Session 3
Land Use

Prepare Your Materials
1. Your Farm Map
2. Land Use Action Plan
3. Have “Examples” handout ready to use.
What You’ll Take Away from this Session

• How to Create a Farm Map

• How to Fill Out a Land Use Action Plan
What You’ll Also Learn

• How pathogens move on the landscape
• What factors influence pathogen reduction
• Using a multiple barrier approach to reducing contamination
• Related FDA regulations
Map Your Farm

What potential contamination risks do you have?

What beneficial conservation practices can you use?

compost
Create a Land Use Action Plan

<table>
<thead>
<tr>
<th>Area of Food Safety Action</th>
<th>What</th>
<th>How SOP or Practice</th>
<th>Who</th>
<th>When</th>
<th>Training</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Policies To Reduce Risk</td>
<td>How is this done?</td>
<td>Who is required to do this?</td>
<td>When is this done?</td>
<td>What training is done, who, and when?</td>
<td>What record keeping system is kept for this action? Where?</td>
</tr>
<tr>
<td>Waterborne Pathogens</td>
<td>Install a Diversion Ditch</td>
<td>Determine required water capacity and correct dimensions of ditch</td>
<td>Farm’s Designated Food Safety Person or Junior Staff that Reports to Her/Him.</td>
<td>Before Crop is Planted</td>
<td>May Want to Request Assistance from USDA NRCS</td>
<td>Check that Diversion is Working During Rainstorms and Record</td>
</tr>
<tr>
<td>Neighboring Livestock are Uphill from Produce Fields</td>
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</table>
# Enlargement of Land Use Action Plan

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<tr>
<td>1b. Waterborne Pathogens</td>
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<tr>
<td>Neighboring Livestock are Uphill from Produce Field</td>
<td>Diversification Ditch</td>
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</tbody>
</table>
FDA states in the Preamble to the rule that they “encourage the application of practices that can enhance food safety and that are also consistent with sustainable conservation.”

“We continue to encourage the co-management of food safety, conservation, and environmental protection”. 
Produce not covered—rarely consumed raw:

asparagus; beans, black; beans, great Northern; beans, kidney; beans, lima; beans, navy; beans, pinto; beets, garden (roots and tops); beets, sugar; cashews; cherries, sour; chickpeas; cocoa beans; coffee beans; collards; corn, sweet; cranberries; dates; dill (seeds and weed); eggplants; figs; ginger; hazelnuts; horseradish; lentils; okra; peanuts; pecans; peppermint; potatoes; pumpkins; squash, winter; sweet potatoes; and water chestnuts.
How Pathogens Get on the Farm

• Wind
• Water
• Animals
• People
# Cases of Airborne Pathogen Contamination

## Selected Cases of Airborne Pathogen Contamination

<table>
<thead>
<tr>
<th>Types of Airborne Pathogens</th>
<th>Location</th>
<th>What the Research Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> O157:H7 (a)</td>
<td>Colorado 6,000-head cattle feedlot</td>
<td>Airborne transport of <em>E. coli</em> O157:H7 from feedlot to various distances of leafy green crops.</td>
</tr>
<tr>
<td>Newcastle disease virus (b)</td>
<td>Pennsylvania poultry farms</td>
<td>Vegetative buffers in Pennsylvania reduced dust and respiratory virus transmission from commercial poultry farms.</td>
</tr>
<tr>
<td><em>E. coli</em> O157:H7 (c)</td>
<td>Ohio fairgrounds</td>
<td>One hundred people were sickened when a dance was held in the same building that had earlier exhibited animals.</td>
</tr>
<tr>
<td>Several kinds of bacteria (d)</td>
<td>Arizona agricultural fields</td>
<td>Wind is a possible mechanism for the aerosolization and off-site transport of land-applied biosolids.</td>
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</tbody>
</table>

From: (a) Berry 2011 (interim report); (b) Burley et al. 2011; (c) Crump et al. 2003; (d) Baertsch et al. 2007.
## Confirmed Outbreaks Associated with Irrigation Water

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pathogen</th>
<th>Irrigation Source</th>
<th>Farm Location</th>
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<tbody>
<tr>
<td>Tomatoes (a)</td>
<td><em>Salmonella</em> Newport</td>
<td>pond</td>
<td>Virginia</td>
</tr>
<tr>
<td>Lettuce (b)</td>
<td><em>E. coli</em> O157:H7</td>
<td>small stream</td>
<td>Sweden</td>
</tr>
<tr>
<td>Shredded lettuce (c)</td>
<td><em>E. coli</em> O157:H7</td>
<td>well water accidentally mixed with dairy lagoon water</td>
<td>California</td>
</tr>
<tr>
<td>Hot peppers (d)</td>
<td><em>Salmonella</em> SaintPaul</td>
<td>holding pond used for irrigation water</td>
<td>Mexico</td>
</tr>
</tbody>
</table>

From: (a) Greene et al. 2008; (b) Soderstrom et al. 2008; (c) US FDA and CA Food Emergency Response Team 2008; (d) CDC 2008.
Prevalence of Pathogens in Domestic Animals

