DETERMINING SEPARATION DISTANCES USING THE ODOR FOOTPRINT TOOL

Example of the Worksheet-Based Tool

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Example:

For illustration, consider the [fictitious] proposal to construct four identical swine finish buildings in Northeast, NE. The facilities will each be 40 feet wide by 200 feet long and have a capacity to house 1,000 market hogs. A shallow pit (pull plug) is below fully slatted floors. Manure is stored in an outdoor concrete tank 300 feet in diameter. Current plans for ventilation are to tunnel ventilate with large fans during hot weather and operate smaller ventilation fans and pit fans during cooler conditions. The producer is weighing options for odor control, and will consider a biofilter on the building filtering all mild-weather airflow and a 2 inch straw cover for the manure storage. The facility is located on flat terrain, except for a low-lying unconfined area to the SW.

Procedure:

Step 1. Fill in the general information describing the project at the top of the worksheet. Refer to the example worksheet to see a completed form. Key information in this example includes the type of livestock operation, the animal capacities, and the fact that there are multiple buildings.

Step 2. Identify the site location and select a representative region. Choose one of the six Nebraska regions that best represents the site. In this example, Norfolk, NE is selected as having weather patterns that are reasonably representative of the site location.

Step 3. Fill in information describing the facilities. List the type in Column A and dimensions in Column B. In this example, note that the four barns are identical so they can all be handled as a group. The manure storage is listed in the following line.

Step 4. Determine the plan area of each of the listed facilities. The total area of the four buildings is calculated and listed in Column C as follows:

length x width x # of buildings = 40'x 200'x 4 = 32,000 ft^2

Assuming the manure storage is round, its total area is calculated and listed in Column C as follows:

3.1416 x $diameter^2$ / 4 = (3.1416)x(300 ft)x(300 ft)/4 = 70,686 ft^2

Step 5. Enter the odor emission number for each of the listed facilities. Referring to Table 1 for animal housing facilities, no distinction is made between naturally ventilated and mechanically ventilated shallow pit swine finishing facilities, so the appropriate value for the odor emission number is 95. This value is entered in Column D on the worksheet. A concrete tank manure storage has an odor emission number of 135.

Step 6. Identify base plan and optional odor control technology to be implemented and/or considered. List the alternative being considered in Column G. In the example, we will consider a biofilter treating cool season fan airflow from the buildings and a 2 inch straw cover for the manure storage.

Step 7. Enter appropriate odor control factors. Since no supplemental odor control technology is incorporated into the base plan, a value of 1 is placed into Column E for the odor control factor. The odor control factor for the odor control alternatives being considered are be found from Table 3. This value, 0.4, is recorded in Column H.

Step 8. Calculate the scaled odor emission rate for each of the listed facilities. The area (Column C) is multiplied by the odor emission number (Column D) and the odor control factor (Column E) then divide by 1 million to determine the scaled odor emission rate (Column F) for the base plan.

Buildings: 32,000 ft^2 x 95 OU/s·ft^2 x 1 / 1,000,000 = 3.04 OU/s
Manure Storage: 70,686 ft^2 x 135 OU/s·ft^2 x 1 / 1,000,000 = 9.54 OU/s

The alternative odor control option is determined by multiplying the scaled odor emission rate (Column F) by the odor control factor (Column H) to give the alternative scaled odor emission rate (Column I).

Buildings: 3.04 OU/s x 0.4 = 1.22 OU/s
Manure Storage: 9.54 OU/s x 0.6 = 5.72 OU/s

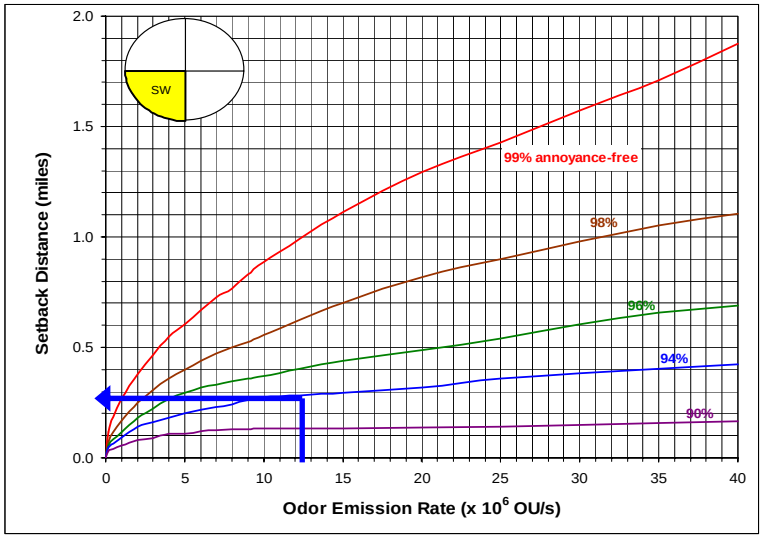
Step 9. Determine the total scaled odor emission rates. Add the values in Column F to determine the total scaled odor emission rate for the Base Plan. Repeat for the Alternate Plan (Column I).

