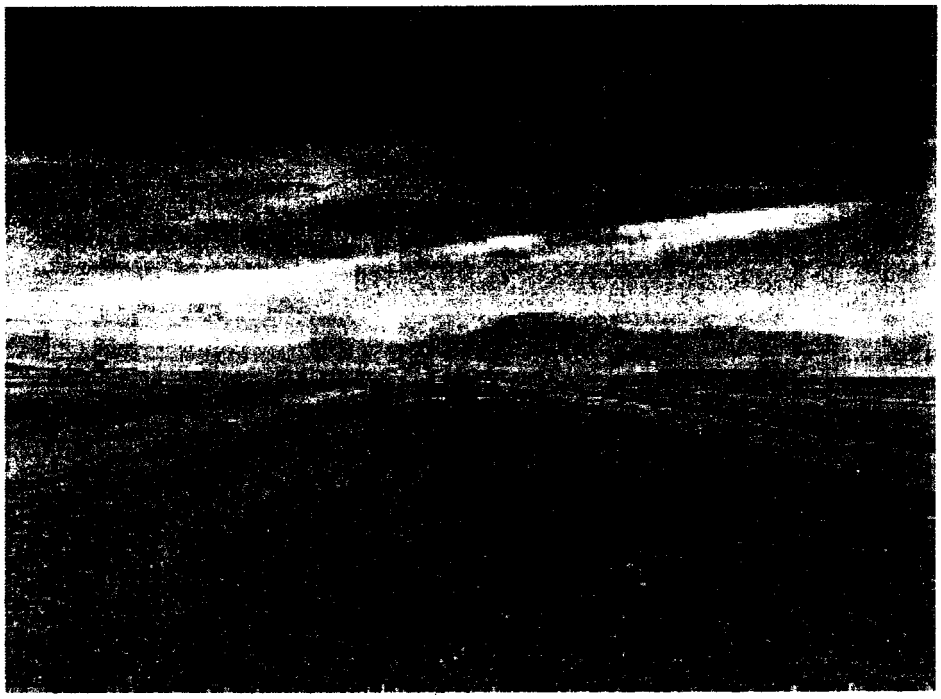
# ASSESSMENT OF AIR EMISSIONS OF TRANSPORTING BIOSOLIDS FOR BENEFICIAL REUSE TO ALTERNATIVE LOCATIONS IN RESPONSE TO KERN COUNTY LAND APPLICATION BAN

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## Executive Summary

The City of Los Angeles currently generates an average of approximately 700 wet tons per day (tpd) of Class A Exceptional Quality biosolids, including 650 tpd at Hyperion Treatment Plant (HTP) and 50 tpd at Terminal Island Treatment Plant (TITP). The biosolids are hauled to the City of Los Angeles' Green Acres Farm, which is located in an unincorporated area of Kern County, California, where they are beneficially used as a fertilizer and soil conditioner to grow a variety of animal feedstock.

On June 6, 2006, Kern County voters adopted an initiative ordinance as Measure E, which prohibits land application of biosolids in unincorporated areas of the county. Under the new Kern biosolids ban, permitted facilities such as the City's Green Acres Farm now have six months from the ban's effective date (July 22, 2006) to cease land application of biosolids.

In response to the new Kern biosolids ban, the City of Los Angeles, Bureau of Sanitation is evaluating potential alternatives to its longstanding biosolids program at Green Acres, where the City has been land applying biosolids since 1994. This report assesses five potential alternatives for beneficially reusing biosolids at other locations in Arizona and California, and compares the air emissions resulting from hauling the City's biosolids to those alternative locations, to the air emissions resulting from hauling biosolids to Green Acres in Kern County. In particular, this report assesses the emissions of air pollutants from diesel-powered transfer trucks, specifically, particulate matter (PM10), which may contribute to increased cancer risk, and oxides of nitrogen (NOx), which are known to cause lung damage. Both pollutants have been identified as toxic air contaminants and are regulated by the California Air Resources Board (CARB).

A. Existing Operations and Other Potential Beneficial Use Options for City of Los Angeles' Class A Exceptional Quality Biosolids:

Sierra Transport, the company that currently hauls the City's biosolids to Green Acres Farm, operates 23 long-haul transfer trucks that all are fueled with CARB Low Sulfur No. 2 Diesel Fuel (CARB Diesel). Each truck has a maximum capacity of 26.4 wet tons/load. Based on 2006 data, on average, there are 24 loads/day and 2 loads/day of biosolids from HTP and TITP, respectively. The biosolids are taken to the Green Acres Farm in Kern Country, California for land application.

Five other potential beneficial use options for the City of Los Angeles' Class A biosolids were involved in this study, including trucking the material to the San Joaquin Composting facility (also in Kern County) for composting and to out-of-state locations in Arizona for land application and/or compositing.

B. Emissions Analysis:

Included in the report is the overall emissions attributed to on-road driving (Travel Emissions), stop-and-go idling (On-Road Idling Emissions) during heavy traffic conditions, and idling during intermittent driving breaks (Off-Road Idling Emissions). The sum of all three provides the Total Emissions.

C. Data Calculation Source:

CARB emission factors for PM10 and NOx were obtained for the various model years of diesel heavy-duty vehicles in the Sierra Transport fleet, along with the idling emission factors for each vehicle.

Table A depicts the potential annual mass emissions of PM10 and NOx corresponding to existing practice, i.e., trucking biosolids to Green Acres Farm, as well as for the other five potential beneficial use scenarios evaluated in this study. The percentage of change as shown in Table A indicates that transporting the biosolids to the Green Acres Farm results in the lowest annual mass emissions of PM10 and NOx while the other options would produce higher emissions, up to a three-fold increase.

Table A: Summary of Potential Annual Mass Emissions of PM10 and NOx Corresponding to Hauling of the City of Los Angeles' Class A Exceptional Quality Biosolids to Various Locations for Beneficial Use.

| | | **Annual Mass Emission** | | | |
|---|---|---|---|---|---|
| | | **PM10** | | **NOx** | |
| **Scenario** | **Description** | **tons/yr** | **Percentage of Existing Emission (%)** | **tons/yr** | **Percentage of Existing Emission (%)** |
| 1 | Green Acres (HTP/TITP) | 0.69 | N/A | 32.4 | N/A |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 0.91 | 132% | 43.8 | 135% |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 2.04 | 296% | 97.9 | 302% |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.80 | 262% | 86.5 | 267% |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.74 | 252% | 83.4 | 257% |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.72 | 249% | 82.3 | 254% |

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## BACKGROUND

The City of Los Angeles generates an average of approximately 700 wet tons per day (tpd) of Class A Exceptional Quality (EQ) biosolids, including 650 tpd at Hyperion Treatment Plant (HTP) and 50 tpd at Terminal Island Treatment Plant (TITP). The City contracts with Responsible Biosolids Management (RBM) for handling and beneficial use of biosolids. RBM retains the service of Sierra Transport for hauling biosolids from the City's wastewater treatment facilities to the Green Acres Farm in Kern County, California. Since 1994, this 4,688-acre farm has served as the land application site for the City's biosolids. At Green Acres Farm, the biosolids are tilled into the soil and beneficially used as a fertilizer and soil conditioner to grow a variety of cattle's feedstock including wheat, alfalfa, and corn.

On June 6$^{th}$ 2006, a majority of Kern County voters adopted an initiative ordinance known as Measure E, which prohibits land application of biosolids to property within the unincorporated area of Kern County. Under the terms of the new Kern biosolids ban, permitted facilities such as the City's Green Acres Farm now have six months from the ban's effective date (July 22, 2006) to cease land application of biosolids.

The Kern biosolids ban is forcing the City to investigate potential alternatives to Green Acres for management of biosolids, including trucking biosolids to other locations for land application and/or composting. The alternative arrangements are not guaranteed to assure a viable alternative for handling all of the City's biosolids. The potential California scenarios evaluated in this study include one site which is not yet operational (ABT Haskell), and other sites may have capacity and contractual restrictions that could preclude the City from selecting these potential alternatives.

The out-of-state alternatives are located at much further distances from the City of Los Angeles as compared to the Green Acres Farm in Kern County. Table 1 lists the existing (i.e., Green Acres Farm) and potential alternative locations for beneficial reuse of the City's biosolids, as well as the companies managing those locations and the round-trip driving distances from the City of Los Angeles to these locations.

Among possible environmental impacts related to trucking of biosolids to distant destinations is the potential increase of emissions of air contaminants released from diesel-powered transfer trucks. In 1998, the California Air Resources Board (CARB) identified exhaust from diesel-powered engines as a toxic air contaminant. The objective of this study is to assess the potential increase of emissions of two CARB regulated vehicular air pollutants, namely, particulate matter (PM10: particles with aerodynamic diameter less than 10 microns in diameter) and oxides of nitrogen (NOx), from diesel-

powered biosolids transfer vehicles. Diesel PM has been listed by CARB to be among the top three contributors of potential cancer risk from mobile sources. NOx, in addition to forming ground-level photochemical ozone, has been known to cause damages to cell membranes in respiratory tissues and constriction of airway passages.

