

APPENDICES[®] TO CANADAGAP FOOD SAFETY MANUALS



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Acknowledgment

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A. Shock Chlorination of Well Water – An Example

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

Note: The procedures below are “general” chlorination procedures. It is advisable to determine if there are any applicable (e.g., provincial/municipal) guidelines for chlorination.

1. What is Shock Chlorination?

Shock chlorination is a self-administered method used to treat bacterial contamination in wells. Bacteria grow on the inside of the well casing, pipes and pumping equipment. Contamination can cause a reduction in well yield, a restriction in the water flow in pipelines, a red staining of plumbing fixtures, the plugging of water treatment equipment and a “rotten egg” odour. In order for shock chlorination to be an effective means of controlling bacterial growth, it must disinfect the entire cased section of the well in addition to the adjacent water-bearing formation (e.g., storage tank, etc.) and the entire water distribution system. It is important to note that shock chlorination does not completely eliminate bacterial growth but it does help to control the problem. Shock chlorination is recommended as a regular well maintenance procedure and repeated each spring and fall. Shock chlorination may also be used to disinfect wells in the event of flooding or contamination (e.g., run-off).

2. Shock Chlorination Procedure for DRILLED Wells

1. Store sufficient water to meet the needs of the family and entire farming operation for 8 to 48 hours. The well will not be in use during the chlorination procedure.
2. Pump the appropriate amount of water from Table 1 (see below; column titled “Volume of Water Needed”) into a clean storage tank (e.g., galvanized stock tank, pick-up truck box lined with 4 mil plastic sheeting). Note that the recommended amount of water is twice that of the volume present in the well casing. Allow the well to return to its non-pumping (static) water level before adding the chlorine solution.

****To calculate how much water is in the well casing:*** subtract the non-pumping (or static) water level from the TOTAL depth of the well.

Table 1. Amount of Chlorine Required to Obtain a Chlorine Concentration of 1000 ppm

Casing Diameter		Volume of Water Needed		5.25% Domestic Chlorine	12% Industrial Sodium Hypochlorite	*70% High Test Hypochlorite
		Water needed per 1 foot (30 cm) of water in the casing		Litres needed per 1 foot (30 cm) of water	Litres needed per 1 foot (30 cm) of water	Dry weight* per 1 foot (30 cm) of water
Inches	mm	Gallons	Litres	Litres	Litres	Grams
4	100	1.10	5.00	0.095	0.042	7.20
6	150	2.40	10.90	0.210	0.091	15.60

8	200	4.20	19.10	0.360	0.160	27.30
24	600	**extra 200 gallons	**extra 1000 litres	1.700	0.740	127.00
36	900	**extra 200 gallons	**extra 1000 litres	3.800	1.700	286.00

* Because a dry chemical is being used, mix it with water to form a chlorine solution before putting it into your well.

** See modified procedure for LARGE DIAMETER wells.

EXAMPLE – How to calculate how much water you will need to pump into a clean storage tank:

- Your drilling record indicates that the casing is 200 feet (61 meters) in length and that the non-pumping (static) water level is 100 feet (30 meters). To determine how much of the casing holds water, use the following equation:

$$\begin{aligned}\text{length of casing} - \text{non-pumping water level} &= \text{length of casing holding water} \\ 200 - 100 &= 100 \text{ feet of casing holding water}\end{aligned}$$

- If your casing has a diameter of 6 inches (15 centimeters) you need 10.9 litres (2.4 gallons) of water (from Table 1) for every foot of water in the casing. To calculate the amount of water you need to pump into your storage tank, use the following equation:

$$\begin{aligned}\text{Litres or gallons/ft. of water (determined by casing diameter)} \times \text{ft. of casing holding water} &= \text{litres or gallons of water} \\ &\text{needed to pump into storage tank}\end{aligned}$$

$$10.90 \text{ litres} \times 100 \text{ ft. of water} = 1090 \text{ litres of water into storage tank}$$

3. Calculate the amount of chlorine required as indicated in Table 1. Mix the proper amount of chlorine with the water you have pumped into the storage tank. This will give you a solution with a chlorine concentration of 1000 ppm. Always follow the chlorine manufacturer's instructions for use.

Note: *If your well is located in a pit, ensure that there is proper ventilation during the chlorination procedure.*

EXAMPLE – How to calculate how much chlorine you will need for your well:

- If your well casing is 6 inches (15 centimeters) in diameter and you are using 5.25% domestic (household) chlorine, you will need to use 0.210 litres of chlorine (from Table 1) per foot (30 cm) of water in the casing.
- If you have 100 feet (30 meters) of water in the casing, calculate the total amount of chlorine you will need by using the following equation:

$$\begin{aligned}\text{litres of chlorine needed per ft. of water in casing} \times \text{ft. of water in casing} &= \text{litres of chlorine needed} \\ 0.210 \text{ litres of chlorine per ft. of water} \times 100 \text{ ft. of water} &= 21.0 \text{ litres of 5.25\% chlorine}\end{aligned}$$

4. Slowly siphon this solution back into the well. Do not exceed the well pumping rate.
5. Open EACH hydrant and faucet (including all appliances that use water) in the distribution system until the water coming out has a chlorine odour to it. This ensures that all plumbing fixtures will be chlorinated. Allow the hot water tank(s) to fill completely. Once this has been done, turn off all hydrants and taps.

Note: *Consult with your water treatment equipment supplier to find out if any part of your water treatment system needs to be bypassed to prevent damage (i.e., corrosion due to chlorine). Do not run chlorinated water through softeners, carbon filters and reverse osmosis systems.*

6. Leave the chlorine solution in the well and distribution system for a period of **8 to 48 hours**. The longer the contact time, the better the results.
7. When the contact time has elapsed, open an outside tap and let the water run until the odour of chlorine is significantly reduced.

Note: *Direct the water away from crops and other sensitive areas (i.e., ponds, grasses, etc.).*

8. Flush the chlorine from the hot water heater and household distribution system (if applicable).
9. Backwash and regenerate/recharge all water treatment equipment. The system is now ready to be used.

3. Modified Shock Chlorination Procedure for LARGE DIAMETER Wells

1. Pump 1000 litres (approx. 200 gallons) of water into a clean storage tank located at the wellhead.
2. Mix 20 litres of 5.25% domestic chlorine (or 8 litres of 12% chlorine or 1.4 kg of 70% high test hypochlorite) into the 1000 litres (200 gallons) of stored water.
3. Use Table 1 to calculate the amount of chlorine required per foot of water in the casing (see calculations for drilled wells). Add this amount of chlorine DIRECTLY to the well.

Note: *If you are using 70% hypochlorite, the dry chemical must be mixed with water prior to being added to the well.*

4. Circulate the chlorine added to the well using a garden hose that is hooked up to an outside faucet. Place the end of the hose into the well and turn the tap on for a minimum of 15 minutes.
5. Siphon the 1000 litres of chlorine solution (made in Step 2).
6. Follow Steps 5 through 9 for DRILLED wells as described above.

4. Disinfection Verification

Sample the well *5 days after the shock chlorination treatment and again at least one week after the well has been in constant use*. Two consecutive "safe" water test results are required before the well can be considered disinfected.

References:

Alberta Agriculture and Food. Shock Chlorination – Well Maintenance. Copyright 1995-2007 [retrieved December 31, 2007]. <https://www.alberta.ca/working-well-resources.aspx#toc-1>

Government of Saskatchewan. High Level Chlorine Well Disinfection (Shock Disinfection). . Copyright 2007 [retrieved December, 31, 2007].

[https://www.wsask.ca/Global/Lakes%20and%20Rivers/Flood%20Watch/Well%20Disinfection%20FS-High%20Level%20revised%20Dec%202007_WSA%20\(2\).pdf](https://www.wsask.ca/Global/Lakes%20and%20Rivers/Flood%20Watch/Well%20Disinfection%20FS-High%20Level%20revised%20Dec%202007_WSA%20(2).pdf)

Other Information Source(s):

<http://www.mddep.gouv.qc.ca/eau/potable/depliant/index.htm> - French web site from Developpement durable, Environnement et Parcs Quebec (also available in English).

Conversion factors:

1 litre = 0.22 gallons

1 gallon = 4.54 litres

1 cm = 0.4 inches

1 m = 39.4 inches or 3.28 feet

1 inch = 2.5 cm

1 foot = 30.5 cm

B. Chlorination of Water for Fluming and Cleaning Fresh Fruits and Vegetables and Cleaning Equipment – An Example

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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Note: The procedures below are “general” chlorination procedures.

1. Water Treatment

The purpose of adding chlorine to water is to keep the water potable, not to sanitize the product. Chlorine can be used effectively to kill microorganisms present in water, but the effectiveness of chlorination depends on the following factors:

- pH of water: Chlorine is most effective when water pH is between 6.0 and 7.5. Above pH, 7.5, little (<50%) chlorine exists in its active form and below pH 6.0, noxious chlorine gas can be released. This gas can be harmful to workers and makes the solution more corrosive to equipment and less effective for sanitation.
- Organic matter: Any organic matter (leaves, soil, stems, etc.) present in water can reduce the effectiveness of chlorine. More chlorine is required to achieve the same level of control in dirty water.
- Contact time: Lower concentrations of chlorine require a longer contact time to achieve the same disinfection as higher concentrations.
- Water temperature: Water temperature has a lesser effect on chlorine effectiveness than the other factors. Lukewarm water is best. Hot water increases the corrosiveness of chlorine while chlorine is somewhat less effective in cold water.

All of the above factors will affect how much chlorine is needed to adequately control the quality of water. The following information provides general guidance for adding and monitoring chlorine in water and can be used as a starting point to develop operation specific procedures. Chlorine concentrations that are too high can damage the product and harm employees. Concentrations that are too low will not adequately control the growth and survival of microorganisms that cause spoilage and human illness.

Chlorine is not the only product that may be used to treat water. The following table compares various types of water treatment chemicals:

	Test Strip Availability	Oxidation Reduction Potential (ORP) Meters	Monitoring Device: Other	Requires Micro Verification	pH Range of Water During Treatment	Concentration Recommended	Effectiveness in the Presence of Organic Matter	Work Safety (Risk)	Environmental Impact	Treatment Speed of Large Volumes of Water	Cost*	Unique Attributes
Chlorine	Yes	Works well	Yes	Yes	6.5 - 7.5	50 - 300 ppm	Limited	Medium: Irritant to skin, eyes and throat	Medium	Fast	1 X	Odour. Continues to be some disposal concerns.
Chlorine Dioxide	Yes	Works well	Yes	Yes	6-10	5 ppm	Effective	High: Irritant to skin, eyes and throat	Medium/High	Fast	15 X	Most demanding form of Chlorine - must produce onsite. Odour.
Hydrogen Peroxide	Yes	Challenging	Yes	Yes	6-8	3%	Effective	Medium: Irritant to skin, eyes and throat	Low	Medium	90 X	Need to acidify to pH 6.
Peroxyacetic Acid	Yes	Challenging	Yes	Yes	< 4	50 - 80 ppm	Effective	High: Severe irritant to skin, eyes and throat. Requires ventilated area	Medium	Medium/Fast	5 X	Not ideal for sensitive produce. pH may need to be increased prior to disposal. Very strong odour.

UV	No	Not suitable	Yes**	Yes	NA	NA	Not Effective (must filter)	Low	Low	Slow	Varie s based on facility	Ensure bulb is functional and clear of mineral deposits. Challenge s with hard water.
Ozone	No	Challenging	Yes	Yes	6-8	3 ppm	Limited (must filter)	Medium: Must have off- destruct device and detector(s)	Low	Slow	Varie s based on facility	Fast oxidizer, however, delivery system reduces speed of large water volume sanitation.

* All cost is relative to
Chlorine
** This is a detector to make
sure the bulb is working

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a) Using Oxidation-Reduction Potential (ORP) to Determine Appropriate Chlorine Levels and Monitor Effectiveness

Oxidation-Reduction Potential is a rapid and accurate way to measure chlorine effectiveness. ORP is measured using an ORP meter, similar to a digital thermometer or pH probe. A single reading can tell you whether the amount of chlorine in your wash water is effective regardless of organic matter or pH. As the amount of organic matter increases or the pH increases above 7.0, more chlorine will be required to reach the same target ORP. Research has shown that water with an ORP value of 650-700 mV can kill bacteria such as *E. coli* in a few seconds while more resistant types of microorganisms are killed within a few minutes. For most post harvest washing or fluming systems, it is unnecessary to operate above 800 mV – a level commonly used in primary wash systems where there is a high amount of organic matter.

Advantages of ORP:

- Easy to use, quick reading tells you if you have enough chlorine regardless of pH and organic matter
- Can help avoid over-chlorination which can be hazardous to product, workers and equipment

Disadvantages of ORP:

- Need to purchase an ORP meter
- Need to clean and (for some meters) calibrate the instrument on a regular basis
- High levels of inorganic compounds in your water such as metals or minerals can interfere with ORP readings. For this reason, when setting up your monitoring system, always double check using chlorine strips and a water test to ensure ORP readings are correct

Using an ORP meter:

- Fill the flume or wash tank and pick a starting chlorine concentration (such as 50 ppm).
- Use the chlorine conversion tables below and add the desired amount of chlorine.
- Always try and take the sample from the same spot and set a target reading between 650-800 mV. A target ORP of 700 or above is recommended to account for variations in meter accuracy.
- For hand-held ORP meters, immerse the meter in water source for 30 seconds or according to manufacturer's instructions. If the water is highly turbulent, use a clean plastic container to collect a sample. Fill the container, swirl, dump the contents, fill again and immerse ORP sensor in water. Gently stir the water with the sensor for 30 seconds (or according to manufacturer's instructions).
- Record the ORP reading on Form (N1) Water Treatment Control and Monitoring. If the reading is below your target level, add more chlorine until you reach the desired ORP. If it is too high, add less the next time so you can determine what the correct starting amount of chlorine is for your system. Record how much chlorine you added.
- It will take some time to determine how often you will need to check ORP and add more chlorine to your system. The first time you use the ORP meter, check ORP levels frequently (e.g., every hour or every product load). If the ORP does not change then reduce the frequency of monitoring. If it drops dramatically, consider starting with a higher level of chlorine and ORP (e.g. 800 mV compared to 700mV or 100 ppm instead of 50 ppm). Over time you will have a better idea of how quickly chlorine is used up in your system, how often you will need to add chlorine and how much to add.
- If you find that the chlorine is being used up too quickly and you have lots of organic matter (dirt, leaves, stems etc.) in your wash water, consider changing the water more often, filtering the water or scooping out some of the plant debris.
- Once you have determined how much chlorine you need to start with, how often you need to check your wash or flume tank, where you take your measurements and your target ORP reading, WRITE THIS DOWN. This will allow your employees to conduct the monitoring and will also save you time at the beginning of next season.
- Occasionally double check ORP readings using pH and chlorine test strips and clean water.

Important Note: High levels of inorganic materials (such as iron) in water can alter ORP readings. Always double check your target ORP with FREE chlorine test strips. You may have to adjust your target ORP readings to compensate. You can check this by using free chlorine test strips and pH strips in clean filtered water. At pH 7.0, in clean water, 3 ppm of free chlorine corresponds to an ORP of approximately 700 mV and 5 ppm to 750 mV.

There are three basic types of ORP meters:

- Pocket meters are the least expensive, small enough to fit in a pocket, and are reasonably reliable. Generally they need to be replaced after a year or two.
- Hand-held meters offer a high degree of accuracy and reliability and may also provide a temperature and/or pH check. The electrodes of hand-held meters need to be replaced approximately every two years.
- Process meters are mounted in a fixed location and provide continuous monitoring and recording of ORP readings. They are more expensive and most commonly used with automatic chlorine injection systems although they can be used when adding chlorine manually.

ORP meters can cost anywhere from \$100 for pocket meters to over \$1,000 for process control meters with internal record keeping and can be purchased from some scientific supply companies (Fischer Scientific; Canadawide Scientific, Omega Engineering Inc.) or water treatment supply companies, or suppliers can be found online from manufacturers' web sites (Extech Instruments or Oakton Instruments). (Prices as of January 2008.)

Reference:

Suslow, T. Oxidation-Reduction Potential (ORP) for Water Disinfection Monitoring, Control, and Documentation, 2004. University of California, Publication 8149 [retrieved December 31, 2007]. <http://anrcatalog.ucdavis.edu/pdf/8149.pdf>

b) Using Total and Free Chlorine to Determine Appropriate Chlorine Levels and Monitor Effectiveness

Measuring total and free chlorine through chlorine strips and pH strips (or probes) is another way to monitor the amount of chlorine in wash and flume water. Total chlorine is the total amount that has been added to the water while free chlorine is the amount of chlorine that remains active in the water. Measuring total chlorine is most useful when determining and checking how much chlorine to start with in clean water. Measuring free chlorine is a much more accurate way of monitoring the effectiveness of your chlorination system over time.

Generally, maintaining 2-7 ppm of FREE chlorine and a pH of 6.0-7.5 in wash water at all times is sufficient to kill bacteria in water. However, it is recommended that fresh fruit and vegetable operations add 50-150 ppm of TOTAL chlorine to their wash water to start. This will help ensure the free, active chlorine will not be used up too quickly.

Determining how much total chlorine to start with in your wash and flume water will depend on what type of product you are washing, the amount of organic matter that collects in the wash water and how often you change the water. For example, field tomatoes will have more soil than greenhouse tomatoes and the chlorine will be used up faster.

You will need to determine the initial amount of total chlorine to add to wash or flume water, the frequency at which you need to check chlorine levels, how much chlorine you need to add throughout a typical day and how often you need to change your water:

- Choose a total chlorine level between 50-150 ppm and, using the chlorine conversion below, add the required amount of chlorine to your wash water (that contains product).
- Check the chlorine level after a few minutes to ensure that you have added the correct amount (using TOTAL chlorine test strips or probe) or that free chlorine levels are between 2-7 ppm (using FREE chlorine test strips or probe).

- For the first several days (go through several water changes), continue to check the FREE chlorine levels at a relatively high frequency (every hour or every product load) to ensure levels do not drop below 2-7 ppm.
- As chlorine levels start to drop below 2-7 ppm add more chlorine as required.
- If you find that, after an hour, there is no FREE chlorine left, increase the amount of total chlorine you start with and increase how frequently you check the chlorine levels.
- If, after a week or two, you find that FREE chlorine levels do not change much at this frequency you may be able to check less often as you get an idea of how quickly the chlorine is used up in your system. You may find that over time, as the water becomes dirtier, it becomes more difficult to maintain FREE chlorine levels.
- If you can no longer maintain FREE chlorine levels between 2-7 ppm, empty and rinse out the wash or flume tank and refill. Adding a filtration system or scooping out organic matter with a net can also help to maintain the potability of the water.
- Once you have determined how much chlorine to start with, how often to check chlorine levels, how much chlorine you need to add and how often to change your water, WRITE THIS DOWN. This will save you a lot of time later, will help you remember exactly what you were doing from year to year and allow employees to follow the procedure properly.

Note: High levels of chlorine can cause pitting or burning of the product and can be hazardous to workers.

