



United States Department of Agriculture



**Hurricane Preparation and Recovery
for North Carolina**

Strawberry Plasticulture Producer's Guide



Forest Service
Southern Research Station
Hurricane Preparedness Guide
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DISCLAIMER

Information in this document was provided by USDA and various university Extension staff and based on shared experiences preparing for and recovering from hurricane impacts. However, individual producer situations will vary, and STATE OR LOCAL GUIDANCE OR REGULATIONS, AND INSURANCE POLICIES SUPERCEDE THE RECOMMENDATIONS IN THIS GUIDE. This guidance should not be interpreted as required actions by regulatory or insurance agencies. Check with your local Extension agent; county, State, or Federal contact; consultant; or insurance agent regarding the appropriateness of these recommendations to your specific situation.

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This guide will focus on:

- Recommendations to mitigate, prepare for, and recover from hurricane associated flood and wind damage in strawberry production

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Introduction

Preparing for and recovering from hurricane events



People who live and work in the Southeastern United States are unfortunately familiar with the devastation and loss of life and property that can accompany a hurricane event. While hurricanes have always been a threat to the Southeast, with an average of over two strikes per year since 1900, the threat posed by hurricanes is growing. Recent studies suggest that as ocean temperatures continue to rise, hurricane intensity is increasing. Hurricanes of the future will likely be slower moving, higher category hurricanes that produce destructive winds and flooding.

To help producers remain resilient and productive in the face of this threat, the U.S. Department of Agriculture (USDA) Southeast Climate Hub developed this guide containing steps that can be taken to prepare for and recover from hurricane events. This guide is separated into four primary sections:

- The **Building a Resilient Operation** section outlines a range of considerations and systems that producers can put in place to increase their resilience to hurricanes.
- The **Long-Term Operation Maintenance** section lists specific pre-hurricane actions and periodic checks to be done on an annual basis (before hurricane season) and monthly basis (during hurricane season).
- The **Short-Term Preparedness** section lists specific actions to be done in the week before a hurricane arrives.
- The **Post-Hurricane Recovery** section outlines activities that producers can take to minimize their losses following a hurricane. It begins with actions immediately following a hurricane that are focused on safety and continues with ongoing actions a week out and a month out.

The guide also includes four appendices, including two customizable templates for a **Farm Emergency Plan** and an **Emergency Contacts List**. Directions on what to include in these two documents is outlined in the **Building a Resilient Operation** section. Their use is described in the **Short-term Preparedness** section. Both the plan and list should be periodically reviewed, as mentioned in the **Long-term Operation Maintenance** section. The appendix also includes an **Initial Site Planning** guide that can be referenced if purchasing or leasing new land, and **Resource Links** to helpful Federal, State and University Extension websites that are also referenced throughout the guide.

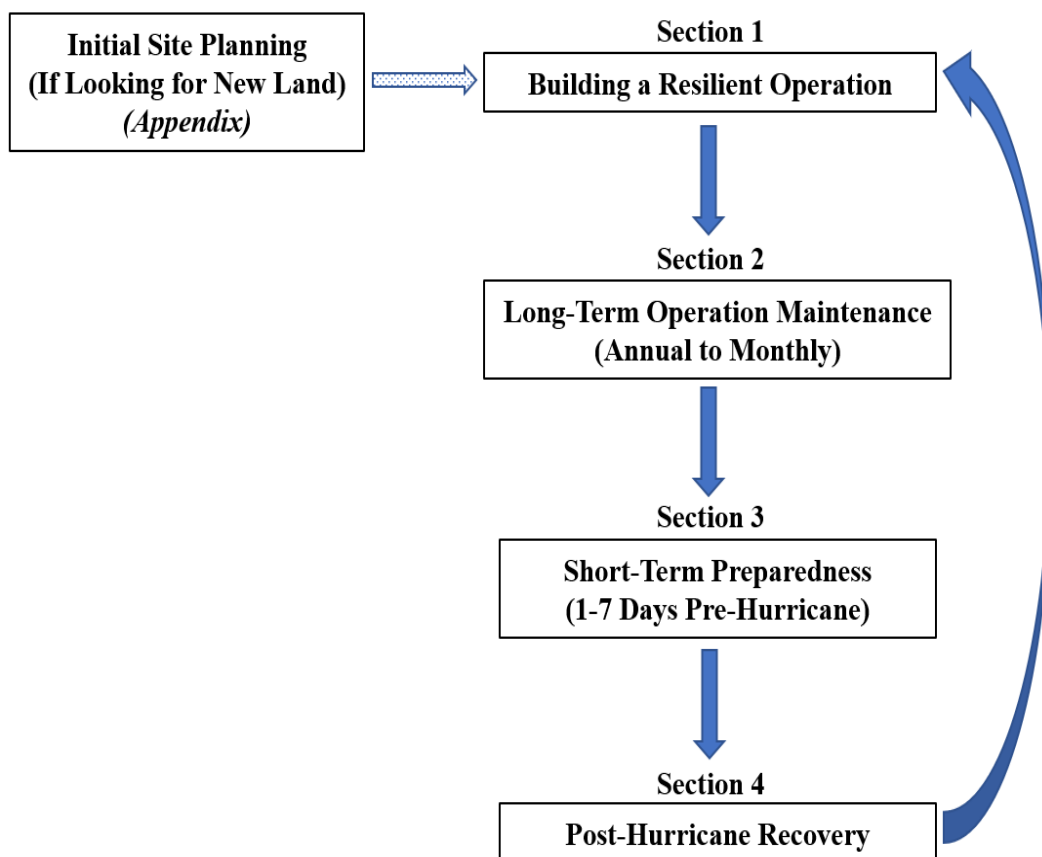


Figure 1. Flowchart for Strawberry Plasticulture Producer's Guide

Building a Resilient Operation

Systems that are recommended to be put in place well before the arrival of any hurricane to increase productivity and reduce your risk of damage and reduce recovery time

Agricultural operations in the Southeast U.S. can implement a range of measures to increase their resilience to hurricanes and tropical storms. Contact your local Extension office and other State and Federal resources for further information.

- Contact your local Extension office and other State and Federal resources for further information.
- Approximately 20 – 25% of all strawberries produced in the United States are grown in areas frequently impacted by hurricanes. North Carolina is the second largest producer of fresh strawberries on the east coast, with 4-5 % of yearly regional strawberry production. North Carolina is also among the states experiencing the most hurricanes per year on the US mainland. North Carolina experiences 1 hurricane every 3 years. In total, North Carolina experiences over 2 tropical cyclones per year (hurricane and non-hurricane scale). Strawberry farms are affected by these hurricanes mainly through flooding and wet soil conditions; however, wind damage can affect operational schedules, plasticulture, generators, and farm infrastructure as well. Hurricane-related damages can impact nursery operations, supply chains, pre-plant management, planting, and after transplant care. The following factors can contribute to crop loss after a hurricane.
- Potential hurricane impacts prior to strawberry planting:
 - Nursery plant production can be compromised if heavy rainfalls are experienced in areas with strawberry nurseries and/or a plug plant producing industry. Risk of anthracnose crown and fruit rot, as well as Phytophthora crown rot, can rise following major hurricanes. Strawberry plug plants can also have insufficient root growth, often leading to suboptimal yields later on.
 - Supply chains for planting material, plastic, fumigant, and pre-plant fertilizer might be disrupted or slower. This often results in delayed planting or insufficient pre-plant management even if field and farm location are not affected by a hurricane directly.
 - Unfavorable conditions for fumigating and/or laying plastic beds may further delay planting dates, even if supply chains still work and all needed materials are in place. Delayed planting dates and compromised fumigant efficacy often lead to lower yields.
 - Delayed planting dates can lead to fields that should be fumigated remaining unfumigated due to unfavorable soil conditions or difficulty accessing the

field. This results in an increase in disease-related losses during the season and a decrease in yield and returns.

- Potential hurricane impacts after strawberry planting:
 - Flooded fields compromise strawberry plants by enhancing disease pressure and causing anaerobic soil conditions. Structural damage can occur to beds and plastic mulch.
 - Wet soil conditions or flooded infrastructure may prevent labor and personnel from accessing the field.
- Potential hurricane impact on field and farm infrastructure:
 - Floodwater in fields often requires the development of drainage ditches to lead water off the field.
 - Wind can damage or destroy plastic mulch, often requiring excessive repairs and a larger stock of supplies.
 - Farm equipment can be damaged by debris and falling trees, requiring expensive repairs and potential replacements and further delays in operations.
 - Roadways to and on farm can be flooded, compromising access to field and farm equipment. This also requires expensive drainage work and possible reconstruction.

Personal Safety

- For safety tips and resources that facilitate informed decision making before, during, and after a hurricane strikes, see the U.S. Department of Homeland Security (DHS) Ready.gov [website](#) and U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA) National Weather Service Weather-Ready Nation Hurricanes [website](#).

