Revised Greenhouse Gas Analysis for Teichert Boca Quarry Project

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Contents

Abbreviations

CalCIMA	California Construction and Industrial Materials Association
CARB	California Air Resources Board
CH_4	Methane
CO_2	Carbon dioxide
EIA	Energy Information Administration
EPA	United States Environmental Protection Agency
gal	U.S. gallon
GHG	greenhouse gases
ha	hectare; metric unit of area equivalent to a square 100 meters on a side (10,000 m2). 1 ha = 2.471 acres
HFC	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
MT	metric ton (or tonne), which equals one Mg (megagram) or 1,000,000 grams (1,000 kilograms)
MW	megawatt (of electricity)
N_2O	Nitrous oxide
NPP	net primary productivity, which is the net above- and below-ground accumulation of biomass by plants (assimilation of gases and minerals minus respiration)
PFC	Perfluorocarbons
ppm	parts per million
SF_6	sulfurhexafluoride
UDA	Ultimate Disturbance Area (area of previously permitted East Pit plus current application for expansion to include West Pit)
yr	year (scientific sources usually abbreviate as "a" from the Latin word annum)

SECTION 1 | Introduction

1.1 CLIMATE CHANGE

The average surface temperature of the Earth has risen by about 1° F over the last 100 years, with most of the change occurring in the last 20 years. Evidence suggests that most of the last 50 years of warming is due to human activities, such as energy production and use of internal combustion vehicles. These activities have increased the amount of greenhouse gases in the atmosphere, which may be causing average temperatures to rise. Warmer temperatures may lead to changes in rainfall patterns, shrinking polar ice caps, a rise in sea level, and other impacts on the environment.

1.2 GREENHOUSE GASES

Greenhouse gases (GHGs) are atmospheric gases that act as global insulators by preventing solar radiation (specifically long-wavelength visible light and infrared radiation) that enters the Earth's atmosphere from being re-radiated into space. Some greenhouse gases, such as water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) occur naturally and are emitted into the atmosphere by natural processes. Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations, as noted above. Over the past 250 years, concentrations of CO_2, CH_4, and N_2O increased globally by 35 percent, 143 percent, and 18 percent, respectively. Other GHGs, such as fluorinated gases, are created and emitted solely by human activities (EPA, 2006).

The principal GHGs in the atmosphere attributable to human activities are CO_2, CH_4, N_2O, and fluorinated gases; these gases are discussed below.

Carbon Dioxide (CO_2)

Production and absorption of CO_2 is a natural process in the terrestrial biosphere and the ocean. However, humankind has altered the natural carbon cycle by burning coal, oil, natural gas, and wood. Since the industrial revolution began in the mid 1700s, each of these activities has increased in scale and distribution. CO_2 was the first GHG demonstrated to be increasing in atmospheric concentration, a finding that was made in the last half of the 20th century. Prior to the industrial revolution, concentrations of CO_2 were fairly stable at 280 parts per million (ppm). Today, CO_2 concentrations in the atmosphere are approximately 370 ppm, an increase of well over 30 percent (EPA, 2006). Based on current trends, the U.S. Environmental

Protection Agency (EPA) projects that the concentration of CO_2 in the atmosphere will increase to at least 540 ppm by 2100. This could result in an average global temperature rise of at 2° C or more (IPCC, 2001).

CO_2 emissions are mainly associated with combustion of carbon-bearing plant and fossil fuels such as wood, gasoline, diesel, and natural gas used in mobile sources and energy-generation-related activities. The EPA estimates that CO_2 emissions accounted for 84.6 percent of GHG emissions in the U.S. in 2004 (EPA, 2006). Similarly, the California Energy Commission (CEC) estimates that CO_2 emissions account for 84 percent of California's anthropogenic (man-made) GHG emissions.

Total CO_2 emissions in the U.S. increased by 20 percent from 1990 to 2004 (EPA, 2006).

