

Can the death of a cetacean in a November 1755 earthquake assist with downtown Boston geotechnical issues?

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Boston's downtown on the south side of the mouth of the Charles River began as the "Shawmut Peninsula" – a near-island connected to the mainland by the bar of "Boston Neck" in the mid-17th century as European settlers arrived to colonize the "New World" of America. Wharves were built, and extended, and infill was added between the wharves to create new land. The wharves were then extended to repeat the cycle and create more land. Within a century one could not easily find the original shoreline, as Boston had expanded in all directions to essentially double its area standing just above sea level of the day.

On Tuesday, November 18, 1755, at 04:30 a.m. local time, a sizeable earthquake was felt and roughly 1000–1500 brick chimneys fell to the ground in Boston. It was immediately recognized that the majority of the fallen chimneys were from houses built on the reclaimed land along the harbour's edge. Infilled land tends to have much more water incorporated in the sediment, which can amplify the vibrations of an earthquake and lead to greater shear, or "s" wave, damage. The 1976 assessment of the risks of building a second Pilgrim nuclear power generating station at Plymouth on Cape Cod compiled the historic seismicity of New England from 1727 to 1927. It placed the epicentre of the 1755 earthquake in the offshore not far to the east of Cape Ann. Later work by geotechnical engineers considering liquefaction events during the 1755 event placed the epicentre onshore not far west of Boston. The currently accepted epicentre by John Ebel in 2006 places the 1755 epicentre about 39 km ENE of Cape Ann, with a magnitude of about 6.3.

All researchers appear to have dismissed, or totally ignored, a west-bound vessel's felt report some 70 "leagues" (387 km) offshore, well east of Cape Ann. The *Pegasus*, bound for Marblehead with a load of salt from Cadiz, encountered significant fish kill and three whales lying motionless on the sea surface and apparently dead. If the position of the *Pegasus* better reflects the true epicentre of the 1755 earthquake then its presently estimated magnitude must be increased somewhat and the building code requirements for downtown Boston and indeed for much of the eastern and coastal areas of the Massachusetts perhaps should be increased. A second nuclear reactor at the Pilgrim facility on Cape Cod has never been built. These issues hang on the question I put to myself last May. "Can an earthquake's large pressure ('p') wave concussive force seriously injure, or even kill a whale?"