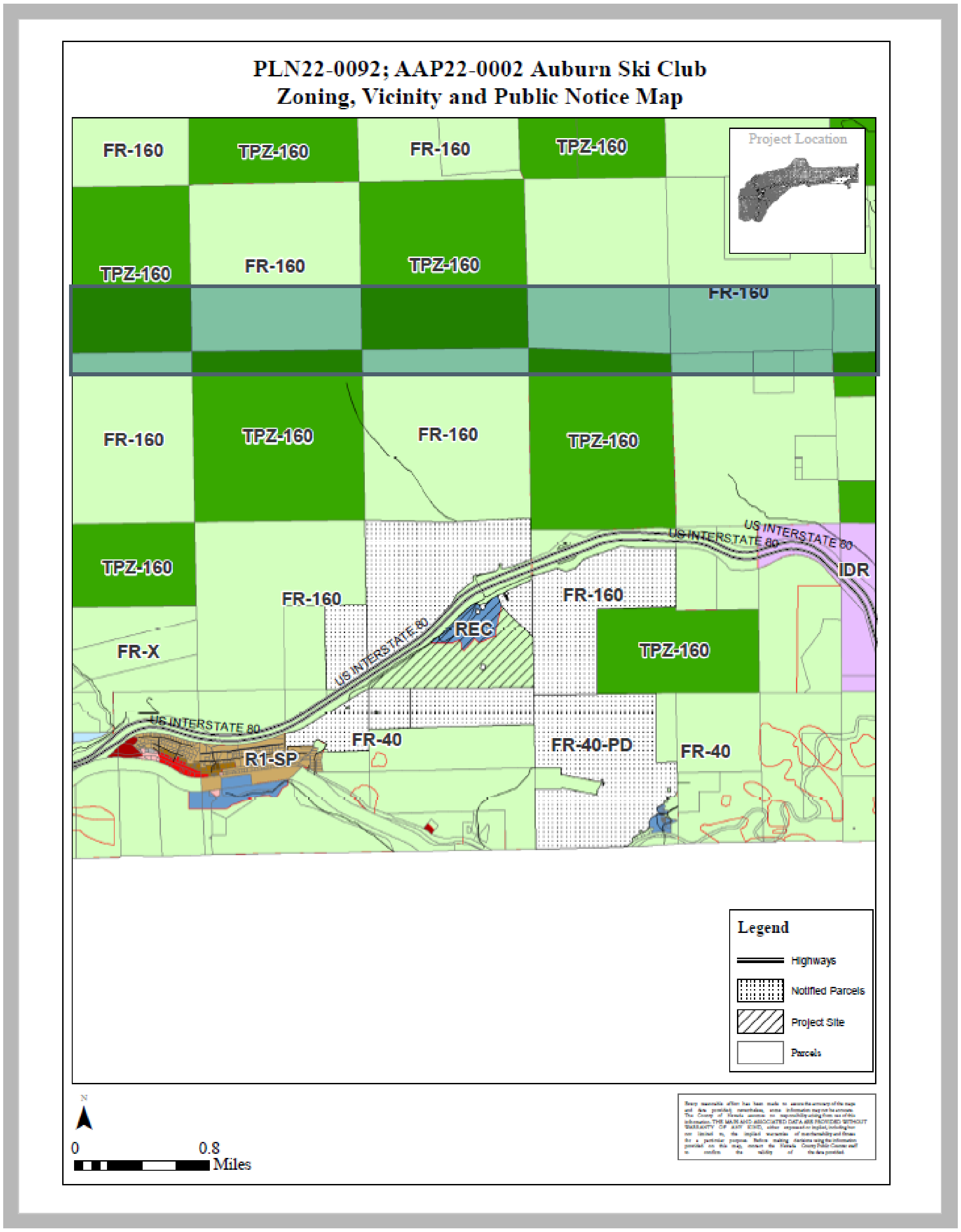


Figure 1 - Site Plan

Project Site and Surrounding Land Uses: The parcel is located in the unincorporated part of eastern Nevada County at 19749 Boreal Ridge Road (APN 047-450-004). The project area is proposed to be within a small portion at the existing Auburn Ski Club Training Center towards the western end of the parcel. Interstate 80 is directly adjacent to the northern property line and connects the local area to Sacramento, California, 90 miles to the southwest and Reno, Nevada, 42 miles northeast.

The area of the proposed trails is zoned as Forest – 40 (FR-40), and Recreation (REC). The parcel is surrounded by other Forest zoning districts with minimum parcel sizes ranging from 40 to 160 acres. These surrounding parcels are mostly undeveloped and the only potentially sensitive land use in the vicinity is Interstate 80. Auburn Ski Club owns the adjacent parcels to the northwest and north, the United States Forest Service owns the parcel to the north and east, and Donner Summit Tramways owns the parcel to the southeast. Donner Summit Tramways is also known as Donner Ski Ranch and will not be impacted by lights on a cross-county skiing trail that is on the other side of Boreal Ridge.



Other Permits, Which May Be Necessary: Based on initial comments received, the following permits may be required from the designated agencies:

1. Building Permits- Nevada County Building Department
2. Electrical Service Development – Truckee Donner Public Utility District
3. Dust Control and Operations Permits – Northern Sierra Air Quality Management District

Relationship to Other Projects: U89-039 approved a three-kilometer trail expansion to the existing seven kilometers of trails that had been used since the 1970s. The project is proposing the addition of 40 light poles along the lower 2-kilometer loop.

This analysis does not intend to "reopen" the environmental review of the approved Mitigation Negative Declaration for the Use Permits (U89-39). The aforementioned documents can be viewed at the Nevada County Planning Department Office located at 950 Maidu Avenue, Suite 170, Nevada City, California 95959. This environmental assessment is intended to be a tiered document pursuant to the California Environmental Quality Act Guidelines Section 2109(b) and shall use both new information and existing information provided with the existing permits. As previously mentioned, the project includes a Variance to Zoning Regulations. Pursuant to Section 15305(a) of the CEQA Guidelines, a Variance is typically categorically exempt from environmental review

Tribal Consultation: Have California Native American Tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code Section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

California Native American Tribes with ancestral land within the project area were routed the project during distribution. The California Native American Tribes will be sent a Notice of Availability for Public Review and Notice of Intent to Adopt a Mitigated Negative Declaration for this project, which will allow the California Native American Tribes the opportunity to comment on the analysis of environmental impacts. Mitigation has been included in Sections 5 and 18 of this initial study to address a plan for further consultation, if needed.

SUMMARY OF IMPACTS and PROPOSED MITIGATION MEASURES

Environmental Factors Potentially Affected:
All of the following environmental factors have been considered. Those environmental factors checked below would be potentially affected by this project, involving at least one impact that is "Less Than Significant with Mitigation" as indicated by the checklist on the following pages.

__	1. Aesthetics	__	2. Agriculture / Forestry Resources	✓	3. Air Quality
✓	4. Biological Resources	✓	5. Cultural Resources	__	6. Energy
✓	7. Geology / Soils	__	8 Greenhouse Gas Emissions	__	9. Hazards / Hazardous Materials
✓	10. Hydrology / Water Quality	__	11. Land Use / Planning	__	12. Mineral Resources
✓	13. Noise	__	14. Population / Housing	__	15. Public Services
__	16. Recreation	__	17. Transportation	✓	18. Tribal Cultural Resources

✓	19. Utilities / Service Systems	__	20. Wildfire	✓	21. Mandatory Findings of Significance

Summary of Impacts and Recommended Mitigation Measures:

3. **AIR QUALITY:** To offset potentially adverse air quality impacts associated with the project activities, the following mitigation measures shall be required:

Mitigation Measure 3A: Implement dust control measures. Prior to the approval of any Grading or Building Permits, to reduce short-term construction impacts, all future development permits shall comply with the following standards to the satisfaction of the Northern Sierra Air Quality Management District, which shall be noted on all grading and improvement plans and shall be included in project bidding documents:

1. The applicant shall implement all dust control measures in a timely manner during all phases of project development and construction.

2 All material excavated, stockpiled or graded shall be sufficiently watered, treated or converted to prevent fugitive dust form leaving the property boundaries and causing a public nuisance or a violation of an ambient air quality standard. Watering should occur at least twice daily, with complete site coverage.

3. All areas (including unpaved roads) with vehicle traffic shall be watered or have dust palliative applied as necessary for regular stabilization of dust emissions.

4. All land clearing, grading, earth moving, or excavation activities on a project shall be suspended as necessary to prevent excessive windblown dust when winds are expected to exceed 20 mph.

5. All on-site vehicle traffic shall be limited to a speed of 15 mph on unpaved roads.

6. All inactive disturbed portions of the development site shall be covered, seeded or watered until a suitable cover is established. Alternatively, the applicant shall be responsible for applying non-toxic soil stabilizers to all inactive construction areas.

7. All material transported off-site shall be either sufficiently watered or securely covered to prevent public nuisance.

Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

Mitigation Measure 3B: Minimize Construction Equipment Idling. In order to reduce emissions from construction equipment, the applicant shall include the following standard note on all Grading Plans, Site Plans or Improvement Plans: "During construction, the contractor shall minimize idling time to a maximum of 5 minutes for all diesel-powered equipment. Signs shall be posted in the designated queuing areas of the construction site to remind off-road equipment operators that idling is limited to a maximum of 5 minutes. Idling of construction-related equipment and construction related vehicles is not recommended within 1,000 feet of any sensitive receptor."

Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Planning Department approval of Grading Permits or Building Permits / Complaint driven*
Responsible Agencies: *Planning and Building Department, Code Compliance Division*

Mitigation Measure 3C: Use Alternative Methods to Open Burning for Vegetation Disposal. Open burning of site-cleared vegetation is prohibited. Among suitable alternatives are chipping, grinding, hauling to an approved disposal site, cutting for firewood, and conversion to biomass fuel.
Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans and during construction*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

Mitigation Measure 3D: Comply with the Asbestos Airborne Toxic Control Measure (ACTM) for construction. If serpentine, ultramafic rock, or naturally occurring asbestos is discovered during construction or grading, the Northern Sierra Air Quality Management District shall be notified no later than the following business day and specific requirements contained in Section 93105 of Title 17 of the California Code of Regulations shall be strictly complied with. This measure shall be included as a note on all grading and improvement plans.

Timing: *Prior to issuance of the grading permits and improvement plans and during grading activity*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

4. **<u>BIOLOGICAL RESOURCES</u>:** To reduce potential construction impacts to biological resources, the following mitigation is required to be outlined on project construction plans for implementation during project construction:

Mitigation Measure 4A: Avoid impacts to nesting raptors and migratory birds. To avoid or minimize potential impacts to nesting birds (including special status species), all project construction activities such as site grubbing, excavation, grading, and the operation heavy equipment occur between September 1 and January 31, outside of the nesting season to the extent feasible. If construction occurs between February 1 and August 31, a pre-qualified biologist shall conduct pre-construction surveys for nesting raptors and migratory birds pursuant to California Department of Fish and Wildlife requirements and according to the Migratory Bird Treaty Act. These surveys should be accomplished within **7 days** prior to commencement of grading activities. In any nesting birds (including special status species) are detected during the pre-construction survey or during construction, work in that area shall be suspended and consultation with County Planning Department staff will immediately commence and CDFW and/or USFWS will be consulted to determine the course of action. If a legally-protected species' nest is located in a tree for removal, the removal shall be deferred until after August 31 or until the adults and young are no longer dependent on the nest, as determined by a qualified biologist.

If any active nests are located onsite, an appropriate no disturbance buffer zone shall be established around the nests, as determined by the qualified biologist. The biologist shall mark the buffer zone with construction tape or pin flags and maintain the buffer zone until the end of the breeding season or until the young have successfully fledged. Buffer zones are 100 feet for migratory bird nests and 250 feet for raptor nests. If active nests are found in areas of work, a qualified biologist shall

3. AIR QUALITY

Existing Setting:

Nevada County is located in the Mountain Counties Air Basin (MCAB). The MCAB includes the central and northern Sierra Nevada Mountain range with elevations ranging from several hundred feet in the foothills to over 6,000 feet above mean sea level along the Sierra Crest. The MCAB generally experiences warm, dry summers and wet winters. Ambient air quality in the air basin is generally determined by climatological conditions, the topography of the air basin, and the type and amount of pollutants emitted. The project site is on the eastern side of the Sierra Nevada Mountain Range and is located within the higher elevations of the Air Basin. During the winter months, temperatures can go below freezing and large quantities of snow can accumulate at the project site. In the summer months, temperatures in the project vicinity are generally mild with daytime peaks between 70 and 80 degrees Fahrenheit. Precipitation rates in the region average about 30 inches annually. The prevailing winds in this area of Nevada County are generally westerly; however, inversions are common in this area during periods of calm winds and clear skies in the fall and winter. The Northern Sierra Air Quality Management District has responsibility for controlling air pollution emissions including "criteria air pollutants" and "toxic air pollutants" from direct sources (such as factories) and indirect sources (such as land-use projects) to improve air quality within Nevada County. To do so, the District adopts rules, regulations, policies, and programs to manage the air pollutant emissions from various sources, and also must enforce certain statewide and federal rules, regulations and laws. The Federal Clean Air Act of 1971 established national ambient air quality standards (NAAQS). These standards are divided into primary and secondary standards. Primary standards are designed to protect public health and secondary standards are designed to protect plants, forests, crops, and materials. Because of the health-based criteria identified in setting the NAAQS, the air pollutants are termed "criteria" pollutants. California has adopted its own ambient air quality standards (CAAQS). Criteria air pollutants include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter. CAAQS include the NAAQS pollutants, in addition to visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. A nonattainment area is an area where a criteria air pollutant's concentration is above either the federal and/or state ambient air quality standards. Depending on the level of severity, a classification will be designated to a nonattainment area. Failure of a state to reach attainment of the NAAQS by the target date can trigger penalties, including withholding of federal highway funds. Table 1 shows the current attainment/nonattainment status for the federal and state air quality standards in Nevada County.

Nevada County has two federally recognized air monitoring sites: The Litton Building in Grass Valley (fine particulate matter, also called PM2.5, and ozone) and the fire station in downtown Truckee (PM2.5 only). For eight-hour average ozone concentrations, Nevada County is serious nonattainment for both the 2008 and 2015 state and federal ozone standards of 75 and 70 parts per billion, respectively (Table 1). Unlike other pollutants, ozone is not typically released directly into the atmosphere from any sources. Ozone is created by the interaction of Nitrogen Oxides and Reactive Organic Gases (also known as Volatile Organic Compounds) in the presence of sunlight, especially when the temperature is high. The major sources of Nitrogen Oxides and Reactive Organic Gases, known as ozone precursors, are combustion sources such as factories, automobiles and evaporation of solvents and fuels. Ozone is mainly a summertime problem, with the highest concentrations generally observed in July and August, when the days are longest, especially in the late afternoon and evening hours. Ozone is considered by the California Air Resources Board to be overwhelmingly transported to Nevada County from the Sacramento Metropolitan area and, to a lesser extent, the San Francisco Bay Area. This recognition of overwhelming transport relieves Nevada County of

CAAQS-related requirements, including the development of a CAAQS attainment plan with a "no-net-increase" permitting program or an "all feasible measures" demonstration. For particulate matter, ambient air quality standards have been established for both PM l0 and PM2.5. California has standards for average PM l0 concentrations over 24-hour periods and over the course of an entire year, which are 50 and 20 µg/m3, respectively. (The notation "µg/m3" means micrograms of pollutant per cubic meter of ambient air.) For PM2.5, California only has a standard for average PM2.5 concentrations over a year, set at 12 µg/m3, with no 24- hour-average standard. Nevada County is in compliance with all of the federal particulate matter standards, but like most California counties it is out of compliance with the state PM10 standards. Particulate-matter is identified by the maximum particle size in microns as either PM2.5 or PM l0. PM2.5, is mostly smoke and aerosol particles resulting from woodstoves and fireplaces, vehicle engines, wildfires, and open burning. PM-10 is a mixture of dust, combustion particles (smoke) and aerosols from sources such as surface disturbances, road sand, vehicle tires, and leaf blowers.

Table 1: Attainment Status by Northern Sierra Air Quality Management District

of State and Federal Air Quality Standards. In addition, the entire district is either Attainment or Unclassified for all State and federal NO_2, SO_2, Pb, H_2S, visibility reducing particles, sulfates, and vinyl chloride standards.

Pollutant	State Designation	Federal Designation
Ozone (O_3)	Nevada County: Non-attainment (due to overwhelming transport)	2008 O_3 Standard (75 ppb) Western Nevada County: Serious Non-attainment; Eastern Nevada County: Unclassifiable.
		2015 O_3 Standard (70 ppb) Western Nevada County: Serious Non-attainment; Eastern Nevada County: Unclassifiable.
PM_{10}	Nevada County: Non-attainment	Unclassified
PM2.5	Nevada County: Unclassified	2012 Annual Standard (12µg/m^3) Nevada County: Unclassifiable/Attainment
		2012 24-hour Standard (35µg/m^3) Unclassifiable/Attainment
CO	Nevada: Unclassified	Unclassifiable/Attainment

Ultramafic rock and its altered form, serpentine rock (or serpentinite), both typically contain asbestos, a cancer-causing agent. Ultramafic rock and serpentine are likely to exist in several areas of western Nevada County. The area of the project site is not mapped as an area that is likely to contain ultramafic rock, but it is adjacent to an ultramafic rock unit (California Department of Conservation, 2000). Natural occurrences of asbestos are more likely to be encountered in, and immediately adjacent to areas of ultramafic rock.

Please see Section 8 of this Initial Study for a discussion of project impacts related to Greenhouse Gas Emissions.

Would the proposed project:	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact	Reference Source (Appendix A)
a. Conflict with or obstruct implementation of the applicable air quality plan.				✓	A,G
b. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable federal or state ambient air quality standard?		✓			A,G
c. Expose sensitive receptors to substantial pollutant concentrations?		✓			A,G,L
d. Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?		✓			A,G
e. Generate substantial smoke ash or dust?		✓			A,G

Impact Discussion:

3a: Nevada County's General Plan, Chapter 14 Air Quality Element, contains numerous policies to protect air quality in Nevada County. With the exception of General Plan Air Quality Element Policy 14.7A, which requires compliance with Northern Sierra Air Quality Management District Rule 226, the Nevada County General Plan Air Quality Element policies are intended to apply to development that generates new residents or new employees. The addition of lights to the trail system or the extended hours of skiing will not create any new residents or employees. By assessing air pollution and emissions associated with the proposed project and recommending mitigation measures based on Thresholds of Significance established by the Northern Sierra Air Quality Management District (NSAQMD), the project as proposed would comply with Northern Sierra Air Quality Management District regulations. In addition, the project has been mitigated, as discussed below to be complaint with the NSAQMD construction guidelines in compliance with Rule 226, which is related to the control of dust emissions as required by Mitigation Measure 3A. In addition, based on the County's review of the NSAQMD Rules and Guidelines for Assessing and Mitigation Air Quality Impacts of Land Use Projects, it appears several of the objectives of the NSAQMD regulations are achieved through the application of mitigation measures provided below and due to the size and type of the project, the minimization of heavy equipment idling times as required by Mitigation Measure 3B, the use of alternative methods to open burning for vegetation disposal, and the compliance with Asbestos Airborne Toxic Control Measures.

Therefore, given the above discussion, the project itself will not violate any established policies or standards for the protection of air quality nor would it conflict with or obstruct implementation of any quality plan, therefore there is ***no impact***.

3b-e: Eastern Nevada County is in non-attainment for the Federal 8-hour ozone standard, and the entirety of Nevada County is in non-attainment for the State 1- and 8-hour ozone standards and PM10 standards. While most of the ozone in the County is transported from urban areas to the southwest, PM10 sources primarily come from within the County. PM10 violations in winter are largely due to wood smoke from the use of woodstoves and fireplaces, while summer and fall violations often occur during forest fires or periods of open burning. The proposed project would result in a temporary but incrementally small net increase in pollutants due to minor land disturbance and construction vehicle and equipment emissions related to the installation of the 40 light poles and trenching for underground electrical.

Construction and Operational Impacts

The California Emissions Estimation Model (CalEEMod) provides a means to estimate potential emissions associated with both construction and operation of land use projects. Using the parameters specific to this proposed project, the CalEEMod model identified potential increases in the pollutants of concern during various stages of the construction phase of the project (*CalEEMod Version 2016.3.2*). Construction, including site preparation and grading, was assumed to occur over a period of a 60 days to provide a conservative analysis. There is expected to be 6,886 square feet of trenching for electrical utilities and 640 square feet of site preparation for the installation of the light poles. The highest amount in any given year over the life of construction was used, with the default variables for the construction of the proposed additions.

Table 1. Project Construction Air Quality Impacts

Pollutant	NSAQMD Threshold*	Project Impact
NOx	24-136 lbs/day	1.13 lbs/day (0.206 tons/year)
ROG	24-136 lbs/day	0.11 lbs/day (0.021 tons/year)
PM10	79-136 lbs/day	0.136 lbs/day (0.025 tons/year)
CO	N/A	1.06 lbs/day (0.194 tons/year)

*These thresholds are "Level B" in NSAQMD's *Guidelines*. All projects require basic mitigations under Level A, which is under 24 pounds per day of any pollutant shown above.

As shown above on Table 1, no mass of pollutant emissions will exceed thresholds established by NSAQMD. Although PM10 is not anticipated to exceed the per diem threshold adopted by NSAQMD, this constituent has been identified in Nevada County as exceeding ambient air quality standards and should be mitigated to the extent possible through dust control measures such as watering and stabilizing of excavated materials, slow vehicle speeds on-site, and halting work during windy periods as required in Mitigation Measure 3A.

Short-term project construction activities have the potential of generating dust and impacting the local ambient air quality with grading and excavation, vegetation removal, and construction activities from site preparation, the installation of underground utilities, and associated light poles. If improperly managed or controlled, and depending upon the time of year and air conditions, the construction activities associated with this project may have the potential to produce off-site dust impacts. The Northern Sierra Air Quality Management District (NSAQMD) therefore recommends mitigation during the construction phase of this project including Mitigation Measure 3B requiring that diesel construction equipment not be idled for more than 5 minutes to prevent smoke and ozone precursors and a requirement for alternatives to open burning of cleared vegetation, as outlined in Mitigation Measure 3C.

Ultramafic Rock

Serpentine soils and ultramafic rock are not mapped on the project site, pursuant to the Northern Sierra Air Quality Management District and the National Geologic Map Database provided by the

United States Geologic Service. However, although unlikely, there is always the potential to encounter these soil types during grading activities. According to the NSAQMD, ultramafic rock typically contains asbestos, a cancer-causing agent. Disturbance of this rock and nearby soil during project construction can result in the release of microscopic cancer-causing asbestos fibers into the air, resulting in potential health and safety hazards. Health risks related to project grading would be reduced by the incorporation of Mitigation Measure 3D, which would require compliance with the Asbestos Airborne Toxic Control Measure (ACTM) for construction.

The mitigation measures recommended above will minimize the potential adverse impacts associated with construction and operational emissions to a level that is ***less than significant with mitigation***.

Mitigation: To offset potentially adverse air quality impacts associated with the project activities, the following mitigation measures shall be required:

Mitigation Measure 3A: Implement dust control measures. Prior to the approval of any Grading or Building Permits, to reduce short-term construction impacts, all future development permits shall comply with the following standards to the satisfaction of the Northern Sierra Air Quality Management District, which shall be noted on all grading and improvement plans and shall be included in project bidding documents:

1. The applicant shall implement all dust control measures in a timely manner during all phases of project development and construction.

2 All material excavated, stockpiled or graded shall be sufficiently watered, treated or converted to prevent fugitive dust form leaving the property boundaries and causing a public nuisance or a violation of an ambient air standard. Watering should occur at least twice daily, with complete site coverage.

3. All areas (including unpaved roads) with vehicle traffic shall be watered or have dust palliative applied as necessary for regular stabilization of dust emissions.

4. All land clearing, grading, earth moving, or excavation activities on a project shall be suspended as necessary to prevent excessive windblown dust when winds are expected to exceed 20 mph.

5. All on-site vehicle traffic shall be limited to a speed of 15 mph on unpaved roads.

6. All inactive disturbed portions of the development site shall be covered, seeded or watered until a suitable cover is established. Alternatively, the applicant shall be responsible for applying non-toxic soil stabilizers to all inactive construction areas.

7. All material transported off-site shall be either sufficiently watered or securely covered to prevent public nuisance.

Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

Mitigation Measure 3B: Minimize Construction Equipment Idling. In order to reduce emissions from construction equipment, the applicant shall include the following standard note on

all Grading Plans, Site Plans or Improvement Plans: "During construction, the contractor shall minimize idling time to a maximum of 5 minutes for all diesel-powered equipment. Signs shall be posted in the designated queuing areas of the construction site to remind off-road equipment operators that idling is limited to a maximum of 5 minutes. Idling of construction-related equipment and construction related vehicles is not recommended within 1,000 feet of any sensitive receptor."
Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans*
Reporting: *Planning Department approval of Grading Permits or Building Permits / Complaint driven*
Responsible Agencies: *Planning and Building Department, Code Compliance Division*

Mitigation Measure 3C: Use Alternative Methods to Open Burning for Vegetation Disposal. Open burning of site-cleared vegetation is prohibited. Among suitable alternatives are chipping, grinding, hauling to an approved disposal site, cutting for firewood, and conversion to biomass fuel.
Timing: *Prior to issuance of Grading Permits, Building Permits or Improvement Plans and during construction*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

Mitigation Measure 3D: Comply with the Asbestos Airborne Toxic Control Measure (ACTM) for construction. If serpentine, ultramafic rock, or naturally occurring asbestos is discovered during construction or grading, the Northern Sierra Air Quality Management District shall be notified no later than the following business day and specific requirements contained in Section 93105 of Title 17 of the California Code of Regulations shall be strictly complied with. This measure shall be included as a note on all grading and improvement plans.
Timing: *Prior to issuance of the grading permits and improvement plans and during grading activity*
Reporting: *Approval of the grading permit and improvement plans*
Responsible Agency: *Northern Sierra Air Quality Management District*

4. BIOLOGICAL RESOURCES

Existing Setting: The habitat of the project area consists of Pacific Northwest Subalpine Forest and Montane Conifer Forest. The United States Geological Survey identifies Upper Castle Creek on the north-eastern end of the parcel as a watercourse, but it will not be impacted by the project since it is not in the same vicinity of the project site. No other wetlands or other aquatic features were identified on the USGS map. Based on history provided by the applicant, the cross-county skiing trails are essentially modified old logging roads. The Boreal lease area of the parcel is highly developed with a ski lodge, chair lifts, an eight-unit condominium, a large parking lot, an extreme sports training facility, outdoor skate parks, an equipment maintenance shop, cellular towers, and other less prominent structures. The portion of the parcel related to the Auburn Ski Club has less intense development and includes a time keeping tower, a retaining wall for snow, an equipment repair shop, the lodge, and a parking lot. The site is developed with many culverts to control the flow of water from the melting snow and to prevent flooding. Based on a walk of the lower loop, the proposed locations of the poles are along a dirt path that is covered with only light amounts of vegetation or rocks. The land is predominately barren because the snow cover appears to have killed the underlaying vegetation. There are many trees in the area which are mainly second growth lodgepole pines and red fir. Higher up in sunny areas are some Jeffery pines and a scattering of western white pine. The project applicant has verified that no trees will be removed for the installation of the light poles.