Reference:

Guide To Minimize Microbial Food Safety Hazards For Fresh Fruits And Vegetables. U.S. Food and Drug Administration, U.S. Department of Agriculture and the Centers for Disease Control and Prevention. 1998.

c) Chlorine Conversions

Target ppm	ml/L	tsp/5 gal	cup/50 gal
Sodium Hypochlorite 5.25%			
50	0.95	3 $\frac{2}{3}$	$\frac{3}{4}$
75	1.43	5 $\frac{1}{2}$	1 $\frac{1}{10}$
100	1.90	7 $\frac{1}{4}$	1 $\frac{1}{2}$
125	2.40	9 $\frac{1}{10}$	1 $\frac{7}{8}$
150	2.90	10 $\frac{7}{8}$	2 $\frac{1}{4}$
Sodium Hypochlorite 12.75%			
50	0.39	1 $\frac{1}{2}$	$\frac{1}{3}$
75	0.59	2 $\frac{1}{4}$	$\frac{1}{2}$
100	0.78	3	$\frac{3}{5}$
125	0.98	3 $\frac{3}{4}$	$\frac{4}{5}$
150	1.18	4 $\frac{1}{2}$	$\frac{9}{10}$

Reference:

Food Safety Begins on the Farm, A Grower's Guide, Good Agricultural Practices for Fresh Fruits and Vegetables. Anusuya Rangarajan, Elizabeth A. Bihn, Robert B. Gravani, Donna L. Scott and Marvin P. Pritts. 2000.

d) Type of Chlorine to Use

- ONLY use **hypochlorite** (usually 5% or 12%). Carefully read the ingredient label to ensure there are no other chemical additives.

- Note that the pH of the fluming or cleaning water will increase when chlorine is added to the water.

2. Chlorine Conversion

These calculations are to be used to determine the amount of chlorine required to treat fluming and cleaning water and control microbial growth. *Refer to Section 1: Water Treatment (above) to determine the level of chlorine required for the produce you will be fluming or cleaning.*

Note: *ONLY sodium hypochlorite, calcium hypochlorite or potassium hypochlorite is to be used. Carefully read the ingredient label to ensure there are no other chemical additives.*

a) Important variables to consider when using chlorine

- pH of fluming or cleaning water
- Concentration of chlorine being used (i.e., 5 or 12%, which can be found on the bottle)
- Volume of water in flume or tank
- How long product will be in the flume or tank
- How much organic matter is in the tank

Once these variables have been determined, they must be used in the following equation.

1. Determine pH of fluming or cleaning water using a pH test strip. Add organic acids as necessary to adjust the pH. Note that the pH of the water must be between 6.0 and 7.5 both before and after chlorine is added.
2. Determine the concentration of chlorine required. Convert the concentration to parts per million (ppm).

Example – if a chlorine concentration of 5.25% (standard household bleach) is used:

$$\frac{5.25}{100} = 0.0525$$

$$\text{Parts per million} = 0.0525 \times 1\,000\,000 = 52\,500 \text{ ppm}$$

3. Calculate the dilution factor.

Example – if a chlorine level of 125 ppm is required:

$$\text{Dilution factor} = \frac{52500 \text{ ppm}}{125 \text{ ppm}} = 420$$

4. Determine the amount of chlorine needed.

Example – if the volume of water is 1000 L:

$$\frac{420}{1} = \frac{1000}{X}$$

$$\text{Then } X = 2.38$$

Thus, 2.38 L of chlorine is required per 1000 L of water; or 2.38 ml of chlorine per 1 L of water.

Note: *To convert litres to gallons, multiply the number of litres by 0.2642.*

5. It is necessary to account for how long the product will be in contact with the chlorinated water. If this time is less than 2 minutes, **INCREASE** the amount of chlorine that needs to be used without exceeding 150 ppm.
6. ANY type of organic matter (dirt, dust, calyx, leaves) inactivates the chlorine present in the water. Consider how long the fluming and cleaning water will be used and adjust the chlorine to be added accordingly [e.g., if the fluming water will be used for 8 hours there will be more organic matter in the tank (as the water is recirculated) and it will be necessary to add more chlorine; if the fluming water is only being used for 4 hours, then less chlorine is required].
7. To reduce the amount of organic matter, pre-wash in potable water, change the water frequently (e.g., daily) or use filters.

3. Water Treatment Test Strips for Maintaining and Monitoring Fluming and Cleaning Water

a) pH Test Strips

1. BEFORE chlorine is added, dip the pH test strip 1-2 seconds in fluming or cleaning water and compare it to the colour chart.
2. Add the required amount of chlorine to the fluming or cleaning water and mix well.
3. Dip a NEW pH test strip 1-2 seconds in the cleaning or fluming water and compare it to the colour chart.
4. In order for the chlorine to be effective, keep the pH of the fluming or cleaning water between 6.0 and 7.5.
5. Adjust the pH of the fluming or cleaning water with acids to lower the pH if necessary and to attain a pH value between 6.0 and 7.5.
6. Use strips to monitor pH on a daily basis.
7. Record the pH level on Form (N1) Water Treatment Control and Monitoring.

b) FREE Chlorine Test Strips

1. Add the required amount of chlorine to the fluming or cleaning water and mix well.
2. Make sure your fingers are dry when you remove a test strip from the vial.
3. Dip the test strip into the fluming or cleaning water. Do not use any agitation.
4. Immediately compare the test strip to the colour chart on the vial's label.
5. Record the total chlorine concentration on Form (N1) Water Treatment Control and Monitoring.
6. The frequency at which you need to test chlorine levels will be different for each operation. You may need to adjust your frequency when temperatures are high, when product is unusually dirty or when running large volumes.
7. Add chlorine as required.
8. Record the total chlorine concentration on Form (N1) Water Treatment Control and Monitoring.

c) Where to Buy Chlorine Test Strips and Probes

Test strips that measure FREE chlorine can usually be purchased at pool supply stores. Make sure that the strips can measure up to 10 ppm, many pool strips or pool test kits only measure up to 4 ppm. Test strips that measure TOTAL chlorine are more difficult to find. Both types of test strips, as well as pH strips and electronic probes to measure chlorine and pH, can be purchased from scientific supply companies such as Fischer Scientific; Canadawide Scientific, Omega Engineering Inc.; water treatment supply companies, or suppliers can be found online from manufacturers' web sites (Extech Instruments or Oakton Instruments).

4. Cleaning equipment

Equipment that comes into direct contact with product has the potential to transfer contamination if not cleaned properly. The term cleaning refers to the removal of unwanted material (e.g., dirt, chemical residues, organic material) from equipment and food contact surfaces. Cleaning is best achieved with water and friction. Friction is needed to loosen materials so they can be washed away with the water. This can be achieved through wiping or scrubbing with cloths or brushes or using a high pressure spray. The use of soaps or surfactants can also help remove unwanted materials by dissolving them or reducing their ability to attach to the equipment.

Water cannot be used on some types of equipment. In these cases, at minimum, friction through brushing or sweeping, is needed to remove soils and other undesirable materials.

Sanitizing is not the same as cleaning. Sanitizing is the treatment of a clean surface with a chemical (e.g., chlorine) or physical agent (e.g., heat) that will kill microorganisms and reduce them to a safe level. Sanitizing with chemicals is a useful risk reduction step, but chemicals must be used properly in order to be effective. Some studies have shown that the use of water and adequate friction was more effective in reducing microorganisms on equipment than just using chemical sanitizers.

Note: *Surfaces must be clean for sanitizers to be effective.*

Knives and hand-held cutting and trimming tools:

Because knives are portable, there is potential for them to become contaminated easily. They may be taken home by employees, left in a car, in a drawer or on a shelf or they may be used for purposes other than cutting product. The possibilities for contamination are numerous. This is why there are specific requirements in Section 8.2 of the CanadaGAP manuals for cleaning knives or other hand-held cutting and trimming tools. Regardless of how knives are handled or stored they must always be thoroughly cleaned **prior** to use each day. The information in this appendix can be used as a guide to help create an appropriate cleaning procedure for hand-held cutting and trimming tools.

In addition to the information below, other resources that may help operations create appropriate cleaning procedures can be found at:

- Ontario Ministry of Agriculture, Food and Rural Affairs. *Foods of Plant Origin cleaning and sanitizing guidebook*. http://www.omafra.gov.on.ca/english/food/inspection/fruitveg/sanitation_guide/cs-guidebook.htm.
- Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). *Nettoyage et assainissement*. <https://www.mapaq.gouv.qc.ca/Fr/Transformation/Qualitedesaliments/securitealiments/nettoyageassainissement/Pages/nettoyageassainissement.aspx> (NOTE: this website is only available in French)
- Government of Manitoba. *Use of Chlorine in the Food Industry*. <https://www.gov.mb.ca/agriculture/food-safety/at-the-food-processor/use-of-chlorine.html>

- Journal of Food Protection. *Sanitation and Design of Lettuce Coring Knives for Minimizing Escherichia coli O157:H7 Contamination*. 2012.

https://www.researchgate.net/publication/221696093_Sanitation_and_Design_of_Lettuce_Coring_Knives_for_Minimizing_Escherichia_coli_O157H7_Contamination.

- University of Minnesota Extension. *Cleaning and sanitizing tools, harvest containers and surfaces*. <https://extension.umn.edu/growing-safe-food/cleaning-and-sanitizing-tools-harvest-containers-and-surfaces>

- Food and Agricultural Products Research and Technology Center – Oklahoma State University. *Guidelines for the Use of Chlorine Bleach as a Sanitizer in Food Processing Operations*. <http://ucfoodsafety.ucdavis.edu/files/26437.pdf>

- Louisiana State University. *Harvest and Field Sanitation Practices: Best Practices To Ensure On-farm Food Safety*. https://www.lsu.edu/agriculture/plant/extension/hcpl-publications/13_Pub.3459-HarvestandFieldSanitationPractices.pdf

- National Collaborating Centre for Environmental Health. *Disinfectants and sanitizers for use on food contact surfaces*.

http://www.ncceh.ca/sites/default/files/Food_Contact_Surface_Sanitizers_Aug_2011.pdf

a) Use of Chlorine for Cleaning and Sanitizing Equipment

Chlorine is the most commonly used sanitizer in food production facilities. However, chlorine can damage sensitive surfaces such as rubber and sponges and can increase rusting and corrosion of some metal surfaces.

The effectiveness of chlorine solutions depends on several factors:

- Chlorine concentration
- Amount of time surface is in contact with chlorine solution
- Water Temperature – lukewarm water is best (24°C/72°F)
- pH – works best between 6.5 and 7.0
- Water quality

Chlorine Concentrations and Contact Times for Various Surfaces:

- Non-porous (e.g., metal, hard plastic) food contact surfaces: Use a **100-200 ppm** chlorine solution, soak for 2 minutes and air dry.
- Porous surfaces: Use a 600 ppm chlorine solution for 2 minutes then thoroughly rinse with potable water and air dry.
- Floors and Walls: Higher concentrations (e.g., 1,000-2,000 ppm) may be used on walls and floors.

Prepare solutions using potable water and the chlorine conversion provided above.

Chlorine is relatively unstable so chlorine solutions gradually lose strength even in covered containers. Fresh solutions must be prepared frequently. Maximum storage life is 24 hours. Always label containers containing chemical solutions.

Safety Considerations

- It is wise to wear protective clothing and eye covering when using chlorine solutions. Also, make sure that the area is well ventilated.
- Harmful chlorine gas can be produced if the solution falls below pH 4.0 or if the chlorine is used in hot water.
- Chlorine is incompatible with most other chemicals. Do not mix chlorine with detergent cleaners. When mixing chlorine solutions, **always add concentrated chlorine to water**; never add water to chlorine to avoid possible explosions when mixing chlorine solutions.

b) Use of Other Chemicals for Cleaning and Sanitizing Equipment

The following are other common types of sanitizing chemicals:

- Quaternary Ammonium Compounds or “Quats” are effective on porous surfaces, non-corrosive, non-staining, odourless and effective over a wide pH range. They are more expensive than chlorine but may be safer to use on equipment. A concentration of 200 ppm for 45 seconds (at 24-44 °C) is required for sanitation.
- Iodine/Iodophors are less affected by organic matter than chlorine but have a limited effective temperature range (24-34°C). They can stain or discolour equipment and a concentration of 25 ppm is required.
- Peroxyacetic Acid is more expensive than chlorine but is not as affected by organic matter as chlorine. Different formulations are available for different purposes such as for food and non-food contact surfaces.

When using any of these sanitizing chemicals, be sure to choose products developed for use on food contact surfaces and always follow the label directions. Refer to *Appendix D: Reference Lists: Packaging Materials, Inks, Lubricants, Maintenance Material, Sanitizers, Water Treatment Aids and Food and Incidental Additives* for information on acceptable cleaning and maintenance materials.

References:

Ontario Ministry of Agriculture, Food and Rural Affairs. Foods of Plant Origin. Cleaning and Sanitation Guidebook. July 2006 [retrieved December 31, 2007]. Available at:
http://www.omafra.gov.on.ca/english/food/inspection/fruitveg/sanitation_guide/cs-guidebook.htm

Chlorine Chemistry Council. Chlorine and Food Safety White Paper. 2007 [retrieved December 31, 2007]. <https://chlorine.americanchemistry.com/Chlorine-Benefits/Health-and-Safety/Chlorine-and-Food-Safety-White-Paper.pdf>

C. Composting Livestock Manure – An Example and Compost Tea Information

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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Note: The procedures below are “general” composting procedures. Refer to T-4-120 – Regulation of Compost under the Fertilizers Act and Regulations (<http://www.inspection.gc.ca/english/plaveg/fereng/tmemo/t-4-120e.shtml>) for federal regulations. It is advisable to determine if there are any applicable (e.g., provincial/municipal) guidelines for composting.

1. What is Composting?

Composting is the aerobic (i.e., requiring oxygen) decomposition of manure and other organic materials. The temperature range in which this process occurs is 40-65°C (104-149°F). The decomposition process is carried out by microorganisms that are already found in the manure. When environmental conditions are appropriate, the microbes grow and multiply by decomposing the organic materials found in the manure. The composting process is most efficient when it is managed and conducted in controlled environmental conditions. Properly composted manure is odourless, fine-textured and has a low moisture level. Composting enhances soil tilth and reduces environmental risk. It also helps to reduce the volume and weight of manure and destroys pathogens and weed seeds.

2. Factors Affecting Composting

a) Ratio of Carbon to Nitrogen (C:N)

Livestock manures compost rapidly under the conditions outlined in Table 1 (below). Nutrient balance is primarily determined by the ratio of carbon to nitrogen. If nitrogen is in excess, high levels of ammonia will be released into the atmosphere. However, when carbon is in excess, the composting rate will slow down. The carbon:nitrogen ratio (C:N) will vary based on the type of manure and bulking agent used. It is important to determine the amount of carbon and nitrogen in manure and bulking agent samples through laboratory analysis.

b) Moisture Level

The recommended moisture content is approximately 60%. It is important to note that the correct moisture level may be more difficult to maintain during the high-temperature phase of composting in open-air windrows and is affected by wet and dry climatic conditions. When the moisture level is too high, the windrows subside, lose porosity and become anaerobic. Once this occurs, the compost pile will begin to ferment and emit odours. If the moisture level is below 50%, the rate of decomposition decreases and nutrients are no longer available to the microorganisms. It is important to note that chicken manure, broiler litter and turkey manure often require the addition of water to reach the appropriate moisture level. Additionally, water may need to be added throughout the composting process in order to maintain the appropriate moisture level. Moisture levels may be easily determined through the hand (or squeeze) test. If the compost is too wet, water can be squeezed out of a handful of compost. If it is too dry, the material will not feel moist to the touch. Moisture probes are also available and can be used to monitor moisture levels.

c) Temperature

As the microorganisms decompose the organic matter in the manure, heat is generated and the temperature of the compost rises. The amount of heat released is directly proportional to the amount of microbial activity in the compost. Consequently, temperature is a good process indicator. The temperature pattern of composting manure typically follows a rapid increase to 49-60°C (120-140°F), which is maintained for several weeks. Once active composting slows down, there is a gradual decrease in temperature to 38°C (100°F), and then a final leveling-off to ambient air temperature. Temperature probes can be purchased and need to be long enough to penetrate one-third of the way towards the centre of the pile. Turn the compost if the temperature drops below 30°C (indicating too little microbial activity) or if it rises above 60°C (which may lead to the death of the composting bacteria and a subsequent halt in the composting process). Most pathogens and weed seeds will be destroyed if the temperature of the compost pile is sustained at 55°C for a period of fourteen days.

d) Aeration

Aeration is also an important factor. Proper aeration removes heat, water vapour and gases trapped within the composting materials. The greatest need for oxygen is in the early stages of the composting process and decreases as the compost reaches maturity. If there is insufficient oxygen present, the compost becomes anaerobic and the process becomes slower, less efficient and results in the generation of little heat (i.e., the temperature of the compost pile does not increase at a proper rate). If there is improper aeration, odorous compounds may be generated during the composting process.

3. Bulking Agents

Because the carbon:nitrogen (C:N) ratio and nutrient content of manure varies depending on species, diet fed to the animals and manure handling system, bulking agents are used to increase carbon levels and porosity. Examples of bulking agents include corn stalks, straw, bark chips, newsprint, sawdust, wood chips and leaves. The choice of bulking agent depends on the nutrient content (chemical composition) of the manure being used. As a result, it is necessary to determine (through a laboratory analysis) what the chemical composition (amount of nitrogen and carbon, carbon:nitrogen ratio and moisture level) of the manure and bulking agent to be used is. If the C:N ratio needs to be adjusted, a recipe or formula can be calculated using various composting manuals or on-line calculators. In order to use these formulas, it is necessary to know the type and chemical composition of the manure being used, and the type and chemical composition of the bulking agent being used, in addition to the moisture level of these materials. Once this information has been obtained, it is used to calculate the amount of manure and bulking agent needed to make compost.

Table 1. Ideal Conditions for the Rapid Composting of Livestock Manure

Condition	Reasonable Range
Carbon:Nitrogen ratio (C:N)	20:1-40:1
Moisture level	40-65%
Oxygen concentration	5%
Particle size (diameter) of material to be composted	1/8-1/2 inch
PH	5.5-9.0
Temperature	43-65°C (110-150°F)

4. Curing

Composting is usually cured outdoors in windrows. Compost piles are ready for curing when there is no longer an increase in temperature within the pile. Curing takes one to two months. Do not disturb piles during this period. Once the curing process is complete, the compost may be screened to remove any non-degradable compounds and then analyzed to determine its nutrient value.

