



## 2007 Area Source Emissions Inventory Methodology

### 430 – SAND AND GRAVEL EXCAVATION AND PROCESSING GRINDING AND CRUSHING OF AGGREGATE

#### I. Purpose

This document describes the Area Source Methodology used to estimate emissions of fine particulate matter less than 10 microns (PM<sub>10</sub>) generated from sand and gravel excavation and processing and aggregate grinding and crushing in the San Joaquin Valley Air Basin. An area source category is a collection of similar emission units within a geographic area (i.e., a County) that are small and numerous, and that may not have been inventoried as specific point, mobile, or biogenic sources. The California Air Resources Board (CARB) has grouped these individual sources with other like sources into area source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology.

#### II. Applicability

The emission calculations from this Area Source Methodology apply to facilities that are identified by the following Category of Emission Source (CES) codes and Reconciliation Emission Inventory Codes (REIC):

**Table 1. Emission inventory codes.**

| CES   | REIC              | Description                               |
|-------|-------------------|---|
| 46995 | 430-422-7078-0000 | Sand and Gravel Excavation and Processing |
| 47019 | 430-426-7078-0000 | Grinding/Crushing of Aggregates           |

#### III. Point Source Reconciliation

Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (ARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and the emissions process' Source Category Code (SCC) combinations. The area sources in this methodology reconcile against processes in our point source inventory with the SIC/SCC combinations listed in Appendix B.

#### **IV. Methodology Description**

This area source methodology is a top down estimation of fugitive emissions of PM<sub>10</sub> from sand and gravel (aggregate) excavation and processing operations (EIC 430-422-7078-0000) in the San Joaquin Valley Air Pollution Control District. Area source emissions for aggregate grinding and crushing operations (EIC 430-426-7078-0000) are included in the sand and gravel processing losses. Therefore, the grinding and crushing of aggregates inventory will be equal to the sum of its point source emissions, and its associated area source emissions inventory will be set to zero.

Emissions from the production of sand and gravel are primarily particulate matter which is from processes such as conveying, screening, crushing, and storing. Generally, sand and aggregate materials are wet or moist when handled, and process emissions are often negligible (see Appendix A for a more detailed discussion of sand and gravel processing).

Sand and gravel (aggregate) production is reported annually to the California Department of Conservation, Office of Mine Reclamation (OMR), but county level data could not be obtained since it is considered confidential. However, the number of disturbed acres for each county was available. The District used Tulare County's 2007 actual production of sand and gravel, sand, decomposed granite, granite, and shale per disturbed acre and the OMR data on the number of disturbed acres per county to estimate production in each county in the District. From the estimated countywide production, the amount of material reported through our point source inventory was subtracted. The remaining amount was considered our area source process rate. This was multiplied by an emission factor developed to represent a "typical" mining facility to estimate area source emissions.

#### **V. Activity Data**

Sand and gravel production is reported annually to the California Department of Conservation, Office of Mine Reclamation, but county level production data could not be obtained since it is considered confidential. The number of disturbed acres for each county was available; however, and was used as a surrogate. The District asked each County to provide their mineral production data. For the Counties that did not provide their data, Tulare County's production rate of 4,641.5 tons per disturbed acre was used as a surrogate. Estimated sand and gravel, sand, decomposed granite, granite, aggregate, and shale production in the District is presented in the following table:

**Table 2. Estimated sand and gravel, sand, decomposed granite, granite, and shale production in the SJVAPCD in 2007.**

| County            | State permitted surface mines (no.) | Number of point sources | Disturbed acres <sup>1</sup> | Estimated total production (tons) | Point source production (tons) <sup>3</sup> | Area source production (tons) <sup>4</sup> |
|-------------------|-------------------------------------|-------------------------|------------------------------|-----------------------------------|---|--|
| Fresno            | 16                                  | 3                       | 1,105.4                      | 5,130,672                         | 3,201,114                                   | 1,929,558                                  |
| Kern <sup>2</sup> | 27                                  | 7                       | 2,502.4                      | 11,614,795                        | 3,586,086                                   | 8,028,709                                  |
| Kings             | 1                                   | 0                       | 9.0                          | 41,773                            | 0   | 41,773                                     |
| Madera            | 2                                   | 0                       | 79.9                         | 370,667                           | 0   | 370,667                                    |
| Merced            | 23                                  | 3                       | 1,283.0                      | 5,955,089                         | 1,897,232                                   | 4,057,857                                  |
| San Joaquin       | 21                                  | 6                       | 2,023.0                      | 9,389,678                         | 8,980,404                                   | 409,274                                    |
| Stanislaus        | 14                                  | 2                       | 480.5                        | 2,230,223                         | 588,895                                     | 1,641,328                                  |
| Tulare            | 27                                  | 4                       | 756.5                        | 3,511,266                         | 207,600                                     | 3,303,666                                  |
| District Total    | 131                                 | 25                      | 8,239.7                      | 38,244,163                        | 18,461,331                                  | 19,782,832                                 |

<sup>1</sup>Number of disturbed acres per county from the California Department of Conservation, Office of Mine Reclamation.

