The study includes particulate matter associated with agricultural and livestock operations, including dairy facilities. The study is expected to be completed in 2003.

Estimation of the amount of ammonia that is converted into ammonium nitrate and the expected contribution to existing $PM_{2.5}$ concentrations cannot be accurately made at this time. Estimation of the $PM_{2.5}$ emissions from this single source would require development of a regionwide photochemical model. Considering the lack of available techniques to estimate $PM_{2.5}$ emissions from secondary sources, particularly from ammonia reactions, development of such a complex regional model is outside the scope of this PEIR. However, it is acknowledged by this document that ammonia emissions from existing dairies could be a major contributor to the formation of secondary $PM_{2.5}$.

ROG Emissions from Manure Decomposition

Cattle manure will naturally undergo anaerobic decomposition once it is excreted from the animal (Zhang and Westerman, 1996). A wide variety of gaseous compounds are emitted during various stages of the decomposition process, such as ROG. Specific ROG that would be generated during the intermediate manure decomposition stage include ethyl amine, trimethyl amine, propyl acetate, isopropyl alcohol, and ethyl alcohol (Radian, 1988).

ROG emissions may be generated from cattle manure at any location where cattle manure is present, provided the manure is undergoing natural anaerobic decomposition. These locations could include the freestall drive lanes, storage ponds, unpaved corrals, manure stockpiles, and areas where manure waste is applied. Limited data for estimating ROG emissions from cattle manure are currently available. CARB's Emission Inventory Procedural Manual, Methods for Assessing Area Source Emissions includes an emission factor for total organic gases; the emission factor is based on the Evaluation of Emissions from Selected Uninventoried Sources in the State of California, prepared for the CARB in April 1988 by Radian Corporation. Approximately eight percent of the total organic gases emission factor was considered ROG, based on the compounds identified as total organic gases (Radian, 1988). It should be noted that the emission factor used to estimate ROG emissions was developed more than ten years ago and was based on limited available data.

ROG emissions were estimated for existing conditions, assuming that none of the dairy facilities are currently treating generated manure to reduce ROG emissions. The number of milk cows currently housed in existing dairies in Kings County was obtained from Table 5 of the Element (Theoretical Dairy Capacity of Kings County). Similarly, the number of support stock (dry cows, heifers, and calves) was determined using the ratio of milk cow to individual support stock and existing milk cow data provided in Table 5 of the Element (Theoretical Dairy Capacity of Kings County). Potentially 1,694 tons per year of ROG could be generated from natural decomposition of the manure produced from existing dairies (Table 4.2-5a).[44]

CARB's November 2000 study indicated that 2,600 tons per year of ROG were generated from dairy operations in Kings County. As previously indicated however, CARB's estimate is artificially inflated since the estimate also accounts for ROG emissions generated from other livestock sources, and not exclusively from dairy animals.

Ammonia Emissions from Manure Decomposition

Ammonia is an odorous compound that is generated from cattle manure. The nitrogen excreted by cattle in the form of urea manure in urine is volatilized into ammonia rapidly through hydrolysis. Ammonia is also generated during decomposition of organic nitrogen contained in the fecal manure. Ammonia generation is dependent on various conditions including the animal type, feed type provided to the animal, environmental conditions (i.e., temperature, humidity), pH of the manure surface, geography, and level of biological activity.

Several studies have been prepared to estimate ammonia emissions from dairy cattle in recent years. Ammonia emission studies conducted during the 1980s and 1990s have reported ammonia emission factors ranging from 11 pounds per head per year to 130 pounds per head per year (Confined Livestock Air Quality Committee of the USDA Agricultural Air Quality Task Force, 2000; CARB, 1999). In 1997, Terry James, et al. conducted field estimates of ammonia volatilization from cattle production facilities in the San Joaquin Valley. The field study estimated an ammonia emission factor of 74 pounds per head per year (James, et al., 1997).[45] According to the July 2000 Air Quality Research and Technology Transfer Programs for Concentrated Animal Feeding Operations Air Quality Research and Technology Transfer White Paper and Recommendations for Concentrated Animal Feeding Operations, field studies were conducted in 1998 in the San Joaquin Valley to estimate upwind and downwind ammonia concentrations and calculate an ammonia emission factor, based on the emission rate and number of animals at the dairy studied. The calculated ammonia emission factors, which accounted for temporal effects, ranged from 24 pounds per head per year during the evening to 227 pounds per head per year in the late morning (Confined Livestock Air Quality Committee of the USDA Agricultural Air Quality Task Force, 2000). More recently in 1999, Ashbaugh and others conducted an additional study that also reports ammonia emissions factors based on field