EXHIBIT K

DRAFT
PROGRAM ENVIRONMENTAL IMPACT REPORT

VOLUME I: PROJECT DESCRIPTION AND ENVIRONMENTAL EVALUATIONS

EMPIRE MINE STATE HISTORIC PARK
Site Characterization and Remediation Project

State Clearinghouse No: 2008082066

August 2009

Lead Agency

State of California
DEPARTMENT OF PARKS AND RECREATION
Acquisition and Development
One Capitol Mall - Suite 410
Sacramento, California 95814

DRAFT
PROGRAM ENVIRONMENTAL IMPACT REPORT

VOLUME I: PROJECT DESCRIPTION AND ENVIRONMENTAL EVALUATIONS

EMPIRE MINE STATE HISTORIC PARK
Site Characterization and Remediation Project

State Clearinghouse No: 2008082066

August 2009

Lead Agency

State of California
DEPARTMENT OF PARKS AND RECREATION
Acquisition and Development
One Capitol Mall - Suite 410
Sacramento, California 95814

4.2 Air Quality

4.2 AIR QUALITY

Section 4.0, Environmental Analysis, provides a description of the analytical methodology that DPR applied to each resource category, including Air Quality, from a Program perspective.

4.2.1 EXISTING CONDITIONS

4.2.1.1 Methods

Quantification of air quality emissions resulting from Program Actions implemented at Remediation Areas was conducted and assumptions documented to ensure that: (1) Project Actions at Remediation Areas were consistent with the programmatic approach; (2) identified impacts not previously considered in the programmatic analysis would be reduced to less than significant by implementing Standard and Specific Project Requirements and mitigation measures evaluated in the Program EIR; and (3) Project Requirements and all applicable mitigation measures identified in the Program EIR would be incorporated.

4.2.1.2 Climate

The Park is located in the foothills of the Sierra Nevada Mountains in western Nevada County, an area with gentle to steep topography, warm to hot and dry summers, and cool and wet winters. The area has a semi-Mediterranean climate type, with pronounced summer and winter seasonal variation in temperature and precipitation. Monthly average summer temperatures range from 54° to 85°F and monthly average winter temperatures range from 32° to 54°F. Most precipitation occurs from late October through early May with winter precipitation falling as rain or snow. Wind direction tends to be from the southwest; winds from the west can transport pollutants into the area from the Sacramento Valley and Bay Area. Surface and elevated inversions are common in the late summer and fall. These inversions can cause stagnation of airflow, allowing air pollutants to become concentrated.

Air quality is affected by both the rate and location of pollutant emissions and by meteorological conditions that influence movement, dispersal and formation of pollutants. Atmospheric conditions such as wind speed, wind direction, and air temperature gradients, along with local topography and sunlight, provide the link between air pollutant emissions and air quality.

Existing Regional Air Quality

Pursuant to the 1990 Federal Clean Air Act Amendments, the USEPA classifies air basins (or portions thereof) as "attainment" or "nonattainment" for each of the criteria air pollutants, based on whether or not the National Ambient Air Quality

Standards (NAAQS) had been achieved. Similarly, the California Air Resources Board (CARB) evaluates the attainment status of air basins based on the California Ambient Air Quality Standards (CAAQS). Table 4.2-1, Mountain Counties Air Basin Attainment Status, shows the current attainment status of the air basin that the Empire mine is located. The Mountain Counties air basin, which includes Nevada County, is in attainment or unclassified for all federal standards except the eight-hour ozone standard. The air basin is designated non-attainment for the ozone and PM_{10} CAAQS.

TABLE 4.2-1
MOUNTAIN COUNTIES AIR BASIN ATTAINMENT STATUS

Pollutant	Averaging Time	State Standard	State Standard Attainment Status	National Primary Standard	National Standard Attainment Status
Ozone	1 hour	0.09 ppm	Non-attainment	–[1]	Non-attainment
	8 hours	0.070 ppm2		0.075 ppm	
Carbon Monoxide	1 hour	20 ppm	Unclassified	35 ppm	Unclassified/ Attainment
	8 hours	9.0 ppm		9 ppm	
Nitrogen Dioxide	1 hour	0.18 ppm	Attainment	–	Unclassified/ Attainment
	Annual Avg.	0.030		0.053 ppm	
Sulfur Dioxide	1 hour	0.25 ppm	Attainment	–	Unclassified
	24 hours	0.04 ppm		0.14 ppm	
	Annual Avg.	–		0.030 ppm	
Respirable Particulate Matter (PM_{10})	24 hours	50 µg/m3	Non-attainment	150 µg/m3	Unclassified
	Annual Avg.	20 µg/m3		–	
Fine Particulate Matter ($PM_{2.5}$)	24 hours	–	Unclassified	35 µg/m3	Unclassified/ Attainment
	Annual Avg.	12 µg/m3		15 µg/m3	
Lead	30-day avg.	1.5 µg/m3	Attainment	–	Attainment
	Quarterly	–		1.5 µg/m3	
	Rolling 3-month avg.3	–		0.15 µg/m3	
Hydrogen Sulfide	1 hour	0.03 ppm	Unclassified	–	–
Sulfates	24 hour	25 µg/m3	Attainment	–	–
Visibility Reducing Particles	8 hour	Extinction of 0.23/km; visibility of 10 miles or more	Unclassified	–	–

Notes:
[1] Federal One Hour Ozone National Ambient Air Quality Standard was revoked on June 15, 2005.
[2] This concentration was approved by the Air Resources Board on April 28, 2005 and became effective May 17, 2006.
[3] Final rule signed October 15, 2008. Proposed standard not yet effected – Nevada County will be nonattainment upon effective date.

Source: California Air Resources Board, 2007b. Area Designation Maps,http://www.arb.ca.gov/desig/ad m/adm.htm, Maps current as of February, 2009.

Compliance with ambient air quality standards is determined for some pollutants with the use of a stationary monitoring network. The Northern Sierra Air Quality Management District (NSAQMD) maintains ambient air quality monitoring stations in Nevada County. The closest monitoring station is located in the City of Grass Valley (at the Litton Building), approximately 16 miles from the Park. The Grass Valley monitoring station currently monitors ozone and particulate matter with aerodynamic diameters equal to or less than 10 microns (PM_{10}) and equal to or less than 2.5 microns ($PM_{2.5}$). The most recent published data for the monitoring station are presented in Table 4.2-2, Air Quality Data Summary (2004-2008). Table 4.2-2 includes a comparison of monitored air pollutant concentrations from the Grass Valley station with state and national ambient air quality standards.

TABLE 4.2-2
AIR QUALITY DATA SUMMARY (2004-2008)

Pollutant-Monitor Location	Monitoring Data by Year						
	Standards[a]						
	National	State	2004	2005	2006	2007	2008
OZONE-GRASS VALLEY-LITTON BUILDING							
Highest 1 Hour Average (ppm)[b]	–	0.09	0.126	0.128	0.112	0.113	0.111
Days over State Standard			11	15	19	5	8
Highest 8 Hour Average (ppm)[b]	0.075	0.07	0.111	0.120	0.105	0.096	0.108
Days over National 8-hour Standard			42	42	60	36	24
Days over State 8-hour Standard			71	66	81	55	42
PARTICULATE MATTER (PM_{10})-GRASS VALLEY-LITTON BUILDING[c]							
Highest 24 Hour Average (µg/m3)[b]-National Measurement	150	50	37.8	32.7	52.1	NA	NA
Days over National Standard[d]			0	0	0	NA	NA
Annual Arithmetic Mean (µg/m3)[b]		20	NA	NA	NA	NA	NA
PARTICULATE MATTER ($PM_{2.5}$)-GRASS VALLEY-LITTON BUILDING							
Highest 24 Hour Average (µg/m3)[b]	35		17.0	10.0	32.0	22.0	102.2
Days over 24-hour National Standard			0	0	0	0	NA
National Standard Annual Average (µg/m3)[b]	15		NA	NA	6.2	4.9	NA
State Standard Annual Average (µg/m3)[b]		12	NA	NA	6.2	NA	NA

Notes:
Values in bold are in excess of at least one applicable standard. NA = Not Available.

a. Generally, State standards and national standards are not to be exceeded more than once per year.
b. ppm = parts per million; µg/m3 = micrograms per cubic meter.
c. No State measurement and exceedance data is available for PM_{10} at his monitoring station.
d. PM_{10} is not measured every day of the year. Number of estimated days over the standard is based on 365 days per year.

Source: California Air Resources Board (ARB), January 29, 2009. Summaries of Air Quality Data, 2004, 2005, 2006, 2007, 2008; http://www.arb.ca.gov/adam/cgi-bin/db2www/polltrendsb.d2w/start.

4.2.1.3 Sensitive Receptors

Sensitive receptors include individuals as well as groups relating to specific land uses; some receptors are considered more sensitive than others to air pollutants. Greater than average sensitivity results from pre-existing health problems, developmental age, proximity to emissions source, and/or duration of exposure to air pollutants. The ARB has identified the following people who are most likely to be affected by air pollution: children under 14, the elderly over 65, athletes, and people with cardiovascular and chronic respiratory diseases. These groups are classified as sensitive receptors. Locations that could contain a high concentration of these sensitive population groups include residential areas, hospitals, daycare facilities, elder care facilities, long-term care facilities, schools, and parks. For example, residential areas could be considered locations including sensitive receptors because people usually stay home for extended periods of time, with associated greater exposure to ambient air quality and some residents will be members of sensitive population groups. Another example is that recreational areas are also considered potential locations of sensitive receptors because engaging in vigorous exercise placing a higher demand on the human respiratory system.

Six houses and two mobile home pads used for DPR Park personnel housing are situated within the Park; currently three of the houses and one of the mobile home pads accommodate eight year-around residents (Clark 2008, Munson 2008a). In addition, private homes are located along Osborne Hill Road. Osborne Hill Road is a private, residential street situated to the east of Osborne Hill and the Park boundary (Wells 2008).

Two public facilities, Grass Valley Seventh Day Adventist Church on Osborne Hill Road and Calvary Bible Church of Grass Valley on SR 174, are situated within several hundred feet of the eastern Park boundary and within ½ mile of Osborne Hill. Both of these facilities include could include sensitive receptors (Superpages.com 2008).

Schools within close proximity of the Park include: Union Hill Elementary School (approximately ¼ mile from the Park), Hennessy Elementary School (approximately 1 mile from the Park), Lyman Gilmore Middle School (approximately 2 miles from the Park), and Sierra Foothills High School (approximately 1 mile from the Park) (Google Maps 2008) (see Figure 4.10-1).

4.2.1.4 Pollutants and Effects

This subsection provides a general background of typical air contaminants.

Ozone

Ground level ozone (O_3) is not emitted directly into the atmosphere, but is a secondary air pollutant produced through a complex series of photochemical reactions involving reactive organic gases (ROG) and nitrogen oxides (NO_x). Significant ozone production generally requires ozone precursors to be present in a stable atmosphere with strong sunlight for approximately 3 hours. Precursors are emitted by a number of industrial and mobile sources. Ozone is a regional air pollutant because it is not emitted directly by sources, but is formed downwind of sources of ROG and NO_x under the influence of wind and sunlight. Ozone concentrations tend to be higher in the late spring, summer, and fall, when the long sunny days create conditions conducive to the formation and accumulation of secondary photochemical compounds, like ozone.

Short-term exposure to ozone can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, both short-term and long-term exposure to ozone can aggravate existing respiratory diseases such as asthma, bronchitis, and emphysema. Long-term exposure to ozone can potentially cause damage to natural ecosystems such as forests and foothill communities and damages agricultural crops and some man-made materials, such as rubber, paint and plastics.

Because ozone is formed by secondary photochemical reactions and isn’t directly emitted from any Project sources, it was not evaluated quantitatively. ROGs and NO_x were evaluated as a surrogate for ozone.

Carbon Monoxide

Ambient carbon monoxide (CO) concentrations normally are considered a local effect and typically correspond closely to the spatial and temporal distributions of vehicular traffic. Wind speed and atmospheric mixing also influences CO concentrations. Under inversion conditions, CO concentrations could be distributed more uniformly over an area that could extend some distance from vehicular sources. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood resulting in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular disease, chronic lung disease, or anemia, as well as for fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death. The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels could cause chest pain and reduce that person's ability to exercise; repeated exposures could contribute to other cardiovascular effects.

Carbon monoxide concentrations have declined dramatically in California due to existing controls and programs. Most areas of the state including the Project region have no problem meeting the state and federal carbon monoxide standards. Carbon monoxide concentrations are expected to continue declining due to the ongoing retirement of older, pollution-prone vehicles from the mix of vehicles on the road network.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish brown gas that is a by-product of combustion processes; automobiles and industrial operations are the main sources of NO_2. NO_2 could be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high ozone levels.

NO_2 is an air quality concern because it acts as a respiratory irritant and is a precursor of ozone. NO_2 is a major component of the group of gaseous nitrogen compounds commonly referred to as nitrogen oxides (NO_x). NO_x are produced by fuel combustion in motor vehicles, industrial stationary sources (such as industrial activities), ships, aircraft, and rail transit. Typically, NO_x emitted from fuel combustion are in the form of nitric oxide (NO) and NO_2. NO is often converted to NO_2 when it reacts with ozone or undergoes photochemical reactions in the atmosphere. Therefore, emissions of NO_2 from combustion sources are typically evaluated based on the amount of NO_x emitted from the source. Additionally, besides contributing to tropospheric ozone, NO_2 also contributes to the formation of PM_{10} and $PM_{2.5}$, both of which contribute to respiratory disease and visibility degradation.

Respirable Particulate Matter

Respirable particulate matter consists of particulate matter that is 10 microns (a micron is one-millionth of a meter) or less (PM_{10}) in aerodynamic diameter and 2.5 microns or less ($PM_{2.5}$) in aerodynamic diameter, respectively. PM_{10} and $PM_{2.5}$ represent fractions of particulate matter that can be inhaled into the air passages and the lungs and can cause adverse health effects. Some sources of particulate matter (such as wood burning in fireplaces, demolition, and construction activities) are more local in nature, while others, such as vehicular traffic, have a more regional effect. Very small particles of certain substances (e.g., sulfates and nitrates) can cause lung damage directly, or can contain adsorbed gases (e.g., chlorides or ammonium) that could be injurious to health. Large dust particles (diameter greater than 10 microns) settle out rapidly and are easily filtered by human breathing passages. This large dust is of more concern as a soiling nuisance rather than a health hazard. The remaining fraction, PM_{10} and $PM_{2.5}$, are a health concern particularly at levels above the federal and state ambient air quality standards. $PM_{2.5}$ (including diesel exhaust particles) is thought to have greater effects on health, because these particles are so small and thus, are able to penetrate to the deepest parts of the lungs.

Scientific studies have suggested links between respirable particulate matter and numerous health problems including asthma, bronchitis, acute and chronic respiratory symptoms such as shortness of breath and painful breathing. Recent studies have shown an association between morbidity and mortality and daily concentrations of particulate matter in the air. Children are more susceptible to the health risks of PM_{10} and $PM_{2.5}$ because their immune and respiratory systems are still developing.

Despite important gaps in scientific knowledge and continued skepticism, a comprehensive evaluation of the research findings provides persuasive evidence that exposure to fine particulate air pollution has adverse effects on cardiopulmonary health (Dockery and Pope 2006). The California Air Resources Board (ARB) has estimated that achieving the ambient air quality standards for PM_{10} could reduce premature mortality rates by 6,500 cases per year (ARB 2002).

As the discussion above illustrates, the main regulatory focus for controlling PM_{10} and $PM_{2.5}$ is to reduce potential health risks; however, particulates can also damage materials and reduce visibility.

Sulfur Dioxide

Sulfur dioxide (SO_2) is a combustion product of sulfur or sulfur-containing fuels such as coal, fuel oil, and diesel. SO_2 is also a precursor to the formation of atmospheric sulfate, particulate matter and contributes to potential atmospheric sulfuric acid formation that could precipitate downwind as acid rain.

SO_2 also contributes to the atmospheric formation of suspended particulate in the PM_{10} and $PM_{2.5}$ size fractions. Ambient SO_2 concentrations have been reduced in recent years due to restriction on the sulfur content in fuel.

Lead

Lead is a criteria pollutant for which there are federal and state ambient air quality standards, as well as a TAC. In the Project area, ambient lead concentrations currently meet state standards, which are more stringent than federal standards. Lead has a range of adverse neurotoxin health effects, and was formerly released into the atmosphere primarily via leaded gasoline products. The phase-out of leaded gasoline in California resulted in decreasing levels of atmospheric lead. However, due to lead concentrations in some soils at the Park that were above the U.S. EPA Region 9 PRG, lead was evaluated as a possible soil PCOC for this assessment.

Odors

Though offensive odors from stationary sources rarely cause any physical harm, they are unpleasant and can lead to public distress. The frequency and severity of the odor impacts depend on the nature, frequency and intensity of the source; wind speed and direction; and the sensitivity of receptors. The CEQA Guidelines recommend that odor impacts be considered for any proposed new odor sources located near existing receptors, as well as any new sensitive receptors located near existing odor sources. Generally, increasing the distance between the receptor and the source will mitigate odor impacts.

Greenhouse Gases

Some gases in the atmosphere affect the Earth's heat balance by absorbing infrared radiation. These gases can prevent the escape of heat in much the same way as glass in a greenhouse. This is often referred to as the "greenhouse effect," and it is responsible for maintaining a habitable climate. On Earth, the gases believed to be most responsible for global warming are water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Enhancement of the greenhouse effect occurs when concentrations of these gases exceed the natural concentrations in the atmosphere. Of these greenhouse gases (GHG), CO_2 and methane are emitted in the greatest quantities from human activities. Emissions of CO_2 are largely by-products of fossil fuel combustion, whereas methane primarily results from off-gassing associated with agricultural practices and landfills and from the natural decay of materials in the environment. SF_6 is a GHG commonly used in the utility industry as an insulating gas in transformers and other electronic equipment. SF_6, while comprising a small fraction of the total GHGs emitted annually world-wide, is a much more potent GHG with 23,900 times the global warming potential as CO_2. Global warming potential is the potential of a gas or aerosol to trap heat in the atmosphere. CO2 is assigned a global warming potential of 1. There is widespread international scientific agreement that human-caused increases in GHGs has and will continue to contribute to global warming, although there is much uncertainty concerning the magnitude and rate of the warming.

Globally, climate change has the potential to impact numerous environmental resources through potential, though uncertain, impacts related to future air temperatures and precipitation patterns. In California the effects of global warming could include loss in snow pack, sea level rise, more extreme heat days per year, more high ozone days, more large forest fires, and more drought years (ARB 2007f). The projected effects of global warming on weather and climate are likely to vary regionally; however, these are expected to include the following direct effects (IPCC 2001):

- Higher maximum temperatures and more hot days over nearly all land areas;
- Higher minimum temperatures, fewer cold days and frost days over nearly all land areas;
- Reduced diurnal temperature range over most land areas;
- Increase of heat index over land areas; and
- Increased intensity of precipitation events.

Also, there are many secondary effects that are projected to result from global warming, including global rise in sea level, impacts to agriculture, changes in disease vectors, and changes in habitat and biodiversity. Because the possible outcomes and the feedback mechanisms involved are not fully understood, more research is required, and the potential for substantial environmental, social, and economic consequences over the long term could be great.

Toxic Air Contaminants

Non-criteria air pollutants, or TACs, are airborne substances that are capable of causing short-term (acute) and/or long-term (chronic or carcinogenic, i.e., cancer-causing) adverse human health effects (i.e., injury or illness). TACs include both organic and inorganic chemical substances. They could be emitted from a variety of common sources including gasoline stations, automobiles, dry cleaners, industrial operations, and painting operations. The current California list of TACs includes approximately 200 compounds, including particulate emissions from diesel-fueled engines.

Diesel Particulate Matter (DPM)

In 2001, the ARB assessed the statewide health risks from exposure to diesel exhaust and to other toxic air contaminants. It is difficult to distinguish the health risks of diesel emissions from the other air toxics, since diesel exhaust contains about 40 different TACs. The ARB study (ARB 2000) detected diesel exhaust by using ambient air carbon soot measurements as a surrogate for diesel emissions. The Study reported that in 2000, the statewide cancer risk from exposure to diesel exhaust was about 540 cancer cases per million people as compared to a total risk for exposure to all ambient air toxics of 760 cancer cases per million. This estimate of risk from diesel exhaust, which accounts for about 70 percent of the total risk from TACs, included both urban and rural areas in the State. It can be considered a plausible worst-case for the State, since it assumes constant exposure to outdoor concentrations of diesel exhaust and does not account for expected lower concentrations indoors, where people spend most of their time.

The California Office of Environmental Health Hazard Assessment (OEHHA) has determined that chronic exposure to DPM can cause carcinogenic and non-carcinogenic health effects. OEHHA has specified an acceptable exposure level (AEL) of DPM as a non-carcinogen of 5 µg/m3 (micrograms per cubic meter) (annual average). OEHHA has also established a unit risk value for DPM, which is the increased probability of contracting cancer if exposed to an average concentration of 1 µg/m3 for 70 years. The unit risk value established for DPM is 300 in a million per microgram per cubic meter.

TAC Metals (Arsenic/Lead/Cadmium)

Project areas containing contaminants in soil are potential sources of air quality impacts. From 2006 to 2008, MFG measured metal concentrations in soils and mine waste rock materials at various Park locations. MFG analyzed the materials for the following metals and their concentrations at the Park: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, and mercury. Of these seventeen metals, arsenic, lead, and cadmium were found to be PCOCs within the Park and Remediation Areas when compared with the commercial/industrial CHHSLs or, in the case of lead, the U.S. EPA PRG.

Average metal concentrations that are below the commercial/industrial CHHSL/PRG values are generally expected to be below thresholds for risk to human health; therefore, the remaining metals are not considered PCOC (see screening analysis in Appendix D, Air Quality Assessment Calculations and Results). The use of the industrial/commercial CHHSL values are considered conservative for construction activities that would occur over relatively short periods of time. Commercial/industrial CHHSLs were developed using an exposure scenario of 250 days per year for 20 years. Although park workers could be on-site for such exposure periods, remediation activities would likely not occur for such a continuous, extended period.

Arsenic (As) is a metallic element with three allotropic forms, yellow, black, and gray, of which the brittle, crystalline gray is the most common. Arsenic exists as both organic and inorganic compounds. Inorganic and organic arsenic occur naturally in the environment with inorganic forms being more abundant. Inorganic arsenic is associated with other metals in igneous and sedimentary rocks, and it also occurs in combination with other elements, especially oxygen, chlorine and sulfur. Organic arsenic contains carbon and hydrogen and is usually less harmful than inorganic arsenic; therefore, inorganic arsenic is the only PCOC at the Park. The majority of atmospheric arsenic is inorganic arsenic. Through ingestion, inhalation and skin permeation, arsenic can cause minor to serious health effects. California has stated under Assembly Bill 1807 and Proposition 65 that inorganic arsenic compounds are cancer-causing compounds. Non-cancer effects from arsenic exposure include irritation of the eyes, nose and bronchi, vascular disorders (hemolysis), neurological disturbances, adverse reproductive effects, and liver or kidney damage.

Lead (Pb) is a bluish gray metal that occurs naturally in various mineral forms in the earth's crust. It has been widely used for hundreds of years because it is readily shaped and molded, and is resistant to corrosion. California considers lead to be a cancer-causing metal. Non-cancer effects from lead are regulated through the ambient air quality standard for lead (discussed in the criteria pollutant section for lead above).

Cadmium (Cd) is a soft, bluish-white metal that occurs naturally at low concentrations in various mineral forms. Materials more concentrated in cadmium can result from refinement and processing. California considers cadmium to be a cancer-causing metal. Target organs for non-cancer effects include the kidneys and the respiratory system.

Asbestos

Asbestos refers to several naturally-occurring fibrous minerals that can be found throughout California. Asbestos is most commonly found in ultrabasic rock that has undergone partial or complete alteration to serpentine rock, which often contains chrysotile asbestos. Asbestos fibers are released when ultrabasic or serpentine rock is abraded, broken, or crushed. The largest concern regarding asbestos is from breathing the fibers which can stay airborne for very long periods once disturbed. If inhaled or swallowed, asbestos fibers can cause cancer and other diseases by remaining and accumulating in the lungs or digestive tract.

The Grass Valley Gold Mining District contains areas of ultrabasic rocks. However, no serpentine or serpentinite soils have been identified within the Park at Project sites (Breedy and Brussard 2002). Therefore, asbestos is not considered a COC in subsequent air analyses.

Potential Constituents of Concern at the Park

Air pollutant emissions include mobile sources such as construction equipment and fugitive dust from surface disturbances. Mobile sources would result in tailpipe emissions containing criteria pollutants (ozone, carbon monoxide, nitrogen dioxide, PM_{10}, $PM_{2.5}$, and lead) and TACs. For construction equipment tailpipe emissions, diesel particulate matter contains many TACs and is a primary concern.

Fugitive dust from surface disturbances would consist of particulate matter containing historically placed Potential Constituents of Concern (PCOC). PCOC are substances that could potentially exceed regulatory screening levels and become Constituent of Concern (COC). COC are identified for each Remediation Area when the concentrations of PCOC exceed screening levels for protection of human health or water quality objectives. Residential CHHSLs have been used to identify COC in soil for the Mine Yard and Stamp Mill, Historic Grounds, and Residences and Residences' Yards, while the commercial/industrial CHHSLs or industrial PRG for lead and cyanide have been used for the other Remediation Areas. EPA storm water benchmarks or Basin Plan water quality objectives have been used to identify COC for waters. COC could potentially be discharged to waters of the state and cause, or threaten to cause, pollution or a nuisance, including impacts to beneficial uses of waters of the state. Release of COC could pose unacceptable risk to human health and the environment.

4.2.2 REGULATORY SETTING

Air quality within the region is addressed through the efforts of various federal, state, regional, and local government agencies. These agencies work jointly, as well as individually, to improve air quality through legislation, regulations, planning, policy-making, education, and a variety of programs. The air pollutants of concern and agencies primarily responsible for improving the air quality and the pertinent regulations are discussed below.

4.2.2.1 Federal

The Federal Clean Air Act (FCAA) requires the U.S. EPA to identify National Ambient Air Quality Standards (NAAQS or national standards) to protect public health and welfare. National standards have been established for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, PM_{10}, $PM_{2.5}$, and lead.

The FCAA has provisions that require each state to prepare an air quality control plan referred to as the State Implementation Plan (SIP) and requires that states containing areas that violate the NAAQS revise their SIP to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, and rules and regulations of air basins as reported by the agencies with jurisdiction over them. The U.S. EPA reviews all state SIPs to determine if they conform to the mandates of the FCAA and will achieve air quality goals when implemented. If the U.S. EPA determines a SIP to be inadequate, it can prepare a Federal Implementation Plan (FIP) for the non-attainment area and can impose additional control measures. Failure to submit an approvable SIP or to implement the plan within mandated timeframes can result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

4.2.2.2 State

The ARB manages air quality, regulates mobile emissions sources, and oversees the activities of County Air Pollution Control Districts and Regional Air Quality Management Districts. ARB establishes state ambient air quality standards and vehicle emissions standards.

California has adopted some ambient standards that are more stringent than the federal standards for the criteria air pollutants. These are shown in Table 4.2-1. Under the California Clean Air Act (CCAA) patterned after the FCAA, areas have been designated as attainment or nonattainment with respect to the state standards. Table 4.2-1 summarizes the attainment status with California standards in the Project area. Nevada County, in the Mountain Counties air basin, is in attainment or unclassified for all state standards except the one-hour ozone standard and the PM_{10} standard.

