Underground Storage Tank Flood Guide

DISCLAIMER

EPA wrote this guide to provide information for underground storage tank (UST) owners and operators in the event of a threatened or actual flood. This guide does not replace existing federal or state laws or regulations, nor does this impose legally binding requirements. The word should, as used in this guide, is intended solely to recommend or suggest and does not connote a requirement.

For regulatory requirements regarding UST systems, refer to 40 CFR Part 280 and corresponding state regulations.

Pictured on Cover: Vehicles nearly submerged by flood waters at a gas station in Rushford, MN on August 19, 2007. Credit: National Weather Service

TYPES OF FLOODING

Coastal flooding occurs when higher than average tides engulf the adjacent land.

Storm surge is also a coastal flood that occurs when tides force water onshore.

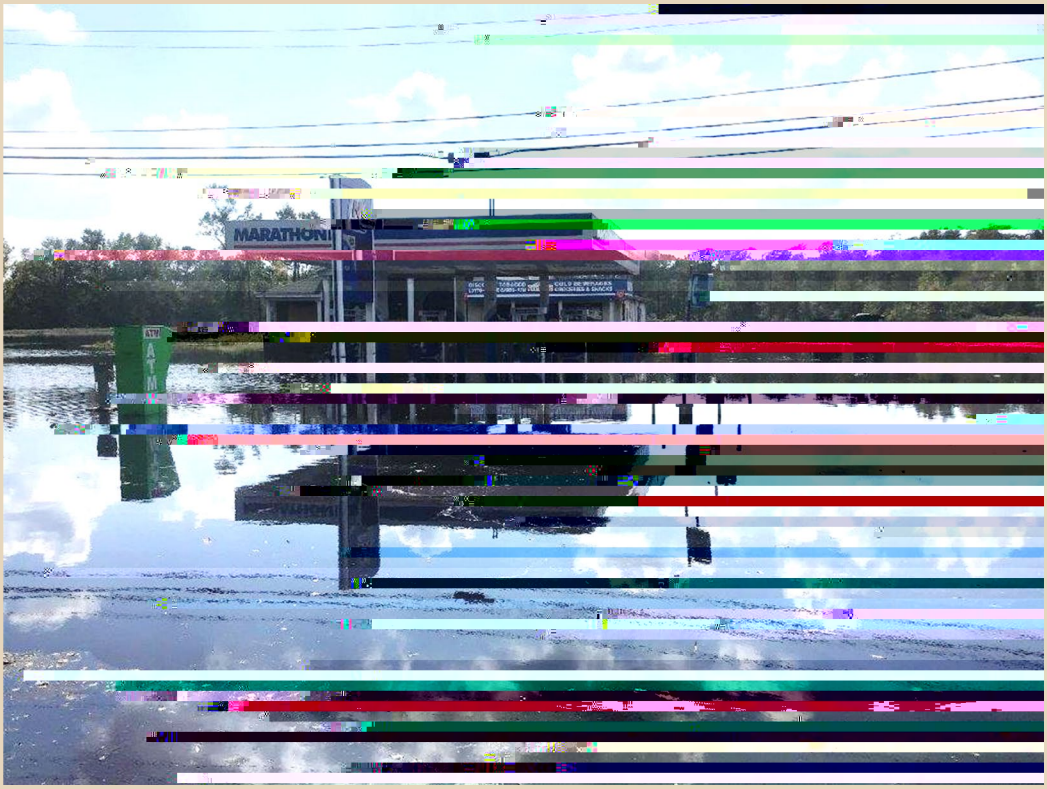
River (fluvial) flooding occurs when a river's capacity is overwhelmed and its water overflows onto surrounding banks.

Learn the difference between a flood watch and a flood warning from the National Weather Service.

Groundwater flooding occurs when the ground becomes saturated with water and subsurface water rises to the surface or into structures

Flash flooding occurs when excessive amounts of water cause a rise in water in a short period of time due to:

- An overwhelmed sewer system
- Heavy or extended rain
- Rapid snowmelt
- Dam or levee failure
- A sudden release of water



Flooded gas station after Hurricane Florence. Credit: EPA

Effects Of Flooding On UST Systems

Factors such as location, water flow, and extent of flooding influence how a flood impacts an UST system. Taking actions before, during, and after flooding events may decrease damage to the UST system and help protect human health and the environment when a flood occurs.

