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Landslide Risk Management



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A NATIONAL LANDSLIDE RISK MANAGEMENT FRAMEWORK FOR AUSTRALIA

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SYNOPSIS

The Australian Geomechanics Society (AGS) is publishing a series of benchmark guidelines on Landslide Risk Management (LRM) and slope management and maintenance. This is a continued recognition by AGS of the benefits of risk based systems in managing landslide hazards. This paper provides an introduction to the LRM guidelines that have been developed under the National Disaster Funding Program (NDMP) - with the aim of managing the risk to occupants and property from landslide hazards. These guidelines are tools that can be introduced into the legislative framework of Australian governments at National, State and Local levels and to thereby promote appropriate use of land in recognition that it is a valuable resource which should be developed on its merit.

1 INTRODUCTION

There have been a number of technical developments and legislation changes in Australia which have presented the opportunity for the development of a national landslide risk management strategy, as discussed by Leventhal & Walker (2005, 2005a).

The continuing need for residential development in all major cities and coastal areas means that increasingly such development will occur in areas previously considered too hazardous for development. Hence, there is an increased likelihood for damage to property and loss of life from landslide. Given the nature of State legislation on planning and development, there is a requirement for Councils to consider a range of planning and development issues for each Development Application and one such issue is whether the area of a proposed development is subject to instability. This is in the context that: (i) slope instability occurs in many parts of urban and rural Australia and (ii) it has been estimated that virtually every Local Government Area (LGA) in Australia has landslide hazards of one form or another.

2 NATIONAL DISASTER MITIGATION PROGRAM

In 2003, the Australian Government introduced the National Disaster Mitigation Program (NDMP) to fund disaster mitigation, addressing hazards such as flooding, bushfire and landslides. Governments throughout Australia recognised the risks posed to property and life from landslides.

AGS has recognised these risks for over 30 years and has developed guidelines for landslide risk management - as it is now known - in 1985, 2000 and 2002. However, it was recognised that there were limitations to these guidelines, that there was a need to develop them further and to complement them with additional advice.

In view of this, AGS and representatives from Local Governments sought funding assistance for the development of three guidelines under the 2004-2005 National Disaster Mitigation Program. Funding assistance for landslide likelihood research was also sought from NDMP under the 2003-2004 funding round.

AGS successfully obtained assistance under the NDMP for three projects dealing with landslide risk management:

- i) landslide likelihood research;
- ii) development of two guidelines - one for landslide zoning, and another for slope management and maintenance (the latter now known as the Australian GeoGuides) and
- iii) development of a practice note.

In addition to the guidelines, two commentaries have been developed to provide further explanation to the Landslide Zoning guideline and the Practice Note. The guidelines, their accompanying commentaries, Australian GeoGuides and technical papers are listed in Table 1. They have been cited consistently in this manner throughout this issue of *Australian Geomechanics*.

The activities have been conducted under the authority of the AGS National Committee and have been subjected to extensive peer review.

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Table 1: NDMP LRM guidelines, commentaries and papers.

Guideline Title	Abbreviated Title	Reference	Intended Users
“Guideline for landslide susceptibility, hazard and risk zoning for land use planning”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	Landslide Zoning Guideline	AGS (2007a)	Regulators, Geotechnical Practitioners
“Commentary on guideline for landslide susceptibility, hazard and risk zoning for land use planning”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	Commentary on Landslide Zoning Guideline	AGS (2007b)	As above
“Practice Note guidelines for landslide risk management”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	Practice Note 2007	AGS (2007c)	Geotechnical Practitioners, Regulators
“Commentary on Practice Note guidelines for landslide risk management”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	Practice Note Commentary	AGS (2007d)	As above
“Australian GeoGuides for slope management and maintenance”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	Australian GeoGuides	AGS (2007e).	General Public, Regulators, Geotechnical Practitioners
“Landslide likelihood in the Pittwater Local Government Area”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	PWC Landslide Likelihood Research	MacGregor <i>et al.</i> , 2007	Geotechnical Practitioners
“Rainfall Data Analysis and Relation to the Incidence of Landsliding at Newport”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	PWC Rainfall Statistics	Walker (2007)	Geotechnical Practitioners
“An assessment of rockfall frequency for the coastal cliff-lines of Pittwater local government area, Sydney”, <i>Australian Geomechanics</i> , Vol 42 No 1, March 2007.	PWC Coastline Rockfall Likelihood	Kotze (2007).	Geotechnical Practitioners

3 DETAILS OF THE PROCESS OF DEVELOPMENT

Landslide Likelihood Research

Under the 2003-2004 NDMP funding round, research was undertaken into landslide likelihood in the Pittwater Council local government area. The objective of the research was to ascertain historic frequencies of landsliding which could be used to assist in estimating landslide hazard and risks within the study area.