Recordkeeping, documentation, and insurance

- The importance of pre- and post-hurricane documentation cannot be overstated. Assistance for disaster recovery may not be available until weeks or months after a hurricane. Therefore, it is important for purposes of insurance compensation and recovery assistance to do thorough record keeping of the damages and losses sustained on your farm as well as your cleanup and recovery efforts.
- The worst time to find out that you do not have enough insurance, or the right insurance, to cover your damages is when you need help recovering. Regularly review your insurance policies with your agent to be sure you have adequate coverage, including flood insurance, for your facilities, vehicles, farm buildings and other structures, and crops.
- Conduct a risk assessment to determine whether crop insurance fits into your farm's finances and operations—given your risk, is it worth the money? Crop loss in strawberries during hurricane season can be caused by a multitude of factors,

so consult with your insurance company to determine whether crop insurance policies cover problems during the pre-plant phase or with planting material. It can be difficult to get compensated for hurricane losses if damages were not directly related to the hurricane, but rather to delayed planting or compromised planting material.

- Be aware that there are limitations on how soon insurance coverage will take effect. Generally, insurance policies will not cover damage if the policy was not in place before a hurricane has formed.
- Establish an inventory system so that you know exactly what's on your farm at all times for potential insurance claims and disaster recovery assistance. It is critical to have a documented inventory (photos, videos, and written lists and descriptions) of your farm buildings, vehicles, and valuable equipment on your farm before a disaster occurs. Maintain accurate records of harvest, equipment inventories, and supplies purchased. This inventory and documentation will be essential for filing insurance claims after the hurricane. Keep copies of this inventory in multiple places such as on your computer, off-site in a safe location, and on a cloud-based server using an established procedure to update and transmit the information weekly.
- Take these records with you when evacuating for hurricanes:
 - Inventories and documentation for insurance and disaster recovery
 - Farm Emergency Plan
 - Emergency Contacts List
- For more information, see:
 - The USDA Risk Management Agency (RMA) Crop Insurance [website](#) for news and information about insurance, including the [Hurricane Insurance Protection—Wind Index \(HIP-WI\) Endorsement](#), for farmers and ranchers. Use their [agent locator](#) to search for approved insurance providers.
 - The U.S. DHS Federal Emergency Management Agency (FEMA) National Flood Insurance Program [website](#) to learn more about flood insurance options for qualifying home and business owners.

Emergency Budget Planning

- Repairs and crop loss due to damage to the crop, facilities, and equipment can lead to substantial financial strain. Develop a well-thought-out emergency budget as part of your long-term business plan, especially if your farm is in an area with frequent hurricane activity.
- An emergency budget for strawberry production should cover costs for short-term preparations such as digging ditches to channel water off the field quickly and will also allow you to immediately repair damage following a hurricane such as repairing paths to the fields, repairing damage to the plastic mulch, and sanitizing the field after the hurricane passes.

- A minimum emergency budget for strawberry crop production should include 10 hours of labor per acre and \$200 per acre to cover the costs for materials, such as additional plastic mulch, and labor to build drenches in the field and repair damages to plastic. Also have funds set aside to buy extra plants planned for the first 2 – 3 weeks after planting.

Infrastructure

Buildings

- Destruction of farm facilities in recent hurricanes has resulted in some of the largest losses compared to immediate crop damage. Locate packing sheds in somewhat higher ground to prevent flooding. Consider sloping land away from the shed to allow for drainage and, in some cases, constructing shallow berms to prevent minor flooding of the packing facility.
- Locate buildings above the 100-year flood zone whenever possible, and construct buildings and other structures to a minimum wind rating of 140 miles per hour (mph), preferably 180 mph.
- For more guidance on protecting farm structures and buildings from winds and flooding, see the [FEMA Compilation of Wind-Resistant Provisions and Design Guide for Improving Critical Facility Safety from Flooding and High Winds](#).

Power and back-up power

Circuit breakers

- Know the location of your main circuit breaker and breaker box. The box is generally located inside of buildings, but additional breakers may be located outside.
- Ensure that the breakers, including the main breaker, are correctly labeled. Correct labeling will help you ensure power is cut to the appropriate appliances or to the entire building.

Back-up power

- If fruit has been harvested, you will need to maintain electricity supplying the coolers during and after a hurricane.
- Create a Backup Power Plan, and store with your Farm Emergency Plan (see “Emergency planning” below).
- Check with local, county, and State codes for any requirements to supply backup power during short-term emergencies.
- To provide power when the main power goes out, supply critical operating areas with a standby generator wired with a transfer switch. Several types of generators and diesel-powered pumps are available. Ensure that your generator is capable of supplying the power required by the irrigation pump to convey water

to the entire area. Install generators with enough fuel storage for at least 2 weeks of full operation.

- Post the operating procedures near each generator. Consult your owner's manual for specific safety, maintenance, and operational recommendations.

Roads

- The primary driveway into the farm should have adequate drainage to prevent flooding. The road should be well packed with a solid base that will hold up to heavy equipment and trucks during extreme conditions. For more information on maintaining unpaved roads, see the USDA [Environmentally Sensitive Road Maintenance Practices for Dirt and Gravel Roads](#).
- If you do not have a secondary entrance to your farm, construct one if possible to provide alternative access from a different road in the event the primary entrance is blocked.
- If the facility is in a location where all roads leading in and out may flood, purchase or make arrangements to rent or borrow a boat that can safely navigate the floodwaters to gain faster post-hurricane access to your property.

Drainage

- Total water management is essential, including irrigation and drainage systems, and must take into account the water table and soil drainage.
- Make sure that your major roadways are able to drain. Drench systems and elevated roadways might help to gain quick access to farmland after a flooding.
- Increased sand content improves drainage, whereas higher silt and clay contents reduce drainage. In soils prone to developing a hard pan, perform deep tillage using a subsoil implement such as a ripper-bedder, or strip tillage to help improve soil percolation and reduce the time that water stands in flooded areas.
- Develop surface and subsoil drainage including a system of canals, ditches, beds, and/or drain tiles. Ditches between beds must have enough capacity to accommodate and channel excess water.
- In the strawberry field: Water drainage and access to the field during flooding should be prioritized when preparing a strawberry field in a high-risk area (for example, if you are on low land, close to a creek, or can easily be flooded). If your fields are prone to flooding or standing water, prepare space and a plan (including labor) for drenches in the strawberry field. Drenches can help to lead excess water out of the field into other, lower areas of the farm.
- Plan for a water reservoir area on your farm (lowest area) which you could utilize during a flooding event to drain your fields.
- Make sure culverts are properly designed regarding size and location.
- For more information about water management, see:

—Sustainable Agriculture Research & Education’s (SARE) *Building Soils for Better Crops Irrigation* and *Drainage* chapters

Water table

- The amount of flooding will be determined by your land’s topography, the amount of precipitation received, and the pre-hurricane water table. The higher the pre-hurricane water table, the more likely that flooding will occur for a given amount of precipitation. The chance of flooding can be estimated by measuring the pre-hurricane water table and considering the effects of varying precipitation amounts:

A general rule of thumb is that 1 inch of rain will cause the water table to rise about 10 inches in fine textured soils, 6 inches in most of the flatwoods sandy soils, and 4 inches in coarse sands. It may take 4 - 6 days for the water table to return to its desired levels following rains of 1 inch or more. For example, if the water table is at 50 inches, 6 inches of precipitation will cause localized flooding on fine textured soils, but no flooding would occur on sandy soils.

Irrigation

- Locate irrigation pumps in elevated areas to reduce flooding risks to the pump, and install them with a backflow prevention device to avoid contamination in case of power loss. Keep the access road to the pump clear so that it is easier to bring in generators or diesel-powered pumps after a hurricane.

Trees and windbreaks

- Remove trees that could potentially blow down and block the entrance to the farm.
- If land is elevated and unprotected, consider creating wind breaks along the edge of fields. This is particularly valuable if adjoining land has bare soil and can prevent or reduce sandblasting of plants during a hurricane.
- Trees and shrubs used as windbreaks should be native species that will develop strong, deep root systems and be hardy enough to resist breaking during high winds. Permanent plantings commonly used for windbreaks include pine trees. Red cedar (*Juniperus virginiana*) also resists strong winds well. Keep trees or shrubs pruned and free of dead or dying branches.
- For more information about how windbreaks can protect crops and provide economic, environmental, and commercial benefits, see the USDA National Agroforestry Center [website](#).

Debris disposal

- Create a plan for salvage operations including a method of debris disposal. Learn what materials and the specifications regarding composition of materials the landfill nearest your farm will accept and identify alternatives if needed. For

disposal of chemicals or other hazardous materials, follow specific procedures to meet U.S. Environmental Protection Agency (EPA) requirements.

Crop concerns

Cultivar selection

- Choose disease-resistant cultivars to improve plant health and decrease susceptibility to outbreaks when stressed. Strawberry cultivars known to be more tolerant to diseases such as Phytophthora crown rot include Albion, Camino Real, Cabrillo, Florida beauty, and Petaluma.
- For the latest on strawberry variety testing, see the North Carolina Cooperative Extension [website](#).

