



San Joaquin Valley

AIR POLLUTION CONTROL DISTRICT



NOV - 6 2018

Greg Hooker
Diamond H Dairy
9730 Avenue 1/2
Chowchilla, CA 93610

Re: Notice of Preliminary Decision - Authority to Construct
Facility Number: C-5289
Project Number: C-1180202

Dear Mr. Hooker:

Enclosed for your review and comment is the District's analysis of Diamond H Dairy's application for an Authority to Construct to consolidate the dairy permits at Defense Ranch with Diamond H Dairy, at 9564 Avenue 1/2, Chowchilla.

The notice of preliminary decision for this project will be published approximately three days from the date of this letter. After addressing all comments made during the 30-day public notice period, the District intends to issue the Authority to Construct. Please submit your written comments on this project within the 30-day public comment period, as specified in the enclosed public notice.

Thank you for your cooperation in this matter. If you have any questions regarding this matter, please contact Mr. John Yoshimura of Permit Services at (559) 230-5887.

Sincerely,

Arnaud Marjollet
Director of Permit Services

AM: jy

Enclosures

cc: Tung Le, CARB (w/ enclosure) via email

Samir Sheikh

Executive Director/Air Pollution Control Officer

Northern Region

4800 Enterprise Way
Modesto, CA 95356-8718
Tel: (209) 557-6400 FAX: (209) 557-6475

Central Region (Main Office)

1990 E. Gettysburg Avenue
Fresno, CA 93726-0244
Tel: (559) 230-6000 FAX: (559) 230-6061

Southern Region

34946 Flyover Court
Bakersfield, CA 93308-9725
Tel: 661-392-5500 FAX: 661-392-5585

San Joaquin Valley Air Pollution Control District

Authority to Construct Application Review

Consolidation of Two Dairy Facilities

Facility Name: Diamond H Dairy
Mailing Address: 9730 Avenue 18 ½
Chowchilla, CA 93610
Contact Person: Greg Hooker
Telephone: (209) 595-4648
E-Mail: ghooker@aol.com
Application #s: C-5289-1-4, '-2-5, '-3-5, '-4-4, and '-13-3
Project #: C-1180202
Deemed Complete: February 26, 2018

I. Proposal

The owner of Diamond H Dairy (facility # C-5289) and Defense Ranch (facility # C-5701) has proposed to modify both facilities by transferring all cows from Defense Ranch to Diamond H Dairy. Even though they are permitted as separate dairies, these facilities are considered the same stationary source pursuant to District Rule 2201 Section 3.29. Finally, the owner has proposed to shut down Defense Ranch after the animals have been transferred. As a result, the following conditions will be placed on each Diamond H Dairy permit:

- Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
- Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]

The proposed modifications for each permit at Diamond H Dairy are summarized as follows:

Milking Parlor (C-5289-1-4)

- Increase the milk cow herd size from 4,900 milk cows to 7,278 milk cows.
- Construct a new 72 stall rotary milking parlor.

Cow Housing (C-5289-2-5)

- Transfer all 1,210 support stock (heifers, calves, and bulls) from Defense Ranch to Diamond H Dairy. The applicant has also proposed to bring additional animals from offsite; the proposed herd profile will be increased from 4,900 milk cows not to exceed a total of 5,650 mature cows and 6,260 total support stock to 7,728 milk cows not to exceed a total of 8,282 mature cows and 8,544 total support stock.
- Construct 5 new freestall barns and 6 new open corrals.
- Convert two existing open corrals into loafing barns.
- Construct upwind and downwind vegetative windbreaks.

Liquid Manure Handling (C-5289-3-5)

- Increase in liquid manure as a result of the increase in herd size.
- Convert one existing storage pond into one covered anaerobic treatment digester lagoon. The covered anaerobic treatment digester lagoon will be operated by a third party, Madera DP2, LLC, and a separate ATC (C-9220-1-0) was issued under project C-1172116.

Solid Manure Handling (C-5289-4-4)

- Increase in solid manure as a result of the increase in herd size.

Feed Storage and Handling (C-5289-13-3)

- Increase in feed and TMR as a result of the increase in herd size.

II. Applicable Rules

Rule 1070 Inspections (12/17/92)

Rule 2010 Permits Required (12/17/92)

Rule 2201 New and Modified Stationary Source Review Rule (2/18/16)

Rule 2410 Prevention of Significant Deterioration (6/16/11)

Rule 2520 Federally Mandated Operating Permits (6/21/01)

Rule 4101 Visible Emissions (2/17/05)

Rule 4102 Nuisance (12/17/92)

Rule 4550 Conservation Management Practices (CMP) (8/19/04)

Rule 4570 Confined Animal Facilities (CAF) (10/21/10)

CH&SC 41700 Health Risk Assessment

CH&SC 42301.6 School Notice

California Environmental Quality Act (CEQA)

Public Resources Code 21000-21177: California Environmental Quality Act (CEQA)

California Code of Regulations, Title 14, Division 6, Chapter 3, Sections 15000-15387: CEQA Guidelines

III. Project Location

The facility is located at 9564 Avenue 18 ½ in Chowchilla, CA. The District has verified that the dairy is not located within 1,000 feet of the outer boundary of a K-12 school. Therefore, the public notification requirement of California Health and Safety Code 42301.6 is not applicable to this project.

IV. Process Description

The primary function of this facility is the production of milk, which is used to make dairy products for human consumption. Production of milk requires a herd of mature dairy cows that are lactating. In order to produce milk, the cows must be bred and give birth. The gestation period for a cow is 9 months, and dairy cows are bred again 4 months after calving. Thus, a mature dairy cow produces a calf every 12 to 14 months. Therefore, a dairy operation may have several types of animal groups present, including calves, heifers, mature cows (lactating and dry cows), and bulls.

The milk cows at a dairy usually generate anywhere from 130 to 150 pounds of manure per day. Manure accumulates in confinement areas such as barns, open corrals, and the milking center. Manure is primarily deposited in areas where the herd is fed and given water. How the manure

is collected, stored, and treated depends directly on the manure management techniques used at a particular dairy.

Dairy manure is collected and managed as a liquid, a semi-solid or slurry, and a solid. Manure with a total solids or dry matter content of 20% or higher usually can be handled as a solid while manure with a total solids content of 10% or less can be handled as a liquid.

Milking Parlor (C-5289-1)

The milking parlor is a separate building, apart from the lactating cow confinement. The milking parlor is designed to facilitate changing the groups of cows milked and to allow workers access to the cows during milking. A holding area confines the cows that are ready for milking. The holding area is covered with open sides and is part of the milking parlor, which in turn, is located in the immediate vicinity of the cow housing.

Diamond H Dairy is currently permitted for one double 34 herringbone (64 stall) milking parlor and one double 45 parallel (90 stall) milking parlor. Furthermore, the facility has proposed to construct a 72 stall rotary milking parlor. The lactating cows will be milked up to three times per day in the milking parlors. The milking parlors will have concrete floors sloped to a drain. Manure that is deposited in the milking parlors will be sprayed or flushed into the drain using fresh water after each milking. The effluent from the milking parlors will be carried through pipes to the lagoon system.

Cow Housing (C-5289-2)

In the freestall barn, cows are grouped in large pens with free access to feed bunks, waterers, and stalls for resting. A standard free-stall barn design has a feed alley in the center of the barn separating two feed bunks on each side. A variety of types of bedding materials are used for animal comfort and to prevent animal injury.

Loafing barns are similar in design to freestall barns, except that the loafing barn floors are not paved and are not divided into stalls. This type of housing structure provides coverage for a very large surface area providing protection from the heat and creating a cooler environment.

An open corral is a large open area where cows are confined, also with unlimited access to feed bunks, water, and possibly an open structure to provide shade. Detailed pre-project and post project housing arrangements are shown in Appendix F.

Liquid Manure Handling (C-5289-3)

The liquid manure handling system consists of settling basin(s), mechanical separator(s), and 3 storage ponds.

Solids Separation/Mechanical Separator(s)

Flush water from the milk barn and housing areas is collected into a processing pit near the mechanical separator(s). The flush water is periodically agitated and pumped over the mechanical separator screens. The liquid passes through the screens and flows into the liquid manure lagoons. The solids fall off the bottom of the screen onto a stacking pad, from where they are later removed by a front end loader and spread out to dry on the drying pads.

Settling Basin(s)

The liquid manure from the flushed lanes will flow to the settling basin(s) for solids separation prior to entering the lagoon. Settling basins are structures designed to separate solids from liquid manure by sedimentation. The inflow of manure is restricted to allow some of the solids

to settle out. A settling basin may achieve a solids removal rate of 40-70%. The liquids from the settling basins will gradually drain to the treatment lagoons. Solids remaining in settling basins are left to dry and then are removed. The separated solids will either be incorporated into cropland or stored for use as fertilizer.

Storage Ponds

The storage ponds are designed to have sufficient volume to hold all of the following: all manure and wastewater accumulated at the dairy for a period of 120 days; normal precipitation and any drainage to the lagoon system minus evaporation from the surface of lagoons; and precipitation during a 25 year, 24 hour storm event. The liquid manure from the storage pond will be used to irrigate crops.

Land Application

Liquid manure from the storage ponds and lagoon will be applied to cropland as fertilizer/irrigation water. The application is done through flood and furrow irrigation, at agronomic rates in conformance with a nutrient management plan that has been approved by the Regional Water Quality Control Board.

Anaerobic Digester System

An anaerobic digester is a sealed basin or tank that is designed to accelerate and control the decomposition of organic matter by microorganisms in the absence of oxygen. Anaerobic decomposition results in the conversion of organic compounds in the substrate into methane (CH_4), carbon dioxide (CO_2), and water rather than intermediate Volatile Organic Compounds (VOCs). The gas generated by this process is known as biogas, waste gas, or digester gas. In addition to methane and carbon dioxide, biogas may also contain small amounts of Nitrogen (N_2), Oxygen (O_2), Hydrogen Sulfide (H_2S), and Ammonia (NH_3). Biogas may also include trace amounts of various VOCs that remain from incomplete digestion of the volatile solids in the incoming substrate. Because biogas is mostly composed of methane, the main component of natural gas, the gas produced in the digester can be cleaned to remove H_2S and other impurities and used as fuel.

For information purposes, the covered anaerobic digester system, permitted as C-9220-1-0, will process the manure slurry (mixed manure solids and liquids) from the reception pits. The manure will be flushed from the milking parlor and the cow housing areas at the dairy and the manure will be routed via the existing underground piping system to reception pits where the waste stream will be adjusted to the proper solids content (9-15% solids) and then pumped into the new digester. The effluent from the digester will be pumped to a solid separation area where the fiber solids will be separated from the liquid digester effluent. After the fiber solids have been separated, the liquid digester effluent will be pumped back to the separated liquids pit to be used in the flush system. Excess liquid will flow to the remaining settling basins and storage ponds to be used to fertilize adjacent cropland.

Solid Manure Handling (C-5289-4)

Manure Stock Piles (Storage)

The solid manure stockpiled at this dairy will include the separated solids from the mechanical separator. The separated solids will be immediately incorporated into cropland, be dried and used as fertilizer or as bedding in the freestall barns, or hauled offsite. The applicant proposes to cover the dry separated solids piles and animal waste piles with weatherproof coverings from October through May, so that the solids will remain dry until they are ready to be used.

Feed Storage and Handling (C-5289-13)

Silage Piles and Commodity Barns

The feed consists primarily of silage, which is made from corn and alfalfa, or a variety of other feed crops. The silage is made by placing the harvested crops, chopped to desired pieces if necessary, into piles, which are then compacted with heavy equipment to remove air. The piles are then tightly covered to avoid reintroduction of air. This allows anaerobic microbes present in the crops to multiply, resulting in fermentation of the organic material in the feed. When the silage is ready, one end of the pile can be opened and the required amount of silage can be removed from that end on a daily basis.

In order to provide the right nutritional balance, silage is usually blended with other feed additives, such as oils, whey, seeds and grains, nut hulls, and various salts and minerals before it is fed to the cattle. These additives are usually stored in commodity barns to avoid exposure to weather.

Total Mixed Rations (TMR)

TMR refers to a blended mixture of silage and additives that is ready to be fed to the cattle. Most cattle facilities prepare their TMRs in small batches using a feed wagon equipped with a mixer. The silage and additives are placed in the feed wagon in the proportions prescribed by the dietary requirements of the group of cows to be fed. These ingredients are then thoroughly mixed in the wagon and delivered to the feed bunks.

V. Equipment Listing

Facility C-5289 (Diamond H Dairy)

- C-5289-1-2: 4,900 COW MILKING OPERATION WITH ONE DOUBLE 34 HERRINGBONE (68 STALLS) MILKING PARLOR AND ONE DOUBLE 45 PARALLEL (90 STALLS) MILKING PARLOR
- C-5289-2-3: COW HOUSING - 4,900 MILK COWS NOT TO EXCEED A COMBINED TOTAL OF 5,650 MATURE COWS (MILK AND DRY); 6,260 TOTAL SUPPORT STOCK (HEIFERS, CALVES AND BULLS); AND EIGHT FREESTALLS WITH FLUSH/SCRAPE
- C-5289-3-4: LIQUID MANURE HANDLING SYSTEM CONSISTING OF SETTLING BASIN(S); DOUBLE MECHANICAL SEPARATOR(S); AND THREE STORAGE PONDS; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION
- C-5289-4-2: SOLID MANURE HANDLING CONSISTING OF MANURE STOCK PILES; SOLID MANURE APPLICATION TO LAND
- C-5289-13-1: FEED STORAGE AND HANDLING CONSISTING OF COMMODITY BARNs AND SILAGE PILES

Facility C-5701 (Defense Ranch)

- C-5701-1-0: DORMANT COW MILKING OPERATION WITH ONE 20 STALL FLAT MILKING PARLOR

- C-5701-2-0: COW HOUSING - NO MATURE COWS (MILK AND DRY COWS) PRESENT AT THIS TIME; TOTAL SUPPORT STOCK NOT TO EXCEED 1,210 HEIFERS, CALVES, AND BULLS
- C-5701-3-0: LIQUID MANURE HANDLING SYSTEM CONSISTING OF ONE STORAGE POND; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION AND FURROW IRRIGATION
- C-5701-4-0: SOLID MANURE HANDLING CONSISTING OF OPEN MANURE STOCK PILES; COMPOSTING; SOLID MANURE APPLICATION TO LAND AND HAULED OFFSITE
- C-5701-5-0: FEED STORAGE AND HANDLING CONSISTING OF COVERED FEED STORAGE OR COMMODITY BARN AND SILAGE PILES

Proposed Modifications

- C-5289-1-4: MODIFICATION OF 4,900 COW MILKING OPERATION WITH ONE DOUBLE 34 HERRINGBONE (68 STALLS) MILKING PARLOR AND ONE DOUBLE 45 PARALLEL (90 STALLS) MILKING PARLOR: INCREASE FROM 4,900 TO 7,278 MILK COWS AND CONSTRUCT A 72 COW ROTARY MILK BARN
- C-5289-2-5: MODIFICATION OF COW HOUSING - 4,900 MILK COWS NOT TO EXCEED A COMBINED TOTAL OF 5,650 MATURE COWS (MILK AND DRY); 6,260 TOTAL SUPPORT STOCK (HEIFERS, CALVES, AND BULLS); AND EIGHT FREESTALLS WITH FLUSH/SCRAPE SYSTEM: INCREASE MILK COWS TO 7,278, MATURE COWS TO 8,282, SUPPORT STOCK TO 8,544; CONSTRUCT 2 LOAFING (CALVING) BARNS WITH FLUSH SYSTEM OVER EXISTING OPEN CORRALS; CONSTRUCT 5 FREESTALL BARNS AND 6 OPEN CORRALS WITH FLUSH SYSTEM
- C-5289-3-5: MODIFICATION OF LIQUID MANURE HANDLING SYSTEM CONSISTING OF SETTLING BASIN(S); DOUBLE MECHANICAL SEPARATOR(S); AND THREE STORAGE PONDS; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION: INCREASE IN LIQUID MANURE DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5, CONVERT 2 SETTLING BASINS TO A COVERED ANAEROBIC TREATMENT DIGESTER LAGOON AS AUTHORIZED BY ATC C-9220-1-0
- C-5289-4-4: MODIFICATION OF SOLID MANURE HANDLING CONSISTING OF MANURE STOCK PILES; SOLID MANURE APPLICATION TO LAND: INCREASE IN SOLID MANURE DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5
- C-5289-13-3: MODIFICATION OF FEED STORAGE AND HANDLING CONSISTING OF COMMODITY BARNS AND SILAGE PILES: INCREASE IN FEED DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5

Post Project Equipment Description

- C-5289-1-4: 7,278 COW MILKING OPERATION WITH ONE 72 COW ROTARY MILKING PARLO, ONE DOUBLE 34 HERRINGBONE (68 STALLS) MILKING PARLOR, AND ONE DOUBLE 45 PARALLEL (90 STALLS) MILKING PARLOR

- C-5289-2-5: COW HOUSING – 7,278 MILK COWS NOT TO EXCEED A COMBINED TOTAL OF 8,282 MATURE COWS (MILK AND DRY); 8,544 TOTAL SUPPORT STOCK (HEIFERS, CALVES, AND BULLS); 13 FREESTALL BARNS AND 2 LOAFING (CALVING) BARNS WITH FLUSH/SCRAPE SYSTEM
- C-5289-3-5: LIQUID MANURE HANDLING SYSTEM CONSISTING OF SETTLING BASIN(S); DOUBLE MECHANICAL SEPARATOR(S); 3 STORAGE PONDS; LIQUID MANURE IS SENT TO A COVERED ANAEROBIC TREATMENT DIGESTER LAGOON OPERATED BY FACILITY C-9220; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION
- C-5289-4-4: SOLID MANURE HANDLING CONSISTING OF MANURE STOCK PILES; SOLID MANURE APPLICATION TO LAND
- C-5289-13-3: FEED STORAGE AND HANDLING CONSISTING OF COMMODITY BARNS AND SILAGE PILES

VI. Emission Control Technology Evaluation

Particulate matter (PM₁₀), volatile organic compounds (VOC), ammonia (NH₃), and hydrogen sulfide (H₂S) are the major pollutants of concern from dairy operations.

Gaseous pollutant emissions at a dairy result from the ruminant digestive processes (enteric emissions), from the decomposition and fermentation of feed, and also from decomposition of organic material in dairy manure. Volatile Organic Compounds (VOCs) are formed as intermediate metabolites when organic matter in manure degrades. Ammonia volatilization is the result of the microbial decomposition of nitrogenous compounds in manure. The quantity of enteric emissions depends directly on the number and types of cows. The quantity of emissions from manure decomposition depends on the amount of manure generated, which also depends on the number and types of cows. Therefore, the total herd size and composition is the critical factor in quantifying emissions from a dairy. Various management practices are used to control emissions at this dairy. Examples of some of these practices are discussed below:

Milking Parlor (C-5289-1)

This dairy uses a flush/spray system to wash out the manure from the milking parlor after each group of cows are milked. Since the milking parlor is constantly flushed, there will be no particulate matter emissions from the milking parlor. Manure, which is a source of VOC emissions, is removed from the milking parlor many times a day by flushing after each milking. Because of ammonia's high affinity for and solubility in water, volatilization of ammonia from the milking parlors will also be reduced by flushing after each milking.

Cow Housing (C-5289-2)

The cows at the facility will be housed in a combination of freestall barns, loafing barns, and open corrals. Some of the practices that will be utilized to reduce emissions are described below:

Freestall Barns (With Exercise Pens)

Particulate matter emissions from freestall barns are greatly reduced because the cows will be on a paved surface rather than on dry dirt. Additionally, flushing of the freestall lanes creates a moist environment, which further decreases particulate matter emissions.

Loafing Barns

Loafing barns are similar in design to freestall barns, except that the loafing barn floors are not paved and are not divided into stalls. This type of housing structure provides coverage for a very large surface area providing protection from the heat and creating a cooler environment. Emissions are reduced in two ways; the soil will contain more moisture (due to cooler temperature and moisture from manure) and less soil disturbance under the barn.

Shade Structures

Some of the support stock will be housed in an open corral with concrete lanes and a shade structure. Providing shade for the animals reduces movement and unnecessary activity during hot weather, which reduces PM₁₀ emissions.

Frequent Flushing

Frequent flushing is also used for the removal of manure from the lanes and walkways in the housing barns. Frequent flushing creates a moist environment that greatly reduces or eliminates PM₁₀ emissions. In addition, flush water dissolves NH₃ as well as various water-soluble VOC in the manure, thereby stopping or decelerating the emission of these pollutants directly into the atmosphere. Both manure and dissolved pollutants are subsequently carried by the flush water into the liquid manure handling system for further treatment.

Liquid Manure Handling (C-5289-3)

Settling Basin Separation

The purpose of settling basin separation is to remove the fibrous materials prior to the liquid manure entering the lagoon. By removing the most fibrous material from the liquid stream prior to entering the pond, it is anticipated that the amount of intermediate metabolites released during digestion in the pond may be reduced. Removal of the fibrous material allows for more complete digestion in the pond and lower emissions. Solids remaining in the settling basin are left to dry and then are removed. The separated solids can be immediately incorporated into cropland or spread in thin layers, harrowed, and dried.

Solids Separation (Mechanical Separator)

The purpose of solids separation is to remove fibrous materials prior to the liquid manure entering the lagoon. By removing the most fibrous material from the liquid stream prior to entering the lagoon, it is anticipated that the amount of intermediate metabolites released during digestion in the lagoon may be reduced. Removal of the fibrous material allows for more complete digestion in the lagoon and lower emissions. Solids remaining are left to dry and then are removed. The separated solids can be immediately incorporated into cropland or spread in thin layers, harrowed, and dried.

Liquid Manure Land Application

Liquid manure will be applied to cropland at agronomic rates, in compliance with the dairy's comprehensive nutrient management plan and the requirements of the Regional Water Quality Control Board. These practices are expected to reduce odors and result in faster uptake of nutrients by crops. When applied nutrients are optimally matched with the nutrient needs of developing crops, the excess nutrients that are associated with increased emissions and/or groundwater pollution are minimized.

Solid Manure Handling (C-5289-4)

Based on the information currently available, emissions from solid manure applied to cropland

are expected to be low. However, to ensure that any possible emissions are minimized, the manure will be promptly incorporated into the soil after application. This will reduce any volatilization of gaseous pollutants, as the soil provides cover from wind and other weather elements that enhance volatilization. In addition, incorporation reduces emissions by biofilter effect, whereby the adsorption of NH_3 , VOC, and other compounds onto soil particles provides an opportunity for oxidation by the action of various microorganisms the soil.¹

Feed Storage and Handling (C-5289-13)

All cows will be fed in accordance with National Research Council (NRC) guidelines using routine nutritional analysis for rations. NRC guidelines are intended to optimize nutrient uptake by the cow, which not only increases feed efficiency but also minimizes the excretion of undigested protein and other nutrients in the manure. Since excess manure nutrients are the feedstock for the processes that result in NH_3 , H_2S , and VOC emissions as manure decomposes, the reduction of nutrients in the manure is expected to reduce the emission of these pollutants.

In addition, any refused feed will be removed from the feed lanes on a regular basis to minimize gaseous emissions from decomposition. Silage piles will be covered with plastic tarps to minimize volatilization of pollutants from the pile surfaces.

Rule 4570 Mitigation Measures

The facility currently complies with all applicable Phase II mitigation measure requirements of District Rule 4570, as previously processed under District project C-1110877 for Diamond H Dairy and project C-1103643 for Defense Ranch. This project does not involve any change to the mitigation measures practiced at the facility.

All mitigation measures are expected to result in VOC emissions reductions for each permit unit at the dairy; reductions in ammonia emissions are also expected. A complete list of the mitigation measures practiced at the facility, and the expected control efficiency for each, is included with the emissions calculations shown in Appendix F.

VII. General Calculations

A. Assumptions

- Potential to Emit for the dairies will be based on the maximum design capacity of the number and types of cows at the dairies;
- All PM_{10} emissions from the dairy will be allocated to the cow housing permit unit;
- For the dairy, only emissions from the lagoon/storage ponds, internal combustion engine, and gasoline dispensing operation will be used in determining if this facility will be a major source since the lagoon/storage ponds, internal combustion engine, and gasoline dispensing operation are considered to be the only non-fugitive emissions at this dairy;
- The PM_{10} emission factors for the dairy animals are based on a District document entitled "Dairy and Feedlot PM_{10} Emissions Factors," which compiled data from studies performed by Texas A&M ASAE and a USDA/UC Davis report quantifying dairy and feedlot emissions;
- The NH_3 emission factors for milk cows are based on an internal document entitled "*Breakdown of Dairy VOC Emission Factor into Permit Units.*" The NH_3 emission factors

¹ Page 9-38 of U.S. EPA's draft document entitled "Emissions From Animal Feeding Operations" (<http://www.epa.gov/ttn/chief/ap42/ch09/draft/draftanimalfeed.pdf>)

for the other cows were developed by taking the ratio of manure generated by the different types of cows to the milk cow and multiplying it by the milk cow emission factor;

- The VOC emission factors for the dairy animals are based on the District document entitled “Air Pollution Control Officer's Revision of the Dairy VOC Emissions Factor”;
- For worst case potential to emit calculations, all heifers, calves, and bulls are assumed to be support stock.
- The mitigation measures practiced at Diamond H Dairy as well as the number, type, and size of silage piles are taken from the Rule 4570 Phase II application, processed under District project C-1110877;
- The post-project mitigation measures practiced at this dairy will be the same as the pre-project mitigation measures;
- There will be no new lagoons/storage ponds or any change to the surface area of the existing lagoons/storage ponds;
- All H₂S emissions will be allocated to the liquid manure permit unit (C-5289-3).

B. Emission Factors

PM₁₀, VOC, NH₃, and H₂S

The emissions calculations shown in Appendix F include the PM₁₀, VOC, NH₃, and H₂S emission factors from the animals and silage at this dairy. These emission factors will be used to calculate the pre-project and post-project PM₁₀, VOC, NH₃, and H₂S emissions from the entire dairy.

C. Calculations

Detailed potential to emit calculations for this project are included in Appendix F.

1. Pre-Project Potential to Emit (PE1)

A summary of the pre-project emissions from units are shown in the following table:

Daily PE1 (lb/day) – C-5289 (Diamond H Dairy)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-2 (milking parlor)	0.0	0.0	0.0	0.0	5.4	1.8	0.0
C-5289-2-3 (cow housing)	0.0	0.0	224.4	0.0	217.9	412.4	0.0
C-5289-3-4 (liquid manure handling)	0.0	0.0	0.0	0.0	56.2	150.2	3.3
C-5289-4-2 (solid manure handling)	0.0	0.0	0.0	0.0	10.9	56.3	0.0
C-5289-13-1 (feed storage and handling)	0.0	0.0	0.0	0.0	324.6	0.0	0.0

Daily PE1 (lb/day) – C-5701 (Defense Ranch)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5701-1-0 (milking parlor)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C-5701-2-0 (cow housing)	0.0	0.0	35.0	0.0	22.5	46.4	0.0
C-5701-3-0 (liquid manure handling)	0.0	0.0	0.0	0.0	4.4	14.9	4.2
C-5701-4-0 (solid manure handling)	0.0	0.0	0.0	0.0	0.9	3.0	0.0
C-5701-5-0 (feed storage and handling)	0.0	0.0	0.0	0.0	51.5	0.0	0.0

Annual PE1 (lb/year) – C-5289 (Diamond H Dairy)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-2 (milking parlor)	0	0	0	0	1,960	670	0
C-5289-2-3 (cow housing)	0	0	81,941	0	79,574	150,539	0
C-5289-3-4 (liquid manure handling)	0	0	0	0	20,534	54,807	1,191
C-5289-4-2 (solid manure handling)	0	0	0	0	3,994	20,550	0
C-5289-13-1 (feed storage and handling)	0	0	0	0	118,524	0	0

Annual PE1 (lb/year) – C-5701 (Defense Ranch)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5701-1-0 (milking parlor)	0	0	0	0	0	0	0
C-5701-2-0 (cow housing)	0	0	12,766	0	8,228	16,940	0
C-5701-3-0 (liquid manure handling)	0	0	0	0	1,609	5,445	1,549
C-5701-4-0 (solid manure handling)	0	0	0	0	315	1,089	0
C-5701-5-0 (feed storage and handling)	0	0	0	0	18,793	0	0

2. Post Project Potential to Emit (PE2)

A summary of the post-project emissions from the modified units are shown in the following table:

Daily PE2 (lb/day) – C-5289 (Diamond H Dairy)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-4 (milking parlor)	0.0	0.0	0.0	0.0	8.0	2.7	0.0
C-5289-2-5 (cow housing)	0.0	0.0	203.7	0.0	295.8	580.4	0.0
C-5289-3-5 (liquid manure handling)	0.0	0.0	0.0	0.0	42.9	134.5	3.3
C-5289-4-4 (solid manure handling)	0.0	0.0	0.0	0.0	14.8	77.9	0.0
C-5289-13-3 (feed storage and handling)	0.0	0.0	0.0	0.0	406.1	0.0	0.0

Annual PE2 (lb/year) – C-5289 (Diamond H Dairy)							
Permit #	NOx	SOx	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-4 (milking parlor)	0	0	0	0	2,911	996	0
C-5289-2-5 (cow housing)	0	0	74,350	0	108,050	211,827	0
C-5289-3-5 (liquid manure handling)	0	0	0	0	15,667	49,088	1,191
C-5289-4-4 (solid manure handling)	0	0	0	0	5,391	28,440	0
C-5289-13-3 (feed storage and handling)	0	0	0	0	148,264	0	0

3. Pre-Project Stationary Source Potential to Emit (SSPE1)

Pursuant to District Rule 2201, the SSPE1 is the Potential to Emit (PE) from all units with valid Authorities to Construct (ATC) or Permits to Operate (PTO) at the Stationary Source and the quantity of Emission Reduction Credits (ERC) which have been banked since September 19, 1991 for Actual Emissions Reductions (AER) that have occurred at the source, and which have not been used on-site. The emissions for permit units C-5289-9 and -10 are calculated in Appendix F; the emissions for permit units C-5701-1 through -5 are calculated in Appendix F.

Pre-Project Stationary Source Potential to Emit [SSPE1] (lb/year)							
	NO _x	SO _x	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-2	0	0	0	0	1,960	670	0
C-5289-2-3	0	0	81,941	0	79,574	150,539	0
C-5289-3-4	0	0	0	0	20,534	54,807	1,191
C-5289-4-2	0	0	0	0	3,994	20,550	0
C-5289-9-0	917	136	36	158	14	0	0
C-5289-10-0	0	0	0	0	47	0	0
C-5289-13-1	0	0	0	0	118,524	0	0
C-5701-1-0	0	0	0	0	0	0	0
C-5701-2-0	0	0	12,766	0	8,228	16,940	0
C-5701-3-0	0	0	0	0	1,609	5,445	1,549
C-5701-4-0	0	0	0	0	315	1,089	0
C-5701-5-0	0	0	0	0	18,793	0	0
SSPE1	917	136	94,743	158	253,592	250,040	2,740

4. Post Project Stationary Source Potential to Emit (SSPE2)

Pursuant to District Rule 2201, the SSPE2 is the PE from all units with valid ATCs or PTOs at the Stationary Source and the quantity of ERCs which have been banked since September 19, 1991 for AER that have occurred at the source, and which have not been used on-site.

Post-Project Stationary Source Potential to Emit [SSPE2] (lb/year)							
	NO _x	SO _x	PM ₁₀	CO	VOC	NH ₃	H ₂ S
C-5289-1-4	0	0	0	0	2,911	996	0
C-5289-2-5	0	0	74,350	0	108,050	211,827	0
C-5289-3-5	0	0	0	0	15,667	49,088	1,191
C-5289-4-4	0	0	0	0	5,391	28,440	0
C-5289-9-0	917	136	36	158	14	0	0
C-5289-10-0	0	0	0	0	47	0	0
C-5289-13-3	0	0	0	0	148,264	0	0
SSPE2	917	136	74,386	158	280,344	290,351	1,191

5. Major Source Determination

Rule 2201 Major Source Determination

Pursuant to District Rule 2201, a major source is a stationary source with an SSPE2 equal to or exceeding one or more of the major source thresholds shown in Table 3-3. For the purposes of determining major source status the following shall not be included:

- Any ERCs associated with the stationary source
- Emissions from non-road engines (i.e. engines at a particular site at the facility for less than 12 months)
- Fugitive emissions, except for the source categories specified in 40 CFR 51.165

Agricultural operations do not belong to any of the source categories specified in 40 CFR 51.165. Since this facility is an agricultural operation, fugitive emissions shall not be

included in determining whether it is a major stationary source.

40 CFR 71.2 defines fugitive emissions as “those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening.” In 2005, the California Air Pollution Control Officers Association (CAPCOA) issued guidance for estimating VOC emissions from dairy farms. This guidance determined that VOC emissions from the milking centers, cow housing areas, corrals, common manure storage areas, and land application of manure are considered fugitive since they are not physically contained and could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening. The guidance also determined that VOC emissions from liquid manure lagoons and storage ponds are not considered fugitive because emission collection technologies for liquid manure systems exist. The District has researched this issue and concurs with the CAPCOA determinations, as discussed in more detail below:

Milking Parlor:

The mechanical ventilation system could arguably be utilized to capture emissions from the milking parlor. In order achieve and maintain the negative pressure required for this purpose, the adjoining holding area would also need to be completely enclosed. However, enclosing the holding area is not practical due to the continuous movement of cows in and out of the barn throughout the day. In addition, the capital outlay required to enclose this large area would be prohibitive. The District therefore determines that emissions from the milking parlor cannot reasonably be captured, and are to be considered fugitive.

Cow Housing:

Although there are smaller dairy farms that have enclosed housing barns, such barns are usually not fully enclosed and do not include any systems for the collection of emissions. In addition, the airflow requirements for dairy cows are extremely high, primarily for herd health reasons. Airflow requirements are expected to be even higher in places such as the San Joaquin Valley, where daytime temperatures can exceed 110 degrees for prolonged periods during the summer months. Given the high air flow rates that will be involved, collection and control of the exhaust from housing barns is not only impractical but also cost prohibitive. The District therefore determines that emissions from housing barns cannot reasonably be captured, and are to be considered fugitive.

Manure Storage Areas:

Solid manure is typically stored in the housing areas, as mounds or piles in individual corrals or pens. Some manure may also be stored in piles outside the housing areas while awaiting land application, shipment offsite, or other uses. Thus, manure storage areas are widely distributed over the dairy site, making it impractical to capture emissions from any significant proportion of the solid manure. The District therefore determines that emissions from manure storage areas cannot reasonably be captured, and are to be considered fugitive.

Land Application:

Since manure has to be applied over large expanses of cropland (hundreds or even thousands of acres), there is no practical method that can be used to capture the associated emissions. The District therefore determines that emissions from land

application of manure cannot reasonably be captured, and are to be considered fugitive.

Feed Handling and Storage:

Silage and total mixed rations (TMR) are the primary sources of emissions from feed storage and handling. Silage is stored in several tarped/covered piles and/or plastic bags. One end/face of the pile/bag that is actively being used to prepare feed rations must remain open to allow extraction of the silage. A front-end loader is used to extract silage from the open face of the pile throughout the day as the feed rations for the various groups or categories of cows are prepared. A significant proportion of silage pile emissions are associated with this open face, which is exposed to the atmosphere and frequently disturbed during silage extraction. Due to the need to access the pile's open face throughout the day, it is not practical to enclose it or equip it with any kind of device or system that could be used to capture of emissions.

TMR is prepared by mixing silage with various additives such as seeds, grains, and molasses. Because the quality of silage degrades fairly rapidly upon exposure to air, TMR is prepared only when needed and promptly distributed to the feed lanes for consumption. Most of the TMR emissions are thus emitted from the feed lanes, which are located inside the housing barns, where the TMR will remain exposed to the air for at least several hours as the cows feed. As previously discussed, collection and control of emissions from housing barns is not only impractical but also cost prohibitive.

The District therefore determines that emissions from feed handling and storage cannot reasonably be captured, and are to be considered fugitive.

As previously stated, emissions from liquid manure lagoons and storage ponds have already been determined to be non-fugitive. The facility's non-fugitive stationary source potential emissions are summarized in the following tables (see Appendix F for non-fugitive totals):

Non-Fugitive SSPE1 (lb/year)						
Category	NO_x	SO_x	PM₁₀	PM_{2.5}	CO	VOC
C-5289-3-4 - Lagoons only	0	0	0	0	0	9,878
C-5289-9-0 - Engine	917	136	36	36	158	14
C-5289-10-0 - GDO	0	0	0	0	0	47
C-5701-3-1 – Lagoons only	0	0	0	0	0	774
Non-Fugitive SSPE1	917	136	36	36	158	10,713

Non-Fugitive SSPE2 (lb/year)						
Category	NO_x	SO_x	PM₁₀	PM_{2.5}	CO	VOC
C-5289-3-5 - Lagoons only	0	0	0	0	0	7,954
C-5289-9-0 - Engine	917	136	36	36	158	14
C-5289-10-0- GDO	0	0	0	0	0	47
Non-Fugitive SSPE2	917	136	36	36	158	8,015

The Rule 2201 major source determination is summarized in the following table:

Rule 2201 Major Source Determination (lb/year)						
	NO_x	SO_x	PM₁₀	PM_{2.5}	CO	VOC
SSPE1	917	136	36	36	158	10,713
SSPE2	917	136	36	36	158	8,015
Major Source Threshold	20,000	140,000	140,000	140,000	200,000	20,000
Major Source?	No	No	No	No	No	No

Note: PM_{2.5} assumed to be equal to PM₁₀

As seen in the table above, the facility is not an existing Major Source and is not becoming a Major Source as a result of this project.

Rule 2410 Major Source Determination

The facility or the equipment evaluated under this project is not listed as one of the categories specified in 40 CFR 52.21 (b)(1)(iii). Therefore the PSD Major Source threshold is 250 tpy for any regulated NSR pollutant.

PSD Major Source Determination (tons/year)						
	NO₂	VOC	SO₂	CO	PM	PM₁₀
Estimated Facility PE before Project Increase	0.5	5.4	0.1	0.1	0.0	0.0
PSD Major Source Thresholds	250	250	250	250	250	250
PSD Major Source ? (Y/N)	N	N	N	N	N	N

As shown above, the facility is not an existing PSD major source for any regulated NSR pollutant expected to be emitted at this facility.

6. Baseline Emissions (BE)

The BE calculation (in lb/year) is performed pollutant-by-pollutant for each unit within the project to calculate the QNEC, and if applicable, to determine the amount of offsets required.

Pursuant to District Rule 2201, BE = PE1 for:

- Any unit located at a non-Major Source,
- Any Highly-Utilized Emissions Unit, located at a Major Source,
- Any Fully-Offset Emissions Unit, located at a Major Source, or
- Any Clean Emissions Unit, located at a Major Source.

otherwise,

BE = Historic Actual Emissions (HAE), calculated pursuant to District Rule 2201.

As shown in Section VII.C.5 above, the facility is not a Major Source for any pollutant.

Therefore BE = PE1.

As calculated in Section VII.C.1 above, PE1 is summarized in the following table:

	BE (lb/year)					
	NO _x	SO _x	PM ₁₀	PM _{2.5}	CO	VOC
C-5289-1-4	0	0	0	0	0	1,960
C-5289-2-3	0	0	81,941	81,941	0	79,574
C-5289-3-5	0	0	0	0	0	20,534
C-5289-4-4	0	0	0	0	0	3,994
C-5289-13-3	0	0	0	0	0	118,524

7. SB 288 Major Modification

SB 288 Major Modification is defined in 40 CFR Part 51.165 as "any physical change in or change in the method of operation of a major stationary source that would result in a significant net emissions increase of any pollutant subject to regulation under the Act."

Since this facility is not a major source for any of the pollutants addressed in this project, this project does not constitute an SB 288 major modification.

8. Federal Major Modification

District Rule 2201 states that a Federal Major Modification is the same as a "Major Modification" as defined in 40 CFR 51.165 and part D of Title I of the CAA.

Since this source is not included in the 28 specific source categories specified in 40 CFR 51.165, the increases in fugitive emissions are not included in the Federal Major Modification determination.

Since this facility is not a Major Source for any pollutants, this project does not constitute a Federal Major Modification.

9. Rule 2410 – Prevention of Significant Deterioration (PSD) Applicability Determination

Rule 2410 applies to any pollutant regulated under the Clean Air Act, except those for which the District has been classified nonattainment. The pollutants which must be addressed in the PSD applicability determination for sources located in the SJV and which are emitted in this project are: (See 52.21 (b) (23) definition of significant)

- PM
- PM₁₀

I. Project Emissions Increase - New Major Source Determination

The post-project potentials to emit from all new and modified units are compared to the PSD major source thresholds to determine if the project constitutes a new major source subject to PSD requirements.

The facility or the equipment evaluated under this project is not listed as one of the categories specified in 40 CFR 52.21 (b)(1)(i). The PSD Major Source threshold is 250 tpy for any regulated NSR pollutant.

PSD Major Source Determination: Potential to Emit (tons/year)						
	NO₂	VOC	SO₂	CO	PM	PM₁₀
Total PE from New and Modified Units	0.0	4.0	0.0	0.0	0.0	0.0
PSD Major Source threshold	250	250	250	250	250	250
New PSD Major Source?	N	N	N	N	N	N

As shown in the table above, the potential to emit for the project, by itself, does not exceed any PSD major source threshold. Therefore Rule 2410 is not applicable and no further analysis is required.

10. Quarterly Net Emissions Change (QNEC)

The QNEC is calculated solely to establish emissions that are used to complete the District's PAS emissions profile screen. Detailed QNEC calculations are included in Appendix H.

VIII. Compliance Determination

Rule 1070 Inspections

This rule allows the District to perform inspections for the purpose of obtaining information necessary to determine whether air pollution sources are in compliance with applicable rules and regulations. The rule also allows the District to require record keeping, to make inspections and to conduct tests of air pollution sources. The following conditions will be listed on the permit to ensure compliance:

- {3215} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
- {3216} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]

Rule 2201 New and Modified Stationary Source Review Rule

A. Best Available Control Technology (BACT)

1. BACT Applicability

BACT requirements are triggered on a pollutant-by-pollutant basis and on an emissions unit-by-emissions unit basis. Unless specifically exempted by Rule 2201, BACT shall be required for the following actions*:

- a. Any new emissions unit with a potential to emit exceeding two pounds per day,
- b. The relocation from one Stationary Source to another of an existing emissions unit with a potential to emit exceeding two pounds per day,

- c. Modifications to an existing emissions unit with a valid Permit to Operate resulting in an Adjusted Increase in Permitted Emissions (AIPE) exceeding two pounds per day, and/or
- d. Any new or modified emissions unit, in a stationary source project, which results in an SB 288 Major Modification or a Federal Major Modification, as defined by the rule.

*Except for CO emissions from a new or modified emissions unit at a Stationary Source with an SSPE2 of less than 200,000 pounds per year of CO.

a. New emissions units – PE > 2 lb/day

Milking Parlor

The facility has proposed to construct a new 72 stall rotary milking parlor. The District will conservatively assume 100% of the milk cows can be milked in the proposed parlor on any given day.

VOC

$$\text{EF2} = 0.40 \text{ lb-VOC/hd-yr}$$

$$\text{PE2} = (0.40 \text{ lb-VOC/hd-yr}) \times (7,278 \text{ hd}) \times (\text{yr}/365 \text{ days}) = 8.0 \text{ lb-VOC/day}$$

NH₃

$$\text{EF2} = 0.14 \text{ lb-NH}_3/\text{hd-yr}$$

$$\text{PE2} = (0.14 \text{ lb-NH}_3/\text{hd-yr}) \times (7,278 \text{ hd}) \times (\text{yr}/365 \text{ days}) = 2.8 \text{ lb-NH}_3/\text{day}$$

As shown above, BACT is triggered for both VOC and NH₃ emissions.

Cow Housing

The facility has proposed to construct 5 new freestall barns, #10 through 14, and 6 new open corrals, #22 through 27. As shown in Appendix F, BACT is required for VOC for freestall barns #10 through 14 and open corrals #22, 23, 24, and 26; BACT is required for NH₃ emissions for freestall Barns #10 through 14 and open corrals #22 through 27; BACT is required for PM₁₀ emissions for freestall barns #10, 11, and 14, and open corrals #22 through 27.

b. Relocation of emissions units – PE > 2 lb/day

As discussed in Section I above, there are no emissions units being relocated from one stationary source to another; therefore BACT is not triggered.

c. Modification of emissions units – AIPE > 2 lb/day

$$\text{AIPE} = \text{PE2} - \text{HAPE}$$

Where,

AIPE = Adjusted Increase in Permitted Emissions, (lb/day)

PE2 = Post-Project Potential to Emit, (lb/day)

HAPE = Historically Adjusted Potential to Emit, (lb/day)

$$\text{HAPE} = \text{PE1} \times (\text{EF2}/\text{EF1})$$

Where,

PE1 = The emissions unit's PE prior to modification or relocation, (lb/day)

EF2 = The emissions unit's permitted emission factor for the pollutant after modification or relocation. If EF2 is greater than EF1 then EF2/EF1 shall be set to 1

EF1 = The emissions unit's permitted emission factor for the pollutant before the modification or relocation

$$AIPE = PE2 - (PE1 * (EF2 / EF1))$$

C-5289-1

The milking parlor at C-5701 will no longer be used, and all cows will be milked in the milking parlors at C-5289. As shown in Appendix F, BACT is triggered for VOC emissions for the existing milking parlors.

C-5289-2

The facility is proposing to increase their animal her size. As a result, there are increases in emissions at existing cow housing units. As shown in Appendix F, BACT is triggered for NH₃ emissions for freestall barns 1, 2, and 9.

C-5289-3

The liquid manure handling emissions are estimated for the entire dairy. As shown in Appendix F, BACT is triggered for VOC and NH₃ emissions for the lagoon storage ponds; BACT is also triggered for VOC and NH₃ emissions for the liquid manure land application.

C-5289-4

The solid manure handling emissions are estimated for the entire dairy. As shown in Appendix E, BACT is triggered for NH₃ emissions for the solid manure storage/separated solids piles; BACT is also triggered for VOC and NH₃ emissions for the solid manure land application.

C-5289-13

The feed handling and storage emissions are estimated using type of feed commodity, number of stockpiles, size of stockpiles, and number of piles that stays open. As shown in Appendix F, BACT is triggered for VOC emissions from TMR.

d. SB 288/Federal Major Modification

As discussed in Sections VII.C.7 and VII.C.8 above, this project does not constitute an SB 288 and/or Federal Major Modification for any pollutant. Therefore BACT is not triggered for any pollutant.

2. BACT Guideline

BACT Guideline 5.8.1, applies to the milking parlor operation. [Milking Parlor] (See **Appendix C**)

BACT Guideline 5.8.2, applies to the freestall barns in the cow housing operation. [Cow Housing – Freestall and Saudi-Style Barns] (See **Appendix C**)

BACT Guideline 5.8.3, applies to the open corrals in the cow housing operation. [Cow Housing – Open Corrals] (See **Appendix C**)

BACT Guideline 5.8.6, applies to the lagoon/storage ponds in the liquid manure handling system. [Liquid Manure Handling – Lagoon/Storage Pond] (See **Appendix C**)

BACT Guideline 5.8.7, applies to the liquid/slurry land application in the liquid manure handling system. [Liquid Manure Handling – Lagoon/Storage Pond] (See **Appendix C**)

BACT Guideline 5.8.8, applies to storage/separated solids piles in the solid manure handling system. [Solid Manure Handling – Storage/Separated Solids Piles] (See **Appendix C**)

BACT Guideline 5.8.9, applies to the land application in the solid manure handling system. [Solid Manure Handling – Land Application] (See **Appendix C**)

BACT Guideline 5.8.11, applies to the feed/TMR in the feed storage and handling operation. [Feed Storage and Handling – Feed/TMR] (See **Appendix C**)

3. Top-Down BACT Analysis

Milking Parlor (C-5289-1-4)

VOC: 1) Flush/spray before, after, or during milking each group of cows.

The following condition will be included on the proposed milking parlor ATC to assure compliance with the BACT requirements of this rule:

1) *Flush/spray before, after, or during milking each group of cows (VOC)*

- {4484} Permittee shall flush or hose milk parlor immediately prior to, immediately after, or during each milking. [District Rules 2201 and 4570]
- {4485} Permittee shall provide verification that milk parlors are flushed or hosed prior to, immediately after, or during each milking. [District Rules 2201 and 4570]

Cow Housing (C-5289-2-5)

Freestall Barns #10 through 14

- VOC:
- 1) Concrete feed lanes and walkways;
 - 2) Flushing the feed lanes and walkways for mature cows four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
 - 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
 - 4) Properly sloping exercise pens (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing exercise pens to maintain a dry surface;
 - 5) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions; and

6) VOC mitigation measures required by District Rule 4570.

- NH₃:
- 1) Concrete feed lanes and walkways;
 - 2) Flushing the feed lanes and walkways for mature cows four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
 - 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
 - 4) Properly sloping exercise pens (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing exercise pens to maintain a dry surface; and
 - 5) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *Concrete Feedlanes and Walkways (VOC and NH₃)*

- Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rules 2201 and 4570]

2) *Frequent Flushing of Feed Lanes and Walkways (VOC and NH₃)*

- For Freestall Barns 10 through 14, permittee shall flush or scrape the freestall feed lanes and walkways at least four times per day for mature cows and at least once per day for support stock. [District Rules 2201 and 4570]
- For Freestall Barns 10 through 14, permittee shall keep records or maintain an operating plan that requires the feed lanes and walkways for mature cows to be flushed or scraped at least four times per day and the feed lanes and walkways for support stock to be flushed at least once per day. [District Rules 2201]

3) *Cows Fed in Accordance with NRC Guidelines (VOC and NH₃)*

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rule 2201]
- Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rule 2201]

4) *Properly Sloping or Maintaining Dry Pens (VOC and NH₃)*

- Permittee shall implement at least one of the following exercise pen mitigation

measures: 1) slope the surface of the exercise pen at least 3% where the available space for each animal is 400 square feet or less and shall slope the surface of the exercise pen at least 1.5% where the available space for each animal is more than 400 square feet per animal; 2) maintain exercise pens to ensure proper drainage preventing water from standing more than forty-eight hours; or 3) harrow, rake, or scrape exercise pen sufficiently to maintain a dry surface except during periods of rainy weather. [District Rules 2201 and 4570]

- Permittee shall either 1) maintain sufficient records to demonstrate that corrals are maintained to ensure proper drainage preventing water from standing for more than forty-eight hours or 2) maintain records of dates corrals are groomed (i.e. harrowed, raked, or scraped, etc.). [District Rules 2201 and 4570]

5) *Pens Scraped Once Every Two Weeks (VOC and NH₃)*

- For Freestall Barns 10 through 14, permittee shall scrape the exercise pens at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
- For Freestall Barns 10 through 14, permittee shall maintain sufficient records to demonstrate that the exercise pens are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]

6) *District Rule 4570 Mitigation Measures (VOC)*

- {4753} Permittee shall remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every seven (7) days. [District Rules 2201 and 4570]
- {4493} Permittee shall record either of the following: 1) the dates when manure that is not dry is removed from individual cow freestall beds or 2) the dates when the freestall bedding is raked, harrowed, scraped, or graded. [District Rules 2201 and 4570]

Freestall Barns #10, 11, and 14

PM₁₀: 1) Concrete feed lanes and walkways; and
2) Scraping exercise pens every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *Concrete Feedlanes and Walkways (PM₁₀)*

- Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rules 2201 and 4570]

2) *Pens Scraped Once Every Two Weeks (PM₁₀)*

- For Freestall Barns 10 through 14, permittee shall scrape the exercise pens at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
- For Freestall Barns 10 through 14, permittee shall maintain sufficient records to

demonstrate that the exercise pens are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]

Open Corrals #22 through 27

- VOC:
- 1) Concrete feed lanes and walkways;
 - 2) Flushing the feed lanes and walkways for mature cows four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
 - 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
 - 4) Properly sloping open corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing open corrals to maintain a dry surface;
 - 5) Scraping open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions; and
 - 6) VOC mitigation measures required by District Rule 4570.
- NH₃:
- 1) Concrete feed lanes and walkways;
 - 2) Flushing the feed lanes and walkways for mature cows four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
 - 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
 - 4) Properly sloping open corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing open corrals to maintain a dry surface; and
 - 5) Scraping open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions.
- PM₁₀:
- 1) Concrete feedlanes and walkways;
 - 2) Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
 - 3) Shade structures in open corrals;
 - 4) Feeding heifers in corrals near dusk (within 1 hour of dusk);
 - 5) Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) Concrete feedlanes and walkways

- Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rules 2201 and 4570]

2) Scraping open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

- For Open Corrals 22 through 27, permittee shall scrape the open corrals and exercise pens at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
- For Open Corrals 22 through 27, permittee shall maintain sufficient records to demonstrate that the open corrals are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]

3) Shade structures in open corrals

- Open Corrals 22 through 27 shall be equipped with at least one shade structure. [District Rule 2201]
- Shade structures shall be installed in any of the following ways: 1) constructed with a light permeable roofing material; 2) uphill of any slope in the corral; 3) installed so that the structure has a North/South orientation. OR Permittee shall clean manure from under corral shades at least once every fourteen (14) days, when weather permits access into the corral. [District Rules 2201 and 4570]
- If permittee has selected to comply using shades constructed with a light permeable roofing material, then permittee shall maintain records, such as design specifications, demonstrating that the shade structures are equipped with such roofing material or if Permittee has selected to comply by cleaning the manure from under corral shades, then Permittee shall maintain records demonstrating that manure is cleaned from under the shades at least once every fourteen (14) days, as long as weather permits access to corrals. [District Rules 2201 and 4570]

4) Feed young near dusk

- At least one of the feedings of the heifers housed in Open Corrals 22 through 27 shall be near (within one hour of) dusk. [District Rule 2201]
- For Open Corrals 22 through 27, permittee shall maintain a schedule listing the times when heifers are fed at or near dusk. [District Rule 2201]
- For Open Corrals 22 through 27, uneaten feed shall be re-fed or removed from the area where animals stand to eat feed on a daily basis to prevent decomposition. Uneaten feed shall be properly disposed after removal. [District Rule 2201]

- 5) Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)
- The applicant shall establish windbreaks adjacent to and along the entire west side (824 ft) and south side (2,288 ft) of Corrals 16, 17, 19, 20, and 21, and along the entire east side (480 ft) and south side (1,888 ft) of Corrals 22 through 27. The windbreaks shall consist of evergreen trees, planted 10 to 15 feet apart. [District Rule 2201]
 - Trees/shrubs that are initially planted as part of the windbreak shall have a minimum container size of five gallons. [District Rule 2201]
 - Windbreaks shall be irrigated and maintained for survivability and rapid growth. Dead trees and shrubs shall be replaced as necessary to maintain a windbreak density of 65%. [District Rule 2201]

Liquid Manure Handling System (C-5289-3-5):

Lagoon/Storage Pond (VOC):

- NH₃: 1) Anaerobic treatment lagoon designed according to Natural Resources Conservation Service (NRCS) guideline, and solids removal/separation system (mechanical separator(s) or settling basin(s)/weeping wall(s)).