**E. coli 0157:H7**
- Widespread in cattle; higher in CAFOs than on pasture
- Also in pigs, dogs, poultry
- Higher in young than in adults

**Salmonella**
- Poultry
- Pigs
- Cattle
- Other livestock
Prevalence of Pathogens in Livestock

**Campylobacter**
- Most common in poultry
- Cattle
- Other livestock

**Cryptosporidium**
- Cattle
- Sheep
- Goats
- Pigs
- Horses
- Geese
- Poultry

**Listeria**
- Sheep
- Goats
- Cattle
- Other livestock

For a thorough discussion, see *Introduction to Waterborne Pathogens in Agricultural Watersheds*, USDA NRSC Nutrient Management Technical Note No. 9.
Recorded Outbreaks Associated with Wildlife

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pathogen</th>
<th>Wildlife</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Spinach (a)</td>
<td><em>E. coli</em> O157:H7</td>
<td>non-native feral pigs*</td>
<td>California</td>
</tr>
<tr>
<td>Strawberries (b)</td>
<td><em>E. coli</em> O157:H7</td>
<td>deer</td>
<td>Oregon</td>
</tr>
<tr>
<td>Peas (c)</td>
<td><em>Campylobacter jejuni</em></td>
<td>sandhill cranes</td>
<td>Alaska</td>
</tr>
<tr>
<td>Carrots (d)</td>
<td><em>Yersinia pseudotuberculosis</em></td>
<td>shrews</td>
<td>Finland</td>
</tr>
</tbody>
</table>

*While feral pigs were found with the same DNA pattern of *E. coli* O157:H7 as the spinach, so were nearby cattle and pasture soil, and water/sediments from a creek that may have contaminated the irrigation well.*

From (a) Jay 2007; (b) Laidler and Keene 2012; (c) McLaughlin 2008; (d) Kangas 2008.
E. coli 0157:H7 Prevalence in US Native and Non-Native Mammal and Avian Species
Salmonella Prevalence in US Native and Non-Native Mammal and Avian Species
Salmonella Prevalence in US Native Amphibians and Reptiles
Campylobacter and Cryptosporidium*
Pathogen Prevalence in US Native and Non-Native Mammal and Avian Species
Biodiversity Loss May Increase Pathogen Prevalence

• A study conducted in California suggests that a reduction in rodent species diversity may cause increased pathogen prevalence in the individuals that remain.

• Other research shows that biodiversity loss frequently increases disease transmission.
Native wildlife species pose a low relative risk of carrying human pathogens such as E. coli O157:H7 and Salmonella (prevalence in wildlife generally <3%), but in localized areas it may be higher.

http://www.wildfarmalliance.org/Press_Room/WFA_Relative_Risk_Animals.pdf
Type of Animals

But it Depends on the Species and Location

Photo Credit for American crows on irrigation pipe: Western Center for Food Safety, UCD; Produce Safety Microbiology Research Unit, WRRC ARS, USDA; Wildlife Services, APHIS, USDA
Animals Associated with Contamination

Animals that frequent contaminated areas can be sources of pathogens.
FDA does not require farms to take measures to exclude animals from outdoor growing areas, or to destroy animal habitat or otherwise clear farm borders around outdoor growing areas or drainages.

FDA does not authorize the “taking” of threatened or endangered species as that term is defined by the Endangered Species Act.
FDA states in the Preamble that the “presence of animals in a production field of produce, in and of itself, is not a significant food safety risk.”

“Domesticated animals, due to their close proximity and interaction with humans, are generally more likely to harbor zoonotic pathogens than are wild animals.”

“However, wild or feral animals are known zoonotic disease reservoirs for human pathogens.”
FDA Produce Rule

Domesticated and Wild Animals

If there is a reasonable probability that grazing animals, working animals, or animal intrusion will contaminate produce, you must:

• Monitor during the growing season based on your produce, your practices and conditions, and your observations and experience.
FDA Produce Rule

Domesticated and Wild Animals

If significant evidence of potential contamination is found (e.g. observation of significant numbers of animals, significant amounts of animal excreta or significant crop destruction), determine how much of the crop can be harvested. A thorough visual assessment of the growing area should be done.

• Determination depends on what can be seen and what is reasonably likely to be contaminated.
• Make sure to take necessary measures during growing to assist you later when you must identify, and not harvest these areas.
Map Your Farm

- Farm name, location
- Date/or update of map
- Indicate North
- Crop production areas
- Buildings and areas for storage
- Wells, irrigation hydrants, ponds and streams
- Indicate wind direction
- Indicate water movement and sloping land
Multi-Barrier Approach to Minimizing Food Safety Concerns on the Farm and in the Watershed

- Barriers that Prevent Pathogens from:
  - Entering the Farm
  - Contaminating Crops
  - Spreading from Livestock to the Crops
  - Moving to the Wider Landscape
1st Barrier— Be Aware of Pathogens That May Enter the Farm Through Wind

1a. Pathogens from neighboring areas
1st — Barriers that Prevent Pathogens From Entering the Farm

1a. Intercepting windborne pathogens

- Windbreaks (NRCS 380)
- Hedgerows (NRCS 422)
1a. Map Prevailing Wind Direction, Pathogen Source and Windbreak
Scenario: A produce grower has assessed the risk from a nearby cow pasture.

