

DRAFT Finfish Producers Information Guide to Preparing for and Recovering from Hurricanes in the Southeast U.S.

This is a draft of guidance being developed by the USDA SE Climate Hub to help finfish producers prepare for and recover from hurricane damage.

This section will focus on:

- Storm preparation for pond production facilities
- Management response during and after storms

I. Pre-Hurricane Planning – Long-term Preparedness

Initial Site Planning *The considerations below could be considered ideal, but they all should be taken into account when evaluating a potential pond production facility. Sites that appear suitable for pond-based aquaculture (flat land with high clay-content soil and abundant water sources) are often particularly vulnerable to storm impacts. Unique challenges will include access, utilities, topography and infrastructural considerations.*

- Search for sites above the 100 year-flood plain.
- Search for sites located far enough inland to avoid coastal storm surge and flooding.
- Search for areas that are not close to water bodies that could flood or are prone to flooding when subjected to heavy rains associated with hurricanes and tropical storms.
- Search for sites with surrounding topography that will allow for efficient and rapid drainage to the watershed.
- Search for areas with good road infrastructure that would allow expedient multiple escape routes when evacuating from hurricanes and tropical storms.
- Search for areas with resilient electrical grids. Avoid relatively isolated sites with limited access to electrical utilities.
- Search for areas where farm equipment can be easily moved to higher elevations to avoid flooding.
- Search for areas where utilities and other critical infrastructure can be permanently established on higher ground to avoid equipment and infrastructure damage during flooding.
- If producing freshwater fish species, look for areas where saltwater intrusion during storm surge or flooding is not likely to occur. Typically, this includes sites that are 15 miles or more from any coastline or water body with a direct connection to the saltwater.
- Search for sites with dependable electrical supplies and infrastructure and close to power plants or electrical substations to minimize frequency and duration of power outages resulting from storms.

Site Establishment *A specific site can be more or less prone to storm damage, but each site can be developed in such a way as to minimize impacts.*

- Construct aquaculture ponds in elevated areas, avoiding low or flood prone areas.
- Establish higher-elevation areas (at or above the 50-year flood elevation) at designated levee junctions throughout the farm, with one elevated area for every 200-300 acres.

- Consider seasonal prevailing winds when laying out ponds. If storm related winds are parallel with the long axis of a pond, excessive wave action can damage down-wind levees during hurricanes and tropical storms.
- Construct levees surrounding the farm and/or pond complex in areas that would potentially flood if a nearby water body rose beyond the established flood stage. Levees should be constructed a minimum of 24" above the highest recorded flood stage for the property.
- Install main drain valves or shut-offs in leveed complexes to prevent flood water intrusion from surrounding high water. Have an alternate drain line running above the levee elevation so water from heavy rains can be physically pumped out of the leveed complex during a flood event. The goal is to be able to release water from ponds while avoiding water entering the facility from outside the levees.
- Install pump stations inside levee complexes to remove water that normal drainage features cannot keep up with during heavy rains. Even non-leveed complexes may require pump stations to maintain adequate pond and facility drainage during heavy rains associated with hurricanes.
- Ensure all pump stations are sufficiently elevated or otherwise protected from flooding and have a protected gas or diesel backup operating system in case of prolonged power outages.
- Increase the normal recommended capacity of pond and main drain lines by 40% or more when constructing aquaculture facilities in areas that could be impacted by hurricanes.
- Clear the facility of large trees and any tall or unused structures that could fall into ponds, block vehicle access or damage electrical or other critical infrastructure during high winds.
- Ensure well casings and caps are located a minimum of 24" above the surrounding grade to help prevent intrusion of floodwater containing high salinity, pesticides, or fertilizers into groundwater supplies. Keep in mind that agriculture well casings installed prior to 1980 only had to extend to grade in many areas, so this may still be an issue for older wells on neighboring property throughout the watershed.
- Locate all hatcheries, shop facilities, equipment buildings and feed storage facilities on higher elevation ground or construct elevated pads on which to place buildings. In some cases, such as feed storage facilities, buildings may need to be constructed on elevated pylons to prevent stored materials from becoming wet.
- Construct all buildings and structures to a minimum 140 mph wind rating and preferably 180 mph wind ratings.
- Install gas or diesel backup generators to operate critical buildings such as hatcheries and broodstock facilities and to power supplemental aeration equipment for ponds and tanks if necessary. Generators and fuel storage tanks must all be elevated or otherwise protected from inadvertent flooding.

