



Malahide Viaduct Collapse County Dublin, Ireland

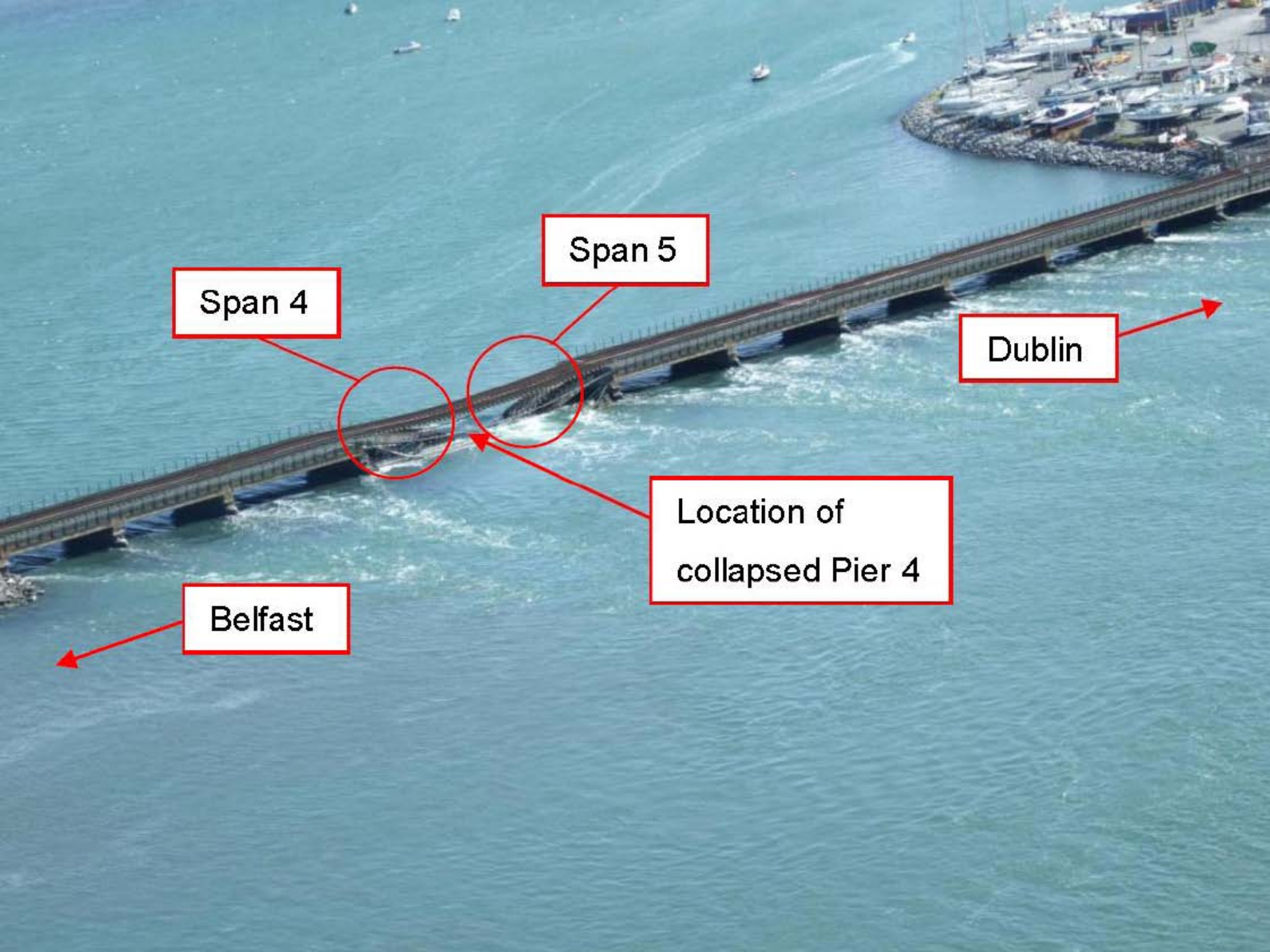
Railway Accident Investigation Unit

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What happened on the 21st August 2009?

