F I N A L

MOBILE SOURCE AIR TOXICS

US 101 EXPRESS LANES PROJECT, SANTA CLARA COUNTY, CALIFORNIA

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Appendix

Appendix A MSAT Modeling Results

Chapter 1. Introduction and Project Description

1.1. Introduction

This report discusses Mobile Source Air Toxics (MSATs) emissions for the proposed United States Highway 101 (US 101) Express Lanes Project (project). This information was prepared to support the project's environmental document's Federal requirements for an MSAT evaluation, as defined by the Federal Highway Administration's (FHWA's) interim guidance update memoranda issued in December 2012. Information from this MSAT evaluation is also summarized in the environmental document for this project (an Initial Study/Environmental Assessment [IS/EA]).

1.2. Project Description

The Santa Clara Valley Transportation Authority (VTA), in cooperation with the California Department of Transportation (Caltrans), proposes to convert the existing High Occupancy Vehicle (HOV) lanes along United States Highway 101 (US 101) to High Occupancy Toll (HOT) lanes (hereafter known as express lanes). A second express lane would be added in each direction on US 101 within the overall project limits from the East Dunne Avenue interchange in Morgan Hill to the Santa Clara/San Mateo County line just north of the Oregon Expressway/Embarcadero Road interchange in Palo Alto. The project would also convert the US 101/State Route (SR) 85 HOV direct connectors in Mountain View to express lane connectors, restripe the northern 1.1 mile of SR 85 to introduce a buffer separating the mixed flow lanes from the express lane, and connect the SR 85 express lanes to the US 101 express lanes (Figures 1 and 2). The project length is 36.55 miles on US 101 and 1.1 miles on SR 85, for a total of 37.65 miles.

A dual express lane facility is proposed for the majority of the corridor, with the exception of short segments near the SR 85 express lane connectors where a single express lane is proposed. A single express lane is proposed between the SR 85 Interchange and the Blossom Hill Road Interchange in San Jose, and between the Mathilda Road Avenue interchange and the SR 85 interchange in Mountain View.

The addition of the second express lane will involve a combination of inside and outside widening. The majority of the inside widening will occur within the US 101 segments south of the SR 85/US 101 interchange in southern Santa Clara County where a wide unpaved median exists. The project proposes to widen and pave the median to

accommodate the additional lanes. The outside widening will occur in the remainder of the corridor to accommodate the additional lanes where needed.

The express lanes facility would be separated from the adjacent mixed-flow lanes by a striped buffer. The buffer zone, delineated with solid stripes, will have designated openings to provide access into and out of the express lanes facility. The express lanes would allow HOVs to continue to use the lanes without cost and eligible single-occupant vehicles (SOVs) to pay a toll.

Bridge widening and modifications to existing abutments would be required at a number of grade separations, overcrossings, and undercrossings. Widening of creek bridges is not proposed as part of this project.

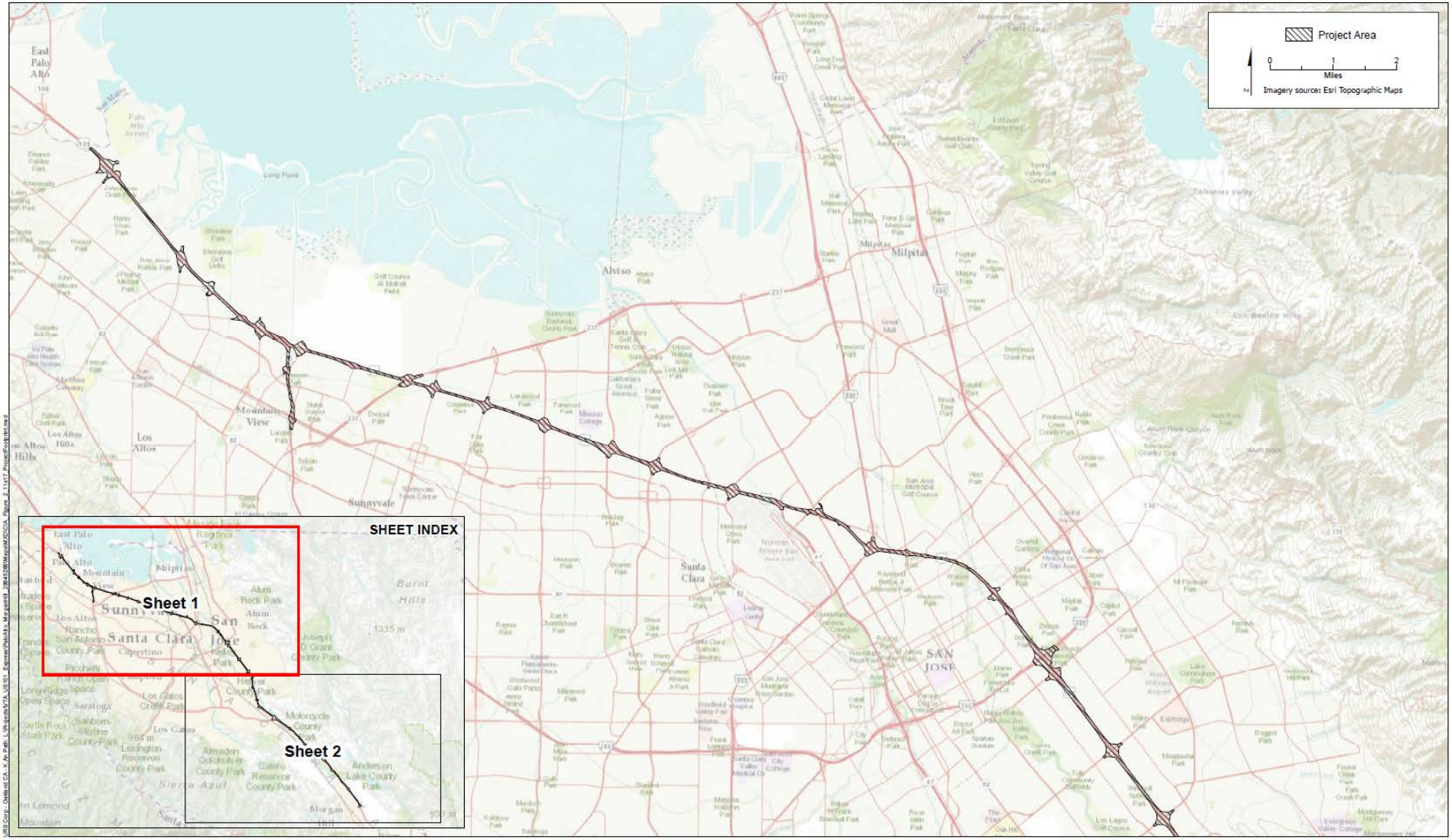
The project would install overhead signs, tolling structures, and lighting. Some Traffic Operations Systems (TOS) equipment such as traffic monitoring stations, Closed Circuit Televisions, cabinets, and controllers would be installed along the outside edge of pavement within the existing right-of-way.

Trenching would be conducted along the outside edge of pavement for installation of conduits. The depth of trenching would be 3 to 5 feet below the roadway surface. Conduits would be jacked across the freeway to the median where needed to provide power and communication feeds to the new overhead signage and tolling equipment.

It is anticipated that the project will require Temporary Construction Easements (TCE). Right of way activities are currently being coordinated based on the approval of design exceptions. Utility relocations are anticipated to accommodate the outside widening.

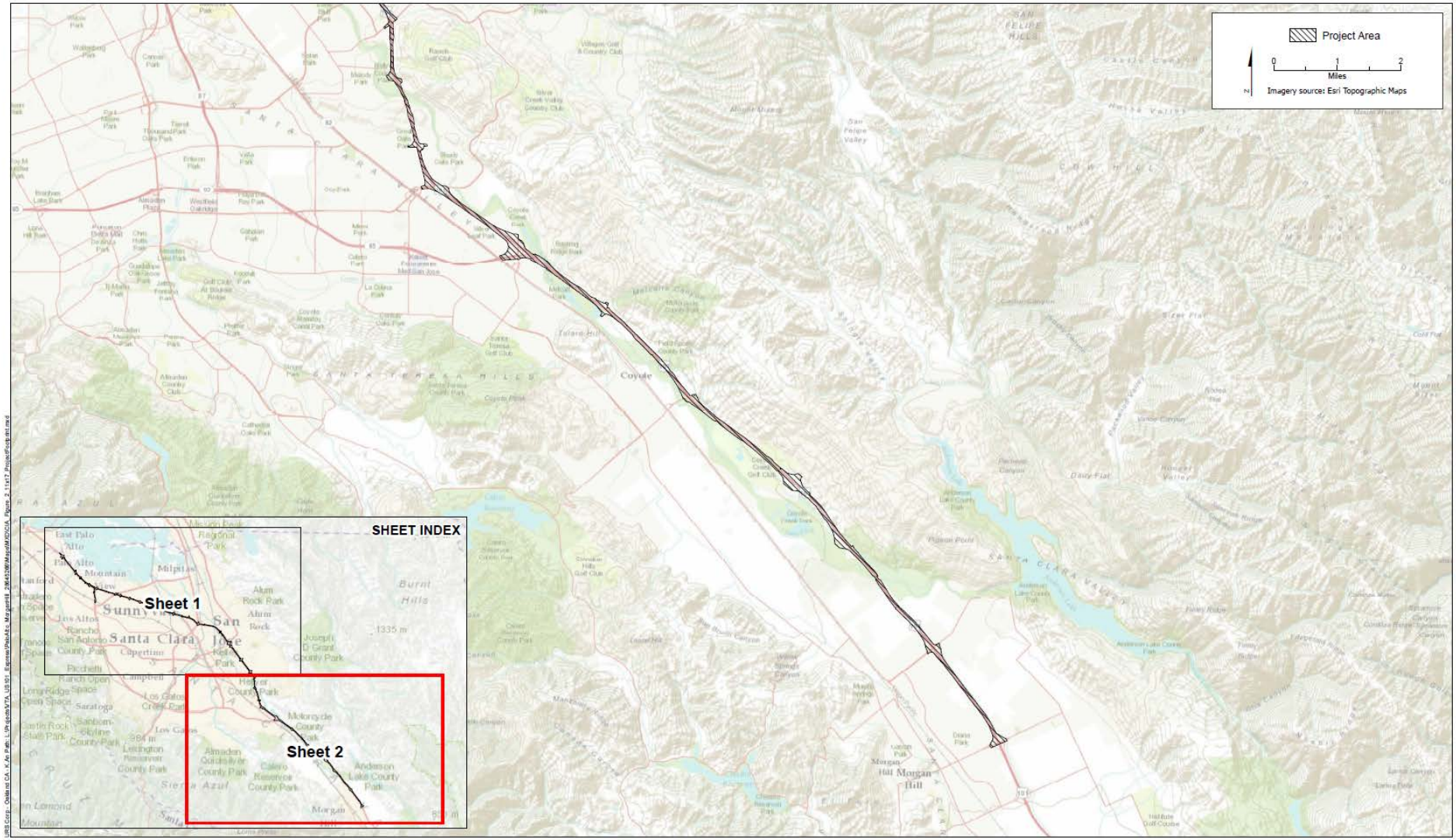
URS Caltrans
US 101 Express Lanes Project