Table 1: Existing and Potential Alternative Locations for Beneficial Reuse of the City of Los Angeles' Class A Exceptional Quality Biosolids.

| Company | Site | Round-Trip Driving Distance from HTP or TITP (miles) | Biosolids Use |
|---|---|---|---|
| RBM* | Green Acres, Kern County, CA | 240 | Land Application |
| RBM | Cullison Farms, Welton, AZ | 700 | Land Application |
| Solid Solutions | San Joaquin Composting, Kern County, CA | 310 | Composting |
| Solid Solutions | Copper Mountain Landfill, Yuma, AZ | 650 | Alternative Daily Cover |
| ABT Haskell | ABT/Haskell, Redlands, San Bernardino County, CA | 160 | Composting |
| Synagro | Arizona Soils, AZ | 580 | Composting |

*: Responsible Biosolids Management

## TECHNICAL APPROACH

### 1. Existing Biosolids Transport Operation

Sierra Transport currently operates a fleet of 23 long-haul trucks to transfer the City of Los Angeles' biosolids. Pertinent information regarding the transfer vehicles is included in Appendix A. All transfer vehicles are fueled in California using the CARB Low Sulfur No. 2 Diesel Fuel (CARB Diesel).

Each transfer vehicle has a maximum capacity of 26.4 wet tons/load. The actual numbers of daily loads of biosolids leaving either HTP or TITP (also known as pick-up loads); however, fluctuate depending on the quantities of biosolids generated daily. Based on 2006 data, the average pick-up loads of biosolids for HTP is 24 loads/day, i.e., transfer vehicles perform an average of 24 round-trips/day to transport biosolids from HTP to Green Acres Farm. For TITP, there are typically 2 loads/day, based on its 50 tpd throughput and 26.4 wet tons/load. For HTP, the daily pick-up loads from January to June 2006 are presented in Appendix B.

## 2. Existing and Potential Alternative Beneficial Use Options for City of Los Angeles' Class A Biosolids

The City of Los Angeles, Bureau of Sanitation is investigating possible alternative options for beneficial use of Class A Exceptional Quality biosolids generated at HTP and TITP. Five potential alternative beneficial use scenarios, in addition to the existing practice of trucking of biosolids to the Green Acres Farm in Kern County, California, are presented in Table 2. The potential alternative scenarios evaluated in this study are representative samples of the types of management alternatives the City is currently considering in response to the Kern County biosolids ban, but do not constitute a comprehensive list. The City continues to work to identify potential alternative options to its biosolids land application program at Green Acres, and to determine how it will safely and lawfully manage its biosoids as soon as January 2007 (when the Kern County biosolids ban would become effective), but no final decision has yet been made.

Table 2: Existing and Potential Alternative Beneficial Use Scenarios for City of Los Angeles' Class A Exceptional Quality Biosolids.

| | HTP | | | | | | TITP | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIOS | RBM (GREEN ACRES) (Wet Tons) | SOLID SOLUTIONS (SJC*) (Wet Tons) | RBM (ARIZONA) (Wet Tons) | SOLID SOLUTIONS (ARIZONA) (Wet Tons) | ABT HASKELL (Wet Tons) | SYNAGRO AZ SOILS (Wet Tons) | RBM (GREEN ACRES) (Wet Tons) | SOLID SOLUTIONS (SJC) (Wet Tons) | SOLID SOLUTIONS (ARIZONA) (Wet Tons) |
| 1 (Existing Operation) | 650 | | | | | | 50 | | |
| 2 | | 650 | | | | | | 50 | |
| 3 | | | 650 | | | | | | 50 |
| 4 | | | 500 | 50 | 50 | 50 | | 50 | |
| 5 | | | 150 | 400 | 50 | 50 | | 50 | |
| 6 | | | 50 | 500 | 50 | 50 | | 50 | |

*: San Joaquin Composting

Based on the daily average of actual truck loads of biosolids taken to the Green Acres Farm from January 2006 to June 2006, the projected number of daily truck loads of biosolids to the potential alternative beneficial use sites are listed in Table 3.

## 3. Emissions Assessment Methodology

The exhaust emissions from long-haul trucks are contributed mainly by those emitted during on-road driving operation (Travel Emissions). However, other modes of operation may also contribute to the overall emissions. In this study, in addition to the Travel Emissions, emissions attributed to stop-and-go idling during heavy traffic conditions (On-Road Idling Emissions) and idling during

intermittent driving breaks (Off-Road Idling Emissions) were also considered.

Table 3: Pick-Up Loads of City of Los Angeles' Class A Exceptional Quality Biosolids Corresponding to Existing and Potential Alternative Beneficial Use Scenarios.

| | HTP | | | | | | TITP | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIOS | RBM (GREEN ACRES) (Pick Up Loads) | SOLID SOLUTIONS (SJC) (Pick Up Loads) | RBM (ARIZONA) (Pick Up Loads) | SOLID SOLUTIONS (ARIZONA) (Pick Up Loads) | ABT HASKELL (Pick Up Loads) | SYNAGRO AZ SOILS (Pick Up Loads) | RBM (GREEN ACRES) (Pick Up Loads) | SOLID SOLUTIONS (SJC) (Pick Up Loads) | SOLID SOLUTIONS (ARIZONA) (Pick Up Loads) |
| 1 (Existing Operation) | 24 | | | | | | 2 | | |
| 2 | | 24 | | | | | | 2 | |
| 3 | | | 24 | | | | | | 2 |
| 4 | | | 18 | 2 | 2 | 2 | | 2 | |
| 5 | | | 6 | 14 | 2 | 2 | | 2 | |
| 6 | | | 2 | 18 | 2 | 2 | | 2 | |

**a. Travel Emissions**

The exhaust emissions associated with traveling per long-haul truck is based on the round-trip driving distance (in miles) from the City of Los Angeles (HTP or TITP) where the biosolids are loaded to the final destinations. The round-trip driving distance corresponding to each beneficial use location is listed in Table 1.

**b. On-Road Idling Emissions**

Depending on traffic conditions, the long-haul vehicles may experience "stop-and-go" operation while proceeding through traffic congestions on freeways and surface roads. During this "stop-and-go" mode, the engines remain idling and likewise emit pollutants while the vehicles are queuing on the roads. The posted speed limit for trucks is 55 mph on freeways. However, according to Mr. Mark Lutrel of Sierra Transport, the transfer trucks can travel at an average speed of 48 mph due to congestion and other traffic conditions. The emissions attributed to on-road idling will be assessed based on the estimated additional time required to transfer the loads to the destinations at the average speed of 48 mph instead of 55 mph. The round-trip on-road idling time corresponding to different scenarios are presented in Table 4.

Table 4. On-Road Idling Time due to Traffic Conditions per Round-trip for Long-Haul Trucks Transporting Biosolids from HTP or TITP to Various Destinations.

| Origin | Destination | Round-Trip Driving Distance (miles) | Round-Trip Travel Time Based on 55 mph* (hours) | Round-Trip Travel Time Based on 48 mph** (hours) | Round-Trip On-Road Idling (hours) |
|---|---|---|---|---|---|
| HTP | Green Acres/Kern County, CA | 240 | 4.36 | 5.00 | 0.64 |
| TITP | Green Acres/Kern County, CA | 240 | 4.36 | 5.00 | 0.64 |
| HTP | San Joaquin Composting /Kern County, CA | 310 | 5.64 | 6.46 | 0.82 |
| TITP | San Joaquin Composting /Kern County, CA | 310 | 5.64 | 6.46 | 0.82 |
| HTP | Cullison Farms/Welton, AZ | 700 | 12.73 | 14.58 | 1.86 |
| TITP | Copper Mountain Landfill/Yuma, AZ | 650 | 11.82 | 13.54 | 1.72 |
| HTP | Copper Mountain Landfill/Yuma, AZ | 650 | 11.82 | 13.54 | 1.72 |
| HTP | Redlands, CA | 160 | 2.91 | 3.33 | 0.42 |
| HTP | Arizona Soils, AZ | 580 | 10.55 | 12.08 | 1.54 |

*: Posted speed limit for trucks.

**: Actual average speed (provided by Mr. Mark Lutrel, President of Sierra Transport)

### c. Off-Road Idling Emissions

During traveling, the drivers need to make off-road stops for resting as well as for vehicle inspections. According to Mr. Mark Lutrel of Sierra Transport, if the one-way travel time is 3 hours or less, the drivers do not make any stops before reaching their destinations. However, if the one-way travel time is more than 3 hours, the drivers are required to make off-road stops every three hours for a period of 30 minutes per stop. Because the engines are equipped with turbochargers, they produce an increased amount of waste heat, and this condition necessitates the engines to remain idling during the off-road stops, thus contributing to the overall emissions. The estimated total time for off-road stops based on the corresponding one-way travel time is shown in Table 5. It should be noted that the drivers are required to make off-road stops every three hours during the transport of biosolids to the destinations and on the return trip to the wastewater treatment plants in Los Angeles.

Table 5. Estimated "Off-Road" Idling Time due to Stops per Round Trip for Long-Haul Trucks Transporting Biosolids from HTP or TITP to Various Destinations.

| Origin | Destination | One-Way Distance (miles) | One-Way Travel Time* (Hours) | Number of Off-Road Stop Per One-Way Trip | Off-Road Idling Time Per Round Trip** (Hours) |
|---|---|---|---|---|---|
| HTP | Green Acres/Kern County, CA | 120 | 2.50 | 0 | 0 |
| TITP | Green Acres/Kern County, CA | 120 | 2.50 | 0 | 0 |
| HTP | San Joanquin Composting /Kern County, CA | 155 | 3.23 | 1 | 1.0 |
| TITP | San Joanquin Composting /Kern County, CA | 155 | 3.23 | 1 | 1.0 |
| HTP | Cullison Farms/Welton, AZ | 350 | 7.29 | 2 | 2.0 |
| TITP | Copper Mountain Landfill/Yuma, AZ | 325 | 6.77 | 2 | 2.0 |
| HTP | Copper Mountain Landfill/Yuma, AZ | 325 | 6.77 | 2 | 2.0 |
| HTP | Redlands, CA | 80 | 1.67 | 0 | 0 |
| HTP | Arizona Soils, AZ | 290 | 6.04 | 2 | 2.0 |

*: Based on the average speed of 48 mph and includes on-road idling during "stop-and-go" driving conditions.

