APPENDIX F
AIR QUALITY MODELING TECHNICAL STUDY

Auto Club Speedway
9300 Cherry Avenue
Fontana, CA 92335

October 2009

Prepared by:

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1.0 Introduction

Auto Club Speedway (Speedway) has requested Yorke Engineering, LLC. (Yorke) to perform an analysis of the air emissions associated with the drag strip operations at their Fontana, California facility. This analysis was performed following the South Coast Air Quality Management District's and the Office of Environmental Heath and Hazard Assessment guidelines.

The analysis was performed by Mr. Kelvin Lu, his contact information is provided below.

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The analysis involved 4 tasks.

1) Fleet Determination
2) Emission Calculations
3) Air Dispersion Modeling
4) Health Risk Assessment

The details of the tasks performed are described in this report.

2.0 Fleet Determination

The first task was to determine the types and quantity of vehicles associated with drag strip activities. By reviewing the facility's racing and activities calendar for the calendar year 2009, Yorke determined that drag strip activities took place on 66 days out of the year. Typically these race events involve regular passenger vehicles fueled by standard gasoline and driven by amateur drivers. Speedway does not maintain a record of the exact number of cars involved in drag strip activities, but it is estimated at approximately 200 races are performed each day, which includes vehicles that may compete multiple times in a day.

The Speedway may hold on occasion special events with specialized vehicles and professional drivers. These events are rare and on those days, the participant count would be dramatically reduced. Due to the lower number of races involved, and the infrequent occurrence of these events, it is assumed that the emissions generated by these special events on any day would be equivalent to a standard racing event day of 200 passenger cars.

This results in a total of 13,200 passenger car equivalent races on an annual basis.

On even rarer occasions, the facility may hold an event involving cars fueled by nitromethane. Again, the number of cars involved in these events is unknown. Based on Speedway estimates, Yorke has assumed that an additional 1% of the total races may involve these vehicles.

Yorke has also determined that a race involves a vehicle traveling a short distance from where it is parked to the starting line. That vehicle will then travel 0.25 miles while pressing the accelerator followed by 0.42 miles to the end of the track to slow down. The vehicle will then return to its original starting location. The distance covered by the vehicle to get to the starting line and to return from the end of the track was determined to be 0.75 miles, for a total race distance of 1.42 miles per race per vehicle.

3.0 EMISSION CALCULATIONS

The second task was to quantify the emissions generated by vehicles participating in drag strip activities. The Environmental Protection Agency (EPA) maintains a publication called "The Master List of Compounds Emitted by Mobile Sources". This document is a compilation of all testing performed by EPA on mobile sources. The document quantifies the maximum and minimum emission rates of any compounds ever detected during a test. The list is very comprehensive and includes various model year vehicles, engine sizes, and fuels.

Yorke took the list and separated out the results for gasoline combustion. The emission factors obtained from the EPA document and used in this analysis are shown below.

Table 3-1: Emitted Compounds

Emitted Compound	CAS	Milligrams per mile (mg/mi)
1,1,1-trichloroethane	00071-55-6	0.03
1,3-butadiene	00106-99-0	338.6232
2,3,7,8-tetrachlorodibenzo-p-dioxin	01746-01-6	0.0000153
2-butanone	00078-93-3	21.6012878
2-methoxy-2-methylpropane	01634-04-4	2069.04102
2-propenal	00107-02-8	46.9000015
acetaldehyde	00075-07-0	604.802307
antimony	07440-36-0	0.13019134
arsenic	07440-38-2	0.03416624
benzene	00071-43-2	2389.7565
benzo(a)anthracene	00056-55-3	14.7200003
benzo(a)phenanthrene	00218-01-9	10.7600002
benzo(a)pyrene	00050-32-8	14.8199997
benzo(b)fluoranthene	00205-99-2	25.2000008
benzo(k)fluoranthene	00207-08-9	5.36999989
bromine	07726-95-6	0.30500001
chlorine	07782-50-5	1.21800005
chrysene	218-01-9	0.03237344
copper	07440-50-8	0.227
cresol	01319-77-3	3.9
dibenz(a,h)anthracene	00053-70-3	0.0134
dibenz(a,h+a,c)anthracene	00053-70-3	1.73000002
dichloromethane	00075-09-2	1.4
ethylbenzene	00100-41-4	432.6778
formaldehyde	00050-00-0	1623.92004
hexane	00110-54-3	1062.5487

Emitted Compound	CAS	Milligrams per mile (mg/mi)
indeno(1,2,3-cd)pyrene	00193-39-5	15.9099998
lead	07439-92-1	1.59599996
m- & p-xylene	1330-20-7	1068.75842
m-xylene	00108-38-3	821.033447
manganese	07439-96-5	1.49300003
mercury	07439-97-6	0.06257816
methyl alcohol	00067-56-1	851.9251
methyl bromide	00074-83-9	0.15
naphthalene	00091-20-3	299.12616
nickel	07440-02-0	0.23545411
o-,m-,p-xylene	01330-20-7	63
o-xylene	00095-47-6	429.720245
p-xylene	00106-42-3	410.529114
phosphorus	07723-14-0	3.41878819
propene	00115-07-1	2483.4958
selenium	07782-49-2	0.15101674
styrene	00100-42-5	150.8451
toluene	00108-88-3	2994.8283
trichloromethane	00067-66-3	0.9
vanadium	07440-62-2	0.0091901
zinc	07440-66-6	5.72800016
benzo(j)fluoranthene	205-82-3	0.00094448
ammonia	7664-41-7	292.399994
hydrogen cyanide	74-90-8	90

