Backflow Prevention for Produce Farms

Introduction

The **intentional, directional, and reliable flow** of water is important to ensure agricultural water is "safe and of adequate sanitary quality".

This post provides information on the importance of backflow prevention and some common practices that help mitigate the risk of backflow. You can also view presentation slides and a recorded webinar on this topic that were provided for the May 2019 Produce Safety Alliance Educators Call.

▲ *Check valves are one of several ways to prevent backflow.*

Regulatory and Training Context

There are at least three places in the FSMA Produce Safety Rule (PSR) that are relevant (emphasis added):

FSMA PSR §112.41

What requirements apply to the quality of agricultural water? All agricultural water must be safe and of adequate sanitary quality for its intended use.

FSMA PSR §112.42:

What requirements apply to my agricultural water sources, water distribution system, and pooling of water?

(a) … you must inspect all of your agricultural water systems… including consideration of the following: …

(5) The likelihood of introduction of known or reasonably foreseeable hazards to agricultural water by another user of agricultural water before the water reaches your covered farm.

(b) You must adequately maintain all agricultural water distribution systems … to prevent the water distribution system from being a source of contamination to covered produce, food contact surfaces, areas used for a covered activity, or water sources…

(c) You must adequately maintain all agricultural water sources… Such maintenance includes regularly inspecting each source to identify any conditions that are reasonably likely to introduce known or reasonably foreseeable hazards into or onto covered produce or food contact surfaces; correcting any significant deficiencies (e.g., … and control of cross-connections); and keeping the source free of … other possible sources of contamination …

(d) … implement measures reasonably necessary to reduce the potential for contamination … as a result of contact of covered produce with pooled water. …

FSMA PSR §112.133:

What requirements apply to plumbing?

The plumbing must be of an adequate size and design and be adequately installed and maintained to:

(a) Distribute water under pressure as needed, in sufficient quantities, in all areas where used for covered activities, for sanitary operations, or for hand-washing and toilet facilities;

(b) Properly convey sewage and liquid disposable waste;

(c) Avoid being a source of contamination to covered produce, food contact surfaces, areas used for a covered activity, or agricultural water sources; and

(d) Not allow backflow from, or cross connection between, piping systems that discharge waste water or sewage and piping systems that carry water used for a covered activity, for sanitary operations, or for use in hand-washing facilities.

These topics are also covered in Modules 51. (slide #12) and 5.2 (slide 17) in the Produce Safety Alliance (PSA) National Curriculum

Flow of Water

When thinking about controlling water flow, it may be helpful to remember some basic things about water.

- Water flows **downhill** due to gravity and/or along the **path of least resistance** (which could be sideways)**.**
- Water flows from **high to low pressure.** We use pumps to increase the pressure in one place so that flow goes in a certain direction. There are times when the pressure difference shifts due to suction or siphoning. A fire hydrant draw is a good example.
- Water flows in **pipes, tubes, and hoses.** This helps to direct flow in only certain directions or along certain paths. But it also "connects" different locations. This can lead to "cross connection" between a relatively dirty or hazardous use and a food contact surface.
- We control the flow of water with **valves.** Most are manual or electronic solenoid valves. But, we also use "**check valves**" as passive, automatic flow controls. They bias flow in only one direction.

INTRODUCTION TO BACKFLOW

Backflow is when water (and anything in it) travels in the "wrong" direction or a direction other than the intended one.

Backflow Prevention is taking steps to ensure water flow is in the intended direction or along a path that minimizes produce safety risk due to cross-connection and cross-contamination.

Backflow is typically prevented by:

- Obstructing flow in one direction (using a check valve, foot valve, etc), or
- Providing an easier flow path in a different direction that results in lower risk (using air gaps, floor sinks, etc.)

The Charleston, SC Water Department offers a great video summarizing the ways backflow can happen and why it can be a problem.

STEP ONE—DON'T BUY ANYTHING

Know your water systems and assess your risks. Start by mapping out your water system using an existing farm map from, e.g., USDA Farm Services Agency (FSA). Or take a screen shot of a Google Map (zoom in using satellite mode) and paste it into PowerPoint or some other easy editor. You can use PowerPoint to easily draw your water networks on the farm map. (See Figure 1)

CHECK & FOOT VALVES

Check valves are used to allow flow only in one direction in plumbing.

There are two main types of check valves:

- **Swing** – Gravity forces the gate down, but high enough water pressure will swing it up.
- **Spring** – A spring forces the shuttle closed, but high enough water pressure from the other side will open the valve.