**: See text for additional information.

### d. Total Emissions

For comparison purposes, the reported total emission from long-haul trucks transporting biosolids from the City of Los Angeles to a specific beneficial use location will be determined as the sum of emissions from three different contributing factors, namely, travel, on-road idling, and off-road idling:

**Total Emission = Travel Emission + On-Road Idling Emission + Off-Road Idling Emission.**

## 4. The California Air Resources Board's Emission Factors

In this study, the following emission factors developed by the California Air Resources Board staff for heavy heavy-duty diesel vehicles with gross vehicle weight rating (GVWR) over 33,000 lbs were employed:

### a. Travel Emission Factors

The emission factors (grams/mile or g/mile) corresponding to diesel heavy heavy-duty vehicles are shown in Table 6.

Table 6. Emission Factors for Diesel Heavy Heavy-Duty Vehicles 33,000+ lbs GVWR.

| Diesel Transfer Truck Model Year | PM10 (g/mile) | NOx (g/mile) |
|---|---|---|
| 1998-2002 | 0.403 | 17.58 |
| 2003-2006 | 0.252 | 11.63 |

Sources: CARB's The Carl Moyer Program Guidelines, Part IV, Appendices, Approved Nov. 17, 2005, Pg. B-5, Table B-5. Criteria: Diesel Heavy Heavy Duty Vehicles 33,000+lbs GVWR, model year 1987-2006.

Based on the CARB's emission factors as shown above and the model years of the trucks (Appendix A), the weighed average of PM10 and NOx emission factors for the entire long-haul truck fleet operated by Sierra Transport were determined as shown in Table 7.

Table 7: Weighed Average of PM10 and NOx Emissions Factors for Diesel Heavy Heavy-Duty Vehicles 33,000+ lbs GVWR and Model Years of 2002-2006.

| Diesel Transfer Vehicles Model Years 2002-2006 | PM10 (g/mile) | NOx (g/mile) |
|---|---|---|
| Weighed Average | 0.272 | 12.41 |

**b. Idling Emission Factors**

The idling emission factors, in grams per hour (g/hr), corresponding to diesel heavy heavy-duty vehicles are listed in Table 8.

Table 8. Idling Emission Factors for Diesel Heavy Heavy-Duty Vehicles 33,000+ lbs GVWR.

| Diesel Transfer Truck Model Year | PM10 (g/hr) | NOx (g/hr) |
|---|---|---|
| 1999-2002 | 2.28 | 171.00 |
| 2003 | 1.65 | 187.00 |
| 2004-2006 | 1.50 | 191.50 |

Sources: CARB's The Carl Moyer Program Guidelines, Part IV, Appendices, Approved Nov. 17, 2005, Pg. B-8, Table B-9. "Heavy Heavy-Duty Vehicles Idling Emission Factors (g/hr)"

The corresponding weighed average PM10 and NOx idling emission factors for the entire long-haul truck fleet operated by Sierra Transport are listed in Table 9.

Table 9. Weighed Average PM10 and NOx Idling Emissions Factors for Diesel Heavy Heavy-Duty Vehicles 33,000+ lbs GVWR and Model Years of 2002-2006.

| Diesel Transfer Vehicles Model Years 1989-2006 | PM10 (g/hr) | NOx (g/hr) |
|---|---|---|
| Weighed Average | 1.62 | 188.43 |

## III. SAMPLE CALCULATIONS

For the purpose of illustration, detailed calculations are shown for the PM10 and NOx emissions corresponding to Scenarios 2 and 3, i.e., the transport of all biosolids generated at both HTP and TITP to the San Joaquin Composting facility in Kern County, CA, and the transport of biosolids from HTP to Cullison Farms in Welton, AZ and biosolids from TITP to Copper Mountain Landfill in Yuma, AZ. The same approach was also used to determine the emissions corresponding to other beneficial use scenarios.

### 1. Scenario 2 (Transport of All Biosolids from HTP and TITP to San Joaquin Composting Facility in Kern County, CA):

#### 1.1. Travel Emissions

For the following calculations, the data presented in Tables 1, 3, and 7 were used.

**PM10:**

a. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
   = Weighed Ave PM10 Emission Factor * Round-Trip Distance
   = (0.272 g/mile)*(310 miles/load)
   = 84.3 g/load
b. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
   = (84.3 g/load)*(24 loads/day)
   = 2024 g/day
c. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
   = (84.3 g/load)*(2 loads/day)
   = 169 g/day
d. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
   = (2024 g/day) + (169 g/day)
   = 2193 g/day

e. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (2193 g/day)*(365 days/yr)*(1 ton/908000g)
= **0.88 tons/yr**

**NOx**:

f. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
= Weighed Ave NOx Emission Factor * Round-Trip Distance
= (12.41 g/mile)*(310 miles/load)
= 3847 g/load

g. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
= (3847 g/load)*(24 loads/day)
= 92330 g/day

h. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (3847 g/load)*(2 loads/day)
= 7694 g/day

i. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
= (92330 g/day) + (7694 g/day)
= 100024 g/day

j. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (100024 g/day)*(365 days/yr)*(1 ton/908000g)
= **40.2 tons/yr**

### 1.2. On-Road Idling Emissions

For the following calculations, the data presented in Tables 3, 4, and 9 were used.

**PM10**:

a. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
= Weighed Ave PM10 Idling Emission Factor * On-Road Idling Time
= (1.62 g/hr)*(0.82 hr/load)
= 1.33 g/load

b. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
= (1.33 g/load)*(24 loads/day)
= 31.88 g/day

c. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (1.33 g/load)*(2 loads/day)
= 2.66 g/day

d. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
= (31.88 g/day) + (2.66 g/day)
= 34.54 g/day

e. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (34.54 g/day)*(365 days/yr)*(1 ton/908000g)
= **0.014 tons/yr**

**NOx:**

f. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
= Weighed Ave NOx Idling Emission Factor * On-Road Idling Time
= (188.43 g/hr)*(0.82 hr/load)
= 154.51 g/load

g. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
= (154.51 g/load)*(24 loads/day)
= 3708 g/day

h. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (154.51 g/load)*(2 loads/day)
= 309 g/day

i. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
= (3708 g/day) + (309 g/day)
= 4017 g/day

j. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (4017 g/day)*(365 days/yr)*(1 ton/908000g)
= **1.62 tons/yr**

### 1.3. Off-Road Idling Emissions

For the following calculations, the data presented in Tables 3, 5, and 9 were used.

**PM10**:

a. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
= Weighed Ave PM10 Idling Emission Factor * Off-Road Idling Time
= (1.62 g/hr)*(1.0 hr/load)
= 1.62 g/load

b. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
= (1.62 g/load)*(24 loads/day)
= 38.88 g/day

c. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (1.62 g/load)*(2 loads/day)
= 3.24 g/day

d. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
= (38.88 g/day) + (3.24 g/day)
= 42.12 g/day

e. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (42.12 g/day)*(365 days/yr)*(1 ton/908000g)
= **0.017 tons/yr**

**NOx**:

f. Daily emission due to transport of one load of biosolids (round trip) from HTP or TITP to SJC:
= Weighed Ave NOx Idling Emission Factor * Off-Road Idling Time
= (188.43 g/hr)*(1.0 hr/load)
= 188.43 g/load

g. Daily emission due to transport of 24 loads of biosolids from HTP to SJC:
= (188.43 g/load)*(24 loads/day)
= 4522 g/day

h. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (188.43 g/load)*(2 loads/day)
= 376.86 g/day

i. Total daily emission due to transport of biosolids from HTP and TITP to SJC:
= (4522 g/day) + (377 g/day)
= 4899 g/day

j. Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (4899 g/day)*(365 days/yr)*(1 ton/908000g)
= **1.97 tons/yr**

### 1.4. Total Emissions

Total Emission = Travel Emission + On-Road Idling Emission + Off-Road Idling Emission.

**PM10**:

Total annual emission due to transport of biosolids from HTP and TITP to SJC:
= (0.88 tons/yr) + (0.014 tons/yr) + (0.017 tons/yr)
= **0.91 tons/yr**

**NOx**:

Total annual emission due to transport of biosolids from HTP and TITP to SJC:

= (40.2 tons/yr) + (1.62 tons/yr) + (1.97 tons/yr)

= **43.8 tons/yr**

2. **Scenario 3 (Transport of Biosolids from HTP and TITP to Cullison Farms in Welton, AZ and Copper Mountain Landfill in Yuma, AZ, respectively):**

### 2.1. Travel Emissions

For the following calculations, the data presented in Tables 1, 3, and 7 were used.

