**Tools for Farmers: Agricultural Water**

The safety of agricultural water is a big concern of the produce industry. Water is used for irrigation, application of pesticides or fertilizers, produce washing and the washing and sanitization of harvest and post-harvest equipment, tools, surfaces and vehicles. Water can also facilitate the spread of bacteria and other pathogens that cause food borne illness.

The Produce Safety Rule agricultural water rules are found in Subpart E (page 74554 of the Federal Register or page 202 of the Rule). A summary of this section of the Rule can be found **here. (link to Food Safety Standards Addressed in the Rule)**

While the agricultural water rules are part of the original Produce Safety Rule, subsequent concerns about the scope and complexity of agricultural water rules and safety resulted in delay of the compliance dates for the agricultural water requirement.

**New agricultural water compliance dates**

* Larger farms: January 26, 2022
* Smaller farms: January 26, 2023
* Very small farms: January 26, 2024

This rule does not change the compliance dates for sprout operations.

**Definition of Agricultural water**

**Agricultural water** is water used in **covered activities** **on covered produce where water is intended to, or is likely to, contact covered produce or food contact surfaces**, including water used in growing activities (including irrigation water applied using **direct water application** methods, water used for preparing crop sprays, and water used for growing sprouts) and in harvesting, packing, and holding activities (including water used for washing or cooling harvested produce and water used for preventing dehydration of covered produce).

**The Rule requires that all agricultural water be safe and of adequate sanitary quality for its intended use.** There are different standards of safety for different uses. For example any water used during harvest or packing must meet the standard of no detectable generic *E. coli* in 100 ml of agricultural water and cannot come from a surface water source, while water used in an overhead irrigation system must meet both of these standards:

(1) A geometric mean (GM) of your agricultural water samples of 126 or less colony forming units (CFU) of generic E. coli per 100 mL of water; and

(2) A statistical threshold value (STV) of your agricultural water samples of 410 or less CFU of generic E. coli per 100 mL of water.

**Identifying the Risks**

The first tool (and a requirement of the Rule) for the farmer is a thorough **agricultural water system inspection**. This inspection must be done at least yearly and more often if there are any questions that the integrity of the system has been compromised in any way during the season.

* Start with listing all of your water sources: surface water (rivers, streams, ponds, cisterns); well water; and municipal water sources. If you truck in water, be sure to include that as well.
* It is helpful to draw a map of your farm or you can download a GPS map of your farm from your computer. Then note on the map where all of the water sources are –especially in relation to fields and to sewage systems, animal operations, port-a-potties, or other potential sources of contamination.
* Inspect piping and pumping systems from all water sources, including surface, well or municipal systems. Check the integrity of well heads and covers.
* Inspect (or have a plumber inspect) back flow prevention devices that ensure the protection of water sources such as wells or municipal systems, especially when these sources are used in toilet systems, pesticide or chemical fertigation application systems, packing house wash or sanitation systems, etc.
* Conduct any water testing as required by the Rule, a third party auditor and/or a customer. Even if you are exempted from the Rule, a water system inspection and regular testing makes good business sense.

If any deficiencies are found, implement needed corrective actions so that the safety of your agricultural water is not compromised and risks are minimized or eliminated.

**Managing production agricultural water**

Production water would include any water used directly on edible portions of the produce you are growing. Water used for direct irrigation methods (overhead, drip for covered products that grow underground [carrots, onions, garlic and others that can be eaten raw]; and water used for fertigation or pesticide application directly on edible product. This water can be sourced from rivers, streams or other surface water; wells; or municipal systems. Each source varies in risk and required testing frequencies.

**Testing: Though testing protocols may change if the FDA determines the need to do so prior to compliance dates, it is recommended that farms adhere to testing guidance in the original Rule as much as is practical for the time being.**

**Surface water**: Gather an initial series of 20 tests over 4 years for **EACH** surface water source. Then, subsequently take 5 tests per year. Generally tests are taken at the beginning of the season, then close to periods of greatest use.

Since you start with 20 tests for each water source, each year you consider the newest 5 tests and drop the oldest five tests when calculating the Geometric Mean (GM) and the Statistical Threshold Value (STV) to see of your water meets Rule standards.