• A food safety action plan describes neighbor’s cattle in a fenced pasture, noting that a hedgerow was installed in between the fields and the pasture to reduce the airborne hazards, because winds sometimes blow from the cattle's loafing area where manure is ground into dust.

• Has enough been done to reduce risk?
• What more do you need to know?
• What, if anything, should be done?
1a. Land Use Action Plan

1st Barrier—Be Aware of Pathogens That May Enter the Farm Through Wind

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<thead>
<tr>
<th>Area of Food Safety Action</th>
<th>What</th>
<th>How SOP or Practice</th>
<th>Who</th>
<th>When</th>
<th>Training</th>
<th>Record</th>
<th>Rank 1-3</th>
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<tr>
<td>Airborne Pathogens</td>
<td>Policies To Reduce Risk</td>
<td>How is this done? Is the SOP or practice written?</td>
<td>Who is required to do this?</td>
<td>When is this done?</td>
<td>What training is done, who, and when?</td>
<td>What record keeping system is kept for this action? Where?</td>
<td>1 is highest priority</td>
</tr>
<tr>
<td>Compost pile</td>
<td>Windbreak</td>
<td>Determine parameters of planting (height, width, species) and strength of wind.</td>
<td>Farm's Designated Food Safety Person or Junior Staff that Reports to Her/Him.</td>
<td>Before Crop is Planted</td>
<td>May Want to Request Assistance from USDA NRCS</td>
<td>Check that Windbreak is Working During Windy Conditions</td>
<td>1</td>
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</tbody>
</table>
## 1a. Land Use Action Plan

- **1\(^{st}\) Barrier— Be Aware of Pathogens That May Enter the Farm Through Wind**

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<td>1a. Airborne Pathogens</td>
<td>Wind-break</td>
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<td>Compost pile</td>
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Agricultural water means water used on covered produce where it is intended to, or is likely to, contact the produce, and food contact surfaces. This includes:

• irrigation water applied using direct water application methods,
• water used for preparing crop sprays, and
• water used for harvesting, packing, and holding activities.
FDA Produce Rule

Farmer must inspect his/her agricultural water system at the beginning of a growing season, and at least once annually, including:

- Water sources
- Water distribution systems
- Facilities
- Equipment
Waterborne Pathways

Processes Affecting Microbial Quality of Irrigation Water

Adapted from: Pachepsky et al. 2011
Animals in Nearby Farm or Natural Area

Animals on hillside above crops may increase risk when rain carries pathogens into crop fields.
Scenario: A produce grower has assessed the risk from a nearby pasture.

• There is evidence of runoff from the pasture that occurred during a rainstorm, which may be contaminating the crop.

• What more do you need to know?
• What actions would you take?
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

1b. Intercepting waterborne pathogens
   – Diversion (NRCS 362)
1.b Land Use Action Plan

1st Barrier— Be Aware of Pathogens That May Enter the Farm Through Water

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<td>Policies To Reduce Risk</td>
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<td>What training is done, who, and when?</td>
<td>What record keeping system is kept for this action? Where?</td>
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<td>Neighboring Livestock are Uphill from Produce Fields</td>
<td>Install a Diversion Ditch</td>
<td>Determine required water capacity and correct dimensions of ditch</td>
<td>Farm’s Designated Food Safety Person or Junior Staff that Reports to Her/Him.</td>
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<td>May Want to Request Assistance from USDA NRCS</td>
<td>Check that Diversion is Working During Rainstorms and Record</td>
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</table>
Animals Higher in Watershed

Animals overly impacting streams can result in polluted water downstream on the farm.
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

1.b Intercepting waterborne pathogens

- Wetlands
  - Constructed (NRCS 656)
  - Natural Wetlands (NRCS 657, 658, 659)
1b. Land Use Action Plan

- **1st Barrier**— Be Aware of Pathogens That May Enter the Farm Through Water

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<tr>
<td>1b. Waterborne Pathogens</td>
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<tr>
<td>Neighboring livestock operation</td>
<td>Wetland</td>
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</table>
1.b Map Livestock Feces Risk & Pathogen Reduction Practices
1st Barrier—Be Aware of Domestic Animals That May Enter the Farm

- 1c. Wandering Livestock or Neighbor’s Dogs
1c. Land Use Action Plan

• 1st Barrier— Be Aware of Pathogens That May Enter the Farm Through Animals

<table>
<thead>
<tr>
<th>Area of Food Safety Action</th>
<th>What</th>
<th>SOP or Practice</th>
<th>Who?</th>
<th>When?</th>
<th>Training?</th>
<th>Record?</th>
</tr>
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<tbody>
<tr>
<td>1c. Domestic Animals</td>
<td>Monitor</td>
<td>Work with neighbors</td>
<td></td>
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<tr>
<td>Escaped livestock or neighboring dogs</td>
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</table>
1st Barrier — Be Aware of Wildlife That May Enter the Farm

• 1d. The risk depends on the type and number of wildlife.
1st Barrier — Deter Problem Wildlife From Entering the Farm

It will scare the wits out of guys like these.
Scenario: An orange crop is grown for fresh market.