[44] CARB's 1996 Emission Inventory estimated that an average of eight tons per day (2,738 tons per year) of ROG were emitted from livestock waste in King County in 1996 (CARB, 1998).

[45] Note that this emission factor is not specific to the cattle type (e.g., cow, heifer, calves) and reflects the emission factor from a combination of the different cattle typically housed at a dairy facility.

studies; however, this study has not yet been published but is expected to be released in 2000. According to CARB, the ammonia emission factors reported in this study are similar to previously reported emission factors (Benjamin, 2000).

In 1999, CARB prepared a preliminary ammonia emission inventory for dairies and beef cattle in California. Because ammonia is a precursor to $PM_{2.5}$, the inventory was conducted as a result of the promulgation of the $PM_{2.5}$ Federal standard in 1997.[46] The emission factors for dairy cattle used in this inventory were from the 1994 Development and Selection of Ammonia Emission Factors, developed for the U.S. EPA (Battye, et al., 1994). The 1994 report provides a compilation of published emission factors for various animals. The emission factors used in the CARB inventory were based on the 1992 Asman emission factors referenced in the 1994 report (Battye, et al., 1994).[47] However, CARB plans on revising the ammonia emission inventory to reflect the recent ammonia emission factor developed by Ashbaugh and others (Shimp, 2000).

Additional ammonia studies are currently being conducted. The South Coast Air Quality Management District is in the process of developing a comprehensive ammonia emission inventory for dairies in Southern California.

A range of potential ammonia emissions from cattle manure were estimated using the emission factors published in the 1994 Development and Selection of Ammonia Emission Factors, developed by Battye, et al. for the U.S. EPA (Battye, et al., 1994) (Scenario One) as well as the factor from James and others (1997) (Scenario Two). The emissions were estimated assuming that manure treatment to reduce ammonia emissions is currently not being implemented by the dairies.

Potentially, between 2,395 and 9,733 tons per year of ammonia could be generated under existing conditions (Tables 4.2-5a). The lower range reflects the emission factors developed in 1994 and is based on the current number of animals throughout the existing dairies, animal type (applicable only for the 1994 emission factor), and specific emission factors for decomposition of newly generated manure at the animal housing unit and decomposition of stored manure. The number of milk cows at existing dairies was obtained from Table 5 of the Element (Theoretical Dairy Capacity of Kings County) and the number of support stock (dry cows, heifers, and calves) was determined using the ratio of milk cow to individual support stock and existing milk cow data provided in Table 5 of the Element.

[46] Ammonia gas can react in the atmosphere to produce particulate matter, such as ammonium nitrate or ammonium sulfate.

[47] The Asman study, conducted in 1992, summarized literature in the Netherlands through 1990.

The higher end of the range reflects the emission factor developed by James and others (74 pounds per head per year) and is based on the current number of animals throughout the existing dairies. This emission factor reflects the emission factor from a combination of the different cattle typically housed at a dairy facility and is not specific to the cattle type (e.g., cow, heifer, calves).

Actual ammonia emissions that could be generated are highly variable and are dependent on site-specific factors as discussed above. CARB's November 2000 study indicates that 7,600 tons per year of ammonia were generated from dairy operations in Kings County. As previously indicated, the estimate is based on the 1998 dairy cattle population data and an emission factor of 74 pounds per head per year (the same emission factor used for Scenario 2).

It should be noted that additional ammonia may also be released into the environment if process water and stockpiled manure from the existing dairies are applied onto agricultural fields. However, ammonia emissions would also be expected with the use of nitrogen-rich manufactured fertilizer that would be necessary if locally generated manure were not used as fertilizer.

