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MANAGING POST-FIRE SOIL EROSION IN THE SOUTHERN MOUNT LOFTY RANGES

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Abstract

Post-fire soil erosion is a great concern to land managers due to the potential adverse effects on water quality, the alteration to soil profiles and the detrimental impacts on human communities. To reduce the potential adverse effects of post-fire erosion mitigation actions have been instigated following severe wildfires. Various programs of prescribed burning have been initiated to reduce the risk of wildfires. In order to predict and manage post-fire erosion a clear understanding is needed of the influential environmental variables, associated processes and whether mitigation actions will be effective. In the Southern Mount Lofty Ranges there is a paucity of post-fire erosion data from which to generate evidence-based predictive models and management recommendations.

This thesis has the overarching goal of developing evidence-based options for managing post-fire sediment movement in the Southern Mount Lofty Ranges. Evidence-based management of sediment movement from both prescribed fire and wildfire can reduce potential erosion and hence protect regional natural services such as soil profile formation, soil mineral health, the regulation of water quality and maintenance of local landscape character. A case study of the Southern Mount Lofty Ranges is used to produce evidence-based options for managing post-fire erosion in relation to a wildfire at Mount Bold and ten prescribed burns conducted within the Southern Mount Lofty Ranges. Field techniques included visual erosion assessments, erosion pins, terrestrial laser scanning, digital close range photogrammetry and sediment traps. Experiments were designed to incorporate the spatial differences within the topography. Regression modelling was used to analyse environmental variables that influence post-fire sediment movement.

Erosion assessments indicated that after prescribed burning sediment movement occurred in 52% of the burnt areas compared to only 4% in the unburnt areas, however magnitude of movement was only minor. Fire severity was the most influential variable in generating sediment movement after prescribed burning. In contrast slope steepness was the most influential environmental variable in relation to the magnitude of erosion after the 2007 wildfire at Mount Bold. After a 1 in 5 year rainfall event hay-bale sediment barriers will reduce but not prevent post-fire charcoal-rich sediment and debris reaching water reservoirs.

Managing soil erosion in the post-fire landscape requires an appreciation of the influencing environmental variables and the available mitigation options. This thesis highlights the importance of recognising the spatial variability of the topography when managing post-fire erosion. A suite of environmental variables including fire severity, rainfall, aspect, bioturbation, slope length, slope angle and cross-slope curvature need consideration when predicting the occurrence of sediment movement following prescribed fire. Mitigation actions to minimise the adverse effects of post-fire erosion need to take account of rainfall intensity, fire severity and topographical influences. Management of post-fire soil erosion in the Southern Mount Lofty Ranges also needs a recognition of the potential influence on regional natural services including soil profile formation, regulating water quality and maintaining local landscape character.

Contents

ABSTRACT	iii
TABLE OF CONTENTS	v
DECLARATION	viii
PUBLICATIONS AND COPYRIGHT DETAILS	ix
ACKNOWLEDGEMENTS	xii
CHAPTER 1 INTRODUCTION	1
1.1 Purpose for the research	3
1.1.1 Erosion and natural services	3
1.1.2 Erosion from wildfires	4
1.1.3 Erosion from prescribed fire	5
1.1.4 Managing post-fire erosion	7
1.1.5 Southern Mount Lofty Ranges case study	10
1.1.6 Evidence-based management	15
1.1.7 Summary	17
1.2 Aims	18
1.3 Structure of the thesis	19
1.4 References (Chapter 1)	21
CHAPTER 2 COMPARISON OF POST-FIRE SOIL	
EROSION ASSESSMENT METHODS	29
2.1 Copyright details	31
2.2 Statement of contributions	31
CHAPTER 3 SOIL EROSION FOLLOWING PRESCRIBED	
BURNING	53
3.1 Copyright details	55
3.2 Statement of contributions	55
CHAPTER 4 SEDIMENT TRAPPING AFTER A WILDFIRE	
AT MOUNT BOLD	91
4.1 Copyright details	93
4.2 Statement of contributions	93

