Good Agricultural Practices (GAPs):
Irrigation Water Mitigation

What should you do if you have received your water test, and the results show that levels of *E. coli* exceed the maximum amount allowed?

1. Before investing in a system to clean and sanitize your irrigation water, first do a **visual survey of your water sources** to investigate what is causing the elevated microbial counts. While performing a survey of your water sources, ask yourself:
    - Is there any obvious animal contamination or runoff into your water source?
        - Evidence of animal intrusion into the water source (livestock, domestic, or wild animals)? Is it possible to fence these animals out or prevent birds from landing?
        - Are animal pastures, buildings, or manure storage located uphill from water sources? Is it possible to build a berm to divert runoff away from the water source?
    - Has it been unusually rainy? High amounts of precipitation can stir up sediment and run off into water sources, increasing bacterial counts.
    - Are backflow prevention devices installed and properly functioning?
    - **Well:**
        - Inspect the well casing: is it cracked or corroded? Are there any areas that allow leaking and contamination into the well? If so, can the cracked areas be patched?
        - Is the well cap broken or missing?
        - Do any seals appear to be broken or missing?
    - **Surface water:** Is the irrigation intake valve floating above the sediment? If the intake is pulling up sediment, that may lead to higher bacterial counts.

2. If possible, **consider switching to an alternative water source** (for irrigation and/or pesticide application) while bacterial counts remain high. If there is not an alternative water source, is it possible to switch to a **less-risky irrigation method**? For example, using trickle irrigation instead of overhead irrigation.

3. After making any changes, give the water source a few weeks to settle out then take another water test.

4. If you survey the water sources and cannot identify a potential source of contamination, and a resulting test does not show a decrease in levels of *E. coli* bacteria, then **mitigation measures might be necessary**.

Disinfection Options for Agricultural Water Sources

1. **Shocking the well with chlorine.** Often used for new wells, shock chlorination is a one-time treatment designed to kill bacteria in the well. It is cheap and often effective. This is the only

disinfection option that treats the water source. When shocking the well, a 200 ppm chlorine solution (often using household bleach, or sodium hypochlorite) is allowed to sit in the well and plumbing system for several hours to overnight. Afterwards, the water is pumped until there is no chlorine smell (and chlorine test strips register at low levels). Colorado State University has published a very detailed guide to shocking wells "Bacteria in Water Wells", which can be found here: http://www.ext.colostate.edu/pubs/natres/06703.html .

2. **Installing an Ultraviolet (UV) filter.** Often used in dairies, a UV filter can effectively and quickly kill microorganisms in water. UV filters can by fairly expensive upfront and do require electricity, however the operating costs and upkeep are minimal. UV filters may be better served with wells or low-flow systems (such as trickle irrigation, as opposed to overhead irrigation) due to the relatively slow water output.
3. **Antimicrobial chemicals.**
    a. **Chemical injector system.** For relatively low-flow irrigation systems (such as trickle irrigation and postharvest water), a chemical injector or chemilizer can be used to inject small amounts of sanitizer into the irrigation system. Chlorine bleach or peroxyacetic acid (PAA) can be used very effectively. As small concentrations of sanitizer are mixed into the irrigation water, microorganisms are killed off and the sanitizer is degraded. This system will also prevent iron-forming bacteria from clogging up drip emitters. Setting up this system will require you to test the levels of chlorine at the beginning of the system and at the emitters. Chlorine concentrations of 4ppm or less in the released water are desired.
    More information on treating drip irrigation systems with sanitizers can be found here http://www.netafimusa.com/files/literature/greenhouse/Maint_Treatment-with-Chlorine.pdf and here: https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_068454.pdf .
    b. **Accu-tab chlorination system.** This system uses calcium hypochlorite tablets to sanitize water. It is suitable for high-output water needs, such as overhead irrigation. As water is pulled in through the intake, a small amount is diverted through venture pressure and run through the chlorine tablets. The chlorinated water then mixes with the rest of the water as it runs through the system, diluting the sanitizer to low levels. More information can be found here: http://accu-tab.com/Applications/Food-Safety-Irrigation/Irrigation .

Additional sources:

1. "What do you do if your water results come back too high?". University of Maryland. https://www.youtube.com/watch?v=e-ezhCpT6JQ&feature=youtu.be .
2. "Bacteria in water wells." Colorado State University. http://www.ext.colostate.edu/pubs/natres/06703.html .
3. "Recommendations for the treatment of drip irrigation systems with chlorine." Netafim USA. http://www.ext.colostate.edu/pubs/natres/06703.html .
4. "Manual for chlorine treatment of drip irrigation systems". Natural Resource Conservation Service, United States Department of Agriculture. https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_068454.pdf .
5. Accutab Irrigation System: http://accu-tab.com/Applications/Food-Safety-Irrigation/Irrigation