- While the Balbriggan to Connolly service passed over at 18.21 pm the driver noticed the partial collapse of down side viaduct
- All post accident procedures were followed correctly resulting in no injuries or fatalities
- Within ten minutes Pier 4 of the Malahide Viaduct had failed catastrophically



Span 4

Span 5

Dublin

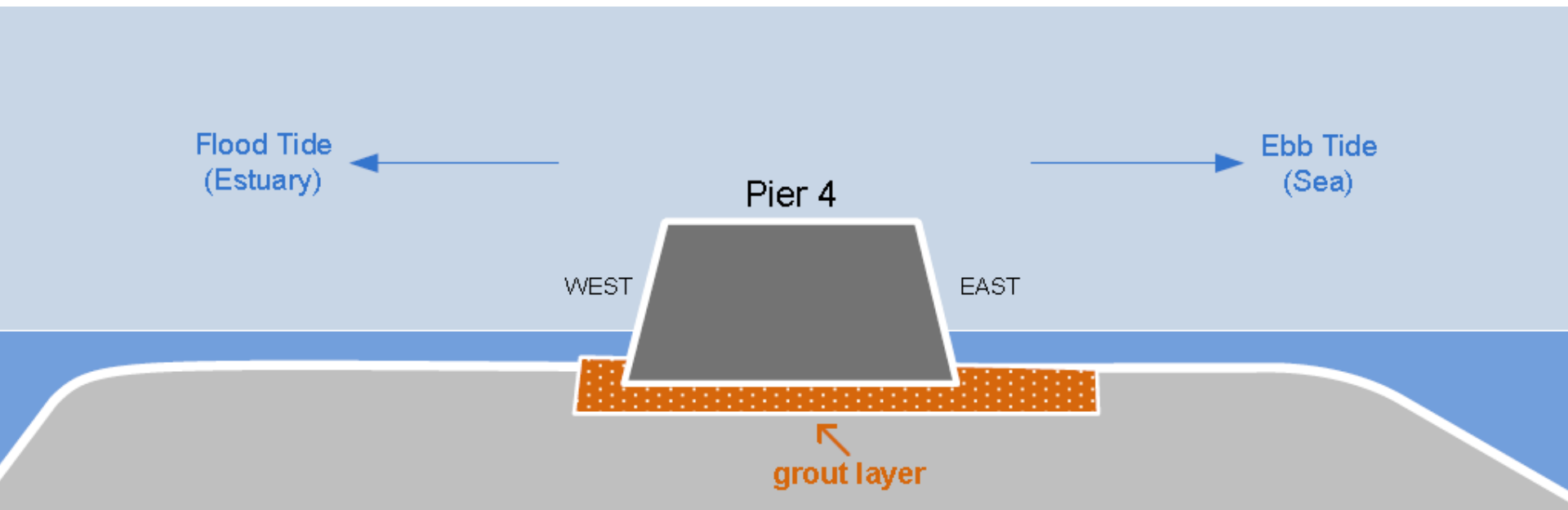
Location of collapsed Pier 4

Belfast



History of the Malahide Viaduct (continued)

