

Report on 2021 monitoring of the Johnsons Landing landslide

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Monitoring of the potentially unstable area above the Johnsons Landing landslide continued in 2021. A site visit and stake measurements were undertaken on May 14 by Peter Jordan and Katy Fraser. Reflectors along the headscarp were surveyed in September by Sproulers' Enterprises Limited (SEL). No visible changes to the headscarp area were observed.

Slope displacement measurements

Eight measurement sites are located along the crack that bounds the top edge of the potentially unstable area (see Figure 1 for measurement site locations). One of these (Site 1) is a line of 6 metal pins, with the top pin drilled into bedrock above the crack. This site is the most reliable measurement location. The other sites consist of two or three wooden stakes driven into soil above and below the crack. The distance between the stakes is measured manually with a tape measure. Unfortunately, many of these wooden stakes have become damaged or slanted because of rockfall and snowload; therefore, the wooden stake measurements in the past few years have become less accurate or have been destroyed.

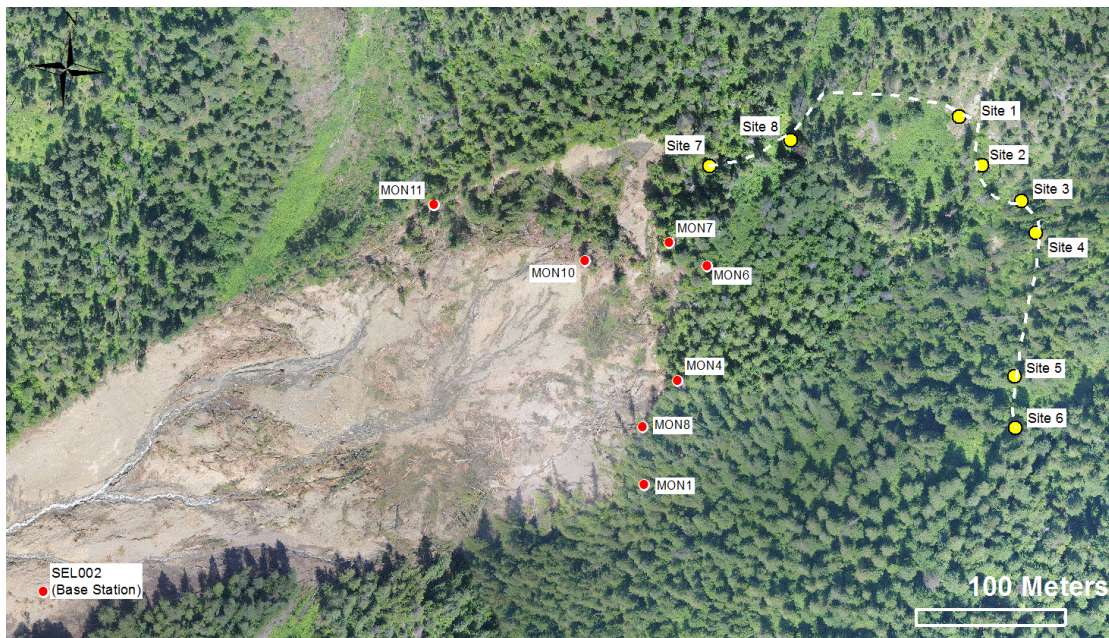


Figure 1. Measurement locations that are measured manually are identified in yellow, and measurement sites surveyed by SEL from a base station are shown in red. The dashed line shows the approximate location of the upper crack that bounds the top edge of the potentially unstable area.

The measurement of the displacement of the upper crack over the past nine years shows systematic, progressive movement at the apex of the tension crack (Figure 2) and limited or no movement towards the outer edges. This year only limited movement was observed at all sites.

