APPENDIX C

Air Quality Study

Draft

AIR QUALITY STUDY

FOR THE PROPOSED

WAIKAPU COUNTRY TOWN PROJECT

WAIKAPU, MAUI, HAWAII

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1.0 SUMMARY

Waikapu Partners, LLC is proposing the Waikapu Country Town Project in Waikapu on the island of Maui. The proposed 1,562-acre project will consist of approximately 170,000 square feet of commercial space, 1579 residential units, an elementary school and 33 acres of park/open space. The project is planned to be built in two phases beginning in 2017 with completion during 2026. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its elevation near sea level and by nearby mountains. The predominant trade winds tend to be channeled through the area by the mountains to the east and west. Temperatures in the project area are generally very consistent and warm with average daily temperatures ranging from about 68°F to 81°F. Rainfall in the

project area is only moderate with an average of about 26 inches per year.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion and local agricultural sources, the present air quality of the project area is believed to be relatively good. There is very little air quality monitoring data from the Department of Health for the project area, but the limited data that are available suggest that concentrations are generally within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, there may be some short- and/or long-term impacts on air quality that may occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust could occur during the project construction phases. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the minor disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures to consider include limiting the area that is disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

To assess the potential long-term impact of emissions from project-related motor vehicle traffic operating on roadways in the project area after construction is completed, a computerized air quality modeling study was undertaken. The air quality modeling study estimated current worst-case concentrations of carbon monoxide at intersections in the project vicinity and predicted future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour worst-case carbon monoxide concentrations are well within both the state and the national ambient air quality standards. In the year 2026 without the project, worst-case carbon monoxide concentrations were predicted to decrease (improve) despite an increase in traffic, and concentrations would remain well within standards. This is because emissions from the increase in traffic will be more than offset by the retirement of older, more-polluting vehicles over time. With the project in the year 2026 and with proposed roadway improvements, estimated worst-case carbon monoxide concentrations indicated only minimal or no impact compared to the without project case. Concentrations would remain well within standards. Due to the negligible impact the project is expected to have, implementing mitigation measures for long-term traffic-related air quality impacts is unnecessary and unwarranted.

2.0 INTRODUCTION

Waikapu Partners, LLC is proposing the Waikapu Country Town Project in Waikapu on the island of Maui (see Figure 1 for project location). The project site is located along Honoapiilani Highway in the Waikapu community in central Maui. The project will be developed in two phases, with the first phase scheduled to begin in 2017 and be completed in 2021 and the second phase to begin in 2022 and be done in 2026. The first phase will include approximately 170,000 square feet of commercial and employment uses as well as 731 residential units, an elementary school and 27 acres of park and open space. Phase 2 will include 848 residential units and approximately 6 acres of park and open space. Primary access would be provided via Honoapiilani Highway and Waiale Road, via the planned southward extension of Waiale Road known as the Waiale Bypass.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

The national AAQS are reviewed periodically, and multiple revisions have occurred over the past 30 years. In general, the national AAQS have become more stringent with the passage of time and as more information and evidence become available concerning the detrimental effects of air pollution. Changes to the Hawaii AAQS over the past several years have tended to follow revisions to the national AAQS, making several of the Hawaii AAQS the same as the national AAQS.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The topography of Maui is dominated by the great volcanic masses of Haleakala (10,023 feet) and the West Maui Mountains (5,788 feet). The island consists entirely of the slopes of these mountains and of a connecting isthmus. Haleakala is still considered to be an active volcano and last erupted about 1790. The project site is located near sea level in the central isthmus area between Haleakala and the West Maui Mountains.

Maui lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Because the project area is located on the isthmus between Haleakala and the West Maui Mountains, the predominant trade wind flow tends to be channeled through the area from north to south by the terrain to the east and west. Local winds such as land/sea breezes and/or upslope/downslope winds also influence the wind pattern for the area when the trade winds are weak or absent. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's lower elevation and near-windward location results in relatively even temperatures compared with many other parts of the island. Average daily minimum and maximum temperatures at nearby Wailuku are 68°F and 81°F, respectively [1]. Temperatures at the project site can be expected to be similar to this.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Waikapu area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the nearby mountains. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the prevailing wind conditions.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3,000 feet (1,000 meters).

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is moderately dry due to the low elevation. Historical records from Wailuku show that this area of Maui averages about 26 inches of precipitation per year with the summer months being the driest [1].

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Maui for calendar year 1993. This is the most recent year for which an island-wide emission inventory is available. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, most of the manmade particulate and sulfur oxides emissions on Maui originate from point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions are roughly equally divided between point sources and area sources (mostly motor vehicle traffic). The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic and sugar cane burning), while hydrocarbons are emitted mainly from point sources. Emissions today are probably higher than those shown in the table, but the proportional relationships are likely about the same.

