MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Water Protection And Soil Conservation Division
Public Drinking Water Program

MODEL

Emergency Operating Plan
For Public Water Supplies

Water Source Emergencies – Groundwater
Before The Emergency (Vulnerability Assessment)
  General
  Security
  Power
  Telemetry/Controls
  Structures
  Contamination
  Transmission Piping
During The Emergency
After The Emergency
PUBLIC WATER SYSTEM
MODEL EMERGENCY OPERATING PLAN

WATER SOURCE EMERGENCIES - GROUNDWATER

The most common problems with a groundwater source in emergencies are:
X loss of power
X loss of telemetry
X structural damage to well casing or housing
X contamination
X loss of water transmission lines from the well field

BEFORE THE EMERGENCY (VULNERABILITY ASSESSMENT)

Before an emergency, think about how your wells may quit working in an emergency. The questions below should help you find weak areas. Think about what you can do to improve these areas. Some areas can be helped by asking others to borrow equipment. Other areas will need physical improvement. Plan to do these system improvements over the next few years. You need to have a plan for what to do until the improvements are built.

General
Are your wells susceptible to natural and human-caused hazards such as drought, earthquake, flood, tornado, winter storms, security threats, contamination, or nuclear release? _________________

Where are drawings or information about the wells and well field kept? List building location and the location in the building or use the Maps section to list locations. _________________

Where is a sketch of how to get to the wells? The Maps section is a convenient place to keep these kinds of sketches. _________________

Are wells installed in liquefiable soils or soils subject to lateral spreading caused by earthquakes that could bend the casing? _________________

Is the liquefiable soil layer stabilized, a double well casing used, and a submersible pump used to prevent damage to the well during an earthquake? _________________

Are well screens used to avoid sand entry problems with slotted casings? _________________

Are wells installed in deep aquifers when possible to avoid problems with earthquake damage? _________________

Are drawings and information stored above flood levels and in fire-protected area? _________________

What is the elevation of the top of the well casing? _________________

What is the elevation of the top of the vent? _________________

What is the elevation of the top of the well cap? _________________

How will you get to the wells in a flood or other emergency? _________________

Do you have alternative routes? _________________

Where are boats and 4-wheel drive vehicles kept? _________________

Do you have alternative raw water sources? _________________
Are emergency water supply interconnections with other water utilities in place? 

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Is there redundancy in the pumping system? 

Do you know where to get correctly sized pumps if needed in an emergency? 

**Security**

Are restricted areas posted with “Employees Only” or Restricted Area” signs? 

Is access to well field (or individual wells) restricted by fence, locked gates, well house, alarms, or other physical barriers? 

Are only authorized personnel given access keys or codes for locked facilities? 

Who has keys to locked facilities? 

Are locks tamper-proof? 

Where are duplicate keys or codes located? 

Is adequate exterior or interior lighting in place? 

Is well field (or individual wells) monitored? 

By utility staff / intrusion alarms / television monitors? 

Does staff vary security checks to the well field to avoid predictable patterns? 

If alarm is activated, what is the response plan? 

Do local law enforcement personnel perform regular security checks? 

Are local homeowners/landowners aware of need for security with telephone number(s) to call to report suspicious behavior? 

Are procedures in-place when specific security threats are issued by local/national law enforcement authorities? 

**Power**

What are the power sources? 

Have you coordinated with electric utility for priority feed to wells? 

Do you have an emergency generator that can be used for the wells? 

Where is this generator stored? 

Are generators exercised regularly? 

Who knows how to operate the generator? 

Where are the directions (operating manual) for the generator? 

Where is the fuel kept? 

Where do you buy fuel? 

Where can you get a generator if you do not have one? 

Where are the electric lines? 

Where is the meter for each well? 

Are the meters below the 100 or 500-year flood level? 

Is the substation feeding the wells in the 100 or 500-year floodplain? 

Have you talked to the power company about how they will supply power during a flood? 

How will they supply power? 