**PM10**:

a. Daily emission due to transport of one load of biosolids (round trip) from HTP to Cullison Farm (CF):
   = Weighed Ave PM10 Emission Factor * Round-Trip Distance
   = (0.272 g/mile)*(700 miles/load)
   = 190.4 g/load
b. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
   = (190.4 g/load)*(24 loads/day)
   = 4569.6 g/day
c. Daily emission due to transport of one load of biosolids (round trip) from TITP to Copper Mountain Landfill (CML):
   = Weighed Ave PM10 Emission Factor * Round-Trip Distance
   = (0.272 g/mile)*(650 miles/load)
   = 176.8 g/load
d. Daily emission due to transport of 2 loads of biosolids from TITP to CML:
   = (176.8 g/load)*(2 loads/day)
   = 353.6 g/day
e. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
   = (4569.6 g/day) + (353.6 g/day)
   = 4923 g/day
f. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
   = (4923 g/day)*(365 days/yr)*(1 ton/908000g)
   = **1.98 tons/yr**

**NOx:**

g. Daily emission due to transport of one load of biosolids (round trip) from HTP to CF:
= Weighed Ave NOx Emission Factor * Round-Trip Distance
= (12.41 g/mile)*(700 miles/load)
= 8687 g/load

h. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
= (8687 g/load)*(24 loads/day)
= 208488 g/day

i. Daily emission due to transport of one load of biosolids (round trip) from TITP to CML:
= Weighed Ave NOx Emission Factor * Round-Trip Distance
= (12.41 g/mile)*(650 miles/load)
= 8066.5 g/load

j. Daily emission due to transport of 2 loads of biosolids from TITP to CML:
= (8066.5 g/load)*(2 loads/day)
= 16133 g/day

k. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (208488 g/day) + (16133 g/day)
= 224621 g/day

l. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (224621 g/day)*(365 days/yr)*(1 ton/908000g)
= **90.3 tons/yr**

## 2.2. On-Road Idling Emissions

For the following calculations, the data presented in Tables 3, 4, and 9 were used.

**PM10:**

a. Daily emission due to transport of one load of biosolids (round trip) from HTP to CF:
= Weighed Ave PM10 Idling Emission Factor * On-Road Idling Time
= (1.62 g/hr)*(1.86 hr/load)
= 3.01 g/load

b. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
= (3.01 g/load)*(24 loads/day)
= 72.24 g/day

c. Daily emission due to transport of one load of biosolids (round trip) from TITP to CML:
= Weighed Ave PM10 Idling Emission Factor * On-Road Idling Time
= (1.62 g/hr)*(1.72 hr/load)
= 2.79 g/load

d. Daily emission due to transport of 2 loads of biosolids from TITP to CML:
= (2.79 g/load)*(2 loads/day)
= 5.58 g/day

e. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (72.24 g/day) + (5.58 g/day)
= 77.82 g/day

f. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (77.82 g/day)*(365 days/yr)*(1 ton/908000g)
= **0.031 tons/yr**

**NOx:**

g. Daily emission due to transport of one load of biosolids (round trip) from HTP to CF:
= Weighed Ave NOx Idling Emission Factor * On-Road Idling Time
= (188.43 g/hr)*(1.86 hr/load)
= 350.48 g/load

h. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
= (350.48 g/load)*(24 loads/day)
= 8412 g/day

i. Daily emission due to transport of one load of biosolids (round trip) from TITP to CML:
= Weighed Ave NOx Idling Emission Factor * On-Road Idling Time
= (188.43 g/hr)*(1.72 hr/load)
= 324.10 g/load

j. Daily emission due to transport of 2 loads of biosolids from TITP to SJC:
= (324.10 g/load)*(2 loads/day)
= 648.20 g/day

k. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (8412 g/day) + (648 g/day)
= 9060 g/day

l. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (9060 g/day)*(365 days/yr)*(1 ton/908000g)
= **3.64 tons/yr**

## 2.3. Off-Road Idling Emissions

For the following calculations, the data presented in Tables 3, 5, and 9 were used.

**PM10**:

a. Daily emission due to transport of one load of biosolids (round trip) from HTP to CF:
   = Weighed Ave PM10 Idling Emission Factor * Off-Road Idling Time
   = (1.62 g/hr)*(2 hr/load)
   = 3.24 g/load
b. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
   = (3.24 g/load)*(24 loads/day)
   = 77.76 g/day
c. Daily emission due to transport of one load of biosolids (round trip) from TITP to CML:
   = Weighed Ave PM10 Idling Emission Factor * Off-Road Idling Time
   = (1.62 g/hr)*(2 hr/load)
   = 3.24 g/load
d. Daily emission due to transport of 2 loads of biosolids from TITP to CML:
   = (3.24 g/load)*(2 loads/day)
   = 6.48 g/day
e. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
   = (77.76 g/day) + (6.48 g/day)
   = 84.24 g/day
f. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
   = (84.24 g/day)*(365 days/yr)*(1 ton/908000g)
   = **0.034 tons/yr**

**NOx**:

g. Daily emission due to transport of one load of biosolids (round trip) from HTP to CF:
   = Weighed Ave NOx Idling Emission Factor * Off-Road Idling Time
   = (188.43 g/hr)*(2 hr/load)
   = 376.86 g/load
h. Daily emission due to transport of 24 loads of biosolids from HTP to CF:
   = (376.86 g/load)*(24 loads/day)
   = 9044.6 g/day

i. Daily emission due to transport of one load of biosolids (round trip) from TITP to CML:
= Weighed Ave NOx Idling Emission Factor * Off-Road Idling Time
= (188.43 g/hr)*(2 hr/load)
= 376.86 g/load

j. Daily emission due to transport of 2 loads of biosolids from TITP to CML:
= (376.86 g/load)*(2 loads/day)
= 753.72 g/day

k. Total daily emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (9044.6 g/day) + (753.7 g/day)
= 9798 g/day

l. Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (9798 g/day)*(365 days/yr)*(1 ton/908000g)
= **3.94 tons/yr**

### 2.4. Total Emissions

Total Emission = Travel Emission + On-Road Idling Emission + Off-Road Idling Emission.

**PM10:**

Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (1.98 tons/yr) + (0.031 tons/yr) + (0.034 tons/yr)
= **2.04 tons/yr**

**NOx:**

Total annual emission due to transport of biosolids from HTP to CF and from TITP to CML:
= (90.3 tons/yr) + (3.64 tons/yr) + (3.94 tons/yr)
= **97.9 tons/yr**

## IV. RESULTS AND DISCUSSION

### 1. Travel Emissions

**PM10:**

The total annual PM10 masses emitted from diesel-powered transfer vehicles operating in travel mode during the transport of biosolids from HTP or TITP to various destinations according to five beneficial use scenarios are presented in Table 10 and Figure 1.

Table 10: Annual PM10 Emissions from Transfer Vehicles Operating On Travel Mode.

| Scenario | Description | Annual PM10 Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 0.68 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 0.88 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 1.98 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.75 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.68 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.66 |

As shown in Table 10 and Figure 1, there is approximately a 30% increase of PM10 emission corresponding to the transport of biosolids to the San Joaquin Composting Facility (Scenario 2) compared to the current transport of biosolids to the Green Acres Farm (Scenario 1). This increase in emissions is due to the further travel distance to SJC as compared to Green Acres Farm. Trucking the City of Los Angeles' biosolids to SJC would require the vehicles to travel an additional round-trip distance of approximately 70 miles Table 1). Because this additional 70 miles of travel would occur within Kern County (where SJC is located), the increased emissions would also likely occur within Kern County.

It should also be noted that the PM10 emission from transfer vehicles increases significantly if the biosolids are hauled to out-of-state locations. It is probable that hauling biosolids from the two major City of Los Angeles' Wastewater Treatment Plants (HTP and TITP) to sites in Arizona would result in increases of PM10 emissions as much as three times the emissions associated with the transport of the City's biosolids to the Green Acres Farm. For instance, the annual PM10 emission corresponding to Scenario 3, i.e., trucking biosolids from HTP and TITP to the Cullison Farms in Welton, AZ and to the Copper Mountain Landfill in Yuma, AZ, respectively, is 1.98 tons/year as compared to the annual PM10 emission of 0.68 tons/year if the biosolids are taken to the Green Acres Farm for beneficial reuse.