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *Anaerobic treatment lagoon (VOC)*

- Permittee shall use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359. [District Rules 2201 and 4570]

Lagoon/Storage Pond (NH₃):

- NH₃: 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *Cows Fed in Accordance with NRC Guidelines (NH₃)*

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]

Land Application (VOC):

- NH₃: 1) Irrigation of crops using liquid/slurry manure from a secondary lagoon/holding/storage pond where preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) Irrigation of crops using liquid/slurry manure (NH₃)

- Permittee shall apply liquid/slurry manure via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]

Land Application (NH₃):

- NH₃: 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) Cows Fed in Accordance with NRC Guidelines (NH₃)

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]

Solid Manure Handling System (C-5289-4-4):

Solid Manure - Separated Solids Piles (NH₃):

- NH₃: 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) Cows Fed in Accordance with NRC Guidelines (NH₃)

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]

Land Application (VOC):

- VOC: 1) Rapid incorporation of solid manure into the soil after land application.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) Rapid incorporation of solid manure into the soil after land application (VOC)

- Solid manure applied to fields shall be incorporated into the soil within two hours after application. [District Rules 2201 and 4570]

Land Application (NH₃):

- NH₃: 1) Rapid incorporation of solid manure into the soil after land application, and all animals fed in accordance with NRCS or other District-approved guidelines.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *Rapid incorporation of solid manure into the soil after land application, and all animals feed in accordance with NRCS or other District approved guidelines (NH₃)*

- Solid manure applied to fields shall be incorporated into the soil within two hours after application. [District Rules 2201 and 4570]
- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]

Feed Storage and Handling (C-5289-13-3):

TMR (VOC):

VOC: 1) Implement District Rule 4570 management practices for feed.

The following conditions will be included on the proposed cow housing ATC to assure compliance with the BACT requirements of this rule:

1) *District Rule 4570 measures (VOC)*

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
- {4456} Permittee shall push feed so that it is within three feet of feedlane fence within two hours of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the animals. [District Rules 2201 and 4570]
- {4458} Permittee shall begin feeding total mixed rations within two hours of grinding and mixing rations. [District Rules 2201 and 4570]
- {4460} Permittee shall store grain in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rules 2201 and 4570]
- {4462} Permittee shall feed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. [District Rules 2201 and 4570]

B. Offsets

Offset requirements shall be triggered on a pollutant by pollutant basis and shall be required if the SSPE2 equals to or exceeds the offset threshold levels in Table 4-1 of Rule 2201. As shown in the table below, the SSPE2 is compared to the offset thresholds. VOC emissions exceed the offset threshold; however, per Section 4.6.9, offsets are not required for agricultural sources unless they are a major source. As determined in Section VII.C.5 above, this facility is not a major source for any pollutant. Therefore, offsets are not required.

Offset Determination (lb/year)					
	NO_x	SO_x	PM₁₀	CO	VOC
SSPE2	917	136	74,386	158	280,344
Offset Thresholds	20,000	54,750	29,200	200,000	20,000
Offsets triggered?	No	No	No	No	No

C. Public Notification

1. Applicability

Public noticing is required for:

- a. New Major Sources, Federal Major Modifications, and SB 288 Major Modifications,
- b. Any new emissions unit with a Potential to Emit greater than 100 pounds during any one day for any one pollutant,
- c. Any project which results in the offset thresholds being surpassed,
- d. Any project with an SSPE of greater than 20,000 lb/year for any pollutant, and/or
- e. Any project which results in a Title V significant permit modification

a. New Major Sources, Federal Major Modifications, and SB 288 Major Modifications

New Major Sources are new facilities, which are also Major Sources. Since this is not a new facility, public noticing is not required for this project for New Major Source purposes.

As demonstrated in Sections VII.C.7 and VII.C.8, this project does not constitute an SB 288 or Federal Major Modification; therefore, public noticing for SB 288 or Federal Major Modification purposes is not required.

b. PE > 100 lb/day

Applications which include a new emissions unit with a PE greater than 100 pounds during any one day for any pollutant will trigger public noticing requirements. There are no new emissions units associated with this project. Therefore public noticing is not required for this project for PE > 100 lb/day.

c. Offset Threshold

The SSPE1 and SSPE2 are compared to the offset thresholds in the following table.

Offset Thresholds				
Pollutant	SSPE1 (lb/year)	SSPE2 (lb/year)	Offset Threshold	Public Notice Required?
NO _x	917	917	20,000 lb/year	No
SO _x	136	136	54,750 lb/year	No
PM ₁₀	94,743	74,386	29,200 lb/year	No
CO	158	158	200,000 lb/year	No
VOC	253,592	280,344	20,000 lb/year	No

As detailed above, there were no thresholds surpassed with this project; therefore public noticing is not required for offset purposes.

d. SSiPE > 20,000 lb/year

Public notification is required for any permitting action that results in a SSiPE of more than 20,000 lb/year of any affected pollutant. According to District policy, the SSiPE = SSPE2 – SSPE1. The SSiPE is compared to the SSiPE Public Notice thresholds in the following table.

SSiPE Public Notice Thresholds					
Pollutant	SSPE2 (lb/year)	SSPE1 (lb/year)	SSiPE (lb/year)	SSiPE Public Notice Threshold	Public Notice Required?
NO _x	917	917	0	20,000 lb/year	No
SO _x	136	136	0	20,000 lb/year	No
PM ₁₀	74,386	94,743	-20,357	20,000 lb/year	No
CO	158	158	0	20,000 lb/year	No
VOC	280,344	253,592	26,752	20,000 lb/year	Yes
NH ₃	290,351	250,040	40,311	20,000 lb/year	Yes
H ₂ S	1,191	2,740	-1,549	20,000 lb/year	No

As demonstrated above, the SSiPEs for VOC and NH₃ were greater than 20,000 lb/year; therefore public noticing for SSiPE purposes is required.

e. Title V Significant Permit Modification

Since this facility does not have a Title V operating permit, this change is not a Title V significant Modification, and therefore public noticing is not required.

2. Public Notice Action

As discussed above, public noticing is required for this project for VOC and NH₃ emissions increasing over 20,000 lb/year. Therefore, public notice documents will be submitted to the California Air Resources Board (CARB) and a public notice will be published in a local newspaper of general circulation prior to the issuance of the ATC for this equipment.

D. Daily Emission Limits (DELs)

DELs and other enforceable conditions are required by Rule 2201 to restrict a unit's maximum daily emissions, to a level at or below the emissions associated with the maximum design capacity. The DEL must be contained in the latest ATC and contained in or enforced by the latest PTO and enforceable, in a practicable manner, on a daily basis. DELs are also required to enforce the applicability of BACT.

For dairies, the DEL is satisfied based on the number and types of cows at the dairy, and any proposed mitigation measures. The number and types of cows are listed in the permit equipment description for the milking parlor and cow housing permits.

The following District Rule 2201 rule references will be added to the ATCs to ensure compliance with applicable BACT requirements and/or control efficiencies attributed to mitigation measures implemented at the facility. Some of the following conditions may reference District Rule 4570, as these are mitigation measures the facility has selected to comply with that rule.

C-5289-1-4 (Cow Milking)

- Permittee shall flush or hose milk parlor immediately prior to, immediately after, or during each milking. [District Rules 2201 and 4570]

C-5289-2-5 (Cow Housing)

- Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rules 2201 and 4570]
- Permittee shall flush or scrape freestall flush lanes at least three (3) times per day. [District Rules 2201 and 4570]
- For Freestall Barns 10 through 14, permittee shall flush or scrape the freestall feed lanes and walkways at least four times per day for mature cows and at least once per day for support stock. [District Rules 2201 and 4570]
- Permittee shall remove manure that is not dry from individual cow freestall beds or shall rake, harrow, scrape, or grade freestall bedding at least once every seven (7) days. [District Rules 2201 and 4570]
- Permittee shall inspect water pipes and troughs and repair leaks at least once every seven (7) days. [District Rules 2201 and 4570]
- Permittee shall clean manure from corrals at least four (4) times per year with at least sixty (60) days between each cleaning, or permittee shall clean corrals at least once between April and July and at least once between September and December. [District Rules 2201 and 4570]
- Permittee shall demonstrate that manure from corrals are cleaned at least four (4) times per year with at least sixty (60) days between each cleaning or demonstrate that corrals are cleaned at least once between April and July and at least once between September and December. [District Rules 2201 and 4570]
- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rule 2201]
- Permittee shall implement at least one of the following corral mitigation measures: 1) slope the surface of the corrals at least 3% where the available space for each animal is 400 square feet or less and shall slope the surface of the corrals at least 1.5% where the available space for each animal is more than 400 square feet per animal; 2) maintain corrals to ensure proper drainage preventing water from standing more than forty-eight hours; or 3) harrow, rake, or scrape pens sufficiently to maintain a dry surface except during periods of rainy weather. [District Rules 2201 and 4570]
- Permittee shall scrape, vacuum or flush concrete lanes in corrals at least once every day for mature cows and every seven (7) days for support stock. [District Rules 2201 and 4570]
- For Freestall Barns 10 through 14, permittee shall scrape the exercise pens at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
- For Open Corrals 22 through 27, permittee shall scrape the open corrals at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
- Open Corrals 22 through 27 at this dairy shall be equipped with at least one shade structure. [District Rule 2201]
- Shade structures shall be installed in any of the following ways: 1) constructed with a light permeable roofing material; 2) uphill of any slope in the corral; 3) installed so that the

structure has a North/South orientation. OR Permittee shall clean manure from under corral shades at least once every fourteen (14) days, when weather permits access into the corral. [District Rules 2201 and 4570]

- Permittee shall knockdown fence line manure build-up prior to it exceeding a height of twelve (12) inches at any time or point. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. However, permittee must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible. [District Rules 2201 and 4570]
- At least one of the feedings of the heifers housed in Open Corrals 22 through 27 shall be near (within one hour of) dusk. [District Rule 2201]
- For Open Corrals 22 through 27, uneaten feed shall be re-fed or removed from the area where animals stand to eat feed on a daily basis to prevent decomposition. Uneaten feed shall be properly disposed after removal. [District Rule 2201]
- The applicant shall establish windbreaks adjacent to and along the entire west side (824 ft) and south side (2,288 ft) of Corrals 16, 17, 19, 20, and 21, and along the entire east side (480 ft) and south side (1,888 ft) of Corrals 22 through 27. The windbreaks shall consist of evergreen trees, planted 10 to 15 feet apart. [District Rule 2201]
- Trees/shrubs that are initially planted as part of the windbreak shall have a minimum container size of five gallons. [District Rule 2201]
- Windbreaks shall be irrigated and maintained for survivability and rapid growth. Dead trees and shrubs shall be replaced as necessary to maintain a windbreak density of 65%. [District Rule 2201]

C-5289-3-5 (Liquid Manure Handling)

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
- Permittee shall remove solids with a solid separator system, prior to the manure entering the lagoon. [District Rules 2201 and 4570]
- Permittee shall not allow liquid manure to stand in the fields for more than twenty-four (24) hours after irrigation. [District Rules 2201 and 4570]
- Permittee shall use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359. [District Rules 2201 and 4570]
- Permittee shall apply liquid/slurry manure via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
- Permittee shall only apply liquid manure that has been treated with an anaerobic treatment lagoon or a digester system. [District Rules 2201 and 4570]

C-5289-4-4 (Solid Manure Handling)

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
- Within seventy two (72) hours of removal of solid manure from housing, permittee shall either 1) remove dry manure from the facility, or 2) cover dry manure outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed twenty-four (24) hours per event. [District Rules 2201 and 4570]
- Solid manure applied to fields shall be incorporated into the soil within two hours after application. [District Rules 2201 and 4570]

C-5289-13-3 (Feed Storage and Handling)

- Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
- Permittee shall push feed so that it is within three feet of feedlane fence within two hours of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the animals. [District Rules 2201 and 4570]
- Permittee shall begin feeding total mixed rations within two hours of grinding and mixing rations. [District Rules 2201 and 4570]
- Permittee shall store grain in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rules 2201 and 4570]
- Permittee shall feed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. [District Rules 2201 and 4570]
- For bagged silage/feedstuff, permittee shall utilize a sealed feed storage system (e.g., ag bag). [District Rules 2201 and 4570]
- Permittee shall cover all silage piles, except for the area where feed is being removed from the pile, with a plastic tarp that is at least five (5) mils (0.005 inches) thick, multiple plastic tarps with a cumulative thickness of at least 5 mils (0.005 inches), or an oxygen barrier film covered with a UV resistant material. Silage piles shall be covered within seventy-two (72) hours of last delivery of material to the pile. Sheets of material used to cover silage shall overlap so that silage is not exposed where the sheets meet. [District Rules 2201 and 4570]
- For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall harvest corn used for the pile at an average moisture content of at least 65% and harvest other silage crops for the pile at an average moisture content of at least 60%. [District Rules 2201 and 4570]
- For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall adjust setting of equipment used to harvest crops for the pile to incorporate the following parameters for Theoretical Length of Chop (TLC) and roller opening, as applicable: 1) Corn with no processing: TLC not exceeding 1/2 inch, 2) Processed Corn: TLC not exceeding 3/4 inch and roller opening of 1-4 mm, 3) Alfalfa/Grass: TLC not exceeding 1.0 inch, 4) Other silage crops: TLC not exceeding 1/2 inch. [District Rules 2201 and 4570]
- For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. [District Rules 2201 and 4570]

E. Compliance Assurance

1. Source Testing

Pursuant to District Policy APR 1705, source testing is not required to demonstrate compliance with Rule 2201.

2. Monitoring

No monitoring is required to demonstrate compliance with Rule 2201.

3. Recordkeeping

C-5289-1-4 (Cow Milking)

- Permittee shall provide verification that milk parlors are flushed or hosed prior to, immediately after, or during each milking. [District Rules 2201 and 4570]
- Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

C-5289-2-5 (Cow Housing)

- Permittee shall keep records or maintain an operating plan that requires freestall flush lanes to be flushed or scraped at least three times per day. [District Rules 2201 and 4570]
- For Freestall Barns 10 through 14, permittee shall keep records or maintain an operating plan that requires the feed lanes and walkways for mature cows to be flushed or scraped at least four times per day and the feed lanes and walkways for support stock to be flushed at least once per day. [District Rules 2201 and 4570]
- Permittee shall record either of the following: 1) the dates when manure that is not dry is removed from individual cow freestall beds or 2) the dates when the freestall bedding is raked, harrowed, scraped, or graded. [District Rules 2201 and 4570]
- Permittee shall maintain records demonstrating that water pipes and troughs are inspected and leaks are repaired at least once every seven (7) days. [District Rules 2201 and 4570]
- Permittee shall demonstrate that manure from corrals are cleaned at least four (4) times per year with at least sixty (60) days between each cleaning or demonstrate that corrals are cleaned at least once between April and July and at least once between September and December. [District Rules 2201 and 4570]
- Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rule 2201]
- Permittee shall either 1) maintain sufficient records to demonstrate that corrals are maintained to ensure proper drainage preventing water from standing for more than forty-eight hours or 2) maintain records of dates pens are groomed (i.e., harrowed, raked, or scraped, etc.). [District Rules 2201 and 4570]
- Permittee shall maintain records demonstrating that concrete lanes in corrals are scraped, vacuumed, or flushed at least once every day for mature cows and at least once every seven (7) days for support stock. [District Rules 2201 and 4570]
- For Freestall Barns 10 through 14, permittee shall maintain sufficient records to demonstrate that the exercise pens are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]
- For Open Corrals 22 through 27, permittee shall maintain sufficient records to demonstrate that the open corrals are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]
- If permittee has selected to comply using shades constructed with a light permeable roofing material, then permittee shall maintain records, such as design specifications, demonstrating that the shade structures are equipped with such roofing material or if

Permittee has selected to comply by cleaning the manure from under corral shades, then Permittee shall maintain records demonstrating that manure is cleaned from under the shades at least once every fourteen (14) days, as long as weather permits access to corrals. [District Rules 2201 and 4570]

- Permittee shall measure and document the depth of manure at the fence line at least once every ninety (90) days. [District Rules 2201 and 4570]
- For Open Corrals 22 through 27, permittee shall maintain a schedule listing the times when heifers are fed at or near dusk. [District Rule 2201]
- Permittee shall maintain a record of the number of animals of each species and production group at the facility and shall maintain quarterly records of any changes to this information. [District Rules 2201 and 4570]
- Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

C-5289-3-5 (Liquid Manure Handling)

- Permittee shall maintain records to demonstrate liquid manure did not stand in the fields for more than twenty-four (24) hours after irrigation. [District Rules 2201 and 4570]
- Permittee shall maintain records, such as design specifications, calculations, including Minimum Treatment Volume (MTV), Hydraulic Retention Time (HRT) demonstrating that the anaerobic treatment lagoon meets the requirements listed in the NRCS Field Office Technical Guide Code 359. [District Rules 2201 and 4570]
- Permittee shall test any other parameters determined necessary by the APCO, ARB, and EPA to demonstrate compliance with rule requirements as frequently as determined necessary by the APCO, ARB, and EPA. [District Rules 2201 and 4570]
- Permittee shall maintain records to demonstrate liquid/slurry manure is applied via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
- Permittee shall maintain records that only liquid manure treated with an anaerobic treatment lagoon or digester system is applied to fields. [District Rules 2201 and 4570]
- Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

C-5289-4-4 (Solid Manure Handling)

- Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
- Permittee shall keep records of dates when manure is removed from the facility or permittee shall maintain records to demonstrate that dry manure piles outside the pens are covered with a weatherproof covering from October through May. [District Rules 2201 and 4570]

- If weatherproof coverings are used, permittee shall maintain records, such as manufacturer warranties or other documentation, demonstrating that the weatherproof covering over dry manure are installed, used, and maintained in accordance with manufacturer recommendations and applicable standards listed in NRCS Field Office Technical Guide Code 313 or 367, or any other applicable standard approved by the APCO, ARB, and EPA. [District Rules 2201 and 4570]
- Permittee shall maintain records to demonstrate that all solid manure has been incorporated within two hours of land application. [District Rules 2201 and 4570]
- Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

C-5289-13-3 (Feed Storage and Handling)

- Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
- Permittee shall maintain an operating plan or record that requires feed to be pushed within three feet of feedlane fence within two hours of putting out the feed, or use of a feed trough or other structure designed to maintain feed within reach of the animals. [District Rules 2201 and 4570]
- Permittee shall maintain an operating plan or record of when feeding of total mixed rations began within two hours of grinding and mixing rations. [District Rules 2201 and 4570]
- Permittee shall maintain records demonstrating grain is/was stored in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rules 2201 and 4570]
- Permittee shall maintain records to demonstrate animals are fed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
- Permittee shall maintain records of the thickness and type of cover used to cover each silage pile. Permittee shall also maintain records of the date of the last delivery of material to each silage pile and the date each pile is covered. [District Rules 2201 and 4570]
- Permittee shall select and implement one of the following mitigation measures for building each silage pile at the facility: Option 1) build the silage pile such that the average bulk density is at least 44 lb/cu ft for corn silage and 40 lb/cu ft for other silage types, as measured in accordance with Section 7.11 of District Rule 4570; Option 2) Adjust filling parameters when creating the silage pile to achieve an average bulk density of at least 44 lb/cu ft for corn silage and at least 40 lb/cu ft for other silage types as determined using a District-approved spreadsheet; or Option 3) build silage piles using crops harvested with the applicable minimum moisture content, maximum Theoretical Length of Chop (TLC), and roller opening identified in District Rule 4570, Table 4.1, 1.d and manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches.

Records of the option chosen as a mitigation measure for building each silage pile shall be maintained. [District Rules 2201 and 4570]

- For each silage pile that Option 1 (Measured Bulk Density) is chosen as a mitigation measure for building the pile, records of the measured bulk density shall be maintained. [District Rules 2201 and 4570]
- For each silage pile that Option 2 (Bulk Density Determined by Spreadsheet) is chosen as a mitigation measure for building the pile, records of the filling parameters entered into the District-approved spreadsheet to determine the bulk density shall be maintained. [District Rules 2201 and 4570]
- {4475} For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records of the average percent moisture of crops harvested for silage shall be maintained. [District Rules 2201 and 4570]
- {4477} For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records that equipment used to harvest crops for the pile was set to the required TLC and roller opening for the type of crop harvested shall be maintained. [District Rules 2201 and 4570]
- {4479} For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall maintain a plan that requires that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. [District Rules 2201 and 4570]
- {4481} If Option 1 (Limiting Exposed Area of Silage) is chosen as a mitigation measure for managing silage piles, the permittee shall calculate and record the maximum (largest part of pile) total exposed area of each silage pile. Records of the maximum calculated area shall be maintained. [District Rules 2201 and 4570]
- {4482} For each silage pile that Option 2 (Shaver/Facer or Smooth Face) is chosen as a mitigation measure for managing the pile, the permittee shall maintain records that a shaver/facer was used to remove silage from the pile or shall visually inspect the pile at least daily to verify that the working face was smooth and maintain records of the visual inspections. [District Rules 2201 and 4570]
- {4483} For each silage pile that Option 3 (Silage Additives) is chosen as a mitigation measure for managing the pile, records shall be maintained of the type additive (e.g. inoculants, preservative, other District & EPA-approved additive), the quantity of the additive applied to the pile, and a copy of the manufacturers instructions for application of the additive. [District Rules 2201 and 4570]
- {4453} Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

4. Reporting

No reporting is required to demonstrate compliance with Rule 2201.

F. Ambient Air Quality Analysis (AAQA)

An AAQA shall be conducted for the purpose of determining whether a new or modified Stationary Source will cause or make worse a violation of an air quality standard. The

District's Technical Services Division conducted the required analysis. Refer to Appendix E of this document for the AAQA summary sheet.

The proposed location is in an attainment area for NO_x, CO, and SO_x. As shown by the AAQA summary sheet the proposed equipment will not cause a violation of an air quality standard for NO_x, CO, or SO_x.

The proposed location is in a non-attainment area for the state's PM₁₀ as well as federal and state PM_{2.5} thresholds. As shown by the AAQA summary sheet the proposed equipment will not cause a violation of an air quality standard for PM₁₀ and PM_{2.5}.

Rule 2410 Prevention of Significant Deterioration

As shown in Section VII.C.9 above, this project does not result in a new PSD major source or PSD major modification. No further discussion is required.

Rule 2520 Federally Mandated Operating Permits

Since this facility's potential emissions do not exceed any major source thresholds of Rule 2201, this facility is not a major source, and Rule 2520 does not apply.

Rule 4001 New Source Performance Standards (NSPS)

This rule incorporates NSPS from Part 60, Chapter 1, Title 40, Code of Federal Regulations (CFR); and applies to all new sources of air pollution and modifications of existing sources of air pollution listed in 40 CFR Part 60. However, no subparts of 40 CFR Part 60 apply to confined animal facilities.

Rule 4002 National Emission Standards for Hazardous Air Pollutants (NESHAPs)

This rule incorporates NESHAPs from Part 61, Chapter I, Subchapter C, Title 40, CFR and the NESHAPs from Part 63, Chapter I, Subchapter C, Title 40, CFR; and applies to all sources of hazardous air pollution listed in 40 CFR Part 61 or 40 CFR Part 63. However, no subparts of 40 CFR Part 61 or 40 CFR Part 63 apply to confined animal facilities operations.

Rule 4101 Visible Emissions

Rule 4101 states that no air contaminant shall be discharged into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is as dark as, or darker than, Ringelmann 1 or 20% opacity.

Pursuant to section 4.12, emissions subject to or specifically exempt from Regulation VIII (Fugitive PM₁₀ Prohibitions) are exempt from Rule 4101. Pursuant to District Rule 8011, section 4.12, on-field agricultural sources are exempt from the requirements of Regulation VIII.

On-field agricultural sources are defined in Rule 8011, section 3.35 as the following:

- Activities conducted solely for the purpose of preparing land for the growing of crops or ***the raising of fowl or animals***, such as brush or timber clearing, grubbing, scraping, ground excavation, land leveling, grading, turning under stalks, disking, or tilling;

Therefore, activities conducted solely for the purpose of raising fowl or animals are exempt from the requirements of Regulation VIII and Rule 4101.

Rule 4102 Nuisance

Rule 4102 prohibits discharge of air contaminants which could cause injury, detriment, nuisance or annoyance to the public. Public nuisance conditions are not expected as a result of these operations, provided the equipment is well maintained. Therefore, compliance with this rule is expected.

California Health & Safety Code 41700 (Health Risk Assessment)

District Policy APR 1905 – *Risk Management Policy for Permitting New and Modified Sources* specifies that for an increase in emissions associated with a proposed new source or modification, the District perform an analysis to determine the possible impact to the nearest resident or worksite.

An HRA is not required for a project with a total facility prioritization score of less than one. According to the Technical Services Memo for this project (Appendix F), the total facility prioritization score including this project was greater than one. Therefore, an HRA was required to determine the short-term acute and long-term chronic exposure from this project.

The cancer risk for this project is shown below:

HRA Summary		
Unit	Cancer Risk	T-BACT Required
C-5289-1-4	0.0472 per million	No
C-5289-2-5	2.3 per million*	No
C-5289-3-5	0.665 per million	No
C-5289-4-4	0.00 per million	No
C-5289-13-3	N/A**	No

*Combined risk score for all cow housing units.

**There is no increase in emissions for this permit unit.

Discussion of T-BACT

BACT for toxic emission control (T-BACT) is required if the cancer risk exceeds one in one million. As demonstrated above, T-BACT is not required for the milking parlor (C-52891-4), liquid manure handling permit unit (C-5289-3-5), solid manure handling permit (C-5289-3-5), or feed storage and handling permit (C-5289-13-3) because the HRA indicates that the risk is below the District's thresholds for triggering T-BACT requirements; T-BACT is not required for the cow housing permit unit (C-5289-2-5) because each individual cow housing unit is below one in a million.

District policy APR 1905 also specifies that the increase in emissions associated with a proposed new source or modification not have acute or chronic indices, or a cancer risk greater than the District's significance levels (i.e. acute and/or chronic indices greater than 1 and a cancer risk greater than 20 in a million). As outlined by the HRA Summary in Appendix E of this report, the emissions increases for this project was determined to be less than significant.

Rule 4550 Conservation Management Practices (CMP)

This rule applies to agricultural operations located within the San Joaquin Valley Air Basin. The purpose of this rule is to limit fugitive dust emissions from agricultural operations.

Pursuant to Section 4.2, dairies with at least 500 mature cows or cattle facilities with at least 190 cattle are subject to the provisions of this rule. Therefore, this facility is currently subject to the provisions of this rule as a dairy, and will continue to be subject to the provisions of this rule as a heifer ranch.

Pursuant to Section 5.1, effective on and after July 1, 2004, an owner/operator shall implement the applicable CMPs selected pursuant to Section 6.2 for each agricultural operation site.

Pursuant to Section 5.2, an owner/operator shall prepare and submit a CMP application for each agricultural operation site to the APCO for approval.

Diamond H Dairy received District approval for its dairy CMP plan on February 15, 2007.

Rule 4570 Confined Animal Facilities (CAF)

This rule applies to Confined Animal Facilities (CAF) located within the San Joaquin Valley Air Basin. The purpose of this rule is to limit emissions of Volatile Organic Compounds (VOC) from Confined Animal Facilities (CAF).

PTOs incorporating Phase II mitigation measures of District Rule 4570, as evaluated under District project C-1110877 have already been issued to this dairy. Under this project, the applicant has not proposed to remove any mitigation measures currently practiced; however, the facility has proposed to implement the following mitigation measures for their Liquid Manure Handling permit unit:

- Use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359
- Only apply liquid manure that has been treated with anaerobic treatment lagoon, aerobic lagoon, or digester system
- Apply liquid/slurry manure via injection with drag hose or similar apparatus

The following conditions will be placed on ATC C-5289-3-5 to ensure compliance:

- Permittee shall use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359. [District Rules 2201 and 4570]
- Permittee shall maintain records, such as design specifications, calculations, including Minimum Treatment Volume (MTV), Hydraulic Retention Time (HRT) demonstrating that the anaerobic treatment lagoon meets the requirements listed in the NRCS Field Office Technical Guide Code 359. [District Rules 2201 and 4570]
- Permittee shall apply liquid/slurry manure via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
- Permittee shall maintain records to demonstrate liquid/slurry manure is applied via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
- Permittee shall only apply liquid manure that has been treated with an anaerobic treatment lagoon or a digester system. [District Rules 2201 and 4570]

- Permittee shall maintain records that only liquid manure treated with an anaerobic treatment lagoon or digester system is applied to fields. [District Rules 2201 and 4570]

California Health & Safety Code 42301.6 (School Notice)

The District has verified that this site is not located within 1,000 feet of a school. Therefore, pursuant to California Health and Safety Code 42301.6, a school notice is not required.

California Environmental Quality Act (CEQA)

CEQA requires each public agency to adopt objectives, criteria, and specific procedures consistent with CEQA Statutes and the CEQA Guidelines for administering its responsibilities under CEQA, including the orderly evaluation of projects and preparation of environmental documents. The District adopted its *Environmental Review Guidelines* (ERG) in 2001. The basic purposes of CEQA are to:

- Inform governmental decision-makers and the public about the potential, significant environmental effects of proposed activities;
- Identify the ways that environmental damage can be avoided or significantly reduced;
- Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible; and
- Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

Greenhouse Gas (GHG) Significance Determination

District is a Responsible Agency

It is determined that another agency has prepared an environmental review document for the project. The District is a Responsible Agency for the project because of its discretionary approval power over the project via its Permits Rule (Rule 2010) and New Source Review Rule (Rule 2201), (CEQA Guidelines §15381). As a Responsible Agency, the District is limited to mitigating or avoiding impacts for which it has statutory authority. The District does not have statutory authority for regulating greenhouse gas emissions. The District has determined that the applicant is responsible for implementing greenhouse gas mitigation measures, if any, imposed by the Lead Agency.

District CEQA Findings

District is a Responsible Agency – Mitigated Negative Declaration

The County of Madera (County) is the public agency having principal responsibility for approving the project. As such, the County served as the Lead Agency (CCR §15367). In approving the project, the Lead Agency prepared and adopted a Mitigated Negative Declaration. The Lead agency filed a Notice of Determination, stating that the environmental document was adopted pursuant to the provisions of CEQA and concluding that the project would not have a significant effect on the environment.

The District is a Responsible Agency for the project because of its discretionary approval power over the project via its Permits Rule (Rule 2010) and New Source Review Rule (Rule 2201), (CCR §15381). As a Responsible Agency the District complies with CEQA

by considering the environmental document prepared by the Lead Agency, and by reaching its own conclusion on whether and how to approve the project (CCR §15096).

The District has considered the Lead Agency's environmental document and finds that it adequately characterizes the project's potential impact on air quality. In addition, all feasible and cost-effective control measures to reduce potential impacts on air quality resulting from project related stationary source emissions have been applied to the project. Furthermore, the District has conducted an engineering evaluation of the project, this document, which demonstrates that Stationary Source emissions from the project would be reduced. Thus, the District finds that through a combination of project design elements, compliance with applicable District rules and regulations, and compliance with District air permit conditions, project specific stationary source emissions would be reduced to lessen the impacts on air quality. The District does not have authority over any of the other project impacts and has, therefore, determined that no additional findings are required (CEQA Guidelines §15096(h)).

Indemnification Agreement/Letter of Credit Determination

According to District Policy APR 2010 (CEQA Implementation Policy), when the District is the Lead or Responsible Agency for CEQA purposes, an indemnification agreement and/or a letter of credit may be required. The decision to require an indemnity agreement and/or a letter of credit is based on a case-by-case analysis of a particular project's potential for litigation risk, which in turn may be based on a project's potential to generate public concern, its potential for significant impacts, and the project proponent's ability to pay for the costs of litigation without a letter of credit, among other factors.

The criteria pollutant emissions and toxic air contaminant emissions associated with the proposed project are not significant, and there is minimal potential for public concern for this particular type of facility/operation. Therefore, an Indemnification Agreement and/or a Letter of Credit will not be required for this project in the absence of expressed public concern.

IX. Recommendation

Compliance with all applicable rules and regulations is expected. Pending a successful NSR Public Noticing period, issue ATCs C-5289-1-4, '-2-5, '-3-5, '-4-4, and '-13-3 subject to the permit conditions on the attached draft ATC in Appendix A.

X. Billing Information

Annual Permit Fees			
Permit Number	Fee Schedule	Fee Description	Annual Fee
C-5289-1-4	3020-06	Cow Milking Operation	\$122
C-5289-2-5	3020-06	Cow Housing	\$122
C-5289-3-5	3020-06	Liquid Manure Handling	\$122
C-5289-4-4	3020-06	Solid Manure Handling	\$122
C-5289-13-3	3020-06	Feed Storage and Handling	\$122

Appendixes

- A: Draft ATCs
- B: Current PTOs
- C: BACT Guideline
- D: BACT Analysis
- E: HRA and AAQA Summary
- F: Dairy and SSPE Calculations
- G: CEQA GHG: Project Specific Analysis
- H: Quarterly Net Emissions Change
- I: Emission Profiles

APPENDIX A

Draft ATCs

San Joaquin Valley
Air Pollution Control District

AUTHORITY TO CONSTRUCT

ISSUANCE DATE: DRAFT

PERMIT NO: C-5289-1-4

LEGAL OWNER OR OPERATOR: DIAMOND H DAIRY
MAILING ADDRESS: 9730 AVENUE 18-1/2
CHOWCHILLA, CA 93610

LOCATION: 9564 AVENUE 18-1/2
CHOWCHILLA, CA 93610

EQUIPMENT DESCRIPTION:

MODIFICATION OF 4,900 COW MILKING OPERATION WITH ONE DOUBLE 34 HERRINGBONE (68 STALLS) MILKING PARLOR AND ONE DOUBLE 45 PARALLEL (90 STALLS) MILKING PARLOR: INCREASE FROM 4,900 TO 7,278 MILK COWS AND CONSTRUCT A 72 COW ROTARY MILK BARN

CONDITIONS

1. Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
2. Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]
3. {3215} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
4. {3216} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
5. {4452} If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]

CONDITIONS CONTINUE ON NEXT PAGE

YOU MUST NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (559) 230-5950 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Samir Sheikh, Executive Director / APCO

Arnaud Marjolle, Director of Permit Services

C-5289-1-4 Oct 31 2018 4:03PM -- YOSHIMUJ Joint Inspection NOT Required

6. Permittee shall flush or hose milk parlor immediately prior to, immediately after, or during each milking. [District Rules 2201 and 4570]
7. Permittee shall provide verification that milk parlors are flushed or hosed prior to, immediately after, or during each milking. [District Rules 2201 and 4570]
8. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]
9. {3658} This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

DRAFT

San Joaquin Valley
Air Pollution Control District

AUTHORITY TO CONSTRUCT

ISSUANCE DATE: DRAFT

PERMIT NO: C-5289-2-5

LEGAL OWNER OR OPERATOR: DIAMOND H DAIRY
MAILING ADDRESS: 9730 AVENUE 18-1/2
CHOWCHILLA, CA 93610

LOCATION: 9564 AVENUE 18-1/2
CHOWCHILLA, CA 93610

EQUIPMENT DESCRIPTION:

MODIFICATION OF COW HOUSING - 4,900 MILK COWS NOT TO EXCEED A COMBINED TOTAL OF 5,650 MATURE COWS (MILK AND DRY); 6,260 TOTAL SUPPORT STOCK (HEIFERS, CALVES, AND BULLS); AND EIGHT FREESTALLS WITH FLUSH/SCRAPE SYSTEM: INCREASE MILK COWS TO 7,278, MATURE COWS TO 8,282, SUPPORT STOCK TO 8,544; CONSTRUCT 2 LOAFING (CALVING) BARNs WITH FLUSH SYSTEM OVER EXISTING OPEN CORRALS; CONSTRUCT 5 FREESTALL BARNs AND 6 OPEN CORRALS WITH FLUSH SYSTEM

CONDITIONS

1. Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
2. Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]
3. {3215} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
4. {3216} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]

CONDITIONS CONTINUE ON NEXT PAGE

YOU MUST NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (559) 230-5950 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Samir Sheikh, Executive Director / APCO

Arnaud Marjollet, Director of Permit Services

C-5289-2-5 Nov 2 2018 1:58PM - YOSHIMUJ Joint Inspection NOT Required

5. {4452} If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
6. Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rules 2201 and 4570]
7. Permittee shall flush or scrape freestall flush lanes at least three (3) times per day. [District Rules 2201 and 4570]
8. Permittee shall keep records or maintain an operating plan that requires freestall flush lanes to be flushed or scraped at least three times per day. [District Rules 2201 and 4570]
9. For Freestall Barns 10 through 14, permittee shall flush or scrape the freestall feed lanes and walkways at least four times per day for mature cows and at least once per day for support stock. [District Rules 2201 and 4570]
10. For Freestall Barns 10 through 14, permittee shall keep records or maintain an operating plan that requires the feed lanes and walkways for mature cows to be flushed or scraped at least four times per day and the feed lanes and walkways for support stock to be flushed at least once per day. [District Rules 2201 and 4570]
11. Permittee shall remove manure that is not dry from individual cow freestall beds or shall rake, harrow, scrape, or grade freestall bedding at least once every seven (7) days. [District Rules 2201 and 4570]
12. Permittee shall record either of the following: 1) the dates when manure that is not dry is removed from individual cow freestall beds or 2) the dates when the freestall bedding is raked, harrowed, scraped, or graded. [District Rules 2201 and 4570]
13. Permittee shall inspect water pipes and troughs and repair leaks at least once every seven (7) days. [District Rules 2201 and 4570]
14. Permittee shall maintain records demonstrating that water pipes and troughs are inspected and leaks are repaired at least once every seven (7) days. [District Rules 2201 and 4570]
15. Permittee shall clean manure from corrals at least four (4) times per year with at least sixty (60) days between each cleaning, or permittee shall clean corrals at least once between April and July and at least once between September and December. [District Rules 2201 and 4570]
16. Permittee shall demonstrate that manure from corrals are cleaned at least four (4) times per year with at least sixty (60) days between each cleaning or demonstrate that corrals are cleaned at least once between April and July and at least once between September and December. [District Rules 2201 and 4570]
17. Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rule 2201]
18. Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rule 2201]
19. Permittee shall implement at least one of the following corral mitigation measures: 1) slope the surface of the corrals at least 3% where the available space for each animal is 400 square feet or less and shall slope the surface of the corrals at least 1.5% where the available space for each animal is more than 400 square feet per animal; 2) maintain corrals to ensure proper drainage preventing water from standing more than forty-eight hours; or 3) harrow, rake, or scrape pens sufficiently to maintain a dry surface except during periods of rainy weather. [District Rules 2201 and 4570]
20. Permittee shall either 1) maintain sufficient records to demonstrate that corrals are maintained to ensure proper drainage preventing water from standing for more than forty-eight hours or 2) maintain records of dates pens are groomed (i.e., harrowed, raked, or scraped, etc.). [District Rules 2201 and 4570]
21. Permittee shall scrape, vacuum or flush concrete lanes in corrals at least once every day for mature cows and every seven (7) days for support stock. [District Rules 2201 and 4570]

DRAFT
CONDITIONS CONTINUE ON NEXT PAGE

22. Permittee shall maintain records demonstrating that concrete lanes in corrals are scraped, vacuumed, or flushed at least once every day for mature cows and at least once every seven (7) days for support stock. [District Rules 2201 and 4570]
23. For Freestall Barns 10 through 14, permittee shall scrape the exercise pens at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
24. For Freestall Barns 10 through 14, permittee shall maintain sufficient records to demonstrate that the exercise pens are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]
25. For Open Corrals 22 through 27, permittee shall scrape the open corrals at least once every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions. [District Rule 2201]
26. For Open Corrals 22 through 27, permittee shall maintain sufficient records to demonstrate that the open corrals are scraped at least once every two weeks, except when prevented by wet conditions. [District Rule 2201]
27. Open Corrals 22 through 27 shall be equipped with at least one shade structure. [District Rule 2201]
28. Shade structures shall be installed in any of the following ways: 1) constructed with a light permeable roofing material; 2) uphill of any slope in the corral; 3) installed so that the structure has a North/South orientation. OR Permittee shall clean manure from under corral shades at least once every fourteen (14) days, when weather permits access into the corral. [District Rules 2201 and 4570]
29. If permittee has selected to comply using shades constructed with a light permeable roofing material, then permittee shall maintain records, such as design specifications, demonstrating that the shade structures are equipped with such roofing material or if Permittee has selected to comply by cleaning the manure from under corral shades, then Permittee shall maintain records demonstrating that manure is cleaned from under the shades at least once every fourteen (14) days, as long as weather permits access to corrals. [District Rules 2201 and 4570]
30. Permittee shall knockdown fence line manure build-up prior to it exceeding a height of twelve (12) inches at any time or point. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. However, permittee must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible. [District Rules 2201 and 4570]
31. Permittee shall measure and document the depth of manure at the fence line at least once every ninety (90) days. [District Rules 2201 and 4570]
32. At least one of the feedings of the heifers housed in Open Corrals 22 through 27 shall be near (within one hour of) dusk. [District Rule 2201]
33. For Open Corrals 22 through 27, permittee shall maintain a schedule listing the times when heifers are fed at or near dusk. [District Rule 2201]
34. For Open Corrals 22 through 27, uneaten feed shall be re-fed or removed from the area where animals stand to eat feed on a daily basis to prevent decomposition. Uneaten feed shall be properly disposed after removal. [District Rule 2201]
35. The applicant shall establish windbreaks adjacent to and along the entire west side (824 ft) and south side (2,288 ft) of Corrals 16, 17, 19, 20, and 21, and along the entire east side (480 ft) and south side (1,888 ft) of Corrals 22 through 27. The windbreaks shall consist of evergreen trees, planted 10 to 15 feet apart. [District Rule 2201]
36. Trees/shrubs that are initially planted as part of the windbreak shall have a minimum container size of five gallons. [District Rule 2201]
37. Windbreaks shall be irrigated and maintained for survivability and rapid growth. Dead trees and shrubs shall be replaced as necessary to maintain a windbreak density of 65%. [District Rule 2201]
38. Permittee shall maintain a record of the number of animals of each species and production group at the facility and shall maintain quarterly records of any changes to this information. [District Rules 2201 and 4570]
39. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

DRAFT

CONDITIONS CONTINUE ON NEXT PAGE

40. {3658} This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

DRAFT

San Joaquin Valley Air Pollution Control District

AUTHORITY TO CONSTRUCT

ISSUANCE DATE: DRAFT

PERMIT NO: C-5289-3-5

LEGAL OWNER OR OPERATOR: DIAMOND H DAIRY
MAILING ADDRESS: 9730 AVENUE 18-1/2
CHOWCHILLA, CA 93610

LOCATION: 9564 AVENUE 18-1/2
CHOWCHILLA, CA 93610

EQUIPMENT DESCRIPTION:

MODIFICATION OF LIQUID MANURE HANDLING SYSTEM CONSISTING OF SETTLING BASIN(S); DOUBLE MECHANICAL SEPARATOR(S); AND THREE STORAGE PONDS; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION; INCREASE IN LIQUID MANURE DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5, CONVERT 2 SETTLING BASINS TO A COVERED ANAEROBIC TREATMENT DIGESTER LAGOON AS AUTHORIZED BY ATC C-9220-1-0

CONDITIONS

1. Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
2. Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]
3. {4452} If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
4. Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
5. Permittee shall remove solids with a solid separator system, prior to the manure entering the lagoon. [District Rules 2201 and 4570]

CONDITIONS CONTINUE ON NEXT PAGE

YOU **MUST** NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (559) 230-5950 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Samir Sheikh, Executive Director / APCO

Arnaud Marjollet, Director of Permit Services

C-5289-3-5 : Nov 2 2016 2:04PM - YOSHIMUJ : Joint Inspection NOT Required

6. Permittee shall not allow liquid manure to stand in the fields for more than twenty-four (24) hours after irrigation. [District Rules 2201 and 4570]
7. Permittee shall maintain records to demonstrate liquid manure did not stand in the fields for more than twenty-four (24) hours after irrigation. [District Rules 2201 and 4570]
8. Permittee shall use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359. [District Rules 2201 and 4570]
9. Permittee shall maintain records, such as design specifications, calculations, including Minimum Treatment Volume (MTV), Hydraulic Retention Time (HRT) demonstrating that the anaerobic treatment lagoon meets the requirements listed in the NRCS Field Office Technical Guide Code 359. [District Rules 2201 and 4570]
10. Permittee shall test any other parameters determined necessary by the APCO, ARB, and EPA to demonstrate compliance with rule requirements as frequently as determined necessary by the APCO, ARB, and EPA. [District Rules 2201 and 4570]
11. Permittee shall apply liquid/slurry manure via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
12. Permittee shall maintain records to demonstrate liquid/slurry manure is applied via injection with drag hose or similar apparatus. [District Rules 2201 and 4570]
13. Permittee shall only apply liquid manure that has been treated with an anaerobic treatment lagoon or a digester system. [District Rules 2201 and 4570]
14. Permittee shall maintain records that only liquid manure treated with an anaerobic treatment lagoon or digester system is applied to fields. [District Rules 2201 and 4570]
15. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]
16. {3658} This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

DRAFT

San Joaquin Valley
Air Pollution Control District

AUTHORITY TO CONSTRUCT

ISSUANCE DATE: DRAFT

PERMIT NO: C-5289-4-4

LEGAL OWNER OR OPERATOR: DIAMOND H DAIRY
MAILING ADDRESS: 9730 AVENUE 18-1/2
CHOWCHILLA, CA 93610

LOCATION: 9564 AVENUE 18-1/2
CHOWCHILLA, CA 93610

EQUIPMENT DESCRIPTION:

MODIFICATION OF SOLID MANURE HANDLING CONSISTING OF MANURE STOCK PILES; SOLID MANURE APPLICATION TO LAND: INCREASE IN SOLID MANURE DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5

CONDITIONS

1. Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
2. Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]
3. {3215} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
4. {3216} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
5. {4452} If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]

CONDITIONS CONTINUE ON NEXT PAGE

YOU MUST NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (559) 230-5950 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Samir Sheikh, Executive Director / APCO

Arnaud Marjolle, Director of Permit Services

C-5289-4-4 Nov 2 2018 2:04PM - YOSHIMUJ Joint Inspection NOT Required

6. Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
7. Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
8. Within seventy two (72) hours of removal of solid manure from housing, permittee shall either 1) remove dry manure from the facility, or 2) cover dry manure outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed twenty-four (24) hours per event. [District Rules 2201 and 4570]
9. Permittee shall keep records of dates when manure is removed from the facility or permittee shall maintain records to demonstrate that dry manure piles outside the pens are covered with a weatherproof covering from October through May. [District Rules 2201 and 4570]
10. If weatherproof coverings are used, permittee shall maintain records, such as manufacturer warranties or other documentation, demonstrating that the weatherproof covering over dry manure are installed, used, and maintained in accordance with manufacturer recommendations and applicable standards listed in NRCS Field Office Technical Guide Code 313 or 367, or any other applicable standard approved by the APCO, ARB, and EPA. [District Rules 2201 and 4570]
11. Solid manure applied to fields shall be incorporated into the soil within two hours after application. [District Rules 2201 and 4570]
12. Permittee shall maintain records to demonstrate that all solid manure has been incorporated within two hours of land application. [District Rules 2201 and 4570]
13. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]
14. {3658} This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

DRAFT

San Joaquin Valley Air Pollution Control District

AUTHORITY TO CONSTRUCT

ISSUANCE DATE: DRAFT

PERMIT NO: C-5289-13-3

LEGAL OWNER OR OPERATOR: DIAMOND H DAIRY
MAILING ADDRESS: 9730 AVENUE 18-1/2
CHOWCHILLA, CA 93610

LOCATION: 9564 AVENUE 18-1/2
CHOWCHILLA, CA 93610

EQUIPMENT DESCRIPTION:

MODIFICATION OF FEED STORAGE AND HANDLING CONSISTING OF COMMODITY BARNs AND SILAGE PILES:
INCREASE IN FEED DUE TO INCREASE IN HERD SIZE AS AUTHORIZED BY ATC C-5289-2-5

CONDITIONS

1. Authority to Construct (ATC) permits C-5289-1-4, '-2-5, '-4-4, and '-13-3 shall be implemented concurrently. [District Rule 2201]
2. Upon implementation of the modification(s) authorized by this Authority to Construct (ATC), the following permits shall be surrendered to the District: C-5701-1-0, '-2-0, '-3-0, '-4-0, and '-5-0. [District Rule 2201]
3. {3215} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
4. {3216} Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
5. {4452} If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]

CONDITIONS CONTINUE ON NEXT PAGE

YOU **MUST** NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (559) 230-5950 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Samir Sheikh, Executive Director / APCO

Arnaud Marjolle, Director of Permit Services
C-5289-13-3 Oct 31 2018 4:03PM -- YOSHIMUJ Joint Inspection NOT Required

6. Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rules 2201 and 4570]
7. Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
8. Permittee shall push feed so that it is within three feet of feedlane fence within two hours of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the animals. [District Rules 2201 and 4570]
9. Permittee shall maintain an operating plan or record that requires feed to be pushed within three feet of feedlane fence within two hours of putting out the feed, or use of a feed trough or other structure designed to maintain feed within reach of the animals. [District Rules 2201 and 4570]
10. Permittee shall begin feeding total mixed rations within two hours of grinding and mixing rations. [District Rules 2201 and 4570]
11. Permittee shall maintain an operating plan or record of when feeding of total mixed rations began within two hours of grinding and mixing rations. [District Rules 2201 and 4570]
12. Permittee shall store grain in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rules 2201 and 4570]
13. Permittee shall maintain records demonstrating grain is/was stored in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rules 2201 and 4570]
14. Permittee shall feed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. [District Rules 2201 and 4570]
15. Permittee shall maintain records to demonstrate animals are fed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rules 2201 and 4570]
16. For bagged silage/feedstuff, permittee shall utilize a sealed feed storage system (e.g., ag bag). [District Rules 2201 and 4570]
17. Permittee shall cover all silage piles, except for the area where feed is being removed from the pile, with a plastic tarp that is at least five (5) mils (0.005 inches) thick, multiple plastic tarps with a cumulative thickness of at least 5 mils (0.005 inches), or an oxygen barrier film covered with a UV resistant material. Silage piles shall be covered within seventy-two (72) hours of last delivery of material to the pile. Sheets of material used to cover silage shall overlap so that silage is not exposed where the sheets meet. [District Rules 2201 and 4570]
18. Permittee shall maintain records of the thickness and type of cover used to cover each silage pile. Permittee shall also maintain records of the date of the last delivery of material to each silage pile and the date each pile is covered. [District Rules 2201 and 4570]
19. Permittee shall select and implement one of the following mitigation measures for building each silage pile at the facility: Option 1) build the silage pile such that the average bulk density is at least 44 lb/cu ft for corn silage and 40 lb/cu ft for other silage types, as measured in accordance with Section 7.11 of District Rule 4570; Option 2) Adjust filling parameters when creating the silage pile to achieve an average bulk density of at least 44 lb/cu ft for corn silage and at least 40 lb/cu ft for other silage types as determined using a District-approved spreadsheet; or Option 3) build silage piles using crops harvested with the applicable minimum moisture content, maximum Theoretical Length of Chop (TLC), and roller opening identified in District Rule 4570, Table 4.1, 1.d and manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. Records of the option chosen as a mitigation measure for building each silage pile shall be maintained. [District Rules 2201 and 4570]
20. For each silage pile that Option 1 (Measured Bulk Density) is chosen as a mitigation measure for building the pile, records of the measured bulk density shall be maintained. [District Rules 2201 and 4570]

DRAFT
CONDITIONS CONTINUE ON NEXT PAGE

21. For each silage pile that Option 2 (Bulk Density Determined by Spreadsheet) is chosen as a mitigation measure for building the pile, records of the filling parameters entered into the District-approved spreadsheet to determine the bulk density shall be maintained. [District Rules 2201 and 4570]
22. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall harvest corn used for the pile at an average moisture content of at least 65% and harvest other silage crops for the pile at an average moisture content of at least 60%. [District Rules 2201 and 4570]
23. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records of the average percent moisture of crops harvested for silage shall be maintained. [District Rules 2201 and 4570]
24. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall adjust setting of equipment used to harvest crops for the pile to incorporate the following parameters for Theoretical Length of Chop (TLC) and roller opening, as applicable: 1) Corn with no processing: TLC not exceeding 1/2 inch, 2) Processed Corn: TLC not exceeding 3/4 inch and roller opening of 1-4 mm, 3) Alfalfa/Grass: TLC not exceeding 1.0 inch, 4) Other silage crops: TLC not exceeding 1/2 inch. [District Rules 2201 and 4570]
25. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records that equipment used to harvest crops for the pile was set to the required TLC and roller opening for the type of crop harvested shall be maintained. [District Rules 2201 and 4570]
26. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. [District Rules 2201 and 4570]
27. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall maintain a plan that requires that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. [District Rules 2201 and 4570]
28. Permittee shall select and implement at least two of the following mitigation measures for management of silage piles at the facility: Option 1) manage silage piles such that only one silage pile has an uncovered face and the total exposed surface area is less than 2,150 square feet, or manage multiple uncovered silage piles such that the total exposed surface area of all uncovered silage piles is less than 4,300 square feet; Option 2) use a shaver/facer to remove silage from the silage pile, or shall use another method to maintain a smooth vertical surface on the working face of the silage pile; or Option 3) inoculate silage with homolactic lactic acid bacteria in accordance with manufacturer recommendations to achieve a concentration of at least 100,000 colony forming units per gram of wet forage, apply propionic acid, benzoic acid, sorbic acid, sodium benzoate, or potassium sorbate at the rate specified by the manufacturer to reduce yeast counts when forming silage piles, or apply other additives at rates that have been demonstrated to reduce alcohol concentrations in silage and/or VOC emissions from silage and have been approved by the District and EPA. Records of the options chosen for managing each silage pile shall be maintained. [District Rules 2201 and 4570]
29. If Option 1 (Limiting Exposed Area of Silage) is chosen as a mitigation measure for managing silage piles, the permittee shall calculate and record the maximum (largest part of pile) total exposed area of each silage pile. Records of the maximum calculated area shall be maintained. [District Rules 2201 and 4570]
30. For each silage pile that Option 2 (Shaver/Facer or Smooth Face) is chosen as a mitigation measure for managing the pile, the permittee shall maintain records that a shaver/facer was used to remove silage from the pile or shall visually inspect the pile at least daily to verify that the working face was smooth and maintain records of the visual inspections. [District Rules 2201 and 4570]
31. For each silage pile that Option 3 (Silage Additives) is chosen as a mitigation measure for managing the pile, records shall be maintained of the type additive (e.g. inoculants, preservative, other District & EPA-approved additive), the quantity of the additive applied to the pile, and a copy of the manufacturers instructions for application of the additive. [District Rules 2201 and 4570]
32. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rules 2201 and 4570]

CONDITIONS CONTINUE ON NEXT PAGE

33. {3658} This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

DRAFT

APPENDIX B

Current PTOs

San Joaquin Valley Air Pollution Control District

PERMIT UNIT: C-5289-1-2

EXPIRATION DATE: 12/31/2018

EQUIPMENT DESCRIPTION:

4,900 COW MILKING OPERATION WITH ONE DOUBLE 34 HERRINGBONE (68 STALLS) MILKING PARLOR AND ONE DOUBLE 45 PARALLEL (90 STALLS) MILKING PARLOR

PERMIT UNIT REQUIREMENTS

1. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
2. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
3. If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
4. Permittee shall flush or hose milk parlor immediately prior to, immediately after, or during each milking. [District Rule 4570]
5. Permittee shall provide verification that milk parlors are flushed or hosed prior to, immediately after, or during each milking. [District Rule 4570]
6. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rule 4570]
7. This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

These terms and conditions are part of the Facility-wide Permit to Operate.