Toxic Air Contaminants

The California Health and Safety Code defines TACs as air pollutants which could cause or contribute to an increase in mortality or in serious illness, or which could pose a present or potential hazard to human health. The State Air Toxics Program was established in 1983 under Assembly Bill (AB) 1807 (Tanner). A total of 243 substances have been designated TACs under California law; they include the 189 (federal) hazardous air pollutants (HAPs) adopted in accordance with AB 2728. The Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588) seeks to identify and evaluate risk from air toxics sources; however, AB 2588 does not regulate air toxics emissions. Toxic air contaminant emissions from individual facilities are quantified and prioritized. "High-priority" facilities perform a health risk assessment and, if specific thresholds are violated, are required to communicate the results to the public in the form of notices and public meetings. NSAQMD implements AB 2588, and is responsible for prioritizing facilities that emit air toxics.

In August 1998, ARB identified particulate emissions from diesel-fueled engines (DPM) as TACs because of their ability to cause cancer. ARB subsequently developed the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (ARB 2000). The document represents proposals to reduce diesel particulate emissions, with the goal of reducing emissions and associated health risks by 75 percent in 2010 and by 85 percent in 2020. The program aims to require the use of state-of-the-art catalyzed diesel particulate filters and ultra low sulfur diesel fuel on diesel-fueled engines. ARB regulations and programs that have been implemented to achieve these goals and that would apply to the project include the following (ARB 2004):

- Cleaner Diesel Fuel: In 2003, the ARB adopted a new regulation lowering the sulfur content of diesel fuel to enable the use of advanced emission control technologies for diesel engines.
- Standards for New On-Road Diesel Engines: In 2001, ARB adopted new PM and NO_x emission standards to clean up large diesel engines that power big-rig trucks, trash trucks, delivery vans and other large vehicles. These standards took effect in 2007 and as the new trucks meeting these standards replace older trucks, the newer trucks will have dramatically reduced diesel PM emissions compared to the average on-road engines currently used in California.
- Standards for New Off-Road Diesel Engines: U.S. EPA has proposed new standards that would reduce the emission from off-road engines to levels similar to the on-road engines discussed above by 2010-2012. These standards will dramatically reduce diesel PM emission compared to the off-road engines currently sold in California. In addition, ARB adopted a new regulation effective May 16, 2008 to reduce emissions from existing off-road diesel vehicles used in California construction, mining and other industries. The regulation is expected to significantly reduce emissions of NO_x and PM. In total, the regulation is expected to reduce 187,000 tons of NO_x emissions and 33,000 tons of PM emissions between 2009 and 2030. The regulation is expected to achieve the 2020 goal of reducing PM 85 percent from 2000 baseline levels set forth in ARB's 2000 Diesel Risk Reduction Plan. It is also projected to reduce PM emissions 37 percent from the 2000 baseline by 2010, and 92 percent by 2020. NO_x is expected to be about 13 percent lower in 2015 as a result of the regulation, and by 2020, NO_x emissions would be 32 percent lower than would occur in the absence of the regulation.
- New Regulations for In-Use Diesel Engines:
  - Stationary Engines Standards (Adopted 2004): Most stationary diesel-fueled engines in California are used as emergency backup in the event of a power failure. Others are used to pump water in some areas, to run compressors, and other equipment. ARB standards for these engines will bring an approximate 80 percent PM reduction by 2020 through stricter standards for new engines and requirements to retrofit existing engines.

- Portable Engines Standards (Adopted 2004): Most portable diesel engines in California are used to power pumps, airport ground support equipment, oil drilling rigs, generators, and a variety of other equipment. ARB's rule requires four stepped reductions in emissions from portable engines, reaching a 95 percent reduction in PM emissions in 2020 with concurrent significant cuts in smog-forming emissions.

Air Quality and Land Use Handbook

ARB recently published the Air Quality and Land Use Handbook: A Community Health Perspective (ARB 2005). The primary goal in developing the handbook was to provide information that will help keep California's children and other vulnerable populations out of harm's way with respect to nearby sources of air pollution. The handbook highlights recent studies that have shown that public exposure to air pollution can be substantially elevated near freeways and certain other facilities. However, the health risk is greatly reduced with distance. For that reason, ARB provided some general recommendations aimed at keeping appropriate distances between sources of air pollution and sensitive land uses, such as residences.

Climate Change and Greenhouse Gases

In 2005, in recognition of California's vulnerability to the effects of climate change, Governor Schwarzenegger established Executive Order S-3-05, which sets forth a series of target dates by which statewide emission of greenhouse gas would be progressively reduced, as follows:

- By 2010, reduce greenhouse gas emissions to 2000 levels;
- By 2020, reduce greenhouse gas emissions to 1990 levels; and
- By 2050, reduce greenhouse gas emissions to 80 percent below 1990 levels.

In 2006, California passed the California Global Warming Solutions Act of 2006 (Assembly Bill No. 32; California Health and Safety Code Division 25.5, Sections 38500, et seq., or AB 32), which requires the ARB to design and implement emission limits, regulations, and other measures, such that feasible and cost-effective statewide greenhouse gas emissions are reduced to 1990 levels by 2020 (representing an approximate 25 percent reduction in emissions).

In June 2007, ARB directed staff to pursue 37 early actions for reducing greenhouse gas emissions under the California Global Warming Solutions Act of 2006 (AB 32). The broad spectrum of strategies to be developed (including a Low Carbon Fuel Standard, regulations for refrigerants with high global warming potentials, guidance and protocols for local governments to facilitate greenhouse gas reductions, and green ports) reflects that the serious threat of climate change requires action as soon as possible (ARB 2007c).

In addition to approving the 37 greenhouse gas reduction strategies, ARB directed staff to further evaluate early action recommendations made at the June 2007 meeting, and to report back to ARB within six months. The general sentiment of ARB suggested a desire to try to pursue greater greenhouse gas emissions reductions in California in the near-term. Since the June 2007 ARB hearing, ARB staff has evaluated all 48 recommendations submitted by several stakeholder and several internally-generated staff ideas and published the Expanded List of Early Action Measures to Reduce Greenhouse Gas Emissions In California Recommended For Board Consideration in October 2007 (ARB 2007d). Based on its additional analysis, ARB staff is recommending the expansion of the early action list to a total of 44 measures.

The 2020 target reductions are currently estimated to be 169 million metric tons/year of CO_2 equivalent (CO_2e) (ARB 2008b). In total, the 44 recommended early actions have the potential to reduce greenhouse gas emissions by at least 42 million metric tons/year CO_2e emissions by 2020, representing about 25 percent of the estimated reductions needed by 2020. ARB staff is working on 1990 and 2020 greenhouse gas emission inventories in order to refine the projected reductions needed by 2020. The 44 measures are in the sectors of fuels, transportation, forestry, agriculture, education, energy efficiency, commercial, solid waste, cement, oil and gas, electricity, and fire suppression. The Program Actions evaluated in this Draft PEIR do not fit into any of these sectors.

In addition to identifying early actions to reduce greenhouse gases, ARB is also developing mandatory greenhouse gas reporting regulations pursuant to requirements of AB 32. The regulations are expected to require reporting for certain types of facilities that make up the bulk of the stationary source emissions in California. Currently, the draft regulation language identifies major facilities as those that generate more than 25,000 metric tons/year of CO_2e. Cement plants, oil refineries, electric-generating facilities/providers, cogeneration facilities, and hydrogen plants and other stationary combustion sources that emit more than 25,000 metric tons/year CO_2e, make up 94 percent of the point source CO_2e emissions in California (ARB 2007e).

In January 2008, the California Air Pollution Control Officers Association (CAPCOA) issued a "white paper" on evaluating greenhouse gas emissions under CEQA (CAPCOA 2008). The CAPCOA white paper strategies are not guidelines and have not been adopted by any regulatory agency; rather, the paper is offered as a resource to assist lead agencies in considering climate change in environmental documents.

The ARB published a Climate Change Draft Scoping Plan (ARB 2008b) that outlines reduction measures to lower the state's greenhouse gas emissions to meet the 2020 limit. The Draft Scoping Plan "proposes a comprehensive set of actions designed to reduce overall carbon emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, and enhance public health while creating new jobs and enhancing the growth in California's economy." ARB will release a Proposed Scoping Plan in early October to the Board for consideration at its meeting in November 2009. Measures included in the Scoping Plan will be developed over the next three years and be in place by 2012.

4.2.2.3 Regional

As a state agency, DPR is exempt from local regulations, including general plans, specific plans, and zoning ordinances, to the extent that such requirements conflict with DPR's own General Plan for the Park (California Constitution Article XI Section 7). However, DPR must comply with the Park's General Plan, as well as applicable state and federal rules and regulations governing historic buildings, structures, and districts and any local regulations applicable to impacts located outside the Park boundaries.

Northern Sierra Air Quality Management District

The Project is under jurisdiction of the NSAQMD, which regulates air quality according to the standards established in the Clean Air Acts and amendments to those acts. The NSAQMD regulates air quality through its permitting authority and through air quality related planning and review activities over most types of stationary emission sources.

The NSAQMD is comprised of three contiguous, mountainous, rural counties in northeastern California (Nevada, Sierra, and Plumas counties). The NSAQMD is part of the Mountain Counties Air Basin. The NSAQMD enforces controls on stationary sources of air pollutants through its permit and inspection programs and regulates open burning. Through its permitting authority, the NSAQMD enforces limitations of criteria and toxic air contaminant emissions. Other NSAQMD responsibilities include monitoring air quality, preparing of implementation plans, and responding to citizen air quality complaints.

The NSAQMD reviews development proposals to ensure that air quality impacts are adequately assessed and mitigated in accordance with attainment planning efforts. Planning efforts are focused on preventing air quality degradation and violations of the California and national ambient air quality standards. Additional responsibility includes acting as a lead or commenting agency on CEQA evaluations. For this purpose, the NSAQMD has prepared the "Guidelines for Assessing and Mitigating Air Quality Impacts of Land Use Projects." These

Guidelines explain that the NSAQMD has adopted District Rule 226 which requires dust control plans that are vital in limiting fugitive emissions from surface-disturbing activities.

4.2.2.4 Local

Nevada County General Plan

The overall air quality in Nevada County is very good. However, there are several pollutants that do not meet state and federal AAQS. The Nevada County General Plan includes an Air Quality element (Nevada County 1996) that contains a number of guiding goals, and objectives that would apply to the proposed Project. The County has adopted the following applicable goals, objectives, and policies in the Air Quality element.

Goal 14.1: Attain, maintain and ensure high air quality.

Objective 14.2: Implement standards that minimize impacts on and/or restore air quality.

Policy 14.4: Encourage and cooperate with the NSAQMD, or any successor agency, to:

a. Adopt control measures to reduce pollutant emissions from open burning;
b. Develop a program to regulate and control fugitive dust emissions from construction projects; and
c. Identify and establish visibility standards for air quality in the County.

Policy 14.5: Encourage and cooperate with the NSAQMD, or any successor agency, to develop and implement a long-term monitoring program to quantify air quality in the County. The County shall work with the District to identify areas for monitoring and to develop an implementation program to begin on-site monitoring upon project application where a proposal will result in an increase of more than 25 tons per year of non-attainment pollutants (or precursors). The County will also cooperate with the District in developing a monitoring program for CO emissions at key intersections as a basis for consideration of short- to long-term air quality in the preparation of the County Road Improvement Program.

4.2.3 THRESHOLDS OF SIGNIFICANCE

The following thresholds have been prepared based on the State CEQA Guidelines (Appendix G) and Section 15065 of the State CEQA Guidelines. The Project would have a significant impact on air quality if it will:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is a non-attainment zone under an applicable federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors);
- Expose sensitive receptors to substantial pollutant concentrations; and
- Create objectionable odors affecting a substantial number of people.

With respect to Greenhouse Gases (GHG) Emissions (OPR 2009) the Project would have a significant air quality impact based on:

- The extent to which the Project could help or hinder attainment of the state's goals of reducing greenhouse gas emissions to 1990 levels by the year 2020 as stated in the Global Warming Solutions Act of 2006;
- The extent to which the Project could result in increased energy efficiency of and a reduction in overall greenhouse gas emissions from an existing facility;
- The extent to which the Project impacts or emissions exceed any threshold of significance that applies to the Project; and
- The extent to which the Project could increase the consumption of fuels or other energy resources, especially fossil fuels that contribute to greenhouse gas emissions when consumed.

Thresholds of significance illustrate the extent of an impact and are a basis from which to apply mitigation measures. In January 2009, the state of California, through the OPH/SCH, published its Interim Greenhouse Gas thresholds (see Table 4.2-3, CARB's Interim GHG Significance Threshold).

The NSAQMD has developed a tiered approach to significance levels for criteria pollutants. A project with emissions qualifying it for Level A thresholds would require the most basic mitigations. Projects that qualify for Level B would require more extensive mitigations, and subsequently, those projects that qualify for Level C would require the most extensive application of mitigation measures. The tiered thresholds for Level A, B and C are given in Table 4.2-4, NSAQMD Emission Significance Thresholds, for a project's estimated emissions of criteria pollutants in pounds per day. These tiered thresholds will be compared to Program Actions per NSAQMD guidelines.

TABLE 4.2-3
CARB'S INTERIM GHG SIGNIFICANCE THRESHOLD

	CARB
Policy Objective	Capture 90 percent of statewide stationary project emissions.
Exemption	Apply applicable exemption.
Regional GHG Reduction Plan	N/A.
Thresholds	Project < 7,000 $MTCO_2eq/yr$ & meets construction & transportation performance standards.
Performance Standards	See above.
Offsets	Off-site substitution allowed.
Determination	GHG emissions significant, EIR is prepared, if meeting none of the above.

TABLE 4.2-4
NSAQMD EMISSION SIGNIFICANCE THRESHOLDS

Threshold Level	NOx (lbs/day)	ROG (lbs/day)	PM10 (lbs/day)
Level A Thresholds	< 24	< 24	< 79
Level B Thresholds	24-136	24-136	79-136
Level C Thresholds	> 136	> 136	> 136

Source: NSAQMD, 2007.

If emissions for NO_x, ROG and/or PM_{10} exceed 136 pounds per day (Level C), then there is a significant impact; below Level C the impact would be potentially significant. The NSAQMD guidelines suggest that projects with higher emissions (Level C Thresholds) should automatically mitigate more emissions, quantitatively, than would a lower impact project (Level A). Also according to the guidelines, if a new project is unable to provide adequate on-site mitigation of their long-term air quality impacts, an off-site mitigation program could be necessary.

For TACs, the Project's emissions are significant if they result in either of the following:

- A lifetime excess cancer risk greater than 10-in-a-million, or
- An acute or chronic hazard index greater than 1.0.

These thresholds are typical for CEQA air quality assessments throughout California.

In a risk assessment, cancer risk for an individual is expressed as the probability of developing cancer over a 70-year lifetime. The predicted concentrations and health impacts (e.g., cancer risk) presented in a site-specific health risk assessment are assumed to exist in excess of background concentrations or resulting health risks. Cancer risks are typically expressed as "chances per million".

For example, if the excess cancer risk were estimated to be 10-in-a-million as a result of emissions from a specific source, then the probability of an individual developing cancer would be expected to not exceed 10 chances in a million above the existing probability of developing cancer from other background risks. If a population (e.g., 1 million people) were exposed to the same potential cancer risk (e.g., 10 chances per million), then the statistics would predict that 10 of those million people exposed are likely to develop cancer from a lifetime of exposure (70 years) due to TAC emissions from an emitting source.

Non-cancer health risk of an air toxic is measure by the hazard quotient, the ratio of the reported concentration of an air toxic compound to an acceptable or REL. Typically, for a given set of chemicals, hazard quotients are summed for each organ system that each chemical can affect to obtain a total hazard index. For any organ system, a total hazard index exceeding 1.0 indicates a potential adverse health effect.

4.2.4 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The Program and Project Actions are described in detail in Section 2.0 of the Draft PEIR. The discussion below lists each type of air quality impact identified and provides an analysis of potential impacts from Project Action(s), assesses the significance of each impact, and if necessary, identifies measures that would mitigate impacts to a level below significance.

The COC concentrations in fugitive dust that are considered in the air quality impact analysis are based on concentrations measured at the Project areas throughout the Park. Because it was determined that those areas with the highest pre-project COC could have a potentially significant air quality impact, a programmatic approach has been taken when evaluating each potential Remediation Area. For areas with COC above specified levels, a project-level evaluation will be completed as part of characterization before a particular remediation option is selected for a Remediation Area.

This air quality impact analysis does not evaluate the impacts following completion of the Project (such as exposure to visitors walking on trail systems), but the impacts as a result of the Project Actions that would occur during Project implementation. Fugitive dust from the Remediation Areas is assumed, for the air quality impact analysis, to contain contaminants at pre-remediation concentrations.

This baseline air quality analysis was based on maximum proposed mobile equipment use, hours of operation, and surface disturbance acreage to evaluate compliance with applicable thresholds of significance. These assumptions have been incorporated into all Standard and Specific Project Requirements to ensure that air quality impacts have been considered to the extent feasible prior to determination of whether additional mitigation measures need to be implemented during Program implementation. If Program Actions are implemented within Remediation Areas meeting certain criteria (e.g., ensuring compliance with CEQA significance thresholds) consistent with Standard and Specific Project Requirements, no additional CEQA evaluation would be necessary on an area-specific basis. For those Remediation Area exceeding the criteria specified later in this section, additional characterization and additional mitigation measures could be required.

The following sub-section provides an air quality analysis to determine the anticipated impacts of the proposed Project Actions. Implementation of particular Program Actions at specific Remediation Areas has not been finalized at this time. However, many likely Program Actions have been identified for each Remediation Area. In this resource section, air quality impacts have been analyzed for activities that would be common throughout the proposed projects, including tailpipe emissions from construction equipment and impacts from fugitive dust that would result from surface disturbance. These activities have been analyzed to determine if they could be implemented at the Park while adhering to applicable CEQA significance threshold criteria outlined in Section 4.2.3, above.

4.2.4.1 Sources of Air Quality Impacts

To evaluate the potential air quality impacts and environmental effects of the Project, it is necessary to understand the Project Actions that are likely to be sources of emissions. Program Actions are described in Section 2.6.3. The key Project Actions that could result in air pollutant emissions include:

- Operation of heavy construction equipment;
- Transportation of contaminated soils leaving the Park and importation of clean fill material entering the Park;
- Mobilization and demobilization of heavy construction equipment to the Park;
- Demolition and/or removal of any structures, including temporary facilities;
- Importation of supplies and materials that could be used for remediation activities;
- Temporary and permanent fencing installation;
- Grading activities;
- Boring activities;

- Excavation activities;
- Blasting activities;
- Scarifying activities;
- Planting and seeding activities;
- Stormwater BMP installation and maintenance activities;
- Removal of trees and other vegetation;
- Construction of ancillary structures, including utilities for either a temporary or permanent active water treatment facility;
- Construction and installation of permanent exclusion barriers;
- Construction and maintenance of access roads; and/or
- Monitoring activities.

Based on the Project Actions, the following pollutants and potential sources of air quality impacts were assessed:

1. Criteria pollutants, greenhouse gases (GHGs) and toxic air contaminants (TACs) from mobile exhaust emissions; and
2. Criteria pollutants and TACs from fugitive dust sources.

The TACs of specific concern as a result of the proposed Project Actions are diesel particulate matter (DPM) from on-site mobile construction equipment exhaust (trucks, generators), and arsenic, lead, and cadmium in the soils where the concentration is above the Commercial/Industrial California Human Health Screening Level (CHHSL), or the U.S. EPA Region 9 Preliminary Remediation Goal (PRG) in the case of lead. Asbestos-containing rock, which can be found throughout California, has not been identified within the Park (according to U.S. Geological Survey map data). Therefore, asbestos fibers are not considered a concern from historic mining activities or proposed surface disturbances.

The approach used in this Draft PEIR for the air quality assessment is to provide a analysis to determine the anticipated impacts of Project Actions. Since some of the specific details of the Project Actions have not been finalized at this time, assumptions needed to be made to complete the quantitative portions of the air impact assessment. Before actual Project Actions are carried out at individual Project Areas at the site, the specific details of the planned actions will need to be compared to the assumptions in this impact assessment to determine if the potential impacts have been adequately characterized, or if additional assessments are required (as would be the case when COC levels exceed specified levels as discussed further later in this section).

4.2.4.2 Criteria Pollutant Assessment

The assessment of criteria pollutants takes into account emissions from Project Actions as described above. The assessment also includes associated activities such as worker commute trips. The evaluation of criteria pollutants in this assessment is limited to a comparison of estimated emissions to associated thresholds of significance established by the NSAQMD.

4.2.4.3 Toxic Air Contaminant Assessment

TAC impacts are evaluated by determining if a particular chemical poses a significant risk to human health and, if so, under what circumstances. Both contaminated soil and diesel internal combustion exhaust were considered as potential sources of TAC emissions to air. DPM and metals determined to be COCs are discussed below.

Exposure Pathways

An exposure pathway describes the route a COC could take from its source to its end point and how human and ecological receptors (wildlife, aquatic life, and plants) can come into contact with (or be exposed to) the COC along the route. An exposure pathway has five parts:

1. A source of COC, such as mine and mill related materials;
2. A way for the COC to travel to the point of contact (e.g., water transporting a COC downstream, or wind blowing a COC through the air);
3. A point of exposure or contact with the constituent;
4. A route of exposure such as ingestion (eating, drinking), inhalation (breathing), or dermal contact (touching); and
5. A receptor, such as humans or sensitive wildlife, birds, and plants.

The exposure pathway is considered to be complete when all five parts are present. Conversely, if any one of these five parts is not present, the exposure pathway is considered to be incomplete.

Completed Pathways of Exposure

Completed pathways demonstrate the link between the environment and human exposure. Assumptions were made based on how receptors might come into contact with soil contamination from fugitive dust/soil at the Park. Once reasonable exposure pathways were determined, chronic daily intake was quantified in milligrams of contaminant per kilogram body weight per day. The chronic daily intake (CDI) is the quantity of a chemical which is available to the body for absorption at a membrane exchange boundary, be it via ingestion, dermal, or inhalation exposure. It is different from the absorbed dose, which is a direct measurement of the concentration of chemical in the blood.

Constituents of Potential Concern (Arsenic/Lead/Cadmium from Soil Contaminants)

The COCs in soil chosen for the air quality assessment for Project Actions (were PCOCs in the soil with average measured concentrations above the CHHSL values, or the U.S. EPA Region 9 PRG for lead. The use of these screening thresholds is conservative in this case because the impacts being assessed are not for human receptors that would be located at the site where Project Actions are taking place, but rather to receptors located at some distance from where these activities are occurring.

PCOC concentrations used for screening purposes were determined based on either the average concentration (calculated as the 95th percentile upper confidence level of the mean), when at least 15 sample values were available, or the maximum concentration, for each potential Remediation Area.

A review of much of the available data suggested that only arsenic, lead, and cadmium concentrations would be above the CHHSL evaluation thresholds for any potential Remediation Area. For purposes of this assessment, it was assumed that the actual concentrations of other metals in soil to be disturbed would be below these thresholds.

Based on the available data, it was estimated that actual PCOC concentrations would not exceed the following values:

- Arsenic: Average concentration of 407 mg/kg; maximum concentration of 15,300 mg/kg.
- Lead: Average concentration of 904 mg/kg; maximum concentration of 5,599 mg/kg.
- Cadmium: Average concentration of 9.9 mg/kg; maximum concentration of 68.2 mg/kg.

Cancer Risks

The cancer risks from COC metals contained in fugitive dust could occur through several pathways (see Table 4.2-7). The total maximum lifetime excess cancer risk due to COC metals exposure was predicted for emissions resulting from Project Actions as well as other non-inhalation pathways.

TABLE 4.2-7
PCOC METALS EXPOSURE PATHWAY SUMMARY

Exposure Route	Pathway Quantified	Exposure Likelihood	Rationale
Inhalation	Yes	Completed pathway	Execution of Program Actions would potentially increase soils coming into contact with public receptors
Ingestion	Yes	Completed pathway	
Dermal contact	Yes	Completed pathway	

Non-Cancer Risks

PCOC metals were also evaluated based upon their known chronic and acute non-carcinogenic human health effects (where applicable). Chronic non-carcinogenic health effects were evaluated for the same exposure pathways assessed for carcinogenic effects. Acute non-carcinogenic health effects were evaluated for the inhalation pathway only, as this was expected to be the most sensitive exposure pathway for acute effects.

Diesel Particulate Matter

When evaluating health risks from diesel exhaust exposure, the potential cancer risk from inhalation exposure to DPM will outweigh the potential non-cancer health impacts. Therefore, inhalation cancer risk is the primary consideration for health effects according to OEHHA and ARB guidelines. When comparing the toxicity of diesel exhaust as a whole to the combined toxicity of the speciated components of diesel exhaust (e.g., Polycyclic Aromatic Hydrocarbon [PAHs], metals), calculated potential cancer risk from inhalation exposure to whole diesel exhaust will outweigh the calculated multipathway cancer risk from the speciated components. For this reason, an analysis of multipathway risk for DPM is not necessary (California EPA 2003). Both carcinogenic and non-carcinogenic health effects from DPM emissions are estimated in this assessment.

Toxic Air Contaminants Impact Assessment Methodology

U.S. EPA's SCREEN3 model was used to determine exposure point concentrations in air for both DPM and PCOC metals. The SCREEN3 model is an appropriate conservative model for determining estimated maximum pollutant concentrations at discrete distances from emissions sources. Emission rates used in the SCREEN3 model were based on particulate matter emissions from both fugitive dust and equipment that result from a maximum daily scenario (discussed further below). The SCREEN3 model was used to calculate estimated maximum 1-hour concentrations. Maximum annual average concentrations were estimated by multiplying the 1-hour maximum impacts by a conversion factor of 0.1, representing the upper end of the range recommended by the U.S. EPA.

DPM (from mobile equipment exhaust) and PCOC metals (contained in fugitive dust) were modeled as area sources. The area source was defined based on the estimated area that emissions might occur over as a result of Project Action activity. Concentrations at discrete distances from the area source were obtained and the maximum concentration estimated by the SCREEN3 model regardless of distance from the area source was used to determine the maximum exposure point concentration for inhalation health effects.

Health and cancer risk were determined for the maximum daily scenario. The NSAQMD has a significance threshold for health risk exposure to diesel emissions of 10 cancers per million for 70-year exposure. Accordingly, the NSAQMD Nevada County Land Use Guidelines requires that DPM from diesel engine exhaust emissions be identified or evaluated using an approved emissions model.

Cancer Risks

As discussed above, cancer risks from DPM and COC metals concentrations in air would occur through the inhalation pathway. In addition, cancer risk from COC metals was also assessed for the ingestion and dermal contact exposure pathways.

The first step in assessing potential lifetime excess cancer risk (LECR) is to use models to estimate maximum lifetime average exposure point concentrations of DPM and COC metals at locations that members of the public might be exposed. From these concentrations, exposure factors are used to estimate total average dose rates to these hypothetical individuals.

Finally, accepted dose-response factors (e.g. slope factors) are used to estimate the LECR due to potential exposures to DPM and COC metals.

The methodologies used to estimate LECR for each of these TACs and exposure pathways are provided in Appendix D, Air Quality Assessment Calculations and Results.

Non-Cancer Health Effects

As discussed above, chronic non-cancer health effects from DPM and COC metals concentrations in air would occur through the inhalation pathway. In addition, chronic non-cancer health effects from COC metals were also assessed for the ingestion and dermal contact exposure pathways. Acute non-cancer health effects were also estimated for arsenic only (none of the other TACs assessed have acute toxicity factors available for California).

