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Developing a more accurate description of soil-pipe interaction for the design of high temperature pipelines

David White
Shell EMI Professor of Offshore Engineering

Fraser Bransby
Senior Principal Engineer, Fugro AG

SUT Evening Technical Meeting, Perth
10 June 2015

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Background references

- White D.J., Westgate Z., Ballard J-C, de Brier C. & Bransby M.F. 2015. Best practice geotechnical characterization and pipe-soil interaction analysis for HPHT flowline design. Proc. Offshore Technology Conference. Houston. OTC26026-MS
- Bransby, M.F., Borges Rodriguez, A., Zhou, H., Low, H.E. & White, D.J. 2014. Sediment mobility effects on seabed resistance for unburied pipelines. Proc. Offshore Technology Conference. Paper OTC25287
- Westgate Z.J. & White D.J. 2015. Quantifying spatial variability in pipeline embedment for subsea pipeline design. Proc. Int. Conf. Offshore Mech. and Arctic Engng. OMAE2015-42292
- White D.J., Leckie, S.H.F., Draper, S., Zakarian, E. 2015. Temporal changes in pipeline-seabed condition and their effect on operating behaviour. Proc. Int. Conf. Offshore Mech. and Arctic Engng. OMAE2015-42216
- Leckie, S., Draper, S., White, D.J., Cheng, L. & Fogliani N. 2015. Lifelong embedment and spanning of a pipeline on a mobile seabed. Coastal Engineering. 95:130-146.
- Hill A. & White D.J. 2015. Pipe-soil interaction: Recent and future improvements in practice. Proc. Int. Symp. on Frontiers in Offshore Geotechnics (ISFOG).

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Unravelling PSI design ranges