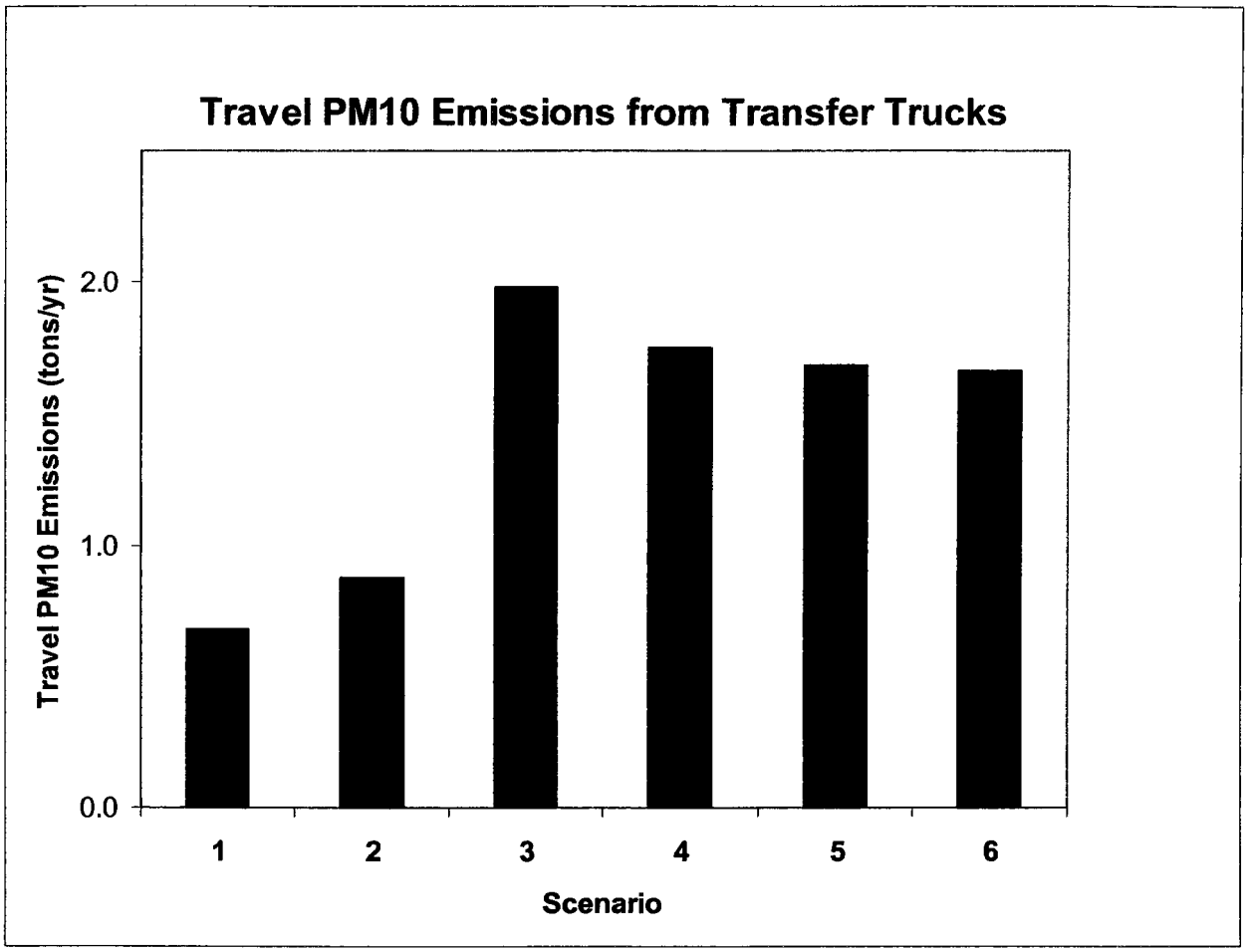


Figure 1. Annual PM10 Emissions from Diesel-Powered Transfer Vehicles Operating in Travel Mode from City of Los Angeles (HTP or TITP) to Various Beneficial use Locations. Please see Table 10 for more details on the six beneficial use scenarios.

**NOx**:

The total annual NOx emissions from diesel transfer vehicles operating in travel mode and transporting biosolids from HTP or TITP to various destinations according to five beneficial use scenarios are presented in Table 11 and Figure 2.

Table 11: Annual NOx Emissions from Transfer Vehicles Operating On Travel Mode.

| Scenario | Description | Annual NOx Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 31.1 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 40.2 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 90.3 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 79.8 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 76.8 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 75.8 |

Similar to the PM10 travel emissions, the NOx emissions also increase nearly 30% for the trucking of biosolids to the San Joaquin Composting Facility compared to the Green Acres Farm. Also, transport of the biosolids to the out-of-state beneficial use locations may result in increased NOx emissions as much as three-fold as compared to the emissions corresponding to the existing operation. The annual NOx emission of 90.3 tons/year corresponding to Scenario 3, i.e., trucking biosolids from HTP and TITP to the Cullison Farms in Welton, AZ and to the Copper Mountain Landfill in Yuma, AZ, respectively, is significantly higher than the annual NOx emission of 31.1 tons/years if the biosolids are taken to the Green Acres Farm.

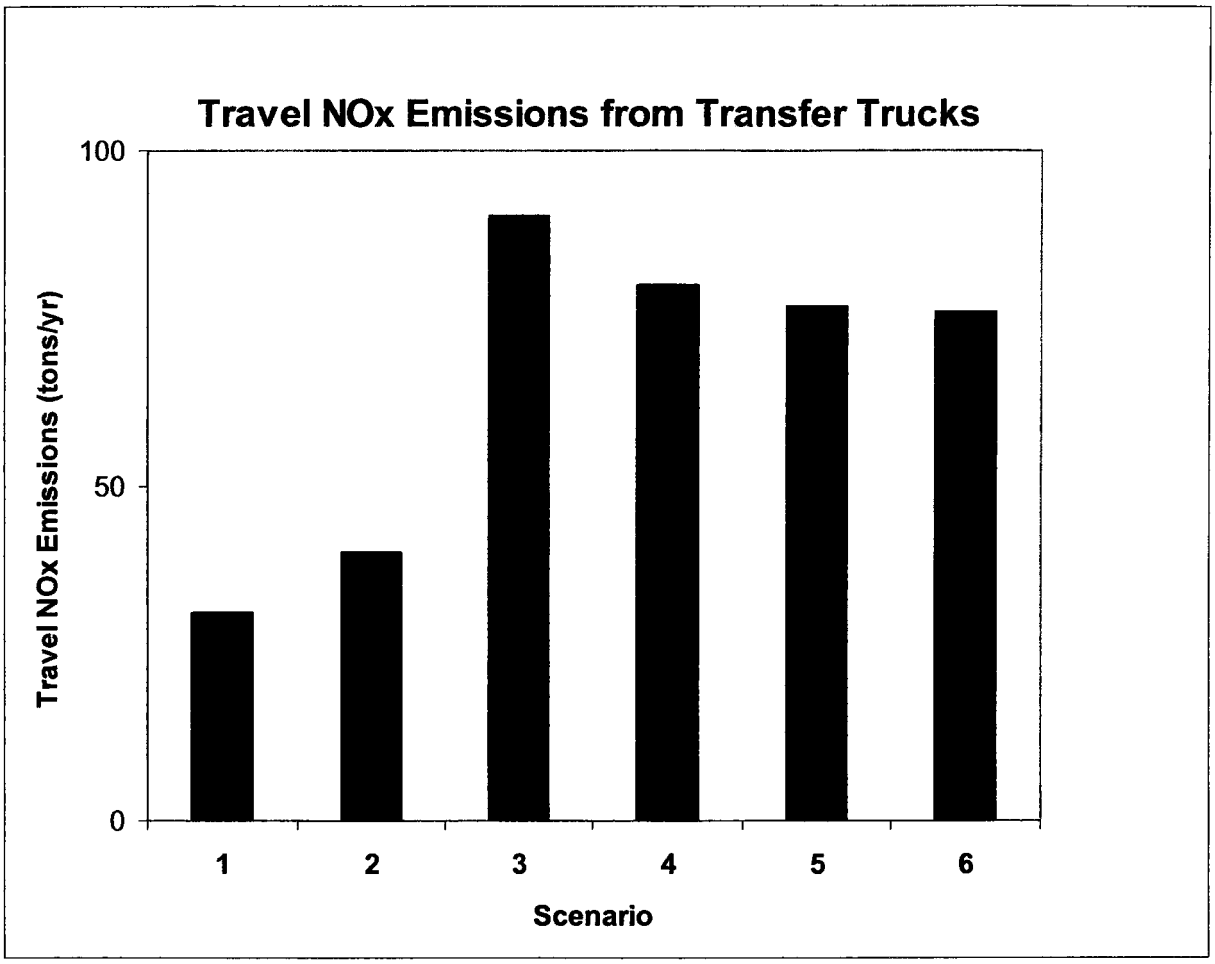


Figure 2. Annual NOx Emissions from Diesel-Powered Transfer Vehicles Operating in Travel Mode from City of Los Angeles (HTP or TITP) to Various Beneficial Use Locations.

## 2. On-Road Idling Emissions

**PM10**:

The PM10 emissions due to on-road idling of transfer vehicles are presented in Table 12 and Figure 3. As shown, the PM10 emissions due to on-road idling corresponding to out-of-state transport of City of Los Angeles' biosolids are significantly higher than the PM10 emissions from vehicles transporting the biosolids to Green Acres Farm in Kern County.

