Member of the Surbana Jurong Group

Advances in scour assessment

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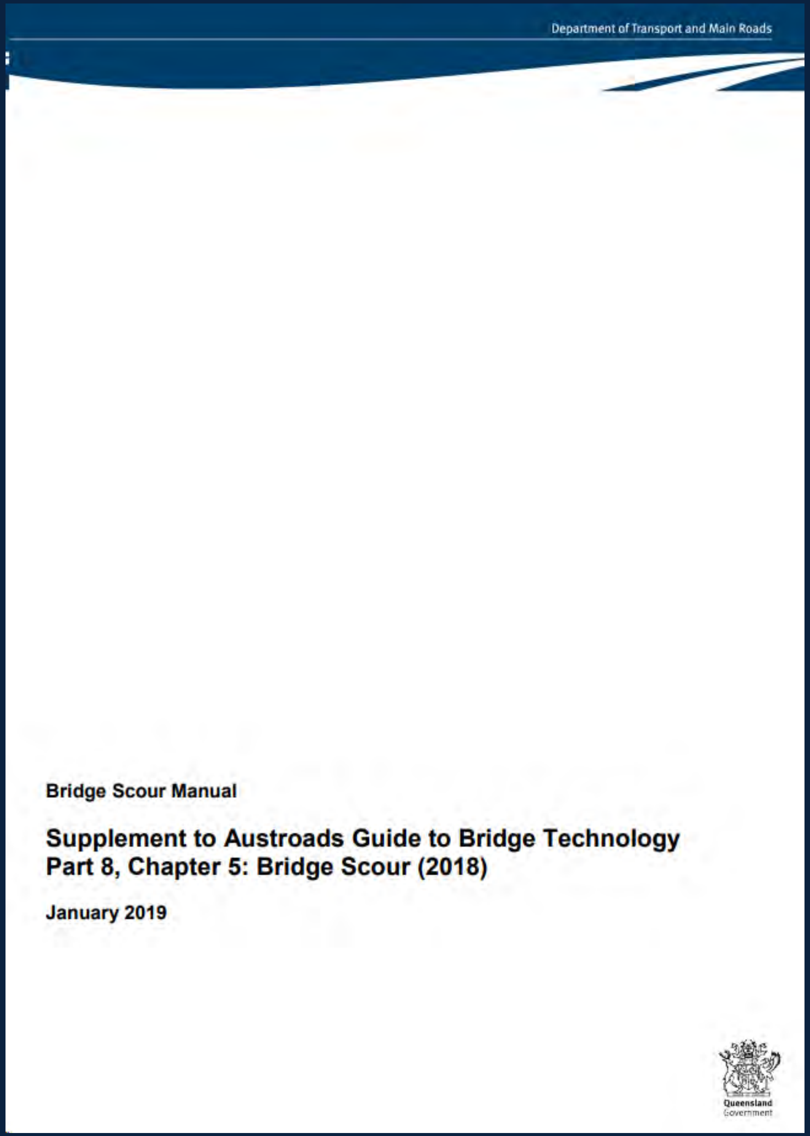
Bridge Scour Manual (TMR, January 2019)

- Formally cross-referenced to *Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures, Chapter 5: Bridge Scour* (Austroads, 2018). Current 2019 Edition minor update of 2018 version.
- Sections of Austroads either accepted, accepted with amendments or not accepted.
- Multidisciplinary approach (Structural/geotechnical and hydraulic engineers)
- River geomorphologist input – General/natural scour assessments.
- Cross correlation with Australian Bridge design standards and nomenclature – Serviceability Limit States (SLS) and Ultimate Limit States (ULS). AS5100.1 and TMR's Design criteria for bridges and other structures.
- **Use of 2D models on all but the simplest bridge crossings**
- Design of piers for new bridges – Not to rely on pier scour protection. Scour depths at piers are estimated to inform design and ensure structural integrity of the bridge under the action of scour.
- In addition to the estimated scour depths – Use geotechnical threshold.
- Protect abutments to prevent scour for floods – Up to SLS event but not relied upon ULS event.