Pittwater Council was the sponsoring agency as it is situated within a geotechnical setting prone to landsliding and the Council area has experienced several significant house-block-sized landslides which have demolished and damaged houses. Records held by Pittwater Council (which are public documents) were used as base data for the study. The outcomes from this study are presented by MacGregor *et al.* (2007), Walker (2007) and Kotze (2007).

Landslide Taskforce Guidelines and Australian GeoGuides

The development of three guidelines was funded under the 2004-2005 NDMP funding round. This application was sponsored by the Sydney Coastal Councils Group (SCCG) with Mosman Council, a northern Sydney Council, as the lead agency representing the SCCG in this project. For convenience use has been made of the name “Landslide Taskforce”.

The Landslide Zoning Guideline provides guidance in the methods of Landslide Zoning to government regulators (officers of local government and state government instrumentalities) and geotechnical practitioners. Such characterisation will provide input to the planning process in areas of landslide hazard.

The Practice Note Guideline provides guidance both to practitioners in the performance of project specific landslide risk assessment and management, and also to government officers in interpretation of the reports they receive. The Practice Note can be used as an external reference document for legislative requirements and supersedes the recognised industry "standard" on LRM in Australia – AGS (2000). AGS (2000) remains as a complementary commentary and reference document. The Practice Note will provide uniformity in the quality of assessment and reporting and so will promote confidence in the planning and risk management process in regard to landslide hazards.

The Practice Note provides: (i) a revised risk to property matrix to address shortcomings identified in usage; (ii) recommendation for the adoption of tolerable risk criteria for risk to life; (iii) the introduction of Importance Levels and linked tolerable risk criteria for risk to property; (iv) the introduction of a suite of model sign-off forms, linked to recommendations from risk assessments, to improve the linkages between assessment, design and construction; (v)

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further explanation of the risk equation and method of calculation, together with further examples and references and (vi) guidance on the contents of a LRM report.x

The Australian GeoGuides for slope management and maintenance provide owners, occupiers and therefore the public in the broader sense with guidance on management and maintenance of properties subject to landslide hazard.

The guidelines and Australian GeoGuides benefit the general community and Local Government regulators through achieving safer, more sustainable communities in relation to their exposure to landslide risk and reduce risk to the community through improved planning and slope management practices – key requisites of the NDMP funding. These guidelines will link with the risk management practices presented in AGS (2000) – enhanced by the Practice Note - and the BCA Guideline (2006) and will provide long-term natural disaster mitigation benefits to housing and infrastructure.

Development and Review Process

A Working Group was established for development of each of the guidelines as well as for development of the Practice Note. All Working Groups report to a Steering Committee which consists of a representative of AGS, the SCCG as the sponsoring agency and the convenors of each of the Working Groups. The convener of each working group is the principal author of that group's guideline. Review was provided by the members of the Steering Committee, the Landslide Taskforce - which consists of 16 practitioners (engineering geologists and geotechnical engineers) and regulators from across the nation. Membership of the Landslide Taskforce did not preclude membership of a working group.



NDMP Landslide Taskforce at their Workshop held in Sydney on 21 September 2005:

(L to R) Andrew Leventhal (chair), Angus Gordon, Arthur Love, Robin Fell (Hazard Zoning working group convener), Grahame Wilson, Fiona MacGregor, Ralph Rallings, Max Ervin, John Braybrooke, Grant Murray, Warwick Davies, Peter Tobin, Alex Litwinowicz, Ian Stewart, Mark Eggers, Greg Kotze, Garry Mostyn, Garth Powell, Tony Phillips (Slope Management working group convener), Bruce Walker (Practice Note convener), Tony Miner, Graham Whitt, Geoff Withycombe (Sydney Coastal Councils Group), Henk Buys.

The SCCG established an External Observer Group to provide nationwide perspective for the SCCG Expert Group. The members of the External Observer Group include managers of federal and state government departments and local government areas responsible for coastal processes throughout the nation.

A peer review process for the guidelines was implemented by the AGS National Committee. Additionally, specific independent technical external review was also established by the Steering Committee. The Expert Panel of the SCCG and the nationwide External Observer Group established by the SCCG each also conducted reviews in regard to planning issues.

The output from the studies are nationally endorsed by AGS as guidelines.