San Joaquin Valley Air Pollution Control District

PERMIT UNIT: C-5289-2-3

EXPIRATION DATE: 12/31/2018

EQUIPMENT DESCRIPTION:

COW HOUSING - 4,900 MILK COWS NOT TO EXCEED A COMBINED TOTAL OF 5,650 MATURE COWS (MILK AND DRY); 6,260 TOTAL SUPPORT STOCK (HEIFERS, CALVES AND BULLS); AND EIGHT FREESTALLS WITH FLUSH/SCRAPE

PERMIT UNIT REQUIREMENTS

1. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
2. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
3. If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
4. Permittee shall pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. [District Rule 4570]
5. Permittee shall flush or scrape freestall flush lanes at least three (3) times per day. [District Rule 4570]
6. Permittee shall keep records or maintain an operating plan that requires freestall flush lanes to be flushed or scraped at least three times per day. [District Rule 4570]
7. Permittee shall remove manure that is not dry from individual cow freestall beds or shall rake, harrow, scrape, or grade freestall bedding at least once every seven (7) days. [District Rule 4570]
8. Permittee shall record either of the following: 1) the dates when manure that is not dry is removed from individual cow freestall beds or 2) the dates when the freestall bedding is raked, harrowed, scraped, or graded. [District Rule 4570]
9. Permittee shall inspect water pipes and troughs and repair leaks at least once every seven (7) days. [District Rule 4570]
10. Permittee shall maintain records demonstrating that water pipes and troughs are inspected and leaks are repaired at least once every seven (7) days. [District Rule 4570]
11. Permittee shall clean manure from corrals at least four (4) times per year with at least sixty (60) days between each cleaning, or permittee shall clean corrals at least once between April and July and at least once between September and December. [District Rule 4570]
12. Permittee shall demonstrate that manure from corrals are cleaned at least four (4) times per year with at least sixty (60) days between each cleaning or demonstrate that corrals are cleaned at least once between April and July and at least once between September and December. [District Rule 4570]

PERMIT UNIT REQUIREMENTS CONTINUE ON NEXT PAGE

These terms and conditions are part of the Facility-wide Permit to Operate.

13. Permittee shall implement at least one of the following corral mitigation measures: 1) slope the surface of the corrals at least 3% where the available space for each animal is 400 square feet or less and shall slope the surface of the corrals at least 1.5% where the available space for each animal is more than 400 square feet per animal; 2) maintain corrals to ensure proper drainage preventing water from standing more than forty-eight hours; or 3) harrow, rake, or scrape pens sufficiently to maintain a dry surface except during periods of rainy weather. [District Rule 4570]
14. Permittee shall either 1) maintain sufficient records to demonstrate that corrals are maintained to ensure proper drainage preventing water from standing for more than forty-eight hours or 2) maintain records of dates pens are groomed (i.e., harrowed, raked, or scraped, etc.). [District Rule 4570]
15. Permittee shall scrape, vacuum or flush concrete lanes in corrals at least once every day for mature cows and every seven (7) days for support stock. [District Rule 4570]
16. Permittee shall maintain records demonstrating that concrete lanes in corrals are scraped, vacuumed, or flushed at least once every day for mature cows and at least once every seven (7) days for support stock. [District Rule 4570]
17. Shade structures shall be installed in any of the following ways: 1) constructed with a light permeable roofing material; 2) uphill of any slope in the corral; 3) installed so that the structure has a North/South orientation. OR Permittee shall clean manure from under corral shades at least once every fourteen (14) days, when weather permits access into the corral. [District Rule 4570]
18. Permittee shall knockdown fence line manure build-up prior to it exceeding a height of twelve (12) inches at any time or point. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. However, permittee must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible. [District Rule 4570]
19. Permittee shall measure and document the depth of manure at the fence line at least once every ninety (90) days. [District Rule 4570]
20. Permittee shall maintain a record of the number of animals of each species and production group at the facility and shall maintain quarterly records of any changes to this information. [District Rule 4570]
21. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rule 4570]
22. This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

These terms and conditions are part of the Facility-wide Permit to Operate.

San Joaquin Valley Air Pollution Control District

PERMIT UNIT: C-5289-3-4

EXPIRATION DATE: 12/31/2018

EQUIPMENT DESCRIPTION:

LIQUID MANURE HANDLING SYSTEM CONSISTING OF SETTLING BASIN(S); DOUBLE MECHANICAL SEPARATOR(S); AND THREE STORAGE PONDS; MANURE LAND APPLIED THROUGH FLOOD IRRIGATION

PERMIT UNIT REQUIREMENTS

1. If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
2. The liquid manure handling system shall handle flush manure from no more than 4,900 milk cows; not to exceed a combined total of 5,650 mature cows (milk and dry cows); and 6,270 total support stock (heifers, calves, and bulls). [District Rule 2201]
3. Permittee shall remove solids with a solid separator system, prior to the manure entering the lagoon. [District Rule 4570]
4. Permittee shall not allow liquid manure to stand in the fields for more than twenty-four (24) hours after irrigation. [District Rule 4570]
5. Permittee shall maintain records to demonstrate liquid manure did not stand in the fields for more than twenty-four (24) hours after irrigation. [District Rule 4570]
6. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rule 4570]
7. This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

These terms and conditions are part of the Facility-wide Permit to Operate.

San Joaquin Valley Air Pollution Control District

PERMIT UNIT: C-5289-4-2

EXPIRATION DATE: 12/31/2018

EQUIPMENT DESCRIPTION:

SOLID MANURE HANDLING CONSISTING OF MANURE STOCK PILES; SOLID MANURE APPLICATION TO LAND

PERMIT UNIT REQUIREMENTS

1. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
2. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
3. If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
4. Within seventy two (72) hours of removal of solid manure from housing, permittee shall either 1) remove dry manure from the facility, or 2) cover dry manure outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed twenty-four (24) hours per event. [District Rule 4570]
5. Permittee shall keep records of dates when manure is removed from the facility or permittee shall maintain records to demonstrate that dry manure piles outside the pens are covered with a weatherproof covering from October through May. [District Rule 4570]
6. If weatherproof coverings are used, permittee shall maintain records, such as manufacturer warranties or other documentation, demonstrating that the weatherproof covering over dry manure are installed, used, and maintained in accordance with manufacturer recommendations and applicable standards listed in NRCS Field Office Technical Guide Code 313 or 367, or any other applicable standard approved by the APCO, ARB, and EPA. [District Rule 4570]
7. Permittee shall incorporate all solid manure within seventy-two (72) hours of land application. [District Rule 4570]
8. Permittee shall maintain records to demonstrate that all solid manure has been incorporated within seventy-two (72) hours of land application. [District Rule 4570]
9. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rule 4570]
10. This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

These terms and conditions are part of the Facility-wide Permit to Operate.

San Joaquin Valley Air Pollution Control District

PERMIT UNIT: C-5289-13-1

EXPIRATION DATE: 12/31/2018

EQUIPMENT DESCRIPTION:

FEED STORAGE AND HANDLING CONSISTING OF COMMODITY BARNS AND SILAGE PILES

PERMIT UNIT REQUIREMENTS

1. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to enter the permittee's premises where a permitted source is located or emissions related activity is conducted, or where records must be kept under condition of the permit. [District Rule 1070]
2. Upon presentation of appropriate credentials, a permittee shall allow an authorized representative of the District to have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit. [District Rule 1070]
3. If a licensed veterinarian or a certified nutritionist determines that any VOC mitigation measure will be required to be suspended as a detriment to animal health or necessary for the animal to molt, the owners/operators must notify the District in writing within forty-eight (48) hours of the determination including the duration and the specific health condition requiring the mitigation measure to be suspended. If the situation is expected to exist longer than a thirty-day (30) period, the owner/operator shall submit a new emission mitigation plan designating a mitigation measure to be implemented in lieu of the suspended mitigation measure. [District Rule 4570]
4. Permittee shall feed all animals according to National Research Council (NRC) guidelines. [District Rule 4570]
5. Permittee shall maintain records of feed content, formulation, and quantity of feed additive utilized, to demonstrate compliance with National Research Council (NRC) guidelines. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rule 4570]
6. Permittee shall push feed so that it is within three feet of feedlane fence within two hours of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the animals. [District Rule 4570]
7. Permittee shall maintain an operating plan or record that requires feed to be pushed within three feet of feedlane fence within two hours of putting out the feed, or use of a feed trough or other structure designed to maintain feed within reach of the animals. [District Rule 4570]
8. Permittee shall begin feeding total mixed rations within two hours of grinding and mixing rations. [District Rule 4570]
9. Permittee shall maintain an operating plan or record of when feeding of total mixed rations began within two hours of grinding and mixing rations. [District Rule 4570]
10. Permittee shall store grain in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rule 4570]
11. Permittee shall maintain records demonstrating grain is/was stored in a weatherproof storage structure or under a weatherproof covering from October through May. [District Rule 4570]
12. Permittee shall feed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. [District Rule 4570]

PERMIT UNIT REQUIREMENTS CONTINUE ON NEXT PAGE

These terms and conditions are part of the Facility-wide Permit to Operate.

13. Permittee shall maintain records to demonstrate animals are fed steam-flaked, dry rolled, cracked or ground corn or other steam-flaked, dry rolled, cracked or ground cereal grains. Records such as feed company guaranteed analyses (feed tags), ration sheets, or feed purchase records may be used to meet this requirement. [District Rule 4570]
14. For bagged silage/feedstuff, permittee shall utilize a sealed feed storage system (e.g., ag bag). [District Rule 4570]
15. Permittee shall cover all silage piles, except for the area where feed is being removed from the pile, with a plastic tarp that is at least five (5) mils (0.005 inches) thick, multiple plastic tarps with a cumulative thickness of at least 5 mils (0.005 inches), or an oxygen barrier film covered with a UV resistant material. Silage piles shall be covered within seventy-two (72) hours of last delivery of material to the pile. Sheets of material used to cover silage shall overlap so that silage is not exposed where the sheets meet. [District Rule 4570]
16. Permittee shall maintain records of the thickness and type of cover used to cover each silage pile. Permittee shall also maintain records of the date of the last delivery of material to each silage pile and the date each pile is covered. [District Rule 4570]
17. Permittee shall select and implement one of the following mitigation measures for building each silage pile at the facility: Option 1) build the silage pile such that the average bulk density is at least 44 lb/cu ft for corn silage and 40 lb/cu ft for other silage types, as measured in accordance with Section 7.11 of District Rule 4570; Option 2) Adjust filling parameters when creating the silage pile to achieve an average bulk density of at least 44 lb/cu ft for corn silage and at least 40 lb/cu ft for other silage types as determined using a District-approved spreadsheet; or Option 3) build silage piles using crops harvested with the applicable minimum moisture content, maximum Theoretical Length of Chop (TLC), and roller opening identified in District Rule 4570, Table 4.1, 1.d and manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. Records of the option chosen as a mitigation measure for building each silage pile shall be maintained. [District Rule 4570]
18. For each silage pile that Option 1 (Measured Bulk Density) is chosen as a mitigation measure for building the pile, records of the measured bulk density shall be maintained. [District Rule 4570]
19. For each silage pile that Option 2 (Bulk Density Determined by Spreadsheet) is chosen as a mitigation measure for building the pile, records of the filling parameters entered into the District-approved spreadsheet to determine the bulk density shall be maintained. [District Rule 4570]
20. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall harvest corn used for the pile at an average moisture content of at least 65% and harvest other silage crops for the pile at an average moisture content of at least 60%. [District Rule 4570]
21. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records of the average percent moisture of crops harvested for silage shall be maintained. [District Rule 4570]
22. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall adjust setting of equipment used to harvest crops for the pile to incorporate the following parameters for Theoretical Length of Chop (TLC) and roller opening, as applicable: 1) Corn with no processing: TLC not exceeding 1/2 inch, 2) Processed Corn: TLC not exceeding 3/4 inch and roller opening of 1-4 mm, 3) Alfalfa/Grass: TLC not exceeding 1.0 inch, 4) Other silage crops: TLC not exceeding 1/2 inch. [District Rule 4570]
23. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, records that equipment used to harvest crops for the pile was set to the required TLC and roller opening for the type of crop harvested shall be maintained. [District Rule 4570]
24. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall manage silage material delivery such that the thickness of the layer of un-compacted material delivered on top of the pile is no more than six (6) inches. [District Rule 4570]

PERMIT UNIT REQUIREMENTS CONTINUE ON NEXT PAGE

These terms and conditions are part of the Facility-wide Permit to Operate.

25. For each silage pile that Option 3 (Moisture, TLC, Roller Opening, & Material Delivery) is chosen as a mitigation measure for building the pile, the permittee shall maintain a plan that requires that the thickness of the layer of uncompacted material delivered on top of the pile is no more than six (6) inches. [District Rule 4570]
26. Permittee shall select and implement at least two of the following mitigation measures for management of silage piles at the facility: Option 1) manage silage piles such that only one silage pile has an uncovered face and the total exposed surface area is less than 2,150 square feet, or manage multiple uncovered silage piles such that the total exposed surface area of all uncovered silage piles is less than 4,300 square feet; Option 2) use a shaver/facer to remove silage from the silage pile, or shall use another method to maintain a smooth vertical surface on the working face of the silage pile; or Option 3) inoculate silage with homolactic lactic acid bacteria in accordance with manufacturer recommendations to achieve a concentration of at least 100,000 colony forming units per gram of wet forage, apply propionic acid, benzoic acid, sorbic acid, sodium benzoate, or potassium sorbate at the rate specified by the manufacturer to reduce yeast counts when forming silage piles, or apply other additives at rates that have been demonstrated to reduce alcohol concentrations in silage and/or VOC emissions from silage and have been approved by the District and EPA. Records of the options chosen for managing each silage pile shall be maintained. [District Rule 4570]
27. If Option 1 (Limiting Exposed Area of Silage) is chosen as a mitigation measure for managing silage piles, the permittee shall calculate and record the maximum (largest part of pile) total exposed area of each silage pile. Records of the maximum calculated area shall be maintained. [District Rule 4570]
28. For each silage pile that Option 2 (Shaver/Facer or Smooth Face) is chosen as a mitigation measure for managing the pile, the permittee shall maintain records that a shaver/facer was used to remove silage from the pile or shall visually inspect the pile at least daily to verify that the working face was smooth and maintain records of the visual inspections. [District Rule 4570]
29. For each silage pile that Option 3 (Silage Additives) is chosen as a mitigation measure for managing the pile, records shall be maintained of the type additive (e.g. inoculants, preservative, other District & EPA-approved additive), the quantity of the additive applied to the pile, and a copy of the manufacturers instructions for application of the additive. [District Rule 4570]
30. Permittee shall keep and maintain all records for a minimum of five (5) years and shall make records available to the APCO and EPA upon request. [District Rule 4570]
31. This permit does not authorize the violation of any conditions established for this facility in the Conditional Use Permit (CUP), Special Use Permit (SUP), Site Approval, Site Plan Review (SPR), or other approval documents issued by a local, state, or federal agency. [Public Resources Code 21000-21177: California Environmental Quality Act]

These terms and conditions are part of the Facility-wide Permit to Operate.

APPENDIX C

BACT Guideline

Best Available Control Technology (BACT) Guideline 5.8.1
Last Update: 12/18/2013

Milking Parlor

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Flush/Spray before, after, or during milking each group of cows	1) Enclosure of milk parlor with biogas vented to incinerator with 95% control 2) Enclosure of milk parlor with biogas vented to biofilter with minimum 80% control	
NH3	Flush/Spray before, after, or during milking each group of cows		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on [Details Page](#).

Best Available Control Technology (BACT) Guideline 5.8.2
Last Update: 12/18/2013

Cow Housing - Freestall and Saudi-Style Barns

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
PM10	1) Concrete feed lanes and walkways; 2) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions		
VOC	1) Concrete feed lanes and walkways; 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day); 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines; 4) Properly sloping exercise pens (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; 5) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions; and 6) Rule 4570 Measures		
NH3	1) Concrete feed lanes and walkways; 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day); 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines; 4) Properly sloping		

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
-----------	------------------------------------	--------------------------	---------------------------

exercise pens (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and 5) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions;

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on [Details Page](#).

Best Available Control Technology (BACT) Guideline 5.8.3
Last Update: 3/17/2015

Cow Housing - Open Corrals

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
PM10	1) Concrete feed lanes and walkways; 2) Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions; 3) Shade structures in open corrals; 4) Feeding heifers in corrals near dusk (within 1 hour of dusk); and 5) Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities); or 6) An alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) = 16%) may be applied as a replacement for the previous measures		
VOC	1) Concrete feed lanes and walkways; 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day); 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines; 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; 5) Scraping corrals and exercise pens every two weeks using		

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
	pull-type scraper in the morning hours except when prevented by wet conditions; and 6) Rule 4570 Measures (only for facilities subject to Rule 4570)		
NH3	1) Concrete feed lanes and walkways; 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day); 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines; 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and 5) Scraping corrals and exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions;		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on Details Page.

Best Available Control Technology (BACT) Guideline 5.8.6
Last Update: 12/18/2013

Liquid Manure Handling - Lagoon/Storage Pond

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Anaerobic treatment lagoon designed according to NRCS Guideline, and solids removal/separation system (mechanical separator(s) or settling basin(s)/weeping wall(s))	1) Aerobic treatment lagoon or mechanically aerated lagoon; 2) Covered lagoon digester vented to a control device with minimum 95% control	
NH3	All animals fed in accordance with NRCS or other District-approved guidelines		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on Details Page.

Best Available Control Technology (BACT) Guideline 5.8.7
Last Update: 12/18/2013

Liquid Manure Handling - Liquid/Slurry Land Application

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Irrigation of crops using liquid/slurry manure from the secondary lagoon/holding/storage pond preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards	1) Irrigation of crops using liquid manure from an aerobic treatment lagoon or mechanically aerated lagoon (95% VOC control efficiency) 2) Irrigation of crops using liquid manure from a holding/storage pond after being treated in a covered lagoon/digester (80% VOC control efficiency)	
NH3	All animals fed in accordance with NRCS or other District-approved guidelines		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on Details Page.

Best Available Control Technology (BACT) Guideline 5.8.8
Last Update: 12/18/2013

Solid Manure Handling - Storage/Separated Solids Piles

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
NH3	All animals fed in accordance with NRCS or other District- approved guidelines		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on [Details Page](#).

Best Available Control Technology (BACT) Guideline 5.8.9
Last Update: 12/18/2013

Solid Manure Handling - Land Application

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Rapid incorporation of solid manure into the soil after land application	1a) Land Application of Solid Manure Processed by Either an Open or Enclosed Negatively-Aerated Static Pile (ASP) Vented to a biofilter (or equivalent) = 80% destruction efficiency With Rapid Incorporation of the Manure Into the Soil After Land Application; 1b) Land Application of Solid Manure Processed by In-Vessel/Enclosed Negatively-Aerated Static Piles vented to biofilter = 80% destruction efficiency; 2) Land Application of Solid Manure Processed by Open Negatively-Aerated Static Piles vented to biofilter = 80% destruction efficiency; 3) Land Application of Solid Manure Processed by an Open Negatively-Aerated Static Piles (ASP) (With Thick Layer of Bulking Agent or Equivalent) With Rapid Incorporation of the Manure Into the Soil After Land Application	
NH3	Rapid incorporation of solid manure into the soil after land application, and all animals fed in accordance with NRCS or other District-approved guidelines		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on Details Page.

Best Available Control Technology (BACT) Guideline 5.8.11
Last Update: 12/18/2013

Feed Storage and Handling - Feed/TMR

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	District Rule 4570 Measures for Feed/TMR		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

This is a Summary Page for this Class of Source. For background information, see Permit Specific BACT Determinations on [Details Page](#).

APPENDIX D

BACT Analysis

Top-Down BACT Analysis for Dairy Milking Parlors

a. Identify all control technologies

BACT Analysis for VOC Emissions:

1) Milking Parlors Vented to an Incinerator

Milking parlors can be either naturally or mechanically ventilated. According to some dairy designers, mechanical ventilation is more reliable than natural ventilation. Mechanical ventilation can be easily applied to all areas of the milking parlors, except the holding area. The mechanical system for the milking parlors can be utilized to capture the gases emitted from the milking parlors, however in order to capture all of the gases, and to keep an appropriate negative pressure throughout the system, the holding area would also need to be entirely enclosed. No facility currently encloses the holding area since cows are continuously going in and out of the barn throughout the day. The capital required to enclose this large area would also be significant. Although the feasibility of such a technology is in question, it will be considered in this analysis.

The captured VOC emissions could then be sent to an incinerator. Thermal incineration is a well-established VOC control technique. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. It is assumed that 95% of the gasses emitted from the milking parlor will be captured by the mechanical ventilation system and that 98% of the captured VOCs will be eliminated by thermal incineration²; therefore the total control for VOCs from the milking parlor = $0.95 \times 0.98 = 93.1\%$.

2) Milking Parlor Vented to a Biofilter

A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration, exhaust air containing pollutants passes through a media that contains an established, diverse population of aerobic microorganisms. These microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. The bacterial cultures (microorganisms that typically consist of several species coexisting in a colony) that use oxygen to biodegrade organics are called aerobic cultures. These aerobic cultures are usually supported by organic material contained in the biofilter, such as compost, wood chips, soil, peat, etc. Biofilters must maintain sufficient porosity to allow the contaminated air stream to pass through for treatment and to prevent anaerobic conditions. The moisture content of biofilter beds must also be regulated to ensure that there is sufficient moisture to maintain the microorganisms needed for treatment while avoiding excess moisture that can cause anaerobic conditions. A filtration system may be required upstream of the biofilter to remove particular matter which will clog the biofilter over time. Biofilters must be maintained free of rodents and weeds to

² OAQPS Control Cost Manual, 4th Edition, EPA 450/3-90-006, January 1990, page 3-8.

avoid channeling of gases through the filter media and a loss of performance. The filter media of natural biofilters needs to be replaced periodically because of deterioration and loss of porosity.

Since biofilters rely on living organisms to function, a biofilter's performance will be affected by several factors, including: ambient temperature; temperature of the air stream being treated; the pollutant concentrations in the air stream; moisture content of the filter and air stream, and pH of the filter media. These parameters should be monitored to ensure optimum operating conditions for the biofilter.

It is assumed that 95% of the gasses emitted from the enclosed animal housing will be captured by the mechanical ventilation system and that a properly functioning biofilter will eliminate 80% of the captured VOC emissions³; therefore, the total control for VOCs from the enclosed animal housing = $0.95 \times 0.80 = 76\%$.

3) Flush/Spray Milking Parlor Before, After, or During Milking Each Group of Cows

Almost all dairy operations utilize some type of flush or spray system to wash out the manure that dairy cows deposit in the milking parlors. The primary purpose of the flush or spray system is to maintain the minimum level of sanitation required in the milking parlors. However, this system also serves as an emission control for reducing VOC and ammonia emissions. The manure deposited in the milking parlor, which is a source of VOC emissions, is removed from the milking parlors many times a day by flushing after each milking. Many of the VOCs emitted from fresh cow manure, such as alcohols (ethanol and methanol) and many Volatile Fatty Acids (VFAs), are highly soluble in water. Therefore, a large percentage of these compounds will dissolve in the flush water and will not be emitted from the milking parlors. The flush water can then carry the manure and the dissolved volatile compounds to an anaerobic treatment lagoon or other manure stabilization process for treatment.

It must be noted that flushing or spraying out the milking parlors before, after, or during each group of cows is milked will only control the VOCs emitted from the manure, it will have little or no effect on enteric emissions produced from the cows' digestive processes. It will be assumed that the control efficiency for VOCs emitted from manure is 75%. Enteric emissions compose approximately 78% of the VOC emissions from the milking parlor and VOC emissions from the manure make up the remaining 22%; therefore the total control for VOCs from the milking parlor = $0.75 \times 0.22 = 16.5\%$.

b. Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate in Step 1.

³ The SCAQMD Rule 1133.2 staff report (page 18) indicates control efficiencies of 80-90% for VOC for existing biofilter composting applications and that a well-designed, well-operated, and well-maintained biofilter is capable of achieving 80 percent control efficiency for VOC, <http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1133/staff-report.pdf?sfvrsn=2>

c. Rank remaining options by control effectiveness

- 1) Milking Parlor Vented to an Incinerator (93% VOC control efficiency)
- 2) Milking Parlor Vented to a Biofilter (76% VOC control efficiency)
- 3) Flush/Spray Milking Parlor Before, After, or During Milking Each Group of Cows (16.5% VOC control efficiency)

d. Cost Effectiveness Analysis

1) Milking Parlor Vented to an Incinerator

The following cost analysis will be performed to determine whether the cost of natural gas alone, not including any capital costs, causes catalytic incineration to exceed the District VOC cost effectiveness threshold. The temperature required for catalytic incineration is 600 °F. The temperature required for thermal incineration is 1,400 °F. Since the fuel requirements and fuel cost for thermal incineration are greater than catalytic incineration, if catalytic incineration is determined not to be cost effective, then it can logically be reasoned that thermal incineration will not be cost effective as well.

Air Flow Rate of Milking Parlor

In order to effectively calculate the costs of this control option, the airflow rate of the milking parlors must be determined. According to Cornell University's publication "Environmental Controls for Today's Milking Center", the minimum ventilation rate required for milking parlors is 15 room exchanges per hour in the winter and 60 to 90 room exchanges per hour in the summer. For calculation purposes, an average airflow rate of 35 room exchanges will assumed for the milking parlor.

The following analysis is based on the cost of emission reductions for 1,000 milk cows. It will assume a conservatively sized milking parlor of 100 ft long by 40 ft wide and a height of 20 feet. The total exhaust airflow rate can be calculated as follows:

$$\begin{aligned}\text{Total exhaust airflow rate} &= 100 \text{ ft} \times 40 \text{ ft} \times 20 \text{ ft} \times 35/\text{hr} \\ &= 2,800,000 \text{ ft}^3/\text{hr}\end{aligned}$$

Fuel Requirement for Thermal Incineration:

The gas leaving the milking parlor is principally air, with a volumetric specific heat of 0.0194 Btu/scf -°F under standard conditions.

$$\text{Natural Gas Requirement} = (\text{flow})(C_{p\text{Air}})(\Delta T)(1-\text{HEF})$$

Where:

Flow (Q) = exhaust flow rate of VOC

CpAir = specific heat of air: 0.0194 Btu/scf

ΔT = increase in the temperature of the contaminated air stream required for catalytic oxidation to occur (It will be assumed that the air stream would increase in temperature from 100 °F to 600 °F.)
HEF = heat exchanger factor: 0.7

$$\begin{aligned}\text{Natural Gas Requirement} &= (2,800,000 \text{ scf/hr})(0.0194 \text{ Btu/scf})(600 \text{ °F} - 100 \text{ °F})(1-0.7) \\ &= 8,148,000 \text{ Btu/hr}\end{aligned}$$

Fuel Cost for Thermal Incineration:

The cost for natural gas shall be based upon the average industrial price in California reported by the Energy Information Administration (EIA), taken from the EIA website at: http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SCA_a.htm.

Average industrial price for natural gas in California for the year 2014
= \$7.73/1,000 scf

$$\begin{aligned}&\$7.73/1,000 \text{ scf} \times 1 \text{ scf}/1,000 \text{ Btu} \times 1,000,000 \text{ Btu/MMBtu} \\ &= \$7.73/\text{MMBtu}\end{aligned}$$

The oxidizer is assumed to operate 16 hours per day (2 shifts) and 365 days per year.

The fuel costs to operate the incinerator are calculated as follows:

$$\begin{aligned}&8,148,000 \text{ Btu/hr} \times 1 \text{ MMBtu}/10^6 \text{ Btu} \times 16 \text{ hr/day} \times 365 \text{ day/year} \times \$7.73/\text{MMBtu} \\ &= \$367,827/\text{year}\end{aligned}$$

VOC Emission Reductions for Thermal Incineration

The annual VOC Emission Reductions for the milking parlor is calculated as follows:
[Number of milk cows] x [Uncontrolled Milking Parlor VOC EF (lb/milk cow-year)] x [Capture Efficiency] x [Thermal Incinerator Control Efficiency]

$$\begin{aligned}&= (7,278 \text{ milk cows}) \times (0.44 \text{ lb-VOC/milk cow-year}) \times (0.95) \times (0.98) \\ &= 2,981 \text{ lb-VOC/year}\end{aligned}$$

Cost of VOC Emission Reductions

$$\begin{aligned}\text{Cost of reductions} &= (\$367,827/\text{year})/[(2,981 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ &= \$246,781/\text{ton of VOC reduced}\end{aligned}$$

As shown above, the natural gas cost alone for thermal or catalytic incineration would cause the cost of the VOC reductions to be greater than the \$17,500/ton cost effectiveness threshold of the District BACT policy. The equipment is therefore not cost effective and is being removed from consideration at this time.

2) Milking Parlor Vented to a Biofilter

The following analysis is based on the cost of emission reductions for confining 7,278 milk cows in a conservatively sized milking parlor of 100 ft long by 40 ft wide and a height of 20 feet, and venting the milking parlor to a biofilter. Costs for larger dairies would be linearly proportional.

Biofiltration can control both VOC and ammonia emissions. Although, this technology can control both pollutants, a cost effectiveness threshold has not been established for ammonia. Therefore, only achieved-in-practice options will be considered for ammonia at this time and a multi-pollutant cost effectiveness analysis for VOC and ammonia will not be performed.

Air Flow Rate of Milking Parlor

In order to effectively calculate the costs of this control option, the airflow rate of the milking parlors must be determined. According to Cornell University's publication "Environmental Controls for Today's Milking Center", the minimum ventilation rate required for milking parlors is 15 room exchanges per hour in the winter and 60 to 90 room exchanges per hour in the summer. For calculation purposes, an average airflow rate of 35 room exchanges will assumed for the milking parlor.

The total exhaust airflow rate can be calculated as follows:

$$\begin{aligned}\text{Total exhaust airflow rate} &= 100 \text{ ft} \times 40 \text{ ft} \times 20 \text{ ft} \times 35/\text{hr} \times 1/60 \text{ min} \\ &= 46,667 \text{ cfm}\end{aligned}$$

Cost of Biofiltration

The table below summarizes the cost information for biofilters found in literature. The references follow the table.

Biofilter Costs from Literature					
Article Number	Year published	Capital Cost Range (\$/cfm)	Adj 2010 Capital Cost (\$/cfm)	Operating Cost Range (\$/cfm/yr)	Adj 2010 Operating Cost (\$/yr)
1	2003	\$2.35 - \$7.74 biofilter	\$6.67	\$3.31 biofilter	\$4.07
2	2003	\$20.20 - 30.30 biotrickling filter	\$33.34	\$6.35 biotrickling filter	\$7.81
3	1991	\$12.79 - \$20.93 open biofilter	\$22.43 - \$36.70		
4	1991	\$20.93 - \$116.28 enclosed biofilter	\$36.70 - \$203.90		
5	1998	-	-	\$2 - \$14	\$2.85 - \$19.96
6	2008	\$15	\$15.91	\$2	\$2.12
7	2005	\$16.99 - \$118.93	\$19.70 - \$137.87	\$5.10 - \$16.99	\$5.91 - \$19.70
8	1996	\$2.50 - \$5.00	\$3.07 - \$6.15	\$2 - \$14	\$2.46 - \$17.22
9	1999	\$13.30 - \$18	\$18.401 - \$24.92	\$3.33 - \$6.67	\$4.61 - \$9.23
10	2002	\$2.79	\$3.53	10% of capital cost	
11	2004	\$0.15 - \$0.25	\$0.25 - \$0.35	\$0.005 - \$ 0.015	\$0.006 - \$0.018

The articles referenced in the previous table are cited below:

1 & 2. U.S. Environmental Protection Agency, The Clean Air Technology Center (CATC), "Using Bioreactors to Control Air Pollution" EPA-456/R-03-003, (E143-03), September 2003, <http://www.epa.gov/ttn/catc/dir1/fbiorect.pdf>

3.U.S. Environmental Protection Agency, "Emissions from Animal Feeding Operations" (Draft), EPA Contract No. 68-D6-0011, August 15, 2001, Section 9.2.3 - Biofiltration of Confinement Housing Exhaust, <http://www.epa.gov/ttn/chief/ap42/ch09/draft/draftanimalfeed.pdf>

4.Leson, G. and A.M. Winer. 1991. "Biofiltration: An Innovative Air Pollution Control Technology for VOC Emissions". Journal of the Air and Waste Management Association. 41(8):1045-54.)

5.Operating Cost Estimate for a Biofilter (1998): \$2-14/cfm (from Boyette, R. A. 1998. "Getting Down to (Biofilter) Basics". *Biocycle* 39(5):58-62)

6.Bohn, Hinrich, "Biofilter Technology Offers Emissions Abatement Option", *Distillers Grain Quarterly*, 3rd Qtr 2008, http://www.ethanolproducer.com/dgq/article-print.jsp?article_id=1257

7.Delhoménie, Marie-Caroline; Heitz, Michèle, "Biofiltration of Air: A Review", *Critical Reviews in Biotechnology*, 1549-7801, Volume 25, Issue 1, 2005, Pages 53 – 72

8. Boyette, R. Allen – E&A Environmental Consultants Inc., “Biofilter Economics and Performance”, 1996, <http://www.p2pays.org/ref/12/11505.pdf>

9. Govind, Rakesh – PRD Tech Inc., White Paper - “Biofiltration: An Innovative Technology for the Future”, 1999, <http://www.prdtechinc.com/PDF/PRDBIOFILTERR&DMAGAZINEPAPER.pdf>

10. South Coast Air Quality Management District, “Technology Assessment for: Proposed Rule 1133: Emission Reductions from Composting and Related Operations”, March 22, 2002, http://www.aqmd.gov/rules/doc/r1133/r1133_techassessment.pdf

11. Schmidt, David. Janni, Kevin. Nicolai, Richard. “Biofilter Design Information”. Biosystems and Agricultural Engineering Update: BAEU-18, Revised March 2004. University of Minnesota Department of Biosystems and Agricultural Engineering, College of Agricultural, Food and Environmental Sciences, <http://www.manure.umn.edu/assets/baeu18.pdf>

Note: The capital cost estimate obtained from article number 11 was ten times lower than the low-end of the cost estimates given in other sources listed above and the estimates from biofilter suppliers presented below and the operating cost estimate from this source was more than 100 times lower than the lowest the cost estimates given in the other sources listed above. Because of this significant difference in costs, the design of this biofilter was evaluated to determine if it would meet District and EPA standards for an add-on VOC control device. This preliminary evaluation is discussed below.

Reference #11 describes a biofilter designed to reduce odors not total VOCs. The document recommends that an open-bed biofilter used to control exhaust from animal housing have a depth of 10-18 inches and an empty bed contact time of 3-5 seconds. For an open-bed biofilter used for VOC control, the recommended depth and contact time are generally 3-5 feet and 30-60 seconds, respectively. The lower recommended depth is the result of limitations with typical exhaust fans used for ventilation in animal housing, which are not designed for the larger pressure drops that would be caused by a deeper biofilter bed. It is likely that the much smaller recommended contact time is related to the fact that the biofilter is only designed to reduce odors. Many odorous compounds are branched-chain volatile fatty acids (VFAs) that consist of large molecules with a strong tendency to adhere to any surfaces that they contact; thus shortening the contact time required to treat these compounds. Although VFAs are largely responsible for objectionable odors from agricultural facilities, recent studies have shown that alcohols comprise the majority of VOC emissions. The biofilter design recommended in the document would not be as effective for reducing alcohols or other VOCs which are more volatile and do not have a strong tendency to adhere to surfaces. The biofilter does not appear to be designed to handle the total flow rates from the animal housing but is probably intended to handle smaller flow rates from high-odor areas such as manure pits. Another limitation with the design is that there is no dedicated outlet to allow measurement and determination of control efficiency;

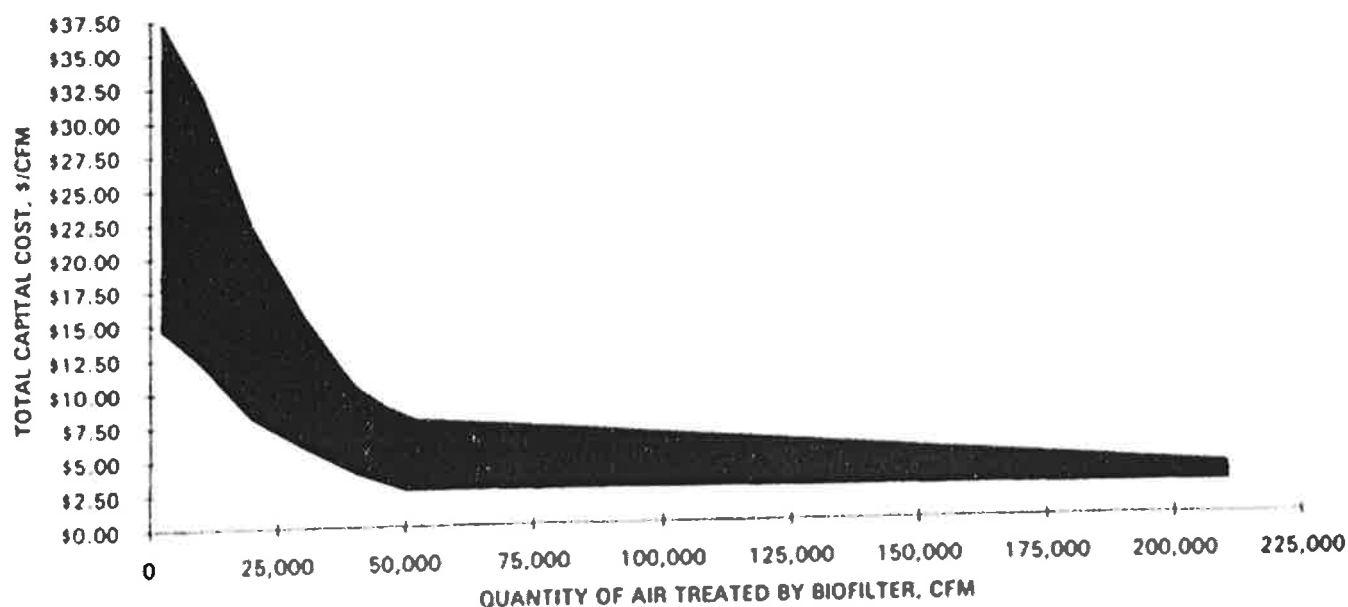
thus there isn't any way to accurately assess if the biofilter is functioning properly. Because of the substantial deviation from established criteria for the design of biofilters for control of VOCs and the lack of information to support and quantify total VOC reductions from this particular design, the cost estimates associated with this design will be removed from further consideration. This design may be re-evaluated at a later time if the necessary information is provided or becomes available.

Reduced Capital Cost from Economy of Scale

The potential for reduced dollar-per-cfm capital costs was considered based on the large airflow rates that would be handled by biofilters for confined animal facilities. Based on the information reviewed, it was determined that there is not any additional cost reduction benefit related to economy of scale for biofilters handling such large flow rates.

The information available indicates significant reductions in biofilter costs per cfm as the flow rate treated increases to a few thousand cfm but diminishing reductions in cost after this until there is no further benefit. This is illustrated in the graph below. The graph shows no additional cost reductions benefits after approximately 50,000 cfm. Also, in a phone conversation with Jim Cash of MEGTEC Systems, Inc. he stated that economy of scale cost reductions for biofilter systems were insignificant after approximately 20,000 cfm. This was because multiple individual units are generally required to treat flows greater than this and each unit would still cost about the same. Additionally, single units, and sometimes even multiple units, handling such large flow rates would not be pre-fabricated but would have to be specially constructed on site, which can increase costs. This was also supported by the information provided by other biofilter suppliers. Therefore, any potential cost reduction benefits related to economy of scale have already been captured in the lower biofilter cost estimates given above and no additional cost benefits will be realized at higher flow rates. As a result, the cost estimates for biofilters will be directly proportional to the airflow rate treated and the number of animals housed.

FIGURE 1 BIOFILTER CAPITAL COST PER CFM OF AIR TREATED



Boyette, R. Allen – E&A Environmental Consultants Inc., "Biofilter Economics and Performance", 1996

Cost Estimate for Biofilters for this Analysis

For purposes of this analysis, the following biofilter cost estimate will be used. The cost estimate is conservative and significantly lower than many of the capital cost estimates given in the references listed above.

Capital Cost (2010): \$3.00/cfm

Capital Cost

The cost estimate for the biofilter includes the costs of the fans, media, plenum, engineering, and labor but does not include installation of the required ductwork. As stated above, a conservative capital cost of \$3.00 per cfm will be assumed in this cost analysis.

Based on the required airflow previously determined, the capital cost of the biofilter is calculated as follows:

$$\text{\$3.00 cfm} \times 46,667 \text{ cfm} = \text{\$140,001}$$

Pursuant to District Policy APR 1305, section X (11/09/99), the cost for the purchase of the biofilter will be spread over the expected life of the system using the capital recovery equation. The biofilter media (e.g., soil, compost, wood chips) must be replaced after 3-5 years in order to remain effective. This is an additional cost that is not being considered in this cost analysis. Therefore, the expected life of the entire

system (fans, media, plenum, etc) will be estimated at 10 years. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times i(1+i)^n]/[(1+i)^n - 1]$$

Where: A = Annual Cost

P = Present Value

I = Interest Rate (10%)

N = Equipment Life (10 years)

$$\begin{aligned} A &= [\$140,001 \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] \\ &= \$22,785/\text{year} \end{aligned}$$

VOC Emission Reductions for Biofiltration

The annual VOC Emission Reductions for the milking parlor is calculated as follows:

$$\begin{aligned} &[\text{Number of milk cows}] \times [\text{Uncontrolled Milking Parlor VOC EF (lb/milk cow-year)}] \times \\ &[\text{Capture Efficiency}] \times [\text{Biofilter Control Efficiency}] \end{aligned}$$

$$\begin{aligned} &= (7,278 \text{ milk cows}) \times (0.44 \text{ lb-VOC/milk cow-year}) \times (0.95) \times (0.80) \\ &= 2,434 \text{ lb-VOC/year} \end{aligned}$$

Cost of VOC Emission Reductions

$$\begin{aligned} \text{Cost of reductions} &= (\$22,785/\text{year})/[(2,434 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ &= \$302,241/\text{ton of VOC reduced} \end{aligned}$$

As shown above, the capital cost alone for a biofilter would cause the cost of the VOC reductions to be greater than the \$17,500/ton cost effectiveness threshold of the District BACT policy. Therefore, this option is not cost effective and is being removed from consideration at this time.

3) Flush/Spray Milking Parlor Before, After, or During Milking Each Group of Cows

The technology/practice is currently used at all dairies and is therefore cost effective.

e. Select BACT

Since the higher-ranked options are not cost effective, the remaining Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is flush/spray milking parlor before, after, or during milking each group of cows.

Top-Down BACT Analysis for Dairy Freestall Barns

1. BACT Analysis for VOC Emissions from Dairy Freestall and Saudi-Style Barns:

a. Step 1 - Identify all control technologies

Since specific VOC emissions control efficiencies have not been identified in the literature for dairy cow housing areas, the control efficiencies will be estimated based on the control efficiencies of similar processes and engineering judgment. Unless specifically noted, for practices required to reduce VOC emissions, a 10% control efficiency will be assumed for the specific portion of the emission source or process affected by the measure.

The following options were identified as possible controls for VOC emissions from the cow housing (cow housing permit unit):

- 1) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (e.g. incinerator, biofilter, e.g) ($\approx 64\text{--}72\%$; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)
- 2) Feed and Manure Management Practices
 - Concrete feed lanes and walkways
 - Frequent Cleaning of lanes and walkways
 - a) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - b) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - c) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - d) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day;
 - All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
 - Exercise pens properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
 - Scraping of exercise pens every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
 - VOC mitigation measures required by District Rule 4570

Description of Control Technologies

1) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device

Description of Dairy Housing

In a freestall or Saudi-style barn, cows are grouped in large pens with free access to feed bunks, water, and stalls for resting. In the mild climate of the San Joaquin Valley, the typical freestall or Saudi-style barn is an open structure (roof but no sides). The primary freestall or Saudi-style barn design consists of a roof that provides shade with all sides open to allow air to flow through, which keeps the cows cool. The open barns take advantage of natural summer winds in the San Joaquin Valley that are generally greater than four mph. The natural winds result in an excellent summer ventilation rate that is equivalent to 1,000 cfm per cow, which is why open dairy barns are generally recommended in the San Joaquin Valley. In colder climates enclosed or partially enclosed barns may be utilized to protect cows from winter extremes. However, no completely enclosed freestall or Saudi-style barn that were installed at a California dairy were identified.

Although the potential to enclose cows in a barn may exist, the feasibility of reasonably collecting the gas through a stack, chimney, or vent remains in question considering the extremely large amounts of airflow going through the barns needed to keep the cows cool. The airflow requirements would be even higher in the San Joaquin valley, where temperatures can exceed 110° F in the hot summer. If the barn exhaust can be properly captured it may be possible to vent it to a VOC control device. It is estimated that up to 80% of the gases emitted from enclosed freestall barns can be captured by the mechanical ventilation system and sent to a control device, such as an incinerator or biofilter.

Thermal incineration is a well-established VOC control technique. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. In addition to the difficulty of capturing all of the gases in a freestall or Saudi-style barn, a disadvantage of thermal incineration is that when concentrations of combustible VOCs in the gas stream are very low, very large amounts of supplemental fuel must be used to sufficiently increase the temperature of all of the ventilation air in order to incinerate these VOCs. This generally renders incineration cost prohibitive for large flows of dilute VOCs, such as in the ventilation air from a freestall or Saudi-style barn. Because of this, biofilters have generally been found to be more cost-effective for handling dilute streams of biodegradable VOCs. A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. Additional information on biofiltration is given below in the analysis for enclosed freestall or Saudi-style barns vented to a control device. One of the disadvantages related to the use of a biofilter to control emissions from enclosed livestock barns is the large space requirement for the traditional biofilter design. To illustrate this, a low-cost natural bed biofilter designed to treat the VOC emissions from 1,000 milk cows and 180 dry cows with no

support stock would cover more than 5.4 acres and would need to be maintained free of pests and approved by the appropriate permitting agencies. To avoid such expansive land requirements, the dairy would likely need to use much more expensive bio-trickling filters or bio-scrubbers.

Although many questions remain about the feasibility of requiring animals to be confined in buildings and capturing the exhaust gas and venting it to a control device, it will be considered for purposes of this analysis.

2) Feed and Manure Management Practices

Concrete Feed Lanes and Walkways

Dairy animals spend a large amount of time on the feed lanes and walkways. Constructing these areas of concrete will reduce particulate matter emissions by having the animals spend more time on a paved surface rather than dry dirt. The concrete lanes and walkways create an avenue for the flush or scrape manure removal systems. The flush system will further reduce particulate matter emissions and will also reduce VOC and ammonia emissions (see below). Although concrete feed lanes and walkways are necessary for an effective manure removal system, they do not individually reduce emissions of gaseous pollutants; therefore, no VOC control efficiency is assigned for this practice.

Frequent Cleaning of Lanes and Walkways

Many dairy operations use flush or scrape systems to remove manure from the freestall or Saudi-style barn lanes and walkways. When dairies use a flush system, a large volume of water is introduced at the head of the paved area of the freestall or Saudi-style barn, and the cascading water removes the manure. The required volume of flush water varies with the size and slope of the area to be flushed. When dairies use a scrape system for manure management, manure is typically scraped from the cow housing lanes using a tractor or skid steer with a scraping attachment, or using an automatic mechanical scraper. The automatic scraper usually consists of a hinged v-shaped scraper driven by a cable or chain. The mechanical scraper is periodically dragged forward to draw manure to the end of a lane. After completing a pass, the chain or cable reverses direction and pulls the scraper back in the opposite direction. The scraped manure is either temporarily stored in a pile where liquids are allowed to drain off, or loaded onto a truck or tractor for transport or land application. A smaller number of dairies may also use vacuum trucks to remove manure from the cow housing areas. Manure vacuumed from the lanes can be applied to adjacent cropland, transported offsite, or placed in a digester. The freestall or Saudi-style barn lanes for milk and dry cows are typically flushed or scraped twice per day, but the cleaning frequency can vary between one to four times per day. The lanes for support stock are usually flushed or scraped once per day or less frequently.

In addition to cleaning the lanes and walkways, the flush, scrape, and vacuum systems also serve as an emission control for reducing VOC emissions. The manure deposited in the lanes, which is a source of VOC emissions, is removed from the cow housing area by the flush, scrape, or vacuum system. Flush systems also reduce PM₁₀ and ammonia emissions. Additionally, many of the VOCs emitted from fresh cow manure, such as

alcohols (ethanol and methanol) and many Volatile Fatty Acids (VFAs), are highly soluble in water. Therefore, when a flush system is used, a large percentage of these compounds will dissolve in the flush water and will not be emitted from the cow housing permit unit. The flush water can then carry the manure and the dissolved volatile compounds to an anaerobic treatment lagoon or other manure stabilization process for treatment.

It must be noted that the system for cleaning the lanes and walkways will only control the VOCs emitted from the manure it will have little or no effect on enteric emissions produced from the cows' digestive processes. As stated above, the lanes and walkways in the cow housing areas are typically cleaned twice per day. Cleaning the lanes four times per day will increase the frequency that manure is removed from the cow housing permit unit. Although the control efficiency for VOCs may actually be much higher, increasing the cleaning frequency of the lanes will be conservatively assumed to have a control efficiency of 10% for VOCs emitted from manure until better data becomes available.

Animals Fed in Accordance with (NRC) or other District-Approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for VOC emissions can be reduced by reducing the quantity of undigested nutrients in the manure. Many of the VOCs emitted from Confined Animal Facilities, including dairies, originate from the decomposition of undigested protein in animal waste.⁴ This undigested protein also produces ammonia and hydrogen sulfide emissions. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of VOCs, ammonia, and hydrogen sulfide.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure.

Based on very limited data (Klaunser, 1998, *J Prod Agric*), diet manipulation decreased nitrogen excretion by 34% while improving milk production. Up to 70% of excess nitrogen is lost off of the farm through volatilization, denitrification and leaching. Because of limited research, feeding dairy animals in accordance with National Research Council (NRC) or other District-approved guidelines will be assumed to have a conservative control efficiency of only 5-10% for both enteric VOC emissions from dairy animals and VOC emissions from manure.