Buoyancy

An UST surrounded by floodwaters or saturated soil is subjected to buoyant forces that could push the tank upward, offsetting the restraints of backfill, pavement, or hold-down straps. Once displaced, the tank could rupture or disconnect from connected piping, vent lines, and other components, releasing product into the environment

Erosion And Scour

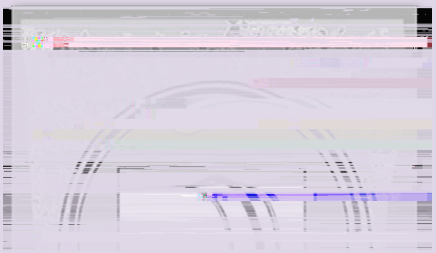
Floodwater can erode the soil and backfill material or scour the soil that surrounds an UST system. Loss of the surrounding soil and scour may expose the UST system to damage, for example buckling and detached piping, that could lead to a release of product into the environment. Additionally, scouring may

PLANNING BEFORE A FLOOD

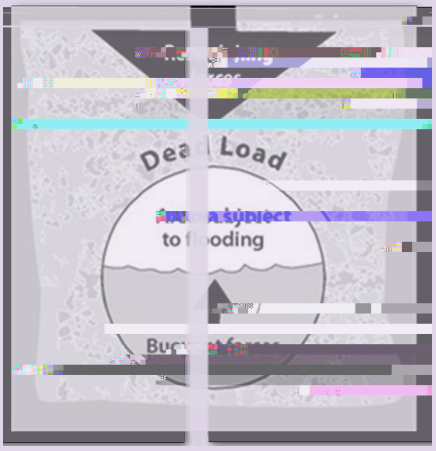
Understand The Risk

- Offset UST Buoyancy - the following methods may prevent the UST from floating:
  - Add a restraining force by increasing the burial depth or the amount of pavement on top of the tank, or both. The burial depth should not exceed the manufacturer's recommendation.
  - Anchor the tank to a reinforced concrete pad with non-corrosive hold-down straps.
  - Install deadman anchors with straps attached, outside the tank diameter alongsi(o)2 (d)2 (s)(nk t)-2 (o t)-2 (o a)-1 (r)3 (e)-1 (i)-2 (n)5 (f)-(.
  - Anchor the restrained r19.685_1 1 Tf -10.94 -1.24 Td <00BE>Tj4 /TT1 1 Tf 0.795 0 Td21.1

Examples Of Offsetting Buoyancy When Installing An UST



A reinforced bottom hold- down pad provides a firm bed for the tank and adds resistance to flotation. Credit: EPA



The extra weight of the backfill and pavement over the tank may be enough to keep the tank from floating. C redit: EPA

UST with hold down straps on a concrete pad Credi2.7 q /GS0 g.7 .0 10416-3.4 (iw T* [(E)-22 (om)-3.3 ( )Tj ET q 28 0.3 512.64 160.4781 168.54 re W n

UST FLOOD CHECKLIST

Using this checklist may help address an UST in the event of a flood. Owners and operators must follow requirements established by their UST implementing agency for:

- Emergency response
- Restarting an UST system
- UST system removal and release cleanup
- Waste disposal
- UST system component testing
- UST system installation

Before The Flood

- Conduct an inspection of the entire facility to determine areas susceptible to flooding and the potential consequences if a flood happens.
- Assess the extent and duration of predicted flooding.
- Turn off power to all UST system including STPs, pumps, and dispensers.
  - Keep the release detection system on as long as power is available.
- Take product inventory and water level readings of all tanks.
- Reduce the chance of a tank rise.
  - Place heavy objects, for example dumpster, sandbags, or large containers full of sand or rock, over the tank.
  - Fill the tank with fuel to decrease buoyancy by weighing down the tank so it will not float out of the ground.
  - If the predicted flood extent and duration is excessive, owners and operators may want to instead consider minimizing the amount of fuel to lessen the likelihood of a release into the environment.
  - Do not fill tanks with water due to additional costs for disposing contaminated water and possible corrosion to the tank system.
- Make sure fill caps are operable and secure.
- Place sand bags on top of the spill catch basin and tank top sump lids to minimize the amount of water entering each tank
- Make sure the seal on spill bucket plungers are operational to keep water out of the tank.
- If possible, have an UST technician drain all product lines back into each tank.
- Close flow restrictors and manually trip shear valves on pressurized piping to prevent product releases from dispenser lines.
- Temporarily cap off vent pipes to prevent wateevemventario the tan bani(r)-2 (s)-1ploraaio product
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- Check the remediation system, if applicable.
  - Shut off power to the remediation system.
  - Disconnect all wiring and piping to remediation trailers and remove portable equipment trailers from the flood hazard area.
  - Cap and secure remediation wells to prevent floodwaters from entering.
  - Store remediation equipment away from the flood hazard area.
  - If possible, close all control valves to isolate the remediation system.