An international Landslide Zoning guideline is being developed under the auspices of JTC-1, the Joint Technical Committee on Landslides and Engineered Slopes established by the ISSMGE, the ISRM and the IAEG. This included an international workshop held in Barcelona in 2006 which was attended by two members of the projects' Steering Committee. The Australian draft of the guideline at that time was used as the initial draft for the international version. Both versions have benefited from review by each group and are similar in their final forms. The international guideline will be published later this year in the international journal, *Engineering Geology*.

4 HOW DOES THIS ALL FIT TOGETHER?

Figure 1 shows the flowchart for LRM as promoted in AGS (2000), which includes brief descriptions of the tasks involved. An abbreviated version is provided in Figure 2 – see also the Landslide Zoning Guideline (AGS, 2007a) and the Practice Note (AGS, 2007c) which also present this flow diagram. Figure 3 demonstrates how the Landslide Zoning (AGS, 2007a), the Practice Note (AGS, 2007c) and the Australian GeoGuides (AGS, 2007e) fit into the framework.

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Figure 3 demonstrates how:

- 1) The technical basis is provided by AGS (2000), and that AGS (2000) is now complemented by AGS (2007c).
- 2) The Building Code of Australia guideline (2006) provides an overarching legislative requirement. Note that the current version of this document requires revision to agree with the outcomes from these NDMP projects.
- 3) Implementation of policies at state and local government levels that are universal and uniform will be beneficial to all participants.
- 4) Landslide zoning guidelines are provided by the Landslide Susceptibility, Hazard and Risk guideline and its commentary (AGS, 2007a and 2007b).
- 5) Landslide likelihood research provides some fundamental data as an example of a starting point for semi-quantitative or quantitative assessments (MacGregor *et al* 2007, Walker 2007 and Kotze, 2007).
- 6) The Practice Note and its commentary (AGS, 2007c and 2007d) provide guidance on the process and minimum requirements for conducting a landslide risk assessment and supersede AGS (2000).
- 7) Slope management principles are provided for the owner and occupier through the Australian GeoGuides (AGS, 2007e).
- 8) Technical competence of practitioners can be demonstrated through the specific area of practice within NPER.

The framework diagram in Figure 3 shows the inter-relationship between each of those elements and the benefits of them in their entirety to complete a systematic and defensible risk management process throughout Australia.

Figure 4 provides an indication of the manner in which the investigation phases of the LRM process could interact and Figure 5 similarly indicates the design and verification stages of a LRM project.

5 WHAT ARE THE NATIONAL BENEFITS?

The Australian Geomechanics Society has established a framework for conducting LRM within a defensible and rigorous set of guidelines and legislative requirements. There is now clear guidance both to the regulator and the practitioner and a consistent approach can be adopted notwithstanding that there will be different drivers and various planning schemes throughout the nation.

The Steering Committee of the Landslide Taskforce believes AGS has made a contribution to the wellbeing of the Australian people, and perhaps to the broader international community.

6 ACKNOWLEDGEMENT

The projects have been conducted with the assistance of NDMP funding. The contribution from the Commonwealth Government, NSW State Government and our sponsors at local government level is recognised.

The support of our sponsors – Pittwater Council and the Sydney Coastal Councils Group – has benefited the development of the projects through their awareness of the needs for the project outcomes and enthusiasm and cooperation to achieve them.

The members of the AGS National Committee are acknowledged for their support during the projects and the peer review of the Landslide Taskforce guidelines that they conducted. Independent peer reviews of those guidelines were conducted by Chris Haberfield, Paul Hardie and Colin Mazengarb and this is gratefully acknowledged.

The developments that have been achieved thus far are the result of the endeavours of many. Without the input of various steering and working groups development of the current status of the guidelines and framework would not have been possible. A list of the contributors to these NDMP projects is presented in the Appendix and their contribution is gratefully acknowledged by the Steering Committee.

It should be appreciated that many of those listed in the Appendix have contributed to this endeavour for a period of over 20 years. That contribution is respectfully noted. The list of employers who have provided support over those years is equally lengthy and their support in these endeavours is also gratefully acknowledged.

Amongst the many, it is important to recognise the particular contribution of the convenors of the Working Groups in this current task, who were responsible as principle authors for the Guideline documents developed under the NDMP Landslide Taskforce:

Robin Fell (Landslide Zoning);
Bruce Walker (Practice Note) and
Tony Phillips (GeoGuides).