Scraping of Exercise Pens and Open Corrals with a Pull-Type Scraper

Many dairies use equipment pulled by tractors to periodically scrape the surfaces of corrals. Frequent scraping the freestall exercise pens and corrals will reduce the amount

⁴ "Emissions of Volatile Organic Compounds Originating from UK Livestock Agriculture", Hobbs, P.J. 2004 – Journal of the Science of Food and Agriculture

of manure on the corral surfaces, which will reduce VOC and ammonia emissions resulting from decomposition of this manure. This practice will also provide a uniform surface, reducing anaerobic conditions on the corral surface, which will reduce gaseous pollutants from this area. The frequency that corrals are scraped at dairies can vary from as little as once a year to every week.

Increasing the frequency that corrals are scraped is expected to reduce emissions of gaseous pollutants from the corral surface and PM that results from the cattle hooves acting on the surface of the corrals; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the corral surface.

b. Step 2 - Eliminate Options

There are no technologically infeasible options to eliminate from step 1. However, the following options will be eliminated from consideration because the emissions from increased use of tractors are expected to offset the benefits of any VOC reductions from these practices.

- a) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day;
- b) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day

c. Step 3 - Rank remaining options by control effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

- 1) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (e.g. incinerator, biofilter, e.g) ($\approx 64\text{--}72\%$; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)
- 2) Feed and Manure Management Practices
 - Concrete feed lanes and walkways
 - Frequent cleaning of lanes and walkways
Flushing is generally the most effective method of using frequent cleaning of the lanes to reduce emissions; however, because some dairies may be unable to flush at increased frequencies because of water constraints, use of automatic scraping system will be allowed when dairies demonstrate that they are unable to flush at increased frequencies.
 - a) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - b) For dairies that are not able to use a flush system, Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic

scraper (or equivalent). Lanes and walkways for support stock (heifers) cleaned at least once per day

- All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
- Exercise pens properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
- Scraping of exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions
- VOC mitigation measures required by District Rule 4570

d. Step 4 - Cost Effectiveness Analysis

Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (Biofilter)

The analysis below is based on the Analysis for Confining Livestock in Enclosed Buildings and Venting Emissions to a Control Device contained in the District document Final Staff Report – Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities), Appendix E – Analysis of Class Two Mitigation Measures for Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010. Additional details regarding the cost analysis can be found in the referenced report for the amendments to District Rule 4570.

This analysis does not quantify all of the costs or examine all of the potential issues that make requiring this option infeasible but it is intended to more accurately reflect the actual costs to implement this measure. The use of a biofilter as a control device for VOCs is expected to result in much lower costs than other control options, such as incineration. The U.S. Environmental Protection Agency (US EPA), Clean Air Technology Center (CATC) document "Using Bioreactors to Control Air Pollution" states, "*The capital cost of a bioreaction installation is usually just a fraction of the cost of a traditional control device installation. Operating costs are usually considerably less than the costs of traditional technology, too.*"⁵ Therefore, this analysis will evaluate the use of a biofilter to determine the minimum cost of the emission reductions that would be achieved by venting enclosed animal housing to a control device.

The following analysis is based on the cost of emission reductions for confining 1,000 milk cows in enclosed freestall buildings vented to a biofilter and venting the milking parlor to the same biofilter. Costs for larger dairies would be proportional.

Description of Control Technology

A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by

⁵ U.S. Environmental Protection Agency, The Clean Air Technology Center (CATC), "Using Bioreactors to Control Air Pollution" EPA-456/R-03-003, (E143-03), September 2003, <http://www.epa.gov/ttn/catc/dir1/fbioreact.pdf>

biological oxidation. During biofiltration, exhaust air containing pollutants passes through a media that contains an established, diverse population of aerobic microorganisms. These microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. The bacterial cultures (microorganisms that typically consist of several species coexisting in a colony) that use oxygen to biodegrade organics are called aerobic cultures. These aerobic cultures are usually supported by organic material contained in the biofilter, such as compost, wood chips, soil, peat, etc. Biofilters must maintain sufficient porosity to allow the contaminated air stream to pass through for treatment and to minimize anaerobic conditions. The moisture content of biofilter beds must also be regulated to ensure that there is sufficient moisture to maintain the microorganisms needed for treatment while avoiding excess moisture that can cause anaerobic conditions. A filtration system may be required upstream of a biofilter to remove particular matter which will clog the biofilter over time. Biofilters must be maintained free of rodents and weeds to avoid channeling of gases through the filter media and a loss of performance. The filter media of natural biofilters needs to be replaced periodically because of deterioration and loss of porosity.

Since biofilters rely on living organisms to function, a biofilter's performance will be affected by several factors, including: ambient temperature; temperature of the air stream being treated; the pollutant concentrations in the air stream; moisture content of the filter and air stream, and pH of the filter media. These parameters should be monitored to ensure optimum operating conditions for the biofilter.

Advantages and Disadvantages of Using a Biofilter to Control Emissions

Some of the general advantages related to the use of biofilters include: low installation costs for traditional biofilter designs; generally low operating costs in comparison to other control technologies; high control efficiencies for some compounds such as aldehydes, organic acids, hydrogen sulfide, and certain water-soluble organic compounds.

Some of the general disadvantages of the use of biofilters include: large land requirements for traditional biofilter designs; difficulty in determining the control efficiency for traditional open biofilter designs; for biofilters that use inexpensive natural bed media, the filter bed media must be replaced every 2 to 5 years; biofilters usually require some time to reach optimum control efficiency after initial startup and after periods of nonuse because of the need to establish or re-establish the microbial population; and biofilters can also be a source of nitrous oxide emissions due to denitrification.

Additional disadvantages specifically related to the use of biofilters to control emissions from livestock include: facilities that currently use natural ventilation would incur additional costs because of the need to convert to mechanical ventilation; facilities that currently use mechanical ventilation systems may need to upgrade these systems to overcome the increased pressure drop across the biofiltration system; greater energy usage for all facilities to push air through the biofilter; few reported cases where a biofilter has been shown to be economically viable when applied to animal feeding operations⁶; a very large

⁶ U.S. Environmental Protection Agency, "Emissions from Animal Feeding Operations" (Draft), EPA Contract No. 68-D6-0011, August 15, 2001, pg. 9-20, <http://www.epa.gov/ttn/chief/ap42/ch09/draft/draftanimalfeed.pdf>

biofilter system must be used to handle these huge flow rates while maintaining adequate contact time for treatment of emissions. Finally, because of the extremely large airflow rates needed to provide adequate ventilation for livestock it is not practical to treat all of the ventilation air from large confined animal housing units.

Biofilter VOC Control Efficiency

It is assumed that 80% of the gasses emitted from the enclosed animal housing will be captured by the mechanical ventilation system and that a properly functioning biofilter will eliminate 85% of the captured VOC emissions⁷; therefore, the total control for VOCs from the enclosed animal housing = $0.80 \times 0.85 = 68\%$.

Cost Estimates for Enclosed Freestall and Saudi-Style Barns for this Analysis

Based on the information contained in the District Staff Report for the Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010, the following cost estimates for enclosed freestall barns will be used in this analysis.

Capital Cost for Enclosed Freestall and Saudi-Style Barn (2010): \$1,700-2,700/cow

Estimated Adjusted Capital Cost: \$1,275-2,025/cow (capital cost estimate was reduced by 25% because it may be possible to use the existing concrete work and some of the existing freestall infrastructure with the new building shell)

Capital cost estimate: **\$1,275-2,025/cow**

Increased Operating Costs⁸: **\$74-98/cow more**

Capital Cost for Freestall and Saudi-Style Barn Enclosure for 7,278 Holstein Milk Cows

Low capital cost estimate: $\$1,275/\text{cow} \times 7,278 \text{ cows} = \$9,279,450$

High capital cost estimate: $\$2,025/\text{cow} \times 7,278 \text{ cows} = \$14,737,950$

Increased Operating Costs for Enclosed Freestall and Saudi-Style Barn for 7,278 Holstein Milk Cows

Low operating cost estimate: $\$74/\text{cow-yr} \times 7,278 \text{ cows} = \$538,572/\text{yr}$

High operating cost estimate: $\$98/\text{cow-yr} \times 7,278 \text{ cows} = \$713,244/\text{yr}$

⁷ The SCAQMD Rule 1133.2 staff report (page 18) indicates control efficiencies of 80-90% for VOC for existing biofilter composting applications and that a well-designed, well-operated, and well-maintained biofilter is capable of achieving 80 percent control efficiency for VOC, <http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1133/staff-report.pdf?sfvrsn=2>

⁸ Increased operating costs were based on information from following document, adjusted to 2010 dollars assuming 3% annual inflation: Dhuyvetter, Kevin C., Harner, Joe P., Smith, John F., & Bradford, Barry J., Kansas State University Department of Agricultural Economics, "Economic Considerations of Low-Profile Cross-Ventilated Freestall Barns", Presented at Dairy Housing of the Future, Sioux Falls, South Dakota. September 10-11, 2008, [http://www.agmanager.info/Faculty/dhuyvetter/presentations/2008/LPCV%20Conference\(Sep2008\).pdf](http://www.agmanager.info/Faculty/dhuyvetter/presentations/2008/LPCV%20Conference(Sep2008).pdf)

Cost Estimate for Biofilters

Several reference documents were consulted to determine the expected capital and operating costs of using a biofilter to control VOC emissions from enclosed animal housing for evaluation of the Class Two Mitigation Measures contained in the District Staff Report for the Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010. Several companies that specialize in building and supplying biofilters and bio-scrubbers for the control of VOC emissions were also contacted to request capital cost estimates for biofilter systems specifically for the treatment of VOC emissions from dairy cows housed in enclosed barns. The resulting cost estimates from the District staff report are summarized below. Based on the information reviewed, it was also determined that there would not be any additional cost reduction benefit related to economy of scale for biofilters handling the large flow rates from freestall barns. For purposes of this analysis, the following biofilter cost estimates will be used.

Capital Cost (2010): **\$3-35/cfm**

Operating Costs (2010): **\$2.12-20/cfm**

The cost is largely dependent on the airflow rate that the biofilter must handle. Biofilters used to treat exhaust air should be sized to treat the maximum ventilation rate, which is typically the warm weather rate. The higher cost estimate is representative of a biotrickling filter, which may be necessary to handle the high air flow rates from the barns.

Required Airflow Rate of the Freestall and Saudi-Style Barns

In order to calculate the costs of this control option, the airflow rate required for the freestall and Saudi-style barns must be determined. The University of Minnesota's publication "Improving Mechanical Ventilation in Dairy Barns"⁹, gives minimum ventilation rates for dairy cattle, which are listed in the table below.

Minimum Ventilation Rates for Dairy Cows (cfm/cow)			
Age	Winter	Mild Weather	Summer
Baby Calf (0-2 months)	15	50	100
Heifer (2-12 months)	20	60	130
Heifer (12-24 months)	30	80	180
Mature Cow	50	170	500 – 1,000

The minimum summer ventilation rate listed for mature cows is 500 cfm per cow. However, according to the University of Minnesota publication and Cornell University's publication "Natural or Tunnel Ventilation of Freestall Structures: What is Right for Your Dairy Facility?"¹⁰, the minimum required airflow rate in the summer increases to 1,000 cfm per cow if tunnel ventilation is used to provide additional cooling.

⁹ "Improving Mechanical Ventilation in Dairy Barns", J.P. Chastain, http://www.milkproduction.com/Library/Articles/Improving_mechanical_ventilation.htm

¹⁰ Natural or Tunnel Ventilation of Freestall Structures: What is Right for Your Dairy Facility?, C.A. Gooch, <http://www.ansci.cornell.edu/pdfs/nattunnel.pdf>

The climate in the San Joaquin Valley is characterized by mild winters and hot summers. Because of the warmer climate, it is expected that tunnel ventilation or a similar system would need to be employed in an enclosed freestall or Saudi-style barn to prevent excessive heat stress. Additionally, tunnel ventilation systems are more representative of the types of systems that would be required to capture and control emissions.

Minimum Summer Air Requirements for Freestall and Saudi-Style Barns Vented to a Biofilter for 7,278 Holstein Milk Cows

The minimum required summer airflow rate for housing 7,278 milk cows is calculated below:

Low Summer Ventilation Rate: 7,278 milk cows x 500 cfm/cow = 3,639,000 cfm

High Summer Ventilation Rate: 7,278 milk cows x 1,000 cfm/cow = 7,278,000 cfm

Capital Cost of a Biofilter for 7,278 Holstein Milk Cows

The lower cost estimate does not include installation of the required ductwork. As stated above, the estimated capital costs for a biofilter range of between \$3.00 per cfm and \$35.00 per cfm. The capital cost estimates of a biofilter for enclosed freestall or Saudi-style barns housing 7,278 milk cows:

Low capital cost estimate: \$3.00/cfm x 3,639,000 cfm = \$10,917,000

High capital cost estimate: \$35.00/cfm x 7,278,000 cfm = \$254,730,000

Operating Costs for a Biofilter for 7,278 Holstein Milk Cows

Low operating cost estimate: \$2.12/cfm-yr x 3,639,000 cfm = \$7,714,680/yr

High operating cost estimate: \$20.00/cfm-yr x 7,278,000 cfm = \$145,560,000/yr

Annualized Capital Costs for Biofilter for 7,278 Holstein Milk Cows

Pursuant to District Policy APR 1305, section X (11/09/99), the cost for the purchase of the biofilter will be spread over the expected life of the system using the capital recovery equation. The expected life of the entire system (fans, media, plenum, etc) will be estimated at 10 years. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times I(I+1)^N]/[(I+1)^N - 1]$$

Where: A = Annual Cost

P = Present Value (freestall enclosure and biofilter)

I = Interest Rate (10%)

N = Equipment Life (10 years)

Low Annualized Capital Cost Estimate =

$$[(\$10,917,000 + \$7,714,680) \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] = \$3,036,964/\text{year}$$

High Annualized Capital Cost Estimate =

$$[(\$254,730,000 + \$145,560,000) \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] = \$65,247,270/\text{year}$$

Total Annual Cost Estimates

The total annualized capital costs and operating costs for a freestall or Saudi-style enclosure vented to a biofilter are given below. For the least expensive biofilters, the biofilter media (e.g., soil, compost, wood chips) must be replaced after 3-5 years in order to remain effective. This may be an additional cost because it may not have been included in the least expensive operating cost estimates provided above.

Total annual cost estimate = (total annualized capital cost) + (increased operating cost for an enclosed freestall barn) + (biofilter operating cost)

Low total annual cost estimate = (\$538,572/yr) + (\$10,917,000/yr) + (\$7,714,680/yr)
= \$19,170,252/year

High total annual cost estimate = (\$713,244/yr) + (\$254,730,000/yr) + (\$145,560,000/yr)
= \$401,003,244/year

Potential Income from Increased Milk Production

Cooling milk cows in enclosed freestall or Saudi-style barns may reduce heat stress and result in increased milk production. Because dairy cows in California already have some of the highest milk production rates in the nation, it is questionable regarding whether enclosing the milk cows will result in any significant increases in milk production. This is because heat stress is related to both temperature and humidity and it is likely that the increased temperatures in California relative to other states are mitigated by the much lower humidity. Although questions remain about the potential to increase milk production in the San Joaquin Valley by reducing heat stress, this potential benefit will be quantified for this analysis.

Potential Increased Daily Milk Production: 4-6 lb/cow-day (District 4570 Staff Report, June 2006)

Potential Increased Annual Milk Production: 1,460-2,190 lb/cow-yr
Average Base Pool Price of milk in 2014¹¹: \$20.95/cwt
Income from increased milk production: \$305.87-458.81/cow-yr

Max Income from increased milk production for 7,278 milk cows:
7,278 milk cows x \$458.81/cow-yr = \$3,339,219/yr

Low total annual cost estimate – income from increased milk production =
(\$19,170,252/yr) - (\$3,339,219/yr) = \$15,831,033/year

VOC Emission Reductions for 7,278 Holstein Milk Cows

The annual VOC Emission reductions for enclosed freestall or Saudi-style barns for 7,278 milk cows vented to a biofilter are calculated as follows:

VOC Emissions from Cows (Enteric) and Manure:

¹¹http://www.cdfa.ca.gov/dairy/prices_main.html; Base Pool Price of milk price was used for this analysis because dairy industry representatives state that increased production is purchased at a lower price. Additionally, sufficient increased production will cause the price to fall

[Number of cows] x [Uncontrolled Cow Housing VOC EF (lb/cow-year)] x [Capture Efficiency] x [Biofilter Control Efficiency]

VOC Reductions from Holstein Cows Housed in Enclosed Freestall or Saudi-Style Barns Vented to a Biofilter (Cows, Stalls, & Lanes)									
Type of Cow	# of cows	x	Housing EF* (lb/cow-yr)	x	Capture (%)	x	Control (%)	=	lb-VOC/yr
Milk Cow (enteric)*	7,278	x	4.1	x	80%	x	85%	=	20,291
Stalls and Lanes	7,278	x	1.8	x	80%	x	85%	=	8,908
Milking Parlor Floor	7,278	x	0.03	x	80%	x	85%	=	148
Total (lb-VOC/yr)									29,347

*Includes emissions in the milk parlor(s)

VOC Emissions from TMR:

[Number of cows] x [Area of TMR (ft²/cow)] x [Uncontrolled TMR Flux Rate (lb-VOC/ft²-day)] x [365/day/year] x [Capture Efficiency] x [Biofilter Control Efficiency]

VOC Reductions from TMR (Feed) for Cows Housed in Enclosed Freestall or Saudi-Style Barns Vented to a Biofilter													
Type of Cow	# of cows	X	TMR Area* (ft ² /cow)	x	TMR Flux (lb/ft ² -day)	x	365 day/yr	x	Capture (%)	x	Control (%)	=	lb-VOC/yr
Milk Cow	7,278	X	7.08	x	3.85E-03	x	365	x	80%	x	85%	=	49,239

Total VOC Emission Reductions from Milk Parlor, Cow Housing, and TMR =
29,347 lb-VOC/yr + 49,239 lb-VOC/yr = 78,586 lb-VOC/yr

Cost of VOC Emission Reductions

Low Estimate¹² = (\$19,170,252/year)/[(78,586 lb-VOC/year)(1 ton/2000 lb)]
= **\$487,880/ton of VOC reduced**

High Estimate = (\$401,003,244/year)/[(78,586 lb-VOC/year)(1 ton/2000 lb)]
= **\$10,205,0463/ton of VOC reduced**

As shown above, the costs for a freestall enclosure and biofilter would cause the cost of the VOC reductions to be at least \$487,880/ton. There are additional costs related to increased electricity use, and regulatory compliance and testing that have not been quantified in this analysis. Even without these costs, it is clear that the cost of the VOC emission reductions achieved would be far greater than the \$17,500/ton-VOC cost effectiveness threshold of the District BACT policy. The equipment is therefore not cost effective and is being removed from consideration at this time.

Feed and Manure Management Practices:

- Concrete feed lanes and walkways
- Lanes and walkways for mature cows (milk and dry cows) flushed four times per day and lanes and walkways for support stock (heifers) flushed at least once per day; or

¹² Includes reduction in overall annual costs because of potential additional revenue from maximum supposed increase in milk production.

for dairies that are not able to use a flush system, lanes and walkways for mature cows scraped four times per day with an automatic scraper (or equivalent) and lanes and walkways for support stock (heifers) cleaned at least once per day

- All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
- Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
- Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions
- VOC mitigation measures required by District Rule 4570

e. Step 5 - Select BACT

BACT for VOC from Dairy Freestall and Saudi-Style Barns is:

- 1) Concrete feed lanes and walkways;
- 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
- 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
- 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and
- 5) Scraping corrals and exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Additionally, District Rule 2201 defines BACT as including the most stringent emission limitation or control technique, including process and equipment changes, that have been found by the APCO to be cost effective and technologically feasible for such class or category of sources or for a specific source. The District has found that the basic mitigation measures required by District Rule 4570 are cost effective and technologically feasible for confined animal facilities and the applicant has proposed these options. Therefore, in addition to the BACT requirements determined in the Top-Down BACT Analysis above, implementation of the mitigation measures that the facility has selected to comply with Rule 4570 will also be required as part of BACT for VOC emissions from the cow housing permit.

2. BACT Analysis for NH₃ Emissions from Dairy Freestall and Saudi-Style Barns:

a. Step 1 - Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, only options that meet the District's definition of Achieved-in-Practice controls will be evaluated.

The following management practices have been identified as possible control options for the NH₃ emissions from the cow housing permit unit:

1) Feed and Manure Management Practices

- Concrete feed lanes and walkways
- Frequent Cleaning of lanes and walkways
 - a) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - b) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - c) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - d) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day;
- All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
- Exercise pens properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
- Scraping of exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Description of Control Technologies

1) Feed and Manure Management Practices

Concrete Feed Lanes and Walkways

Dairy animals spend a large amount of time on the feed lanes and walkways. Constructing these areas of concrete will reduce particulate matter emissions by having the animals spend more time on a paved surface rather than dry dirt. The concrete lanes and walkways create an avenue for the flush or scrape manure removal systems. The flush system will further reduce particulate matter emissions and will also reduce VOC and ammonia emissions (see below).

Frequent Cleaning of Lanes and Walkways

Many dairy operations use flush or scrape systems to remove manure from the freestall and Saudi-style lanes and walkways. When dairies use a flush system, a large volume of water is introduced at the head of the paved area of the freestall and Saudi-style barn, and the cascading water removes the manure. The required volume of flush water varies with the size and slope of the area to be flushed. When dairies use a scrape system for manure management, manure is typically scraped from the cow housing lanes using a tractor or skid steer with a scraping attachment, or using an automatic mechanical scraper. The automatic scraper usually consists of a hinged v-shaped scraper driven by a cable or chain. The mechanical scraper is periodically dragged forward to draw manure to the end of a lane. After completing a pass, the chain or cable reverses direction and pulls the scraper back in the opposite direction. The scraped manure is either temporarily stored in a pile where liquids are allowed to drain off, or loaded onto a truck or tractor for transport or land application. A smaller number of dairies may also use vacuum trucks to remove manure from the cow housing areas. Manure vacuumed from the lanes can be applied to adjacent cropland, transported offsite, or placed in a digester. The freestall and Saudi-style lanes for milk and dry cows are typically flushed or scraped twice per day, but the cleaning frequency can vary between one to four times per day. The lanes for support stock are usually flushed or scraped once per day or less frequently.

In addition to cleaning the freestall and Saudi-style lanes and walkways, the flush, scrape, and vacuum systems also serve as an emission control for reducing emissions. The manure deposited in the lanes, which is a source of NH₃ emissions, is removed from the cow housing area by the flush, scrape, or vacuum system. Additionally, ammonia is highly soluble in water. Therefore, when a flush system is used, a large portion of ammonia will be flushed away with the flush water and will not be emitted from the cow housing permit unit.

Animals fed in accordance with (NRC) or other District-approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure.

Scraping of Exercise Pens with a Pull-Type Scraper

Frequent scraping the freestall or Saudi-style exercise pens will reduce the amount of manure on the surfaces, which will reduce VOC and ammonia emissions resulting from

decomposition of this manure. This practice will also provide a uniform surface, reducing anaerobic conditions on the surface, which will reduce gaseous pollutants from this area.

Increasing the frequency that exercise pens are scraped is expected to reduce emissions of gaseous pollutants from the corral surface and PM that results from the cattle hooves acting on the surface of the corrals; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the exercise pen surface.

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1. However, the following options will be eliminated from consideration because the emissions from increased use of tractors are expected to offset the benefits of any NH₃ reductions from these practices.

- a) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
- b) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day

c. Step 3 - Rank remaining options by control effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

1) Feed and Manure Management Practices

- Concrete feed lanes and walkways
- Frequent cleaning of lanes and walkways
Cleaning lanes by frequent flushing is much more effective at reducing ammonia emissions than frequent scraping; however, because some dairies may be unable to flush at increased frequencies because of water constraints, use of automatic scraping system will be allowed when dairies demonstrate that they are unable to flush at increased frequencies.
 - a) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - b) For dairies that are not able to use a flush system, Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper (or equivalent). Lanes and walkways for support stock (heifers) cleaned at least once per day
- All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
- Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400

square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)

- Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

d. Step 4 - Cost Effectiveness Analysis

The options above are all achieved in practice; therefore a cost analysis is not required.

e. Step 5 - Select BACT

BACT for NH₃ from Dairy Freestall and Saudi-Style Barns:

- 1) Concrete feed lanes and walkways;
- 2) Flushing the Lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals at least once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
- 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
- 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and
- 5) Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

1. BACT Analysis for PM₁₀ Emissions from Dairy Freestall and Saudi-Style Barns:

a. Step 1 - Identify All Possible Control Technologies

The control technology options include:

- 1) Design and Management Practices
 - Concrete feed lanes and walkways
 - Scraping of exercise pens every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions.

Description of Control Technologies

1) Concrete Feedlanes and Walkways

Constructing the feed lanes and walkways of concrete causes the dairy animals to spend an increased amount of time on a paved surface rather than dry dirt, thus reducing PM₁₀ emissions. Additionally, the manure that is deposited in the lanes and walkways will be flushed, which will prevent PM₁₀ emissions from drying manure.

2) Scraping of Exercise Pens with a Pull-Type Scraper

The surface of the freestall or Saudi-style exercise pens is composed of earth and deposited manure, both of which have the potential for particulate matter emissions either as a result of wind or animal movement. Frequent scraping of exercise pen surfaces will reduce the amount of dry manure on the corral surfaces that may be pulverized by the cows' hooves and emitted as PM₁₀.

Increasing the frequency that exercise pen are scraped is expected to reduce emissions of gaseous pollutants from the exercise pen surface and PM that results from the cattle hooves acting on the surface of the exercise pen; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the exercise pen surface.

b. Step 2 - Eliminate Technologically Infeasible Options

There are no technologically infeasible options.

c. Step 3 - Rank Remaining Control Technologies by Control Effectiveness

Freestall or Saudi-Style Barns

- 1) Design and Management Practices
 - Concrete feed lanes and walkways
 - Scraping of exercise pens every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions

d. Step 4 - Cost Effectiveness Analysis

Freestall or Saudi-Style Barns

1) Design and Management Practices

- Concrete feed lanes and walkways
- Scraping of exercise pens every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions

The options above are all achieved in practice; therefore a cost analysis is not required.

e. Step 5 - Select BACT

BACT for PM₁₀ from freestall or Saudi-Style barns is satisfied with:

- 1) Concrete feed lanes and walkways;
- 2) Scraping exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Top-Down BACT Analysis for Dairy Open Corrals

a. Identify All Possible Control Technologies

Top-Down BACT Analysis for PM₁₀ Emissions:

Step 1 - Identify all control technologies

Design and Management Practices

1. Concrete feed lanes and walkways
2. Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
3. Shade structures in open corrals
4. Feeding heifers in corrals near dusk (within 1 hour of dusk)
5. Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)

Description of Control Technologies

1. Concrete Feedlanes and Walkways

Dairy animals are typically housed in freestall barns or open corrals. An open corral is a large open area where cows are confined with unlimited access to feed and water.

Constructing the feed lanes and walkways of concrete causes the dairy animals to spend an increased amount of time on a paved surface rather than dry dirt, thus reducing PM₁₀ emissions. Additionally, the manure that is deposited in the lanes and walkways will be flushed, which will prevent PM₁₀ emissions from drying manure.

2. Scraping of Exercise Pens and Open Corrals with a Pull-Type Scraper

As stated above, dairy animals are typically housed in freestall barns or open corrals. The surface of the corrals and freestall exercise pens is composed of earth and deposited manure, both of which have the potential for particulate matter emissions either as a result of wind or animal movement. Frequent scraping of corral surfaces will reduce the amount of dry manure on the corral surfaces that may be pulverized by the cows' hooves and emitted as PM₁₀.

Increasing the frequency that corrals are scraped is expected to reduce emissions of gaseous pollutants from the corral surface and PM that results from the cattle hooves acting on the surface of the corrals; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the corral surface.

3. Shade Structures in Open Corrals

Installing shade structures in corral areas helps to decrease PM₁₀ emissions. Dairy animals are easily susceptible to heat stress and will tend to seek out shade to reduce the effects of heat, particularly in the warmer months when higher PM₁₀ emissions are expected because of drier conditions. PM₁₀ emissions are reduced because the cows will spend less time walking on the dry corral surface.

4. Feeding Heifers in Corrals Near Dusk (within 1 hour of dusk)

Feeding the heifers near dusk will reduce their activity during this time, which is the time when the corral surface is the driest and there is greater chance for particulate matter from the corral to be entrained into the atmosphere.

5. Shelterbelts/Windbreaks Controlling Dust from Corrals or an Equivalent Alternative

A windbreak, or shelterbelt, is composed of one or more rows of trees or shrubs, which are planted in a manner that breaks up wind and reduces the force of wind on downwind of the windbreak. Windbreaks can be used to prevent soil erosion, improve air quality by intercepting dust, chemicals, and odors, to protect crops, and to provide habitat for wildlife. The District has worked with NRCS to establish guidelines for windbreaks used for dust control around dairies. In general, the guidelines require that a downwind shelterbelt with three rows be installed, the first row consisting of shrubs, second row consisting of a medium size tree and the last row consisting of an evergreen (larger tree). NRCS also requires that an irrigation system be maintained so that there is greater survivability and rapid growth of the trees and shrubs. A windbreak will reduce the amount of particulate matter entrained into the atmosphere.

There may be instances where windbreaks are not practical or feasible for a particular operation such as existing dairy facilities that is expanding but lacks adequate space for a windbreak. The soil conditions in the area where installation of the windbreak would be required should also be considered when determining if establishment of windbreaks is feasible for a particular dairy. Soil properties that should be considered include, but are not limited to, the pH and salinity or electrical conductivity of the soil. It is best to consult the National Resources Conservation Services (NRCS) or other experts to determine if a particular area can reasonably sustain windbreaks. NRCS also maintains information on the soil properties and vegetative productivity of agricultural areas, which is available online through their Web Soil Survey¹³. Another possible factor that may need to be considered when determining if windbreaks are feasible in a particular area is if insufficient water is available for establishment of a windbreak because of sustained drought conditions. Windbreaks will not be required if an operation demonstrates satisfactorily that they are infeasible or impractical for the particular operation. Additionally, because there are a number of factors (soil conditions, drought/water availability of sufficient water, climate, etc.) that are specific to each site that must be considered when determining if an effective windbreak can be established and maintained, as with other BACT requirements dairies will be allowed to substitute an alternative measure that can achieve equivalent PM₁₀ reductions.

¹³ The NRCS Web Soil Survey can be accessed at <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

6. Sprinklers/Water Application in Corrals

Sprinkling or water application can reduce dust by maintaining adequate moisture in the layer of manure and earth on the corral surface. Studies have shown that increasing the moisture of the corral surface greatly reduces the entrainment of PM₁₀ into the atmosphere as a result of animal movement. Installation of a sprinkler system for dust control is an effective mitigation measure that reduces PM₁₀ emissions. However, because of concerns for animal health and welfare, water application is not commonly used. Excess moisture from sprinkling systems can potentially accumulate in shaded areas where the cows lie down, which will lead to a breeding ground for pathogens and vermin, which will increase nuisance conditions and instances of disease. Excessive moisture also increases the chances of clinical mastitis - infections of the udder tissue that result in swelling, pain, and/or redness of the udder. For these reasons, sprinkler systems have not been commonly used to control dust at dairies.

Step 2 - Eliminate Technologically Infeasible Options

Sprinklers/Water Application in Corrals

As stated above, excess moisture from sprinkling systems can lead to a breeding ground for pathogens and vermin, which will increase nuisance conditions and instances of disease. Excessive moisture also increases the chances of mastitis. For these reasons, sprinkler systems for dust control will not be required at this time; however, sprinkler systems or water application may be proposed by dairies as an alternative measure because they can determine and consider any adverse effects for the particular dairy for which the sprinkler systems or water application are proposed. To mitigate these health concerns, each facility will need to design the sprinkler system or water truck application method specifically for the facility's layout and climate in order to apply water to the corrals uniformly to prevent inconsistent distribution of water and areas of excessive moisture.

Step 3 - Rank Remaining Control Technologies by Control Effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

Design and Management Practices

1. Concrete feed lanes and walkways
2. Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
3. Shade structures in open corrals
4. Feeding heifers in corrals near dusk (within 1 hour of dusk)
5. Windbreaks controlling dust from corrals (when feasible and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)

Step 4 - Cost Effectiveness Analysis

Design and Management Practices

1. Concrete feed lanes and walkways
2. Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
3. Shade structures in open corrals
4. Feeding heifers in corrals near dusk (within 1 hour of dusk)
5. Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)

The options above are all achieved in practice; therefore a cost analysis is not required.

Step 5 - Select BACT

BACT for PM₁₀ from open corrals is satisfied with:

- 1) Concrete feed lanes and walkways
- 2) Scraping of open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
- 3) Shade structures in open corrals
- 4) Feeding heifers in corrals near dusk (within 1 hour of dusk)
- 5) Windbreaks controlling dust from corrals (when feasible, supported by soil conditions, and there is adequate space at existing facilities) or an alternative measure with equivalent PM control (e.g. sprinkling/water application over at least 25% of the corral surface or average corral surface moisture content (wet-based) $\geq 16\%$)

1. Tope Down BACT Analysis for VOC Emissions from the Open Corrals

a. Identify All Possible Control Technologies

Step 1 - Identify all control technologies

Since specific VOC emissions control efficiencies have not been identified in the literature for dairy cow housing areas, the control efficiencies will be estimated based on the control efficiencies of similar processes and engineering judgment. Unless specifically noted, for practices required to reduce VOC emissions, a 10% control efficiency will be assumed for the specific portion of the emission source or process affected by the measure.

The following options were identified as possible controls for VOC emissions from the cow housing (cow housing permit unit):

- 1) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (e.g. incinerator, biofilter, e.g) (≈64-72%; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)
- 2) Feed and Manure Management Practices
 - Concrete feed lanes and walkways
 - Frequent Cleaning of lanes and walkways
 - a) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - b) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - c) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - d) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day;
 - All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
 - Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
 - Scraping of exercise pens and open corrals every two weeks using a pull-type scraper in the morning hours except when prevented by wet conditions
 - VOC mitigation measures required by District Rule 4570

Description of Control Technologies

3) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device

Description of Dairy Housing

In a freestall barn, cows are grouped in large pens with free access to feed bunks, water, and stalls for resting. In the mild climate of the San Joaquin Valley, the typical freestall barn is an open structure (roof but no sides). The primary freestall design consists of a roof that provides shade with all sides open to allow air to flow through, which keeps the cows cool. The open freestall barns take advantage of natural summer winds in the San Joaquin Valley that are generally greater than four mph. The natural winds result in an excellent summer ventilation rate that is equivalent to 1,000 cfm per cow, which is why open dairy barns are generally recommended in the San Joaquin Valley. In colder climates enclosed or partially enclosed barns may be utilized to protect cows from winter extremes. However, no completely enclosed freestall barns that were installed at a California dairy were identified.

Although the potential to enclose cows in a barn may exist, the feasibility of reasonably collecting the gas through a stack, chimney, or vent remains in question considering the extremely large amounts of airflow going through the barns needed to keep the cows cool. The airflow requirements would be even higher in the San Joaquin valley, where temperatures can exceed 110° F in the hot summer. If the barn exhaust can be properly captured it may be possible to vent it to a VOC control device. It is estimated that up to 80% of the gases emitted from enclosed freestall barns can be captured by the mechanical ventilation system and sent to a control device, such as an incinerator or biofilter.

Thermal incineration is a well-established VOC control technique. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. In addition to the difficulty of capturing all of the gases in a freestall barn, a disadvantage of thermal incineration is that when concentrations of combustible VOCs in the gas stream are very low, very large amounts of supplemental fuel must be used to sufficiently increase the temperature of all of the ventilation air in order to incinerate these VOCs. This generally renders incineration cost prohibitive for large flows of dilute VOCs, such as in the ventilation air from a freestall barn. Because of this, biofilters have generally been found to be more cost-effective for handling dilute streams of biodegradable VOCs. A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. Additional information on biofiltration is given below in the analysis for enclosed freestall barns vented to a control device. One of the disadvantages related to the use of a biofilter to control emissions from enclosed livestock barns is the large space requirement for the traditional biofilter design. To illustrate this, a low-cost natural bed biofilter designed to treat the VOC emissions from 1,000 milk cows and 180 dry cows with no support stock would cover more than 5.4 acres and would need to be maintained free of pests and approved by the appropriate permitting agencies. To avoid such expansive land requirements, the dairy would likely need to use much more expensive bio-trickling filters or bio-scrubbers.

Although many questions remain about the feasibility of requiring animals to be confined in buildings and capturing the exhaust gas and venting it to a control device, it will be considered for purposes of this analysis.

4) Feed and Manure Management Practices

Concrete Feed Lanes and Walkways

Dairy animals spend a large amount of time on the feed lanes and walkways. Constructing these areas of concrete will reduce particulate matter emissions by having the animals spend more time on a paved surface rather than dry dirt. The concrete lanes and walkways create an avenue for the flush or scrape manure removal systems. The flush system will further reduce particulate matter emissions and will also reduce VOC and ammonia emissions (see below). Although concrete feed lanes and walkways are necessary for an effective manure removal system, they do not individually reduce emissions of gaseous pollutants; therefore, no VOC control efficiency is assigned for this practice.

Frequent Cleaning of Lanes and Walkways

Many dairy operations use flush or scrape systems to remove manure from the corral and freestall lanes and walkways. When dairies use a flush system, a large volume of water is introduced at the head of the paved area of the corrals or freestalls, and the cascading water removes the manure. The required volume of flush water varies with the size and slope of the area to be flushed. When dairies use a scrape system for manure management, manure is typically scraped from the cow housing lanes using a tractor or skid steer with a scraping attachment, or using an automatic mechanical scraper. The automatic scraper usually consists of a hinged v-shaped scraper driven by a cable or chain. The mechanical scraper is periodically dragged forward to draw manure to the end of a lane. After completing a pass, the chain or cable reverses direction and pulls the scraper back in the opposite direction. The scraped manure is either temporarily stored in a pile where liquids are allowed to drain off, or loaded onto a truck or tractor for transport or land application. A smaller number of dairies may also use vacuum trucks to remove manure from the cow housing areas. Manure vacuumed from the lanes can be applied to adjacent cropland, transported offsite, or placed in a digester. The freestall and corral lanes for milk and dry cows are typically flushed or scraped twice per day, but the cleaning frequency can vary between one to four times per day. The lanes for support stock are usually flushed or scraped once per day or less frequently.

In addition to cleaning the corral and freestall lanes and walkways, the flush, scrape, and vacuum systems also serve as an emission control for reducing VOC emissions. The manure deposited in the lanes, which is a source of VOC emissions, is removed from the cow housing area by the flush, scrape, or vacuum system. Flush systems also reduce PM₁₀ and ammonia emissions. Additionally, many of the VOCs emitted from fresh cow manure, such as alcohols (ethanol and methanol) and many Volatile Fatty Acids (VFAs), are highly soluble in water. Therefore, when a flush system is used, a large percentage of these compounds will dissolve in the flush water and will not be emitted from the cow housing permit unit. The flush water can then carry the manure and the dissolved volatile compounds to an anaerobic treatment lagoon or other manure stabilization process for treatment.

It must be noted that the system for cleaning the lanes and walkways will only control the VOCs emitted from the manure it will have little or no effect on enteric emissions produced from the cows' digestive processes. As stated above, the lanes and walkways in the cow housing areas are typically cleaned twice per day. Cleaning the lanes four times per day will increase the frequency that manure is removed from the cow housing permit unit. Although the control efficiency for VOCs may actually be much higher, increasing the cleaning frequency of the lanes will be conservatively assumed to have a control efficiency of 10% for VOCs emitted from manure until better data becomes available.

Animals Fed in Accordance with (NRC) or other District-Approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for VOC emissions can be reduced by reducing the quantity of undigested nutrients in the manure. Many of the VOCs emitted from Confined Animal Facilities, including dairies, originate from the decomposition of undigested protein in animal waste.¹⁴ This undigested protein also produces ammonia and hydrogen sulfide emissions. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of VOCs, ammonia, and hydrogen sulfide.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure.

Based on very limited data (Klaunser, 1998, *J Prod Agric*), diet manipulation decreased nitrogen excretion by 34% while improving milk production. Up to 70% of excess nitrogen is lost off of the farm through volatilization, denitrification and leaching. Because of limited research, feeding dairy animals in accordance with National Research Council (NRC) or other District-approved guidelines will be assumed to have a conservative control efficiency of only 5-10% for both enteric VOC emissions from dairy animals and VOC emissions from manure.

Scraping of Exercise Pens and Open Corrals with a Pull-Type Scraper

Many dairies use equipment pulled by tractors to periodically scrape the surfaces of corrals. Frequent scraping the freestall exercise pens and corrals will reduce the amount of manure on the corral surfaces, which will reduce VOC and ammonia emissions resulting from decomposition of this manure. This practice will also provide a uniform surface, reducing anaerobic conditions on the corral surface, which will reduce gaseous pollutants from this area. The frequency that corrals are scraped at dairies can vary from as little as once a year to every week.

¹⁴ "Emissions of Volatile Organic Compounds Originating from UK Livestock Agriculture", Hobbs, P.J. 2004 – Journal of the Science of Food and Agriculture

Increasing the frequency that corrals are scraped is expected to reduce emissions of gaseous pollutants from the corral surface and PM that results from the cattle hooves acting on the surface of the corrals; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the corral surface.

b. Step 2 - Eliminate Options

There are no technologically infeasible options to eliminate from step 1. However, the following options will be eliminated from consideration because the emissions from increased use of tractors are expected to offset the benefits of any VOC reductions from these practices.

- a) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day;
- b) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day

c. Step 3 - Rank remaining options by control effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

- 1) Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (e.g. incinerator, biofilter, e.g) (≈64-72%; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)
- 2) Feed and Manure Management Practices
 - a. Concrete feed lanes and walkways
 - b. Frequent cleaning of lanes and walkways
 - Flushing is generally the most effective method of using frequent cleaning of the lanes to reduce emissions; however, because some dairies may be unable to flush at increased frequencies because of water constraints, use of automatic scarping system will be allowed when dairies demonstrate that they are unable to flush at increased frequencies.
 - b) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - c) For dairies that are not able to use a flush system, Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper (or equivalent). Lanes and walkways for support stock (heifers) cleaned at least once per day
- c. All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
- d. Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400

- square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
- e. Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions
- f. VOC mitigation measures required by District Rule 4570

d. Step 4 - Cost Effectiveness Analysis

Confining Animals in Enclosed Buildings and Venting Emissions to a Control Device (Biofilter)

The analysis below is based on the Analysis for Confining Livestock in Enclosed Buildings and Venting Emissions to a Control Device contained in the District document Final Staff Report – Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities), Appendix E – Analysis of Class Two Mitigation Measures for Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010. Additional details regarding the cost analysis can be found in the referenced report for the amendments to District Rule 4570.

This analysis does not quantify all of the costs or examine all of the potential issues that make requiring this option infeasible but it is intended to more accurately reflect the actual costs to implement this measure. The use of a biofilter as a control device for VOCs is expected to result in much lower costs than other control options, such as incineration. The U.S. Environmental Protection Agency (US EPA), Clean Air Technology Center (CATC) document "Using Bioreactors to Control Air Pollution" states, "*The capital cost of a bioreaction installation is usually just a fraction of the cost of a traditional control device installation. Operating costs are usually considerably less than the costs of traditional technology, too.*"¹⁵ Therefore, this analysis will evaluate the use of a biofilter to determine the minimum cost of the emission reductions that would be achieved by venting enclosed animal housing to a control device.

The following analysis is based on the cost of emission reductions for confining 1,000 milk cows in enclosed freestall buildings vented to a biofilter and venting the milking parlor to the same biofilter. Costs for larger dairies would be proportional.

Description of Control Technology

A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration, exhaust air containing pollutants passes through a media that contains an established, diverse population of aerobic microorganisms. These microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. The bacterial cultures (microorganisms that typically consist of several species coexisting in a colony) that use oxygen to biodegrade organics are called aerobic cultures. These aerobic cultures are usually supported by organic material contained in the biofilter, such as

¹⁵ U.S. Environmental Protection Agency, The Clean Air Technology Center (CATC), "Using Bioreactors to Control Air Pollution" EPA-456/R-03-003, (E143-03), September 2003, <http://www.epa.gov/ttn/catc/dir1/fbioreact.pdf>

compost, wood chips, soil, peat, etc. Biofilters must maintain sufficient porosity to allow the contaminated air stream to pass through for treatment and to minimize anaerobic conditions. The moisture content of biofilter beds must also be regulated to ensure that there is sufficient moisture to maintain the microorganisms needed for treatment while avoiding excess moisture that can cause anaerobic conditions. A filtration system may be required upstream of a biofilter to remove particular matter which will clog the biofilter over time. Biofilters must be maintained free of rodents and weeds to avoid channeling of gases through the filter media and a loss of performance. The filter media of natural biofilters needs to be replaced periodically because of deterioration and loss of porosity.

Since biofilters rely on living organisms to function, a biofilter's performance will be affected by several factors, including: ambient temperature; temperature of the air stream being treated; the pollutant concentrations in the air stream; moisture content of the filter and air stream, and pH of the filter media. These parameters should be monitored to ensure optimum operating conditions for the biofilter.

Advantages and Disadvantages of Using a Biofilter to Control Emissions

Some of the general advantages related to the use of biofilters include: low installation costs for traditional biofilter designs; generally low operating costs in comparison to other control technologies; high control efficiencies for some compounds such as aldehydes, organic acids, hydrogen sulfide, and certain water-soluble organic compounds.

Some of the general disadvantages of the use of biofilters include: large land requirements for traditional biofilter designs; difficulty in determining the control efficiency for traditional open biofilter designs; for biofilters that use inexpensive natural bed media, the filter bed media must be replaced every 2 to 5 years; biofilters usually require some time to reach optimum control efficiency after initial startup and after periods of nonuse because of the need to establish or re-establish the microbial population; and biofilters can also be a source of nitrous oxide emissions due to denitrification.

Additional disadvantages specifically related to the use of biofilters to control emissions from livestock include: facilities that currently use natural ventilation would incur additional costs because of the need to convert to mechanical ventilation; facilities that currently use mechanical ventilation systems may need to upgrade these systems to overcome the increased pressure drop across the biofiltration system; greater energy usage for all facilities to push air through the biofilter; few reported cases where a biofilter has been shown to be economically viable when applied to animal feeding operations¹⁶; a very large biofilter system must be used to handle these huge flow rates while maintaining adequate contact time for treatment of emissions. Finally, because of the extremely large airflow rates needed to provide adequate ventilation for livestock it is not practical to treat all of the ventilation air from large confined animal housing units.

¹⁶ U.S. Environmental Protection Agency, "Emissions from Animal Feeding Operations" (Draft), EPA Contract No. 68-D6-0011, August 15, 2001, pg. 9-20, <http://www.epa.gov/ttn/chief/ap42/ch09/draft/draftanimalfeed.pdf>

Biofilter VOC Control Efficiency

It is assumed that 80% of the gasses emitted from the enclosed animal housing will be captured by the mechanical ventilation system and that a properly functioning biofilter will eliminate 85% of the captured VOC emissions¹⁷; therefore, the total control for VOCs from the enclosed animal housing = $0.80 \times 0.85 = 68\%$.

Cost Estimates for Enclosed Freestall Barns for this Analysis

Based on the information contained in the District Staff Report for the Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010, the following cost estimates for enclosed freestall barns will be used in this analysis.

Capital Cost for Enclosed Freestall Barn (2010): \$1,700-2,700/cow

Estimated Adjusted Capital Cost: \$1,275-2,025/cow (capital cost estimate was reduced by 25% because it may be possible to use the existing concrete work and some of the existing freestall infrastructure with the new building shell)

Capital cost estimate: **\$1,275-2,025/cow**

Increased Operating Costs¹⁸: **\$74-98/cow more**

Capital Cost for Freestall Barn Enclosure for 7,278 Holstein Milk Cows

Low capital cost estimate: \$1,275/cow x 7,278 cows = \$9,279,450

High capital cost estimate: \$2,025/cow x 7,278 cows = \$14,737,950

Increased Operating Costs for Enclosed Freestall Barns for 7,278 Holstein Milk Cows

Low operating cost estimate: \$74/cow-yr x 7,278 cows = \$538,572/yr

High operating cost estimate: \$98/cow-yr x 7,278 cows = \$713,244/yr

Cost Estimate for Biofilters

Several reference documents were consulted to determine the expected capital and operating costs of using a biofilter to control VOC emissions from enclosed animal housing for evaluation of the Class Two Mitigation Measures contained in the District Staff Report for the Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities) dated October 21, 2010. Several companies that specialize in building and supplying biofilters and bio-scrubbers for the control of VOC emissions were also contacted to request capital cost estimates for biofilter systems specifically for the treatment of VOC emissions from dairy cows housed in enclosed barns. The resulting cost estimates from the District staff

¹⁷ The SCAQMD Rule 1133.2 staff report (page 18) indicates control efficiencies of 80-90% for VOC for existing biofilter composting applications and that a well-designed, well-operated, and well-maintained biofilter is capable of achieving 80 percent control efficiency for VOC, <http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1133/staff-report.pdf?sfvrsn=2>

¹⁸ Increased operating costs were based on information from following document, adjusted to 2010 dollars assuming 3% annual inflation: Dhuyvetter, Kevin C., Harner, Joe P., Smith, John F., & Bradford, Barry J., Kansas State University Department of Agricultural Economics, "Economic Considerations of Low-Profile Cross-Ventilated Freestall Barns", Presented at Dairy Housing of the Future, Sioux Falls, South Dakota. September 10-11, 2008, [http://www.agmanager.info/Faculty/dhuyvetter/presentations/2008/LPCV%20Conference\(Sep2008\).pdf](http://www.agmanager.info/Faculty/dhuyvetter/presentations/2008/LPCV%20Conference(Sep2008).pdf)

report are summarized below. Based on the information reviewed, it was also determined that there would not be any additional cost reduction benefit related to economy of scale for biofilters handling the large flow rates from freestall barns. For purposes of this analysis, the following biofilter cost estimates will be used.

Capital Cost (2010): **\$3-35/cfm**

Operating Costs (2010): **\$2.12-20/cfm**

The cost is largely dependent on the airflow rate that the biofilter must handle. Biofilters used to treat exhaust air should be sized to treat the maximum ventilation rate, which is typically the warm weather rate. The higher cost estimate is representative of a biotrickling filter, which may be necessary to handle the high air flow rates from the barns.

Required Airflow Rate of the Freestall Barns

In order to calculate the costs of this control option, the airflow rate required for the freestall barns must be determined. The University of Minnesota's publication "Improving Mechanical Ventilation in Dairy Barns"¹⁹, gives minimum ventilation rates for dairy cattle, which are listed in the table below.

Minimum Ventilation Rates for Dairy Cows (cfm/cow)			
Age	Winter	Mild Weather	Summer
Baby Calf (0-2 months)	15	50	100
Heifer (2-12 months)	20	60	130
Heifer (12-24 months)	30	80	180
Mature Cow	50	170	500 – 1,000

The minimum summer ventilation rate listed for mature cows is 500 cfm per cow. However, according to the University of Minnesota publication and Cornell University's publication "Natural or Tunnel Ventilation of Freestall Structures: What is Right for Your Dairy Facility?"²⁰, the minimum required airflow rate in the summer increases to 1,000 cfm per cow if tunnel ventilation is used to provide additional cooling.

The climate in the San Joaquin Valley is characterized by mild winters and hot summers. Because of the warmer climate, it is expected that tunnel ventilation or a similar system would need to be employed in an enclosed freestall barn to prevent excessive heat stress. Additionally, tunnel ventilation systems are more representative of the types of systems that would be required to capture and control emissions.

Minimum Summer Air Requirements for Freestall Barns Vented to a Biofilter for 7,278 Holstein Milk Cows

The minimum required summer airflow rate for housing 7,278 milk cows is calculated below:

¹⁹ "Improving Mechanical Ventilation in Dairy Barns", J.P. Chastain, http://www.milkproduction.com/Library/Articles/Improving_mechanical_ventilation.htm

²⁰ Natural or Tunnel Ventilation of Freestall Structures: What is Right for Your Dairy Facility?, C.A. Gooch, <http://www.ansci.cornell.edu/pdfs/nattunnel.pdf>

Low Summer Ventilation Rate: 7,278 milk cows x 500 cfm/cow = 3,639,000 cfm
High Summer Ventilation Rate: 7,278 milk cows x 1,000 cfm/cow = 7,278,000 cfm

Capital Cost of a Biofilter for 7,278 Holstein Milk Cows

The lower cost estimate does not include installation of the required ductwork. As stated above, the estimated capital costs for a biofilter range of between \$3.00 per cfm and \$35.00 per cfm. The capital cost estimates of a biofilter for enclosed freestall barns housing 1,000 milk cows:

Low capital cost estimate: \$3.00/cfm x 3,639,000 cfm = \$10,917,000
High capital cost estimate: \$35.00/cfm x 7,278,000 cfm = \$254,730,000

Operating Costs for a Biofilter for 7,278 Holstein Milk Cows

Low operating cost estimate: \$2.12/cfm-yr x 3,639,000 cfm = \$7,714,680/yr
High operating cost estimate: \$20.00/cfm-yr x 7,278,000 cfm = \$145,560,000/yr

Annualized Capital Costs for Biofilter for 7,278 Holstein Milk Cows

Pursuant to District Policy APR 1305, section X (11/09/99), the cost for the purchase of the biofilter will be spread over the expected life of the system using the capital recovery equation. The expected life of the entire system (fans, media, plenum, etc) will be estimated at 10 years. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times I(1+I)^n] / [(1+I)^n - 1]$$

Where: A = Annual Cost
P = Present Value (freestall enclosure and biofilter)
I = Interest Rate (10%)
N = Equipment Life (10 years)

Low Annualized Capital Cost Estimate =
[(\$10,917,000 + \$7,714,680) x 0.1(1.1)¹⁰] / [(1.1)¹⁰ - 1] = \$3,036,964/year

High Annualized Capital Cost Estimate =
[(\$254,730,000 + \$145,560,000) x 0.1(1.1)¹⁰] / [(1.1)¹⁰ - 1] = \$465,537,270/year

Total Annual Cost Estimates

The total annualized capital costs and operating costs for a freestall enclosure vented to a biofilter are given below. For the least expensive biofilters, the biofilter media (e.g., soil, compost, wood chips) must be replaced after 3-5 years in order to remain effective. This may be an additional cost because it may not have been included in the least expensive operating cost estimates provided above.

