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IPL Project Proposal Form 2022

(MAXIMUM THREE PAGES IN LENGTH)

Project Title

SLOW-MOVING LANDSLIDE MONITORING PROJECT (ASHCROFT, BC, AND RUSSELL, MN, CANADA) – EXTENSION OF IPL-202

Main Project Fields

Fundamental Geoscience – Bedrock and Quaternary Geology, Geomorphology and Landform Evolution, Hydrogeology and Geophysics, Remote Sensing and Photogrammetry

Technology Development – Monitoring and Early Warning, Hazard Mapping, Vulnerability and Risk Assessment

Capacity Building – Technology transfer and capacity building to government and private sector

Mitigation, Preparedness and Recovery – Preparedness, Mitigation and Recovery related to socioeconomic infrastructure, primarily (1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(2) Targeted Landslides: Mechanisms and Impacts

A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation, C. Recovery

Name of Project leader

David Huntley

Affiliation (office and position):

Geological Survey of Canada, Senior Scientist

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Core members of the Project, Names/Affiliations (4 individuals maximum):

Dr. David Huntley and Dr. Peter Bobrowsky (Geological Survey of Canada); Prof. David Elwood (University of Saskatchewan); Dr. Jonathan Chambers (British Geological Survey of Canada)

Objectives (5 lines maximum; what you expect to accomplish?):

The Geological Survey of Canada (GSC), universities of Alberta and Saskatchewan, Canadian Pacific Railway

(CP) and Canadian National Railway (CN) are coordinating a multi-partner effort to apply and test a suite of technologies and methods used in the characterization, assessment and monitoring of slow moving landslides in the Thompson River valley, British Columbia (BC), and Assiniboine River valley, Manitoba (MN). Results are being shared with the professional community to improve global landslide monitoring.

Background Justification (10 lines maximum):

Railway transportation networks require sustainable, cost-effective management of service operations to meet future socioeconomic needs and ensure protection of the natural environment. Where transportation corridors traverse unstable terrain, critical rail infrastructure and safe operations are jeopardized, and presents potential local and national economic, social, and environmental challenges. The economic importance of national railway corridors, along with the need to understand and manage the safety issues related to landslides make on-site investigations a strategic priority for governments, the rail industry, and academia. Monitoring unstable slopes and vulnerable infrastructure is a cost-effective hazard management practice that also provides important geoscience information to help develop appropriate mitigation and adaptation measures.

Study Area (2 lines maximum; where will the project be conducted/applied?):

Primary focus is on the Ripley Landslide, but includes several other landslides of concern along the Thompson River, south of Ashcroft, BC, and in the Assiniboine River valley, near Russell, Manitoba.

Project Duration (1 line maximum)

Project may continue indefinitely depending on funding (minimum to 2025)

Resources necessary for the Project and their mobilization (Personnel, Facilities, and Budgets)

This work is funded by Transport Canada and National Science and Engineering Research Council (NSERC). Transport Canada funding over five years will result in direct expenditures of $1 million on landslide research and development for the next five years. Partnership with the railway industry is ongoing.

Project Description (30 lines maximum)

This project aims to gain a better understanding of how extreme weather events and climate change influence landslide activity in the Thompson River valley, British Columbia, and the Assiniboine River valley, Saskatchewan-Manitoba. This fundamental geoscience information will contribute to more robust landslide hazard management strategies to maintain the resilience and accessibility of critical transportation infrastructure along strategically important sections of the national railway network, while also protecting the natural environment, community stakeholders, and Canadian economy. Landslide monitoring technologies have been operational in the Thompson River Valley from 2013-2020 (as part of IPL-202), and have been installed at new sites in the Assiniboine River. The three primary research and development objectives include: 1) Better understand controls on landslide movement, and in particular, the impacts of extreme weather events and climate change. 2) Compare, evaluate, and identify the monitoring technologies which provide the most useful

information on why, how, and when landslides move. 3) Help identify reliable real-time monitoring solutions for critical railway infrastructure (e.g., ballast, tracks, retaining walls, tunnels and bridges) able to withstand the harsh environmental conditions of Canada.

Work Plan/Expected Results (20 lines maximum; work phases and milestones)

Plans for 2021-2025 includes upgrades and repairs to the PRIME, Geocube, GNSS and weather station networks, maintenance and addition of soil moisture probes, and internet connections to Ripley, South and North slides in the Thompson River valley, BC. In addition, efforts will be focused on developing comparative landslide test sites along the Assiniboine River valley, MN. Change detection monitoring will employ advanced UAV photogrammetric, LiDAR and hyperspectral data for all slides that are hazards to railway infrastructure. Ongoing InSAR, SAA, piezometric and weather information will be compiled to develop models for geohazard management and landslide risk assessment. Collaboration with the Canada Centre for Mapping and Earth Observation and private sector will be extended to enhance InSAR data analysis. Partnership with the railway industry will potentially allow developing a quantitative correlation between landslide deformations in the area (satellite InSAR) and railway track serviceability and risk.

Deliverables/Time Frame (10 lines maximum; what and when will you produce?)

Each year (2021-2025), major results from the work plan will be published in the journal *Landslides* and elsewhere. Report of activities will presented at KLC and WLF conferences, and other symposia (to be determined). Annual reporting will be completed for IPL, ICL and KLC. Other publication outlets will include government documents, for example Geological Survey of Canada Open File Reports.

Project Beneficiaries (5 lines maximum; who directly benefits from the work?)

The initial beneficiaries of the project include the two primary rail companies in Canada (CN and CP), but this includes sharing with the professional community in Canada as well. With the number of international publications released to date in the coming years, we expect the global landslide community will benefit from the extension of Project 202. This research and development also benefits training of highly qualified personnel (M.Sc. and Ph.D. students, as well as post-doctoral fellows).

References (Optional) (6 lines maximum; i.e. relevant publications)

Huntley, D., Bobrowsky, P., MacLeod, R., Cocking, R., Joseph, J. and Rotheram-Clarke, D. 2021a Ensuring resilient socio-economic infrastructure: field testing innovative differential GNSS-InSAR-UAV monitoring technologies in mountainous terrain near Ashcroft, British Columbia, Canada. *Journal of Mountain Science*, Vol. 18 (1), pp. 1-20; https://doi.org/10.1007/s11629-020-6552-y

Sattler, K., Elwood, D., Hendry, M., Berscheid, B., Marcotte, B., Abdulrazagh, P. and Huntley, D. Field collection of geotechnical measurements for remote or low-cost data-logging requirements. *Geotechnical Testing Journal.* Vol. 45 (1) https://doi.org/10.1520/GTJ20200323