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SUMMARY OF *"INVESTIGATING PROPERTY DAMAGE ALONG DUBLIN PORT TUNNEL ALIGNMENT"* BY ANDREA GILLARDUZZI AND ITS IMPACT ON METROLINK

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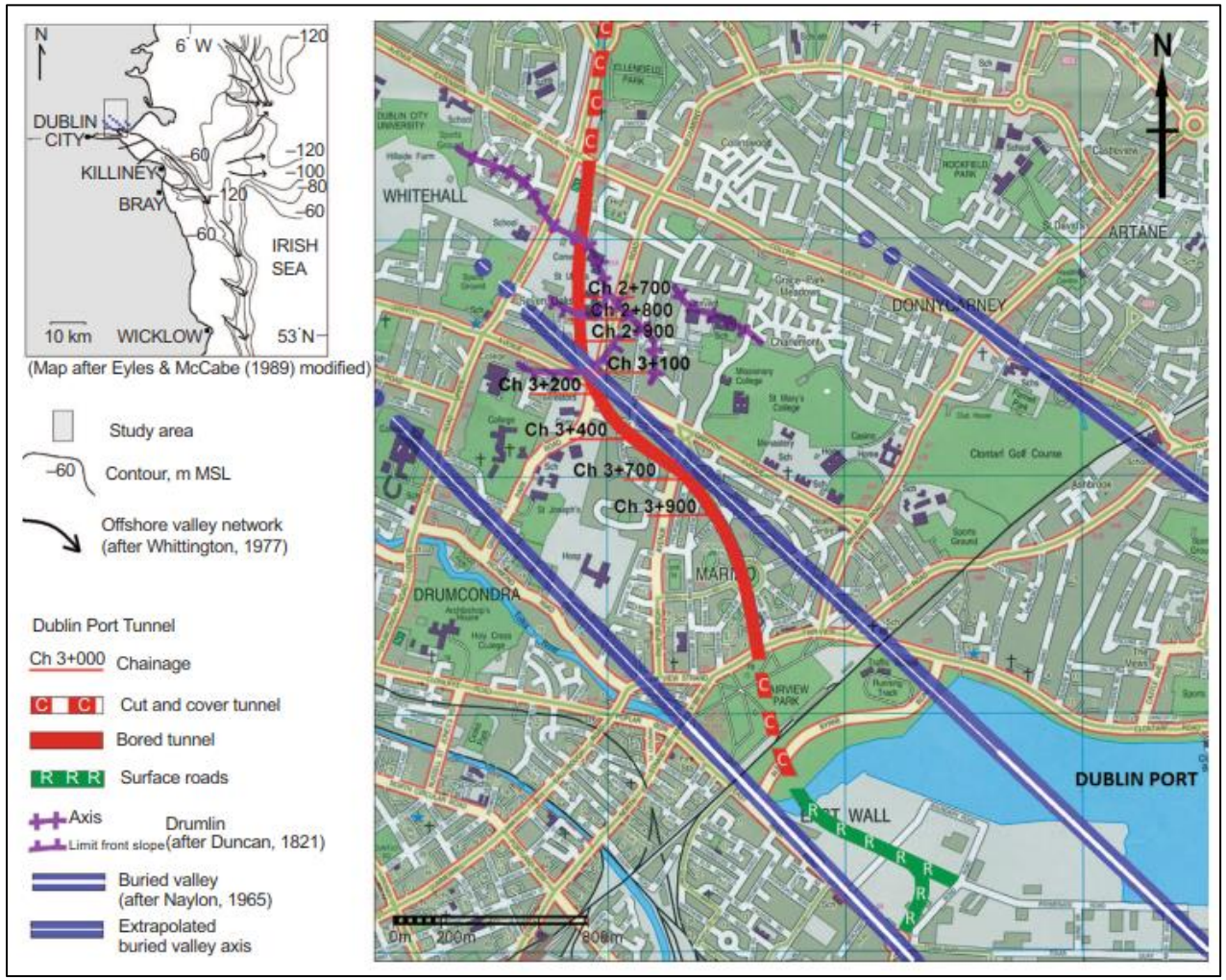
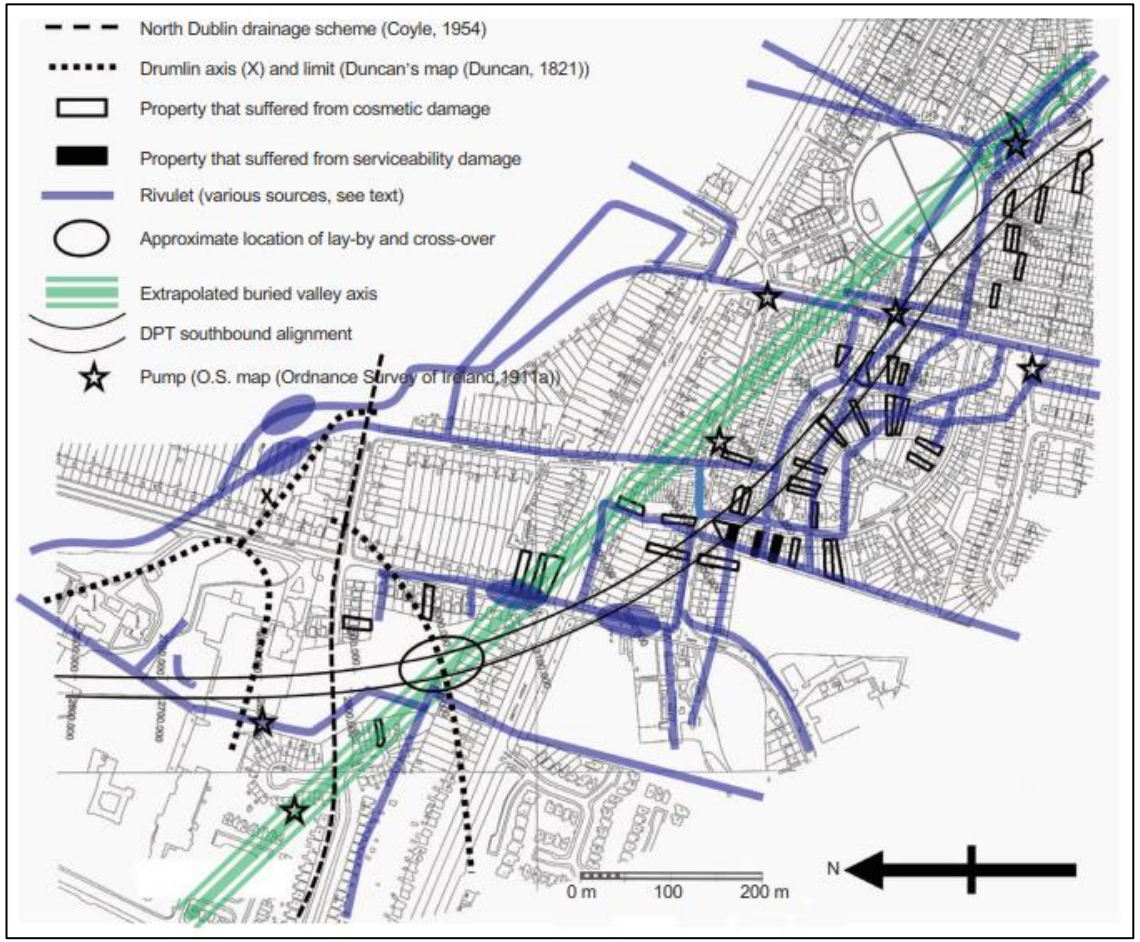
Gillarduzzi 2014 Paper

