HEALTH RISK ASSESSMENT
for the
South Line Rail Goods Movement Project
San Diego County, California

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NOVEMBER 2009
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SUMMARY

The San Diego Association of Governments (SANDAG) is seeking to improve portions of a 15.5-mile segment of the San Diego and Arizona Eastern (SD&AE) Railroad mainline between the San Diego and San Ysidro Rail Yards, which is referred to as the South Line. Improvements between Milepost (MP) 2.0 and MP 14.5 would allow for a doubling of freight traffic, from two to four trains, during the operating window. The proposed project would allow expansion of the operating window by approximately one hour. The operating window is currently 1:30 a.m. to 4 a.m. With the proposed project, the window would generally be between 12:30 a.m. and 4:00 a.m.

The purpose of this health risk assessment is to determine the impact to the nearby communities of the increased diesel particulate matter (DPM) emissions resulting from the increased rail traffic on the South Line. The dispersion modeling conducted for this assessment was conducted using the Industrial Source Complex Short Term (ISCST3) model.

The San Diego Air Pollution Control District (SDAPCD) indicates that the health impacts of a project would not be significant if they do not exceed the health risk public notification thresholds adopted by the SDAPCD Board (SDAPCD 2006). The public notification thresholds are 10 excess cancer cases in one million for cancer risk and a hazard index of more than 1.0 for noncancer health effects.

This health risk assessment finds that the maximum anticipated cancer risk associated with the project is 0.7 in one million for residents within 250 meters of the track, based on a 70-year lifetime exposure. The assessment also finds that the acute and chronic hazard indices for noncancer health impacts are below 1.0 at all receptors.
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1.0 INTRODUCTION

1.1 Project Description

The San Diego Association of Governments (SANDAG) is seeking to improve portions of a 15.5-mile segment of the San Diego and Arizona Eastern (SD&AE) Railroad mainline between the San Diego and San Ysidro Rail Yards (see Figures 1 and 2). Currently, freight traffic along this segment, referred to herein as the “South Line,” is only allowed between 1:30 a.m. and 4:00 a.m. Monday through Saturday. Freight service is not allowed on Sunday morning. Improvements to the track between Milepost (MP) 2.0 to MP 14.5 would allow for a doubling of freight rail traffic from two to four trains.

Businesses and residential housing units lie immediately adjacent to the South Line along portions of the corridor. The northern portion between the San Diego yard to the north and Palm Avenue to the south, are aligned with Interstate 5 (I-5) and generally run in a north / south direction. South of Palm Avenue the tracks turn to the east, and are oriented northwest / southeast, all the way to their terminus at the San Ysidro yard.

The proposed project, and its affiliated increase in rail traffic along the South Line, will expose the adjacent residences and businesses to increased concentrations of diesel exhaust particulate matter (DPM). Dudek conducted this health risk assessment to estimate the health impacts of the increased DPM emissions on nearby homes and businesses.

1.2 Thresholds of Significance

The San Diego Air Pollution Control District (SDAPCD) indicates that the health impacts of a project would not be significant if they do not exceed the health risk public notification thresholds adopted by the SDAPCD Board (SDAPCD 2006). The public notification thresholds are 10 excess cancer cases in one million for cancer risk and a hazard index of more than 1.0 for noncancer health effects. The estimated project health impacts will be evaluated in relation to these thresholds.

2.0 CALCULATION OF EMISSIONS

2.1 Locomotive Emissions

Operation of the project would produce DPM emissions associated with the operation of two additional trains each morning on the South Line segment. Currently, two trains (each train consisting of two GP-38 locomotives) utilize the South Line segment for a 30-minute line haul cycle, and spend an additional 6 hours switching (at either the San Diego Rail Yard or the San
Ysidro Rail Yard). The proposed project would add two trains to the current 30-minute line haul cycle; however, these additional trains would travel through the corridor and would not work the sidings. While the proposed project has the potential to reduce the amount of time spent in the line haul cycle, it was conservatively assumed that the additional two trains would spend 30 minutes hauling freight.

