Overview of Scour Manual CIRIA C551

Andrew Kirby

Manual on scour at bridges and other hydraulic structures: CIRIA C551

- Published in 2002
- A useful primer for all things scour related for asset owners, managers, designers, contractors, researchers
- Key day-to-day users probably “designers”

Why update the Manual?

- Researched, written and published over ten years ago
- At the time limited other books and references covering the subject in depth
- Over the last 10 years some key new references and research, particularly:
  - In the US – HEC Manuals
  - National Cooperative Highway Research Program (NCHRP) research
  - In NZ – Bruce Melville & colleagues
- Recent extreme weather events and bridge failures; Cumbria, Malahide viaduct, Feltham
- New techniques and practices

Project conception

- Meeting of key asset owners: Network Rail, Highways Agency , RSSB; practitioners and others in March 2012
- Development of scope and coverage of an update
- Development of a full project proposal and discussion with key stakeholders
- Funding sought and obtained
- Contract awarded to Research Contractor Jan 2013

Funders

- Environment Agency
- Highways Agency
- Department for Transport
- ICE
- Northern Ireland Roads Authority
- RSSB
- Network Rail
- Scottish Government
- Transport Scotland
- National Roads Authority (Eire)

The Research Contractor's team

- Mott MacDonald
- HR Wallingford
- JBA Consulting

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Project Steering Group

Project Director
Andrew Kirby - Mott MacDonald
River Engineering, Hydraulic and Scour protection design and Modelling

Project Team Members

Mott MacDonald
John Chesterton
Countermeasures, Project Management

JBA Consulting
Amanda Kitchen
Scour risk management system, debris, hydrodynamic forces on bridges

HR Wallingford

Marta Roca Collell
Flood estimation, hydraulic models, pipelines, estimation of scour

Manuela Escarameia
Scour processes, estimation of scour

Specialist Inputs

HR Wallingford
Richard Whitehouse
Overview of manual

JBA Consulting
Jeremy Benn
Legal Framework
George Heritage
Natural Scour
Richard Buck
Scour risk management system, scour countermeasures, general issues
Matt Kendall
Inspection, monitoring & maintenance
Peter May
Public safety and emergency planning
Andrew Gubbin
Asset management systems

Richard Whitehouse

Jeremy Benn

George Heritage

Richard Buck

Matt Kendall

Peter May

Andrew Gubbin

Objectives

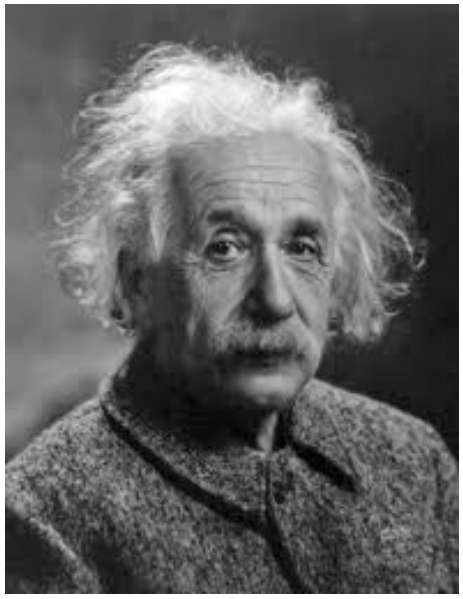
Update the C551 Scour Manual to incorporate advances made in the understanding and application of the science, engineering and hydraulics of scour at bridge sites, hydraulic structures and pipeline crossings.

- Up-to-date, practical and detailed technical guidance
- Guidance in the context of prevailing and projected climatic conditions
- Informative case histories

Key gaps to be filled and changes to be made

- Legislative changes and government directives
- A greater emphasis on scour risk management:
  - identification of sources of risk,
  - asset vulnerability and
  - risk assessment/management methods
  - inspection and condition monitoring
  - long term maintenance
- Updated case studies and lessons learnt
- Review of latest research to update scour assessment methods and scour protection design methods – e.g. scour in cohesive soils and rock

Developments & uncertainties



Albert Einstein

Hans Albert Einstein

The cause of the formation of meanders in the courses of rivers and of the so-called Baer's Law (1926)

