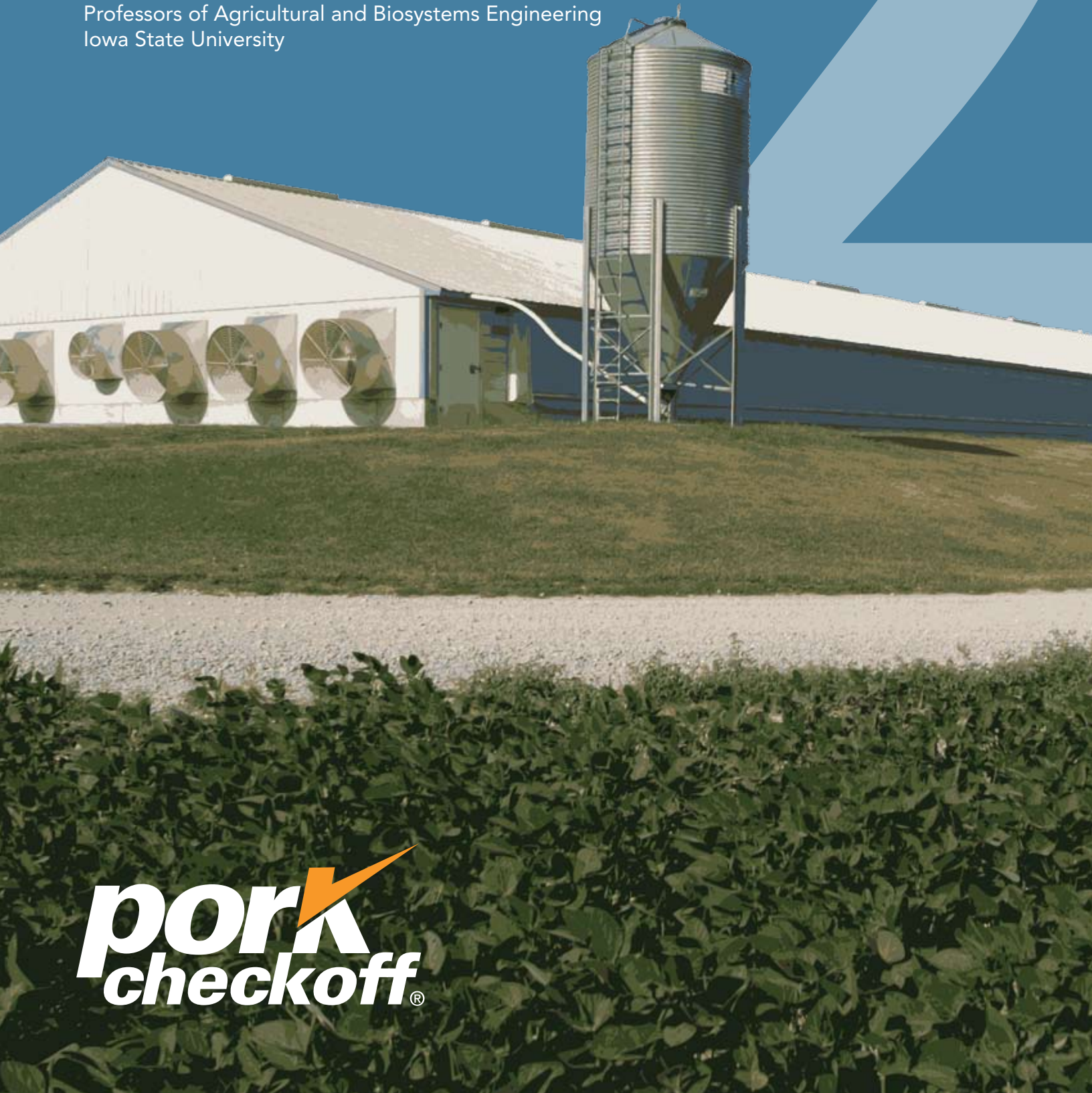


Siting and Building Design Considerations to Reduce Odor Potential from Swine Facilities

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Introduction

The best time to reduce the potential for odor and odor complaints from any swine facility is before the site is constructed. Siting and building design have a tremendous influence on odor potential, not only through position relative to neighbors, highway, parks and municipalities, but also due to the community's perception of odor potentials. This brochure will illustrate key factors to successfully site and design buildings in a way that minimizes the potential for odor.

Factors impacting the “zone of influence” of a swine site

There is no one right answer to the question: “How far will odors travel?”, but understanding the factors which influence odor transmission helps to minimize impacts on neighbors. Factors include:

- **Wind Direction** – The predominant direction of the wind is an important factor in examining the potential impact on neighbors. Weather data is used to create wind roses what show the direction and frequency of the wind from compass points. Figure 1 shows an example from Des Moines, Iowa for July. The graph shows that wind originates from the south approximately 13 percent of the time, followed by SSE 11 percent. This means that for Des Moines, locating a swine unit directly south of neighbors would not be wise. Consult wind data for the general area before selecting a site.
- **Atmospheric Stability** – Weather conditions play a big part in how well odors are dispersed. When it is sunny, thermal currents will mix air vertically thereby dissipating odors more quickly. Windy conditions will dilute odors more quickly as well as increasing travel distance.