<sup>2</sup>Includes only mines and disturbed acres within the SJVAPCD

<sup>3</sup>Large sources within the District are under permit and report their emissions through the point source inventory.

<sup>4</sup>The area source total includes small facilities not represented in the District's point source inventory..

## VI. Emission Factors

Sand and gravel (aggregate) excavation and processing emission factors were taken from AP-42 (EPA, 2004) Section 11.19.2.2 *Crushed Stone Processing Operations* and Section 13.2.4 *Aggregate Handling and Storage Piles*.

**Table 3. Emission factors for sand and gravel excavation and processing and grinding/ crushing of aggregate.**

| Emission Process                        | Emission Factor                     | Source                         |
|---|-------------------------------------|--------------------------------|
| Receiving – truck unloading             | 0.000016 lb-PM <sub>10</sub> /ton   | AP-42, Table 11.19.2-2, (8/04) |
| Crusher (uncontrolled)                  | 0.0024 lb-PM <sub>10</sub> /ton     | AP-42, Table 11.19.2-2, (8/04) |
| Screening (uncontrolled)                | 0.0087 lb-PM <sub>10</sub> /ton     | AP-42, Table 11.19.2-2, (8/04) |
| Conveyor transport point (uncontrolled) | 0.0011 lb-PM <sub>10</sub> /ton     | AP-42, Table 11.19.2-2, (8/04) |
| Stockpiles                              | 0.050 lb-PM <sub>10</sub> /acre/day | District Permitting Assumption |

To calculate emissions, we reviewed the processes present in permitted facilities. From this, we determined that a typical small operation has 1 crusher, 1 screen, 5 conveyors and 1 acre of stockpiles. It is further assumed that the crusher processes one half of each facility's throughput. For calculation simplicity, the crusher emission factor is divided by two rather than the throughput.

Using these assumptions we calculated an area source emissions factor of 0.015416 pounds-PM<sub>10</sub>/ton of material processed as presented in the table below:

**Table 4. Area source emissions rate for sand and gravel excavation and processing.**

| Emission Process                           | Emission Factor (lb PM <sub>10</sub> /ton) | Processes per Facility | Emissions (lb PM <sub>10</sub> /ton) |
|--|--|------------------------|--------------------------------------|
| Receiving – truck unloading                | 0.000016                                   | 1                      | 0.000016                             |
| Crusher <sup>1</sup>                       | 0.0024                                     | ½ of throughput        | 0.0012                               |
| Screening                                  | 0.0087                                     | 1                      | 0.0087                               |
| Conveyor Transfer Point                    | 0.0011                                     | 5                      | 0.0055                               |
| <b>Facility Total (without stockpiles)</b> |  |                        | <b>0.015416</b>                      |

<sup>1</sup>The District assumes one crusher per facility that processes ½ of the material throughput. For calculation simplicity, the crusher emissions factor is divided by two rather than the throughput.

In addition to the processing emissions, we assumed that each small operation has one acre of stockpiles. Annual PM<sub>10</sub> emissions from these stockpiles were calculated as follows:

$$\text{Stockpile PM}_{10} \text{ Emissions} = \left( \frac{0.050 \text{ lbs PM}_{10}}{\text{acre} - \text{day}} \right) \times 1 \text{ acre} \times \left( \frac{365 \text{ days}}{\text{year}} \right) \times \left( \frac{1 \text{ ton}}{2,000 \text{ lbs}} \right) = \frac{0.009125 \text{ tons of PM}_{10}}{\text{year}}$$

**Table 5. Area source emission rate for sand and gravel stockpiles**

| Emission Process | Emission Factor (lb PM <sub>10</sub> /acre/day) | Processes per Facility | Emissions (tons PM <sub>10</sub> /year) |
|------------------|---|------------------------|---|
| Stockpiles       | 0.050   | 1                      | 0.009125                                |

