



COMMONWEALTH of VIRGINIA

DEPARTMENT OF HEALTH

OFFICE OF DRINKING WATER

Richmond Field Office

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Incident: Louisa County Water Authority 12-inch Water Main Break (PWSID 2109510)

Date of Incident: May 14, 2025

The Office of Drinking Water, Richmond Field Office, responded to a 12-inch water main break in the Louisa County Water Authority (LCWA) waterworks distribution system on May 14, 2025, which resulted in a Boil Water Advisory (BWA). The BWA was issued on May 14, 2025, and lifted on May 16, 2025.

Water system general description

Louisa County Water Authority operates a water system that has a permitted capacity of 1 million gallons per day (MGD) and consists of one well source, one surface water treatment plant, one elevated storage tank, one ground storage tank, and distribution system. The water system wholesales water to Town of Louisa (PWSID 2109450) and Town of Mineral (PWSID 2109525).

LCWA facilities

- Permitted capacity 1 MGD (694 gpm)
- One well with a capacity of 23 gallons per minute (gpm) or 33,120 gpd (0.033 MGD)
- One surface water treatment plant with conventional treatment (rapid mix, flocculation, sedimentation filtration) ahead of nanofiltration.
 - Nanofiltration is used for disinfection byproduct precursor removal.
 - The capacity of the treatment plant is 1.0 MGD (694 gpm)
 - Plant feeds alum, soda ash, lime, gas chlorine for disinfection, fluoride, sodium permanganate
- One elevated atmospheric storage tank with an effective storage capacity of 224,090 gallons (0.22 MG)
- One standpipe type atmospheric storage tank with a reported nominal size of 570,000 gallons (0.57 MG). This standpipe was previously dormant and offline, but has been recently been placed back online

Town of Louisa facilities

- Permitted capacity 350,000 gpd (0.35 MGD, 243 gpm)
- Two master meter connections to LCWA, all water is purchased from LCWA
- Two elevated storage tanks
 - Downtown tank- 75,000 gallons (0.075 MG) effective storage capacity
 - Acme tank- 100,000 gallons (0.10 MG) effective storage capacity

Town of Mineral facilities

- Permitted capacity 120,000 gpd (0.12 MGD, 83 gpm)
- Two drilled wells are listed on the operation permit, however both wells are currently offline due to declining well yields and require rehabilitation or replacement to be placed back online
- One elevated storage tank with an effective storage capacity of 60,000 gallons (0.06 MG)

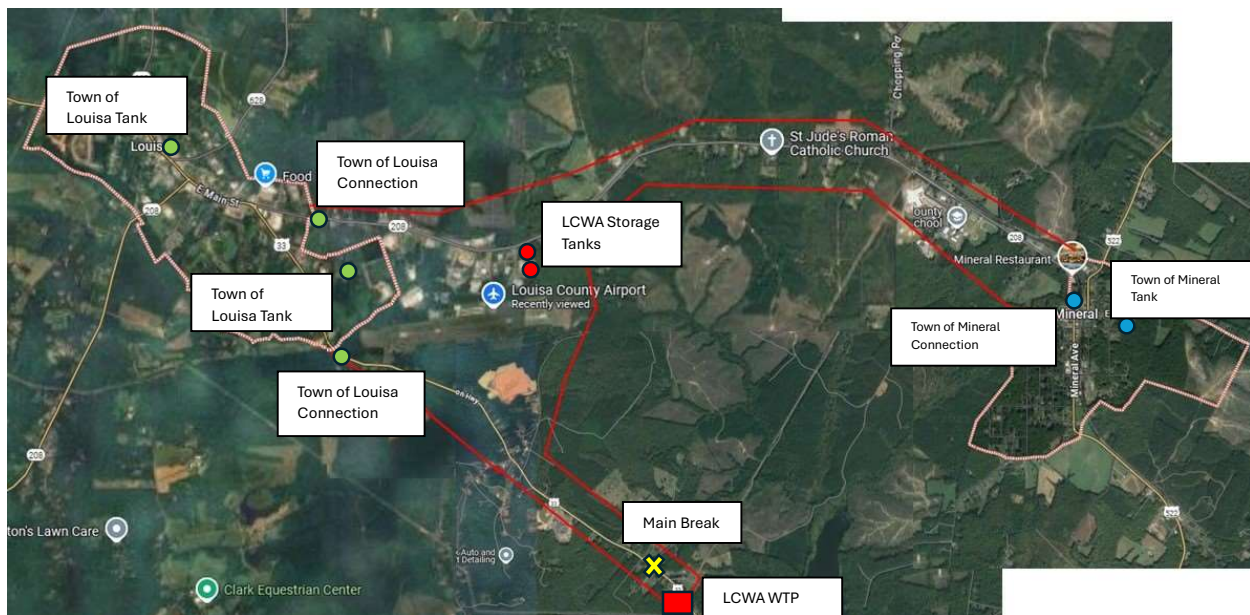


Figure 1. Map of combined service areas of Town of Louisa (left), LCWA (center), Town of Mineral (right)

