“Your Farm”

Family Farm

GOOD AGRICULTURAL PRACTICES
“GAPs”

AND

STANDARD OPERATING PROCEDURES
“SOPs”

July 2010

Community Alliance with Family Farmers
PO Box 363
Davis CA 95617

Forward

The mission of the Community Alliance with Family Farmers (CAFF) is to strengthen the relationship between the food consuming community and local family farmers. CAFF has been working for 30 years to promote a sustainable agriculture in California and to defend the interests of family farmers.

The following GAPs are intended for the small to medium family farm with limited resources in both time and money which is seeking to implement basic food safety practices or is looking to sell into wholesale markets or to retail stores. This program can be implemented by the farm operator or assigned to an employee. We intend for these GAPs to suffice in most if not all circumstances the grower may encounter. Of course the grower needs to be aware that various buyers may have different requirements, and ultimately it is up to that buyer and his consultants what metrics or audits will be required. It may serve the grower to insist that his farm has a food safety plan and that he can only implement one plan at a time. In many cases the buyer is only looking for evidence that food safety is being addressed at the farm level.

We need to be very clear in saying that CAFF does not believe that family farms produce unsafe food. Quite the contrary, we believe that fresh local food is in fact the safest food sold in America. We are also not saying that family farms should necessarily adopt these GAPs across the board. CAFF sees these practices as a tool the grower can use when the market demands it, and they may be more or less appropriate to different crops. In spite of vetting these GAPs with farmers, we are aware that these practices may come as a shock to many farmers. Take time and think about it. The grower cannot expect to implement these practices in two weeks, more like two months, and probably it will take a couple of years to comfortably make them a part of the farm culture. Some practices will be one time only (prior land use), others will need monitoring seasonally (adjacent land use and water testing), others will be ongoing, if not weekly (employee hygiene, training).

These GAPs are not meant to substitute for any metrics required in a processing contract. Processors—especially fresh cut processors—have particular concerns that are usually spelled out in the private contract.

A Note About This Document

This document provides guidelines and practical tools for use by family farmers. It is intended as an educational resource and not as technical advice tailored to a specific farming operation, or, even though it reflects food safety guidance from the FDA, as a substitute for actual regulations and guidance from FDA or other regulatory agencies. It is also not intended as legal advice. We cannot guarantee that use of these guidelines and tools will: (i) eliminate the risk of pathogenic contamination of fresh fruits and vegetables; (ii) eliminate the risk of harm to human and environmental health; (iii) enable a grower to comply with all applicable legal requirements, buyer sourcing requirements or processing contract terms; (iv) defend successfully against legal claims; (v) reduce insurance costs; or (vi) sell into new markets. This document also identifies websites and other resources for possible use by growers. CAFF does not endorse and is not responsible for the availability or content of these resources. CAFF will not be responsible or liable, directly or indirectly, for any consequences resulting from use of this document or any resources identified in this document. CAFF is providing this document to family farmers as an educational service in line with its mission of fostering family-scale agriculture.

Acknowledgements

These GAPs are based on the FDA recommendations of 1998, as well as various crop-specific GAPs developed from them. We thank Drs. Trevor Suslow and Richard Molinar of the University of California Cooperative Extension for their assistance in developing and reviewing them. We also thank a committee of CAFF farmers who went through them line by line. A special thank you is due to Ken Kimes, the chair of the committee and a CAFF board member, who spent many hours developing them and sharing his personal experience with food safety audits. Finally, we thank JoAnn Baumgartner of the Wild Farm Alliance for providing Appendices I and II on animals of concern and laws relating to natural resources.

ROW, TREE, AND SMALL FRUIT CROPS

GOOD AGRICULTURAL PRACTICES
“GAPs”

YOUR FARM
FIELD OPERATIONS GAP CHART

Table of Contents

Standard Operating Procedure 1.1.
LAND USE
PRIOR LAND USE:

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that prior land use does not represent a likely source of contamination, whether by human pathogens or chemicals, to produce intended for human consumption in a raw or uncooked form.

Concern:
Growing produce in microbiologically or chemically tainted soils may lead to contamination. Extraordinary land uses such as feedlots or prolonged spreading of municipal sludge may interfere with safe produce production.

Contamination Process:

a) Direct contact of produce with contaminated soils.
b) Contamination via irrigation water applied to contaminated soils.
c) Indirect contamination by equipment or human traffic tainted with contaminated soils

Prevention or corrective actions:

a) Avoid planting in land previously used for questionable practices.
b) At least one-year buffer before harvesting produce from land previously used for concentrated animal husbandry is recommended.
c) Conduct title search or question state or local officials to establish whether previous land use involved disposal of chemicals or biological wastes.
d) If previous land use is considered to be questionable, conduct soil analysis in line with those concerns, e.g. for pathogens, heavy metals, etc.

Documentation:

a) Soil analyses for possible chemical contamination,
b) Title search and documentation pertaining to previous land use.
c) Maintain organic certification, if applicable.

Standard Operating Procedure 1.2.
LAND USE
ADJACENT LAND USE:

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that adjacent land use does not represent a likely source of contamination, whether by human pathogens or chemicals, to produce intended for human consumption in raw or uncooked form.

Concerns:
Pesticide drift from an adjacent crop may lead to residues of pesticides not registered or above established tolerances for the crop. Dairy or animal husbandry, composting operations, etc., may lead to biological contaminants such as fecal matter or heavy metals

Contamination Processes:

a) Spray drifts onto crops at a critical stage relative to harvest.
b) Manure spreading to fields adjacent to produce growing area leading to direct contamination.
c) Water runoff or dust containing animal waste directly contaminating the soil, wells, surface water, or product.

Prevention or corrective actions:

a) If conditions warrant, test product for possible non-compliant residues prior to harvest. Dispose of contaminated produce in such a way as to make it clearly non-consumable.
b) Prevent the movement of unwanted animals using fences or barriers.
c) Dig trenches or divert any potential contaminated runoff.
d) Maintain vegetative buffer strips between cropped fields and areas used as animal pasture.
e) Manure stored in close proximity to production areas should be covered with plastic or tarpaulins.
f) Manure applications in adjacent fields should not be within two weeks of harvest.
g) Un-composted manure will not be used within 120 days of harvest.

Documentation:

a) Pesticide residue analysis (if needed).
b) Runoff mitigation efforts. Date and method.
c) Timing of manure use on adjacent fields (NUOCA log)
d) Inspection of unwanted animal intrusion and of prevention fencing.

Standard Operating Procedure 2.1
WATER QUALITY
IRRIGATION/SPRAY WATER APPLICATION:

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that water used for crop production does not represent a likely source of contamination, whether by human pathogens or chemicals, to produce intended for human consumption in raw or uncooked form.

Concerns:
Contaminated water used for irrigation, produce washing, mixing foliar sprays or frost protection may act as a source of human pathogens or chemical contamination.

Contamination Processes:

a) Direct application of contaminated water containing *E. coli* O157:H7*,* *Salmonella* etc, to produce for human consumption.
b) Secondary contamination of soils with tainted water source that may lead to contamination of produce containers, equipment, etc.

Prevention or corrective actions:

a) Conduct a Sanitary Survey of all water sources, creating a "map" of the water supply system and identifying components of the system
b) Surface water tested quarterly for bacterial contamination or more often if historical data indicates a need.
c) Closed water sources tested yearly for bacterial contamination.
d) Water should be sampled as close to use point as possible; water source should be indentified on sample submittal forms.
e) Water that tests out of specified limits will not be used for crop production. Mitigation measures will be taken or an alternative water source will be used.
f) Do not use water reclaimed from municipal waste sources except in forage crop production.
g) Use potable water source for foliar applications and for produce washing.
h) Any produce that shows evidence of contamination or that is known to be contaminated will be disposed of in such a way as to render the produce unusable.