5. Different Composting Systems

a) Open/Turned Windrow Composting

This form of composting uses a mechanized turner and involves the placement of manure in long rows on an all-weather surface. Rows are typically one to two meters high (three to six feet) and two to five meters (six to sixteen feet) at the base. Piles are turned periodically to mix the composting material, ensure that all material is composted evenly, and to introduce oxygen and rebuild bed porosity. Mixing can be done with either regular farming or specialized equipment. The recommended turning frequency is as follows:

Week 1 – 3 turnings

Week 2 – 2 to 3 turnings

Week 3 – 2 turnings

Weeks 4 and 5 – 1 turning per week

Week 6 and beyond – 1 turning per every 2 weeks **if heating still occurs**

This method usually takes one to two months. Once the composting process has finished and the temperature of the pile remains constant and at ambient temperature even after turning, the compost must then cure, which takes one to three months.

b) Passive Windrow/Pile Composting

This is the production of compost in piles or windrows. Rows are typically the same size as those used in the open/turned windrow composting method. Passive composting uses natural aeration over long periods of time (six months to two years). It is not necessary to turn the material, but it is recommended to occasionally turn the piles/windrows to allow moisture to be redistributed and expose fresh material to microbial activity.

c) Aerated Static Windrow/Pile Composting

Compost produced using this method involves mechanical aeration. Windrows or piles are located above air ducts, perforated pipes, aeration cones or perforated floors and aeration is achieved by blowing or drawing air (forced air) through the composting material. As there is no mechanical turning used in this method, it is not necessary to turn windrows/piles; however, it is occasionally recommended to improve the efficiency of the composting process. The optimum size of the compost pile is determined by the materials being composted, air flow capabilities and the type of handling equipment. Additionally, the timing, duration and uniform movement of the air are critical. Air flow requirements are dependent on the materials being composted, the size of the pile and the age of the compost.

d) In-Vessel Systems

Includes turned bins, rectangular agitated beds, silos and rotating drums. These systems confine the composting material within a container or building and use aeration (forced air) and mechanical turning to increase the rate of the composting process. The composting process takes seven to thirty days. One to two months are required for curing. In-vessel composting is costly when compared to other composting methods.

6. Factors to Consider When Selecting Compost and Curing Sites

In order to make the compost process as efficient as possible, consider the following:

- Amount of space required (determined by composting and curing method used; windrows require the most amount of land, followed by aerated windrows/static piles and in-vessel systems)

- Pile dimensions
- Proximity to manure source
- Wind direction and proximity to neighbours
- Topography (i.e., slopes, depressions, potential for run-off, etc.)
- Soil type
- Compost storage space

7. Pollution Prevention

To reduce the likelihood of compost polluting the environment and being a potential source of contamination to horticulture crops, it is highly recommended that:

- the compost site is located a minimum of 90 meters (300 feet) from a watercourse, well, pond, etc.,
- windrows are NOT located on coarse-textured soils,
- all clean SURFACE water is diverted away from the composting site,
- in areas where there is high rainfall, covering compost windrows/piles is recommended to prevent runoff and leaching (e.g., plastic covers are now available that can be used to cover open-air windrows, which protect them from climatic conditions but allow gas exchange),
- space is allowed for runoff structures and runoff containment structures.

References:

Buckley, K., Penn, G. Producing Quality Compost from Livestock Manure. Agriculture and Agri-Food Canada. Brandon Research Centre. 2003-09-12 [Summary of the article retrieved December 31, 2007]. Summary was available at <http://www.prairieswine.com/producing-quality-compost-from-livestock-manure> [resource no longer available online]

Alberta Agriculture, Food and Rural Affairs. 2005. Manure Composting Manual. [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex8875/\\$file/400_27-1.pdf?OpenElement](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex8875/$file/400_27-1.pdf?OpenElement)

Agriculture, Fisheries and Aquaculture: 4. Manure Storage. Prince Edward Island Department of Agriculture and Forestry and Prince Edward Island Department of Technology and Environment. 1999-01-07 [retrieved December 31, 2007]. <https://peipotatoagronomy.com/wp-content/uploads/2018/10/PEI-Manure-Mgmt-Guidelines.pdf>

British Columbia Ministry of Agriculture, Food and Fisheries. Composting Methods. September 1996 [retrieved December 31, 2007]. http://www.rdosmaps.bc.ca/min_bylaws/es/solid_waste/bcagcomposthandbook1998.pdf

Compost Tea Information

Note: *The person responsible is advised to determine if there are any applicable (e.g., provincial/municipal) guidelines for composting.*

1. What Are Compost Teas?

Compost teas are liquid solutions made by steeping compost (produced properly by a managed process that includes a thermophilic phase) in water. It can be used as a fertilizer.

Please refer to the following websites for further information on production and application of compost teas.

National Organic Standards Board, Compost Tea Task Force Report, April 6th, 2004. <https://www.ams.usda.gov/sites/default/files/media/NOP%20Final%20Rec%20Guidance%20use%20of%20Compost.pdf>

Composting Procedure

By filling in the information below, you can use this chart to describe your composting procedure:

Batch Identifier: _____

Composting method (e.g. windrow, static piles, in-vessel)	
Compost pile location (consider location in relation to product, packaging, water sources etc.)	
Starting substrate (e.g., cattle manure with straw bedding)	
How is the pH checked (e.g., soil test strips, sent to a laboratory)?	
What is the target pH?	
How often is the pH checked?	
How often is the temperature checked at each phase?	
How often is the compost pile turned?	
Are other procedures being followed?	
How do you determine when compost is ready for use?	

Composting Record

Batch Identifier: _____

Treatment Method: _____

Substrate (include the source of the substrate e.g., cattle manure and straw): _____

Starting pH: _____

Date	Substrate added (e.g., straw)	Temperature (indicate °C or °F)	Pile turned? (Circle Y/N)	Observations (e.g., odour, moisture)	Initials
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		
			YES NO		

D. Reference Lists: Packaging Materials, Inks, Lubricants, Maintenance Materials, Sanitizers, Water Treatment Aids and Food and Incidental Additives

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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The following link, “Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products”, provides a list of **packaging materials, inks, lubricants, maintenance materials, sanitizers and water treatment aids, etc.** permitted for use in federally registered food establishments (e.g., minimally processed fruits and vegetables, meat, dairy, honey, poultry) by the Canadian Food Inspection Agency: <http://www.inspection.gc.ca/>.

Please note this list is not necessarily complete, is subject to change and that the CFIA no longer evaluates materials for inclusion in the Reference Listing so new or other products will not be added. Further information can be found in the *Guidance for Food Establishments Concerning Construction Materials and Packaging Materials and Non-Food Chemicals* document found at: <http://inspection.gc.ca/food/archived-food-guidance/safe-food-production-systems/technical-references/guidance/eng/1412187967735/1412187968391>

NOTE	<i>Horticultural operations have available to them a number of options for safe materials, other than those on the CFIA Reference Listing. Some of these materials have also received a letter of no objection from Health Canada. Check with your product supplier.</i>
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The following link, “Food and Drug Regulations”, provides further information on **food additives and incidental additives** permitted for use by Health Canada under the Food and Drug Regulations: <http://laws.justice.gc.ca>.

The following link, “Guidelines for the Use of Food Additives and/or Processing Aids Intended for Fresh Fruits and Vegetables”, provides further information on **food additives and processing aids and on the use of new chemical agents** (other than agricultural chemicals and pesticides) in the production of fresh fruit and vegetables: <http://www.inspection.gc.ca/english/fssa/frefra/safsal/additivee.shtml>

For non-regulated additives such as post harvest wax or fruit and vegetable coatings, the person responsible is encouraged to ask their suppliers for **letters of no objection** from Health Canada to ensure these products are safe and free from potential allergens. The following link, “Packaging Materials”, provides further information on **letters of no objection** issued by Health Canada for packaging materials: http://www.hc-sc.gc.ca/fn-an/securit/packag-emball/index_e.html.

Where to buy

Sanitizers and cleaning supplies (including hand sanitizers and antibacterial hand wipes) can be purchased from janitorial supply companies (can be found in the yellow pages) who also supply restaurants, retailers, health care and other industries. Distributors of janitorial supplies may be able to

provide advice on what products are suitable for use in your operation. Suppliers of sanitation and cleaning chemicals or other maintenance materials can also be found by looking up products on the CFIA website (above) and contacting the manufacturer to find suppliers in your area or by contacting known manufacturers such as Petro-Canada (lubricants), JohnsonDiversey Canada or Ecolab (sanitizers), Flexo, or Kimberly-Clark (hand sanitizers and hand wipes). Representatives at these companies should be able give you the name of a supplier in your area and may also provide advice on what products are appropriate for your use

E. Resources for Agricultural Chemical Application Equipment Calibration

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

Calibration is a test measurement of the output of your application equipment under typical operating conditions.

Calibrating application equipment ensures that:

- The agricultural chemical is being applied at the application rate recommended on the label.
- The agricultural chemical is being applied evenly over the whole field.

There are many different types of agricultural chemical application equipment and each will need to be calibrated following instructions either received with the equipment or those written based on expert recommendations.

Resources for agricultural chemical application equipment can be found at:

Airblast sprayer resources:

Sprayers 101: <http://sprayers101.ca/>

Washington State University Extension: <https://extension.wsu.edu/chelan-douglas/agriculture/treefruit/pestmanagement/air-blastsprayercalibration/>

BC Ministry of Ag: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agriservicebc/production-guides/berries/sprayer_calibration_2012.pdf

OMAFRA: <http://www.omafra.gov.on.ca/english/crops/facts/10-047.htm>

University of California Coop Extension: <http://www.ipm.ucdavis.edu/training/incorporating-calibration.html>

Texas A&M Extension: <http://www.extension.org/pages/65642/airblast-sprayer-calibration-worksheet#.VW2nDkYYPfc>

Boom sprayer resources:

OMAFRA: <http://www.omafra.gov.on.ca/english/crops/sprayer/ep75.htm>

Colorado State University Extension: <https://extension.colostate.edu/topic-areas/agriculture/sprayer-calibration-fundamentals-5-003/>

Ohio State University Extension:

http://wayne.osu.edu/sites/wayne/files/imce/Program_Pages/ANR/Boom%20Sprayer%20Calibration.pdf

BC Ministry of Agriculture: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agriservicebc/production-guides/berries/sprayer_calibration_2012.pdf

Louisiana State University: <http://www.lsuagcenter.com/NR/rdonlyres/E34233DB-CB3C-45B5-9E6A-82ED5A4A2C70/70220/pub3057calibrationofsprayersJune2010HIGHRES.pdf>

New Brunswick (FR):

<http://www2.gnb.ca/content/dam/gnb/Departments/10/pdf/Agriculture/WildBlueberries-BleuetsSauvages/C120-f.pdf>

MAPAQ: <https://www.agrireseau.net/agroenvironnement/documents/bsp05-07.pdf>

Handheld sprayer resources:

OMAFRA: <http://www.omafra.gov.on.ca/english/crops/sprayer/ep75.htm>

Virginia cooperative Extension: <https://pubs.ext.vt.edu/456/456-502/456-502.html>

MSU Extension: <http://www.msuextension.org/BSSA/articles/96>

Granular spreader resources:

North Carolina State University Extension: <https://onslow.ces.ncsu.edu/2017/03/calibrating-your-spreader/?src=rss>

University of Georgia: <http://extension.uga.edu/publications/detail.cfm?number=C818>

Rutgers New Jersey Ag Experiment Station:

https://profact.rutgers.edu/Documents/ProFACT_Training_Manual.pdf

Other resources:

Ag Canada 1846 Field Guide to Sprayers: http://publications.gc.ca/collections/collection_2013/aac-aafc/agrhist/A43-1849-1990-eng.pdf

F. General Guidelines for Adequate Lighting

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

The following chart provides general guidelines for adequate lighting levels for various tasks. The amount of light falling on a surface is measured in units called lux. Depending on factors such as type of task being done and type of surface, adequate general lighting is usually between 500 and 1000 lux when measured 76 cm (30 inches) above the floor.

Area/Activity	Lighting Level
Offices	650-750 lux (100 foot candles)
Food inspection and grading areas	540 lux (50 foot candles)
Frequently used work areas not involving inspection and grading	220 lux (20 foot candles)
Other areas (e.g. where repair and maintenance work is done or seldom used areas)	110 lux (10 foot candles)

To reach proper light levels, many light fixtures are designed to reflect light off walls, ceilings and objects. The amount of light reflected off a surface can be measured. Suggestions for the percent of light reflected off surfaces in a typical office include:

- window blinds (40-50%),
- walls (50% maximum),
- business machines (50% maximum),
- ceiling (70-80%),
- floor (20-40%), and
- furniture (25-45%).

The percent value refers to the amount of light that a surface reflects relative to the amount that falls on the surface.

In addition, light fixtures that are too widely spaced or wrongly positioned can create shadows. Objects between the light fixture and work being done can block the light and cast shadows. Likewise, workers sitting with their backs to windows, with light fixtures directly overhead or to the rear, cast shadows on work areas.

Testing for insufficient light problems

To detect insufficient light, try the following:

- Wipe light fixtures with a damp cloth to check for cleanliness. An evenly deposited film of dust is hard to detect by sight alone.
- Measure the average illumination throughout the workplace. Compare this to the recommended levels.
- Look for shadows, especially over work areas and on stairways.
- Ask workers if they suffer from eye strain or squint to see.

Having workers sit in their normal working positions during measurement will give you more accurate results.

To correct insufficient light:

- Replace bulbs on a regular schedule. Old bulbs give less light than new ones so replace them before they burn out. Follow manufacturers' instructions.
- Clean light fixtures regularly. Dirt on light fixtures reduces the amount of light given off. Light fixtures with open tops allow air currents to move dust up through the fixture so dust and dirt do not accumulate on the fixture.
- Add more light fixtures in appropriate places.
- Paint walls and ceilings light colours so light can be reflected.
- Use more reflected light and local lighting to eliminate shadows. For example, a covered light mounted under a transparent guard on a grinding wheel provides the added light needed to clearly see the task.
- Do not position work station with light fixture directly behind worker.

References:

Canadian Centre for Occupational Health and Safety. Lighting Ergonomics. 2006 [retrieved December 31, 2007]. http://www.ccohs.ca/oshanswers/ergonomics/lighting_survey.html

Canadian Food Inspection Agency. Good Importing Practices for Food. 2006 [retrieved December 31, 2007]. <http://www.inspection.gc.ca/english/fssa/imp/goodbonne.shtml> [archived page]

G. Water Testing

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

Note: The potable water standards below are from the Canadian Guidelines for Drinking Water Quality (developed by Health Canada);

1. Testing Well Water

a) When to Test Well Water

It is recommended that existing wells be tested at least two times a year for microbiological contamination. The best time to sample your well water is when the probability of contamination is greatest. This is likely to be in early spring just after the thaw, after an extended dry spell, following heavy rains or after lengthy periods of non-use. In addition to regular testing, test well water after any repairs such as a pump repair or replacement and if there has been a change in water appearance, colour or odour.

b) Procedure for Testing Well Water

Depending on the location, bacteriological testing of well water is done either by the public health laboratory in your area or by a certified private laboratory. Many public health laboratories do not charge for this service. Choose an accredited laboratory for testing microbes in water.

1. Get a proper, sterile sample bottle from an accredited laboratory. Make sure you read and follow the instructions included with the bottle. Do not use any other container to collect the sample because it will not yield meaningful results and will not be accepted by the laboratory.
2. Plan to sample your well water when you're sure you can deliver it to the designated location within 24 hours. Do not let your water sample sit for a long period of time as this can lead to inaccurate results.
3. Remove any aerator, screen or other attachments from your faucet. Don't take a sample from an outside faucet or the garden hose. Take a sample from an inside tap with no aerator, such as the sink.
4. Disinfect the end of the faucet spout with an alcohol swab or dilute bleach solution (1 part household bleach to 10 parts water) before running water to remove debris or bacteria. Disinfecting the tap with a flame is not recommended because this can damage the faucet.
5. Turn on cold water and let it run for three to four minutes to remove standing water from your plumbing system.
6. Remove the sample bottle lid.
 - Don't touch the inside of the lid.
 - Don't put the lid down.
 - Don't rinse out the bottle.
7. Fill the bottle to the level that is marked, as described in the enclosed instructions, and close the lid firmly.
8. Make sure to fill out the enclosed paperwork completely and accurately or you may not get your results back.

9. Keep the sample refrigerated (but not frozen) until it's returned to the drop-off location. Again, deliver the sample within 24 hours or it may not be processed. Remember that proper handling will help to make sure that your test results are accurate! Use a cooler with ice packs to keep the sample cold until it can be refrigerated and while transporting it to the lab.

If you have experienced gastrointestinal illness and suspect that it might be associated with your well water, consult your physician and local health unit.

c) Interpreting the Test Results

The microbiological quality of your water is determined by looking for the presence of bacteria indicative of fecal (sewage) contamination - namely, total coliforms and *Escherichia coli*. Total coliforms occur naturally in soil and in the gut of humans and animals. Thus, their presence in water *may* indicate fecal contamination. *E. coli* are present only in the gut of humans and animals. Their presence therefore indicates *definite* fecal (sewage) pollution.

d) Total Coliforms

The presence of total coliform bacteria in well water is a result of surface water infiltration or seepage from a septic system. According to Health Canada's *Guidelines for Canadian Drinking Water Quality* (Sixth Edition, 1996), the maximum acceptable concentration for drinking water is "0" total coliform bacteria per 100 mL of water. The maximum acceptable concentration for water to be considered potable by in the CanadaGAP Food Safety Manuals is also "0" total coliform bacteria per 100 mL of water. Resample if any total coliforms are found. If the repeat sample contains any coliform bacteria per 100 mL, take corrective action immediately.

e) *E. coli*

Escherichia coli (*E. coli*) appear in water samples recently contaminated by faecal matter; thus, they indicate the possible presence of disease-causing bacteria, viruses or protozoa. Water containing *E. coli* is not safe to drink. **Corrective action is to be taken immediately.** The maximum acceptable concentration of *E. coli* is "0" per 100 mL of water.

f) Corrective Action

Corrective actions for adverse water tests generally include three steps:

- Identify and correct the source of contamination (e.g., working condition of the well; overland flooding due to improper location of well casing or land grading; drifting or leaching of manure due to improper storage; problems with septic or sewage systems).
- Treat the water (e.g. shock chlorination of wells; batch treatment of cisterns or tanks; installing a permanent treatment system).
- Re-test water.

2. Testing Ice

Testing ice is similar to testing water with a few extra considerations:

1. Most public health units will not test ice. Choose an accredited laboratory for testing microbes in water and call first to arrange shipping and analysis.

2. Use a sterile bottle or container with a tight fitting lid. A large bottle with a wide mouth is ideal; however, if the ice cubes do not fit, then sterile sampling bags can be used. If using bags, be careful during handling and transporting that the melted ice does not leak out. Most laboratories will be able to provide you with bottles and detailed instructions. Be sure to read and follow the instructions closely.
3. Do not touch the inside of the bottle, container or the lid. Do not set the lid down and do not rinse out the bottle.
4. The laboratory will need at least 100 mL of water from the ice. Check with the lab to determine the volume of water required. Depending on the size of the ice cubes/pieces and the container, you may need 3 times the volume of ice to yield sufficient water for testing.
5. Refrigerate the sample immediately after collection and have it transported, under refrigerated conditions (e.g., in a cooler with ice packs), to a lab within 24 hours. It is okay for the ice to melt before reaching the lab.
6. Ask the laboratory to test for *E. coli* and total coliforms.

a) Interpreting Test Results

The microbiological quality of ice is determined in the same manner as water and the applicable drinking water standards apply to ice as well. For example, according to Health Canada's *Guidelines for Canadian Drinking Water Quality* the maximum allowable concentration for drinking water is "0" total coliform bacteria per 100 mL of water and "0" *E. coli* per 100 mL. If any total coliforms per 100 mL are detected, determine the cause of contamination and take corrective action as appropriate.

If test results report the presence of *E. coli* and/or total coliforms, **corrective action is to be taken immediately** and the ice is not to be used until follow-up test results confirm that it is safe to use.