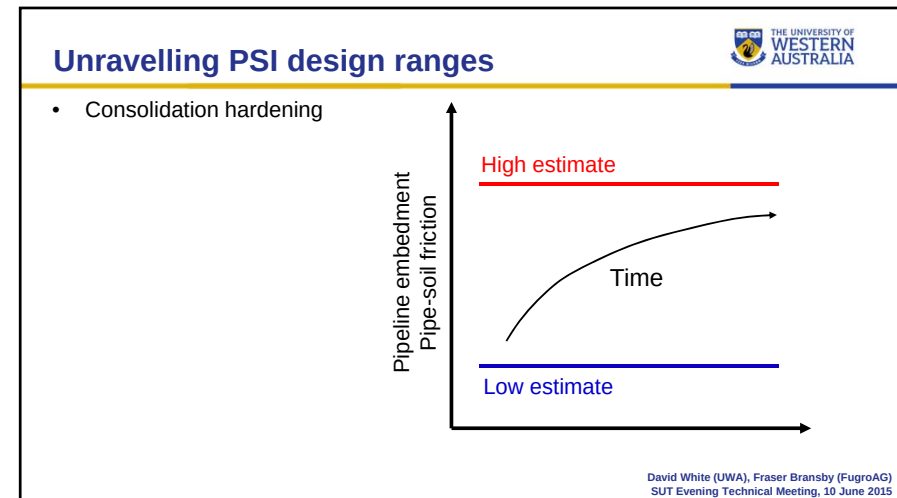
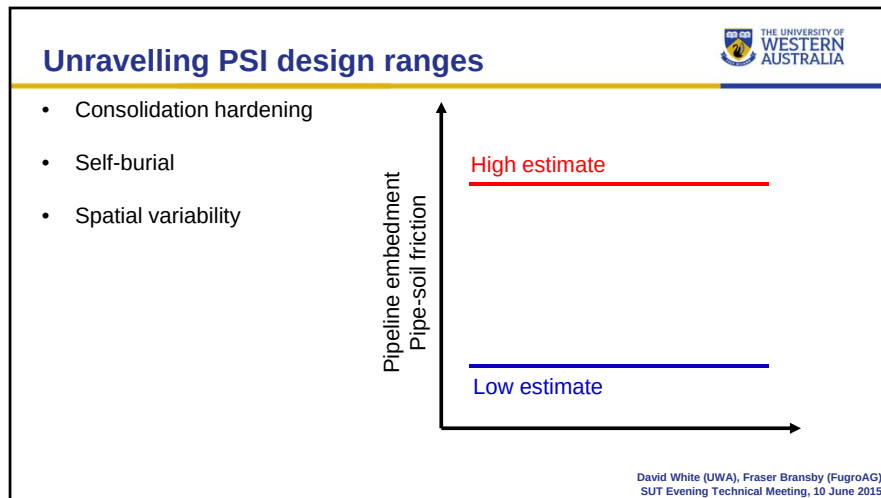
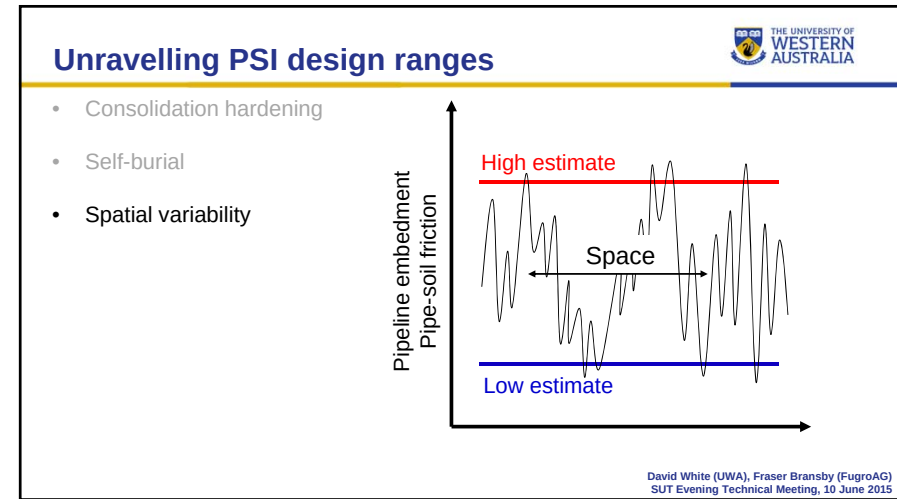
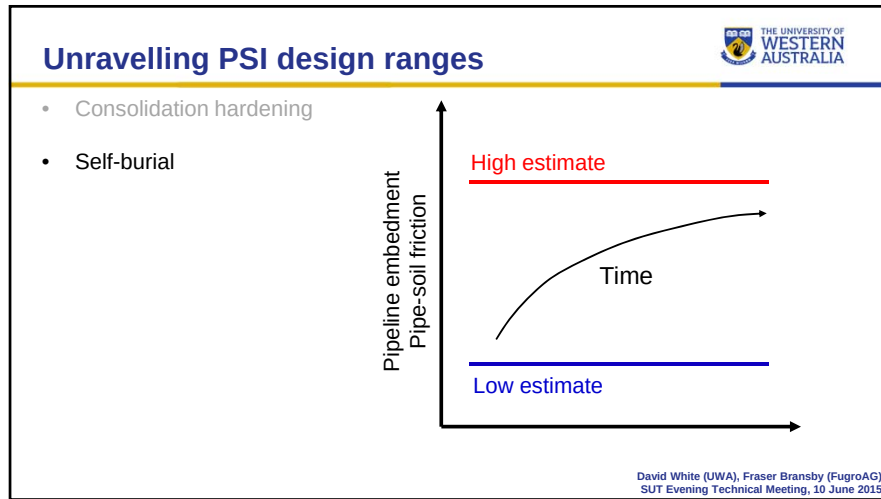
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