

APPENDIX E - AIR QUALITY BMP SELECTION MATRIX

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.).

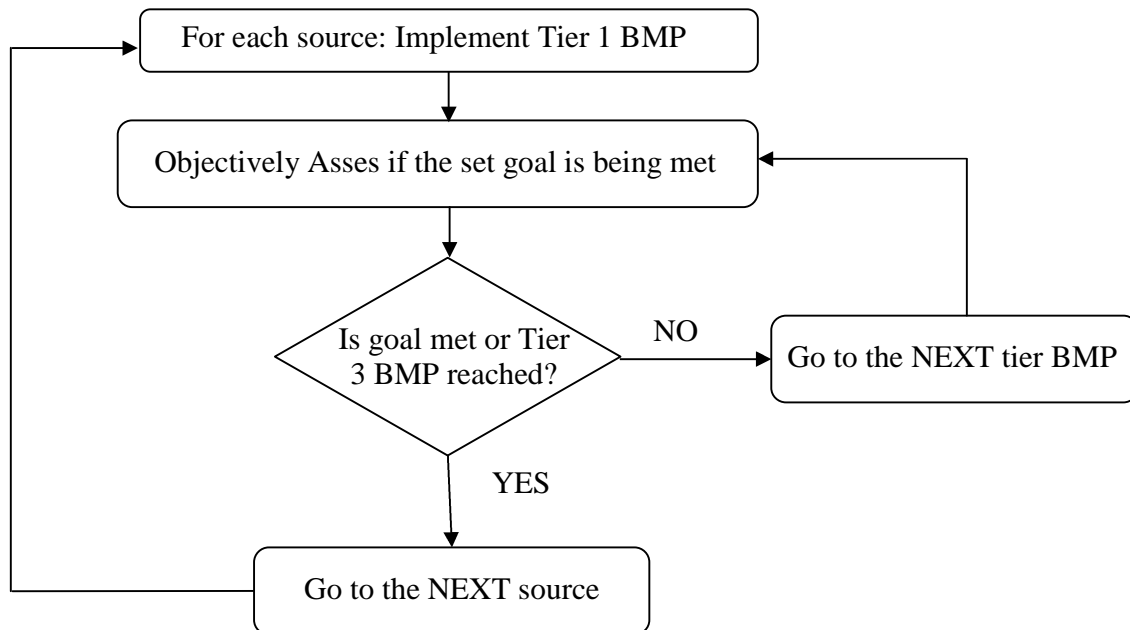
IV. Define the emissions mitigation goal for each of the sources.

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

1. To address existing regulations – either local, State, 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

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 Management
3. Milk Parlor
4. Housing - Freestall Barns
5. Housing - Drylot Pens
6. Grazing Management
7. Manure Management
8. Land Application
9. Other

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: NH₃, CH₄, H₂S, N₂O.
2. Feed Management: VOC, PM, Odor.
3. Milk Parlor: NH₃, VOC, Odor, H₂S.
4. Housing - Freestall Barns: NH₃, VOC, Odor, CH₄, H₂S.
5. Housing - Drylot Pens: NH₃, PM, Odor, H₂S, CH₄, VOC, N₂O.
6. Grazing Management: NH₃, N₂O.
7. Manure Management – Liquid: NH₃, H₂S, CH₄, Odor, VOC; Solid: NH₃, H₂S, PM, CH₄.
8. Land Application: NH₃, PM, Odor, N₂O.
9. Other

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. Housing - Freestall Barns
 - c. Housing - Drylot Pens
 - d. Milk Parlor
 - e. Land Application
 - f. Manure Management
 - g. Grazing Management
 - h. Feed Management
2. Methane (CH₄)
 - a. Manure Management
 - b. Nutrition
3. Hydrogen Sulfide (H₂S)
 - a. Manure Management
 - b. Housing - Drylot Pens
 - c. Nutrition
4. Volatile Organic Compounds (VOC)
 - a. Feed Management
 - b. Housing - Freestall Barns
 - c. Housing - Drylot Pens
 - d. Milk Parlor
 - e. Manure Management
5. Particulate Matter (PM)
 - a. Housing - Drylot Pens
 - b. Land Application
 - c. Feed Processing
 - d. Manure Management
6. Nitrous Oxide (N₂O)
 - a. Nutrition
 - b. Housing - Drylot Pens
 - c. Land Application
 - d. Grazing Management

7. Odor

- a. Land Application
- b. Manure Management
- c. Housing - Drylot Pens
- d. Housing - Freestall Barns
- e. Milk Parlor
- f. Feed Management
- g. 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

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* - Properly Manage Level of Dietary Protein (%CP) in Diet 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 Group and/or Stage of Lactation Feeding (NH₃).
- c. *Tier 3* - Increase the Level or Quality of Starch in the Diet (CH₄); Utilize feed additives to maximize efficiency (NH₃, H₂S, CH₄).

2. Feed Management

- a. *Tier 1* - Regularly Remove Spilled and Unused Feed from Feeding Area (VOC, Odor, and PM); Manage or Minimize the Mixing of Feed During Windy Times (PM).
- b. *Tier 2* - Properly Cover and Manage Ensiled Feedstuffs (VOC, Odor).
- c. *Tier 3* - Store Feed in a Sheltered Storage Structure (VOC, Odor, PM).