3. Testing Agricultural/Surface Water

The CanadaGAP Food Safety Manuals do not require agricultural water testing. However, the procedures below are provided for those who want to test their agricultural water. These suggestions are based on the Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses developed by (CCME).

a) When to Test Agricultural/Surface Water

Surface water quality varies with both time and location. Sampling is only a small snapshot of the big picture, therefore, it is difficult to establish sample frequencies. However, a baseline can be established by sampling 1-2 times per month to determine what would be normal for your source. Thereafter, sample at least three times per season to detect major changes in water quality.

b) When to Test Other Agricultural Water Sources

Water quality in wells or municipal water used as sources for agricultural water does not change as frequently as surface water and generally does not need to be tested as often. One or two annual tests (at least one pre-season) is recommended. Use the water testing procedures described above for testing well water.

c) Procedure for Testing Agricultural/Surface Water

1. Choose a laboratory and call first to arrange shipping and analysis. Choose an accredited laboratory for testing microbes in water.
2. Use a sterile bottle or container with a tight fitting lid. Most laboratories will be able to provide you with bottles and detailed instructions. Be sure to read and follow the instructions closely.

3. Do not touch the inside of the bottle, cup or the lid. Do not set the lid down and do not rinse out the bottle.
4. When sampling surface water, use a clean, dry weighted pail or a sampling cup mounted on a long handle. Collect the water sample from well below the surface. Alternatively, take the sample at the end of the irrigation line; from the sprinkler or open drip tape.
5. Refrigerate the sample immediately after collection and have it transported, under refrigerated conditions (e.g., in a cooler with ice packs), to a lab within 24 hours.
6. Ask the laboratory to test for *E. coli* and total coliforms.

d) Interpreting the Test Results

Different guidelines exist for agricultural water quality. You may refer to a relevant authority (e.g., provincial government guidelines, CCME, etc.).

- Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses - http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html (click on 'Canadian Environmental Quality Guidelines Summary Table' and then choose 'Coliforms, fecal' and 'Coliforms, total Coliforms')

Provincial government guidelines (where available)

- British Columbia - <http://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/food-safety/good-agricultural-practices/4-1-water-quality>
- Alberta - <https://www.alberta.ca/water-quality-guidelines.aspx>
- Manitoba - https://www.gov.mb.ca/waterstewardship/water_quality/quality/pdf/mb_water_quality_standardc_onsultation_draft.pdf
- Ontario - <http://www.omafra.gov.on.ca/english/food/foodsafety/producers/gap-gf-wa-quality.htm>
- Nova Scotia - <http://novascotia.ca/agri/documents/food-safety/factsheet-water-quality.pdf>

If you have consistent problems with agricultural water quality, the best solution is to try and identify and correct the source of the problem. Look for upstream contamination sources such as livestock operations or campsites, or on-site contamination sources such as domestic and wild animals, improper manure or chemical storage and faulty sewage or septic systems. Vegetative buffer zones around ponds and along streams can help by filtering water and slowing down run-off. Ponds can be protected from significant and persistent problems with wildlife by building fences and/or creating steep sides or rocky berms to discourage the nesting of birds.

For serious and persistent water quality problems, site-specific remediation may be possible. Seek advice to avoid harming your crop, your workers or the environment.

4. Composite Water Samples

a) What is a Composite Water Sample?

A composite water sample is simply a physical mixture of individual water samples to form a composite sample, as shown in Figure 1. A single water sample test is performed on the composite, which is used to represent the results of each of the original individual samples.

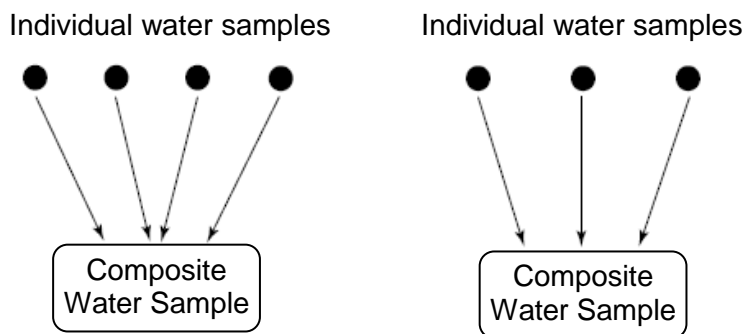


Figure 1: Examples of forming composite water sample from individual water samples.

b) Why Would Composite Samples be Taken?

Composite sampling can substantially reduce costs because the number of required tests are reduced by compositing several samples into one and analyzing the composited sample. By appropriate selection of the composite sample size and retesting of select individual samples, composite sampling may reveal the same information as would otherwise require many more analyses.

The person responsible must show that ALL of their water uses are potable (for water for fluming and cleaning and ice). The only way to do this is to take a water sample test, but this doesn't mean they have to individually test all of them. They can create a composite water sample out of multiple sources (i.e., a variety of storage containers, different packinglines etc.) and test that.

c) How and When Would Composite Samples be Taken?

Individual water sample units would be taken, and a composite sample would be created by physically mixing individual samples. Approximately equal volumes of individual water samples should be used.

Composite samples could be used when there were multiple individual water samples that needed to be tested for potability. For example, for multiple packinglines that each require a potable final rinse, potability would need to be shown for all packinglines. Each packingline could be tested as an individual sample, or one composite sample could be done and potability could be determined using this method.

d) Where Would Composite Samples be Taken From?

The water samples must be taken from specific locations. Final rinse water must be taken from the final rinse equipment. Treated water needs to be taken from where it is being treated to ensure it is being treated appropriately. Water that is being stored needs to be taken from where it is being stored. Water used for all other uses (e.g., to fill ponds, dump tanks, handwashing, etc.) can be taken from the point closest (generally a tap) to the source.

e) When Can Composite Samples NOT be Taken?

When taking composite samples, the sample needs to be a true representation of the water being tested. The sample will need to demonstrate if the water is actually potable or not. Therefore, treated water should not be mixed with untreated water in order to form a composite sample. If this is done, it may create a sample that does not truly indicate the potability of the water. The treated water could react with the untreated water and the composite sample results may show the water to be potable even if it was not. Alternatively, the untreated water could dilute the treated sample and the composite sample results may show the water to be not potable even if it was.

f) What Do the Results from a Composite Sample Mean?

If the results of the composite sample water test show the water is potable, then all individual samples comprising that composite are classified as potable (see Figure 2). When a composite tests positive for total coliforms or *E.coli*, retesting is performed on the individual samples in order to locate the source of contamination.

For example, if multiple individual samples were taken from a number of pieces of final rinse equipment to create a composite sample and sent for water testing, the result would have to show the water was potable. If it was not, one would have to go back to each individual water sample and retest to see which piece of final rinse equipment was contaminated.

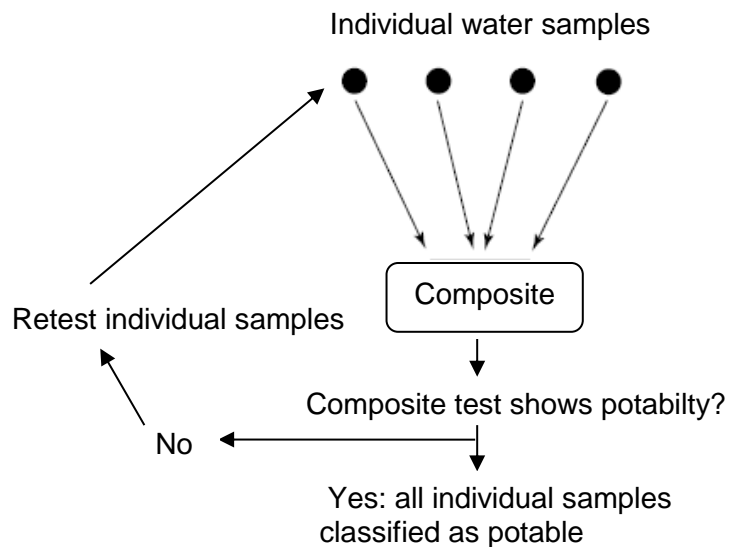


Figure 2: Example of composite sampling

References:

Canadian Council of Ministers of the Environment, Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses. <http://www.ccme.ca>

Health Canada's Guidelines for Canadian Drinking Water Quality. <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html>

Health Canada. What's In Your Well? - A Guide To Well Water Treatment And Maintenance. 2007 [retrieved December 31, 2007]. <http://publications.gc.ca/site/eng/92836/publication.html>

Ontario Ministry of Food and Rural Affairs. Improving On-Farm Food Safety Through Good Irrigation Practices. April 2010 [retrieved December 31, 2007]. <http://www.omafr.gov.on.ca/english/crops/facts/10-037.htm>

Patil, G. P. 2002. Composite sampling. Encyclopedia of Environmetrics, Volume 1, A. H. El-Shaarawi and W. W. Piegorsch, eds. John Wiley & Sons, Chichester, pp. 387-391

H. Cleaning and Treating Cisterns – An Example

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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Note: The procedures below are “general” chlorination procedures. Check applicable guidelines (e.g., provincial/municipal) for chlorination.

A properly constructed cistern that is filled with treated water from an approved source and delivered by an approved/licensed water hauler is likely to provide potable water. The cistern, however, needs to be periodically inspected, cleaned and disinfected. The easiest and most effective solution is to have the cistern cleaned by a licensed professional. If you want to clean the cistern yourself the following procedure can be used as a guide.

1. Procedure for Cleaning Out a Cistern

1. If the cistern is new (i.e., has never been used) clean out all dirt resulting from building the cistern.
2. If the cistern has been in use and is holding water, drain out all the water and remove all sediment.
3. Using a brush or broom, scrub the inside of the cistern (floor and walls) with 50ml (1/4 cup) of 5% chlorine bleach mixed in 45 litres (10 gallons) of water.
4. Run concentrated bleach solution through the system (pipes and taps) and then close the system and allow the solution to remain in the system for 8 hours.
5. Hose down the inside of the cistern with potable water and run potable water through the entire system until you no longer smell bleach. This is important to prevent corrosion of pipes.
6. Drain the cistern.

2. Batch Treatment for Cisterns

If cistern water does not meet water quality standards required for its type and use, treat the cistern and, if possible, identify and correct the source of contamination. To treat a cistern:

1. Add 40 mL of 5% chlorine bleach per 1000 L of water in cistern (or 5 – 6 oz per 1000 gallons).
2. Thoroughly mix the water.
3. Re-test the water.

If the cistern holds surface water collected from a roof or other catchment system, this batch treatment cannot be relied on to keep the water potable. Permanent water treatment devices such as a UV system or chlorine injector may be considered.

References:

City of Hamilton. Testing Private Well Water for Bacteria – Safe Water.

Public Health Ontario. Water Testing. [retrieved July 11, 2016]

<https://www.publichealthontario.ca/en/ServicesAndTools/LaboratoryServices/Pages/Water-testing.aspx>

U.S. Centers for Disease Control. Disinfecting Cisterns and Other Rain-Catchment Systems After Floods. Tsunamis: Water Quality. February 1, 2005 [retrieved December 31, 2007].

<http://www.cdc.gov/healthywater/emergency/drinking/disinfection-cisterns.html>

Conversion factors:

1 litre = 0.22 gallons

1 gallon = 4.54 litres

1 cm = 0.4 inches

1 m = 39.4 inches or 3.28 feet

1 inch = 2.5 cm

1 foot = 30.5 cm

I. Hand Washing Sign Templates

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Note: The following are different templates for hand washing signs. The person responsible may make copies and post the signs that apply to their operation or they may adapt them to suit their needs.

There are also several online resources for hand washing signs.

EXAMPLES:

The United States Department of Agriculture's Foodborne Illness Education Center has many online resources including hand washing signs in different languages. This resource is available at:
http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets?src_location=content&src_page=FSEd

A multilingual hand washing sign is also available from the University of Hawaii at:
<http://www.ctahr.hawaii.edu/NEW/GermCity/TOOLS/HWSPGM7.pdf>

Wash your hands before you return to work!

- Use soap and potable water
- Lather hands with soap up to the elbows and rub hands together for 20 seconds
- Wash back of hands, wrists, between fingers and under fingernails
- Rinse hands with potable water
- Dry with a disposable paper towel
- Put the paper towel in the garbage

OR if potable water is not available:

- Use water on hands
- Dry with a disposable paper towel and put the paper towel in the garbage
- Use hand sanitizer, rub all over front and back of hands, wrists and fingernails

OR if water is not available:

- Use hand wipes
- Be sure to throw used wipes in proper garbage receptacle
- Use hand sanitizer, rub all over front and back of hands, wrists and fingernails

Wash your hands before you return to work!

- Use soap and potable water
- Lather hands with soap up to the elbows and rub hands together for 20 seconds
- Wash back of hands, wrists, between fingers and under fingernails
- Rinse hands with potable water
- Dry with a disposable paper towel
- Put the paper towel in the garbage



Wash your hands before you return to work!

- Use water on hands
- Dry with a disposable paper towel and put the paper towel in the garbage
- Use hand sanitizer, rub all over front and back of hands, wrists and fingernails



Always wash your hands before you return to work!

If water is not available:

- **Use hand wipes**
- **Be sure to throw used wipes in proper garbage receptacle**
- **Use hand sanitizer, rub all over front and back of hands, wrists and fingernails**



**Always clean your hands
using hand wipes and hand sanitizer
before you go back to work**

Please Put Used Toilet Paper in the Toilet



NOT
in the Garbage can.
Thank you

J. Controlled Access Area Sign Templates

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Note: *The following are different templates for controlled access area signs. The person responsible may make copies and post the signs that apply to their operation or they may adapt them to suit their needs.*

**Attention
Authorized
Personnel Only**

**Authorized
Personnel Only**

**All Visitors Must
Sign In**

K. Agricultural Water Source Assessment

NOTE:

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Assess whether the following potential hazards exist in areas adjacent to your water sources. All scenarios should be considered and recorded below. Place a check mark in the appropriate column; describe the hazard (if yes) and actions (if any) taken to reduce the risk.

Are the following items present (place a check mark in the appropriate column)?	Y	N	Specific hazards and location (e.g., cattle grazing on SW side of pond 7; :	Action taken to reduce potential hazard NOTE: The following are options ; there may be other appropriate actions.
Assessment of risks from hazards adjacent to agricultural water sources:				
Upstream contamination sources (e.g., livestock with access to water, campsites)				<input type="checkbox"/> Seek information and cooperation from source of hazard, experts or government on potential risks and solutions <input type="checkbox"/> Water tests <input type="checkbox"/> Other: _____ _____
On-site domestic animal access				<input type="checkbox"/> Seek information and cooperation from source of hazard, experts or government on potential risks and solutions <input type="checkbox"/> Water tests <input type="checkbox"/> Other: _____ _____
Wildlife access				<input type="checkbox"/> Create steep or rocky sides to discourage wildlife from using or nesting in ponds <input type="checkbox"/> Fence ponds <input type="checkbox"/> Water tests <input type="checkbox"/> Other: _____ _____
Sources of sewage contamination (e.g., faulty sewage or septic systems, portable or outdoor toilets)				<input type="checkbox"/> Seek information and cooperation from source of hazard, experts or government on potential risks and solutions <input type="checkbox"/> Call municipality or hire professionals to service sewage or septic system <input type="checkbox"/> Water tests <input type="checkbox"/> Other: _____ _____

Are the following items present (place a check mark in the appropriate column)?	Y	N	Specific hazards and location (e.g., cattle grazing on SW side of pond 7; :	Action taken to reduce potential hazard NOTE: The following are options ; there may be other appropriate actions.
Agronomic inputs (e.g., chemical storages, manure storage, down slope from agricultural fields)				<input type="checkbox"/> Plant vegetative buffer zones to slow down runoff <input type="checkbox"/> Implement or build proper storage facilities for manure and chemicals <input type="checkbox"/> Seek cooperation from neighbours on protecting water sources <input type="checkbox"/> Water tests <input type="checkbox"/> Other: _____ _____

L. Temperature Monitoring For Internal Product and Water Temperature and Thermometer Use - An Example

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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Monitoring Water Temperature and Internal Product Temperature

1. Using the thermometer, take water temperature from the point at which the water will contact the product.
2. Insert the sensing area of the thermometer into the water; do not touch the sides or bottom of the tank.
3. Record this temperature on Form N2.
4. Choose an individual product (e.g., tomato, apple) from as close to the middle of the bin as possible to ensure that it is representative of the rest of the product temperature.
5. Using a thermometer with a metal probe, insert the probe into the centre of the product until the sensing area is completely immersed in the product.
6. Record this temperature on Form N2.
7. Record the temperature differential on Form N2. The product should be **at least** 5.5 °C or 10°F colder than the temperature of the water (i.e., water temperature is **at least** 5.5 °C or 10°F warmer than the product).

Checking the Accuracy of a Thermometer: Thermometers should be routinely checked for accuracy at minimum at the beginning of the season. Follow the manufacturer's instructions that come with the thermometer for checking accuracy and calibration.

If there are no manufacturer's instructions, the following procedure can be used to check the accuracy of a thermometer:

1. Fill a large glass (at least 6" in diameter) with crushed ice. Add cold, clean tap water until the glass is full. Stir the mixture well so that it will be at 0°C or 32°F.
2. Put the end of the clean thermometer or probe stem into the ice water so that the sensing area is completely submerged, but the stem does not touch the bottom or sides of the glass. Wait 30 seconds. The thermometer stem or probe stem must remain in the ice water.
3. The thermometer should read 0°C or 32°F.
4. If not, and if applicable, press the reset button on a digital thermometer to adjust the readout, replace the thermometer or send the thermometer back to the manufacturer for calibration. If the thermometer cannot be calibrated, it should be replaced.

Note: *some thermometers come with certificates of calibration. Keep this calibration certificate on file.*

Type of Thermometer to Use

There are many different types of thermometers available for measuring internal core temperature of product (i.e., tomatoes, apples) and water. In general, avoid thermometers with glass components or mercury. The three main types of food thermometers are digital thermometers, dial (bimetal coil thermometers) and infrared thermometers:

Digital food thermometers come in a wide array of sizes and styles and can be used to measure both water and product temperature.

- Digital pocket thermometers are relatively inexpensive \$10-\$50, easy to find (online or at most department stores or kitchen stores) and easy to use, providing a quick accurate reading. They may not last as long as more expensive models and run on a small battery that must be changed on a regular basis (most last around 1 year). Many cannot be calibrated (check manufacturers' instructions) but can be checked against another thermometer annually to ensure accuracy.
- Larger scientific thermometers are more expensive (\$100-\$300), may last longer and can usually measure a larger temperature range. These thermometers often give faster readings than pocket thermometers.
(Prices as at December 2007.)

Bimetal probe thermometers are inexpensive thermometers with a dial display (not digital). They are not recommended for measuring the internal temperature of product. They are more difficult to read than a digital thermometer, are not quite as accurate, and are designed for measuring a large volume of material because the thermometer reads the average temperature over a portion of the probe (usually two inches). They require frequent calibration, are not appropriate for thin foods and may not be useful for measuring small temperature differences.

Infrared thermometers only measure surface temperature. They do not measure internal temperature of product and are therefore not recommended.