• The crop is monitored weekly for animal activity. Feral pig prints and feeding of fallen oranges were noted in the pre-harvest assessment. The food safety plan does not allow fruit to be picked up off the ground.

• Is this okay?
• What more do you need to know?
• What, if anything, should be done?
1d. Land Use Action Plan

- **1st Barrier**— Be Aware of Pathogens That May Enter the Farm Through Wildlife

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<tr>
<td>1d. Wildlife</td>
<td>Monitor</td>
<td>Trap, hunt, possibly exclude</td>
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<td>Especially feral pigs</td>
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</table>
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:

- Avoid frequently flooded land or institute a waiting period after flooding
2a. Map Areas of High Flooding Risk
2a. Land Use Action Plan

2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:

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<tr>
<th>Area of Food Safety Action</th>
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<th>Training</th>
<th>Record</th>
<th>Rank 1-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water contaminated</td>
<td>Destroy Crop</td>
<td>Possibly Plant Next Crop for Livestock Consumption</td>
<td>Farm’s Designated Food Safety Person or Junior Staff that Reports to Her/Him.</td>
<td>Destroy Crop When Field Dries Out</td>
<td>All Farm Staff Must Be Trained Not to Harvest from Flooded Fields</td>
<td>Dates of flood, Dried Field, Planting and Harvest</td>
<td>1</td>
</tr>
</tbody>
</table>
Write a Standard Operating Procedure (SOP)

• Title and Date: Flooded Field; 1/1/15
• Policy: Destroy Crop; Implement Waiting Period
• Purpose: Adulterated Food
• Responsibility: John Doe, Farm Manager
• Materials: Records
• Procedure:
  • 1. Remind Staff of Policy for Not Harvesting Flooded Field
  • 2. Once field is dry, mow first and let dry more.
  • 3. Replant based on waiting period for crop.
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:
• Avoid nearby contamination
2b. Map Compost Making Area and Windbreak
## 2b. Land Use Action Plan

### 2\textsuperscript{nd} Barrier — Reduce Crop Contamination

#### Choosing the Appropriate Sites:

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<td>2b. Nearby Contamination</td>
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<tr>
<td>Landfill or compost pile</td>
<td>Plant less risky crop</td>
<td>Plant crop that is not eaten raw</td>
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2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:
• Avoid overhead contamination
2c. Map Areas of Overhanging Vegetation
## 2c. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

#### Choosing the Appropriate Sites:

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<tr>
<td>2c. Overhead Contamination</td>
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<tr>
<td>Bird feces on crop</td>
<td>Don’t plant or harvest under tree limbs</td>
<td>Trim limbs when birds are not nesting</td>
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Discourage unwanted wildlife in the crop fields by leaving them corridors to get where they need to go.
2d. Map Area of Abundant Wildlife
# 2d. Land Use Action Plan

## 2\textsuperscript{nd} Barrier — Reduce Crop Contamination

### Choosing the Appropriate Sites:

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<tr>
<td>2d. Abundant Wildlife</td>
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<tr>
<td>Significant number of animals</td>
<td>Where they are</td>
<td>Movement patterns</td>
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</table>
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

• Monitor for significant animal signs in the crop during crop growing season
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

- Establishing a no-harvest buffer around contamination
## 2e. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

**Reduce Pathogens from Contacting Crop:**

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<tbody>
<tr>
<td>2e. Monitor for animals</td>
<td>Monitor during growing season</td>
<td>Flag or cordon off area</td>
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<tr>
<td>Significant signs</td>
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</table>
2nd Barrier — Encourage Raptors to Deter Pests on the Farm Contaminating Crops
2e. Map Barn Owl Box and Raptor Perches
## 2e. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<td>Significant signs</td>
<td>Monitor during growing season</td>
<td>Encourage rodent-eating predators</td>
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</table>
2nd Barrier — Reduce Likelihood of Wildlife on the Farm Contaminating Crops

Double electric deer fencing

Inexpensive electric pig fencing

Ground squirrel / rabbit fencing

Expense pig fencing
2nd Barrier — Other Ways to Deter Rodents on the Farm Contaminating Crops

- Removing brush and cull piles near crops
- Stacking irrigation pipe off ground
2nd Barrier — Reduce Likelihood of Pathogens Contaminating Crops

• Monitoring Water Quality
FDA Produce Rule

Farmer must inspect his/her agricultural water system at the beginning of a growing season, and at least once annually, including:

- Water sources
- Water distribution systems
- Facilities
- Equipment
Farmer must consider the following for each water source:

• Intended use on “covered” produce versus food contact surfaces;
• Ground water vs. surface water source;
• Farmer’s control over each source;
• Protection of each source;
• Use of adjacent or nearby land; and
• Contamination of water by another user before it reaches the farm.
FDA Produce Rule

Farmer must:

• Adequately maintain all water sources, regularly inspecting and correcting issues.
Waterborne Pathways

Processes Affecting Microbial Quality of Irrigation Water

Adapted from: Pachepsky et al. 2011
Sediments and algae blooms can be a key site for pathogen persistence in water bodies.

