

AIR QUALITY BMP SELECTION MATRIX

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The matrix presented here provides a tool for selecting best management practices (BMPs) for air quality emission reduction. For detailed descriptions of respective BMPs, refer to the sister-document entitled “Descriptions of Best Management Practices (BMP)”. This current document is neither intended to provide detailed information as to how the BMPs should be selected (or implemented), nor is it the only feasible approach on selection (or implementation) of BMPs. It is expected that exact selection or implementation will vary from farm to farm. When applicable, be mindful of tradeoffs, limitations, or both for each BMP.

Definitions: NH_3 = ammonia; N_2O = nitrous oxide; H_2S = hydrogen sulfide; CH_4 = methane; *VOC* = volatile organic compounds; *PM* = particulate matter.

The following matrix outlines the process for identifying sources of emissions on your facility and how to choose and implement BMPs to mitigate those emissions. Use this chart and the detailed example that follows it as guides when developing your Air Quality Management Plan.

I. List the sources of emissions on the dairy

II. For each source, list the expected pollutants in order of importance
(Example: VOCs for silage storage area; PM for dry open feedlots; etc.)

III. List the sources in order of importance with respect to expected or projected emission level
(Example: Open anaerobic lagoons because of their size and open nature, are likely to be more important with respect to air emissions than sand-settling basins; broadcast (big gun) land application is likely to have greater impact on air quality than injection; etc.)

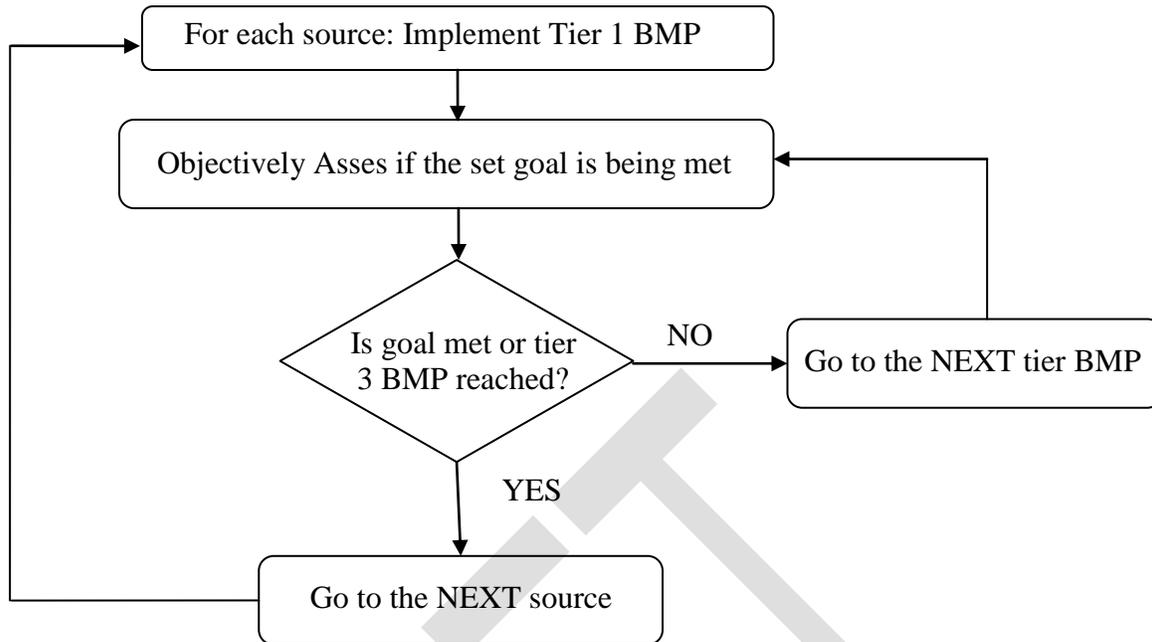
IV. Define the emissions mitigation goal for each of the sources.

The goal for individual sources, for example, could be:

1. To address existing regulations – either local or federal
2. To minimize nuisance lawsuits
3. To champion environmental stewardship
4. To address the most important pollutant in terms of volume or health impact
5. To address other goals (i.e. etc.)