Documentation:

a) Water tests results
b) Inspection records, and plot maps identifying wells, reservoirs, turnouts, gates, pump locations, other irrigation system features and their locations.

Standard Operating Procedure 3.1.
FERTILIZER APPLICATIONS
MANURE, COMPOST, AND FERTILIZER:

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that manure or biological mulches used for crop production do not represent a likely source of contamination, whether by human pathogens or chemicals, to produce intended for human consumption in raw or uncooked form.

Concerns:
Foodborne pathogens transferred from animal fecal matter or biological mulches onto produce.
Human viruses and other pathogens transferred from human waste onto produce.

Contamination Processes:

a) Direct application of pathogens such as *E. coli* O157:H7*, Salmonella* etc, to produce during spreading of animal manures.
b) Secondary contamination of soils with animal or human waste that may contact produce.

Prevention or corrective actions:

a) Do not use municipal biosolids for crop production.
b) Composted manure will be used rather than fresh or aged manures if available.
c) Crops will not be harvested until at least 120 days after application of un-composted manure.
d) Any produce that shows evidence of contamination or that is known to be contaminated will be disposed of in such a manner as to render the produce unusable.
e) All compost will be produced following the National Organic Program guidelines.
f) Compost and non-synthetic crop treatments will be incorporated/used prior to planting, bud burst, and not within 45 days of harvest.

Documentation:

a) Fertilizer and compost application records.
b) Certificate of Analysis for all purchased fertilizer products.
c) Records from compost producer or compost production (composting duration, turning frequency, temperatures)
d) Manure supplier (name, address) date of receipt.
e) Copies of testing, and certification from supplier if available.

Standard Operating Procedure 4.1

CROP PROTECTION CHEMICALS
PREVENTING CONTAMINATION

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To prevent the contamination of produce by the misuse of crop protection chemicals.

Concerns:
Contamination of produce and endangerment of applicators by the misuse of crop protection chemicals (herbicides, pesticides, etc.)

Contamination Processes:

a) Chemicals not mixed and applied as per label instructions.
b) Inadequate worker training, protective gear, and improper disposal of left over material and containers.
c) Drift from adjacent fields.
d) Contamination from tank clean out areas.
e) Contamination of water supply by cross connections and backflow.

Prevention or corrective actions:

a) Mix and apply chemicals as per label instructions.
b) Properly licensed or trained applicators only.
c) Proper disposal of left over material and containers.
d) Maintain adequate distance between crop and water sources when mixing, loading, diluting chemicals.
e) Properly clean and rinse equipment.
f) Properly store chemicals.
g) Backflow prevention, air gaps, etc.

Documentation:

a) Application records, material use reports.
b) Training records, license documents.
c) Cleaning and disposal records.

Standard Operating Procedure 5.1
HARVESTING EQUIPMENT
PREVENTING CONTAMINATION

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that harvesting equipment, personal protective equipment, picking bins/containers are free from sources of contamination such as animal or human waste that may lead to contamination of the crop with food borne pathogens or prohibited chemicals.

Concerns:
Use of soiled harvesting equipment transfers human- or animal-borne pathogens to produce destined for human consumption.

Contamination Processes:

a) Produce placed in bins or containers that have been contaminated by animal, human contact, contaminated soil, or chemicals.
b) Contaminated hand tools, gloves, or picking bins transfer pathogens or chemicals to produce.

Prevention or corrective actions:

a) Clean clothing, personal protective equipment, and picking containers are used.
b) Personal protective equipment and picking sacks are replaced as necessary.
c) Picking bins are inspected before each use. Any sign of contamination is removed and the bin is cleaned.
d) Harvesting clippers and hand tools are cleaned daily.
e) Harvest knives and tools are not used for personal tasks.
f) Clothing showing presence of contaminates (human blood, human or animal waste, etc) will not be worn.
g) Clothing will be laundered using soap and water.

Documentation:

a) Inspection, cleaning and replacement records.

Standard Operating Procedure 6.1.
WORKER HYGIENE:

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To reduce the potential for contamination of produce by an employee, either by his/her actions, hygiene or health.

Concerns:
Failure of all people working in direct contact with the produce or produce contact surfaces to follow proper food handling procedures may lead to the contamination of the produce with pathogens causing food-borne illness.

Contamination Processes:

a) Not washing hands after using the toilet and/or prior to handling crops or equipment that contacts produce.
b) Use of soiled clothing, gloves or equipment.
c) Eating, drinking and smoking in crop production areas.
d) People with open wounds, and/or infections, or communicable diseases that can contaminate the product.

Prevention or corrective actions:

a) Toilets and hand washing facilities will be maintained and in close proximity to all workers as per OSHA requirements (29CFR, Part 1928.110).
b) Adequate supplies of potable water for hand washing.
c) Disposal of trash in designated containers and removal from site.
d) Eating, drinking and smoking limited to non-production areas.
e) Workers who display symptoms of open sores, wounds, diarrhea, vomiting or infectious disease will not be permitted to handle product.
f) Employees will receive appropriate training in proper food safety principles (recommend video).

Documentation:

a) Employee hygiene training logs.
b) Toilet cleaning and supply logs.

Standard Operating Procedure 7.1
Sanitary Facilities

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that sanitary facilities are maintained in accordance with laws and regulations describing field sanitation practices. To address correct worker hygiene practices and reduce the potential for produce contamination by an employee, either by his/her actions, hygiene, health, or habits.

Concerns:
All persons working in direct contact with produce must follow proper produce-handling techniques and food protection principles. Failure to follow these principles may lead to contamination of produce and/or food borne illnesses.

Contamination Processes:
1. Improperly maintained hand-washing facilities.
2. Improperly maintained toilet facilities.
3. Inadequate trash disposal.

Prevention or corrective actions:
All reasonable measures should be taken to assure the following:

1. You should consult your state regulations to determine the appropriate number of toilet facilities
2. Each toilet facility must have toilet paper in a proper holder.
3. Each toilet facility must be kept in a clean and sanitary condition.
4. It is recommended to have a current cleaning check sheet indicating each time the facility has been cleaned.
5. Toilet facilities must be placed within ¼ mile or 5 minute walking distance of all employees. Workers should always have the opportunity to use the facilities when they require them.
6. The hand washing facility must have sufficient water available for use, and the hand wash water in a portable facility must be labeled: 'This water for hand washing purposes only' in a language understood by the workers
7. The hand-washing facility must have soap in a proper dispenser.
8. The hand-washing facility must be supplied with single use disposable towels in a proper holder.
9. The hand-washing facility shall have a receptacle capable of keeping the trash contained.

10. It is recommended that each toilet/hand-washing facility have a supplies check sheet available indicating date checked and when supplies have been refilled.
11. If possible, portable toilet facilities should be cleaned and serviced away from the field.
12. When serviced by septic trucks near the field, all steps shall be taken to minimize the likelihood of crop contamination in the event of leakage or a spill.

Documentation:

a) Toilet cleaning logs
b) Copy of contractors license (if applicable).
c) Copy of leakage and spill response plan.

Standard Operating Procedure 8.1.

RODENT CONTROL

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that rodents entering storage and packing areas do not act as a source of biological contamination to produce intended for human consumption.