Timeline

The following is a timeline of events as observed and reported. Speculation on how break occurred is in the next section:

May 14, 2025 0130- LCWA receives low tank water level alarm. On-call operator begins response, reports to water treatment plant

May 14, 2025 0230- LCWA WTP started, LCWA WTP does not run 24/7

May 14, 2025 0530- LCWA WTP starts a high service pump, observes finished water flow increase and tank level dropping quickly. Operator contacts Water Operations Manager. Water Operations Manager contacts general manager for LCWA and maintenance crew. General Manager attempts to

contact Town of Mineral, but it was before work hours and couldn't reach anyone. Communications between LCWA, Louisa County, Town of Louisa, Town of Mineral occur throughout the day between various parties.

May 14, 2025 0545- LCWA maintenance crew and operations staff look for water main leak

May 14, 2025 0551- Water Operations Manager contacts Richmond Field Office Director. Indicates may lose system pressure due to a break

May 14, 2025 0645- LCWA staff locate leak approximately 0.5 miles west of WTP on Jefferson Highway. Staff put in emergency ticket with Miss Utility to come out and mark water line location. Additional maintenance crews called in to assist with repairs. Equipment staged and ready to go.

The highway is rural with no development on either side of the road and grass shoulders that slope to divert surface water runoff from the road into a vegetated swale. The line is a 12-inch major transmission main that takes water from WTP to the distribution system and is made of ductile iron. The pipe appears to be located near the bottom of the swale. There are no customers between WTP and break site.

Operations indicate that tank level drop over 5 minutes estimates flow through break at around 3,100 gpm. The water treatment plant was also sending about 800 gpm of water through the main, resulting in around 4,000 gpm of water flowing from the main at the time of catastrophic failure.

LCWA staff observe what appears to be tire tracks at location of break on top of the water line. It is thought that someone may have veered off the road overnight but did not have an accident. Rains occurred overnight and saturated soil.