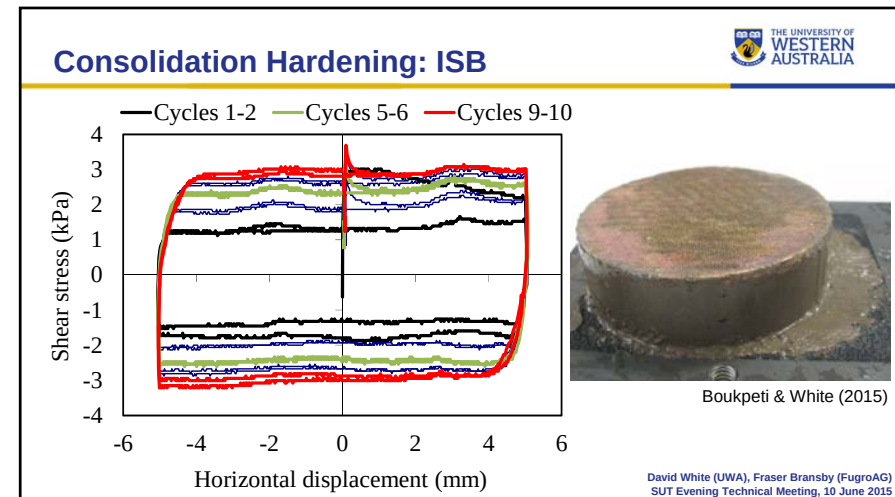
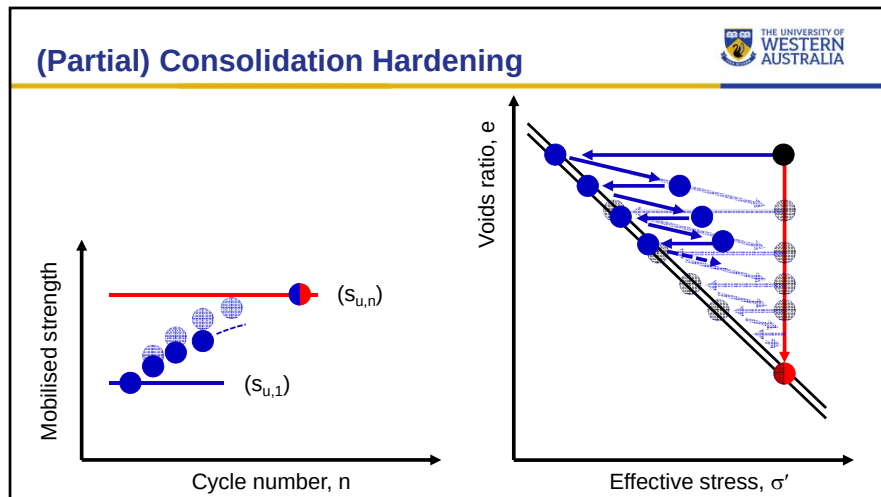
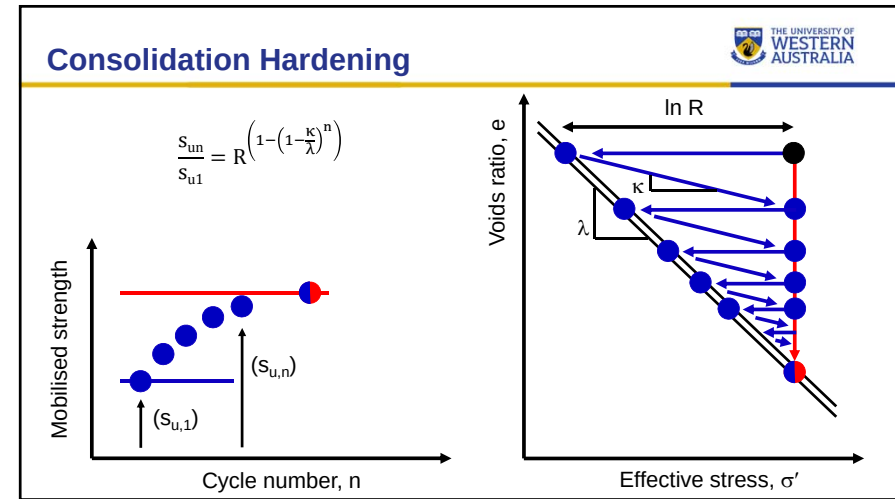
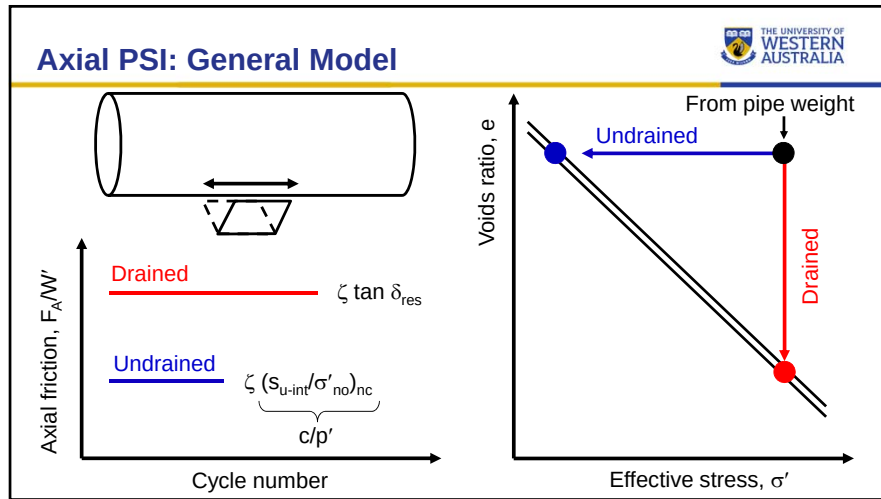
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