After The Flood

Take the following actions after the water recedes and local officials allow entry. Remember that every situation is different and site-specific issues will dictate the proper course of action.

Before bringing an UST system back into service

- Make sure the power is off.
- Remove all debris and water from the concrete pad.
- Inspect the concrete pad for any indication of tank movement or shifting.
  - If the pad has been damaged, have a contractor evaluate the entire UST system to determine its suitability to receive product.
- Inspect UST system components, such as secondary and under-dispenser containment and sumps for leaks
  - Have a technician check the connections and verify that all dry secondary containment areas are still dry.
  - Ensure that the isolation boot under the dispenser is working properly. Loose or defective boots may allow water seepage into the piping secondary containment.
- Measure the product and water levels in each tank.
  - If there is a discrepancy in pre and post flood levels, follow the UST implementing agency requirements for release notification and response.
- Remove any debris from each tank.

‰ Make sure that the remaining product is suitable for use

- The owner or operator should consider not using the product if there is greater than 2” of water on the bottom of the tank.
- A tank with ethanol blended gasoline should not have any water on the bottom (and the product is not usable if water has caused phase separation or fuel degradation from its quality specification).
- In emergency situations, a diesel tank or a non-ethanol gasoline tank may be used with up to 2” of water on the bottom of the tank
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RESPONDING TO AN UST EMERGENCY

UST owners and operators are expected to be the first responders to handle most UST emergencies. They are primarily responsible for initial response and cleanup of UST system releases. Because initial response actions to an UST emergency is critical, it is important that initial responders understand the risks and are properly trained on the procedures to take in order to assess a situation and safely and efficiently respond to an UST emergency

In the event of an emergency, owners and operators may use the following information to help them perform actions to recover and effectively restart their facilities.

- Some UST facilities maintain site specific contingency plans that provide internal and external notifications and actions to take when responding to different types of emergencies. Facility personnel should obtain and follow procedures in that plan.
- If applicable, notify the on-call emergency response contractor to provide hands-on and immediate emergency response services.
- Owners and operators may also contact their local fire department.
- In Indian country, notify local and tribal officials as the first responders. EPA is available for further assistance.
- State and local emergency management agencies plan initial response actions for emergencies within their jurisdiction. They may not perform actual incident response, but do attempt to identify potential hazards,

FINANCIAL ASSISTANCE

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- Small Business Administration (SBA), offers low interest loans for businesses if their insurance and funding from the FEM

Aboveground Storage Tanks at UST Facilities

Owners and operators may have concerns about flooding effects on an aboveground storage tank (AST) located at an UST facility. An AST is extremely vulnerable to damage and a potential threat to human health and the environment when exposed to a flood. Below are some of the ways ASTs are affected by flooding and selected practices on how to manage them if a flood is threatened or occurs.

Tank Flotation And Displacement

Floodwater pressure can dislodge anchor bolts and lift the tank off its foundation and disconnect the hoses and piping that are attached to the tank. An AST lifted off its foundation may float to a different location. A lifted tank can block the flow of water if it becomes lodged to another object, resulting in damming of the water. A floating AST may also cause damage by crashing into objects in its path.

According to the National Institute for Storage Tank Management (NISTM), flood depths of a half a meter (1.5 ft.) will float most large diameter storage tanks when they are empty.

NISTM 's presentation on hazard management of ASTs, including floods, can be found here.

Loss Of Product

Moving floodwaters may push the contents out of the AST and its openings into the environment. Product loss may also occur when the tank lifts and disconnects from attached hoses or piping, or when the AST floats along a water pathway.

System And Structural Damage

The following damages may occur as a result of flooding:

- AST shell buckling or collapsing from moving floodwater.
- Soil erosion and scour beneath the tank's concrete slab, undermining its ability to adequately support the tank.
- Prolonged contact with floodwater increasing the risk of corroding the AST bottom and shell joints.
- Damaged AST containment reducing its ability to contain spilled product.
- Contact with floodwaters affecting electrical and system component connections, for example release detection, cathodic protection, switches, meters, motors, alarm systems, lightning protection and grounding.