These emission factors were then applied to the distance travelled by the vehicles. Since the emission factors include various modes of vehicle operations, Yorke applied the published maximum emission factor for the 0.75 miles that the vehicle travels off the drag strip. During the 0.25 miles of the actual race, the vehicle will be accelerating the entire time and would be less efficient on fuel. It was assumed that the vehicle would consume four (4) times the same amount of fuel during this acceleration period and would therefore produce 4 times the amount of pollutants. Once the race is finished, the vehicle would be decelerating and would use less fuel. It was assumed that the vehicle would use only half the amount of fuel during this period and therefore emit half the pollutants.

The final emissions used for the analysis are included in appendix to this report. These emissions were applied to the 13,200 passenger car equivalent races.

For the 1% of nitromethane fuel races, Yorke was unable to identify any sources citing the expected emissions of pollutants from nitromethane combustion. Nitromethane has approximately one-fourth the heat content (the ability to produce heat when combusted) of gasoline. However, nitromethane requires less oxygen to burn than gasoline does. Therefore, an engine fueled by nitromethane would be capable of using 8 times as much nitromethane as it would gasoline, which in the end would produce twice the energy of gasoline.

Yorke also discovered that the combustion of nitromethane is believed to only produce trace levels of pollutant emissions versus gasoline, except for emissions of formaldehyde and ammonia.

Yorke therefore added extra emissions of formaldehyde and ammonia to account for these addition vehicles. Yorke was unable to determine the actual level of emissions of formaldehyde and ammonia from nitromethane combustion. Therefore, it was conservatively assumed that emissions of formaldehyde and ammonia from nitromethane combustion would be 10 times that of gasoline combustion. Also, since a vehicle would require 8 times as much fuel, the resulting emissions from a nitromethane fueled vehicle would be 80 times that of a normal gasoline fueled vehicle.

The nitromethane vehicles represent an additional 1% of the total races, this means that an additional 80% of formaldehyde and ammonia emissions would be generated from these vehicles.

In addition to vehicle emissions, the Speedway applies a substance to the race track known as VHT to allow the vehicles' tires to grip the track better. Based on manufacturer's data, the substance was found to contain isopropyl alcohol, solvent naphtha, and toluene. The facility is limited to 10,000 lbs of VHT on an annual basis per SCAQMD Rule 442 – Usage of Solvent (833 lbs./Month). The emissions from all 10,000 lbs of VHT were included in the analysis.

4.0 Air Dispersion Modeling

Atmospheric dispersion modeling was conducted to analyze potential localized ambient air quality impacts associated with the drag strip operations of the Speedway. The atmospheric dispersion modeling methodology is based on generally accepted modeling practices and modeling guidelines of both the USEPA and the SCAQMD. All dispersion modeling was performed using the Industrial Source Complex Short Term 3 (ISCST3) dispersion model (Version 02035) (USEPA, 2002).

The options used in the ISCST3 dispersion modeling are summarized in Table 4-1. USEPA regulatory default modeling options were selected, except for the calm processing option. Since the meteorological data sets developed by the SCAQMD are based on hourly average wind measurements, rather than airport observations that represent averages of just a few minutes, the SCAQMD's modeling guidance requires that this modeling option not be used.

Table 4-1: Dispersion Modeling Options for ISCST3

Feature	Option Selected
Terrain processing selected	No
Meteorological data input method	Card Image
Rural-urban option	Urban
Wind profile exponents values	Defaults
Vertical potential temperature gradient values	Defaults
Program calculates final plume rise only	Yes
Program adjusts all stack heights for downwash	No
Concentrations during calm period set = 0	No
Aboveground (flagpole) receptors used	No
Buoyancy-induced dispersion used	Yes
Year of surface data	1981
Year of upper air data	1981

Building downwash parameters were not used for this analysis since there are no large buildings or other large structures near the race strip.

The SCAQMD has established a standard set of meteorological data files for use in air quality modeling in the Basin. For the vicinity of the Speedway, the Fontana 1981 meteorological data file was used.

The area surrounding the facility is fairly level with little terrain changes. It was therefore not necessary to include elevation data in the model.

Appropriate model receptors must be selected to determine the worst-case modeling impact. A grid of receptors spaced 100 meters apart extending from the end of the finish line extending 1,000 meters in all directions was created. Additional receptors were placed to represent nearby residential locations. The residential locations used in this analysis are summarized below:

Table 4-2: Residential Receptors

	Address	UTM-X	UTM-Y	Comment
Receptor 1	13934 Whitram Ave.	453770	3772760	House
Receptor 2	8726 Calabash Ave	453690	3772770	House
Receptor 3	8705 Calabash Ave	453720	3772810	House
Receptor 4	14224 Whitram Ave	454370	3772890	Trailer Park
Receptor 5	14136 Whitram Ave	453300	3772780	House Structure

Note – Receptor 5 was the structure of a house but appeared to be a business. This receptor was treated as a residential receptor to be conservative.