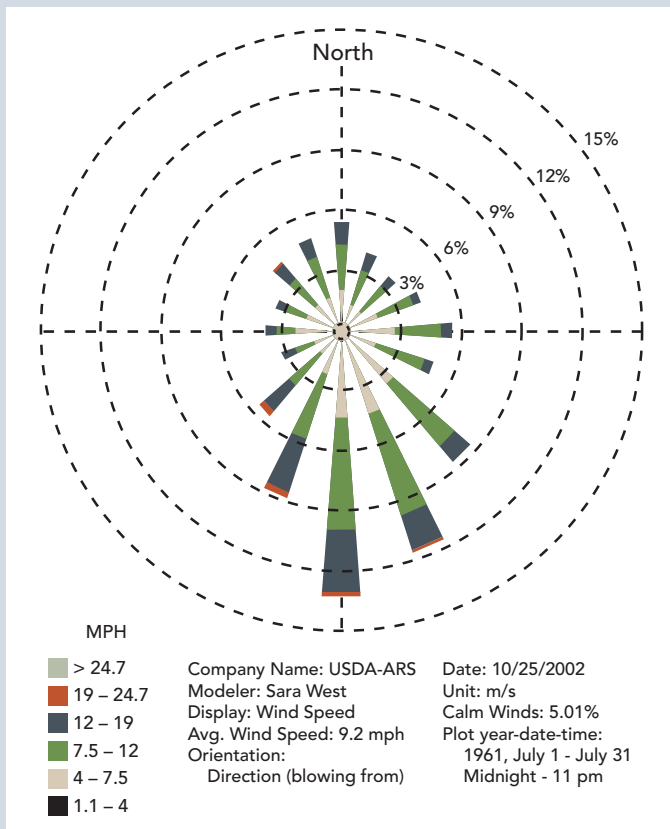


Figure 1: Wind Rose for Des Moines, IA., July

The atmosphere is most stable from sunset to sunrise and on cloudy, relatively calm days. While this is not something a producer can manage, it is something that should be kept in mind when siting a building, considering when to land apply manure or in undertaking other activities which may cause an increase in odors.

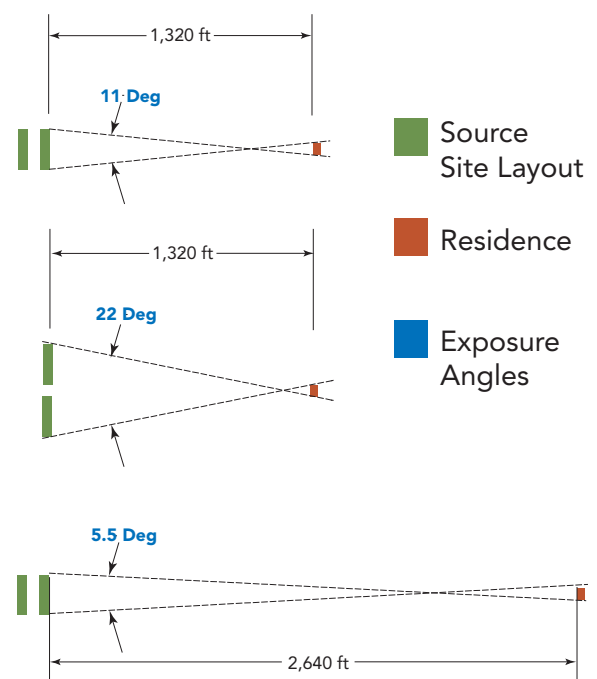
- **Terrain and Air Drainage** – Terrain such as hills, valleys or trees can influence how odor disperses, especially under calm conditions. Especially near dusk as air cools, air will flow from high terrain to low in the absence of wind. For this reason, placing swine facilities at the top of a hill where air could flow from the site to residences located further down should be avoided, when possible. Trees can cause air currents to raise and swirl, thereby dispersing the odor (Figure 2).



Figure 2: Trees can dissipate odor by forcing the plume to elevate and stir.

- **Exposure Angle** – When siting a building, it is desirable to minimize the number of hours that wind blows from the source directly to a receptor. The sum of the wind angles when this will happen is referred to as the exposure angle. Figure 3 illustrates that the building site layout, as well as the distance from residences, can impact this angle. The smaller the angle, the less likely that wind will carry odor from the source directly to a neighbor. A small exposure angle also limits the view of the site by the neighbor.

Figure 3: Effect of site layout and distance on exposure angle.