Nitrous Oxide (N_2O)

Concentrations of N_2O also began to rise with the industrial revolution. N_2O is produced by microbial processes in soil and water, including biogeochemical reactions which result from application of fertilizer containing nitrogen. The use of nitrogen-containing fertilizers has increased exponentially over the last century. In addition to agricultural sources of anthropogenic N_2O, certain industrial processes also contribute to its atmospheric load (e.g., fossil fuel fired power plants, nylon production, nitric acid production, and vehicle emissions). The EPA estimates that N_2O emissions accounted for 5.5 percent of total GHG emissions in the U.S. in 2004 (EPA, 2006); the CEC estimates N_2O emissions from various sources represent 6.6 percent of California's total GHG emissions (CEC, 2005).

Total N_2O emissions in the U.S. decreased by 2 percent from 1990 to 2004 (EPA, 2006).

Fluorinated Gases

Fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), are powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are typically emitted in smaller quantities than CO_2, CH_4, and N_2O, but each molecule can have a much greater global warming effect than the latter three gasses. Therefore, fluorinated gases are sometimes referred to as High Global Warming Potential gasses (EPA, 2006). The EPA estimates that fluorinated gas emissions accounted for 2 percent of total GHG emissions in the U.S. in 2004 (EPA, 2006). The CEC estimates that these gases represent 3.4 percent of California's total GHG emissions (CEC, 2005).

Total fluorinated gas emissions in the U.S. increased by 58 percent from 1990 to 2004 (EPA, 2006).

1.3 REGULATORY FRAMEWORK

Executive Order S-3-05. In June 2005, Governor Schwarzenegger issued Executive Order S-3-05 calling for statewide reductions in GHG emissions and creating the Climate Action Team.

Assembly Bill 32 (Chapter 488, Statutes 2006) Global Warming Solutions Act of 2006. AB 32 directs the California Air Resources Board (CARB) to adopt regulations requiring the reporting and verification of statewide GHG emissions (defined as CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6). AB 32 also requires that CARB estimate 1990 GHG emissions levels prior to January 1, 2008, and adopt a statewide GHG emissions limit equivalent to the statewide GHG emissions in 1990 to be achieved by year 2020. The law focuses on the "maximum technologically feasible and cost-effective GHG emissions reductions" necessary to reduce emissions to 1990 levels by 2020. AB 32 allows CARB to establish "market-based compliance mechanisms" that cap GHG emissions and allow emitters to purchase, bank, or trade GHG "allowances" from third parties who have either reduced their GHG emissions or are no longer emitting.

Senate Bill 97 (Chapter 185, Statutes 2007) CEQA: Greenhouse Gas Emissions. SB 97 was signed into law in August 2007 and requires that the Governor's Office of Planning and Research prepared and transmit to the Resources Agency CEQA guidelines for the mitigation of GHG emissions. The Resources Agency was required to adopt the guidelines by January 1, 2010.

CEQA Guidelines. The Natural Resources Agency adopted the CEQA Guidelines Amendments for the quantification and mitigation of GHG emissions on December 30, 2009. The Amendments, however, are still not effective and will not be until 30 days after the Office of Administrative Law transmits them to the Secretary of State. The guidelines require that local agencies determine the significance of GHG emissions based on scientific and factual data. The lead agency has discretion to determine whether to use a model or a quantitative analysis. The guidelines do not provide a threshold of significance, but allow lead agencies to consider previously adopted thresholds adopted or recommended by other agencies, so long as the threshold is supported by substantial evidence. The guidelines encourage the use of programmatic documents and explain how the programmatic documents can be used to analyze cumulative impacts (Proposed Guidelines Section 15064 et seq.).

California Attorney General Guidance. The California Attorney General has filed comment letters under CEQA about a number of proposed projects, as well as legal actions or briefs. For example, the Attorney General filed a complaint against San Bernardino County based on the county's failure to analyze increased GHG emissions that would result from the county's proposed general plan amendment. That case resulted in a settlement agreement in which the county agreed to adopt a Greenhouse Gas Emissions Reduction Plan. In addition, the Office of the Attorney General has prepared a list of various mitigation measures that local agencies may consider under CEQA to offset or reduce global warming impacts (California Attorney General, 2010; list available at http://ag.ca.gov/globalwarming/pdf/GW_mitigation_measures.pdf).