The largest sources of air pollution in the immediate project area are most likely agricultural operations and automobile traffic using local roadways. Emissions from these sources consist primarily of particulate, carbon monoxide and nitrogen oxides. Nearby sugarcane planting and harvesting operations sometimes result in significant emissions of smoke and dust that can impact the area. Industrial sources in the project vicinity include Kahului Power Plant, which is located about 2 miles to the north, and Puunene Sugar Mill, which is situated about 2 miles to the east. These are older facilities that emit mostly sulfur dioxide, nitrogen oxides and particulate. Volcanic emissions from distant natural sources on the Big Island also affect the air quality at times during kona wind conditions. By the time the volcanic emissions reach the project area, they consist mostly of fine particulate sulfate.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state, but only very limited data are available for Maui Island. The only air quality data for the island of Maui consists of particulate measurements collected at Kihei, which is about 7 miles to the south. Table 3 summarizes the data from the Kihei monitoring station. The annual second-highest 24-hour PM-10 particulate concentration (which is most relevant to the air quality standard) was 60 $\mu g/m^3$ in 2008. The average annual concentration was 20 $\mu g/m^3$. Prior to 2008, occasional exceedances of the state PM-10 standard have been recorded. These were generally due to either agricultural tilling operations or brush fires in the area. Monitoring of PM-10 at the Kihei monitoring station was discontinued in 2009.

As indicated in Table 3, PM-2.5 particulate is also monitored at the Kihei monitoring station. Annual 24-hour 98th percentile PM-2.5 particulate concentrations (which are most relevant to the air quality standards) ranged from 13 to 16 $\mu g/m^3$ between 2008 and 2012. Average annual concentrations ranged from 4 to 6 $\mu g/m^3$. No values above 35 $\mu g/m^3$ (which relates to the national standard) were recorded during this period.

Given the limited air pollution sources in the area, it is likely that air pollution concentrations are near natural background levels most of the time, except possibly for locations adjacent to agricultural operations or near traffic-congested intersections. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation activities; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by roadway lane closures.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site could be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could become airborne. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average; thus it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel engines are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities could obstruct the normal flow of traffic for short periods of times such that overall vehicular emissions in the project area could temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

After construction is completed, use of the proposed facilities may result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation required further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, and these began to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways.

To evaluate the potential long-term ambient air quality impact of motor vehicle traffic using the proposed new roadway facilities, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways within the project area. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single project.

For this project, three scenarios were selected for the carbon monoxide modeling study: (1) year 2013 with present conditions, (2) year 2026 without the project, and (3) year 2026 with the project. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, four of the key intersections identified in the traffic study [4] were selected for air quality analysis. These included the following intersections:

- Honoapiilani Highway at Kuikahi Drive
- Waiale Road at Maui Lani Parkway
- South Kamehameha Avenue at Maui Lani Parkway
- Kuihelani Highway at Maui Lani Parkway.

The traffic study indicated that the selected intersections generally had higher traffic volumes and/or more congestion. The traffic study describes the existing and projected future traffic conditions and laneage configurations of the study intersections in detail. In performing the air quality impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

Vehicular carbon monoxide emissions for each year studied were calculated using EPA's Motor Vehicle Emission Simulator (MOVES) computer model [5]. MOVES was configured for a project-level analysis specifically for Hawaii. Assumptions included an urban, unrestricted road type, default fuel supply and fuel formulation, default vehicle age distribution and ambient temperature of 68 F. MOVES emission factors were generated both for idling and for moving traffic.

After computing vehicular carbon monoxide emissions through the use of MOVES, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model had become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOVES based on assumed free-flow vehicle speeds corresponding to the posted or design speed limits.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This acknowledges that pedestrian sidewalks already exist or may exist in the future in these locations. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to all predicted concentrations for 2013. Although increased traffic is expected to occur within the project area within the next few years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 2013 with existing traffic, year 2026 without the project and year 2026 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2013) case was 1.8 ppm. This was projected to occur during the morning peak traffic hour at three of the four intersections studied. Predicted worst-case 1-hour concentrations at all locations studied for the 2013 scenario were well within both the national AAQS of 35 ppm and the state standard of 9 ppm.

In the year 2026 without the proposed project, the highest worst-case 1-hour carbon monoxide concentrations in the project area were predicted to reach a maximum of 1.1 ppm during the morning peak traffic hour. Compared to the existing case, predicted concentrations for the year 2026 without the project decreased (improved) at all locations, and worst-case concentrations remained well within the state and national standards. This suggests that emissions from higher traffic volumes and increased traffic congestion in the future will be more than offset by the retirement of older, more-polluting vehicles over time.

Predicted 1-hour worst-case concentrations for the 2026 with project scenario remained nearly unchanged at the study intersections. Forecast worst-case concentrations at all locations studied remained well within the state and federal standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6

depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2013 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the four locations studied ranged from 0.7 to 0.9 ppm. The estimated worst-case concentrations for the existing case were well within both the state standard of 4.4 ppm and the national limit of 9 ppm.