Reliable and accurate types of each can also be purchased by contacting manufactures and checking for dealers in Canada (www.control3.com) or by contacting foodservice supply companies (Ecolab) or scientific supply companies (Fisher Scientific Canada www.fishersci.ca, Canadawide Scientific www.canadawide.ca).

M. Traceability and Product Identification – Some Examples

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

1. What is Traceability?

Traceability is the ability to track products up and down a supply chain. It permits the source of the product to be identified at any stage in the distribution system.

2. How is Traceability Achieved?

Traceability is achieved through two mechanisms: product identification and record keeping. Product identification is a way to physically identify the product so that it can be tracked through the supply/production chain. Records carry the information to tell what the physical identifiers mean.

3. What are the CanadaGAP Traceability Requirements?

All market product must be identified with the correct identifying information (i.e., name and address) of:

- 1) the operation that produced the product, OR
- 2) the operation that packaged the product, OR
- 3) the company for whom it was produced/packaged

This company could be a buyer (e.g., when packing private label for a retailer such as Sobeys), or an operation that does not pack product (e.g., they pay someone else to pack their product).

In addition, the product must be labeled with a Pack ID. The Pack ID must identify, at minimum, who produced the product and when the product is packed. For those who do not pack for others, and already have their company name on the packaging, the Pack ID then only includes when the product was packed. This could be done by hour, day or week depending on the operation. However, identifying product by packing day rather than week will help limit the amount of product that needs to be recalled if a problem occurs.

Pack ID's are usually a combination of letters OR figures, or letters AND figures, and are linked with lot ID's for complete traceability. Lot ID's can complete the traceability system by linking to a field or orchard or further defining the pack ID (e.g., by time, building, production line).

4. Methods for Marking Market Ready Packaging Materials

Different marking methods may be better suited to certain types of packaging. All methods for marking individual packaging materials must contain information identifying who produced the product and when the product was packed. It must resist any stresses the packages may endure (e.g., rinsing, icing) and be appropriate for the type of packaging material used (e.g., permanent marker may not work well with waxed cardboard containers).

a) Permanent Marker

Individuals may create their own coding scheme to identify packages, and manually write this code on each product package using a permanent marker. Most commonly a combination of numbers and letters are used. This can be labour intensive but packing house employees can mark the packaging materials as they fill them with product.

b) Stickers

Stickers are placed on individual packages and may have the code printed from a computer, written manually, be colour coded or any combination of the above. For example, a regular printer could be used to pre-print sheets of dates or date codes. These can then be stuck to each box during packing, palletizing or when wrapping pallets.

c) Stamps

Stamping can be used to place a product code on the individual packages. Date stamps with rotating month, date and year bands can be utilized, or personalized rubber stamps may be used for coding. Colour coded ink can also be used to differentiate between who produced the product or packing dates. For example, a number of operations pack their product into boxes labeled with the name of a different company who sells the product. Each operation is assigned a number and given a rubber stamp with this number. They then stamp each box with the operations number and add a date identifier.

d) Computer Systems and Bar Codes

There are also more sophisticated systems that are tied to computer software packages that are designed for traceability. Often they come with label printers or box printers and the computer will automatically assign codes to a production run. These codes may be bar codes or alphanumeric codes.

A bar code system is a machine-readable method for storing product information. Bar codes are read by barcode scanners or special software, require special printers and are an expensive system to implement.

With automated packing lines, they can be set up by computer to print and automatically attach the codes to the packing materials as they travel along the packing line thus saving employee time. The data tied to each code is then captured and stored in the computer system.

e) Other Methods

Other systems that have been used are coloured handles on product baskets and colour coded stickers or ties for closing plastic bags for products such as carrots.

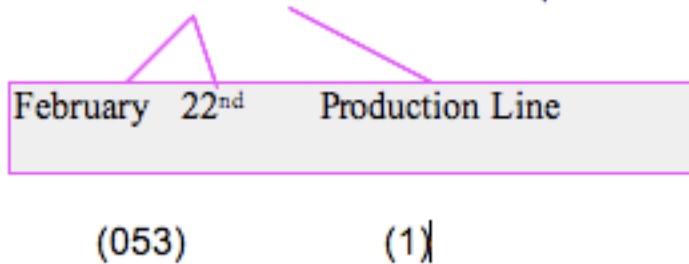
3. Examples of Pack ID Systems and Codes

For some, a coded date is preferable so that only the operation knows what the code means.

a) Using a Julian Code

The Julian date or Julian Day Number (JDN) is the integer number of days that have elapsed since January 1st of a particular year. This will vary for leap years (those years that include February 29th). The JDN is often used for product coding, as seen in the example below, where 053 represents the 53rd day of the year, February 22nd. This particular example also includes an additional lot ID to indicate the production line of the product. This could be replaced with an operation code if being used by someone who packs product for others.

A product coded **053-1** would have been produced on



b) Colour Coding

A colour-coded system can be used. This involves using selected colours to represent selected packing dates or names of who produced the product. This can be done through coloured stickers, tags, stamp ink or markers. Some different examples are included below.

Example 1: An asparagus operation only packs asparagus for four weeks. They use small coloured circle stickers, have four different colours and assign a different colour to each packing week. In the event of a recall they would have to recall a whole week's worth of production but find this acceptable. If they were to pack for others, they could write the initials or the operations code number on the stickers or add an additional stamp to the boxes.

Example 2: Another operation has picked up coloured return address labels that work on their ink-jet printer. They have managed to get these labels in four colours. They print a few pages of labels ahead of time with the following code AM-3. The "A" indicates who produced the product, the "M" indicates the month as May, the colour (e.g., pink) indicates it is the 2nd week of the month, and the "3" indicates the day of the week.

c) Letter and Number Combinations

The most common coding system used is a combination of letters and/or numbers. These codes can range from simple [e.g., (1M3) for operation number one, packed on May 3], to more complex (e.g., 012608AX where 01 is the first month of packing, 2 is the second week of the month, 6 is Friday, 08 is the year, A is the operation and X is the lot code which links to the harvest date). Any combination will work as long as records are kept of what the codes mean.

N. Sanitation Standard Operating Procedures (SSOP) - an Example

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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1. What is an SSOP?

An SSOP is a procedure that explains exactly how a certain cleaning task is completed. CanadaGAP asks for written procedures for activities such as cleaning equipment and packaging materials that will be different from operation to operation. The purpose of the SSOP is to provide enough detail so employees can perform the task correctly by reading the procedure without any additional instruction. It also shows an auditor exactly how the task is performed.

2. What is required when filling in the CanadaGAP SSOP?

In some sections of the manual, such as Section 8. Equipment, step-by-step cleaning procedures must be written down to complete the SSOP. CanadaGAP does not require the person responsible to write full SSOP's. The frequency, monitoring, record keeping, corrective actions and confirmation signature are already in the body of the CanadaGAP manuals in the various sections.

The key elements that must be included in the step-by-step instructions are:

1. Equipment used (e.g., hoses, cloths, buckets, pressure washer, scrub brushes, brooms)
2. Chemicals used (if any) as well as concentrations and mixing instructions (e.g., sanitizers, soaps, is it mixed with water, sprayed on, how much chemical, how it is measured)
3. Step by step procedures clear enough that you could do the cleaning without having to ask any questions.

3. Examples of instructions to complete the CanadaGAP SSOP

Examples of instructions that would meet the requirements for the CanadaGAP manuals are below:

Example A:

1. Use the black hose in the packing barn to rinse the grading table
2. Use the purple scrub brush to scrub the surface of the table
3. Use the hose again to rinse the grading table a second time
4. Allow the table to dry before use

Example B (using cleaning chemicals):

1. Connect the pressure washer to the tap in the packing barn closest to the grading line
2. Use the pressure washer to wash down the entire grading line. Start at the top of the machine and work your way down
3. Ensure that all visible organic matter, including leaves, dirt and other debris are removed from all parts of the grading line
4. Fill the 5 L bucket with water from any tap in the packing barn
5. Add two teaspoons of bleach to the bucket
6. Use the bleach solution and a clean cloth to wash down the stainless steel grading tables. Ensure that the solution is in contact with the table for at least two minutes
7. Allow to air dry

Example C (reusable market ready packaging materials)

1. Only the dark green hard plastic crates are reused for packing market product
2. Dirty crates are stacked on the floor on the left side of the receiving door
3. Sweep any dirt, leaves or organic matter out of the crates with the small hand broom hanging on the wall beside the receiving door
4. Connect the pressure washer to the tap closest to the receiving door
5. Thoroughly wash the inside and outside of each plastic crate with the pressure washer
6. Stack clean crates on pallets on the west wall of the packing barn
7. Allow to air dry before using the clean crates

O. Examples of Backflow Prevention During Mixing of Agricultural Chemicals

NOTE:

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1. What Is Backflow?

Backflow occurs when water flows opposite to its normal direction and can lead to contamination of the original water supply. Backflow can occur when collecting water from a source (well, watercourse, etc.) to combine with agricultural chemicals in a sprayer tank. This can cause chemical contamination of the source water.

2. Preventing Backflow

The following table describes examples of backflow prevention techniques:

Option	Description	Advantage	Disadvantage	Costs/Availability
Use separate water tank	Use an alternate tank to supply water to the sprayer as opposed to filling directly from the well, watercourse, etc. Water is pumped from the source into the water tank and moved to the mixing/ loading area, located an adequate distance from wells and surface water	Complete backflow prevention	Requires an additional step, filling the alternate tank before filling the sprayer tank	Variable cost; the alternate tank should be clean
Anti-backflow device	Install a permanent anti-backflow device on the water supply line to prevent the potential for backflow of chemicals from the sprayer tank. Devices include: double check valve or hose vacuum break valve	Quick solution, requires no monitoring or additional steps after installation	Installation may be complicated, some types are susceptible to damage from debris or freezing	Price ranges from ~\$100.00 to \$800.00; can be purchased from plumbing supply stores or most hardware stores. Watts, Wilkins and Bavco are some companies that produce these valves
Maintain an air gap	A permanently fixed air gap between the water supply line and the sprayer tank can be maintained. The gap must be located a distance of at least twice the diameter of the pipe/ hose, above the topmost rim of the sprayer tank, but the gap distance may never be less than one inch (25 mm)	Requires no additional equipment	Requires some monitoring	No cost

3. Types of Anti-Backflow Devices

The most inexpensive backflow protection option is a hose bibb atmospheric vacuum breaker. It is installed on faucets and hydrants with hose connectors to prevent backflow from a hose. Pressure vacuum breakers may be used on high hazard applications, or applications where valves are located downstream. They often include test cocks that allow for performance checks. However, vacuum breakers must be prevented from freezing when installed outdoors.

Double check valve assemblies are the most common backflow prevention devices used and are best for most non-hazardous situations: These valves have safeguards in two different places and provide a higher level of protection. They are less susceptible to freezing damage and therefore can be installed below ground; however, when debris (sand, clay, insects etc.) becomes lodged in the valve it will fail, so they are less suitable for high hazard applications or when the water source contains debris (e.g., pond, lake).

In cases where there is a high risk of contamination, such as when an operation is connected to a municipal water supply, a reduced pressure zone assembly backflow preventer may be required. These devices have safety checks in place to protect the integrity of the municipal water supply.

4. Where to Place Anti-Backflow Devices

Generally, a backflow preventer should be installed on the line that leads to the cross-connection or potential cross-connection. Exactly where it should be placed depends on the situation. For example, a garden hose connection on a frost-free hydrant would use a hose bib vacuum breaker on the end of the hydrant, at the hose connection. A community pipeline system will often require backflow preventers installed where the community water line enters the operation.

More information and technical assistance on backflow prevention is available in some areas from regional government specialists or through agricultural chemical safety courses.

References:

OMAFRA. 2008. Infosheet #3- Pesticide Handling and Storage. Retrieved online May 2008 from: <http://www.ontariosoilcrop.org/wp-content/uploads/2015/08/EFPInfosheet3.pdf>

WCS AWWA Cross Connection Control Committee. 2007. Frequently Asked Questions Relating to Cross Connection Control. Retrieved online, February 2009 from: <http://www.wcsawwa.net/index.php/backflow-prevention/faqs/>

The Alberta Environmental Farm Plan Company. Where should a backflow prevention device be placed on a water line? Retrieved online, May, 2008 from: http://www.albertaefp.com/n_magazine/tech_talk_0712.php [no longer available online]

P. Customizing Record Keeping Forms

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

The forms provided in the CanadaGAP Manual are templates only. They provide the minimum record keeping requirements but are generic and were designed to apply to all users across Canada. It is recognized, however, that operations and practices differ from one another and that the templates will need to be customized to satisfy the uniqueness of the operation.

Forms can be changed, manipulated or completely replaced with customized versions if it makes it easier to fill them out. **However, all key elements must still be included in the customized forms.** During an audit, an auditor will check that the required information is still being recorded.

Some common ways to manipulate or customize the forms are included below:

1. Reduce the amount of writing required by creating lists of common tasks with check boxes or pre-printing commonly repeated items.

For example, for equipment cleaning tasks, make a list of weekly tasks with places for employees to initial when they have completed the tasks rather than having to write out what was done each time. The dates can be written in ahead of time as in the example below if the weekly cleaning always occurs on the same day each week (e.g., every Sunday).

Packing Barn Weekly Cleaning Record

Date	Floors swept	Packing Line Cleaned	Garbage Emptied	Initials
September 1				
September 7				
September 14				
September 21				

For Forms P1/P2 and Q, which require you to record the packaging materials used, there may be only one type or size of packaging used for that product. If this is the case, the column could be removed and the type of packaging could be written at the top of the page.

2. Combine forms or split them up.

Smaller operations may find it useful to combine forms, while larger operations with many different production areas may find it easier to separate them. In the example below, the person responsible has combined Forms B and G since they have only one building with one storage. The person filling out the form fills in the actual day beside the month when he/she completes the inspection and initials the boxes. Only half of the form is included but this person included space at the bottom of the checklist to write down how and when the storage was cleaned along with any corrective actions that were completed.

Building Interior and Storage	Pre-season	June 1	Jul 2	Aug 1	Sept
No Animals (wild or domestic, pests and birds)					
Lighting shatterproof/protected and adequate to inspect product and cleanliness					
Walls and ceilings in good condition (no holes, crevices or leaks in walls, floor, windows, screens)					
Floor is clean and free of contaminants					
Equipment, oil/fuel, agricultural chemicals, fertilizers are stored and repaired elsewhere					
No leaking/drips onto product or packaging in storage or building interior					

Separate sheets for activities such as maintenance and inspections for each building, storage, or piece of equipment can also be created and kept either in a central location or where they are most likely to be used. Some examples used by others include having a separate Form I for each piece of equipment that is kept in the building where equipment maintenance and calibration is most likely to occur.

In the following example, a separate shipping sheet is filled out for every shipment. All the possible types of product and packaging they ship is already printed on the page. The person loading the vehicle simply adds the quantity and the traceability information.

Shipping Log

Truck ID:
Order Number:

Destination:

Date:

Quantity	Product	Pack ID	Lot ID
	20 lb Romas		
	20 lb Beefsteak		
	11 lb tray Clusters		

Truck inspected (circle) and is acceptable: Yes No

Loader's signature: _____

3. Remove elements if they do not apply to your operation

In the example below, the operation has a rented portable toilet in the field and has records from the rental company when the toilet is cleaned and stocked. They initial these records when the facilities are checked to ensure the cleaning was completed properly. Below is the modified Form J that they use just for the hand sanitizer and hand wipes. They have already put the dates down the side.

J. Cleaning and Maintenance – Personal Hygiene Facilities

Instructions: Record cleaning and maintenance of both exterior and interior washrooms and hand washing facilities. Complete at least weekly (while in use) and daily during peak season for each facility.

Type of Facility and Location: Production Site Hand Sanitizing Station

Date	Time	Items to inspect for (✓)			Employee Responsible
		Hand Wipes	Hand Sanitizer	Garbage emptied	
June 28					
June 29					
June 30					
July 1					
July 2					

4. Use existing records and find creative ways to add the missing information.

Many record-keeping systems that work well are already in place, particularly for packing and shipping. For example, an operation may use a generic bill of lading to record all product shipments. These bills of lading have all the required information for Form O except for the vehicle inspection. Some operations use little coloured stickers to indicate that the inspection has been completed. When the truck with the shipment is inspected and determined to be acceptable, the employee initials and dates the stickers, then sticks them to the bottom of their copy of the bill of lading.

For things like field records, the provided forms do not have to be used at all. The information can be recorded in notebooks or in a computer system. However it can be more difficult to remember what all the required elements are when the forms are not pre-made.

The above are just some examples of how to customize the record keeping forms for an individual operation. It is understood that every operation is different and the templates in the manual are provided to show the necessary information that needs to be recorded. It is more important that the records suit the user's needs so they are more likely to be filled out than for the records to look the same as the templates provided in the CanadaGAP Manual.

Q. Documentation Requirements on Agricultural Chemicals for Exported Product

NOTE:

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If a product is being shipped to another country, it must be ensured that any agricultural chemicals used are registered in the destination country and that they do not exceed the Maximum Residue Levels (MRLs) in that country.

Using a product where the MRL in the receiving country is lower than Canada's MRL for the specified use, or that is registered in Canada but not in the destination country, can lead to trade problems. This rarely occurs with the United States because most MRLs are harmonized or higher in the United States (US). Problems more often occur with countries in Europe or Asia (e.g. Japan).

There are several common ways to show the requirements have been met in the destination country and to obtain appropriate documentation to help decide which chemicals to use and what the MRLs are in various countries.

1. *Documentation from the customer.* Many customers will supply documentation with specific lists of prohibited agricultural chemicals or lists of selected chemicals that can be used. If the customer wants residue testing done, they will also provide a specific request along with which chemicals residues they want tested. This documentation should be kept on file and presented during an audit.
2. *Maximum Residue Levels.* It is up to the exporter to know the MRLs in the receiving country for the agricultural chemicals they are using. MRL lists for various agricultural chemicals, products and countries may be obtained online and/or from the manufacturer. Once the MRLs in the destination country are known, they must then be compared to the MRLs in Canada for the active ingredients that are being used. If the MRLs are the **same** or **higher** in the destination country, then the agricultural chemical can be used according to the Canadian label directions and will still meet the MRL in the destination country. If the MRL in the destination country is **lower** than in Canada, then the person responsible can either choose not to use that chemical or try and find appropriate label directions and application information so they can meet the MRL.

Here is a list of MRL databases:

- a. International MRL Database (but a paid subscription is required to access the site): <http://www.globalmrl.com>
- b. United States Environmental Protection Agency. Grower Priority Database: <https://www.epa.gov/pesticide-registration/grower-priority-database>
- c. The default standard for most countries is the Codex system <http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/>
- d. Database on harmonized MRLs in the European Union: <http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=homepage&language=EN>
- e. United Kingdom MRL database (but a paid subscription is required to access the site): <https://secure.fera.defra.gov.uk/liaison/>

- f. Japanese MRL
database: <http://www.m5.ws001.squarestart.ne.jp/foundation/search.html>
- g. Australian MRL
database: <http://www.comlaw.gov.au/Series/F2012L02501/Compilations>

International pesticide and MRL database Homologa™ is available with information pertaining to international pesticide registrations and residue limits. This comprehensive resource gathers data concerning crop protection products (registration restrictions, approved methods of application, etc.) and current Maximum Residue Limits (MRLs) for 60 countries. Go to <https://v5.homologa.com/en> for more information and to request an account.