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7 REFERENCES

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LANDSLIDE RISK ASSESSMENT & MANAGEMENT

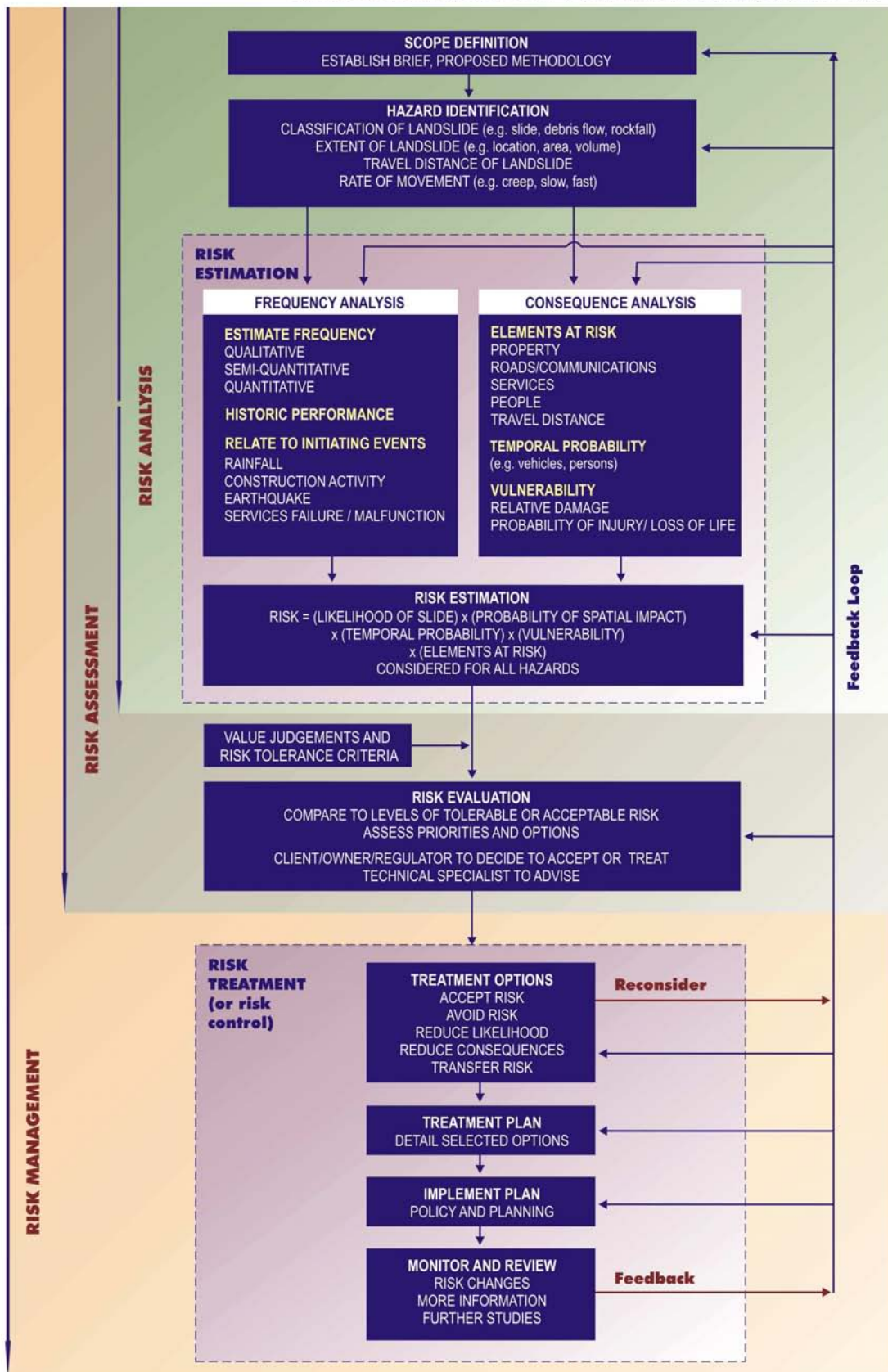


Figure 1: Flowchart for Landslide Risk Management (after AGS 2000).