Figure 1
Project Location and Regional Setting



URS Caltrans
US 101 Express Lanes Project

Figure 2, Sheet 1
Project Area



URS Caltrans
US 101 Express Lanes Project

Figure 2, Sheet 2
Project Area

Chapter 2. Mobile Source Air Toxics

2.1. Introduction

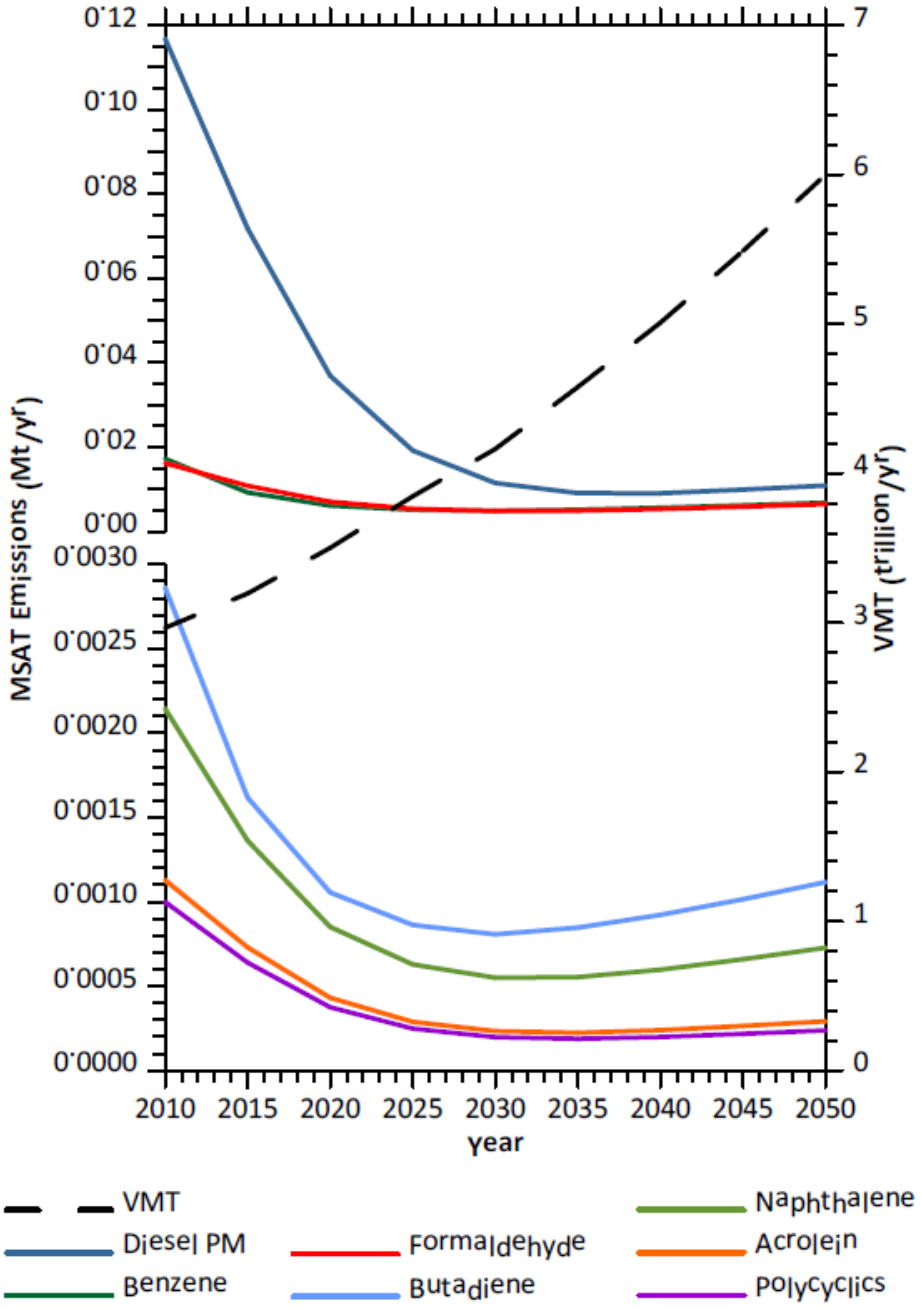
Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the U.S. Environmental Protection Agency (EPA) regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (EPA 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS; EPA 2012a). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA; EPA 2010). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter (DPM) plus diesel exhaust organic gases, specifically formaldehyde, naphthalene, and polycyclic organic matter. While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

Motor Vehicle Emissions Simulator (MOVES)

According to EPA, MOVES improves upon the previous MOBILE model in several key aspects: MOVES is based on a vast amount of in-use vehicle data collected and analyzed since the latest release of MOBILE, including millions of emissions measurements from light-duty vehicles. Analysis of this data enhanced EPA's understanding of how mobile sources contribute to emissions inventories and the relative effectiveness of various control strategies. In addition, MOVES accounts for the significant effects that vehicle speed and temperature have on PM emissions estimates, whereas MOBILE did not. MOVES2010b includes all air toxic pollutants in NATA that are emitted by mobile sources. EPA has incorporated more recent data into MOVES2010b to update and enhance the quality of MSAT emission estimates. These data reflect advanced emission control technology and modern fuels, plus additional data for older technology vehicles.

Based on an FHWA analysis using EPA's MOVES2010b model, as shown in Figure 3, even if vehicle-miles traveled (VMT) increases by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period.

Figure 3 Projected National MSAT Emission Trends 2010 – 2050 for Vehicles Operating on Roadways Using EPA's MOVES2010b Model



Note:
Trends for specific locations may be different, depending on locally derived information representing vehicle-miles traveled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

Source: EPA MOVES 2012b model runs conducted during May – June 2012 by FHWA (EPA 2012b).

MSAT Research

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure should be factored into project-level decision-making within the context of the National Environmental Policy Act (NEPA).

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, we are duly expected by the public and other agencies to address MSAT impacts in our environmental documents. The FHWA, EPA, the Health Effects Institute (HEI), and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this emerging field.

2.2. NEPA Context

The NEPA requires, to the fullest extent possible, that the policies, regulations, and laws of the Federal Government be interpreted and administered in accordance with its environmental protection goals. The NEPA also requires Federal agencies to use an interdisciplinary approach in planning and decision-making for any action that adversely impacts the environment. The NEPA requires and FHWA is committed to the examination and avoidance of potential impacts to the natural and human environment when considering approval of proposed transportation projects. In addition to evaluating the potential environmental effects, we must also take into account the need for safe and efficient transportation in reaching a decision that is in the best overall public interest. The FHWA policies and procedures for implementing NEPA are contained in regulation in 23 CFR § 771.

2.3. Consideration of MSAT in NEPA Documents

The FHWA developed a tiered approach with three categories for analyzing MSAT in NEPA documents, depending on specific project circumstances:

1. No analysis for projects with no potential for meaningful MSAT effects;

2. Qualitative analysis for projects with low potential MSAT effects; or

3. Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

2.4. Section 1502.22 Incomplete or Unavailable Information

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.

(a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

(b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement:

1. a statement that such information is incomplete or unavailable;

2. a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;

3. a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and

4. the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, "reasonably foreseeable" includes impacts that have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

(c) The amended regulation will be applicable to all environmental impact statements for which a Notice to Intent (40 CFR 1508.22) is published in the Federal Register on or after May 27, 1986. For environmental impact statements in progress, agencies may choose to comply with the requirements of either the original or amended regulation.

Incomplete or Unavailable Information for Project-Specific MSAT Health Impact Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the IRIS, which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA 2012a). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the HEI. Among the adverse health effects linked to MSAT compounds at high exposures are; cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI 2008) or in the future as vehicle emissions substantially decrease (HEI 2009).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more

complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (HEI 2008). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for DPM. The EPA (EPA 2013a) and the HEI (HEI 2007) have not established a basis for quantitative risk assessment of DPM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

Chapter 3. Assessment / Discussion of Mobile Source Air Toxics

3.1. Introduction

As discussed in Chapter 2, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to assess the levels of future MSAT emissions by comparing the project alternatives.

The 2012 FHWA guidance suggests a three-tiered approach to analyzing the effects of a transportation project in terms of public exposure to MSAT emissions. The level of analysis is related to expected size and impact of the project, as follows:

1. No analysis for projects with no potential for meaningful MSAT effects.
2. Qualitative analysis for projects with low potential MSAT effects.
3. Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

3.2. MSAT Assessment

The project would convert the existing HOV lanes along US 101 to express lanes and add a second express lane in each direction on northbound and southbound US 101 within the overall project limits of East Dunne Avenue interchange in Morgan Hill to the Santa Clara/San Mateo County line just north of the Oregon Expressway/Embarcadero Road interchange in Palo Alto. The project will also convert the US 101/ SR 85 HOV direct connectors in Mountain View to express lane connectors and restripe the northern 1.1 mile of SR 85 to introduce a buffer separating the mixed flow lanes from the express lane and connecting the SR 85 express lanes to the US 101 express lanes. The 2012 FHWA guidance lists the following criteria for projects that have a higher potential for MSAT effects and that are in proximity to populated areas:[1]

[1] Interim Guidance Update on Mobile Source Air Toxics Analysis in NEPA Documents (December 6, 2012), "(3) Projects with Higher Potential MSAT effects" page 6.

- *Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of DPM in a single location, involving a significant number of diesel vehicles for new projects or accommodating with a significant increase in the number of diesel vehicles for expansion projects.*

The project would not create or alter an intermodal freight facility.

- *Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000, or greater, by the design year.*[2]

US 101 in the Mountain View segment of the project limits already has traffic volumes exceeding 150,000 Annual Average Daily Traffic (AADT), and SR 85 is projected to have volumes exceeding 150,000 by 2035. The project would convert the existing HOV lanes to an express facility.

And also

- *Proposed to be located in proximity to populated areas.*

Various sensitive receptors are located in the vicinity of the project area. In general, the route is adjacent to residential, commercial, open space or undeveloped lands and several recreational trails cross underneath the freeway at river and creek crossings.

Therefore, a quantitative analysis was performed using the Caltrans program CT-EMFAC5 to identify and compare the potential differences among the priority MSAT emissions from the project alternatives. CT-EMFAC5 is a California-specific analysis tool for modeling MSAT emissions using the latest version of the California Mobile Source Emission and Inventory model, EMFAC2011. The CT-EMFAC5 model forecasts emissions for all of the priority MSATs. Modeling results are included in Appendix A.

To perform the CT-EMFAC5 modeling, composite emission factors for the project were obtained for Santa Clara County, using 2009 as the analysis year for existing conditions, 2015 for opening year and 2035 for design year. Traffic data for existing conditions (2009), opening year (2015) and the design year (2035) were obtained from CDM Smith.

[2] Using EPA's MOVES2010b emissions model, FHWA staff determined that this range of AADT would result in emissions significantly lower than the Clean Air Act definition of a major hazardous air pollutant (HAP) source, i.e., 25 tons/yr. for all HAPs or 10 tons/yr. for any single HAP. Variations in conditions such as congestion or vehicle mix could warrant a different range for AADT; if this range does not seem appropriate for your project, please consult with the contacts from HEPN and HEPE identified in this memorandum.

Total AM and PM peak period traffic data for existing conditions (2009), the projected opening year (2015) and the design year (2035) as well as the speed bin VMT distribution were obtained from CDM Smith. Based on these input parameters, CT-EMFAC5 was used to estimate DPM, benzene, acrolein, acetaldehyde, formaldehyde, 1,3-butadiene, naphthalene, and polycyclic organic matter (POM) emissions.

Table 3-1 shows the estimated MSAT levels in the project area for 2009, which represents the existing condition for purposes of the traffic analysis.