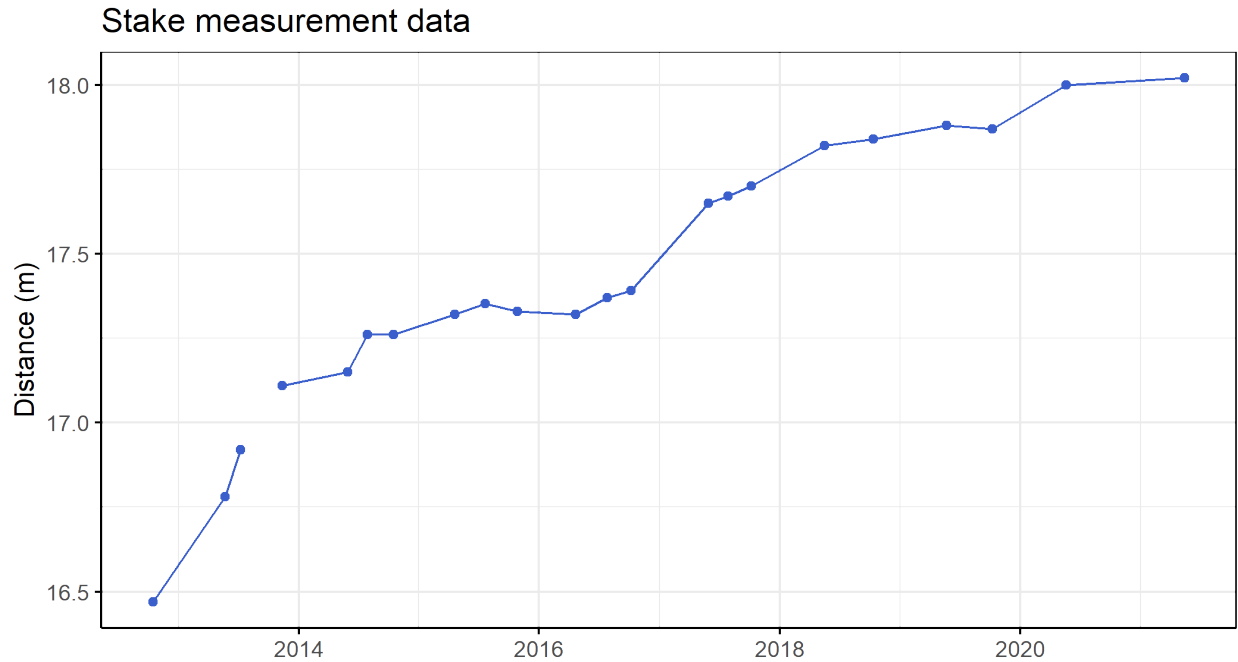


Figure 2. Cumulative downslope movement of the upper crack at Site 1 (see Figure 1 for site location). Downslope movement was measured as the distance between stakes spanning the crack.

Weather record

Table 1 summarizes April to June rainfall over the past ten years as recorded by the Powder Creek fire weather station. Rainfall was below normal throughout spring 2021. The snowpack at Upper Gray Creek Pass to the south of Johnsons Landing is also summarized in Table 1. In 2021 the snowpack was near normal on April 1.

Table 1. Weather and snow data from 2012-2021 near Johnsons Landing.

Spring Rainfall at Powder Creek	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Normal at Kaslo
April, May, June sum (mm)	314	272	200	93	193	171	224	129	169	118	200
April, May, June (% of Normal)	157%	136%	100%	47%	97%	86%	112%	65%	85%	59%	
Upper Gray Creek Snowpack	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Normal SWE (mm)
April 1 (% of Normal)	134%	100%	113%	83%	118%	109% (est. ¹)	127%	75%	129% (est. ¹)	95%	722

¹No data were collected April 2017 and 2020 at the Upper Gray Creek snow course; therefore, snowpack was estimated based on comparison with the March 1 and May 1 values and the Redfish snow pillow.

Survey of Reflectors at the Headscarp

A set of reflectors were installed on the rim of the headscarp in 2014. The reflectors have been measured once a year by Sproulers' Enterprises Limited (SEL). See Figure 1 for reflector locations.

The spatial and temporal pattern of movement of the surveyed reflectors along the headscarp rim indicates that there has been some minor (15 - 23 cm) westerly movement of the headscarp over the past seven years. This corresponds to an average annual displacement of approximately 2 to 3 cm per year. Less overall movement has been observed at MON10 (the reflector on the dropped block), and no movement (within measurement error) has been observed at MON11, which is located on stable ground outside the landslide source area.

Conclusions and recommendations

Given the low spring precipitation and average snowpack, it is unsurprising that there was little movement observed at Johnsons Landing this year. I recommend that monitoring continue next year. I will likely recommend discontinuing monitoring in the next year or two if no increase in movement is detected.