## VII. Emissions Calculations

### A. Assumptions

1. PM is the only pollutant emitted from the sand and gravel (aggregate) handling process.
2. Sand and gravel has a moisture content of 1.5%.
3. PM emissions from non-permitted facilities are uncontrolled.
4. Based on a review of District permitted sand and gravel (aggregate) facilities, the average small sand and gravel (aggregate) facility consists of 1 crusher, 1 screen, 5 conveyors and 1 acre of stockpiles.
5. One half of a facility’s throughput is crushed.
6. The area source emission factor, excluding stockpiles, is 0.015416 lb-PM<sub>10</sub>/ton material.

7. The area source emission factor for stockpiles is 0.009125 tons-PM<sub>10</sub>/year for each facility.
8. Each California permitted non-fuel mineral surface mine is a separate sand and gravel (aggregate) facility and each facility has one acre of stockpiles.

## **B. Sample Calculations**

### **Given:**

1. Fresno County's 2007 area source process rate was 1,929,558 tons of sand and gravel from 13 area source facilities.
2. The processing PM<sub>10</sub> emission factor of 0.015416 lbs PM<sub>10</sub> per ton of material processed is based on an average sand and gravel operation. (See Table 4)

### **Calculate Emissions:**

Emissions of PM<sub>10</sub> from non-permitted sand and gravel processing facilities is calculated as follows:

#### ***Step 1. Calculate Processing PM<sub>10</sub> Emissions.***

$$Pr oces sin g PM_{10} = \left( \frac{\text{tons material processed}}{\text{year}} \right) \times \left( \frac{0.015416 \text{ lbs } PM_{10}}{\text{ton}} \right) \times \left( \frac{1 \text{ ton}}{2,000 \text{ lbs}} \right) = \frac{\text{tons of } PM_{10}}{\text{year}}$$

$$Pr oces sin g PM_{10} = \left( \frac{1,929,558 \text{ tons processed}}{\text{year}} \right) \times \left( \frac{0.015416 \text{ lbs } PM_{10}}{\text{ton}} \right) \times \left( \frac{1 \text{ ton}}{2,000 \text{ lbs}} \right) = \frac{14.87 \text{ tons of } PM_{10}}{\text{year}}$$

#### **Step 2. Calculate Storage Pile PM<sub>10</sub> Emissions**

$$Storage \text{ Pile } PM_{10} = \frac{0.009125 \text{ tons } PM_{10}}{\text{Facility} - \text{Year}} \times \text{No. Facilities}$$

$$Storage \text{ Pile } PM_{10} = \frac{0.009125 \text{ tons } PM_{10}}{\text{Facility} - \text{Year}} \times 13 \text{ Facilities} = \frac{0.12 \text{ tons } PM_{10}}{\text{Year}}$$

#### **Step 3. Calculate Total PM<sub>10</sub> Emissions**

$$Total PM_{10} \text{ Emissions} = Processing PM_{10} \text{ Emissions} + Storage Pile PM_{10} \text{ Emissions}$$

$$Total PM_{10} \text{ Emissions} = \frac{14.87 \text{ tons } Pr oces sin g PM_{10}}{\text{Year}} + \frac{0.12 \text{ tons } Storage \text{ Pile } PM_{10}}{\text{Year}}$$

$$Total PM_{10} \text{ Emissions} = \frac{14.99 \text{ tons } PM_{10}}{\text{Year}}$$

## **VIII. Temporal Variation**

### **A. Daily**

CARB Code 12. 12 hours per day - uniform activity during the day.

### **B. Weekly**

CARB Code 5. 5 days per week - uniform activity during the week.

### **C. Monthly**

Uniform monthly activity – 8.33% per month.

## **IX. Spatial Variation**

Area source emissions for this source category can be assigned to *Sand and Gravel Mine Locations* as identified in the National Atlas (USGS, 2004).

## **X. Growth Factor**

Growth factors are developed by either the District's Strategies and Incentives Department or CARB for each EIC. These factors are used to estimate emissions in future years. The growth factors associated with this emissions category may be obtained from the District's Strategies and Incentives Department.

## **XI. Control Level**

Control levels are developed by either the District's Strategies and Incentives Department or CARB for each EIC. Control levels are used to estimate emissions reductions in future years due to implementation of District rules. These control levels take into account the effect of control technology, compliance and exemptions at full implementation of the rules.