- In 1967 – 1972, the weir was grouted to form a grouted rock apron



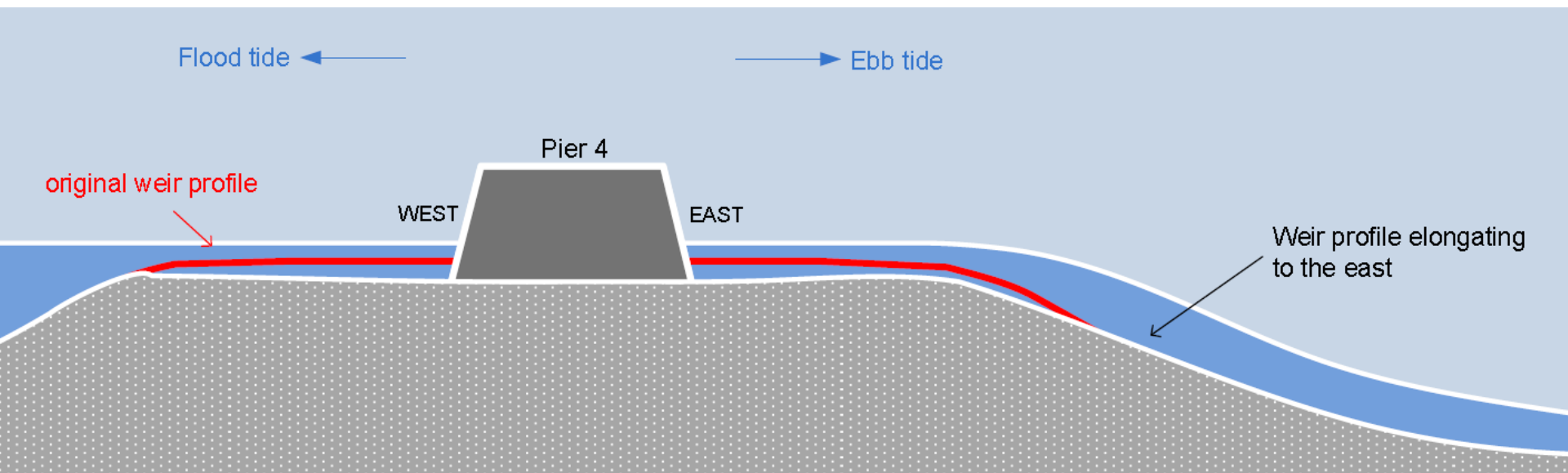
Why did it happen?