Planting considerations

- To ensure that any hurricane damage to your crop is covered by your crop insurance, plant your crop before the final planting day for crop insurance in your State. This may vary by county and year, so use the USDA RMA Actuarial Information Browser Tool to determine the final planting date for your crop. While the late planting period continues beyond the final planting date, check with your insurance provider for details that may apply if you plant during this time period. Look closely at insurance policies to determine specific details, as requirements can change.
- Avoid planting in areas on the farm that are prone to flooding even following normal rainfall, including close to creeks, rivers, or other water bodies prone to flooding.
- Leave space for ditches for fast drainage. Orient rows to support field drainage.
- Plan each preparation step with enough buffer time in mind. We recommend starting with field preparations 2 weeks earlier than usual. If you are in a high-risk area, start preparing your field approximately 50 – 55 days before the target planting date, and aim to fumigate 30 – 35 days before planting.
 - Field preparation: If not in sandy soils, prepare the soil before applying fumigants and laying beds to a fine soil structure, which may allow better drainage.
 - Fumigation: Fumigation is one of the most critical tasks in strawberry production, and a hurricane can affect fumigation in several ways, including: (1) after flooding or heavy rainfalls, soil conditions will not be favorable for fumigation until the soil water is reduced, and (2) fumigant supply chains might be disrupted, leading to hold-ups in fumigant delivery and/or custom application. Targeting fumigation 30 – 35 days before planting rather than the required 21 days allow for some buffer time in case a hurricane impacts your area.

- Bed establishment: Establish beds at the correct soil moisture and with a fine soil structure, making sure the soil has been loosened. If flat-fumigated (or if no fumigation is used), wait with bed establishment until shortly before planting. Some shank fumigation practices, drip chemigation, anaerobic soil disinfestation (ASD), or solarization practices require raised beds 21 days or more before planting. If that is the case, beds need to be established on the timeline of fumigation or alternative methods (see above).
- Establish beds 8 - 10 inches high if possible. Firmly secure the plastic to the edges and ends of the bed.
- Plan ahead for flooding conditions that can promote strawberry diseases. The right calculation of fumigants is important to prevent these diseases. Other measures include the use of drip applied fungicides to control Phytophthora crown rot after flooding. For a complete list of fumigants, view the U.S. Environmental Protection Agency [Soil Fumigant Toolbox](#). For an updated and complete list of pesticides for strawberry production, view the University of Florida IFAS Extension [Strawberry Production Guide](#).

Cover crops and crop rotation

- Consider planting cover crops in rotations of 3 - 4 years to improve soil health, reduce pest pressure, and help reduce the development of disease should field access become restricted due to a hurricane.
- Sustainable and organic strawberry production: In some operations, strawberries are grown under multi-year crop rotations. For example, it is common practice for organic strawberry producers in the Southeast to rotate their strawberry patch with a different crop in one year and cover crops in the following. For more information, view the North Carolina Cooperative Extension [Sustainable Strawberry Production in the Southeast](#).
- Hurricanes can certainly have an impact on the growth and success of both the secondary crop as well as the cover crops. If flooding persists over several weeks or months (after Hurricane Florence in 2018, several areas in the Carolinas were flooded for the following months due to ongoing rain events), soils may become contaminated with high salt levels and other minerals and metals, depending on the contamination of the flooding source. Soils in those fields would have to be tested for pH, salt levels, minerals and metals. An additional year of cover cropping should be planned for fields that were subject to continuous flooding.
- Follow-up crops: Some operations plant a follow up crop (e.g. watermelons or cantaloupes) into existing strawberry beds after the season. For the implications of this practice for hurricane resilience, please refer to the relevant USDA Producers Guide for the specific crop.
- See the following resources for integrating cover crops into your management plan:
 - USDA Natural Resources Conservation Service [website](#)

- North Carolina Cooperative Extension [website](#)
- SARE [Cover Crop Economics: Opportunities to Improve Your Bottom Line in Row Crops](#)
- To learn about cover crops and Federal crop insurance visit the USDA RMA [Cover Crops and Federal Crop Insurance website](#).

Emergency planning

Farm Emergency Plan

- U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations require an employer with more than 10 employees to have a printed copy of an emergency action plan readily accessible to all employees. (If you have 10 employees or fewer, the emergency plan may be reviewed orally.) For more information about emergency preparedness for farm workers, see the OSHA [Agricultural Safety Fact Sheet](#).
- Consider bringing together a disaster planning team, which could consist of the farm owner and engaged family members, the farm manager, an insurance representative, county extension agent, and other individuals.
- Have an emergency budget planned.
- Create your Farm Emergency Plan. See Appendix: Farm Emergency Plan for a sample plan that you can customize for your operation. The plan should include a checklist of tasks necessary to secure the facilities, fuel supplies, chemical supplies, and equipment; disconnect electricity and gas service; ensure that critical supplies are well stocked; etc.
- Make sure all of your employees know the formats (electronic or hard copy) and locations where the Farm Emergency Plan is stored.
- Consider creating a “hurricane suggestion box” where employees can place ideas for training and planning they believe would increase the operation’s resilience and safety in the face of a hurricane, based on their previous experience.

Maps and signage

- Prepare or update maps for all facilities, including locations of alternate entry/exit routes, electrical equipment (with shut-off options), fuel storage tanks (both above and below ground), propane tanks, compressed gas (for welding, etc.), and chemical spill equipment.

Hurricane tracking apps

- Download one or more computer and mobile device applications (apps) that model hurricane track predictions, send alerts, and track hurricane impacts. Given the rapid advance of mobile technologies, check for new options each

year prior to hurricane season. The NOAA National Hurricane Center [website](#) is a good source for keeping up to date on the latest hurricane activities. For more information about emergency alerts, see the U.S. DHS [Ready.gov website](#).

Roles and responsibilities

- Designate an Emergency Response Team for your farm. Members of the team should be:
 - Thoroughly trained and physically capable of performing assigned duties
 - Knowledgeable about the hazards found on the farm
 - Trained in decision making regarding when to take actions themselves and when to wait on outside emergency responders
- Define a chain of command with clearly defined primary and secondary roles and each person's responsibilities. Some individuals may not be reachable after a hurricane, so alternative levels of authority need to be established to resolve critical issues quickly. In your Farm Emergency Plan, list who will be responsible for each task and how they'll report fire, flooding, building collapses, and other emergencies. Identify procedures to be followed by the people who remain to handle critical operations.

Communication

Emergency Contacts List

- Develop and maintain a list of all people connected with your operation that should be contacted in an emergency. See **Appendix: Emergency Contacts List** for a template that you can customize. The Emergency Contacts List should include names, phone numbers, email addresses, locations, and all other pertinent information for individuals (owners, family members, employees, employee family members), emergency responders, State and local agencies, contractors and suppliers, and anyone else who is on your farm on a regular basis or provides crucial emergency services.
- Keep copies of your Emergency Contacts List—hard copies as well as electronic copies—in multiple locations including your home, office, and vehicle; with all family members and key employees. It is a good idea to have this information stored on your and your employees' cellular devices.

Lines of communication with local businesses and officials

- Establish communication with your local law enforcement and fire departments, electricity and gas providers, and other key groups to help them understand the nature of your business so that they can respond as needed in the event of a hurricane. Let them know the number of employees typically on site, the potential impact of the hurricane on crops, and the potential hazards that could lead to environmental contamination in the event of a flood or structural damage.

- Talk to nurseries across the country to prepare for potential last-minute orders.

Post-hurricane communications

- Purchase a battery-powered or hand-crank radio to stay up to date about conditions beyond your property in case you lose electricity for an extended period of time.
- Consider ahead of time the locations where producers and others could meet if all communication lines are down (e.g., a local feed or equipment supplier).
- Contact a local AM radio station to see whether it could serve as a communication channel in the aftermath of a hurricane.
- For more information about communicating before, during, and after a major disaster, see the [FEMA website](#).

Electricity and gas

- Contact your local utility company for guidance on how to disconnect power in the event of downed lines. Record their instructions in your Farm Emergency Plan.
- If certain equipment requires specialized shutdown procedures, train employees in these procedures.

Equipment operation

- Train personnel in the safe operation of unfamiliar equipment (such as generators or drainage pumps) that they may have to use in case of a hurricane.
- Make sure that appropriate employees are prepared to set up your backup generators. They should refer to your Backup Power Plan for information about where generators and generator fuel can be found, where they should be placed in preparation for a hurricane, and how they are to be connected to the electrical loads they will power.

Drones

- Consider getting an unmanned aerial vehicle (UAV) (i.e., drone) pilot license and purchasing a UAV. Small UAV quadcopters or hexacopters that can be equipped with visual or RGB cameras are relatively inexpensive (\$500 to more than \$2,000). Use of UAVs will help with damage assessment if accessing fields directly is impossible or unsafe. For regulations and information about operating a UAV, see:
 - U.S. Department of Transportation Federal Aviation Administration [Unmanned Aircraft Systems website](#)
 - University of Florida IFAS Extension [Preflight and Flight Instructions on the Use of Unmanned Aerial Vehicles \(UAVs\) for Agricultural Applications](#)

Chemical safety

- Take the necessary steps to prevent chemical spills from storage tanks containing fuel, herbicides, pesticides or other potentially dangerous liquids.