FRAMEWORK FOR LANDSLIDE RISK MANAGEMENT

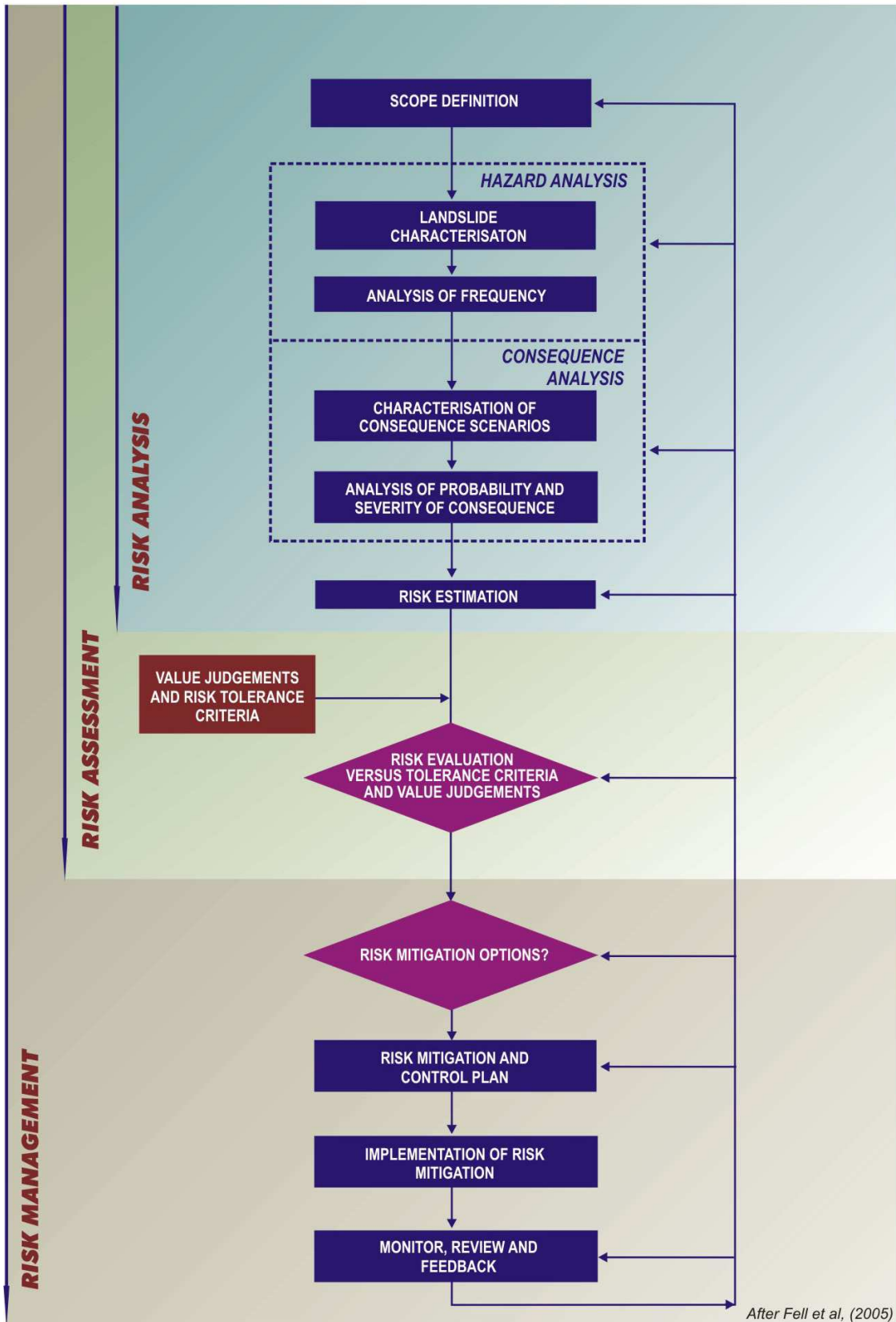


Figure 2: Abbreviated flowchart for Landslide Risk Management.
Ref: AGS (2007a, 2007c)

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DEVELOPMENT OF SYSTEMATIC AND DEFENSIBLE LANDSLIDE RISK MANAGEMENT PROCESS