V. Depending on the goal for each source, list three BMPs to address the goal based on a three-tier-system with respect to effectiveness, cost, ease of implementation, compatibility with other BMPs, and in compatibility with your nutrient management plans.

1. Tier 1 being the least expensive and easy to implement
2. Tier 3 being the most advanced and most expensive to implement



I. List the sources of emission on the dairy. The following sources are the most common areas of air pollutant emission on a dairy operation. Not all areas may apply to your farm. Select the sources that do apply and list the specific factors (i.e., production areas) within that source that can contribute to air pollutant emission (e.g., Manure Storage may have manure holding pit, lagoon, and compost pile as areas within the source that can contribute emissions).

1. Nutrition.
2. Feed Processing and Management.
3. Housing - Freestall Barns.
4. Housing – Drylots.
5. Grazing Management.
6. Manure Storage.
7. Land Application.

II. For each source, list the expected pollutants in order of importance. For each source, the pollutants of concern have been listed below in general order of importance. Your farm may have a different order. When in doubt, use the order listed below.

1. Nutrition: NH_3 , CH_4 , H_2S , N_2O .
2. Feed Processing and Management: VOC, PM, Odor.
3. Housing - Freestall Barns: NH_3 , VOC, Odor, CH_4 , H_2S .
4. Housing – Drylots: NH_3 , PM, Odor, H_2S , CH_4 , VOC, N_2O .
5. Grazing Management: NH_3 , N_2O .
6. Manure Storages – Liquid: NH_3 , H_2S , CH_4 , Odor, VOC; Solid: NH_3 , H_2S , PM, CH_4 .
7. Land Application: NH_3 , PM, Odor, N_2O .

III. List the sources in order of importance with respect to expected or projected emission level. For each pollutant of concern, the primary sources that emit that pollutant have been listed below in order of importance. Your farm may have a different order; when in doubt, use the order listed below. For each source, identify and list the specific factors that are contributing to that pollutant (these should have been listed in **I** above).

1. Ammonia (NH₃).
 - a. Nutrition.
 - b. Freestall barns.
 - c. Drylot.
 - d. Land Application.
 - e. Manure Storage.
 - f. Grazing.
 - g. Feed Management.
2. Methane (CH₄).
 - a. Manure Storage.
 - b. Nutrition.
3. Hydrogen Sulfide (H₂S).
 - a. Manure Storage.
 - b. Drylot.
 - c. Nutrition.
4. Volatile Organic Compounds (VOC).
 - a. Feed Management.
 - b. Freestall barns.
 - c. Drylots.
 - d. Manure Storage.
5. Particulate Matter (PM).
 - a. Drylot.
 - b. Land Application.
 - c. Feed Processing.
 - d. Manure Storage.
6. Nitrous Oxide (N₂O).
 - a. Nutrition.
 - b. Drylot.
 - c. Land Application.
 - d. Grazing.
7. Odor.
 - a. Land Application.

- b. Manure Storage.
- c. Drylot.
- d. Freestall Barn.
- e. Feed Processing.
- f. Nutrition.

IV. Define the emissions mitigation goal for each of the sources. Emission mitigation goals are going to be specific to your farm, objectives, and source emissions. List goals for each source.

The goal for individual sources, for example, could be:

- To address existing regulations – either local or federal
- To minimize nuisance lawsuits
- To champion environmental stewardship
- To address the most important pollutant in terms of volume or health impact
- To address other goals (i.e. etc.)

V. Depending on the goal for each source, list three BMPs to address the goal based on a three-tier-system with respect to effectiveness, cost, ease of implementation, compatibility with other BMPs, and in compatibility with your nutrient management plans. Tier 1 being the least expensive and easy to implement. Tier 3 being the most advanced and most expensive to implement. Tier 1, 2, and 3 level BMPs have been listed for each source on a dairy farm. This list correlates to the BMPs listed in the “Descriptions of Best Management Practices (BMP)” document. This list is not exhaustive and tier level BMPs may vary for your individual farm. Refer to Table 1 (at the end of this document) for a selection matrix guide for choosing tier level BMPs for each source.