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Developments & uncertainties – Cohesive soils

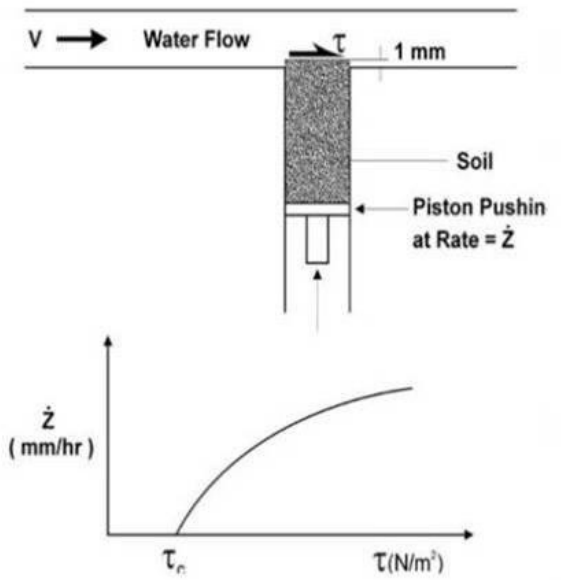
- Different erosion mechanisms to cohesionless soils
- Cannot be defined in terms of standard soil parameters
- Strongly time dependent

TABLE 2.1 Factors influencing the erodibility of cohesive soils

When this parameter increases	Erodibility
Soil water content	*
Soil unit weight	decreases
Soil plasticity index	decreases
Soil undrained shear strength	increases
Soil void ratio	increases
Soil swell	increases
Soil mean grain size	*
Soil percent passing sieve #200	decreases
Soil clay minerals	*
Soil dispersion ratio	increases
Soil cation exchange capacity	*
Soil sodium absorption ratio	increases
Soil pH	*
Soil temperature	increases
Water temperature	increases
Water chemical composition	*

* unknown

Developments & uncertainties – Cohesive soils



SRICOS-EFA (Scour Rate In COhesive Soil – Erosion Function Apparatus)

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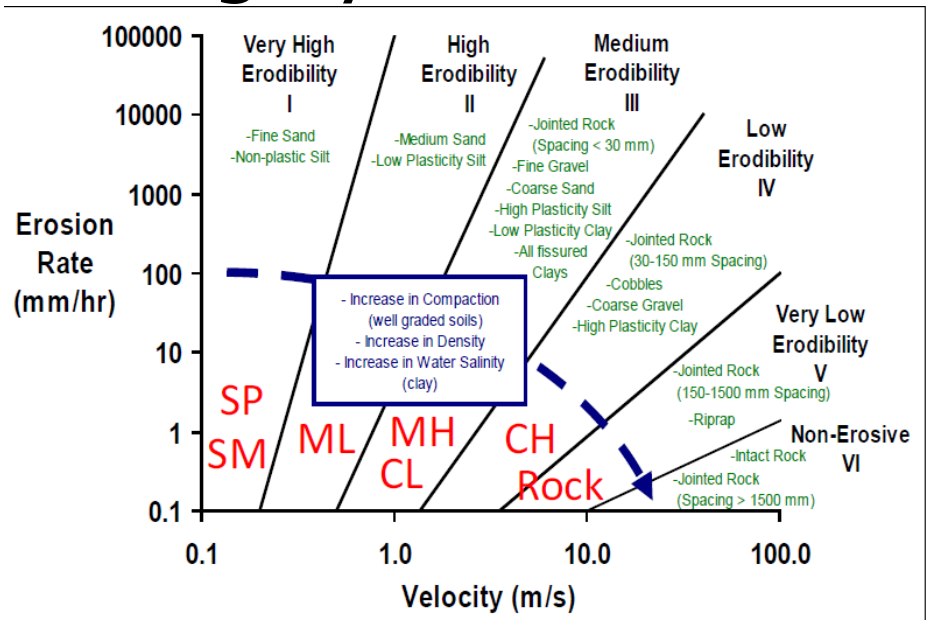
Developments & uncertainties – Scour in rock