Current Status. No GHG target or threshold of significance has been established by either the State of CARB or by the proposed CEQA Guidelines. Neither has such a target or threshold been established by the Northern Sierra Air Quality Management District. The decision as to whether to include a quantitative or qualitative analysis in the CEQA document is up to the lead agency. However, in accordance with current OPR guidelines, this analysis provides a quantification of the Boca Quarry Project's GHG emissions and reductions and provides sufficient information if Nevada County elects to include quantitative analysis in its CEQA compliance documentation.

SECTION 2 | Boca Project GHG Emissions and Savings

2.1 BOCA PROJECT OVERVIEW AND GHG BALANCE

The Boca Project will involve various activities with potential to increase GHG emissions, as well as the potential to provide an overall net GHG benefit. This overview presents the main components of the Project's GHG balance during the initial phase of the proposed expansion, during operations, and during reclamation. In terms of GHG effects, the Project is relatively simple and is unlike the various types of urban and/or development projects to which certain standard computer models are applicable. Accordingly, the present analysis simply addresses each of the significant GHG budget contributions in turn and summarizes the subtotals and overall Project consequences in Table 1.

Site clearing is an initial phase in most mining operations, with additional clearing usually occurring later as mining proceeds. Unless the cleared vegetation is incorporated into soil stockpiles and transformed into soil organic matter, release of some GHGs may result from burning or open decomposition. When arid sites are cleared, below-ground organic material usually remains as fixed carbon in soil stockpiles or soil backfill.

During mining operations, the capacity of the pre-existing vegetation to assimilate GHGs, especially CO_2, is lost. As with all aggregate mining projects, diesel-powered heavy equipment will be used for mining, and electricity is used for processing and other plant operations. These uses will result in GHG emissions, albeit an extremely small proportion of the state and worldwide production of GHGs. Trucking of aggregates from the mining site to project sites where the aggregate is to be used is also a source of GHG emissions.

In the Project region, other permitted regional sources of aggregate will be exhausted within a few years' time. After that time, all aggregate used for road and highway paving projects (including, but not limited to, the regular repaving of I-80 that is necessitated by weather conditions and resulting chain requirements), residential and commercial construction, and public sector construction work (including dam maintenance and upgrades which are currently being planned) will have to be provided either by a newly permitted or expanded source such as the Boca Quarry, or from quarries in the greater Reno region or farther away. Approval of the proposed Project will shorten the haulage distance by about 40 miles from the next closest source of aggregate (a distance which will likely increase over the lifetime of the Project). Thus, the production of an estimated 17 million tons of aggregate at the Boca Quarry will potentially save at least 27 million miles of driving by loaded 25-ton trucks, thereby resulting in a net GHG benefit over the Project life.

GHG SOURCE/SINK	WITH PROJECT		WITHOUT PROJECT	
	GHG Released	GHG Absorbed	GHG Released	GHG Absorbed
1. Pre-mining vegetation clearing (overlaps with operations)				
Estimated GHG release from clearing of vegetation	1,365	1,365	n.a.	n.a.
Net long-term GHG balance from this source is zero, assuming reclamation after mining.				
2. Mining operations				
Diesel equipment	721	0	721	0
Electricity	1,317	0	1,317	0
GHG not absorbed by vegetation	0	77	0	0
3. Shipping (round trip fuel consumption)				
Shipping from Reno area to I-80 Hirschdale interchange	0	0	2,576	0
Subsequent shipping to construction site (40 miles RT)	1,289	0	1,289	0
4. Total				
GHG balance from mining and shipping to Hirschdale interchange	2,115		4,614	
Reduction in GHG emissions with Project, for product to arrive at I-80 interchange	54.2 percent reduction		n.a.	
GHG balance, product shipped to site of use	3,404		5,903	
Reduction in GHG emissions from mining through delivery	42.3 percent reduction		n.a.	