Seasonal Considerations Outside of Hurricane Season

- Develop a disaster plan that identifies chain of command, with clearly defined primary/secondary roles and responsibilities of various team members. The specific actions outlined below can serve as the basis for the most sections of the plan. A 5-day timeline should be included to reflect specific preparation activities leading up to the storm impact. Post-impact actions should also be programmed based on recovery priorities. Incorporate realistic expectations regarding the time involved for both hurricane preparation and response.
- Designate an Emergency Response Team for the facility. Members of the emergency response team should be thoroughly trained and physically capable of performing assigned duties and responsibilities. They should also be knowledgeable about the hazards found on the farm. Maps for each block of ponds and all other facilities should be prepared, including locations of electrical equipment (with shut-off options), fuel storage tanks (both above and below ground), propane tanks, compressed gas (for welding, fish transport, etc.), feed bins, chemical spill equipment and alternate entry/exit routes. The team should be trained in decision making regarding when to take actions themselves or when to wait on outside emergency responders. All team members must be trained in:
 - • Use of various types of fire extinguishers

- • First aid, including CPR
- • Shutdown procedures for electricity, tractors and other equipment
- • Chemical spill control (for fuel tanks, stored herbicides, etc.)
- Download one or more of the readily available computer and cellular phone apps that model storm track predictions, send alerts, and track hurricane impacts.
- Purchase and maintain a stockpile of “weather-proofing” supplies on-hand at the facility, such as tarps and sand bags for buildings, pumps, generators, fuel tanks and damaged levees.
- Purchase and maintain emergency medical supplies, a drinking water supply, and a dry and canned food supply adequate for 3 or more weeks of survival for employees that become stranded at the facility or may need to return to the facility for animal care or recovery before utility and emergency services are restored.
- Perform adequate facility infrastructure maintenance to ensure items such as loose roofing materials or improperly/inadequately grounded electrical equipment to not become much more major issues during a hurricane.
- Maintain good fish inventory, equipment inventory, and feeding records at all times. This information is critical during recovery and insurance claims. Take these records with you when evacuating for hurricanes. Establish a procedure to store records digitally and transmit them weekly to one or more recipients so they will exist and be retrievable on computers in other locations.

Monthly Considerations During Hurricane Season

- Check short- and long-term weather forecasts and radar at least once daily during hurricane season (May – November).
- Monitor newscasts and weather reports for potential and impending hurricane and other storm threats.
- Perform adequate facility infrastructure maintenance to ensure items such as loose roofing materials or improperly/inadequately grounded electrical equipment to not become much more serious threats to life and property during a hurricane.
- Any equipment not in use, or equipment used primarily during other seasons (such as during spawning season) should be stored or secured in a safe location, as if a hurricane were already on its way. This reduces the time potentially required for moving and securing equipment in the event a hurricane evacuation needs to be made.
- Maintain good fish inventory, equipment inventory, and feeding records at all times. This information is critical during recovery and insurance claims and hard copies should be maintained where they can be taken with producers when evacuating for hurricanes. Transmit this information to other locations on a weekly basis to serve as a backup.
- Evaluate the vulnerability of your feed storage facilities. Consider limiting feed purchases and supplies on hand to prevent feed loss from water damage in case of a hurricane. This is particularly true for ground-level storage facilities.
- If secure storage facilities are available on site, arrange for fuel deliveries several days prior to the expected storm impact. Consider fuel needs for tractors, generators and farm vehicles. Keep in mind that any fuel stored on site poses a contamination risk if storage tanks cannot be adequately protected from anticipated flooding.

- Go over emergency preparedness and evacuation plans with employees. A step-by-step plan should already be in place (see above), including a check list that must be done to secure the facility, fuel supplies, chemical supplies, fish and equipment in case a hurricane is forecast to make landfall near the facility.
- Identify and repair potholes and low areas on levees that could become impassable with heavy rainfall.
- Identify key points on each block of ponds where levee and road elevations will first become impassable in the event of rising water.
- Maintain effective aquatic vegetation and algal bloom control to limit oxygen demands during prolonged periods of power outages.