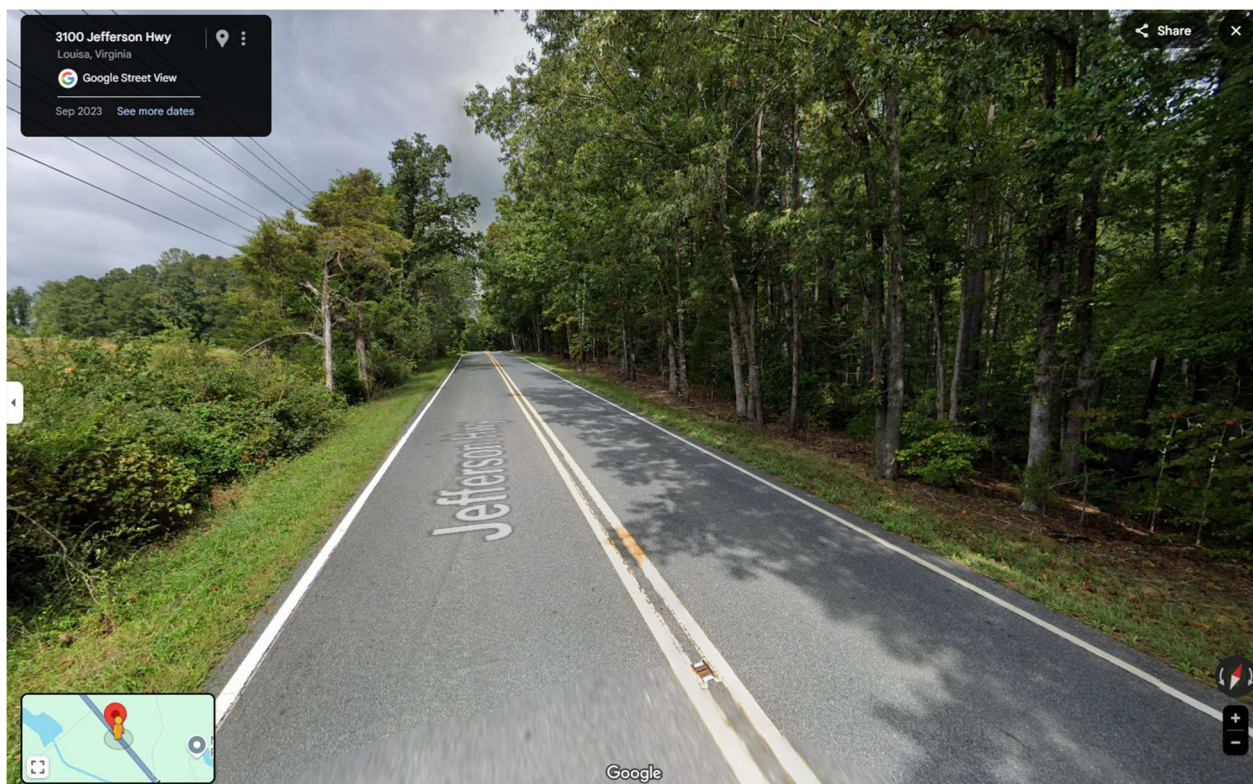


Figure 2. Location of break site



Figure 3. Break site. Appears to be tire tracks over pipe location

May 14, 2025 0700- LCWA issues Boil Water Advisory for its service area. Town of Louisa and Town of Mineral still have water in their tanks and maintaining pressure

May 14, 2025 1043-1110- Low tank level alarm at Town of Louisa Downtown tank. Other Town of Louisa tank levels dropping.

May 14, 2025 1130- Boil Water Advisory expanded to Town of Louisa, Town of Mineral. Anticipate imminent pressure loss to both consecutive systems based on Town of Louisa tank level drop

May 14, 2025 1200- Water main repair completed. Exposed break site shows an approximately 9 foot void around leak location when digging. Water main at break site was cut and replaced. Approximately 15-inch longitudinal split on bottom of excavated pipe observed. Marking of underground utilities took approximately 2-3 hours.



Figure 4. Exposed water main at break site



Figure 5. Excavated and replaced water main break

May 14, 2025 1251- RFO Director talks to Town of Mineral, still maintaining positive pressure. At this time there is possibility that Town of Mineral will not lose pressure if the LCWA WTP starts up and starts sending out water. Mineral has smaller population (300-400) than Town of Louisa and majority of event occurred while people most likely at work which helped maintain tank levels in comparison to Town of Louisa

May 14, 2025 1300- LCWA WTP started back up, begin to fill tanks. Valve off standpipe to allow more water to go to Town of Louisa and Town of Mineral

May 14, 2025 1500- Tanks maintaining level and slowly rising. LCWA begins flushing in preparation of taking first set of bacti samples for LCWA and Town of Louisa.

May 14, 2025 1600- First set of bacti samples collected for LCWA and Town of Louisa. Town of Mineral collects bacti samples in its distribution system

May 15, 2025 0000- All tanks in LCWA and Town of Louisa except for valved off standpipe are completely full

May 15, 2025 Morning- Standpipe valve opened

May 15, 2025 1030-1130- Second set of bacti samples collected in all three waterworks

May 15, 2025 1400- All tanks including standpipe full, LCWA WTP shutdown

May 15, 2025 1600- First set of bacti sample results absent total coliform and E. coli

May 15, 2025 1156- Second set of bacti sample results absent total coliform and E. coli

May 16, 2025 1217- LCWA and Town of Louisa lift Boil Water Advisory. Town of Mineral lifts Boil Water Advisory around the same time

What Possibly Happened

Based on conversations with LCWA staff and previous technical experience with similar situations, this appears to be a likely way things occurred:

1. A small leak has possibly been occurring at the break site for an extended period of time. LCWA reported there were no visible standing water in this location in the days leading up to the event and that they travel past this location frequently. The leak was small enough that it did not appear visible on the surface. This may have primed the soil for further pipe damage by undermining support bedding and allowing pipe to settle in softened soil
2. A vehicle runs off the road overnight during rainy conditions. No accident occurred, but tire tracks indicate vehicle could have been directly over water main and appear to be parallel to water main for several feet. This increased stress along the length of the pipe and possibly causing the leak to grow to the point it was observable by dropping tank levels overnight when the plant was offline
3. LCWA WTP starts a high service pump which causes an internal surge in water pressure which completes the longitudinal break in the pipe and results in a large main break that began dropping tank levels rapidly. Figure 5 appears to show failure going from inside the pipe outward (internal pressure) vs outside the pipe inward (crushing force).

