= 2010 Guatemala City sinkhole =

The 2010 Guatemala City sinkhole was a disaster in which an area approximately 65 ft (20 m) across and 300 ft (90 m) deep collapsed in Guatemala City 's Zona 2 , swallowing a three @-@ story factory . The sinkhole occurred for a combination of reasons , including Tropical Storm Agatha , the Pacaya Volcano eruption , and leakage from sewer pipes .

= = Background = =

Overall , the risk of sinkholes occurring in Guatemala City is high and unpredictable . One recent , similar sinkhole had collapsed in 2007 , forming a pit 100 metres deep . The 2007 Guatemala City sinkhole was formed by fluid from a sewer eroding uncemented volcanic ash , limestone , and other pyroclastic deposits underlying Guatemala City . The hazards around the pipe have since then been mitigated , by improved handling of the city 's wastewater and runoff . Several rainstorms also contributed to the sinkhole 's collapse , as stormwater percolated into the ground , further dissolving the rocks beneath Guatemala City . The 2010 sinkhole was formed for similar reasons .

= = Formation = =

= = = Sewage pipes = = =

The sinkhole formed due to volcanic pumice deposits , upon which Guatemala City is built . These deposits were unconsolidated and of low density , allowing easy erosion . According to Sam Bonis , a geologist at Dartmouth College , leaking pipes went unfixed long enough to create the conditions necessary for sinkhole formation because of lax city zoning regulations and building codes . Bonis also says that the Guatemala City sinkhole is a misnomer : sinkholes have natural causes , but this one was mainly artificial . In addition , according to Bonis , sinkholes are usually formed from limestone but there is no limestone hundreds of metres underneath Guatemala City . Bonis proposes that the sinkhole be renamed a piping feature .

= = = Tropical Storm Agatha = = =

Tropical Storm Agatha was first identified as a trough of low pressure of the western coast of Costa Rica on May 24 , 2010 . On May 29 , the depression intensified into a tropical storm and was given the name Agatha . Later that day , the system intensified slightly before making landfall near the Mexico @-@ Guatemala border with winds of 45 mph (75 km / h) . By the morning of May 30 , the center of Agatha moved over the highest terrain in Central America , resulting in the dissipation of the low @-@ level circulation . Torrential rains from the storm widened the cavity , eventually causing the collapse of the sinkhole .

= = = Pacaya volcano eruption = = =

On May 27 , three days before Agatha became a tropical depression , the Pacaya volcano , located about 25 mi (40 km) south of Guatemala City , erupted , killing at least one person and blanketing nearby areas with layers of ash . The eruption prompted officials to shut down the country 's international airport . Upon the formation of Agatha , people feared that excessive rainfall from the storm could exacerbate the situation and trigger lahars . This had the effect of clogging the underground pipes with soot , increasing the chances of pipe rupture .

= = Collapse and aftermath = =

Mariela Castañón , a reporter for the daily newspaper La Hora , reported that the ground collapsed

suddenly , taking a three @-@ story house that was used as a factory , and possibly a security guard , along with it . Electricity poles were also sucked in . Authorities said they could not confirm the security guard 's death .

The sinkhole 's collapse in Guatemala City 's Zona 2 left at least 15 dead , and a further 300 residents ' lives were put at risk . Because of the role played by sewage pipes in the sinkhole 's collapse , Sam Bonis , along with other geologists , has demanded that the government inspect the sewer system more regularly .

According to officials , the sinkhole had similarities with another Guatemalan sinkhole which collapsed in 2007 , which may also have been formed by ruptured sewage pipes .

On a wider scale , immediately following reports of fatalities due to Agatha , a state of emergency was declared for Guatemala . On May 31 , the government started to deploy national aid , and donation centers for victims of the storm were opened across the country . According to the Office for the Coordination of Humanitarian Affairs (OCHA) , schools in Guatemala were to be closed until at least June 4 .

= = = Filling in the sinkhole = = =

Immediately after the sinkhole 's collapse , there were plans to fill it in with a soil cement made from cement , limestone , and water known locally as lodocreto . This substance was also used to fill in the 2007 Guatemala City sinkhole . However , another technique , which geologists call the graded @-@ filter technique , in which the sinkhole is filled with successive layers of boulders , smaller rocks , and gravel , could possibly be a better solution . This is because filling the hole in with cement diverts water runoff to other areas , potentially increasing the risk of sinkholes occurring in other parts of the city . The graded @-@ filter technique , on the other hand , allows water to seep through .