- **Distance** – Distance is always good in minimizing the odor potential to neighbors. This not only decreases the exposure angle but also provides an opportunity for more stirring and dissipation of the air plume from a swine unit. In odor transport, there is no substitute for increased separation distance.

Factors impacting the community

Often people look at odor impact from the perspective of the source rather than the receptor. This is understandable but it is actually the receptor where complaints originate and these complaints may be based on a composite of events from multiple facilities. Factors to be considered include:

- **Summation of sources** – The total odor level that neighbors might face is an important concern and not just what a new facility adds to it. Consider the situation in which neighbors receive some level of odor from nearby swine farms and have been understanding. A new facility constructed in this area might impact the neighbors very little, yet the additional exposure takes the neighbors from a tolerable situation to one that they feel is a nuisance.
- **Public Venues** – Avoid areas near parks, churches, cemeteries and highways. People may react strongly to odors in areas in which they go to relax, spend family time or participate in other community activities. Odors in these areas are not well received and they impact the public image of the swine industry.
- **Visibility and Site Aesthetics** – The old saying “out of sight, out of mind” is truer than most people realize. Facilities that are blocked from view generally have fewer complaints than ones that are near roads or are visible to neighbors. Trees help to hide facilities although care should be taken to avoid disrupting the flow of air to naturally ventilated buildings. A well mowed and landscaped site will also deter complaints. People assume that a well-kept site is a sign of a well-run operation. Make sure you provide a screened area for mortality pick-up also.

Building Design Considerations

Building design to reduce odor potential requires ballancing building traits for efficient production while considering the environmental impact. Factors include:

- **Manure Storage** – Uncovered outdoor storage of manure allows wind to blow across the surface creating a large plume. For that reason most people choose to either store manure below the building in a deep pit or cover their outside manure storage or use anaerobic lagoons. Covers can be expensive and require some maintenance while deep pits are easier to maintain but present a potential hazard from gases during agitation and pump-out periods.
- **Ventilation Issues** – Ventilation is a considerable issue because air leaving the building carries odors, gases and particulate matter. Proper ventilation is critical also to animal health and worker safety.
 - **Natural vs Mechanical Ventilation** – In many parts of the country, naturally ventilated or curtain-sided

barns are preferred by producers. These facilities provide a good environment for swine, but because the air exits from relatively large openings, it may create a relatively large plume and is difficult to treat. For instance, a 40-ft wide, 1000-head finishing facility will generally have a sidewall opening of nearly 800 square feet. In comparison, mechanical systems provide the opportunity to direct the air away from neighbors and provide centralized areas where air can be treated. However, mechanically ventilated buildings use more electricity and require more equipment than naturally ventilated ones.



Pit ventilation in a nursery facility

- **Pit Ventilation** – Most deep pit buildings utilize fans which draw air directly from the manure pit head space. This is thought to draw ventilation down through the flooring and keeps the air quality within the animal zone better. However, this is a misconception and the convenience of placing fans on manure pumping access ports is probably a more defensible reason to use pit ventilation. Drawing air from the pit actually accelerates volatilization from the manure pit surface and does not improve animal zone conditions by a perceptible amount. Wall fans may be substituted for pit fans in order to reduce odor emission.



Pit ventilation in a finishing facility

- **Biofilters** – Biofilters may be constructed to filter exhaust air and remove most of the odorous compounds from it. Studies have shown they can remove more than 50 percent of odor when properly maintained and operated. Biofilters are

generally made of wood chips and are designed to retain the air in the filter for 3 or 4 seconds. Biofilters are effective, but can be quite large and take some maintenance. Care should be taken to design and install biofilters in a way that does not reduce ventilation appreciably. Biofilters require more pressure than just exhausting air to the environment and some fans may not be designed to operate under these conditions.

- **Chimneys** – One way to minimize odor potential is to avoid creating a plume which flows toward neighbors. Exhausting air vertically rather than simply horizontally through wall fans can allow the plume to vertically disperse more quickly. Chimneys should be taller than the peak of the roof. Fans can be installed in chimneys or chimneys can be built around wall fans in order to direct air upward. Naturally ventilated buildings use chimneys quite often, however chimneys are mostly

for cold weather ventilation and most of the time air is exhausted through sidewall curtains rather than chimneys.

- **Building Size** – Many times one large building may seem less obtrusive to neighbors than a building site complex. This may have a minor impact and care should be taken to first abide by biosecurity and ventilation concerns.
- **Color** – Some members of the public think that white steel buildings are an eyesore so it has an impact upon the perception of the site. Some light colors such as tan or light brown might be helpful.

To learn more about odor mitigation practices, visit the Checkoff-funded Air Management Practices Assessment Tool at <http://www.extension.iastate.edu/airquality/practices/homepage.html>.

Naturally ventilated building

Mechanically ventilated building