- Long term events
- Medium term events
- Short term events



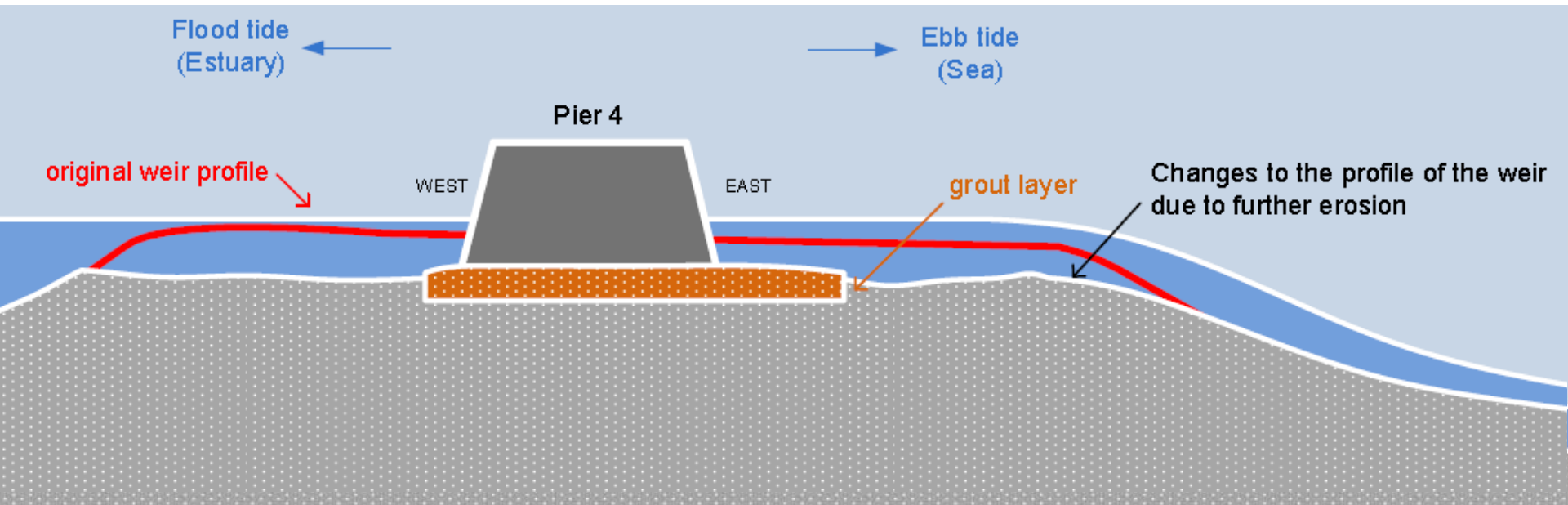
Long term events

- Stones eroded from the crest of the weir
- Elongated weir on the eastern side

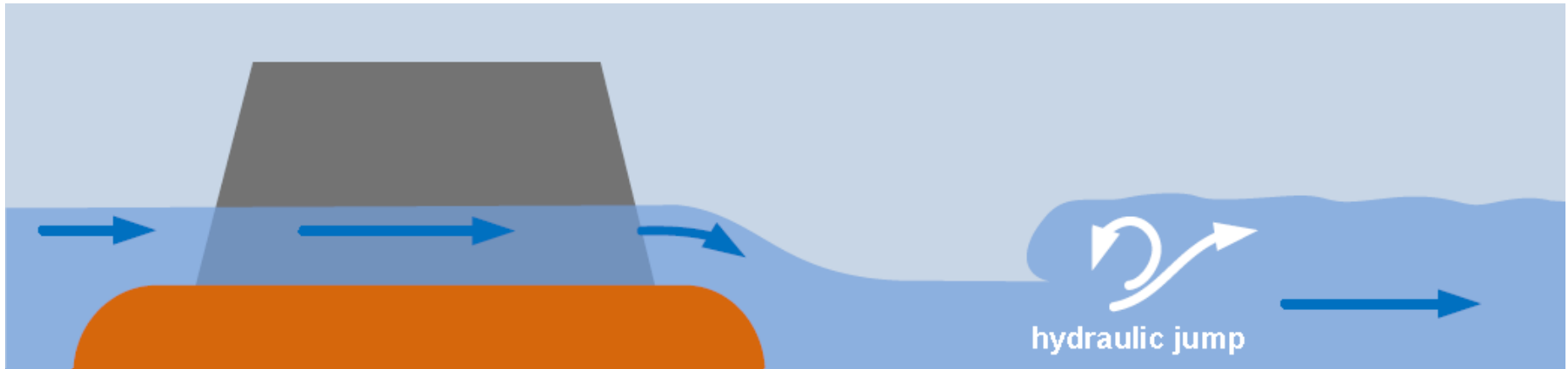


Medium term events

- Grout stabilised the weir profile for a period
- Grout began to degrade and the erosion continued



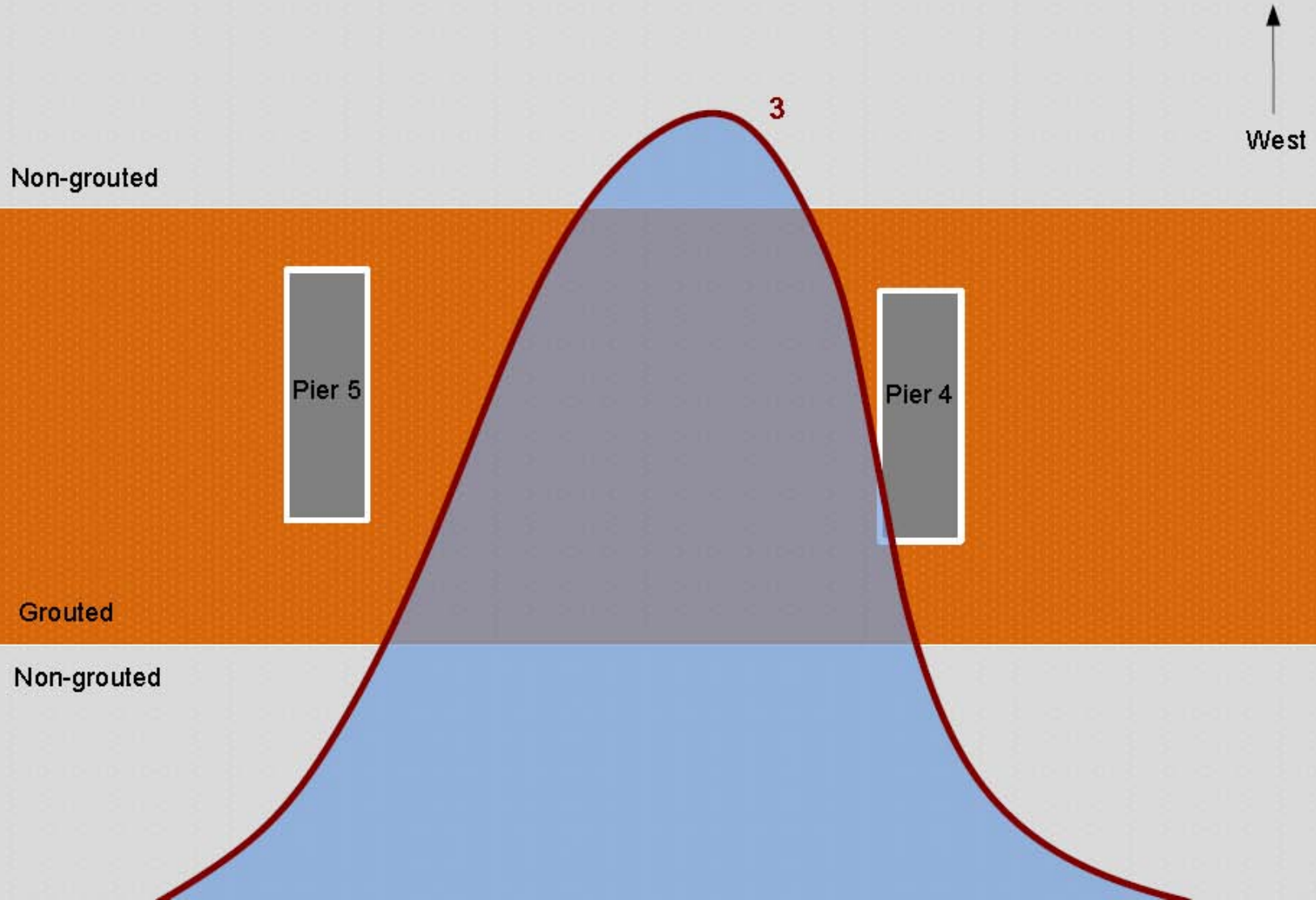
Medium term events (continued)