The EPA’s *Emission Factors for Locomotives* (EPA 2009) was utilized to obtain emission factors for criteria pollutants. Data regarding fuel consumption, horsepower, line-haul and switching cycles, and notch settings specific to the GP-38 locomotive was obtained from Kimley-Horn and Associates (Kimley-Horn 2009). These data were used to calculate emissions for the existing condition as well as the emissions associated with the South Line after completion of the proposed project. The net change in DPM emissions due to the proposed project was found to be 0.88 pounds per day. Additional details regarding the emission calculations are found in the Air Quality Technical Report for the South Line Rail Goods Movement Project (Dudek 2009).
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Health Risk Assessment for the South Line Rail Goods Movement Project

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3.0 MODELING METHODOLOGY

The Industrial Source Complex – Short Term, Version 3 (ISCST3) air quality dispersion model, which can estimate the air quality impacts of single or multiple sources using actual meteorological conditions, was used to model the air quality impacts of DPM emissions from the increased locomotive traffic on the South Line. Use of ISCST3 is accepted by the SDAPCD for a health risk assessment. The ISCST3 input and output files are included in Appendix A.

The model was configured with the following control parameters:

- Modeling switches: Regulatory Defaults
- Averaging periods: Period
- Choice of dispersion coefficients based upon land-use type: Rural.

ISCST3-ready meteorological data from 1996 through 1998 were provided by the SDACPD for use in ISCST3. The data were collected at San Diego’s Lindbergh Field. Rural dispersion coefficients were selected because they are the default for San Diego County health risk assessments (SDAPCD 2006). Wind roses illustrating prevailing wind speeds and directions for 1996 through 1998 are shown in Figure 3.

Because the trains only run between 1:30 a.m. and 4 a.m., the model was run using in the variable emissions mode. The source was only initialized to emit between 1 a.m. and 4 a.m.

The emissions from the travelling freight trains were modeled as a series of volume sources along the South Line. Source parameters for the diesel locomotives were obtained from an air dispersion modeling analysis for the BNSF Rail Yard in San Diego (Environ 2008) and data on the width of the locomotives used on the South Line (Diesel Shop 2009). The source parameters are shown in Table 1. Because this risk assessment is only concerned with cancer and chronic risks, the daily emissions were converted to an annualized average. The net increase in daily emissions resulting from the proposed increase in train activity (0.88 pounds per day) was first multiplied by the number of operating days per year (312 days per year) to generate an annual emission rate of 274.5 pounds per year. This actual emission rate was then converted to an annualized gram per second emission rate assuming 3 operating hours per day and 453.59 grams per pound.
Table 1
Source Parameters

<table>
<thead>
<tr>
<th>Locomotives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Volume Sources</td>
<td>257 per 1-mile segment</td>
</tr>
<tr>
<td>Release Height</td>
<td>11.25 meters</td>
</tr>
<tr>
<td>Initial Vertical Dimension</td>
<td>2.62 meters</td>
</tr>
<tr>
<td>Initial Lateral Dimension</td>
<td>3.15 meters</td>
</tr>
</tbody>
</table>

Two separate model runs using representative 1-mile sections of track were conducted for the health risk assessment (see Figures 4 and 5). The first, using a section of track between H Street and L Street in Chula Vista (Figure 4), examined the dispersion along the northern section of the South Line. The second run, using a section of track between Dairy Mart Road and Cottonwood Road in San Ysidro (Figure 5), examined dispersion along the southern section of the South Line. The two sections of track were chosen to represent the dispersion patterns along the tracks with two distinct geographic orientations.
**Wind Rose – Station #23188, San Diego/Lindbergh Field, CA**

**DATA PERIOD:**
1996-1998
Jan 1 - Dec 31
00:00 - 23:00

**CALM WINDS:**
16.22%

**TOTAL COUNT:**
26304 hrs.

**AVG. WIND SPEED:**
5.58 Knots

**DATE:**
10/1/2009

---

**WIND SPEED (Knots):**
- >= 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4
- Calms: 16.22%
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FIGURE 4
CHULA VISTA SECTION OF TRACK

MODELED SECTION OF TRACK

Legend
4.0 RECEPTORS USED FOR EVALUATING MODELED IMPACTS

A nested grid of receptors was set up around each section of track modeled. The flagpole receptor height was set to 1.5 meters for all model runs. Per SDAPCD Guidelines (SDAPCD, 2006), a fine receptor grid with 25 meters interval spacing was used in the areas encompassing the points of maximum cancer impact. On the northern section of track, the receptor interval increased to 50 meters within 500 meters of the track and 100 meters within 750 meters of the track sections. On the southern section of track, the receptor interval increased to 50 meters within 750 meters of the track and 100 meters within 1 kilometer of the track.