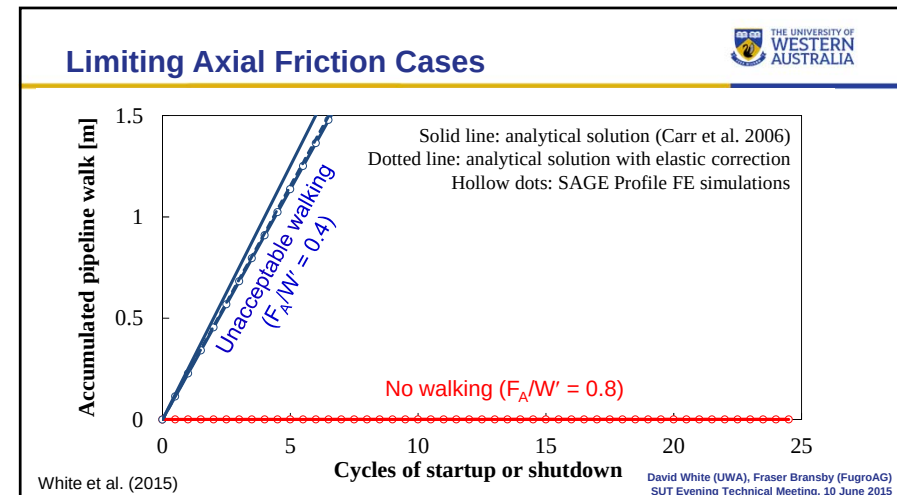
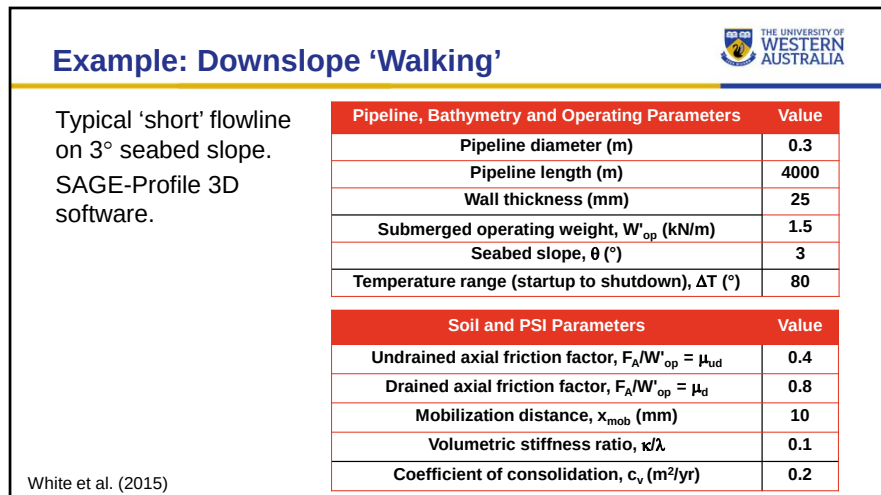
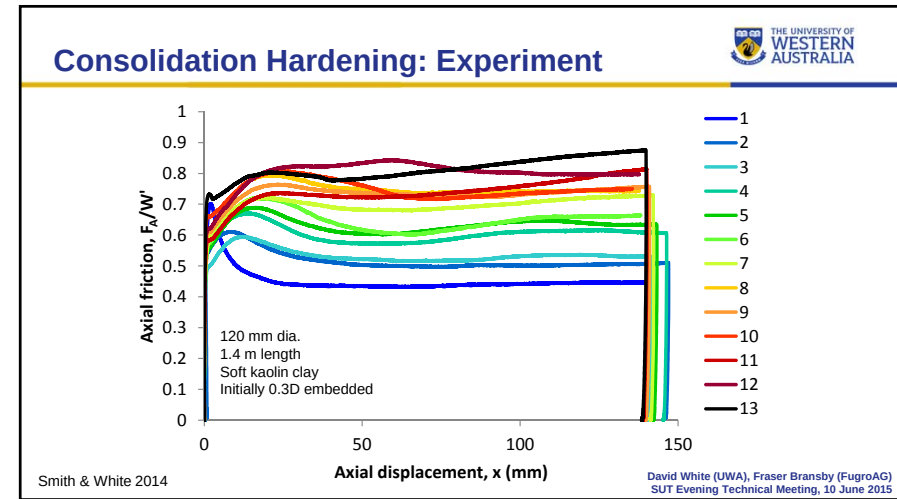
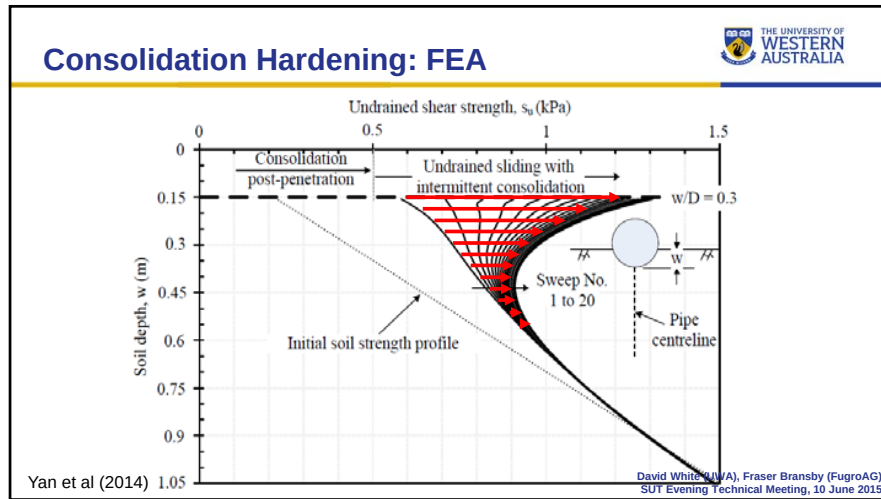
Unravelling PSI design ranges