- 3. *Product labels:* Product labels in destination countries can be difficult to obtain. Some may be available from the chemical companies who manufacture the agricultural chemical such as Bayer Crop Science or Syngenta. Information on obtaining and interpreting foreign label information can be obtained by calling a customer service representative for the agricultural chemical manufacturer (e.g. Bayer Crop Science). However, since the formulations may differ across countries, the information on the foreign label may not be applicable to a product purchased and manufactured in Canada. For this reason, many agricultural chemical specialists will recommend **not** using agricultural chemicals if the MRL in the destination country is lower than in Canada.
- 4. *Residue Testing:* Residue testing is not required unless the customer demands it. If your customer requires residue testing, testing must be completed at least annually, unless required more frequently, by a laboratory that is accredited to ISO 17025. Call the laboratory to find out if the lab has the proper accreditation and ask them to send you proof of accreditation, either a letter or a copy of the accreditation certificate. Both the Standards Council of Canada (SCC) and The Canadian Association of Laboratory Accreditation (CALA) can perform ISO 17025 accreditation.

Residue testing can be done by the individual, by a group (e.g. an operation testing samples for a group of individuals) or the buyer if the buyer is willing to share the test results as well and information on the accreditation of the laboratory. If the group is responsible for testing, the group can take composite samples from several individuals (e.g. taking a sample from a mixed lot or if 10 tomatoes are needed taking a few from each bin). It is important to record which individuals are included in each sample. Also, units (e.g. each apple) and individuals should be chosen randomly for each sample.

Laboratories are able to conduct multi-residue screens where they screen for a single agricultural chemical or up to 300 chemicals in one test. The amount or size of each sample to be taken will depend on the product and the desired tests. Most tests require approximately one kilogram of product taken randomly. For example, this might mean 10 apples taken from various parts of a bulk bin or a packing line. More information can be obtained by calling the laboratory to discuss which specific tests are required, appropriate ways to collect a sample and the amount of product required for each sample.

If test results indicate that the MRLs exceed what is allowed, then retesting must be done from all the individuals in the original sample and, if possible, each tested individually. If product exceeding the MRL has been shipped then the person responsible initiates the recall process and takes corrective actions according to Section 23 Deviations and Crisis Management.

R. How to Conduct a Mock Recall – An Example

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Periodic mock recalls should be carried out at least annually to evaluate the product recall program. All information obtained during the Mock recall is documented on the **Mock Recall Log***. Mock recalls are used to determine whether the recall procedure is capable of identifying and quickly controlling a given lot of potentially affected product and reconciling the quantities produced, quantities in inventory, and quantities distributed. Mock recalls are used to test all steps of the recall procedure, including identifying where the product went. A mock recall will identify potential problems and allow personnel to become familiar with recall procedures. Use the **Mock Recall Log** to document all corrective actions and deficiencies identified. The steps below and attached sample **Mock Recall Log** can help guide you through the mock recall process:

1. Identify and write down the mock recall scenario. Make up something fairly realistic and be specific about the customer or supplier (where the recall originated) and the specific product to be recalled. **Example:** We determined that when Bravo 500 was sprayed on our cabbage fields on July 5th (9 days ago) the third party applicator also accidentally sprayed two of our spinach fields (fields S9 and S10). Since Bravo 500 is not registered for spinach we need to recall any spinach that has been harvested and distributed from those two fields since we started harvesting on July 12th. **Example:** On August first we received notification from CFIA that their surveillance sampling program found a positive result for *Salmonella poona* on a roma tomato. The roma tomato sample was taken from a distribution warehouse and had the following pack ID: 225AR. We need to find out whose tomatoes are in the affected pack ID's, whether tomatoes from the affected product from the identified delivery date are in any other Pack ID's and where all potentially affected product went.
2. Identify and record who will be involved in the mock recall. For example: John Smith, recall coordinator, will be in charge of the mock recall with help from Jane Brown the field supervisor and Jay White the packing house supervisor. All members of the recall team should participate in a mock recall.
3. Record the time when you start the exercise.
4. Once the particular affected lot is chosen for the scenario, trace the product forward to the customers and, if applicable, back to the field or the operation. Find out how much of that particular lot or pack ID was produced, where it came from and where it was sent. Collect and gather copies of records with the supporting data such as: transportation records (Form O), packing and/or harvesting records (Forms P and Q), agronomic inputs (Forms H1 and H2). The mock recall file also should include the name, address and telephone number of customers and/or suppliers for the lot tested.
5. Keep track of everyone within your organization you contacted to collect each piece of information or where it is stored (e.g. which binder or file in which office). If records are kept electronically keep track of how reports were generated (what is the report called in the software system?) so that it is easy to repeat the process if a real recall occurs.
6. Make copies of the applicable forms from your Recall Program and record how much product was found and where it was found (e.g. 4 skids with each with 50 masters sent to Sobeys on Aug 7).
7. It is recommended that your customers are contacted to ensure that their contact information is accurate etc. At the beginning of the call you would let them know that it is a mock recall/simulation. Write down which customers you would call to get the product back and write down a mock entry. Include company, contact person and phone numbers.

8. Record the time when you finished the exercise.
9. Meet with your recall team to discuss the mock recall, and how things could be improved. Record these findings and create an action plan for continuous improvements. Other topics to discuss during the final review meeting could include what you would do to dispose of the product, media policy, communication strategy, etc.

*A sample **Mock Recall Log** is included on the following page

Ways to make your mock recall more effective and a better learning experience:

1. Timing and frequency: be unpredictable (do not tell staff ahead of time) and schedule the mock recall for busy or inconvenient times. This can give you the most realistic idea of how effective your recall process is.
2. Be Realistic: the more realistic the scenario, the better prepared you will be if something actually happens. Start with a fairly easy scenario, then in subsequent years try and make the scenario more complex.
3. Be comprehensive: include all departments and test all aspects of your recall plan. If possible involve other supply chain partners (e.g. if you pack product involve the individual operations.)

Mock Recall Log

Company Name: _____

Date: _____

START Time: _____

Who participated in the Mock Recall?			Comments
Name	Position	Mock Recall Responsibilities/Duties	
Mock Recall Scenario <ul style="list-style-type: none">- Specific product to be recalled- Customers/suppliers involved			Comments

Contacting Customers/Suppliers

- Identify who/where product was shipped to and who/where it came from
Who would you call to get the products back?

Comments

Company	Contact	Number

**List of applicable records collected/gathered
(Attach all relevant forms)****Where is this information
stored?****Comments**

Finish Time: _____

Identify gaps in your Recall Program and create action plan for improvement

S. Recall Program

NOTE:

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1. Introduction

Everyone involved in the produce supply chain must do their part to ensure that the fruits and vegetables they offer are safe for consumers. Although most fresh fruits and vegetables retain a short shelf life, it is important to establish a recall program within an operation. If a product has been implicated as the source of a problem, accurate information must be readily and easily accessible to aid in the recall process.

Users following any of the CanadaGAP manuals will have a traceability system in place whereby packaging materials have a pack ID and have been identified (name/address). However, if a problem were to occur, the person responsible requires a means to recall product, thus the need for a recall program.

2. Program Components

An effective program includes, as a minimum, the following elements:

1. Name(s) and contact information of the recall coordinator(s) and recall team.
2. Written step-by-step procedures to be followed during a recall:
 - Record the reason for the recall and the health risk **(Form 1 – Recall Information)**.
 - Halt distribution of the product and isolate the quantities still within the operation.
 - Identify the product and determine the quantities involved **(Form 2 – Product Information)**.
 - Identify who needs to be contacted **(Form 3 – Contact Information)**.
 - Communicate with the parties concerned **(Forms 4A and 4B – Recall Notifications)**.
 - Recall the product **(Form 5 – Product Retrieval)**.
 - Properly dispose of all contaminated product.
 - Determine preventative plans and review effectiveness of recall **(Form 6 – Follow-Up Plan)**.

It is very important to keep accurate and complete records during the recall process. A recall is terminated when both CFIA and the recalling person responsible agree that the recalled product has been effectively removed from the supply chain and that the proper disposition and/or corrective action(s) have been completed.

References:

Canadian Food Inspection Agency (CFIA) Recall Procedure:
<http://www.inspection.gc.ca/food/food-safety-and-emergency-response/recall-procedure/eng/1535516097375/1535516168226>

FORM 1

RECALL INFORMATION

Recall Coordinator: _____

Contact Information: _____

Date/Time: _____

Reason for Recall: Describe the reason for the recall (biological, chemical or physical contamination) and how the product deficiency was discovered.

Hazard Assessment: The CFIA will assess the health risk and rank according to the following classifications:

Class 1: A *reasonable* possibility of *serious adverse* health consequences.

Class 2: A *remote* possibility of *serious adverse* health consequences.
A possibility of *temporary adverse* health consequences.

Class 3: A *low* possibility of *adverse* health consequences.

** Go to the following CFIA website for complete definitions: <http://inspection.gc.ca/food/safe-food-production-systems/food-recall-and-emergency-response/food-manual/eng/1378402475724/1378403080658?chap=12>

FORM 2

PRODUCT INFORMATION

Product	Lot Number/ Code/Date	Lot Quantity	Shipped To			Quantity Shipped and Requiring Recovery
			Name/Location	Date Shipped	Quantity Left On-Farm	
					TOTAL=	

FORM 3

CONTACT INFORMATION

Canadian Food Inspection Agency (CFIA)

When there is a potential food recall, the CFIA Area/Regional Recall Coordinators/Contacts must be notified. They will help with the recall process and will determine the recall class and course of action.

Website: www.inspection.gc.ca	1-800-442-2342
Nova Scotia, Newfoundland and Labrador, Prince Edward Island & New Brunswick	506-381-7683
Quebec	866-806-4115
Ontario	416-665-5049
Manitoba	204-797-4501
Saskatchewan	306-529-0671
Alberta	587-230-2518
British Columbia	604-292-5780

Who needs to be contacted? (Person responsible keeps a complete list of customer contacts available)

Who?	(✓ all applicable)	Why?
CFIA Contact	✓	Contact will help with recall process
Person Who Produced the Product		
Provincial/Territorial Association/Organization		
Person Who Packed the Product		
Wholesaler		
Broker		
Certification Body		
Retailer		
Foodservice		
Consumer		
Other (e.g., CanadaGAP, law enforcement, etc.)		

Other Communications

	Yes	No
Press Release		
Public Notification		
Other (specify):		

FORM 4A

RECALL NOTIFICATION – Via Phone

The following information is to aid you when contacting people to recall your product. Fill out one sheet for each group contacted.

This is _____ . I am calling from _____
Name of Recall Coordinator *your operation's name*
to notify you that all product _____ on _____ needs to be
lot # *date/time*

returned, destroyed, modified, etc.

I have the following questions to ask you about this recall:

1. Who do I speak to about a recall and what is their contact information?

Contact (name): _____

Phone Number: _____

Fax Number: _____

Title: _____

2. Do you have any of the product(s) being recalled? (If no, terminate questioning)

_____ YES _____ NO

If the answer to question #2 is YES, the product must be _____
returned, destroyed, modified, etc.

3. The _____ of this product will be dealt with by
return, destruction, modification, etc.

action intended

4. Have you received any reports of illness or injury related to this product?

_____ YES _____ NO

If yes, please provide details.

Thank you for your time.

Confirmation Signature: _____ **Date:** _____

Form 4B

RECALL NOTIFICATION – Via Written Correspondence

Template

Urgent - Recall of (name of Product)

(Name and address of your company)
(date)

Dear Customer,

or

Attention: (name of customer contact)

(Your company name) is recalling the products listed below because they may contain (name the problem, e.g. an ingredient which may cause an allergic reaction and is not declared on the label, bacteria, foreign pieces of material).

This table is a checklist for the recalled products listed below.

Product Name	Brand	Size	Code, Best Before date, UPC

Please discontinue selling these products *immediately* by removing them from display, counting the amount in your inventory and storing them in a secure place.

Please contact all accounts to which you sell this product immediately and inform them of this recall.

(Your company name) staff will credit you for the recalled product. Please mark the product "**Recalled**" and (your company name) staff will call you to arrange pick up.

Important

Please record the time and date you received this Recall Notice and acknowledge receipt by signing and faxing this document to (your company name) at (your company fax number).

Date / Time Received:_____ Signature:_____

Name of store / Distributor:_____

Thank you for your cooperation.

(Signature)

(your company's contact, their position, your company name)

FORM 5

PRODUCT RETRIEVAL

Quantity Shipped and Requiring Recovery (from Form 2)	Date/ Time (from Form 4)	Person Contacted	Quantity Recovered or Destroyed	Quantity Remaining With Contact	Action Taken and Description (e.g., picked up, returned, destroyed, etc.)	Total Quantity Recovered (should be the same as column#1)
					TOTAL =	
					(Total to equal the total on Form 2)	

FORM 6

FOLLOW-UP PLAN

Post Recall Review - Preventive Plan

1. Why was there a recall (i.e., what was the source of the problem)?

2. What corrective action(s) was/were taken? (*List and describe*)

3. What ongoing procedures did you put in place to prevent recurrence of the problem?

4. Identify the person(s) responsible for ensuring the above actions and procedures are monitored and implemented.

Post Recall Review - Effectiveness of the Recall

5. How effective was the implementation of the recall?

6. Identify any problems experienced during the recall implementation.

7. How was the recall program amended to address any problems identified?

Confirmation Signature: _____ **Date:** _____

T. Food Defense: Assessment of Possible Risks and List of Security Measures

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
--------------	--

Assess whether the following potential food defense/security risk factors exist in your operation. Choose from the list of possible corrective actions to reduce the risk. You may already have measures and/or tools in place, and not all measures will be appropriate for every operation.

Place a check mark in the appropriate column; describe the risk (if yes) and actions (if any) taken to reduce the potential risk.

Could there be a risk in the following category (check the Y/N)?	Y	N	If YES, give details of what the risk may be	Action(s) taken to reduce potential risk NOTE: The following are options ; there may be other appropriate actions.
Assessment of Outside Security Risks				
Physical Security (e.g., door locks, lighting, etc.)				<input type="checkbox"/> Ensure proper lighting to monitor the establishment outdoors at night and early morning. <input type="checkbox"/> Protect perimeter access <input type="checkbox"/> Install self-locking doors and/or alarms on emergency exits. <input type="checkbox"/> Ensure doors, windows, roof openings/hatches, storage tanks etc., are secured <input type="checkbox"/> Regularly conduct and document security inspections of storage facilities, including temporary storage vehicles. <input type="checkbox"/> Restrict outdoor access to water wells/sources. <input type="checkbox"/> Other: _____ <input type="checkbox"/> Other: _____
Entry of inputs/product (e.g., monitoring loading/unloading etc.)				<input type="checkbox"/> Closely monitor loading and unloading of vehicles <input type="checkbox"/> Control access to loading docks to avoid unverified or unauthorized deliveries. <input type="checkbox"/> Keep parking areas separate from entrances to storage and packing/storing areas <input type="checkbox"/> Require advance notification from suppliers for all deliveries. Check all deliveries. <input type="checkbox"/> Hold unscheduled deliveries outside establishment premises pending verification. <input type="checkbox"/> Require drivers or delivery personnel to provide identification, preferably with a photo ID. <input type="checkbox"/> Other: _____

Assessment of Inside Security Risks

General Security (e.g., signs, observations, areas, etc.)			<input type="checkbox"/> Suspicious packages are reported to appropriate personnel <input type="checkbox"/> Clearly identify controlled access areas of the establishment <input type="checkbox"/> Previously unattended materials are checked before use <input type="checkbox"/> Increase visibility within the establishment (e.g., improve lighting, openness, increase supervision, add cameras). <input type="checkbox"/> Restrict access to controls for the following systems (HVAC, propane, natural gas, water, disinfection systems etc.) <input type="checkbox"/> Restrict access to market ready product <input type="checkbox"/> Other: _____
Storage Security (e.g., controlled access)			<input type="checkbox"/> Access to storage areas is controlled <input type="checkbox"/> Keep track of incoming materials and materials in use <input type="checkbox"/> Labels and packaging materials are controlled to prevent theft and misuse <input type="checkbox"/> Periodic examinations for tampering of materials in storage(s) are performed <input type="checkbox"/> Other: _____
Water/Ice Security			<input type="checkbox"/> Restrict access to storage tanks for potable water and to water reuse systems. <input type="checkbox"/> Access to ice-making equipment is controlled <input type="checkbox"/> Supplier food safety/security information is requested <input type="checkbox"/> Restrict access to product and packaging storage areas to designated employees only <input type="checkbox"/> Inspect water lines for possible tampering <input type="checkbox"/> Make arrangements with local health officials to ensure immediate notification to the establishment if the potability of the municipal water supply is compromised. <input type="checkbox"/> Other: _____
Agricultural Chemical/ Cleaning and Maintenance Materials Control Security			<input type="checkbox"/> Agricultural Chemicals are in a controlled access area or secured by a lock <input type="checkbox"/> Cleaning and Maintenance materials are stored properly <input type="checkbox"/> Maintain an up-to-date inventory of materials and investigate discrepancies. <input type="checkbox"/> Potentially hazardous waste (biological or chemical) is controlled and disposed of properly <input type="checkbox"/> Other: _____

Information Security			<input type="checkbox"/> Keep details of food defense/security procedures confidential as necessary. <input type="checkbox"/> Have up-to-date operation sketches/layout/blueprints for local law enforcement, including the fire department if needed. <input type="checkbox"/> Access to sensitive information such as site plans is controlled <input type="checkbox"/> Access to computer systems is protected through firewalls and/or passwords. <input type="checkbox"/> Validate the computer security system. <input type="checkbox"/> Other: _____ _____
Assessment of Personnel Security Risks			
Personnel Security (e.g., check references, use visitor log, check IDs, etc.)			<input type="checkbox"/> A method to recognize or identify employees and/or visitors is in place <input type="checkbox"/> Background or reference checks are conducted for new hires <input type="checkbox"/> Employees and/or visitors have restrictions on what they can bring in or take from the operation <input type="checkbox"/> Employees are not permitted to lock their lockers (if applicable) <input type="checkbox"/> Maintain employee records <input type="checkbox"/> Maintain visitor logs <input type="checkbox"/> Awareness training on security measures is provided <input type="checkbox"/> Employees are trained to report suspicious activities or unusual observations <input type="checkbox"/> Provide an appropriate level of supervision to employees <input type="checkbox"/> Other: _____ _____
Assessment of Threat/Incident Response			
Threat/Incident Response (e.g., reference your security plan, etc.)			<input type="checkbox"/> Establish procedures for responding to threats/incidents <input type="checkbox"/> Establish evacuation procedures and include in food defense/security plan. <input type="checkbox"/> Have procedures to ensure that adulterated or potentially harmful inputs/products are held. <input type="checkbox"/> Customer/consumer comments are investigated <input type="checkbox"/> Reporting unusual activities is encouraged <input type="checkbox"/> Product recall program is in place <input type="checkbox"/> Employees have the ability to stop activities to minimize a potential food defense incident/threat <input type="checkbox"/> Personnel and emergency contact information is kept up to date (including police/fire/ambulance) <input type="checkbox"/> Other: _____ _____

Resources Available:

U.S. Food and Drug Administration. Food Defense Plan Builder
<http://www.fda.gov/Food/FoodDefense/ToolsEducationalMaterials/ucm349888.htm>

References:

United States Department of Agriculture. Food Defense Plan: Security Measures for Food Defense.
<http://www.fsis.usda.gov/wps/wcm/connect/673736b4-dd67-464f-a565-57f42fd984bd/Form-5420-5-General-Food-Defense-Plan.pdf?MOD=AJPERES>. Sept 2009.