Base Plan: 3.04 OU/s + 9.54 OU/s = 12.58 OU/s
Alternate Plan: 1.22 OU/s + 5.72 OU/s = 6.94 OU/s

Step 10. Select an odor annoyance-free frequency. We will assume the area is fairly livestock tolerant and choose 94% as the odor annoyance-free frequency.

Step 11. Access directional setback distance graphs and identify primary directions. For the Northeast region of Nebraska, the graphs from Norfolk are used. The primary directions for Norfolk are NE, SE, SW, and NW circle these on the worksheet.

Step 12. Determine separation distances. Using the graphs for the Northeast region, determine each of the directional separation distances using the Base and Alternate Plan odor emission rates. Record in the worksheet.



Step 13. Enter terrain factors. The example has all flat terrain except for an unconfined, low lying area to the SW. From Table 4, it can be found that the terrain adjustment factor is 1 for flat terrain. This value is placed in the columns for NE, SE, and NW. The unconfined, low-lying area has a factor of 1.2, which is placed in the SW column.

Step 14. Calculate final, terrain-adjusted separation distances. The final terrain adjusted separation distance is determined by multiplying the base separation distance by the terrain factor for each of the primary directions.

Base Plan:	NE: 0.54 mi. x 1 = 0.54 mi.	SE: 0.36 mi. x 1 = 0.36 mi.
	SW: 0.28 mi. x 1.2 = 0.34 mi.	NW: 0.55 mi. x 1 = 0.55 mi.
Alternate Plan:	NE: 0.40 mi. x 1 = 0.40 mi.	SE: 0.28 mi. x 1 = 0.28 mi.
	SW: 0.23 mi. x 1.2 = 0.28 mi.	NW: 0.49 mi. x 1 = 0.49 mi.

ESTIMATING SETBACK DISTANCES USING THE ODOR FOOTPRINT TOOL

Worksheet for Calculating Separation Distances for a Particular Animal Production Site

Project description: *Example: 4000 hog finisher 1,000 head capacity in each building*

Location: *Northeast Nebraska*

Region: *NE (Norfolk)*

GENERAL INFORMATION FOR BASE PLAN						INFORMATION FOR ODOR CONTROL OPTION		
Column A	**Column B**	**Column C**	**Column D**	**Column E**	**Column F**	**Column G**	**Column H**	**Column I**
Source Facility *Describe*	Plan Dimensions (e.g. ft x ft) *Show*	Plan Area (sq. ft.) *Calculate*	Odor Emission Number ($OU/s \cdot ft^2$) *Tables 1 & 2*	Odor Control Factor *Table 3*	Scaled Odor Emission Rate ($x\ 10^6$ OU/s) *C x D x E ÷ 1,000,000*	Odor Control Practice Being Considered *Describe*	Odor Control Factor *Table 3*	Scaled Odor Emission Rate ($x\ 10^6$ OU/s) *F x H*
1) *Shallow-pit barns (4), curtain-sided w/pit fans*	*40' x 200'*	*8,000ea 32,000*	*95*	*1*	*3.04*	*Biofilter of cool season airflow*	*0.4*	*1.22*
2) *Manure Storage Concrete tank*	*Diameter 300 ft.*	*70,686*	*135*	*1*	*9.54*	*Straw 2" thick*	*0.6*	*5.72*
3)								
4)								
5)								
				Total scaled odor emission rate = *Sum of values in Column F*	*12.58*	Total scaled odor emission rate = *Sum of values in Column I*		*6.94*

Annoyance-Free Percentage *Circle value chosen by you or by community* 90 94 96 98 99 %	Directional Setback Distances (miles or fraction thereof) *Locate using set of setback curves for region*				Directional Setback Distances (miles or fraction thereof) *Locate using set of setback curves for region*			
	North / NE	East / SE	South / SW	West / NW	N / NE	E / SE	S / SW	W / NW
Base separation distance *Read off of regional curves*	*0.54*	*0.36*	*0.28*	*0.55*	*0.40*	*0.28*	*0.23*	*0.49*
Applicable terrain factor *From Table 4*	*1*	*1*	*1.2*	*1*	*1*	*1*	*1.2*	*1*
Adjusted separation distance *Base distance x Terrain factor*	*0.54*	*0.36*	*0.34*	*0.55*	*0.40*	*0.28*	*0.28*	*0.49*