- Consolidation hardening

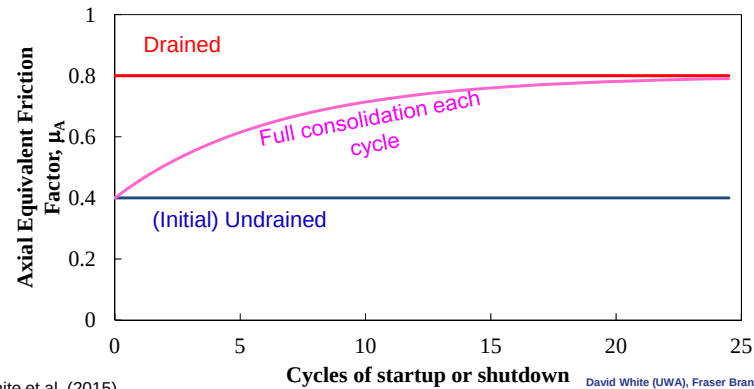
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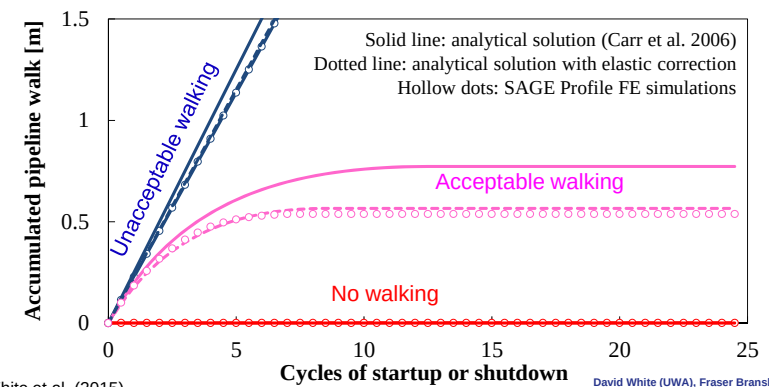
With Consolidation Hardening



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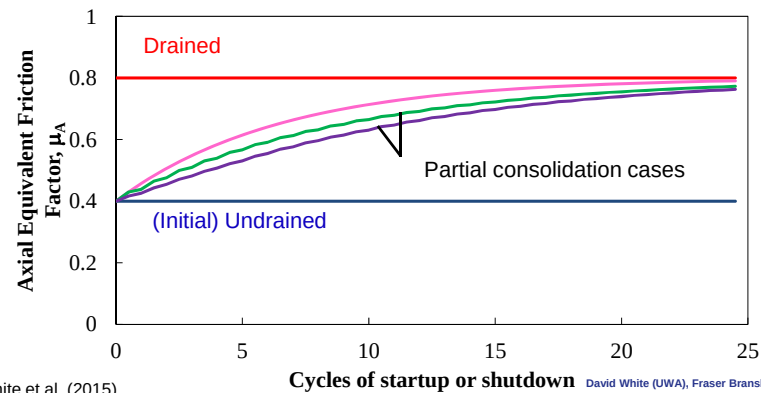
With Consolidation Hardening



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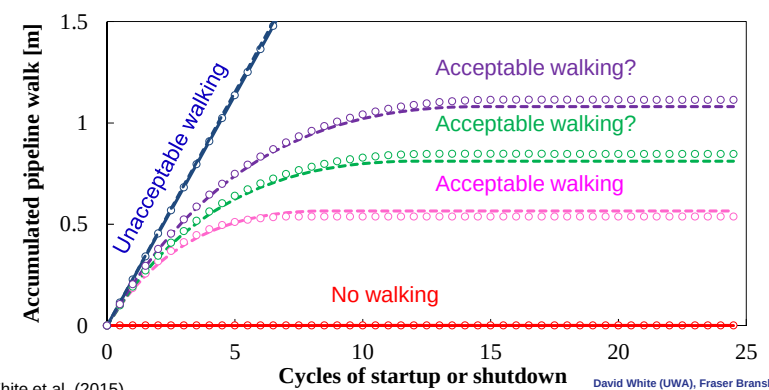
Friction With Operational Effects



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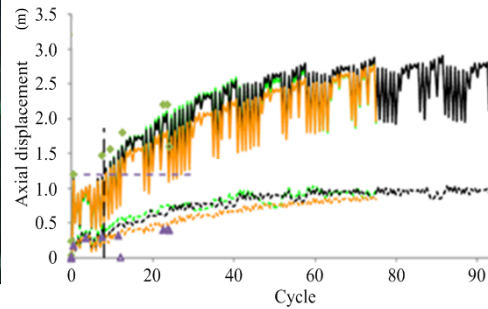
Range of Walking Responses



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Consolidation Hardening: Field?