Table 3-1 MSAT Emissions for Existing Conditions (Tons per Day)

	DPM	Formaldehyde	Butadiene	Benzene	Acrolein	Acetaldehyde	Naphthalene	POM
Existing Conditions	1.01E-01	4.36E-02	7.11E-03	5.08E-02	1.58E-03	1.66E-02	3.04E-03	7.38E-04

Note:
DPM = diesel particulate matter
POM = polycyclic organic matter

For the Build and No Build alternatives considered in the IS/EA in both the opening year and horizon year, the amount of MSATs emitted would be proportional to the vehicle miles traveled, or VMT, if other variables such as fleet mix and speed remain the same. The estimated VMT in the local area for the Build Alternative would be slightly higher because it includes an additional, or second, express lane.

As shown in Table 3-2, in 2015, the emissions for the Build Alternative would increase compared to the No Build Alternative by 3 percent for DPM and 1 percent for benzene, and would decrease for the other MSATs (formaldehyde, butadiene, acrolein, acetaldehyde, naphthalene, and POM). Emissions would decrease for all MSATs compared to the Existing Conditions, with the largest decrease being a 61 percent reduction in DPM emissions.

Table 3-2 MSAT Emissions for No Build and Build Alternatives in Opening Year 2015 (Tons per Day)

Scenario	DPM	Formaldehyde	Butadiene	Benzene	Acrolein	Acetaldehyde	Naphthalene	POM
2015 No Build	6.06E-02	2.64E-02	4.02E-03	2.24E-02	8.94E-04	9.18E-03	1.80E-03	3.46E-04
2015 Build	4.41E-02	1.90E-02	2.91E-03	1.63E-02	6.46E-04	8.34E-03	1.76E-03	3.41E-04
Percent Difference from No	3%	-8%	-2%	1%	-2%	-9%	-2%	-2%

Build								
Percent Difference from Existing	-61%	-49%	-49%	-42%	-48%	-50%	-42%	-54%

Note:
DPM = diesel particulate matter
POM = polycyclic organic matter

As shown in Table 3-3, in 2035, the MSAT emissions for DPM, butadiene, benzene, acrolein, and POM would increase for the Build Alternative compared to the No Build Alternative by 3 to 13 percent. However, the MSAT emissions for the other pollutants (formaldehyde, acetaldehyde, and naphthalene) would decrease for the Build Alternative compared to the No Build Alternative by 1 to 11 percent. Emissions would decrease for all MSATs compared to the Existing Conditions, with the largest decrease being 69 percent reductions in DPM and acrolein emissions.

Table 3-3 MSAT Emissions for No Build and Build Alternatives in 2035 (Tons per Day)

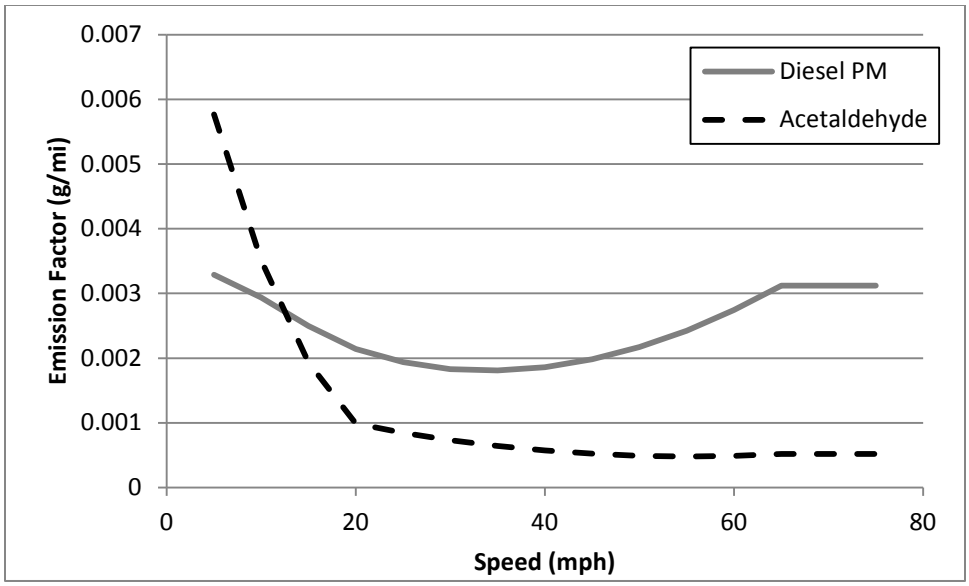
	DPM	**Formaldehyde**	**Butadiene**	**Benzene**	**Acrolein**	**Acetaldehyde**	**Naphthalene**	**POM**
2035 No Build	2.81E-02	2.39E-02	2.23E-03	1.93E-02	4.71E-04	1.03E-02	2.28E-03	**3.93E-04**
2035 Build	3.18E-02	2.19E-02	2.30E-03	2.01E-02	4.95E-04	9.18E-03	2.26E-03	4.01E-04
Percent Difference from No Build	13%	-9%	3%	4%	5%	-11%	-1%	2%
Percent Difference from Existing	-69%	-50%	-68%	-60%	-69%	-45%	-26%	-46%

Note:
DPM = diesel particulate matter
POM = polycyclic organic matter

The increases and decreases in emissions for the different MSATs are the result of the different MSAT emission factor trends relative to vehicle speed. This is demonstrated by the differing trends of DPM and acetaldehyde with speed, as shown in Figure 4. Emission factors for both MSATs decrease as speed increases toward 30 mph, but the DPM emission factor begins to increase at speeds greater than 40 mph. The acetaldehyde emission factor does not show this trend, and instead continues to decrease at speeds greater than 40 mph. Although the increased VMT of the Build Alternative would

suggest an increase in all MSAT emissions, the increase in average speed of the Build Alternative leads to a reduction in certain MSAT emissions and an increase in others.

Figure 4 Diesel Particulate Matter and Acetaldehyde Emission Factors for 2035



Source:
CT-EMFAC5 emission factors for Santa Clara County (2035).

Emissions for all MSATs would be substantially lower for both alternatives in the opening year (2015) and design year (2035) as compared to the existing condition (2009). As shown in Tables 3-2 and 3-3, emissions of MSATs would decrease by up to 61 percent in the opening year and 69 percent in the horizon year compared to the existing condition. These reductions are a result of EPA's national control programs, which are projected to reduce national MSAT emissions by 72 percent by 2020. The magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases (see Figures 5 through 12). As such, the risk of health impacts would be reduced substantially by year 2035 as compared to existing conditions.