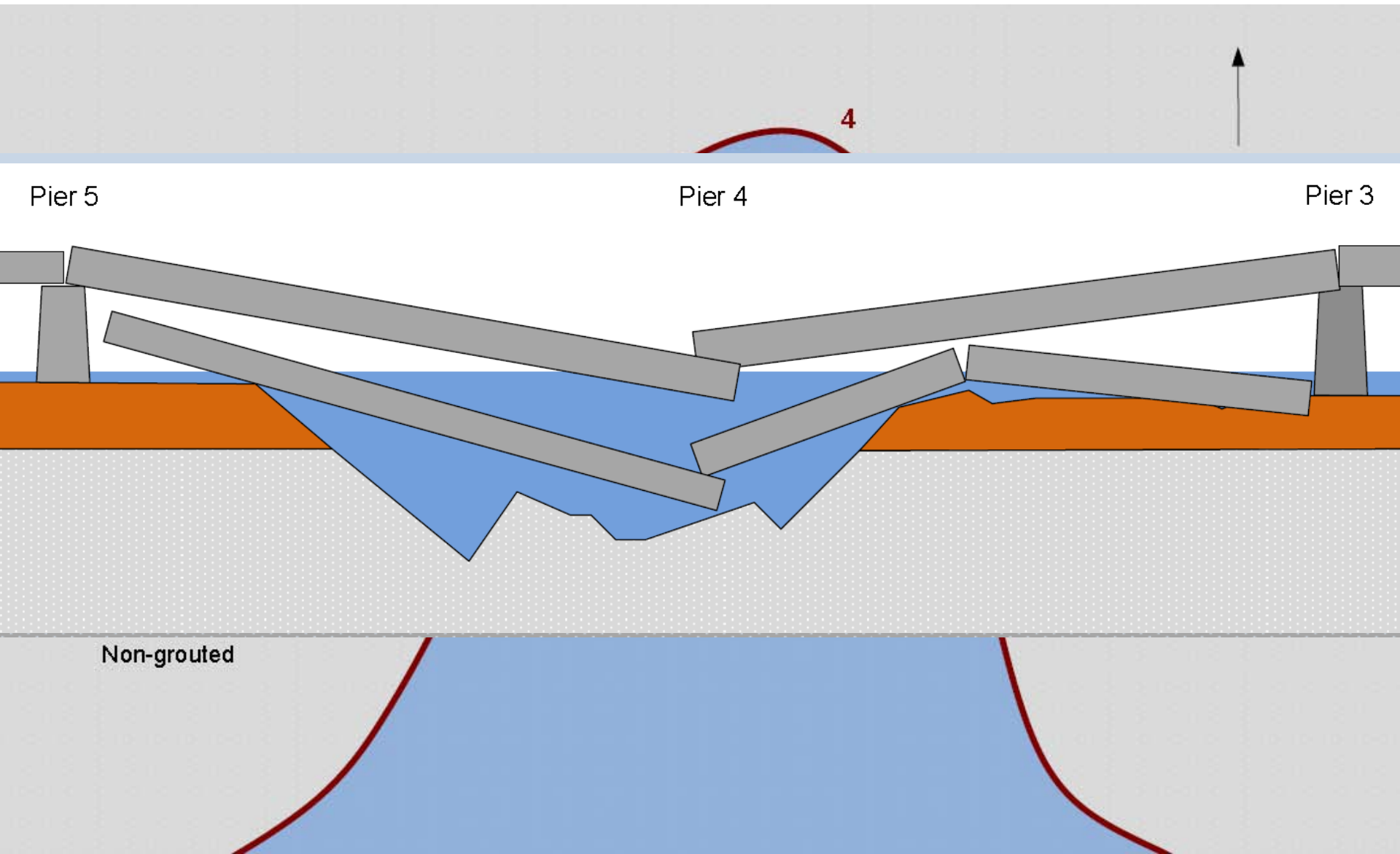
However.....