Figures 2 and 3 illustrate the different types. Supplyhouse.com also offers a great video that explains the differences between swing and spring check valves.

A foot valve is a check valve used on the inlet side of a pump to maintain prime by preventing backflow out of the pump back into the water source (see Figure 6).

CHECK VALVES - 5 KEY POINTS

1. Intent – What is the intent of the check valve. Think it through from a systematic perspective and make sure it is going to prevent the flow you're trying to prevent. Map your water system, identify potential backflow risks and insert check valves as needed.

2. Type - Know the difference between swing and spring check valves. SupplyHouse offers a good video: https://youtu.be/Sj1vJkhc5XE

3. Material Compatibility – Almost everything should work with water. If you're dealing with any injected chemicals, review the housing and seal materials for compatibility. For PAA and chlorine bleach mixed to common packshed concentrations (24-80 PPM and 25 PPM respectively), there shouldn't be any issues. If you have plumbing lines at higher concentrations it could require more attention. Watch out for chemical and mechanical contamination risks such as lead from brass check or foot valves.

4. Orientation – There is an arrow on the housing of check valves. It indicates the direction of intended flow. Some check valves have other restrictions on installation orientation as noted previously (esp. swing type). See Figures 4 & 5.

5. Sizing – It is typically OK to go with the existing line size as a guide. If there are pressure drop concerns (limited pressure pump, gravity feed, etc.) up-sizing the check valve or using a low pressure drop type may be required.

Figure 1—Start with a Farm Water Map - Use an existing map from USDA Farm Services Agency (FSA) or take a screen shot of your farm location on Google Maps using satellite view mode. Then, note the location of all of your farm water sources, major plumbing, drains, and drain outlets (including septic systems or sewer connections.). Think about potential hazards and the risks that may be present relative to these water sources and distribution systems. Then think about specific places where backflow prevention would be important to mitigate those risks.