Figure 5 Diesel Particulate Matter Emissions Comparison for 2009, 2015 and 2035

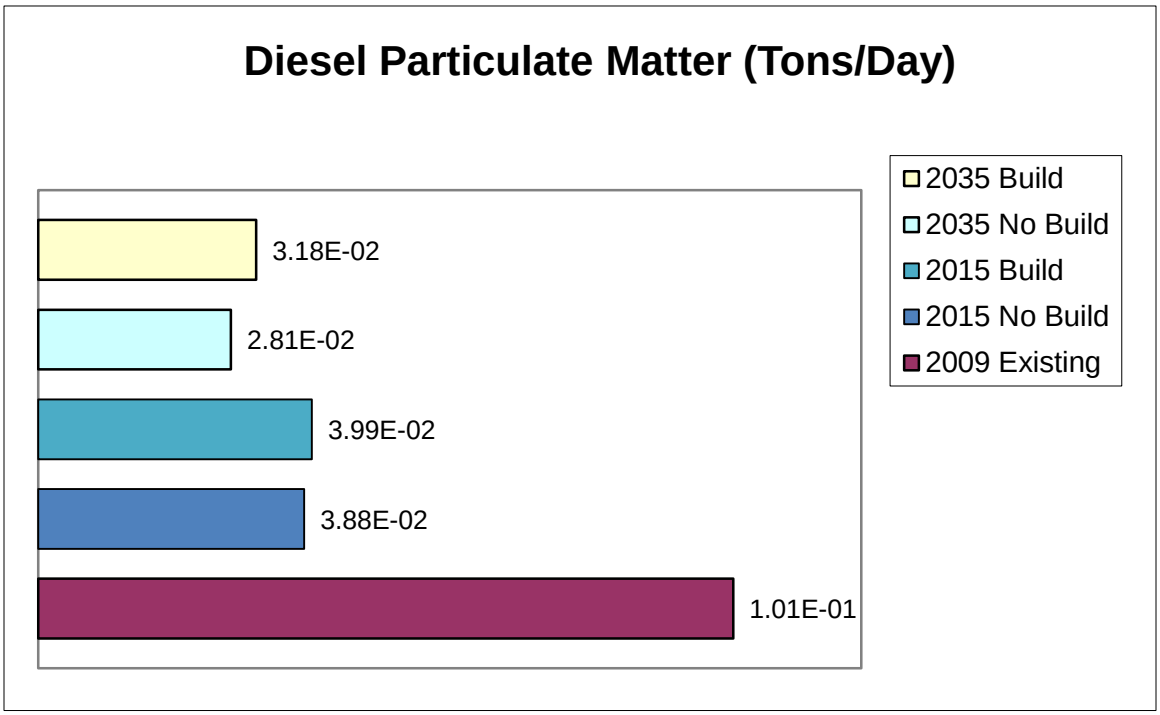


Figure 6 Formaldehyde Emissions Comparison for 2009, 2015 and 2035

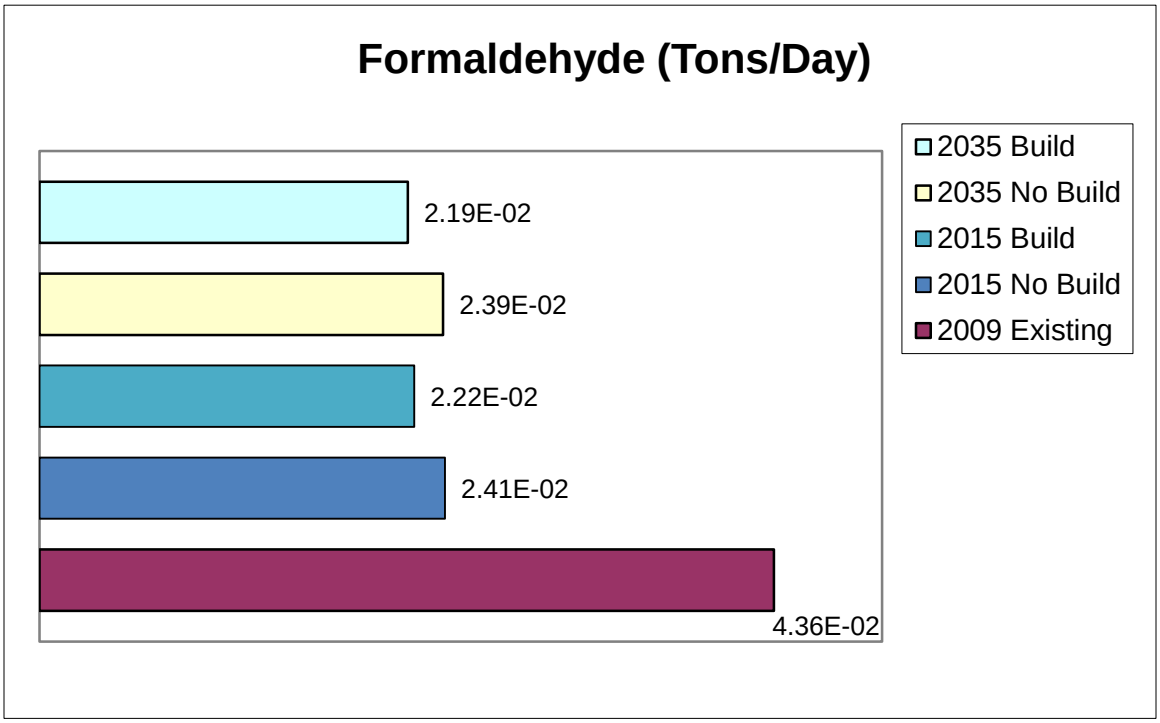


Figure 7 Butadiene Emissions Comparison for 2009, 2015 and 2035

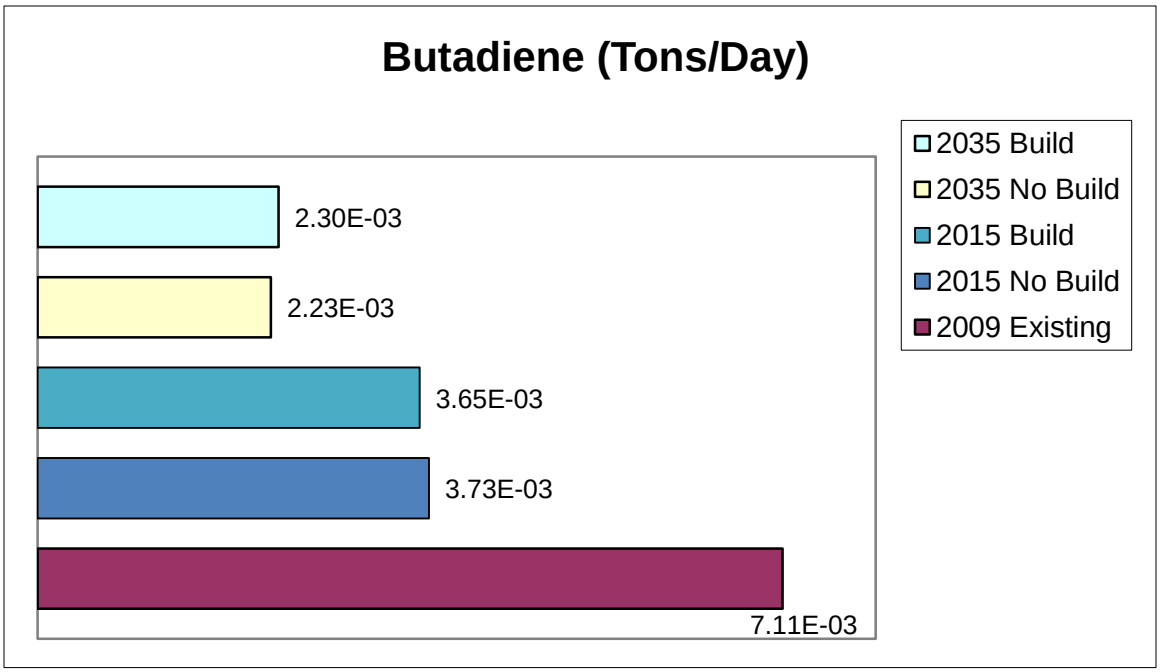


Figure 8 Benzene Emissions Comparison for 2009, 2015 and 2035

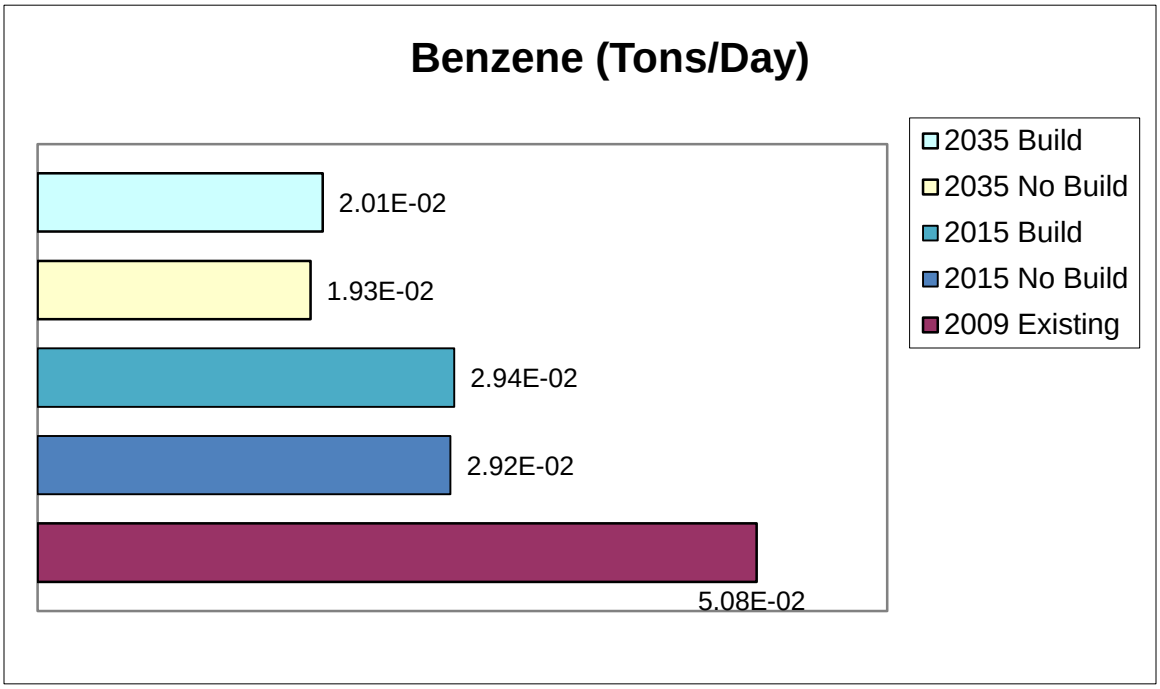


Figure 9 Acrolein Emissions Comparison for 2009, 2015 and 2035

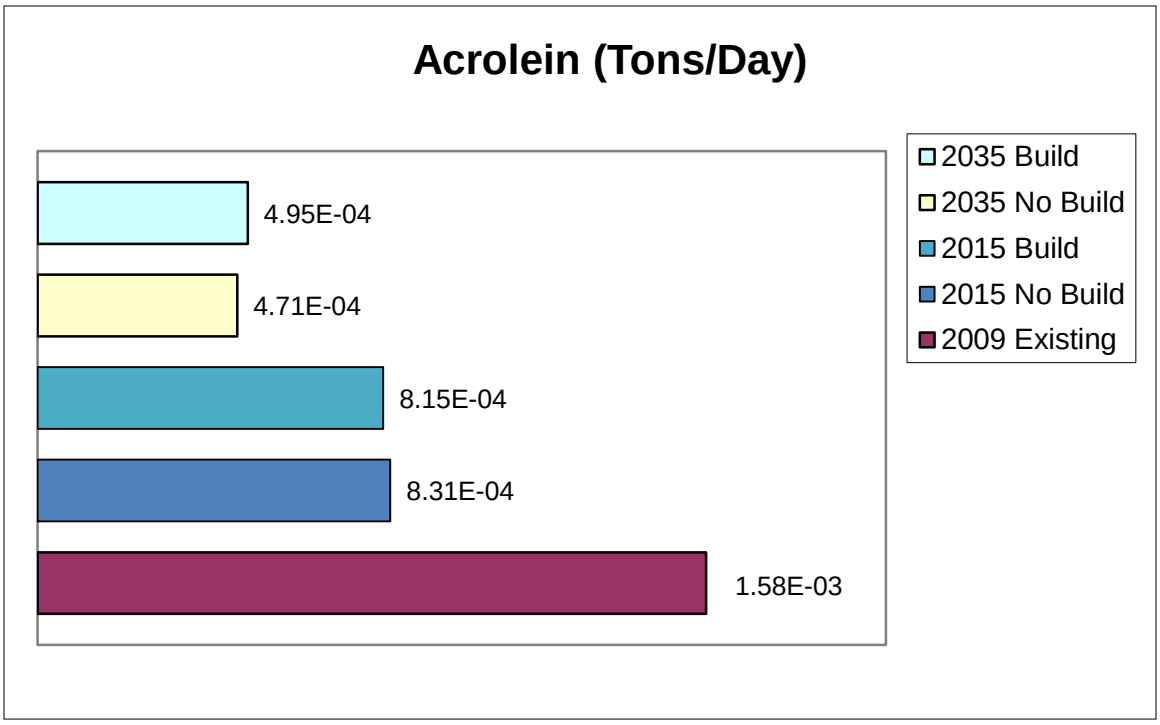


Figure 10 Acetaldehyde Emissions Comparison for 2009, 2015 and 2035

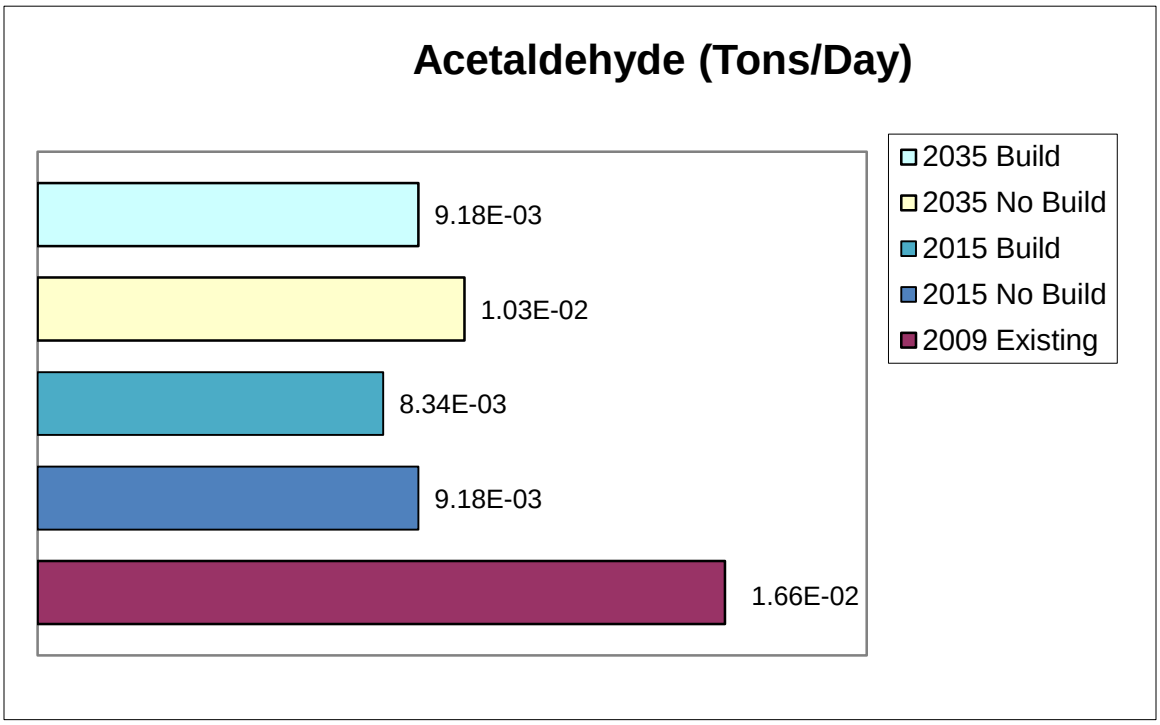


Figure 11 Naphthalene Emissions Comparison for 2009, 2015 and 2035

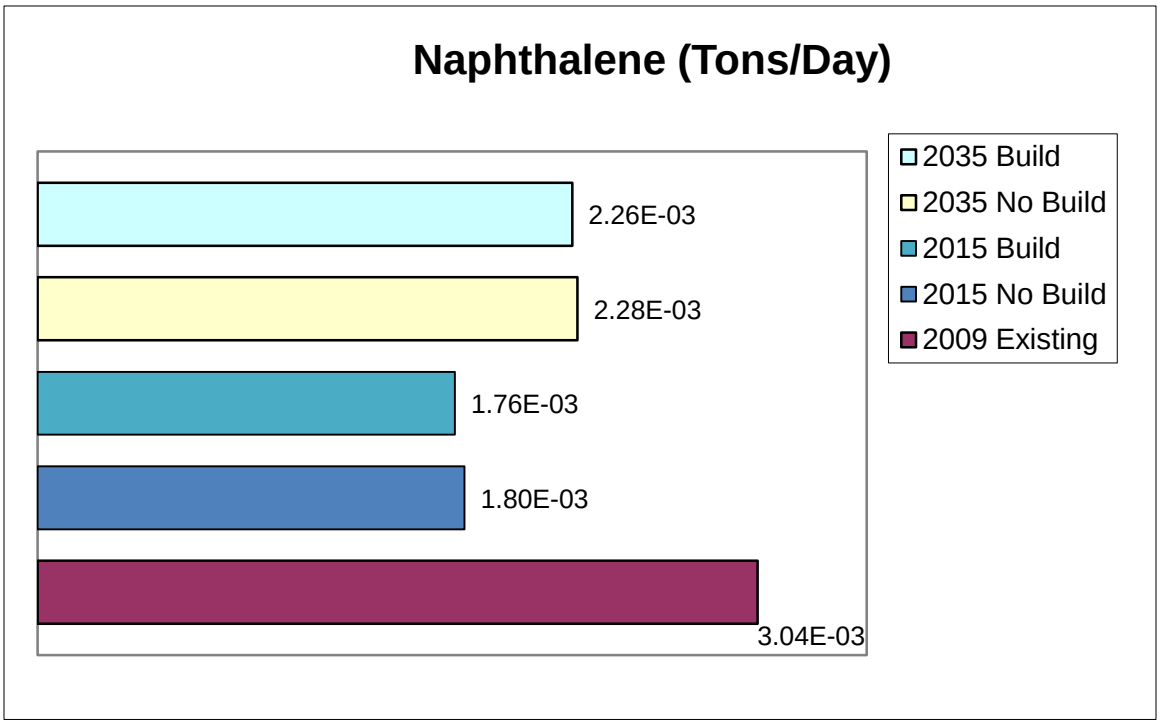
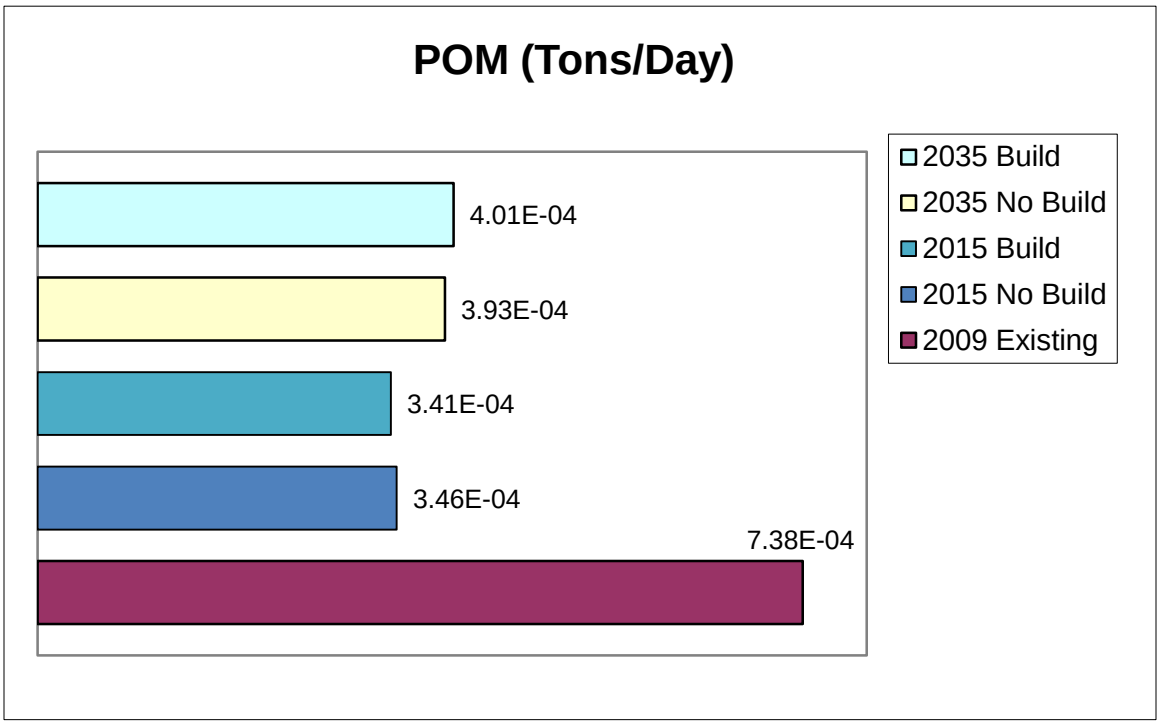


Figure 12 POM Emissions Comparison for 2009, 2015 and 2035



In conclusion, MSAT emissions for the Build Alternative would be slightly higher than the No Build Alternative in the project design year (2035) for some pollutants (DPM, butadiene, benzene, acrolein, and POM), but would be lower for other pollutants (formaldehyde, acetaldehyde, and naphthalene). The emissions for both the Build Alternative and No Build Alternative in 2035 are substantially lower than existing conditions, even with the increase in VMT due to improvements in emission rates for roadway vehicles. Reductions in MSAT emissions for the Build Alternative in 2035 compared to existing conditions would range from 26 to 69 percent. In addition, the project is also designed to accommodate and encourage clean air vehicles, carpooling, the generation of highway transportation funds, and improve the operational efficiency of US 101. Improving the operational efficiency of US 101 would be expected to relieve congestion by increasing average peak period speeds. The results of the analysis demonstrated that the project would not result in a substantial increase in MSAT emissions and there would not be meaningful differences in MSAT emissions between alternatives, especially in light of the substantial reductions in MSAT emissions that would occur from existing conditions. Consequently, no significant adverse impact on air quality would occur from projected-related MSAT emissions.

Chapter 4. References

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Appendix A
MSAT Modeling Results

US 101 Express Lanes

PEAK PERIODS ONLY

	2009 Existing				2015 No Build				2015 Build				2035 No Build				2035 Build			
Speed (u	AM	PM	Total	**Percent**	AM	PM	Total	**Percent**	AM	PM	Total	**Percent**	AM	PM	Total	**Percent**	AM	PM	Total	**Percent**
5	0	0	0	**0.00%**	0	7557	7557	**0.25%**	0	0	0	**0.00%**	29932.04	33333.16	63265.2	**1.74%**	0	0	0	**0.00%**
10	6314.6	8234.73	14549.33	**0.53%**	27160.9	32702.21	59863.06	**1.97%**	0.0	0.00	0.00	**0.00%**	56776.32	92607.16	149383.5	**4.10%**	44734.81	24625.93	69360.74	**1.74%**
15	34388.43	25509.97	59898.40	**2.18%**	33385.5	18562.36	51947.87	**1.71%**	2067.2	5739.82	7807.04	**0.24%**	88011.03	106956.8	194967.8	**5.35%**	130524.9	104814.5	235339.4	**5.91%**