Concerns:
Foodborne pathogens such as *E. coli* O157:H7*, Salmonella* etc, from animal fecal matter or mechanical transfer.

Contamination Processes:

a) Presence of rodents can cause contamination of produce with human pathogens through direct contact with fecal matter.

Prevention or corrective actions:

a) Efforts are made to keep rodents out of crop holding, packing areas, and packing material storage areas.
b) Eliminate potential food sources, aside from crop, that may attract rodents.
c) Remove weeds and debris near storage and packing areas that may act as food source or habitat for rodents.
d) Apply corrective actions to eliminate pests in the sorting, packing shed areas

Documentation:

a) Rodent control records.

Standard Operating Procedure 9.1.
<u>SELF-AUDIT:</u>

Approved By: ___________ (Food Safety Officer / Responsible Party)

Purpose:
To ensure that all aspects of our GAP program are being conducted satisfactorily by all of the employees and contractors that are involved with the production of produce.

Concerns:
Any deviation from our documented GAP program may allow potentially contaminated produce to leave our premises destined for human consumption.

Contamination Processes:

a) Contamination of produce with sources of food-borne illness such as *E. coli* O157:H7*, Salmonella* etc., as a result of non-compliance with the established GAP program with respect to: land use, water quality, fertilizer and pesticide applications, harvesting equipment, worker hygiene, toilet facilities, and pest control practices

Self-Audit protocol:
Self-Audits will be conducted once before season starts and once during the season by an assigned individual who has been trained in our Good Agricultural Practices program. All aspects of the GAP program will be audited and a written record of required corrective action will be documented. The self-audit will address employee practices and worker hygiene for all employees and sub-contractors. Written records of employee food safety training will be evaluated. The audit will observe whether SOP's established in this GAP program are followed at all times. All documentation including water quality logs and pesticide application records will be available and up to date at the time of the self-audit.

Documentation:

a) Self-audit checklist.

APPENDIX I: RELATIVE RISK TO UNPROCESSED PRODUCE FROM ANIMAL PRESENCE

Most cattle operations, some feral pigs, and relatively few wildlife, especially those associated with polluted areas, are a food safety concern. Wildlife have a low incidence of carrying pathogens, yet many well-intentioned efforts to make the growing environment "clean" have created misguided farm requirements, harmful to both food safety and land stewardship practices. Grasses and wetlands can filter microbial pollution, especially when the residence time for water flowing through the systems is prolonged. While nature can never provide zero risk, the benefits that habitat brings outweighs the drawbacks of a denuded farm.

SUMMARY TABLE **RELATIVE RISK TO UNPROCESSED PRODUCE FROM ANIMAL PRESENCE** **PREPARED BY WILD FARM ALLIANCE** **www.wildfarmalliance.org**			
DOMESTIC ANIMALS[1]	**FOOD SAFETY RISK**	**CURRENT SCIENCE WE KNOW**	**WHAT A FARMER CAN DO**
Cattle	Very High	Research shows cattle are major reservoirs of *E. coli* pathogens on the landscape. For *E. coli* pathogens in cattle farms and feedlots in the study areas, 63, 64, 75, 100, 100, 100, and 100% of the operations were positive with *E. coli* pathogens in 13 States and in Northwest U.S. In specific cattle herds within these and other operations, 0.3, 0.35, 0.7, 0.9, 1.0, 1.01, 1.25, 1.4, 1.8, 2.5, 3.7, 4.3, 6.9, 6.9, 13.4, 16.1, 19.7, 20.0, 21.0, 26.7, 27.3, 33.8, 53.0% were found to have *E. coli* pathogens in California, Kansas, Nebraska, North Dakota, Southern U.S., Texas, Washington, Wisconsin, Czech Republic, England, Norway, and Switzerland. For *Salmonella* pathogens, cattle were found with 1.25 and 7% in Texas and Colorado (see supporting data). Amounts of *E. coli* pathogens present in herds depend on the age of the cattle, season, and how management of feed and grazing lands can affect re-infection rates (Hancock et al. 1998a, Hancock and Besser 2006, Hussein 2007, Khaitsa et al. 2006, Knox et al. 2007, Kuhnert et al. 2005). Grasses and wetlands can filter up to 99% of *E. coli* in water (Knox et al. 2007, Tate et al. 2006). Pathogens in made compost containing cattle manure can exist for up to 150 days or longer under some conditions. The outside edges of improperly made compost are known to contain pathogens (Erickson et al. 2010).	Prevent pasture and rangeland runoff from direct contamination of cropland and water sources used for crop management. Keep grasses and other vegetated buffers between crops and grazing lands. Rest grazing areas at least a week prior to irrigation. Filter runoff through conserved and restored wetlands. Putting cattle on healthy grasslands, instead of in confined feeding areas, may reduce the incidence of *E coli* pathogens. Use certified compost or ensure compost made on the farm is turned evenly and the temperature is measured in multiple locations so that all parts reach proper temperature.

[1] Other domestic livestock, such as sheep, goats, and pigs, have been found at times to carry human pathogens, but further research is needed to determine the extent of the problem.

NON-DOMESTIC ANIMALS	**FOOD SAFETY RISK**	**CURRENT SCIENCE WE KNOW**	**WHAT A FARMER CAN DO**
Cattle (con't)	Very High	*E. coli* O157 can survive in dried conditions for long periods and be transferred in aerosols. Manure-laden *E. coli* O157 dust has made people sick at county fairs (Brabban 2004, Cooley et al. 2007). Pathogens like *E. coli* O157 are allowed to mutate and proliferate in confined animal feeding operations where unhealthy conditions and sub-therapeutic doses of antibiotics are given to make the animals gain weight quickly (Pew Charitable Trusts 2008).	Cattle loafing areas can be sites where manure is ground into dust and blown onto crops. Use hedgerows and windbreaks to reduce dust blowing in on the wind.
Feral (non native) Pigs	Moderately Low	In California, two studies documented 5% and 14.9% of feral pig samples containing *E. coli* O157 (see supporting data). These pigs were found in association with cattle. Feral pigs did not evolve in the U.S. and so are not compelled to hide from natural predators, although they may learn to hide from hunters. Since they are highly mobile on large home ranges, removing habitat is not an effective control strategy (Jay and Wiscomb, 2008). Feral pigs compete with native wildlife for resources and can help to destroy fragile ecosystems in wild areas.	Monitor cropped field for feral pig intrusion and define a no-harvest zone if fecal matter is present. Hunt feral pigs, or if continuously present in large numbers, install a short, hog wire fence. Do not remove habitat; it will not dissuade the animals.
WILDLIFE			
Deer	Low	For *E. coli* pathogens, deer were found with 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.25, 0.3, 0.4, 0.64, 0.7, 0.79, 1.5, 1.8, and 2.4% in California, Kansas, Louisiana, Nebraska, Oregon, Texas, Washington, Wisconsin, Wyoming, Southern US, Norway, and Sweden. Higher results of 9% came from a small study in Oregon where deer feces, not colon swabs, were collected; and of 23.9% from Spain where a mix of European elk, deer, and mountain sheep results were reported together. For *Salmonella* pathogens, deer tested positive 0, 0, 1, and 7.69% in Nebraska, Texas, Norway and Sweden (see supporting data).	Since the incidence of deer carrying *E. coli* O157 is low, removing habitat that protects water quality is counterproductive and the cost would not appear, at this time, to be justified. Providing an inexpensive feeding attractant away from cropped areas may reduce intrusion. If unusually high deer activity is detected in the field, consider discouraging animals with loud noises, motion sensors, food attractants placed in other areas, and fencing as a last resort (fence only the growing fields, not the whole farm).