Reducing And Managing Risks

Owners and operators of ASTs must follow all applicable regulations when installing and designing aboveground storage tanks in flood-prone areas. Several design and installation codes and recommended practices are available, and some are listed below.

Selected AST Design And Installation Codes

- NFPA 30 provides safeguards to reduce hazards associated with the storage, handling and use of flammable and combustible liquids.
- API 650 includes the minimum requirements for ASTs with internal pressures not exceeding the weight of the roof plates. Applies only to tanks whose entire bottom is uniformly supported and tanks in nonrefrigerated service that have a maximum design temperature of 93°C (200°F) or less.
- API 653 covers the inspection, repair, alteration, and reconstruction of steel aboveground storage tanks.
- PEI RP200 provides reference to preferred practices and procedures for the installation of ASTs at service stations, marinas and other fueling sites.
- Federal Emergency Management Agency P-348, Protecting Building Utility Systems From Flood Damage (2017) illustrates design and construction of new utility systems and structures in flood-prone areas.
- FEMA's Compilation of Flood Resistant Provisions contain excerpts from 2018 international building codes.

The National Institute for Storage Tank Management (NISTM) suggests the following practices to reduce flood impacts.

- Make sure that the AST is anchored properly.
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EPA's Flood (Hurricane) Preparedness, Recommended Best Practices fact sheet provides information on preparing an AST before a flood, and how to return it back to service after a flood. The checklist below includes information from NFPA 30 and the best practices fact sheet section.

Preparing An AST Before A Flood

- Use a dependable water supply to fill empty or partially filled tanks.
  - If filling with water is impractical or hazardous because of the contents, use other means to protect tanks against movement or collapse.
- Close valves associated with piping and dispensing.
- Anchor tanks and all piping to prevent uplift or floatation.
- Use stiffener rings to prevent buckling from storm surge and wind loads.
- To the greatest extent possible, remove or secure all possible projectile hazards from the facility grounds.
- Ensure all storm drains and dewatering intakes are clear and free of debris.
- Shut off the power to the fuel system.
- Record the pt level-1 (pe)245 TD [(f)-2 u410.737 c 500.2379>Tj /TT1 1 1 0 Tc 0 Tw s1 1 Tf 1.5 0

Keep All Facility Plans Current

Certain facilities are required to develop Spill Prevention, Control, and Countermeasure (SPCC) Plans. SPCC plans describe equipment, workforce, training, and countermeasures to prevent, control, and respond to a discharge of oil.

Although each SPCC Plan is unique to the facility, certain elements that must be described in every plan include:

- Operating procedures to prevent oil discharges and spills;
- Control measures, such as secondary containment, installed to prevent oil spills from entering navigable waters or adjoining shorelines; and

USEFUL RESOURCES AND LINKS

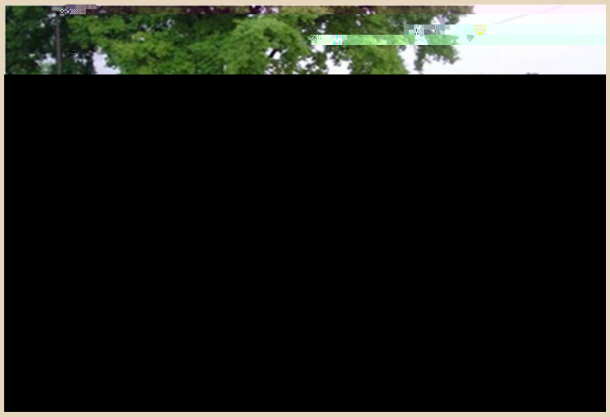
- If there is a threat of a flood, the following websites developed by federal agencies provide specific locational real-time flood information.
  - U.S. Geological Survey's Flood Information website provides information on hourly flood conditions.
  - NOAA's - Hydrologic Conditions and Forecasts web page provides information on hydrologic conditions and forecasts.
  - National Weather Service Interactive Flood Water Level Map

- EPA's Natural Disasters and Underground Storage Tanks web page provides resources to help UST owners and operators prepare for, prevent, or lessen effects and environmental harm from natural disasters.
- EPA's Power Resilience Guide for Water and Wastewater Utilities provides water and wastewater utilities with information on increasing their resilience to power outages and includes tips on fuel supply planning.
- Centers for Disease Control and Prevention's Natural Disasters and Severe Weather provides information on preparing for a flood, safety during a flood, and protecting health after returning from a flood.
- Occupational Safety and Health Administration's Hurricane Preparedness and Response web page provides information on hurricane warnings, hazards, and precautions that

- ¾ American Petroleum Institute (API) Oil and Natural Gas Industry Preparedness Handbook – highlights information exchange between levels of the government and industry, and how that flow can be managed to facilitate appropriate disaster response.
- ¾ International Code Council (ICC) Disaster Response Alliance – provides a national database of skilled volunteers willing to assist with response and recovery activities, including post-disaster safety assessments, building damage assessments, inspections and other code-related functions in the aftermath of a disaster.