Hydrogen Sulfide Emissions from Manure Decomposition

Hydrogen sulfide is an odorous compound that is generated during decomposition of cattle manure. However, emission factors for hydrogen sulfide production from manure decomposition are not currently available and therefore, hydrogen sulfide emissions from existing dairies could not be accurately estimated. However, a sampling of 58 dairies in Minnesota by the Minnesota Pollution Control Agency (MPCA) in 1998 indicated that the median concentration of hydrogen sulfide at or near the facility boundary was typically less than 0.02 ppm. Due to significant differences in climatic conditions in the southern San Joaquin Valley, the MPCA data may not be directly applicable to this EIR. By comparison, the permissible exposure limit (PEL) established in Title 8 of the California Code of Regulations Section 5155 for the protection of human health is 10 ppm.

Methane Emissions from Cattle and Manure Decomposition

Methane emissions are generated from cattle and manure management. Methane generated during the cattle's digestive process is released through the animal's mouth and nostrils. Cattle throughout the existing dairies could potentially generate on the order of 23,173 tons per year of methane (Table 4.2-5a). The emissions were estimated based on EPA-developed emission factors for dairy cattle in the western United States (U.S. EPA, 1998c) and the total number and types of cows at the existing dairies.[48] However, the actual amount of methane generated by cattle depends on the feed quality, feeding level and schedule, and animal health.

Cattle manure generated throughout the existing dairies also release methane during the decomposition process. The amount of methane that could be released from decomposing manure by existing dairies could be on the order of 14,804 tons per year, assuming that none of the dairies currently implement manure treatment to reduce methane emissions (Table 4.2-5a). The estimate was based on the number of cows at the existing dairies and emission factors for natural manure decomposition available from the Emission Inventory Procedural Manual, Methods for Assessing Area Source Emissions developed by the California Air Resources Board (CARB, 1989b; Radian, 1988).

CARB's November 2000 study did not estimate methane emissions from the cattle's digestive process. The study indicated 8,300 tons per year of methane were generated from dairy livestock waste in Kings County. As previously indicated, CARB's estimate includes emissions generated from other livestock sources, and does not exclusively provide emissions from dairy animals. However, it is unknown why CARB's emissions estimate (8,300 tons per year) is considerably less than the emissions estimated for current conditions (15,983 tons per year).

Exhaust (ROG, NOx, and PM_{10}) Emissions from Dairy Farm Equipment

Air pollutant emissions from dairy farm equipment exhaust include ozone precursors (i.e., ROG and NOx) and PM_{10}. Similar to exhaust generated from agricultural equipment, ROG, NOx, and PM_{10} emissions generated from dairy farm equipment would be dependent on the types of equipment used (e.g., diesel-fueled equipment such as tractors, trucks, and miscellaneous equipment), equipment use duration, equipment horsepower, crop areas, annual operating hours for each equipment, emission factors, and load factors. ~~Since this information varies throughout the County, and is site-specific, estimations of ROG, NOx, and PM_{10} emissions under current conditions could not be estimated.~~

RECEPTORS

Receptors are generally regarded to be people exposed to air emissions generated by development construction and operation. The SJVUAPCD defines a "sensitive receptor" as a location where human populations, especially children, seniors, and sick persons are present, and where there is a reasonable expectation of continuous human exposure to pollutants, according to the averaging period for the ambient air quality standards, such

[48] The emission factors were based on a mechanistic model outlined in the 1993 U.S. EPA Report to Congress entitled "Anthropogenic Methane Emissions in the United States: Estimates for 1990."

as 24 hour, 8 hour, or 1 hour. Examples of receptors include residences, hospitals, and schools (SJVUAPCD, 1998). Although the SJVUAPCD definition of receptors includes residences, it is generally interpreted to include areas designated by the General Plan for residential use. Future dairy sites under the Element would be located in areas designated General Agricultural. Receptors in such agricultural areas are subject to the Right to Farm Ordinance and are expected to be subject to discomfort and inconveniences caused by air emissions associated with existing standard agricultural operations or practices.

CONSISTENCY WITH EXISTING PLANS AND POLICIES

The Air Quality section of the Resources Conservation Element of the Kings County General Plan does not contain specific goals, objectives, or policies related to air quality pollutants that would be relevant to the proposed project. The main goal of the General Plan is to protect human health and preserve the environment by achieving good air quality.