Table 12: Annual PM10 Emissions due to On-Road Idling of Transfer Vehicles.

| Scenario | Description | Annual PM10 Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 0.011 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 0.014 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 0.031 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.028 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.027 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.026 |

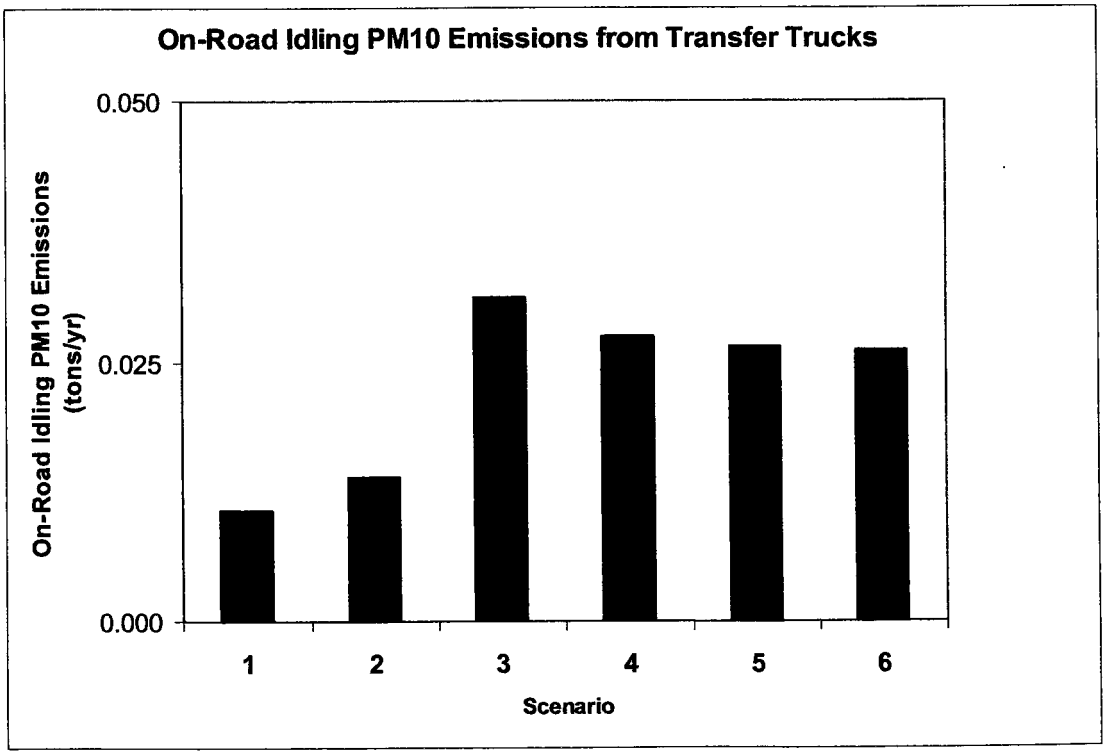


Figure 3. Annual PM10 Emissions Attributed to On-Road Idling of Diesel-Powered Transfer Vehicles.

**NOx:**

The NOx emissions due to on-road idling of transfer vehicles are shown in Table 13 and Figure 4. As with PM10 emissions, the on-road idling emissions of NOx are significantly higher for out-of-state transport as compared with the City's current practice of transporting biosolids to Green Acres Farm.

Table 13: Annual NOx Emissions due to On-Road Idling of Transfer Vehicles.

| Scenario | Description | Annual NOx Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 1.25 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 1.62 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 3.64 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.21 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.09 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.05 |

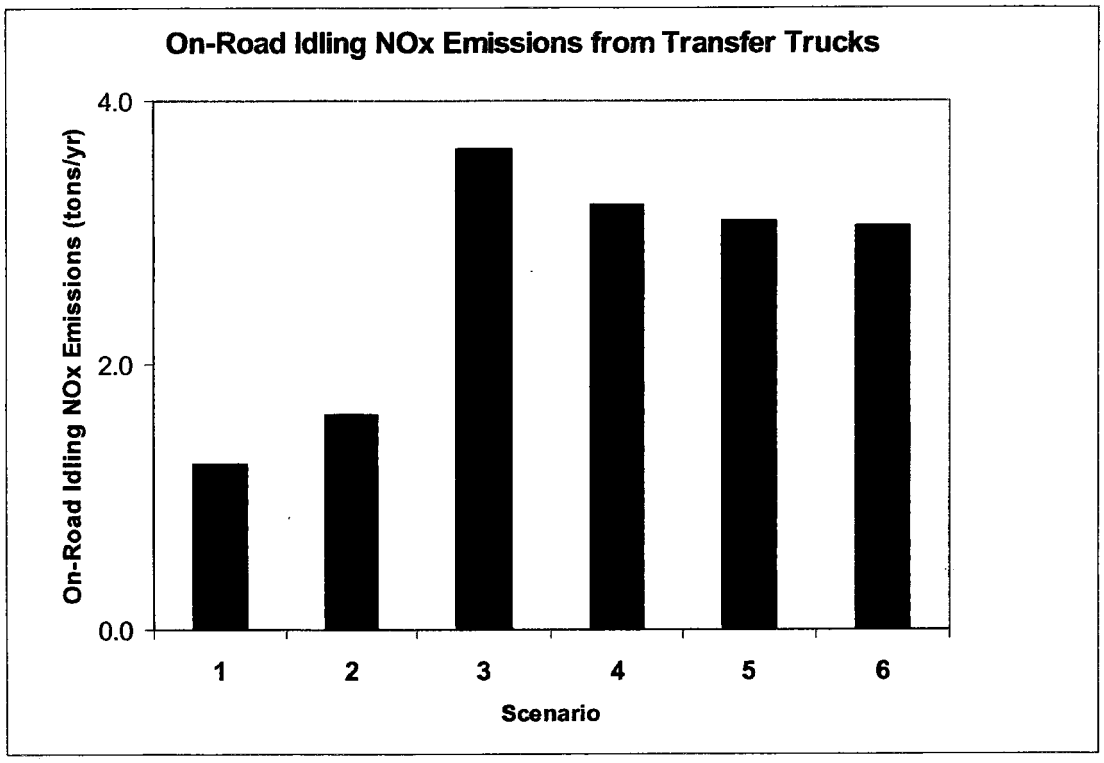


Figure 4. Annual NOx Emissions due to On-Road Idling of Diesel-Powered Transfer Vehicles.

## 3. Off-Road Idling Emissions

**PM10**:

The PM10 emissions due to off-road idling of the transfer vehicles are included in Table 14 and depicted in Figure 5.

Figures 1 and 5 illustrate that the increase in emissions associated with off-road idling of transfer vehicles for transporting biosolids to out-of-state destinations has a strong correlation with the increase of emissions due to traveling time, since both of these factors depend on driving distance.

Table 14: Annual PM10 Emissions due to Off-Road Idling of Transfer Vehicles.

| Scenario | Description | Annual PM10 Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 0 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 0.017 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 0.034 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.030 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.030 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 0.030 |

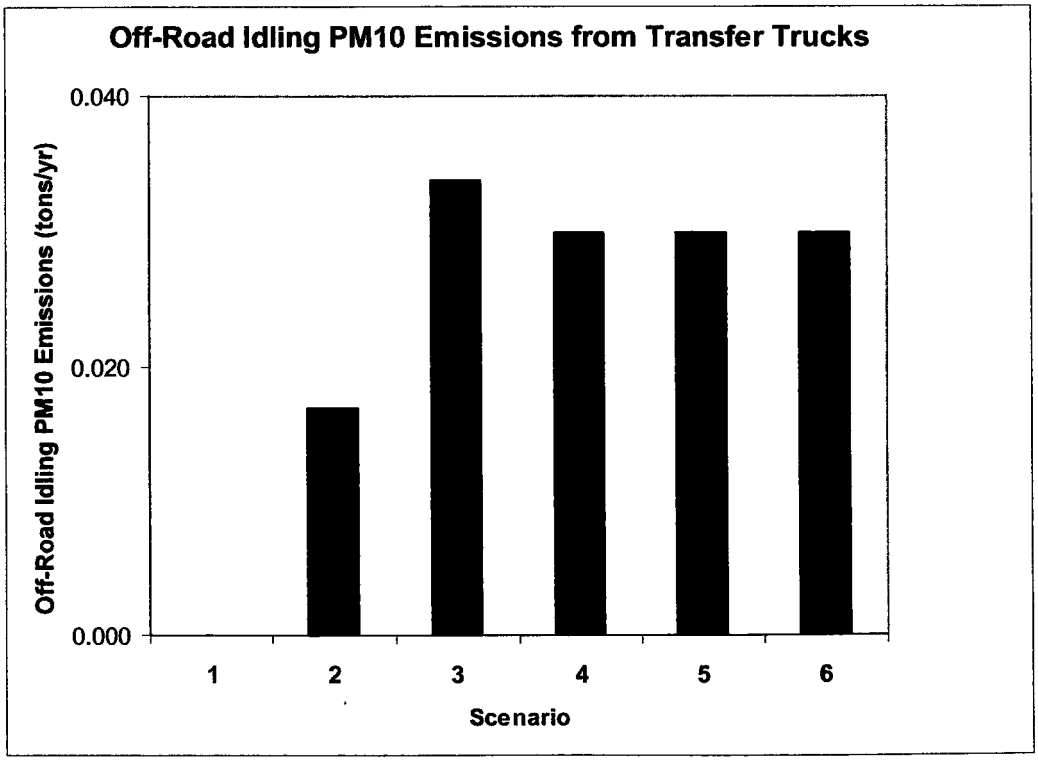


Figure 5. Annual PM10 Emissions Attributed to Off-Road Idling of Diesel-Powered Transfer Vehicles.

**NOx:**

The NOx emissions due to off-road idling of the transfer vehicles are included in Table 15 and depicted in Figure 6.

Table 15: Annual NOx Emissions due to Off-Road Idling of Transfer Vehicles.

| Scenario | Description | Annual NOx Emission (tons/yr) |
|---|---|---|
| 1 | Green Acres (HTP/TITP) | 0 |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 1.97 |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 3.94 |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.48 |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.48 |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 3.48 |

As shown in Table 15, there is an increase in NOx emissions from transfer vehicles due to off-road idling in all of the alternative scenarios when compared to the current transport to Green Acres.