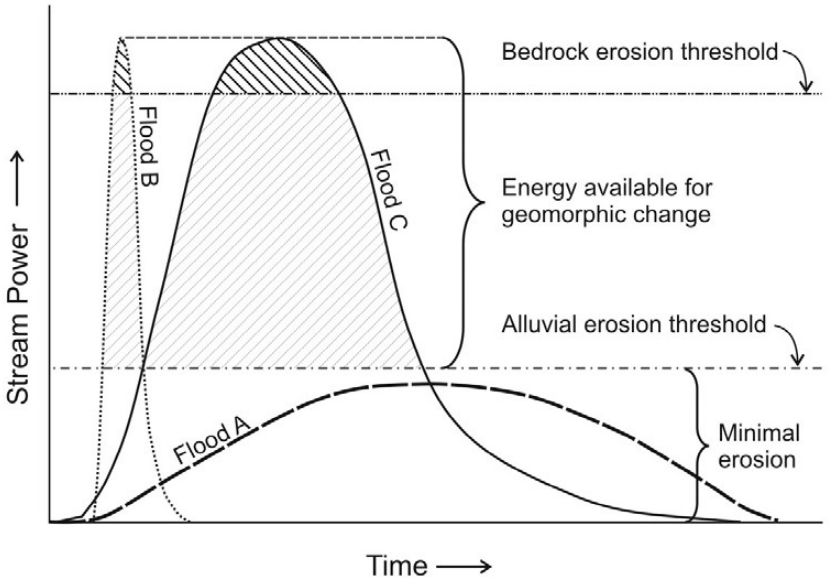
Mechanisms:

- Dissolution of soluble rocks
- Cavitation
- Plucking out of durable jointed rock
- Abrasion and plucking of grains of degradable rock

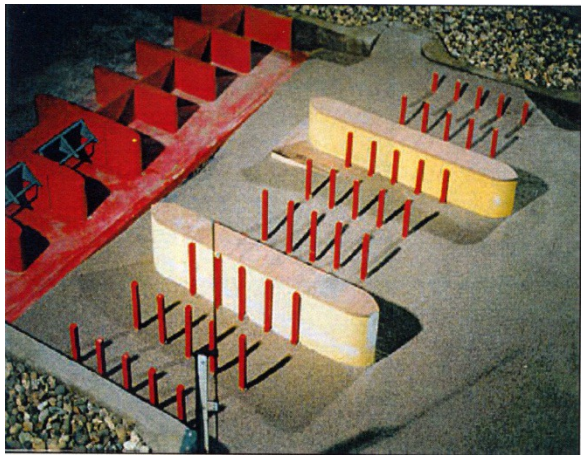
Developments & uncertainties – Scour in rock

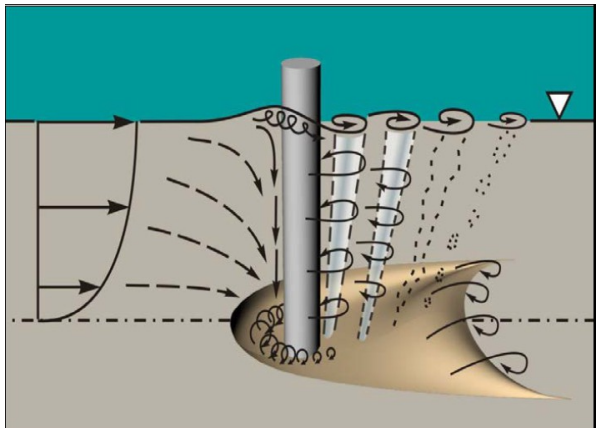
Use of an Erodibility Index like Rock Mass Rating System