Goal 13: Protect human health and preserve the environment by achieving good air quality.

Objective 13.1: Implement air quality standards that protect human health and prevent crop, plant, and property damage.

Policy 13b: Require that commercial and industrial development minimize air pollution emissions by using Best Available Control Technology (BACT).

Policy 13c: Refer development projects to the San Joaquin Valley Unified Air Pollution Control District as appropriate for their review and comment. Consider their suggestions and requirements as conditions of approval.

Although Policy 13c indicates that development projects should be referred to the SJVUAPCD as appropriate for their review and comment, agricultural and livestock operations, such as the proposed project, are exempt from the permitting requirements of SJVUAPCD. Air pollutants generated from new or expanded dairies under the Element may be released into the environment at levels that would exceed significance thresholds for permitted sources established by the SJVUAPCD, as discussed in the impacts discussions below.

RELEVANT GOALS, OBJECTIVES, AND POLICIES

The following goals, objectives, and policies of the Kings County Draft Dairy Element address air quality issues:

Dairy Siting Goals, Objectives, and Policies

Goal DE 1 restricts the locations where dairies may be located to those areas of the County where they are most compatible with surrounding uses and activities, and environmental constraints. **Objective DE 1.2** requires ~~that~~ specific ~~criteria~~ standards to minimize potential land use conflicts when approving new dairies and expansion of existing dairies. Such conflicts could include nuisance odors at residences near existing or proposed dairies, which are addressed in Impact ~~4.2-5~~ 4.2-4 of this EIR.

Policy DE 1.2g provides a buffer zone between dairy facilities and schools. The policy indicates that dairies (including manure and dairy process water storage areas) are prohibited from locating within a one-half mile buffer zone around any existing public or private school site. The policy allows manure used as fertilizer and dairy process water used to irrigate cropland to be transported to and used within the school buffer zone, but must be scheduled during weekends or summer vacation when the schools are closed.

Policy DE 1.2h provides a buffer zone between dairy facilities. The policy indicates that the minimum distance between dairy facilities and other dairies and confined animal feeding operations shall be one-quarter mile. This restriction includes only the actual dairy facilities, i.e., corrals, milk barns, feed storage areas, manure storage areas, etc., but not cropland used to spread dairy process water and manure.

Policy DE 1.2i requires a one-half mile buffer zone between any residential zone and a dairy facility, including corrals, barns, feed and manure storage areas, and ponds. **Policy DE 1.2j** addresses "compatibility zone" boundaries. The policy indicates that the "compatibility zone" boundaries around the cities of Hanford, Lemoore, and Corcoran shall be updated periodically to ensure that changes are reflected in the boundaries.

Theoretical Herd Capacity Goals, Objectives, and Policies

Goal DE 3 requires the development of a countywide policy for the evaluation and distribution of dairies and dairy stock replacement location and operation. **Objective DE 3.1** requires consideration of potential environmental effects of dairies when reviewing and evaluating proposals for new or expanded dairies.

Policy DE 3.1a requires the consideration of the following criteria for both the general dairy siting criteria and site specific dairy projects: 1) Ground and surface water quality and quantity; 2) Soil characteristics; 3) Air quality, including dust control (construction and operation) and odors; 4) Traffic and road conditions; 5) Dead animal disposal management; 6) Insect, i.e., fly and mosquito control and rodent control; ~~7) Loss of agricultural land~~; ~~8~~ 7) Light and glare and noise; ~~9) Cumulative effects;~~ ~~10~~ 8) Biological resources; ~~11~~ 9) Cultural and archeological resources; ~~and 12) Other potential health, safety, and/or nuisance~~

~~problems that may be identified on a case by case basis~~ 10) Slope stability and potential for erosion; 11) Proximity to the nearest residences; and 12) Irrigation management.

Goal DE 5 recommends control of potential adverse air emissions at dairies to promote protection of air quality in the San Joaquin Valley. **Objective DE 5.1** requires that emerging air emissions control practices and technologies be implemented at dairies to reduce the potential for degradation of air quality and odor generation.