Assumptions and notes:

1. Assumes that both the Project and any other aggregate source would be reclaimed to pre-existing vegetation. Vegetation-related GHG release/non-absorption at other mining sites is unknown.
2. Assumes that the amount of electricity and diesel fuel needed to mine an equivalent amount of aggregate is roughly the same for any mine site.
3. Total haul distance from aggregate mine (whether Boca Quarry or another site) to construction projects is unknown, but the minimum ***increase*** in haul distance for aggregate not produced at Boca is known: about 36 miles each way (estimated 40 mile average distance to quarries in greater Reno area, minus 4 mile distance from Boca Quarry to I-80).
4. Actual GHG reduction from the Project will likely be substantially higher than shown in this table; see text for details.

Table 1 Teichert Boca Quarry Project estimated GHG balance. All figures are metric tons per year (MT/yr), rounded to nearest integer; estimated shipping emissions are based on total mining divided by 30 year Project lifetime.

After mining is complete (and concurrently, to the extent that is feasible), the majority of the Project's disturbance area will be reclaimed with native vegetation similar to that which occurs there presently. The growth of this vegetation will result in the reabsorption of an amount of GHGs that is nearly as great as the release that might result from vegetation clearing.

The remainder of this report provides additional quantification of the net GHG emissions and benefits likely to result from Boca Project implementation, as summarized in Table 1.

2.2 SITE CLEARING/VEGETATION REMOVAL

Pre-mining Vegetation Clearing

Vegetation will be removed from the site before mining but will ultimately be replaced through reclamation practices described in the Boca Quarry Reclamation Plan (EcoSynthesis, 2010). This plan establishes performance standards which mandate that re-established post-mining vegetation must achieve a similar cover and species diversity to that which currently exists on the site. Therefore, the GHG release resulting from vegetation clearing will be ultimately be balanced by the GHG that is fixed as carbon by the reclamation vegetation as it grows (even prior to commencing annual carbon fixation of 76.7 MT/y). The previously cleared and mined East Pit is included in the present GHG analysis, although the CEQA project as defined is the mine area expansion. The overestimate of Project GHG releases that results from this approach is relatively small.

The biomass of the site's vegetation was estimated from figures reported by Law and Waring (1994): total of annual growth in the study year plus other standing biomass for their ecologically similar study site was 22.63 MT/ha for pine-bitterbrush vegetation and 7.22 MT/ha for bitterbrush shrubland. These amounts equate to potential GHG releases of 15.4 MT/ha and 4.9 MT/ha, respectively, or a total of 1,365 MT of GHG from the entire site. (See discussion below for explanations of biomass/GHG conversion and acreages of vegetation.) As noted above, most of this GHG release will be recaptured as reclamation vegetation grows and therefore is not included in the net long-term Project GHG balance.

Operational Vegetation Effects and Post-mining Reclamation

However, the amount of GHG that would otherwise have been absorbed by the vegetation community during the Project life would not be fixed as carbohydrate-based compounds (and then either stored in the vegetation or become litter), nor would it be transformed into carbon stored in the soil. Carbon that is absorbed by vegetation but used for respiration is released again into the atmosphere. The difference between CO_2 fixation by photosynthesis and release by respiration is referred to as net primary productivity (NPP) and is closely related to the carbon dioxide absorption capacity of the vegetation over any stated unit of area and time. It is usually stated in total plant biomass (dry weight) in ecological studies, but is then converted to weight of GHG or of carbon itself in other discussions of GHG and climate change impacts. The scientific literature normally states NPP in terms of metric tons (MT) of dry plant biomass per hectare (10,000 square meters, abbreviated ha) per year. Based on the atomic weights of the elements involved in the chemical equation of photosynthesis (CO_2 plus water becomes sugar, cellulose, and other plant components, and oxygen is released), vegetation absorption of CO_2 is about 0.68 gram of GHG per gram of NPP.

The vegetation of the Project Site is overwhelmingly shrub dominated, and in fact just barely meets the 10 percent tree cover criterion for a vegetated area to be considered as a forest or woodland in the new Manual of California Vegetation (Sawyer et al., 2009). Thus, the productivity of the plant communities, which is directly related to their capacity to absorb and fix GHG, is likely to be overestimated in this analysis.