Department of Transport and Main Roads

Bridge Scour Manual

Supplement to Austroads Guide to Bridge Technology Part 8, Chapter 5: Bridge Scour (2018)

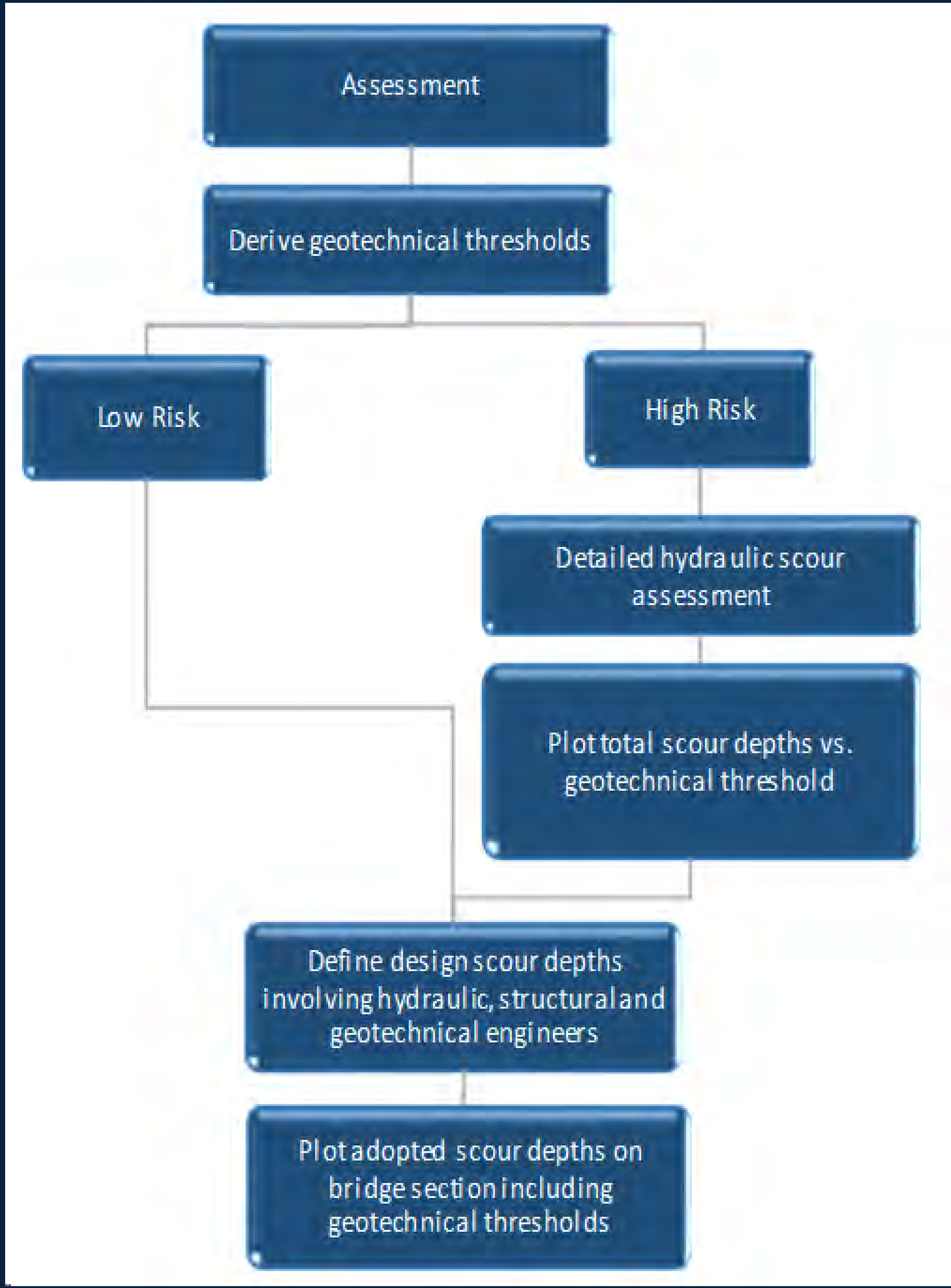
January 2019

Queensland Government

https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Bridge-scour-manual

Initial Assessment

- ❑ Evidence of previous scour at bridge.
- ❑ Steep streams or high velocities.
- ❑ Scour at substructure/soundness of the proposed type/depth.
- ❑ Experienced River Geomorphologist.
- ❑ Soil types and Standard Penetration Test required Interpretation requires RPEQ Geotechnical Engineer
- ❑ Low scour risk – Outside floodplain or founded on erosion resistant material.
- ❑ Founding material unknown - Detailed scour assessment.
- ❑ Total scour = General Scour + lateral/vertical contraction Scour + local abutment/pier scour



General Scour

- ❑ Aggradation/degradation
- ❑ Channel migration
- ❑ Scour at bends and confluences
- ❑ Some quantitative methods presented
- ❑ Specialist topic, experienced river geomorphologist input.