CHAPTER 5 SOIL EROSION AND MITIGATION AFTER THE MOUNT BOLD WILDFIRE	109
5.1 Copyright details	111
5.2 Statement of contributions	111
CHAPTER 6 DISCUSSION AND CONCLUSION	125
6.1 Overall significance and contribution to knowledge	127
6.1.1 Soil profile formation and soil mineral health	129
6.1.2 Water quality	130
6.1.3 General landscape character	131
6.2 Problems encountered	132
6.3 Future direction of the work	135
6.4 Evidence-based management of post-fire erosion	137
6.5 Conclusion	138
6.6 References (Chapter 6)	139
APPENDICES	143
APPENDIX A HOLOCENE PALAEOFIRE	145
A1 Copyright details	147
A2 Statement of contribution	147
APPENDIX B EMERGENCY RESPONSE	165
B1 Copyright details	167
B2 Statement of contribution	167
APPENDIX C CONFERENCE POSTERS	181
C1 Managing soil erosion in the Southern Mount Lofty Ranges	183
C2 The dirt on assessing post-fire erosion	184
C3 Prescribed burning and sediment movement	185
C4 Does an emergency response protect our water reservoirs?	186
C5 Terrestrial laser scanning and sediment movement	187
C6 Trapping sediment following bushfire at Mount Bold	188
C7 Laser scanning of sediment movement after bushfire	189

APPENDIX D FIRE NOTE AND CASE STUDY	191
D1 Fire note: Protecting our water reservoirs with sediment traps	193
D2 Case study: Measuring sediment movement	197

Declaration

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Publications and copyright details

Journal papers

Buckman S, Brownlie KC, Bourman RP, Murray-Wallace CV, **Morris RH**, Lachlan TJ, Roberts RG, Arnold LJ, Cann JH (2009) Holocene palaeofire records in a high-level, proximal valley-fill (Wilson Bog), Mount Lofty Ranges, South Australia. *Holocene* **19**, 1017-1029. doi: 10.1177/0959683609340998

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Refereed conference papers

Morris R, Buckman S, Connelly P, Dragovich D, Ostendorf B, Bradstock R (2011) The dirt on assessing post-fire erosion in the Mount Lofty Ranges: comparing methods. In Thornton RP (Ed) 2011 'Proceedings of Bushfire CRC and AFAC 2011 Conference Science Day' 1 September 2011, Sydney, Australia, 152-169. (Bushfire CRC: Melbourne)

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Morris R, Calliss S, Frizenschaf J, Blason M, Dragovich D, Henderson M, Ostendorf B (2008) Controlling sediment movement following bushfire - a case study in managing water quality, Mount Bold, South Australia. In Lambert M, Daniell T, Leonard M (Eds) 'Proceedings, Water Down Under 2008 Conference, incorporating 31st Hydrology and Water Resources Symposium and 4th International Conference on Water Resources and Environment Research' 14-17 April 2008, Adelaide, Australia, 1937-1947. (Engineers Australia: Modbury)

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Morris R, Dragovich D, Ostendorf B (2012) Hillslope erosion and post-fire sediment trapping at Mount Bold, South Australia. In Stone M, Collins A, Martin T (Eds) 'Wildfire and water quality: processes, impacts and challenges' Banff, Canada, 11–14 June 2012. *IAHS Publication* 354, 42-50. (IAHS Publication: Oxfordshire)

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Conference proceeding

Morris R, Calliss S (2009) Does an emergency response protect our water reservoirs? In 'AFAC 2009 Conference Meeting Expectations' 21-24 Sept 2009, Surfers Paradise, Australia, 595-600. (AFAC: Melbourne)

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Conference posters

Morris R, Bradstock B, Dragovich D, Ostendorf B (2012) Managing soil erosion in the Mount Lofty Ranges, South Australia. AFAC/Bushfire CRC 2012 conference 'Diverse country, common ground' 28-31 August, Perth, WA, Australia.

Morris R (2011) The dirt on assessing post-fire erosion. AFAC/Bushfire CRC 2011 conference 'New world, new thinking' 29 August – 1 September 2011, Sydney, NSW, Australia.

Morris R, Bradstock B, Dragovich D, Henderson M, Ostendorf B (2010) Prescribed burning and sediment movement in the Mount Lofty Ranges, AFAC/Bushfire CRC 2010 conference 'Same, same, but different – learning lessons in a changing world' 8-10 September 2010, Darwin, NT, Australia.

Morris R, Calliss S (2009) Does an emergency response protect our water reservoirs? AFAC 2009, 'Meeting expectations' 22-25 September 2009 Gold Coast, QLD, Australia.

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Morris R, Dragovich D, Henderson M, Moncrieff J, Ostendorf B (2007) 3D laser scanning of sediment movement following bushfire at Mount Bold Reservoir. AFAC/Bushfire CRC 2007 conference 19-21 September 2007 Hobart, TAS, Australia.

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Fire note and case study

Fire Note

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Case study

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