Exact figures for the NPP (net CO_2-fixation capacity) of all of the kinds of existing vegetation on the Project Site are not available, but the maximum rate of GHG absorption can be estimated from available scientific literature for sites that are generally ecologically similar, albeit probably having somewhat higher productivity. There are about 60 acres (24.3 ha) mapped as mixed pine-shrub communities within the Ultimate Disturbance Area (UDA), and about 90 acres (36.4 ha) of shrub communities, mostly bitterbrush-sagebrush. (We could not find a report of NPP of curl-leaf mountain mahogany in the literature, but given the more challenging growing conditions where it co-dominates, its NPP is likely to be less than that of bitterbrush. Thus, the loss of GHG absorption by vegetation described here is probably an overestimate.) The pine-shrub communities are not highly productive, supporting only a sparse tree stratum of about 20 trees per acre (estimate based upon count of trees visible in aerial photo within the 60 acres of the UDA that are pine-shrub communities), compared with a typical mature pine-bitterbrush community which supports 60 or more trees per acre. Nevertheless, the analysis here uses NPP figures from the more productive typical vegetation community and therefore provides an overestimate of the loss of GHG absorption capacity.

Pine-bitterbrush vegetation that is generally ecologically similar to that of the Project Site has an NPP of 3.2 MT/ha-yr (Waring et al., 1999), which equates to net absorption and fixation of 2.2 MT/ha-yr of GHG. Assuming that the entirety of the vegetation removal would occur at the beginning of the Project, the maximum annual loss of GHG absorption capacity from removal of the pine-shrub vegetation would be 53.5 MT/yr for the whole UDA. Earlier research by some of the same scientists (Law and Waring, 1994) showed that bitterbrush scrub produced about 29 percent of the amount of biomass that is produced by pine-bitterbrush vegetation, which calculates to a potential GHG absorption of 0.64 MT/ha-yr of GHG, or about 23.2 MT/ha-yr over the whole area that is vegetated by shrubby plant communities.

Thus, the total annual loss of GHG absorption capacity that results from the absence of vegetation over the entirety of the disturbance area (including the previously cleared East pit area) is estimated to be a maximum of 76.7 MT/yr.

The NPP of pine-bitterbrush vegetation as reported by Waring et al. (1999) is somewhat lower than the lower end of the few "arid temperate conifer" forests reported by Cannell (1982, cited in Perry, 1994). This is exactly as one would expect based upon the standard ecological principles that lower forest cover (smaller total leaf area) and drier conditions result in lower plant productivity (and lower GHG absorption), and provides an independent confirmation of the quantitative analysis provided here.

The assessment of GHG balance for the Project must consider that a significant part of the existing Boca UDA currently is bare rock (talus and outcrops) which supports almost no vegetation. Although the biological inventory map of the site depicts only about eight acres of large contiguous areas of rock outcrop and talus, in reality a large amount of rock is exposed at the surface as scattered smaller areas within areas that are otherwise mostly vegetated; this latter unmapped area is probably three to five times larger than the area that was mapped as unvegetated. About 51 acres of the UDA will remain as unreclaimed high walls and will remain bare or minimally vegetated (as is the condition for the rock outcrop and talus areas within the Project Site at present). Thus, the unreclaimed area may be larger than the present unvegetated rock and talus. On the other hand, the soil backfill of the large lowest bench will be much deeper soil than is present now, resulting in significantly higher potential plant productivity than is presently possible. The relative contributions of these considerations to the Project's overall GHG balance are not quantifiable in detail but are minor in comparison with the main carbon balance factors described below.

Mining, Processing, and Stockpiling

During mining operations, heavy equipment is used to remove overburden and aggregate rock from the Quarry and transport it to the processing area, and electricity is used to process the aggregate. These activities are direct consequences of specific construction projects, as mining and stockpiling of the aggregate does not occur, or at most occurs only to a minimal extent, in the absence of demand for the aggregate resource. Thus, although the GHG emissions are more properly attributed to the environmental assessment of each specific construction project, the GHG emissions of the Boca Quarry production are described and quantified here for completeness.