Annual Considerations

- Conduct annual audits of fish inventory, equipment inventory, and feeding records to ensure they are correct.
 - Refresh emergency medical supplies, a drinking water supply, and a dry and canned food supply.
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II. Pre-hurricane Planning – Short-term Preparedness

When a Hurricane Is Forecast to Impact Your Area (1 to 7 days before)

- Harvest as many large fish (at or above market-size) as possible and transport to processors or buyers 4-7 days before a hurricane is forecast to pass through the area. Reducing inventory and creating a positive cash flow prior to the hurricane can be critical to recovery should the facility be flooded, severely damaged, or destroyed. This also thins out stocks so oxygen demands will not be as high during periods of prolonged power outages.
- Begin working through the facility's step-by-step hurricane emergency preparedness check list of tasks that must be done to secure the facility, fuel supplies, chemical supplies, fish and equipment.
- Thin fish in high-density ponds/tanks and spread them out among less dense ponds/tanks to alleviate aeration demands during prolonged periods without power. Selling off marketable fish prior to the hurricane helps free pond space to thin out stocks.
- Secure all feed and feed storage facilities (bins and buildings) and apply sand bags if necessary. Feed is frequently the single largest cost of production and massive moisture-related feed losses can occur due to building damage or flooding.
- Move all non-critical equipment to higher elevations or store in secure buildings.
- To the extent possible, deploy portable aerators across the ponds, but avoid those areas that have the lowest elevations and would be the first to flood. Although most portable aerators are quite heavy, they should be secured to power poles or water inlet pipes, using chains or heavy-duty rope, to avoid wind- or tornado-related equipment loss.

- Lower pond standpipes 12-18” below normal level, depending on projected rainfall amounts, 3-4 days before hurricane impact to allow sufficient time for water to drain and make room for excessive rainfall that can occur during hurricanes and tropical storms. NOTE: Be sure to raise standpipes back up before significant rainfalls begin, to prevent floodwaters from entering ponds through the drains.
- Ensure all pumps and pump stations needed to remove water from the facility are working, and gas and diesel backup systems and generators are full of fuel. Protect these assets from flooding with sandbags as needed.
- Stop feeding 2 days prior to predicted hurricane arrival to reduce biological oxygen demand of fish and ponds. Provide additional aeration to ponds in order to offset decreased photosynthesis resulting from cloud cover and to allow fish to go into the storm in the best condition possible.

One Day Before a Hurricane is Forecast to Impact Your Area

- Unplug or shut off electrical supplies to any non-critical equipment.
 - Some facilities that culture exotic species are required to have emergency measures in place to ensure no escapement to the wild occurs for potentially invasive species. These measures may include maintaining a supply of rotenone or other chemicals to euthanize all fish in outdoor ponds or tanks. These measures should not be taken until the day before a hurricane is predicted to make landfall or pass near the facility. Emergency euthanasia procedures should specify the projected rainfall amounts designated for decision making purposes and consider the time requirements to allow employees to evacuate after applying (and subsequently neutralizing) treatments.
 - Verify that all pond standpipes have been returned to their normal levels.
 - Make sure all facility 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/pylons that can withstand hurricane winds and rain, sufficient stores of clean water and food, medical supplies, sufficient supplies of any medications they normally take, working radios or cell phones and sufficient battery or generator power.
 - Those workers remaining on site should have cell phone 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.
 - Personnel remaining on site to monitor fish and facilities until the last moment should observe water levels in low-lying and problematic areas to have sufficient warning to allow workers to exit the operation before levees and surrounding roads and highways are blocked with floodwaters.
 - If the decision is made to abandon the farm, tractors and equipment that have not already been moved to the highest ground available must be left in place.
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III. Post-hurricane Recovery

Immediately After the Hurricane has Passed

- Do not rush back into a facility until you are sure it is safe. Drowning and electrocutions are two of the largest dangers in aquaculture production, and the danger increases several-fold in the wake of a hurricane. Proceed cautiously and avoid driving across any submerged roads or levees.
- Check on the safety of any employees that may have remained behind during the storm to care for the facility or animals.
- Check for levee breaches, flooded ponds, rising or incoming water, and evidence of structural fire or damage before entering any infrastructure on the property.
- Check the entire facility for downed powerlines or other utilities (such as gas pipelines) that may pose a hazard or need to be repaired.
- Inspect roofs and cover wind-damaged areas to reduce water damage inside structures.
- Start the process of water removal from the facility by pumping if necessary and if possible. Facility recovery cannot be undertaken until roads, levees, and buildings are no longer flooded.
- If ponds or tanks have become flooded, determine if water is leaving the property and potentially carrying fish with it. If so, seines or orange vinyl roadside fencing may be placed across shallow or slow-moving water to prevent further fish escapement and retain them on property. For safety reasons, do not attempt to enter, seine, or fence fast moving water that is more than ankle deep. It is better to dam the fast-flowing water using heavy construction equipment if possible.
- Aeration is the first item critical to recovery that must be restored following a hurricane. This can be especially important for watershed ponds. Runoff from above the pond will replace algae-laden water with water carrying high levels of silt and bacteria, severely limiting natural oxygen production after the storm. After conducting the aforementioned safety checks, determine if power to stationary aerators is still functioning or has been restored. If it has, start normal aeration with electrical aerators. If it has not, begin to move portable emergency aeration equipment from secure locations to ponds with the lowest dissolved oxygen levels.
- Begin to collect, enumerate, and document dead fish, damaged feed, and other losses as soon as possible. Losses due to scavenging and decay may not be able to be adequately documented later.