**Well water**: For each water well source, you begin by gathering 5 tests over several years. Then, subsequently take one test per year. Generally tests are taken just prior to use for the season. Each year you consider 5 tests. You drop the oldest and add the newest test each year.

**Municipal water**: For municipal water sources, you will need to annually update your records to include testing information from the water provider. This information is often found on the company website and/or in your bill.

**How to collect water for testing**

It is recommended that you contact your water testing laboratory for instructions for accurate collection of water samples for testing.

Go [**here**](https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/environmental_laboratories/pdf/In-State-Approved-Commercial-Environmental-Laboratories.pdf) to find a laboratory that can conduct testing. Be sure the laboratory offers tests on the FDA list of accepted methodologies.

Go [**here**](https://www.fda.gov/media/107656/download) for a list of water test methodologies that are accepted by FDA. Share with your lab if they are unfamiliar.

Go [**here**](https://www.youtube.com/watch?v=_SvjCidO6KE) to find a video that explains how to take a water test.

**Use test results to calculate your Microbial Water Quality Profile (MWQP)**

Next, take your test results (up to 20 of newest results for surface water and 5 for well water) and determine the Geometric Mean and Statistical Threshold Values for each. The GM indicates the average water quality over time or “typical” value, while the STV takes into account outliers or “high range” that may be far from average due to a weather event, for example.

A tool for calculating the GM and STV can be found [**here**](https://www.wcfs.ucdavis.edu/resources/)**.**

If your results indicate that the water quality does not meet the Rule standards, then you must institute **Corrective Actions.**

There are basically three corrective action options when water does not meet the Rule standards.

* First, re-inspect the water system to see if you can figure out what the problem is and make any changes needed to address them. If it not fixable in the short term, you can
  + Apply a **time interval for microbial die off** between last application and harvest and/or between harvest and the end of storage and/or removal during activities such as commercial washing
  + You can also choose to **treat the water**. If water treatment is used (chemical or non-chemical) you must keep records of the type, amount and timing of the water treatment as well as monitoring records to ensure that the treatment continues to be effective.

**Determining microbial die-off as a corrective action**

Keep in mind that the more days there are between the last application of water (irrigation, pesticide application, etc.), and harvest, the more likely that risk will be reduced. Die off is facilitated by UV (sunlight) and drying. Sometimes there may not be enough time for sufficient to die off to occur if the water application is too close to harvest.

One option for a corrective measure is to use a time interval between last application of water using a direct water application method and harvest. The Rule allows a 0.5 log calculated reduction in generic *E. coli* for each day (up to four consecutive days) between last application of water and harvest to reach levels that meet the GM and STV water quality criteria required by the Rule.

If it would take longer than 4 days to achieve the level required by the Rule, then this option for a die off period would not work as an effective corrective action.

An example outlined in the PSA Grower Training curricula states:

“If the microbial water quality profile shows a GM of 1000 CFU generic *E. coli* per 100 mL of water:

* A time interval of one day with a 0.5 log per day reduction would result in a GM of 316 CFU/100 mL.
* A time interval of two days would result in a GM value of the water source of 100 CFU/100 mL and the water would meet the GM criterion of 126 CFU/100 mL. “

You can use the same calculator as that used to calculate the GM and STV found [**here**](https://www.wcfs.ucdavis.edu/resources/) to determine if there is an effective die off interval with the test results.

What if you are using irrigation or water application methods that do not directly touch the edible portion of the plant, so it is not defined as “agricultural water?” This may include the use of drip irrigation systems. Keep in mind that often times either the tubing or emitters in such a system can break or leak. For this reason it is a good idea to test your water just to have an understanding of the quality of water you are using. If this water inadvertently contacts edible parts of your crop, knowing the quality of your water will help you to choose the most effective corrective actions.

If your farmland is prone to flooding by rivers or streams or other surface water sources, go [**here**](While%20the%20agricultural%20water%20rules%20are%20part%20of%20the%20original%20Produce%20Safety%20Rule,%20subsequent%20concerns%20about%20the%20scope%20and%20complexity%20of%20agricultural%20water%20rules%20and%20safety%20resulted%20in%20delay%20of%20the%20compliance%20dates%20for%20the%20agricultural%20water%20requirement.) for information on what to do if flooding results in contamination of edible product.