The fuel usage estimates provided below are based upon hourly equipment usage. The Project Description provides for an average workday of 11.5 hours (12 hours Monday through Friday and 9 hours on Saturday), with 158 operating days per year minus any holidays. It has been our observation of actual active quarry operations that not all equipment operates continuously throughout all operational days, for the entire daily duration of quarry operations. Also, in the event of sustained equipment operation at all times, the average annual production would be exceeded, and therefore quarry lifetime would be shortened. Thus, the figures for fuel and electricity usage provided below are almost certainly overestimates.

The following estimated GHG emissions would result from Project operations:

- 721 MT/yr (using EPA [2005] emissions ratio) from use of diesel fuel to operate heavy equipment (estimate based on one Komatsu PC750 excavator which consumes an average of 10.7 gal/hr at medium output; two Komatsu WA600 loaders, 12.8 gal/hr each; and one water truck estimated to use 3 gal/hr: total of 71,408 gal of diesel fuel over a 11.5-hr/day, 158-day work year); and
- 1,317 MT/hr from use of electricity to operate processing equipment (based on estimated and expected usage as stated by former plant manager of 1,200 kVA = 960 kW x 11.5 hours x 158 days = 1,744 MW/year; conversion factor of MW to MT of GHG is 0.755 MT/MW for Nevada (EIA, 2001; applicable to the Project because the electricity is supplied from that state).

In summary, the total Project operational use is anticipated to release GHG of about 2,038 MT/yr to produce the aggregate used by construction and highway maintenance projects in the region. This GHG emission is a result of use of aggregate by construction, and would occur in a similar magnitude no matter where the aggregates for those projects were produced. For these reasons, it is entered in both the "with Project" and "without Project" columns in Table 1.

2.3 AGGREGATE SHIPPING

Once mined and sold, the aggregate is transported to construction sites, generally in haul trucks with a maximum capacity of 25 tons. The shipping (trucking) of aggregate constitutes a very large proportion of the GHG impacts resulting from construction projects. Although operational GHG impacts of aggregate mining (i.e., excavation equipment and electricity use) are basically fixed, production of aggregate materials closer to sources of demand by the construction market can dramatically reduce the overall GHG impact of construction activities.

According to the former manager of Teichert's quarries in the Truckee area, Ed Herrnburger (personal communication, June 2010), essentially all of the aggregate production in the greater Truckee and Lake Tahoe region is used by construction projects within the region. The nearest sources of aggregate outside the region are in the greater Reno vicinity, a travel distance of at least 40 miles each way (80 miles round trip, for one truck trip to acquire a load and transport it to a Truckee-Tahoe project). This travel, and resultant GHG emissions, would be very substantially minimized by mining the Boca Quarry aggregates rather than relying on sources in Nevada, or from other California aggregate deposits that are even farther away.

Overall GHG emissions from aggregate shipping are affected by the fact that the average aggregate truckload leaving the Boca Quarry is actually only about 18 tons, due to the variability in the capacity of haul trucks arriving at the Quarry. Constraints of topography or simply of size of construction sites in the Project region often preclude access and turnaround or drive-through by a 25-ton truck and trailer combination, thus limiting aggregate deliveries to a standard 12-ton truck without trailer. Indeed, the average load sold at Teichert's Martis plant is about 18 tons. When quantified, this adjustment shows the actual GHG emissions savings from product shipping to be about 33 percent larger than estimated by the quantitative analysis summarized in Table 1 and detailed below. However, the figures available from CalCIMA (2010) for diesel consumption are for a 25-ton load rather than one of 18 tons, so we did not have a precise consumption figure to use for an estimate based upon 18-ton loads.

Another GHG emissions variable in aggregate shipping relates to the possibility that a substantial number of the trucks transporting aggregate from the Boca Quarry would originate from Reno at the beginning of each construction work day, thus reducing the overall GHG savings of the local aggregate source. However, even if ***all*** of the trucks originated in Reno, the adjustment in trucking-related GHG emissions would result in a maximum adjustment of about 25 percent (one Reno round trip per 8-hour construction day). Thus, the adjustment for trucks originating in Reno is less than the increased GHG savings (33 percent) identified above in the discussion of truck load size (i.e., about half of the aggregate deliveries are in trucks with only 12-ton capacity rather than the 25-ton capacity that was used to make the GHG emissions calculations). Overall, considering both of these adjustments to the estimated GHG emissions related to shipping of aggregate from outside the Project region, the GHG emissions reductions will be ***greater*** than those described below and shown in Table 1.

