# Non-Market Benefits of Covers

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# Overview

- Synthetic impermeable covers have the added advantages of excluding precipitation, increasing storage capacity, reducing manure hauling costs, reducing odors as well as concentrating nutrients
  - Case-by-case situation
    - e.g. increase storage volume &/or decrease hauling cost?
    - Increase nutrient concentration of manure
      - But, what about agitation & application?
        - e.g. broadcast vs injection/incorporation?

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# Annual Rainfall

## by Month

| | Prec | Evap | Diff |
|---|---|---|---|
| January | 2.7 | 0.7 | 2 |
| February | 2.2 | 0.87 | 1.33 |
| March | 3.5 | 1.73 | 1.77 |
| April | 3.5 | 2.75 | 0.75 |
| May | 4 | 4.13 | -0.13 |
| June | 3.9 | 4.8 | -0.9 |
| July | 4 | 4.87 | -0.87 |
| August | 2.9 | 4.25 | -1.35 |
| September | 2.6 | 2.9 | -0.3 |
| October | 2 | 2.16 | -0.16 |
| November | 2.6 | 1.18 | 1.42 |
| December | 2.4 | 0.75 | 1.65 |
| Total | 36.3 | 31.09 | 5.21 |

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# Net Rainfall

## by Month

| | Prec | Evap | Diff |
|---|---|---|---|
| November | 2.6 | 1.18 | 1.42 |
| December | 2.4 | 0.75 | 1.65 |
| January | 2.7 | 0.7 | 2 |
| February | 2.2 | 0.87 | 1.33 |
| March | 3.5 | 1.73 | 1.77 |
| April | 3.5 | 2.75 | 0.75 |
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| July | 4 | 4.87 | -0.87 |
| August | 2.9 | 4.25 | -1.35 |
| September | 2.6 | 2.9 | -0.3 |
| October | 2 | 2.16 | -0.16 |
| Total | 31.3 | 29.16 | **8.92** |

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# Rainfall Calculations

- 1 acre inch of rain = 27,154 gallons
  - 43,560 sq ft/acre = 0.62 gal/sq ft
  - $0.025/gallon application cost
    - = $0.0155/ft^2/1 inch of rain

# Rainfall Exclusion

| Design Dimensions | | | |
|---|---|---|---|
| Length | Width | Depth | Total Volume |
| (Feet) | (Feet) | (Feet) | (gal) |
| 385 | 385 | 11 | 10,855,228 |

| Net Rainfall | Rainfall Volume | Hauling cost rainwater |
|---|---|---|
| (inch) | (gal) | ($/yr) |
| 9 | 831,591 | $20,790 |

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# Storage Capacity

- Annual rainfall = 831,591 gallon/yr
  - 21 gal/day/cow manure + wastewater
  - ~ 40 day/1,000 cows add'l storage capacity
    - Value to /cow or /gal for your operation?
      - Could be significant, if storage is a limiting factor.

# Odor Reduction

- Covers are a very effective method of reducing odor release from manure storage structures.
  - In theory, impermeable covers could eliminate odor releases
  - most covers are expected to reduce odors by 80% – 95%.
- Reduction in odors should improve/build "goodwill"
  - Goodwill is an intangible asset
    - Difficult to quantify and even harder to capitalize on

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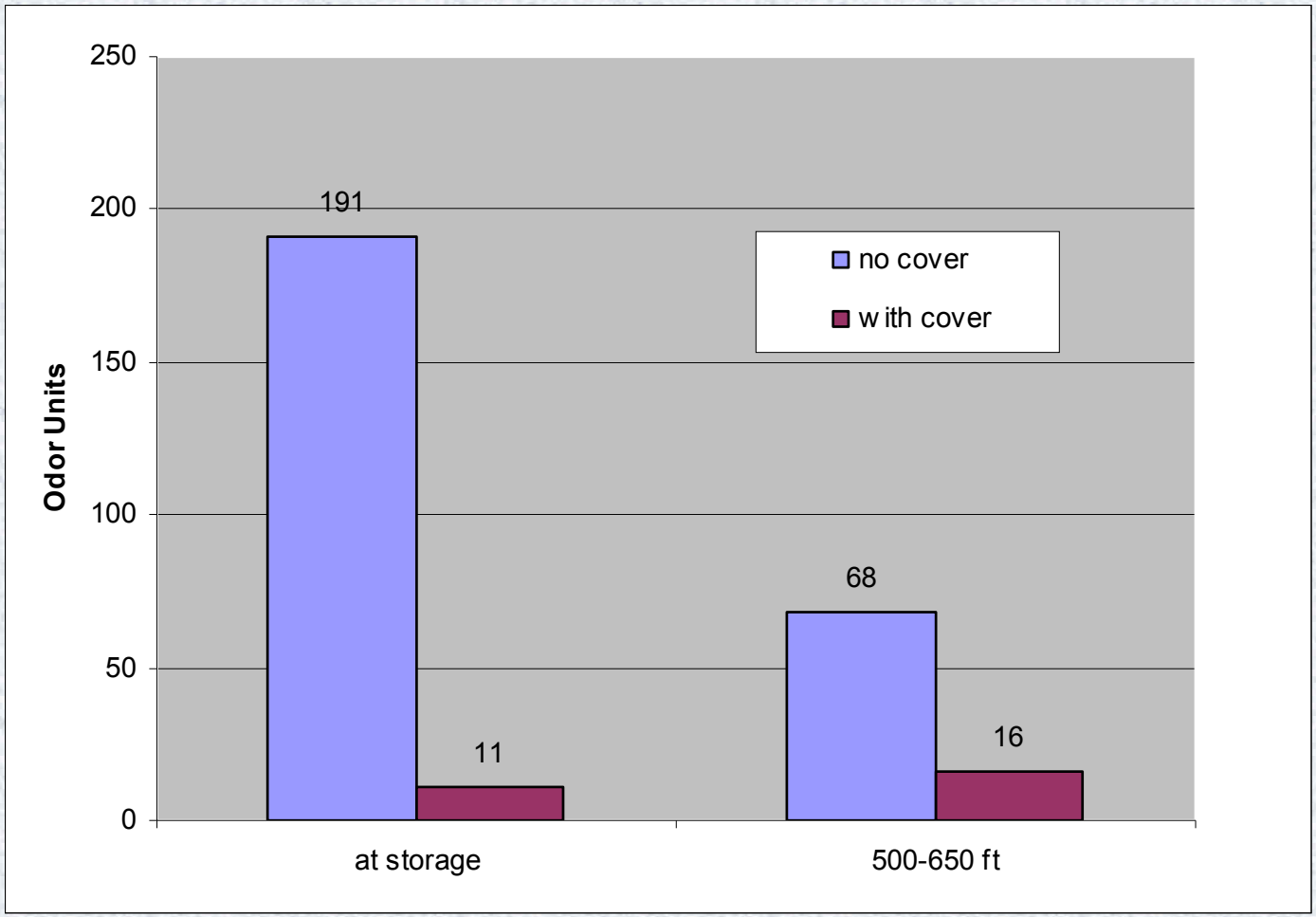
# Odor Benefits

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# Property Value Impacts

## Hedonic regression model

| Author | State | Animal Type | Impact |
|---|---|---|---|
| Bayoh, Irwin, Roe (2004) | Ohio | Various | Small change |
| Herriges, Secchi, Babcock (2005) | Iowa | Swine | -6% to +4% |
| Kim, Goldsmith, Thomas (2004) | North Carolina | Swine | -2% |
| Palmquist, Roka, Vukina (1997) | North Carolina | Swine | -3.6% to 0% |

# Concentrate Nutrients

- Impermeable covers reduce ammonia nitrogen loss to the atmosphere. In Manitoba, a covered earthen manure storage basin (swine) reduced ammonia nitrogen loss by 82 percent compared to an open earthen manure storage basin (*DHG Engineering*).

| Table 21-8. Nitrogen lost and retained in various types of manure handling and storage systems. | | |
|---|---|---|
| **System** | **Nitrogen Lost, %** | **Nitrogen Retained, %** |
| Daily scrape and haul | 20-35 | 65-80 |
| Manure pack | 20-40 | 60-80 |
| Open lot | 40-55 | 45-60 |
| Deep pit (poultry) | 25-50 | 50-75 |
| Litter | 25-50 | 50-75 |
| Underfloor pit | 15-30 | 70-85 |
| Aboveground tank | 10-30 | 70-90 |
| Holding pond | 20-40 | 60-80 |
| Anaerobic lagoon | 70-85 | 15-30 |
| Adapted from MWPS-18, Livestock Waste Facilities Handbook 1993. | | |

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# Nitrogen Conservation

- As excreted*
  - TN: 234-273 lb/cow/yr
    - Urea + $NH_3$ : 98-125 lb/cow/yr
      - $45 - $57/cow/yr Urea + $NH_3$ only ($0.46/lb N)
- Storage loss ~ 20 - 40% (MWPS-18)
  - Urea + $NH_3$ loss: 20 – 50 lb/cow/yr
    - Lost $9 - $23/cow/yr ($0.46/lb N)

* Source: H.H. Van Horn, et al.: **Dairy Manure Management: Strategies for Recycling Nutrients to Recover Fertilizer Value and Avoid Environmental Pollution**

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# Covered Storage

- Urea + $NH_3$ conserved?
  - capture 80% of $NH_3$ lost w/o cover
    - Urea + $NH_3$ capture: 16 – 40 lb/cow/yr
    - $7 - $18/cow/yr ($0.46/lb N)
- Estimate $NH_3$ capture w/cover: (4%-8% loss)
  - $41 - $55/cow/yr ($0.46/lb N)
- What about application?
  - broadcast?
  - injection/incorporation?

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# Recap: Dairy

- Cover reduces $NH_3$ loss (est. $34 - $52/cow/yr?? )
- Water exclusion (est. 9”/yr Ohio)
  - Estimated hauling savings: $0.0155/ft^2/inch of rain
- Odor control 80% - 95% reduction
  - $??? Depends
    - Goodwill = intangible asset
      - Positive or negative value
- Estimated cost of cover: $1.80/ft^2??

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# Summary

- Non-market benefits of manure storage cover can be significant and decrease the payback period considerable.
- Capitalizing on these benefits requires additional management and reduction in purchased inputs, e.g. commercial fertilizer
- Additional costs will be incurred to obtain these benefits, e.g. water management on cover, injection/incorporation of manure, others
- What's the value of odor control?
  - "goodwill" toward your farming operation
  - Non-tangible asset, difficult to translate in $$$$

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