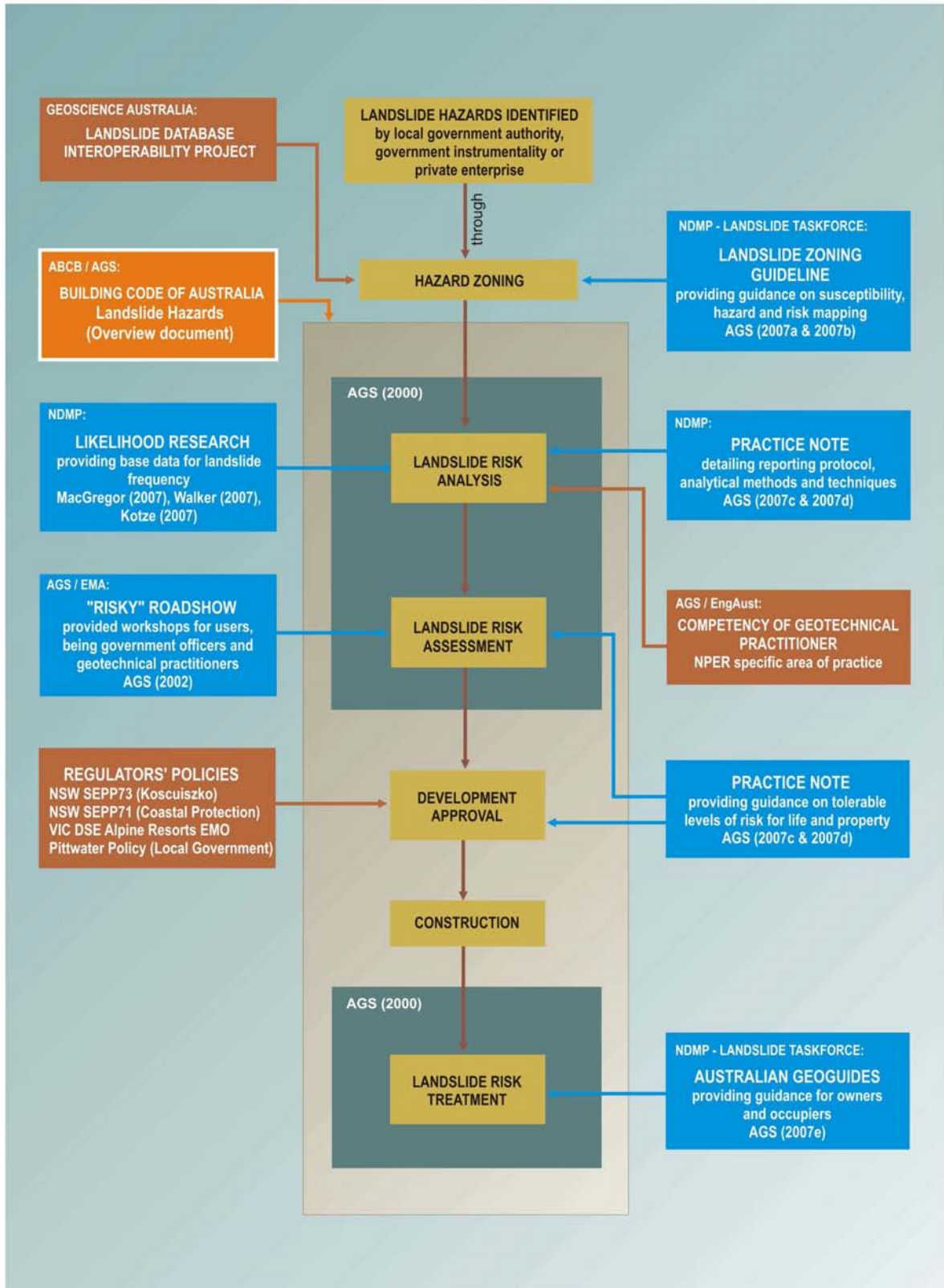


Figure 3: Systematic and defensible Landslide Risk Management framework.