Sand and gravel (aggregate) operations are subject to District Rules 2201 New and Modified Stationary Source Review and 4101 Visible Emissions. Control levels associated with this emissions category may be obtained from the District's Strategies and Incentives Department.

## **XII. CARB Chemical Speciation**

CARB has developed particulate matter speciation profiles in order to calculate particulate matter (PM), particulate matter with a diameter less than or equal to 10 microns (PM<sub>10</sub>) or particulate matter with a diameter less than or equal to 2.5

microns (PM<sub>2.5</sub>) given any one of the three values. For each speciation profile, the fraction of PM that is PM<sub>10</sub> and PM<sub>2.5</sub> is given. The particulate matter profile codes can also be used to lookup associated toxics. CARB’s particulate matter speciation profile for Sand and Gravel Excavation and Processing and Grinding/Crushing of Aggregates is presented in the following table:

**Table 6. CARB particulate matter speciation profile for 430-422-7078-0000 and 430-426-7078-0000.**

| Profile Description  | CARB PM Profile# | Fractions        |                   |
|----------------------|------------------|------------------|-------------------|
|                      |                  | PM <sub>10</sub> | PM <sub>2.5</sub> |
| Mineral Process Loss | 371              | 0.5              | 0.146             |

### XIII. Assessment Of Methodology

The accuracy of this estimate depends upon the following:

1. Non-fuel mineral surface mining disturbed acreage for each county provided by the California Department of Conservation, Office of Mine Reclamation (OMR) is accurately reported and a good predictor of sand and gravel (aggregate) production.
2. Tulare County’s 2007 production rate (total tons of material mined as reported by Tulare County divided by Tulare County’s disturbed acreage as reported by OMR) is a good surrogate for sand and gravel (aggregate) mining operations in the other seven counties in the District.
3. The area source emission factors developed by the District accurately represent actual emissions.
4. Assuming emissions from all non-permitted operations are uncontrolled may overestimates PM<sub>10</sub> emissions.

We would prefer to be able to use tons of material mined as reported to OMR by operators directly, but this information is not available as OMR considers it confidential. Statewide sand and aggregate production values are available. In the past, these values have been disaggregated to the counties using mining employment data from the US Census. However, based on the data in the 2007 economic census, the number of establishments in each county does not correlate to the number of non-fuel mineral surface mine permits issued by the State of California.

We do know of some issues with the use of disturbed acres in our analysis.

1. OMR identifies acreage that is under going reclamation, and not being mined, as disturbed; therefore, the use of disturbed acres may overestimate the production of sand and gravel (aggregate) and PM10 emissions.

2. Assuming each California permitted non-fuel mineral surface mine is a sand and gravel (aggregate) facility may overestimate the production of sand and gravel (aggregate) and PM<sub>10</sub> emissions.
3. California's 2007 production of construction aggregate (sand and gravel and crushed stone) was estimated to be 192.8 million tons. Producers report material sold or consumed by the producer to the USGS; however, stockpiled production is not reported until it is sold or consumed by the producer.
4. District wide production of sand and gravel (aggregate) using Tulare County data as a surrogate is 19.83% of the statewide total. District wide production using the State values as a surrogate is 11.04% of the statewide total. Aggregate availability in California indicates the District has 13% of the permitted aggregate resources. District wide production of sand and gravel (aggregate) most likely lies between 11% and 20% of the statewide total production. The District will revisit this methodology when better data is available.

#### **XIV. Emissions**

Following is the 2007 area source emissions inventory estimated by this methodology. Emissions are reported for each county in the District.



**Table 7. Area source emissions for Sand and Gravel Excavation and Processing (REIC 430-422-7078-0000) and Grinding and Crushing of Aggregates (REIC 430-426-7078-0000), 2007.**

| County   | Emissions (tons/year) |    |     |     |                                 |                                  |
|--|-----------------------|----|-----|-----|---------------------------------|----------------------------------|
|  | NOx                   | CO | SOx | VOC | PM <sub>10</sub> <sup>(1)</sup> | PM <sub>2.5</sub> <sup>(2)</sup> |
| <b>Sand and Gravel Excavation and Processing</b> |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 15.00                           | -                                |
| Kern   | -                     | -  | -   | -   | 62.09                           | -                                |
| Kings  | -                     | -  | -   | -   | 0.33                            | -                                |
| Madera   | -                     | -  | -   | -   | 2.88                            | -                                |
| Merced   | -                     | -  | -   | -   | 31.46                           | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 3.29                            | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 12.76                           | -                                |
| Tulare   | -                     | -  | -   | -   | 25.70                           | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>153.51</b>                   | -                                |
| <b>Grinding and Crushing of Aggregates</b>       |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 0.00                            | -                                |
| Kern   | -                     | -  | -   | -   | 0.00                            | -                                |
| Kings  | -                     | -  | -   | -   | 0.00                            | -                                |
| Madera   | -                     | -  | -   | -   | 0.00                            | -                                |
| Merced   | -                     | -  | -   | -   | 0.00                            | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 0.00                            | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 0.00                            | -                                |
| Tulare   | -                     | -  | -   | -   | 0.00                            | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>0.00</b>                     | -                                |