The health risk to sensitive receptors, defined as schools, day care centers, nursing homes, retirement homes, health clinics, and hospitals (SDAPCD 2006) was captured by the nested receptor grid, and no distinct sensitive receptors were defined in the model. Because the trains run only between 1:30 a.m. and 4:00 a.m., only residential receptors were considered sensitive receptors for this analysis. There were no hospitals within the model receptor grid.

5.0 EVALUATION OF HEALTH IMPACTS

5.1 Cancer Risk

The cancer risk calculations were performed by multiplying the predicted DPM concentrations from ISCST3 by the appropriate risk values. The exposure and risk equations that are used to calculate the cancer risk at residential receptors are taken from the California Environmental Protection Agency Office of Environmental Health Hazard Assessment (OEHHA) manual for health risk assessments prepared under the Air Toxics Hot Spots program (OEHHA 2003).

The potential exposure pathway for DPM includes inhalation only. To be conservative (i.e., health protective), the cancer risk calculations for all exposures assume that a receptor is exposed continuously for 70 years. Cancer risks were evaluated using the inhalation Cancer Potency Factors published by the OEHHA and CARB (CARB 2009). The Cancer Potency Factor for DPM is 1.1 per milligram per kilogram of body weight per day (mg/kg-day). The potential exposure through other pathways (e.g., ingestion) requires substance and site-specific data, and the specific parameters for diesel exhaust are not known for these pathways. The Cancer Potency Factor also assumes that a person is exposed continuously for 70 years. This approach is intended to result in conservative (i.e., health protective) estimates of health impacts and is used for the receptors previously identified.

The following equations were used to calculate the cancer risk due to inhalation using the modeled DPM concentrations:
Risk = Inhalation potency factor * Dose Inhalation  \hspace{1cm} (1)

where:

Inhalation potency factor = 1.1 (mg/kg-day) for diesel particulate matter, and:

Dose Inhalation = C_{air} * DBR * A * EF * ED * 10^{-6} / AT \hspace{1cm} (2)

where:

- \( C_{air} \) = concentration of DPM in microgram per cubic meter (\( \mu g/m^3 \))
- DBR = breathing rate in liter per kilogram of body weight per day
- A = inhalation absorption factor (1 for DPM)
- EF = exposure frequency in days per year
- ED = exposure duration in years
- AT = averaging time period over which exposure is averaged in days (25,550 days for 70 years)

In accordance with CARB policy (CARB 2003) and the SDAPCD Guidelines (SDAPCD 2006), the breathing rate equal to the 80\textsuperscript{th} percentile, or 302 liters per kilogram of body weight per day, was used for the cancer risk calculations. In order to directly calculate risk from the modeled concentrations, a multiplying factor was derived based on the information discussed above. This multiplying factor, when multiplied by the concentration that the dispersion model calculates, results in a risk in one million at a particular receptor. The multiplying factor was calculated as follows:

Multiplying factor = CPF*(DBR*A*EF*ED*10^{-6}/AT)*10^6

= 1.1 (mg/kg-day)^{-1} * (302 L/kg body weight–day * 1 * 350 day/yr *70 yr *10^{-6} / 25,550 days) *10^6

= 318.55 (\mu g/m^3)^{-1}.

Table 2 shows the maximum modeled annual DPM concentrations adjacent to each 1-mile track segment and the associated cancer risk. Selected results from ISCST3 indicating the maximum modeled impacts are provided in Appendix B. The differences in risk between the two modeled sections of track reflect the different dispersion patterns related to the change in track orientation. The cancer risks at the receptors along both sections of modeled track are less than the SDAPCD significance threshold of 10 in one million for cancer impacts.
Table 2
Summary of Maximum Modeled Cancer Risks

<table>
<thead>
<tr>
<th>Receptor</th>
<th>DPM Concentration (μg/m³)</th>
<th>Cancer Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Track Segment</td>
<td>0.001</td>
<td>0.3 x 10⁻⁶</td>
</tr>
<tr>
<td>Southern Track Segment</td>
<td>0.002</td>
<td>0.7 x 10⁻⁶</td>
</tr>
</tbody>
</table>

5.2 Noncancer Impacts

In addition to the potential cancer risk, DPM has chronic (i.e., long-term) noncancer health impacts. The chronic hazard indices were evaluated using the OEHHA/CARB inhalation Reference Exposure Levels (REL) (CARB 2009). The REL is the concentration (inhalation) or daily dosage (noninhalation) at or below which no adverse health effects are anticipated. The chronic noncancer inhalation hazard indices for the proposed project were calculated by dividing the modeled annual average concentrations of DPM by its Reference Exposure Level (REL), which is 5 micrograms per cubic meter.

