

Canadian Technical Landslide Guidelines and Best Practices for Landslide Professionals – An Update

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ABSTRACT

In 2010, the Geological Survey of Canada (GSC) initiated a project to develop Canadian technical landslide guidelines and best practices. Between 2011 and early 2014, assisted by more than 60 landslide professionals, the GSC completed and released nine of the 11 chapters of this document as separate GSC Open File publications. They were made available on the GSC website. Review comments were encouraged and received from both the national and international landslide communities. At the present time, the chapters are being revised, updated and compiled into a GSC Bulletin-series publication. *Canadian Technical Landslide Guidelines and Best Practices related to Landslides: a national initiative for loss reduction* is expected to be available in English later in 2014, and in French shortly thereafter.

RÉSUMÉ

En 2010, la Commission géologique du Canada (CGC) a lancé un projet visant à élaborer des lignes directrices et les meilleures pratiques canadiennes en matière de glissements de terrain. Entre 2011 et début 2014, avec l'aide de plus de 60 professionnels de glissements de terrain, la CGC a terminé et publié neuf des 11 chapitres de ce document sous forme de dossiers publics de la CGC. Ils ont été mis à la disposition de tous sur le site Web de la CGC. Les communautés nationale et internationale en matière de glissements de terrain international ont été sollicitées et ont fournis des commentaires critiques constructifs. À l'heure actuelle, les chapitres sont en cours de révision, mis à jour et compilés dans une publication de la série Bulletin de la CGC. *Canadian Technical Landslide Guidelines and Best Practices related to Landslides: a national initiative for loss reduction* devrait être disponible en anglais plus tard en 2014, et en français peu de temps après.

1 INTRODUCTION

This paper is an update of the Geological Survey of Canada's (GSC) initiative to develop Canadian technical landslide guidelines and best practices for landslide professionals. Previous progress reports were provided by Couture et al. (2011) and Couture et al. (2012).

In 2006, the GSC, a part of Natural Resources Canada's Earth Science Sector, initiated a project to inform and educate the non-professional community about landslides. The goal was to write a document that could be easily understood by the average citizen. *The Landslide Handbook*, jointly written and published by the GSC and United States Geological Survey (Highland and Bobrowsky, 2008) was the result. That document explained the basics of landslides and their behavior including why they occur, where they occur and what activities contribute to their occurrence. In addition, it provided options for avoidance, management and treatment of unstable slopes.

Following the success of that initiative, in 2010, the GSC consulted with landslide professionals and users of landslide data across Canada. Over 40 meetings were held with stakeholders representing academia, government, industry and consultants. The results of those meetings were summarized by Couture (2010). Although some provinces have landslide guidelines (e.g. Association of Professional Engineers and Geoscientists of BC, 2010), no national guidelines existed in Canada as they did in other countries (e.g. Australian Geomechanical Society, 2007). Almost all participants

who were consulted agreed that Canadian landslide guidelines were a good idea. All agreed that the GSC was the appropriate organization to lead the development and publication process, but in partnership with the Canadian Geotechnical Society (CGS).

2 PURPOSE AND ORGANIZATION

The intention was to develop a document that would provide guidance, best practices and additional information for Canadian landslide professionals. The intent was that it could be easily incorporated into practice without being a legislated document or otherwise limiting practice. The intent was to:

- update, but not unnecessarily duplicate, information;
- describe 'what should be done', not 'how to do it';
- focus on Canadian issues and needs;
- be a resource for all levels of government; and
- provide a common landslide terminology.

For efficiency, it was decided to publish each chapter 'on-line' as a GSC Open File as soon as it was completed, following appropriate external and internal GSC review. Accompanying each open file would be a request for review comments from all readers, both national and international.

It was agreed that the *Canadian Technical Landslide Guidelines and Best Practices related to Landslides: a national initiative for loss reduction* should be written by a team of landslide professionals as a series of chapters under the direction of 'chapter leads' and an overall

'scientific editor' and bilingual 'co-editor'. The entire process would be overseen and approved by an 'advisory panel'. D. VanDine (VanDine Geological Engineering) was retained as scientific editor and J. Lafleur (Polytechnique de Montréal) was retained as co-editor. The advisory panel was composed of the Chair, J. Locat (Université Laval), R. Couture (GSC and Federal Scientific Authority), D. Cruden (University of Alberta), C. Froese (Alberta Geological Survey and CGS representative), M. Jakob (BGC Engineering), N. Morgenstern (University of Alberta), M. Ruel (CN Rail) as well as the scientific editor and co-editor. In 2012, P. Bobrowsky (GSC) assumed the role of Federal Scientific Authority and M. Porter (BGC Engineering) assumed the role of CGS representative.

After several meetings, the editors and the advisory panel identified the various chapters and chapter leads (Table 1 at end of paper).

3 STATUS AS OF EARLY 2014

Between the fall of 2010 and early 2014, the chapter leads and 60 other landslide professionals researched and wrote their respective chapters. As completed, each chapter was reviewed by the scientific editor, two reviewers external to the GSC, an internal GSC reviewer, and the advisory panel. Upon approval and with the required changes, the chapters were published on-line as GSC Open Files (Table 2 at end of paper). The on-line 'uniform resource locators' (urls) are noted in Table 3 (at end of paper). The chapters can also be downloaded from <http://geopub.nrcan.gc.ca/>, and typing 'Open File XXXX'.

With the publication of each open file, review comments were encouraged and have been received from both the national and international landslide communities.

4 SUMMARY OF CONTENT

Currently (February 2014) nine of the 11 chapters have been completed and published; the remaining two are nearing completion. The following briefly summarizes the content of each chapter.

Introduction (GSC Open File 6765) sets the stage by introducing landslides in Canada, then reviews the purpose, scope and limitations of, and the process used to develop, the subsequent chapters.