What electrical equipment is below the 100 or 500-year flood level?
Other than submersible pumps, how will you protect this electrical equipment from flooding?
**Telemetry/Controls**
Are controls automatic and/or by telemetry? _____________________________________________
How will the well be controlled if telemetry is lost? ______________________________________
If you will need to control the well locally, how will you get to the well? ______________________
Are SCADA system sensors operational and tested? _________________________________________

**Structures**
Is there a well house? _______________________________________________________________
Is the structure constructed of fire-safe building material? _________________________________
Is reinforced masonry and other hazard-resistant construction used? _________________________
What is the condition of the well house? _______________________________________________
How will you protect the well house if there is a flood? _________________________________
Will you need sump pumps to keep the well house dry? _________________________________
Where can you get a sump pump? ______________________________________________________

**Contamination**
Is a contamination monitoring system in place, operational and tested? _____________________
Do you monitor pH, turbidity, total and fecal coliform, total organic carbon, ultraviolet
absorption, color and odor of source water? _____________________________________________
Are wells adequately setback from potential contamination sources? _______________________
What will you do if there is a security threat/violation? _________________________________
Is the casing above the 100 or 500-year flood level? _____________________________________
How will you protect the well if there is a flood? _______________________________________
Can you cap the vent? _______________________________________________________________
What is the condition of the grout? ____________________________________________________
How will the grout protect the well in a flood? __________________________________________
What is the condition of the sanitary seal? _____________________________________________
Does the well cap give a good seal? ___________________________________________________
If not, how will you seal the well from flood waters and other foreign materials? __________

Is there chemical feed at the well? ____________________________________________________
How will the chemical feeder be controlled if there is a loss of telemetry? __________________
What happens if the chemical feed quits? ______________________________________________
How will you deliver chemicals to the well if roads are inaccessible? ______________________

What will you do if there is a chemical overfeed or a chemical spill? (see Appendix J for
chlorine or Appendix K for other chemicals) _____________________________________________
Transmission Piping
How many pipelines come from the well field? ___________________________________________
Is there redundancy in the system? ___________________________________________________
Are there isolation valves on each line? _______________________________________________
Where are the isolation valves? _______________________________________________________
Are the isolation valves marked on any drawings? ________________________________________
How will valves be located and operated during high water or when covered with debris? _______
Are there air and vacuum valves? _____________________________________________________
What are the elevations of the air valves? _______________________________________________
Can they be flooded, letting sand and silt clog the valve and get into the raw water line? _______
How will you protect the air and vacuum valves? _________________________________________
What are the elevations of the control valves? ___________________________________________
Are the valves and valve pits protected from flooding and tampering? ___________________________
How? ____________________________________________________________________________
Are valves regularly operated and maintained? __________________________________________
Is piping flexible to allow for ground movements? _______________________________________
Are piping buried below the frost depth (typically 3 feet for Missouri)? _______________________
Are valves, sleeves, clamps and piping spares available for an emergency? ________________
Are piping adequately setback from sewer lines or other sources of contamination? _________
**DURING THE EMERGENCY**

The damage assessment form at the end of this section can be used to evaluate the condition of the wells during an emergency.

Always check for safety before doing anything!

What needs to be done in an emergency:

- If unauthorized intrusion is evident, notify law enforcement, determine type of security threat and respond accordingly.
- Coordinate alternative water supply if necessary.
- Increase sampling efforts if contamination is threatened.
- See the treatment responses for various contamination in *General Procedures for Specific Emergencies* under Contamination.
- Know current flood level and predicted flood crest.
- Compare elevations of all wells and well housings and roads to the predicted flood levels.
- Sandbag before flood levels threaten a well or well housing. Use a ringdike when sandbagging.
- Make sure power will be available during any emergency.
- Get generators if needed. The emergency form lists where to get generators (also refer to information in Appendix D).
- Get extra chemicals if roads or bridges will be inaccessible.
- Seal wells at cap and vent tube if they will be overtopped by flood waters.
- If a well will be overtopped by flood waters, turn the power to that well off.
- Get boats or 4-wheel drive vehicles if they might be needed. The emergency form lists where to get these. There is also information in Appendix G.
- Call MDNR for advice and to tell them what is happening. (Phone number is on emergency form or in Appendix A.)
- If an emergency is threatening all wells, get another water supply. The emergency form should list where you can get tank trucks and potable water or where you can get bottled water. If the sources you prepared for in advance are not available, use Appendix H to find another source.
- Call MDNR and tell your customers about the need or possible need for using another supply.
- Keep track of all emergency related labor hours and work repairs performed. Take pictures of all damaged to facilities and building contents.
AFTER THE EMERGENCY

The first thing to do after an emergency is check the condition of the wells, well housings, and raw water pipelines and power supply. A form for damage assessment is at the end of this section.