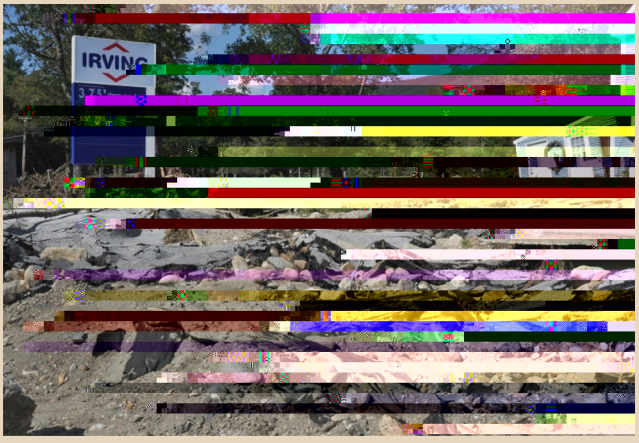
x PEI Recommended Practices

- ¾ RP100: Installation of Underground Liquid Storage Systems
- ¾ RP200: Installation of Aboveground Storage Systems for Motor Vehicle Fueling
- ¾ RP300: Installation and Testing of Vapor Recovery Systems at Vehicle Fueling Sites
- ¾ RP 400: Testing Electrical Continuity of Fuel Dispensing Hanging Hardware
- ¾ RP500: Inspection and Maintenance of Motor Fuel Dispensing Equipment
- ¾ RP 800: Design and Installation of Bulk Storage Plants
- ¾ RP900: Inspection and Maintenance of UST Systems
- ¾ RP 1000: Marina Fueling Systems
- ¾ RP1200: Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities
- ¾ RP 1300 Aviation Fueling Systems
- ¾ RP1400: Design and Installation of Fueling Systems for Emergency Generators, Stationary Diesel Engines and Oil Burner Systems
- ¾ RP1700: Closure of Underground Storage Tank and Shop-Fabricated Aboveground Storage Tank Systems

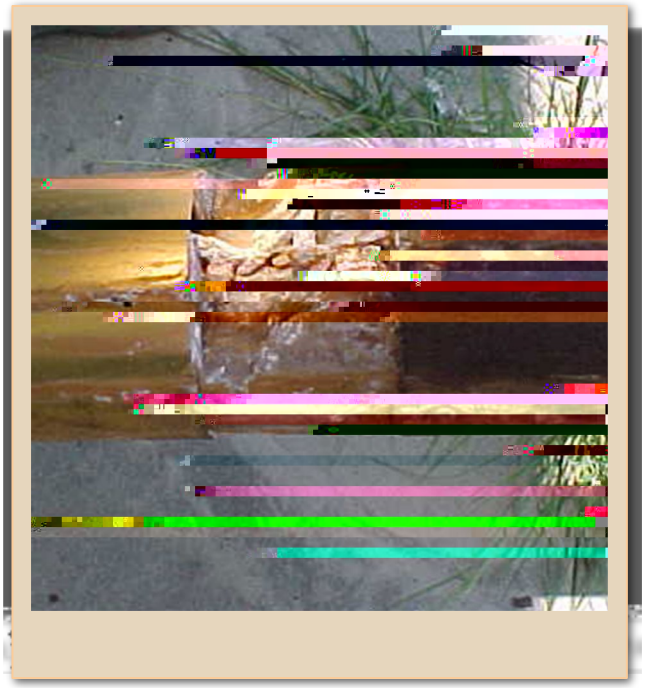


Examples of USTs affected by buoyancy.Hurricane Katrina, 2008. Credit: EPA

Examples of USTs affected by buoyancy.Hurricane Matthew, 2016. Credit: NCDEQ



Blackie's General Store - Soil erosion and scour from Ottaquechee River flooding. Tropical Storm Irene – August 2011. Credit: New England Interstate Water Pollution Control Commission



Facility with displaced ASTs, product release, and fuel containment – Hurricane Matthew, 2018. Credit: NCDEQ