LANDSLIDE RISK ASSESSMENT & MANAGEMENT
INVESTIGATION PHASE

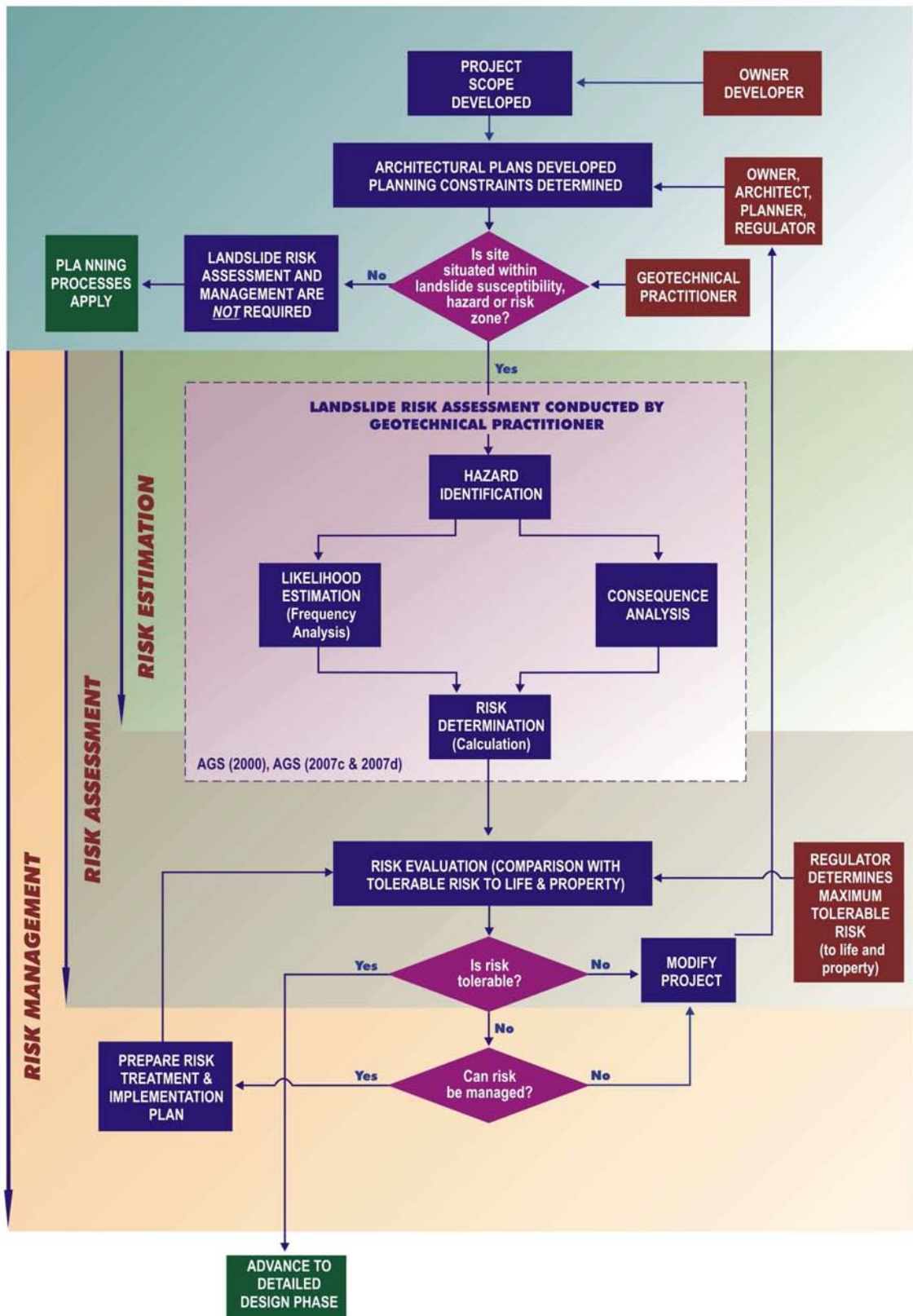


Figure 4: Investigation phase of a project incorporating LRM.