Basic emergency response skills

- Train all members of your Emergency Response Team in the use of various types of fire extinguishers, first aid, and CPR (cardiopulmonary resuscitation).

Long-Term Operation Maintenance

Periodic checks of systems already in place
(described in the previous section)

Prior to hurricane season

Contact your local Extension office and other State and Federal resources for further information specific to your circumstances.

Annual review of emergency planning tasks

Farm Emergency Plan review and reassessment

- Review your Farm Emergency Plan with your employees to ensure that they are familiar with all elements. Make any necessary additions or updates.
- Review your Emergency Contacts List with your employees and update it with current names and contact information.
- Review items provided in the “hurricane suggestion box,” and add them to your Farm Emergency Plan or training list as relevant.

Employee training

- Identify key tasks that employees will need to complete during hurricane preparation and recovery operations.
- Once each year, provide training for all employees that will participate in the key tasks identified above.

Personal health and safety tasks

- Make sure you and your employees have up-to-date tetanus shots.
- For information and links to time-specific guidance for preparing yourself and your home, visit the Ready.gov Hurricanes [website](#).
- Download the FEMA [Mobile App](#) to learn emergency safety tips, receive real-time weather alerts and important disaster planning reminders, information about shelters and recovery centers, and more.

Recordkeeping, documentation, and insurance

- Meet with your crop insurance and/or USDA Farm Service Agency (FSA) representative to make sure you are signed up for eligible programs. Review your insurance policies with your agent to be sure that you have adequate flood insurance and coverage for vehicles, farm buildings and structures, and crops.

- Keep records of harvest, equipment inventories, and purchases of supplies up to date. Long-term records will help to establish a production baseline from which losses can be determined. Be sure that copies of each are in a safe location chosen in the **Building a Resilient Operation** section above.

Infrastructure

Buildings and facilities

- Inspect all buildings and all facilities for structural soundness. Perform maintenance on facilities and infrastructure to repair items such as loose roofing materials or improperly/inadequately grounded electrical equipment to reduce hazard risk during a hurricane.

Drainage

- Clean out culverts and ditches in order to improve drainage, both before and during the peak hurricane season. Keep ditches clear through a good maintenance program including chemical weed control. Regrade areas of the property that are prone to flooding to improve drainage.
- Check any new construction areas, housing developments, or Department of Transportation projects nearby to see whether they are affecting your land's drainage. Determine where the water is draining now, and address any new drainage needs before hurricane season begins.

Maintenance of trees, windbreaks, and roads

- Remove dead and dying branches from trees on your property.
- Maintain windbreaks with regular pruning, especially if they are close to aerial power or telephone lines. To learn more about proper pruning practices, see:
 - Inland Urban Forest Council [A Practical Guide to Proper Pruning of Trees and Shrubs](#)
 - OSHA Line-Clearing Tree Trimming Operations [website](#)
- Evaluate roads for any repairs or improvements needed before a hurricane arrives

Harvest equipment

- If possible, ensure that you have access to additional harvest equipment for increasing row capacity, as this can reduce the time required to harvest portions of your acreage under time-limited windows, such as when a hurricane is approaching. The demand for this equipment will rapidly increase as the hurricane approaches so plan early for this contingency.
- Ensure that you have or have access to a flatbed trailer to move tractors and other equipment if necessary.

Generators

- Do routine annual maintenance on backup generators. Replace old stored fuel with new, fresh fuel. Replace fuel filters, test all generator circuits, and make sure you have all necessary supplies on hand, including spare belts and fuel filters.
- Ensure that all essential equipment functions when powered by the backup generator.

Emergency equipment and supplies

- Maintain an ample supply of emergency medical supplies, flashlights, and mosquito repellent, and have raincoats and boots available for employees.
- Maintain a supply of drinking water and dry and canned food sufficient for at least 2 weeks for employees who become stranded at the farm or who need to return to the farm before utility and emergency services are restored.
- Maintain an ample supply of weather-proofing supplies such as tarps and sandbags; fencing supplies; plumbing supplies; lumber, construction tools, nails and screws, and ropes; portable lights; batteries; and battery-powered or hand-crank radios.
- Also make sure that you have on hand shovels and small equipment to dig ditches; extra plastic mulch and tape to repair damages on plastic; emergency water pumps, irrigation pump repair kits, and other equipment.
- Keep a supply of lightweight (0.5 - 0.75 ounces) row covers on hand to help increase growing degree days after a delayed planting due to an early-season hurricane. The covers will encourage the growth of crowns and flower buds.

Monthly considerations during hurricane season

See **Appendix: Resource Links** for local Extension offices and other State and Federal resources which you may consult for further information.

Weather monitoring

- During the June to November hurricane season, pay regular attention to long-term weather forecasts. Check your weather tracker daily if a hurricane is forecast to move closer to your area.

Roads

- Make sure the main access roads on the farm are in good condition.

Equipment and supplies

- Check list of equipment and supplies for repairs that may be needed after the hurricane.

- Note supplies that take longer to deliver and order early to ensure they are available after a hurricane. Stockpile chemicals that are essential for your operation.
- Refresh emergency medical supplies, water, and dry and canned food supplies.
- Obtain sufficient quantities of plywood to protect windows and doors and store in a dry area. As the hurricane gets closer, plywood may be scarce or unavailable.
- Keep a stock of tools, utilities, first aid kits, water, and mosquito repellent available to all personnel. Tools should include a shovel, communication devices, gloves, rubber boots, etc.

Farm equipment

- Make sure that sprayers, tractors, and harvest equipment are in good working order to ensure that the crop can be harvested as efficiently as possible when conditions allow.
- Make sure access to your main machinery will be easy and not in the path of locations that are prone to flooding.
- Contact your equipment manufacturers to establish procedures for dealing with damaged equipment. Make sure you won't invalidate your warranty if you attempt repairs yourself.

Fuel

- Consider fuel needs for tractors, generators and farm vehicles. Any fuel stored on site poses a contamination risk if storage tanks are not adequately protected from flooding, especially if stored at a low elevation. Maintain additional fuel supplies on the farm in elevated tanks protected from flooding. This could even be in trailer- or truck- mounted diesel tanks. If secure storage facilities are available on site, arrange for fuel deliveries several days prior to the expected hurricane impact.

Generators

- Verify there is adequate fuel to power the generators for at least 2 weeks.

Crop

- Check the condition of row covers, looking especially for large holes and ripped pieces. Replace any row covers in poor condition. If row-covers are in poor condition, crop enhancement will be minimized and the risk of grey-mold will be high.
- If possible, prepare drenches in field ahead of time. Make sure they are deep and steep enough to move water out of the field.

Short-Term Preparedness

Specific actions to be done in the week
before a hurricane arrives

Bracing for the hurricane

(1–7 days before a hurricane is forecast to strike)

First and foremost, take whatever precautions necessary to protect your family, your employees, and yourself. After that is accomplished, focus on protecting your farm. Once forecasters have put your area in a hurricane's path, there are a number of precautions you should take to prepare.

Employees' roles and responsibilities

- Review your Farm Emergency Plan with all employees and discuss each person's responsibilities.
- Continue to monitor hurricane track and strength updates. Listen closely for evacuation orders in your area.
- Determine whether individual employees plan to evacuate or stay during the hurricane. For those who evacuate, establish a schedule for checking in after the hurricane so that they know the extent of the damages and when it is safe to return. For employees who stay, be sure they have safe lodging, sufficient food and water, and an established plan for checking in.
- Ensure that all managers know their responsibilities prior to, during, and after the hurricane. Handling the hurricane damage is too much work for 1 or 2 people.
- Ensure that personnel have training in first aid and key personnel know how to operate unfamiliar equipment (for example, a chainsaw to remove trees blocking roads).

Communications

- Ensure that all communication equipment is in good working order. Mobile devices are good for communication, but ensure radios are available and in good conditions of use. Keep mobile devices fully charged. Have rechargeable battery packs or charging cables for your vehicle to maintain communication. Texting may be a more valuable form of communication than calling when the phone networks may be overwhelmed.

Food, water, and cash

- Make sure your operation still has a 2-week supply of drinking water as well as dry and canned food.
- Secure cash reserves for purchasing supplies after the hurricane. In widespread power outages, credit and debit cards will not work, and many vendors do not accept checks.

Recordkeeping, documentation, and insurance

- Ensure that important documents are in a safe dry place and that duplicates are in alternative locations off site.
- Document the condition of your facilities and your crop. Take photographs and video (where helpful), record crop maturity, and estimate yield, as this will aid with insurance claims and disaster recovery assistance. If the crops are damaged or lost, these records will help with the damage assessment and post-hurricane claims. Check with your Extension or crop advisor on the best way to calculate a yield estimate for your crop.
- If you have insurance through FEMA's National Flood Insurance Program, your policy may cover up to \$1,000 in loss-avoidance measures such as installing sandbags and water pumps to protect insured property. Check with your insurance provider to confirm. Keep copies of all receipts and a record of the time spent performing the work and submit these documents to your insurance adjuster when you file a claim to be reimbursed.

