To: Dan Austin
From: Will Kwan
Date: March 18th, 2025
RE: GISC480 Lab #8

This memo summarizes the methods, discussions, and results from Lab #8, which assesses the risk of potential slope failures on roads in the Harris Creek watershed, with a focus on the Vidler Creek watershed. The analysis identifies surficial materials within the watershed and evaluates their intersection with the existing road network.

Introduction

A GIS analysis was conducted on location-based open data and non-GIS data to classify zones of surficial materials within the study area and their corresponding effect on the potential slope failures on roads. As shown in Figure 2.1, the study area corresponds to the 1151.36 ha Vidler Creek watershed. The watershed contains 37.57 km of road network (Table 1).

Surficial materials are relatively young, loosely consolidated sediments found at or near the Earth's surface. These materials are predominantly composed of clay, silt, sand, or gravel-sized particles, which are produced through the erosion, transport, and deposition of parent materials such as bedrock or older sediments. Each type of surficial deposit exhibits unique characteristics, including varying susceptibility to flooding, erosion, ground subsidence, and mass wasting (USGS, 1984; Government of British Columbia, 2020).

Given these distinctive features, the suitability of surficial deposits as a natural foundation for supporting roads can be assessed. This analysis categorizes areas within the Vidler Creek watershed according to their surficial materials to assess the potential risk of slope failures along roads in the existing network.

Methods

A PDF of the *Quaternary Geomorphology and Terrain Map of the Harris Creek Area, British Columbia* (OF1991-18), was sourced from the British Columbia Geological Survey. Watershed boundary polygons, as well as stream and road data, were sourced from the BC Data Catalogue.

Initially, the PDF required georeferencing to ensure its correct positioning within the GIS. This process involved assigning spatial coordinates to the PDF and aligning it with the watershed boundary polygons, stream and road data. The residual error, which is the difference between the transformed and actual location of control points, was calculated. The total root mean square (RMS) error, computed by taking the root mean square of all residuals, assesses the consistency of the transformation (ESRI, n.d.).

Once correctly positioned, the Vidler Creek watershed polygon was split according to the surficial material units defined by the PDF. The resulting polygons were assigned codes representing their respective surficial materials, and these surficial material polygons were then intersected with the road data to generate a summary of road lengths within each surficial material unit.

Results and Discussion

Once the analysis was complete, the data could be meaningfully represented figuratively and tabularly. Figure 1 illustrates each control point's residual error and the georeferenced PDF's total RMS error. The total RMS error was found to be 0.461755 m, indicating that, on average, the georeferenced points are 0.461755 m away from the true positions of their control points.

Figure 1

Control Point Residual Error and Total Root Mean Square (RMS) Error for the Georeferenced PDF

Image: OF1991-18_1.pdf

Summary

Transformation	1st Order Polynomial (Affine)
Control Points	4 / 4
Total RMS Errors (Forward, Inverse, Forward-inverse)	0.461755, 1.133765, 0.000000

Control Points

Link	Enabled	Source X	Source Y	Map X	Map Y	Residual	Residual X	Residual Y
17	Y	21,506.332442	-11,950.054613	1,506,595.508580	598,560.698001	0.513659	0.248347	-0.449632
18	Y	18,604.365669	-15,014.452476	1,505,590.576861	597,180.172215	0.511878	-0.247486	0.448074
21	Y	26,836.694686	-13,367.916997	1,508,815.707417	598,258.483073	0.403464	0.195070	-0.353173
23	Y	30,478.842153	-9,490.946227	1,510,074.296447	600,005.440331	0.405245	-0.195931	0.354732

Note: RMS error units are measured in meters.

The series of Figures 2.1–2.7 illustrates the risk levels of surficial material units and roads within the Vidler Creek watershed. The majority of low-risk surficial material units were concentrated in the northern part of the watershed, while most moderate-risk units were located in the southwestern portion. High-risk surficial material units were found in the central northern region (Figures 2.5, 2.6) and the southwesternmost area (Figure 2.1) of the watershed.

Table 1 presents the road lengths within each surficial material unit. The only surficial material unit that posed a high risk of potential slope failures on roads was *$Lgut,* which affected 150 meters of road in the southwesternmost portion of the watershed (Figure 2.1). A total of 15.07 km of road was classified as being at medium risk for potential slope failures, with the majority of this road length located within the *Mbv* surficial material unit (11.22 km). Roads at medium risk were primarily concentrated in the southwest of the watershed (Figures 2.1–2.4). The remaining 22.34 km of road was classified as low risk for potential slope failures, much of which was situated within the *Mhw* or *Mvw* surficial material units (6.03 km and 5.32 km, respectively). Most low-risk roads were concentrated in the northeast of the watershed (Figures 2.5–2.7).

Table 1

Surficial Material Risk Level and Road Length Summary

Risk Level and Surficial Material Code	Road Length within Surficial Material Unit (km)
H	**0.15**
$Lgut	0.15
M	**15.07**
Cv	0.07
Cv//Ra	0.85
Cv/Mw	0.43
Fgt	0.53
Mb/gFg	0.11
Mbv	11.22
Mv	0.21
Mv.Cv	0.94
Mw//Ra	0.20
Rr	0.37
Rsa	0.15
L	**22.34**
gFgt.Muh	3.28
Mb	0.64
Mhw	6.03
Mu.gFgp	2.52
Mub	2.39
Mvw	5.32
Mw//Rmu	1.27
Other	0.88
Grand Total	**37.57**

Note: H, M, and L represent high, medium, and low risk, respectively, indicating the potential slope failure risk on road segments within a given surficial material unit. Surficial units that did not contain roads were excluded. Surficial material units are ordered first by risk level, then alphabetically. Figure 2.8 provides a legend for surficial material codes.

References

Esri. (n.d.). *Overview of georeferencing*. ArcGIS Pro. Retrieved March 17, 2025, from https://pro.arcgis.com/en/pro-app/latest/help/data/imagery/overview-of-georeferencing.htm

U.S. Geological Survey. (1984). *Surficial geology*. U.S. Department of the Interior. Retrieved March 17, 2025, from https://www.usgs.gov/publications/surficial-geology

Government of British Columbia. (2020). *Surficial mapping*. British Columbia Geological Survey. Retrieved March 17, 2025, from https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/british-columbia-geological-survey/geology/surficialmapping