Diamantina Developmental Road crossing of the Georgina River during flood, Bedourie - Boulia, Western QLD

Contraction Scour

- ❑ Contraction scour/abutment scour traditionally treated independently.
- ❑ New method combining both processes is included. New method developed by the U.S National Cooperative Highway research program (NCHRP)
- ❑ Contraction scour in cohesive materials/erodible rock.
- ❑ 2D models instead of 1D HEC-RAS recommended to predict scour depths
- ❑ Pressure Flow (vertical contraction) scour included

Local scour at Abutments

- ❑ Traditionally very conservative.
- ❑ New method developed by the U.S National Cooperative Highway research program (NCHRP)
- ❑ Abutment scour computed using the NCHRP approach is total scour at the abutment and should not be added to contraction scour.
- ❑ Consideration of geotechnical/structural information at abutments.

Collards Creek Bridge 2 after Cyclone Marcia, February 2015

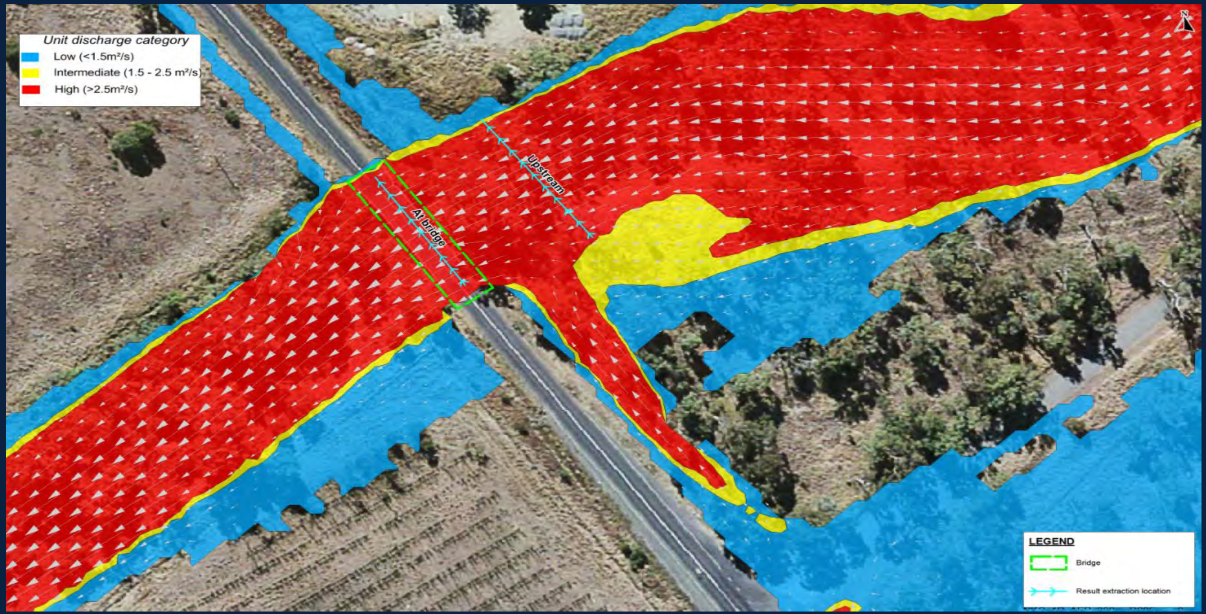
Local scour at Piers

- ❑ Live bed or clear water.
- ❑ HEC-18 (based on CSU equations).
- ❑ Alternative methods included (Melville, 2000).
- ❑ Scour at wide piers and complex piers foundations (Superposition and FDOT).
- ❑ Local scour in cohesive materials/ erodible rock (SRICOS-EFA).
- ❑ Consideration of geotechnical information at piers.