The first step in assessing potential noncancer hazard is to use models to estimate maximum annual average (chronic) or hourly average (acute) exposure point concentrations of DPM and COC metals at locations that members of the public might be exposed. From these concentrations, exposure factors are used to estimate total average dose rates to these hypothetical individuals (no adjustment is made for acute exposure). Finally, accepted health threshold factors (e.g. reference exposure levels) are used to estimate the hazard quotients due to potential exposures to DPM and COC metals.

The methodologies used to estimate a hazard quotient for each of these TACs and exposure pathways are provided in Appendix D.

Exposure of Human Receptors

This assessment conservatively evaluates worst-case human health impacts to Park employees, Park users, and nearby off-Park residents and occupational workers. Due to the conservative exposure assumptions used, exposures for actual human receptors are expected to be significantly less than those estimated in this assessment.

Maximum Daily Scenarios and Impact Assessment Results

In most instances, area-specific information (referred to as a Remediation Area in Section 2.5.2 of the Draft PEIR) is not yet available on which to base assumptions for the quantification of air emissions. Hence, for the purposes of this air quality impact assessment, it is necessary to conduct an evaluation that is broader in nature to determine what level of activity related to Program Actions would result in emissions and ambient impacts that are less than significant when compared to the NSAQMD significance thresholds. This level of activity (for Program Actions) is termed the Maximum Daily Scenario (MDS) and it is an estimate of foreseeable Program Actions that could be occurring either concurrently or consecutively that are likely potential sources of emissions.

Specific Project Requirements contain provisions that will be incorporated into the MDS, which would allow Project Actions to be conducted at a specific activity level and would result in air quality impacts below NSAQMD significance thresholds. For example, the requirement to keep activity levels, daily disturbed areas, and soil hauling below specified levels, and requirements for daily watering, will ensure that the maximum actual air quality impacts will be below those specified in this assessment.

For the purposes of quantification and simplification of analysis, Project Actions were assumed to take the form of one of four construction activities. That is, any proposed interim or remediation action could be one of four "construction activities" namely; (i) Grubbing and Land Clearing, (ii) Grading and Excavation (includes soil hauling emissions), (iii) Drainage and Utilities and (iv) Paving.

Table 4.2-8, Construction Activities and Associated Equipment Usage and Quantity, and Table 4.2-9, Engine Tiers by Horsepower and Year, lists the type, quantity, and horsepower of each piece of equipment that has been evaluated in the MDS.

TABLE 4.2-8
CONSTRUCTION ACTIVITIES AND ASSOCIATED EQUIPMENT USAGE AND QUANTITY

Construction Activities (Urbemis Phase Descriptions)	Equipment Used (Quantity)	Horsepower Rating
Grubbing and Land Clearing (Mass Grading)	Rubber Tire Dozer(1)	357
	Scraper (1)	313
Grading and Excavation (Fine Grading)	Scraper(1)	313
	Excavator (1)	168
	Grader (1)	174
	Rubber Tire Loader (1)	157
Drainage Utilities (Trenching)	Scraper (1)	313
	Grader(1),	174
	Plate Compactor (1)	8
	Trencher (1)	63
Paving (Asphalt)	Pavers (1)	100
	Paving Equipment (1)	104
	Roller (1)	95

The list of equipment used to execute Project Actions is limited to the list presented in Table 4.2-9.

TABLE 4.2-9
ENGINE TIERS BY HORSEPOWER AND YEAR

Year	Horsepower Groups							
	25-49	50-74	75-99	100-174	175-299	300-599	600-750	750+
2005	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1
2006	Tier 2	Tier 2	Tier 2	Tier 2	Tier 3	Tier 3	Tier 3	Tier 2
2007	Tier 2	Tier 2	Tier 2	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2
2008	Tier 4I	Tier 4I	Tier 3	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2
2009	Tier 4I	Tier 4I	Tier 3	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2
2010	Tier 4I	Tier 4I	Tier 3	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2
2011	Tier 4I	Tier 4I	Tier 3	Tier 3	Tier 4I	Tier 4I	Tier 4I	Tier 4I

Notes: I = Interim standard

Scenarios 1 and 2

Under Scenario 1, the only construction activity permitted is grading and excavation (includes soil hauling emissions). The types of equipment that would be assumed would be one Scraper, one Grader, one Rubber Tire Loader, and Haul Trucks that would be utilized to transport material to and from the Remediation Area.

Under Scenario 2, the types of construction activities that could occur include grubbing and land clearing, installation of drainage and utilities and paving. The types of equipment that would be assumed include one Dozer, two Scrapers, one grader, one Plate Compactor, one Trencher, on Paver, two pieces of Paving Equipment, and one Roller that would operate at the Remediation Area.

In addition to the equipment list, the MDS is correlated to the following hypothetical operating scenario:

1. The maximum disturbed acreage should be 5 acres or less;
2. The soil is assumed to be weathered rock and or soil;
3. The amount of soil imported/exported should not exceed 10,000 cubic yards over a 2-month period during scenario; and
4. The truck capacity for off-site hauling is 20 cubic yards.

Emissions were quantified using URBEMIS Version 9.2.4 for the construction activities that lead to the maximum daily scenario (MDS) and are presented in Table 4.2-10, Emissions of Scenarios that Lead to the MDS. The URBEMIS program output files are provided in Appendix D.

TABLE 4.2-10
EMISSIONS OF SCENARIOS THAT LEAD TO THE MDS (POUNDS/DAY)

Scenarios	ROG[a] (lbs/day)	CO (lbs/day)	NO_x[a] (lbs/day)	PM_{10}[a] (lbs/day)	$PM_{2.5}$ (lbs/day)	CO_2 (lbs/day)
Scenario 1	2.75	23.59	46.19	40.88	10.02	6,182.20
Scenario 2	5.67	49.79	92.46	40.86	11.69	12,183.93
NSAQMD Level A Thresholds	<24	-	<24	<79	-	-
NSAQMD Level B Thresholds	24-136	-	24-136	79-136	-	-
NSAQMD Level C Thresholds	>136	-	>136	>136	-	-

Notes:
[a] NSAQMD thresholds only exist for these pollutants.

Maximum Annual Scenario for COC Metals

COC metals at the Park could be released into the air from contaminated soils/dust and respired from either wind or other disturbances of the soil. Inhalation of soil from wind erosion could pose some risk; however, of greater concern are mechanical disturbances of the soil by remediation contractors engaging in short-term Project Actions that could produce much larger quantities of dust.

Inhalation of non-volatile COC metals adsorbed to respirable particles (generally particulate matter 10 microns in diameter or PM_{10}) was based on predicting the annual average concentration during periods of exposure from fugitive PM_{10} emissions (based on the MDS) using the SCREEN3 dispersion model.

Human exposure was based on the assumption that implementation of Program Actions would occur for six months per year, five days per week, and 8.0 hours per day for one year. Human exposure receptors were assumed to be present during all periods of Project Actions, consistent with residential exposure assumptions. Exposure parameters, such as daily breathing rates, were also conservatively based on residential exposure assumptions.

Inhalation Exposure

Based on estimated emissions of COC metals adhering to fugitive dust, human receptors subjected to Program Actions as described above for a 1-year period were estimated to have a maximum average exposure concentration of 1.47E-07 µg/m^3 for arsenic, 3.27E-03 µg/m^3 for lead, and 3.57E-05 µg/m^3 for cadmium. The resulting maximum LECR from COC metals due to the inhalation exposure pathway is estimated to be 1.58E-01 in a million (calculations are provided in Appendix D). The resulting maximum chronic HQ from COC metals due to the inhalation exposure pathway is estimated to be 9.98E-02 (calculations are provided in Appendix D). Acute impacts from arsenic exposure are discussed separately below.

Soil Ingestion

Soils contaminated by fugitive dust resulting from Program Actions are assumed to contain up to 4.36E-02 mg/kg of arsenic, 9.71E-02 mg/kg of lead, and 1.06E-03 mg/kg of cadmium (calculated values are provided in Appendix D). Based on the assumed ingestion rates, the resulting maximum LECR from COC metals due to the ingestion exposure pathway is estimated to be 3.35E-03 in a million (calculations are provided in Appendix D). The resulting maximum chronic HQ from COC metals due to the ingestion exposure pathway is estimated to be 1.78E-02 (calculations are provided in Appendix D).

Dermal Exposure

Soils contaminated by fugitive dust resulting from Program Actions are assumed to contain up to 4.36E-02 mg/kg of arsenic, 9.71E-02 mg/kg of lead, and 1.06E-06 mg/kg of cadmium (calculated value are provided in Appendix D). Human receptors are assumed to have up to 4,700 cm2 of skin surface exposed at any one time. Based on the assumed dosing rate, the resulting maximum LECR from COC metals due to the dermal contact exposure pathway is estimated to be 2.57 E-04 in a million (calculations are provided in Appendix D). The resulting maximum chronic HQ from COC metals due to the dermal contact exposure pathway is estimated to be 6.69E-03 (calculations are provided in Appendix D).

Acute Exposure to Arsenic

Arsenic is the only COC metal with a 1-hour acute reference exposure level published by the California Air Resources Board (CARB). Because of the presence of some localized pockets of materials within the Park with relatively high arsenic concentrations, the potential exists for significant impacts from fugitive emissions of soil materials containing arsenic in these areas. Therefore, the evaluation of potential acute health impacts from Program Actions was subdivided based on three levels of Remediation Areas:

1) Those Remediation Areas with maximum arsenic concentrations less than or equal to 363 mg/kg, within which only Standard and Specific Project Requirements would be necessary when Program Actions were taking place in accordance with the MDS.

2) Those Remediation Areas with maximum arsenic concentrations less than or equal to 3,500 mg/kg, but greater than 363 mg/kg, within which additional Mitigation Measures would be necessary when Program Actions were taking place, which include modifications to the MDS.

3) Those Remediation Areas with maximum arsenic concentrations greater than 3,500 mg/kg, within which a project-specific approach and MDS would need to be developed and assessed outside of this Program EIR. Project-specific requirements would then be developed to ensure that less than significant acute hazard impacts result.

Therefore, before Program Actions are commenced for a given Remediation Area, the area would be classified as described above, and the appropriate Project Requirements implemented. This will result in acute hazard impacts with a hazard index less than 1.0 for all Program Actions.

Total COC Metals Exposure

The total health effects resulting from exposure to COC metals from the exposure pathways discussed above is simply the sum of either the LECRs or the HQs. The sum of the individual HQs is referred to as the hazard index (HI). Therefore, the maximum total LECR due to potential exposure to COC metals is 1.62E-01 in a million and the maximum total chronic HI due to potential exposure to COC metals is 1.24E-01. The maximum total acute HI due to potential exposure to arsenic is less than 1.0 as described in the preceding section.

Maximum Annual Scenario for Diesel Particulate Matter

The maximum annual scenario for particulate matter is based on the summation of Scenarios 1 and 2. DPM emissions from Scenario 2 are greater than DPM emissions from Scenario 1 and are predicted to be 3.37 lb/day over a 5-acre area during the course of an 8-hour work day. The annual total DPM emissions were used to determine an area source emissions rate from which a maximum average DPM 1-hour concentration is estimated. Using the SCREEN3 model, the hourly concentration was used to determine the average annual DPM concentration by applying a factor of 0.1 to derive a concentration of 1.64E-01 $\mu g/m^3$.

The resulting maximum LECR from DPM due to the inhalation exposure pathway is estimated to be 1.56 in a million (calculations are provided in Appendix D).

The resulting maximum chronic HQ from DPM due to the inhalation exposure pathway is estimated to be 3.28E-02 (calculations are provided in Appendix D).

Impact 4.2-1: Program Actions Could Generate Criteria Pollutant Emissions at the Park

Project Action-related dust emissions would vary from day to day, depending on the level and type of activity, silt content of the soil, and the weather. Emissions of PM_{10} could potentially affect local visibility and concentrations in the air could be adversely affected; however, only on a temporary and intermittent basis during these activities.

Combustion emissions from heavy equipment and construction worker commute trips would also vary from day to day, and could contribute incrementally to regional ozone concentrations during the implementation of Project Actions.

Fugitive dust would occur both during implementation of Project Actions and as a result of wind erosion over exposed earth surfaces. Clearing and earthmoving activities generally comprise the major source of construction dust emissions; however, traffic and general disturbance of the soil also generate dust emissions.

As shown in Table 4.2-10, emissions would be below the NSAQMD Level A threshold for ROG and PM_{10} and below the Level B (potentially significant) threshold for NO_x. The NSAQMD does not have significance criteria for SO_2, CO, or $PM_{2.5}$.

To ensure that criteria pollutant emissions are less than significant, the Project Proponents will comply with all applicable NSAQMD and State Rules and Regulations (where applicable) during the execution of Project Actions. These include District Rule 226 (Dust Control), the Statewide Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations, as well as the Statewide Asbestos Airborne Toxic Control Measure for Surfacing Applications.

Standard Project Requirement AIR-1 requires that all active construction areas will be lightly sprayed with dust suppressant to reduce dust without causing runoff during dry, dusty conditions. AIR-1 further states that all trucks or light equipment hauling soil, sand, or other loose materials while implementing Program Actions on public roads will be covered or required to maintain at least two feet of free board. Additionally, AIR-1 requires that all gasoline-powered equipment will be maintained in good mechanical condition (according to manufacturer's specifications), and in compliance with all state and federal requirements.

Pursuant to AIR-1, paved streets adjacent to the Park will either be swept or washed at the end of each day, or as required, to remove excessive accumulations of silt and/or mud that could have resulted from remediation construction activities. Finally, AIR-1 requires that excavation and grading activities will be suspended when sustained winds exceed 15 miles per hour (mph), instantaneous gusts exceed 25 mph, or when dust occurs from construction related activities where visible emissions cannot be controlled by watering or conventional dust abatement controls.

With the implementation of Standard Project Requirement AIR-1, air quality impacts from criteria pollutant emissions (including NO_x) associated with Project Actions will be less than significant.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact 4.2-2: Program Actions Would Generate TAC Emissions and Increase Exposure to TAC Emissions at Nearby Receptors

Exposure levels of TACs generated by Project Actions were estimated by conducting an analysis to determine their concentrations from TAC sources at the Park. Figure 4.2-1, Location of Potential TAC Emissions for Remediation Areas 1-4 and 6-9, shows the location of Remediation Areas that could result in potential TAC impacts.

TAC emission sources evaluated in this health risk assessment are DPM from mobile equipment exhaust and COC metals present in onsite soils that could become airborne fugitive dust (COC metals are the only soil contaminants assumed to have concentrations in soil above CHHSL levels, or the U.S. EPA Region 9 PRG in the case of lead).

The emissions from these sources were entered into the USEPA SCREEN3 model to calculate maximum ambient air concentrations at the Park. The maximum concentrations were then used to assess cancer risks and non-cancer health effects (see Appendix D).

Cancer Risk

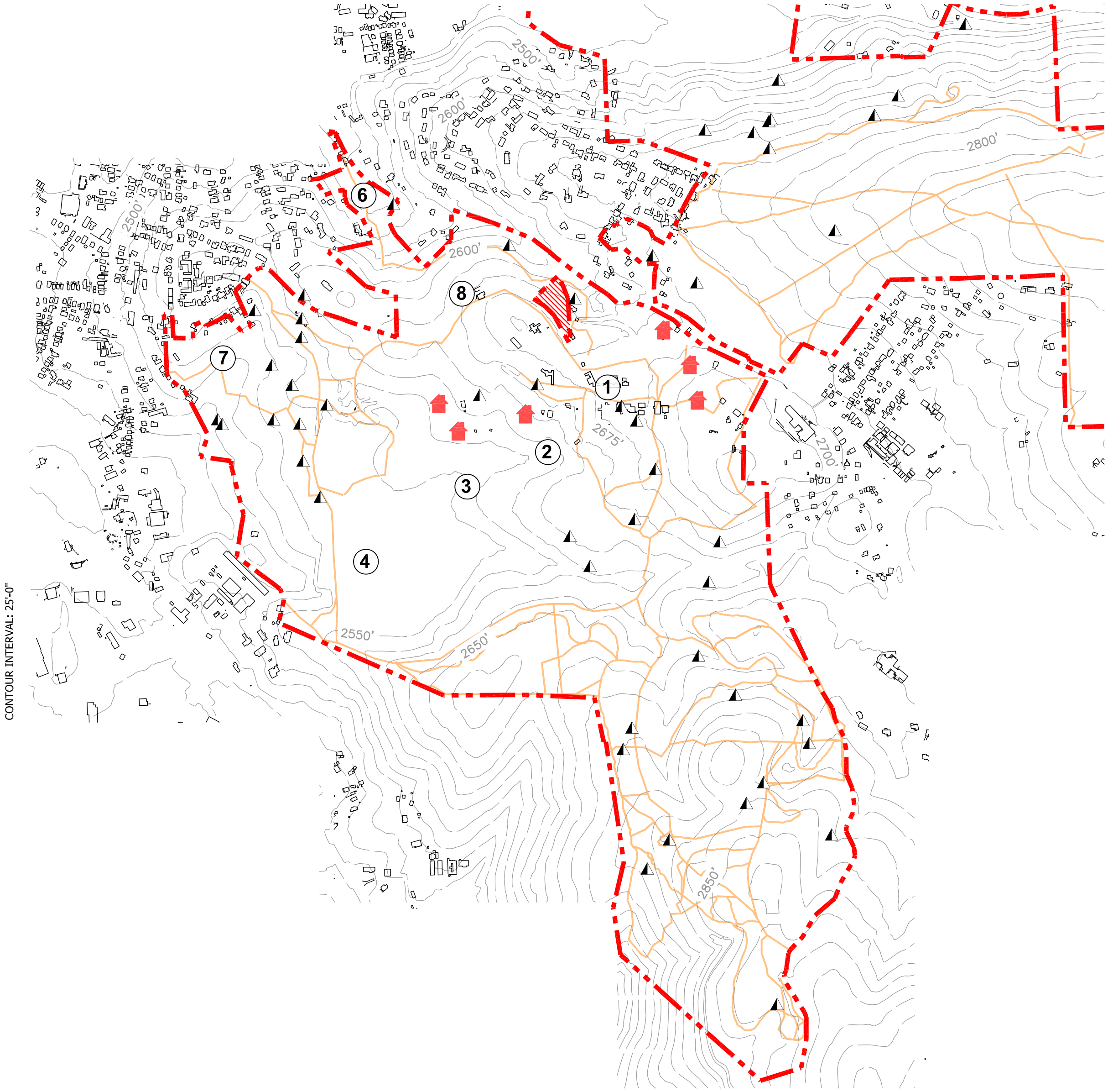
The maximally exposed individual (MEI) receptor as predicted to be 325 and 140 meters from the area sources of DPM and COC metals-containing fugitive dust respectively

The MDS is proposed to operate over a 2-year time period, for 6 months (125 working days) within each year. Assuming that the MEI receptor would be exposed to maximum annual average concentrations for 2 years over a 70-year lifetime, the LECR would be 1.56 and 1.62E-01 in a million for DPM and COC metals respectively, or a total LECR of 1.72 in a million. This is less than the associated significance threshold (10 in a million LECR) in regard to cancer risk at the MEI receptor.

It is important to note that cancer risk has been evaluated assuming that the peak daily emissions would occur over the entire span of the Project implementation to present a conservative approach. Therefore, actual impacts from the Project would likely be much lower than predicted in this assessment.

Non-Cancer Risk

Non-cancer adverse health effects, both for acute (short-term) and chronic (long-term) time periods, are assessed using the HQ, which is defined as the ratio of the predicted incremental exposure concentration or dose from the Project to a published threshold concentration or dose that could cause adverse health effects as established by OEHHA. The sum of the HQs for each non-carcinogenic substance that affects a certain target organ system is added to produce an overall HI for that target organ system. Overall HIs are generally calculated for each target organ system and if the overall HI for the highest-impacted target organ system is greater than one, then the impact is considered to be significant. Conservatively, however, the HQ for each individual TAC can simply be added together irrespective of the target organ system affected; this is the approach used in this health risk assessment.



Remediation Areas:

- ① Mine Yard and Stamp Mill (DPM)
- ② Cyanide Plant Area (DPM)
- ③ Conveyance Corridor and Adit Project (DPM)
- ④ Sand Dam Area (DPM)
- ▲ Historic Mine and Mill Sites (DPM) **(Area 5)**
- ⑥ Magenta Drain Area (DPM)
- ⑦ Stacy Lane Pond Area (DPM)
- ⑧ Historic Grounds Area (DPM)
- Residences and Residences Yards (DPM) **(Area 9)**
- Trails (DPM and As) **(Area 10)**

- Empire Mine SHP Boundary
- Buildings (Potential Receptors)
- In Holding

DPM - Diesel Particulate Matter
As - Arsenic

N

0 1000'-0"

SCALE: 1" = 1000'-0"

Figure 4.2-1
Location of Potential TAC Emissions for Remediation Areas 1-4 and 6-9

EMPIRE MINE SHP
SITE CHARACTERIZATION
AND REMEDIATION PROJECT

RESOURCE DESIGN TECHNOLOGY, INC.

Acute Health Hazard

Acute hazard was assessed for arsenic only and only for the inhalation exposure pathway (since other COC metals and exposure pathways did not have applicable toxicity data provided by CARB). Within each Remediation Area, maximum arsenic concentrations would be classified as following levels:

1) Those Remediation Areas with maximum arsenic concentrations less than or equal to 363 mg/kg, within which only Standard and Specific Project Requirements would be necessary when Program Actions were taking place in accordance with the MDS.
2) Those Remediation Areas with maximum arsenic concentrations less than or equal to 3,500 mg/kg, but greater than 363 mg/kg, within which additional Mitigation Measures would be necessary when Program Actions were taking place, which include modifications to the MDS.
3) Those Remediation Areas with maximum arsenic concentrations greater than 3,500 mg/kg, within which a project-specific approach and MDS would need to be developed and assessed outside of this Program EIR. Project-specific requirements would then be developed to ensure that less than significant acute hazard impacts result.

For Remediation Areas in classification Level 1, the maximum HI is estimated to be less than 1.0, resulting in less than significant acute health impacts.

For Remediation Areas in classification Level 2, potential significant acute health impacts could result without implementation of additional mitigation. However, with implementation Mitigation Measure 4.2-1: Additional Dust Suppression Measures would result in less than significant impacts.

For Remediation Areas in classification Level 3, potential significant acute health impacts could result. However, an area-specific Remediation and Mitigation Plan would be developed to ensure that acute hazard from arsenic would have Hazard Index of less than 1.0. This would involve the selection of a remediation option (e.g., Placement of cover over selected areas) that would ensure that less than significant acute health impacts would result.

Chronic Health Hazard

Chronic non-carcinogenic health hazard was assessed for both DPM and COC metals. The MEI receptor for chronic health hazard was calculated to have HI's of 3.28E-02 and 1.24E-01 respectively for DPM and COC metals, for a total combined HI of 1.57E-01. Since the maximum chronic HI is less than 1.0, this impact would be less than significant.

Asbestos

Asbestos was not evaluated in this PEIR as no asbestos-containing soils were discovered at the Park and the NSAQMD requires that all projects that would disturb more than one acre submit an Asbestos Dust Mitigation Plan (which would include adopted standards for grading, excavation, blasting, and other construction or operational activities that could generate asbestos containing fugitive dust) before beginning any clearing, grading or construction activities, and implementation of an approved plan would result in impacts from asbestos that are less than significant.

Level of Significance Before Mitigation: Less than Significant for all TAC impacts except for acute health impacts from arsenic in Remediation Areas classified as Level 1. For Remediation Areas classified as Level 2 or 3, acute health impacts from arsenic could be significant; therefore, mitigation measures will be implemented.

Mitigation Measure 4.2-1 (a): Additional Dust Suppression Measures: For Project Actions within Remediation Areas classified as Level 2 (maximum arsenic concentrations less than or equal to 3,500 mg/kg, but greater than 363 mg/kg) the Project Proponents will implement the following:

- All active construction areas will be watered whenever material being disturbed is not moist. This includes areas subject to vehicle travel; material to be excavated, dozed, scraped, etc.; and material being hauled if it is not otherwise covered.
- Enclose, cover, water to maintain moist conditions, or apply (non-toxic) soil binders to exposed stockpiles containing materials with arsenic concentrations within the Level 2 classification range.
- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded areas inactive for 5 days or more).
- Limit the area subject to excavation, grading and other construction activity at any one time to as small as practically possible, but not to exceed 2.5 acres per day

Mitigation Measure 4.2-1 (b): Remediation and Mitigation Plan

If area-specific characterization indicates that a Remediation Area is classified as Level 3 (maximum arsenic concentrations greater than 3,500 mg/kg), the Project Proponents will develop a Remediation and Mitigation Plan that demonstrates that acute arsenic health impacts have an Hazard Index less than 1.0, and are therefore less than significant. This Plan will likely require selection of a remediation option that reduces potential exposure to unacceptable health risks associated with arsenic (e.g., Placement of cover over selected areas).

Level of Significance After Mitigation: Less than Significant

When mitigation measures are implemented within Remediation Areas classified as Level 2 (maximum arsenic concentrations less than or equal to 3,500 mg/kg, but greater than 363 mg/kg) and when a Remediation and Mitigation Plan is developed for Remediation Areas classified as Level 3 (maximum arsenic concentrations greater than 3,500 mg/kg), the acute arsenic health impacts would have an Hazard Index less than 1.0, and would be less than significant.

Impact 4.2-3: Program Actions Would Generate Localized CO Emissions at Intersections and Roadways in the Project Vicinity due to Offsite Worker and Haul Truck Emissions

Increased traffic levels generated by the Project have the potential to affect carbon monoxide concentrations along surface streets in the Project area due to commuting by Project workers, and haul trucks bringing equipment and material to and from the Park. Such increases in traffic typically have the highest impacts at intersections, where vehicles idle in the queues formed at the intersection. These areas are often referred to as CO "hot spots."

As noted in Section 4.11, several regulatory entities have traffic number and capacity thresholds that would trigger a specific Traffic Impact Study (TIS), the most stringent of which comes from the City of Grass Valley, with a threshold of 50 peak hour trips. Specific Project Requirements have been developed for this Project limiting peak hour truck trips and providing guidance as to when a TIS would be prepared.

For purposes of this Draft PEIR, it was assumed that carbon monoxide concentrations at locations impacted by any increases in off-site traffic would be less than significant at levels below 50 peak-hour trips (i.e. a TIS not required). If it was identified through Project Requirements that a TIS is required, a demonstration of insignificant impact (i.e. peak concentrations less than the applicable CO ambient air quality standards) would be completed. For comparison, the Bay Area AQMD considers most increases in traffic less than 100 peak hour trips to be less than significant under CEQA.

Based on implementation of the Specific Project Requirements for traffic, the impacts from localized CO emissions associated with Project Actions at intersections and roadways are less than significant.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact 4.2-4: Program Actions Could Lead to Increases in Odor Emissions

The proposed work would not result in the long-term generation of odors; however, Program Actions-related emissions could result in a short-term generation of odors, including diesel exhaust and fuel or solvent vapors. Some receptors could consider these odors objectionable. However, Program Actions would be short-term and odor emissions would be limited and dissipate rapidly in the air with increased distance from the source.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact 4.2-5: Program Actions Could Conflict with Implementation of State Goals for Reducing Greenhouse Gas (GHG) Emissions and thereby have an Adverse Effect on Global Climate Change

The geographic scope of potential cumulative greenhouse gas impacts encompasses the NSAQMD jurisdiction, statewide considerations, and contribution to attainment of State global climate change policies. ARB is required under AB 32 to develop methods to estimate and report emissions of GHG from facilities that emit GHG. This reporting will help establish a baseline from which to measure progress toward the emission reduction goals of AB 32. ARB has also been directed to develop lists of potential early actions to reduce GHG emissions statewide. In addition, SB 97 directed OPR to establish draft CEQA guidelines for the mitigation of GHG in CEQA documents by July 1, 2009, and adopt final guidelines by the beginning of 2010.