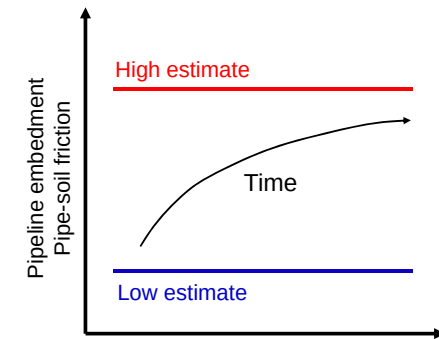
Hill & White (2015)

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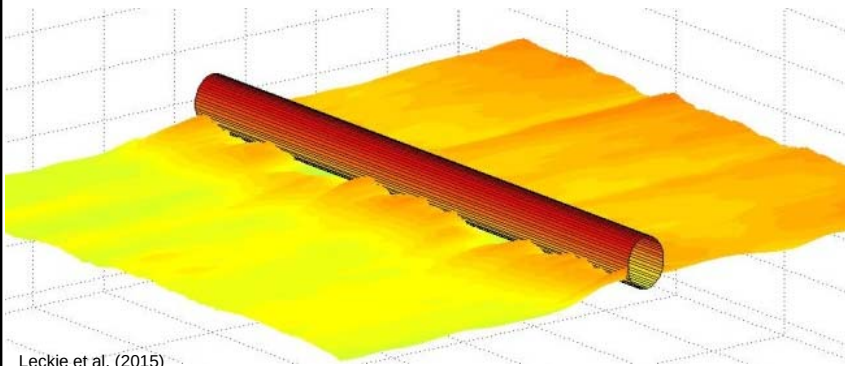


- Consolidation hardening
- Self-burial



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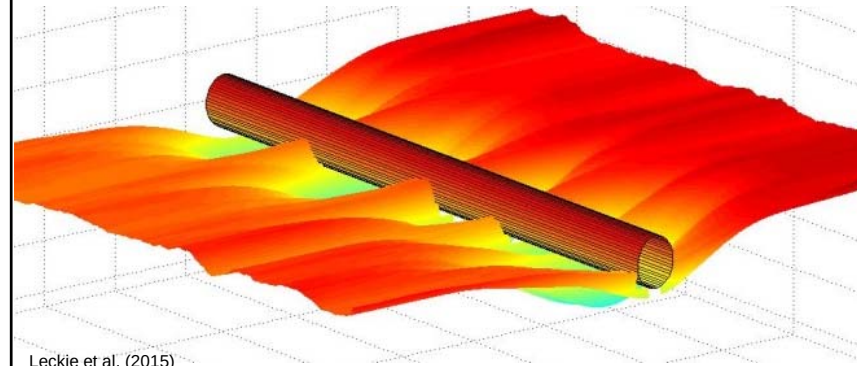
As-laid condition



Leckie et al. (2015)

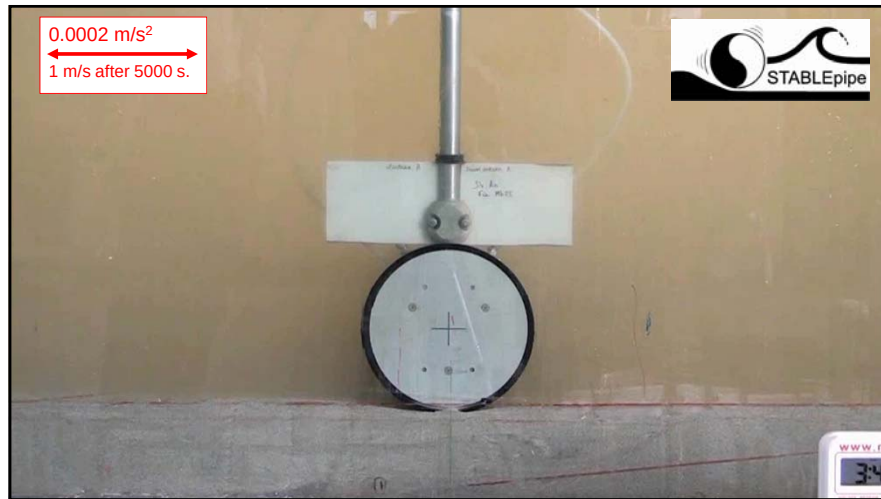
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Intermittent self-burial and spanning

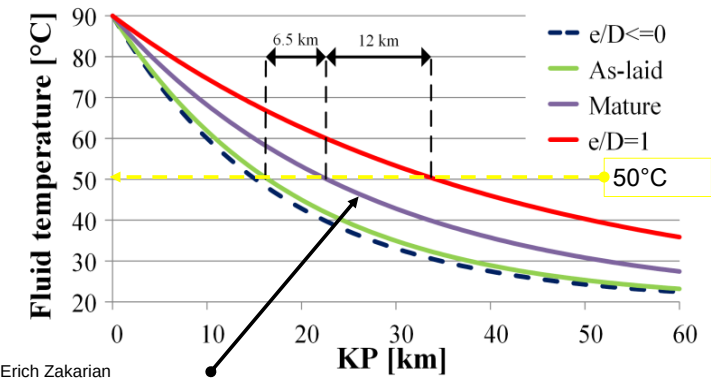


Leckie et al. (2015)