Developments & uncertainties – Complex foundations & abutments





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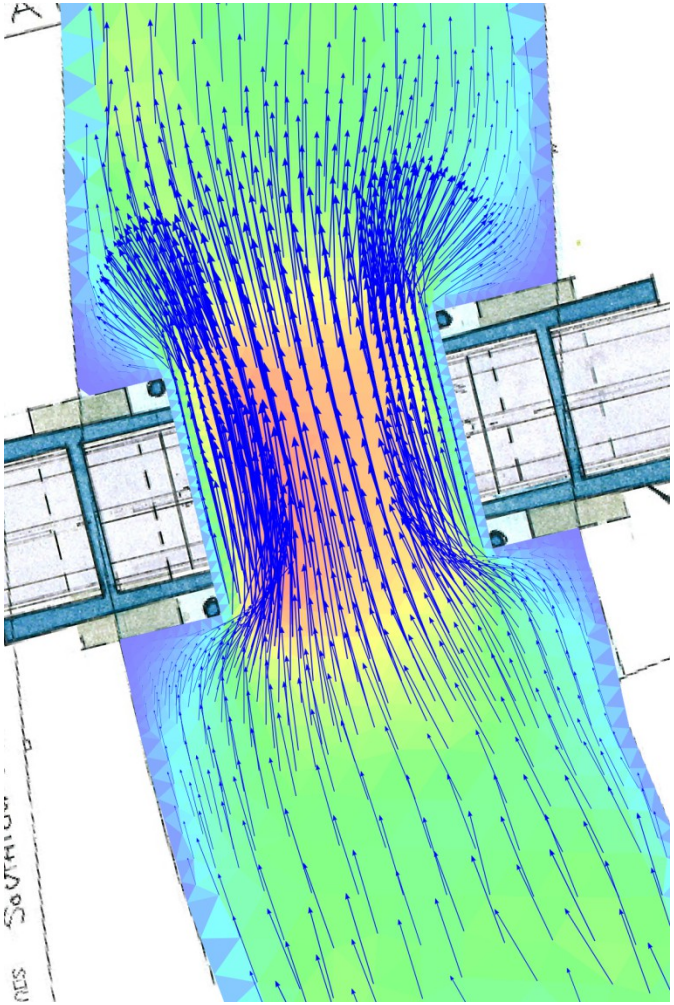
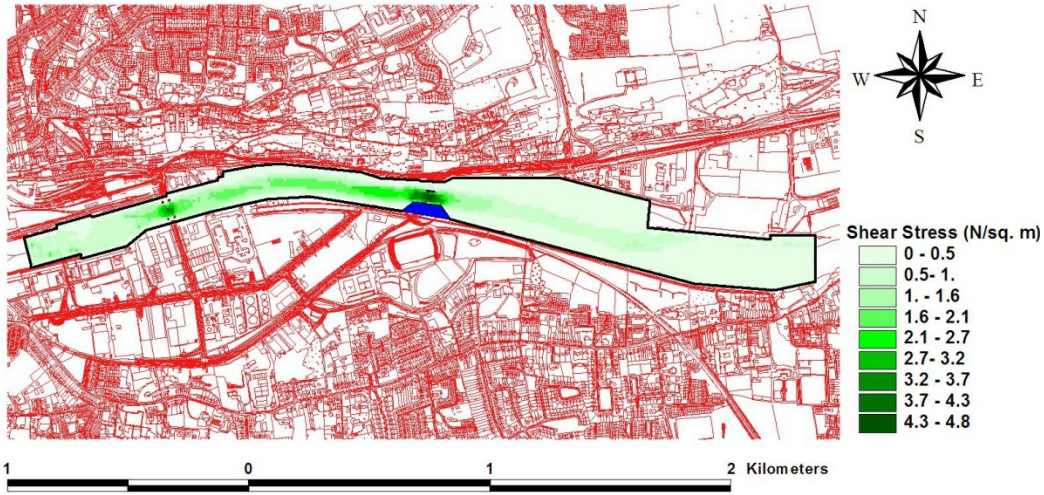
Developments & uncertainties – Computational fluid dynamics





