

Sixty-five to 100 ft (20 to 30 m) south of Le Noireau River in Conde-sur-Noireau, France, lies a facility that manufactures automobile brake pads and brake linings. The site was originally a marsh that was backfilled in 1945 with construction debris.

The facility's original buildings were constructed in 1962, and although the river has never been known to threaten the facility, no one knew the river's flooding history because records for the area were destroyed in World War II, and adequate records for the river had not been kept since. As a result, the local planning bureau classified the river as "not subject to flood."

On February 14 and 15, 1990, the river broke with tradition and began to rise at an abnormally high rate. Excessive rainfall following a drought is believed to have reduced the overall capability of the soil to absorb water, resulting in an unpredictable water flow in Le Noireau River. The flow of the river during the flood reached 105 million gph (400,000 m³/h). Since 1945, the previous highest recorded flow was 52.6 million gph (200,000 m³/h).

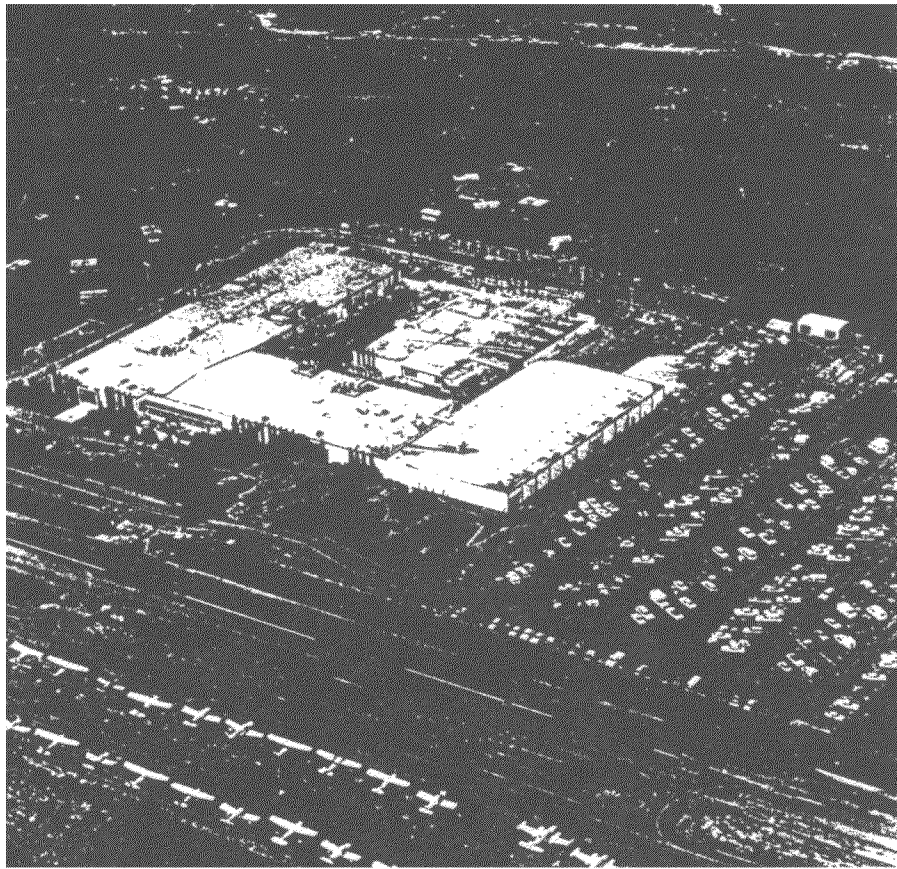
Rainfall records taken at Caen Airport, 19 miles (30 km) north of the facility, showed that 3.7 in. (9.3 cm) of rain fell February 9-16. The highest previous record was 5 in. (12 cm) for a complete month. Measurements made locally by the Conde-sur-Noireau municipality from February 12-15 indicated a rainfall of 3.1 in. (7.8 cm) in four days.

At 8 a.m. on Wednesday, February 15, facility personnel noticed that the Le Noireau River was rising to an abnormally high level. By 8 p.m., the water had reached its highest level at the facility: 6 to 12 in. (15 to 30 cm) depending on the location. Damage to the facility included cracks on the floor-slab wearing surface in numerous areas of the facility and wetting of equipment and in-process products, specifically 55,000 brake linings that showed signs of rust. Also, the bitumen-based wearing surface on the floor peeled off in 25 patches of 215 to 323 ft² (20 to 30 m²) each.

Salvage operations continued over the next few days and although adequate spontaneous emergency action minimized the damage and interruption to production, the facility did incur damages totaling more than \$3.4 million. (All loss amounts herein reflect estimated gross loss indexed to 1991 values.)

On March 17, 1990, rain in the watershed north of Elba, Alabama, resulted in the breaking of the north levee and the flooding of Elba. According to local officials, 17 in. (43 cm) of rain fell in a 24-hour period. Floodwater at a trailer manufacturing facility in Elba varied from 4½ to 8½ ft (1.4 to 2.6 m) deep. The floodwater left ¼ in. (0.6 cm) of silt on the floors and up to ⅛ in. (0.3 cm) on items above the floor. Paint, oil and solvents floating on the water left a residue on the outer metal skin of many of the 100 in-process trailers.

In the office and warehouse areas, all equipment and materials were also wetted and covered with



silt. The entire facility was shut down for four weeks while cleanup and salvage took place. The loss amounted to \$15 million.

The magnitude

These examples illustrate the severity and damage potential of floods. In the last five years, flooding has caused more than \$118 million in damage worldwide to insureds of Allendale Insurance, Arkwright, Protection Mutual Insurance and Factory Mutual International. This damage includes collapsed walls, wet merchandise and equipment, yard storage transported miles downstream, and equipment smashed and ruptured by floating tanks or other debris.

Even items thought to be above the reach of floodwater can sustain water damage if the storage topples or if it is susceptible to damage from high humidity. In addition, receding waters can leave behind layers of silt and sediment that are difficult, and sometimes impossible, to remove from equipment and merchandise, rendering them worthless.

Many companies choose to locate alongside a river or other body of water for transportation reasons and also because the nearby source of water is useful in production. Although the site may have been considered safe at the time (local residents have no memory of the river ever flooding, or recent records show no flood experience), changes to the landscape around the area and future development upstream, can have far-reaching effects.

More and more of the world's landscape is changing from rural to industrial. As vegetation is removed and the land is paved, rain that normally would have been absorbed into the ground

▲ Some companies build near a river or other body of water because the nearby water is useful for production or transportation purposes.