Over the 30-year project lifetime, the total permitted mining of aggregate from the Project is 17 million tons; transported in 25-ton trucks, this requires 680,000 truck trips (or about 944,444 trips for 18-ton average loads).

Each round trip to a Reno-region quarry is an average of at least 72 miles longer than a delivery to the Truckee-Tahoe region from the Boca Quarry (80 mile round trip minus approximately 8 mile round trip between Hirschdale interchange and the quarry itself); for 680,000 trips, this amounts to a minimum of 48.96 million miles of additional truck travel (round trip; 68.0 million miles for 18-ton loads).

Average mileage for a 25-ton aggregate dump truck is 6.4 miles/gallon of diesel fuel (CalCIMA, 2010); therefore, the total trucking fuel use to replace the Boca Quarry aggregate production by a source in the northern Nevada area (or further away) is at least 7.65 million gallons of diesel fuel (or up to 10.6 million gallons for 18-ton loads). Also, hauling aggregate from the Reno area to the Truckee-Tahoe region is a substantial uphill trip the entire distance, which reduces the mileage per gallon of fuel of a laden truck. According to the EPA, GHG emissions from consumption of diesel fuel are 10.1 kg/gallon (EPA, 2005), which calculates to a reduction of GHG from reduced diesel consumption of 77,265 MT of GHG over the 30-year Project lifetime, or 2,576 MT/yr (or significantly more if calculated on the basis of 18-ton loads).

The GHG emissions calculation above, which is based upon the average mileage of a 25-ton truck and the EPA emissions rate for diesel fuel, equates to an emissions factor of 1,578 grams of CO_2. The EMFAC model used by California Air Resources Board provides a factor of 1,570.7 g/mile. Given that the trip is an uphill haul and that trucks on I-80 generally travel faster than the nominal 45 mph stated for the EMFAC emissions factor, if anything, the actual rate of CO_2 emission is likely to be higher than the nominal rates for average heavy duty truck operation. Also, these figures are all based upon all aggregate having been shipped in 25-ton trucks filled to capacity. In reality, past history indicates that loads are likely to be approximately 18 tons rather than 25 tons, therefore, the actual reduction in GHG emissions from producing aggregate for Truckee-Tahoe area projects at the Boca quarry rather than at more distant quarries in the Reno area will be substantially better than shown in Table 1 (probably by about 30 percent).

SECTION 3 | Summary of GHG Benefits of the Project

3.1 PROJECT NET EFFECTS

Considering the main GHG components (use of diesel fuel and electricity for operations, loss of GHG absorption by vegetation, and emissions from aggregate shipping), the Project will result in an estimated reduction of GHG emissions of 2,576 (shipping GHG emissions savings) minus 77 (loss of vegetation CO_2 fixation) = 2,499 MT/yr. (GHG emissions from mining and processing can reasonably be assumed to be approximately the same at any quarry.) As a proportion of total GHG emission from production and shipping to the same point (I-80 Hirschdale interchange), with and without the Project, the net reduction of GHG emission with the Project represents a 54.2 percent reduction compared with the no project alternative. If subsequent shipping to a construction site (estimated average distance of 20 miles) is included, the reduction of GHG emission with the Project represents a 42.3 percent reduction compared with the no project alternative.

3.2 COMPARISON WITH INTERNATIONAL AND STATE GOALS

Although the United States did not ratify the treaty that implements the Kyoto Protocol to the United Nations Framework Convention on Climate Change pertaining to GHG emissions, the Protocol provides one benchmark against which to compare the GHG benefits of a selected project. Specifically, the Kyoto standard calls for a reduction of GHG emissions of 5.2 percent below 1990 levels (which, as noted in Section 1.2, were about 20 percent lower than today). The Teichert Boca Project therefore provides an opportunity to realize GHG emissions savings that are much greater than those contemplated by the Kyoto Protocol or by AB 32 (namely, reduction of GHG emissions to 1990 level).

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