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Impact on temperature profile

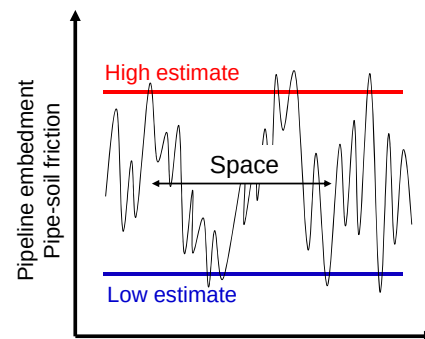


Simon Leckie, Erich Zakarian
OMAE 2015-42216

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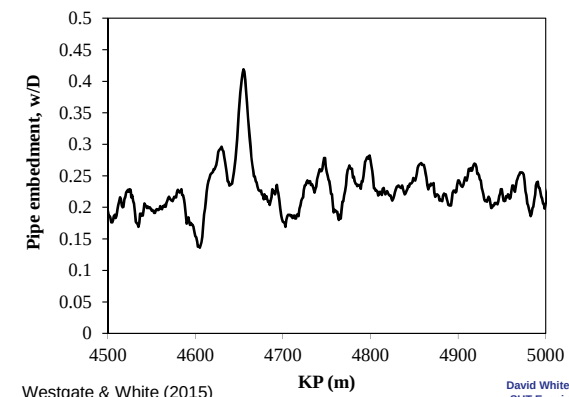
Unravelling PSI design ranges