- Gillarduzzi, published in 2014 volume 167 Issue FE3 of Forensic Engineering
- The paper investigates the causes of the damage (serviceability and aesthetic) to several property's in the Marino area of Dublin.
- The buildings were mostly constructed between 1925 and 1929 and comprise of two-story houses in terraces of four, six and eight. The majority comprise a concrete ground floor and foundations, generally without reinforcing bars and an upper timber floor.
- Pre surveys competed 30m each side of the tunnel recorded various defects in the buildings often related to poor-quality construction



Gillarduzzi 2014 Paper

- A detailed review of the geology was undertaken using historic maps and considering the formation of the site, and the history of the area, including the ground water and changes during the quaternary evolution
- Importance of a holistic engineering–geological ground model for the study area and the specific site volume loss of the ground.
- Tunnel-related causes of settlement at ground level:
  - **Deformation and local failure** of the tunnel excavation.
  - **Dewatering** of strata embedded in and beneath the Boulder Clay, with removal of fine soil particles.
  - **Vibro-densification** of coarse strata.
  - **Slow tunnel production** and possibly **consolidation** of the Boulder Clay and superficial clayey strata.
- A comparison between the **position of the properties where damages are being claimed and that of post-glacial rivulets and lakes**, backfilled in the 1920s following a rapid expansion of Dublin suburbs, clearly indicates a direct linkage between the two.