**Managing post-harvest agricultural water**

Water used in post-harvest applications **MUST NOT** be from surface water sources, no matter what test results indicate. Post-harvest water must be sourced from municipal water sources or from a tested well that meets the standard of no detectable generic *E. Coli*. This is not the same as potability – the standard for drinking water or water used for sanitation in a home, institution or restaurant. If your well water has been tested for potability, however, it will meet the standards for agricultural water under the Rule. You may use presence/absence tests for this post-harvest water: you do not need to quantify as the generic *E. Coli* must be absent or 0.

Management of post-harvest water includes inspection of the system (see above), testing, and managing produce wash water to minimize contamination of produce.

**Testing:**

Again, water used in post-harvest applications must have no detectable generic *E. Coli.* Testing should be conducted at least once yearly prior to normal use in a post-harvest operation. Keep all water test records on file.

**Water treatment: washing produce**

If you choose to wash produce (not required by the Rule), it is important to understand that while washing is employed to clean produce of dirt and debris, it can also contribute to contamination of produce if the water is not kept clean. If one apple or one head of lettuce is contaminated and the water is not kept clean, uncontaminated product in the wash bin can easily become contaminated. Water is a great carrier of bacteria from a dirty/contaminated product to a clean one.The risks associated with post-harvest water depend in part on the type of wash water system you are using.

**Single pass water** is water that might be used in a bunch or root washer, or a flume. The water is constantly replaced with fresh water (water is not recycled and reused for subsequent batches). It may still make sense to use a sanitizer in single pass water systems in order to keep equipment cleaner and prevent the buildup of biofilms which can harbor bacteria. Temperature may also be a concern for some types of fruits and vegetables.

**Recirculating or batch water** is water that is reused. Either it is recycled in your water system and reused or it is in a dump tank or other type of tank and several batches of product are washed before the water is changed. Again, sanitizer is a good idea because, especially if produce is dirty, sanitizer can help minimize cross contamination. Sanitizers will also help to keep equipment clean. You will also need to consider temperature and turbidity (see below) in these systems.

**Keeping water clean**

There are two ways to minimize cross contamination by wash water**.**

First, pay attention to **turbidity**, or the cloudiness of water caused by dirt and debris. Using **sanitizers in the wash water** is also an effective way to keep water clean and reduce cross contamination. The sanitizer in the wash water is there to keep the water clean—not to clean or sanitize the product itself.

**Turbidity**

Turbidity is the measure of cloudiness of your water. When dirt, soil, and plant debris (leaves, etc.) build up in the water, it becomes dirtier and cloudier. This makes the water less able to clean and more able to facilitate contamination of your product. Visual cues can tell you if the water is too dirty or is too turbid to continue using it. You can also use a tool, such as a turbidity meter or a Secchi disk, which sits on the bottom of the water tank. When the disk is no longer visible through the water, then it is time to change the water.

Water change schedules should be determined for different products and the variety of conditions (rainy weather leading to more mud and dirt on product). Use your experience or keep records of future wash water change schedules. Then, develop an SOP so that workers will have a standard procedure to follow when washing produce. For more information on measuring turbidity, go [**here**](https://foodsafetyclearinghouse.org/sites/default/files/files/043_01.pdf).

**Sanitizers**

Sanitizers, while not required by the Rule, will help to minimize both cross-contamination (dirty product to clean product) and to minimize build-up of bacteria and biofilms in wash tubs, flumes, and root washers.

If you choose to use a sanitizer, then you must follow rules for use of sanitizers and keep records of how, when, and what you are using.

All sanitizers must be EPA (US Environmental Protection Agency) approved and labeled. All label instructions for use must be followed. Safety Data Sheets (SDS) must be kept on file.

The Produce Safety Alliance has a list of approved sanitizers that can be used in produce water applications (irrigation, washing, and equipment sanitation).