Medium term events (continued)



Short term events



Immediate Cause

- The **immediate cause** of the collapse of Pier 4 was as a result of the undermining of the remaining grout apron that surrounds and supports Pier 4 through the action of piping (scour).



Contributory Factors

- Iarnród Éireann had not developed a flood/scour management plan at the time of the accident.
 - Despite independent reviews (2001 & 2006) recommending that this plan be developed
 - Contributory to Iarnród Éireann not developing this flood/scour management plan was the fact that the Railway Safety Commission closed this recommendation in 2008

Contributory Factors

- Engineers were not appropriately trained for inspection duties, in that the inspections training course they completed was an abridged version of the intended format, and there no formal mentoring programme, for Engineers on completion of this course
- There was a shortfall in Iarnród Éireann's suite of structural inspection standards in that a standard which provided guidance for inspectors in carrying out inspections was not formalised

Contributory Factors

- There existed an unrealistic requirement for patrol gangers to carry out annual checks for scour, as they do not have access under the structure and in addition, they did not have the required specialist training/ skills to identify defects caused by scouring
- A formal programme for Special Inspections for structures vulnerable to scour was not adopted, as per Iarnród Éireann's Structural Inspections Standard at the time of the accident

Underlying Factors

- There was a loss of corporate memory when former Iarnród Éireann staff left the Division, which resulted in valuable information in the relation to the historic scouring and maintenance not being available to the staff in place at the time of the accident
- There was a dearth of information in relation to the Malahide Viaduct due to Iarnród Éireann's failure to properly introduce their information asset management system
- Iarnród Éireann's inadequate resourcing of Engineers for structural inspections to be carried out at the Malahide Viaduct;

Underlying Factors

- Iarnród Éireann's failure to meet all the requirements of their Structural Inspections Standard in that:
 - Visual inspections were not carried out for all visible elements of structures;
 - Bridge Inspection Cards, for recording findings of inspections, were not completed to standard or approved by the relevant personnel;
 - A formal programme for systematic visual inspections of all elements of a structure, including hidden or submerged elements, despite an independent review recommending that Iarnród Éireann implement this programme in 2006.

Recommendations

- As a result of the findings of the investigation, the RAIU have made 15 safety recommendations
 - 13 safety recommendations have been made to Iarnród Éireann
 - 1 safety recommendation has been made to the Railway Safety Commission
 - 1 joint recommendation has been made to Iarnród Éireann and the Railway Safety Commission

Recommendations

- 2 recommendations related to track patrolling
- 7 in relation to standards and processes
- 1 in relation to training, assessment and competency management systems
- 1 in relation to maintenance systems
- 2 in relation to data and asset management
- 2 in relation to the tracking and management of recommendations

Thank You

For the full RAIU investigation report, please see our website www.raiu.ie