- Consolidation hardening
- Self-burial
- Spatial variability



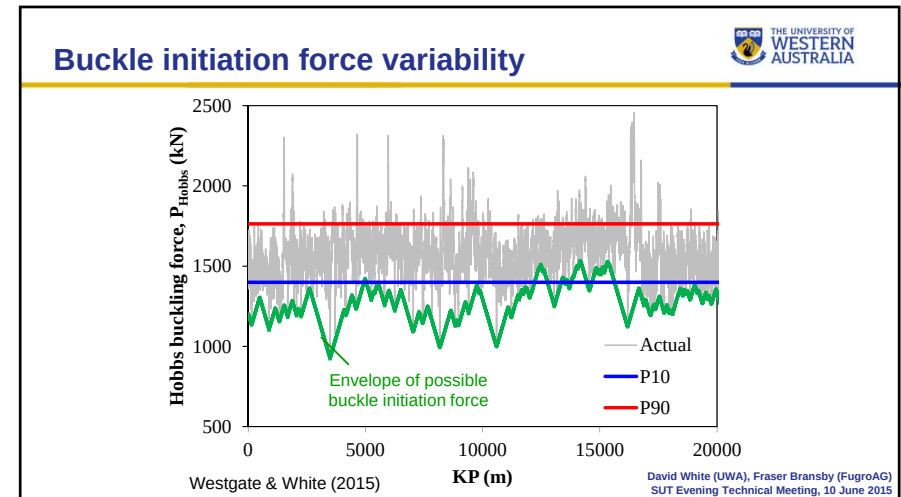
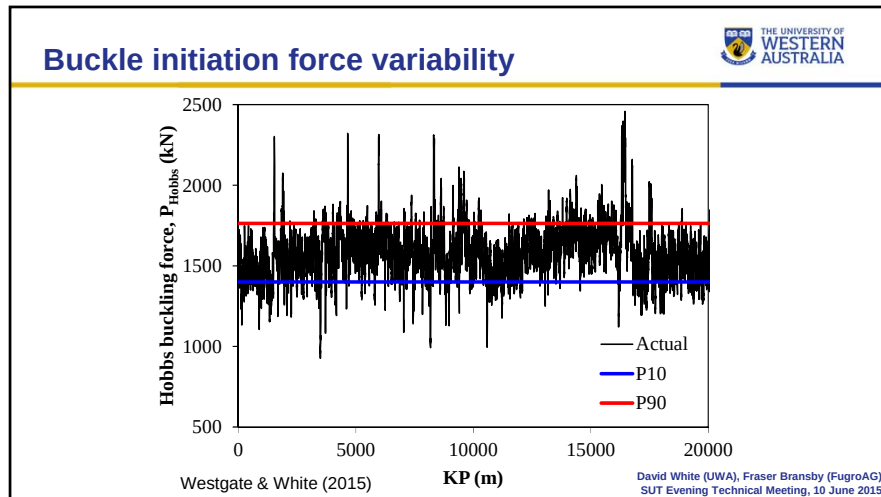
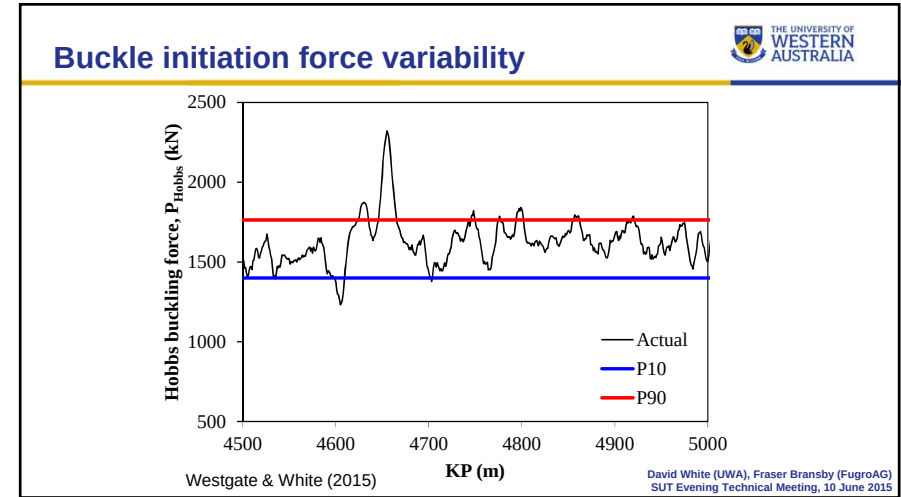
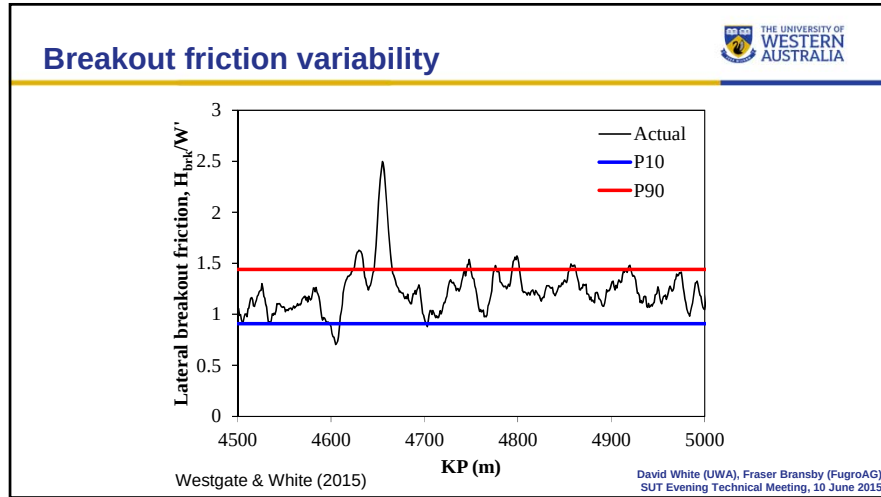
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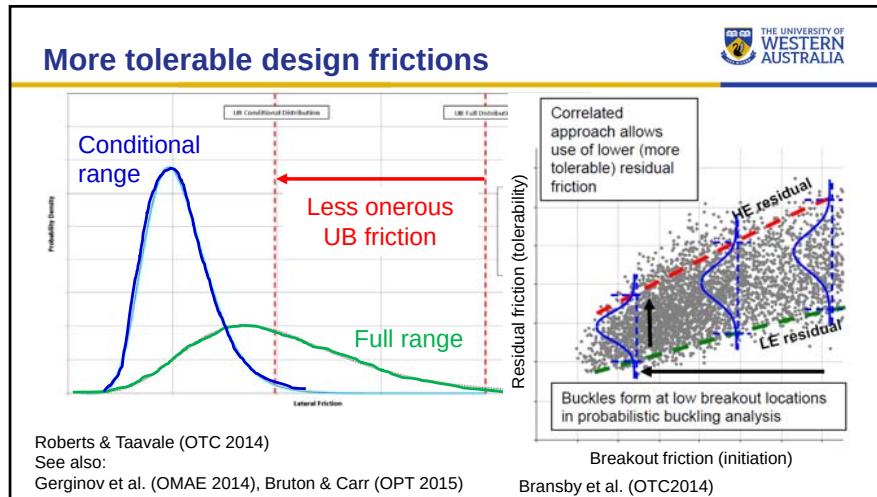
Pipeline embedment variability



Westgate & White (2015)

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- ### Concluding comments
- Design pipe-soil friction ranges mask temporal and spatial effects
 - Consolidation hardening – rise in axial friction
 - Potential reduction in pipeline walking
 - Self-burial – increase in thermal insulation and stability
 - Potential improvement in corrosion and/or flow assurance
 - Potential reduction in (secondary) stabilisation measures
 - Spatial variability
 - Less onerous buckling design via better PSI characterisation
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