As with other individual projects (even major projects that emit more than 25,000 metric tons/year CO_2e), the project specific emissions from this Project would not individually be likely to have an impact on global climate change, but it could conflict with the State goals for reducing greenhouse gas emissions (AEP 2007) and therefore could constitute a cumulatively but minimal contribution to global climate change.

Several types of analyses are used to determine whether a project could be in conflict with the State goals for reducing greenhouse gas emissions. The analyses are reviews of:

1. The potential conflicts with the ARB 44 early action strategies;
2. The relative size of the project in comparison to the estimated greenhouse reduction goal of 174 million metric tons/year of CO_2e emissions by 2020 and in comparison to the size of major facilities that are required to report greenhouse gas emissions (25,000 metric tons/year of CO_2e);

3. The basic energy efficiency parameters of a project to determine whether its design is inherently energy efficient; and
4. Project GHG Emissions < 7,000 $MTCO_2eq$/yr.

The Project does not pose any apparent conflict with the most recent list of the ARB early action strategies (see Table 4.2-3). In addition, the Project is predicted to generate approximately 5.52 metric tons of CO_2 per day and an estimated yearly amount of 690 metric tons of CO_2 which is considerably less than the interim threshold of 7,000 metric tons of CO_2 per year as established by ARB.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

4.2.5 EFFECTS CONSIDERED NO IMPACT OR LESS THAN SIGNIFICANT WITHOUT PROJECT REQUIREMENTS

No impacts have been identified as having no impact or having a less than significant impacts without incorporation of Project Requirements. All air quality CEQA thresholds are addressed in Impacts 4.2-1 through 4.2-4, above.

4.2.6 FINDINGS

The proposed remedial options are projected to result in less than significant air quality impacts for all Remediation Areas assuming the Project Proponents adhere to analytical assumptions (including MDS), incorporate all applicable Standard and Specific Project Requirements, and implement mitigation measures 4.2-1(a) and 4.2-1(b), as applicable.

EXHIBIT L

3.3 AIR QUALITY

This section of the Draft Environmental Impact Report (Draft EIR; DEIR) includes a summary of applicable regulations, a description of existing air quality conditions, and an analysis of potential air quality impacts associated with the proposed project. Mitigation measures are recommended, as necessary, to reduce significant air quality impacts. All technical analyses related to this section are contained in **Appendix 3.3-A**.

3.3.1 SETTING

CLIMATE, METEOROLOGY, AND AIR POLLUTION POTENTIAL

The project site is located in western Nevada County south of the Lake of the Pines community and in the Mountain Counties Air Basin (MCAB). The MCAB consists of nine counties or portions of counties stretching from Plumas County on the north to Mariposa County on the south. The Northern Sierra Air Quality Management District (NSAQMD) is the local agency for air quality planning with authority over air pollutant sources.

Nevada County exhibits large variations in terrain and consequently exhibits large variations in climate, both of which affect air quality. The western portions of the county slope relatively gradually with deep river canyons running from southwest to northeast toward the crest of the Sierra Nevada range. East of the divide, the slope of the Sierra is steeper, but river canyons are relatively shallow. The warmest areas in Nevada County are found at the lower elevations along the county's west side, while the coldest average temperatures are found at the highest elevations (NSAQMD 2005).

The prevailing wind direction over the county is westerly. However, the terrain of the area has a great influence on local winds, so that wide variability in wind direction can be expected. Afternoon winds are generally channeled up-canyon, while nighttime winds generally flow down-canyon. Winds are, in general, stronger in spring and summer and weaker in fall and winter. Periods of calm winds and clear skies in fall and winter often result in strong, ground-based inversions forming in mountain valleys. These layers of very stable air restrict the dispersal of pollutants, trapping these pollutants near the ground, representing the worst conditions for local air pollution occurring in the county (NSAQMD 2005).

Regional airflow patterns have an effect on air quality patterns by directing pollutants downwind of sources. Localized meteorological conditions, such as light winds and shallow vertical mixing, and topographical features, such as surrounding mountain ranges, create areas of high pollutant concentrations by hindering dispersal. An inversion layer is produced when a layer of warm air traps cooler air close to the ground. Such temperature inversions hamper dispersion by stratifying contaminated air near the ground.

AMBIENT AIR QUALITY STANDARDS

Pollutants subject to federal and state ambient standards are referred to as "criteria" pollutants because the U.S. Environmental Protection Agency (USEPA) publishes criteria documents to justify the choice of standards. These standards define the maximum amount of an air pollutant that can be present in ambient air without harming the public's health. An ambient air quality standard is generally specified as a concentration averaged over a specific time period, such as 1 hour, 8 hours, 24 hours, or one year. The different averaging times and concentrations are meant to protect against different exposure effects. The USEPA has established two types of ambient standards: primary standards, which protect public health, and secondary standards, which protect public welfare from non-health-related adverse effects. The State of California has also adopted ambient air quality standards. **Table 3.3-1** summarizes federal and state ambient air quality standards.

TABLE 3.3-1
SUMMARY OF AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards	National Standards	
			Primary[1]	Secondary[2]
Ozone (O_3)	1-hour	0.09 ppm	–	Same as primary
	8-hour	0.070 ppm	0.075 ppm	
Particulate Matter (PM_{10})	AAM	20 $\mu g/m^3$	–	
	24-hour	50 $\mu g/m^3$	150 $\mu g/m^3$	
Fine Particulate Matter ($PM_{2.5}$)	AAM	12 $\mu g/m^3$	15 $\mu g/m^3$	
	24-hour	No Separate State Standard	35 $\mu g/m^3$	
Carbon Monoxide (CO)	1-hour	20 ppm	35 ppm	None
	8-hour	9 ppm	9 ppm	
	8-hour (Lake Tahoe)	6 ppm	–	
Nitrogen Dioxide (NO_2)	AAM	0.030 ppm	0.053 ppm	Same as primary
	1-hour	0.18 ppm	0.1 ppm	
Sulfur Dioxide (SO_2)	24-hour	0.04 ppm	--	–
	3-hour	–	–	0.5 ppm
	1-hour	0.25 ppm	0.075 ppm	–
Lead	30-day average	1.5 $\mu g/m^3$	–	–
	Calendar quarter	–	1.5 $\mu g/m^3$	Same as primary
	Rolling 3-month average	–	0.15 $\mu g/m^3$	Same as primary
Sulfates	24-hour	25 $\mu g/m^3$	No federal standards	
Hydrogen Sulfide	1-hour	0.03 ppm		
Vinyl Chloride	24-hour	0.01 ppm		
Visibility-Reducing Particle Matter	8-hour	Extinction coefficient of 0.23 per kilometer —visibility of 10 miles or more (0.07—30 miles or more for Lake Tahoe) due to particles when the relative humidity is less than 70%.		

Notes:
[1] Levels necessary to protect the public health
[2] Levels necessary to protect the public welfare from known or anticipated adverse effects
AAM = annual arithmetic mean; µg/m3 = micrograms per cubic meter; ppm = parts per million
Source: CARB 2010a

CURRENT AMBIENT AIR QUALITY

The primary criteria air pollutants of concern in the project area include ozone (O_3) and coarse particulate matter (PM_{10}). Ambient concentrations of carbon monoxide (CO) are typically low, though localized concentrations, particularly near congested roadway intersections, are a potential local concern.

In Nevada County, ambient air quality is currently monitored at stations located in the City of Grass Valley, in the Town of Truckee, and at one seasonal location in Nevada County known as White Cloud Mountain. The closest monitoring site to the proposed project is the Grass Valley-Litton Building air quality monitoring station, which monitors ambient concentrations of O_3 and both coarse and fine particulate matter. **Table 3.3-2** summarizes the last three years of published ambient air quality data obtained from this monitoring station.

TABLE 3.3-2
SUMMARY OF ANNUAL AMBIENT AIR QUALITY DATA

Pollutant Standards	2007	2008	2009
Grass Valley-Litton Building Monitoring Site			
Ozone (*number of days standard exceeded)*			
State 1-hour standard	5	8	3
Federal 8-hour standard	36	24	17
State 8-hour standard	55	42	38
Particulate Matter (*number of days standard exceeded)*			
State 24-hour standard (PM_{10})	NA	NA	NA
Federal 24-hour standard (PM_{10})	*	*	*
Federal 24-hour standard ($PM_{2.5}$)	0	26.3	0

Note: Ambient ozone and PM concentrations were obtained from the Grass Valley-Litton Building monitoring station. Measured days are those days that an actual measurement was greater than the level of the state daily standard or the national daily standard. Measurements are typically collected every 6 days. The number of days above the standard is not necessarily the number of violations of the standard for the year.
** = There is insufficient (or no) data available to determine the value.*
N/A – indicates that certain pollutant is not measured at monitoring site.
Source: CARB 2010b

AMBIENT AIR QUALITY ATTAINMENT STATUS

Table 3.3-3 shows the federal and state attainment status for Nevada County. The region is nonattainment for federal ozone standards and nonattainment for state ozone and PM_{10} standards (CARB 2010c).

Areas with air quality that exceed adopted air quality standards are designated as nonattainment areas for the relevant air pollutants. Areas that comply with air quality standards are designated as attainment areas for the relevant air pollutants. State Implementation Plans (SIPs) must be prepared by states for areas designated as federal nonattainment areas to demonstrate how the area will come into attainment of the exceeded federal ambient air quality standard.

As detailed in the Regulatory Framework discussion below, both the California Air Resources Board (CARB) and the USEPA have established air pollution standards in an effort to protect human health and welfare. Geographic areas are designated attainment if these standards are met and nonattainment if they are not met.

TABLE 3.3-3
FEDERAL AND STATE AMBIENT AIR QUALITY ATTAINMENT STATUS FOR NEVADA COUNTY

Pollutant	Federal	State
1-hour Ozone (O_3)	–	Nonattainment
8-hour Ozone (O_3)	Nonattainment	Nonattainment
Coarse Particulate Matter (PM_{10})	Unclassified	Nonattainment
Fine Particulate Matter ($PM_{2.5}$)	Unclassified/Attainment	Unclassified
Carbon Monoxide (CO)	Unclassified/Attainment	Unclassified
Nitrogen Dioxide (NO_2)	Unclassified/Attainment	Attainment
Sulfur Dioxide (SO_2)	Unclassified	Attainment
Hydrogen Sulfide (H_2S)	–	Unclassified

Source: CARB 2010c

AIR POLLUTANTS OF CONCERN AND HEALTH EFFECTS

One of the most important reasons for air quality standards is the protection of those members of the population who are most sensitive to the adverse health effects of air pollution, termed "sensitive receptors." The term "sensitive receptors" refers to specific population groups, as well as the land uses where individuals would reside for long periods. Commonly identified sensitive population groups are children, the elderly, the acutely ill, and the chronically ill. Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, residential dwellings, and convalescent-care facilities are examples of sensitive receptors (CARB 2005). Select criteria air pollutants, emission sources, and associated health and welfare effects are summarized in **Table 3.3-4.**

TABLE 3.3-4
SUMMARY OF SELECT CRITERIA AIR POLLUTANTS, COMMON SOURCES, AND EFFECTS

Pollutant	Major Man-Made Sources	Human Health & Welfare Effects
Ozone (O_3), a colorless or bluish gas.	Formed by a chemical reaction between reactive organic gases (ROG) and nitrous oxides (NO_x) in the presence of sunlight. Motor vehicle exhaust, industrial emissions, gasoline storage and transport, solvents, paints and landfills.	Irritates and causes inflammation of the mucous membranes and lung airways; causes wheezing, coughing and pain when inhaling deeply; decreases lung capacity; aggravates lung and heart problems. Damages plants; reduces crop yield. Damages rubber, some textiles and dyes.
Particulate Matter (PM), airborne solid particle and liquid particles. Grouped into two categories: PM_{10} and $PM_{2.5}$.	Power plants, steel mills, chemical plants, unpaved roads and parking lots, wood-burning stoves and fireplaces, automobiles and others.	Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. Impairs visibility (haze).

Pollutant	Major Man-Made Sources	Human Health & Welfare Effects
Carbon Monoxide (CO), an odorless, colorless gas.	Formed when carbon in fuel is not burned completely; a component of motor vehicle exhaust.	Reduces the ability of blood to deliver oxygen to vital tissues, affecting the cardiovascular and nervous systems. Impairs vision, causes dizziness, and can lead to unconsciousness or death.
Nitrogen Dioxide (NO_2), a reddish-brown gas.	Fuel combustion in motor vehicles and industrial sources. Motor vehicles; electric utilities, and other sources that burn fuel.	Respiratory irritant; aggravates lung and heart problems. Precursor to ozone and acid rain. Contributes to global warming, and nutrient overloading which deteriorates water quality. Causes brown discoloration of the atmosphere.
Sulfur Dioxide (SO_2), a colorless, nonflammable gas.	Formed when fuel containing sulfur, such as coal and oil, is burned; when gasoline is extracted from oil; or when metal is extracted from ore. Examples are petroleum refineries, cement manufacturing, metal processing facilities, locomotives, large ships, and fuel combustion in diesel engines.	Respiratory irritant. Aggravates lung and heart problems. In the presence of moisture and oxygen, sulfur dioxide converts to sulfuric acid which can damage marble, iron and steel; damage crops and natural vegetation. Impairs visibility. Precursor to acid rain.
Lead, a metallic element.	Metal refineries, smelters, battery manufacturers, iron and steel producers, use of leaded fuels by racing and aircraft industries.	Anemia, high blood pressure, brain and kidney damage, neurological disorders, cancer, lowered IQ. Affects animals, plants, and aquatic ecosystems.

Source: CARB 2010d

With regard to human health, the air pollutants of primary concern in Nevada County include ozone and coarse particulate matter, as previously mentioned. The standards for carbon monoxide, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, and lead are either unclassified or are being met within the region.

Ozone

O_3 is the most prevalent of a class of photochemical oxidants formed in the urban atmosphere. The creation of ozone is a result of complex chemical reactions between reactive organic gases and nitrogen oxides in the presence of sunlight. Unlike other pollutants, ozone is not released directly into the atmosphere from any sources. The major sources of nitrogen oxides and reactive hydrocarbons, known as ozone precursors (i.e., ROG and NO_x), are combustion sources such as factories and automobiles, and evaporation of solvents and fuels. The health effects of ozone are eye irritation and damage to lung tissues. Ozone also damages some materials such as rubber, and may damage plants, crops, and marine life. The ozone problem in the MCAB is further aggravated by the transport of emissions from the metropolitan Sacramento area. Ozone is a seasonal problem, typically occurring during the months from May through October, when there is plenty of sunlight. Within the MCAB, the primary source of ozone precursors is motor vehicles.

Particulate Matter

Particulate matter consists of solid and liquid particles of dust, soot, aerosols, and other matter, which are small enough to remain suspended in the air for a long period of time. Particulate matter can be divided into several size fractions. Coarse particles (PM_{10}) are between 2.5 and 10 microns in diameter and arise primarily from natural processes, such as wind-blown dust or soil. Fine particles ($PM_{2.5}$) are less than 2.5 microns in diameter and are produced mostly from combustion or burning activities. Fuel burned in cars and trucks, power plants, factories, fireplaces, and wood stoves produces fine particles. The level of $PM_{2.5}$ in the air is a public health concern because it can bypass the body's natural filtration system more easily than larger particles and can lodge deep in the lungs. The health effects vary depending on a variety of factors, including the type and size of particles. Research has demonstrated a correlation between high PM concentrations and increased mortality rates. Elevated PM concentrations can also aggravate chronic respiratory illnesses such as bronchitis and asthma.

A portion of the particulate matter in the air is due to natural sources such as wind-blown dust and pollen, which are associated with the aggravation of respiratory conditions. Man-made sources include combustion, automobiles, field burning, factories, and road dust. A portion of the particulate matter in the atmosphere is also a result of photochemical processes. The effects of high concentrations on humans include aggravation of chronic disease and heart/lung disease symptoms. Non-health effects include reduced visibility and soiling of surfaces.

Primary sources of PM_{10} emissions in the MCAB are road traffic, construction, open burning, and wildfires. The amount of particulate matter and PM_{10} generated is dependent on the soil type and the soil moisture content. Traffic also generates particulate matter emissions through entrainment of dust and dirt particles that settle onto roadways and parking lots. Burning of wood in residential woodstoves and fireplaces and open agricultural burning are other sources of PM_{10}. As stated above, sources of $PM_{2.5}$ include fuel burning automobiles, power plants, factories, fireplaces, and wood stoves.

Toxic Air Contaminants

Toxic air contaminants (TACs) are not considered criteria pollutants in that TACs are not addressed through the setting of federal or state ambient air quality standards. Instead, the USEPA and CARB regulate hazardous air pollutants (HAPs) and TACs, respectively, through statutes and regulations that generally require the use of the maximum or best available control technology to limit emissions. In conjunction with NSAQMD rules, they establish the regulatory framework for TACs. At the national level, the USEPA has established National Emission Standards for HAPs (NESHAPs), as required by the federal Clean Air Act Amendments. These are technology-based source-specific regulations that limit allowable emissions of HAPs.

At the state level, CARB has authority for the regulation of emissions from motor vehicles, fuels, and consumer products. In 1998, CARB added diesel-exhaust particulate matter (DPM) to the list of TACs. DPM is the primary toxic air contaminant of concern for mobile sources. Of all controlled TACs, emissions of DPM are estimated to be responsible for about 70 percent of the total ambient TAC risk. CARB has made the reduction of the public's exposure to DPM one of its highest priorities, with an aggressive plan to require cleaner diesel fuel and cleaner diesel engines and vehicles.

Local air districts have authority over stationary or industrial sources. All projects that require air quality permits from the NSAQMD are evaluated for TAC emissions. The NSAQMD limits emissions and public exposure to TACs through a number of programs. The NSAQMD prioritizes TAC-emitting stationary sources, based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors. The NSAQMD also requires a comprehensive health risk assessment for facilities that are classified in the significant-risk category, pursuant to Assembly Bill 2588.

Land Use Compatibility with TAC Emission Sources

The location of a development project is a major factor in determining whether it will result in localized air quality impacts. The potential for adverse air quality impacts increases as the distance between the source of emissions and members of the public decreases. While impacts on all members of the population should be considered, impacts on sensitive receptors are of particular concern.

In 2005, CARB released an informational guide entitled, "Air Quality and Land Use Handbook: A Community Health Perspective." The purpose of this guide is to provide information to aid local jurisdictions in addressing issues and concerns related to the siting of sensitive land uses near major sources of air pollution. The handbook includes recommended separation distances for various land uses, which are summarized in **Table 3.3-5**. These recommendations were based on analyses that suggested that health risks associated with mobile sources, particularly DPM, increased within 300 feet of a major freeway, and that a 70 percent reduction in ambient particulate levels occurs at 500 feet from the source (CARB 2005).

Within urbanized areas, the CARB handbook currently recommends that new sensitive land uses not be located within 500 feet of a freeway, urban roadways with 100,000 vehicles per day, or rural roads with 50,000 vehicles per day. However, these recommendations are not site-specific and should not be interpreted as defined "buffer zones." The recommendations of the handbook are advisory and need to be balanced with other state and local policies (CARB 2005). The nearest major roadway in relation to the project site is State Route (SR) 49, which is located west of the project site. Based on estimates obtained from the California Department of Transportation, the adjacent segments of SR 49 currently average approximately 21,500 vehicles per day (Caltrans 2010).

TABLE 3.3-5
RECOMMENDATIONS ON SITING NEW SENSITIVE LAND USES NEAR AIR POLLUTANT SOURCES

Source Category	Advisory Recommendations
Freeways and High-Traffic Roads	Avoid siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles per day, or rural roads with 50,000 vehicles per day.
Distribution Centers	Avoid siting new sensitive land uses within 1,000 feet of a distribution center (that accommodates more than 100 trucks per day, more than 40 trucks with operating transport refrigeration units (TRUs) per day, or where TRU unit operations exceed 300 hours per week).
	Take into account the configuration of existing distribution centers and avoid locating residences and other new sensitive land uses near entry and exit points.
Rail Yards	Avoid siting new sensitive land uses within 1,000 feet of a major service and maintenance rail yard.
	Within one mile of a rail yard, consider possible siting limitations and mitigation approaches.
Ports	Avoid siting of new sensitive land uses immediately downwind of ports in the most heavily impacted zones. Consult local air districts or CARB on the status of pending analyses of health risks.
Refineries	Avoid siting new sensitive land uses immediately downwind of petroleum refineries. Consult with local air districts and other local agencies to determine an appropriate separation.
Chrome Platers	Avoid siting new sensitive land uses within 1,000 feet of a chrome plater.
Dry Cleaners Using Perchloroethylene	Avoid siting new sensitive land uses within 300 feet of any dry cleaning operation. For operations with two or more machines, provide 500 feet. For operations with 3 or more machines, consult with the local air district.
	Do not site new sensitive land uses in the same building with perchloroethylene dry cleaning operations.
Gasoline Dispensing Facilities	Avoid siting new sensitive land uses within 300 feet of a large gas station (defined as a facility with a throughput of 3.6 million gallons per year or greater). A 50-foot separation is recommended for typical gas-dispensing facilities.

Note: Recommendations are advisory, are not site-specific, and may not fully account for future reductions in emissions, including those resulting from compliance with existing/future regulatory requirements, such as reductions in diesel-exhaust emissions anticipated to occur with continued implementation of CARB's Diesel Risk Reduction Plan.

Source: CARB 2005

California Diesel-Risk Reduction Plan

In September 2000, CARB adopted the Diesel Risk Reduction Plan (DRRP), which recommends many control measures to reduce the risks associated with DPM and achieve a goal of 75 percent DPM reduction by 2010 and 85 percent by 2020. The DRRP incorporates measures to reduce emissions from diesel-fueled vehicles and stationary diesel-fueled engines. Ongoing efforts by CARB to reduce diesel-exhaust emissions from these sources include the development of specific statewide regulations, which are designed to further reduce DPM emissions. The goal of each regulation is to make diesel engines as clean as possible by establishing state-of-the-art technology requirements or emission standards to reduce DPM emissions.

Since the initial adoption of the DRRP in September of 2000, CARB has adopted numerous rules related to the reduction of DPM from mobile sources, as well as the use of cleaner-burning fuels. Transportation sources addressed by these rules include public transit buses, school buses, on-road heavy-duty trucks, and off-road heavy-duty equipment. Some of the more notable rules and programs recently adopted by CARB are discussed in more detail below.

Standards for New Off-Road Diesel Engines

CARB has worked closely with the USEPA on developing new PM and NO_x standards for engines used in off-road equipment such as backhoes, graders, and farm equipment. The USEPA has proposed new standards that would reduce the emission from off-road engines to similar levels to the on-road engines discussed below by 2012. These standards will reduce DPM emissions by over 90 percent from new off-road engines currently sold in California.

Standards for New On-Road Diesel Engines

In 2001, CARB adopted new particulate matter (PM) and NO_x emission standards to clean up large diesel engines that power big-rig trucks, trash trucks, delivery vans, and other large vehicles. The new standard for PM took effect in 2007 and reduces emissions to 0.01 gram of PM per brake horsepower-hour (g/bhp-hr.) This is a 90 percent reduction from the pre-2007 PM standard. New engines will meet the 0.01 g/bhp-hr PM standard with the aid of diesel particulate filters that trap the particulate matter before exhaust leaves the vehicle.

Odors

Although offensive odors rarely cause physical harm, they can be very unpleasant, leading to considerable stress among the public and often generating citizen complaints to local governments and agencies. Some facilities are commonly known to produce odors, including wastewater treatment facilities, chemical manufacturing, painting/coating operations, feedlots/dairies, composting facilities, landfills, and transfer stations. Because offensive odors rarely cause physical harm and no requirements for their control are included in state or federal air quality regulations. Any actions related to odors are based on citizen complaints to local governments and the NSAQMD. No major sources of odors were identified in the project area.

3.3.2 REGULATORY FRAMEWORK

Air quality in the project area is regulated by several jurisdictions including the USEPA, CARB, NSAQMD, and the County of Nevada. Each of these jurisdictions develops rules, regulations, and policies to attain the goals or directives imposed upon them through legislation. Although the USEPA regulations may not be superseded, both state and local regulations may be more stringent.

FEDERAL

USEPA and the Federal Clean Air Act

At the federal level, the USEPA has been charged with implementing national air quality programs. The USEPA's air quality mandates are drawn primarily from the federal Clean Air Act (CAA), which was signed into law in 1970. Congress substantially amended the CAA in 1977 and again in 1990.

The Clean Air Act required the USEPA to establish National Ambient Air Quality Standards (NAAQS) and also set deadlines for their attainment. Two types of NAAQS have been established: primary standards, which protect public health, and secondary standards, which protect public welfare from non-health-related adverse effects. The CAA also required each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The federal Clean Air Act Amendments of 1990 added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. The USEPA has responsibility to review all state SIPs to determine conformance to the mandates of the Clean Air Act Amendments, and the amendments thereof, and determine whether implementation will achieve air quality goals. If USEPA determines a SIP to be inadequate, a Federal Implementation Plan may be prepared for the nonattainment area that imposes additional control measures. Failure to submit an approvable SIP or to implement the plan within the mandated time frame may result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

STATE

CARB and the California Clean Air Act

CARB is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California Clean Air Act of 1988. The California Clean Air Act (CCAA) requires that all air districts in the state endeavor to achieve and maintain California Ambient Air Quality Standards (CAAQS) for ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide by the earliest practical date. Plans for attaining CAAQS were to be submitted to CARB by June 30, 1991. The CCAA specifies that districts focus particular attention on reducing the emissions from transportation and area-wide emission sources, and the act provides districts with authority to regulate indirect sources. Each district plan is required to either (1) achieve a 5 percent annual reduction, averaged over consecutive three-year periods, in district-wide emissions of each nonattainment pollutant or its precursors, or (2) provide for implementation of all feasible measures to reduce emissions. Any planning effort for air quality attainment would thus need to consider both state and federal planning requirements.

Other CARB duties include monitoring air quality (in conjunction with air monitoring networks maintained by air pollution control districts and air quality management districts), establishing CAAQS (which in many cases are more stringent than the NAAQS), and setting emissions standards for new motor vehicles. The emission standards established for motor vehicles differ depending on various factors including the model year and the type of vehicle, fuel, and engine used.

Assembly Bills 1807 and 2588 – Air Toxics

Within California, toxic air contaminants (TACs) are regulated primarily through AB 1807 (Tanner Air Toxics Act; codified at Health and Safety Code Sections 39650, 39655, 39656–39659, 39660–39664, 39665–39669, 39670–39671, 39674–39675) and AB 2588 (Air Toxics Hot Spots Information and Assessment Act of 1987; codified at Health and Safety Code Sections 44300–44309). The Tanner Air Toxics Act sets forth a formal procedure for CARB to designate substances as TACs. This includes research, public participation, and scientific peer review before CARB designates a substance as a toxic air contaminant. Existing sources of TACs that are subject to the Air Toxics Hot Spots Information and Assessment Act are required to: (1) prepare a toxic emissions inventory; (2) prepare a risk assessment if emissions are significant; (3) notify the public of significant risk levels; and (4) prepare and implement risk reduction measures.