* [**Here**](https://producesafetyalliance.cornell.edu/sites/producesafetyalliance.cornell.edu/files/shared/documents/Sanitizer-Factsheet.pdf) you will find a fact sheet on choosing sanitizers.
* Go [**here**](https://producesafetyalliance.cornell.edu/sites/producesafetyalliance.cornell.edu/files/shared/documents/PSA-Labeled-Sanitizers-for-Produce.xlsx) to see the Excel list of sanitizers.
* Go [**here**](https://www.youtube.com/watch?v=wNNJOeITtxU) to see a video that teaches you how to best make use of the list.

**Water temperature**

Water temperature can have on impact on the safety of produce that is being water cooled or washed. Some produce is at greater risk for **infiltration**. Infiltration happens when produce is warmer (i.e. field warm) than the water that is being used for cooling/washing. Bacteria and other microorganisms that may be in the water (due to an apple contaminated with bird droppings, for example, or a melon that was growing on soil contaminated with feces from wildlife), can infiltrate or seep into the fruit or vegetable as the warm produce cools down and potentially “sucks in” contaminated water.

This is most likely to happen if produce is allowed to sit in/soak in water for a longer period of time and if the produce is bruised or the skin is broken. Certain varieties of produce are also more prone to infiltration through the stem end, including, but not limited to, tomatoes, melon, and apples. It is important that you know the characteristics of your product and know if it is likely to be prone to infiltration.

You can minimize the effects of infiltration by using a sanitizer in the water. And, in addition, by ensuring that the water temperature is no more than 10 degrees colder than the produce you are washing. Sometimes it might be necessary to use warmer water to achieve that standard. It is also a good idea to take the temperature of the wash water if you think this could be a problem to make sure that your wash water is not too cold.

Another reason to monitor water temperature is to ensure that your sanitizer is effective. If water temperature is too high and you are using a chlorine sanitizer, it can actually cause the chlorine to evaporate and reduce the concentration and effectiveness of the sanitizer. Be sure to read all label instructions for your sanitizer to see if it is necessary to monitor the temperature of your wash water.

An inexpensive standard bimetallic dial type thermometer (often seen in restaurants or chef’s pockets) can be used for this. Be sure to immerse the stem at least up to the notch on the stem. These thermometers are easy to calibrate in ice water and should be recalibrated often. A digital or instant read thermometer can be more accurate and quicker to use, though they may be a bit more expensive. Follow manufacturer’s instruction regarding calibration. Be sure to keep a record of temperatures taken.

**pH**

Depending on .the type of sanitizer you are using, the pH of your water may impact the effectiveness and the safety of the sanitizer. If the water is too alkaline (high pH), it may reduce the effectiveness of the sanitizer: if the pH is too low (too acidic), it may cause development of a toxic gas if you are using chlorine based sanitizer. It is important to know the characteristics of your sanitizer so you know if the pH of your water is a concern.

If you need to test and monitor your water pH, you can use either pH test strips or a pH meter. Test strips are an inexpensive alternative, but may not be as accurate. Be sure to purchase test strips that are testing for the pH range your sanitizer needs to be effective. Also, replace test strips yearly as they can become less accurate over time.

If you choose to purchase a pH meter, keep in mind that you will also need to purchase chemicals called buffers that are used to calibrate a pH meter. For more information on the purchase and use of a pH meter, contact your produce safety Extension Specialist**.**

**What the Rule requires: Agricultural water**

* Water system inspection: conduct and document
* Testing (as described above): conduct and keep records
* Conducting corrective actions if needed: conduct and keep records
* Monitor and maintain quality of post-harvest water used to wash produce (temperature, pH, sanitizer concentration, turbidity): monitor and keep records

**What to do in addition to the Rule**

Develop written SOPs for water system inspection, testing (how to take a water test), monitoring and maintaining quality of post-harvest water used to wash produce

**Sample SOP for agricultural water**

Link to each SOP found in ag water folder

SOP for using Peroxyacetic Acid (PAA) in wash water (Haddad, Cornell)

**Sample record keeping forms for agricultural water**

Link to each record keeping form found in ag water folder

Water System Inspection Record template

Water Testing Log

Water Treatment Monitoring Record

Wash Water Sanitizer Log