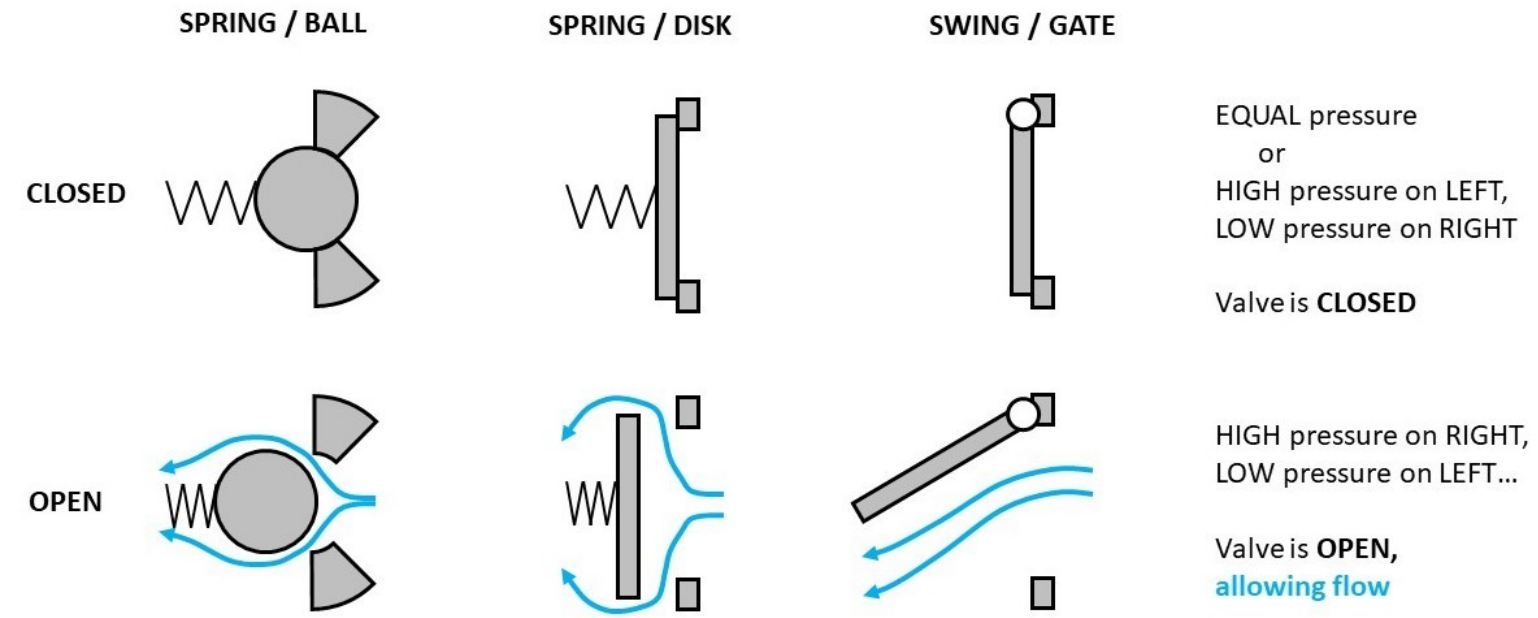

Figure 2—Check valves - This image shows how different kinds of check valves work. Check valves work on the principle of pressure difference. They allow flow only in one direction by biasing the closure of the valve in one direction. Different types of check valves have different "opening" or "cracking" pressures based on how they are forced closed. A spring type check valve generally has a higher "cracking" pressure and, therefore, a higher operating pressure drop.

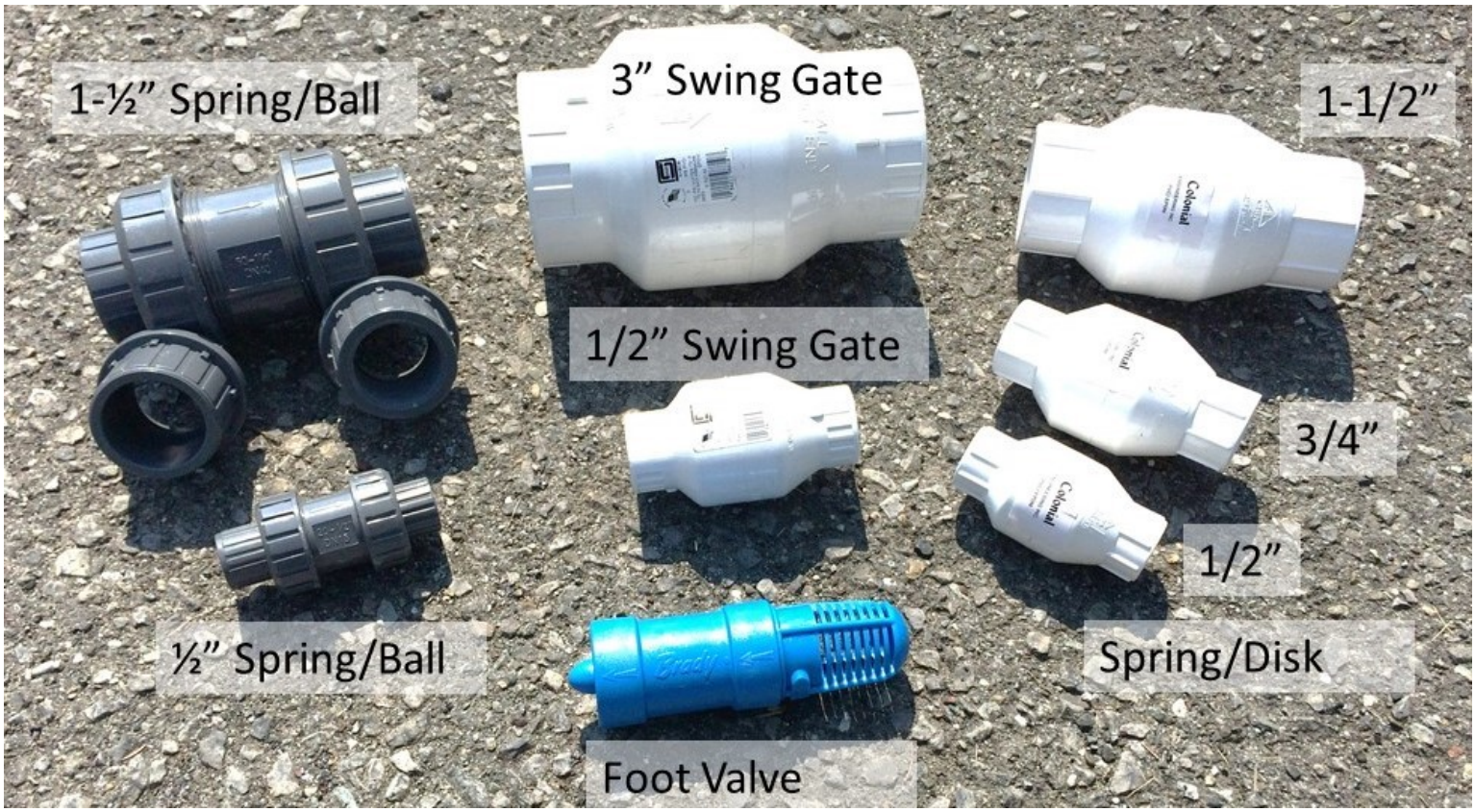

Figure 3—Check and Foot Valves - This picture shows a range of check valve types and sizes. All check valves have an arrow on the outside of the valve body indicating the direction of allowed flow. This is also how you can easily find the check valve in a plumbing system.