Biofilms can provide protection from environmental stress and predation by other microbes.
2nd Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Intercept waterborne and windborne pathogens before they reach the crop

- Diversion (NRCS 362)
- Grassed Waterway (NRCS 412)
- Sediment Basin (NRCS 350)
- Filter Strips (NRCS 393)
- Windbreaks (NRCS 380)
FDA Produce Rule

Farmer must:

• Keep water sources free of debris, trash, domesticated animals.
## 2f. Land Use Action Plan

### 2\textsuperscript{nd} Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<tr>
<td>2f. Monitor water quality</td>
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<tr>
<td>Surface water for irrigation</td>
<td>Monitor during growing season</td>
<td>Keep free of trash and animals</td>
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</table>
Prevent Backflow

- Drain / overflow pipe
- Fill pipe from well
- Potential cross-connection
FDA Produce Rule

Farmer must:

• Reduce hazards associated with pooled water which can be a source of contamination.
Test water when:

• Directly contacts the harvestable portion of a crop prior to, during, or after harvest, such as:
  • Using sprinklers on lettuce
  • Using drip on carrots

If irrigation water does not contact the produce (e.g., drip or furrow irrigation of tree fruit), testing is not required.
Don’t need to test water when:
• Uses an irrigation method that does not directly contact the harvestable portion covered produce;
• Uses water from public water systems and has public water system results or certificates of compliance; or
• Treats the water according to the water treatment requirements
Different requirements for different intended uses. For:

- **Sprouts**;
- **Applied during or after harvest**;
- **Food contact surfaces**; and
- **Hand washing during or after harvest**.

- No detectable generic E. coli in 100 mL of ag water, and you must not use untreated surface water
If ag water is not safe for sprouts, use during and after harvest, food contact surfaces or hand washing during and after harvest, then farmer must:

• Immediately discontinue that use;
• Make effective changes to fix problem;
  or
• Treat water.
Requirements to treating ag water:

• Must be effective in making water safe for intended use;
• Deliver it safely; and
• Monitor its safety.
Examples of methods that can be used to treat ag water:

• Physical treatment, including using a pesticide device as defined by EPA;
• EPA registered antimicrobial pesticide product (none are registered so far); or
• Other suitable method.
FDA has determined that presently, there is no EPA-approved chemical treatment for contaminated water used to irrigate cropland.

“The most commonly used antimicrobials for microbial population reduction are chlorine chemicals, specifically sodium hypochlorite, calcium hypochlorite, gaseous chlorine and chlorine dioxide. It is anticipated that chlorine compounds would be among the preferred chemicals for which industry would be likely to seek FIFRA registration.”
## 2f. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<td>2f. Monitor water quality</td>
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<tr>
<td>Ground-water for food contact surfaces</td>
<td>Test or get results of public water system</td>
<td>Possibly treat</td>
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</table>
Different requirements for different intended uses - Growing produce:

(1) A geometric mean (GM) of ag water samples of 126 or less CFU of generic E. coli per 100 mL of water; and

(2) A statistical threshold value (STV) of your ag water samples of 410 or less CFU of generic E. coli per 100 mL of water.
If ag water is not safe for growing produce, farmer must:

• Discontinue use, as soon as practicable and not later than the following year, unless you either:
  • Apply a time interval or log reduction;
  • Adequately re-inspect and correct issues; or
• Treat water.
Apply a time interval between:

• Between last irrigation and harvest
• Harvest and end of storage
This time interval is applied with known log reduction:

- Between last irrigation and harvest use a microbial die-off rate of 0.5 log per day but no greater than 4 consecutive days;

- Between harvest and end of storage use a microbial die-off rate or calculated removal rate such as what is used with commercial washing.
There are different tests for surface and groundwater. Both must conduct initial surveys to develop a microbial water quality profile:

• The microbial water quality profile is calculated using the data of the geometric mean (GM) and the statistical threshold value (STV) of generic *E. coli* CFU per 100 mL over time.
For surface water:

- **Initially**: A minimum total of 20 samples of ag water over a minimum period of 2 years, but not greater than 4 years.

- **Annually thereafter**: a minimum number of 5 samples per year.
For groundwater:

- **Initially**: A minimum total of four samples of agricultural water during the growing season or over a period of 1 year.