(1) The District only reports PM<sub>10</sub> to CARB.

(2) At this time, the District does not calculate PM<sub>2.5</sub> emissions. PM<sub>2.5</sub> emissions can be estimated using the speciation profiles found in Section XII.

Following is the 2007 point source emissions inventory for sand and gravel excavation and processing and grinding and crushing of aggregates as reported to the District by our permit holders. Emissions are reported for each county in the District.

**Table 8. Point source emissions for Sand and Gravel Excavation and Processing (REIC 430-422-7078-0000) and Grinding and Crushing of Aggregates (REIC 430-426-7078-0000), 2007.**

| County   | Emissions (tons/year) |    |     |     |                                 |                                  |
|--|-----------------------|----|-----|-----|---------------------------------|----------------------------------|
|  | NOx                   | CO | SOx | VOC | PM <sub>10</sub> <sup>(1)</sup> | PM <sub>2.5</sub> <sup>(2)</sup> |
| <b>Sand and Gravel Excavation and Processing</b> |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 3.82                            | -                                |
| Kern   | -                     | -  | -   | -   | 3.78                            | -                                |
| Kings  | -                     | -  | -   | -   | 0.00                            | -                                |
| Madera   | -                     | -  | -   | -   | 0.00                            | -                                |
| Merced   | -                     | -  | -   | -   | 2.81                            | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 16.18                           | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 5.45                            | -                                |
| Tulare   | -                     | -  | -   | -   | 28.27                           | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>60.31</b>                    | -                                |
| <b>Grinding and Crushing of Aggregates</b>       |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 0.03                            | -                                |
| Kern   | -                     | -  | -   | -   | 0.06                            | -                                |
| Kings  | -                     | -  | -   | -   | 0.00                            | -                                |
| Madera   | -                     | -  | -   | -   | 0.00                            | -                                |
| Merced   | -                     | -  | -   | -   | 0.00                            | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 0.06                            | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 0.00                            | -                                |
| Tulare   | -                     | -  | -   | -   | 0.00                            | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>0.15</b>                     | -                                |

(1) The District only reports PM<sub>10</sub> to CARB

(2) At this time, the District does not calculate PM<sub>2.5</sub> emissions. PM<sub>2.5</sub> emissions can be estimated using the speciation profiles found in Section XII.

430 –Sand, Gravel and Aggregate

Following is the 2007 total unreconciled (point source plus area source) emissions inventory for sand and gravel excavation and processing and grinding and crushing of aggregates. Emissions are reported for each county in the District.

**Table 9. Total emissions for Sand and Gravel Excavation and Processing (REIC 430-422-7078-0000) and Grinding and Crushing of Aggregates (REIC 430-426-7078-0000), 2007.**

| County   | Emissions (tons/year) |    |     |     |                                 |                                  |
|--|-----------------------|----|-----|-----|---------------------------------|----------------------------------|
|  | NOx                   | CO | SOx | VOC | PM <sub>10</sub> <sup>(1)</sup> | PM <sub>2.5</sub> <sup>(2)</sup> |
| <b>Sand and Gravel Excavation and Processing</b> |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 18.82                           | -                                |
| Kern   | -                     | -  | -   | -   | 65.87                           | -                                |
| Kings  | -                     | -  | -   | -   | 0.33                            | -                                |
| Madera   | -                     | -  | -   | -   | 2.88                            | -                                |
| Merced   | -                     | -  | -   | -   | 34.27                           | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 19.47                           | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 18.21                           | -                                |
| Tulare   | -                     | -  | -   | -   | 53.97                           | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>213.82</b>                   | -                                |
| <b>Grinding and Crushing of Aggregates</b>       |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 0.03                            | -                                |
| Kern   | -                     | -  | -   | -   | 0.06                            | -                                |
| Kings  | -                     | -  | -   | -   | 0.00                            | -                                |
| Madera   | -                     | -  | -   | -   | 0.00                            | -                                |
| Merced   | -                     | -  | -   | -   | 0.00                            | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | 0.06                            | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 0.00                            | -                                |
| Tulare   | -                     | -  | -   | -   | 0.00                            | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | <b>0.15</b>                     | -                                |

(1) The District only reports PM<sub>10</sub> to CARB. same as VOC.