FIGURE 4—SWING CHECK VALVE OVERVIEW

▼ *Swing Type Check Valve - Swing type check valves have the same arrow that indicates the direction of allowed flow. But, they also have additional labels indicating proper installation orientation. Because they are closed by gravity using a hinge, they only work properly in specific orientations.*

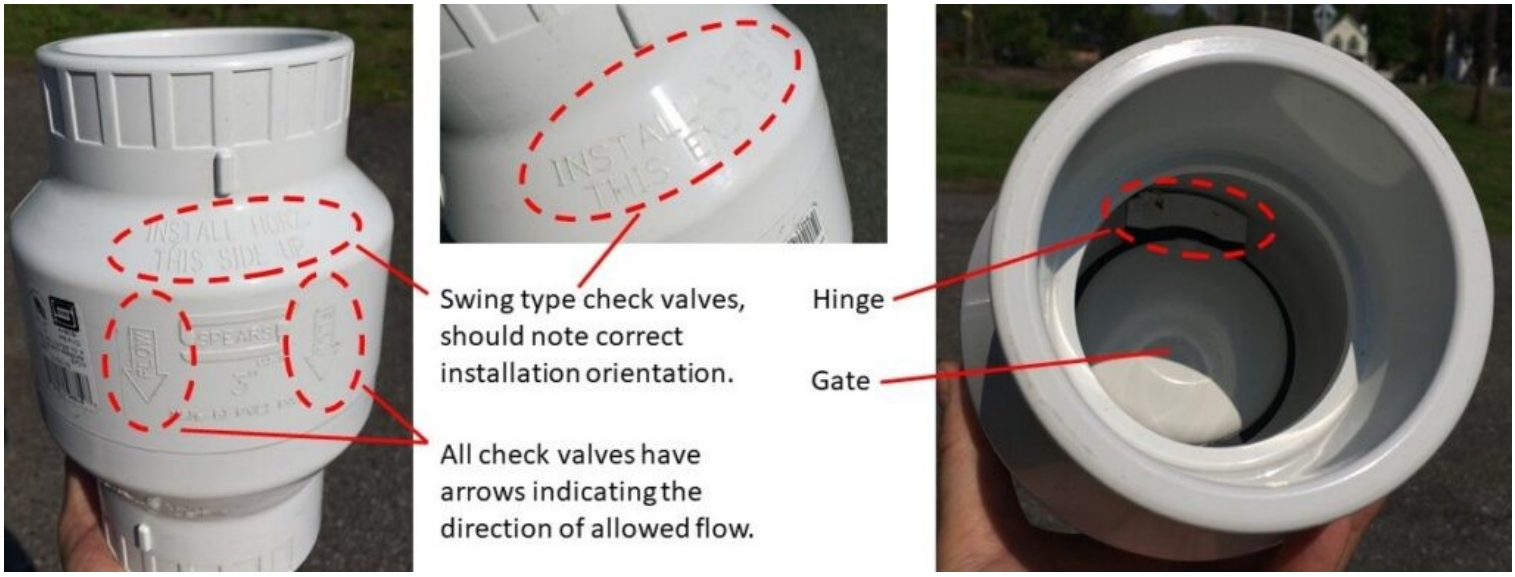

FIGURE 5—SWING CHECK VALVE ORIENTATION

▼ *Swing Check Valve Orientation - Be sure to follow the directions and valve labeling regarding the orientation of a swing check valve to avoid a #backflowfail. In this photo series the intended flow is away from the viewer. In the two photos on the left the sing hinge is on the top which is correct. On the right, the valve is oriented with the sing hing on the bottom which results in the valve always being open and flow being allowed toward the viewer.*