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IMPACT ON METROLINK

DPT settlement / MetroLink relevance

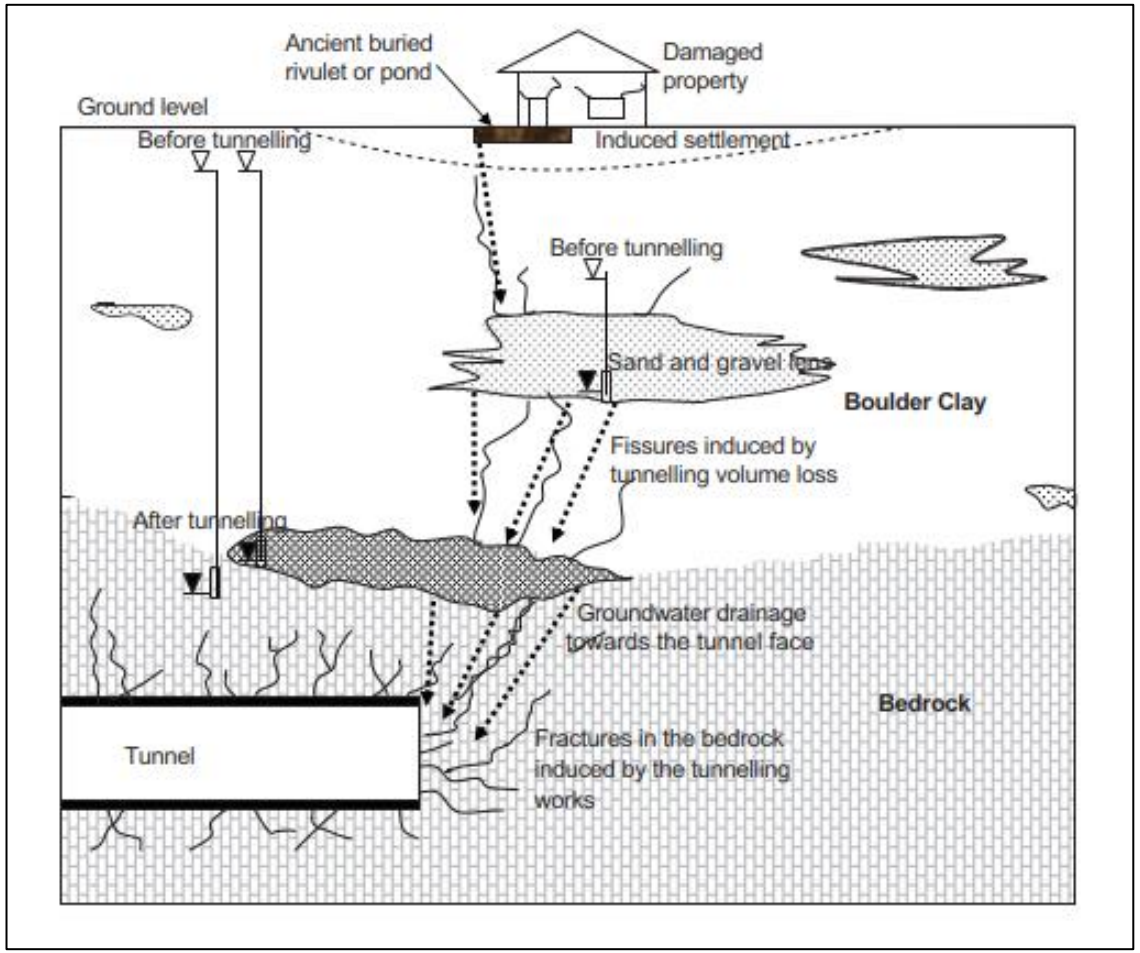
Deformation and volume loss

- Gillarduzzi concluded settlement was caused by local failure and deformation of the tunnel excavation and that it was greater where the tunnel alignment intersected:
  - faults and the axis of very tight chevron folds;
  - difficult ground conditions (e.g. rock rich in expansive clay);
  - thinly bedded plastic mudstone (rather than thicker and stiffer limestone strata); and
  - areas with thin and fractured rock cover above the tunnel crown (e.g. where the axis of the buried valley intersects the tunnel alignment).
- MetroLink: Extensive ground investigation identifying faults. Variable density TBM enables pressures to be maintained at all times when faults are encountered.

DPT settlement

Dewatering deposits and bedrock

- Subordinated dewatering caused removal of ‘fines’ and consequent volume loss of the ground located above the tunnel excavation.
- Gillarduzzi also suggested that the dewatering causing consolidation of Boulder Clay is plausible but unlikely. However, he states that the progressive ingress and removal of fine soil particles was a factor.
- MetroLinks will use a TBM which has a closed face, this prevents groundwater entering the tunnel.



DPT settlement / MetroLink relevance

Vibro-densification

- Vibro-densification occurs by the combined action of dewatering, with loss of fines and groundborne vibrations from the TBM. The combined effect is the densification of the soil with reduction of porosity and consequently of volume.
- MetroLink, The dewatering aspect is eliminated using the variable density TBM.

DPT settlement / MetroLink relevance Dewatering causing consolidation

- Gillarduzzi concludes there is no systematic correlations between the amount of settlement (0–20 mm range) and the location of rivulets and ponds
- However, Gillarduzzi did note that areas affected by settlement over 5 mm lay very close to backfilled rivulets
- Gillarduzzi concludes that consolidation of pond and rivulet strata is more likely to have occurred where settlement, due to DPT tunnelling works, had already occurred, triggering the dewatering of strata close to ground level
- Settlement was observed over a relatively short time frame. (1 month)
- MetroLink: The closed face tunnelling method will not drain the strata

DPT settlement / MetroLink relevance

Slow tunnel production

- When the TBM approached the residential area of Marino, working hours were reduced down to 13 h per day, in order to limit noise and disturbance to residents.
- As a result, the tunnel front face remained unsupported for longer periods. This allowed greater relaxation and more intense dewatering of the ground, both of which are generally conducive to greater settlement at ground level.
- MetroLink is proposing 24/7 working hours for tunnelling with a Tunnelling machine which will have a pressurised face.