- **Annually thereafter**: a minimum of 1 sample per year.
Initial and later samples are used in a rolling data set:

• To update the microbial water quality profile, calculate revised GM and STV values using your current annual survey data, combined with your most recent initial or annual survey data from within the previous 4 years, to make up a rolling data set.
Initial and later samples are used in a rolling data set:

At least 20 samples for untreated surface water sources; and

At least 4 samples for untreated ground water sources.
When farmers have to comply with testing irrigation water:

- 6 years for very small farms,
- 5 years for small farms, and
- 4 years for all other farms
Scenario: A row crop operation is sourcing water from an open pond on-site for irrigation.

- The operation has no testing data but claims there are no risks because their children swim in it.

- What more do you need to know?
- What actions would you take?
## 2f. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<td>2e. Monitor water</td>
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<td></td>
<td>Surface water for irrigation</td>
<td>Test and determine what to do</td>
<td>Use time interval or treat water</td>
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</table>
(a) You must manage the water as necessary, including by establishing and following water-change schedules for re-circulated water, to maintain its safety and adequate sanitary quality (for example, hazards that may be introduced into the water from soil adhering to the covered produce).
FDA Produce Rule

When using water during harvest, packing and holding activities

(b) You must visually monitor the quality of water (for example, water used for washing covered produce in dump tanks, flumes, or wash tanks, and water used for cooling produce in hydrocoolers) for buildup of organic material (such as soil and plant debris).
FDA Produce Rule

When using water during harvest, packing and holding activities

(c) You must maintain and monitor the temperature of water at a temperature that is appropriate for the commodity and operation (considering the time and depth of submersion).
## 2f. Land Use Action Plan

### 2\textsuperscript{nd} Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<tr>
<td>Water for harvesting, packing, and holding</td>
<td>Monitor clarity and temperature</td>
<td>Schedule changes; look for debris, °F</td>
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</table>
FDA Produce Rule

Records must be kept of:

• Inspection of agricultural water sources and systems, and pooling of water
• Generic *E. coli* test results
• Water treatment monitoring
• Microbial die-off or removal rates, and scientific documentation of method
• Public water (annual) documentation
Raw manure and compost are considered biological soil amendments:

- A soil amendment is a material, including manure, that is intentionally added to the soil to improve its chemical or physical condition for growing plants or to improve its capacity to hold water.
A biological soil amendment is considered “treated” if it:

• Is compost that has been processed correctly, or

• Is an agricultural tea that is made correctly . . .
An agricultural tea** is considered treated if:

- Made with the correctly processed biological materials of animal origins
- Made with water that:
  - is not untreated surface water
  - has no detectable generic *E. coli*

If made correctly, it may be used in water distribution systems.
Raw manure, or other untreated biological soil amendments:

must be applied in a manner that does not contact covered produce during application and minimizes the potential for contact with covered produce after application.
FDA Produce Rule

Compost, or other treated biological soil amendments:

Must be applied in a manner that *minimizes the potential for contact* with covered produce during and after application.
2nd Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Nutrient Management
- Irrigation Management
## 2g. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

**Reduce Pathogens from Contacting Crop:**

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<td><strong>2g. Use care with manure</strong></td>
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<tr>
<td><strong>Pathogens in manure</strong></td>
<td><strong>Plan applications</strong></td>
<td><strong>Depends on weather</strong></td>
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</table>
Persistence of Soil Pathogens

- Examples of Pathogen Persistence
  - *E. coli* O157:H7 (25 - 226 days)
  - *Salmonella* (7 - 332 days)
  - *Campylobacter* (31 – 64 days)
  - *Listeria* (43 - 128 days)
  - *Cryptosporidium* (<1 year)
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- Soil management practices that reduce pathogens
  - Using manure and waiting between applications and the next harvest
Using USDA’s National Organic Program standards for raw manure:

• “At this time, the FDA does not object to farmers complying with the USDA’s National Organic Program standards, which call for a 120-day interval between the application of raw manure for crops in contact with the soil and 90 days for crops not in contact with the soil.”
2g. Land Use Action Plan

2nd Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<td>2g. Use care with manure</td>
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<tr>
<td>Pathogens in manure</td>
<td>Waiting period used</td>
<td>Depends on crop</td>
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</table>
Handling, conveying and storing a biological soil amendment:

Must be done in a manner and location such that it does not become a potential source of contamination to:
produce, food contact surfaces, areas used for a covered activity, water sources, water distribution systems, and other soil amendments.
When using equipment, such as tractors, that may contact produce, you must use them in a way that minimizes the potential for contamination of that produce.
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- **Soil management practices that reduce pathogens**
  - Contaminated site management
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- **Soil management practices that reduce pathogens**
  - Cover cropping and crop rotations
Mapping Areas of Risk & Pathogen Reduction Practices
## 2h. Land Use Action Plan

### 2nd Barrier — Reduce Crop Contamination

**Reduce Pathogens from Contacting Crop:**

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<tr>
<td>2h. Reduce soil pathogens</td>
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<tr>
<td>Feces from grazing animals</td>
<td>Cover crops</td>
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2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- **Soil management practices that reduce pathogens**
  - Using compost as an alternative to raw manure
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- *Soil management practices that reduce pathogens*
  - Using green waste
The following treatment processes for biological soil amendments are acceptable when they satisfy specific microbial standards:

- physical process (e.g., thermal),
- chemical process (e.g., high alkaline pH), or
- biological process (e.g., composting**)

**FDA Produce Rule**
Correctly made compost is either:

Static compost that maintains aerobic (i.e., oxygenated) conditions at a minimum of 131 °F (55 °C) for 3 consecutive days and is followed by adequate curing; or

Turned compost that maintains aerobic conditions at a minimum of 131 °F (55 °C) for 15 days (which do not have to be consecutive), with a minimum of five turnings, and is followed by adequate curing.