Senate Bill 656 – Reducing Particulate Matter in California

In 2003, the Legislature passed Senate Bill (SB) 656 (codified at Health and Safety Code Section 39614) to reduce public exposure to PM_{10} and $PM_{2.5}$. The legislation requires CARB, in consultation with local air pollution control and air quality management districts, to adopt a list of the most readily available, feasible, and cost-effective control measures that could be implemented by air districts to reduce PM_{10} and $PM_{2.5}$. The legislation establishes a process for achieving near-term reductions in PM throughout California ahead of federally required deadlines for $PM_{2.5}$ and provides new direction on PM reductions in those areas not subject to federal requirements for particulate matter. Source categories addressed by SB 656 include measures to address residential wood combustion and outdoor green waste burning; fugitive dust sources such as paved and unpaved roads and construction; combustion sources such as boilers, heaters, and charbroiling; solvents and coatings; and product manufacturing.

LOCAL

Nevada County General Plan

The Nevada County General Plan serves as the overall guiding policy document for the unincorporated areas of Nevada County. A summary of the project's consistency with applicable General Plan air quality-related policies is contained in **Appendix 3.0-A**. While this Draft EIR analyzes the project's consistency with the General Plan pursuant to California Environmental Quality Act (CEQA) Section 15125(d), the Nevada County Board of Supervisors makes the ultimate determination of consistency with the General Plan.

Northern Sierra Air Quality Management District

The Northern Sierra Air Quality Management District (NSAQMD) is the agency primarily responsible for ensuring that federal and state ambient air quality standards are not exceeded and that air quality conditions are maintained. Responsibilities of NSAQMD include, but are not limited to, preparing plans for the attainment of ambient air quality standards, adopting and enforcing rules and regulations concerning sources of air pollution, issuing permits for stationary sources of air pollution, inspecting stationary sources of air pollution and responding to citizen complaints, monitoring ambient air quality and meteorological conditions, and implementing programs and regulations required by the federal CAA and the CCAA. NSAQMD rules and regulations applicable to the proposed project include, but are not necessarily limited to, the following:

Rule 205, Nuisance. This rule prohibits the discharge of air contaminants or other material from any source which cause injury, detriment, nuisance, or annoyance to any considerable number of persons, or to the public, or which endangers the comfort, repose, health, or safety of any such persons, or the public or which cause to have a natural tendency to cause injury or damage to business or property.

Rule 226, Dust Control. This rule requires the submittal of a Dust Control Plan to the NSAQMD for approval prior to any surface disturbance, including clearing of vegetation.

Rule 302, Prohibited Open Burning. In accordance with this rule, no person (except as otherwise authorized in Sections 41801–41805.6, 41807–41809, and 41811–41815 of the Health and Safety Code) shall use open outdoor fires for the purpose of disposal, processing, or burning of any flammable or combustible material as defined in Section 39020 of the Health and Safety Code; or unless issued a permit by NSAQMD and in accordance with other applicable NSAQMD rules and regulations, including, but not limited to, Rule 308, Land Development Clearing, and Rule 312, Burning Permits.

Rule 308, Land Development Clearing. The NSAQMD finds it more economically desirable to dispose of wood waste from trees, vines, and bushes on property being developed for commercial or residential purposes by burning instead of burial at a sanitary landfill. In such instances, disposal by burning shall comply with NSAQMD rules, including, but not limited to, Rule 312, Burning Permit Requirements; Rule 313, Burn Days; Rule 314, Minimum Drying Times; Rule 315, Burning Management; and Rule 316, Burn Plan Preparation.

Rule 501, Permit Required. Before any source may be operated, a Permit to Operate shall be obtained from the Air Pollution Control Officer. No Permit to Operate shall be granted either by the Air Pollution Control Officer or the Hearing Board for any source constructed or modified without authorization or not in compliance with other NSAQMD rules and regulations, including those specified in NSAQMD Regulation IV.

3.3.3 IMPACTS AND MITIGATION MEASURES

STANDARDS OF SIGNIFICANCE

The impact analysis provided below is based on the application of the following State CEQA Guidelines Appendix G thresholds of significance, which indicate that a project would have a significant impact if it would:

1) Conflict with or obstruct implementation of any applicable air quality plan.

2) Violate any air quality standard or contribute substantially to an existing or projected air quality violation.

3) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors).

4) Expose sensitive receptors to substantial pollutant concentrations.

5) Create objectionable odors affecting a substantial number of people.

NSAQMD thresholds have also been used to determine air quality impacts in this analysis. To assist local jurisdictions in the evaluation of air quality impacts, the NSAQMD has published a guidance document for the preparation of the air quality portions of environmental documents that includes thresholds of significance to be used in evaluating land use proposals. Thresholds of significance are based on a source's projected impacts and are a basis from which to apply mitigation measures (NSAQMD 2009). The NSAQMD has developed a tiered approach to significance levels: a project with emissions meeting Level A thresholds will require the most basic mitigations; projects with projected emissions in the Level B range will require more extensive mitigations; and those projects which exceed Level C thresholds will require the most extensive mitigations. The NSAQMD-recommended thresholds are identified in **Table 3.3-6** below.

TABLE 3.3-6
NSAQMD-RECOMMENDED SIGNIFICANCE THRESHOLDS

Significance Level	Project-Generated Emissions (lbs/day)		
	NO_X	ROG	PM_{10}
Level A	<24	<24	<79
Level B	25–136	25–136	80–136
Level C	≥ 137	≥ 137	≥ 137

Source: NSAQMD 2009

According to the NSAQMD (NSAQMD 2009), these thresholds are recommended for use by lead agencies when preparing initial studies. If, during the preparation of the initial study, the lead agency finds that any of the following thresholds may be exceeded and cannot be mitigated to Level B, then a determination of significant air quality impact must be made and an EIR is required.

For evaluation of project-related air quality impacts and considering that this EIR has been prepared to analyze the project, implementation of the proposed project would be considered significant if the project would:

- Exceed NSAQMD-recommended significance thresholds, as identified in **Table 3.3-6**. In accordance with NSAQMD-recommended thresholds of significance, project-generated short- or long-term increases in emissions in excess of Level C thresholds for NO_X, reactive organic gases (ROG), or PM_{10} would be considered significant. The NSAQMD has not adopted thresholds of significance for $PM_{2.5}$. However, because $PM_{2.5}$ is a subset of PM_{10}, significant increases in PM_{10} would be considered to also result in significant increases in $PM_{2.5}$.

  It is important to note that in cases when predicted emissions are projected to be below the Level C thresholds but exceeding the Level A thresholds (thereby placing project-related air quality impacts at Level B), the project would be considered potentially significant, subject to the recommended measures of NSAQMD's *Mitigation for Use During Design and Construction Phases for Classifications as Level B Threshold* (NSAQMD 2009). Implementation of the appropriate NSAQMD mitigation from this collection of measures would reduce Level B air quality impacts to a less than significant level.

- Exceed the NSAQMD health risk public notification thresholds set at 10 excess cancer cases in a million for cancer risk, or a Hazard Index of greater than one (1.0) for non-cancer risk.

- Contribute to localized concentrations of air pollutants at nearby receptors that would exceed applicable ambient air quality standards.
- Result in the frequent exposure of sensitive land uses to odorous emissions.

METHODOLOGY

Short-Term Impacts

Short-term construction emissions were estimated using the URBEMIS2007 (Version 9.2.4) computer program, as recommended by the NSAQMD. The URBEMIS2007 program is designed to model construction emissions for land use development projects and allows for the input of project-specific information. Modeling was based primarily on the default settings contained within the computer program for Nevada County and included emissions from off-highway mobile equipment, travel on unpaved surfaces, soil disturbance, and evaporative emissions from asphalt paving and architectural coating applications, as well as on-highway worker commute trips. Initial site preparation activities during phase one of project construction include export of 6,000 cubic yards of soil and 11 round trips per day (hauling) with a round-trip distance of 20 miles. Modeling was conducted for each of the proposed project phases assuming an overall 6-month construction period for each phase. It is anticipated that phases one and two would begin in the spring of 2012. Phases three through ten would continue buildout of the project to the outer areas surrounding the Village Center, including additional project amenities, cottage-style homes for independent living, duplexes, fourplexes, cohousing affordable units, and assisted living and nursing care units. It is anticipated that phases three and four would begin in spring of 2013 and, assuming favorable market demand, phases five and six would begin in 2014. Buildout of the project would be anticipated by 2016.

Modeled construction phases and associated proposed land uses are summarized in **Table 3.3-7**. Short-term construction emissions impacts are described under Impact 3.3.1**.**

Long-Term Impacts

Regional area- and mobile-source emissions were estimated using the URBEMIS2007 (Version 9.2.4) computer program. Emissions were calculated for annual operational conditions based on the default parameters contained in the model for Nevada County. Default trip-generation rates contained in the model were amended to correspond with trip-generation rates identified in the traffic analysis prepared for this project. Modeling was conducted for weekday and annual operational conditions. Emissions associated with the use of hearth devices were based on the modeling default assumptions.

The evaluation of local mobile-source CO concentrations was conducted using a screening procedure developed by the Bay Area Air Quality Management District (BAAQMD), which is a methodology previously approved for use by the NSAQMD. The BAAQMD screening procedure is based on the CALINE4 computer model, which was developed by the California Department of Transportation. Localized concentrations were quantitatively assessed for roadway intersections projected to operate at unacceptable levels of service (i.e., LOS E or worse), based on data obtained from the traffic analysis prepared for the proposed project. Ambient CO concentrations were based on the highest measured background concentrations measured at the nearest monitoring station for the last three years of available data. Emission factors were derived from the Emfac2007 computer model for Nevada County, for winter operational conditions. Eight-hour concentrations were calculated based on predicted 1-hour concentrations and assuming a persistence factor of 0.7. Exposure to localized concentrations of odors and TACs were qualitatively assessed based on the projects potential to result in increased exposure of sensitive receptors to new or existing emission sources.

PROJECT IMPACTS AND MITIGATION MEASURES

Short-Term Construction-Generated Emissions of Criteria Air Pollutants (Standard of Significance 2)

Impact 3.3.1 Construction-generated emissions would exceed applicable significance thresholds and could result in a significant contribution to local and regional pollutant concentrations. This impact is **potentially significant**.

Construction of the proposed project would generate short-term emissions of criteria air pollutants. The criteria pollutants of primary concern in Nevada County include ozone-precursor pollutants (i.e., ROG and NO_x) and PM_{10}.

Construction-generated emissions are short term and of temporary duration, lasting only as long as construction activities occur, but possess the potential to represent a significant air quality impact. The construction and development of residential, commercial, and industrial uses would result in the temporary generation of emissions resulting from site grading and excavation, road paving, motor vehicle exhaust associated with construction equipment and worker trips, and the movement of construction equipment, especially on unpaved surfaces. Emissions of airborne particulate matter are largely dependent on the amount of ground disturbance associated with site preparation activities.

The predicted maximum daily construction-generated emissions of ROG, NO_x, and PM_{10} associated with project construction are summarized in **Table 3.3-7**. Based on the modeling conducted, maximum unmitigated construction-generated emissions of NO_x and PM would occur during the initial site preparation/grading of the project site. Emissions of ROG would largely occur during the building construction phase, associated with the application of architectural coatings, as well as during road construction, associated with asphalt application. As indicated in **Table 3.3-7**, emissions would vary depending on the project phase, the specific land uses being constructed and the specific activities conducted. As previously stated, emissions were calculated using the URBEMIS2007 computer program as recommended by NSAQMD (NSAQMD 2009). The air quality model assumes one-quarter of the project phase area would be actively disturbed on any given day and an overall estimated 6-month construction period for each project phase. Project construction is estimated to require the import of 6,000 cubic yards of soil. For the purposes of this analysis, this soil is estimated to be imported with 11 round trips per day (hauling) at a round-trip distance of 20 miles during Phases 1 and 2.

TABLE 3.3-7
ESTIMATED SHORT-TERM EMISSIONS OF CRITERIA AIR POLLUTANTS
FOR THE PROPOSED RINCON DEL RIO CONTINUING CARE RETIREMENT COMMUNITY

Project Phase	Emissions (lbs/day)			
	ROG	NOx	PM_{10}	$PM_{2.5}$
Phase I and Phase 2 (constructed in 2012)	141	44	62	14.5
Phase 1 and Phase 2 with mitigation	*127*	*44*	*35*	*9*
Phase 3	74	21	23	5.5
Phase 4	23	21	12	3
Phase 5	55	19	19	4.5
Phase 6	20	19	12	3
Phase 7	20	18	9	2.5
Phase 8	79	30	29	7.5
Phase 9	45	16	16	4
Phase 10	34	16	17	4
Trail System Development Phase	6	38	18	5
NSAQMD Level A/C Thresholds	24/137	24/137	79/137	None
Individual Project Phases Exceed NSAQMD Level A/C Thresholds?	Yes/Yes	Yes/No	No/No	NA

As previously stated, the NSAQMD considers emissions in excess of Level C thresholds to have a significant air quality impact. Emissions below Level C thresholds are considered potentially significant and subject to the recommended mitigation of NSAQMD's *Mitigation for Use During Design and Construction Phases for Classifications as Level B Threshold* (NSAQMD 2009). NSAQMD-recommended mitigation measures are dependent on level of impact in comparison to NSAQMD-recommended significance thresholds (NSAQMD 2009). Accordingly, implementation of NSAQMD-recommended mitigation measures sufficient to reduce emissions to levels below 137 lbs/day are considered adequate to reduce air quality impacts to a less than significant level. NSAQMD-recommended significance thresholds are defined in **Table 3.3-6** above.

Based on the modeling conducted, estimated short-term daily emissions of NO_x and PM_{10} associated with the individual project phases would not exceed the NSAQMD-recommended Level C significance threshold of 137 pounds per day (lbs/day). However, emissions would exceed the NSAQMD-recommended Level C ROG significance threshold of 137 lbs/day during Phases 1 and 2.

In addition, emissions would exceed the Level A significance threshold of 24 lbs/day for ROG during Phases 3, 5, 8, 9, and 10 and for NO_x during construction Phases 1, 2, and 8, as well as during installation of the trail system.

As noted earlier in this section, Nevada County is currently designated nonattainment for the ozone and PM_{10} ambient air quality standard. Short-term increases of ozone-precursor pollutants (ROG and NO_x) could potentially contribute to existing nonattainment conditions, depending on the construction phase. As a result, short-term increases of ROG and NO_x would be considered

potentially significant and mitigation is required to reduce these increases. In the case of Phases 1 and 2, ROG emissions would have to be reduced to a level below 137 lbs/day during those phases. ROG emissions generated during construction Phases 3, 5, 8, 9, and 10 would trigger the requirement for NSAQMD-recommended mitigation measures from NSAQMD's *Mitigation for Use During Design and Construction Phases for Classifications as Level B Threshold.* NO_X emissions generated during construction Phases 1, 2, and 8 and during trail system installation would also be subject to these NSAQMD-recommended measures.

In addition, NSAQMD Rule 226, Dust Control, requires the submittal of a Dust Suppression Control Plan to the NSAQMD for approval prior to any surface disturbance, including grading activities and the clearing of vegetation. In accordance with NSAQMD Rule 226, Dust Control, a Dust Suppression Control Plan (DSCP) shall be submitted for approval by the Nevada County Community Development Agency and NSAQMD. The DSCP must identify project phases and construction schedules to be implemented in order to ensure that mitigated construction-generated emissions would not exceed NSAQMD-recommended significance thresholds. The DSCP is required to include, but is not limited to, the following NSAQMD-recommended measures for the control of fugitive dust emissions:

- The project applicant shall be responsible for ensuring that all adequate dust control measures are implemented in a timely manner during all phases of project development and construction.
- All material excavated, stockpiled, or graded shall be sufficiently watered, treated, or covered to prevent fugitive dust from leaving the property boundaries and causing a public nuisance or a violation of an ambient air standard. Watering should occur at least twice daily, with complete site coverage.
- All areas with vehicle traffic shall be watered or have dust palliative applied as necessary for regular stabilization of dust emissions.
- All on-site vehicle traffic shall be limited to a speed of 15 mph on unpaved roads.
- All land clearing, grading, earth moving, or excavation activities on a project shall be suspended as necessary to prevent excessive windblown dust when winds are expected to exceed 20 mph.
- All inactive portions of the development site shall be covered, seeded, or watered until a suitable cover is established. Alternatively, the applicant may apply County-approved nontoxic soil stabilizers (according to manufacturers' specifications) to all inactive construction areas (previously graded areas which remain inactive for 96 hours) in accordance with the local grading ordinance.
- All material transported off-site shall be either sufficiently watered or securely covered to prevent public nuisance, and there must be a minimum of 6 inches of freeboard in the bed of the transport vehicle.
- Paved streets adjacent to the project shall be swept or washed at the end of each day, or more frequently if necessary, to remove excessive or visibly raised accumulations of dirt and/or mud which may have resulted from activities at the project site.
- Prior to final occupancy, the applicant shall re-establish ground cover on the site through seeding and watering in accordance with the local grading ordinance.

The following mitigation is required to address increases in the ozone-precursor pollutants, ROG and NO_X. Mitigation measures **MM 3.3.1c** and **MM 3.3.1d** are sourced from NSAQMD's *Mitigation for Use During Design and Construction Phases for Classifications as Level B Threshold*, and mitigation measure **MM 3.3.1a** has been adapted from these recommendations in order to be more specific to the project and thus more stringent. Mitigation measure **MM 3.3.1b** is in addition to NSAQMD-recommended mitigation measures.

Mitigation Measures

MM 3.3.1a The project applicant shall submit to the NSAQMD for approval an Off-Road Construction Equipment Emission Reduction Plan prior to groundbreaking demonstrating that all off-road equipment (portable and mobile) meets or is cleaner than Tier 2 engine emission specifications unless prior written approval for any exceptions is obtained from NSAQMD. Note that all off-road equipment must meet all applicable state and federal requirements.

Construction contracts shall stipulate the following:

- Emissions from on-site construction equipment shall comply with NSAQMD Regulation II, Rule 202, Visible Emissions.
- The primary contractor shall be responsible to ensure that all construction equipment is properly tuned and maintained.
- Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes when not in use (as required by California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations). Clear signage shall be provided for construction workers at all access points.
- All construction equipment shall be maintained and properly tuned in accordance with manufacturers' specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Existing power sources (e.g., power poles) or clean fuel generators shall be utilized rather than temporary power generators where feasible.

Timing/Implementation: *The Off-Road Construction Equipment Emission Reduction Plan shall be submitted and approved prior to issuance of grading permits for the first phase of construction. The plan shall be implemented during all phases of construction.*

Enforcement/Monitoring: *Nevada County Community Development Agency; Northern Sierra Air Quality Management District*

MM 3.3.1b All architectural coating activities associated with construction of the proposed project shall be required to use interior and exterior coatings that contain less than 250 grams of volatile organic compounds (VOC/ROG) per liter of coating.

Timing/Implementation: *During construction*

Enforcement/Monitoring: *Nevada County Community Development Agency; Northern Sierra Air Quality Management District*

MM 3.3.1c Grid power shall be used (as opposed to diesel generators) for construction site power needs where feasible during construction.

Timing/Implementation: *During construction*

Enforcement/Monitoring: *Nevada County Community Development Agency; Northern Sierra Air Quality Management District*

MM 3.3.1d Deliveries of construction materials shall be scheduled to direct traffic flow to avoid the peak hours of 7–9:00 AM and 4–6:00 PM.

Timing/Implementation: *During construction*

Enforcement/Monitoring: *Nevada County Community Development Agency; Northern Sierra Air Quality Management District*

In accordance with NSAQMD Rule 226 and mitigation measures **MM 3.3.1a** through **MM 3.3.1d**, the project would be required to prepare a Dust Suppression Control Plan and an Off-Road Construction Equipment Emission Reduction Plan, employ the use of interior and exterior coatings that contain less than 250 grams of VOC/ROG, use grid power when feasible thus reducing diesel fuel consumption, and schedule off-peak-hour material deliveries. The DSCP would be required to identify construction schedules and project phases to be implemented, which would ensure that multiple project phases or construction activities would not occur simultaneously, thus reducing the amount of pollutants emitted in a single day.

Based on the proposed project phasing schedules, and with implementation of the above mitigation measures, maximum predicted construction-generated emissions would be reduced to a less than significant level. Due to limitations in the air quality computer model, only air pollutant reductions associated with watering the construction site twice daily as mandated by NSAQMD Rule 226 and the requirement to use interior and exterior coatings that contain less than 250 grams of VOC/ROG (mitigation measure **MM 3.3.1b**) can be quantified. Accounting for the reductions from these two mitigation strategies alone would reduce maximum predicted construction-generated emissions to approximately 127 lbs/day of ROG during Phases 1 and 2 when the Level C ROG significance threshold would be exceeded without mitigation, as shown in **Table 3.3-7**. However, it should be noted that emissions would most likely be reduced to an even further extent with implementation of the remaining aspects of Rule 226 and mitigation measures **MM 3.3.1a, MM 3.3.1c**, and **MM 3.3.1d**, which as previously stated could not be quantified. This is especially noteworthy in the case of NO_x emissions, which are addressed under mitigation measure **MM 3.3.1a**.

The NSAQMD considers ROG and NO_x emissions of less than 137 lbs/day to have a less than significant impact, and as demonstrated above, with incorporation of mitigation measures, no construction-generated emissions would exceed this threshold. The NSAQMD considers emissions that are below the Level C thresholds but exceeding the Level A thresholds to be potentially significant, subject to mitigation in order to be considered less than significant. Mitigation measures **MM 3.3.1c** and **MM 3.3.1d** are sourced from NSAQMD's recommended mitigations, and **MM 3.3.1a** has been adapted from these recommendations in order to address generated emissions that exceed Level A thresholds.

With implementation of the proposed mitigation measures, this impact would be considered **less than significant**.

Short-Term Exposure of Sensitive Receptors to Toxic Air Contaminants (Standard of Significance 4)

Impact 3.3.2 Health risks associated with intermittent exposure to construction-generated diesel-exhaust emissions would not be anticipated to exceed applicable thresholds. As a result, short-term exposure of sensitive receptors to TACs would be considered **less than significant**.

Potential sources of toxic air contaminants (TACs) associated with construction-related activities are primarily associated with the airborne entrainment of asbestos due to the disturbance of naturally occurring asbestos-containing soils, as well as emissions of DPM associated with the use of diesel-powered construction equipment. The proposed project is not located within an area designated by the State of California as likely to contain naturally occurring asbestos (DOC 2000). As a result, construction-related activities would not be anticipated to result in increased exposure of sensitive land uses to asbestos. Construction of the proposed land uses would, however, result in construction-generated diesel-exhaust emissions. Particulate exhaust emissions from diesel-fueled engines (DPM) were identified as a toxic air contaminant by CARB in 1998.

Health-related risks associated with diesel-exhaust emissions are primarily linked to long-term exposure and the associated risk of contracting cancer. For residential land uses, the calculation of cancer risk associated with exposure to TACs is typically based on a 70-year period of exposure. The use of diesel-powered construction equipment would be temporary and episodic and would occur over a relatively large area. In addition, mitigation measures incorporated for the control of particulate emissions from on-site construction equipment would substantially reduce emissions of DPM by approximately 40 percent or more. For these reasons, DPM generated by project construction, in and of itself, would not be expected to create conditions where the probability of contracting cancer is greater than 10 in 1 million for nearby receptors. Long-term health risks associated with short-term construction activities would therefore be considered **less than significant**.

Mitigation Measures

None required.

Long-Term Emissions of Criteria Air Pollutants (Standard of Significance 2)

Impact 3.3.3 Project-generated long-term operational emissions would exceed applicable significance thresholds and could contribute to regional nonattainment conditions. As a result, this impact is considered **potentially significant.**

Long-term operation of the proposed project would generate emissions of ozone-precursor pollutants (i.e., ROG and NO_x) and PM_{10}. Long-term increases in area- and mobile-source emissions associated with the proposed land uses were estimated using the CARB-approved URBEMIS2007 computer program. Trip-generation rates assigned to the proposed land uses were based on those identified in the traffic analysis prepared for this project. Predicted maximum daily operational emissions were calculated for winter and summer conditions. Annual emissions, in tons per year, were also calculated.

Predicted operational emissions are summarized in **Table 3.3-8**. Based on the modeling conducted, mobile sources resulted in the greatest predicted contribution to project-related emissions during the summer months. However, during the winter months, estimated daily emissions would increase due to the assumed use of wood-burning fireplaces and stoves within proposed residential dwelling units, as well as the reentrainment of road dust due to the increased sanding of area roadways. Emissions from these two primary sources are discussed in more detail below.

Sewer Lift Station Pump Generator

The project proposes to construct an on-site sewer lift station (and possibly an intermediate lift station) and extend a 6-inch force main from the project site to Rodeo Flat Road. From the high point near the intersection of Rodeo Flat and Timber Ridge, the line would then gravity flow down Timber Ridge Road and eventually terminate at an existing manhole located on Riata Way near the Lake of the Pines Sewer Treatment Facility. All off-site construction of the sewer main would be located within existing public utility easements (PUEs) (the proposed wastewater system is illustrated on **Figure 2.0-16**).

The on-site sewer lift station is anticipated to include an emergency power generator, control panel, exhaust fans, and booster pump. The booster pump would be located below grade in an underground vault. The remaining equipment would be located above ground and housed in an enclosed structure. The emergency power generator would run on diesel fuel and therefore be an intermittent source of emissions as its operation will be rare and intermittent. Therefore, while the emergency power generator would be a source of air pollutant emissions, their use would be limited and resultant emissions negligible.

Wood-Burning Devices

The calculation of emissions from wood-burning devices assumes that 35 percent of the residential dwellings would be equipped with wood-burning stoves and 10 percent would be equipped with wood-burning fireplaces, based on default modeling assumptions contained in the URBEMIS2007 computer model for Nevada County. Based on the modeling conducted and in comparison to summer emissions, wood-burning appliances (i.e., fireplaces and stoves) would result in increased daily emissions of approximately 93 lbs/day of ROG, 12.5 lbs/day of NO_x, 97 lbs/day of PM_{10}, and 94 lbs/day of $PM_{2.5}$. During the winter months, estimated emissions from wood-burning hearth devices constituted a majority of the estimated project-generated ROG and NO_X emissions, resulting in increased emissions of these pollutants. However, despite the projected increases, NSAQMD's Level C significance thresholds would not be exceeded.

Reentrained Roadway Dust

The calculation of reentrained road dust is dependent, in part, on various factors including roadway conditions, vehicle speed, vehicle weight, and what is referred to as silt loading. The term "silt loading" can be defined as the amount of particles less than 74 microns in diameter per unit area of surface. The default assumptions contained in the URBEMIS2007 model are largely based on an average silt-loading factor of 0.1 grams per meter, which accurately reflect site-specific conditions of the project site.

As previously stated, operational emissions were calculated using the URBEMIS2007 (v9.2.4) computer program, based on default vehicle fleet distributions, trip characteristics, and emissions data contained in the model, except as noted. Trip-generation rates are based on the traffic analysis prepared for this project, and it is assumed that hearth devices are made up of 35 percent wood-burning stoves, 10 percent wood-burning fireplaces, and 55 percent natural gas fireplaces. The silt-loading factor of 0.1 gram/meter^2 for summer and winter conditions was used. Predicted operational emissions are summarized in **Table 3.3-8**.