WILDLIFE	**FOOD SAFETY RISK**	**CURRENT SCIENCE WE KNOW**	**WHAT A FARMER CAN DO**
Rodents	Moderate	Rodents near buildings, confined animal feeding operations, and polluted areas are sometimes found carrying human pathogens. Rodents were found with 0 and 40% *E. coli* pathogens on dairy farms and cattle feedlots, respectively. Mice and rats tested positive 16.2% for *Salmonella* pathogens on chicken layer farms (see supporting data).	See p. 14 about rodents in or near storage areas. Do not grow crops eaten raw next to areas of concentrated cow manure.
Field Rodents	Low	*E. coli* pathogens were prevalent in rodents 0, 0, 1.4, and 20% (2 out of 10 rodents on cattle farms). According to UC Cooperative Extension, it is hard to justify extensive trapping, baiting, fencing, and vegetation clearing for the specific purpose of reducing animal (rodent) vectoring of *E. coli* O157, unless future research findings indicate otherwise (Salmon et al. 2008). Field rodents can be a significant food quality risk for processed crops because of the possibility of being chopped up into the harvest (see supporting data).	Since the incidence of field rodents carrying *E. coli* O157 is low, removing habitat that filters pathogens in water is counterproductive.
Birds Near Cattle Feedlots, Cattle Ranches, Dairy Farms or Polluted Areas	Low	Some of the time some birds near cattle and other pollution sources do carry *E. coli* and *Salmonella* pathogens, but the prevalence is low. For *E. coli* pathogens, birds near cattle or pollution were found with 0, 0, 0, 0, 0.5, 0.9, 1, 1.6, 2.2, 2.9, 3.3, 3.6, 5, and 5.4% in California, Kansas, Nebraska, Ohio, Pacific Northwest, Washington, Wisconsin, Czech Republic, Denmark and England. For *Salmonella* pathogens, birds near cattle or pollution were found with 0, 0.7, 9, and12.9% in Colorado, Kansas and Scotland (see supporting data).	While some birds can be a low risk, it may be prudent when growing freshly eaten crops near cattle or polluted areas, to not plant (or at least not harvest) in areas where birds consistently perch directly over the planted beds. Since the incidence of birds carrying *E. coli* and *Salmonella* pathogens is low, removing habitat that filters pathogens in water is counterproductive.
Birds Not Near Cattle or Pollution	Very Low	No birds were found with *E. coli* pathogens in study areas not near cattle or pollution: 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, and 0% in Colorado, Massachusetts, New Jersey and Virginia and Sweden. For *Salmonella* pathogens, a few birds were found with low levels of 0.6, 4, and 4% in New Jersey, Virginia, and Wisconsin (see supporting data).	Even though birds not associated with cattle are a very low food safety risk, monitoring for high bird populations and when found creating a non-harvest zone in this area may be wise.

WILDLIFE	**FOOD SAFETY RISK**	**CURRENT SCIENCE WE KNOW**	**WHAT A FARMER CAN DO**
Amphibians and Reptiles	Low	Pathogens are known to be associated with amphibians and reptiles when exposed to abnormally high doses and when in unnatural areas, but the practical significance of this information for farmers is limited (Lowell et al. 2010). Frogs were found to shed *E. coli* O157 during specific lifecycle stages, but they had been inoculated with abnormally high levels under laboratory conditions (Gray et al. 2007). Kids and adults have been infected with *Salmonella* when handling their caged pets, which are often kept in unclean enclosures (Mermin et al. 2004) or in zoos (Bauwens et al. 2007). The cause of an outbreak with *Salmonella* tainted orange juice was never determined even though rodent and bird droppings were found inside the juice processing plant and one toad carrying the pathogen outside (Cook et al. 1998). No *Salmonella* was found in wild reptiles in Virginia (see supporting data).	Since amphibians are attracted to water, ensure that nearby riparian areas are not unnaturally depleted of water during the crop season. Conserve habitat.
Insects	Low	Studies show that flies can be vectors of *E. coli* pathogens from infected manure to crops, but data on the practical significance or relationship to outbreaks is unknown. For *E. coli* pathogens, 0, 3.33, 3.4, 5, 17, and 61% were found in Central California, Southern California, Wisconsin and Denmark. While fly regurgitation found on spinach had persisted for one week in the lab, it is unknown if it would persist in the field. It is thought flies tend to stay close to manure source unless they are drawn into a produce field by other food source, such as honeydew excreted by aphids.	Do not grow crops eaten raw next to areas of concentrated cow manure. Do not harvest crops impacted by high populations of flies close to harvest.

SUPPORTING DATA[2, 3]

DOMESTIC ANIMALS

Cattle Found with *E. coli* Pathogens

Branham et al. 2005, livestock grazing in **Texas**
    1.25% (1/80)
Chapman et al. 1997, 4,800 tests of cattle in **England**
    13.4% of beef cattle
    16.1% of dairy cattle
Cizek et al. 1999, fecal samples of cattle in feedlot in the **Czech Republic**
    20% (72/365)
Faith et al. 1996, dairy cow manure in **Wisconsin**
    1.8% (10/ 560) calves
    3.7% (19/51) follow-up testing
Fischer et al. 2001, cattle in **Southern U.S.**
    4.3% (13/305)
Hancock et al. 1998a, cattle in confined animal feeding operations (CAFO) in **13 States**
    63% (63/100) of beef cattle feedlots with one or more samples testing positive
    75% (27/36) of dairy herds with highest herd prevalence of 10 - 26.7%
Hancock et al. 1998b, cattle on farms in the **Northwest U.S.**
    100% (12/12) farms with 1.1% to 6.1% prevalence within herds
Hancock, et al. 1997, cattle herds
    64% (9/14) of herds, with overall herd prevalence of 1·0%, with higher amounts in the summer
Hussein et al. 2005 feedlot and range cattle
    0.3 to 19.7% in feedlot cattle
    0.7 to 27.3% in cattle on irrigated pasture
    0.9 to 6.9% in cattle grazing rangeland forages
Jay et al. 2007, cattle on rangeland in **California**
    33.8% (26/77)
Johnsen et al. 2001, intestinal contents from 1,541 cattle in **Norway**
    0.35% (n=1,541)
Khaitsa et al. 2006, seasonal shedding of *E. coli* O157: H7 in feedlot cattle in **North Dakota**
    1.4% (2/144) cattle in October
    6.9% (10/144) cattle in November
    21 – 53% (30/143 – 76/143) cattle twice in March
Kuhnert et al. 2005, organically and conventionally managed dairy cows in **Switzerland**
    100% (60/60) STEC on organic dairy farms
    100% (60/60) STEC on conventional dairy farms
    25% (15/60) *E. coli* O157: H7 on organic dairy farms
    17% (10/60) *E. coli* O157: H7 on conventional dairy farms
LeJeune et al. 2008, cow manure in Ohio
    2.5% (48/1869)
Renter et al. 2003, fecal samples of cattle on ranches in **Kansas** and **Nebraska**
    1.01% (92/9122)

Cattle Found with *Salmonella* Pathogens

Branham et al. 2005, livestock grazing in **Texas**
    1.25% (1/80)
Pedersen et al. 2006, dairy manure in **Colorado**
    7% (8/120)

[2] When available, data is presented as a percentage of animals with pathogens, and then in parentheses with the first number corresponding to the number of animals testing positive, and the second the total animals tested.
[3] Where possible, a distinction is made between samples taken with swabs from trapped animals and from the colons of dead animals, versus those taken from the ground where they could have been contaminated by other animals, or multiple feces could have been deposited by the same animal.