Equipment

- Ensure that all emergency equipment is ready (e.g., compressors and heavy machinery).
- Make sure chainsaws are in good working condition. Stock up on fuel mixture and bar and chain oil. Sharpen the chain, keep the saw file and saw wrench close at hand, and make sure you have a spare chain.
- Move all non-critical farm equipment to higher elevations or store in secure buildings.
- Move pesticides, herbicides, and fertilizers to a secure place, on high ground above any potential flooding if possible.
- Ensure that tanks containing fuel, fertilizer, and other liquids are kept full and tied down.
- Make sure that farm equipment you will need after the hurricane, such as tractors with front-end loaders or skid-steer loaders, is fully fueled and operational.
- Unplug computers and other electronic equipment to protect from electrical surges, and store these items safely.

Infrastructure

Backup generators

- Make sure generators are functioning properly and have full fuel tanks and portable fuel storage tanks. Your generators may have to run for several days until the power company can restore electricity. Review the owner's manual for the maximum run time and other unit specifics.

Fuel

- Make sure that you have at least a 2-week supply of diesel and gas. Be sure the supplier understands how much you use daily and that it is necessary for farm operations. If secure storage facilities are available on site, arrange for fuel deliveries several days prior to the expected hurricane impact. Consider fuel needs for tractors, generators and farm vehicles.
- Service stations will not be able to supply fuel if they do not have electric power for the pumps, so make sure portable fuel storage tanks are full.
- Any fuel stored on site poses a contamination risk if storage tanks cannot be adequately protected from anticipated flooding. Move them to higher ground or secure in place.

Electricity and gas shut-off

- Consult your Farm Emergency Plan and follow procedures for disconnecting electrical power and gas to some or all buildings and any non-critical equipment in danger of being flooded.

Buildings and grounds

- Secure building components—Check on the security of roofing and siding materials and windows and doors, and make sure all other building components are tied down securely. Windows of buildings should be secured with wood planks.
- Secure outdoor objects—Secure outside objects around your farm so that they don't blow away or become hazardous projectiles.

Roads

- If the roads leading to the farm are likely to flood, stage your boat in a secure, easy-to-access location.

Drainage

- Check drainage ditches and culverts around your facilities and remove any debris so that water can move freely.
- Pump down all water from ditches to the maximum extent possible.

Supplies

- Review inventories and order any additional supplies that can be delivered before the hurricane.
- Be sure to stockpile any chemicals you may need, including sun burn protectant for melons.

Crop

Harvesting

- Strawberry harvest in the Southeast usually does not occur during hurricane season. However, if your strawberry production extends into hurricane season and a hurricane is forecast for your area you should:
 - Pick all ripe berries 1 day before the rain begins.
 - Harvest fields first that are most vulnerable to flooding.
 - Move your PYO stand and all equipment to a safe shelter.
 - Sanitize the field and remove diseased and dead plant material
 - Assess the need for a preventative fungicide application to reduce inoculum of *Botrytis* (gray-mold). It might be impossible to enter the field for several days after the hurricane.
- Fields can be in different stages of production when a hurricane impacts your farm. Your pre-hurricane preparation will depend on the fields stage of crop development.

Scenario 1: Plastic mulch has not been laid, and fumigants were not applied. The field is fallow.

- Don't plan to lay plastic in the few days before the expected hurricane.
- Be prepared to wait 2 - 4 weeks until you can enter the field after heavy rainfall to lay plastic and to apply pre-plant fertilizer.
- Document the status of your field, block by block, before the hurricane (see above).
- Secure plastic rolls and fumigant cylinders on high ground, in designated shelter, and in an area that is protected from the wind.

Scenario 2: Plastic mulch has been laid and fumigants are applied, but plants are not planted.

- Do not plant before the hurricane.
- Document the status of your field, block by block (see above).

If flooding is expected:

- Prepare to redo some of the beds, as they may collapse.
- Make sure major access roads have ditches for water to run off.
- Check and clean ditches in production fields.

- Secure row covers on elevated ground if possible.
- Wait until it is dry enough to plant (2 – 4 weeks).
- Diseases such as Phytophthora and anthracnose can be a big problem in flooded fields, so you will need to closely monitor those fields after planting.

If wind is expected to be a major problem:

- Go out as soon as possible and make sure that the plastic is safe and secure.
- Cover all holes with heavy-duty duct tape. No holes should remain, and the plastic should be firm to the bed.
- Secure all major pieces of equipment, plastic rolls, bed layer, etc. or move to a secure place.

Scenario 3: The field is planted.

- Document the status of your field, block by block (see above).
- Prepare to redo some of the beds, as they may collapse.
- If you are less than 4 weeks after planting date, identify a plant provider and ask whether they can ship extra plants on short notice for replanting.
- Make sure major access roads have ditches for water to run off.
- Check and clean ditches in production fields.
- Secure row covers on elevated ground.

Personal safety the day before the hurricane hits

- Perform a final verification of the hurricane track and strength. Listen closely for evacuation orders for your area.
- Obey all mandatory evacuation orders. Failure to do so, can put you and your workers at risk, and could tie-up rescue resources. Do not require your personnel to be present on the farm either, since they also have to prepare themselves and their families.
- Make sure your employees have evacuated to secure areas at least 1 day prior to hurricane impact. If some staff will remain on site, confirm that they have access to structures on high ground or elevated slabs or pylons that can withstand hurricane winds and rain, sufficient stores of clean water and food, medical supplies, working radios or cell phones, and sufficient battery or generator power. Those workers remaining on site will likely need to rely on cell phone/text communication with evacuated supervisors and colleagues, since local radio and television communications often black out for several hours as a hurricane passes. Local first responders may also be out of communication at the time of hurricane impact.

SECTION 3: Short-Term Preparedness

- Personnel remaining on site to monitor the farm until the last moment should keep an eye on water levels in low-lying areas so that they may give sufficient warning and allow workers to exit the operation before levees, surrounding roads, and highways are blocked with floodwaters.

Post-Hurricane Recovery

Activities that can be taken to minimize losses immediately after, a week after, and a month after a hurricane

Immediately after the hurricane has passed

Safety

- Make safety your first priority. Do not rush back into a facility until you are sure it is safe. Note the integrity of buildings, power lines, trees, equipment, and electrical and gas systems that may have been damaged during the hurricane. Address all hazards to ensure safety before proceeding with recovery actions.
- Continue to watch the weather forecast. Are waters still forecast to rise more than they are now? Some floodwaters peak up to a week after the hurricane.
- Meet with your personnel to go over responsibilities during recovery and check on their well-being.

Electricity and gas

- Avoid downed power lines, as these may still be live and represent an electrocution hazard. Operate on the assumption that all downed power lines are live.
- When restoring electricity to buildings that have flooded, use extreme caution and consult with an electrician and your power provider. See the Alabama Cooperative Extension System guidance on [restoring electrical power after flooding](#).
- Natural gas or liquid petroleum (LP) gas leaks can cause deadly explosions. Check for natural gas or LP gas leaks, and if a leak is suspected, turn off the gas, evacuate the area, and notify your gas company and local law enforcement. Tell employees to stay clear.

Groundwater

- After a flood event, groundwater should be used with caution if contamination is suspected anywhere in the general vicinity.

Roads and buildings

- Before entering any buildings, check for levee breaches, rising or incoming water, and evidence of structural fire or damage.
- As soon as it is safe, call in the employees needed for inspection and clearing debris from roads. Cordon off areas that are unsafe.

Security

- Watch your farm for unwelcome visitors like looters. Secure your equipment and farm entrances, and make sure your security cameras are operational.

Recordkeeping, documentation, and insurance

- Do not begin cleaning up or repairing damage until you have thoroughly documented the damage. Contact your crop insurance adjuster as soon as possible to decide on the best plan moving forward with potential damage to your crop. (See “Within a week following hurricane impacts” below regarding post-hurricane documentation.)
- If you have experienced flooding and have flood insurance through the FEMA National Flood Insurance Program, visit their [website](#) for more information about starting a claim.

Within a week following hurricane impacts

Personal health and safety

- Take care of yourself during recovery. Disasters and the recovery period afterward take a toll on human health. Disaster recovery takes a long time and can be very stressful. For guidance to help you through this difficult time, see:
 - Colorado State University Extension [Coping with Natural Disasters](#)
 - North Carolina Cooperative Extension [Tips for Handling Family Stress After Disasters](#)

Communications

- The local supply/seed stores are often natural sources of information if the power is down and electronic communication is limited. In addition, radio stations have generators that allow them to transmit if their towers are not damaged.

Recovery assistance

- Before beginning cleanup, talk with your insurance company and consult with disaster assistance program agents to learn about available programs, eligibility requirements, and application procedures. (See “Disaster assistance” below for more information about assistance programs.)

Documentation of damage

- Many disaster assistance programs will become available after the disaster, perhaps even years later, and an operation can only receive assistance for damage that was documented. For instance, the [Emergency Conservation Program](#) (ECP), administered by FSA, can compensate farmers for repairing damage due to a natural disaster which would create new conservation problems. The work must

be documented, and farmers must have gotten authorization from their local USDA office in advance.