TABLE 3.3-8
ESTIMATED OPERATIONAL EMISSIONS AT BUILDOUT WITHOUT MITIGATION

Source	Estimated Emissions[1]								
	Summer (lbs/day)			Winter (lbs/day)			Annual (tons/year)		
	ROG	NO_X	PM_{10}	ROG	NO_X	PM_{10}	ROG	NO_X	PM_{10}
Area Sources	25	4.5	--	118	17	94	8.2	1.2	4
Mobile Sources	13	12	18	12	17.5	3	2.3	2.5	3.2
Total	38	16.5	18	130	35	97	10.5	3.7	7.2
NSAQMD Level A/C Thresholds	24/137	24/137	79/137	24/137	24/137	79/137	None	None	None
Individual Project Phases Exceed NSAQMD Level A/C Thresholds?[2]	Yes/No	No/No	No/No	Yes/No	Yes/No	Yes/No	None	None	None

As previously stated, the NSAQMD considers emissions in excess of Level C thresholds to have a significant air quality impact. Accordingly, implementation of NSAQMD-recommended mitigation measures sufficient to reduce emissions to levels below 137 lbs/day is considered adequate to reduce air quality impacts to a less than significant level. In addition, the NSAQMD considers emissions that are below the Level C thresholds but exceeding the Level A thresholds to be potentially significant, subject to mitigation of NSAQMD's *Mitigation for Use During Design and Construction Phases for Classifications as Level B Threshold* (NSAQMD 2009) in order to be considered less than significant. NSAQMD-recommended significant thresholds are defined in **Table 3.3-6** above.

Estimated operational emissions of ROG, NO_X, and PM_{10} would not exceed the NSAQMD's Level C significance threshold of 137 lbs/day during either the summer or winter months. However, emissions of ROG, NO_X, and PM_{10} are projected to exceed the NSAQMD's Level A significance threshold. According to NSAQMD guidance, emissions exceeding the Level A significance threshold would contribute to existing nonattainment conditions and may also interfere with the region's ability to maintain ambient air quality standards if no mitigation is implemented. This impact would be considered **potentially significant**, and the following mitigation is required.

Mitigation Measures

MM 3.3.3 The project applicant shall adhere to the following NSAQMD-recommended mitigation measures to reduce long-term operational emissions:

- Use of wood-burning stoves or fireplaces within interior and exterior areas of residential land uses shall be prohibited. Each residence shall be equipped with a non-wood-burning source of heat.
- The project applicant shall provide, operate, and fund a green-waste drop-off site for residents.

Timing/Implementation: *Throughout the time span of project operations*

Enforcement/Monitoring: *Nevada County Community Development Agency; Northern Sierra Air Quality Management District*

In addition to this mitigation, mitigation measure **MM 3.5.1b** (see Section 3.5, Climate Change and Greenhouse Gases, of this DEIR) Furthermore, many of the NSAQMD-recommended mitigations (NSAQMD 2009) are already proposed as part of the project. For instance, the proposed project would incorporate mixed land uses (residential and commercial) as well as recreational amenities and a minimum of two paratransit vehicles for the purposes of transporting facility residents to various business appointments, grocery and service needs, recreation, and special events. Each of these measures would reduce automobile trips and thus air pollutant emissions.

Implementation of the NSAQMD-recommended mitigation measures **MM 3.3.3** would result in substantial reductions in project-generated emissions, as shown in **Table 3.3-9**. Furthermore, mitigation measure **MM 3.5.1b** and various project proposals would also reduce air pollutant emissions during project operations, yet these reductions are unable to be quantified accurately. These measures would reduce pollutant emissions and conform to NSAQMD guidance regarding impacts that surpass the Level A significance threshold.

TABLE 3.3-9
ESTIMATED OPERATIONAL EMISSIONS AT BUILDOUT WITH MITIGATION

Source	Estimated Emissions[1]								
	Summer (lbs/day)			Winter (lbs/day)			Annual (tons/year)		
	ROG	NO_X	PM_{10}	ROG	NO_X	PM_{10}	ROG	NO_X	PM_{10}
Area Sources	25	4.5	--	22	7	0.2	4	0.8	0
Mobile Sources	13	12	18	12	17.5	18	2	2.4	3
Total	38	16.5	18	34	24.5	18	6	3.2	3

Notes:

[1] Operational emissions were calculated using the URBEMIS2007 (v9.2.4) computer program, based on default vehicle fleet distributions, trip characteristics, and emissions data contained in the model, except as noted. Trip-generation rates based on the traffic analysis prepared for this project; hearth devices assume no wood-burning stove and no wood-burning fireplaces; silt-loading factor of 0.1 g/m^2 for summer and winter conditions.

The NSAQMD considers emissions of less than 137 lbs/day to have a less than significant impact, and as demonstrated in **Table 3.3-8**, no operational emissions would exceed this threshold.

The NSAQMD considers emissions that are below the Level C thresholds but exceeding the Level A significance thresholds to be potentially significant, subject to mitigation in order to be considered less than significant. As shown, prohibiting the use of wood-burning heating devices as mandated with mitigation measure **MM 3.3.3** would reduce area-source winter emissions to a total of approximately 22 lbs/day of ROG, 7 lbs/day of NO_X, and 0.2 lbs/day of PM_{10}. In total, project-generated winter emissions from both area and mobile sources would be reduced to approximately 34 lbs/day of ROG, 25 lbs/day of NO_X, and 18 lbs/day of PM_{10}. With implementation of mitigation measure **MM 3.3.3**, project-generated emissions would be reduced and the project would be in conformance with NSAQMD guidance regarding impacts that surpass the Level A significance threshold. Furthermore, mitigation measure **MM 3.5.1b** and various project proposals would also reduce air pollutant emissions during project operations. This impact would be considered **less than significant**.

Contribution to Near-Term Local Mobile-Source CO Concentrations (Standard of Significance 4)

Impact 3.3.4 Implementation of the proposed project would not contribute to localized concentrations of mobile-source CO that would exceed applicable standards. This impact would be considered **less than significant.**

The primary mobile-source criteria pollutant of local concern is carbon monoxide (CO). As noted previously, Nevada County is currently designated attainment for both state and national CO ambient air quality standards, and the county typically experiences low background CO concentrations.

Concentrations of CO are a direct function of the number of vehicles, length of delay, and traffic flow conditions. Transport of this criteria pollutant is extremely limited; CO disperses rapidly with distance from the source under normal meteorological conditions. Under certain meteorological conditions, however, CO concentrations close to congested intersections that experience high levels of traffic and elevated background concentrations may reach unhealthy levels, affecting nearby sensitive receptors. Given the high traffic volume potential, areas of high CO concentrations, or "hot spots," are typically associated with intersections that are projected to operate at unacceptable levels of service (LOS E or worse) during the peak commute hours. Modeling is therefore typically conducted for intersections that are projected to operate at unacceptable levels of service during peak commute hours.

Based on the traffic analysis prepared for this project (KD Anderson 2011), the intersection of State Route 49 and Rincon Way would be projected to operate at an unacceptable level of service under future cumulative conditions. The State Route 49/Rincon Way intersection will operate with the westbound approach at an LOS F condition in the PM peak hour with implementation of the project. Modeling was conducted based on PM peak hour traffic volumes for winter operating conditions. To ensure a conservative analysis, predicted 1-hour and 8-hour CO concentrations were calculated assuming background CO concentrations of 3.4 and 2.6 ppm, respectively, based on data obtained from the nearest monitoring station. A persistence factor of 0.7 was used to convert predicted hourly concentrations to 8-hour concentrations. The predicted 1-hour and 8-hour CO concentrations for future cumulative conditions are summarized in **Table 3.3-10**.

TABLE 3.3-10
PREDICTED LOCAL MOBILE SOURCE CARBON MONOXIDE CONCENTRATIONS
FUTURE PLUS PROJECT CONDITIONS (YEAR 2023 – ASSUMED PROJECT BUILDOUT)

Interchange	Predicted CO Concentration (ppm)	
	1-hour	8-hour
State Route 49/Rincon Way	4.1	5.5
California Ambient Air Quality Standards (CAAQS)	20	9
Predicted Concentrations Exceed CAAQS?	No	No

Note: Predicted CO concentrations are the sums of a background component, which includes the cumulative effects of all CO sources in the project area vicinity and the proposed project's contribution.

As noted in **Table 3.3-10**, under future conditions predicted maximum 1-hour CO concentrations at the State Route 49/Rincon Way intersection are estimated at 4.1 parts per million (ppm) and predicted 8-hour CO concentrations would be 5.5 ppm. Predicted 1-hour and 8-hour CO concentrations would not exceed even the most stringent corresponding California Ambient Air Quality Standards (CAAQS) of 20 and 9 ppm, respectively. Since the proposed project would not contribute to predicted localized concentrations of mobile-source CO that would exceed applicable ambient air quality standards, this impact would be considered **less than significant**.

Mitigation Measures

None required.

Exposure of Sensitive Receptors to Odorous Emissions (Standard of Significance 5)

Impact 3.3.5 Implementation of the proposed project would not result in increased exposure of sensitive receptors to odorous emissions. As a result, potential exposure of sensitive receptors to odors would be considered **less than significant**.

The occurrence and severity of odor impacts depends on numerous factors, including the nature, frequency, and intensity of the source, wind speed and direction, and the sensitivity of the receptors. While offensive odors rarely cause any physical harm, they still can be very unpleasant, leading to considerable distress among the public and often generating citizen complaints to local governments and regulatory agencies. Projects with the potential to frequently expose members of the public to objectionable odors would be deemed to have a significant impact. Land uses commonly considered to be potential sources of odorous emissions include wastewater treatment plants, sanitary landfills, food processing facilities, chemical manufacturing plants, rendering plants, paint/coating operations, and agricultural feedlots and dairies.

No major sources of odors were identified in the vicinity of the project site that could potentially affect proposed on-site residential land uses. In addition, implementation of the proposed project would not result in the development or long-term operation of any on-site sources of odors. As a result, exposure of sensitive receptors to odorous emissions would be considered **less than significant**.

Mitigation Measures

None required.

Long-Term Exposure of Sensitive Receptors to Toxic Air Contaminants (Standard of Significance 4)

Impact 3.3.6 Implementation of the proposed project would not result in increased exposure of planned residential land uses to mobile-source TACs. As a result, this impact is considered **less than significant**.

No major existing stationary sources of toxic air contaminants (TACs) were identified within one-quarter mile of the project site (CARB 2009). However, the proposed project would result in the construction of support services including a café, post office, recycling center, bakery, theater, ice cream parlor, pub, pharmacy, market/deli, beauty shop, bank, and dry cleaning, which could generate emissions of TACs. Such sources of TACs would be subject to NSAQMD rules and regulations, including NSAQMD Regulation IV (Authority to Construct), Regulation V (Permit to Operate), and Regulation IX (Toxics Air Contaminants). All stationary sources that have the potential to emit TACs are required to obtain permits from the NSAQMD. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations. As part of the NSAQMD's permitting requirements, sources having the potential to emit TACs would be required to implement measures designed to ensure that potential health risks to nearby receptors would not exceed established standards.

In addition to stationary sources of emissions, mobile sources of emissions may also contribute to localized concentrations of TACs that could adversely affect sensitive population groups. The project site is located east of State Route 49. Diesel-powered trucks traveling along State Route 49 are a source of DPM, which could adversely affect proposed sensitive land uses. Most researchers believe that diesel exhaust particles contribute the majority of the risk (roughly 70 percent by some estimates) because the particles in the exhaust carry many harmful organics and metals. Based on information obtained from CARB, population-weighted statewide average DPM concentrations for year 2010 are estimated to result in approximately 450 excess cancer cases per million people over a 70-year exposure period. It is important to note that this estimated cancer risk is best interpreted as background cancer risk. Cancer risks would be greater in areas located near major transportation corridors and stationary sources.

CARB released the *Air Quality and Land Use Handbook: A Community Health Perspective* in 2005. According to the handbook, sensitive land uses should generally not be located within 500 feet of a freeway with 100,000 vehicles per day. The project site is located approximately 1,300 feet east of State Route 49 at the closest point, well beyond the CARB-recommended buffer. Furthermore, existing traffic volumes along the closest segment of State Route 49 average approximately 56,000 vehicles per day (Caltrans 2010). Existing State Route 49 traffic volumes do not exceed CARB's handbook criteria of 100,000 vehicles per day for freeways.

Given that the proposed project is well beyond the CARB-recommended buffer of 500 feet from a highway which does not generated 100,000 vehicle trips per day, the proposed project would not result in increased exposure of planned residential land uses to mobile-source TACs. This impact would be considered **less than significant**.

Mitigation Measures

None required.

3.3.4 CUMULATIVE SETTING, IMPACTS, AND MITIGATION MEASURES

CUMULATIVE SETTING

The cumulative setting for air quality includes Nevada County in its entirety and the Mountain Counties Air Basin. Nevada County is currently designated nonattainment for ozone and PM_{10} standards. Cumulative growth in population, vehicle use, and industrial activity could inhibit efforts to improve regional air quality and attain the ambient air quality standards.

CUMULATIVE IMPACTS AND MITIGATION MEASURES

Contribution to Cumulative CO and TAC Concentrations (Standard of Significance 4)

Impact 3.3.7 Implementation of the proposed project, in combination with existing, approved, proposed, and reasonably foreseeable development in the Mountain Counties Air Basin, would not contribute to localized concentrations of mobile-source CO or TACs that would exceed applicable ambient air quality standards. This impact would be considered **less than cumulatively considerable.**

Proposed CCRC Development

As noted in the discussion for Impact 3.3.4, the criteria mobile-source air pollutant of primary local concern is carbon monoxide. However, implementation of the proposed project would not be anticipated to contribute to localized concentrations of CO that would exceed applicable ambient air quality standards under future cumulative conditions. In addition, as noted in the discussion for Impact 3.3.6, implementation of the proposed project would not result in the long-term operation of any major stationary sources of toxic air contaminants, and no major stationary sources of TACs have been identified in the vicinity of the proposed project site. As a result, the proposed project's cumulative contribution to localized concentrations of criteria and hazardous air pollutants would be considered **less than cumulatively considerable**.

General Plan and Zoning Ordinance Text Amendments

As discussed in further detail in Section 4.0, Cumulative Impacts Summary, the proposed General Plan and Zoning Ordinance text amendments are policy actions that would not directly contribute to localized concentrations of CO and TAC in the cumulative setting. Although CCRCs would be permitted in either a PD (Planned Development) or SDA (Special Development Area) land use designation with approval of a zone change after implementation of the proposed project, such rezoning applications would be subject to further CEQA analysis of project-specific impacts (proposed Zoning Ordinance amendment Section L.II 2.7.11(C)(4)), including air quality impacts. At a programmatic level, the environmental impacts associated with development of all PD and SDA designated areas in the county were analyzed in the Nevada County General Plan Environmental Impact Report, Volume I, SCH #1995102136 (1995). Future site-specific CEQA analysis would result in project-specific mitigation to address CO and TAC concentrations. Therefore, cumulative regional air quality impacts associated with the proposed General Plan and Zoning Ordinance text amendments are considered **less than cumulatively considerable**.

Mitigation Measures

None required.

Contribution to Cumulative Regional Air Quality Conditions (Standards of Significance 1 & 3)

Impact 3.3.8 Long-term operation of the proposed project, in combination with existing, approved, proposed, and reasonably foreseeable development in the Mountain Counties Air Basin, would contribute to cumulative increases in emissions of ozone-precursor pollutants (ROG and NO_x) and PM_{10} that could contribute to future concentrations of ozone and PM_{10}, for which the region is currently designated nonattainment. This impact would be considered **cumulatively considerable.**

Proposed CCRC Development

The county is designated nonattainment status for ozone and PM_{10}. As a nonattainment area, the NSAQMD is required to prepare a federally enforceable State Implementation Plan (SIP) for western Nevada County in accordance with the Clean Air Act. The SIP is an air quality attainment plan designed to reduce emissions of ozone precursors enough to re-attain the federal ozone standard by the earliest practicable date. The air quality attainment plan (titled *Reasonably Available Control Technology State Implementation Plan Revision for Western Nevada County 8-Hour Ozone Non-Attainment Area)* includes various pollution control strategies. Overall emissions of ozone precursors must be reduced in western Nevada County (consistent with Reasonable Further Progress requirements specified in the Clean Air Act) until attainment is reached. As discussed for Impact 3.3.1, predicted short-term construction-generated emissions of ROG would exceed NSAQMD's Level C significance thresholds, though they would be mitigated to a less than significant level (see mitigation measures **MM 3.3.1a** through **3.3.1d**). In addition, with implementation of mitigation measure **MM 3.3.3**, project-generated operational emissions would be reduced to a less than significant level. Adherence to these mitigation measures would ensure the project, by itself, does not surpass NSAQMD significance thresholds and therefore does not conflict with the goals of the SIP.

According to NSAQMD guidance, impacts of local pollutants are cumulatively significant when modeling shows that combined emissions from the project and other existing and planned projects will exceed air quality standards. As discussed for Impact 3.3.1, predicted short-term construction-generated emissions of ROG would exceed NSAQMD's Level C significance thresholds, though they would be mitigated to a less than significant level and project-generated operational emissions would also be reduced to a less than significant level. However, other projects are planned within the county. For example, the Loma Rica Ranch Specific Plan project has proposed to develop 700 residential units, 54,000 square feet of commercial and retail building space, and 364,161 square feet of business and light industrial building space in Grass Valley. The combined emissions from the Loma Rica Ranch Specific Plan and the proposed project would exceed NSAQMD's Level C significance thresholds.

General Plan and Zoning Ordinance Text Amendments

As discussed in further detail in Section 4.0, Cumulative Impacts Summary, the proposed General Plan and Zoning Ordinance text amendments are policy actions that would not directly contribute to cumulative increases in emissions of ozone-precursor pollutants (ROG and NO_x) and PM_{10} in the cumulative setting. Although CCRCs would be permitted in either a PD (Planned Development) or SDA (Special Development Area) land use designation with approval of a zone change after implementation of the proposed project, such rezoning applications would be subject to further CEQA analysis of project-specific impacts (proposed Zoning Ordinance amendment Section L.II 2.7.11(C)(4)), including air quality impacts. At a programmatic level, the environmental impacts associated with development of all PD and SDA designated areas in the county were analyzed in the Nevada County General Plan Environmental Impact Report, Volume I, SCH #1995102136 (1995). Future site-specific CEQA analysis would result in project-specific mitigation to address impacts.

Mitigation Measures

Implement mitigation measures **MM 3.3.1a** through **MM 3.3.1d** and **MM 3.3.3**.

According to NSAQMD guidance, impacts of local pollutants are cumulatively significant when modeling shows that combined emissions from the project and other existing and planned projects will exceed air quality standards. As discussed above, other projects, in combination with the proposed project, are planned within the county. Just the combined emissions of the Loma Rica Ranch Specific Plan proposal (700 residential units, 54,000 square feet of commercial and retail uses, and 364,161 square feet of business and industrial uses) and the proposed project would exceed NSAQMD's Level C significance thresholds. As a result, increases in project-related emissions, though considered less than significant at the project level, could on a cumulative basis contribute to existing nonattainment conditions. As a result, this impact would be considered **cumulatively considerable** and **significant and unavoidable.**

REFERENCES

Caltrans (California Department of Transportation). 2010. "Traffic Volumes on California Highways." Accessed August 9, 2011. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/.

CARB (California Air Resources Board). 2005. *Air Quality and Land Use Handbook: A Community Health Perspective.*

———. 2009. "Community Health Air Pollution Information System (CHAPIS)." Accessed August 9. http://www.arb.ca.gov/gismo2/chapis_v01_6_1_04/.

———. 2010a. "Ambient Air Quality Standards." Accessed April 22, 2011. http://www.arb.ca.gov/research/aaqs/aaqs2.pdf.

———. 2010b. "Air Quality Data Statistics." Accessed April 22, 2011. http://www.arb.ca.gov/adam/index.html.

———. 2010c. "Area Designation Maps – State and National." Accessed April 22, 2011. http://www.arb.ca.gov/desig/adm/adm.htm.

———. 2010d. "ARB Health-Related Fact Sheets." Accessed April 22, 2011. www.arb.ca.gov/research/health/fs/fs.htm.

DOC (California Department of Conservation). 2000. *A General Location Guide for Ultramafic Rocks in California-Areas More Likely to Contain Naturally Occurring Asbestos.*

KD Anderson & Associates, Inc. 2011. *Traffic Impact Analysis for Rincon del Rio Continuing Care Retirement Community, Nevada County, CA*.

NSAQMD (Northern Sierra Air Quality Management District). 2005. "Ambient Air Quality Monitoring, Annual Report." www.myairdistrict.com/index.php/air-monitoring/2005-report.

———. 2009. *Guidelines for Assessing and Mitigating Air Quality Impacts of Land Use Projects.* Revised August 18, 2009.

EXHIBIT M

Draft

SARGENT RANCH QUARRY

Environmental Impact Report
SCH # 2016072058

Prepared by
County of Santa Clara
With Technical Assistance by: ESA

July 2022

Draft

SARGENT RANCH QUARRY

Environmental Impact Report
SCH # 2016072058

Prepared by
County of Santa Clara
With Technical Assistance by: ESA

July 2022

ESA

3.8 Greenhouse Gas Emissions

3.8.1 Introduction

This section evaluates the greenhouse gas (GHG) emissions impacts of the Project. The following discussion is based, in part, on a GHG emissions calculations prepared by Illingworth & Rodkin, Inc. in February 2017 and revised in August of 2021 (Illingworth & Rodkin, Inc. 2021). Calculation tables and model output from that analysis are included as Appendix D to this EIR.

3.8.1.1 Greenhouse Gas Emissions and Global Climate Change

Climate change is caused by GHGs emitted into the atmosphere around the world from a variety of sources, including the combustion of fuel for energy and transportation, cement manufacturing, and refrigerant emissions. GHGs are those gases that have the ability to trap heat in the atmosphere, a process that is analogous to the way a greenhouse traps heat. GHGs may be emitted as a result of human activities, as well as through natural processes. Increasing GHG concentrations in the atmosphere is leading to global climate change resulting in direct and indirect impacts to loss in snow pack; sea-level rise; more extreme heat days per year; more high ozone days; more extreme forest fires; more severe droughts punctuated by extreme precipitation events; increased erosion of California's coastlines and sea water intrusion into the Sacramento and San Joaquin Deltas and associated levee systems; and increased pest infestation (OPR 2018).

Carbon dioxide (CO_2) is the most important anthropogenic GHG because it comprises the majority of total GHG emissions emitted per year and it is very long-lived in the atmosphere. Other common GHGs include methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine). Typically, when evaluating GHG emissions they are expressed as CO_2 equivalents, or CO_2e, which is a means of weighting the global warming potential (GWP) of the different gases relative to the global warming effect of CO_2, which has a GWP value of one. Other GHGs, such as CH_4 and N_2O, which are commonly found in the atmosphere, but at much lower concentrations, have a GWP of 21 and 310, respectively. In the United States, CO_2 emissions account for about 80 percent of the GHG emissions, followed by CH_4 at about 10 percent and nitrous oxide at about 7 percent (USEPA 2021).

3.8.2 Regulatory Setting

3.8.2.1 Federal

The U.S. participates in the United Nations Framework Convention on Climate Change (UNFCCC). In 2007, the U.S. Environmental Protection Agency (USEPA) identified CO_2 as an air pollutant as defined under the Clean Air Act, and that the USEPA has the authority to regulate emissions of GHGs. The USEPA has promulgated several GHG regulations, which for the most part, apply to larger facilities that emit large amounts of CO_2 or its equivalent in other regulated GHGs. These regulations include the Federal Mandatory Reporting of Greenhouse Gases (Mandatory Reporting Rule) and the Title V Greenhouse Gas Tailoring Rule (Tailoring Rule). The Mandatory Reporting Rule, which requires reporting of CO_2 and other GHG emissions, applies to particular facility types that emit GHGs (primarily large facilities that emit 25,000 metric tons per year or more of CO_2e emissions) and to most upstream suppliers of fossil fuels and industrial GHGs, as well as to manufacturers of vehicles and engines (USEPA 2009). Since the quarry would emit well under 25,000 metric tons CO_2e per year, it would not be subject to this rule.

The USEPA also issued a rule addressing GHG emissions from stationary sources and requirements under Title V and Prevention of Significant Deterioration (PSD) permitting programs. This rule is known as the PSD and Tailoring Rule. The Sargent Quarry would not be a major GHG source under the PSD or Tailoring Rule permit regulations.

Light-Duty Vehicle Greenhouse Gas and Corporate Average Fuel Economy Standards

In addition to setting emission standards for stationary sources, the USEPA sets nationwide emission standards for mobile sources, which include on-road (highway) motor vehicles such as trucks, buses, and automobiles, and non-road (off-road) vehicles and equipment used in construction, agricultural, industrial, and mining activities (such as bulldozers and loaders). The USEPA also sets nationwide fuel standards, such as the Corporate Average Fuel Economy (CAFE) standards (adopted in 2010) that require improved fuel economy and lower GHG emissions.

In 2018, the USEPA and the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) proposed the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One and Part Two. Part One revokes California's authority to set its own fuel economy and greenhouse gas standards and zero-emission vehicle mandate, and Part Two increased the federal greenhouse gas emissions and fuel economy standards (84 Federal Register 51,310 for Part One and 85 Federal Register 24,173 for Part Two).

On April 22, 2021, NHTSA proposed to formally roll back portions of the SAFE Rule, thereby restoring California's right to set more stringent fuel efficiency standards. NHTSA is also planning to issue a new rule to increase the national fuel economy standard for light duty vehicles beyond those in Part Two of the SAFE Vehicles Rule (Federal Register 2021).

3.8.2.2 State

In response to the increasing body of evidence that GHGs will continue to affect the global climate, the State has enacted key legislation and promulgated regulations in an effort to reduce the State's contribution to climate change.

Executive Orders

There are three primary EOs related to the State's GHG reduction efforts. In general, EOs provide direction to State government agencies but do not place mandates on regional or local governments or the private sector.

- **EO S-03-05:** Established GHG-reduction targets for 2010 (2000 emission levels), 2020 (1990 emission levels) and 2050 (80 percent below 1990 levels).

- **EO S-30-15:** Established a GHG reduction target for 2030 (40 percent below 1990 levels).
- **EO B-55-18:** Established a new statewide goal "to achieve carbon neutrality as soon as possible, and no later than 2045, and achieve and maintain net negative emissions thereafter." This EO directs CARB to ensure future Climate Change Scoping Plans (discussed below) identify and recommend measures to achieve the carbon neutrality goal.

Assembly Bill 1493

California Assembly Bill 1493 of 2002 (Pavley) required the California Air Resources Board (CARB) to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light duty trucks. Responsive regulations adopted by CARB apply to 2009 and later model year vehicles. CARB estimates that the regulation will reduce GHG emissions from light duty passenger vehicles in California by an estimated 18 percent in 2020 and by 27 percent in 2030 (CARB 2021b).

Assembly Bill 32 and Senate Bill 32

In 2006, Assembly Bill 32 (AB 32), the *California Global Warming Solutions Act of 2006* was adopted and codified in California Health and Safety Code Division 25.5. Under AB 32, CARB established a statewide GHG emissions cap for 2020, adopted mandatory reporting rules for significant sources of GHGs, and adopted a comprehensive plan, known as the Climate Change Scoping Plan, identifying how emission reductions would be achieved from significant GHG sources.