NON- DOMESTIC ANIMALS
Feral Pigs Found with *E. coli* Pathogens
Jay et al. 2007, necropsy swabs and fecal samples from the ground of feral pigs on cattle rangeland in **California**
    14.9% (13/87)
Jay-Russell et al. 2010 trapped and killed or hunter harvested feral pigs on cattle ranches and nearby produce fields in **California**
    5% (10/200)

WILDLIFE
Deer Found with *E. coli* Pathogens
Branham et al. 2005, fecal and rumen samples of white-tailed deer near livestock grazing in **Texas**
    0% (0/26) *E. coli* O157: H7
California Department of Fish and Game 2009, hunter harvested black-tailed deer in **California**
    0% (0/311)
Dunn 2004, 3 studies of hunter harvested white-tailed deer in **Louisiana**
    0.3% (n=338)
    1.8% (n=55), captive in summer
    0.4% (n=226) captive year average
Fischer et al. 2001, 3 studies of deer (both hunter harvested and feces on the ground) with cattle nearby in **So. U.S**.
    0% (0/310)
    0.64% (3/469)
    0.7% (1/140)
Garcia-Sanchez 2007, deer rectal swab in **Spain**
    1.5% (n=206)
Jay et al. 2010, hunter harvested black-tailed deer in produce fields and on cattle ranches in **California**
    0% (0/19)
Keene et al. 1997, black-tailed deer feces on the ground in **Oregon**
    9% (3/32)
    0% (0/3), 4 months later
Lillehaug et al. 2005, hunter harvested deer in **Norway**
    0% (0/135) red deer
    0% (0/206) roe deer
    0% (0/150) raindeer
Olsen et al. 2002, fecal samples of deer in **Wyoming**
    0% (0/5 includes deer and elk samples)
Renter et al. 2003, ground scat and from hunter harvested deer near range cattle in **Kansas** and **Nebraska**
    0% (0/141)
Renter 2001, hunter harvested white tailed deer in **Nebraska**
    0.25% (4/1,608)
Rice et al. 2003, white tailed deer fecal samples
    0.79% (5/630)
Samadpour et al. 2002, fecal samples of deer near cattle in **Washington**
    0% (0/2)
Sanchez et al. 2009, deer in **Spain**
    23.9% (58/243, includes deer and 2 other species)
Sargaent et al. 1999, wild white-tailed deer fecal samples taken near cattle ranches in **Kansas**
    2.4% (5/212)
Shere et al. 1998, guts of deer near dairy farm in **Wisconsin**
    0% (0/89 includes deer and 9 other non deer species)
Wahlstrom et al. 2003, hunter harvested roe deer in **Sweden**
    0% (0/791 includes roe deer and 5 other non deer species)

Deer Found with *Salmonella* Pathogens
Branham et al. 2005, fecal and rumen samples of white-tailed deer near livestock grazing in **Texas**

7.69 % (2/26)

Lillehaug et al. 2005, hunter harvested deer in **Norway**
0% (0/135) red deer
0% (0/196) roe deer
0% (0/153) reindeer
Renter 2006, hunter harvested white tailed deer in **Nebraska**
1% (5/500)
Wahlstrom et al. 2003, hunter harvested roe deer in **Sweden**
0% (0/791 includes deer and 5 other species)

Rodents Found with *E. coli* or *Salmonella* Pathogens
Cizek et al. 1999, stool samples of rats associated with **cattle feedlot** in the **Czech Republic**
40% (4/10) Norway rat *E. coli* O157
Henzler and Opitz 1992, rodents on **chicken layer farms** in **Maine**
16.2% (116/715) mice & rats *Salmonella* pathogens
Shere et al. 1998, guts of mice and rats near a **dairy** in **Wisconsin**
0% (1/89 includes multiple other species) *E. coli* O157

Field Rodents Found with *E. coli* Pathogens
Hancock et al., 1998b, live caught rodents on cattle ranches in the **Pacific Northwest**
0% (0/300)
Jay-Russell et al. 2010 trapped and release wild mice, voles and pack rats on nearby produce fields and cattle ranches in **California**
1.4% (1/72) deer mouse
Nielson et al. 2004, fresh rodent feces on cattle farms in **Denmark**
20% (2/10)
Rice et al. 2003, rodents in an undisclosed location
0% (0/300)

Birds Found Near Cattle or Polluted Areas with *E. coli* Pathogens
Cizek et al. 1999, fresh feces of birds nearby cattle feedlot in the **Czech Republic**
0% (0/50) pigeon
0% (0/20) sparrow
Gaukler et al. 2009, cloacal swabs of birds associated with a feedlot in **Kansas**
0% (0/434) European starlings
Hancock et al., 1998b, feces of wild birds on cattle ranches in the **Pacific Northwest**
0.5% (1/200)
Jay-Russell et al. 2010, colonic fecal samples or swabs from birds on cattle ranches and nearby produce fields in **California**
5.4% (5/93) American crows
3.3% (2/60) brown-headed cowbirds
LeJeune et al. 2008, guts of birds near a dairy farm in **Ohio**
2.2% (7/316) European starlings
Nielson et al. 2004, bird feces near cattle and pig farms in **Denmark**
1.6% (4/244) two tree sparrows, one barn swallow and one European starling
Renter et al. 2003, fecal samples of wild birds near cattle ranches in **Kansas** and **Nebraska**
0% (0/9)
Samadpour et al. 2002, ducks, cows and other species near a lake in **Washington**
5% (1/20) one duck
Sanderson et al. 2006, feces of birds from in a cattle feedlot
3.6 % (6/165) unknown bird species
Shere et al. 1998, guts of pigeons, turkeys, sparrows, starlings near a dairy in **Wisconsin**
1% (1/99) one pigeon
Wallace et al., 1997, fresh feces of Herring gull, black-headed gull, and common gull, crow, and jackdaw in two locations in **England**

2.9% intertidal zone
0.9% landfill

<u>Birds Found Near Cattle or Polluted Areas with *Salmonella* Pathogens</u>
Fenlon, 1981, seagull feces near sewage outfalls and lakes in **Scotland**, the former of which had the highest rates (17-21%)
12.9% (160/1,242)
Gaukler et al. 2009, cloacal swabs of birds associated with a feedlot in **Kansas**
0.7 % (3/434) European starlings
Pedersen et al. 2006, cloacal swabs of rock pigeons in two locations in **Colorado**
9% (9/106) dairy farms
0% (0/171) urban areas

<u>Birds Not Near Cattle or Polluted Areas Found with *E. coli* Pathogens</u>
Converse et al., 1999, bird feces in non-agricultural areas of **Massachusetts**, **New Jersey** and **Virginia**
0% (0/360) goose
Kullas et al. 2002, bird feces in **Colorado**
0% (0/397) goose
Palmgren et al. 1997, stool samples of birds in **Sweden**
0% (0/101) passerines
0% (0/50) seagulls
Rice et al. 2003, birds in an undisclosed location
0% (0/121) Canada geese
0% (0/67) trumpeter swan
0% (0/150) gull
0% (0/20) duck
0% (0/124) European starling
0% (0/83) wild turkey
Wahlstrom et al. 2003, hunter harvested geese and seagulls in **Sweden**
0% (0/791 includes geese and 5 other species)