Terminology (GSC Open File 6824) provides a glossary of common landslide-related terms used in Canada, and elsewhere, and sets the standard for common usage in the subsequent chapters. The revised version of this chapter will also provide a reference citation for each term.

Classification, Description, Causes and Indirect Effects (GSC Open File 7359) updates Cruden and Varnes (1996) and provides a method to classify and describe landslides. It also discusses related topics such as landslide size, intensity, travel angles, causes and indirect effects.

Socio-Economic Significance (GSC Open File 7311) summarizes the socio-economic significance of Canadian landslides considering both direct and indirect costs. It reviews the significance of Canadian landslides in the context of other natural hazards and landslides worldwide. It includes a summary of losses associated with 56 notable Canadian landslides.

Review of Existing Guidelines (GSC Open File 7058) reviews 35 national and international guidelines, standards, and best practices-type publications, as they relate to landslide risk management, landslide zoning, geotechnical assessment, land use planning, treatment, and codes of responsibilities.

Professional Practice (GSC Open File 6981) summarizes current requirements for landslide professionals: qualifications, responsibilities, and quality management. It also addresses the related issues of professional liability and insurance including property owner's landslide insurance.

Risk Management (GSC Open File 6996) reviews the steps of an effective landslide risk management process: initiation, assessment (identification, analysis, evaluation), treatment, communication and consultation, and monitoring and review.

Identification and Mapping (GSC Open File 7059) focuses on approaches associated with: landslide identification; mapping, map elements, components and types of landslide maps; and field mapping methods, including field description of landslides.

Investigation, Analysis, Monitoring and Treatment (GSC Open File pending) will briefly review both commonly used methods, as well as introduce the reader to new methods and techniques that are currently being developed, tested and used.

Risk Evaluation (GSC Open File 7312) examines aspects of landslide risk: individual vs. societal risk; voluntary and involuntary risk; tolerable vs. acceptable risk; qualitative and quantitative risk methods; and partial risk. It includes examples of current landslide tolerable risk criteria across Canada.

Examples of Common Landslide Types (GSC Open File pending) will provide a number of examples of common Canadian landslide types, and their typical characteristics.

5 FROM HERE

At the present time, the two pending chapters are being completed and the nine published chapters are being revised, updated and compiled into a GSC Bulletin-series publication. GSC Bulletins typically include comprehensive final technical reports on topics of either national or broad regional and local interest and are available for free download. *Canadian Technical Landslide Guidelines and Best Practices related to Landslides: a national initiative for loss reduction* is expected to be available in English later in 2014, and in French shortly thereafter.

ACKNOWLEDGEMENTS

The authors are grateful for the support provided by Natural Resources Canada (Public Safety Geoscience Program), and the tremendous contributions made by the chapter leads, contributors and authors, reviewers, editors, and members of an advisory panel.

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Table 1. Chapters and Chapter Leads

Chapter	Chapter Lead(s)	Affiliation
Introduction	R. Couture	GSC
Terminology	R. Couture	GSC
Classification, Description, Causes and Indirect Effects	D. Cruden	University of Alberta
Socio-Economic Significance	R. Guthrie	SNC-Lavalin
Review of Existing Guidelines	B. Wang	GSC
Professional Practice and Insurance Issues	D. VanDine	VanDine Geological Engineering
Risk Management	D. VanDine	VanDine Geological Engineering
Identification and Mapping	L. Jackson Jr	GSC
Investigation, Analysis, Monitoring and Treatment	P. Bobrowsky	GSC
Risk Evaluation and Communication	M. Porter	BGC Engineering
Examples of Common Landslide Types	O. Hungr and J. Locat	University of British Columbia and Université Laval

Table 2. Chapters, Authors, GSC Open Files and Year of Publication

Chapter	Author(s)*	GSC Open File	Year
Introduction	R. Couture	6765	2011a
Terminology	R. Couture	6824	2011b
Classification, Description, Causes and Indirect Effects	D. Cruden and D. VanDine	7359	2013
Socio-Economic Significance	R. Guthrie	7311	2013
Review of Existing Guidelines	B. Wang, M. Ruel, R. Couture, P.T. Bobrowsky and A. Blais-Stevens	7058	2012
Professional Practice and Insurance Issues	D. VanDine	6981	2011
Risk Management	D. VanDine	6996	2012
Identification and Mapping	L.E. Jackson, Jr., P.T. Bobrowsky and A. Bichler	7059	2012
Investigation, Analysis, Monitoring and Treatment	P.T. Bobrowsky, D. VanDine, S. Bean, S. Powell, and M. Lato.	pending	
Risk Evaluation and Communication	M. Porter and N. Morgenstern	7312	2013
Examples of Common Landslide Types	O. Hungr and J. Locat	pending	

*not all contributors are listed as authors or co-authors, but they are acknowledged in the respective chapters

Table 3. Chapters and on-line 'uniform resource locators' (urls)

Chapter	url*
Introduction	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/288/288065/of_6765.pdf
Terminology	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/288/288066/of_6824.pdf
Classification, Description, Causes and Indirect Effects	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292505/of_7359.pdf
Socio-Economic Significance	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292241/of_7311.pdf
Review of Existing Guidelines	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292122/of_7058.pdf
Professional Practice and Insurance Issues	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/289/289423/of_6981.pdf
Risk Management	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/289/289863/of_6996.pdf
Identification and Mapping	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292122/of_7059.pdf
Investigation, Analysis, Monitoring and Treatment	pending
Risk Evaluation and Communication	ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292234/of_7312.pdf
Examples of Common Landslide Types	pending

*also available from <http://geopub.nrcan.gc.ca/>, and typing 'Open File XXXX'