1. Nutrition.

- a. Tier 1 - Reduce the Amount of Dietary Protein (N) in the Ration to Match, rather Than Exceed, an Animal’s Needs (NH₃, N₂O, Odor); Properly Manage and Minimize Overfeeding Sulfur in the Diet (H₂S, Odor),
- b. Tier 2 - Practice Phase-Feeding (NH₃),
- c. Tier 3 - Increase the Level of Starch in the Diet (CH₄); Utilize feed additives to maximize efficiency (NH₃, H₂S, CH₄).

2. Feed Management.

- a. Tier 1 - Remove Spilled and Unused Feed from Feeding Area on a Regular Basis (VOC, Odor, and PM),
- b. Tier 2 - Properly Cover and Manage Ensiled Feedstuffs (VOC, Odor); Do Not Mix Feed During Windy Times (PM),
- c. Tier 3 - Store Feed in a Weatherproof Storage Structure (VOC, Odor, PM),

3. Housing – Freestall Barns.

- a. Tier 1 - Remove Manure from Barns Frequently (NH₃, VOC, Odor); Ensure

- Proper Ventilation of Freestall barns (NH₃, Odor, and PM),
- b. Tier 2 - Bedding Selection and Management (NH₃, H₂S, Odor),
 - c. Tier 3 - Treat Recycled Lagoon Water Used for Flushing (NH₃, Odor); Modify Alleyway Floors (NH₃, VOC, Odor).
4. Housing – Drylot Pens.
- a. Tier 1 - Remove and Spread (Harrow) Manure Frequently (NH₃, PM); Surface Moisture Content Management (NH₃, N₂O, VOC, Odor, CH₄, H₂S, Odor, PM),
 - b. Tier 2 - Incorporate Wood Chips in Surface Layer (NH₃, PM, Odor); Use Straw Bedding in Drylot Pens (NH₃, PM, Odor); Knockdown and Remove Fence Line Manure (VOC, Odor),
 - c. Tier 3 - Urease Inhibitors (NH₃, N₂O); Provide Shade for Cattle (NH₃, PM); Locate Feed and Water Opposite in Pens (NH₃, PM).
5. Grazing Management.
- a. Tier 1 - Stock Appropriate Number of Animals (NH₃, N₂O); Use Rotational Grazing (NH₃, N₂O),
 - b. Tier 2 - Move Water and Feeding Areas Frequently (NH₃, N₂O),
 - c. Tier 3 - Irrigate Immediately after Grazing (NH₃).
6. Manure Storage.
- a. Tier 1 - Manure Solids Separation (NH₃, VOC, Odor, H₂S, CH₄); Properly Manage Composted Solid Manure (H₂S, Odor, PM, CH₄); Properly Manage Stockpiled Manure (H₂S, Odor, PM),
 - b. Tier 2 - Lagoon or Storage Covers (NH₃, H₂S, VOC, Odor, CH₄); Scrub Exhaust of Enclosed Waste Containers (CH₄, Odor, H₂S),
 - c. Tier 3 - Installation of an Anaerobic Digester (CH₄); Surface Aeration of Lagoons (NH₃, H₂S, VOCs); Reduce the pH of Lagoons and Manure Piles (NH₃, CH₄); Encourage Purple Sulfur Bacterial Formation in Anaerobic Lagoons (H₂S, Odor).
7. Land Application – Manure and/or Chemical Fertilizer.
- a. Tier 1 - Apply Nutrients According to Agronomic Recommendations Based on Soil Test Results (NH₃, N₂O); Inject or Incorporate Fertilizer into Soil within 24 Hours of Application (NH₃, Odor); Do Not Over-irrigate (NH₃, N₂O); Apply During Cool Weather and on Still Rather than Windy Days (NH₃, Odor, PM),
 - b. Tier 2 - Utilize Cover Crops (NH₃, N₂O, PM); Apply N Fertilizer below No-Till Residue (NH₃, PM),
 - c. Tier 3 - Installation of Windbreaks or Shelterbelts (Odor, PM).