Table 3 shows the maximum modeled annual DPM concentrations adjacent to each 1-mile track segment and the maximum chronic hazard indices. The chronic hazard indices at the points of maximum impact are less than the SDAPCD significance threshold of 1.0 for noncancer health impacts.

Table 3
Summary of Maximum Chronic Hazard Indices

<table>
<thead>
<tr>
<th>Receptor</th>
<th>DPM Concentration (μg/m³)</th>
<th>Chronic Hazard Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Rail Segment</td>
<td>0.001</td>
<td>0.0002</td>
</tr>
<tr>
<td>Southern Rail Segment</td>
<td>0.002</td>
<td>0.0004</td>
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6.0 CONCLUSIONS

The results determined in this analysis reflect reasonable estimates of source emissions and exhaust characteristics available meteorological data in the vicinity of the project site and the use of currently approved air quality models. Given the limits of available tools for such an analysis, the actual impacts may vary from the estimates in this assessment. However, the combined use of the ISCST3 dispersion model and the health impact calculations required by the OEHHA and the SDAPCD tend to overpredict impacts, such that they produce conservative (i.e., health-
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protective) results. Accordingly, the health impacts are not expected to be higher than those estimated in this assessment.

Based on this analysis, the health impacts resulting from the proposed project would not exceed the SDAPCD significance threshold of an incremental cancer risk of 10 in one million since the maximum anticipated cancer risk is 0.7 in one million within 250 meters of the track. In addition, the chronic hazard indices for noncancer health impacts are below the significance threshold of 1.0 at the maximally exposed receptors.

7.0 REFERENCES


APPENDIX A

ISCST3 Files

(Files are provided on the enclosed CD)
APPENDIX B

Selected ISCST3 Modeling Results
Selected Results for the Northern / Chula Vista Section of Track
** ISCST3 Control Pathway  
********************************

** ISCST3 - VERSION 02035 ***    *** G:\6264 Southline HRA\SLHRAN1\SLHRAN5.isc ***        10/05/09
***                                             ***        11:52:37
**MODELOPTs:                                                                                  PAGE 169
CONC RURAL ELEV FLGPOL DFAULT MULTIYR

*** THE SUMMARY OF MAXIMUM PERIOD (26304 HRS) RESULTS ***

** CONC OF PM-10 IN MICROGRAMS/M**3 **

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<th>GROUP ID</th>
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<th>RECEPTOR (XR, YR, ZELEV, ZFLAG)</th>
<th>OF</th>
<th>TYPE</th>
<th>GRID-ID</th>
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<tr>
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<td>1.50</td>
<td>DC</td>
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<tr>
<td>3RD HIGHEST VALUE IS</td>
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<tr>
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<tr>
<td>6TH HIGHEST VALUE IS</td>
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*** RECEPTOR TYPES:  GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY
Selected Results for the Southern / San Ysidro Section of Track
CO STARTING
TITLE ONE G:\6264 Southline HRA\SLHRA2\SLHRA7.isc
MODELOPT DFAULT CONC RURAL
AVERTIME ANNUAL
POLLUTID PM-10
TERRHGTS ELEV
FLAGPOLE 1.50
RUNORNOT RUN
MULTYEAR H6H SLHRA7.sa1
CO FINISHED

*** ISCST3 - VERSION 02035 ***    *** G:\6264 Southline HRA\SLHRA2\SLHRA7.isc    ***        10/05/09
***                                                                      ***        12:41:47
**MODELOPTs:

PAGE 217

** THE SUMMARY OF MAXIMUM ANNUAL (   3 YRS) RESULTS **

** CONC OF PM-10 IN MICROGRAMS/M**3 **

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<th>AVERAGE CONC</th>
<th>RECEPTOR (XR, YR, ZELEV, ZFLAG)</th>
<th>OF TYPE</th>
<th>NETWORK</th>
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<tr>
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<tr>
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<td>DC</td>
<td>NA</td>
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<td>DC</td>
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<tr>
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<td>(495450.00, 3602405.25, 36.66, 1.50)</td>
<td>DC</td>
<td>NA</td>
</tr>
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<td>9TH HIGHEST VALUE IS</td>
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<td>(495375.00, 3602480.25, 35.98, 1.50)</td>
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<td>(495350.00, 3602430.25, 34.44, 1.50)</td>
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*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY