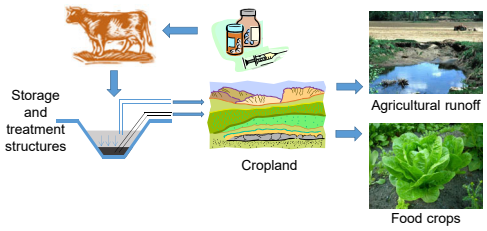
The Agroecosystem



Management Practices

- **Land application methods**

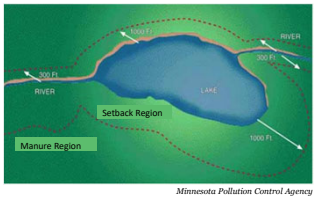
Broadcast Injection Incorporation

Joy *et al.*, ES&T 2013

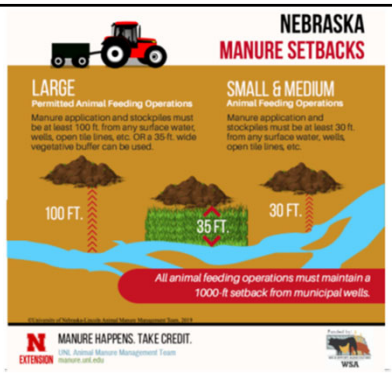
- **Vegetative barrier**

Soni *et al.*, JEQ 2015

- **Additives and disinfectants**
- **Setback distance**



Minnesota Pollution Control Agency



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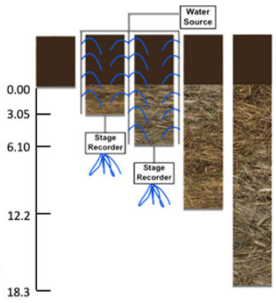
Objective

Determine the setback distance needed to minimize the contamination of surface water from manure-borne antibiotics and antibiotic resistance genes (ARGs).

Experimental Design

- Summer of 2016
- UNL Roger's Memorial Farm
  - 4.9% slope
  - Uniform crop residue cover
  - Aksarben silty clay loam
- Amended plots and control plots
  - 0, 3, 6.1, 12.2, and 18.3 m
- Randomized complete block design
  - Four blocks
- 2 rainfall events
  - Rainfall #1: 1 day after manure application
  - Rainfall #2: 1 day after Rainfall #1



Experimental Setup: Plot Tests

Antibiotic Resistance Genes for Analyses

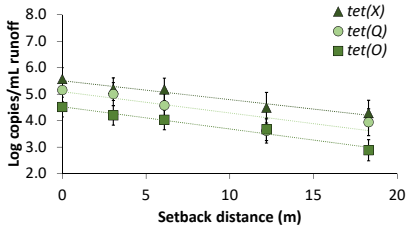
Antibiotic	Antibiotic Resistance Gene
Chlortetracycline	*tet*(D), *tet*(O), *tet*(Q), *tet*(X)
Lincomycin	*erm*(B), *erm*(C), *erm*(F)
Penicillin	bla_{TEM}
Tiamulin	–

- 16S rRNA gene
- Class 1 integron integrase (*intI1*)

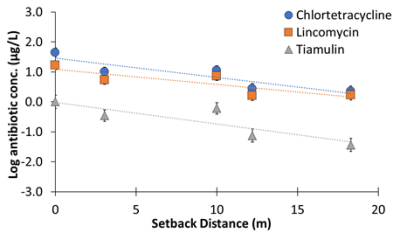
Antibiotic Resistance Genes In Runoff

Setback Distance (m)	16S rRNA (copy/mL)
0.0	7.9×10^{6} a
3.0	2.6×10^{6} ab
6.1	1.3×10^{6} bc
12.2	5.0×10^{5} bc
18.3	3.7×10^{5} c
p-values:	0.025

ARGs in Runoff



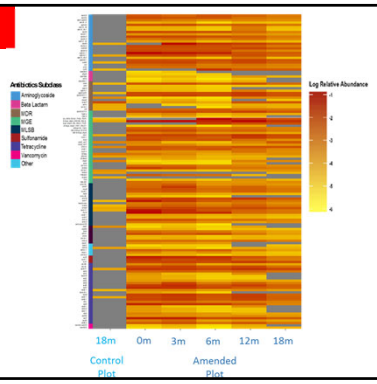
Antibiotics in Runoff



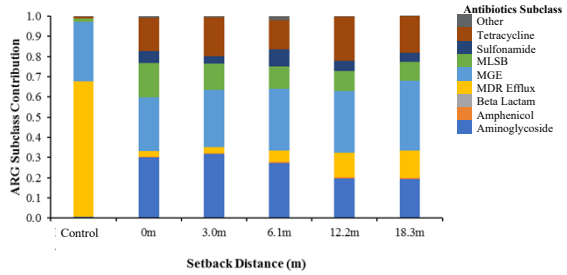
ARGs in Runoff

Analytes		Linear Eqn.[b] (ax + b)	R^2	Setback Distance Required[c] (m)
Gene (log copies/mL)	16S rRNA gene	-0.064x + 6.737	0.913	**43** Or 141 ft
Antibiotic (log µg/L)				

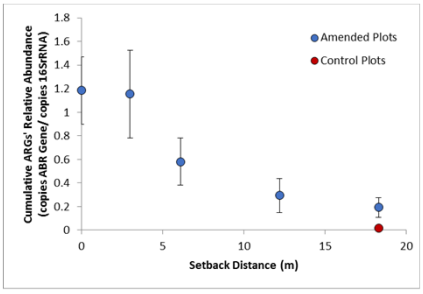
Resistome in Runoff



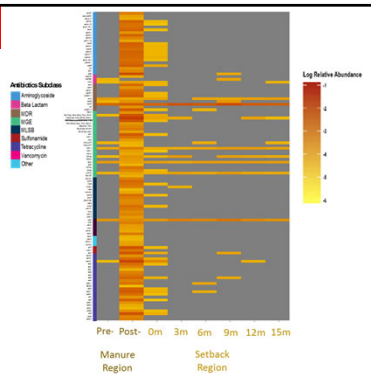
Composition of Resistome in Runoff



Cumulative ARG's Relative Abundance in Runoff



Resistome in Soil



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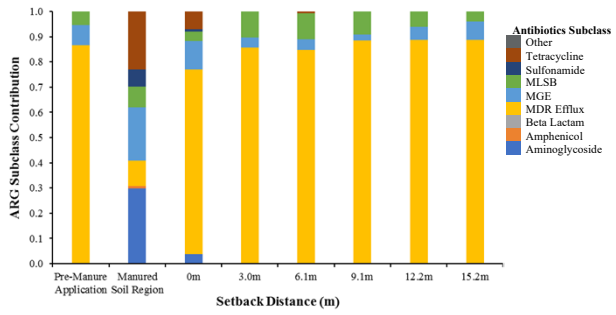
Composition of Resistome in Soil



Summary about the Setback Distance Study

- Setback distance is an effective means to control the transport of antibiotics and ARGs via agricultural runoff
- A setback distance of 65 m (i.e., 213 ft) is deemed necessary to limit antibiotic and ARG transport in runoff
- The soil resistome in the setback region is minimally impacted by manure application

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Thank You!