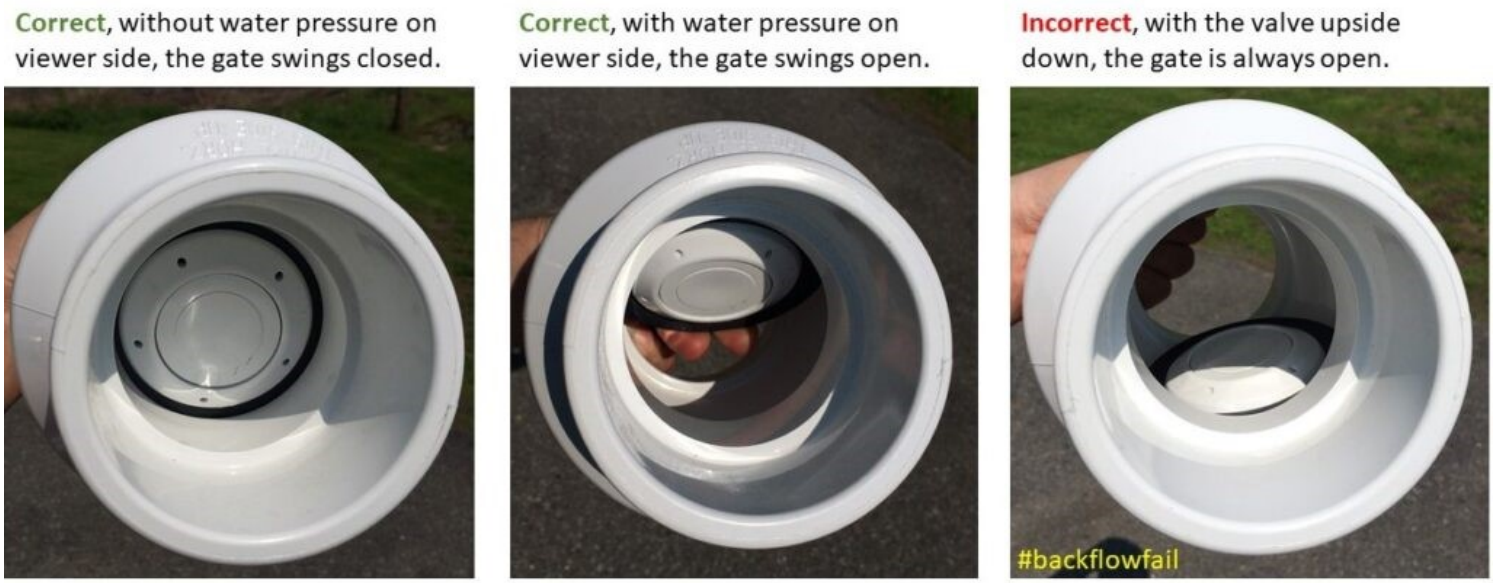

FIGURE 6
FOOT VALVES

Pump side. Threaded. Spring is pushing a disk away from us to close the valve.

Coarse filter basket. Removable for cleaning / maintenance.

Hey! A flow arrow!

Two views from source side.

▲ *Foot Valves - A foot valve is just a special type of check valve. They are used on the suction side of pump at water source. Primary purpose is to maintain pump "prime". But, this also results in whatever water is in the line to the pump and beyond not being allowed to flow back into the water source.*

FIGURE 7
AIR GAPS AND FLOOR SINKS

▲ *Air Gap Drains and/or Floor Sinks - This practice provides a path of lower resistance for backflow. The result of a down stream blockage or backflow is a messy floor. But it could be worse. If the drain was connected, the backflow would go all the way to the sink above and contaminate whatever was inside.*

AIR GAP DRAINS AND FLOOR SINKS

Air gaps can be introduced into drain lines to break the path of backflow. This can help to ensure that food contact surfaces are not exposed to backflow resulting from downstream blockages (see Figure 8). A special floor receptacle known as a "floor sink" can be used to capture the intended discharge flow from one or more sinks or vessels (see Figure 7). Consider reviewing local and national building code for specific dimensions and location of different lines coming into a floor sink.

ADDITIONAL RESOURCES

- Charleston (SC) Water System – Backflow Video - https://www.youtube.com/watch?v=YyUi4RMb-bA
- SupplyHouse.com – Check Valve Video – https://youtu.be/Sj1vJkhc5XE
- Case Histories of Selected Backflow Incidents. FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION. UF TREEO. https://treeo.ufl.edu/backflow/epa-resources/backflow-case-histories/.