When doing a damage assessment, always check for safety before going in a building, driving to the wells, or getting out of a truck or car.

The damage assessment should cover:
X security
X power supply
X controls
X well casing, cap, sanitary seal, and vent tube
X well housing
X visible signs of contamination
X raw water pipeline

If you can see possible contamination at the well or if the well was overtopped by flood waters, turn the well off if it is still running. Call MDNR (phone number on emergency form).

Once damage assessment for the entire system has been done, repair work can be prioritized and repair work can begin.

Repairing a damaged well or cleaning a well filled with silt and dirt should be done by a certified well contractor. A list of contractors is in Appendix E or look on the Emergency Form.

A well that has been overtopped with floodwaters will need disinfection. General guidelines for disinfecting a well are (portions are adapted from a Department of Health Fact Sheet):
X Pump well for 48 hours to clear river water and sediment
X Disinfect well and let stand for 12 hours or more (50 ppm of chlorine for heavy contamination, 5 ppm for routine disinfection)
X Pump until you can=t smell chlorine
X Take samples for bacteriological testing
X Retest in three days
X Repeat if necessary

Note that pipelines will probably also need disinfecting (See Water Distribution Emergencies).
To determine the well volume for disinfection:
Gallons in well = 0.041 x D x d x (wd - swl)

Where

D = Diameter of drilled hole, in inches

= Diameter of casing, in inches

swl = static water level in well, in feet from top of well

wd = well depth, in feet from top of well

If D is unknown, use D = d + 18

For example, a well with a 12-inch casing, static water level of 20 feet and depth of 50 feet:

Gallons in well = 0.041 x (12+18) x (12) x (50-20) = 443 gallons

Table M-1 gives information on disinfection materials. Specific directions for disinfecting are after the table.

Table M-1
Disinfection Material

<table>
<thead>
<tr>
<th>Disinfection material</th>
<th>% Chlorine in Material</th>
<th>Amount to add per 1000 gal to get 50 ppm chlorine</th>
<th>Amount to add per 1000 gal to get 5 ppm chlorine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Hypochlorite (liquid laundry bleaches like Clorox or Purex)</td>
<td>5.25</td>
<td>1-gallon</td>
<td>1 2 cups</td>
</tr>
<tr>
<td>Sodium Hypochlorite – commercial strength</td>
<td>12</td>
<td>7 cups</td>
<td>3/4 cup</td>
</tr>
<tr>
<td>Chlorinated lime (powder)</td>
<td>25</td>
<td>3 2 cups</td>
<td>5 tablespoons</td>
</tr>
<tr>
<td>Calcium Hypochlorite (B.K. powder)</td>
<td>50</td>
<td>1 2 cups</td>
<td>2 2 tablespoons</td>
</tr>
<tr>
<td>Calcium Hypochlorite (H.T.H. Perchloron, etc.)</td>
<td>70</td>
<td>1 1/8 cups</td>
<td>2 tablespoons</td>
</tr>
</tbody>
</table>
If a powdered or granular compound is used, blend the material with water until you get a smooth paste. Let this mixture settle, then filter the liquid through a finely woven cloth. The disinfectant is then ready to add to the water supply.

If a liquid compound is used, the needed amount should be mixed in one or two gallons of water, and poured into the well. If possible, the water should be stirred to aid mixing of the disinfectant. This may be done by recirculating the water back into the well with the use of a garden hose or other pipe.

The liquid or powdered material may not reach the bottom of a deep well in a large enough quantity to be effective. Calcium hypochlorite in tablet form will sink to the bottom of the well before dissolving and is preferable in this case.

Cautions in using disinfecting materials:
X The dust of powdered and granular products is extremely irritating to the lungs. Use precautions so that the dust is not inhaled.
X Chlorine-bearing compounds are strong bleach agents and should not touch clothing.
X Prepare chlorine-bearing compounds in clean containers; grease or oil in a container may react violently with the chlorine.
X Chlorine compounds may cause skin irritation. Wash the skin with water as soon as possible after contact.
X Read product labels and strictly observe all statements of caution.

After the emergency is over, damage are assessed and repairs are complete, apply for financial assistance (see Appendix N).