3. Milk Parlor

- a. *Tier 1* - Use Recycled Parlor (Clean) Water Used for Flushing/Cleaning Parlor and Holding Area (NH₃, Odor); Ensure Proper Ventilation (NH₃, Odor, and PM).
- b. *Tier 2* - Remove Manure from Parlor and Holding Area Frequently (NH₃, VOC, Odor).
- c. *Tier 3* - Treat Recycled Water Used for Flushing/Cleaning Holding Area (NH₃, Odor);

4. 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); Manure Removal Technology and Efficiency (NH₃, VOC, Odor).
- c. *Tier 3* - Treat Recycled Lagoon Water Used for Flushing (NH₃, Odor); Alleyway Floor Texture and Type (NH₃, VOC, Odor); Manure Removal Technology and Efficiency (NH₃, VOC, Odor).

5. Housing - Drylot Pens

- a. *Tier 1* - Spread (Harrow) Manure Frequently (NH₃, PM); Surface Moisture Content Management (NH₃, N₂O, VOC, Odor, CH₄, H₂S, Odor, PM).
- b. *Tier 2* - Remove Manure Frequently (NH₃, PM); 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); Sitting of Water Trough within Pen (NH₃, PM).

6. 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).

7. Manure Management

- a. *Tier 1* - Manure Solids Separation (NH₃, VOC, Odor, H₂S, CH₄); Properly Manage the Composting of 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 and Proper Operation 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).

8. Land Application – Manure and/or Chemical Fertilizer

- a. *Tier 1* - Apply Nutrients According to Agronomic Recommendations Based on Soil and Manure 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).

9. Other

- a. *Tier 1* - Installation of Windbreaks or Shelterbelts (NH₃, Odor, PM).
- b. *Tier 2* - Vehicle Road Condition and Management (PM).
- c. *Tier 3* - Engine Selection and Efficiency (NO_x).

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 Tier 1	Suggested BMPs for emissions reduction Tier 2	Suggested BMPs for emissions reduction Tier 3
Nutrition	NH ₃ , CH ₄ , H ₂ S, N ₂ O	<p>Properly Manage Level of Dietary Protein (%CP) in Diet to Match, Rather Than Exceed, an Animal's Needs (NH₃, N₂O, Odor)</p> <p>Properly Manage and Minimize Overfeeding Sulfur in the Diet (H₂S, Odor)</p>	Practice Group and/or Stage of Lactation Feeding (NH ₃)	<p>Increase the Level or Quality of Starch in the Diet (CH₄)</p> <p>Utilize feed additives to maximize efficiency (NH₃, H₂S, CH₄)</p>
Feed Management	VOC, PM, Odor	<p>Regularly remove Spilled and Unused Feed from Feeding Area (VOC, Odor, PM)</p> <p>Manage or Minimize the Mixing of Feed During Windy Times (PM)</p>	Properly Cover and Manage Ensiled Feedstuffs (VOC, Odor)	Store Feed in a Sheltered Storage Structure (VOC, Odor, PM)
Milk Parlor	NH ₃ , VOC, Odor, H ₂ S	<p>Use Recycled Parlor (Clean) Water Used for Flushing/Cleaning Parlor and Holding Area (NH₃, Odor);</p> <p>Ensure Proper Ventilation (NH₃, Odor, and PM)</p>	Remove Manure from Parlor and Holding Area Frequently (NH ₃ , VOC, Odor)	Treat Recycled Water Used for Flushing/Cleaning Holding Area (NH ₃ , Odor)
Housing – Freestall Barns	NH ₃ , VOC, Odor, CH ₄ , H ₂ S	<p>Remove Manure from Barns Frequently (NH₃, VOC, Odor);</p> <p>Ensure Proper Ventilation of Freestall barns (NH₃, Odor, and PM)</p>	<p>Bedding Selection and Management (NH₃, H₂S, Odor)</p> <p>Manure Removal Technology and Efficiency (NH₃, VOC, Odor)</p>	<p>Treat Recycled Lagoon Water Used for Flushing (NH₃, Odor)</p> <p>Alleyway Floor Texture and Type (NH₃, VOC, Odor)</p> <p>Manure Removal Technology and Efficiency (NH₃, VOC, Odor)</p>
Housing – Drylot Pens	NH ₃ , PM, Odor, H ₂ S, CH ₄ , VOC, N ₂ O	<p>Spread (Harrow) Manure Frequently (NH₃, PM)</p> <p>Surface Moisture Content Management (NH₃, N₂O, VOC, Odor, CH₄, H₂S, Odor, PM)</p>	<p>Remove Manure Frequently (NH₃, PM)</p> <p>Incorporate Wood Chips in Surface Layer (NH₃, PM, Odor)</p> <p>Use Straw Bedding in Drylot Pens (NH₃, PM, Odor)</p> <p>Knockdown and Remove Fence Line Manure (VOC, Odor)</p>	<p>Urease Inhibitors (NH₃, N₂O)</p> <p>Provide Shade for Cattle (NH₃, PM)</p> <p>Sitting of Water Trough within Pen (NH₃, PM)</p>