Total annual cost estimate = (total annualized capital cost) + (increased operating cost for an enclosed freestall barn) + (biofilter operating cost)

Low total annual cost estimate = (\$9,279,450/yr) + (\$538,572/yr) + (\$7,714,680/yr)
= \$17,532,702/year

High total annual cost estimate = (\$14,737,950/yr) + (\$713,244/yr) + (\$145,560,000/yr)
= \$161,011,194/year

Potential Income from Increased Milk Production

Cooling milk cows in enclosed freestall barns may reduce heat stress and result in increased milk production. Because dairy cows in California already have some of the highest milk production rates in the nation, it is questionable regarding whether enclosing the milk cows will result in any significant increases in milk production. This is because heat stress is related to both temperature and humidity and it is likely that the increased temperatures in California relative to other states are mitigated by the much lower humidity. Although questions remain about the potential to increase milk production in the San Joaquin Valley by reducing heat stress, this potential benefit will be quantified for this analysis.

Potential Increased Daily Milk Production: 4-6 lb/cow-day (District 4570 Staff Report, June 2006)

Potential Increased Annual Milk Production: 1,460-2,190 lb/cow-yr

Average Base Pool Price of milk in 2014²¹: \$20.95/cwt

Income from increased milk production: \$305.87-458.81/cow-yr

Max Income from increased milk production for 7,278 milk cows:

7,278 milk cows x \$458.81/cow-yr = \$3,339,219/yr

Low total annual cost estimate – income from increased milk production =

(\$17,532,702/yr) - (\$3,339,219/yr) = \$14,193,483/year

VOC Emission Reductions for 7,278 Holstein Milk Cows

The annual VOC Emission reductions for enclosed freestall barns for 7,278 milk cows vented to a biofilter are calculated as follows:

VOC Emissions from Cows (Enteric) and Manure:

[Number of cows] x [Uncontrolled Cow Housing VOC EF (lb/cow-year)] x [Capture Efficiency] x [Biofilter Control Efficiency]

VOC Reductions from Holstein Cows Housed in Enclosed Freestall Barns Vented to a Biofilter (Cows, Stalls, & Lanes)									
Type of Cow	# of cows	x	Housing EF* (lb/cow-yr)	x	Capture (%)	x	Control (%)	=	lb-VOC/yr
Milk Cow (enteric)*	7,278	x	4.1	x	80%	x	85%	=	20,291
Stalls and Lanes	7,278	x	1.8	x	80%	x	85%	=	8,908
Milking Parlor Floor	7,278	x	0.03	x	80%	x	85%	=	148
Total (lb-VOC/yr)									29,347

*Includes emissions in the milk parlor(s)

²¹http://www.cdfa.ca.gov/dairy/prices_main.html; Base Pool Price of milk price was used for this analysis because dairy industry representatives state that increased production is purchased at a lower price. Additionally, sufficient increased production will cause the price to fall

VOC Emissions from TMR:

[Number of cows] x [Area of TMR (ft²/cow)] x [Uncontrolled TMR Flux Rate (lb-VOC/ft²-day)] x [365/day/year] x [Capture Efficiency] x [Biofilter Control Efficiency]

VOC Reductions from TMR (Feed) for Cows Housed in Enclosed Freestall Barns Vented to a Biofilter													
Type of Cow	# of cows	x	TMR Area* (ft ² /cow)	x	TMR Flux (lb/ft ² -day)	x	365 day/yr	x	Capture (%)	x	Control (%)	=	lb-VOC/yr
Milk Cow	7,278	x	7.08	x	3.85E-03	x	365	x	80%	x	85%	=	49,239

Total VOC Emission Reductions from Milk Parlor, Cow Housing, and TMR =
29,347 lb-VOC/yr + 49,239 lb-VOC/yr = 78,586 lb-VOC/yr

Cost of VOC Emission Reductions

Low Estimate²² = (\$17,532,702/year)/[(78,586 lb-VOC/year)(1 ton/2000 lb)]
= **\$446,204/ton of VOC reduced**

High Estimate = (\$161,011,194/year)/[(78,586 lb-VOC/year)(1 ton/2000 lb)]
= **\$4,0997,707/ton of VOC reduced**

As shown above, the costs for a freestall enclosure and biofilter would cause the cost of the VOC reductions to be at least \$446,204/ton. There are additional costs related to increased electricity use, and regulatory compliance and testing that have not been quantified in this analysis. Even without these costs, it is clear that the cost of the VOC emission reductions achieved would be far greater than the \$17,500/ton-VOC cost effectiveness threshold of the District BACT policy. The equipment is therefore not cost effective and is being removed from consideration at this time.

Feed and Manure Management Practices:

1. Concrete feed lanes and walkways
2. Lanes and walkways for mature cows (milk and dry cows) flushed four times per day and lanes and walkways for support stock (heifers) flushed at least once per day; or for dairies that are not able to use a flush system, lanes and walkways for mature cows scraped four times per day with an automatic scraper (or equivalent) and lanes and walkways for support stock (heifers) cleaned at least once per day
3. All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
4. Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
5. Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions
6. VOC mitigation measures required by District Rule 4570

²² Includes reduction in overall annual costs because of potential additional revenue from maximum supposed increase in milk production.

e. Step 5 - Select BACT

BACT for VOC from Dairy Open Corrals:

- 1) Concrete feed lanes and walkways;
- 2) Flushing the lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
- 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
- 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and
- 5) Scraping corrals and exercise pens every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Additionally, District Rule 2201 defines BACT as including the most stringent emission limitation or control technique, including process and equipment changes, that have been found by the APCO to be cost effective and technologically feasible for such class or category of sources or for a specific source. The District has found that the basic mitigation measures required by District Rule 4570 are cost effective and technologically feasible for confined animal facilities and the applicant has proposed these options. Therefore, in addition to the BACT requirements determined in the Top-Down BACT Analysis above, implementation of the mitigation measures that the facility has selected to comply with Rule 4570 will also be required as part of BACT for VOC emissions from the cow housing permit.

2. Top Down BACT Analysis for NH₃ Emissions from the Open Corrals

a. Step 1 - Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, only options that meet the District's definition of Achieved-in-Practice controls will be evaluated.

The following management practices have been identified as possible control options for the NH₃ emissions from the cow housing permit unit:

2) Feed and Manure Management Practices

1. Concrete feed lanes and walkways
2. Frequent Cleaning of lanes and walkways
 - i. Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - ii. Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - iii. Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
 - iv. Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day;
3. All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
4. Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)
5. Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Description of Control Technologies

1) Feed and Manure Management Practices

Concrete Feed Lanes and Walkways

Dairy animals spend a large amount of time on the feed lanes and walkways. Constructing these areas of concrete will reduce particulate matter emissions by having the animals spend more time on a paved surface rather than dry dirt. The concrete lanes and walkways create an avenue for the flush or scrape manure removal systems. The flush system will further reduce particulate matter emissions and will also reduce VOC and ammonia emissions (see below).

Frequent Cleaning of Lanes and Walkways

Many dairy operations use flush or scrape systems to remove manure from the corral and freestall lanes and walkways. When dairies use a flush system, a large volume of water is introduced at the head of the paved area of the corrals or freestalls, and the cascading water removes the manure. The required volume of flush water varies with the size and slope of the area to be flushed. When dairies use a scrape system for manure management, manure is typically scraped from the cow housing lanes using a tractor or skid steer with a scraping attachment, or using an automatic mechanical scraper. The automatic scraper usually consists of a hinged v-shaped scraper driven by a cable or chain. The mechanical scraper is periodically dragged forward to draw manure to the end of a lane. After completing a pass, the chain or cable reverses direction and pulls the scraper back in the opposite direction. The scraped manure is either temporarily stored in a pile where liquids are allowed to drain off, or loaded onto a truck or tractor for transport or land application. A smaller number of dairies may also use vacuum trucks to remove manure from the cow housing areas. Manure vacuumed from the lanes can be applied to adjacent cropland, transported offsite, or placed in a digester. The freestall and corral lanes for milk and dry cows are typically flushed or scraped twice per day, but the cleaning frequency can vary between one to four times per day. The lanes for support stock are usually flushed or scraped once per day or less frequently.

In addition to cleaning the corral and freestall lanes and walkways, the flush, scrape, and vacuum systems also serve as an emission control for reducing emissions. The manure deposited in the lanes, which is a source of NH_3 emissions, is removed from the cow housing area by the flush, scrape, or vacuum system. Additionally, ammonia is highly soluble in water. Therefore, when a flush system is used, a large portion of ammonia will be flushed away with the flush water and will not be emitted from the cow housing permit unit.

Animals fed in accordance with (NRC) or other District-approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure.

Scraping of Exercise Pens and Open Corrals with a Pull-Type Scraper

Frequent scraping the freestall exercise pens and corrals will reduce the amount of manure on the corral surfaces, which will reduce VOC and ammonia emissions resulting from

decomposition of this manure. This practice will also provide a uniform surface, reducing anaerobic conditions on the corral surface, which will reduce gaseous pollutants from this area.

Increasing the frequency that corrals are scraped is expected to reduce emissions of gaseous pollutants from the corral surface and PM that results from the cattle hooves acting on the surface of the corrals; however, requiring an excessively high frequency may negate these emission reductions because of the NO_x and PM emitted from combustion of fuel for the tractor and PM emissions resulting from use of the tractor on the corral surface.

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1. However, the following options will be eliminated from consideration because the emissions from increased use of tractors are expected to offset the benefits of any NH₃ reductions from these practices.

- a) Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with a tractor/skid steer. Lanes and walkways for support stock (heifers) cleaned at least once per day; or
- b) Lanes and walkways for mature cows (milk and dry cows) vacuumed four times per day. Lanes and walkways for support stock (heifers) cleaned at least once per day

c. Step 3 - Rank remaining options by control effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

- 1) Feed and Manure Management Practices
 - a. Concrete feed lanes and walkways
 - b. Frequent cleaning of lanes and walkways
 - a. Cleaning lanes by frequent flushing is much more effective at reducing ammonia emissions than frequent scraping; however, because some dairies may be unable to flush at increased frequencies because of water constraints, use of automatic scraping system will be allowed when dairies demonstrate that they are unable to flush at increased frequencies.
- 2) Lanes and walkways for mature cows (milk and dry cows) flushed four times per day. Lanes and walkways for support stock (heifers) flushed at least once per day; or
 - c. For dairies that are not able to use a flush system, Lanes and walkways for mature cows (milk and dry cows) scraped four times per day with an automatic scraper (or equivalent). Lanes and walkways for support stock (heifers) cleaned at least once per day
 - a. All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines
 - b. Exercise pens and open corrals properly sloped to promote drainage (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal), or managed to maintain a dry surface (except during periods of rainy weather)

- c. Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

d. Step 4 - Cost Effectiveness Analysis

The options above are all achieved in practice; therefore a cost analysis is not required.

e. Step 5 - Select BACT

BACT for NH₃ from Dairy Open Corrals:

- 1) Concrete feed lanes and walkways;
- 2) Flushing the Lanes and walkways for the mature cows (milk and dry cows) four times per day and flushing lanes and walkways for the remaining animals at least once per day (or for dairies that cannot use a flush system, Scraping lanes and walkways for mature cows with an automatic scraper (or equivalent) four times per day and cleaning lanes and walkways for support stock (heifers) at least once per day);
- 3) Feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines;
- 4) Properly sloping corrals (minimum of 3% slope where the available space for each animal is 400 square feet or less and minimum of 1.5% where the available space for each animal is more than 400 square feet per animal) or managing corrals to maintain a dry surface; and
- 5) Scraping of exercise pens and open corrals every two weeks using pull-type scraper in the morning hours except when prevented by wet conditions

Top Down BACT Analysis for Liquid Manure Handling

1. BACT for VOC Emissions from the Lagoon & Storage Pond(s)

a. Identify all control technologies

1) Aerobic Treatment Lagoon or Mechanically Aerated Lagoon

An aerobic lagoon is a waste treatment lagoon that is designed to facilitate the decomposition of wastewater by microbes in the presence of oxygen (O_2). The process of aerobic decomposition results in the conversion of organic compounds in the wastewater into carbon dioxide (CO_2), and (H_2O), nitrates, sulfates, and inert biomass (sludge). The process of aerobic digestion is sometimes referred to as nitrification (especially when discussing NH_3 transformation). Complete aerobic digestion (100% aeration) removes nearly all malodors and also virtually eliminates VOCs, H_2S , and NH_3 emissions from liquid waste.

In completely aerated lagoons sufficient oxygen must be provided to sustain the aerobic microorganisms. NRCS Practice Standard Code 359 specifies that naturally aerobic lagoons have a minimum surface area determined by regional climate and daily Biological Oxygen Demand (BOD_5) and requires the depth of naturally aerobic lagoons have a maximum depth no greater than five feet. For mechanically aerated lagoons NRCS Practice Standard Code 359 specifies that the aeration equipment shall provide a minimum of 1 pound of oxygen for each pound of daily BOD_5 loading. The mechanical aerators that provide the required oxygen may float on the lagoon surface or be submerged in the lagoon. Aeration can also be performed by injection of tiny air bubbles into the lagoon water, mixing of the lagoon water, or spraying of the water into the air. According to Dr. Ruihong Zhang, a researcher at the University of California, Davis, at least 95% VOC control can be achieved if the dissolved oxygen (DO) concentration of the liquid manure is 2.0 mg/L or more. However, the DO concentrations achieved in mechanically aerated lagoons treating manure are typically much less than this and will therefore have lower control efficiencies.

2) Covered Lagoon Digester Vented to a Control Device

Covered treatment lagoons are one type of anaerobic digester. An anaerobic digester is an enclosed basin or tank that is designed to facilitate the decomposition of wastewater by microbes in the absence of oxygen. The process of anaerobic decomposition results in the preferential conversion of organic compounds in the wastewater into methane (CH_4), carbon dioxide (CO_2), and water rather than intermediate metabolites (VOCs). The gas generated by this process is known as biogas, waste gas or digester gas. In addition to methane and carbon dioxide, biogas also contains small amounts of Nitrogen (N_2), Oxygen (O_2), Hydrogen Sulfide (H_2S), and Ammonia (NH_3). Biogas will also include trace amounts of various Volatile Organic Compounds

(VOCs) that remain from incomplete digestion of the volatile solids in the incoming wastewater. The small amounts of undigested solids that remain after digestion are removed from the digester as sludge. Because biogas is mostly composed of methane, the main component of natural gas, the gas produced in the digester can be cleaned to remove H₂S and other impurities and used as fuel. The captured biogas can be combusted in a flare or may be sent to a boiler or internal combustion engine, where the gas can be used to generate useful heat or electrical energy.

As stated above, the gas generated in the covered lagoon anaerobic digester can be captured and then sent to a suitable combustion device. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. The VOCs emitted from the liquid manure in the covered lagoon can be reduced by 95% with the use of an appropriate combustion device. Therefore, installation of the digester will lower the total VOCs emitted from the liquid manure from the liquid manure handling system. Although the control efficiency of the gas captured from the primary lagoon is expected to be 95% or more, the overall control efficiency is expected to be less since VOCs will also be emitted from the storage pond and as fugitive emissions. For this analysis, the overall control efficiency is assumed to be 80% of the emissions that would have been emitted from the lagoon system.

3) Anaerobic Treatment Lagoon Designed to Meet Natural Resources Conservation Service (NRCS) Standards

An anaerobic treatment lagoon is a waste treatment lagoon that is designed to facilitate the decomposition of manure by microbes in the absence of oxygen. The process of anaerobic decomposition results in the preferential conversion of organic compounds in the wastewater into methane (CH₄), carbon dioxide (CO₂), and water rather than intermediate metabolites (VOCs). The National Resource Conservation Service (NRCS) California Field Office Technical Guide Code 359 - Waste Treatment Lagoon specifies the following criteria for the design of anaerobic treatment lagoons:

- Required volume: The minimum design volume should account for all potential sludge, treatment, precipitation, and runoff volumes.
- Treatment period: retention time of the material in the lagoon shall be the time required to provide environmentally safe utilization of waste. The minimum hydraulic retention time for a covered lagoon in the San Joaquin Valley is about 38 days.
- Waste loading: shall be based on the maximum daily loading considering all waste sources that will be treated by the lagoon. The loading rate is typically based on volatile solids (VS) loading per unit of volume. The suggested loading rate for the San Joaquin Valley is 6.5-11 lb-VS/1000 ft³/day depending on separation and type of system.
- The operating depth of the lagoon shall be 12 feet or greater. Maximizing the depth of the lagoon minimizes the surface area, which

in turn minimizes the cover size and cost. Increasing the lagoon depth has the following advantages:

- Minimizes surface area in contact with the atmosphere, thus reducing surface available to convection, evaporation
- Smaller surface areas provide a more favorable and stable environment for methane bacteria
- Better mixing of lagoon due to rising gas bubbles
- Requires less land
- More efficient for mechanical mixing

The lagoon design shall also consider location, soils and foundation, erosion, and depth to groundwater as required by the regional water control board.

The NRCS guideline suggests that this system consist of two cells, a treatment lagoon (primary lagoon) and a storage pond (secondary lagoon). The first stage of the lagoon system is the biological treatment stage and is designed with a constant liquid level to stabilize the anaerobic digestion. The effluent from the first stage overflows into a second lagoon designed for liquid storage capacity. Effluent from the second lagoon is used in the flush lanes and for the irrigation of cropland. The secondary (overflow) lagoon acts as the storage pond, which can be emptied when necessary. However, a single lagoon can also be considered an anaerobic lagoon as long as all the criteria are met and that the liquid manure is not drawn less than 6 feet at any time.

A properly designed anaerobic treatment lagoon will reduce the Volatile Solids (VS) by at least 50% and will reduce the biological oxygen demand (BOD), which will result in greater efficiency in degrading compounds that contain carbon into methane and carbon dioxide rather than VOCs. Although, the VS reduction is expected to be at least 50%, a conservative control efficiency of 40% will be assumed for anaerobic treatment lagoons, until better data becomes available.

4) Solids Removal/Separation

Mechanical Separation

Mechanical separators separate solids out from the liquid/slurry stream. There are many different versions of separators on the market. The percentage of separation varies depending on screen size and type of separation system. However, a 50% solid removal efficiency is used as a general rule of thumb. Although the separation efficiency can be improved by better separation or addition of separators or screens, it does not necessarily result in an increase in VOC emission reduction. The type of solids removed are generally non-digestible (lignins, cellulose, etc.) materials that do not easily digest in the lagoons; the amount of volatile solids that end up in the lagoon will most likely not change even though there is an increase in solid removal efficiency. In

addition, there is no data that links higher removal efficiency with an increase in VOC emission reduction.

Settling Basin Separation

The purpose of settling basin separation is to remove the fibrous materials prior to the liquid manure entering the lagoon. By removing the most fibrous material from the liquid stream prior to entering the pond, it is anticipated that the amount of intermediate metabolites released during digestion in the pond may be reduced. Removal of the fibrous material allows for more complete digestion in the pond and lower emissions.

Solids remaining in the settling basin are left to dry and then are removed. The separated solids can be immediately incorporated into cropland or spread in thin layers, harrowed, and dried.

The control efficiency of settling basins is not known at this time. Separation systems in general have the potential of reducing emissions from the lagoon system by allowing for more complete digestion to take place in the lagoon through the prior removal of indigestible solids. Settling basins dewater predominantly through draining. Some evaporation can occur (depending on weather), but the settling basin is drained, thereby creating a biofilter (crust) over the top of the basin.

Weeping Wall Separation

The purpose of weeping wall separation is to remove the fibrous materials prior to the liquid manure entering the lagoon and enhance the dewatering surface when compared to any other separation pit, basin, or pond. By removing the most fibrous material from the liquid stream prior to entering the pond, it is anticipated that the amount of intermediate metabolites released during digestion in the pond will be reduced. Removal of the fibrous material allows for more complete digestion in the pond and lower emissions. With weeping walls the effluent is allowed to weep through the slots between boards or screens while the solids are retained. Liquid manure enters the structure and slowly drains through the solids in the structure to dewater at a face. Solids from the structure can be hauled directly out of the structure if farming practices permit or they can be further dried for future use. Weeping wall systems can remove 60% of the solids in manure.

The emissions control efficiency of weeping walls is not known at this time. Separation systems in general have the potential of reducing emissions from the lagoon system by allowing for more complete digestion to take place through the removal of indigestible solids.

5) Phototropic Lagoon

Phototropic lagoons or red water lagoons can be identified by their characteristic purple, pink or rose color. Phototropic are the result of naturally occurring phenomena that lead to higher concentrations of purple sulfur and purple non-sulfur bacteria in municipal wastewater lagoons, lagoons treating animal waste, as well as natural lagoons and estuaries, etc. Purple sulfur bacteria utilize hydrogen sulfide and volatile organic acids as an electron source for anoxygenic photosynthesis. Under anaerobic conditions purple sulfur bacteria utilize volatile organic acids and alcohols as a carbon source and ammonia as a nitrogen source for cell growth. This reduces the concentration of these compounds at the surface of the lagoons and reduces the rate of volatilization of these compounds to the atmosphere. A number of studies have found reduced odors and emissions of volatile organic acids from lagoons with higher concentrations of phototropic bacteria. Some of these studies have also found reduced emissions of ammonia from phototropic lagoons.

In nature blooms of purple sulfur and purple non-sulfur bacteria are transitory. These blooms occur when the appropriate conditions are present to promote the growth of these bacteria (e.g. limited oxygen availability, sufficient light penetration, generally warmer temperatures, dilute nutrient loading, etc.). Although phototropic lagoons have shown promise for reduction of emissions from lagoons, there remain limitations to the continuous use of this option. As mentioned above, blooms of phototropic bacteria are generally transitory and the blooms cannot reliably be predicted in different lagoons, even when the lagoons are operated under similar conditions. Phototropic lagoons depend on living organisms to function; therefore, the effectiveness of the system is affected by several factors that are not always under the operator control. Establishment of an effective concentration of phototropic can take several months to more than a year and if this population dies off for any reason it can take the same amount of time for a population of phototropic bacteria to become re-established. Because of uncertainty related to successful establishment of an effective population of phototropic bacteria and the other difficulties related to the continuous use of this option, phototropic lagoons will not be required as BACT at this time; however, phototropic lagoons will remain an option that may be proposed by the operator.

b. Eliminate technologically infeasible options

A phototropic lagoon will be removed as an option.

c. Rank remaining options by control effectiveness

- 1) Aerobic Treatment Lagoon or Mechanically Aerated Lagoon (95% VOC control efficiency)

- 2) Covered Lagoon Digester Vented to a Control Device (80% VOC control efficiency)
- 3) Anaerobic Treatment Lagoon Designed to Meet Natural Resources Conservation Service (NRCS) Standards (40% VOC control efficiency)
- 4) Solids Removal/Separation

d. Cost Effectiveness Analysis

1) Aerobic Treatment Lagoon or Mechanically Aerated Lagoon

The following analysis is based on the treatment of manure from 7,278 milk cows in naturally aerobic lagoons and mechanically aerated lagoons.

Space Requirement for a Naturally Aerobic Lagoon Treating Manure from 7,278 Dairy Cows

NRCS Practice Standard Code 359 requires that naturally aerobic lagoons be designed to have a minimum treatment surface area as determined on the basis of daily BOD₅ loading per unit of lagoon surface. The standard specifies that the maximum loading rate of naturally aerobic lagoons shall not exceed the loading rate indicated by the NRCS Agricultural Waste Management Field Handbook (AWMFH) or the maximum loading rate according to state regulatory requirements, whichever is more stringent. According to Figure 10-30 (August 2009) of the latest version of the AWMFH, the maximum aerobic lagoon loading rate for the San Joaquin Valley is 45 - 55 lb-BOD₅/acre-day. According to Table 4-5 (March 2008) of the NRCS AWMFH, the total daily manure produced by a milk cow will have 2.9 lb-BOD₅/day. Assuming that 80% of the manure will be flushed to the lagoon system, the minimum lagoon surface area required for a naturally aerobic lagoon treating manure from 7,278 milk cows in the San Joaquin Valley can be calculated as follows:

$$\begin{aligned} \text{BOD}_5 \text{ loading (lb/day)} &= 7,278 \text{ milk cows} \times 2.9 \text{ lb-BOD}_5/\text{cow-day} \times 0.80 \\ &= 16,885 \text{ lb-BOD}_5/\text{day} \end{aligned}$$

$$\begin{aligned} \text{Minimum Surface Area (acres) in areas of the San Joaquin Valley with a} \\ \text{maximum loading rate of 55 lb-BOD}_5/\text{acre-day} &= \\ 16,885 \text{ lb-BOD}_5/\text{day} \div 55 \text{ lb-BOD}_5/\text{acre-day} &= 307 \text{ acres} \end{aligned}$$

$$\begin{aligned} \text{Minimum Surface Area (acres) in areas of the San Joaquin Valley with a} \\ \text{maximum loading rate of 45 lb-BOD}_5/\text{acre-day} &= \\ 16,885 \text{ lb-BOD}_5/\text{day} \div 45 \text{ lb-BOD}_5/\text{acre-day} &= 375 \text{ acres} \end{aligned}$$

As shown above the minimum surface area required for a naturally aerobic lagoon treating manure from 7,278 milk cows in the San Joaquin Valley would range from approximately 307 to 375 acres. This does not include the additional surface area that would be required to treat manure from support stock onsite. Based on the space requirements alone it is clear that this option cannot reasonably be required and no further analysis is needed.

Analysis for a Mechanically Aerated Lagoon Treating Manure from 7,278 Dairy Cows

As discussed above, the very large space requirements for naturally aerobic lagoons cause this option to be infeasible for most confined animal facilities. Mechanically aerating a lagoon can achieve some of the benefits of a naturally aerobic lagoon without the large space requirements. However, the costs of energy for complete aeration have also caused this option to be infeasible. The amount of energy required for aeration is based on the amount of volatile solids excreted by animals that must be treated; thus, this cost will be directly proportional to the number of animals at a site. The following analysis will determine the cost of emission reductions that can be achieved from a mechanically aerated lagoon treating manure from 7,278 milk cows.

Biological Oxygen Demand (BOD₅)

In order to effectively calculate the costs of this control option, the energy requirement for complete aeration must be determined. It should be noted that approximately 1.5 to 2.5 pounds of oxygen is required to digest 1 pound of Biological Oxygen Demand (BOD₅) with additional oxygen required for conversion of ammonia to nitrate (nitrification). It is generally accepted that at least twice the BOD should be provided for complete aeration. According to Dr. Ruihong Zhang of the University of California, Davis, 2.4 lbs (1.1 kg) of oxygen (O₂) per cow must be provided each day for removal of BOD and an additional 3 lbs (1.4 kg) per cow for oxidation of 70% of the nitrogen.²²

The proposed rule specifies that an aerobic lagoon be designed and operated in accordance with NRCS Practice Standard Code 359. NRCS Practice Standard Code 359 requires that mechanically aerated lagoons use aeration equipment that provides a minimum of one pound of oxygen for each pound of daily BOD loading. As discussed above, the total daily manure produced by a milk cow will have a BOD₅ of 2.9 lb/day and a lagoon handling flushed manure from 7,278 milk cows will have a loading rate of approximately 16,885 lb-BOD₅/day (7,675 kg-BOD₅/day).

Energy Requirement a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk Cows:

Based on the data gathered in a UC Davis study on aerator performance for wastewater lagoons, aeration efficiencies for mechanical aerators ranged from 0.10 to 0.68 kg of oxygen provided per kW-hr of energy utilized. The most efficient aerator tested that had been installed in dairy lagoons had an aeration efficiency of 0.49 kg-O₂/kW-hr. These efficiency tests were performed in clean water and lower aeration efficiencies are expected in liquid manure because of the significant amount of solids that it contains. The yearly energy requirement mechanically aerated lagoon treating flushed manure from 7,278 milk cows is calculated as follows:

High Efficiency Aerator

$7,675 \text{ kg-BOD}_5/\text{day} \div (0.68 \text{ kg-O}_2/\text{kW-hr}) \times (365 \text{ day/year}) = 4,119,669 \text{ kW-hr/year}$

Low Efficiency Aerator

$7,675 \text{ kg-BOD}_5/\text{day} \div (0.10 \text{ kg-O}_2/\text{kW-hr}) \times (365 \text{ day/year}) = 28,013,750 \text{ kW-hr/year}$

Cost of Electricity for a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk cows:

The cost for electricity will be based upon the average price for industrial electricity in California as of September 2013, as taken from the Energy Information Administration (EIA) Website:

http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_b

Average Cost for electricity = \$0.1115/kW-hr

The electricity costs for complete aeration are calculated as follows:

Low Cost Estimate (High Efficiency Aerator)

$4,119,669 \text{ kW-hr/year} \times \$0.1115/\text{kW-hr} = \$459,343/\text{year}$

High Cost Estimate (Low Efficiency Aerator)

$28,013,750 \text{ kW-hr/year} \times \$0.1115/\text{kW-hr} = \$3,123,533/\text{year}$

VOC Emission Reductions from a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk Cows:

It will be conservatively assumed that a mechanically aerated lagoon providing 1 lb of oxygen for every 1 lb of BOD₅ loading will control 90% of the VOC emissions from the lagoon/storage pond. However, as noted above, it is generally accepted that the oxygen provided should be twice the BOD₅ loading rate for complete aeration; therefore, the actual control from providing 1 lb of oxygen for every 1 lb of BOD₅ loading is probably closer to 50%.

The annual VOC Emission Reductions for mechanically aerated lagoon(s) treating the manure from 7,278 milk cows are calculated as follows and shown in the table below:

[Number of cows] x [Lagoon/Storage Pond VOC EF (lb/cow-year)] x [Complete Aeration Control Efficiency for Lagoon/Storage Pond]

VOC Reductions for a Mechanically Aerated Lagoon							
Type of Animal	# of cows	x	Lagoon EF (lb/cow-yr)	x	Control (%)	=	lb-VOC/yr
Milk Cow (freestall)	7,278	x	1.3	x	90%	=	8,515

Cost of VOC Emission Reductions

Low Estimate = $(\$459,343/\text{year}) / [(8,515 \text{ lb-VOC}/\text{year})(1 \text{ ton}/2000 \text{ lb})]$
= \$107,890/ton of VOC reduced

High Estimate = $(\$3,123,533/\text{year}) / [(8,515 \text{ lb-VOC}/\text{year})(1 \text{ ton}/2000 \text{ lb})]$
= \$733,654/ton of VOC reduced

As shown above, the electricity cost alone for a mechanically aerated lagoon would cause the cost of the VOC reductions to be greater than \$107,890/ton. This cost does not include the additional electricity cost for nitrification that would naturally occur as the lagoons were aerated or equipment costs. Even without these costs, this control technology would not be cost effective.

2) Covered Lagoon Digester Vented to a Control Device

The costs associated with treating the manure excreted by milk cows in a covered lagoon digester vented to a control device are analyzed below. Because it may be possible to generate power from the system to offset some of the costs associated with installation, this potential benefit is included in the analysis below. The following analysis is based on the treatment of manure from 7,278 milk cows in a covered lagoon anaerobic digester with power generation.

Capital Cost for Installation of a Covered Lagoon Digester for Dairy Cows

The capital cost estimates for installation of a covered lagoon digester are based on information from the United States EPA AgSTAR publication "Anaerobic Digestion Capital Costs for Dairy Farms" (May 2010)²³ and the California Energy Commission (CEC) Public Interest Energy Research (PIER) Program Dairy Methane Digester System Program Evaluation Report (Feb 2009)²⁴. The formula in the AgSTAR publication results in a capital cost of \$1,032 per cow for a covered lagoon anaerobic digester treating manure from 1,000 cows. This estimate excludes costs of solids separation after digestion, hydrogen sulfide removal, and utility charges including line upgrades and interconnection costs and fees. Based on information from installations in California, the CEC PIER Dairy Methane Digester Program Evaluation Report gives an average cost of \$585 per cow for installation of covered lagoon anaerobic digesters (see Table 9 - Total Project Costs and Cost per Cow and per kW). Therefore, for purposes of this analysis the capital cost for installation of a covered lagoon digester system for 7,278 cows will be assumed to be

²³ "Anaerobic Digestion Capital Costs for Dairy Farms" (May 2010), EPA AgSTAR http://www.epa.gov/agstar/pdf/digester_cost_fs.pdf

²⁴ "Dairy Power Production Program – Dairy Methane System Program Evaluation Report" (February 2009). Western United Resource Development, Inc prepared for the California Energy Commission (CEC) Public Interest Energy Research Program. (CEC-500-2009-009) <http://www.energy.ca.gov/2009publications/CEC-500-2009-009/CEC-500-2009-009.PDF>

between \$585/cow and \$1,032/cow. The capital cost estimates of a covered lagoon digester treating the manure of 1,000 milk cows is calculated as follows:

Low capital cost estimate: \$585/cow x 7,278 cows = \$4,257,630

High capital cost estimate: \$1,032/cow x 7,278 cows = \$7,510,896

The annualized capital cost estimates will be calculated below. The capital cost for the installation of the covered lagoon digester will be spread over the expected life of the system using the capital recovery equation. The expected life of the entire system will be estimated at 10 years though the cover may require replacement during this period. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times i(i+1)^n]/[(i+1)^n - 1]$$

$$\begin{aligned} \text{Low Annual Capital Cost Estimate} &= [\$4,257,630 \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] \\ &= \$693,994/\text{year} \end{aligned}$$

$$\begin{aligned} \text{High Annual Capital Cost Estimate} &= [\$7,510,896 \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] \\ &= \$1,224,276/\text{year} \end{aligned}$$

Potential Production of Electricity from a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows:

It may be possible to offset some of the installation costs of a covered lagoon anaerobic digester with revenue from generation of electricity. Based on the information given in the CEC PIER Dairy Methane Digester Program Evaluation Report, Table 7 – Actual Generation per Cow Comparisons, California dairies that used a covered lagoon digester to produce electricity generated between 429.1 and 1,031.8 kW-hr/yr per lactating cow with an overall per facility average generation rate of 670.3 kW-hr/yr per lactating cow. This average annual generation rate is actually higher than all the facilities included in the average except one that had a very high generation rate. In addition, this average may overestimate the per-cow generation potential because the contributions of support stock to the digesters were not accounted for. However, for more conservative calculations, this average will be used to calculate the potential annual savings in electricity costs. The potential production of electricity from a covered lagoon digester treating manure from 7,278 milk cows is calculated as follows:

$$\text{Electrical Production: } 670.3 \text{ kW-hr}/(\text{milk cow-yr}) \times 7,278 \text{ milk cows} = 4,878,443 \text{ kW-hr/yr}$$

Potential Cost Savings from Production of Electricity from a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows:

Based on the reference given above, the value of electricity used for this analysis will be = \$0.1115/kW-hr

The potential annual cost savings from electricity generation from a covered lagoon digester treating manure from 7,278 milk cows is calculated as follows:

Potential Annual Cost Savings from Electrical Production:

$$4,878,443 \text{ kW-hr/yr} \times \$0.1115/\text{kW-hr} = \$543,946/\text{yr}$$

Annualized Capital Cost for a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows minus Potential Savings from Generation of Electricity:

$$\text{Low Annual Capital Cost Estimate minus Savings from Potential Generation} \\ = \$693,994/\text{yr} - \$543,946/\text{yr} = \$150,048/\text{year}$$

$$\text{High Annual Capital Cost Estimate minus Savings from Potential Generation} \\ = \$1,224,276/\text{yr} - \$543,946/\text{yr} = \$680,330/\text{year}$$

VOC Emission Reductions from a Covered Lagoon Anaerobic Digester Treating Manure from 7,278 Milk Cows:

The annual VOC Emission Reductions for covered lagoon anaerobic digester treating the manure from 1,000 milk cows are calculated as follows and shown in the table below:

[Number of cows] x [Lagoon/Storage Pond VOC EF (lb/cow-year)] x [Covered Lagoon Digester Control Efficiency for Lagoon/Storage Pond]

VOC Reductions for a Covered Lagoon Vented to Control Device							
Type of Cow	# of cows	x	Lagoon EF (lb/cow-yr)	x	Control (%)	=	lb-VOC/yr
Milk Cow (freestall)	7,278	x	1.3	x	80%	=	7,569

Cost of VOC Emission Reductions

$$\text{Low Estimate} = (\$150,048/\text{year})/[(7,569 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ = \$39,648/\text{ton of VOC reduced}$$

$$\text{High Estimate} = (\$680,330/\text{year})/[(7,569 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ = \$179,767/\text{ton of VOC reduced}$$

As shown above, the capital cost alone for a covered lagoon digester for a dairy would cause the cost of the VOC reductions to be greater than \$39,648/ton. This cost includes the potential revenue generated by electrical production but does not include the additional maintenance required for the system. Additionally, this analysis did not consider the additional pollution that would be generated by any combustion equipment that would utilize the gas, which may offset any reductions in VOCs. Therefore, this control technology would not be cost effective.

3) Anaerobic Treatment Lagoon Designed to Meet Natural Resources Conservation Service (NRCS) Standards

The technology/practice is currently used at multiple dairies located throughout the valley, therefore a cost effective analysis is not required.

4) Solids Removal/Separation

The technology/practice is currently used at multiple dairies located throughout the valley, therefore a cost effective analysis is not required.

e. Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is an anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards. Additionally, solids removal/separation using mechanical separation, settling basin(s), or weeping wall(s) is determined to be BACT.

2. BACT for NH₃ Emissions from the Lagoon & Storage Pond(s)

a. Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, although there is ongoing research for multiple ammonia control technologies, only options that meet the District's definition of Achieved-in-Practice controls will be considered for ammonia at this time.

The following practices have been identified as possible control options for NH₃ emissions from the lagoon and storage pond(s). No other control technologies that meet the definition of Achieved-in-Practice have been identified for the lagoon or storage pond(s).

1) Phototropic Lagoon

Phototropic lagoons or red water lagoons can be identified by their characteristic purple, pink or rose color. Phototropic are the result of naturally occurring phenomena that lead to higher concentrations of purple sulfur and purple non-sulfur bacteria in municipal wastewater lagoons, lagoons treating animal waste, as well as natural lagoons and estuaries, etc. Purple sulfur bacteria utilize hydrogen sulfide and volatile organic acids as an electron source for anoxygenic photosynthesis. Under anaerobic conditions purple sulfur bacteria utilize volatile organic acids and alcohols as a carbon source and ammonia as a nitrogen source for cell growth. This reduces the concentration of these compounds at the surface of the lagoons and reduces the rate of volatilization of these compounds to the atmosphere. A number of studies have found reduced odors and emissions of volatile organic acids from lagoons with higher concentrations of phototropic bacteria. Some of these studies have also found reduced emissions of ammonia from phototropic lagoons.

In nature blooms of purple sulfur and purple non-sulfur bacteria are transitory. These blooms occur when the appropriate conditions are present to promote the growth of these bacteria (e.g. limited oxygen availability, sufficient light penetration, generally warmer temperatures, dilute nutrient loading, etc.). Although phototropic lagoons have shown promise for reduction of emissions from lagoons, there remain limitations to the continuous use of this option. As mentioned above, blooms of phototropic bacteria are generally transitory and the blooms cannot reliably be predicted in different lagoons, even when the lagoons are operated under similar conditions. Phototropic lagoons depend on living organisms to function; therefore, the effectiveness of the system is affected by several factors that are not always under the operator control. Establishment of an effective concentration of phototropic can take several months to more than a year and if this population dies off for any reason it can take the same amount of time for a population of phototropic bacteria to become re-established. Because of uncertainty related to successful establishment of an effective population of phototropic bacteria and the other difficulties related to the continuous use of this option, phototropic lagoons will not be required as BACT at this time; however, phototropic lagoons will remain an option that may be proposed by the operator.

2) Animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure, which will reduce ammonia emissions from liquid manure applied to cropland.

b. Step 2 - Eliminate technologically infeasible options

A phototropic lagoon will be removed as an option.

c. Step 3 - Rank remaining options by control effectiveness

All options are ranked according to their control efficiency.

- 1) Animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

d. Step 4 - Cost Effectiveness Analysis

- 1) All animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

The technology/practice is currently used at all dairies located throughout the valley, therefore a cost effective analysis is not required.

e. Step 5 - Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines are determined to be BACT.

Top-Down BACT Analysis for Liquid/Slurry Manure Land Application

1. BACT for VOC Emissions from Liquid/Slurry Manure Land Application

a. Identify all control technologies

1) Irrigation of crops using liquid/slurry manure from an aerobic treatment lagoon or mechanically aerated lagoon

An aerobic lagoon is a waste treatment lagoon that is designed to facilitate the decomposition of wastewater by microbes in the presence of oxygen (O_2). The process of aerobic decomposition results in the conversion of organic compounds in the wastewater into carbon dioxide (CO_2), and (H_2O), nitrates, sulfates, and inert biomass (sludge). The process of aerobic digestion is sometimes referred to as nitrification (especially when discussing NH_3 transformation). Complete aerobic digestion (100% aeration) removes nearly all malodors and also virtually eliminates VOCs, H_2S , and NH_3 emissions from liquid waste.

In completely aerated lagoons, sufficient oxygen must be provided to sustain the aerobic microorganisms. NRCS Practice Standard Code 359 specifies that naturally aerobic lagoons have a minimum surface area determined by regional climate and daily Biological Oxygen Demand (BOD_5) and requires the depth of naturally aerobic lagoons have a maximum depth no greater than five feet. For mechanically aerated lagoons NRCS Practice Standard Code 359 specifies that the aeration equipment shall provide a minimum of 1 pound of oxygen for each pound of daily BOD_5 loading. The mechanical aerators that provide the required oxygen may float on the lagoon surface or be submerged in the lagoon. Aeration can also be performed by injection of tiny air bubbles into the lagoon water, mixing of the lagoon water, or spraying of the water into the air. According to Dr. Ruihong Zhang, a researcher at the University of California, Davis, at least 95% VOC control can be achieved if the dissolved oxygen (DO) concentration of the liquid manure is 2.0 mg/L or more. However, the DO concentrations achieved in mechanically aerated lagoons treating manure are typically much less than this and will therefore have lower control efficiencies.

2) Irrigation of crops using liquid/slurry manure from a holding/storage pond after being treated in a covered lagoon/digester

This practice would only allow the irrigation of liquid manure to cropland from the secondary lagoon after proper treatment has taken place in a covered lagoon/anaerobic digester. Covered treatment lagoons are one type of anaerobic digester. An anaerobic digester is an enclosed basin or tank that is designed to facilitate the decomposition of wastewater by microbes in the absence of oxygen. The process of anaerobic decomposition results in the preferential conversion of organic compounds in the wastewater into methane (CH_4), carbon dioxide (CO_2), and water rather than intermediate metabolites (VOCs). The gas generated by this

process is known as biogas, waste gas or digester gas. In addition to methane and carbon dioxide, biogas also contains small amounts of Nitrogen (N₂), Oxygen (O₂), Hydrogen Sulfide (H₂S), and Ammonia (NH₃). Biogas will also include trace amounts of various Volatile Organic Compounds (VOCs) that remain from incomplete digestion of the volatile solids in the incoming wastewater. The small amounts of undigested solids that remain after digestion are removed from the digester as sludge.

Assumptions:

- 80% of the Volatile Solids (VS) can be removed from the covered anaerobic digestion process.
- 20% of the remaining VS will be assumed to be in the manure during land application. This will be considered worst-case because further digestion of the VS is likely to occur from the secondary lagoon.
- As a worst-case scenario, it will be assumed that all remaining VS will be emitted as VOCs during land application.

Since 80% of the VS is removed or digested in the covered lagoon and the remaining VS have been assumed to be emitted as VOCs, a control efficiency of 80% can be applied when applying liquid manure to land from a holding/storage pond after a covered lagoon.

3) Irrigation of crops using liquid/slurry manure from the secondary lagoon/holding/storage pond where preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards

This practice would only allow the irrigation of liquid manure to cropland from the secondary lagoon after going through a treatment phase in an anaerobic treatment lagoon, or the primary lagoon.

An anaerobic treatment lagoon is a waste treatment lagoon that is designed to facilitate the decomposition of manure by microbes in the absence of oxygen. The process of anaerobic decomposition results in the preferential conversion of organic compounds in the wastewater into methane (CH₄), carbon dioxide (CO₂), and water rather than intermediate metabolites (VOCs).

The National Resource Conservation Service (NRCS) California Field Office Technical Guide Code 359 - Waste Treatment Lagoon specifies the following criteria for the design of anaerobic treatment lagoons:

- Required volume: The minimum design volume should account for all potential sludge, treatment, precipitation, and runoff volumes.
- Treatment period: retention time of the material in the lagoon shall be the time required to provide environmentally safe utilization of waste. The minimum hydraulic retention time for a covered lagoon in the San Joaquin Valley is about 38 days.

- Waste loading: shall be based on the maximum daily loading considering all waste sources that will be treated by the lagoon. The loading rate is typically based on volatile solids (VS) loading per unit of volume. The suggested loading rate for the San Joaquin Valley is 6.5-11 lb-VS/1000 ft³/day depending on separation and type of system.
- The operating depth of the lagoon shall be 12 feet or greater. Maximizing the depth of the lagoon minimizes the surface area, which in turn minimizes the cover size and cost. Increasing the lagoon depth has the following advantages:
 - Minimizes surface area in contact with the atmosphere, thus reducing surface available to convection, evaporation
 - Smaller surface areas provide a more favorable and stable environment for methane bacteria
 - Better mixing of lagoon due to rising gas bubbles
 - Requires less land
 - More efficient for mechanical mixing

The lagoon design shall also consider location, soils and foundation, erosion, and depth to groundwater as required by the regional water control board.

The NRCS guideline suggests that this system consist of two cells, a treatment lagoon (primary lagoon) and a storage pond (secondary lagoon). The first stage of the lagoon system is the biological treatment stage and is designed with a constant liquid level to stabilize the anaerobic digestion. The effluent from the first stage overflows into a second lagoon designed for liquid storage capacity. Effluent from the second lagoon is used in the flush lanes and for the irrigation of cropland. The secondary (overflow) lagoon acts as the storage pond, which can be emptied when necessary.

A properly designed anaerobic treatment lagoon will reduce the Volatile Solids (VS) by at least 50% and will reduce the biological oxygen demand (BOD), which will result in greater efficiency in degrading compounds that contain carbon into methane and carbon dioxide rather than VOCs. Since 50% of the Volatile Solids in the liquid manure will have been removed or digested in the lagoon, there will be less Volatile Solids remaining in the effluent to decompose into VOCs. Although, the Volatile Solids reduction will be at least 50%, to be conservative a 40% control will be applied to irrigation from a storage pond after an anaerobic treatment lagoon.

4) Irrigation of crops using liquid/slurry manure from the primary lagoon and/or secondary lagoon

Currently, this is the practice for many existing dairies, especially dairies that only have one lagoon at their facility. However, some dairies with multiple lagoons still flush their cropland with liquid manure from either of their lagoons including the primary lagoon.

Control efficiency is unknown at this time and is expected to depend on treatment volume in the lagoon and residence time (digestion time) prior to application, as well as overall loading rate (dilution). However, control efficiency may be much lower from this system than a two-stage anaerobic treatment lagoon system.

5) Land application of lagoon water such that there is no standing water

During land application, minimize or eliminate standing water in an irrigated field within 24 hours, which reduces the potential to volatilize into the atmosphere and/or emit due to anaerobic conditions.

Control efficiency is unknown at this time and additional study will be required. While emission rates are not well known for land application practices, new data may be available soon from on-going research in California. In the absence of emission rates, emission reductions could potentially be assumed to occur where practices are used that decrease the time, temperature or area of water surface from which VOCs could be emitted.

6) Injection of liquid and slurry manure

Liquid and slurry manure is used to irrigate crops on land farmed by dairies. Manure can either be injected into the soil or left on the surface of the soil and allowed to soak in. Because the liquid and slurry manure is high in Nitrogen, Phosphorus, and Potassium (N-P-K), it supplies nutrients needed by crops. Dairies have nutrient management programs to regulate the amount of liquid and slurry manure applied to cropland. This program is used to balance the specific nutrients applied to the crops, such as nitrogen, with the amount of nutrients that the crops can utilize. Balancing the needs of the crop with what is supplied helps to minimize contamination of ground water. During the process of liquid and slurry manure application to the crops, VOC and NH_3 are emitted. Injecting manure hinders volatilization and speeds the uptake of nutrients that would degrade into gaseous pollutants. It is estimated that injection of manure will reduce VOC emissions from land application of manure by 50%.

The manure can only be injected during the time when the crop is not fully mature. This is because a tractor must be used to pull a cultivator with the liquid and slurry manure shanks. Once the crop is planted and grown to a certain height, it is no longer feasible for the tractor to get into the field due to the potential of damaging the crop. Ron Prong of Till-Tech Systems [(519) 775-2575] states that his company's liquid and slurry manure injection system can be used up to four weeks after planting of the crops without causing damage. Therefore, injection of slurry manure can only be required until the crops become so tall that damage will occur.

b. Eliminate technologically infeasible options

Injection of Liquid and Slurry Manure

The Dairy Permitting Advisory Group (DPAG) found that injection of flushed manure was not be a feasible BACT option in their report of BACT options for dairies in the San Joaquin Valley.²⁵

Injection is typically restricted to slurry manure that has been vacuumed from the cow housing or that has been removed from settling basins and/or weeping walls. Injection of flushed liquid manure from the lagoons is not considered feasible because the additional water from flushing increases the amount of liquid that must be transported by the trucks or honeywagons, which will generate more emissions. Because of the added time and expense, injection is not used for flushed liquid manure; therefore, this option will be removed from consideration at this time.

c. Rank remaining options by control effectiveness

- 1) Irrigation of crops using liquid/slurry manure from an aerobic treatment lagoon or mechanically aerated lagoon (95% VOC control efficiency)
- 2) Irrigation of crops using liquid/slurry manure from a holding/storage pond after being treated in a covered lagoon/digester (80% VOC control efficiency)
- 3) Irrigation of crops using liquid/slurry manure from the secondary lagoon/holding/storage pond where preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards (40% VOC control efficiency)
- 4) Irrigation of crops using liquid/slurry manure from the primary lagoon and/or secondary lagoon
- 5) Land application of lagoon water such that there is no standing water

d. Cost Effectiveness Analysis

- 1) Irrigation of crops using liquid/slurry manure from an aerobic treatment lagoon or mechanically aerated lagoon

The following analysis is based on the treatment of manure from 1,000 milk cows in naturally aerobic lagoons and mechanically aerated lagoons. Because the liquid/slurry manure applied to land will come from an aerobic treatment lagoon or mechanically aerated lagoon, it will be assumed the reduction in VOC emissions from the lagoon will result in similar VOC reductions to land application.

²⁵ Page 150 of the Final DPAG Report - "Recommendations to the San Joaquin Valley Air Pollution Control Officer Regarding Best Available Control Technology for Dairies in the San Joaquin Valley" January 31, 2006 (http://www.valleyair.org/busind/pto/dpag/dpag_idx.htm)

Space Requirement for a Naturally Aerobic Lagoon Treating Manure from 7,278 Dairy Cows

NRCS Practice Standard Code 359 requires that naturally aerobic lagoons be designed to have a minimum treatment surface area as determined on the basis of daily BOD₅ loading per unit of lagoon surface. The standard specifies that the maximum loading rate of naturally aerobic lagoons shall not exceed the loading rate indicated by the NRCS Agricultural Waste Management Field Handbook (AWMFH) or the maximum loading rate according to state regulatory requirements, whichever is more stringent. According to Figure 10-30 (August 2009) of the latest version of the AWMFH, the maximum aerobic lagoon loading rate for the San Joaquin Valley is 45 - 55 lb-BOD₅/acre-day. According to Table 4-5 (March 2008) of the NRCS AWMFH, the total daily manure produced by a milk cow will have 2.9 lb-BOD₅/day. Assuming that 80% of the manure will be flushed to the lagoon system, the minimum lagoon surface area required for a naturally aerobic lagoon treating manure from 7,278 milk cows in the San Joaquin Valley can be calculated as follows:

$$\begin{aligned}\text{BOD}_5 \text{ loading (lb/day)} &= 7,278 \text{ milk cows} \times 2.9 \text{ lb-BOD}_5/\text{cow-day} \times 0.80 \\ &= 16,885 \text{ lb-BOD}_5/\text{day}\end{aligned}$$

Minimum Surface Area (acres) in areas of the San Joaquin Valley with a maximum loading rate of 55 lb-BOD₅/acre-day =
 $16,885 \text{ lb-BOD}_5/\text{day} \div 55 \text{ lb-BOD}_5/\text{acre-day} = 307 \text{ acres}$

Minimum Surface Area (acres) in areas of the San Joaquin Valley with a maximum loading rate of 45 lb-BOD₅/acre-day =
 $16,885 \text{ lb-BOD}_5/\text{day} \div 45 \text{ lb-BOD}_5/\text{acre-day} = 375 \text{ acres}$

As shown above the minimum surface area required for a naturally aerobic lagoon treating manure from 7,278 milk cows in the San Joaquin Valley would range from approximately 307 to 375 acres. This does not include the additional surface area that would be required to treat manure from support stock onsite. Based on the space requirements alone it is clear that this option cannot reasonably be required and no further analysis is needed.