Photos and video

- Take photos or video first before beginning any cleanup or repairs. Photograph and take video of damaged crops and property, with written notes describing what is in the pictures and where they were taken. This “after” documentation will be used with your pre-hurricane, “before” documentation to clearly show your losses.

Drones

- If you own and have a license to operate a UAV (i.e., drone), utilize it now to take aerial photographs of damage to your fields. Some local Extension offices might have access to drones and personnel with a drone pilot license to assist you.

Written records

- Keep a notebook with you throughout the recovery period. Describe the work you did and record all expenses. Keep a running log of names and what was discussed during conversations with insurance, State, and Federal agency contacts to create a valuable, third-party record of your recovery efforts that can be used later as documentation for disaster assistance programs. You may not remember everything that was discussed at these meetings, so have a second person involved in the conversations if possible so that one can ask questions and the other can take notes.

Disaster assistance

- Communicate early and often with recovery assistance contacts. Check in with them throughout the recovery process. Note that assistance will vary from one hurricane to the next and one budget year to the next.
- Call your local FSA Office to report any losses or damages and inquire about available assistance programs, application procedures, and deadlines.
- Check in with your local Cooperative Extension office, USDA agencies, and your State department of agriculture to see what assistance may be available following the hurricane.
- Consult the following resources:
 - FEMA Individual Disaster Assistance website to find the closest recovery center and other resources to assist you during your recovery
 - USDA Disaster Resource Center’s Storm website for updates on emergency designation areas and available assistance programs
 - Farmers.gov, including the five-step Disaster Assistance Discovery Tool to learn which USDA disaster assistance programs are available to assist you with your recovery
 - U.S. Department of Labor’s Disaster Unemployment Assistance Program website

- To learn more about USDA Disaster Assistance Programs that may be right for you, see:
 - Noninsured Crop Disaster Assistance Program (NAP)—FSA program that provides assistance for eligible farmers who suffer losses or are prevented from planting agricultural commodities that are not eligible for protection by Federal crop insurance
 - Emergency Farm Loans—FSA program that provides eligible farmers and ranchers low-interest loans to help them recover from production and physical losses
 - Disaster Set-Aside Program—FSA program that allows eligible FSA borrowers to skip an annual installment payment and move it to the end of the loan repayment period
 - Emergency Watershed Protection (EWP) Recovery Assistance—NRCS program that provides financial and technical assistance to quickly address serious and long-lasting damage to infrastructure and land
 - EWP Floodplain Easement Program (EWPP-FPE)—NRCS program option for converting land to permanent easements for the purpose of improving floodplain management and reducing the threat to life and property
 - Environmental Quality Incentives Program (EQIP)—Year-round NRCS rehabilitation program with funding authority to provide financial assistance to repair and prevent excessive soil erosion caused or impacted by natural disasters
 - Emergency Conservation Program (ECP)—FSA program with technical assistance through NRCS that helps eligible farmers and ranchers repair damage to farmlands caused by natural disasters

Insurance claims process

- Begin the insurance claims process (Federal, private, or both). Accurate losses of inventory and equipment may not be fully documented yet, but insurance claims can take months to resolve following hurricane events so start the paperwork now.

Infrastructure assessment and repairs

- Assess damage to equipment and infrastructure and create a prioritized list of needed repairs.
- Repair access roads, and repair main facilities if damage occurred.
- Dig ditches or deepen existing ditches for the water to pass freely.
- Gather quotes from qualified vendors to make repairs to facilities and equipment. Vendors are often overwhelmed in the months following a hurricane, so making contact soon after the hurricane is important for an expedient response.

- Monitor fuel levels in backup generators and order additional fuel as needed.

Floodwater contamination

- “Floodwater” refers to the overflow of external sources of water such as rivers or canals and not to direct precipitation that may pool in or near your fields or facilities.

Water supply

- If you have a well, regardless of whether the wellhead was flooded, submit groundwater samples for microbial and chemical testing to ensure that the aquifer was not contaminated. Also monitor wells for coliform contamination.

Crops

Soil contamination

- If floodwater entered your fields, consult your local U.S. Food and Drug Administration (FDA) office and State, industry, and/or university Extension specialists for guidance on how to proceed. The U.S. FDA recommends determining the source of floodwaters (and likelihood that they carried human pathogens), letting fields dry before reworking, and testing for pathogens. Other specialists suggest a 30- to 60-day wait period to reduce bacterial contamination of soil. Chemical contamination may require a longer waiting period depending on the chemical and the level of contamination.
- Collect soil samples throughout the flooded portion of your fields and test them for known contaminants and general chemical contamination. For more information about soil testing, visit the [North Carolina Cooperative Extension website](#).
- See U.S. FDA [Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables](#).
- Take measures to avoid cross-contamination between flooded and nonflooded fields. Do not use equipment in a nonflooded field that was used in a flooded field unless it has been cleaned and sanitized.

Crops for human consumption

- According to U.S. FDA regulations, any fruit that comes into contact with floodwater cannot be harvested. Floodwaters may contain elevated levels of not only pathogenic bacteria but also chemicals, which cannot be removed from a food once contaminated. The U.S. FDA considers all human and animal foods that come into contact with floodwaters to be adulterated. If you must destroy and dispose of food products, keep documentation showing that the crop did not enter the food supply.
- If the edible portion of the crop has come into contact with flood waters keep it separate from uncontaminated crops and dispose of it. This applies to surface

crops; underground crops; crops with a hard skin or shell; grain, nuts, corn, and similar crops; and others. For more information, see the U.S. FDA's:

- Guidance for Industry: Evaluating the Safety of Flood-affected Food Crops for Human Consumption
- Safety of Food and Animal Food Crops Affected by Hurricanes, Flooding, and Power Outages

- If floodwater was nearby but did not contact the edible portion of the crop, work with State regulators and U.S. FDA offices to determine whether the crop is considered adulterated.

Food-Handling Equipment

- Thoroughly clean and sanitize all food contact equipment and food handling environments that may have become contaminated during the hurricane. First, physically remove dirt or debris with a brush or with water and a detergent. Then, sanitize with an antimicrobial chemical to reduce microorganisms on the surface of the equipment.

Crop

Inspection of row covers and plastic mulch

- If using lightweight row covers to enhance crop growth after a delayed planting, apply fungicides beforehand to prevent gray-mold. For more information, see the University of Florida IFAS Extension Strawberry Production Guide. Since different cultivars react differently to the use of row covers to enhance crop performance, check with your local extension service before applying them.
- If using lightweight row covers, check frequently for signs of *Botrytis* crown rot under covers and treat accordingly. Especially under warm and wet conditions, *Botrytis* (gray-mold) can very quickly become a large problem under the row covers. For pesticide recommendations, see the Southern Small Fruits Consortium Southeast Regional Strawberry Integrated Pest Management Guide.
- After heavy winds, monitor strawberry fields for potential damages in plastic mulch. If it is possible to access field with equipment, repair damages to mulch.

Planting

- If you have yet to plant strawberries, analyze the soil conditions for available nutrients. There is a chance than some of your pre-plant fertilizer has leached. In that case, you will have to support plant growth through the use of liquid fertilizer through drip fertigation. If your soils have drained well, proceed with planting as usual.
- If soils are too wet, avoid planting until the soil conditions are more favorable. Fields can be drained through drenches. Smaller field portions can be pumped out.

Harvesting

- Assess equipment damage and take this into account for upcoming harvest operations. This will help in developing a plan for the coming weeks and months.
- Any fields that were damaged but not flooded and are able to be harvested should be prioritized from the least to most damaged to minimize profit losses.

Diseases, pests, and weeds

- Identify fields in most immediate need of fungicide application and make plans to apply by ground when the conditions allow. Fungicides with Oomycete activity (e.g., *Phytophthora cactorum*) should be applied via drip line. If it appears that the time frame for ground-based application will extend too long, make arrangements for aerial application. Note that aerial applications of fungicides are less effective than applications by ground.
- Diseases, especially those transmitted through water, may develop quickly if the crop has been flooded. The most important disease is *Phytophthora* root and crown rot, caused by *Phytophthora cactorum*.
- If your fields have been flooded with off-farm water sources, be aware of weed seeds that could have been carried in, presenting a new weed problem on your farm. Be aware of the management implications in subsequent seasons.

Potential Salt Damage

- Higher soil salt levels can accompany storm surges and cause severe damage and die-back to strawberry plants. Strawberries are classified as sensitive to salt water and yields will decrease with elevated salt levels. Avoid measuring electrical conductivity (EC) with a probe, as this will result in artificially high values.
- The most important salts to be aware of after a hurricane surge are sodium, chloride, and some extended nitrates. To manage sodium and chloride, do additional watering after the flooding to leach out some of the salts until the EC is reduced to an acceptable level. The water amount depends on the outside temperature and water needs of the plant.
- Contact your university Extension office if you suspect your crops have been damaged by salt water.

Within a month after hurricane impacts

Recovery assistance and insurance claims

- After many natural disasters that result in widespread damage, additional programs often become available to aid with agricultural losses. These programs are not guaranteed, however, and are generally handled on a case-by-case basis depending on the hurricane's impact. In addition, some programs require

additional processing time for a special appropriation from the U.S. Congress and Presidential approval.