<u>Birds Not Near Cattle or Polluted Areas Found with *Salmonella* Pathogens</u>
Converse et al., 1999, bird feces in non-agricultural areas of **Massachusetts**, **New Jersey** and **Virginia**
0.6% (2/360) goose
Palmgren et al. 1997, stool samples of birds in **Sweden**
4% (2/50) seagulls
Wahlstrom et al. 2003, hunter harvested birds in **Sweden**
4% seagulls

<u>Amphibians and Reptiles Found with *E. coli* and *Salmonella* Pathogens</u>
Gray et al. 2007, two ages of American bullfrog inoculated with high levels of *E. coli* O157 in **Tennessee** lab.
0% tadpoles in flow-through aquaria
54% metamorphs placed in stagnant aquaria (stale water used to speed up experiment)
Richards et al. 2004, cloacal swabs from free-living reptiles in **Virginia**.
0% *Salmonella* for 34 eastern box turtles, 14 eastern painted turtles, 14 snapping turtles, 6 black rat snakes, 2 redbelly turtles, 2 yellowbelly sliders, 2 eastern garter snakes, and 1 eastern river cooter.

<u>Insects Found with *E. coli* Pathogens</u>
Nielson et al. 2004, insects on cattle and pig farms in **Denmark**
0% (0/6) pooled insect samples
Rice et al. 2003, rodents in an undisclosed location
3.33% (2/60) pooled flies
Sanderson et al. 2006, houseflies in a cattle feedlot
3.4% (53/1,540) housefly
Shere et al. 1998, flies caught in a fly trap on a dairy in **Wisconsin**

5% (1/20)

Talley et al., 2009 filth flies fly captured in leafy green fields in **Central California**

61% (11/18)

Wayadande 2010, flies that fed on inoculated manure or bacterial lawns and then regurgitated onto spinach in **Southern California**.

17% (17/98) of pooled flies *E. coli* O157:H7

APPENDIX II: REGULATIONS PROTECTING NATURAL RESOURCES[4]

This table has been created to help producers understand federal and state regulations in order for them to educate their food safety inspectors/auditors. If a producer believes that their food safety inspector/auditor is suggesting or requiring an action that is contrary to these regulations, please contact the applicable agency immediately.

REGULATIONS PROTECTING NATURAL RESOURCES			
AGENCY	**WHAT IT PROTECTS / REGULATES**	**WHY IT IS IMPORTANT TO PROTECT**	**WEBSITES FOR MORE INFORMATION**
USDA National Organic Program	Soil, Water, Wetlands, Woodlands, and Wildlife	Conserves fertile soils, ensures water quality, helps to recharge groundwater and alleviate flooding, and protects native species and ecosystems important to agricultural production and the larger landscape.	www.wildfarmalliance.org http://attra.ncat.org/attra-pub/summaries/OSPtemplates.html
State and Federal Wildlife Agencies	Threatened and endangered plants and animals and their habitats. Migratory birds.	Helps to address the biodiversity crisis.	www.fws.gov/offices/statelinks.html
National Marine Fisheries Service	Threatened and endangered anadromous fish species (i.e. salmon, trout, sturgeon) and their habitats	Helps to address the biodiversity crisis.	www.nmfs.noaa.gov/
Environmental Protection Agency and State Water Agencies	Water quality	Helps to provide clean water resources and supplies for human and wild communities.	http://epa.gov/agriculture/water.html
US Army Corps of Engineers	Modifications to surface waters under USACE jurisdiction, such as: disposal of materials into water, adding or fixing a culvert, regrading slopes, and filling in wet depressional areas.	Helps to conserve riparian areas, recharge groundwater and alleviate flooding.	www.usace.army.mil/

[4] The regulations presented here are not meant to be an exhaustive. More detailed information can be obtained from the agencies themselves.

REFERENCES

1. Bauwens, L., F. Vercammen, S. Bertrand, J. M. Collard, and S. De Ceuster. 2006. Isolation of *Salmonella* from environmental samples collected in the reptile department of Antwerp Zoo using different selective methods. *Journal of Applied Microbiology* 101: 284–289.

2. Brabban, A. D., D. A. Nelsen, E. Kutter, T. S. Edrington, and T. R. Callaway. 2004. Approaches to Controlling *Escherichia coli* 01 57:H7, a Foodborne Pathogen and an Emerging Environmental Hazard. *Environmental Practice* 6 (3).

3. Branham, L. A., M. A. Carr, C. B. Scott and T. R. Callaway. 2005. *E. coli* O157:H7 and *Salmonella* spp. in white-tailed deer and livestock. *Current Issues in Intestinal Microbiology* 6:25-29.

4. California Department of Fish and Game. 2009. Preliminary research results find less than one half of one percent occurrences of *E.coli* 0157:H7 in wildlife in California Central Coast Counties. Fish and Game News Release. Office of Communications, (916) 322-8962.

5. Cizek, A., P. Alexa, I. Literak, J. Hamrik, P. Novak and J. Smola. 1999. Shiga toxin-producing *Escherichia coli* O157 in feedlot cattle and Norwegian rats from a large-scale farm. *Letters in Applied Microbiology* 28(6):435-439.

6. Chapman, P.A., C.A. Siddons, A.T. Cerdon Malo, and M.A. Harkin. 1997. A 1-year study of *Escherichia coli* O157 in cattle, sheep, pigs and poultry. *Epidemiology and Infection* 119(2): 245-250.

7. Converse, K., M. Wolcott, D. Docherty, and R. Cole. 1999. *Screening for potential human pathogens in fecal material deposited by resident Canada geese on areas of public utility.* USGS National Wildlife Heath Center. FWS ALC 14-16-0006.

8. Cook, K., T. E. Dobbs, W. G. Hlady, J. G. Wells, T. J. Barrett, N. D. Puhr, G. A. Lancette, D. W. Bodager, B. L. Toth, C. A. Genese, A. K. Highsmith, K. E. Pilot, L. Finelli, and D. L. Swerdlow. 1998. Outbreak of *Salmonella* Serotype Hartford Infections Associated With Unpasteurized Orange Juice. *JAMA* 280 (17).

9. Cooley, M., D. Carychao, L. Crawford-Miksza, M. T. Jay, C. Myers, C. Rose, C. Keys, J. Farrar, and R. E. Mandrell. 2007. Incidence and Tracking of *Escherichia coli* O157:H7 in a Major Produce Production Region in California. *PLoS ONE* 2 (11).

10. Dunn, J. R., J. E. Keen, D. Moreland, and R. A. Thompson. 2004. Prevalence of *Escherichia co*li O157:H7 in white-tailed deer from Louisiana. *Journal of Wildlife Diseases* 40(2): 361-365.

11. Erickson, M., F. Critzer, and M. Doyle. 2010. Composting criteria for animal manure. Department Food Science & Technology, *University of Georgia and Georgetown University*. http://www.producesafetyproject.org/

12. Faith, N., J. Shere, R. Brosch, K. Arnold, S. Ansay, M. Lee, J. Luchansky, and C. Kaspar. 1996. Prevalence and clonal nature of *Escherichia coli* O157:H7 on dairy farms in Wisconsin. *Applied and Environmental Microbiology* 62(5):1519- 1525.

13. Fenlon, D.R. 1981. Seagulls (*Larus* spp.) as vectors of *Salmonellae* --- an investigation into the range of serotypes and numbers of *Salmonellae* in gull feces. *Journal of Hygiene* 86(2): 195-202.