For the year 2026 without project scenario, predicted worst-case concentrations ranged between 0.4 and 0.6 ppm, decreasing (improving) compared to the existing scenario. All predicted concentrations were within the standards.

For the 2026 with project scenario, worst-case concentrations remained nearly unchanged compared to the without project case, indicating minimal project impact. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Although very little ambient air quality data are available to characterize existing conditions, it is likely that state and federal ambient air quality standards are currently being met in the project area. Occasional air quality degradation may occur due to dust and smoke emissions from nearby sugarcane operations.

Project-related short-term impacts on air quality may occur from the emission of fugitive dust during construction phases. Uncontrolled fugitive dust emissions from construction activities could amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Establishment of landscaping early in the construction schedule will also help to control dust.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After the proposed project is completed, any long-term impacts on air quality in the project area due to emissions from project-related motor vehicle traffic should be negligible. Worst-case concentrations of carbon monoxide should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is unnecessary and unwarranted.

REFERENCES

1. "Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", U.S. Department of Commerce, Weather Bureau, Washington, D.C., 1965.

2. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

3. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

4. Fehr & Peers, Waikapu Country Town Transportation Impact Analysis Report, December 2014.

5. User Guide for Motor Vehicle Emission Simulator, MOVES2010b, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, June 2012, EPA-420-B-12-001b.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

7. User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, U.S. Environmental Protection Agency, November 1992.

8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 2006-2010, State of Hawaii Department of Health.

Figure 1 - Project Location

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	µg/m³	Annual	–	–	50
		24 Hours	150[a]	150[a]	150[b]
Particulate Matter (<2.5 microns)	µg/m³	Annual	15[c]	15[c]	–
		24 Hours	35[d]	35[d]	–
Sulfur Dioxide	ppm	Annual	–	–	0.03
		24 Hours	–	–	0.14[b]
		3 Hours	–	0.5[b]	0.5[b]
		1 Hour	0.075[e]	–	–
Nitrogen Dioxide	ppm	Annual	0.053	0.053	0.04
		1 Hour	0.100[f]	–	–
Carbon Monoxide	ppm	8 Hours	9[b]	–	4.4[b]
		1 Hour	35[b]	–	9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	µg/m³	3 Months	0.15[h]	0.15[h]	–
		Quarter	1.5[i]	1.5[i]	1.5[i]
Hydrogen Sulfide	ppm	1 Hour	–	–	0.035[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF MAUI, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	63,275	7,030	70,305
Sulfur Oxides	6,419	nil	6,419
Nitrogen Oxides	7,312	8,618	15,930
Carbon Monoxide	4,612	20,050	24,662
Hydrocarbons	1,991	234	2,225

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST WAIKAPU COUNTRY TOWN PROJECT

Parameter / Location	2008	2009	2010	2011	2012
Particulate (PM-10) / Kihei					
24-Hour Averaging Period:					
No. of Samples	331	-	-	-	-
Highest Concentration ($\mu g/m^3$)	78	-	-	-	-
2^{nd} Highest Concentration ($\mu g/m^3$)	60	-	-	-	-
No. of State AAQS Exceedances	0	-	-	-	-
Annual Average Concentration ($\mu g/m^3$)	20	-	-	-	-
Particulate (PM-2.5) / Kihei					
24-Hour Averaging Period:					
No. of Samples	58	358	332	301	337
Highest Concentration ($\mu g/m^3$)	16	26	24	15	18
98^{th} Percentile Concentration ($\mu g/m^3$)	15	16	14	13	14
No. of values greater than 35 $\mu g/m^3$	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	6	4	5	6	6

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2008 – 2012"

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR WAIKAPU COUNTRY TOWN PROJECT (parts per million)

Roadway Intersection	Year/Scenario					
	2013/Present		2026/Without Project		2026/With Project	
	AM	PM	AM	PM	AM	PM
Honoapiilani Highway at Kuikahi Drive	1.8	1.1	0.9	0.7	0.9	0.7
Waiale Road at Maui Lani Parkway	1.8	1.2	1.1	0.8	1.1	0.9
S. Kamehameha Ave at Maui Lani Parkway	1.8	1.3	1.1	0.8	1.0	0.8
Kuihelani Highway at Maui Lani Parkway	1.4	1.2	1.1	0.8	1.0	0.9

Hawaii State AAQS: 9
National AAQS: 35

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR WAIKAPU COUNTRY TOWN PROJECT (parts per million)

Roadway Intersection	Year/Scenario		
	2013/Present	2026/Without Project	2026/With Project
Honoapiilani Highway at Kuikahi Drive	0.9	0.4	0.4
Waiale Road at Maui Lani Parkway	0.9	0.6	0.6
S. Kamehameha Ave at Maui Lani Parkway	0.9	0.6	0.5
Kuihelani Highway at Maui Lani Parkway	0.7	0.6	0.5

Hawaii State AAQS: 4.4
National AAQS: 9