(2) At this time, the District does not calculate PM<sub>2.5</sub> emissions. PM<sub>2.5</sub> emissions can be estimated using the speciation profiles found in Section XII.

## 430 –Sand, Gravel and Aggregate

Following is the net change in total unreconciled emissions between this update (2007 inventory year) and the CEIDARS data for the previous year (2006 inventory year) for sand and gravel excavation and processing and grinding and crushing of aggregates.. The change in emissions are reported for each county in the District.

**Table 10. Net emissions change for Sand and Gravel Excavation and Processing (REIC 430-422-7078-0000) and Grinding and Crushing of Aggregates (REIC 430-426-7078-0000), 2007-2006.**

| County   | Emissions (tons/year) |    |     |     |                                 |                                  |
|--|-----------------------|----|-----|-----|---------------------------------|----------------------------------|
|  | NOx                   | CO | SOx | VOC | PM <sub>10</sub> <sup>(1)</sup> | PM <sub>2.5</sub> <sup>(2)</sup> |
| <b>Sand and Gravel Excavation and Processing</b> |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 13.81                           | -                                |
| Kern   | -                     | -  | -   | -   | 48.00                           | -                                |
| Kings  | -                     | -  | -   | -   | 0.33                            | -                                |
| Madera   | -                     | -  | -   | -   | 2.88                            | -                                |
| Merced   | -                     | -  | -   | -   | -66.83                          | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | -16.63                          | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | -32.59                          | -                                |
| Tulare   | -                     | -  | -   | -   | 5.24                            | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | -45.79                          | -                                |
| <b>Grinding and Crushing of Aggregates</b>       |                       |    |     |     |                                 |                                  |
| Fresno   | -                     | -  | -   | -   | 0.01                            | -                                |
| Kern   | -                     | -  | -   | -   | 0.01                            | -                                |
| Kings  | -                     | -  | -   | -   | 0.00                            | -                                |
| Madera   | -                     | -  | -   | -   | 0.00                            | -                                |
| Merced   | -                     | -  | -   | -   | 0.00                            | -                                |
| San Joaquin                                      | -                     | -  | -   | -   | -0.14                           | -                                |
| Stanislaus                                       | -                     | -  | -   | -   | 0.00                            | -                                |
| Tulare   | -                     | -  | -   | -   | -0.47                           | -                                |
| <b>TOTAL</b>                                     | -                     | -  | -   | -   | - 0.59                          | -                                |

(1) The District only reports PM<sub>10</sub> to CARB.

(2) At this time, the District does not calculate PM<sub>2.5</sub> emissions. PM<sub>2.5</sub> emissions can be estimated using the speciation profiles found in Section XII.

## XV. Revision History

2007. This is a new District methodology.

## XVI. Update Schedule

In an effort to provide inventory information to CARB and other District programs and maximize limited resources, the District has developed an update cycle based on emissions within the source category as shown in the following table:

**Table 11. Area source update frequency criteria.**

| Total Emissions<br>(tons/day) | Update Cycle<br>(years) |
|-------------------------------|-------------------------|
| <=1                           | 4                       |
| >1 and <= 2.5                 | 3                       |
| >2.5 and <=5                  | 2                       |
| >5                            | 1                       |

Since PM<sub>10</sub> emissions are less than one ton per day, this source category will be updated every four years.

## XVII. References

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3. Quinn, H.. 2001. Area Source Summary – Sacramento County, Sand and Gravel Excavation and Processing Losses. [http://www.arb.ca.gov/ei/areasrc/districtmeth/Sac/AS\\_AGGRE01\\_430.pdf](http://www.arb.ca.gov/ei/areasrc/districtmeth/Sac/AS_AGGRE01_430.pdf)
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8. United States Environmental Protection Agency. 2006. AP-42, Fifth Edition: Compilations of Air Pollution Emissions Factors, Volume 1: Stationary Point and Area Sources, Section 13.2.4 Aggregate Handling and Storage Piles.  
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9. United States Geological Survey. 2009. 2007 Minerals Yearbook: Sand and Gravel Construction [Advance Release].  
[http://minerals.usgs.gov/minerals/pubs/commodity/sand\\_&\\_gravel\\_construction/myb1-2007-sandc.pdf](http://minerals.usgs.gov/minerals/pubs/commodity/sand_&_gravel_construction/myb1-2007-sandc.pdf)
10. United States Geological Survey. 2002. Mineral operations: Sand and gravel operations. Map layer available at <http://www.nationalatlas.gov>.