U.S. Food and Drug Administration. Guidance for Industry: Food Producers, Processors, and Transporters: Food Security Preventive Measures Guidance. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-security-preventive-measures-guidance-food-producers-processors-and>. Oct 2007.

U. Introduction on How to Assess Risk - with Examples

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

Assessing the risks that may be present in your operation is a useful tool in determining hazards that may exist. These risks can help to determine the likelihood of undesirable events, and possible consequences of these events.

Definitions:

Hazard: A condition or circumstance having the potential to cause harm. Hazards can be physical, chemical or biological. In terms of food safety, a hazard can be defined as a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Biological – e.g., bacteria [i.e., *E.coli*, *Salmonella* etc.], viruses [i.e., Hepatitis A etc.] or parasites

Physical – e.g., glass, metal, wood splinters, hard plastic, jewellery parts, etc.

Chemical – e.g., agricultural chemicals, fuel, heavy metals, cleaners, fuel, lubricants, etc.

Risk: The likelihood of the occurrence and the magnitude of the consequences of exposure to a hazard on human health. Risk can also be defined as “a function of the probability of an adverse effect and the magnitude of that effect, consequential to a hazard(s) in food” (FAO and WHO, 1995).

Likelihood: It is the probability or the chance that a certain risk can occur. Likelihood could be described in a variety of ways. For example, it could be categorized as high, medium and low or by rating it as likely, probable, possible, remote or improbable.

Why is it important to assess risk?

The purpose of assessing risk is to remove a hazard or reduce the level of its risk by adding preventative or control measures, as necessary. Once hazards are identified at specific points within a product's flow through an operation, these hazards can be prevented, eliminated, or reduced to acceptable levels. Once a hazard has been identified, an operation can be mindful of the hazard and possible risks associated with them.

How do you assess risk?

1. Identify process steps/inputs

Step: A process step is a point, procedure, operation, or stage in the food chain from primary production to packing to storage to transportation (e.g., spreading of manure, harvesting of product, etc.)

Input: Any input to the process. These are resources that are put into the system (e.g., manure, water, commodity starter products etc.).

In order to identify the risk, one needs to pick a step or input. Once a step or input has been identified, you can move on to identifying hazards.

2. Identify the hazards

Once inputs and steps have been determined, the next step would be to identify any hazards associated with these inputs/steps. A hazard is something that might be harmful and may result in either biological, chemical or physical contamination of the product if not controlled. The hazard may have a direct impact on the product (e.g., unclean packing line, employee's dirty hands, etc.) or an indirect impact on food safety (e.g., unlocked agricultural chemical shed, allowing random visitor access, etc.). All hazards specific to an operation should be considered.

3. Identify the likelihood and severity of the risk

Once the hazards have been identified, the likelihood of the hazard occurring and the severity of the risks associated with the hazards should be taken into consideration. The likelihood of the hazard occurring should be determined in some way, e.g., is there a high (expected to occur most of the time), medium (expected to occur many of the times) or low chance (expected to occur some of the time) that the hazard will occur. The severity of the risk can be determined by considering how serious the outcome of the potential risk occurring will be, for example, the outcome could be categorized as catastrophic, critical, moderate, negligible.

4. Identify the preventative and/or control measures

Once you have identified possible hazards and the likelihood of these hazards occurring along with the severity of the potential outcome, you must then determine what controls or preventative measures you can put in place to eliminate the hazards or reduce them to a safe, acceptable level. The preventative measures and/or controls must be practical and relevant.

What to consider when assessing risk

Risks will be different for every operation since all operations are unique and will have different hazards. When considering how to assess risk the person responsible would need to consider all aspects in the production/packing/storing of fruits and vegetables, including all possible inputs and steps.

Possible inputs could include:

- agronomic inputs (e.g., manure, compost/compost teas, agricultural chemicals, mulch and row cover materials, trap crops, commercial fertilizers, commodity starter products, pulp sludge, soil amendments, other by-products etc.)
- water (agricultural water and water for fluming and cleaning)
- water treatment aids
- ice
- packaging materials (both harvested product and market ready)

Possible steps could include steps carried out before/during production, during packing, during storage and during transporting. These could include:

- purchasing and receiving
- spreading (manure, compost etc.)
- applying agricultural chemicals
- storing (agronomic inputs, water, packaging materials, product etc.)
- irrigating/fertigating/chemigating
- harvesting
- washing/hydro-cooling/fluming/rinsing
- sorting and grading of product
- packing
- transportation

Examples of how to assess risks in an operation:

Example #1

Step 1: Identify steps/inputs

Step – Application of agricultural chemicals in the production site.

Step 2: Identify the hazards

One hazard associated with the application of agricultural chemicals in the production site, could be chemical contamination of the product because the spray equipment wasn't cleaned between applications of different agricultural chemicals. The agricultural chemical that was first used in the equipment might not be registered for use on the product you are applying a different chemical to. Since it wasn't cleaned properly between applications, the product will now become contaminated.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring would high (expected to occur most of the time) as there is no way to avoid the hazard without using a preventative measure.

Step 4: Identify the preventative/control measures

This hazard could be controlled by the person responsible rinsing and flushing the agricultural chemical application equipment between different chemical applications according to the label instructions.

Example #2

Step 1: Identify steps/inputs

Input – Ice

Step 2: Identify the hazards

One hazard associated with ice as an input could be physical contamination of product because there are physical contaminants (e.g., glass) in the ice. When this ice is used on the product, the glass could be transferred to the product, and it could become contaminated.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring is low (expected to occur some of the time). Something really needs to go wrong with the ice making process for glass to be within the ice.

Step 4: Identify the preventative/control measures

This hazard could be prevented by the person responsible buying ice from a supplier and asking for a letter of assurance that states that the ice was made under conditions that are not a source of contamination.

Example #3

Step 1: Identify steps/inputs

Step – Harvesting of product

Step 2: Identify the hazards

One hazard associated with the manual harvesting of product could be biological contamination of product from employees who are not following proper personal hygiene practices (e.g., not washing their hands after using the washroom). The product in this case could become contaminated by the employees' hands.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring would be high (expected to occur most of the time) as there is direct contact with the product by the employees hands.

Step 4: Identify the preventative/control measures

This hazard could be prevented by the person responsible providing training to employees on personal hygiene practices (e.g., when and how to wash their hands, etc.). The person responsible could observe employees for compliance with personal hygiene policies.

Example #4

Step 1: Identify steps/inputs

Step – Holding of harvested or market product

Step 2: Identify the hazards

One possible hazard associated with the holding of harvested or market product could be biological contamination of product from air that is being pushed out from a nearby henhouse. The building could have fans that blow air outside. If the product was held in a location underneath or near where the air was blowing, the product could become contaminated as dust or debris that is contaminated with pathogenic organisms (*Salmonella* or other bacteria) landed on the product.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring would be high (expected to occur most of the time) as there is direct contact with the product by the blowing air which has been shown to contain pathogens.

Step 4: Identify the preventative/control measures

This hazard could be controlled by setting up procedures so that product is not ever held near where the fans were blowing air. The containers that will hold this product should not be transported through this area. Procedures could be put into place to reduce the risk of spreading of dust or debris (e.g., feathers etc.) that might be a source of biological contamination.

Example #5

Step 1: Identify steps/inputs

Step – Manure Storage

Step 2: Identify the hazards

One possible hazard associated with manure storage could be biological contamination of product from the manure storage location. If there is a production site that is located near the manure storage there could be a risk of manure being transported into the production site (drifting, leaching, cross-contamination, etc.) and causing contamination of product. The manure could be transported through people's shoes, wheels of production site equipment (e.g., tractors), rain, etc.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring would be high (expected to occur most of the time) as the manure will wash away in the rain and can be carried on feet if traveled through.

Step 4: Identify the preventative/control measures

This hazard could be controlled by moving the manure storage location (especially for the hazard of rain washing manure away). If rain is not an issue, then employees could be trained not to walk in the areas that may allow for manure to be transported onto their shoes. Procedures should be in place to restrict the movement of employees and equipment through the area that might be contaminated with manure.

Example #6

Step 1: Identify steps/inputs

Step – Harvesting of product

Step 2: Identify the hazards

One hazard associated with harvesting product could be biological contamination in a U-pick operation where there is an area of the operation that holds animals and is used as a petting zoo. Biological contamination could arise if visitors are petting the animals (goats, sheep, etc.) and then proceeding to the production site to pick product.

Step 3: Identify the likelihood and severity of the hazard

The likelihood of this hazard occurring would be high (expected to occur most of the time) as there is direct contact with the product from potentially contaminated hands.

Step 4: Identify the preventative/control measures

This hazard could be prevented by having a clear hand washing policy for the visitors and having properly maintained and cleaned hand washing facilities. The visitors should be aware of the hazards and have access to appropriate facilities.

References

FAO and WHO, 1995. Application of Risk Analysis to Food Standards Issues. Report of the joint FAO/WHO expert consultation. Geneva, Switzerland, 13-17 March 1995. WHO, Geneva.

Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA). 2001. Food Safety Risk Assessment.

V. Repacking and Wholesale Generic HACCP Model Workbook – An Example

NOTE:

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Repacking and Wholesale Generic HACCP Model Workbook for Fresh Fruits and Vegetables

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A. INSTRUCTIONS

Generic Standard workbook – Introduction

What is HACCP?

How to Develop a HACCP Plan

How to Complete the HACCP Workbook

B. Generic HACCP Model Workbook

The Workbook provides a flexible template for an operator to customize a company specific HACCP Plan within the limits of the identified product descriptions and process flow steps as defined by the Repacking and Wholesale Food Safety Generic HACCP Plan.

What is HACCP?

Hazard Analysis Critical Control Point (HACCP) is a systematic and preventative approach to achieve food safety standards. HACCP is a system based on Codex Alimentarius Commission - A subsidiary body of the Food and Agriculture Organization and the World Health Organization of the United Nations, which provides a recognized system of standards. <http://www.fao.org/docrep/005/y1579e/y1579e03.htm>

The Food Safety Enhancement Program (FSEP) is the Canadian Food Inspection Agency's approach to encourage and support the development, implementation and maintenance of HACCP systems. Additional generic FSEP HACCP programs can be found at <http://www.inspection.gc.ca/food/fsep-haccp/eng/1299855874288/1299859914238>

A complete HACCP Program includes a documented, verified standard and identifies potential hazards with a HACCP Plan

How to Develop a HACCP Plan

1. Read and understand the contents of the Repacking and Wholesale Generic HACCP Model.
2. Follow the Principles of HACCP to create a company and market product
 - Form 1: Describe your product (market product)
 - Form 2: Identify other inputs
 - Form 3: Describe & create a diagram for the process
 - Form 4: Create a diagram of your facility and show the people and flows
 - Form 5: Identify Biological Hazards & Controls
 - Form 6: Identify Chemical Hazards & Controls
 - Form 7: Identify Physical Hazards & Controls
 - Form 8: Identify any Critical Control Points
 - Form 9: Additional Control Measures
 - Form 10: HACCP Plan
3. Analyze your product categories and product flows from start (supplier approval) to finish (shipping) to identify hazards that are not covered by the Repacking and Wholesale Generic HACCP Model or any other generic models.
4. Maintain all necessary records and written procedures.
5. Review the HACCP Plan when operational changes occur and/or at a minimum on a yearly basis to ensure it reflects company conditions.

How to Complete the HACCP Workbook

1. Read and understand the contents of the Repacking and Wholesale Generic HACCP Model.
2. Complete the steps when completing each provided instructional page and blank form using the Repacking and Wholesale Generic HACCP Model as a guide.
3. Customize the contents of the Workbook to reflect your company's operations.

This Workbook Includes, for Each One of the Ten Forms

1. A purpose statement about the corresponding form and instructional steps that explain how the form is to be completed. This instructional page is useful in determining what next steps will be required for each specific form. The instructional step pages can be completed by a food safety team member and approved by the organization's senior management (owner, general manager, etc.).
2. A blank Form to be company customized

**Title: Form 1 – Product Description**Code: **FR-001**

Completed/Amended Date:

By:

Approved By: Date:

Form 1 identifies the Important Product Characteristics, End Use, Packaging, Shelf life, How & Where it will be sold, Labelling instructions, and Transportation and Special distribution control. This is to identify specific food safety related concerns (i.e. special temperature controls, allergens, modified atmosphere packaging).

Some market product have important characteristics that may warrant a separate HACCP program e.g. Apples, Tomatoes, Leafy Greens, Cantaloupes and Musk Melons

Step 1:

Product Description: Market Products: descriptions identified in the Generic HACCP Model.

Step 2:

Complete a Form 1 for each identified product description(s) (using the Repacking and Wholesale Generic HACCP Model - Form 1 as a guide).

(Note: You may need more than one Form 1; e.g. your company may choose to separate market product that is considered high risk)

If you handle products that are not part of the Repacking and Wholesale Generic HACCP Model; you will need to create separate HACCP programs for food products not covered under the Repacking and Wholesale Generic HACCP Model.

Ensure that the hazard analyses for these other products are accurate. This may be accomplished with other generic models; or further HACCP education and/or analysis and/or by consulting a HACCP expert for assistance.

Step 3:

Proceed to Form 2.

Company Name:	Title: Form 1 – Product Description	
	Code: FR-001	
	Completed/Amended By:	Date:
	Approved By:	Date:
<p style="text-align: center;">PRODUCT DESCRIPTION Market product: Packed Fresh Fruits and Vegetables</p>		
1. Product Name(s)		
2. Important product characteristics		
3. End Use		
4. Packaging		
5. Shelf life		
6. How & Where it will be sold		
7. Labelling instructions		
8. Transportation and Special Distribution Control		



Title: Form 2 – List of Product Ingredients and Incoming Materials

Code: **FR-002**

Completed By:

Date:

Approved By:

Date:

Form 2 lists four groups of product ingredients and incoming materials.
This is to identify that all the products are accounted for in the product descriptions.

Step 1:

The first column, first section of Form 2 is Market Product

Step 2:

The first column, second section of Form 2 is Packaging Materials & Accessories
Identify and list all the materials used in your company; add any that are not on the list

Step 3:

The second column, first section identifies Other Ingredients

Identify and list all the materials used in your company; add any that are not on the list

Step 4:

The second column, second section identifies Other Incoming Materials

Identify and list all the materials used in your company; add any that are not on the list

The generic HACCP model does not identify hazards related to non-listed ingredients, ensure that the analysis is accurate with HACCP analysis and/or by consulting a HACCP expert for assistance.

Step 5:

Proceed to Form 3.



Title: Form 3 – Repacking, Wholesale, and Transportation Flow Diagram

Code: **FR-003**

Completed By:

Date:

Approved By:

Date:

Form 3 is a diagram of how product flows through your operation. This analysis will assist in identifying any handling and/or any other control of hazards during the flow of product within your operation.

Step 1:

Identify the Inputs & Process Steps from your operation.

Inputs:

Market Product

Water

Water Treatment Aids

Ice

Packaging Materials and Accessories

Transport and Storage Aids

Processes:

Purchasing/Selecting

Receiving

Storing

Using

Transporting

If company repacks:

Repacking Activities:

Trimming, Sorting & Grading, Repacking/labelling /palletizing, Waste Disposal

(Note: Ensure that your company specific flow diagram is representative of the correct steps and their corresponding order of occurrence.)

Step 4:

Proceed to Form 4

Company Name:	Title: Form 3 – Repacking, Wholesale, and Transportation Flow Diagram	
	Code: FR-003	
	Completed By:	Date:
	Approved By:	Date:

**REPACKING, WHOLESALE AND TRANSPORTATION PROCESS
FLOW DIAGRAM FOR MARKET PRODUCT**

Form 4 identifies product and employee flow within an operation. Reviewing the flow of product and employee flow allows you to identify potential areas of cross contamination or other problems that are related to food safety.

Form 4 Instructions

Steps

1) Create a building schematic

- a) Create a schematic diagram
- b) Indicate the location of production and storage areas, receiving and shipping docks, locker rooms, lunchrooms and offices.
- c) Walk through facility and Verify

2) Add Movement through facility

a) People

- Employees
 - Enter building
 - Drop their personal effects in lockers or other designated areas, and then prepare for their assignments; this could include changing their clothes and shoes.
 - Before entering the production area, they wash their hands
 - During their shifts they will also use
 - Break or lunchrooms
 - Sanitary facilities i.e. bathrooms or wash stations
- People flow is dependent on their roles
 - Supervisors may also enter the offices.
 - Maintenance personnel will enter the maintenance area and then proceed to the production area when required.
 - Receivers & Shippers, Forklift operators and all personnel have different traffic patterns; these must be included in the people flow diagram. If office personnel enter the food contact areas, they should be included.
- Visitors should also be included in the traffic flow. Visitors include buyers, third party service providers e.g. pest control, maintenance, HVAC etc.

b) Market product

Market product movement from receiving through all the relevant process steps (Form 3) until it leaves the company must be included

c) All other incoming materials

From receiving, storage, usage & exit if applicable

- Agricultural chemicals
- Cleaning & maintenance materials
- Water Treatment Chemicals
 - Packaging Materials & Accessories

- Transport Aids
- Ice
- Water
- Personnel Protective Supplies

d) Waste

Indicate from where waste is created and show the movement until it leaves the building. Include waste from all areas including offices and labs, if applicable.

Walk through facility and Verify Flow Patterns

It is advisable to use different colours to show flow of different processes.

3) Identify potential sources of contamination

- Examine your plant schematic to see if there are any areas of potential cross contamination.
 - Do the paths of market product cross?
 - Does waste or chemicals come in contact with market product or any food contact materials?
 - If any lines cross, there is a potential for cross contamination.
- Add these points to the diagram and identify the B, C, P hazards
- Record these points in Forms 5, 6, 7; transfer to Form 8 for analysis

4) Manage the potential sources of contamination

Can or should any of the traffic flows be altered to reduce points of potential contamination?

e.g.

Sanitation occurs after the shifts have ended and all the market product and materials have been properly stored.

Can the activities be separated by time?

e.g.

Waste is not on the docks at the same time when receiving and shipping activities occur

Chemicals are not received at the same time as market product

5) Review Form 4 at a minimum annually or whenever changes occur that affect the food safety traffic flow

(Note: Due to the size and complexity of your operation, the blank Form 4 provided may not be of adequate size.)

Step 6: Proceed to Form 5

Company Name:	Title: Form 4 – Plant Schematic	
	Code: FR-004	
	Completed By:	Date:
	Approved By:	Date:

PLANT SCHEMATIC

Form 5 identifies the biological hazards that are associated with the market product. It also identifies where and how the biological hazards could be controlled. The analysis for the Form 1 (of the Repacking and Wholesale Generic HACCP Model) and the relevant market product process steps (listed on Form 3 of the Repacking and Wholesale Generic HACCP Model) has been completed on Form 5 of the Repacking and Wholesale Generic HACCP Model.