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Case studies and examples

River Crane, Feltham

Tillynaught Bridge, Aberdeenshire

Ballysadare, Co. Sligo

Jubilee River, Berkshire

Case studies and examples

Scour monitoring devices

Scour at pipelines

Bridge scour - Albania

Wingwall failure at weir

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Case studies and examples

Swat Valley, Pakistan

Intrusive investigations

Repairs

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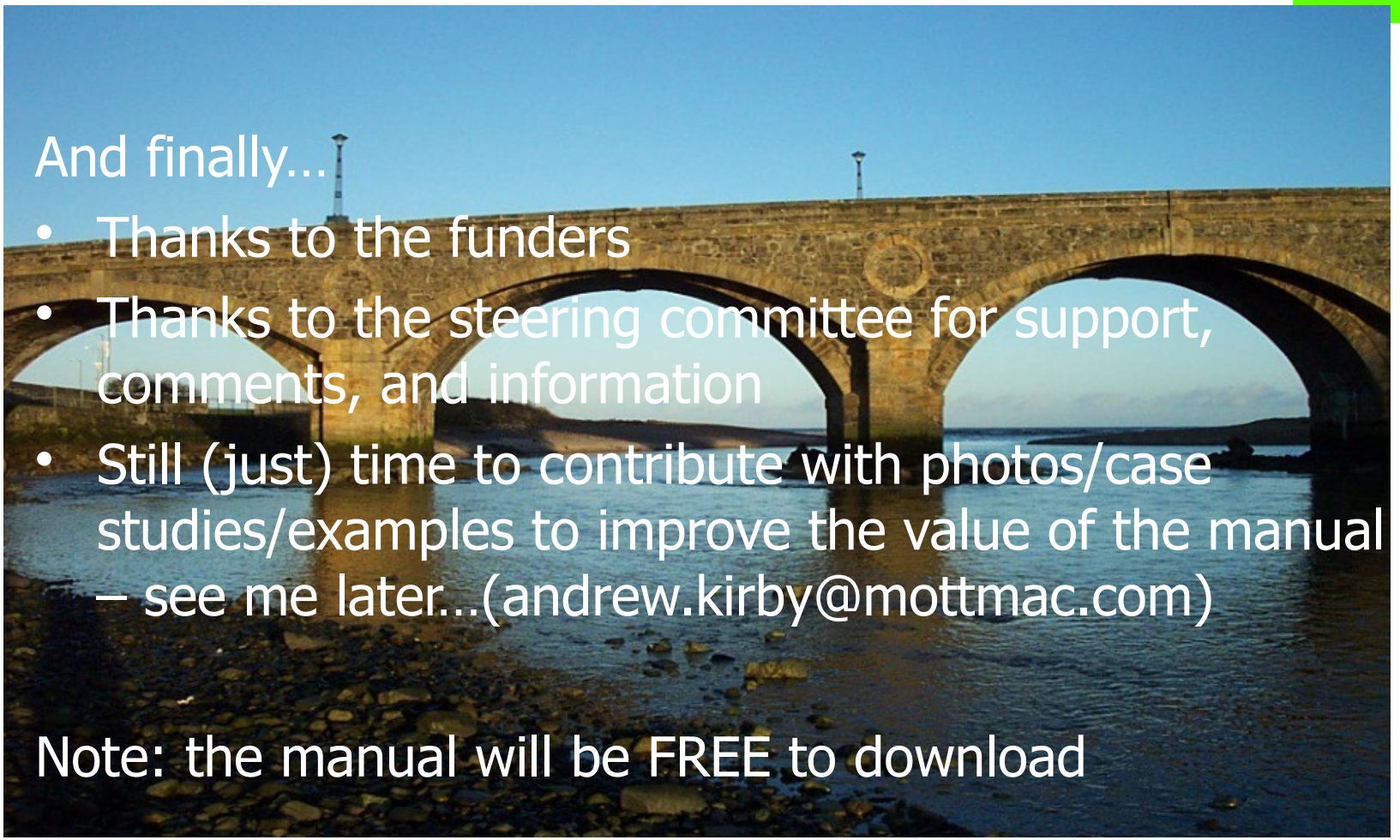
Current Progress

- Revision and mapping of contents
- Literature review
- Collation of resources and information
- Consultation workshop July 2013
- Preparation of 1st and 2nd Drafts
- Comments & feedback
- Final draft under preparation

Programme

- Final Draft – end of March
- Handover to publishing – end of June
- Publication - summer 2014
- Launch event - September



And finally…

- Thanks to the funders
- Thanks to the steering committee for support, comments, and information
- Still (just) time to contribute with photos/case studies/examples to improve the value of the manual – see me later…(andrew.kirby@mottmac.com)

Note: the manual will be FREE to download