## **XVIII. Appendices**

Appendix A. Process Description

Appendix B. Inventory Reconciliation Codes

## Appendix A. Process Description

AP-42 Section 11.19.1.1 Sand and Gravel Processing, Process Description, states that *sand and gravel is typically mined in a moist or wet condition by open pit excavation or by dredging. Open pit excavation is carried out with power shovels, draglines, front end loaders, and bucket wheel excavators. In rare situations, light charge blasting is done to loosen the deposit. Mining by dredging involves mounting the equipment on boats or barges and removing the sand and gravel from the bottom of a body of water by suction or bucket-type dredges. After mining, the materials are transported to the processing plant by suction pump, earth mover, barge, truck, belt conveyors, or other means.*

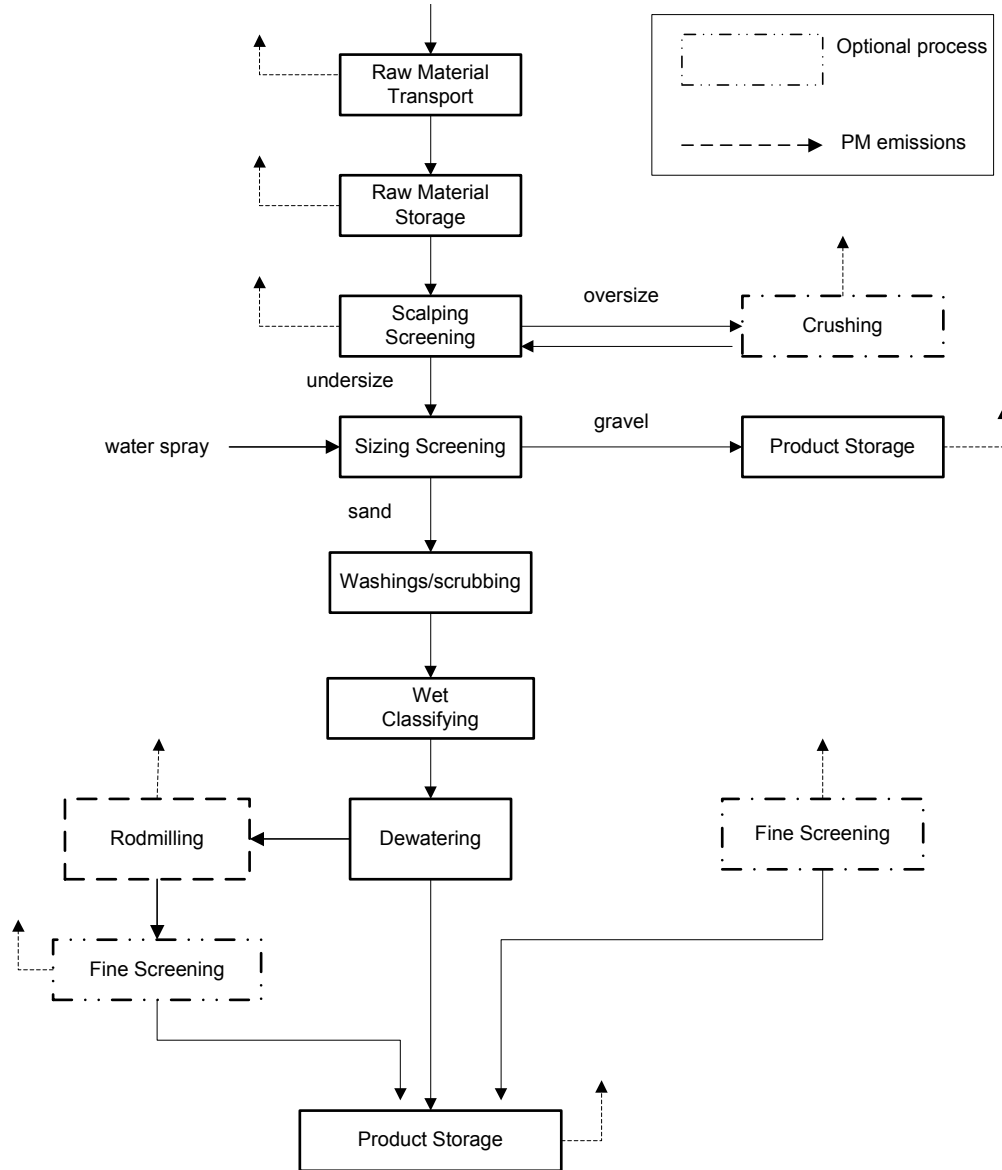
Most domestic sand and gravel is processed prior to use. The processing of sand and gravel involves the use of different combinations of washers, screens, and classifiers to segregate particle sizes; crushers to reduce oversized material; and storage and loading facilities.