Step 1:

Match the product ingredients and incoming materials (on Form 2 you completed above) and the process flow steps (on Form 3 you completed above) to the hazard analysis that has been completed for Form 5 of the Repacking and Wholesale Generic HACCP Model.

Step 2:

Transfer the identified product ingredients and incoming materials and process flows steps as well as their corresponding hazard analysis on to the blank Form 5 provided. Ensure that the suggested “controlled at” measure corresponds to your operation. Note that “controlled at” part of this form must be filled in only once Form 8 and the hazard analysis is complete. Once completed, results from Form 8 can be copied to show the prerequisite programs or CCP under which risks are controlled in the “controlled at” column.

(Note: Due to the size and complexity of your operation, the blank Form 5 provided may not be of adequate size.)

Step 3:

Proceed to Form 6.

Company Name:	Title: Form 5 – Biological Hazards	
	Code: FR-005	
	Completed By:	Date:
	Approved By:	Date:

**HAZARD IDENTIFICATION
IDENTIFIED BIOLOGICAL HAZARDS**

Product Ingredients and Incoming Materials, Process Step Biological Hazards	Controlled at

Title: Form 6 – Chemical Hazards

Code: **FR-006**

Completed By:

Date:

Approved By:

Date:

Form 6 identifies the chemical hazards that are associated with the market product. It also identifies where and how the chemical hazards could be controlled. The analysis for the market product descriptions (listed on Form 1 of the Repacking and Wholesale Generic HACCP Model) and the relevant market product process steps (listed on Form 3 of the Repacking and Wholesale Generic HACCP Model) has been completed on Form 6 of the Repacking and Wholesale Generic HACCP Model.

Step 1:

Match the market product ingredients and incoming materials (on Form 2 you completed above) and the process flow steps (on Form 3 you completed above) to the hazard analysis that has been completed for Form 6 of the Repacking and Wholesale Generic HACCP Model.

Step 2:

Transfer the identified market product ingredients and incoming materials and process flow steps as well as their corresponding hazard analysis on to the blank Form 6 provided. Ensure that the suggested “controlled at” measure corresponds to your operation. Note that “controlled at” part of this form must be filled in only once Form 8 and the hazard analysis is complete. Once completed, results from Form 8 can be copied to show the prerequisite programs or CCP under which risks are controlled in the “controlled at” column.

(Note: Due to the size and complexity of your operation, the blank Form 6 provided may not be of adequate size.)

Step 3:

Proceed to Form 7.

Company Name:	Title: Form 6 – Chemical Hazards	
	Code: FR-006	
	Completed By:	Date:
	Approved By:	Date:

HAZARD IDENTIFICATION IDENTIFIED CHEMICAL HAZARDS

Product Ingredients and Incoming Materials, Process Step Chemical Hazards	Controlled at

Title: Form 7 – Physical HazardsCode: **FR-007**

Completed By:

Date:

Approved By:

Date:

Form 7 identifies the physical hazards that are associated with the market product. It also identifies where and how the physical hazards could be controlled. The analysis for the market product descriptions (listed on Form 1 of the Repacking and Wholesale Generic HACCP Model) and the relevant market product process steps (listed on Form 3 of the Repacking and Wholesale Generic HACCP Model) has been completed on Form 7 of Repacking and Wholesale Generic HACCP Model.

Step 1:

Match the market product ingredients and incoming materials (on Form 2 you completed above) and the process flow steps (to Form 3 you completed above) to the hazard analysis that has been completed for Form 7 of the Repacking and Wholesale Generic HACCP Model.

Step 2:

Transfer the identified market product ingredients and incoming materials and process flows steps as well as their corresponding hazard analysis on to the blank Form 7 provided. Ensure that the suggested “controlled at” measure corresponds to your operation. Note that “controlled at” part of this form must be filled in only once Form 8 and the hazard analysis is complete. Once completed, results from Form 8 can be copied to show the prerequisite programs or CCP under which risks are controlled in the “controlled at” column.

(Note: Due to the size and complexity of your operation, the blank Form 7 provided may not be of adequate size.)

Step 3:

Proceed to Form 8.

Company Name:	Title: Form 7 – Physical Hazards	
	Code: FR-007	
	Completed By:	Date:
	Approved By:	Date:

**HAZARD IDENTIFICATION
IDENTIFIED PHYSICAL HAZARDS**

Product Ingredients and Incoming Materials, Process Step Hazards	Controlled at



Title: Form 8 – Critical Control Point Determination

Code: **FR-008**

Completed By:

Date:

Approved By:

Date:

Form 8 analyzes the biological, physical, and chemical hazards that are identified in Forms 5, 6, and 7. The hazards are analyzed by answering the questions of the **Decision Tree** (Determination whether the hazard is fully controlled by prerequisite programs, and Q1 to Q4) in Form 8. This process (Q1 to Q4) will identify if any of the hazard(s) is a Critical Control Point (CCP). If the analysis identifies a CCP (Yes to Q3, or No to Q4), monitoring and verification must be applied for a complete HACCP Program.

Step 1:

Match the market product ingredients and incoming materials and the process flow steps hazard analysis (on Forms 5, 6, and 7 you completed above) that has been completed for Form 8 of the Repacking and Wholesale Generic HACCP Model.

Step 2:

Transfer the identified market product ingredients and incoming materials and process flow steps hazard analysis on to the blank Form 8 provided. Ensure that the answers to the Decision Tree questions (Determination whether the hazard is fully controlled by prerequisite programs, and Q1 to Q4) correspond to your operation.

(Note: Due to the size and complexity of your operation, the blank Form 8 provided may not be of adequate size.)

Step 3:

Proceed to Form 9.

Company name:	Title: Form 8 – Critical Control Point Determination									
	Code: FR-008									
	Completed By:						Date:			
	Approved By:						Date:			
CRITICAL CONTROL POINT DETERMINATION										
Column 1 Inputs/Incoming Materials OR Production/Process Steps	Column 2 Category and Identified Hazard Determine if fully controlled by GMP(s). * If yes = indicate and fully reference the GMP(s) and proceed to next identified hazard. * If no = proceed to Q1.					Column 3 Q1. Could a control measure(s) be used by the operator at any production/process step? *If no = not a CCP. Identify how this hazard will be controlled before and after the production/process step then proceed to the next identified hazard *If yes = describe the measure and proceed to Q2.	Column 4 Q2. Is it likely that contamination by the identified hazard could occur in excess of the acceptable level or could increase to an unacceptable level? *If no = not CCP + proceed to the next identified hazard *If yes = proceed to Q3	Column 5 Q3. Is this production/process step specifically designed to eliminate or reduce the likely occurrence of the identified hazard to an acceptable level? * If no = proceed to Q4. * If yes = CCP. Enter its number in the last column	Column 6 Q4. Will a subsequent step eliminate the identified hazard or reduce its likely occurrence to an acceptable level? * If no = CCP. Enter its number in the last column. * If yes = not a CCP. Identify subsequent (controlling) step and proceed to the next identified hazard	Column 7 CCP Number *Proceed to the next identified hazard
Incoming Materials	Hazard	B	C	P	Yes/No	Control Prerequisite Program				
Process Step										

**Title: Form 9 – Hazards Not Controlled by Operator**Code: **FR-009**

Completed By:

Date:

Approved By:

Date:

Form 9 identifies what market product ingredients and incoming materials and process flow steps are not in the control of the Repacking and Wholesale operation, but in the control of the supplier and/or manufacturer and/or producer and/or customer. This will identify other responsibility of control of the food safety hazards.

Step 1:

Match the market product ingredient(s) and incoming material(s) and the process flow step(s) (on Form 8 you completed above) to Form 9 of the Repacking and Wholesale Generic HACCP Model.

Step 2:

Transfer the identified market product ingredients and incoming materials and process flows steps that are not controlled by the Repacking and Wholesale operator on to the blank Form 9 provided.

(Note: Due to the size and complexity of your operation, the blank Form 9 provided may not be of adequate size.)

Step 3:

Proceed to Form 10

Company Name:	Title: Form 9 – Hazards Not Controlled by Operator	
	Code: FR-009	
	Completed By:	Date:
	Approved By:	Date:
HAZARDS NOT CONTROLLED BY OPERATOR		
HAZARDS	INDICATE THE WAY THE HAZARD COULD BE ADDRESSED (COOKING INSTRUCTIONS, PUBLIC EDUCATION, USE BEFORE DATE,).	
<u>Incoming Material/Process Step</u>		

**Title: Form 10 – HACCP Plan**Code: **FR-010**

Completed By:

Date:

Approved By:

Date:

Form 10 identifies what and where a CCP occurs as well as its cause and result. Form 10 also includes critical limits, monitoring procedures, deviation procedures, verification procedures, and HACCP records or logs or documentation. This ensures that CCPs are handled consistently, can be verified, and are under control, which will minimize the occurrence of food safety issues.

Step 1:

Match the identified CCP on Form 10 of the Repacking and Wholesale Generic HACCP Model to the analysis completed on Form 8 above.

Step 2:

Transfer the identified CCP and its corresponding information from Form 10 of the Repacking and Wholesale Generic HACCP Model to the blank Form 10 provided. Ensure that the CCP identification and its accompanying information correspond to your operation.

(Note: Due to the size and complexity of your operation, the blank Form 10 provided may not be of adequate size.)

**YOU HAVE NOW CUSTOMIZED THE REPACKING AND WHOLESALE GENERIC
HACCP MODEL**

Company name:	Title: Form 10 – HACCP Plan	
	Code: FR-010	
	Completed By:	Date:
	Approved By:	Date:

HACCP PLAN

Process Step/Incoming Material:
CCP/Hazard Number:

Hazard Description	Critical Limits	Monitoring Procedures	Deviation Procedures	Verification Procedure	HACCP Records

W. Evaluating Food Safety Risks after Flooding Events - Resources

NOTE:	NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.
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Flooding, an uncontrolled event where water outside of the operation's control, overflows onto the premises, can directly or indirectly contaminate the product. Flood waters can carry various biological, chemical and physical hazards such as sewage, chemicals, heavy metals, pathogenic microorganisms, debris etc. onto the premises. Cross-contamination can also occur from other items such as equipment, packing materials, water sources, etc., that may have come into contact with the flood waters or other areas that have been flooded.

Flooding poses a very high food safety risk for fresh fruit and vegetables as they are grown close to the ground and/or can be eaten raw. The person responsible needs to assess all aspects of the production/packing/storing of fruits and vegetables, including all possible inputs and steps for potential contamination. If flooding has occurred, talk to provincial and/or federal agricultural specialists to discuss safe food options or concerns.

Resources for evaluating food safety risks after flooding events:

Ontario Ministry of Agriculture, Food and Rural Affairs (OMFRA):
<http://www.omafr.gov.on.ca/english/food/foodsafety/producers/gap-cr-soil.htm>

British Columbia Ministry of Agriculture:
<https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/food-safety/good-agricultural-practices/8-1-soil-environment-evaluation>

Government of New Brunswick:
https://www2.gnb.ca/content/gnb/en/news/public_alerts/river_watch/2018flood_recovery/farmers-impacted-by-flooding.html

U.S Food & Drug Administration (FDA):
<https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-evaluating-safety-flood-affected-food-crops-human-consumption>

California Leafy Green Products Handler Marketing Agreement:
<https://lgmatech.com/wp-content/uploads/2017/06/CALGMA-Flooding-Fact-Sheet.pdf>

Ohio State University Extension:
<https://ohioline.osu.edu/factsheet/anr-27>

Produce Safety Alliance:
<https://producesafetyalliance.cornell.edu/sites/producesafetyalliance.cornell.edu/files/shared/Food%20Safety%20for%20Flooded%20Farms.pdf>

X. Environmental Monitoring Program (EMP) - Resources

NOTE:

NOTE: The Appendices were originally developed for Canadian operations, and provide examples only, based on Canadian and international resources. If your operation is outside of Canada, the following information may be relevant to you. It is recommended that you check whether country-specific requirements or guidance are available instead.

An environmental monitoring program (EMP) is an evaluation of the effectiveness of the microbial controls in place to prevent contamination of product. The EMP will help to assess the overall effectiveness of sanitation protocols, employee practices and operational methods as well as provide necessary information to prevent possible microbial contamination of products. Once established, the EMP is specific to the operation that designed and implemented the program.

There are a number of ways to set up an EMP. The information below is designed to give an overview and provide some templates of how an operation may set up an EMP for their operation.

1. It is best practice to determine numbered zones within your operation prior to performing a risk assessment. The four-zone system below begins at the food contact surfaces and extends to areas not in close proximity to food contact surfaces.

The following chart could be used as a template to determine the zones within an operation. Before completing the chart it is recommended that the person responsible tours the entire operation, including all packing/repacking areas, storage areas, receiving and loading docks, employee facilities such as lunch/break rooms, washrooms, maintenance areas, offices, and any other areas that may be operation specific.

ZONE		Surfaces/Areas Specific to Your Operation (List ALL relevant)
Zone 1 Food contact surfaces	Handling, sorting, grading, packing, cooling, washing, rinsing, etc. equipment, tables, knives, scales, employees' hands, etc.	
Zone 2 Non-food contact surfaces that are in close proximity to food contact surfaces	Equipment framework, drip shields, control panels and buttons, overhead pipes directly over Zone 1 surfaces, computer screens, maintenance tools, etc.	

<p>Zone 3</p> <p>Non-food contact surfaces that are NOT in close proximity to food contact surfaces. (These could lead to product cross-contamination through employees, movement of equipment, inherent risk, etc.)</p>	<p>Floors, walls, ceilings, drains, condensate drip pans, hoses, carts, forklifts, garbage containers, pallets, brooms, mops, squeegees, toolboxes, cell phones, etc.</p>	
<p>Zone 4</p> <p>Areas NOT in close proximity to food contact surfaces (These could lead to cross-contamination if not well-maintained)</p>	<p>Hallways, receiving/loading docks, washrooms, lunch/break rooms, maintenance room, offices, etc.</p>	

2. Carry out a risk assessment of all the zones. Pay particular attention to surfaces/areas within the operation where inputs, practices or the environment could be a potential source of contamination and/or have a higher risk of cross-contamination.

Sampling should focus on high-risk areas such as:

- Surfaces/Areas which are often wet
- Surfaces/Areas with high humidity
- Surfaces/Areas where dirtier activities occur
- Surfaces/Areas with high levels of staff activity
- Surfaces/Areas with high levels of equipment movement
- Areas that are cooled (e.g., with a condenser unit)
- Handling/storage of higher risk product(s)

Considerations:

- Some higher risk products include leafy greens, berries, cantaloupe, tomatoes, etc.
- The inherent characteristics of products may make them high risk (e.g., ability to internalize water, large surface area, etc.)
- Product that is eaten raw may be a higher risk commodity than those that are generally cooked
- Handling practices (e.g., washing, rinsing, trimming, etc.) may make the commodity higher risk
- A combination of the above may make a lower risk commodity higher risk

Not all operations have the same risk, therefore not all programs look the same. One tool that could be used is a risk assessment tool (e.g., likelihood vs. severity matrix) like the one below.

Likelihood of Occurrence	High	M	H	H
	Medium	M	M	H
	Low	L	M	M
		Low	Medium	High
		Severity of Hazard to Food Safety		

- Determine which surfaces/areas may be included in the environmental monitoring sampling plan, using the risk assessment as guidance. Note: *ONLY those surfaces/areas where it is deemed necessary (e.g., through careful consideration of risk) to obtain microbiological evidence of potential contamination need to be listed.*

List the specific surface/area:

- _____
- _____
- _____
- _____
- _____

- Develop a sampling plan for the identified surfaces/areas (listed above). **Below is an example of a sampling plan.** This is ONLY a template to show what information is required. It is NOT stating which surfaces/areas should be sampled, what frequency of testing must occur, nor which test should be chosen. *The operation must determine that, again based on risk.*

Ideally, sampling should take place at the “dirtiest” time of the operation (e.g., right before shutting down for cleaning). Sampling sites should be those where microbial harborage is more likely, such as crevices, rough surfaces or surfaces/areas that are harder to access.

It is important to test for the microorganisms or indicators that are relevant to your type of operation.

Example of a sampling plan:

Zone	Identified Surface/Area	Frequency of Testing	Testing For?
Zone 1	Conveyor #3 for product	Monthly	Aerobic Plate Count (APC)
Zone 2	Packing line #1 equipment framework	Monthly	Aerobic Plate Count (APC)
Zone 3	Packing line floor drain #4	Monthly	Aerobic Plate Count (APC)
Zone 4	Employee breakroom	Monthly	Aerobic Plate Count (APC)

There are a number of resources available to help operations establish and implement their environmental monitoring program. A few are listed below for your information. Note that some of these resources are not specific to whole fruits and vegetables, but the information can be used to customize your own EMP.

General information on Environmental Monitoring Programs:

- AIB International. General Guidance for Establishing an Environmental Monitoring Program.
https://www.aibinternational.com/aibonline_/www.aibonline.org/newsletter/Magazine/Mar_Apr2012/5Guidance.pdf
- AIB International. Environmental Monitoring Program: An Early Warning System for Microbiological Hazards
https://www.aibinternational.com/aibonline_/www.aibonline.org/newsletter/Magazine/Nov_Dec2013/EPMEarlyWarningHazards.pdf
- The SQF Code and Environmental Monitoring Programs Presentation
http://ontariotenderfruit.ca/uploads/file/Th_FoodSafety_1000_Schreurs.pdf
- United Fresh Produce Association. Guidance on Environmental Monitoring and Control of Listeria for the Fresh Produce Industry.
<https://www.centerforproducesafety.org/amass/documents/document/263/Listeria%20Guidance%20UFPA%202013.pdf>
- FDA. Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-guide-minimize-microbial-food-safety-hazards-fresh-cut-fruits-and-vegetables>
- FDA. Control of Listeria monocytogenes in Ready-To-Eat Foods: Guidance for Industry (Draft Guidance). <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/draft-guidance-industry-control-listeria-monocytogenes-ready-eat-foods>

- 3M, Cornell University. Environmental Monitoring Handbook for the Food and Beverage industry. <https://multimedia.3m.com/mws/media/1684575O/environmental-monitoring-handbook.pdf>
NOTE: This resource does NOT cover fresh fruits and vegetables, but contains a lot of general information about EMPs, testing information, sampling plans, how to swab, etc.

Information Specific to Sampling and Testing:

- OMAFRA. Environmental Monitoring Programs: Swabbing to Verify Sanitation Effectiveness in Foods of Plant Origin Facilities.
<http://www.omafra.gov.on.ca/english/food/inspection/fruitveg/emp-swabbing.htm>
- United Fresh. Microbiological Testing of Fresh Produce (White Paper).
https://www.unitedfresh.org/content/uploads/2014/07/FST_MicroWhite-Paper.pdf

Training:

Operations may also require training to help in establishing their EMP. A number of training facilities offer training on setting up EMPs including the following (*Note: this is not an inclusive list and is subject to change. CanadaGAP does not endorse specific training or training institutions*):

- <https://www.sgs.ca/en/training-services/industry-based-training/agriculture-and-food/fsma-training/environmental-monitoring-program-emp-training-for-food-facilities>
- <https://www.nsflearn.com/us/courses/fundamentals-developing-your-environmental-monitoring-program-webinar>