- While a special allocation may not be immediately available, it is important to document losses and to illustrate to your legislators the impact of the hurricane on your operation. This information will help promote policy decisions and additional allocations that may become available.
- Continue to follow up on the insurance claims process. Begin filing for any additional State or Federal disaster assistance programs for hurricane recovery.
- Visit the USDA Disaster Resource Center Storms [website](#) for updated information about FEMA aid and other disaster programs.
- Continue to document everything and keep a record of conversations with agency contacts. This creates a valuable, third-party record of your recovery efforts that may be used later as documentation for assistance programs.

Organic certification

- If your farm is organic, it is important to consider how the hurricane impacts may affect your certification. Temporary variances from some organic practices are possible, so contact your certifier to determine whether your practices qualify. It is most important to report prohibited substances that may have infiltrated your farm during the hurricane.

Infrastructure and equipment.

- Continue to gather quotes from qualified vendors to make repairs to facilities and equipment. Vendors are often overwhelmed in the months following a hurricane, so making contact soon after the hurricane is important for an expedient response.
- Monitor buildings for water damage or mold development, and monitor wells for coliform bacteria.
- Continue to refill fuel tanks and check backup generators until full power is restored.
- Perform general and preventative maintenance on any equipment that was flooded. Keep all receipts for parts and labor as well as a list of any equipment that is determined to be a total loss.
- Examine drainage ditches and canals to determine to what extent they were silted in by floodwaters. Dredge and/or repair them if necessary.
- Remove fallen trees. Tree wood can sometimes be sold.
- For information about assessing hurricane-damaged trees, see the North Carolina Cooperative Extension [website](#).

Crop concerns

- Repair damages to the plastic mulch.
- Remove dead plants and remove dead tissue. Do not replant.
- Control diseases, especially *Phytophthora*, *Botrytis* (gray-mold), anthracnose, and root rots.
- Make sure that your fields continue to drain properly.
- Supplement fertilizer through the drip tape once soils are at normal moisture again in order to support plant growth.
- If planting dates were delayed, use row covers to enhance growing degree days (see above).
- Make cost-benefit decisions on whether or not to keep a field/block in production. Sometimes it's not worth the extra time and material investment. For example, calculate how much labor and material per acre it will cost to build drenches and lay new plastic assess, then assess your plant damage and potential yield loss, and calculate the potential return of the crop you expect to harvest.

Caution about adding wood debris to agricultural land

Following recent hurricanes, farmers have been approached by contractors wishing to spread chipped and shredded tree debris on their land, often paying hundreds of dollars per acre to do so. While these additional dollars may be very helpful at this time, you will need to consider how this influx of carbon will likely require additional nitrogen inputs to maintain crop productivity in the future. If you are approached about considering this type of contract, ask lots of questions, know exactly what is going to be applied and at what rate, and factor in additional nitrogen fertilizer costs. If you want help determining the impact of a land application for your specific operation, contact your local county Extension agent. Like many other farming decisions, this all comes down to how much income it will produce versus the additional management it will require. For more information, see University of Florida IFAS Extension [Considerations Before Contracting for Chipped or Shredded Wood Debris Application on Agricultural Land](#).

Appendix

Farm Emergency Plan

Hurricane preparedness can have a direct effect on your farm's profitability and long-term survival. For agricultural operations in hurricane-vulnerable regions, it is critical to have a Farm Emergency Plan in place outlining key tasks and different people's roles and responsibilities as you brace for the hurricane. Your Farm Emergency Plan can save valuable time in a chaotic situation when multiple challenges clamor for immediate attention, helping you prioritize your actions and recover from the hurricane as efficiently as possible.

Use this sample plan to customize for your operation. Preparation for these tasks—putting the systems in place—is described in the main guide (see “Emergency planning” in the **Building a Resilient Operation** section). Though there is some overlap with the tasks listed in the **Short-Term Preparedness** section, this sample plan is intended to be a document you can use during an actual emergency.

Before the hurricane

Tracking the hurricane

- Use your hurricane tracking app. The NOAA National Hurricane Center [website](#) is a good source for keeping up to date on the latest hurricane activities. Learn more about emergency alerts at the U.S. DHS Ready.gov [website](#).

Emergency Response Team

- Gather the members of your farm's Emergency Response Team, who have been thoroughly trained in their respective tasks and are knowledgeable about the hazards found on the farm.
- Review the chain of command and individuals' primary and secondary roles and responsibilities.
- Discuss modes of communication as well as alternatives in case any communication channels become unusable during or after the hurricane.
- Review your farm's Emergency Contacts List.

Employees' status and location

- Review procedures to account for all people and employees after an emergency evacuation. Determine who will evacuate and who (if anyone) will stay during the hurricane. For those who evacuate, establish a schedule for checking in after the hurricane. For those who stay, be sure they have safe lodging and sufficient food and water and establish a clear plan for them to check in.

Maps and emergency escape routes

- Using the map of your farm with all buildings and contents, review emergency escape routes and hurricane preparation procedures for each building, facility, and area of the operation.

Emergency equipment and supplies

Locate the following equipment and supplies:

- Emergency medical supplies
- Raincoats and boots
- Weather-proofing supplies such as tarps and sandbags
- Fencing supplies
- Plumbing supplies
- Lumber, construction tools, nails, and ropes
- Portable lights, batteries, and battery-powered or hand-crank radios

Food, water, and cash

- Make sure there is a 2-week supply of dry and canned food and drinking water (at least ½ gallon per person per day) stored on site if personnel will be staying on site.
- Secure cash reserves to use for purchasing supplies after the hurricane.

Facility security

- Ensure that important documents are in a safe, dry place.
- Check on the security of roofing and siding materials and windows and doors, and make sure all other building components are tied down securely.
- Secure outside objects around your farm, so that they don't blow away or become hazardous projectiles.
- Protect greenhouses (if applicable).
- Check drainage ditches and culverts around your facilities for debris.
- Pump down all water from ditches.

Equipment

- Ensure that all emergency equipment is ready (chainsaws, compressors, heavy machinery, etc.).
- Move all non-critical farm equipment to secure locations or higher elevations.
- Move pesticides, herbicides, and fertilizers to a secure place, on high ground if possible.
- Make sure that farm equipment you will need after the hurricane, such as tractors with front-end loaders or skid-steer loaders, is fully fueled.
- Be sure your backup generator(s) are fully operational. Fill the fuel tank(s) and portable fuel storage tanks.

Fuel

- Make sure you have a minimum of a 2-week supply of diesel and gas. Be sure the supplier understands how much you use daily and that it is necessary for farm operations. If secure storage facilities are available on site, arrange for fuel deliveries several days prior to the expected hurricane impact. Consider fuel needs for tractors, generators, and farm vehicles.
- Any fuel stored on site poses a contamination risk if storage tanks cannot be adequately protected from anticipated flooding. Move to higher ground or secure in place.
- Since fuel may be unavailable if service stations have no power, make sure portable fuel storage tanks are full.
- Ensure that tanks containing fuel, fertilizer, and other liquids are kept full and are tied down.

Backup generators

- Retrieve backup generators and fuel and place them where needed.
- Connect generators to critical electrical loads as outlined in your Backup Power Plan.

Electricity and gas shutdown

[Outline the shutdown procedures for electricity and gas, according to instructions you are given by your utilities and other experts.]

[Outline the shutdown procedures for specific equipment.]

Service or equipment to be shut down	Procedures for shutdown

Crop

[Add actions specific to your crop.]

Immediately after the hurricane

Safety

- Make safety your first priority. Do not rush back into a facility until you are sure it is safe. Use extreme caution due to the potentially injurious situations presented by weakened trees and damaged structures, equipment, and electrical and gas systems.
- Continue to watch the weather forecast. Are waters still forecast to rise more than they are now? Some floodwaters peak up to a week after the hurricane.

Electricity and gas

- Avoid downed power lines as these may still be live and represent an electrocution hazard. Operate on the assumption that all downed power lines are live. Remember that a downed power line on a fence may energize the fence.
- When restoring electricity to buildings that have flooded, use extreme caution and consult with an electrician and your power provider. See the Alabama Cooperative Extension System guidance on [restoring electrical power after flooding](#).
- Natural gas or liquid petroleum (LP) gas leaks can cause deadly explosions. Check for natural gas or LP gas leaks, and if a leak is suspected, turn off the main property gas line, evacuate the area, and notify your gas company and the authorities. Tell employees to stay clear.

Roads and buildings

- Before entering any buildings, check for levee breaches, rising or incoming water, and evidence of structural fire or damage.
- As soon as it is safe, call in the employees needed for inspection and clearing debris from roads.
- Cordon off areas that are unsafe.

Security

- Watch your farm for unwelcome visitors like looters. Secure your equipment and farm entrances, and make sure your security cameras are operational.

Insurance and documentation

- Do not begin cleaning up or repairing damage until you have thoroughly documented the damage. Contact your crop insurance adjuster as soon as possible to decide on the best plan for moving forward with potential damage assessment, cleanup, and repair.
- If you have experienced flooding and have flood insurance through the FEMA National Flood Insurance Program, visit their [website](#) to learn how to start a claim.