At the processing plant, the wet sand and gravel raw feed is stockpiled or emptied directly into a hopper, which typically is covered with a “grizzly” of parallel bars to screen out large cobbles and boulders. Next, the material is transported to fixed or vibrating scalping screens by gravity, conveyors, hydraulic pump, or bucket elevators. Scalping screens separate the oversize material. Oversize material may be used for erosion control, reclamation, or other uses, or it may be directed to a crusher for size reduction, to produce crushed aggregate, or to produce manufactured sands. Crushing generally is carried out in one or two stages, although three-stage crushing may also be performed. Following crushing, the material is returned to the screening operation for sizing.

The material that passes through the scalping screen is fed into sizing screens, which generally consists of either horizontal or sloped, and either single or multi-deck, vibrating screens. Trommel screens with water sprays are also used to process and wash wet sand and gravel. Screening separates the sand and gravel into different size ranges. Water is sprayed onto the sand and gravel throughout the screening process. The sized gravel is then transported to stockpiles, storage bins, or to crushers by conveyors.

Emissions from the production of sand and gravel are primarily particulate matter which is from processes such as conveying, screening, crushing, and storing. Generally, sand and aggregate materials are wet or moist when handled, and process emissions are often negligible.

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Process flow diagram for construction sand and gravel processing. Source: AP-42, Chapter 11 Section 19.1.1



## Appendix B. Inventory Reconciliation Codes

Table 12. EIC, SCC and SIC codes in the District's 2007 point source inventory that reconciled to REIC 430-422-7078-0000.

| EIC               | SCC      | Point Source Type  | SIC  |
|-------------------|----------|--|------|
| 430-422-7078-0000 | 30502001 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - PRIMARY CRUSHING   | 1442 |
|                   | 30502002 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - SECONDARY CRUSHING | 1442 |
|                   | 30502004 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - RECRUSH/SCREENING  | 1442 |
|                   | 30502005 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - FINES MILL         | 1442 |
|                   | 30502006 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - SCREEN/CONVEY      | 1442 |
|                   | 30502011 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - HAULING            | 1442 |
|                   | 30502502 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - AGGREGATE STORAGE      | 1442 |
|                   | 30502503 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - TRANSFER STATION       | 1442 |
|                   | 30502506 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - BULK LOADING           | 1442 |
|                   | 30502510 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - CRUSHING               | 1442 |
|                   | 30502511 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - SCREENING              | 1442 |
|                   | 30502513 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - EXCAVATING             | 1442 |
|                   | 30502007 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - OPEN STORAGE       | 1442 |

**Table 13. EIC, SCC and SIC codes in the District's 2007 point source inventory that reconciled to REIC 430-426-7078-0000.**

| EIC               | SCC      | Point Source Type  | SIC        |
|-------------------|----------|--|------------|
| 430-426-7078-0000 | 30502031 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - TRUCK UNLOADING      | 3295       |
|                   | 30502032 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - TRUCK LOADING-CONVYR | 1442, 3295 |
|                   | 30502506 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - BULK LOADING             | 1429       |
|                   | 30502510 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - CRUSHING                 | 1429       |
|                   | 30502511 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - SCREENING                | 5093       |
|                   | 30502002 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - SECONDRY CRUSHING    | 1429       |
|                   | 30502004 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - RECRUSH/SCREENING    | 1429       |
|                   | 30502006 | MINING OPERATIONS - NONMETALLIC MINRL - STONE QUARRYING - SCREEN/CONVEY        | 1429       |
|                   | 30502503 | MINING OPERATIONS - NONMETALLIC MINRL - SAND/GRAVEL - TRANSFER STATION         | 1429       |