Within a Week Following Hurricane Impacts

- Start the Federal and private crop insurance claims process. 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.
- Check structural soundness and document any damage to facility buildings.
- Check and document water damage to equipment and machinery.
- Continue to collect, enumerate, and document any dead fish or feed spoilage.
- Work to restore electrical and water supplies if needed.
- Maintain heavy aeration in ponds to reduce stress and associated disease of fish caused by temporary lack of aeration due to power outages or by rapid changes in water chemistry from heavy rainfall, flooding, or saltwater intrusion.
- Do not feed any portion of feed if a bag, container, or bin has been found to have water damage or spoilage. Clean out feed storage buildings, bins or other containers with spoiled feed. Thoroughly rinse them with a 10% bleach solution and allow to dry completely before restocking feed. Fish will survive for a week or more without feed but may die if spoiled feed is consumed.

- If structural, equipment, and operational damages are minimal, pond inventory assessments should be started. Ponds that were flooded (over the levees or via drain pipes) and ponds with visible mortality should be fully seined or partially seined and fish numbers extrapolated based on total pond volume to determine inventory losses.
- Just as critically, seining should be done to determine if undesirable or damaging fish species were introduced to ponds through storm surge or flooding. For example, after Hurricane Harvey Texas redfish producers found that many of their fish stayed put in the ponds, but in some cases large numbers of black drum and Atlantic croaker were also present in the ponds. These unwanted fish would have continued to consume feed, potentially preyed upon production fish, and reduced profit margins. Other introduced fish that were found included sheepshead, alligator gar, flounder, seatrout, and even a rare, random bluefish was found that was full of red drum fingerlings. Similarly, a striped bass farm that partially flooded ended up with several species of gar as well as carp, freshwater drum, and buffalo that came in from a nearby bayou.
- Contact your local extension agent or state aquaculture Extension specialist for more guidance on recovering from a hurricane disaster.

Within a Month Following Hurricane Impacts

- Continue and follow-up on the insurance claims process. Begin filing for any additional State or Federal disaster assistance programs for hurricane recovery.
- Water supply and aeration should be fully restored across the farm.
- Pond, levee, and road structural repairs should be underway.
- Continue to check for any structural or equipment damages or losses and document each incidence when discovered.
- Drainage ditches and canals should be examined to determine to what extent, if any, they have been silted in by floodwaters or blocked by downed trees or other debris.
- Continue to collect, enumerate, and document any dead fish or feed spoilage.
- Pond inventories should be continued. Ponds should be fully seined or partially seined and fish numbers extrapolated based on total pond volume to determine inventory losses. Undesirable fish species should be removed from production ponds or tanks to the extent possible.
- New feed, replacement production fish requirements, and broodfish inventories should be obtained after inventorying ponds, if necessary.
- Equipment that was flooded or inundated with water should have general and preventative maintenance done to ensure future working order. Keep all receipts for parts and labor, as well as a list of any equipment that is determined to be a total loss.

This draft guidance was developed by subject matter experts from Texas A&M University, Louisiana State University, and the University of Georgia



Flooding inside a leveed complex. This shows three separate ponds underwater. Although the fish all got mixed together, none left the facility and only a few were lost as the water was eventually pumped out.



Foreign fish introduced to a redfish pond by Hurricane Harvey.



An example of placing hatchery buildings on constructed earthen raised platforms well above historic flood levels. The leveed pond complex is visible in the distance, behind the building.



Low levees can be overtopped from flooding in the surrounding watershed. In this instance the pond liner and levee surface are visible, as is air bubbling up from diffusers supplied by an emergency blower located on the platform.



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Both ponds pictured here were protected by levees constructed well above the surrounding floodplain and bayou.



Water over-topping leveed ponds. During non-storm seasons, elevations should be determined to allow particularly vulnerable low elevations to be reinforced.



Water flowing out of a full pond that was not lowered prior to hurricane-related rains.



Pond topping and mixing, due to improperly sized drains incapable of handling heavy rainfall associated with hurricane events.



Once a pond is under water it is difficult or impossible to tell where levees and roads are.



Emergency generators must also be protected from flooding. This unit is pre-crated and ready to move to high ground for emergency electricity generation.