Analysis for a Mechanically Aerated Lagoon Treating Manure from 7,278 Dairy Cows

As discussed above, the very large space requirements for naturally aerobic lagoons cause this option to be infeasible for most confined animal facilities. Mechanically aerating a lagoon can achieve some of the benefits of a naturally aerobic lagoon without the large space requirements. However, the costs of energy for complete aeration have also caused this option to be infeasible. The amount of energy required for aeration is based on the amount of volatile solids excreted by animals that must be treated; thus, this cost will be directly

proportional to the number of animals at a site. The following analysis will determine the cost of emission reductions that can be achieved from a mechanically aerated lagoon treating manure from 7,278 milk cows.

Biological Oxygen Demand (BOD₅)

In order to effectively calculate the costs of this control option, the energy requirement for complete aeration must be determined. It should be noted that approximately 1.5 to 2.5 pounds of oxygen is required to digest 1 pound of Biological Oxygen Demand (BOD₅) with additional oxygen required for conversion of ammonia to nitrate (nitrification). It is generally accepted that at least twice the BOD should be provided for complete aeration. According to Dr. Ruihong Zhang of the University of California, Davis, 2.4 lbs (1.1 kg) of oxygen (O₂) per cow must be provided each day for removal of BOD and an additional 3 lbs (1.4 kg) per cow for oxidation of 70% of the nitrogen. ²²

The proposed rule specifies that an aerobic lagoon be designed and operated in accordance with NRCS Practice Standard Code 359. NRCS Practice Standard Code 359 requires that mechanically aerated lagoons use aeration equipment that provides a minimum of one pound of oxygen for each pound of daily BOD loading. As discussed above, the total daily manure produced by a milk cow will have a BOD₅ of 2.9 lb/day and a lagoon handling flushed manure from 7,278 milk cows will have a loading rate of approximately 16,885 lb-BOD₅/day (7,675 kg-BOD₅/day).

Energy Requirement a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk cows:

Based on the data gathered in a UC Davis study on aerator performance for wastewater lagoons, aeration efficiencies for mechanical aerators ranged from 0.10 to 0.68 kg of oxygen provided per kW-hr of energy utilized. The most efficient aerator tested that had been installed in dairy lagoons had an aeration efficiency of 0.49 kg-O₂/kW-hr. These efficiency tests were performed in clean water and lower aeration efficiencies are expected in liquid manure because of the significant amount of solids that it contains. The yearly energy requirement mechanically aerated lagoon treating flushed manure from 7,278 milk cows is calculated as follows:

High Efficiency Aerator

$7,675 \text{ kg-BOD}_5/\text{day} \div (0.68 \text{ kg-O}_2/\text{kW-hr}) \times (365 \text{ day/year}) = 4,119,669 \text{ kW-hr/year}$

Low Efficiency Aerator

$7,675 \text{ kg-BOD}_5/\text{day} \div (0.10 \text{ kg-O}_2/\text{kW-hr}) \times (365 \text{ day/year}) = 28,013,750 \text{ kW-hr/year}$

Cost of Electricity for a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk cows:

The cost for electricity will be based upon the average price for industrial electricity in California as of May 2012, as taken from the Energy Information Administration (EIA) Website:

http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_b

Average Cost for electricity = \$0.1115/kW-hr

The electricity costs for complete aeration are calculated as follows:

Low Cost Estimate (High Efficiency Aerator)

4,119,669 kW-hr/year x \$0.1115/kW-hr = \$459,343/year

High Cost Estimate (Low Efficiency Aerator)

28,013,750 kW-hr/year x \$0.1115/kW-hr = \$3,123,533/year

VOC Emission Reductions from a Mechanically Aerated Lagoon Treating Manure from 7,278 Milk Cows that will be applied to land:

It will be conservatively assumed that a mechanically aerated lagoon providing 1 lb of oxygen for every 1 lb of BOD₅ loading will control 90% of the VOC emissions from the lagoon/storage pond. However, as noted above, it is generally accepted that the oxygen provided should be twice the BOD₅ loading rate for complete aeration; therefore, the actual control from providing 1 lb of oxygen for every 1 lb of BOD₅ loading is probably closer to 50%.

The annual VOC Emission Reductions for a mechanically aerated lagoon treating land applied manure from 7,278 milk cows are calculated as follows and shown in the table below:

[Number of cows] x [Liquid Manure Land Application VOC EF (lb/cow-year)] x [Complete Aeration Control Efficiency for Lagoon/Storage Pond]

VOC Reductions for a Mechanically Aerated Lagoon							
Type of Animal	# of cows	x	Liquid Manure Land Application EF (lb/cow-yr)	x	Control (%)	=	lb-VOC/yr
Milk Cow (freestall)	7,278	x	1.4	x	90%	=	9,170

Cost of VOC Emission Reductions

Low Estimate = (\$459,343/year)/[(9,170 lb-VOC/year)(1 ton/2000 lb)]
= \$100,184/ton of VOC reduced

$$\begin{aligned}\text{High Estimate} &= (\$3,123,533/\text{year})/[(9,170 \text{ lb-VOC}/\text{year})(1 \text{ ton}/2000 \text{ lb})] \\ &= \$681,250/\text{ton of VOC reduced}\end{aligned}$$

As shown above, the electricity cost alone for a mechanically aerated lagoon would cause the cost of the VOC reductions to be greater than \$100,184/ton. This cost does not include the additional electricity cost for nitrification that would naturally occur as the lagoons were aerated or equipment costs. Even without these costs, this control technology would not be cost effective.

2) Irrigation of crops using liquid/slurry manure from a holding/storage pond after being treated in a covered lagoon/digester

The costs associated with treating the manure excreted by milk cows in a covered lagoon digester vented to a control device are analyzed below. Because it may be possible to generate power from the system to offset some of the costs associated with installation, this potential benefit is included in the analysis below. The following analysis is based on the treatment of manure from 7,278 milk cows in a covered lagoon anaerobic digester with power generation. Because the liquid/slurry manure applied to land will come from a storage pond after being treated in a covered lagoon/digester, it will be assume the reduction in VOC emissions from the lagoon/digester will result in similar VOC reductions to land application.

Capital Cost for Installation of a Covered Lagoon Digester for Dairy Cows

The capital cost estimates for installation of a covered lagoon digester are based on information from the United States EPA AgSTAR publication "Anaerobic Digestion Capital Costs for Dairy Farms" (May 2010)²⁶ and the California Energy Commission (CEC) Public Interest Energy Research (PIER) Program Dairy Methane Digester System Program Evaluation Report (Feb 2009)²⁷. The formula in the AgSTAR publication results in a capital cost of \$1,032 per cow for a covered lagoon anaerobic digester treating manure from 1,000 cows. This estimate excludes costs of solids separation after digestion, hydrogen sulfide removal, and utility charges including line upgrades and interconnection costs and fees. Based on information from installations in California, the CEC PIER Dairy Methane Digester Program Evaluation Report gives an average cost of \$585 per cow for installation of covered lagoon anaerobic digesters (see Table 9 - Total Project Costs and Cost per Cow and per kW). Therefore, for purposes of this analysis the capital cost for installation of a covered lagoon digester system for 1,000 cows will be assumed to be

²⁶ "Anaerobic Digestion Capital Costs for Dairy Farms" (May 2010), EPA AgSTAR http://www.epa.gov/agstar/pdf/digester_cost_fs.pdf

²⁷ "Dairy Power Production Program – Dairy Methane System Program Evaluation Report" (February 2009). Western United Resource Development, Inc prepared for the California Energy Commission (CEC) Public Interest Energy Research Program. (CEC-500-2009-009) <http://www.energy.ca.gov/2009publications/CEC-500-2009-009/CEC-500-2009-009.PDF>

between \$585/cow and \$1,032/cow. The capital cost estimates of a covered lagoon digester treating the manure of 1,000 milk cows is calculated as follows:

Low capital cost estimate: \$585/cow x 7,278 cows = \$4,257,630

High capital cost estimate: \$1,032/cow x 7,278 cows = \$7,510,896

The annualized capital cost estimates will be calculated below. The capital cost for the installation of the covered lagoon digester will be spread over the expected life of the system using the capital recovery equation. The expected life of the entire system will be estimated at 10 years though the cover may require replacement during this period. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times i(1+i)^n]/[(1+i)^n - 1]$$

$$\begin{aligned}\text{Low Annual Capital Cost Estimate} &= [\$4,257,630 \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] \\ &= \$693,994/\text{year}\end{aligned}$$

$$\begin{aligned}\text{High Annual Capital Cost Estimate} &= [\$7,510,896 \times 0.1(1.1)^{10}]/[(1.1)^{10} - 1] \\ &= \$1,224,276/\text{year}\end{aligned}$$

Potential Production of Electricity from a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows:

It may be possible to offset some of the installation costs of a covered lagoon anaerobic digester with revenue from generation of electricity. Based on the information given in the CEC PIER Dairy Methane Digester Program Evaluation Report, Table 7 – Actual Generation per Cow Comparisons, California dairies that used a covered lagoon digester to produce electricity generated between 429.1 and 1,031.8 kW-hr/yr per lactating cow with an overall per facility average generation rate of 670.3 kW-hr/yr per lactating cow. This average annual generation rate is actually higher than all the facilities included in the average except one that had a very high generation rate. In addition, this average may overestimate the per-cow generation potential because the contributions of support stock to the digesters were not accounted for. However, for more conservative calculations, this average will be used to calculate the potential annual savings in electricity costs. The potential production of electricity from a covered lagoon digester treating manure from 1,000 milk cows is calculated as follows:

$$\text{Electrical Production: } 670.3 \text{ kW-hr}/(\text{milk cow-yr}) \times 7,278 \text{ milk cows} = 4,878,443 \text{ kW-hr/yr}$$

Potential Cost Savings from Production of Electricity from a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows:

Based on the reference given above, the value of electricity used for this analysis will be = \$0.1115/kW-hr

The potential annual cost savings from electricity generation from a covered lagoon digester treating manure from 7,278 milk cows is calculated as follows:

Potential Annual Cost Savings from Electrical Production:

$$4,878,443 \text{ kW-hr/yr} \times \$0.1115/\text{kW-hr} = \$543,946/\text{yr}$$

Annualized Capital Cost for a Covered Lagoon Digester Treating Manure from 7,278 Milk Cows minus Potential Savings from Generation of Electricity:

Low Annual Capital Cost Estimate minus Savings from Potential Generation
= \$693,994/yr - \$543,946/yr = \$150,048/year

High Annual Capital Cost Estimate minus Savings from Potential Generation
= \$1,224,276/yr - \$543,946/yr = \$680,330/year

VOC Emission Reductions from a Covered Lagoon Anaerobic Digester Treating Manure from 7,278 Milk Cows that will be applied to land:

The annual VOC Emission Reductions for covered lagoon anaerobic digester treating the manure from 7,278 milk cows are calculated as follows and shown in the table below:

[Number of cows] x [Liquid Manure Land Application VOC EF (lb/cow-year)] x
[Covered Lagoon Digester Control Efficiency for Lagoon/Storage Pond]

VOC Reductions for a Covered Lagoon Vented to Control Device							
Type of Animal	# of cows	x	Liquid Manure Land Application EF (lb/cow-yr)	x	Control (%)	=	lb-VOC/yr
Milk Cow (freestall)	7,278	x	1.4	x	80%	=	8,151

Cost of VOC Emission Reductions

Low Estimate = (\$150,048/year)/[(8,151lb-VOC/year)(1 ton/2000 lb)]
= \$36,817/ton of VOC reduced

High Estimate = (\$680,330/year)/[(8,151 lb-VOC/year)(1 ton/2000 lb)]
= \$166,932/ton of VOC reduced

As shown above, the capital cost alone for a covered lagoon digester for a dairy would cause the cost of the VOC reductions to be greater than \$36,817/ton. This cost includes the potential revenue generated by electrical production but does not include the additional maintenance required for the system. Additionally, this analysis did not consider the additional pollution that would be generated by any combustion equipment that would utilize the gas, which may offset any reductions in VOCs. Therefore, this control technology would not be cost effective.

- 3) Irrigation of crops using liquid/slurry manure from the secondary lagoon/holding/storage pond where preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards

The technology/practice is currently used at multiple dairies located throughout the valley, and is therefore cost effective.

- 4) Irrigation of crops using liquid/slurry manure from the primary lagoon and/or secondary lagoon

The technology/practice is currently used at multiple dairies located throughout the valley, and is therefore cost effective.

- 5) Land application of lagoon water such that there is no standing water

This technology is currently required by the Central Valley Regional Water Quality Control Board, and is therefore cost effective.

e. Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is the option with the greatest VOC control: irrigation of crops using liquid manure from the secondary lagoon/holding/storage pond where preceded by an uncovered anaerobic treatment lagoon designed to meet Natural Resources Conservation Service (NRCS) standards.

2. BACT for NH₃ Emissions from the Liquid Manure Land Application

a. Step 1 - Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, although there is ongoing research for multiple ammonia control technologies, only options that meet the District's definition of Achieved-in-Practice controls will be considered for ammonia at this time.

The following practice has been identified as a possible control option for NH₃ emissions from the lagoon and storage pond(s). No other control technologies that meet the definition of Achieved-in-Practice have been identified for the lagoon or storage pond(s).

1) Animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure, which will reduce ammonia emissions from liquid manure applied to cropland.

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1.

c. Step 3 - Rank remaining options by control effectiveness

All options are ranked according to their control efficiency.

1) Animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

f. Step 4 - Cost Effectiveness Analysis

- 1) Animals fed in accordance with National Research Council (NRC) or other District-approved Guidelines

The technology/practice is currently used at all dairies located throughout the valley, therefore, a cost effective analysis is not required.

g. Step 5 - Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is feeding all animals in accordance with National Research Council (NRC) or other District-approved guidelines are determined to be BACT.

Top Down BACT Analysis for Solid Manure Land Application

1. BACT for VOC Emissions from Solid Manure Land Application

a. Identify all control technologies

1) Rapid incorporation of solid manure into the soil after land application

Various types of spreading techniques, such as box spreaders, flail type spreaders, side discharge spreaders, and spinner spreaders, are used to apply solid manure to cropland. Regardless of which technique is used, this practice requires the immediate incorporation of the manure into the soil, reducing emissions and surface run-off while minimizing the loss of nitrogen into the atmosphere. Based on a study by a local Valley dairy, there is a great potential of reducing emissions by incorporating slurry manure rapidly into the soil. A similar reduction may be obtained by the rapid incorporation of solid manure. This technology is expected to yield a VOC control efficiency of up to 58%.²⁸

2) Land Application of Solid Manure Processed by an Open Negatively-Aerated Static Piles (ASP) (With Thick Layer of Bulking Agent or Equivalent)

Aerated static piles are piles that are aerated directly with forced or drawn air systems to speed up the compost process. The aerated static pile is constructed to allow forced airflow (low pressure-high volume blowers and a piping system) so that the oxygen supply can be more accurately controlled. The material is piled over perforated pipes connected to a blower to withdraw air from the pile. The result is improved control of aerobic degradation or decomposition of organic waste and biomass bulking agents. This is considered a more efficient composting method than the industry standard of windrow composting.

VOC emissions primarily occur during the active and curing phases of the composting. To ensure consistent temperatures and prevent escape of odors and VOCs, the piles should be covered with a thick layer (12 to 18 inches) of finished compost or bulking agent.

With positive pressure aeration, contaminated air is pushed through the pile to the outer surface; therefore, making it difficult to be collected for odor treatment. However, positive pressure aeration is more effective at cooling the pile because it provides better airflow.

With negative aeration, air is pulled through the pile from the outer surface. Contaminated air is collected in the aeration pipes and can be directed to an

²⁸ Page 87 of "Recommendations to the San Joaquin Valley Air Pollution Control Officer Regarding Best Available Control Technology for Dairies in the San Joaquin Valley" January 31, 2006 (http://www.valleyair.org/busind/pto/dpag/dpag_idx.htm).

odor treatment system. To avoid clogging, condensed moist air drawn from the pile must be removed before reaching the blower. Negative aeration might create uneven drying of the pile due to its airflow patterns.

A study conducted by City of Columbus, Ohio, demonstrated that the weighted-average odor emissions from an outdoor negative aeration pile is approximately 67% lower than those from an outdoor positive aeration pile. Negative aeration is usually used during the beginning of the composting process to greatly reduce odors. In enclosed active composting area, negative pressure aeration also reduces moisture released into the building, and thus, reduces fogging. Positive aeration is used mostly near the end of the composting cycle for more efficient drying of the compost.²⁹

An odor and emissions study done at the City of Philadelphia biosolids co-composting facility by the Department of Water³⁰ also concluded that controlling the temperature by controlling the oxygen availability using negative aeration composting is expected to result in lower emissions than those from open windrow composting.

The control efficiency can be estimated from the Technology Assessment for SCAQMD Proposed Rule 1133 Table 3-2 which uses a capture efficiency of 25 to 33% from an open ASP and multiplies it by a conservative 80% control equipment efficiency. The average control efficiency for open aerated static piles based on the Technology Assessment is 23.2%. Additional emission reduction potential from open ASPs cannot be quantified at this time. Therefore, a conservative control efficiency of 23.2% will be applied to the ASP.

No control is expected from the land application of the manure since the manure is not being injected or incorporated into the soil. However, since the manure has gone through a pre-control system, the control efficiency of that system would carry over to land application

3) Land Application of Solid Manure Processed by an Open Negatively-Aerated Static Piles (ASP) (With Thick Layer of Bulking Agent or Equivalent) Vented to a Biofilter (or Equivalent)

This technology is the same as that described above for negatively aerated static piles except that the exhaust gases are vented to a biofilter. As discussed above negative aeration appears to be more efficient in reducing odors and emissions than positive aeration.

²⁹ Technology Assessment for SCAQMD proposed Rule 1133 Table 3-2

³⁰ Conclusion # 2, "Measurement and Control of Odor and VOC emissions from the largest municipal aerated-static pile biosolids composting facility in the United States". William Toffey, Philadelphia Water Department; Lawrence Hentz, Post, Buckley, Schuh and Jernigan.

Biofiltration is an air pollution control technology that uses a solid media to absorb and adsorb compounds in the air stream and retains them for subsequent biological oxidation. A biofilter consists of a series of perforated pipes laid in a bed of gravel and covered with an organic media. As the air stream flows up through the media, the odorous compounds are removed by a combination of physical, chemical and biological processes. However, depending upon the airflow from the composting material and the design and material selection for the biofilter, the organic matter could quickly deteriorate.

In the biofiltration process, live bacteria biodegrade organic contaminants from air into carbon dioxide and water. Bacterial cultures (microorganisms that typically consist of several species coexisting in a colony) that use oxygen to biodegrade organics are called aerobic cultures. These bacteria are found in soil, peat, compost and natural water bodies including ponds, lakes, rivers and oceans. They are environmentally friendly and non-harmful to humans unless ingested. Chemically, the biodegradation reaction for aerobic cultures is written as:

Organic(s) + Oxygen + Nutrients + Microorganisms => CO₂ + H₂O + Microorganisms

The organic(s) are air contaminants, the oxygen is in air, the nutrients are nitrogen and phosphorus mineral salts needed for microbial growth and the microorganisms are live bacteria on the biofilter media.

Biofiltration is a well-established emission and control technology in Europe where over two hundred biofilters were in use as of 1984 and even more are expected today. In the United States, biofilters have been mainly utilized for the treatment of odors as well as VOCs in wastewater treatment plants. Based on the information collected by SCAQMD, existing biofilter composting applications have achieved control efficiencies of about 80% to 90% for VOC and 70% to over 90% for ammonia (one of this composting applications reported an initial control efficiency of 65 percent for VOC but was later improved to achieve an 80 percent control efficiency). This specific field example along with other available data presented in SCAQMD's Technology Assessment Report demonstrates that a well-designed, well-operated, and well-maintained biofilter is capable of achieving 80% control efficiency for VOC and ammonia.³¹

No control is expected from the land application of the manure since the manure is not being injected or incorporated into the soil. However, since the manure has gone through an ASP vented to biofilter, the 80% control efficiency of that system would carry over to land application.

³¹ SCAQMD Final Staff Report for Rule 1133, page 18

4) Land Application of Solid Manure Processed by an Enclosed Aerated Static Piles (AgBag, Gore Cover, or Equivalent)

An enclosed aerated static pile uses the same forced aeration principle of an open ASP, except that the entire pile is fully enclosed, either inside a building or with a tarp around it.

There are a few companies that are promoting this type of system. In this analysis, the following two companies will be discussed: AgBag International Ltd and the Gore Cover. Both technologies are briefly described below:

AgBag International Ltd.

The AgBag system was developed by Compost Technology International and is based in Oregon. The system has controlled aeration capabilities and has minimal space requirements. It is suited for small to mid-size composting. The system is comprised of the following components:

- Large sealed bags (pods) of adjustable length up to 200 ft, either 5 ft or 10 ft diameter
- 9 mm recyclable plastic (not re-usable)
- Adjustable aeration system with inserted valved vents
- Hopper, mixer & compost compactor

The Ag-Bag Environmental system provides a cycle time of as little as 8 weeks. Curing adds another 30 to 60 days. AgBag states that three annual composting cycles could be obtained. The area needed to compost is determined by the volume of waste material.

Mixing – A composite mix of materials needs to be balanced for proper carbon to nitrogen (C:N) ratio. This means a mix of greens (nitrogen sources) to browns (carbon sources). The best ratio that AgBag recommends is between 20 to 40:1, with 30:1 being ideal.

The oxygen supply is replenished by forced aeration. This eliminates the labor-intensive need to turn piles. Temperature monitors indicate when the airflow needs adjusting to maintain proper temperatures. Moisture is adjusted at time of filling or added to the total mixture upon blending. The compost matrix is sufficient in size to maintain heat, even in cold climates. The system contains vents throughout to allow air to escape. These vents are controlled by the operator. Ag-Bag is considered an in-vessel system.

After 8-12 weeks of composting, the compost cycle is completed. The “Pod”, as AgBag likes to call it, is opened and the material is static piled for 30-60 days to cure or mature.

A representative of AgBag has claimed very high control efficiencies for both VOCs and ammonia and has claimed that the system acts as its own biofilter, thus reducing emissions. However, VOC and ammonia control efficiencies are not readily available at this time. Furthermore, AgBag has not provided any technical information to support their claimed level of control.

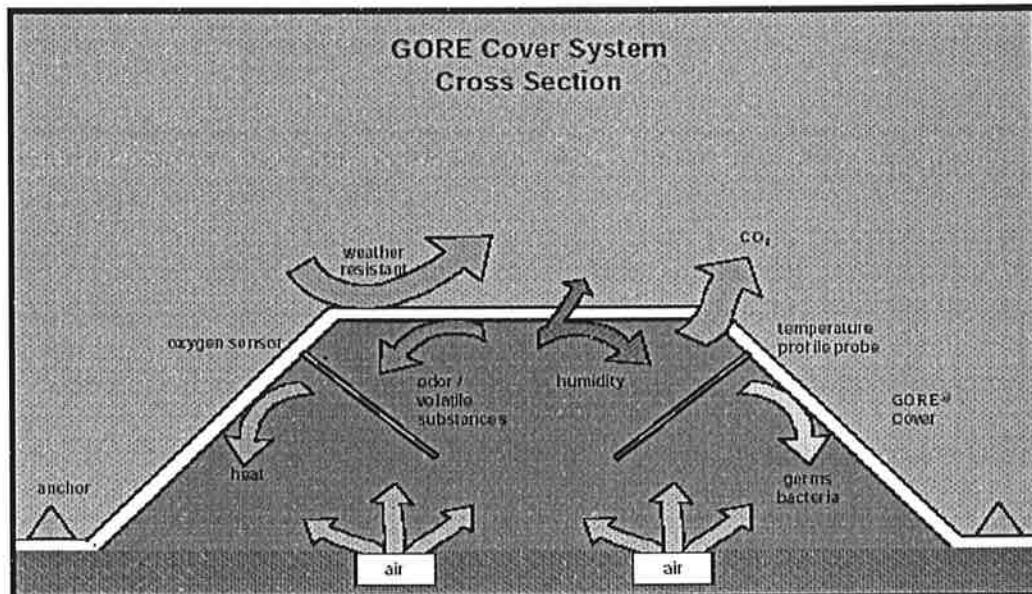
AgBag is working closely with SCAQMD and the Milk Producers Council to perform a pilot study to evaluate the efficiency of this technology. Until the study is completed, this technology will be conservatively assumed to control emissions by at least 10% more than open aerated static piles, with a minimum control efficiency of 33.2%. Once the study is completed, the District will be able to more accurately determine the control efficiency for this technology.

Gore Cover

The Gore Cover, manufactured by Gore Creative Technologies Worldwide, utilizes positive aeration and a specially designed cover to create an enclosed system that controls odors, microorganisms and creates a consistent product unaffected by outside environmental conditions. Medium pressure aerators connect to aeration pipes on the floor or aeration ducts in the floor. Stainless steel probes inserted into the pile monitor oxygen and temperature parameters. The data is relayed to and stored in a computer. This data controls the aerators to keep pile conditions consistent. The Gore Cover system can significantly reduce odors by the controlled use of a semi permeable membrane that is permeable to oxygen but impermeable to large molecules. The cover protects the pile from weather conditions, but allows release of CO₂. These controlled conditions allow consistent product to be produced without risk of damp pockets that may create anaerobic conditions and increased odors.

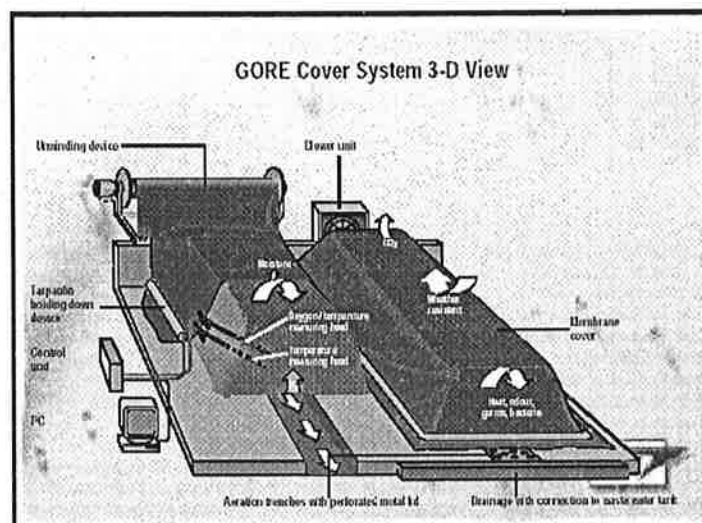
In addition to the membrane, which covers the organic material during composting, the system includes a concrete floor and wall, blowers for aeration, and a winder for efficient movement of the cover. The system also requires consistent management including preparation of materials to achieve a homogenous mixture with moisture content of 55-60% and monitoring of temperature and oxygen levels. With this system, the composting process takes eight weeks. The "heap" of organic material is covered by the membrane, which is secured to the ground, allowed to compost for four weeks, then moved and re-covered for two weeks for stabilization. During the final two weeks of curing, the heap is uncovered.

A fine film of condensation develops during the composting process that collects on the inside cover. According to the manufacturer, the moisture helps to dissolve the gases. The condensation then drips back onto the pile, where they can continue to be broken down by the composting process.



The system, according to Gore Cover, shortens the time required to produce finished, premium compost, as follows:

- First zone – Four weeks – Material stays on the initial placement zone in-vessel
- Second zone – Two weeks – Material moved to another in-vessel zone with minimizing addition of water. Water addition is nominal because the in-vessel system retains the initial moisture within the system and only releases minimal amounts.
- Third zone – Two weeks – the final move is to a third uncovered zone.
- Screening – Material will be screened then ready to sell within 15 days.



There is no control efficiency available at this time for enclosed aerated static piles. A study is under way by SQAQMD and the Milk Producers Council to

determine the control efficiencies for VOC and ammonia emissions from enclosed aerated composting systems. Until the study is completed, this technology will be conservatively assumed to control emissions by 10% more than open aerated static piles, with a minimum control efficiency of 33.2% until additional data are available.

No control is expected from the land application of the manure since the manure is not being injected or incorporated into the soil. However, since the manure has gone through a pre-control system, the control efficiency of that system would carry over to land application

5) Land Application of Solid Manure Processed by an In-Vessel/Enclosed (Building, AgBag, Gore Cover, or Equivalent) Negatively-Aerated Static Piles Vented to a Biofilter

An in-vessel aerated static pile uses the same forced aeration principle of an open ASP, except that the entire pile is fully enclosed, either inside of a building or with a tarp around it. In addition to the in-vessel ASP, the biogas must be sent to a biofilter capable of reducing at least 80% emissions.

According to the SCAQMD Rule 1133.2 final staff report (page 18) "Technology Assessment Report states a well-designed, well operated, and well-maintained biofilter is capable of achieving 80% destruction efficiency for VOC and NH₃." The overall control efficiency of this technology is equal to the combined control efficiencies of the enclosed aerated system (33.2% - calculated above in section 19) and the biofilter (80%), calculated as follows:

$$CE = (0.332) + (1-0.332)*0.8 = 86.6\%$$

No control is expected from the land application of the manure since the manure is not being injected or incorporated into the soil. However, since the manure has gone through a pre-control system, the control efficiency of that system would carry over to land application.

6) Land Application of Solid Manure Processed by Open Negatively-Aerated Static Piles (ASP) (With Thick Layer of Bulking Agent or Equivalent) With Rapid Incorporation of the Manure Into the Soil After Land Application

This technology is the same as described in Option 3 above but with the added control of rapid incorporation of the manure into the soil.

As discussed in Option 1, the VOC control efficiency from immediate incorporation is up to 58%. The overall control efficiency of the combination of both practices is equal to the combined control efficiencies of the open aerated system (23%) and the control efficiency of immediate incorporation.

$$VOC \text{ Overall Control efficiency } (0.23) + (1-0.23)*(58\%) = 67.7\%$$

7) Land Application of Solid Manure Processed by Either an Open or Enclosed Negatively-Aerated Static Pile (ASP) Vented to a Biofilter With Rapid Incorporation of the Manure Into the Soil After Land Application

This technology is the same as described in Options 4 and 6 above but with the added control of rapid incorporation of the manure into the soil.

As discussed in Option 1, the VOC control efficiency from immediate incorporation is up to 58%. The overall control efficiency of the combination of both practices is equal to the combined control efficiencies of the ASP and biofilter system (80%) and the control efficiency of immediate incorporation.

$$\text{VOC Overall Control efficiency} (0.80) + (1-0.80) \times (58\%) = 91.6\%$$

b. Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate in Step 1.

c. Rank remaining options by control effectiveness

- 1) Land Application of Solid Manure Processed by Either an Open or Enclosed Negatively-Aerated Static Pile (ASP) Vented to a Biofilter With Rapid Incorporation of the Manure Into the Soil After Land Application (91.6%)
- 2) Land Application of Solid Manure Processed by In-Vessel/Enclosed Negatively-Aerated Static Piles vented to biofilter $\geq 80\%$ destruction efficiency for both active and curing phases (or a combination of controls) ($\approx 86.6\%$)
- 3) Land Application of Solid Manure Processed by Open Negatively-Aerated Static Piles vented to biofilter $\geq 80\%$ destruction efficiency for both active and curing phases (or a combination of controls) ($\approx 80\%$)
- 4) Land Application of Solid Manure Processed by an Open Negatively-Aerated Static Piles (ASP) (With Thick Layer of Bulking Agent or Equivalent) With Rapid Incorporation of the Manure Into the Soil After Land Application (67.7%)
- 5) Rapid incorporation of solid manure into the soil after land application (58%)
- 6) Land Application of Solid Manure Processed by Enclosed Negatively-Aerated Static Pile ($\approx 33.2\%$)
- 7) Land Application of Solid Manure Processed by Open Negatively-Aerated Static Pile (ASP) ($\approx 23.2\%$)

d. Cost Effectiveness Analysis

- 1) Options 1, 2, and 3: Land Application of In-Vessel/Enclosed Negatively-Aerated Static Piles Vented to Biofilter or Open Negatively-Aerated Static Piles Vented to Biofilter (With Rapid Incorporation of the Manure Into the Soil After Land Application)

The following costs are taken from the final staff report for District Rule 4565 - Biosolids, Animal Manure, and Poultry Litter Operations (May 30, 2007).³² The cost information is based on a large composting facility with a throughput of 200,000 wet tons per year. On a per ton basis the costs for smaller composting facilities would be higher since there would not be the economies of scale for building and operations created by large composting facilities.

Low Cost Scenario: ASP & Biofilter (200,000 wet ton/yr)	
Total Capital Cost	\$7,775,000
Annualized capital cost (10% interest - 10 years)	\$1,265,345
Total Annual O & M Cost	\$124,305
Total Annualized Cost - ASP & Biofilter (Low-Estimate of Annual Costs) (\$/yr/facility)	\$1,389,650

High Cost Scenario: In-Vessel and RTO (200,000 wet ton/yr)	
Total Capital Cost	\$21,185,000
Annualized capital cost (10% interest - 10 years)	\$3,447,761
Total Annual O & M Cost	\$285,910
Total Annualized Cost - In-Vessel & RTO (High-Estimate of Annual Costs) (\$/yr/facility)	\$3,733,671

The final staff report for District Rule 4565 stated that the use of ASPs and in-vessel composting would have unreasonably high costs for facilities that have a throughput of less than 100,000 wet tons per year. The costs given above are for a facility with a throughput of 200,000 wet tons per year. It will conservatively be assumed that the cost for a facility with a throughput of 100,000 wet tons per year will be half of the values given above. Therefore, the cost estimates for a facility with a throughput of 100,000 are as follows:

Low Annual Capital Cost Estimate (100,000 wet ton/yr) = \$694,825/year

High Annual Capital Cost Estimate (100,000 wet ton/yr) = \$1,866,836/year

Because it has been determined that composting or storing solid manure removed from dairy cow housing in an ASP or enclosure vented to a control device would not be cost-effective for a facility with a throughput of less than

³² The capital and operation costs for ASP and in-vessel composting given in the final staff report were taken from: United States Environmental Protection Agency, "Biosolids Technology Fact Sheet: Use of Composting for Biosolids Management" EPA 832-F-02-024, September 2002, http://water.epa.gov/scitech/wastetech/upload/2002_10_15_mtb_combioman.pdf. These costs were not adjusted for inflation

100,000 tons per year, this analysis will be based on a dairy facility that can produce 100,000 tons of solid manure per year.

Number of Cows to Produce 100,000 ton/yr of Solid Manure

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Agricultural Waste Management Field Handbook (AWMFH), Chapter 4 - Agricultural Waste Characteristics (March 2008), dairy cows in scraped open corrals produce approximately 77 lb per day of solid manure that can be removed and transferred for storage or composting. The amount of solid manure removed for dairy cows housed in corrals or freestall barns with a flush system would be much less. The number of cows needed to produce 100,000 ton/year of solid manure is calculated as follows:

$$(100,000 \text{ ton/year} \times 2,000 \text{ lb/ton}) \div (77 \text{ lb/cow-day} \times 365 \text{ day/yr}) = 7,116 \text{ cows}$$

VOC Emission Reductions from an ASP or Enclosure Handling Solid Manure from 7,116 Milk Cows:

The annual VOC Emission Reductions for ASP or in-vessel enclosure handling the solid manure from 7,116 milk cows are calculated as follows and shown in the table below:

$$[\text{Number of cows}] \times [\text{Solid Manure VOC EF (lb/cow-year)}] \times [\text{ASP/In-Vessel Capture Efficiency}] \times [\text{Control Device VOC Control Efficiency}]$$

VOC Reductions for Dairy Solid Manure in ASP or Enclosure Vented to a Biofilter									
Type of Animal	# of cows	x	Solid Manure Land Application EF (lb/cow-yr)	x	Capture (%)*	x	Control (%)	=	lb-VOC/yr
Milk Cow	7,116	x	0.33	x	50%	x	80%	=	939

*The capture efficiency is conservatively assumed to be 50%. The technical assessment of SCAQMD Rule 1133.2 and the staff report for District Rule 4565 give a capture efficiency of 33% for composting facilities, which would result in lower emission reductions.

Cost of VOC Emission Reductions

$$\begin{aligned} \text{Low Estimate} &= (\$694,825/\text{year}) / [(939 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ &= \$1,479,925/\text{ton of VOC reduced} \end{aligned}$$

$$\begin{aligned} \text{High Estimate} &= (\$1,866,836/\text{year}) / [(939 \text{ lb-VOC/year})(1 \text{ ton}/2000 \text{ lb})] \\ &= \$3,976,222/\text{ton of VOC reduced} \end{aligned}$$

As shown above, the cost alone of an ASP or in-vessel enclosure vented to a biofilter to handle the solid manure at a dairy would cause the cost of the VOC

reductions to be greater than \$1,479,925/ton. The excessively high costs of this option make it impractical for most confined animal facilities. Therefore, this control technology is not cost effective.

2) Options 4, 7, and 8: Land Application of Solid Manure Processed by an Open Negatively-Aerated Static Pile (ASP) or Enclosed Negatively-Aerated Static Pile (With Rapid Incorporation of the Manure Into the Soil After Land Application)

A cost effectiveness was evaluated by SCAQMD for a variety of controls for new and existing co-composting facilities based on implementation of several possible scenarios. The cost effectiveness for new co-composting facilities was estimated to be about \$24,000 to \$27,000 per ton of VOC reduced or \$11,000 to \$12,000 per ton of VOC and ammonia reduced based on fabric or concrete type of enclosure for the active phase of composting and forced aeration system for the active and curing phases vented to a bio-filter.³³

For existing co-composting operations, SCAQMD analyzed a few different scenarios. Under one of the scenarios, assuming enclosure without an aeration system for active phase of composting and a forced aeration system for curing phase (both vented to a biofilter) and depending on the type of enclosure, the cost-effectiveness ranged from \$11,400 to \$15,400 per ton of VOC and ammonia reduced, or \$30,000 to \$40,000 per ton of VOC reduced. Under another scenario, using enclosure and aeration system for active phase, and aeration system for curing phase, both vented to biofilter, the cost effectiveness ranged from \$8,700 to \$10,000 per ton of VOC and ammonia reduced or \$23,000 to \$26,500 per ton of VOC reduced (depending on the type of enclosure). Under another scenario, assuming that forced aeration system (in combination with process controls, optimized feedstock mix ratios, and best management practices) for both active and curing phases (combined with a biofiltration system) could achieve the required reductions (i.e., 70% for VOC and ammonia), the cost-effectiveness could be as low as \$6,500 per ton of VOC and ammonia reduced or \$17,000 per ton of VOC reduced. However, SCAQMD stated that additional test data would be necessary to validate the efficiency of such control methods.³⁴

The VOC and ammonia baseline emission factors, used in determining the cost effective analysis (also included in Rule 1133.2), were developed based on the AQMD source tests conducted in 1995 and 1996 for three windrow co-composting facilities (1.78 pounds of VOC and 2.93 pounds of ammonia per ton of throughput). These emission factors do not accurately represent the baseline emissions of manure storage piles from dairy/calf facilities. The emission factor for manure piles may in fact be lower.

³³ Final Staff report for proposed Rule 1133, 1133.1, and 1133.2)

³⁴ The cost assumptions used in this analysis (capital and operating cost) are included in the Technology Assessment Report for SCAQMD PR1133 (Attachment A to the Final Staff Report)

Enclosed ASP or in-vessel systems with control equipment, while feasible and effective at significantly reducing emissions, are costly. There may be additional emission reductions associated with ASP systems that have not been quantified in this evaluation. Additional testing of ASP systems, such as the ones discussed in this evaluation would allow the emission reduction potential of all control scenarios to be refined.

Therefore, these aerated static composting systems will be eliminated at this time.

3) Rapid incorporation of solid manure into the soil after land application

This practice is currently used at many dairies and can easily be incorporated into existing and new dairies. Therefore, a cost effective analysis will not be performed.

e. Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is rapid incorporation of solid manure into the soil after land application.

BACT for NH₃ Emissions from Solid Manure Land Application

a. Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, although there is ongoing research for multiple ammonia control technologies, only options that meet the District's definition of Achieved-in-Practice controls will be considered for ammonia at this time.

The following practices have been identified as possible control options for NH₃ emissions from solid manure land application. No other control technologies that meet the definition of Achieved-in-Practice have been identified for solid manure land application.

1) Rapid incorporation of solid manure into the soil after land application

Various types of spreading techniques, such as box spreaders, flail type spreaders, side discharge spreaders, and spinner spreaders, are used to apply solid manure to cropland. Regardless of which technique is used, this practice requires the immediate incorporation of the manure into the soil, reducing emissions and surface run-off while minimizing the loss of nitrogen into the atmosphere. Based on a study by a local Valley dairy, there is a great potential of reducing emissions by incorporating slurry manure rapidly into the soil. A similar reduction may be obtained by the rapid incorporation of solid manure. This technology is expected to yield a NH₃ control efficiency ranging from 49% to upwards of 98%.³⁵

2) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure, which will reduce ammonia emissions from solid manure.

³⁵ Page 81 of "Recommendations to the San Joaquin Valley Air Pollution Control Officer Regarding Best Available Control Technology for Dairies in the San Joaquin Valley" January 31, 2006 (http://www.valleyair.org/busind/pto/dpag/dpag_idx.htm).

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1.

c. Step 3 - Rank remaining options by control effectiveness

- 1) Rapid incorporation of solid manure into the soil after land application
- 2) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

d. Cost Effectiveness Analysis

- 1) Rapid incorporation of solid manure into the soil after land application

The technology/practice is currently used at multiple dairies located throughout the valley, therefore a cost effective analysis is not required.

- 2) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

The technology/practice is currently used at all dairies located throughout the valley, therefore a cost effective analysis is not required.

e. Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is rapid incorporation of solid manure into the soil after land application, and to feed all animals at the dairy in accordance with National Research Council (NRC) or other District-approved guidelines.

Top Down BACT Analysis for Solid Manure Storage/Separated Solids Piles

1. BACT for NH₃ Emissions from Solid Manure Storage/Separated Solids Piles

a. Identify all control technologies

A cost effectiveness threshold has not been established for ammonia. Therefore, although there is ongoing research for multiple ammonia control technologies, only options that meet the District's definition of Achieved-in-Practice controls will be considered for ammonia at this time.

The following practices have been identified as possible control options for NH₃ emissions from solid manure storage/separated solids piles. No other control technologies that meet the definition of Achieved-in-Practice have been identified for solid manure storage/separated solids piles.

- 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

Nutritional management of dairy feed is routinely practiced to improve milk production and herd health. The potential for ammonia emissions can be reduced by reducing the amount of undigested nitrogen compounds in the manure. The level of microbial action in the manure corresponds to the level of organic nitrogen content in the manure; the lower the level of nitrogen the lower the level of microbial action and the lower the production of ammonia and VOCs.

A diet that is formulated to feed proper amounts of ruminantly degradable protein will result in improved nitrogen utilization by the animal and corresponding reduction in urea and organic nitrogen content of the manure, which will reduce the production of VOCs and ammonia. The latest National Research Council (NRC) guidelines for the selection of an optimal bovine diet should be followed to the maximum extent possible. The diet recommendations made in this publication seek to achieve the maximum uptake of protein by the animal and the minimum carryover of nitrogen into the manure, which will reduce ammonia emissions from solid manure.

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1.

c. Step 3 - Rank remaining options by control effectiveness

- 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

d. Cost Effectiveness Analysis

- 1) All animals fed in accordance with National Research Council (NRC) or other District-approved guidelines

The technology/practice is currently used at all dairies located throughout the valley, therefore a cost effective analysis is not required.

e. Select BACT

Achieved in Practice option is determined to be BACT. Therefore, BACT for this operation is to feed all animals at the dairy in accordance with National Research Council (NRC) or other District-approved guidelines.

Top Down BACT Analysis for the Feed Storage and Handling System – Total Mixed Ration (TMR)

1. BACT Analysis for VOC Emissions

a. Identify all control technologies

Since specific VOC emissions control efficiencies have not been identified in the literature for dairy TMR, the control efficiencies will be estimated based on the control efficiencies of similar processes and engineering judgment.

The following options were identified as possible controls for VOC emissions from the Total Mixed Ration (TMR) (Feed Handling and Storage permit):

- 1) Enclosed Buildings for Animals and TMR with Emissions Vented to a Control Device (e.g. incinerator, biofilter, e.g) ($\approx$ 64-72%; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)

Total Mixed Ration (TMR) refers to feed (primarily silage with grains, oils, minerals, and other additives) that has been mixed to meet the nutritional needs of dairy animals and placed in the feeding areas of the cow housing unit for consumption by the cattle. Because the TMR is placed in the cow housing areas, if emissions from enclosed freestall barns could be captured and vented to a control device, emissions from the TMR could also be controlled.

Description of Dairy Housing

In a freestall barn, cows are grouped in large pens with free access to feed bunks, water, and stalls for resting. In the mild climate of the San Joaquin Valley, the typical freestall barn is an open structure (roof but no sides). The primary freestall design consists of a roof that provides shade with all sides open to allow air to flow through, which keeps the cows cool. The open freestall barns take advantage of natural summer winds in the San Joaquin Valley that are generally greater than four mph. The natural winds result in an excellent summer ventilation rate that is equivalent to 1,000 cfm per cow more, which is why open dairy barns are generally recommended in the San Joaquin Valley. In colder climates enclosed or partially enclosed barns may be utilized to protect cows from winter extremes. However, no completely enclosed freestall barns that were installed at a California dairy were identified.

Although the potential to enclose cows and TMR in a barn may exist, the feasibility of reasonably collecting the gas through a stack, chimney, or vent remains in question considering the extremely large amounts of airflow going through the barns needed to keep the cows cool. The airflow requirements would be even higher in the San Joaquin valley, where temperatures can exceed 110° F in the hot summer. If the barn exhaust can be properly captured it may be possible to vent it to a VOC control device. It is estimated that up to 80% of the gases emitted from enclosed freestall barns can

be captured by the mechanical ventilation system and sent to a control device, such as an incinerator or biofilter.

Thermal incineration is a well-established VOC control technique. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. In addition to the difficulty of capturing all of the gases in a freestall barn, a disadvantage of thermal incineration is that when concentrations of combustible VOCs in the gas stream are very low very large amounts of supplemental fuel must be used to sufficiently increase the temperature of all of the ventilation air in order to incinerate these VOCs. This generally renders incineration cost prohibitive for large flows of dilute VOCs, such as in the ventilation air from a freestall barn. Because of this biofilters have generally been found to be more cost-effective for handling dilute streams of biodegradable VOCs. A biofilter is a device for removing contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. Additional information on biofiltration is given above in the analysis for the cow housing permit unit for enclosed freestall barns vented to a control device. One of the disadvantages related to the use of a biofilter to control emissions from enclosed livestock barns is the large space requirement for the traditional biofilter design. To illustrate this, a low-cost natural bed biofilter designed to treat the VOC emissions from 1,000 milk cows and 180 dry cows with no support stock would cover more than 5.4 acres and would need to be maintained free of pests and approved by the appropriate permitting agencies. To avoid such expansive land requirements, the dairy would likely need to use much more expensive bio-trickling filters or bio-scrubbers.

Although many questions remain about the feasibility of requiring animals and TMR to be confined in buildings and capturing the exhaust gas and venting it to a control device, it will be considered for purposes of this analysis.

2) Rule 4570 Management Practices for TMR

District Rule 4570 requires the implementation of various management practices to reduce VOC emissions from TMR. These practices include pushing feed so that it is within three feet of feedlane fence within two hours of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the animals, so the area of the feed is minimized and the feed can be consumed by the cows in a shorter time period instead of continuing to emit VOCs; beginning feeding total mixed rations within two hours of grinding and mixing rations, reducing the time that fresh feed emits VOCs; storing grain in a weatherproof storage structure or under a weatherproof covering from October through May; feeding steam-flaked, dry rolled, cracked or ground corn or other ground cereal grains; removal of uneaten wet feed from feeding areas; and preparing TMR with a minimum moisture content, which reduces VOCs since most of the compounds emitted are highly soluble in water. More details about these management practices are included in the District document Final Staff Report – Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities), dated October 21, 2010.

b. Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1.

c. Step 3 - Rank remaining options by control effectiveness

After eliminating the technologically infeasible options, the remaining options are ranked according to their control efficiency.

- 1) Enclosed Buildings for Animals and TMR with Emissions Vented to a Control Device (e.g. incinerator, biofilter, e.g) ($\approx 64-72\%$; 80% Capture and 80-90% Control of emissions from cow housing and total mixed ration (TMR) feed placed in the cow housing unit)
- 2) Rule 4570 Management Practices for TMR

d. Step 4 - Cost Effectiveness Analysis

Enclosed Freestall Barns Vented to a Control Device (Biofilter)

The cost analysis performed for the BACT analysis for VOC emissions from the cow housing permit demonstrated that this option exceeded the District VOC cost effective threshold by a significant amount. (See BACT analysis for the Cow Housing Permit for details of the analysis.) This analysis included VOC reductions from Total Mixed Ration (TMR) as well as the cow housing since enclosed freestall barns vented to a control device would control emissions from both sources because the TMR is placed in the cow housing areas to feed the cows. Therefore, no further cost analysis is required for enclosed freestall barns to control emissions from TMR.

Rule 4570 Management Practices for TMR:

This option is achieved in practice; therefore a cost analysis is not required.

e. Step 5 - Select BACT

BACT for VOC from TMR is to implement the management practices required by District Rule 4570 to reduce VOC emissions from the TMR.

APPENDIX E

HRA and AAQA Summary

San Joaquin Valley Air Pollution Control District

Risk Management Review

To: Johnathan Yoshimura – Permit Services
From: Jessica Rosas – Technical Services
Date: June 13, 2018
Facility Name: Diamond H Dairy
Location: 9564 Avenue 18 ½, Chowchilla
Application #(s): C-5289-1-4, 2-5, 3-5, 4-4 and 13-3
Project #: C-1180202

A. RMR SUMMARY

RMR Summary						
Units	Prioritization Score	Acute Hazard Index	Chronic Hazard Index	Maximum Individual Cancer Risk	T-BACT Required?	Special Permit Requirements?
Unit 1-4 (Milking Operation)	0.02	0.00	0.00	4.72E-08	No	No
Unit 2-5 (Cow Housing)	1.45	0.15	0.06	2.30E-06	No ²	No
Unit 3-5 (Liquid Manure)	0.99	0.01	0.00	6.65E-07	No	No
Unit 4-4 (Solid Manure)	0.00	0.00	0.00	0.00	No	No
Unit 13-3 (Feed Storage)	N/A ¹	N/A ¹	N/A ¹	N/A ¹	No	No
Project Totals	2.47	0.16	0.06	3.01E-06		
Facility Totals	>1	0.16	0.06	3.01E-06		

¹There was no increase in emissions for this unit.

² Technical Services determines if T-BACT is triggered on a corral by corral basis. Each individual corral's cancer risk score is below 1.0 in a million, therefore T-BACT is not required.

Proposed Permit Requirements

To ensure that human health risks will not exceed District allowable levels; the following shall be included as requirements for:

Unit # 1-4, 2-5, 3-5, 4-4 & 13-3

No special requirements are required.

B. RMR REPORT

I. Project Description

Technical Services received a request on February 26, 2018, to perform a Risk Management Review for a proposed modification to a dairy operation. The modification consisted of: a consolidation of two dairies, resulting in the shutdown of Defense Ranch (C-5701) and the expansion of Dairy H Dairy (C-5289).

II. Analysis

Toxic emissions for the Cow Housing, Lagoon and Milk Parlor were calculated using emission factors derived from the District's evaluation of dairy research studies conducted by California colleges and universities. PM based toxic emissions for the cow housing were calculated emission factors generated from using the worst case composite of the 1997 EPA speciation of Kern County feedlot soil, and input into the San Joaquin Valley APCD's Hazard Assessment and Reporting Program (SHARP). In accordance with the District's Risk Management Policy for Permitting New and Modified Sources (APR 1905, May 28, 2015), risks from the proposed unit's toxic emissions were prioritized using the procedure in the 2016 CAPCOA Facility Prioritization Guidelines. The prioritization score for this proposed facility was greater than 1.0 (see RMR Summary Table). Therefore, a refined health risk assessment was required. The AERMOD model was used, with the parameters outlined below and meteorological data for 2009-2011 from Madera to determine the dispersion factors (i.e., the predicted concentration or X divided by the normalized source strength or Q) for a receptor grid. These dispersion factors were input into the SHARP Program, which then used the Air Dispersion Modeling and Risk Tool (ADMRT) of the Hot Spots Analysis and Reporting Program Version 2 (HARP 2) to calculate the chronic and acute hazard indices and the carcinogenic risk for the project.