§ 112.55 What microbial standards
Records that need to be kept for a treated product from a 3rd party, such as compost from a compost maker, includes:

Annual paperwork (e.g. Certificate of Conformance) that ensures:

• The process used is scientifically valid and has been carried out with appropriate monitoring; and

• It is handled, conveyed and stored in a manner and location to minimize the risk of contamination

FDA Produce Rule
Records that need to be kept for treated product you make yourself (e.g. compost) include:

documentation that process controls (for example, time, temperature, and turnings) were achieved.
Keep Records of Soil Amendment Use

- Source and methods used to produce compost or the manure storage time.
- Application rates, timing, and fields receiving manure or compost.

### Manure Applications log

<table>
<thead>
<tr>
<th>Name of operation:</th>
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<tr>
<td>Please see the food safety plan for overall manure application procedures</td>
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<thead>
<tr>
<th>Date</th>
<th>Field Applied</th>
<th>Rate</th>
<th>Incorporated (Yes or No)</th>
<th>Supplier</th>
<th>Crop Planted (Type and Date)</th>
<th>Crop Harvested (Date)</th>
<th>Initials</th>
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Reviewed By:  
Title:  
Date:
Scenario: Compost being spread on a field adjacent to a strawberry operation just prior to harvest.

• The operation’s pre-harvest assessment was performed prior to the compost being spread and did not comment on it. The strawberry operation has no protection against wind drift and compost drift is visibly coming onto the field. The food safety plan has no provision for the event.

• What more do you need to know?
• What actions would you take?
## 2i. Land Use Action Plan

### 2\textsuperscript{nd} Barrier — Reduce Crop Contamination

Reduce Pathogens from Contacting Crop:

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<td>2i. Compost making/using</td>
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<tr>
<td>Pathogens in manure</td>
<td>Must be made correctly</td>
<td>Depends on static vs. turned compost</td>
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</table>
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

• Avoiding contamination

• Decreasing pathogens through air and water management

• Restricting wild and feral animals that move between livestock areas and crop fields
Animals on Farm
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

- 3a. Intercepting waterborne pathogens
  - Grassed Waterways (NRCS 412)
  - Filter Strips (NRCS 393)
### 3a. Land Use Action Plan

**3rd Barrier — Reduce Livestock Spreading Livestock Pathogens to Crops**

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<td>3a. Avoid crop contamination</td>
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<tr>
<td>Pathogens in livestock feces</td>
<td>Grassland or filter strip</td>
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### 3a. Land Use Action Plan

**3rd Barrier — Reduce Livestock Spreading Livestock Pathogens to Crops**

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<td>3a. Avoid crop contamination</td>
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<tr>
<td>Pathogens in livestock feces</td>
<td>Increase distance between them</td>
<td>Place water trough and food away from crops</td>
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3a. Map Area of Prescribed Grazing
## 3a. Land Use Action Plan

### 3rd Barrier — Reduce Livestock Spreading Livestock Pathogens to Crops

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<td>3a. Avoid crop contamination</td>
<td>- Increase infiltration - Decrease runoff</td>
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<tr>
<td>Pathogens in livestock feces</td>
<td></td>
<td>Prescribed grazing</td>
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</table>
3a. Map Area of Livestock and Waste Storage Pond
### 3a. Land Use Action Plan

#### 3rd Barrier — Reduce Livestock Spreading Livestock Pathogens to Crops

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<td>3a. Avoid crop contamination</td>
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<tr>
<td>Pathogens in livestock feces</td>
<td>Waste storage pond</td>
<td>Design correctly</td>
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- Design correctly waste storage pond.
- Avoid crop contamination.
FDA eliminated the proposed requirement for an adequate waiting period between grazing and harvesting in the proposed rule. However, they encourage farms to voluntarily consider applying such waiting periods, as appropriate for the farm’s commodities and operations.
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- Managing animals used for traction
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

• Managing animals used for weeding, or guarding crops or livestock
Scenario: A diversified produce grower has documented his assessment of risk from a nearby cow pasture.

The farmer has made special effort to note and assess bird movement between cattle and the crop at different stages of crop growth and especially near and during harvest.