20	33339.83	20471.60	53811.43	**1.96%**	30220.0	37360.19	67580.19	**2.23%**	22788.5	19924.92	42713.40	**1.32%**	112981.7	147424.5	260406.3	**7.15%**	158957.9	213105.3	372063.2	**9.35%**
25	30929.16	22057.22	52986.38	**1.93%**	54232.8	63963.14	118195.98	**3.90%**	51260.8	30928.58	82189.37	**2.54%**	175372.4	144643.7	320016.1	**8.78%**	132396.7	166571.2	298967.9	**7.51%**
30	21355.35	49745.96	71101.31	**2.59%**	27916.7	42344.32	70261.04	**2.32%**	55263.9	53976.50	109240.36	**3.38%**	63912.77	164583.7	228496.5	**6.27%**	114715.1	153232.4	267947.5	**6.73%**
35	31714.26	60248.08	91962.34	**3.35%**	82866.9	92439.68	175306.60	**5.78%**	122426.5	129520.88	251947.39	**7.80%**	167539	143323.9	310862.9	**8.53%**	139532.9	142896.3	282429.2	**7.10%**
40	60906.03	66186.80	127092.83	**4.63%**	131320.40	131670.60	262991.00	**8.68%**	118611.66	126938.43	245550.09	**7.60%**	175583.6	137674.5	313258	**8.60%**	86680.74	110238.7	196919.4	**4.95%**
45	53982.3	88426.02	142408.32	**5.19%**	99671.59	130528.43	230200.02	**7.59%**	133443.08	164078.02	297521.10	**9.21%**	109088	145230.6	254318.6	**6.98%**	83318.89	150098.5	233417.4	**5.87%**
50	154660.9	135687.89	290348.79	**10.57%**	137242.45	181068.25	318310.70	**10.50%**	144237.54	194111.80	338349.34	**10.47%**	116566.6	197347.2	313913.8	**8.62%**	129663	170459.3	300122.3	**7.54%**
55	130716	190516.04	321232.04	**11.70%**	155311.68	178078.15	333389.83	**11.00%**	139001.43	231246.44	370247.86	**11.46%**	125426.3	153667.4	279093.7	**7.66%**	138621.8	202058.6	340680.3	**8.56%**
60	198110.2	221197.52	419307.73	**15.27%**	184704.76	202589.97	387294.73	**12.78%**	181360.76	227325.29	408686.05	**12.65%**	136930.9	298493.2	435424.1	**11.95%**	180506.8	312964.8	493471.6	**12.40%**
65	414935.5	686288.59	1101224.09	**40.10%**	352906.26	595369.35	948275.61	**31.28%**	420577.25	655548.07	1076125.31	**33.31%**	211323.5	308879.8	520203.3	**14.28%**	372340.8	516281.1	888621.9	**22.33%**
Total	1171353	1574570.42	2,745,923	**100.00%**	1316939.98	1714233.65	3031173.63	**100.00%**	1391038.571	1839338.748	3230377.318	**100.00%**	1569444	2074166	3643610	**100.00%**	1711994	2267347	3979341	**100.00%**
Daily VMT				**6,047,479**				**6,675,475**				**7,117,765**				**8,021,638**				**8,766,823**
Weighted Speed				**54**				**51**				**53**				**41**				**44**
											1.065718336	1.06625603							1.092142	1.092896842

Tons per day

	DPM	Formaldehyde	Butadiene	Benzene	Acrolein	Acetaldehyde	Naphthaler	POM
Existing	1.01E-01	4.36E-02	7.11E-03	5.08E-02	1.58E-03	1.66E-02	3.04E-03	7.38E-04
2015 No Build	3.88E-02	2.41E-02	3.73E-03	2.92E-02	8.31E-04	9.18E-03	1.80E-03	3.46E-04
2015 Build	3.99E-02	2.22E-02	3.65E-03	2.94E-02	8.15E-04	8.34E-03	1.76E-03	3.41E-04
Delta 1	3%	-8%	-2%	1%	-2%	-9%	-2%	-2%
2035 No Build	2.81E-02	2.39E-02	2.23E-03	1.93E-02	4.71E-04	1.03E-02	2.28E-03	3.93E-04
2035 Build	3.18E-02	2.19E-02	2.30E-03	2.01E-02	4.95E-04	9.18E-03	2.26E-03	4.01E-04
Delta 2	13%	-9%	3%	4%	5%	-11%	-1%	2%
	-61%	-49%	-49%	-42%	-48%	-50%	-42%	-54%
	-69%	-50%	-68%	-60%	-69%	-45%	-26%	-46%