The following parameters were used for the review:

Analysis Parameters Unit 1-4 Milk Parlor			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	3727	Release Height (m)	1
VOC (lb/hr)	0.11	Ammonia (lb/hr)	0.04
VOC (lb/yr)	951	Ammonia(lb/yr)	325

Analysis Parameters Unit 2-5 (FS 1)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	10895.8	Release Height (m)	1
PM10 (lb/hr)	0.0107	PM10 (lb/yr)	94
VOC (lb/hr)	0.1	VOC (lb/Yr)	645
Ammonia (lb/hr)	0.2	Ammonia (lb/yr)	1458

Analysis Parameters Unit 2-5 (FS 2)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	11171.5	Release Height (m)	1
PM10 (lb/hr)	0.0107	PM10 (lb/yr)	94
VOC (lb/hr)	0.1	VOC (lb/Yr)	645
Ammonia (lb/hr)	0.2	Ammonia (lb/yr)	1458

Analysis Parameters Unit 2-5 (FS 9)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	6472.3	Release Height (m)	1
PM10 (lb/hr)	0.0151	PM10 (lb/yr)	132
VOC (lb/hr)	0.1	VOC (lb/Yr)	513
Ammonia (lb/hr)	0.1	Ammonia (lb/yr)	1038

Analysis Parameters Unit 2-5 (OC 11)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	6474	Release Height (m)	1
PM10 (lb/hr)	0.0	PM10 (lb/yr)	-4
VOC (lb/hr)	0.02	VOC (lb/Yr)	178
Ammonia (lb/hr)	0.03	Ammonia (lb/yr)	244

Analysis Parameters Unit 2-5 (OC 12)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	12154.8	Release Height (m)	1
PM10 (lb/hr)	0.067	PM10 (lb/yr)	532
VOC (lb/hr)	0.1	VOC (lb/Yr)	528
Ammonia (lb/hr)	0.1	Ammonia (lb/yr)	720

Analysis Parameters Unit 2-5 (OC 14)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	3431.8	Release Height (m)	1
PM10 (lb/hr)	0.0	PM10 (lb/yr)	0
VOC (lb/hr)	0.04	VOC (lb/Yr)	362
Ammonia (lb/hr)	0.1	Ammonia (lb/yr)	493

Analysis Parameters Unit 2-5 (OC 17)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	29066.4	Release Height (m)	1
PM10 (lb/hr)	0.297	PM10 (lb/yr)	2600
VOC (lb/hr)	0.2	VOC (lb/Yr)	1462
Ammonia (lb/hr)	0.2	Ammonia (lb/yr)	1993

Analysis Parameters Unit 2-5 (New FS 10)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	5371.8	Release Height (m)	1
PM10 (lb/hr)	0.1095	PM10 (lb/yr)	959
VOC (lb/hr)	0.7	VOC (lb/Yr)	6545
Ammonia (lb/hr)	1.7	Ammonia (lb/yr)	14790

Analysis Parameters Unit 2-5 (New FS 11)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	16616.1	Release Height (m)	1
PM10 (lb/hr)	0.1095	PM10 (lb/yr)	959
VOC (lb/hr)	0.7	VOC (lb/Yr)	6545
Ammonia (lb/hr)	1.7	Ammonia (lb/yr)	14790

Analysis Parameters Unit 2-5 (New FS 12)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	6020.4	Release Height (m)	1
PM10 (lb/hr)	0.0656	PM10 (lb/yr)	575
VOC (lb/hr)	0.5	VOC (lb/Yr)	3927
Ammonia (lb/hr)	1.0	Ammonia (lb/yr)	8874

Analysis Parameters Unit 2-5 (New FS 13)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	6109.2	Release Height (m)	1
PM10 (lb/hr)	0.0656	PM10 (lb/yr)	575
VOC (lb/hr)	0.5	VOC (lb/Yr)	3927
Ammonia (lb/hr)	1.0	Ammonia (lb/yr)	8874

Analysis Parameters Unit 2-5 (New FS 14)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	19598.3	Release Height (m)	1
PM10 (lb/hr)	0.0981	PM10 (lb/yr)	859
VOC (lb/hr)	0.4	VOC (lb/Yr)	3317
Ammonia (lb/hr)	0.8	Ammonia (lb/yr)	6715

Analysis Parameters Unit 2-5 (New OC 22)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	14283.1	Release Height (m)	1
PM10 (lb/hr)	0.652	PM10 (lb/yr)	5714
VOC (lb/hr)	0.3	VOC (lb/Yr)	3045
Ammonia (lb/hr)	0.5	Ammonia (lb/yr)	4152

Analysis Parameters Unit 2-5 (New OC 23)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	15431	Release Height (m)	1
PM10 (lb/hr)	0.652	PM10 (lb/yr)	5714
VOC (lb/hr)	0.3	VOC (lb/Yr)	3045
Ammonia (lb/hr)	0.5	Ammonia (lb/yr)	4152

Analysis Parameters Unit 2-5 (New OC 24)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	19259.4	Release Height (m)	1
PM10 (lb/hr)	0.739	PM10 (lb/yr)	6476
VOC (lb/hr)	0.4	VOC (lb/Yr)	3451
Ammonia (lb/hr)	0.5	Ammonia (lb/yr)	4706

Analysis Parameters Unit 2-5 (New OC 25)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	6500.8	Release Height (m)	1
PM10 (lb/hr)	0.1287	PM10 (lb/yr)	0.1287
VOC (lb/hr)	0.1	VOC (lb/Yr)	601
Ammonia (lb/hr)	0.1	Ammonia (lb/yr)	819

Analysis Parameters Unit 2-5 (New OC 26)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	11968.2	Release Height (m)	1
PM10 (lb/hr)	0.4071	PM10 (lb/yr)	3566
VOC (lb/hr)	0.2	VOC (lb/Yr)	1900
Ammonia (lb/hr)	0.3	Ammonia (lb/yr)	2591

Analysis Parameters Unit 2-5 (New OC 27)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	4529.5	Release Height (m)	1
PM10 (lb/hr)	0.1478	PM10 (lb/yr)	1295
VOC (lb/hr)	0.1	VOC (lb/Yr)	690
Ammonia (lb/hr)	0.1	Ammonia (lb/yr)	941

Analysis Parameters Unit 3-5 Liquid Manure Handling (Lagoon)			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	73227.8	Release Height (m)	0
# of Cows	2,378*	Ammonia (lb/hr)	0.4
		Ammonia(lb/yr)	3285

*Used to calculate VOC TAC emissions

Analysis Parameters Unit 4-4 Solid Manure Handling			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	30139.1	Release Height (m)	0
Ammonia (lb/hr)	0.4	Ammonia(lb/yr)	3650

Analysis Parameters (Units 3-5 & 4-4) Land Application*			
Source Type	Area	Location Type	Rural
Approx. Area (m ²)	11016123	Release Height (m)	0
Unit 3-0 Land Application Ammonia (lb/hr)	1.2	Unit 3-0 Land Application Ammonia (lb/yr)	10356
Unit 4-0 Land Application Ammonia (lb/hr)	0.5	Unit 4-0 Land Application Ammonia (lb/yr)	4198

*Ammonia emissions for both liquid manure and dry manure application was evaluated based on farmland application area. The risk from the type of land application was associated with its respective unit.

AAQA. In addition to the RMR, Technical Services performed modeling for the criteria pollutant PM₁₀ using AERMOD. The emission rate used was 31,272 lb PM₁₀/year. The results from the Criteria Pollutant Modeling are as follows:

PM₁₀ Pollutant Modeling Results*
Values are in µg/m³

Category	24 Hours	Annual
Net Value	9.39	0.84
Interim Significance Level	10.4 ¹	2.08 ¹
Result	Pass	Pass

¹The District has decided on an interim basis to use a SIL threshold for fugitive dust sources of 10.4 µg/m³ for the 24-hour average concentration and 2.08 µg/m³ for the annual concentration.

²The PM₁₀ concentration is above the District's interim threshold for fugitive dust sources.

III. Conclusion

The acute and chronic indices are below 1.0 and the cancer risk associated with the project is greater than 1.0 in a million, but less than 20 in a million. Although the cancer risk exceeds 1.0 in a million, the unit/cow housings do not trigger TBACT because Technical Services determines TBACT on a corral by corral basis for dairy projects. **In accordance with the District's Risk Management Policy, the project is approved without Toxic Best Available Control Technology (T-BACT).**

These conclusions are based on the data provided by the applicant and the project engineer. Therefore, this analysis is valid only as long as the proposed data and parameters do not change.

The ambient air quality impacts from PM₁₀ emissions at the proposed dairy (modification) (does not) exceed the District's 24-hour or Annual interim threshold for fugitive dust sources.

IV. Attachments

- A. RMR request from the project engineer
- B. Additional information from the applicant/project engineer
- C. Prioritization score w/ toxic emissions summary
- D. Facility Summary

APPENDIX F

Dairy and SSPE Calculations

Pre-Project Facility Information

- Does this facility house Holstein or Jersey cows?
Most facilities house Holstein cows unless explicitly stated on the PTO or application.
- Does the facility have an anaerobic treatment lagoon?
- Does the facility land apply liquid manure?
Answering "yes" assumes worst case.
- Does the facility land apply solid manure?
Answering "yes" assumes worst case.
- Is any scraped manure sent to a lagoon/storage pond?
Answering "yes" assumes worst case.

Pre-Project Herd Size							
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals		
Milk Cows	4,900				4,900		
Dry Cows			750		750		
Support Stock (Heifers, Calves, and Bulls)			7,480		7,480		
Large Heifers					0		
Medium Heifers					0		
Small Heifers					0		
Bulls					0		
	Calf Hutches				Calf Corrals		Total # of Calves
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Flushed	Scraped	
Calves							0

Total Herd Summary	
Total Milk Cows	4,900
Total Mature Cows	5,650
Support Stock (Heifers, Calves, and Bulls)	7,480
Total Calves	0
Total Dairy Head	13,130

Pre-Project Silage Information			
Feed Type	Max # Open Piles	Max Height (ft)	Max Width (ft)
Corn	1	20	200
Alfalfa	1	12	120
Wheat	1	20	150

Post-Project Facility Information

- Does this facility house Holstein or Jersey cows?
Most facilities house Holstein cows unless explicitly stated on the PTO or application.
- Does the facility have an anaerobic treatment lagoon?
- Does the facility land apply liquid manure?
Answering "yes" assumes worst case.
- Does the facility land apply solid manure?
Answering "yes" assumes worst case.
- Is any scraped manure sent to a lagoon/storage pond?
Answering "yes" assumes worst case.
- Does this project result in any new lagoon/storage pond(s) or an increase in surface area for any existing lagoon/storage pond(s)?

Post-Project Herd Size							
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals		
Milk Cows	7,278				7,278		
Dry Cows	627		377		1,004		
Support Stock (Heifers, Calves, and Bulls)			8,544		8,544		
Large Heifers					0		
Medium Heifers					0		
Small Heifers					0		
Bulls					0		
	Calf Hutches				Calf Corrals		Total # of Calves
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Flushed	Scraped	
Calves							0

Total Herd Summary	
Total Milk Cows	7,278
Total Mature Cows	8,282
Support Stock (Heifers, Calves, and Bulls)	8,544
Total Calves	0
Total Dairy Head	16,826

Post-Project Silage Information			
Feed Type	Max # Open Piles	Max Height (ft)	Max Width (ft)
Corn	1	20	200
Alfalfa	1	12	120
Wheat	1	20	150

VOC Mitigation Measures and Control Efficiencies

Milking Parlor				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	VOC Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Enteric Emissions Mitigations		
☒	☒	(D) Feed according to NRC guidelines	10%	10%
		Total Control Efficiency	10%	10%
		Milking Parlor Floor Mitigations		
☒	☒	(D) Feed according to NRC guidelines	10%	10%
☒	☒	(D) Flush or hose milk parlor immediately prior to, immediately after, or during each milking. Note: If selected for dairies > 999 milk cows, control efficiency is already included in EF.	0%	0%
		Total Control Efficiency	10%	10%

Cow Housing				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	VOC Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Enteric Emissions Mitigations		
☒	☒	Feed according to NRC guidelines	10%	10%
		Total Control Efficiency	10%	10%
		Corrals/Pens Mitigations		
☒	☒	Feed according to NRC guidelines	10%	10%
☒	☒	Inspect water pipes and troughs and repair leaks at least once every seven days. Note: If selected for dairies > 999 milk cows, CE is already included in EF.	0%	0%
☒	☒	Dairies: Clean manure from corrals at least four times per year with at least 60 days between cleaning, or clean corrals at least once between April and July and at least once between September and December. Note: If selected for dairies > 999 milk cows, CE is already included in EF. Note: No additional control given for increased cleaning frequency (e.g. BACT requirement). Heifer/Calf Ranches: Scrape corrals twice a year with at least 90 days between cleanings, excluding in-corral mounds. Note: No additional control given for increased cleaning frequency (e.g. BACT requirement).	0%	0%
☒	☒	Scrape, vacuum, or flush concrete lanes in corrals at least once every day for mature cows and every seven days for support stock, or clean concrete lanes such that the depth of manure does not exceed 12 inches at any point or time. Note: No additional control given for increased cleaning frequency (e.g. BACT requirement).	10%	10%
☒	☒	Implement one of the following: 1) slope the surface of the corrals at least 3% where the available space for each animal is 400 sq ft or less and slope the surface of the corrals at least 1.5% where the available space for each animal is more than 400 sq ft; 2) maintain corrals to ensure proper drainage preventing water from standing more than 48 hrs; 3) harrow, rake, or scrape pens sufficiently to maintain a dry surface. Note: If selected for dairies > 999 milk cows, CE already included in EF.	0%	0%
☐	☐	Install shade structures such that they are constructed with a light permeable roofing material. Note: If selected for dairies > 999 milk cows, the control efficiency will be 5% since the EF used includes a partial control for this measure.	5%	5%
☐	☐	Install all shade structures uphill of any slope in the corral. Note: If selected for dairies > 999 milk cows, the control efficiency will be 5% since the EF used includes a partial control for this measure.		
☐	☐	Clean manure from under corral shades at least once every 14 days, when weather permits access into corral. Note: If selected for dairies > 999 milk cows, the control efficiency will be 5% since the EF used includes a partial control for this measure.		
☒	☒	Install shade structure so that the structure has a North/South orientation. Note: If selected for dairies > 999 milk cows, the control efficiency will be 5% since the EF used includes a partial control for this measure.	0%	0%
☐	☐	Manage corrals such that the manure depth in the corral does not exceed 12 inches at any time or point, except for in-corral mounding. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. The manure facility must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible. Note: If selected for dairies > 999 milk cows, control efficiency is already included in EF.		
☒	☒	Knockdown fence line manure build-up prior to it exceeding a height of 12 inches at any time or point. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. The facility must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible.		
☐	☐	Use lime or a similar absorbent material in the corral according to the manufacturer's recommendation to minimize moisture in the corrals.	0%	0%
☐	☐	Apply thymol to the corral soil in accordance with the manufacturer's recommendation.	0%	0%
		Total Control Efficiency	30.75%	30.75%
		Bedding Mitigations		
☒	☒	Feed according to NRC guidelines	10%	10%
☐	☐	Use non-manure-based bedding and non-separated solids based bedding for at least 90% of the bedding material, by weight, for freestalls (e.g. rubber mats, almond shells, sand, or waterbeds).	0%	0%

☒	☒	For a large dairy (1,000 milk cows or larger) or a heifer/calf ranch - Remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 7 days.	10%	10%
☐	☐	(D) For a medium dairy only (500 to 999 milk cows) - Remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 14 days.	0%	0%
Total Control Efficiency			19.00%	19.00%
Lanes Mitigations				
☒	☒	Feed according to NRC guidelines	10%	10%
☒	☒	Pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers. Note: No control efficiency at this time.	0%	0%
☒	☒	Dairies: Flush, scrape, or vacuum freestall flush lanes immediately prior to or after, or during each milking; or flush or scrape freestall flush lanes at least 3 times per day. Heifer/Calf Ranches: Vacuum, scrape, or flush freestalls at least once every seven days.	10%	10%
☐	☐	(D) Have no animals in exercise pens or corrals at any time.	0%	0%
Total Control Efficiency			19.00%	19.00%

Liquid Manure Handling				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	VOC Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Lagoons/Storage Ponds Mitigations		
☒	☒	Feed according to NRC guidelines	10%	10%
☐	☐	Use phototropic lagoon	0%	0%
☐	☒	Use an anaerobic treatment lagoon designed according to NRCS Guideline No. 359	0%	40%
☒	☒	Remove solids from the waste system with a solid separator system, prior to the waste entering the lagoon. Note: If selected for dairies > 999 milk cows, control efficiency is already included in EF.	0%	0%
☐	☐	Maintain lagoon pH between 6.5 and 7.5	0%	0%
Total Control Efficiency			10.00%	46.00%
		Liquid Manure Land Application Mitigations		
☒	☒	Feed according to NRC guidelines	10%	10%
☐	☒	Only apply liquid manure that has been treated with an anaerobic or aerobic treatment lagoon, aerobic lagoon, or digester system	0%	40%
☒	☒	Allow liquid manure to stand in the fields for no more than 24 hours after irrigation. Note: If selected for dairies > 999 milk cows, control efficiency is already included in EF.	0%	0%
☐	☒	Apply liquid/slurry manure via injection with drag hose or similar apparatus	0%	10%
Total Control Efficiency			10.00%	51.40%

Solid Manure Handling				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	VOC Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
Solid Manure Storage Mitigations				
☒	☒	Feed according to NRC guidelines	10%	10%
☒	☒	LARGE CAFO ONLY: Within 72 hours of removal from housing, either a) remove dry manure from the facility, or b) cover dry manure outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed 24 hours per event.	10%	10%
Total Control Efficiency			19.00%	19.00%
Separated Solids Piles Mitigations				
☒	☒	Feed according to NRC guidelines	10%	10%
☐	☐	LARGE CAFO ONLY: Within 72 hours of removal from the drying process, either a) remove separated solids from the facility, or b) cover separated solids outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed 24 hours per event.	0%	0%
Total Control Efficiency			10.00%	10.00%
Solid Manure Land Application Mitigations				
☒	☒	Feed according to NRC guidelines	10%	10%
☒	☒	Incorporate all solid manure within 72 hours of land application. Note: If selected for dairies > 999 milk cows, control efficiency is already included in EF. Note: No additional control given for rapid manure incorporation (e.g. BACT requirement).	0%	0%
☐	☐	Only apply solid manure that has been treated with an anaerobic treatment lagoon, aerobic lagoon or digester system.	0%	0%
☐	☐	Apply no solid manure with a moisture content of more than 50%	0%	0%
Total Control Efficiency			10.00%	10.00%

Silage and TMR				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	VOC Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Corn/Alfalfa/Wheat Silage Mitigations		
		1. Utilize a sealed feed storage system (e.g. Ag-Bag) for bagged silage, or		
		2. Cover the surface of silage piles, except for the area where feed is being removed from the pile, with a plastic tarp that is at least 5 mils thick (0.005 inches), multiple plastic tarps with a cumulative thickness of at least 5 mils (0.005 inches), or an oxygen barrier film covered with a UV resistant material within 72 hours of last delivery of material to the pile, and implement one of the following:		

☒	☒	a) build silage piles such that the average bulk density is at least 44 lb/cu-ft for corn silage and 40 lb/cu-ft for other silage types, as measured in accordance with Section 7.10 of Rule 4570, b) when creating a silage pile, adjust filling parameters to assure a calculated average bulk density of at least 44 lb/cu-ft for corn silage and at least 40 lb/cu-ft for other silage types, using a spreadsheet approved by the District, c) harvest silage crop at > or = 65% moisture for corn; and >= 60% moisture for alfalfa/grass and other silage crops; manage silage material delivery such that no more than 6 inches of materials are uncompacted on top of the pile; and incorporate the applicable Theoretical Length of Chop (TLC) and roller opening for the crop being harvested. For dairies - implement <u>two</u> of the following: For heifer/calf ranches - implement <u>one</u> of the following: Manage Exposed Silage: a) manage silage piles such that only one silage pile has an uncovered face and the uncovered face has a total exposed surface area of less than 2,150 sq. ft., or b) manage multiple uncovered silage piles such that the total exposed surface area of all silage piles is less than 4,300 sq ft. Maintain Silage Working Face: a) use a shaver/facer to remove silage from the silage pile, or b) maintain a smooth vertical surface on the working face of the silage pile Silage Additive: a) inoculate silage with homolactic acid bacteria in accordance with manufacturer recommendations to achieve a concentration of at least 100,000 colony forming units per gram of wet forage or apply propionic acid, benzoic acid, sorbic acid, sodium benzoate, or potassium sorbate at a rate specified by the manufacturer to reduce yeast counts when forming silage pile; or b) apply other additives at specified rates that have been demonstrated to reduce alcohol concentrations in silage and/or VOC emissions from silage and have been approved by the District and EPA.	39.0%	39.0%
Total Control Efficiency*			39.00%	39.00%

*Assumes 25% control for density mitigation measures and 10% each for the two optional measures, resulting in an overall control of 39%. The same conservative control efficiency will be applied to the sealed feed storage system (Ag-Bag).

		TMR Mitigations		
☒	☒	(D) Push feed so that it is within 3 feet of feedlane fence within 2 hrs of putting out the feed or use a feed trough or other feeding structure designed to maintain feed within reach of the cows.	10%	10%
☒	☒	(D) Begin feeding total mixed rations within 2 hrs of grinding and mixing rations. Note: If selected for dairies > 999 milk cows, control efficiency already included in EF.	0%	0%
☒	☒	Feed steam-flaked, dry rolled, cracked or ground corn or other ground cereal grains.	10%	10%
☐	☐	Remove uneaten wet feed from feed bunks within 24 hrs after the end of a rain event.	0%	0%
☐	☐	(D) For total mixed rations that contain at least 30% by weight of silage, feed animals total mixed rations that contain at least 45% moisture.	0%	0%
☒	☒	Feed according to NRC guidelines. Note: If selected for dairies, control efficiency already included in EF.	0%	0%
Total Control Efficiency			19.00%	19.00%

Ammonia Mitigation Measures and Control Efficiencies

Milking Parlor				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	NH3 Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Milking Parlor Floor Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
Total Control Efficiency			28%	28%

Cow Housing				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	NH3 Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Corrals/Pens Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
☒	☒	Clean manure from corrals at least four times per year with at least 60 days between cleaning, or clean corrals at least once between April and July and at least once between September and December. OR Use lime or a similar absorbent material in the corral according to the manufacturer's recommendation to minimize moisture in the corrals. OR Apply thymol to the corral soil in accordance with the manufacturer's recommendation.	50%	50%
Total Control Efficiency			64%	64%
		Bedding Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
☒	☒	Use non-manure-based bedding and non-separated solids based bedding for at least 90% of the bedding material, by weight, for freestalls (e.g. rubber mats, almond shells, sand, or waterbeds). OR For a large dairy only (1,000 milk cows or larger) - Remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 7 days. OR For a medium dairy only (500 to 999 milk cows) - Remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 14 days.	47.7%	47.7%
Total Control Efficiency			62.34%	62.34%
		Lanes Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
Total Control Efficiency			28%	28%

Liquid Manure Handling				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	NH3 Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Lagoons/Storage Ponds Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
☒	☒	Use phototropic lagoon OR Remove solids from the waste system with a solid separator system, prior to the waste entering the lagoon.	80%	80%
Total Control Efficiency			85.6%	85.6%
		Liquid Manure Land Application Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
☐	☒	Only apply liquid manure that has been treated with an anaerobic treatment lagoon	0%	42%
Total Control Efficiency			28.00%	58.24%

Solid Manure Handling				
Measure Proposed?		Mitigation Measure(s) per Emissions Point	NH3 Control Efficiency (%)	
Pre-Project	Post-Project		Pre-Project	Post-Project
		Solid Manure Land Application Mitigations		
☒	☒	Feed according to NRC guidelines	28%	28%
☐	☐	Incorporate all solid manure within 72 hours of land application. AND Only apply solid manure that has been treated with an anaerobic treatment lagoon, aerobic lagoon or digester system. AND Apply no solid manure with a moisture content of more than 50%	0%	0%
Total Control Efficiency			28.00%	28.00%

Ibidity Dairy Emissions Factors for Holstein Cows																					
		Large Heifers (15 to 24 months)						Medium Heifers (7 to 14 months)						Small Heifers (3 to 6 months)						Bulls	
		Uncontrolled		Controlled		1000 milk cows		1000 milk cows		1000 milk cows		1000 milk cows		1000 milk cows		1000 milk cows					
Milk Cows	Emissions in Milk Cows	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2	EF1	EF2		
		1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	1000 milk cows	
Milking Parlor	Enteric Emissions in Milking Parlor	0.43	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Milking Parlor Floor	0.47	0.44	0.40	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Total	0.90	0.85	0.80	0.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	NH3	0.19	0.19	0.14	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Total	0.99	0.89	0.92	0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Cow Housing	Enteric Emissions in Cow Housing	0.39	0.39	0.32	0.32	2.23	2.23	2.01	1.81	1.71	1.54	1.54	1.23	1.17	1.05	0.69	0.65	0.58	0.58		
	Heating	10.00	6.00	4.57	4.57	5.40	5.40	2.40	2.40	2.70	2.70	1.88	1.88	1.30	1.30	0.85	0.85	0.85	0.85		
	Cooling Pans	1.05	1.00	0.81	0.81	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34		
	Bedding	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
	Lanes	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
Total	15.28	12.09	9.55	9.55	8.75	8.80	5.29	5.29	4.66	4.66	4.62	3.66	2.77	2.77	2.65	1.96	1.54	1.22	0.95		
Liquid Manure Handling	Enteric Emissions in Liquid Manure Handling	1.64	1.40	1.26	0.68	0.89	0.76	0.69	0.37	0.69	0.56	0.56	0.28	0.47	0.40	0.36	0.19	0.26	0.22	0.20	
	Animal	3.16	2.70	2.43	1.38	1.71	1.47	1.33	1.15	1.02	0.57	0.90	0.77	0.69	0.39	0.51	0.43	0.28	0.22	0.21	
	Storage	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	
	Land	8.90	8.90	6.41	3.72	4.50	4.50	3.24	1.88	2.30	2.30	1.66	0.96	1.70	1.70	1.22	0.71	1.30	1.30	0.94	
	Total	17.40	17.40	7.69	4.90	7.20	6.70	3.94	2.48	4.50	4.50	1.97	1.28	3.20	3.20	1.44	0.93	2.60	2.50	1.11	
Solid Manure Storage	Enteric Emissions in Solid Manure Storage	0.16	0.15	0.12	0.09	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	
	Animal	0.06	0.06	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	
	Storage	0.39	0.39	0.30	0.30	0.21	0.18	0.16	0.16	0.16	0.14	0.12	0.12	0.11	0.09	0.06	0.06	0.05	0.05	0.05	
	Land	0.81	0.84	0.67	0.67	0.53	0.53	0.26	0.26	0.26	0.23	0.20	0.17	0.15	0.13	0.10	0.09	0.07	0.07	0.07	
	Total	0.95	0.99	0.95	0.95	0.84	0.84	0.48	0.48	0.48	0.45	0.40	0.39	0.39	0.36	0.33	0.34	0.34	0.34	0.34	
Solid Manure Handling	Enteric Emissions in Solid Manure Handling	0.39	0.39	0.30	0.30	2.23	2.23	2.01	1.81	1.71	1.54	1.54	1.23	1.17	1.05	0.69	0.65	0.58	0.58		
	Heating	10.00	6.00	4.57	4.57	5.40	5.40	2.40	2.40	2.70	2.70	1.88	1.88	1.30	1.30	0.85	0.85	0.85	0.85		
	Cooling Pans	1.05	1.00	0.81	0.81	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34		
	Bedding	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
	Lanes	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
Total	15.28	12.09	9.55	9.55	8.75	8.80	5.29	5.29	4.66	4.66	4.62	3.66	2.77	2.77	2.65	1.96	1.54	1.22	0.95		
Liquid Manure Handling	Enteric Emissions in Liquid Manure Handling	1.64	1.40	1.26	0.68	0.89	0.76	0.69	0.37	0.69	0.56	0.56	0.28	0.47	0.40	0.36	0.19	0.26	0.22	0.20	
	Animal	3.16	2.70	2.43	1.38	1.71	1.47	1.33	1.15	1.02	0.57	0.90	0.77	0.69	0.39	0.51	0.43	0.28	0.22	0.21	
	Storage	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	
	Land	8.90	8.90	6.41	3.72	4.50	4.50	3.24	1.88	2.30	2.30	1.66	0.96	1.70	1.70	1.22	0.71	1.30	1.30	0.94	
	Total	17.40	17.40	7.69	4.90	7.20	6.70	3.94	2.48	4.50	4.50	1.97	1.28	3.20	3.20	1.44	0.93	2.60	2.50	1.11	
Solid Manure Storage	Enteric Emissions in Solid Manure Storage	0.16	0.15	0.12	0.09	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	
	Animal	0.06	0.06	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	
	Storage	0.39	0.39	0.30	0.30	0.21	0.18	0.16	0.16	0.16	0.14	0.12	0.12	0.11	0.09	0.06	0.06	0.05	0.05	0.05	
	Land	0.81	0.84	0.67	0.67	0.53	0.53	0.26	0.26	0.26	0.23	0.20	0.17	0.15	0.13	0.10	0.09	0.07	0.07	0.07	
	Total	0.95	0.99	0.95	0.95	0.84	0.84	0.48	0.48	0.48	0.45	0.40	0.39	0.39	0.36	0.33	0.34	0.34	0.34	0.34	
Solid Manure Handling	Enteric Emissions in Solid Manure Handling	0.39	0.39	0.30	0.30	2.23	2.23	2.01	1.81	1.71	1.54	1.54	1.23	1.17	1.05	0.69	0.65	0.58	0.58		
	Heating	10.00	6.00	4.57	4.57	5.40	5.40	2.40	2.40	2.70	2.70	1.88	1.88	1.30	1.30	0.85	0.85	0.85	0.85		
	Cooling Pans	1.05	1.00	0.81	0.81	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34		
	Bedding	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
	Lanes	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
Total	15.28	12.09	9.55	9.55	8.75	8.80	5.29	5.29	4.66	4.66	4.62	3.66	2.77	2.77	2.65	1.96	1.54	1.22	0.95		
Liquid Manure Handling	Enteric Emissions in Liquid Manure Handling	1.64	1.40	1.26	0.68	0.89	0.76	0.69	0.37	0.69	0.56	0.56	0.28	0.47	0.40	0.36	0.19	0.26	0.22	0.20	
	Animal	3.16	2.70	2.43	1.38	1.71	1.47	1.33	1.15	1.02	0.57	0.90	0.77	0.69	0.39	0.51	0.43	0.28	0.22	0.21	
	Storage	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	
	Land	8.90	8.90	6.41	3.72	4.50	4.50	3.24	1.88	2.30	2.30	1.66	0.96	1.70	1.70	1.22	0.71	1.30	1.30	0.94	
	Total	17.40	17.40	7.69	4.90	7.20	6.70	3.94	2.48	4.50	4.50	1.97	1.28	3.20	3.20	1.44	0.93	2.60	2.50	1.11	
Solid Manure Storage	Enteric Emissions in Solid Manure Storage	0.16	0.15	0.12	0.09	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	
	Animal	0.06	0.06	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	
	Storage	0.39	0.39	0.30	0.30	0.21	0.18	0.16	0.16	0.16	0.14	0.12	0.12	0.11	0.09	0.06	0.06	0.05	0.05	0.05	
	Land	0.81	0.84	0.67	0.67	0.53	0.53	0.26	0.26	0.26	0.23	0.20	0.17	0.15	0.13	0.10	0.09	0.07	0.07	0.07	
	Total	0.95	0.99	0.95	0.95	0.84	0.84	0.48	0.48	0.48	0.45	0.40	0.39	0.39	0.36	0.33	0.34	0.34	0.34	0.34	
Solid Manure Handling	Enteric Emissions in Solid Manure Handling	0.39	0.39	0.30	0.30	2.23	2.23	2.01	1.81	1.71	1.54	1.54	1.23	1.17	1.05	0.69	0.65	0.58	0.58		
	Heating	10.00	6.00	4.57	4.57	5.40	5.40	2.40	2.40	2.70	2.70	1.88	1.88	1.30	1.30	0.85	0.85	0.85	0.85		
	Cooling Pans	1.05	1.00	0.81	0.81	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34		
	Bedding	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
	Lanes	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84		
Total	15.28	12.09	9.55	9.55	8.75	8.80	5.29	5.29	4.66	4.66	4.62	3.66	2.77	2.77	2.65	1.96	1.54	1.22	0.95		
Liquid Manure Handling	Enteric Emissions in Liquid Manure Handling	1.64	1.40	1.26	0.68	0.89	0.76	0.69	0.37	0.69	0.56	0.56	0.28	0.47	0.40	0.36	0.19	0.26	0.22	0.20	
	Animal	3.16	2.70	2.43	1.38	1.71	1.47	1.33	1.15	1.02	0.57	0.90	0.77	0.69	0.39	0.51	0.43	0.28	0.22	0.21	
	Storage	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	
	Land	8.90	8.90	6.41	3.72	4.50	4.50	3.24	1.88	2.30	2.30	1.66	0.96	1.70	1.70	1.22	0.71	1.30	1.30	0.94	
	Total	17.40	17.40	7.69	4.90	7.20	6.70	3.94	2.48	4.50	4.50	1.97	1.28	3.20	3.20	1.44	0.93	2.60	2.50	1.11	
Solid Manure Storage	Enteric Emissions in Solid Manure Storage	0.16	0.15	0.12	0.09	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	
	Animal	0.06	0.06	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	
	Storage	0.39	0.39	0.30	0.30	0.21	0.18	0.16	0.1												

Silage and TMR (Total Mixed Ration) Emissions ($\mu\text{g}/\text{m}^3 \cdot \text{min}$)			
	Silage Type	EF1	EF2
Feed Storage and Handling	Core Storage	34,581	21,159
	Alfalfa Silage	11,408	10,649
	Wheat Silage	43,644	26,745
	TMR	13,056	19,575

Assumptions: 1) Each slope pile is completely covered except for the front face and 2) Racons are fed within 48 hours.

Type of Cow	Dairy EF	PM ₁₀ Emission Factors (lb/head-yr)	Source
Cows in Forests	1.37	Based on a Summer 2003 study by Texas A&M ASAE at a West Texas Dairy	SWAPCD
Milk/Cow in Leasing Barns	2.73		
Heifers/Bulls in Leasing Barns	5.28		
Cows in Leasing Barns	0.69	Based on a Summer 2003 study by Texas A&M ASAE at a West Texas Dairy	SWAPCD
Milk/Cow in Corrals	5.46		
Support Stock (Heifers/Bulls) in Open Corrals	10.95		
Large Heifers in Open Corrals	8.01	Based on a USDA/UC Davis report quantifying dairy and feedlot emissions in Tulare & Kern Counties (April 01)	SWAPCD
Calf (under 3 mo.) open corrals	1.37		
Calf on-ground hutchies	0.343		
Calf above-ground flushed	0.669		

Call above-ground scenario	0.206	See the PM Mitigation Measures for calculations or call hitch area	SJWAPCD
Call above-ground scenario	0.206	See the PM Mitigation Measures for calculations or call hitch area	SJWAPCD

PM10 Mitigation Measures and Control Efficiencies

Control Measure	PM10 Control Efficiency
Shaded corrals (milk and dry cows)	16.7%
Shaded corrals (heifers and bulls)	8.3%
Downwind shelterbelts	12.5%
Upwind shelterbelts	10%
Fibreball with no exercise pens and non-mature based bedding	90%
Fibreball with no exercise pens and mature based bedding	80%
Fibreball with no exercise pens and mature based bedding	10%
Fibreball layer in dusty areas (i.e. hay, etc.)	15%
Bi-weekly corral/exercise pen scraping and/or manure removal using a pull type manure harvesting equipment in morning hours when moisture in air except during periods of rainy weather	15%
Sprinkling of open corral/exercise pens	15%
Feeding young stock (heifers and calves) near dusk	10%

Pre-Project PM10 Mitigation Measures

[illegible][illegible]

Post-Project PM10 Mitigation Measures

Post-Project PM10 Mitigation Measures														
Housing Name(s) or #s	Type of Housing	Type of cow	Total # of cows in Each Housing Structure(s)	Maximum Design Capacity of Each Structure	# of Combined Housing Structures in row	Shaded Corrals	Downwind Shelterbelts	Upwind Shelterbelts	No exercise pens, non-mature bedding	No exercise pens, mature bedding	Elbowt layer	Bi-weekly scraping Corrals/Pens	Sprinkling Corrals/Pens	Feed Young Stock Near Dusk
1 FS 1	freestall	milk cows	419	419										
2 FS 2	freestall	milk cows	419	419										
3 FS 3	freestall	milk cows	700	700										
4 FS 4	freestall	milk cows	700	700										
5 FS 5	freestall	milk cows	700	700										
6 FS 6	freestall	milk cows	700	700										
7 FS 7	freestall	milk cows	700	700										
8 FS 8	freestall	milk cows	700	700										
9 FS 9	freestall	dry cows	377	377										
10 LB 10	loafing barn	support stock	330	470										
11 OC 11	open corral	support stock	356	356										
12 OC 12	open corral	support stock	600	600										
13 OC 13 (removed)	open corral	support stock	217	217										
14 OC 14	open corral	support stock	712	712										
15 OC 15	open corral	support stock	730	1,265										
16 OC 16	open corral	support stock	730	1,265										
17 OC 17	open corral	support stock	370	370										
18 OC 17a	open corral	support stock	360	360										
19 OC 19	open corral	support stock	600	1,000										
20 OC 20	open corral	support stock	270	493										
21 OC 21	open corral	support stock	350	405										
Post-Project PM10 Mitigation Measures for New Housing Units at an Expanding Dairy														
Housing Name(s) or #s	Type of Housing	Type of cow	Total # of cows in Each Housing Structure(s)	Maximum Design Capacity of Each Structure	# of Combined Housing Structures in row	Shaded Corrals	Downwind Shelterbelts	Upwind Shelterbelts	No exercise pens, non-mature bedding	No exercise pens, mature bedding	Elbowt layer	Bi-weekly scraping Corrals/Pens	Sprinkling Corrals/Pens	Feed Young Stock Near Dusk
1 New FS 10	freestall	milk cows	700	700										
2 New FS 11	freestall	milk cows	700	700										
3 New FS 12	freestall	milk cows	420	420										
4 New FS 13	freestall	milk cows	420	420										
5 New FS 14	freestall	dry cows	627	627										
6 New OC 22	open corral	support stock	750	750										
7 New OC 23	open corral	support stock	750	750										
8 New OC 24	open corral	support stock	850	850										
9 New OC 25	open corral	support stock	148	148										
10 New OC 26	open corral	support stock	468	468										
11 New OC 27	open corral	support stock	170	170										
Post-Project Total # of Cows			16,326				10,823		6,003		new cows from the expansion			

Post-Project PM10 Control Efficiencies and Emission Factors															
Housing Name(s) #s	Type of Housing	Type of cow	Total # of cows in Each Housing Structure(s)	Maximum Design Capacity of Each Structure	Uncontrolled EF (lb/d-yr)	Shaded Corrals	Downwind Shelterbelts	Upwind Shelterbelts	No exercise pens, non-mature bedding	No exercise pens, mature bedding	Fibrous layer	Bi-weekly scraping Corrals/Pens	Sprinkling Corrals/Pens	Feed Young Stock Near Dusk	Controlled EF (lb/d-yr)
1 FS 1	freestall	milk cows	419	419	1,370										1.37
2 FS 2	freestall	milk cows	419	419	1,370										1.37
3 FS 3	freestall	milk cows	700	700	1,370										1.37
4 FS 4	freestall	milk cows	700	700	1,370										1.37
5 FS 5	freestall	milk cows	700	700	1,370										1.37
6 FS 6	freestall	milk cows	700	700	1,370										1.37
7 FS 7	freestall	milk cows	700	700	1,370										1.37
8 FS 8	freestall	milk cows	700	700	1,370										1.37
9 FS 9	freestall	dry cows	377	377	1,370										1.37
10 LB 10	loafing barn	support stock	330	470	5,280										5,280
11 OC 11	open corral	support stock	356	356	10,550	8.3%	12.5%								8.47
12 OC 12	open corral	support stock	600	600	10,550	8.3%	12.5%								8.47
13 OC 13 (removed)	open corral	support stock	217	217	10,550	8.3%	12.5%								8.47
14 OC 14	open corral	support stock	712	712	10,550	8.3%	12.5%								8.47
15 OC 15	open corral	support stock	730	1,265	10,550	8.3%	12.5%								8.47
16 OC 16	open corral	support stock	730	1,265	10,550	8.3%	12.5%								8.47
17 OC 17	open corral	support stock	370	370	10,550	8.3%	12.5%								8.47
18 OC 17a	open corral	support stock	360	360	10,550	8.3%	12.5%								8.47
19 OC 19	open corral	support stock	600	1,000	10,550	8.3%	12.5%								8.47
20 OC 20	open corral	support stock	270	493	10,550	8.3%	12.5%								8.47
21 OC 21	open corral	support stock	350	405	10,550	8.3%	12.5%								8.47
Post-Project PM10 Control Efficiencies and Emission Factors for New Housing Emissions Units															
Housing Name(s) #s	Type of Housing	Type of cow	Total # of cows in Each Housing Structure(s)	Maximum Design Capacity of Each Structure	Uncontrolled EF (lb/d-yr)	Shaded Corrals	Downwind Shelterbelts	Upwind Shelterbelts	No exercise pens, non-mature bedding	No exercise pens, mature bedding	Fibrous layer	Bi-weekly scraping Corrals/Pens	Sprinkling Corrals/Pens	Feed Young Stock Near Dusk	Controlled EF (lb/d-yr)
1 New FS 10	freestall	milk cows	700	700	1,370										1.37
2 New FS 11	freestall	milk cows	700	700	1,370										1.37
3 New FS 12	freestall	milk cows	420	420	1,370										1.37
4 New FS 13	freestall	milk cows	420	420	1,370										1.37
5 New FS 14	freestall	dry cows	627	627	1,370										1.37
6 New OC 22	open corral	support stock	750	750	10,550	8.3%	12.5%	10%				15%		10%	5.83
7 New OC 23	open corral	support stock	750	750	10,550	8.3%	12.5%	10%				15%		10%	5.83
8 New OC 24	open corral	support stock	850	850	10,550	8.3%	12.5%	10%				15%		10%	5.83
9 New OC 25	open corral	support stock	148	148	10,550	8.3%	12.5%	10%				15%		10%	5.83
10 New OC 26	open corral	support stock	468	468	10,550	8.3%	12.5%	10%				15%		10%	5.83
11 New OC 27	open corral	support stock	170	170	10,550	8.3%	12.5%	10%				15%		10%	5.83

Pre-Project Potential to Emit - Cow Housing

Pre-Project Potential to Emit - Cow Housing											
Housing Name(s) or #s	Type of Cow	# of Cows	Controlled VOC EF (lb/hd-yr)	Controlled NH3 EF (lb/hd-yr)	Controlled PM10 EF (lb/hd-yr)	VOC (lb/day)	VOC (lb/yr)	NH3 (lb/day)	NH3 (lb/yr)	PM10 (lb/day)	PM10 (lb/yr)
1 FS 1	milk cows	350	9.35	21.13	1.37	9.0	3,273	20.3	7,395	1.3	480
2 FS 2	milk cows	350	9.35	21.13	1.37	9.0	3,273	20.3	7,395	1.3	480
3 FS 3	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
4 FS 4	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
5 FS 5	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
6 FS 6	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
7 FS 7	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
8 FS 8	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
9 FS 9	dry cows	280	5.29	10.71	1.37	4.1	1,481	8.2	2,999	1.1	384
10 LB 10	support stock	470	4.06	5.54	5.28	5.2	1,908	7.1	2,602	6.8	2,482
11 OC 11	support stock	312	4.06	5.54	9.67	3.5	1,267	4.7	1,727	8.3	3,018
12 OC 12	support stock	470	4.06	5.54	9.67	5.2	1,908	7.1	2,602	12.5	4,547
13 OC 13 (removed)	support stock	217	4.06	5.54	9.67	2.4	881	3.3	1,201	5.8	2,099
14 OC 14	support stock	623	4.06	5.54	9.67	6.9	2,529	9.4	3,449	16.5	6,027
15 OC 15	support stock	1,265	4.06	5.54	9.67	14.1	5,136	19.2	7,003	33.5	12,238
16 OC 16	support stock	1,265	4.06	5.54	9.67	14.1	5,136	19.2	7,003	33.5	12,238
17 OC 17	support stock	370	4.06	5.54	9.67	4.1	1,502	5.6	2,048	9.8	3,579
18 OC 18 (replaced by 17a)	support stock	1,000	4.06	5.54	9.67	11.1	4,060	15.2	5,536	26.5	9,674
19 OC 19	support stock	1,000	4.06	5.54	9.67	11.1	4,060	15.2	5,536	26.5	9,674
20 OC 20	support stock	493	4.06	5.54	9.67	5.5	2,002	7.5	2,729	13.1	4,769
21 OC 21	support stock	465	4.06	5.54	9.67	5.2	1,888	7.1	2,574	12.3	4,498
Pre-Project Total # of Cows		13,130				217.9	79,574	412.4	150,539	224.4	81,941

Pre-Project Totals						
Total # of Cows	VOC (lb/day)	VOC (lb/yr)	NH3 (lb/day)	NH3 (lb/yr)	PM10 (lb/day)	PM10 (lb/yr)
13,130	217.9	79,574	412.4	150,539	224.4	81,941

Calculations:

Annual PE 1 for each pollutant (lb/yr) = Controlled EF (lb/hd-yr) x # of cows (hd)
Daily PE1 for each pollutant (lb/day) = (Controlled EF (lb/hd-yr) x # of cows (hd)) ÷ 365 (day/yr)

Post-Project Potential to Emit - Cow Housing

Post-Project Potential to Emit - Cow Housing											
Housing Name(s) or #s	Type of Cow	# of Cows	Controlled VOC EF (lb/hd-yr)	Controlled NH3 EF (lb/hd-yr)	Controlled PM10 EF (lb/hd-yr)	VOC (lb/day)	VOC (lb/yr)	NH3 (lb/day)	NH3 (lb/yr)	PM10 (lb/day)	PM10 (lb/yr)
1 FS 1	milk cows	419	9.35	21.13	1.37	10.7	3,918	24.3	8,853	1.6	574
2 FS 2	milk cows	419	9.35	21.13	1.37	10.7	3,918	24.3	8,853	1.6	574
3 FS 3	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
4 FS 4	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
5 FS 5	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
6 FS 6	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
7 FS 7	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
8 FS 8	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
9 FS 9	dry cows	377	5.29	10.71	1.37	5.5	1,994	11.1	4,037	1.4	516
10 LB 10	support stock	330	4.06	5.54	5.28	3.7	1,340	5.0	1,827	4.8	1,742
11 OC 11	support stock	356	4.06	5.54	8.47	4.0	1,445	5.4	1,971	8.3	3,014
12 OC 12	support stock	600	4.06	5.54	8.47	6.7	2,436	9.1	3,322	13.9	5,079
13 OC 13 (removed)	support stock										
14 OC 14	support stock	712	4.06	5.54	8.47	7.9	2,891	10.8	3,942	16.5	6,027
15 OC 15	support stock	730	4.06	5.54	8.47	8.1	2,964	11.1	4,041	16.9	6,179
16 OC 16	support stock	730	4.06	5.54	8.47	8.1	2,964	11.1	4,041	16.9	6,179
17 OC 17	support stock	370	4.06	5.54	8.47	4.1	1,502	5.6	2,048	9.8	3,579
18 OC 17a	support stock	360	4.06	5.54	8.47	4.0	1,462	5.5	1,993	8.3	3,047
19 OC 19	support stock	600	4.06	5.54	8.47	6.7	2,436	9.1	3,322	13.9	5,079
20 OC 20	support stock	270	4.06	5.54	8.47	3.0	1,096	4.1	1,495	6.3	2,286
21 OC 21	support stock	350	4.06	5.54	8.47	3.9	1,421	5.3	1,938	8.1	2,963
Post-Project # of Cows (non-expansion)		10,823				194.5	71,057	384.8	140,423	142.7	52,145

Post-Project Potential to Emit - Cow Housing: New Housing Units at an Expanding Dairy											
Housing Name(s) or #s	Type of Cow	# of Cows	Controlled VOC EF (lb/hd-yr)	Controlled NH3 EF (lb/hd-yr)	Controlled PM10 EF (lb/hd-yr)	VOC (lb/day)	VOC (lb/yr)	NH3 (lb/day)	NH3 (lb/yr)	PM10 (lb/day)	PM10 (lb/yr)
1 New FS 10	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
2 New FS 11	milk cows	700	9.35	21.13	1.37	17.9	6,545	40.5	14,790	2.6	959
3 New FS 12	milk cows	420	9.35	21.13	1.37	10.8	3,927	24.3	8,874	1.6	575
4 New FS 13	milk cows	420	9.35	21.13	1.37	10.8	3,927	24.3	8,874	1.6	575
5 New FS 14	dry cows	627	5.29	10.71	1.37	9.1	3,317	18.4	6,715	2.4	859
6 New OC 22	support stock	750	4.06	5.54	5.83	8.3	3,045	11.4	4,152	12.0	4,371
7 New OC 23	support stock	750	4.06	5.54	5.83	8.3	3,045	11.4	4,152	12.0	4,371
8 New OC 24	support stock	850	4.06	5.54	5.83	9.5	3,451	12.9	4,706	13.6	4,954
9 New OC 25	support stock	148	4.06	5.54	5.83	1.6	601	2.2	819	2.4	863
10 New OC 26	support stock	468	4.06	5.54	5.83	5.2	1,900	7.1	2,591	7.5	2,728
11 New OC 27	support stock	170	4.06	5.54	5.83	1.9	690	2.6	941	2.7	991
Total # of Cows From Expansion		6,003				101.3	36,993	195.6	71,404	61.0	22,205

Post-Project Totals						
Total # of Cows	VOC (lb/day)	VOC (lb/yr)	NH3 (lb/day)	NH3 (lb/yr)	PM10 (lb/day)	PM10 (lb/yr)
16,826	295.8	108,050	580.4	211,827	203.7	74,350

Calculations:

Annual PE 2 for each pollutant (lb/yr) = Controlled EF (lb/hd-yr) x # of cows (hd)
Daily PE2 for each pollutant (lb/day) = (Controlled EF (lb/hd-yr) x # of cows (hd)) ÷ 365 (day/yr)

Pre-Project Potential to Emit (PE1)

Pre-Project Herd Size					
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals
Milk Cows	4,900	0	0	0	4,900
Dry Cows	0	0	750	0	750
Support Stock (Heifers, Calves and Bulls)	0	0	7,480	0	7,480
Large Heifers	0	0	0	0	0
Medium Heifers	0	0	0	0	0
Small Heifers	0	0	0	0	0
Bulls	0	0	0	0	0

	Calf Hutches				Calf Corrals		Total # of Calves
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Flushed	Scraped	
Calves	0	0	0	0	0	0	0

Silage Information				
Feed Type	Maximum # Open Piles	Maximum Height (ft)	Maximum Width (ft)	Open Face Area (ft²)
Corn	1	20	200	2,720
Alfalfa	1	12	120	979
Wheat	1	20	150	2,135

Milking Parlor				
Cow	VOC		NH3	
	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	5.4	1,960	1.8	670

Cow Housing						
Cow	VOC		NH3		PM10	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Total	217.9	79,574	412.4	150,539	224.4	81,941

Liquid Manure Handling						
Cow	VOC		NH3		H2S*	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	32.6	11,907	101.9	37,191	2.4	859
Dry Cows	2.7	998	7.9	2,880	0.2	61
Support Stock (Heifers, Calves and Bulls)	20.9	7,630	40.4	14,736	0.7	271
Large Heifers	0.0	0	0.0	0	0	0
Medium Heifers	0.0	0	0.0	0	0	0
Small Heifers	0.0	0	0.0	0	0	0
Calves	0.0	0	0.0	0	0	0
Bulls	0.0	0	0.0	0	0	0
Total	56.2	20,534	150.2	54,807	3.3	1,191

Solid Manure Handling				
Cow	VOC		NH3	
	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	6.3	2,303	38.0	13,867
Dry Cows	0.5	195	2.9	1,073
Support Stock (Heifers, Calves and Bulls)	4.1	1,496	15.4	5,610
Large Heifers	0.0	0	0.0	0
Medium Heifers	0.0	0	0.0	0
Small Heifers	0.0	0	0.0	0
Calves	0.0	0	0.0	0
Bulls	0.0	0	0.0	0
Total	10.9	3,994	56.3	20,550

Feed Handling and Storage		
	Daily PE (lb-VOC/day)	Annual PE (lb-VOC/yr)
Corn Emissions	16.9	6,181
Alfalfa Emissions	1.5	560
Wheat Emissions	16.8	6,135
TMR	289.4	105,649
Total	324.6	118,524

Total Daily Pre-Project Potential to Emit (lb/day)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0.0	0.0	0.0	0.0	5.4	1.8	0.0
Cow Housing	0.0	0.0	224.4	0.0	217.9	412.4	0.0
Liquid Manure	0.0	0.0	0.0	0.0	56.2	150.2	3.3
Solid Manure	0.0	0.0	0.0	0.0	10.9	56.3	0.0
Feed Handling	0.0	0.0	0.0	0.0	324.6	0.0	0.0
Total	0.0	0.0	224.4	0.0	615.0	620.7	3.3

Total Annual Pre-Project Potential to Emit (lb/yr)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0	0	0	0	1,960	670	0
Cow Housing	0	0	81,941	0	79,574	150,539	0
Liquid Manure	0	0	0	0	20,534	54,807	1,191
Solid Manure	0	0	0	0	3,994	20,550	0
Feed Handling	0	0	0	0	118,524	0	0
Total	0	0	81,941	0	224,587	226,565	1,191

Calculations for milking parlor:

Annual PE = (# milk cows) x (EF1 lb-pollutant/hd-yr)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculations for cow housing:

See detailed calculations under Cow Housing Calculations worksheet.

Calculations for liquid manure and solid manure handling:

Annual PE = [(# milk cows) x (EF1 lb-pollutant/hd-yr)] + [(# dry cows) x (EF1 lb-pollutant/hd-yr)] + [(# large heifers) x (EF1 lb-pollutant/hd-yr)] + [(# medium heifers) x (EF1 lb-pollutant/hd-yr)] + [(# small heifers) x (EF1 lb-pollutant/hd-yr)] + [(# calves) x (EF1 lb-pollutant/hd-yr)] + [(# bulls) x (EF1 lb-pollutant/hd-yr)]

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

The H2S emission factor is assumed to be 10% of the NH3 lagoon/storage pond(s) emission factor, for each respective herd size.