The dispersion modeling was performed by separating the race track into 4 emission groups.

- Vehicle Acceleration
- Vehicle Braking
- Vehicle Standard Travel
- VHT Emissions

Each emission group is represented by a series of volume sources. A volume source represents an emission source where emissions are emitted in all directions (except downward)

The air dispersion modeling performed produced results for expected ground level concentrations (GLC) for various averaging times based on a unit emission rate of 1.0 g/s. The predicted ground level concentrations for the nearby residential receptors were then extracted. The predicted ground level concentration for each emission group at the residential receptors is shown below in Table 4-2 and Table 4-3.

Table 4-3: Maximum Hourly Ground Level Concentration (ug/m^3)

	VHTEMIS	ACCEL	BRAKE	TRAVEL
Receptor 1	56.78031	145.9441	86.98813	53.13748
Receptor 2	54.7207	140.6352	77.16071	52.52551
Receptor 3	46.18293	118.6957	72.65688	44.29022
Receptor 4	38.13597	97.81641	58.61419	34.11319
Receptor 5	38.38391	98.6235	47.30045	49.70192

Table 4-4: Annual Average Ground Level Concentration (ug/m^3)

	VHTEMIS	ACCEL	BRAKE	TRAVEL
Receptor 1	1.40501	3.60621	0.86134	1.70505
Receptor 2	0.94095	2.41544	0.7018	1.21541
Receptor 3	0.8068	2.07087	0.68209	1.09949
Receptor 4	1.58352	4.06349	2.2398	2.43184
Receptor 5	0.31738	0.81489	0.36545	0.51629

The final GLC for a receptor could then be found by multiplying the predicted GLC with the actual emission rate for the source group. Instead of performing this for every receptor, the receptor with the highest impact was determined. This was done by multiplying the predicted GLC by the emission multiplication factor for that emission group and by the travel distance for that group. The summation of these calculations identifies which receptor would have the highest GLC once the actual emissions were applied.

It was determined that Receptor 1 has the highest 1-hour GLC and Receptor 4 would have the highest annual average GLC.

5.0 HEALTH RISK ASSESSMENT

A health risk assessment (HRA) involves the determination of the maximum individual cancer risk (MICR), cancer burden, and noncancer acute and chronic hazard indices (HI). The HRA was performed following the SCAQMD Risk Assessment Procedure for Rule 1401 and 212 (Procedures) version 7.0 dated July 1, 2005.

The resulting GLCs for each pollutant were then used to estimate the expected health risk impacts from the various pollutant emissions. The potential cancer risk from a pollutant is calculated using an equation developed by the Environmental Protection Agency (EPA) Office of Environmental Health Hazard Assessment (OEHHA).

Cancer risk is based on a 70-year lifetime exposure. It is assumed that the person affected is exposed to the annual average GLC, every year for 70-years.

$$CancerRisk = Dosh - inh * CP$$

$$\frac{Dose - inh = C_{air} * DBR * A * EF * ED * 10^{-6}}{AT}$$

Where:

CP = cancer potency as published by OEHHA (mg/kg/d)
C_{air} = annual average ground level concentration (µg/m3)
DBR = daily breathing rate (l/kg body weight – day)
A = inhalation absorption factor
EF = exposure frequency (day/year)
ED = exposure duration (years)
AT = averaging time (days)

The cancer risk for each pollutant was found using the equation above. The resulting risks were summed to obtain the final MICR.

The cancer risk at the MICR was calculated to be $4.94x10^{-7}$ or 0.494 in a million. The level of concern of environmental significance is usually 1 in a million. The highest impacts to the local residences are lower than the levels typically considered as environmentally significant.

In addition to carcinogenic impacts, exposure to pollutants can also result in non-carcinogenic impacts. The impact from short term exposures, typically 1–hour, is known as the acute health risk. This risk is calculated as the ratio of the maximum hourly GLC to an acute reference exposure level (REL) determined by OEHHA to not result in noticeable health impacts. This ratio is known as the Acute Hazard Index (HIA).

A non-carcinogenic impact from long term exposure, typically 1-year, is known as the chronic health risk. This risk is calculated as the ratio of the annual average GLC to a chronic REL. This ratio is known as the Chronic Hazard Index (HIC).

The highest HIA and HIC for the nearby residences are calculated to be 0.051 and 0.011, respectively. The typical environmentally significant level is 1.0 for each value. The highest impacts to the local residences are lower than the levels typically considered as environmentally significant.

Table 5-1: Residential Receptors

	MICR	**HIC**	**HIA**
Receptor 1	N/A	N/A	5.09E-02
Receptor 4	4.94E-07	1.06E-02	N/A

6.0 CONCLUSION

Based on the above analysis, the air dispersion modeling and health risk assessment calculations indicate that emissions from the drag strip operations will not result in health risks considered to be environmentally significant.