Observations

The RFO Director was the primary point of contact throughout the boil water advisory event and observed the following:

1. Response to overnight alarm appeared to be quick with plant going from offline to online within an hour of the alarm
2. Flow of communications between operator, operations manager, and general manager appeared to be handled appropriately and as soon as large increase in demand and rapid drop in tank levels observed. Operations manager responded and was on site quickly
3. Communication to ODW was within 20 minutes of catastrophic failure of main and would meet 2-hour reporting deadlines of new legislation starting July 1, 2025
4. Repair was conducted as quickly as possible with crew and equipment staged to act as soon as utilities were marked

5. Coordination between Town of Louisa, LCWA, Louisa County, and ODW appeared to be fairly good with several standing meetings and involvement of upper management.
6. Coordination between ODW Emergency Preparedness and VDEM appeared to be good with constant communication and advanced planning of bottled water distribution, etc. very early into the event
7. Town of Mineral representatives were reported to be in communication with LCWA and Louisa County Administrator throughout the day. A contractor who was on the scene of the repair was also on the Town of Mineral's Utility Committee and provided updates per LCWA. LCWA general manager and Town of Mineral manager have since exchanged cell phone numbers for communication during emergency events. An incident command structure to include the Town of Mineral should be established for use during emergencies. Due to the Town of Mineral maintaining pressure, the coordination was more focused on LCWA and Town of Louisa. Town of Mineral has less experience handling emergency situations and establishing an incident command structure may have allowed them to lean on the expertise of others a little more.
8. Town of Mineral indicated some mixed communication between Town and local health department, with Town issuing a boil water advisory without a drop below 20 psi and local health telling restaurants since they have pressure they were ok to not boil water
9. Assuming the ductile iron pipe is the original pipe from the inception of LCWA around 1984, the pipe is around 41 years old. Ductile iron pipe should have a service life around 70-100 years on average.

Recommendations- Short Term

1. Standing meetings between LCWA and others should include operations to provide a perspective of current events and allow for technical input.
2. LCWA may experience an increase in heavy machinery traffic on Jefferson Highway as construction of a data center campus begins across from the WTP site. Heavy machinery should be transported with care and avoid driving on the shoulder where the water main is located.
3. Related, LCWA should develop a communications plan- if not already in development to request data centers to isolate from the distribution system and rely on on-site storage during high impact main breaks and other similar events. As large water users, this may potentially help avoid significant impacts from main breaks or shorten recovery times.
4. This event put additional stress on already stretched thin operations staff and maintenance and distribution crew. LCWA should evaluate the need for additional utility staff to provide adequate coverage to respond to main breaks and other emergency response without relying on existing staff to work excessive hours. Exhausted staff may be prone to more errors after the immediate response to the event.
5. Town of Mineral should develop standard operating procedures and emergency response plans for handling situations like main breaks, including boil water advisories, bacteriological sampling requirements, etc. LCWA and Town of Louisa should review their documents to see if they need revisions in response to the event.

6. Town of Mineral is working on re-establishing groundwater wells in their water system. The LCWA consecutive connection appears to be intended as a supplemental source and not a primary source. Bringing wells back online or drilling new wells would introduce some resiliency to the Town of Mineral system.
7. Joint tabletop exercises between LCWA, Town of Louisa, and Town of Mineral would help establish lines of communication and improve coordination between all parties.

Recommendations- Medium Term

1. LCWA should investigate the use of variable frequency drive motors for high service pumps for higher level of operator control of pumps. High service pumps at LCWA utilize a star delta starter which ramps up the speed of the pump motor over a set period of time. While this results in a stepped increase in motor speed and potentially increases water pressure in a stepwise manner, it does not provide a controlled stop in similar fashion. Water hammer may still be experienced on the stop of the pump. In addition, the operator has less control over the ramp up time as that is set by the starter. If the ramp up time is not in tune with the hydraulics of the system, there may still be a water hammer as flow is not developed until the pump head overcomes the system pressure. If this occurs after the pump reaches full speed, it would act similar to a direct on and off pump starter.
2. LCWA should investigate, in conjunction with the Town of Mineral, having the ability to remotely monitor Town of Mineral tank levels to have a better understanding of both consecutive systems during routine and emergency operations.
3. Town of Louisa should investigate the reliability of the current tank level monitoring system.
4. LCWA should investigate alternatives to protecting the critical water main through conversations with VDOT.
5. LCWA should evaluate main break historical information to determine if ductile iron piping is approaching the end of its useful life. If so, LCWA should investigate why service life of ductile iron piping is shorter than industry averages.

Recommendations- Long Term

1. LCWA should investigate creating a complete loop of the water system by running water main to connect to the other side of the Town of Mineral. This would provide added resiliency to a major break on the 12-inch line near the vicinity of the WTP.
2. LCWA should investigate the possibility of providing a secondary water source to the distribution system from the Ferncliff WTP once it is online. Ferncliff WTP will primarily serve the Zion Crossroads area.
3. LCWA should investigate the potential benefits of additional storage in the distribution system. This should be balanced with the potential detrimental effects of increased water age and disinfection byproducts formation.
4. During future pipe replacement projects, LCWA should investigate if ductile iron is the best pipe material for locations like unprotected shoulders that may experience occasional spikes in loading by vehicles, etc. Casing of water main in the area or other materials such as HDPE may provide extra protection against breaks.