File Name:	Santa Clara (SF) - 2009 - Annual_Existing.EC
CT-EMFAC Version:	5.0.0.14319
Run Date:	11/27/2013 9:03
Area:	Santa Clara (SF)
Analysis Year:	2009
Season:	Annual

==========

Vehicle Category	VMT Fraction Across Category	Diesel VMT Fraction Within Category
Truck 1	0.037	0.3
Truck 2	0.029	0.944
Non-Truck	0.934	0.005

==========

Road Length:	1	miles
Volume:	6047479	vehicles per hour
Number of Hours:	1	hours
Avg. Idling Time:	0	minutes per vehicle
Tot. Idling Time:	0	hours

VMT Distribution by Speed (mph):

5	0.00%
10	0.50%
15	2.20%
20	2.00%
25	1.90%
30	2.60%
35	3.30%
40	4.60%
45	5.20%
50	10.60%
55	11.70%
60	15.30%
65	40.10%
70	0.00%
75	0.00%

==========

Summary of Project Emissions

Pollutant Name	Running Exhaust (grams)	Idling Exhaust (grams)	Running Loss (grams)	Tire/Brake Wear (grams)	Total (grams)	Total (US tons)
ROG	857741.6	0	1702462	-	2560203.6	2.822
TOG	1063123.1	0	1702462	-	2765585.1	3.049
CO	19628356.3	0	-	-	19628356.3	21.637
NOx	5075837.9	0	-	-	5075837.9	5.595
CO2	2649743291	0	-	-	2649743291	2920.842
CO2 (Pavley I + LCFS)	2649502313	0	-	-	2649502313	2920.576
PM10	114180.4	0	-	293224.1	407404.5	0.449
PM2.5	104693.9	0	-	116420	221113.9	0.244
Benzene	29048.3	0	17023.7	-	46071.9	0.051
Acrolein	1429.5	0	0	-	1429.5	0.002
Acetaldehyde	15038.9	0	0	-	15038.9	0.017
Formaldehyde	39543.7	0	0	-	39543.7	0.044
Butadiene	6451.5	0	0	-	6451.5	0.007
Naphthalene	2079.4	0	677.3	-	2756.7	0.003
POM	669.8	0	-	-	669.8	<0.001
Diesel PM	91931.1	0	-	-	91931.1	0.101
DEOG	129452.6	0	-	-	129452.6	0.143

==========END==========

File Nai Santa Clara (SF) - 2015 - Annual_No Build.EC
CT-EMFAC 5.0.0.14319
Run Da 11/27/2013 13:02
Area Santa Clara (SF)
Analysis \ 2015
Seaso Annual

==========

Vehicle Cat	VMT Fraction Across Category	Diesel VMT Fraction Within Category
Truck	0.034	0.295
Truck	0.034	0.939
Non-Tr	0.932	0.005

==========

Road Le	1	miles
Volun	6675475	vehicles per hour
Number o	1	hours
Avg. Idling	0	minutes per vehicle
Tot. Idling	0	hours

VMT Distribution by Speed (mph):

5	0.25%
10	1.97%
15	1.71%
20	2.23%
25	3.90%
30	2.32%
35	5.78%
40	8.68%
45	7.59%
50	10.50%
55	11.00%
60	12.78%
65	31.29%
70	0.00%
75	0.00%

==========

Summary of Project Emissions

Polluta	Running Exhaust (grams)	Idling Exha (grams	Running I (grams	Tire/Brake (grams	Total (grams	Total (US tons)
ROG	478537.8	0	1091160	-	1569698	1.73
TOG	613546.6	0	1091160	-	1704706	1.879
CO	11330737.1	0	-	-	11330737	12.49
NOx	3237383.8	0	-	-	3237384	3.569
CO2	2997617331	0	-	-	3E+09	3304.307
CO2 (Pavle	2682392196	0	-	-	2.68E+09	2956.831
PM10	48245.6	0	-	324821.9	373067.6	0.411
PM2.5	44325.6	0	-	128883.4	173209	0.191
Benzene	15540.7	0	10914.4	-	26455.1	0.029
Acrolein	754.1	0	0	-	754.1	<0.001
Acetaldehy	8330	0	0	-	8330	0.009
Formaldeh	21825.9	0	0	-	21825.9	0.024
Butadiene	3388.2	0	0	-	3388.2	0.004
Naphthale	1194.4	0	440.6	-	1635	0.002
POM	314.3	0	-	-	314.3	<0.001
Diesel PM	35188.7	0	-	-	35188.7	0.039
DEOG	77283.9	0	-	-	77283.9	0.085

==========END==========

File Name: Santa Clara (SF) - 2015 - Annual_Build.EC
CT-EMFAC Version 5.0.0.14319
Run Date: ################
Area: Santa Clara (SF)
Analysis Year: 2015
Season: Annual

==========

Vehicle Category	VMT Fraction Across Category	Diesel VMT Fraction Within Category
Truck 1	0.034	0.295
Truck 2	0.034	0.939
Non-Truck	0.932	0.005

==========

Road Length:	1	miles
Volume:	7117765	vehicles per hour
Number of Hours:	1	hours
Avg. Idling Time:	0	minutes per vehicle
Tot. Idling Time:	0	hours

VMT Distribution by Speed (mph):

5	0.00%
10	0.00%
15	0.24%
20	1.32%
25	2.54%
30	3.38%
35	7.80%
40	7.60%
45	9.21%
50	10.47%
55	11.46%
60	12.65%
65	33.33%
70	0.00%
75	0.00%

==========

Summary of Project Emissions

Pollutant Nam	Running Exhaust (grams)	Idling Exhaust (grams)	Running Loss (grams)	Tire/Brake Wear (grams)	Total (grams)	Total (US tons)
ROG	463304.1	0	1163455.7	-	1626759.8	1.793
TOG	590729	0	1163455.7	-	1754184.7	1.934
CO	11661614.3	0	-	-	11661614.3	12.855
NOx	3355189	0	-	-	3355189	3.698
CO2	3030618798	0	-	-	3030618798	3340.685
CO2 (Pavley I + LCF	2712321994	0	-	-	2712321994	2989.823
PM10	48487	0	-	346343.3	394830.4	0.435
PM2.5	44542.5	0	-	137422.7	181965.2	0.201
Benzene	15058.8	0	11637.5	-	26696.3	0.029
Acrolein	739	0	0	-	739	<0.001
Acetaldehyde	7561.8	0	0	-	7561.8	0.008
Formaldehyde	20172.1	0	0	-	20172.1	0.022
Butadiene	3307.1	0	0	-	3307.1	0.004
Naphthalene	1127.7	0	469.8	-	1597.5	0.002
POM	309.2	0	-	-	309.2	<0.001
Diesel PM	36201	0	-	-	36201	0.04
DEOG	67251.3	0	-	-	67251.3	0.074

==========END==========

File Name:	Santa Clara (SF) - 2035 - Annual_No Build.EC
CT-EMFAC Versior	5.0.0.14319
Run Date:	##############
Area:	Santa Clara (SF)
Analysis Year:	2035
Season:	Annual

==========

Vehicle Category	VMT Fraction Across Category	Diesel VMT Fraction Within Category
Truck 1	0.034	0.297
Truck 2	0.043	0.954
Non-Truck	0.923	0.005

==========

Road Length:	1	miles
Volume:	8021638	vehicles per hour
Number of Hours:	1	hours
Avg. Idling Time:	0	minutes per vehicle
Tot. Idling Time:	0	hours

VMT Distribution by Speed (mph):

5	1.74%
10	4.10%
15	5.35%
20	7.15%
25	8.78%
30	6.27%
35	8.53%
40	8.60%
45	6.98%
50	8.62%
55	7.66%
60	11.95%
65	14.27%
70	0.00%
75	0.00%

==========

Summary of Project Emissions

Pollutant Nam	Running Exhaust (grams)	Idling Exhaust (grams)	Running Loss (grams)	Tire/Brake Wear (grams)	Total (grams)	Total (US tons)
ROG	334075.8	0	737308.8	-	1071384.6	1.181
TOG	443546.9	0	737308.8	-	1180855.7	1.302
CO	6233414.3	0	-	-	6233414.3	6.871
NOx	1452107.7	0	-	-	1452107.7	1.601
CO2	4146003524	0	-	-	4146003524	4570.187
CO2 (Pavley I + LCI	2855911807	0	-	-	2855911807	3148.104
PM10	45275.9	0	-	393669.9	438945.8	0.484
PM2.5	41807.4	0	-	155996.8	197804.2	0.218
Benzene	10115.2	0	7371.9	-	17487.1	0.019
Acrolein	426.9	0	0	-	426.9	<0.001
Acetaldehyde	9343.3	0	0	-	9343.3	0.01
Formaldehyde	21725.3	0	0	-	21725.3	0.024
Butadiene	2018.9	0	0	-	2018.9	0.002
Naphthalene	1770.9	0	296.8	-	2067.7	0.002
POM	356.4	0	-	-	356.4	<0.001
Diesel PM	25506.2	0	-	-	25506.2	0.028
DEOG	109057.7	0	-	-	109057.7	0.12

==========END==========

File Na Santa Clara (SF) - 2035 - Annual_Build.EC
CT-EMFAC 5.0.0.14319
Run Da 11/27/2013 13:07
Area Santa Clara (SF)
Analysis \ 2035
Seasc Annual

==========

Vehicle Cat	VMT Fraction Across Category	Diesel VMT Fraction Within Category
Truck	0.034	0.297
Truck	0.043	0.954
Non-Tr	0.923	0.005

==========

Road Le	1	miles
Volur	8766823	vehicles per hour
Number o	1	hours
Avg. Idling	0	minutes per vehicle
Tot. Idling	0	hours

VMT Distribution by Speed (mph):

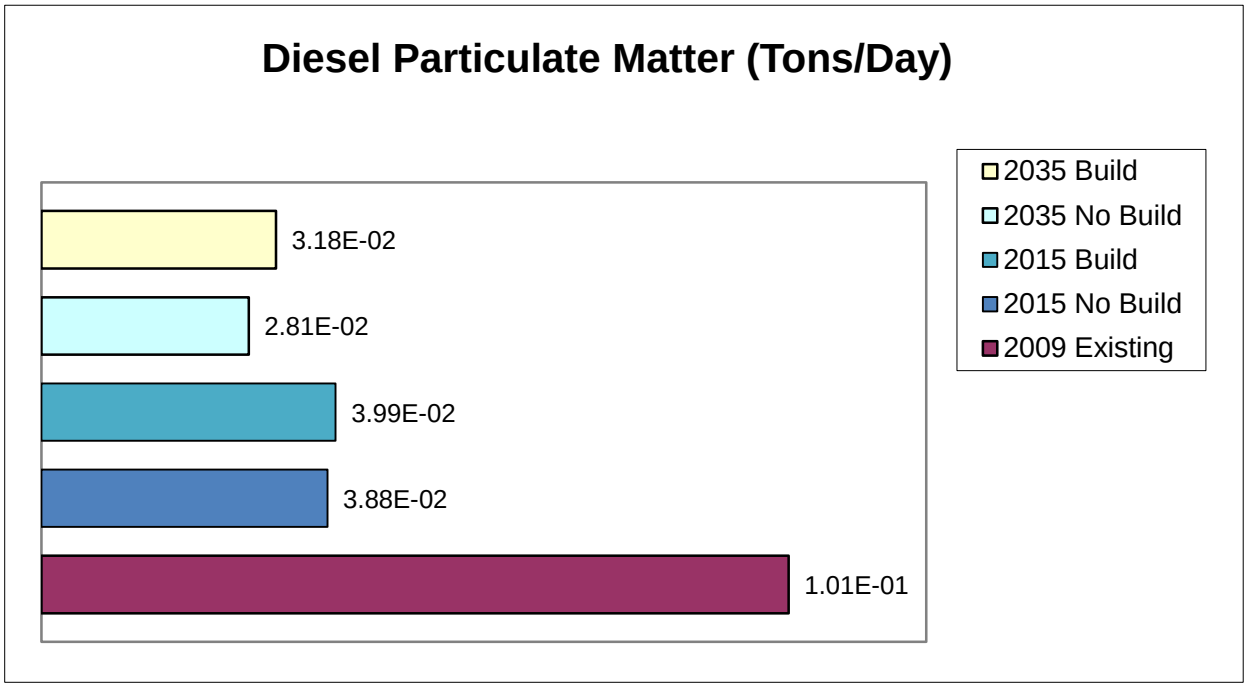
5	0.00%
10	1.74%
15	5.91%
20	9.35%
25	7.51%
30	6.73%
35	7.10%
40	4.95%
45	5.87%
50	7.54%
55	8.56%
60	12.40%
65	22.34%
70	0.00%
75	0.00%