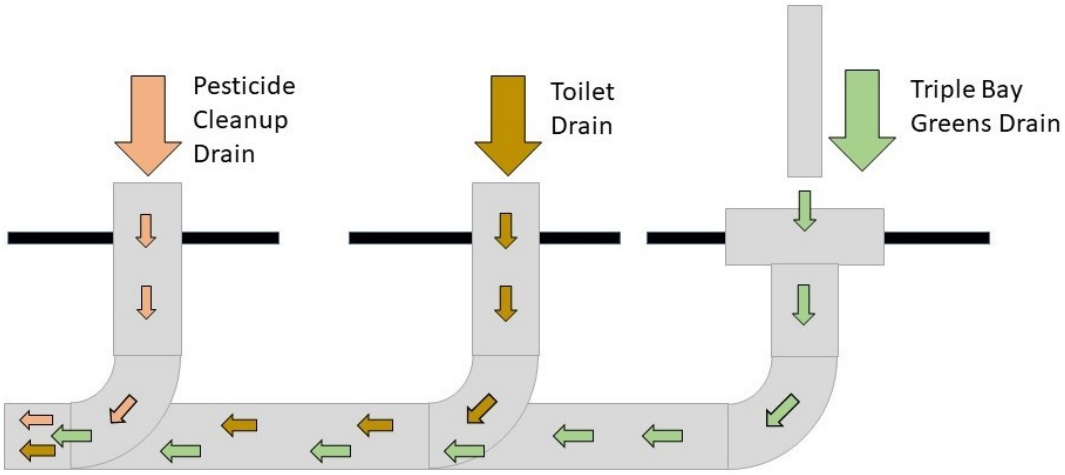

Figure 8a- An Air Gap Drain - Working as it should. Three sources of effluent all draining away from the area of use.

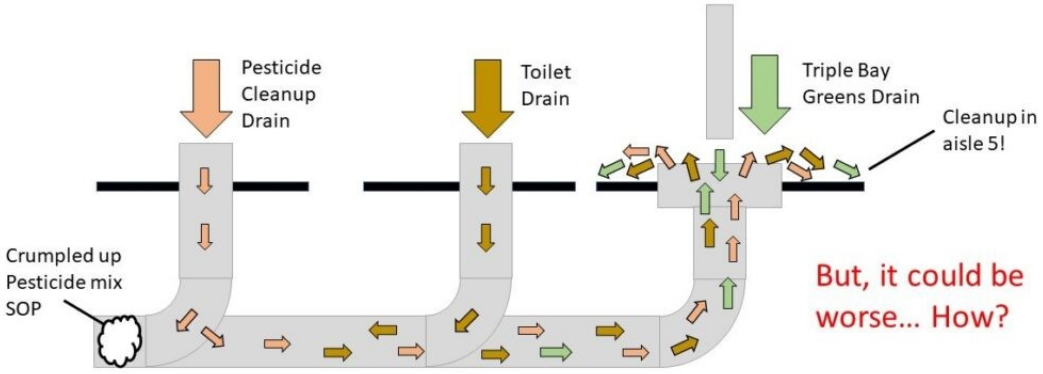

Figure 8b—Blockage! - There is a blockage downstream of the three uses. This results in backflow. Everything gets mixed up and spills out onto the floor. A big mess. But it could be worse.

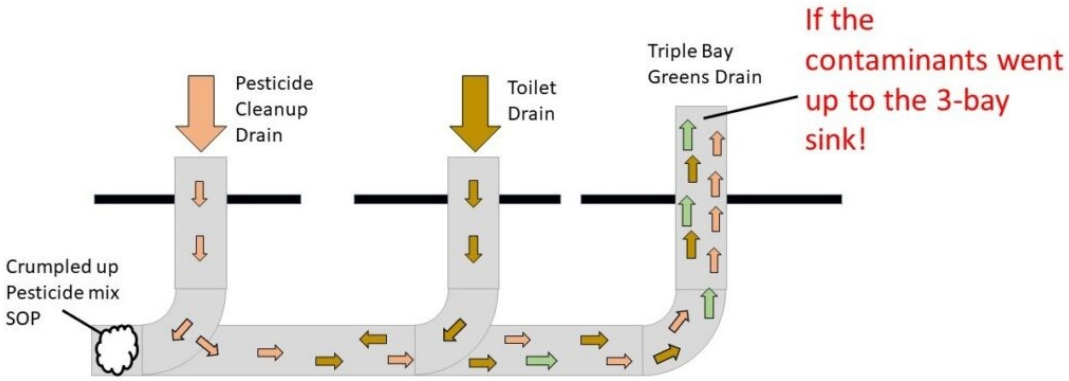

Figure 8c—Without an Air Gap Drain - There is a potential for the backflow to go right up the continuous drain to the sink which is a food contact surface. It might even have food in it at the time!

Agricultural ENGINEERING

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