Calculations for silage emissions:

Annual PE = (EF1) x (area ft²) x (0.0929 m²/ft²) x (8,760 hr/yr) x (60 min/hr) x 2.20E-9 lb/μg

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculation for TMR emissions:

Annual PE = (# cows) x (EF1) x (0.658 m³) x (525,600 min/yr) x (2.20E-9 lb/μg)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calves are not included in TMR calculation.

*Since there will be no change to the lagoons/storage ponds surface area, no change in H2S emissions is expected. Therefore, it will be assumed that PE1 for H2S emissions is equal to PE2 for H2S emissions.

Major Source Emissions (lb/yr)					
Permit	NOx	SOx	PM10	CO	VOC
Milk Parlor	0	0	0	0	0
Cow Housing	0	0	0	0	0
Liquid Manure	0	0	0	0	9,878
Solid Manure	0	0	0	0	0
Feed Handling	0	0	0	0	0
Total	0	0	0	0	9,878

Post-Project Potential to Emit (PE2)

Post-Project Herd Size					
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals
Milk Cows	7,278	0	0	0	7,278
Dry Cows	627	0	377	0	1,004
Support Stock (Heifers, Calves, and Bulls)	0	0	8,544	0	8,544
Large Heifers	0	0	0	0	0
Medium Heifers	0	0	0	0	0
Small Heifers	0	0	0	0	0
Bulls	0	0	0	0	0
Calf Hutches			Calf Corrals		
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Total # of Calves
Calves	0	0	0	0	0

Silage Information				
Feed Type	Maximum # Open Piles	Maximum Height (ft)	Maximum Width (ft)	Open Face Area (ft ²)
Corn	1	20	200	2,720
Alfalfa	1	12	120	979
Wheat	1	20	150	2,135

Milking Parlor				
Cow	VOC		NH3	
	lb/day	lb/yr	lb/day	lb/yr
Milk Cows				
Total	8.0	2,911	2.7	996

Cow Housing						
	VOC		NH3		PM10	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Total	295.8	108,050	580.4	211,827	203.7	74,350

Liquid Manure Handling						
Cow	VOC		NH3		H2S	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	27.5	10,044	97.7	35,662	2.4	859
Dry Cows	2.1	753	6.8	2,490	0.2	61
Support Stock (Heifers, Calves, and Bulls)	13.3	4,870	30.0	10,936	0.7	271
Large Heifers	0.0	0	0.0	0	0	0
Medium Heifers	0.0	0	0.0	0	0	0
Small Heifers	0.0	0	0.0	0	0	0
Calves	0.0	0	0.0	0	0	0
Bulls	0.0	0	0.0	0	0	0
Total	42.9	15,667	134.5	49,088	3.3	1,191

Solid Manure Handling				
Cow	VOC		NH3	
	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	9.4	3,421	56.4	20,597
Dry Cows	0.7	261	3.9	1,436
Support Stock (Heifers, Calves, and Bulls)	4.7	1,709	17.6	6,408
Large Heifers	0.0	0	0.0	0
Medium Heifers	0.0	0	0.0	0
Small Heifers	0.0	0	0.0	0
Calves	0.0	0	0.0	0
Bulls	0.0	0	0.0	0
Total	14.8	5,391	77.9	28,440

Feed Handling and Storage		
	Daily PE (lb-VOC/day)	Annual PE (lb-VOC/yr)
Corn Emissions	16.9	6,181
Alfalfa Emissions	1.5	560
Wheat Emissions	16.8	6,135
TMR	370.9	135,388
Total	406.1	148,264

Total Daily Post-Project Potential to Emit (lb/day)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0.0	0.0	0.0	0.0	8.0	2.7	0.0
Cow Housing	0.0	0.0	203.7	0.0	295.8	580.4	0.0
Liquid Manure	0.0	0.0	0.0	0.0	42.9	134.5	3.3
Solid Manure	0.0	0.0	0.0	0.0	14.8	77.9	0.0
Feed Handling	0.0	0.0	0.0	0.0	406.1	0.0	0.0
Total	0.0	0.0	203.7	0.0	767.6	795.5	3.3

Total Annual Post-Project Potential to Emit (lb/yr)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0	0	0	0	2,911	996	0
Cow Housing	0	0	74,350	0	108,050	211,827	0
Liquid Manure	0	0	0	0	15,667	49,088	1,191
Solid Manure	0	0	0	0	5,391	28,440	0
Feed Handling	0	0	0	0	148,264	0	0
Total	0	0	74,350	0	280,282	290,352	1,191

Calculations for milking parlor:

Annual PE = (# milk cows) x (EF2 lb-pollutant/hd-yr)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculations for cow housing:

See detailed calculations under Cow Housing Calculations worksheet.

Calculations for liquid manure and solid manure handling:

Annual PE = [(# milk cows) x (EF1 lb-pollutant/hd-yr)] + [(# dry cows) x (EF2 lb-pollutant/hd-yr)] + [(# large heifers) x (EF2 lb-pollutant/hd-yr)] + [(# medium heifers) x (EF2 lb-pollutant/hd-yr)] + [(# small heifers) x (EF2 lb-pollutant/hd-yr)] + [(# calves) x (EF2 lb-pollutant/hd-yr)] + [(# bulls) x (EF2 lb-pollutant/hd-yr)]

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

The H2S emission factor is assumed to be 10% of the NH3 lagoon/storage pond(s) emission factor, for each respective herd size.

Calculations for silage emissions:

Annual PE = (EF2) x (area ft²) x (0.0929 m²/ft²) x (8,760 hr/yr) x (60 min/hr) x 2,20E-9 lb/μg

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculation for TMR emissions:

Annual PE = (# cows) x (EF2) x (0.658 m³) x (525,600 min/yr) x (2.20E-9 lb/μg)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calves are not included in TMR calculation.

Major Source Emissions (lb/yr)					
Permit	NOx	SOx	PM10	CO	VOC
Milk Parlor	0	0	0	0	0
Cow Housing	0	0	0	0	0
Liquid Manure	0	0	0	0	7,954
Solid Manure	0	0	0	0	0
Feed Handling	0	0	0	0	0
Total	0	0	0	0	7,954

BACT Applicability

Milking Parlor					
VOC Emissions					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	6.0	5.4	0.40	0.40	2.6
BACT triggered for VOC for milking parlor					Total
					2.6
NH3 Emissions					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	2.7	1.8	0.14	0.14	0.9
					Total
					0.9

Cow Housing	
See detailed cow housing AIPE calculations on following pages.	

Liquid Manure Handling					
VOC Emissions - Lagoon/Storage Pond(s)					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	14.0	15.7	0.70	1.17	4.6
Dry Cows	1.0	1.3	0.38	0.64	0.2
Support Stock (Heifers, Calves, and Bulls)	6.8	10.0	0.29	0.49	0.9
Large Heifers	0.0	0.0	0.29	0.49	0.0
Medium Heifers	0.0	0.0	0.20	0.33	0.0
Small Heifers	0.0	0.0	0.11	0.19	0.0
Calves	0.0	0.0	0.05	0.09	0.0
Bulls	0.0	0.0	0.18	0.30	0.0
BACT triggered for VOC for Lagoon/Storage Ponds					Total
					5.7
VOC Emissions - Land Application					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	13.6	16.9	0.68	1.26	4.5
Dry Cows	1.0	1.4	0.37	0.69	0.2
Support Stock (Heifers, Calves, and Bulls)	6.7	10.6	0.28	0.53	0.9
Large Heifers	0.0	0.0	0.28	0.53	0.0
Medium Heifers	0.0	0.0	0.19	0.36	0.0
Small Heifers	0.0	0.0	0.11	0.20	0.0
Calves	0.0	0.0	0.05	0.10	0.0
Bulls	0.0	0.0	0.17	0.32	0.0
BACT triggered for VOC for Liquid Manure Land Application					Total
					5.6
NH3 Emissions - Lagoon/Storage Pond(s)					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	23.5	15.9	1.18	1.18	7.6
Dry Cows	1.7	1.2	0.60	0.60	0.5
Support Stock (Heifers, Calves, and Bulls)	7.4	6.5	0.32	0.32	0.9
Large Heifers	0.0	0.0	0.32	0.32	0.0
Medium Heifers	0.0	0.0	0.22	0.22	0.0
Small Heifers	0.0	0.0	0.17	0.17	0.0
Calves	0.0	0.0	0.05	0.05	0.0
Bulls	0.0	0.0	0.43	0.43	0.0
BACT triggered for NH3 for Lagoon/Storage Ponds					Total
					9.0
NH3 Emissions - Land Application					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	74.1	86.0	3.72	6.41	24.2
Dry Cows	5.2	6.7	1.88	3.24	1.3
Support Stock (Heifers, Calves, and Bulls)	22.5	33.9	0.96	1.66	2.8
Large Heifers	0.0	0.0	0.96	1.66	0.0
Medium Heifers	0.0	0.0	0.71	1.22	0.0
Small Heifers	0.0	0.0	0.54	0.94	0.0
Calves	0.0	0.0	0.15	0.27	0.0
Bulls	0.0	0.0	1.35	2.33	0.0
BACT triggered for NH3 for Liquid Manure Land Application					Total
					28.4
H2S Emissions - Lagoon/Storage Pond(s)					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	2.4	2.4	0.12	0.12	0.0
Dry Cows	0.2	0.2	0.06	0.06	0.0
Support Stock (Heifers, Calves, and Bulls)	0.7	0.7	0.03	0.03	0.0
Large Heifers	0.0	0.0	0.03	0.03	0.0
Medium Heifers	0.0	0.0	0.02	0.02	0.0
Small Heifers	0.0	0.0	0.02	0.02	0.0
Calves	0.0	0.0	0.01	0.01	0.0
Bulls	0.0	0.0	0.04	0.04	0.0
					Total
					0.0

Solid Manure Handling					
VOC Emissions - Solid Manure Storage/Separated Solids Piles					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	3.5	2.4	0.18	0.18	1.1
Dry Cows	0.3	0.2	0.10	0.10	0.1
Support Stock (Heifers, Calves, and Bulls)	1.7	1.5	0.10	0.07	0.2
Large Heifers	0.0	0.0	0.07	0.07	0.0
Medium Heifers	0.0	0.0	0.05	0.05	0.0
Small Heifers	0.0	0.0	0.03	0.03	0.0
Calves	0.0	0.0	0.01	0.01	0.0
Bulls	0.0	0.0	0.05	0.05	0.0
					Total
					1.4
VOC Emissions - Land Application					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	5.9	4.0	0.30	0.30	1.9
Dry Cows	0.4	0.3	0.16	0.16	0.1
Support Stock (Heifers, Calves, and Bulls)	2.9	2.5	0.12	0.12	0.4
Large Heifers	0.0	0.0	0.12	0.12	0.0
Medium Heifers	0.0	0.0	0.08	0.08	0.0
Small Heifers	0.0	0.0	0.05	0.05	0.0
Calves	0.0	0.0	0.02	0.02	0.0
Bulls	0.0	0.0	0.07	0.07	0.0
BACT triggered for VOC for Solid Manure Land Application					Total
					2.4
NH3 Emissions - Solid Manure Storage/Separated Solids Piles					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	26.5	17.9	1.33	1.33	8.6
Dry Cows	1.8	1.4	0.67	0.67	0.4
Support Stock (Heifers, Calves, and Bulls)	8.2	7.2	0.35	0.35	1.0
Large Heifers	0.0	0.0	0.35	0.35	0.0
Medium Heifers	0.0	0.0	0.25	0.25	0.0
Small Heifers	0.0	0.0	0.18	0.18	0.0
Calves	0.0	0.0	0.06	0.06	0.0
Bulls	0.0	0.0	0.49	0.49	0.0
BACT triggered for NH3 for Solid Manure Storage					Total
					10.0
NH3 Emissions - Land Application					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Milk Cows	30.0	20.2	1.50	1.50	9.8
Dry Cows	2.1	1.6	0.76	0.76	0.5
Support Stock (Heifers, Calves, and Bulls)	9.3	8.1	0.40	0.40	1.2
Large Heifers	0.0	0.0	0.40	0.40	0.0
Medium Heifers	0.0	0.0	0.28	0.28	0.0
Small Heifers	0.0	0.0	0.22	0.22	0.0
Calves	0.0	0.0	0.06	0.06	0.0
Bulls	0.0	0.0	0.55	0.55	0.0
BACT triggered for NH3 for Solid Manure Land Application					Total
					11.5

Feed Storage and Handling					
VOC Emissions - Silage					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
Corn Silage	16.9	16.9	21,155	21,155	0.0
Alfalfa Silage	1.5	1.5	10,649	10,649	0.0
Wheat Silage	16.8	16.8	26,745	26,745	0.0
					Total
					0.0
VOC Emissions - TMR					
	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)
TMR	370.9	289.4	10,575	10,575	81.5
BACT triggered for VOC for TMR					Total
					81.5

Cow Housing - VOC Emissions							
	Housing Name(s) or # (s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)	BACT Triggered?
1	FS 1	10.7	9.0	9.35	9.35	1.7	No
2	FS 2	10.7	9.0	9.35	9.35	1.7	No
3	FS 3	17.9	17.9	9.35	9.35	0.0	No
4	FS 4	17.9	17.9	9.35	9.35	0.0	No
5	FS 5	17.9	17.9	9.35	9.35	0.0	No
6	FS 6	17.9	17.9	9.35	9.35	0.0	No
7	FS 7	17.9	17.9	9.35	9.35	0.0	No
8	FS 8	17.9	17.9	9.35	9.35	0.0	No
9	FS 9	5.5	4.1	5.29	5.29	1.4	No
10	LB 10	5.2	5.2	4.06	4.06	0.0	No
11	OC 11	4.0	3.5	4.06	4.06	0.5	No
12	OC 12	6.7	5.2	4.06	4.06	1.5	No
13	OC 13 (removed)	2.4	2.4	4.06	4.06	0.0	No
14	OC 14	7.9	6.9	4.06	4.06	1.0	No
15	OC 15	14.1	14.1	4.06	4.06	0.0	No
16	OC 16	14.1	14.1	4.06	4.06	0.0	No
17	OC 17	4.1	4.1	4.06	4.06	0.0	No
18	OC 17a	4.0	11.1	4.06	4.06	-7.1	No
19	OC 19	11.1	11.1	4.06	4.06	0.0	No
20	OC 20	5.5	5.5	4.06	4.06	0.0	No
21	OC 21	5.2	5.2	4.06	4.06	0.0	No

New Units from Expansion							
	Housing Name(s) or #(s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	PE2 (lb/day)	BACT Triggered
1	New FS 10	17.9	0.0	9.35	0.00	17.9	Yes
2	New FS 11	17.9	0.0	9.35	0.00	17.9	Yes
3	New FS 12	10.8	0.0	9.35	0.00	10.8	Yes
4	New FS 13	10.8	0.0	9.35	0.00	10.8	Yes
5	New FS 14	9.1	0.0	5.29	0.00	9.1	Yes
6	New OC 22	8.3	0.0	4.06	0.00	8.3	Yes
7	New OC 23	8.3	0.0	4.06	0.00	8.3	Yes
8	New OC 24	9.5	0.0	4.06	0.00	9.5	Yes
9	New OC 25	1.6	0.0	4.06	0.00	1.6	No
10	New OC 26	5.2	0.0	4.06	0.00	5.2	Yes
11	New OC 27	1.9	0.0	4.06	0.00	1.9	No

Cow Housing - NH3 Emissions						
Housing Name(s) or #(s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)	BACT Triggered?
FS 1	24.3	20.3	21.13	21.13	4.0	Yes
FS 2	24.3	20.3	21.13	21.13	4.0	Yes
FS 3	40.5	40.5	21.13	21.13	0.0	No
FS 4	40.5	40.5	21.13	21.13	0.0	No
FS 5	40.5	40.5	21.13	21.13	0.0	No
FS 6	40.5	40.5	21.13	21.13	0.0	No
FS 7	40.5	40.5	21.13	21.13	0.0	No
FS 8	40.5	40.5	21.13	21.13	0.0	No
FS 9	11.1	8.2	10.71	10.71	2.9	Yes
LB 10	7.1	7.1	5.54	5.54	0.0	No
OC 11	5.4	4.7	5.54	5.54	0.7	No
OC 12	9.1	7.1	5.54	5.54	2.0	No
OC 13 (removed)	3.3	3.3	5.54	5.54	0.0	No
OC 14	10.8	9.4	5.54	5.54	1.4	No
OC 15	19.2	19.2	5.54	5.54	0.0	No
OC 16	19.2	19.2	5.54	5.54	0.0	No
OC 17	5.6	5.6	5.54	5.54	0.0	No
OC 17a	5.5	15.2	5.54	5.54	-9.7	No
OC 19	15.2	15.2	5.54	5.54	0.0	No
OC 20	7.5	7.5	5.54	5.54	0.0	No
OC 21	7.1	7.1	5.54	5.54	0.0	No

New Units from Expansion						
Housing Name(s) or #(s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	PE2 (lb/day)	BACT Triggered?
New FS 10	40.5	0.0	21.13	0.00	40.5	Yes
New FS 11	40.5	0.0	21.13	0.00	40.5	Yes
New FS 12	24.3	0.0	21.13	0.00	24.3	Yes
New FS 13	24.3	0.0	21.13	0.00	24.3	Yes
New FS 14	18.4	0.0	10.71	0.00	18.4	Yes
New OC 22	11.4	0.0	5.54	0.00	11.4	Yes
New OC 23	11.4	0.0	5.54	0.00	11.4	Yes
New OC 24	12.9	0.0	5.54	0.00	12.9	Yes
New OC 25	2.2	0.0	5.54	0.00	2.2	Yes
New OC 26	7.1	0.0	5.54	0.00	7.1	Yes
New OC 27	2.6	0.0	5.54	0.00	2.6	Yes

*Multiple emissions units (freestalls, corrals, calf hutch areas, etc.) are combined in these rows. BACT applicability has been calculated for EACH emissions unit in this row

Cow Housing - PM10 Emissions							
	Housing Name(s) or #(s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	AIPE (lb/day)	BACT Triggered?
1	FS 1	1.6	1.3	10.70	9.00	0.3	No
2	FS 2	1.6	1.3	10.70	9.00	0.3	No
3	FS 3	2.6	2.6	17.90	17.90	0.0	No
4	FS 4	2.6	2.6	17.90	17.90	0.0	No
5	FS 5	2.6	2.6	17.90	17.90	0.0	No
6	FS 6	2.6	2.6	17.90	17.90	0.0	No
7	FS 7	2.6	2.6	17.90	17.90	0.0	No
8	FS 8	2.6	2.6	17.90	17.90	0.0	No
9	FS 9	1.4	1.1	5.50	4.10	0.3	No
10	LB 10	6.8	6.8	5.20	5.20	0.0	No
11	OC 11	8.3	8.3	4.00	3.50	0.0	No
12	OC 12	13.9	12.5	6.70	5.20	1.4	No
13	OC 13 (removed)	5.0	5.8	2.40	2.40	-0.8	No
14	OC 14	16.5	16.5	7.90	6.90	0.0	No
15	OC 15	29.3	33.5	14.10	14.10	-4.2	No
16	OC 16	29.3	33.5	14.10	14.10	-4.2	No
17	OC 17	8.6	9.8	4.10	4.10	-1.2	No
18	OC 17a	8.3	26.5	4.00	11.10	-1.2	No
19	OC 19	23.2	26.5	11.10	11.10	-3.3	No
20	OC 20	11.4	13.1	5.50	5.50	-1.7	No
21	OC 21	10.8	12.3	5.20	5.20	-1.5	No

New Units from Expansion							
	Housing Name(s) or #(s)	PE2 (lb/day)	PE1 (lb/day)	EF2	EF1	PE2 (lb/day)	BACT Triggered?
1	New FS 10	2.6	0.0	1.37	0.00	2.6	Yes
2	New FS 11	2.6	0.0	1.37	0.00	2.6	Yes
3	New FS 12	1.6	0.0	1.37	0.00	1.6	No
4	New FS 13	1.6	0.0	1.37	0.00	1.6	No
5	New FS 14	2.4	0.0	1.37	0.00	2.4	Yes
6	New OC 22	12.0	0.0	5.83	0.00	12.0	Yes
7	New OC 23	12.0	0.0	5.83	0.00	12.0	Yes
8	New OC 24	13.6	0.0	5.83	0.00	13.6	Yes
9	New OC 25	2.4	0.0	5.83	0.00	2.4	Yes
10	New OC 26	7.5	0.0	5.83	0.00	7.5	Yes
11	New OC 27	2.7	0.0	5.83	0.00	2.7	Yes

*Multiple emissions units (freestalls, corrals, calf hutch areas, etc.) are combined in these rows. BACT applicability has been calculated for EACH emissions unit in this row.

Increase in Emissions

SSIP E (lb/yr)							
	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0	0	0	0	951	325	0
Cow Housing	0	0	-7,591	0	28,476	61,288	0
Liquid Manure	0	0	0	0	-4,867	-5,718	0
Solid Manure	0	0	0	0	1,397	7,891	0
Feed Handling	0	0	0	0	29,739	0	0
Total	0	0	-7,591	0	55,696	63,786	0

Total Daily Change in Emissions (lb/day)							
	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0.0	0.0	0.0	0.0	2.6	0.9	0.0
Cow Housing	0.0	0.0	-20.7	0.0	77.9	168.0	0.0
Liquid Manure	0.0	0.0	0.0	0.0	-13.3	-15.7	0.0
Solid Manure	0.0	0.0	0.0	0.0	3.9	21.6	0.0
Feed Handling	0.0	0.0	0.0	0.0	81.5	0.0	0.0
Total	0.0	0.0	-20.7	0.0	152.6	174.8	0.0

Total Annual Change in Non-Fugitive Emissions (Major Source Emissions) (lb/yr)							
	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0	0	0	0	0	0	0
Cow Housing	0	0	0	0	0	0	0
Liquid Manure	0	0	0	0	-1,924	0	0
Solid Manure	0	0	0	0	0	0	0
Feed Handling	0	0	0	0	0	0	0
Total	0	0	0	0	-1,924	0	0

C-5289-9-0: 145 BHP CATERPILLAR MODEL 3412 DIESEL-FIRED EMERGENCY IC ENGINE POWERING AN ELECTRICAL GENERATOR

Assumptions

Non-emergency operating schedule:	100 hours/year
Density of diesel fuel:	7.1 lb/gal
EPA F-factor (adjusted to 60°F):	9,051 dscf/MMBtu
Fuel heating value:	137,000 Btu/gal
BHP to Btu/hr conversion:	2,542.5 Btu/hp·hr
Thermal efficiency of engine:	commonly $\approx$ 30%
PM ₁₀ fraction of diesel exhaust:	0.96 (CARB, 1988)

Emission Factors

Diesel-fired IC Engine Emission Factors			
	lb/hp·hr	g/hp·hr	Source
NO _x	--	6.4	Manufacturer's Specifications
SO _x	0.0021	0.95	AP-42 (10/96) Table 3.3-1
PM ₁₀	--	0.25	Manufacturer's Specifications
CO	--	1.1	Manufacturer's Specifications
VOC	--	0.1	Manufacturer's Specifications

Calculations

Annual Actual Emissions (AE)								
NO _x	6.4	(g/hp·hr) x	650	(hp) x	100	(hr/yr) ÷ 453.6 (g/lb) =	917	(lb/yr)
SO _x	0.95	(g/hp·hr) x	650	(hp) x	100	(hr/yr) ÷ 453.6 (g/lb) =	136	(lb/yr)
PM ₁₀	0.25	(g/hp·hr) x	650	(hp) x	100	(hr/yr) ÷ 453.6 (g/lb) =	36	(lb/yr)
CO	1.1	(g/hp·hr) x	650	(hp) x	100	(hr/yr) ÷ 453.6 (g/lb) =	158	(lb/yr)
VOC	0.1	(g/hp·hr) x	650	(hp) x	100	(hr/yr) ÷ 453.6 (g/lb) =	14	(lb/yr)

C-5289-10-0: AGRICULTURAL GASOLINE DISPENSING OPERATION WITH ONE 550 GALLON PHASE I EXEMPT ABOVEGROUND STORAGE TANK AND 1 FUELING POINT WITH 1 PHASE II EXEMPT GASOLINE DISPENSING NOZZLE USED EXCLUSIVELY FOR IMPLEMENTS OF HUSBANDRY

Assumptions

This permit unit may operate 24 hours per day, 365 days per year.
VOC is the only pollutant emitted from this operation.

Emission Factors

These emission factors were obtained from Appendix A - Emission Factors For Gasoline Stations published by CAPCOA Air Toxic "Hot Spots" Program in the Gasoline Service Station Industrywide Risk Assessment Guidelines dated December 1997.

8.4	lb/1,000 gal	Tank filling loss
2.1	lb/1,000 gal	Breathing loss
8.4	lb/1,000 gal	Vehicle fueling loss
0.61	lb/1,000 gal	Spillage
19.5	lb/1,000 gal	Total VOC losses

Calculations

Annual Actual Emissions (AE)						
VOC	19.5	(lb/1000 gal) x	2,400	(gal/year) =	47	(lb/year)

Facility Information - Defense Ranch C-5701

1. Does this facility house Holstein or Jersey cows?

Answering "Holstein" assumes worst case. Facilities receiving in-house PTOs should be grandfathered assuming they could house Holstein cows.

2. Does the facility land apply liquid manure?

Answering "yes" assumes worst case.

3. Does the facility land apply solid manure?

Answering "yes" assumes worst case.

4. Is any scraped manure sent to a lagoon?

Answering "yes" assumes worst case.

Facility Herd Size							
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals		
Milk Cows					0		
Dry Cows					0		
Support Stock (Heifers, Calves, and Bulls)			1,210		1,210		
Large Heifers					0		
Medium Heifers					0		
Small Heifers					0		
Bulls					0		
	Calf Hutches				Calf Corrals		Total # of Calves
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Flushed	Scraped	
Calves							0

Total Herd Summary	
Total Milk Cows	0
Total Mature Cows	0
Support Stock (Heifers, Calves, and Bulls)	1,210
Total Calves	0
Total Dairy Head	1,210

Silage Information			
Feed Type	Max # Open Piles	Max Height (ft)	Max Width (ft)
Corn	1	15	70
Alfalfa			
Wheat	1	15	70

This spreadsheet serves only as a resource to calculate potential emissions from dairies, and may not reflect the final emissions used by the District due to parameters not addressed in this spreadsheet and/or omissions from the spreadsheet. Any other permissible equipment (e.g., IC engines, gasoline tanks, etc.) at a facility will need to be calculated separately. All final calculations used in permitting projects will be conducted by District staff.

		lb/head Dairy Emissions Factors for Holstein Cows											
		Milch Cows				Dry Cows				Large heifers (15 to 24 months)			
		Uncontrolled		Controlled		Uncontrolled		Controlled		Uncontrolled		Controlled	
		<1000 milch cows	>1000 milch cows	EF1	EF2	<1000 milch cows	>1000 milch cows	EF1	EF2	<1000 milch cows	>1000 milch cows	EF1	EF2
Milking Parlor	VOC	0.43	0.41	0.43	0.39	-	-	-	-	-	-	-	-
	NH3	0.47	0.44	0.47	0.42	-	-	-	-	-	-	-	-
	CH4	0.19	0.19	0.19	0.14	-	-	-	-	-	-	-	-
	Total	0.69	0.69	0.69	0.69	-	-	-	-	-	-	-	-
Cow Housing	VOC	10.00	6.60	10.00	5.90	5.40	3.50	5.40	3.50	1.80	1.80	1.80	1.80
	NH3	1.05	1.05	1.05	0.95	0.57	0.54	0.57	0.54	0.30	0.30	0.30	0.30
	CH4	0.84	0.84	0.84	0.76	0.45	0.44	0.45	0.44	0.23	0.23	0.23	0.23
	Total	15.78	12.09	15.78	11.11	6.39	4.89	6.39	4.89	2.33	2.33	2.33	2.33
Liquid Manure Handling	VOC	1.64	1.48	1.64	1.48	0.89	0.76	0.89	0.76	0.40	0.40	0.40	0.40
	NH3	3.16	2.70	3.16	2.54	1.71	1.47	1.71	1.47	0.90	0.90	0.90	0.90
	CH4	1.70	1.70	1.70	1.70	0.89	0.89	0.89	0.89	0.40	0.40	0.40	0.40
	Total	6.50	5.88	6.50	5.88	3.08	2.91	3.08	2.91	1.70	1.70	1.70	1.70
Solid Manure Handling	VOC	0.41	0.41	0.41	0.41	0.21	0.19	0.21	0.19	0.10	0.10	0.10	0.10
	NH3	0.95	0.95	0.95	0.95	0.48	0.48	0.48	0.48	0.25	0.25	0.25	0.25
	CH4	0.38	0.38	0.38	0.38	0.19	0.19	0.19	0.19	0.10	0.10	0.10	0.10
	Total	1.74	1.74	1.74	1.74	0.88	0.86	0.88	0.86	0.45	0.45	0.45	0.45

		lb/head Dairy Emissions Factors for Holstein Cows			
		Uncontrolled	Controlled	EF1	EF2
Feed Storage and Handling	VOC	17.10	17.10	17.10	17.10
	NH3	8.51	8.51	8.51	8.51
	CH4	0.18	0.18	0.18	0.18
	Total	25.79	25.79	25.79	25.79

		lb/head Dairy Emissions Factors for Holstein Cows			
		Uncontrolled	Controlled	EF1	EF2
Feed Storage and Handling	VOC	17.10	17.10	17.10	17.10
	NH3	8.51	8.51	8.51	8.51
	CH4	0.18	0.18	0.18	0.18
	Total	25.79	25.79	25.79	25.79

The controlled PM10 EF will be calculated based on the specific PM10 mitigation measures, if any, for each freestall, corral, or calf hutch area. See the PM Mitigation Measures for calculations.

Pre-Project Potential to Emit (PE1)

Facility Herd Size							
Herd	Flushed Freestalls	Scraped Freestalls	Flushed Corrals	Scraped Corrals	Total # of Animals		
Milk Cows	0	0	0	0	0		
Dry Cows	0	0	0	0	0		
Support Stock (Heifers, Calves, and Bulls)	0	0	1,210	0	1,210		
Large Heifers	0	0	0	0	0		
Medium Heifers	0	0	0	0	0		
Small Heifers	0	0	0	0	0		
Bulls	0	0	0	0	0		
	Calf Hutches				Calf Corrals		Total # of Calves
	Aboveground Flushed	Aboveground Scraped	On-Ground Flushed	On-Ground Scraped	Flushed	Scraped	
Calves	0	0	0	0	0	0	0

Silage Information				
Feed Type	Maximum # Open Piles	Maximum Height (ft)	Maximum Width (ft)	Open Face Area (ft ²)
Corn	1	15	70	803
Alfalfa	0	0	0	
Wheat	1	15	70	803

Milking Parlor				
Cow	VOC		NH3	
Milk Cows	lb/day	lb/yr	lb/day	lb/yr
	0.0	0	0.0	0

Cow Housing						
Cow	VOC		NH3		PM10	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	0.0	0	0.0	0	0.0	0
Dry Cows	0.0	0	0.0	0	0.0	0
Support Stock (Weifers, Calves, and Bulls)	22.5	8,228	46.4	16,940	35.0	12,766
Large Heifers	0.0	0	0.0	0	0.0	0
Medium Heifers	0.0	0	0.0	0	0.0	0
Small Heifers	0.0	0	0.0	0	0.0	0
Calves	0.0	0	0.0	0	0.0	0
Bulls	0.0	0	0.0	0	0.0	0
Total	22.5	8,228	46.4	16,940	35.0	12,766

Liquid Manure Handling						
Cow	VOC		NH3		H2S	
	lb/day	lb/yr	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	0.0	0	0.0	0	0.0	0
Dry Cows	0.0	0	0.0	0	0.0	0
Support Stock (Heifers, Calves, and Bulls)	4.4	1,609	14.9	5,445	4.2	1,549
Large Heifers	0.0	0	0.0	0	0.0	0
Medium Heifers	0.0	0	0.0	0	0.0	0
Small Heifers	0.0	0	0.0	0	0.0	0
Calves	0.0	0	0.0	0	0.0	0
Bulls	0.0	0	0.0	0	0.0	0
Total	4.4	1,609	14.9	5,445	4.2	1,549

Solid Manure Handling				
Cow	VOC		NH3	
	lb/day	lb/yr	lb/day	lb/yr
Milk Cows	0.0	0	0.0	0
Dry Cows	0.0	0	0.0	0
Support Stock (Heifers, Calves, and Bulls)	0.9	315	3.0	1,089
Large Heifers	0.0	0	0.0	0
Medium Heifers	0.0	0	0.0	0
Small Heifers	0.0	0	0.0	0
Calves	0.0	0	0.0	0
Bulls	0.0	0	0.0	0
Total	0.9	315	3.0	1,089

Feed Handling and Storage		
	Daily PE (lb-VOC/day)	Annual PE (lb-VOC/yr)
Corn Emissions	8.2	2,991
Alfalfa Emissions	0.0	0
Wheat Emissions	10.4	3,782
TMR	32.9	12,020
Total	51.5	18,793

Total Daily Pre-Project Potential to Emit (lb/day)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cow Housing	0.0	0.0	35.0	0.0	22.5	46.4	0.0
Liquid Manure	0.0	0.0	0.0	0.0	4.4	14.9	4.2
Solid Manure	0.0	0.0	0.0	0.0	0.9	3.0	0.0
Feed Handling	0.0	0.0	0.0	0.0	51.5	0.0	0.0
Total	0.0	0.0	35.0	0.0	79.3	64.3	4.2

Total Annual Pre-Project Potential to Emit (lb/yr)							
Permit	NOx	SOx	PM10	CO	VOC	NH3	H2S
Milking Parlor	0	0	0	0	0	0	0
Cow Housing	0	0	12,766	0	8,228	16,940	0
Liquid Manure	0	0	0	0	1,609	5,445	1,549
Solid Manure	0	0	0	0	315	1,089	0
Feed Handling	0	0	0	0	18,793	0	0
Total	0	0	12,766	0	28,945	23,474	1,549

Calculations for milking parlor:

Annual PE = (# milk cows) x (EF1 lb-pollutant/hd-yr)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculations for cow housing:

See detailed calculations under Cow Housing Calculations worksheet.

Calculations for liquid manure and solid manure handling:

Annual PE = [(# milk cows) x (EF1 lb-pollutant/hd-yr)] + [(# dry cows) x (EF1 lb-pollutant/hd-yr)] + [(# large heifers) x (EF1 lb-pollutant/hd-yr)] + [(# medium heifers) x (EF1 lb-pollutant/hd-yr)] + [(# small heifers) x (EF1 lb-pollutant/hd-yr)] + [(# calves) x (EF1 lb-pollutant/hd-yr)] + [(# bulls) x (EF1 lb-pollutant/hd-yr)]

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

The H2S emission factor is assumed to be 10% of the NH3 lagoon/storage pond(s) emission factor, for each respective herd size.

Calculations for silage emissions:

Annual PE = (EF1) x (area ft²) x (0.0929 m²/ft²) x (8,760 hr/yr) x (60 min/hr) x 2.20E-9 lb/μg

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Calculation for TMR emissions:

Annual PE = (# cows) x (EF1) x (0.658 m³) x (525,600 min/yr) x (2.20E-9 lb/μg)

Daily PE = (Annual PE lb/yr) ÷ (365 day/yr)

Major Source Emissions (lb/yr)					
Permit	NOx	SOx	PM10	CO	VOC
Milk Parlor	0	0	0	0	0
Cow Housing	0	0	0	0	0
Liquid Manure	0	0	0	0	774
Solid Manure	0	0	0	0	0
Feed Handling	0	0	0	0	0
Total	0	0	0	0	774

APPENDIX G
CEQA GHG: Project Specific Analysis

Greenhouse Gas Emissions - CEQA

Uncontrolled GHG Emission Factors (lb/hd-yr)						
Animal Type	CH4 (Anaerobic Treatment Lagoon)	CH4 (Lagoon)	CH4 (Manure Spreading)	CH4 (Solid Manure Storage)	CH4 (Enteric)	CO2 Equivalent Multiplier for CH4
Milk Cows	513	307.8	3.5	27.7	271.5	21
Dry Cows	513	307.8	3.5	27.7	271.5	21
Support Stock*	110.4	110.4	1.6	—	151.6	21
Large Heifers	110.4	110.4	1.6	—	151.6	21
Medium Heifers	110.4	110.4	1.6	—	100.5	21
Small Heifers	110.4	110.4	1.6	—	100.5	21
Calves	—	—	—	—	—	—
Bulls*	110.4	110.4	1.6	—	151.6	21

Uncontrolled GHG Emission Factors (lb/hd-yr)					
Animal Type	N2O (Anaerobic Treatment Lagoon)	N2O (Manure Spreading)	N2O (Solid Manure Storage)	N2O (Enteric)	CO2 Equivalent Multiplier for N2O
Milk Cows	1.5	0	2.6	0	310
Dry Cows	1.5	0	2.6	0	310
Support Stock*	1.4	0	—	0	310
Large Heifers	1.4	0	—	0	310
Medium Heifers	1.4	0	—	0	310
Small Heifers	1.4	0	—	0	310
Calves	—	—	—	—	—
Bulls*	1.4	0	—	0	310

*Emission factors for Support Stock and Bulls assumed to be the same as Large Heifers.

1 short ton = 0.9072 metric ton

CO₂e from CH₄ = [CH₄ (anaerobic treatment lagoon) + CH₄ manure spreading + CH₄ solid manure storage + CH₄ enteric] × 21 × 0.9072 metric tons/short tons + 2000 lb/ton

CO₂e from N₂O = [N₂O anaerobic treatment lagoon + N₂O manure spreading + N₂O solid manure storage + N₂O enteric] × 310 × 0.9072 metric tons/short tons + 2000 lb/ton

Pre-Project CO₂e Emissions

Pre-Project Lagoon CO ₂ e Emissions from CH ₄ (metric tons/yr)				
Animal Type	Number of Cows	CH ₄ Lagoons (lb/hd-yr)	CO ₂ e Multiplier	CO ₂ e Lagoons (metric tons/yr)
Milk Cows	4,900	307.8	21.0	14,367
Dry Cows	750	307.8	21.0	2,199
Support Stock	7,480	110.4	21.0	7,866
Large Heifers	0	110.4	21.0	0
Medium Heifers	0	110.4	21.0	0
Small Heifers	0	110.4	21.0	0
Calves	0	—	—	0
Bulls	0	110.4	21.0	0

Pre-Project Non-Lagoons CO ₂ e Emissions from CH ₄ (metric tons/yr)						
Animal Type	Number of Cows	CH ₄ Manure Spreading (lb/hd-yr)	CH ₄ Solid Manure Storage (lb/hd-yr)	CH ₄ Enteric (lb/hd-yr)	Multiplier	CO ₂ e Non-Lagoons (metric tons/yr)
Milk Cows	4,900	3.5	27.7	271.5	21.0	14,129
Dry Cows	750	3.5	27.7	271.5	21.0	2,163
Support Stock	7,480	1.6	—	151.6	21.0	10,916
Large Heifers	0	1.6	—	151.6	21.0	0
Medium Heifers	0	1.6	—	100.5	21.0	0
Small Heifers	0	1.6	—	100.5	21.0	0
Calves	0	—	—	—	—	0
Bulls	0	1.6	—	151.6	21.0	0

Pre-Project Lagoon CO ₂ e Emissions from N ₂ O (metric tons/yr)				
Animal Type	Number of Cows	N ₂ O Lagoons (lb/hd-yr)	CO ₂ e Multiplier	CO ₂ e Lagoons (metric tons/yr)
Milk Cows	4,900	0.0	310.0	0
Dry Cows	750	0.0	310.0	0
Support Stock	7,480	0.0	310.0	0
Large Heifers	0	0.0	310.0	0
Medium Heifers	0	0.0	310.0	0
Small Heifers	0	0.0	310.0	0
Calves	0	0.0	—	0
Bulls	0	0.0	310.0	0

Pre-Project Non-Lagoons CO ₂ e Emissions from N ₂ O (metric tons/yr)						
Animal Type	Number of Cows	N ₂ O Manure Spreading (lb/hd-yr)	N ₂ O Solid Manure Storage (lb/hd-yr)	N ₂ O Enteric (lb/hd-yr)	Multiplier	CO ₂ e Non-Lagoons (metric tons/yr)
Milk Cows	4,900	0.0	2.6	0.0	310.0	1,791
Dry Cows	750	0.0	2.6	0.0	310.0	274
Support Stock	7,480	0.0	—	0.0	310.0	0
Large Heifers	0	0.0	—	0.0	310.0	0
Medium Heifers	0	0.0	—	0.0	310.0	0
Small Heifers	0	0.0	—	0.0	310.0	0
Calves	0	0.0	—	0.0	—	0
Bulls	0	0.0	—	0.0	310.0	0

Total Pre-Project CO ₂ e Emissions (metric tons/yr)			
Animal Type	CO ₂ e from CH ₄	CO ₂ e from N ₂ O	Total
Milk Cows	28,495	1,791	30,287
Dry Cows	4,362	274	4,636
Support Stock	18,782	0	18,782
Large Heifers	0	0	0
Medium Heifers	0	0	0
Small Heifers	0	0	0
Calves	0	0	0
Bulls	0	0	0
Total			53,704

Post-Project CO₂e Emissions

Post-Project Lagoon CO ₂ e Emissions from CH ₄ (metric tons/yr)				
Animal Type	Number of Cows	CH ₄ Lagoons (lb/hd-yr)	CO ₂ e Multiplier	CO ₂ e Lagoons (metric tons/yr)
Milk Cows	7,278	307.8	21.0	21,338
Dry Cows	1,004	307.8	21.0	2,844
Support Stock	8,544	110.4	21.0	8,985
Large Heifers	0	110.4	21.0	0
Medium Heifers	0	110.4	21.0	0
Small Heifers	0	110.4	21.0	0
Calves	0	—	—	0
Bulls	0	110.4	21.0	0

Post-Project Non-Lagoons CO ₂ e Emissions from CH ₄ (metric tons/yr)						
Animal Type	Number of Cows	CH ₄ Manure Spreading (lb/hd-yr)	CH ₄ Solid Manure Storage (lb/hd-yr)	CH ₄ Enteric (lb/hd-yr)	Multiplier	CO ₂ e Non-Lagoons (metric tons/yr)
Milk Cows	7,278	3.5	27.7	271.5	21.0	20,985
Dry Cows	1,004	3.5	27.7	271.5	21.0	2,895
Support Stock	8,544	1.6	—	151.6	21.0	12,468
Large Heifers	0	1.6	—	151.6	21.0	0
Medium Heifers	0	1.6	—	100.5	21.0	0
Small Heifers	0	1.6	—	100.5	21.0	0
Calves	0	—	—	—	—	0
Bulls	0	1.6	—	151.6	21.0	0

Post-Project Lagoon CO ₂ e Emissions from N ₂ O (metric tons/yr)				
Animal Type	Number of Cows	N ₂ O Lagoons (lb/hd-yr)	CO ₂ e Multiplier	CO ₂ e Lagoons (metric tons/yr)
Milk Cows	7,278	0.0	310.0	0
Dry Cows	1,004	0.0	310.0	0
Support Stock	8,544	0.0	310.0	0
Large Heifers	0	0.0	310.0	0
Medium Heifers	0	0.0	310.0	0
Small Heifers	0	0.0	310.0	0
Calves	0	0.0	—	0
Bulls	0	0.0	310.0	0

Post-Project Non-Lagoons CO ₂ e Emissions from N ₂ O (metric tons/yr)						
Animal Type	Number of Cows	N ₂ O Manure Spreading (lb/hd-yr)	N ₂ O Solid Manure Storage (lb/hd-yr)	N ₂ O Enteric (lb/hd-yr)	Multiplier	CO ₂ e Non-Lagoons (metric tons/yr)
Milk Cows	7,278	0.0	2.6	0.0	310.0	2,661
Dry Cows	1,004	0.0	2.6	0.0	310.0	367
Support Stock	8,544	0.0	—	0.0	310.0	0
Large Heifers	0	0.0	—	0.0	310.0	0
Medium Heifers	0	0.0	—	0.0	310.0	0
Small Heifers	0	0.0	—	0.0	310.0	0
Calves	0	0.0	—	0.0	—	0
Bulls	0	0.0	—	0.0	310.0	0

Total Post-Project CO ₂ e Emissions (metric tons/yr)			
Animal Type	CO ₂ e from CH ₄	CO ₂ e from N ₂ O	Total
Milk Cows	42,324	2,661	44,985
Dry Cows	5,839	367	6,206
Support Stock	21,454	0	21,454
Large Heifers	0	0	0
Medium Heifers	0	0	0
Small Heifers	0	0	0
Calves	0	0	0
Bulls	0	0	0
Total			72,644

Change in CO₂e Emissions

Change in Project GHG Emissions			
Animal Type	Pre-Project CO ₂ e (metric tons/yr)	Post-Project CO ₂ e (metric tons/yr)	Change (metric tons/yr)
Milk Cows	30,287	44,985	14,698
Dry Cows	4,636	6,206	1,570
Support Stock	18,782	21,454	2,672
Large Heifers	0	0	0
Medium Heifers	0	0	0
Small Heifers	0	0	0
Calves	0	0	0
Bulls	0	0	0
Total			19,940

APPENDIX H

Quarterly Net Emissions Change

Quarterly Net Emissions Change (QNEC)

The Quarterly Net Emissions Change is used to complete the emission profile screen for the District's PAS database. The QNEC shall be calculated as follows:

QNEC = PE2 - PE1, where:

- QNEC = Quarterly Net Emissions Change for each emissions unit, lb/qtr
- PE2 = Post-Project Potential to Emit for each emissions unit, lb/qtr
- PE1 = Pre-Project Potential to Emit for each emissions unit, lb/qtr

The quarterly PE values are calculated as follows: PE (lb/yr) ÷ 4 (qtr/yr)

Using the annual PE2 and PE1 values previously calculated, the QNEC (lb/qtr) for each permit unit is shown below:

Milking Parlor						
	NOx	SOx	PM10	CO	VOC	NH3
Annual PE2 (lb/yr)	0	0	0	0	2,911	996
Daily PE2 (lb/day)	0.0	0.0	0.0	0.0	8.0	2.7
1:	0.0	0.0	0.0	0.0	237.75	81.50
2:	0.0	0.0	0.0	0.0	237.75	81.50
3:	0.0	0.0	0.0	0.0	237.75	81.50
4:	0.0	0.0	0.0	0.0	237.75	81.50

Cow Housing						
	NOx	SOx	PM10	CO	VOC	NH3
Annual PE2 (lb/yr)	0	0	74,350	0	108,050	211,827
Daily PE2 (lb/day)	0.0	0.0	203.7	0.0	295.8	580.4
1:	0.0	0.0	-1,897.75	0.0	7,119.0	15,322.0
2:	0.0	0.0	-1,897.75	0.0	7,119.0	15,322.0
3:	0.0	0.0	-1,897.75	0.0	7,119.0	15,322.0
4:	0.0	0.0	-1,897.75	0.0	7,119.0	15,322.0

Liquid Manure Handling							
	NOx	SOx	PM10	CO	VOC	NH3	H2S
Annual PE2 (lb/yr)	0	0	0	0	15,667	49,088	1,191
Daily PE2 (lb/day)	0.0	0.0	0.0	0.0	42.9	134.5	3.3
1:	0.0	0.0	0.0	0.0	-1216.75	-1,429.75	0.0
2:	0.0	0.0	0.0	0.0	-1216.75	-1,429.75	0.0
3:	0.0	0.0	0.0	0.0	-1216.75	-1,429.75	0.0
4:	0.0	0.0	0.0	0.0	-1216.75	-1,429.75	0.0

Solid Manure Handling						
	NOx	SOx	PM10	CO	VOC	NH3
Annual PE2 (lb/yr)	0	0	0	0	5,391	28,440
Daily PE2 (lb/day)	0.0	0.0	0.0	0.0	14.8	77.9
1:	0.0	0.0	0.0	0.0	349.25	1,972.50
2:	0.0	0.0	0.0	0.0	349.25	1,972.50
3:	0.0	0.0	0.0	0.0	349.25	1,972.50
4:	0.0	0.0	0.0	0.0	349.25	1,972.50

Feed Storage and Handling						
	NOx	SOx	PM10	CO	VOC	NH3
Annual PE2 (lb/yr)	0	0	0	0	148,264	0
Daily PE2 (lb/day)	0.0	0.0	0.0	0.0	406.1	0.0
1:	0.0	0.0	0.0	0.0	7,435.0	0.0
2:	0.0	0.0	0.0	0.0	7,435.0	0.0
3:	0.0	0.0	0.0	0.0	7,435.0	0.0
4:	0.0	0.0	0.0	0.0	7,435.0	0.0

APPENDIX I

Emission Profiles

Permit #: C-5289-1-4	Last Updated
Facility: DIAMOND H DAIRY	09/07/2018 YOSHIMUJ

Equipment Pre-Baselined: NO

	<u>NOX</u>	<u>SOX</u>	<u>PM10</u>	<u>CO</u>	<u>VOC</u>
Potential to Emit (lb/Yr):	0.0	0.0	0.0	0.0	2911.0
Daily Emis. Limit (lb/Day)	0.0	0.0	0.0	0.0	8.0
Quarterly Net Emissions Change (lb/Qtr)					
Q1:	0.0	0.0	0.0	0.0	237.0
Q2:	0.0	0.0	0.0	0.0	238.0
Q3:	0.0	0.0	0.0	0.0	238.0
Q4:	0.0	0.0	0.0	0.0	238.0
Check if offsets are triggered but exemption applies	N	N	N	N	Y
Offset Ratio					
Quarterly Offset Amounts (lb/Qtr)					
Q1:					
Q2:					
Q3:					
Q4:					

Permit #: C-5289-2-5	Last Updated
Facility: DIAMOND H DAIRY	09/07/2018 YOSHIMUJ

Equipment Pre-Baselined: NO

	<u>NOX</u>	<u>SOX</u>	<u>PM10</u>	<u>CO</u>	<u>VOC</u>
Potential to Emit (lb/Yr):	0.0	0.0	74350.0	0.0	108050.0
Daily Emis. Limit (lb/Day)	0.0	0.0	203.7	0.0	295.8
Quarterly Net Emissions Change (lb/Qtr)					
Q1:	0.0	0.0	-1897.0	0.0	7119.0
Q2:	0.0	0.0	-1898.0	0.0	7119.0
Q3:	0.0	0.0	-1898.0	0.0	7119.0
Q4:	0.0	0.0	-1898.0	0.0	7119.0
Check if offsets are triggered but exemption applies	N	N	N	N	Y
Offset Ratio					
Quarterly Offset Amounts (lb/Qtr)					
Q1:					
Q2:					
Q3:					
Q4:					

Permit #: C-5289-3-5	Last Updated
Facility: DIAMOND H DAIRY	11/01/2018 YOSHIMUJ

Equipment Pre-Baselined: NO

	<u>NOX</u>	<u>SOX</u>	<u>PM10</u>	<u>CO</u>	<u>VOC</u>
Potential to Emit (lb/Yr):	0.0	0.0	0.0	0.0	15667.0
Daily Emis. Limit (lb/Day)	0.0	0.0	0.0	0.0	42.9
Quarterly Net Emissions Change (lb/Qtr)					
Q1:	0.0	0.0	0.0	0.0	-1216.0
Q2:	0.0	0.0	0.0	0.0	-1217.0
Q3:	0.0	0.0	0.0	0.0	-1217.0
Q4:	0.0	0.0	0.0	0.0	-1217.0
Check if offsets are triggered but exemption applies	N	N	N	N	Y
Offset Ratio					
Quarterly Offset Amounts (lb/Qtr)					
Q1:					
Q2:					
Q3:					
Q4:					

Permit #: C-5289-4-4	Last Updated
Facility: DIAMOND H DAIRY	09/07/2018 YOSHIMUJ

Equipment Pre-Baselined: NO

	<u>NOX</u>	<u>SOX</u>	<u>PM10</u>	<u>CO</u>	<u>VOC</u>
Potential to Emit (lb/Yr):	0.0	0.0	0.0	0.0	5391.0
Daily Emis. Limit (lb/Day)	0.0	0.0	0.0	0.0	14.8
Quarterly Net Emissions Change (lb/Qtr)					
Q1:	0.0	0.0	0.0	0.0	349.0
Q2:	0.0	0.0	0.0	0.0	349.0
Q3:	0.0	0.0	0.0	0.0	349.0
Q4:	0.0	0.0	0.0	0.0	350.0
Check if offsets are triggered but exemption applies	N	N	N	N	Y
Offset Ratio					
Quarterly Offset Amounts (lb/Qtr)					
Q1:					
Q2:					
Q3:					
Q4:					

Permit #: C-5289-13-3	Last Updated
Facility: DIAMOND H DAIRY	09/07/2018 YOSHIMUJ

Equipment Pre-Baselined: NO

	<u>NOX</u>	<u>SOX</u>	<u>PM10</u>	<u>CO</u>	<u>VOC</u>
Potential to Emit (lb/Yr):	0.0	0.0	0.0	0.0	148264.0
Daily Emis. Limit (lb/Day)	0.0	0.0	0.0	0.0	406.1
Quarterly Net Emissions Change (lb/Qtr)					
Q1:	0.0	0.0	0.0	0.0	7435.0
Q2:	0.0	0.0	0.0	0.0	7435.0
Q3:	0.0	0.0	0.0	0.0	7435.0
Q4:	0.0	0.0	0.0	0.0	7435.0
Check if offsets are triggered but exemption applies	N	N	N	N	Y
Offset Ratio					
Quarterly Offset Amounts (lb/Qtr)					
Q1:					
Q2:					
Q3:					
Q4:					