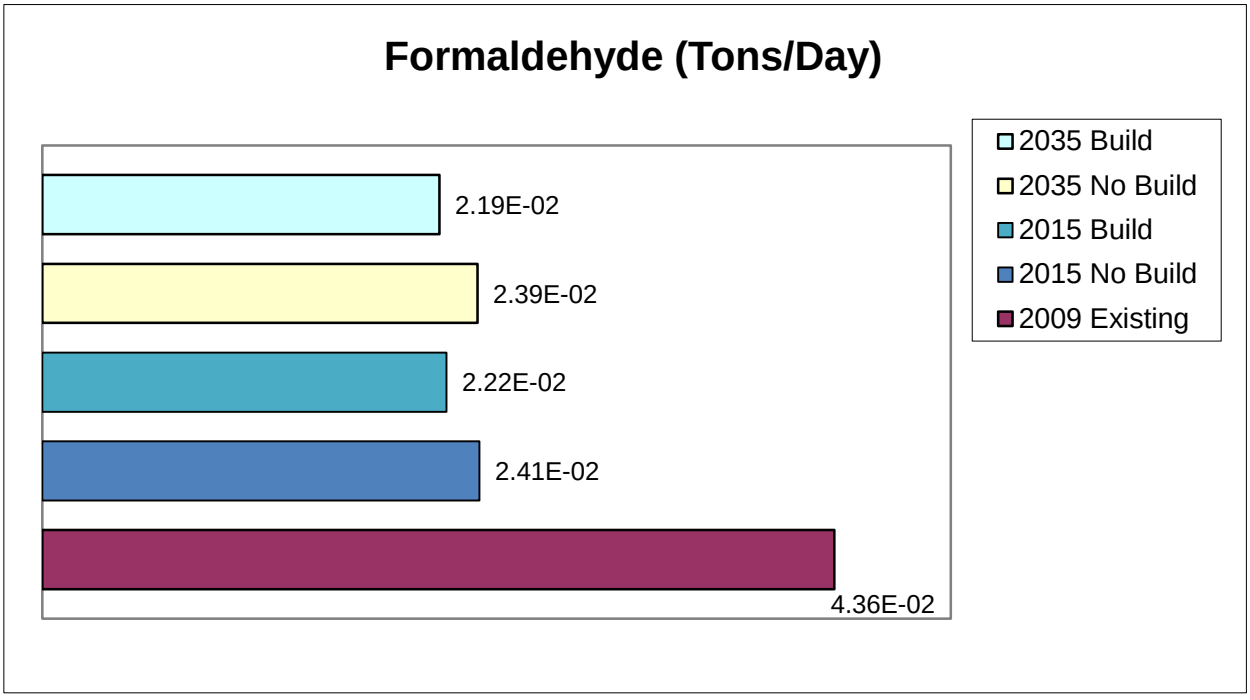
==========

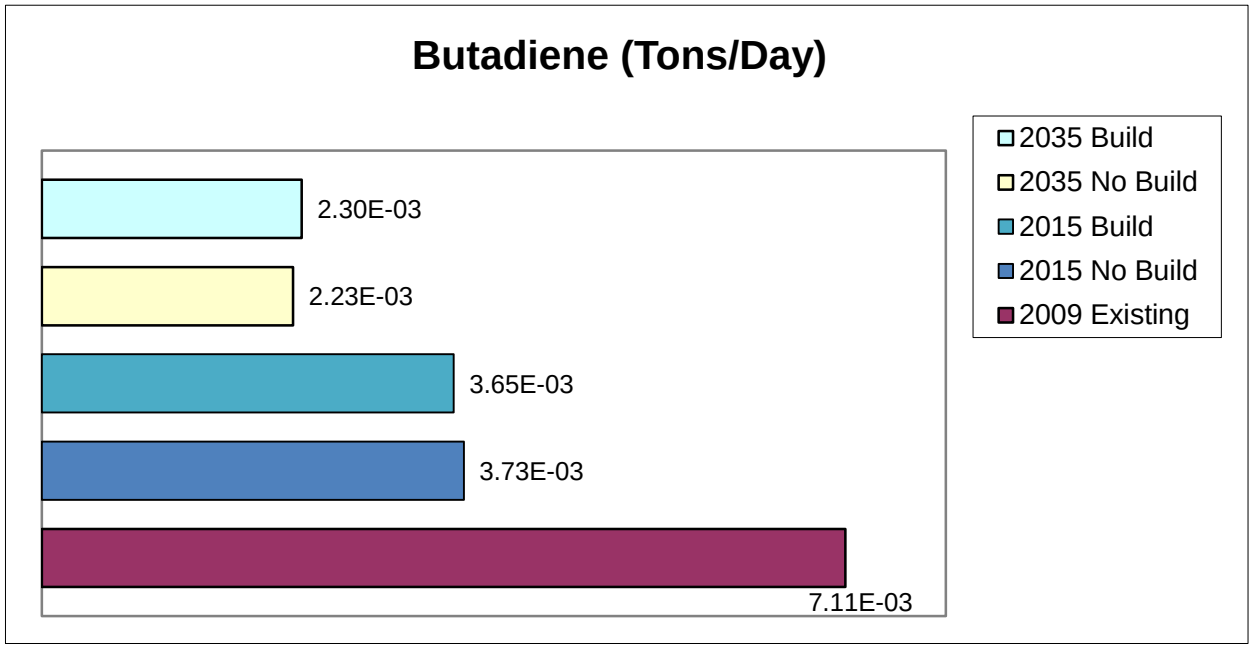
Summary of Project Emissions

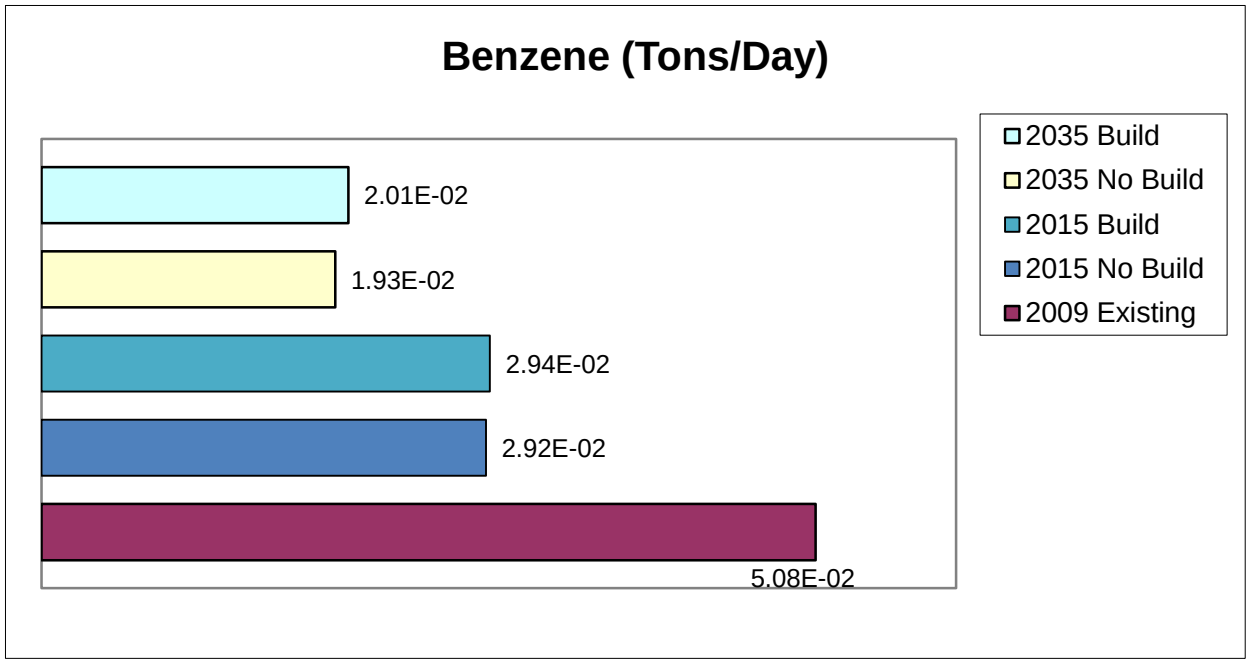
Polluta	Running Exhaust (grams)	Idling Exha (grams	Running I (grams	Tire/Brake (grams	Total (grams	Total (US tons)
ROG	335134.6	0	805802.5	-	1140937	1.258
TOG	441904.8	0	805802.5	-	1247707	1.375
CO	6644521.1	0	-	-	6644521	7.324
NOx	1535199.5	0	-	-	1535200	1.692
CO2	4339867565	0	-	-	4.34E+09	4783.885
CO2 (Pavle	2989211252	0	-	-	2.99E+09	3295.041
PM10	48027.4	0	-	430240.6	478268	0.527
PM2.5	44333.9	0	-	170488.4	214822.4	0.237
Benzene	10214.6	0	8056.7	-	18271.3	0.02
Acrolein	449.1	0	0	-	449.1	<0.001
Acetaldehy	8330.5	0	0	-	8330.5	0.009
Formaldeh	19831.4	0	0	-	19831.4	0.022
Butadiene	2086.8	0	0	-	2086.8	0.002
Naphthaler	1722.8	0	324.4	-	2047.2	0.002
POM	364.1	0	-	-	364.1	<0.001
Diesel PM	28853	0	-	-	28853	0.032
DEOG	93906.7	0	-	-	93906.7	0.104