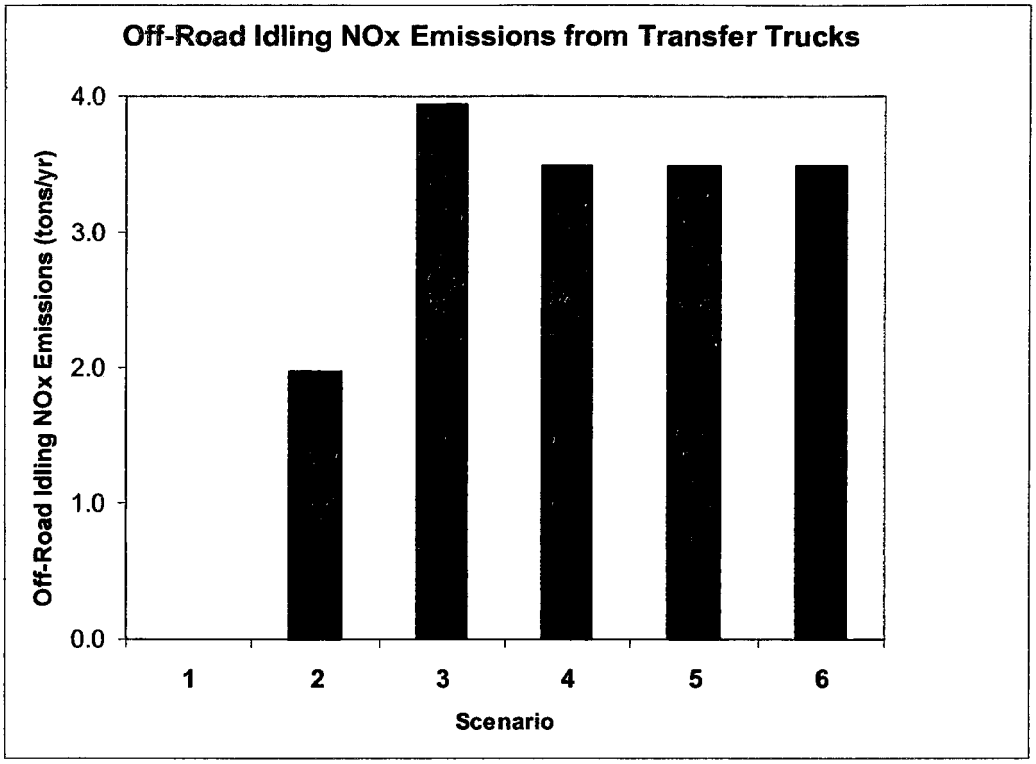


Figure 6. Annual NOx Emissions due to Off-Road Idling of Diesel-Powered Transfer Vehicles.

## 4. Total Emissions

**PM**:

The total annual PM10 emissions including those contributed by travel, on-road idling, and off-road idling are presented in Table 16 and Figure 7. Based on the baseline emission corresponding to Scenario 1, i.e., trucking biosolids to the Green Acres Farm, the percentage of existing emissions for other scenarios are presented in Table 16 using the following formula:

Percentage of Existing Emission (%) = [(Total Annual Emission)*100%]/(Total Baseline Emission)

Table 16: Total Annual PM10 Emissions from Transfer Vehicles Transporting Biosolids to Various Beneficial Use Locations.

| Scenario | Description | Annual PM10 Emission (tons/yr) | Percentage of Existing Emission (%) |
|---|---|---|---|
| 1 | Green Acres (HTP/TITP) | 0.69 | N/A |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 0.91 | 132% |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 2.04 | 296% |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.80 | 262% |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.74 | 252% |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 1.72 | 249% |

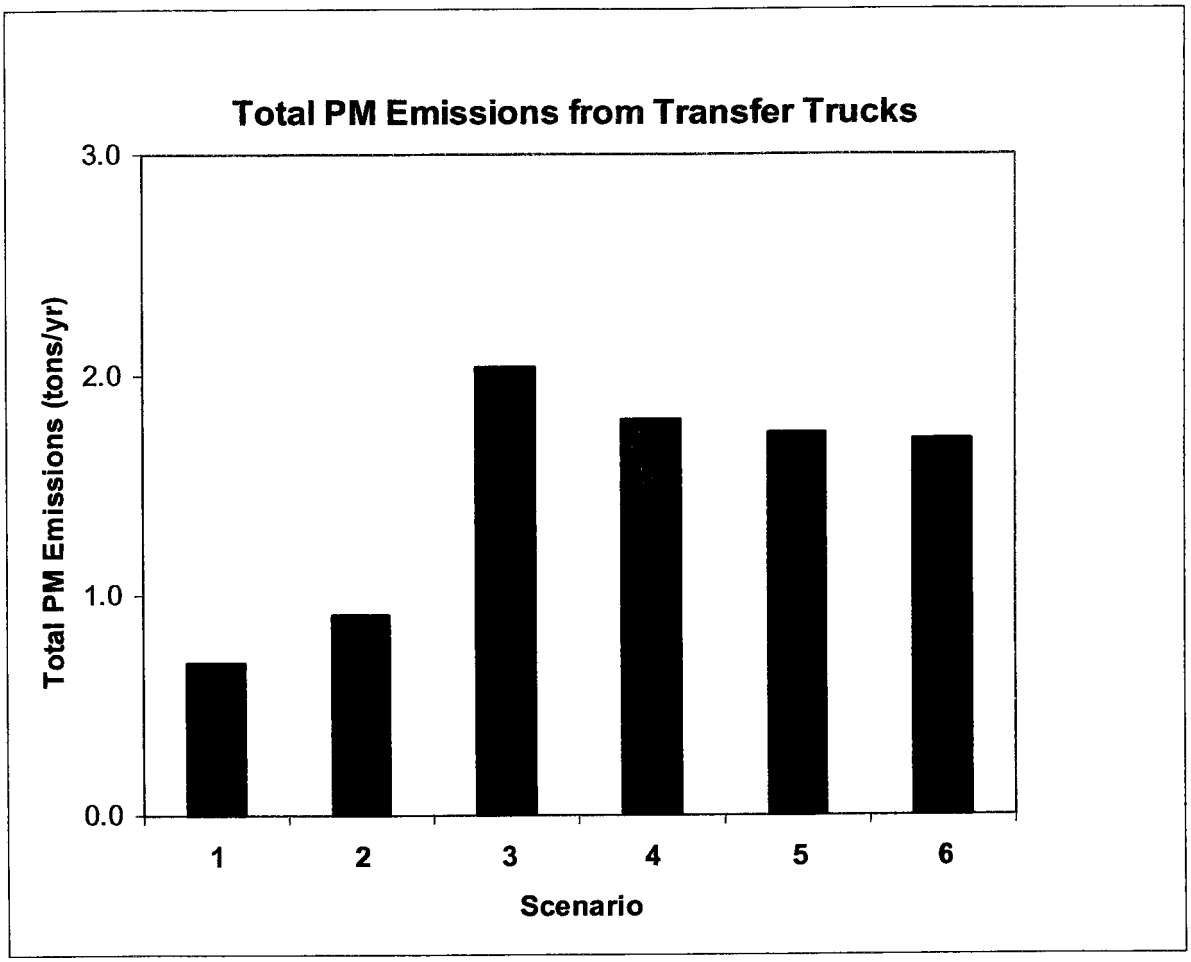


Figure 7. Total Annual PM10 Emissions from Transfer Vehicles Transporting City of Los Angeles' Biosolids to Various Destinations.

**NOx**:

The total annual NOx emissions from transfer vehicles are presented in Table 17 and Figure 8.

Table 17: Total Annual NOx Emissions from Transfer Vehicles Transporting Biosolids to Various Beneficial Use Locations.

| Scenario | Description | Annual NOx Emission (tons/yr) | Percentage of Existing Emission (%) |
|---|---|---|---|
| 1 | Green Acres (HTP/TITP) | 32.4 | N/A |
| 2 | Solid Solutions/SJC (HTP)<br>Solid Solutions/SJC (TITP) | 43.8 | 135% |
| 3 | RBM/Arizona (HTP)<br>Solid Solutions/Arizona (TITP) | 97.9 | 302% |
| 4 | RBM Arizona (HTP, 500 tpd)<br>Solid Solutions/Arizona (HTP, 50 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 86.5 | 267% |
| 5 | RBM Arizona (HTP, 150 tpd)<br>Solid Solutions/Arizona (HTP, 400 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 83.4 | 257% |
| 6 | RBM Arizona (HTP, 50 tpd)<br>Solid Solutions/Arizona (HTP, 500 tpd)<br>ABT Haskell (HTP, 50 tpd)<br>Synagro (HTP, 50 tpd)<br>Solid Solutions/SJC (TITP, 50 tpd) | 82.3 | 254% |