Policy DE 5.1a requires ~~the participation in~~ monitoring of the efforts of the SJVUAPCD in developing air emissions control guidelines for agricultural uses, including dairy operations. **Policy DE 5.1b** requires that an Odor Management Plan (OMP) be prepared as part of the technical information submitted with each application to either establish a new dairy or expand an existing dairy. The Plan is to specifically address standard operating practices for livestock handling, and manure collection, treatment, storage, and land application.

Policy DE 5.1c requires that a Manure Treatment Management Plan (MTMP) be prepared as part of the technical report submitted with each application to either establish a new dairy or expand an existing dairy. The policy requires that the technical report also present an estimate of the anticipated increase in ROG, ammonia, and methane emissions generated by manure and process water management proposed by the dairy development project.

The MTMP would provide treatment of all manure to reduce ROG, nitrous oxides, ammonia, methane, hydrogen sulfide, and odor emissions. The MTMP would describe general housekeeping practices, feed management, solid manure moisture management, the purpose and procedures for the use of additives or adsorbents, and land application methodologies that effectively minimize air pollutant emissions. The policy further requires that the MTMP include an advanced treatment technology to reduce ROG emissions for all new dairies and dairy expansions that include construction of new dairy facilities. Effective advanced treatment technologies provided in the policy include: 1) controlled anaerobic digestion; 2) aerobic treatment; and 3) combined controlled aerobic/anaerobic treatment.

The MTMP would include a quality assurance/quality control protocol to monitor the implementation and effectiveness of the manure treatment system. An estimate of the volatile solids removal efficiency of the proposed treatment system would be presented in the MTMP. The MTMP would demonstrate that the proposed advanced treatment system shall meet or exceed the goal of 50 percent reduction in volatile solids in the treated manure and dairy process water. The MTMP would be revised as necessary, based on the results of the monitoring program, to ensure that the selected treatment technology is being implemented in a manner that will reduce or control air emissions and odor from dairy operations.

The policy indicates that the requirement for implementation of advanced treatment technologies would be waived for proposed existing dairy expansion projects that do not include proposed construction of new dairy facilities and for which the expanded dairy herd would not exceed the calculated capacity and would not result in ROG emissions that would exceed the SJVUAPCD threshold limits set for a stationary source.

Policy DE 5.1d requires that SJVUAPCD Regulation VIII~~, Rule 8020~~ rules be implemented during construction activities to reduce PM_{10} emissions and control fugitive dust emissions.

Policy DE 5.1e requires that fugitive dust emissions from cattle movement and maintenance activities at the unpaved corrals, perimeter roadways, and other unpaved areas throughout dairy ~~sites~~ facilities be effectively stabilized by the use of water or chemical stabilizer/suppressant that is safe for the environment and cattle. Stabilization shall be conducted in a manner that will not result in the potential for breeding of mosquitoes and other vectors. The policy requires the owner/operator to also ensure that manure generated in the corrals is removed periodically to prevent the manure from becoming a PM_{10} source and further requires that removal activities be conducted in a manner that will minimize dust emissions.

~~**Policy DE 5.1f** requires that a Livestock Management Plan (LMP) be prepared as part of the technical report submitted with each application to either establish a new dairy or expand an existing dairy. The LMP is required to identify practices to reduce methane emissions from ruminant livestock and must be consistent with the voluntary practices incorporated in EPA's Ruminant Livestock Efficiency Program.~~

Policy DE ~~5.1g~~ 5.1f requires the owner/operator of a proposed dairy development or ~~redevelopment~~ expansion to ensure that ~~specific~~ measures are implemented to control exhaust emissions generated from heavy-duty construction equipment.

Policy DE ~~5.1h~~ 5.1g requires the calculation of anticipated PM_{10} emissions from cattle movement and maintenance activities at the unpaved corrals, perimeter roadways, and other unpaved areas throughout the dairy site. In addition, the policy requires that a Fugitive Dust Emissions Control Plan (FDECP) be submitted with all applications for proposed dairies and all dairy expansions. The Plan shall describe and demonstrate conformance with SJVUAPCD fugitive dust emissions control requirements.

Policy DE ~~5.1i~~ 5.1h requires that all dairies comply with the ~~Best Available Control Measures (BACM)~~ control measures for fugitive dust emissions from agricultural sources