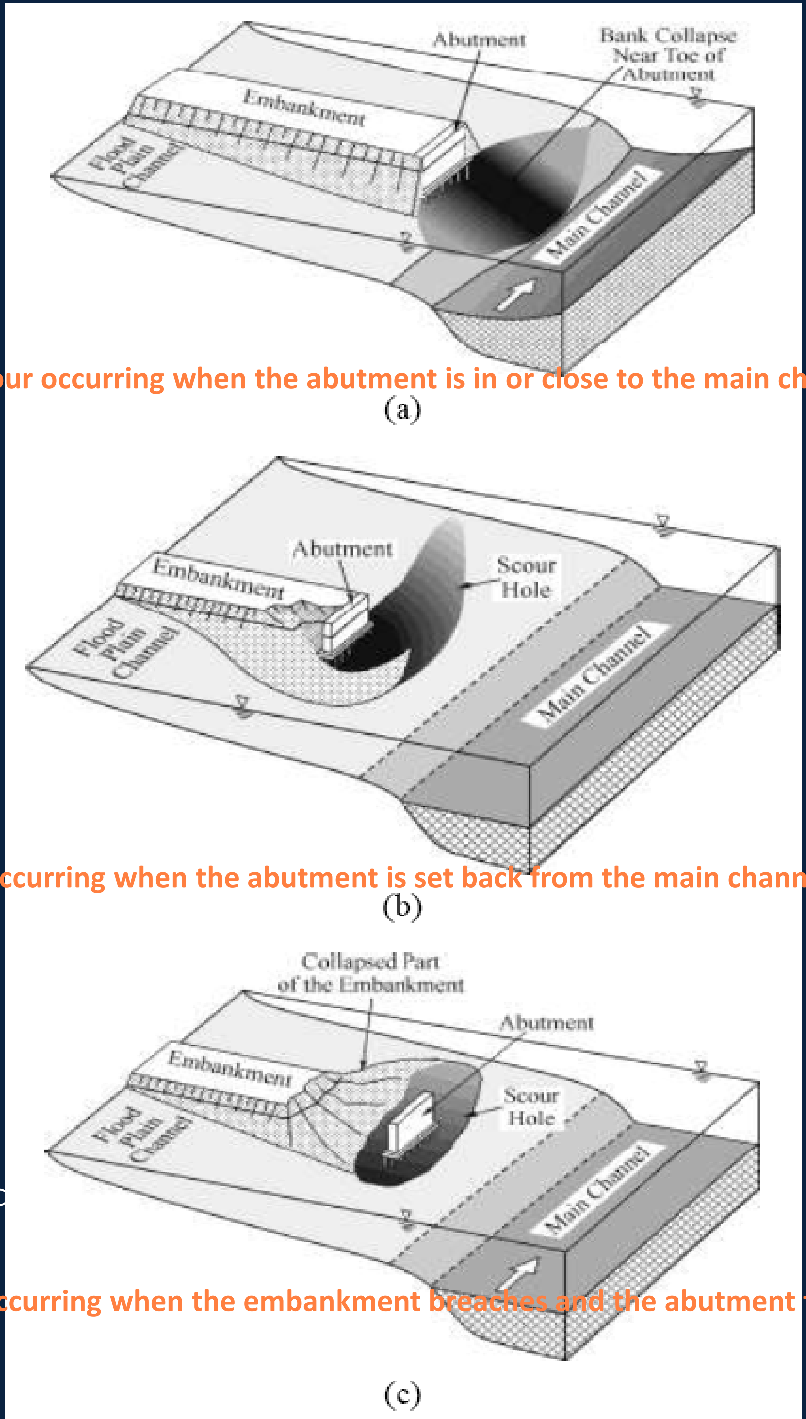
Collards Creek Bridge 5 after Cyclone Marcia, February 2015

Example

- ❑ Local Abutment Scour
- ❑ There are many uncertainties in determining the variables for abutment scour equations.
- ❑ Two-dimensional models provide better estimates of conveyance throughout the bridge opening than one-dimensional models, this is the recommended method.