- Is this okay?
- What more do you need to know?
- What, if anything, should be done?
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

• Monitoring for wildlife feces
### 3b. Land Use Action Plan

**3rd Barrier — Reduce Livestock Spreading Livestock Pathogens to Crops**

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<td>3b. Monitor 4 animal feces</td>
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<tr>
<td>Pathogens in wildlife feces</td>
<td>Monitor during growing season</td>
<td>Flag off contaminated area</td>
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</tbody>
</table>
4th Barrier — Prevent Pathogens From Leaving the Farm

• Placing manure and compost stockpiles away from water sources
• Intercepting waterborne pathogens

NRCS
4a. Map Riparian Vegetation
4th Barrier — Prevent Pathogens From Leaving the Farm

• Sediment basin
4a. Map Sediment Basin
## 4a. Land Use Action Plan

### 4th Barrier — Prevent Pathogens From Leaving the Farm

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<td>4a. Avoid contaminating landscape</td>
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<td>Manure pile</td>
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Farm Conservation Practices That Support Public Health – Specifically Food Safety

Grassed Waterways
Riparian Buffers
Wetlands

Cover crops
Compost

Soil Microbes Outcompete and Kill Human Pathogens

Windbreaks Hedgerows

Water Quality

Air Quality

- Cover crops
- Compost

- Nutrient Cycling
- Increase Water Holding Capacity

- Grassed Waterways
- Riparian Buffers
- Wetlands

- Nutrient and Pesticide Filtration
- Soil and Riverbank Stabilization
- Groundwater Recharge

- Windbreaks
- Hedgerows

- Reduction of Airborne Pesticide Drift
- Pollination Services
- Beneficial Insect and Raptor Pest Control
FARMING WITH FOOD SAFETY AND CONSERVATION IN MIND

Food-borne illness linked to pathogens in meat, processed food, and produce has led to increased attention to food safety issues at all points along the supply chain, including the farm. Farmers can produce safe food without sacrificing responsible on-farm conservation measures, such as maintaining riparian habitat or other non-crop vegetation. Some corporate buyers, attorneys, marketers, and food safety regulators have suggested that such practices may pose risks on the assumption that wildlife may carry pathogens. On the contrary, research demonstrates that wildlife have a low prevalence for carrying food-borne pathogens. Evidence indicates that conservation practices and natural areas can often reduce pathogen risk while providing many other benefits, such as soil and water conservation, and habitat for pollinators and beneficial insects. By using risk assessment strategies and explaining their rationale for management decisions that include conservation measures, farmers can more effectively advocate for their farming practices with buyers and food safety auditors.

How Did We Get Here?

Long before 2006, when E. coli O157:H7 made its way into packaged fresh-cut spinach—killing five people and sickening more than two hundred—food safety auditors were on Salinas Valley, California, farms. The E. coli outbreak was not a new phenomenon. Numerous similar incidents had occurred since 1993. But the deaths and large numbers of people sickened by the produce in 2006 generated a strong response from the produce industry and the Food and Drug Administration (FDA). Response to a broad FDA Consumer Advisory effectively shut down spinach sales, causing large financial losses in spinach and other sectors of the produce industry. The handlers within the industry responded by creating the California (and later Arizona) Leafy Green Products Handler Marketing Agreements (LGMA), which require participating leafy green handlers to ensure that their farm suppliers are practicing Good Agricultural Practices (GAPs) that the agreements define.

A FARMER’S GUIDE TO FOOD SAFETY AND CONSERVATION: FACTS, TIPS & FREQUENTLY ASKED QUESTIONS

October 2013

Background

It seems every few months headlines like these make breaking news: “E. coli Fears Prompt Romaine Lettuce Recall,” “Spinach Recalled in 29 States,” “California's Largest Outbreak Deadliest in a Decade.” These dramatic headlines reflect the attention given to food-borne illness outbreaks associated with contaminated fruits and vegetables. Taking sound, science-based steps to reduce the risk of contaminating produce with pathogens makes sense, but some misguided food-safety standards and interpretations of audit checklists have encouraged or required the removal of on-farm conservation plantings such as hedgerows, windbreaks and grassed-waterways, and the destruction of riparian areas and wetlands. Conservation-minded farmers know that conserving these areas on the farm helps protect water and air quality, supports pollinators, and reduces erosion and greenhouse gases. In a climate of food-safety angst, knowing the basics of managing crops and conservation practices to address food safety can go a long way in maintaining on-farm conservation plantings while reducing the risk of pathogen contamination.

It is highly unlikely that farmers would ever intentionally sell contaminated products. In the past, it was long held that common sense approaches were sufficient to ensure produce did not have food-borne pathogens. Animals were discouraged from production areas because they damaged crops. The potential for animal manures applied as fertilizers and soil amendments to result in water and crop contamination with human pathogens was well recognized. However, in 2006, everything changed when an outbreak of E. coli O157:H7 was traced back to a farm on California’s Central coast, the center of the state’s fresh-cut salad industry. While it was never unequivocally determined how the spinach became contaminated, non-native feral pigs, contaminated irrigation water, and adjacent cattle operations were all considered as possible sources. All wildlife and the habitat they occupied became scrutinized by public health, academia, and especially the leafy greens industry.

What do hedgerows, cover crops, and grassed waterways have in common?

Food safety!
Continue working on your Maps and Land Use Action Plans