LANDSLIDE RISK ASSESSMENT & MANAGEMENT
DESIGN & VERIFICATION

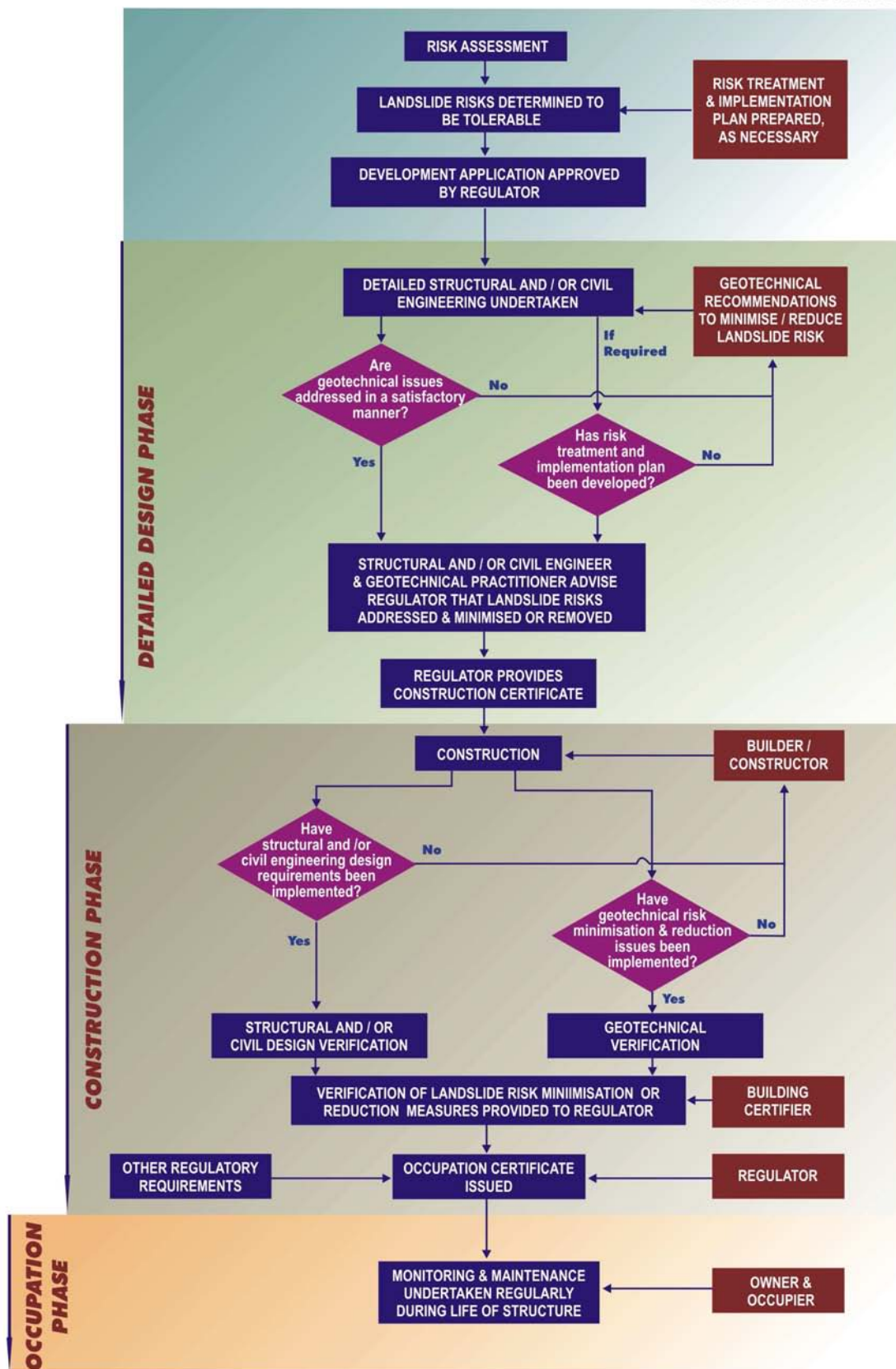


Figure 5: Design and verification phases of a LRM project.

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APPENDIX

NDMP LANDSLIDE TASKFORCE GUIDELINES PROJECTS

STEERING COMMITTEE

Andrew Leventhal, GHD Geotechnics, Sydney, (Chair).

Robin Fell, School of Civil and Environmental Engineering, UNSW, Sydney, Convenor, Guidelines on Landslide Susceptibility, Hazard and Risk Working Group.

Tony Phillips, Tony Phillips Consulting, Sydney, Convenor Slope Management and Maintenance Working Group.

Bruce Walker, Jeffery and Katauskas, Sydney, Convenor Practice Note Working Group.

Geoff Withycombe, Sydney Coastal Councils Group, Sydney

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Tony Miner, A.G. Miner Geotechnical, Geelong

Phil Flentje, University of Wollongong.

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John Braybrooke, Douglas Partners, Sydney

Tony Miner, A.G. Miner Geotechnical, Geelong

WORKING GROUP – Practice Note

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Warwick Davies, Davies Geotechnical, Sydney

Grahame Wilson, Douglas Partners, Sydney

LANDSLIDE TASKFORCE

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Arthur Love, Coffey Geotechnics, Newcastle

Alex Litwinowicz, GHD Geotechnics, Brisbane

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Grant Murray, Sinclair Knight Merz, Auckland

Garth Powell, Coffey Geotechnics, Brisbane

Ralph Rallings, Pitt and Sherry, Hobart

Ian Stewart, NSW Roads and Traffic Authority, Sydney

Peter Tobin, Wollongong City Council, Wollongong

Graham Whitt, Shire of Yarra Ranges, Lillydale

NDMP PITTWATER LANDSLIDE LIKELIHOOD RESEARCH PROJECT

STEERING COMMITTEE

Andrew Leventhal, GHD Geotechnics, Sydney, (Chair).

John Carter, University of Newcastle and previously University of Sydney, NSW

Robin Fell, School of Civil and Environmental Engineering, UNSW, Sydney

Angus Gordon, retired, Sydney

Paul Hardie, Pittwater Council, Sydney

Garry Mostyn, Pells Sullivan Meynink, Sydney

Bruce Walker, Jeffery and Katauskas, Sydney

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