14. Fischer, J.R., T. Zhao, M. P. Doyle, M. R. Goldberg, C. A. Brown, C. T. Sewell, D. M. Kavenough, C. D. Bauman. 2001. Experimental and field studies of *Escherichia coli* O157:H7 in white-tailed deer. *Applied and Environmental Microbiology* 67(3): 1218-1224.

15. Garcia-Sanchez, A., S. Sanchez, R. Rubio, J. M. Alonso, J. Hermoso De Mendoza, and J. Rey. 2007. Presence of Shiga toxin- producing *E. coli* O157:H7 in a survey of wild artiodactyls. *Veterinary Microbiology* 121(3-4): 373-377.

16. Gray, M.J., S. Rajeev, D. L. Miller, A. C. Schmutzer, E. C. Burton, E. D. Rogers, and G. J. Hickling. 2007. Preliminary evidence that American bullfrog (*Rana catesbeiana*) are suitable hosts for *Escherichia coli* O157:H7. *Applied and Environmental Microbiology* 73(12): 4066-4068.

17. Gaukler, S. M, H. J. Homan, N. W. Dyer, G. M. Linz, and W. J. Beier. 2008. Pathogenic diseases and movements of wintering European starlings using feedlots in central Kansas. *Proceedings of Vertebrate Pest Conference* 23:280-282.

18. Hancock, D. D., T. E. Besser, D. H. Rice, D. E. Herriott and P. I. Tarr. 1997. A longitudinal study of *Escherichia coli* O157 in fourteen cattle herds. *Epidemiology and Infection* 118 (2):193-195.

19. Hancock, D. D., T. E. Besser, and D. H. Rice. 1998a. Ecology of *E. coli* O157 in cattle. *In Escherichia coli* O157:H7 and other Shiga toxin-producing *E. coli* strains, A. D. O'Brien and J. B. Kaper (eds.). American Society for Microbiology, Washington, D.C., pp. 85–91.

20. Hancock, D. D., T. E. Besser, D. H. Rice, E. D. Ebel, D. E. Herriott and L. V. Carpenter. 1998b. Multiple sources of *Escherichia coli* O157 in feedlots and dairy farms in the Northwestern USA. *Preventive Veterinary Medicine* 35 (1): 11-19.

21. Hancock, D. D. and T. E. Besser. 2006. *E. coli* O157:H7 in hay- or grain-fed cattle. *College of Veterinary Medicine*. Washington State University.

22. Henzler, D. J. and H.M. Opitz, 1992. The role of mice in the epizootiology of *Salmonella* enteritidis infection on chicken layer farms. *Avian Diseases* 36:625-631.

23. Hussein, H. S., and L. M. Bollinger. 2005. Prevalence of Shiga toxin-producing *Escherichia coli* in beef cattle. *J. Food Prot*. 68:2224–2241.

24. Hussein, H. S. 2007. Prevalence and pathogenicity of Shiga toxin-producing *Escherichia coli* in beef cattle and their products. Journal of Animal Science 85 (13 Suppl): E63-72.

25. Jay, M.T., M. Cooley, D. Carychao, G.W. Wiscomb, R. A. Sweitzer, L. Crawford-Miksza, J.A. Farrar, D. K. Lau, J.O'Connell, A. Millington, R. V. Asmundson, E. R. Atwill, R.E. Mandrell. 2007. *Escherichia coli* O157:H7 in feral swine near spinach fields and cattle, central California coast. *Emerging Infectious Diseases* 13(12):1908-1911.

26. Jay, M.T. and G. W. Wiscomb. 2008. Food safety risks and mitigation strategies for feral swine (*Sus scrofa*) near agricultural fields. *Proceedings of 23rd Vertebrate Pest Conference*, University of California, Davis. 21-25.

27. Jay- Russell, M. T., E. R. Atwill, M. Cooley, D. Carychao, E. Vivas, S. Chandler, D. Orthmeyer, X. Lii, and R. E. Mandrell. 2010. Occurrence of *Escherichia coli* O157: H7 in wildlife in a major produce production region in California. *Poster given at 110th General Meeting of the American Society for Microbiology,* May 23-27, 2010, San Diego, California, USA.

28. Johnsen, G., Y. Wasteson, F. Heir, O. I. Berget, H. Herikstad. 2001. *Escherichia coli* O157:H7 in faeces of cattle, sheep and pigs in the southwest part of Norway during 1998 and 1999. *International Journal of Food Microbiology* 65:193-200.

29. Keene, W.E., E. Sazie, J. Kok, D. H. Rice, D. D. Hancock, V. K. Balan, T. Zhao, and M. P. Doyle. 1997. An outbreak of *Escherichia coli* O157:H7 infections traced to jerky made from deer meat. *Journal of American Medical Association* 277(15): 1229- 1231

30. Khaitsa, M. L., M. Bauer, G. Lardy, D. K. Doetkott, R. B. Kegode, Redempta and P. S. Gibbs. 2006. Fecal Shedding of *Escherichia coli* O157:H7 in North Dakota Feedlot Cattle in the Fall and Spring. *Journal of Food Protection* 69 (5): 1154-1158.

31. Knox, A. K., K. W. Tate, R. A. Dahlgren, and E. R. Atwill. 2007. Management reduces *E. coli* in irrigated pasture runoff. *California Agriculture* 61 (4).

32. Kullas, H. M. Coles, J. Rhyan, and L. Clark. 2002. Prevalence of *Escherichia coli* serogroups and human virulence factors in faeces of urban Canada geese (*Branta canadensis*). *International Journal of Environmental Health Research* 12(2): 153-162.

33. Kuhnert, P., and C. R. Dubosson, R. M. Roesch, E. Homfeld, M. G. Doherr, and J. W. Blum. 2005. Prevalence and risk-factor analysis of Shiga toxigenic *Escherichia coli* in faecal samples of organically and conventionally farmed dairy cattle.

34. LeJeune, J., J. Homan, G. Linz and D. L. Pearl 2008. Role of the European starling in the transmission of *E. coli* O157:H7 on dairy farms. *Proceedings of the 23rd Vertebrate Pest Conference*, 31-34.

35. Lillehaug, A., B. Bergsjø, J. Schau, T. Bruheim, T. Vikøren and K. Handeland. 2005. *Campylobacter* spp., *Salmonella* spp., Verocytotoxic *Escherichia coli*, and antibiotic resistance in indicator organisms in wild Cervids. *Acta Veterinaria Scandinavica* 46(1-2): 23-32.

36. Lowell, K., J. Langholz, and D. Stuart. 2010. Safe and Sustainable: Co-Managing for Food Safety and Ecological Health in California's Central Coast Region. San Francisco, CA and Washington, D.C: The Nature Conservancy of California and the Georgetown University Produce Safety Project. http://www.producesafetyproject.org/admin/assets/files/wildlife.pdf

37. Mermin, J., L. Hutwagner, D. Vugia, S. Shallow, P. Daily, J. Bender, J. Koehler, R. Marcus, and F. J. Angulo. Reptiles, Amphibians, and Human *Salmonella* Infection: A Population-Based, Case-Control Study. CID 2004:38 (Suppl 3).

38. Nielsen, E. M., M. N. Skov, J. J. Madsen, J. Lodal, J. B. Jespersen, and D. L. Baggesen. 2004. Verocytotoxin-Producing *Escherichia coli* in Wild Birds and Rodents in Close Proximity to Farms. *Applied and Environmental Microbiology* 70: 6944–6947.