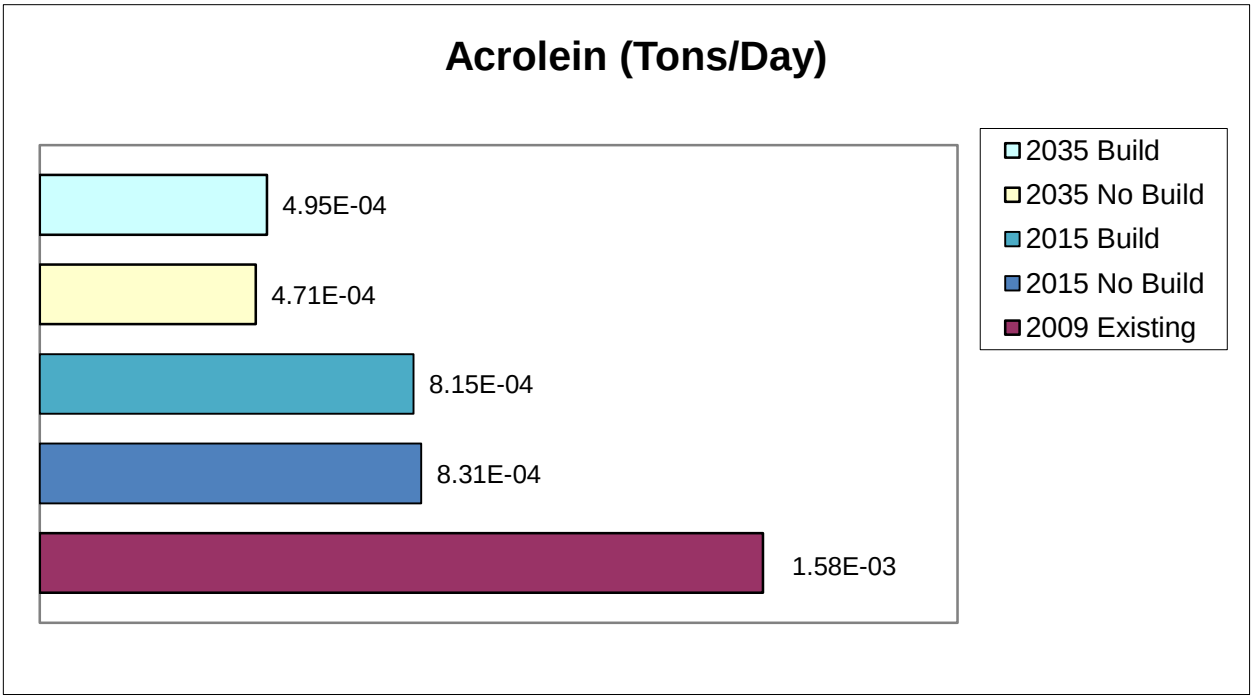
==========END==========

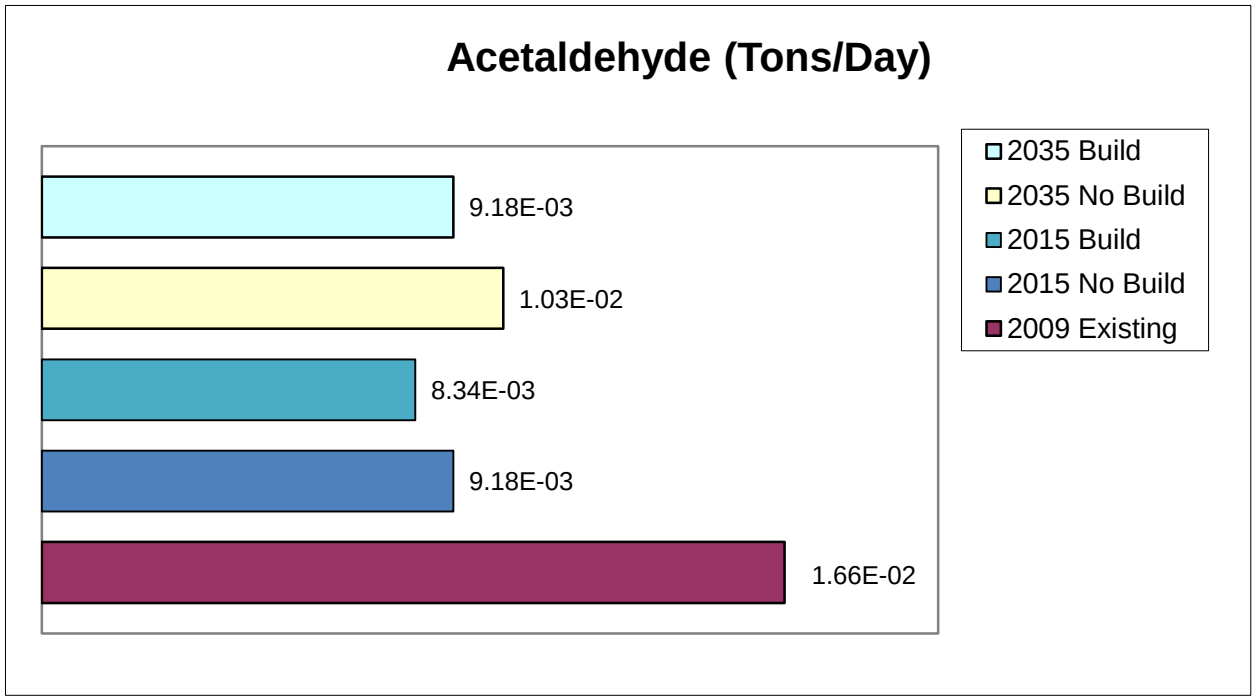

Diesel Particulate Matter (Tons/Day)
3.18E-02
2.81E-02
3.99E-02
3.88E-02
1.01E-01
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing

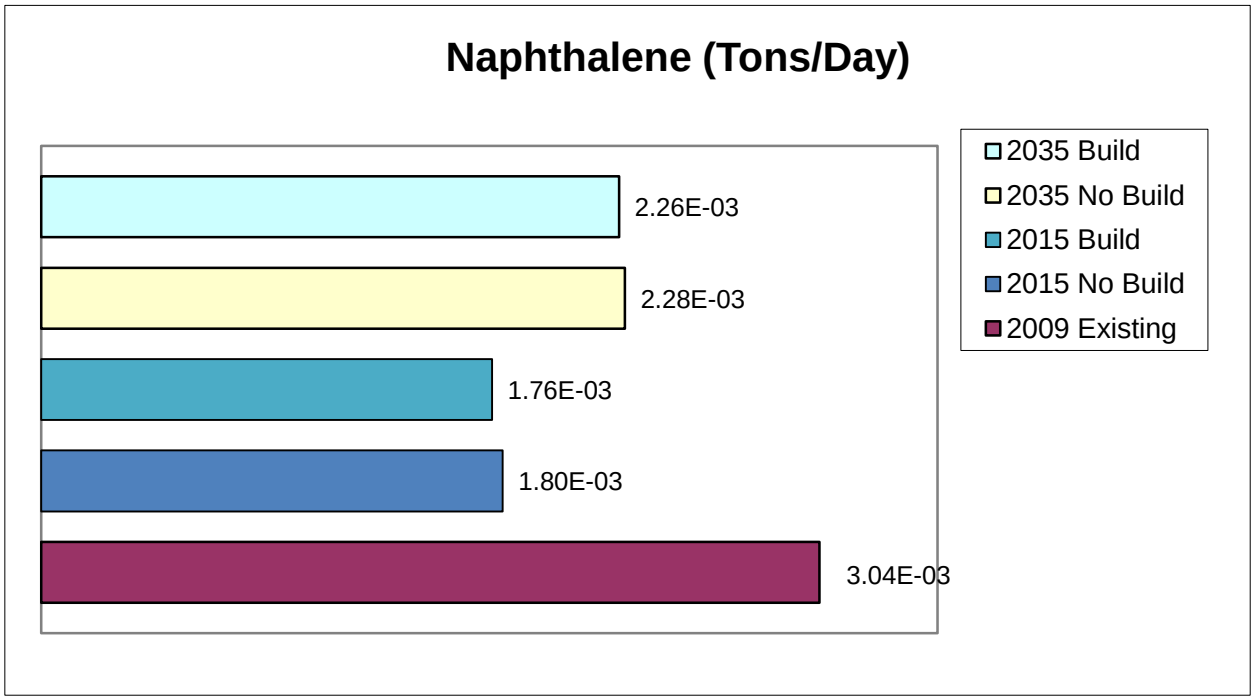

Formaldehyde (Tons/Day)
2.19E-02
2.39E-02
2.22E-02
2.41E-02
4.36E-02
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing

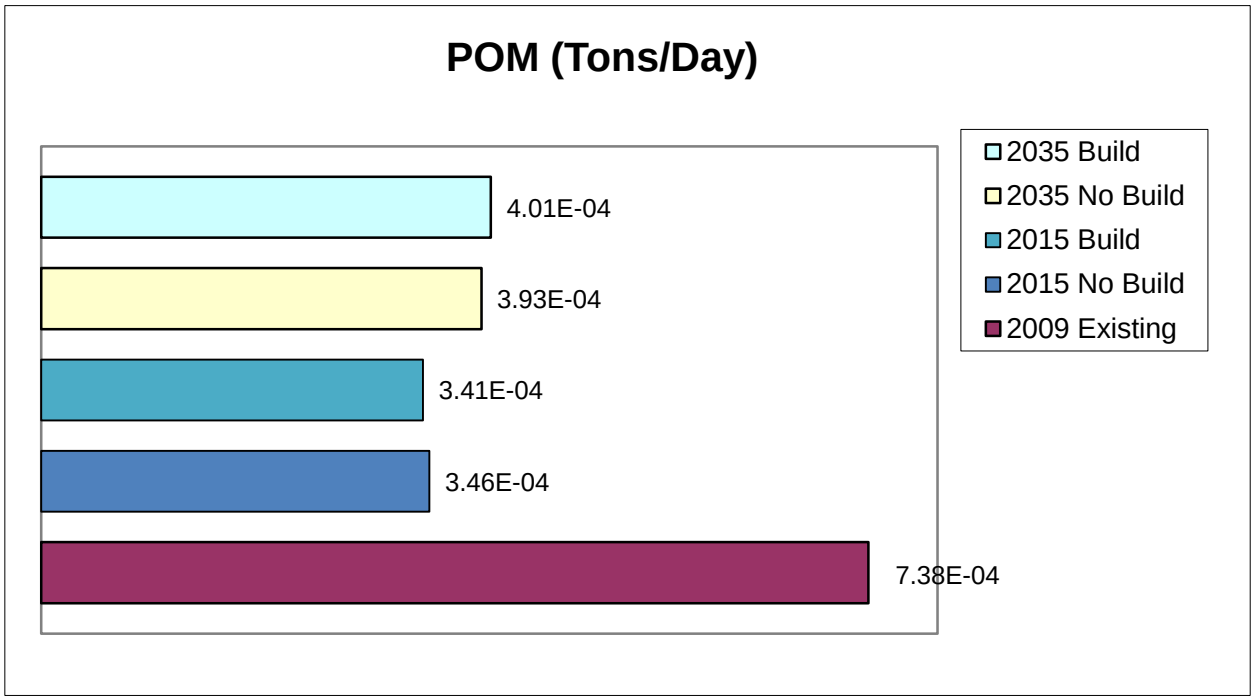

Butadiene (Tons/Day)
2.30E-03
2.23E-03
3.65E-03
3.73E-03
7.11E-03
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing


Benzene (Tons/Day)
2.01E-02
1.93E-02
2.94E-02
2.92E-02
5.08E-02
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing


Acrolein (Tons/Day)
4.95E-04
4.71E-04
8.15E-04
8.31E-04
1.58E-03
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing


Acetaldehyde (Tons/Day)
9.18E-03
1.03E-02
8.34E-03
9.18E-03
1.66E-02
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing


Naphthalene (Tons/Day)
2.26E-03
2.28E-03
1.76E-03
1.80E-03
3.04E-03
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing


POM (Tons/Day)
4.01E-04
3.93E-04
3.41E-04
3.46E-04
7.38E-04
2035 Build
2035 No Build
2015 Build
2015 No Build
2009 Existing