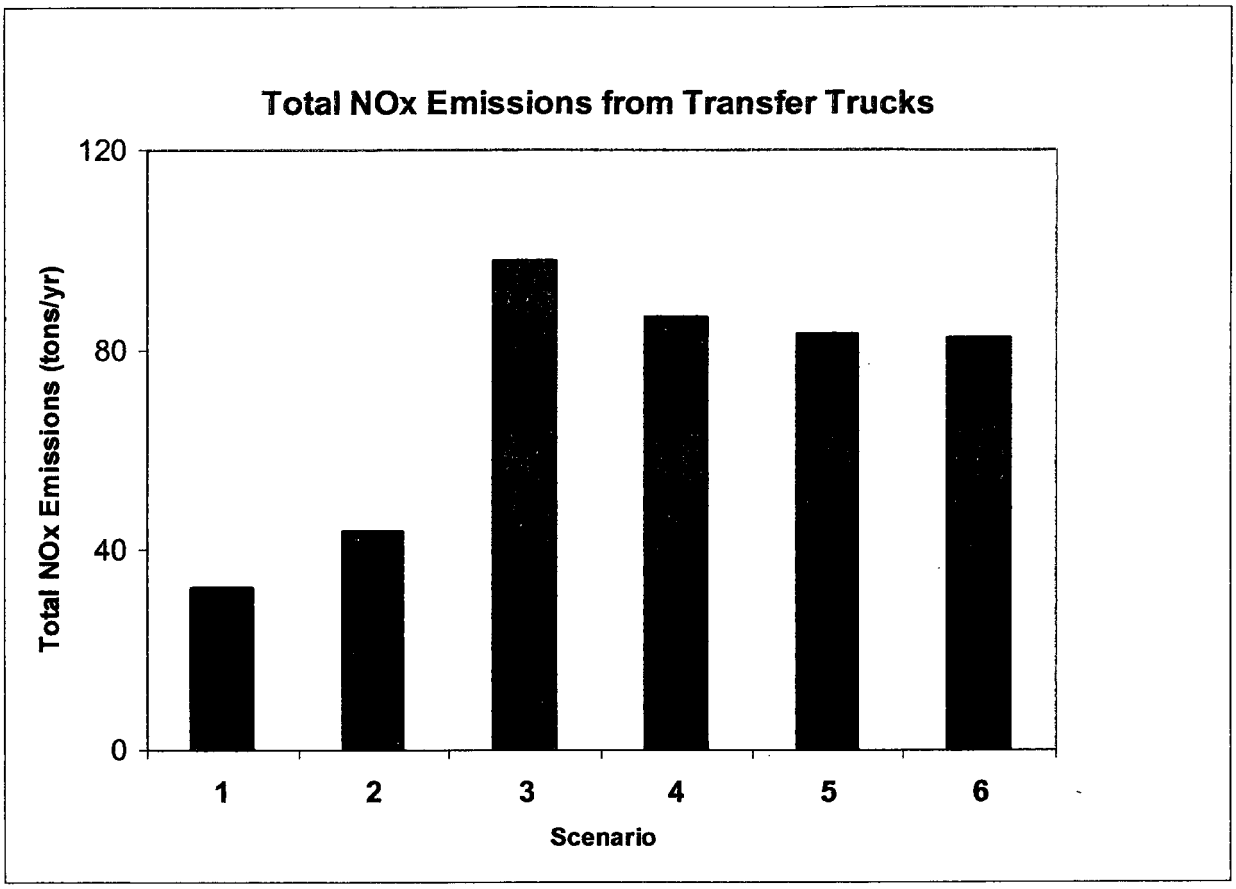


Figure 8. Total Annual NOx Emissions from Transfer Vehicles Transporting City of Los Angeles' Biosolids to Various Destinations.

## V. CONCLUSION

This study was conducted to estimate emissions of PM10 and NOx from transfer vehicles associated with various potential scenarios for transporting biosolids from the City of Los Angeles for beneficial reuse. The study demonstrates that transporting biosolids to potential locations in Arizona would result in significant increases in emissions when compared to the City's current and longstanding program of transporting the City's biosolids to Green Acres Farm. In particular, the study shows that the newly adopted Kern biosolids ban, by prohibiting land application at Green Acres and by forcing the City of Los Angeles to try to identify alternative, more distant locations for beneficial reuse of biosolids, could result in a three-fold increase in overall emissions of PM10 and NOx as compared with current conditions.

## APPENDIX A

**Inventory of Heavy-Duty Long-Haul Vehicles Transporting the City of Los Angeles' Class A Exceptional Quality Biosolids to the Green Acres Farm in Kern County, California.**

| No. | Vehicle No. | Type | Model Year | Manufacturer | Licence Plate | VIN |
|---|---|---|---|---|---|---|
| 1 | 224 | Truck | 2002 | Peterbilt | 9B93462 | 1XPGDU9X92D574617 |
| 2 | 227 | Truck | 2002 | Peterbilt | 9B93495 | 1XP5DU9X82D583123 |
| 3 | 228 | Truck | 2002 | Peterbilt | 9B93496 | 1XP5DU9X62D583122 |
| 4 | 239 | Truck | 2003 | International | 7C12692 | 2HSCEAXR43C073238 |
| 5 | 240 | Truck | 2003 | International | 9D42406 | 2HSCEAXR33C074302 |
| 6 | 241 | Truck | 2004 | Freightliner | 9D42397 | 1FUJA6CV04PN12875 |
| 7 | 242 | Truck | 2005 | Freightliner | 9D42897 | 1FUJA6CVX5DN5S123 |
| 8 | 243 | Truck | 2005 | Freightliner | 9D42896 | 1FUJA6CV65DN55121 |
| 9 | 244 | Truck | 2005 | Freightliner | 9D56755 | 1FUJA6CV75DN74146 |
| 10 | 245 | Truck | 2005 | Freightliner | 9D56756 | 1FUJA6CV25DN74149 |
| 11 | 246 | Truck | 2005 | Freightliner | 9D54930 | 1FUJA6CV45DN74167 |
| 12 | 247 | Truck | 2005 | Freightliner | 9D54929 | 1FUJA6CV65DN74171 |
| 13 | 248 | Truck | 2006 | Freightliner | 9D83004 | 1FUJA6CV26DU30439 |
| 14 | 249 | Truck | 2006 | Freightliner | 9D83005 | 1FUJA6CV36DU30448 |
| 15 | 250 | Truck | 2006 | Freightliner | 9D86674 | 1FUJA6CV56DU30466 |
| 16 | 251 | Truck | 2006 | Freightliner | 9D86670 | 1FUJA6CVX6DU30480 |
| 17 | 252 | Truck | 2006 | Freightliner | 9D86673 | 1FUJA6CV26DU30456 |
| 18 | 253 | Truck | 2006 | Freightliner | 9D86668 | 1FUJA6CV96DU30485 |
| 19 | 254 | Truck | 2006 | Freightliner | 9D86671 | 1FUJA6CV76DU30484 |
| 20 | 255 | Truck | 2006 | Freightliner | 9D86678 | 1FUJA6CV56DU30483 |
| 21 | 256 | Truck | 2006 | Freightliner | 9D86695 | 1FUJA6CV36DU30479 |
| 22 | 257 | Truck | 2006 | Freightliner | 9D86672 | 1FUJA6CV16DU30481 |
| 23 | 258 | Truck | 2006 | Freightliner | 9D86669 | 1FUJA6CV66PV93707 |

## APPENDIX B

**Daily Pick-up Loads of Class A Exceptional Quality Biosolids from the City of Los Angeles' Hyperion Treatment Plant to the Green Acres Farm in Kern County, California.**

| Date | Jan. 2006 | Feb. 2006 | Mar. 2006 | Apr. 2006 | May 2006 | Jun. 2006 |
|---|---|---|---|---|---|---|
| 1 | 20 | 26 | 28 | 24 | 23 | 24 |
| 2 | 23 | 25 | 22 | 21 | 25 | 25 |
| 3 | 22 | 29 | 26 | 24 | 16 | 21 |
| 4 | 22 | 22 | 25 | 31 | 15 | 15 |
| 5 | 27 | 24 | 20 | 29 | 23 | 26 |
| 6 | 25 | 22 | 27 | 25 | 26 | 26 |
| 7 | 16 | 27 | 27 | 26 | 21 | 25 |
| 8 | 24 | 22 | 26 | 21 | 23 | 25 |
| 9 | 29 | 22 | 25 | 23 | 25 | 26 |
| 10 | 24 | 28 | 26 | 28 | 21 | 22 |
| 11 | 18 | 26 | 24 | 25 | 23 | 16 |
| 12 | 24 | 20 | 3 | 26 | 28 | 27 |
| 13 | 22 | 28 | 25 | 23 | 27 | 22 |
| 14 | 20 | 32 | 30 | 28 | 22 | 25 |
| 15 | 17 | 34 | 28 | 21 | 26 | 30 |
| 16 | 28 | 25 | 30 | 22 | 28 | 26 |
| 17 | 27 | 28 | 26 | 21 | 24 | 21 |
| 18 | 31 | 26 | 20 | 25 | 25 | 20 |
| 19 | 27 | 24 | 23 | 26 | 27 | 28 |
| 20 | 24 | 26 | 28 | 23 | 22 | 22 |
| 21 | 18 | 30 | 33 | 23 | 19 | 33 |
| 22 | 14 | 22 | 30 | 20 | 24 | 17 |
| 23 | 20 | 25 | 25 | 17 | 27 | 21 |
| 24 | 19 | 26 | 26 | 28 | 24 | 23 |
| 25 | 19 | 22 | 27 | 29 | 22 | 24 |
| 26 | 22 | 19 | 24 | 22 | 17 | 27 |
| 27 | 27 | 22 | 26 | 23 | 21 | 28 |
| 28 | 23 | 28 | 26 | 28 | 16 | 26 |
| 29 | 22 | | 17 | 19 | 17 | 26 |
| 30 | 30 | | 28 | 23 | 13 | 17 |
| 31 | 22 | | 31 | | 21 | |
| **Daily Ave.** | 23 | 25 | 25 | 24 | 22 | 24 |