Emergency Contacts List

You may customize this for your operation. Delete items that do not pertain to your commodity or location and add companies or organizations specific to your commodity.

Individuals

Name(s)	Role(s)	Phone number(s)	Notes
	Owner(s)		
	Members of the Emergency Response Team		
	Other key employees or managers		

Emergency Services

Organization	Name(s)	Phone number(s)	Notes
Emergency medical responders			
Hospitals			
Fire department			
Sheriff's office			
Emergency management agency			

Utilities, Roads, and Trees

Organization	Name(s)	Phone number(s)	Notes
Electric utility or cooperative			
Natural gas utility			
Water utility			
County road department or State Department of Transportation			

Insurance Companies

Organization	Name(s)	Phone number(s)	Notes
Commodity insurance companies			

Contractors

Organization	Name(s)	Phone number(s)	Notes
Electrical contractor			
Plumbing contractor			
Mechanic			
Fuel supplier			
Generator servicing			
Equipment dealer			
Equipment rental company (emergency generators, lifts, etc.)			

Federal, State, and County Organizations

Organization	Name(s)	Phone number(s)	Notes
State Department of Agriculture			
County/ University Extension Office			
County emergency management agency			
County Health Department			
USDA Farm Service Agency			
USDA Natural Resources Conservation Service (NRCS)			
U.S. DHS Federal Emergency Management Agency (FEMA)			

Initial Site Planning

Considerations when deciding on a new location to establish or purchase farmland

The National Oceanic and Atmospheric Administration (NOAA) developed a map for illustrating the probability that an area of the country will be hit by multiple hurricanes, expressed as the number of years between storms (known as the return period, Figure A1). While no model can determine when and where hurricanes will strike during any given hurricane season, the return period map is a good indication or relative hurricane risk.

It is important to remember that this map represents a long-term average and that even if the average return rate for a hurricane is 25 years, hurricanes could still occur at one spot on successive years or even in the same year. It is also important to understand that while most data show only where hurricanes have made landfall, they can also move hundreds of miles inland causing significant wind damage and flooding.

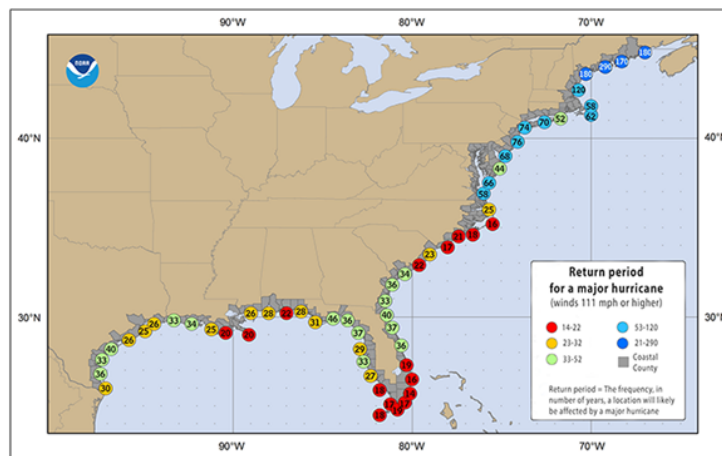


Figure A1. Return period (years) for major hurricanes for the coastal Eastern United States. Graphic provided by the National Oceanographic and Atmospheric Administration (NOAA).

Use NOAA’s [Historical Hurricane Tracks tool](#) for a map and dates of hurricanes that have impacted your area in the past 150 years. The timing and track of historic hurricanes may be different than those for future hurricanes and should be used with caution.

Site characteristics

Topography

- While storm surges occur in coastal areas, heavy rain and resulting flooding can be a primary concern inland, not only in the case of a hurricane, but also when tropical storms with lower wind speeds occur. Rivers and creeks can raise over their beds, landslides can block roads to farms, and ground water levels can push above ground.
- Strawberry production on the east coast of the United States is especially vulnerable to the impact of hurricanes, because preparing and planting of strawberry fields occurs during hurricane season. The correct site selection and field preparation can mitigate some of the risk associated with flooding and storm surges.
- When planning for long-term preparedness, evaluate a potential site for your operations with an eye toward reducing the risk of surface flooding or coastal storm surge. It is unlikely that all risks can be avoided. However, the negative considerations of an elevated open site are often less than those of low-lying areas susceptible to flooding.
- If possible, choose a site that has higher-elevation areas so that farm equipment can be easily moved to avoid flooding.
- Sufficient water drainage is one of the most important factors to consider when selecting a field site for strawberry production. If you are in a high-risk area for flooding and storm surges, here are some key points to consider:
 - If possible, find elevated land that has sandy/loose soil not near a river or creek.
 - Land should be gently sloping with adequate drainage. Avoid steeper slopes if possible.
 - If you are in an area with a lot of slopes and hills, select a site that is not blocking naturally occurring surface water drainage during heavy rains.
 - In some areas in the southeast coastal plain, hard layers of bedrock beneath the sandy soils prohibit quick water drainage. While this usually does not affect strawberry production under normal weather conditions, it can become important when heavy rain falls, flooding, or storm surges occur. If possible, test your potential field site for such hard layers before pre-plant preparations by drilling holes with an auger in several areas of the field. Contact your extension office to assist. Auger holes should be at least 40 inches deep.

Flood risk and storm surge

- Assess historic and predictable patterns of flooding to determine which areas are at the highest risk of damage during extreme weather.
- Consult the following Federal and State-level resources for estimating flood risk:

- U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) [Flood Map Service Center](#)—for official flood maps
- North Carolina Flood Risk Information System [website](#)
- Determine proximity to bodies of water at risk for storm surge. In some areas, storm surge can cause flooding many miles inland from the coast. View the NOAA [National Storm Surge Hazard Map](#) to assess your risk.

Roads and utilities

- Choose a site with good roads that will allow multiple escape routes when evacuating from hurricanes and tropical storms that can cause rising flood waters, storm surge, or downed trees.
- Plan to have utilities and other critical infrastructure permanently constructed on higher ground to avoid equipment and infrastructure damage during flooding.
- Search for areas with resilient electrical grids. Avoid relatively isolated sites with limited access to electrical utilities.

Natural windbreaks

- If possible, choose a site with natural windbreaks, such as wooded areas surrounding the field.

Resource Links

North Carolina Resource Links

University Extension, State, and Federal websites

University Extension Websites	Purpose
<u>Strawberries*</u>	Resources to help farmers improve strawberry management and productivity
<u>Extension Office Locator*</u>	Contact information for University Extension Agents in your county
<u>Disaster Preparedness and Recovery*</u>	Resources to help prepare for and recover from hurricanes and other disasters
<u>Extension Disaster Education Network (EDEN)</u>	Information and program resources to help with hurricane preparedness and recovery

* North Carolina Cooperative Extension Service

State Websites	Purpose
<u>North Carolina Governor's Office</u>	News and information from the Governor, including evacuation orders and emergency declarations
<u>North Carolina Department of Agriculture and Consumer Services (NCDA&CS)</u>	Main source for answers to your agricultural-related questions
<u>North Carolina Division of Emergency Management</u>	News and resources to help you prepare for, respond to, and recover from emergencies, including hurricanes.

APPENDIX: Resource Links

Federal Websites	Purpose
United States Department of Agriculture (USDA)	News and announcements related to agricultural commodities and disaster recovery programs
USDA Disaster Resource Center	Resources to help you build long-term resilience to and recover from hurricanes and other disasters
USDA Office Locator	Contact information for USDA offices in your county, including FSA, NRCS, Rural Development, and Conservation Districts
USDA Farm Service Agency (FSA)	Assistance with securing loans, receiving payments, and applying for disaster relief programs
USDA FSANorth Carolina	Focus on State FSA resources, including financial and technical information sharing
USDA Natural Resources Conservation Service (NRCS)	Financial and technical assistance for farmers, ranchers and forest landowners
USDA NRCS North Carolina	Focus on State NRCS resources, including financial and technical information sharing
USDA Risk Management Agency (RMA)	Assistance with Federal Crop Insurance and managing risk
USDA RMA Agent Locator	Contact information for local RMA offices in your county
US Department of Homeland Security Federal Emergency Management Agency (FEMA)	News and information to help you prepare for and recover from hurricanes and other disasters
US Department of Homeland Security Hurricane Preparedness	Resources to help individuals prepare for and recover from hurricanes
US Department of Commerce National Oceanic and Atmospheric Administration (NOAA)	Resources to view historical, current and predicted hurricane activity and warnings in your areas
NOAA National Hurricane Center	Current and forecasted tropical cyclone activity, educational resources, and advisory warnings for your area of interest
NOAA National Weather Service Weather-Ready Nation	Latest news, information and technology to enable informed decision-making before, during, and after a hurricane strikes

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USDA Southeast Climate Hub

<https://www.climatehubs.usda.gov/hubs/southeast/>

To access this guide, as well as those produced
for other commodities, please visit:
<https://www.climatehubs.usda.gov/hubs/southeast/topics/>



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