Collards C



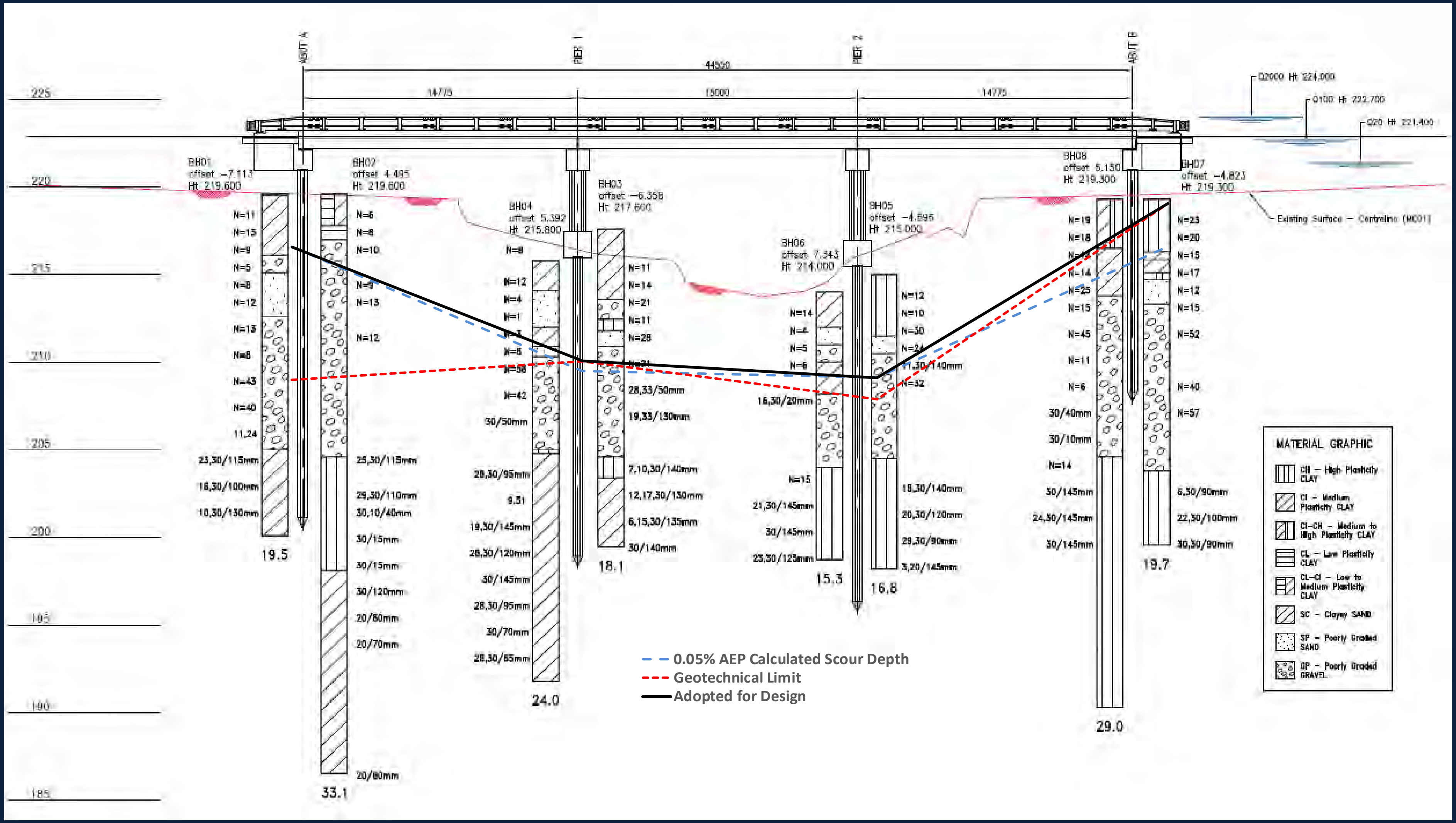
(a) scour occurring when the abutment is in or close to the main channel

(b) scour occurring when the abutment is set back from the main channel

(c) scour occurring when the embankment breaches and the abutment foundation acts as a pier

Example

- ❑ Scour profile at a bridge (including geotechnical thresholds)



Summary

- ❑ Multidisciplinary approach (structural/geotechnical and hydraulic engineers).
- ❑ Initial Risk assessment
- ❑ River geomorphologist input advisable for general/natural scour assessments.
- ❑ Geotechnical threshold based on material erodibility under bridge.
- ❑ In addition to the scour analysis conducted, an (RPEQ) geotechnical engineer shall be consulted when determining the maximum design scour depths at the bottom of the abutment headstock to use for bridge design.
- ❑ Cross-correlation with TMR's Australian and TMR's Bridge Design standards.
- ❑ 2D models are used on all but the simplest bridge crossings.
- ❑ Abutment scour computed using the NCHRP approach (combining contraction and abutment scour)
- ❑ Compute vertical contraction scour (if relevant)
- ❑ Design of piers for new bridges shall not rely on pier scour protection
- ❑ Bridge abutments shall be designed by taking into consideration possible scour determined by scour analysis.

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Thank you

Acknowledgements

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