Table 1. BMP selection matrix based on source and tier level mitigation

Sources of emission on a dairy	Expected pollutants for each source in order of importance	Suggested BMPs for emissions reduction <u>Tier 1</u>	Suggested BMPs for emissions reduction <u>Tier 2</u>	Suggested BMPs for emissions reduction <u>Tier 3</u>
Nutrition	NH ₃ , CH ₄ , H ₂ S, N ₂ O	Reduce the Amount of Dietary Protein (N) in the Ration to Match, rather Than Exceed, an Animal's Needs (NH ₃ , N ₂ O, Odor) Properly Manage and Minimize Overfeeding Sulfur in the Diet (H ₂ S, Odor)	Practice Phase-Feeding (NH ₃)	Increase the Level of Starch in the Diet (CH ₄) Utilize feed additives to maximize efficiency (NH ₃ , H ₂ S, CH ₄)
Feed Processing and Management	VOC, PM, Odor	Remove Spilled and Unused Feed from Feeding Area on a Regular Basis (VOC, Odor, PM) Minimize feed transport with good loading practices (PM)	Properly Cover and Manage Ensiled Feedstuffs (VOC, Odor) Do Not Mix Feed During Windy Times (PM)	Store Feed in a Weatherproof Storage Structure (VOC, Odor, PM)
Housing – Freestall Barns	NH ₃ , VOC, Odor, CH ₄ , H ₂ S	Remove Manure from Barns Frequently (NH ₃ , VOC, Odor); Ensure Proper Ventilation of Freestall barns (NH ₃ , Odor, and PM)	Bedding Selection and Management (NH ₃ , H ₂ S, Odor)	Treat Recycled Lagoon Water Used for Flushing (NH ₃ , Odor) Modify Alleyway Floors (NH ₃ , VOC, Odor)
Housing – Drylot Pens	NH ₃ , PM, Odor, H ₂ S, CH ₄ , VOC, N ₂ O	Remove and Spread (Harrow) Manure Frequently (NH ₃ , PM) Surface Moisture Content Management (NH ₃ , N ₂ O, VOC, Odor, CH ₄ , H ₂ S, Odor, PM)	Incorporate Wood Chips in Surface Layer (NH ₃ , PM, Odor) Use Straw Bedding in Drylot Pens (NH ₃ , PM, Odor) Knockdown and Remove Fence Line Manure (VOC, Odor)	Urease Inhibitors (NH ₃ , N ₂ O) Provide Shade for Cattle (NH ₃ , PM) Locate Feed and Water Opposite in Pens (NH ₃ , PM)
Grazing Management	NH ₃ , N ₂ O	Stock Appropriate Number of Animals (NH ₃ , N ₂ O) Use Rotational Grazing (NH ₃ , N ₂ O)	Move Water and Feeding Areas Frequently (NH ₃ , N ₂ O)	Irrigate Immediately after Grazing (NH ₃)
Manure Storage	Liquid: NH ₃ , H ₂ S, CH ₄ , Odor, VOC Solid: NH ₃ , H ₂ S, PM, CH ₄	Manure Solids Separation (NH ₃ , VOC, Odor, H ₂ S, CH ₄) Properly Manage Composted Solid Manure (H ₂ S, Odor, PM, CH ₄) Properly Manage Stockpiled Manure (H ₂ S, Odor, PM)	Lagoon or Storage Covers (NH ₃ , H ₂ S, VOC, Odor, CH ₄) Scrub Exhaust of Enclosed Waste Containers (CH ₄ , Odor, H ₂ S)	Installation of an Anaerobic Digester (CH ₄) Surface Aeration of Lagoons (NH ₃ , H ₂ S, VOC) Reduce the pH of Manure (NH ₃ , CH ₄) Encourage Purple Sulfur Bacterial Formation in Anaerobic Lagoons (H ₂ S, Odor)
Land Application	NH ₃ , PM, Odor, N ₂ O	Apply Nutrients According to Agronomic Recommendations Based on Soil Test Results (NH ₃ , N ₂ O) Inject or Incorporate Fertilizer into Soil within 24 Hours of Application (NH ₃ , Odor) Do Not Over-irrigate (NH ₃ , N ₂ O) Apply During Cool Weather and on Still Rather than Windy Days (NH ₃ , Odor, PM)	Utilize Cover Crops (NH ₃ , N ₂ O, PM) Apply N Fertilizer below No-Till Residue (NH ₃ , PM)	Installation of Windbreaks or Shelterbelts (Odor, PM)