39. Palmgren, H., M. Sellin, S. Bergstrom, and B. Olsen. 1997. Enteropatheogenic bacteria in migrating birds arriving in Sweden. *Scandinavian Journal of Infectious Diseases* 29 (6).

40. Pedersen, K., L. Clark, W. F. Andelt, and M. D. Salman, 2006. Prevalence of Shiga toxin producing *Escherichia Coli* and *Salmonella* Enterica in rock pigeons captured in Fort Collins, Colorado. *Journal of Wildlife Diseases* 42(1): 46–55.

41. Pew Charitable Trusts. 2008. Putting Meat on the Table: Industrial Farm Animal Production in America. A Report of the Pew Commission on Industrial Farm Animal Production and the Johns Hopkins Bloomberg School of Public Health. http://www.livablefutureblog.com/pdf/Putting_Meat_on_Table_FULL.pdf.

42. Olsen, S. J., G. Miller, T. Breuer, M. Kennedy, C. Higgins, J. Walford, G. McKee, K. Fox, W. Bibb, and P. Mead. 2002. A waterborne outbreak of *Escherichia coli* O157: H7 infections and hemolytic uremic syndrome: Implications for rural water systems. *Emerging Infectious Diseases* 8(4): 370-375.

43. Renter, D. G., J. M. Sargeant, S. E. Hygnstorm, J. D. Hoffman, and J. R. Gillespie. 2001. *Escherichia coli* O157:H7 in free-ranging deer in Nebraska. *Journal of Wildlife Diseases* 37(4): 755-760.

44. Renter, D. G., J. M. Sargeant, R. D. Oberst and M. Samadpour. 2003. Diversity, frequency, and persistence of *Escherichia coli* O157 strains from range cattle environments. *Applied and Environmental Microbiology* 69(1): 542-547.

45. Renter, D. G., D. P. Gnad, J. M. Sargeant and S. E. Hygnstorm. 2006. Prevalence and serovars of *Salmonella* in the feces of free-ranging white-tailed deer (*Odocoileus virginianus*) in Nebraska. *Journal of Wildlife Diseases* 42(3): 699-703.

46. Rice, D. H., Hancock, D. D. and I. E. Besser. 2003. Faecal culture of wild animals for *Escherichia coli* O157:H7. *Veterinary Record* 152(3): 82-83.

47. Richards J. M., B. A., J. D. Brown, T. R. Kelly, A. L. Fountain, and J. M. Sleeman. 2004. Absence of detectable *Salmonella* cloacal shedding in free-living reptiles on admission to the wildlife center of Virginia. *Journal of Zoo and Wildlife Medicine* 35(4): 562–563.

48. Salmon, T., R. Smith and S. Koike. 2008. *Food safety and Salinas Valley crops: 3. Rodent control in leafy green vegetable production.* Cooperative Extension Monterey County, California.

49. Samadpour, M., J. Stewart, K. Steingard, C. Addy, J. Louderback, M. McGin, J. Ellington, and T. Newman. 2002. Laboratory investigation of an *E. coli* O157:H7 outbreak associated with swimming in Battle Ground Lake, Vancouver, Washington. *Journal of Environmental Health* 64 (10): 16-20.

50. Sanchez, S., A. Garcia-Sanchez, R. Martinez, J. Blanco, J.E. Blanco, M. Blanco, G. Dahbi, A. Mora, J. Hermoso de Mendoza, J.M. Alonso, J. Rey. 2009. Detection and characterization of Shiga-producing *Escherichia coli* other than *Escherichia coli* O157:H7 in wild ruminants. *Veterinary Journal* 180: 384-388.

51. Sanderson, M. W., J. M. Sargeant, X. R. Shi, T. G. Nagaraja, L. Zurek, and M. J. Alam. 2006. Longitudinal emergence and distribution of *Escherichia coli* O157 genotypes in a beef feedlot. *Applied and Environmental Microbiology* 72 (12): 7614- 7619.

52. Sargeant, J.M., D.J. Hafer, J.R. Gillespie, R.D. Oberst, S.J. Flood. 1999. Prevalence of *Escherichia coli* O157:H7 in white- tailed deer sharing rangeland with cattle. Jo*urnal of the American Veterinary Medical Association* 215 (6): 792-794.

53. Shere J.A., K. J. Bartlett, and C. W. Kaspar. 1998. Longitudinal study of *Escherichia coli* O157:H7 dissemination on four dairy farms in Wisconsin. *Applied and Environmental Microbiology* 64:1390-1399.

54. Tate, K., E. Atwill, J. W. Bartolome, and G. Naderd. 2006. Significant *Escherichia coli* attenuation by vegetative buffers on annual grasslands. *Journal of Environmental Quality* 35.

55. Talley, J. L., A. C. Wayadande, L. P. Wasala, A. C. Gerry, J. Fletcher, U. DeSilva, and S. E. Gilliland. 2009. Association of *Escherichia coli* O157:H7 with Filth Flies (*Muscidae* and *Calliphoridae*) Captured in Leafy Greens Fields and Experimental Transmission of *E. coli* O157:H7 to Spinach Leaves by House Flies (*Diptera: Muscidae*). *Journal of Food Protection* 72 (7): 1547-1552.

56. Wayadande, A. 2010. Fly reservoirs of *E. coli* O157:H7 and their role in contamination of leafy greens. Presentation at Center for Food Safety Symposium.

57. Wahlstrom, H., E. Tysen, E. Olsson Engvall, B. Brandstrom, E. Eriksson, T. Morner, and I. Vagsholm. 2003. Survey of *Campylobacter* species, VTEC O157 and *Salmonella* species in Swedish wildlife. *Veterinary Record* 153 (3): 74-80.

58. Wallace, J.S., T. Cheasty, and K. Jones. 1997. Isolation of Vero cytotoxin producing *Escherichia coli* O157 from wild birds. *Journal of Applied Microbiology* 82: 399- 404.

MONITORING LOGS

SMALL FARM

Water Sampling Monitoring Log

DATE	SAMPLED BY	SAMPLE LOCATION	REQUESTED ANALYSIS

SMALL FARM

Employee Non-Compliance Form

Date:
Employee Name:
Supervisor:

Employee was found in violation of the following regulation:

___

E.g. Clean clothing not worn
Clean rubber gloves not worn where appropriate
Wearing hand jewelry or watches in post harvest handing area area.
Not using hand/gloves dip stations
Eating, drinking, smoking, or chewing tobacco in the re-packing area
Not using facial mask while suffering a respiratory illness
Unsafe use of equipment
Product Abuse (describe)

The Supervisor notifies the employee of the violation and explains the reasoning behind the regulation.
1st Warning (Verbal):_______________ 3rd Warning (Disciplinary):

2nd Warning (Written):______________

Supervisor has given the appropriate warning:
Signature Date

Employee understands the significance of the violation:

____
Signature Date

SMALL FARM
NUOCA LOG (Notice of Unusual Occurrence and Corrective Action)

Date:___________________________ Time of Occurrence:

Description of Problem or Occurrence:

____

____

____

____

Corrective Action:

____

____

____

____

Reported By:____

Supervisor on Duty:____

SMALL FARM
Employee Education and Training Log

Date of Training The following employees were present	Topic Materials:
1	21
2	22
3	23
4	24
6	25
6	26
7	27
8	28
9	29
10	30
11	31
12	32
13	33
14	34
15	35
16	36
17	37

Date of Training The following employees were present	Topic Materials:
18	38
19	39
20	40