Scour prevention and management

What is the Situation?

Scour is the removal of material from the bed and banks of a channel and from around structure foundations by the action of water, leading to structural damage or failure. Scour is the leading cause of bridge failures in the last 100 years in the UK.

Diver inspections are currently used to detect scour. The outcome is often uncertain due to low water visibility, resulting in ambiguities and inherent risk at structures.

During flood events, bridges at risk of scour may have restrictions placed upon them (including closure) as a safety precaution. The restrictions can only be lifted following an inspection by divers or through flood waters receding, once an engineer has satisfied him or herself that no scour/erosion/damage has occurred that could affect the structural integrity.

CP5 National Costs for protective works is £27m

Estimated Likely Failure of Bridge due to Scour 27% of failure or 1 in every 3.7 years*

**from JBA Trust (2013) 'Flood and related Failure incidents at Railway Assets between 1846 & 2013' report*

47 years during which one or more structural failures were observed in the UK

RSSB T112 Report (2004) 60 failures over approx. 150 years.

No downward trend or risk reduction noted.

4500 structures at risk of scour
750 rated as High or Medium/High risk

Analysis of Causes

The factors causing scour to develop are complex and differ according to the type of structure. Scour solutions can be summarised into 3 areas:

Identify:

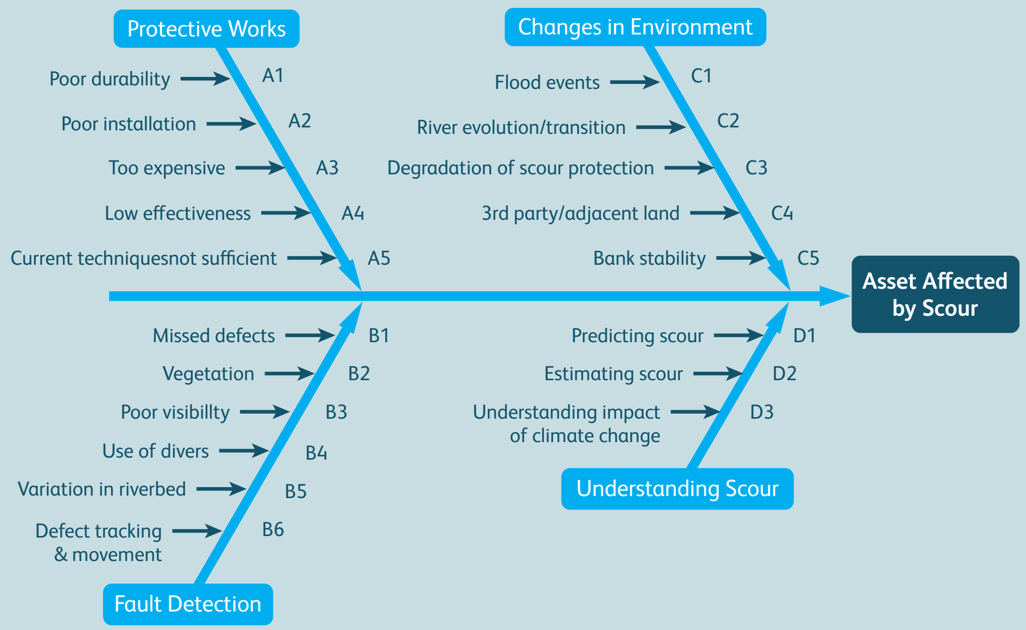
Development of tools to accurately predict level of scour at structures

Protect:

Physical works to alter scour susceptible structures to protect them during high flow events

Detect:

During flood conditions confirm scour conditions and monitor.



Priority Problems

Specific Priority Problems

- Detection of scour
- Improved safety of workforce
- Protective physical works
- Prediction of scour

Related Goals

- Overcoming poor visibility
- Live remote condition monitoring
- Reduced need for divers in examinations and assessments
- Cheaper, more effective, more durable protective solutions
- Better understanding scour processes and failure mechanisms

Benefits

- Safer workforce.
- The risk profile of assets reduced.
- Reduction in time that asset is closed during extreme weather events.

Scope

To address these challenges it is expected that R&D actions will need to address the following aspects:

The use of technology to determine if/when infrastructure can be re-opened following a flood event.

Divers are generally used to inspect river beds and check structural integrity below the water line. In many cases, this leads to delays re-opening the structure as water conditions can prevent divers being able to gain access to the water. Some form of remote monitoring would also result in much safer working practices.

Notes:

- The System would need to provide positive confirmation that bed levels have not dropped and/or supports remain intact.
- Scour holes generated by floods tend to re-fill at lower flow rates, but may not attain the original support characteristics.
- Some scour could be acceptable at certain structures (can the system detect this?)
- Costs need to be proportionate, ultimately remedial works (such as solid inverts/rock armour) can greatly reduce scour risk.

Establishment of foundation type/depth

Foundation depth is one of the most critical factors for understanding scour risk at a structure. Foundation depths are currently investigated by core drilling, which is intrusive, expensive and sometimes not particularly accurate.

A non-intrusive technology that could accurately determine an asset's foundation depths, type and condition would be a huge benefit.

Alternative cost-effective, easy to install, robust scour protection techniques

(Acceptable to Environment Agency/NRW/SEPA)

Established current scour protection techniques are in many cases not proving resilient due to the use of concrete in watercourses which is problematic environmentally.

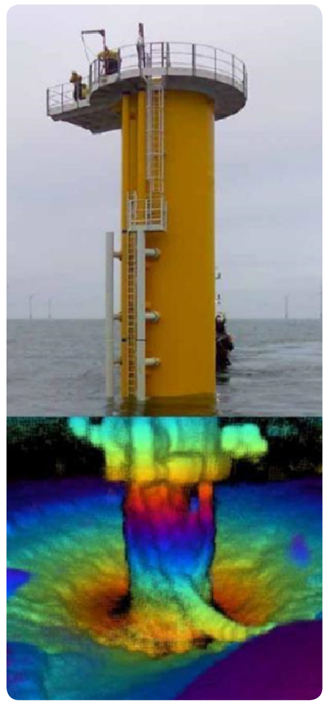


fig. 1 Offshore wind turbine from Echo scope

fig. 2 - ARC boat

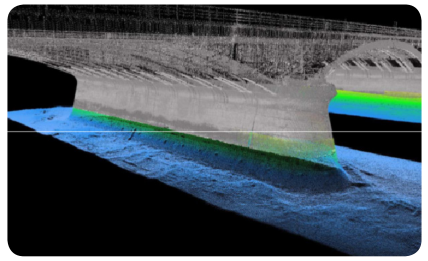


fig. 3 - Comtreer model using multiple data sources

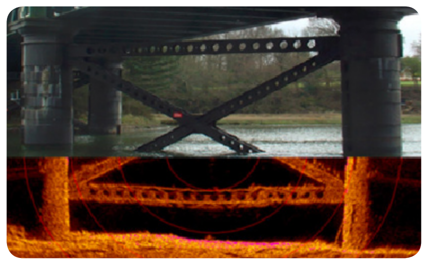


fig. 4 - MS 1171 High-resolution vertical imaging

fig. 5 - Submersible remote camera