In 2016, SB 32 amended the California Global Warming Solution Act. SB 32 and accompanying Executive Order B-30-15 require CARB to ensure that statewide GHG emissions are reduced to 40 percent below the 1990 level by 2030. CARB updated its Climate Change Scoping Plan in December of 2017 (CARB 2017) to express the 2030 statewide target in terms of million metric tons of CO_2e (MMTCO_2e). The 2008 Climate Change Scoping Plan shows 1990 emissions at 426.6 MMTCO_2e (CARB 2008). Based on the emissions reductions directed by SB 32, the annual 2030 statewide target emissions level for California is 260 MMTCO_2e. The 2017 Climate Change Scoping Plan identifies measures for how California could achieve the 2030 GHG reduction target established in SB 32,and substantially advance towards the 2050 reduction goal identified in EO S-3-05.

Cap-and-Trade Program

The California Cap-and-Trade Program is a core strategy that the state is using to meet its GHG reduction targets for 2020 and 2030, and ultimately achieve an 80 percent reduction from 1990 levels by 2050. CARB designed and adopted the California Cap-and-Trade Program to reduce GHG emissions from "covered entities" (e.g., electricity generation, petroleum refining, cement production, and large industrial facilities that emit more than 25,000 MTCO2e per year), setting a firm cap on statewide GHG emissions and employing market mechanisms to achieve reductions. Under the Cap-and-Trade Program, an overall limit is established for GHG emissions from capped sectors. The statewide cap for GHG emissions from the capped sectors commenced in 2013. The cap declines over time. Facilities subject to the cap can trade permits to emit GHGs.

Senate Bill 100

On September 10, 2018, Governor Brown signed SB 100, establishing that 100 percent of all electricity in California must be obtained from renewable and zero-carbon energy resources by December 31, 2045. Specifically, the law increases the percentage of energy that both investor-owned utilities and publicly-owned utilities must obtain from renewable sources(i.e., the renewables portfolio standard) from 50 percent to 60 percent by 2030. Incrementally, these energy providers must also have a renewable energy supply of 33 percent by 2020, 44 percent by 2024, and 52 percent by 2027.

Senate Bill 375

Senate Bill 375 (SB 375), known as the *Sustainable Communities Strategy and Climate Protection Act*, was signed into law in September 2008. SB 375 builds upon AB 32 by requiring CARB to develop regional GHG reduction targets for automobile and light truck sectors for 2020 and 2035. The initial per-capita GHG emissions reduction targets for passenger vehicles in the San Francisco Bay Area included a seven percent reduction by 2020 and a 15 percent reduction by 2035. In 2018, CARB set updated targets for a 10 percent reduction by 2020 and a 19 percent reduction by 2035 (CARB 2018).

Senate Bill 1383 (Short-Lived Climate Pollutants)

SB 1383, enacted in 2016, requires statewide reductions in short-lived climate pollutants across various industry sectors. The climate pollutants covered under SB 1383 include methane, fluorinated gases, and black carbon—all GHGs with a much higher warming impact than CO2 and with the potential to have detrimental effects on human health. SB 1383 requires CARB to adopt a strategy to reduce methane by 40 percent, hydrofluorocarbon gases by 40 percent, and anthropogenic black carbon by 50 percent below 2013 levels by 2030. The methane emissions reduction goals include a 75 percent reduction in the level of statewide disposal of organic waste from 2014 levels by 2025.

3.8.2.3 Regional

2017 Clean Air Plan

The BAAQMD prepared the 2017 Clean Air Plan to reduce air pollution, protect public health, and reduce GHG emissions (BAAQMD 2017b). The plan defines a vision for transitioning the region to a post-carbon economy needed to achieve ambitious GHG reduction targets for 2030 and 2050, and provides a regional climate protection strategy that will put the Bay Area on a pathway to achieve those GHG reduction targets.

The 2017 Clean Air Plan includes control measures designed to reduce emissions of CH_4 and other super-GHGs that are potent climate pollutants in the near-term, and to decrease emissions of CO_2 by reducing fossil fuel combustion.

Plan Bay Area

Consistent with the requirements of SB 375, the Metropolitan Transportation Commission (MTC) partnered with the Association of Bay Area Governments (ABAG) to prepare Plan Bay Area 2050, the region's Sustainable Communities Strategy (SCS), as part of the Regional Transportation Plan process. However, the SCS would not be directly applicable to Sargent Quarry, because the reductions would be achieved through the promotion of compact, high-density, mixed-use neighborhoods near transit, and alternatives to single passenger vehicle use.

3.8.2.4 Local

County of Santa Clara General Plan

Section G of the Health Element of the Santa Clara County General Plan (County of Santa Clara 2015) addresses GHG and Climate Change. This element includes several GHG-related policies that pertain to this Project:

> ***Policy HE-G.3:*** Fleet upgrades. Promote Air District mobile source measures to reduce emissions by accelerating the replacement of older, dirtier vehicles and equipment, and by expanding the use of zero emission and plug-in vehicles.
>
> ***Policy HE-G.4:*** Off-road sources. Encourage mobile source emission reduction from off-road equipment such as construction, farming, lawn and garden, and recreational vehicles by retrofitting, retiring and replacing equipment and by using alternate fuel vehicles.
>
> ***Policy HE-G.5:*** GHG reduction. Support efforts to reduce GHG emissions from mobile sources, such as reducing vehicle trips, vehicle use, vehicle miles traveled (VMT), vehicle idling, and traffic congestion. These efforts may include improved transit service, better roadway system efficiency, state-of-the-art signal timing and Intelligent Transportation Systems (ITS), transportation demand management, parking and roadway pricing strategies, and growth management measures.
>
> ***Policy HE-G.10:*** Conservation. Promote energy conservation and efficiency in homes, businesses, schools, and other infrastructure to reduce energy use and criteria pollutant and greenhouse gas emissions.
>
> ***Policy HE-G.11:*** Renewable energy. Encourage renewable energy, such as solar and wind turbines, on commercial, industrial, and residential buildings.
>
> ***Policy HE-G.12:*** Energy technologies. Support regional and local initiatives that promote integrated building systems, distributed generation, demand response programs, smart grid infrastructure, energy storage and backup, and electric transportation infrastructure.

3.8.3 Environmental Setting

3.8.3.1 U.S. Emissions

In 2018, the U.S. emitted about 6,677 $MMTCO_2e$, with 75.4 percent of those emissions coming from fossil fuel combustion. Of the major sectors nationwide, transportation accounts for the highest amount of GHG emissions (approximately 28 percent), followed by electricity (27 percent), industry (22 percent), commercial and residential buildings (12 percent), and agriculture

(10 percent). Between 1990 and 2018, total U.S. GHG emissions rose by 6 percent, but emissions have generally decreased since peaking in 2005. Since 1990, U.S. emissions have increased at an average annual rate of 0.2 percent (USEPA 2020).

3.8.3.2 California Greenhouse Gas Emissions Inventory

CARB compiles GHG inventories for the state. Based on the 2019 GHG inventory data (i.e., the latest year for which data are available from CARB), California emitted 418.2 MMTCO_2e, including emissions resulting from imported electrical power (CARB 2021a).

California has experienced both population and economic growth in the last 20 years, but GHG emissions have actually declined. Between 1990 and 2020, the population of California grew by approximately 10 million (from 29.8 to 39.8 million) (CDF 2020a). This represents an increase of approximately 34 percent from 1990 population levels. In addition, the California economy, measured as gross state product, grew from $773 billion in 1990 to $3.14 trillion in 2019, representing an increase of approximately 306 percent (more than three times the 1990 gross state product) in today's dollars (CDF 2020b). Despite this growth, CARB's 2019 statewide inventory indicated that California's net GHG emissions in 2019 were below 1990 levels (i.e., 431 MMTCO_2e), which is the 2020 GHG reduction target codified pursuant to AB 32.

Table 3.8-1 identifies and quantifies statewide anthropogenic GHG emissions and non-anthropogenic sinks (e.g., carbon sequestration due to forest growth) in 1990 and 2019. As shown in the table, the transportation sector is the largest contributor to statewide GHG emissions at approximately 40 percent in 2019.

TABLE 3.8-1
STATE OF CALIFORNIA GREENHOUSE GAS EMISSIONS

Category	Total 1990 Emissions Using IPCC SAR (MMTCO_2e)	Percent of Total 1990 Emissions	Total 2019 Emissions Using IPCC AR4 (MMTCO_2e)	Percent of Total 2019 Emissions
Transportation	150.7	35%	166.1	40%
Electric Power	110.6	26%	58.8	14%
Commercial and Residential	44.1	10%	43.8	10%
Industrial	103.0	24%	88.2	21%
Recycling and Waste[a]	—	—	8.9	2%
High GWP/Non-Specified[b]	1.3	<1%	20.6	5%
Agriculture/Forestry	23.6	6%	31.8	8%
Forestry Sinks	-6.7	-2%	—[c]	—
Net Total (IPCC SAR)	**426.6**	**100%[e]**	**—**	**—**
Net Total (IPCC AR4)[d]	**431**	**100%[e]**	**418.2**	**100%**

NOTES:

AR4 = Fourth Assessment Report; GWP = global warming potential; IPCC = Intergovernmental Panel on Climate Change; MMTCO2e = million metric tons of carbon dioxide equivalents; SAR = Second Assessment Report

a. Included in other categories for the 1990 emissions inventory.
b. High GWP gases are not specifically called out in the 1990 emissions inventory.
c. Revised methods under development (not reported for 2019).
d. CARB revised the state's 1990-level greenhouse gas (GHG) emissions using GWPs from the IPCC AR4.
e. Total of individual percentages may not add up to 100% due to rounding.

SOURCES: CARB 2021a; CARB 2020.

3.8.3.3 Bay Area GHG Emissions

The BAAQMD 2017 Clean Air Plan presents GHG inventory data for the Bay Area compiled by BAAQMD. **Table 3.8-2** shows the Bay Area GHG inventory by source category, organized according to the economic sectors used in the AB 32 Scoping Plan Update. The four largest sectors—transportation, stationary sources, energy, and buildings— collectively account for 91 percent of the total inventory (BAAQMD 2017b).

TABLE 3.8-2
2015 BAY AREA GHG EMISSIONS (CO_2E PER YEAR)

Source Category	Total Emissions by Source (CO_2e)
Transportation	**35,420,000**
On-road	30,750,000
Off-road	4,670,000
Electricity/Co-Generation	**12,240,000**
Co-generation	5,880,000
Electricity generation	5,080,000
Electricity imports	1,280,000
Buildings	**9,270,000**
Residential fuel usage	5,450,000
Commercial fuel usage	3,820,000
Stationary Sources	**22,360,000**
Oil refineries	15,680,000
Natural gas combustion	4,980,000
Natural gas distribution*	460,000
Cement manufacturing	990,000
Fugitive and process emissions*	250,000
Waste Management	**2,300,000**
Landfills*	1,850,000
Composting/POTWs*	450,000
Fluorinated Gases	**3,560,000**
HFCs and PFCs (commercial, industrial, and transportation)*	3,470,000
SF_6 (electricity production and semiconductor manufacturing)*	90,000
Agriculture	**1,390,000**
Animal waste*	760,000
Soil management	280,000
Agricultural equipment	230,000
Biomass burning	120,000
TOTAL EMISSIONS (CO_2e)	**86,540,000**

NOTES:
* Significant source of super-GHGs.
POTWs = treatment of water and wastewater at publicly owned treatment works.
HFCs = hydrofluorocarbons.
PFCs = perfluorocarbons.
SOURCE: BAAQMD 2017b.

3.8.3.4 Project Site GHG Emissions

The majority of Sargent Ranch is undeveloped, and there are limited GHG-emitting activities at the Project site associated with cattle ranching (e.g., CH_4). As shown in Table 3.8-2, agricultural activities in the Bay Area region represent only 1.6 percent of total GHG emissions, and the cattle operation at the Project site would produce only a small portion of the overall agricultural emissions. For the purposes of a conservative analysis, it is assumed that the existing cattle ranching activities at the site would be moved to another area at Sargent Ranch, and therefore the associated emissions are not considered to be baseline emissions for the Project.

3.8.4 Impact Evaluation

3.8.4.1 Approach to the Analysis

The GHG assessment evaluates proposed mining and processing operations based on the quantity of processed aggregate proposed be exported from the quarry, processing equipment and processing rates, off-road mobile equipment for use in mining and processing, the number and types of quarry vehicles, and the operation schedule.

GHG emissions associated with the Project were calculated consistent with the methods identified for calculation of the air pollutants described in Section 3.3, Air Quality, using the CalEEMod, EMFAC2021, and OFFROAD Orion models. The following sources of GHG emissions were identified as part of the Project:

- On-site operation of mobile quarry mining equipment (bulldozers, excavators, loaders, scrapers);
- On-site vehicle travel (haul trucks);
- On-site operation of processing equipment (screens, washers, and conveyors);
- On-site emergency generator;
- Off-site vehicle travel (rail and haul truck transport and worker traffic); and
- Electricity usage, including on-site rock processing equipment.

For the Project, it is conservatively assumed that the proposed maximum throughput of 1,860,000 tons of sand and aggregate materials per year could be reached by 2024.[1] Therefore, to determine the significance of the increase in GHG emissions, the projected GHG emissions for 2024 are compared to the significance threshold.

Construction and operational activities were calculated separately. For the construction period, exhaust emissions were calculated from construction-related equipment and vehicles. The Project's total short-term construction emissions were amortized over the 30-year mining term to annualize the emissions. The emergency generator would be located on site to provide back-up power in the event of an electrical outage. No other stationary sources of combustion emissions are proposed.

1 Emissions modeling was conducted assuming construction in 2022 and operations starting in 2023. This results in a conservative estimate of emissions, because emission rates decrease with future years due to improvements in engine and fuel technology plus retirement of older, dirtier engines from the fleet.

Vehicle Travel and Equipment Exhaust Emissions

GHG emissions from vehicle travel, both on- and off-site, along with equipment operation were computed using the same modeling techniques as conducted to estimate the criteria air pollutants. This methodology is described in detail under Impact 3.3-1 in Section 3.3, *Air Quality*.

Indirect Emissions from Electricity Usage

The processing plant and conveyoer belts would use electric power to operate, so they would not directly emit GHG. The quarry processing facility would include numerous fixed equipment that would be powered by electricity such as washing, separation, and classification equipment, and screens, conveyors, and stacking conveyors. Electricity also would be used to power water pumps and to support the office. Operation of the quarry would require 1,250 megawatt-hours per year (Illingworth and Rodkin, Inc. 2021).

Indirect emissions of CO_2e would occur at the power plant(s) that would generate the electricity that would be consumed by the Project. Silicon Valley Clean Energy (SVCE) is the official electricity provider for Santa Clara County. SVCE purchases carbon-free electricity and partners with PG&E to deliver this electricity over existing power lines that they maintain. SVCE provides nearly 100-percent carbon-free energy (CAPCOA 2021), so CO2e emissions associated with electricity for the project operations would be negligible.

Significance Thresholds

On April 20, 2022, the BAAQMD adopted new CEQA Thresholds for Evaluating the Significance of Climate Impacts from Land Use Projects and Plans (BAAQMD 2022a). The revised CEQA thresholds are designed for "land use development" projects based on what will be required of such projects to achieve California's long-term climate goal of carbon neutrality by 2045. The BAAQMD found that GHG emissions associated with new land use development projects would be considered to result in less-than-significant impacts if they incorporate design elements such as restricting natural gas usage and the wasteful, inefficient, or unnecessary energy usage at buildings; achieving VMT reductions for residential, office, and retail projects: and compliance with state off-street electric vehicle requirements (BAAQMD 2022b). These significance thresholds are not directly applicable to industrial quarry projects, such as the Project, and are therefore not used in this analysis.

The BAAQMD CEQA Air Quality Guidelines (BAAQMD 2017a) identifies GHG significance thresholds for operation of stationary source projects and for operation of land use development projects that do not include stationary sources. The Project processing plant and generator would be subject to BAAQMD permitting requirements for stationary sources. The threshold for stationary sources is 10,000 metric tons CO_2e per year, but this threshold is not applicable because the Project would include both stationary and mobile sources of GHG emissions. Following are the three thresholds of significance options for GHG emissions of land use development projects: 1) compliance with a qualified GHG reduction strategy; 2) 1,100 metric tons CO_2e per year; or 3) 4.6 metric tons CO_2e per service population (residents + employees) per year.

The first threshold is not applicable because the County has not adopted a qualified GHG reduction strategy. Similar to the BAAQMD's new significance thresholds, the second and third thresholds of significance, which were primarily developed by the BAAQMD for residential, office, or mixed-use projects in urban infill locations, are not directly applicable to the Project because it would be an industrial use located in a rural unincorporated area. In addition, these significance thresholds were designed for the BAAQMD to meet the AB 32 goal of reducing GHG emissions to 1990 levels by 2020, and BAAQMD has not updated its significance thresholds to be consistent with the more recently adopted SB 32 target of reducing statewide GHG emissions to 40 percent below 1990 levels by 2030.

In the absence of an updated mass emissions threshold for industrial uses in rural areas that is applicable to the Project and consistent with the targets established by SB 32, this EIR in Impact 3.8-1 considers any net increase in Project-related GHG emissions to be significant.

3.8.4.2 Significance Criteria

The Project would result in a significant impact related to GHG emissions if it would:

a) Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment; or

b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs.

3.8.4.3 Project Impacts

Impact 3.8-1: The Project would generate greenhouse gas emissions directly and indirectly, contributing to global climate change. (Less than Significant with Mitigation)

This impact addresses Significance Criterion (a).

All Components

Table 3.8-3 reports the estimated amortized construction GHG emissions and operations emissions for the Project assuming the first year of maximum quarry throughput operations. The Project would cause an increase in GHG emissions of 7,408 metric tons CO_2e annually. These emissions include construction emissions amortized over the proposed 30-year mining period. Emissions would decrease in subsequent years due to a reduction in tailpipe emissions from on-road mobile sources in the future, and because not every year would be a maximum throughput year. The majority, or 65 percent, of the emissions would be associated with off-site truck travel, followed by 30 percent that would be associated with on-site off-road equipment. The GHG estimates are based on the emission calculations provided in Appendix D. The resulting emissions are greater than the significance threshold value of zero, so the impact would be **significant**.

TABLE 3.8-3
PROJECT ANNUAL GHG EMISSIONS

Emission Source	2024 CO2e (tons/year)
Amortized construction emissions	8
Off-road equipment exhaust (dozers, loader, graders, and scrapers)	2,266
On-site quarry vehicle exhaust (service trucks, pickup trucks, and water trucks)	116
Rail emissions	288
Off-site vehicle emissions (haul truck and employee vehicles)	4,730
Electricity consumption[1]	~1
Total[2]	7,408
Threshold	**No net increase**
Above Threshold	**Yes**

NOTES:
1. Based on assumption that the Project would use electricity that is nearly carbon-free supplied by SVCE.
2. Numbers may not add exactly due to rounding.

SOURCE: Illingworth and Rodkin, Inc. 2021.

Mitigation Measure 3.8-1a: Prior to the commencement of the construction activities, the Applicant shall purchase offset credits in the amount of 7,408 metric tons CO_2e. This amount represents amortized construction emissions plus estimated first year operational emissions. The Applicant shall provide verification to the County that carbon offset credits have been purchased.

The Applicant shall prioritize offsets within Santa Clara County, BAAQMD boundaries, the rest of California, and from other states with offset laws at least as strict as California's, in order of preference. The carbon offset credits shall be real, permanent, quantifiable, verifiable, additional, and enforceable, as defined by 17 CCR 95802. Offset protocols must also be consistent with CARB requirements under 17 CR 95972. Carbon offsets must meet these requirements and be purchased from offset programs verified by a recognized third-party registry such as the American Carbon Registry, Verra, or Climate Action Reserve. For each subsequent year of Project operations, the Applicant shall choose one of the following options.

- ***Option 1***: The Applicant shall continue to make the offset payment each subsequent year in the complete amount of 7,408 metric tons CO_2e.
- ***Option 2***: The Applicant shall purchase offset credits in the amount of 7,408 metric tons CO_2e minus the difference between 7,408 metric tons and the actual CO_2e emissions that the project generated in the prior year. Based on actual Project construction and/or subsequent year operational activities that resulted in GHG emissions, the Applicant shall calculate annual GHG emissions, including consideration of any measures that have been taken to reduce project GHG emissions, and provide emissions estimates to the County for review and approval. Within 60 days of County approval of the estimated emissions, the Applicant shall provide verification to the County that carbon offset credits have been purchased for the amount identified by the County-approved emissions estimates.

Mitigation Measure 3.8-1b: For construction and operational off-road equipment, the Applicant shall replace diesel and gasoline-powered vehicles with electric or other low or zero-GHG emissions equipment as feasible, based on availability of the technology and whether the cost would be prohibitive. In addition, biodiesel or renewable diesel shall replace traditional petroleum-based diesel to fuel off-road equipment where feasible, based on availability of the technology and whether the cost would be prohibitive. Any resulting changes to the Project fleet or fuel type shall be reflected in the calculations of GHG emissions for Option #2 of Mitigation Measure 3.8-1a. Prior to the commencement of construction activities, and every five years afterward, the Applicant shall provide the County with a report for County review and approval describing the feasibility of using low carbon-emitting equipment and fuels for the Project.

Mitigation Measure 3.8-1c: If and when electric haul trucks are used for product hauling associated with the Project, the Applicant shall install conduit and EV charging stations at locations where trucks will be parked or idling. The Applicant shall notify the County when installation of conduit and EV charging stations is completed, following which the County shall verify installation. Any resulting changes to the Project fleet shall be reflected in the calculations of GHG emissions for Options #2 in Mitigation Measure 3.8-1a. This mitigation measure will also reduce future NOx emissions from trips to the site.

Significance after Mitigation: Less than significant.

Implementation of Mitigation Measures 3.8-1a through 3.8-1c would reduce the significant impact to a less-than-significant level. Specifically, pursuant to Mitigation Measure 3.8-1a, the Applicant would be required to purchase carbon credits to offset GHG emissions associated with the Project to achieve the net zero significance threshold, taking into account the implementation of Mitigation Measures 3.8-1b and 3.8-1c.

Impact 3.8-2: The Project could conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs. (Less than Significant with Mitigation)

This impact addresses Significance Criterion (b).

All Components

The Project would emit GHGs in the amount shown in Table 3.8-3. Because it would increase GHG emissions, the Project would impede the state's efforts to achieve the GHG reductions needed to comply with the SB 32, the CARB 2017 GHG Scoping Plan, and Executive Order B-55-18. As such, the impact would be **significant**.

Mitigation: Implement Mitigation Measures 3.8-1a through 3.8-1d.

Significance after Mitigation: Less than significant.

Mitigation Measures 3.8-1a through 3.8-1d would reduce the GHG emissions associated with the Project to zero. This would not conflict with the SB 32 reduction goal for 2030, CARB 2017 GHG Scoping Plan, or Executive Order B-55-18. Therefore, as mitigated, the Project would not conflict with plans, policies, or regulations to reduce GHG emissions.

3.8.4.4 Cumulative Analysis

Although the geographical extent of GHG emissions and climate change is global, as climate change is caused by GHGs emitted into the atmosphere around the world from a variety of sources, the analysis in this EIR focuses on GHG emissions within California to evaluate the significance of the Project's contribution. In the CEQA context, because an individual project could not alter the climate, a project's GHG emissions are inherently cumulative because they contribute to significant statewide cumulative GHG emissions. Because they exceed significance thresholds, Impacts 3.8-1 and 3.8-2 are also cumulatively considerable, but would be reduced to less-than—cumulatively considerable and less-than-significant levels by Mitigation Measures 3.8-1a through 3.8-1d.

3.8.5 References

Bay Area Air Quality Management District (BAAQMD). 2017a. CEQA Air Quality Guidelines. Available at https://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en, accessed August 2021.

BAAQMD. 2017b. Spare the Air – Cool the Climate: A Blueprint for Clean Air and Climate Protection in the Bay Area. Available at https://www.baaqmd.gov/plans-and-climate/air-quality-plans/current-plans. Accessed August 2021.

BAAQMD. 2022a. CEQA Thresholds and Guidelines Update webpage. Available at https://www.baaqmd.gov/plans-and-climate/california-environmental-quality-act-ceqa/updated-ceqa-guidelines. Accessed June 24, 2022.

BAAQMD. 2022b. Justification Report: CEQA Thresholds for Evaluating the Significance of Climate Impacts from Land Use Projects and Plans. Available at https://www.baaqmd.gov/plans-and-climate/california-environmental-quality-act-ceqa/updated-ceqa-guidelines. Accessed June 24, 2022.

California Air Pollution Control Officers Association (CAPCOA). 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Public Draft, August. Available online at: Handbook Public Draft_2021-Aug.pdf (airquality.org). Accessed September 2021.

California Air Resources Board (CARB). 2008. Climate Change Scoping Plan: A Framework for Change, 2008, Appendix F. Available at https://ww3.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf. Accessed October 20, 2021.

CARB. 2017. *California's 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target*, 2017. Available at https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf. Accessed October 20, 2021.

CARB. 2018. SB 375 Regional Greenhouse Gas Emissions Reduction Targets. Available at https://ww2.arb.ca.gov/sites/default/files/2020-06/SB375_Final_Targets_2018.pdf. Accessed October 21, 2021.

CARB. 2020. California Greenhouse Gas Emissions Inventory: Data used to generate figures in the California Greenhouse Gas Emissions for 2000 to 2018- Trends of Emissions and Other Indicators report. Available online at https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2018/2000_2018_ghg_inventory_trends_figures.xlsx. Accessed January 29, 2021.

CARB. 2021a. California Greenhouse Gas Emissions for 2000-2019, Trends of Emissions and Other Indicators, Figure 3. Available at https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ghg_inventory_trends_00-19.pdf. Accessed August 2021.

CARB. 2021b. California's GHG Vehicle Emission Standards under Assembly Bill 1493 of 2002 (Pavley). Available online at: https://ww2.arb.ca.gov/californias-greenhouse-gas-vehicle-emission-standards-under-assembly-bill-1493-2002-pavley. Accessed August 2021.

California Department of Finance (CDF). 2020a. E-4 Historical Population Estimates for Cities, Counties, and the State and E-5 Population and Housing Estimates for Cities, Counties, and the State, 2020. Available at http://www.dof.ca.gov/Forecasting/Demographics/Estimates/. Accessed August 2021.

CDF. 2020b. Gross State Product, 2020. Available at http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/. Accessed August 2021. Amounts are based on current dollars as of the date of the report (April 2020).

California Governor's Office of Planning and Research, Scripps Institution of Oceanography, CEC, California Public Utilities Commission (OPR). 2018. California's Fourth Climate Change Assessment: Statewide Summary Report, Publication no. SUMCCCA4-2018-013, August 2018. Available at https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf. Accessed October 22, 2021.

County of Santa Clara. 2015. Santa Clara County General Plan Health Element. August 25, 2015.

Federal Register. 2021. National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT), Notice of Proposed Rulemaking. May 12. Available at https://www.federalregister.gov/documents/2021/05/12/2021-08758/corporate-average-fuel-economy-cafe-preemption. Accessed October 27, 2021.

Illingworth & Rodkin, Inc. 2021. Sargent Quarry Air Quality and Greenhouse Gas Assessment Santa Clara County, CA. Updated August 2021.

Metropolitan Transportation Commission and Association of Bay Area Governments. 2021. Final Plan Bay Area 2050. Available at https://www.planbayarea.org/finalplan2050. Accessed October 21, 2021.

U.S. Environmental Protection Agency (USEPA). 2009. Federal Register, 40 CFR Parts 86, 87, 89 et al., Mandatory Reporting of Greenhouse Gases; Final Rule, page 56264, October 30, 2009.

USEPA. 2021. Data Highlights Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018, April 13, 2020. Available at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-fast-facts-and-data-highlights. Accessed August 2021.