

Accounting for Wildfire Effects in Slope Failure Risk Analysis

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Abstract

While it has been well established that wildfires significantly change the potential for landslides and slope failures in general within the watershed, the exact mechanisms by which this occurs is still largely unknown.

The role that variability may play in post-fire bank stability was investigated through a Monte Carlo simulation (1000 trials) using the closed form unsaturated flow infinite slope model proposed by Travis et al. (2010). The Tumwater Mountain stability data was used for the analysis (Koler et al. 1995; Koler, 1998).

It was found that slope failure risk can be increased not only from the direct effect that wildfires have on the overlaying surface properties, but also indirectly by introducing variability in the subsurface properties.

Relevant Slope Stability Factors Changed by Wildfire

- Cohesion
- Plasticity Limit
- Liquid Limit
- Friction Angle
- Grain Size Distribution
- Matric Friction Angle
- Air Entry Value
- Hydraulic Conductivity
- Elastic Modulus
- Specific Storage

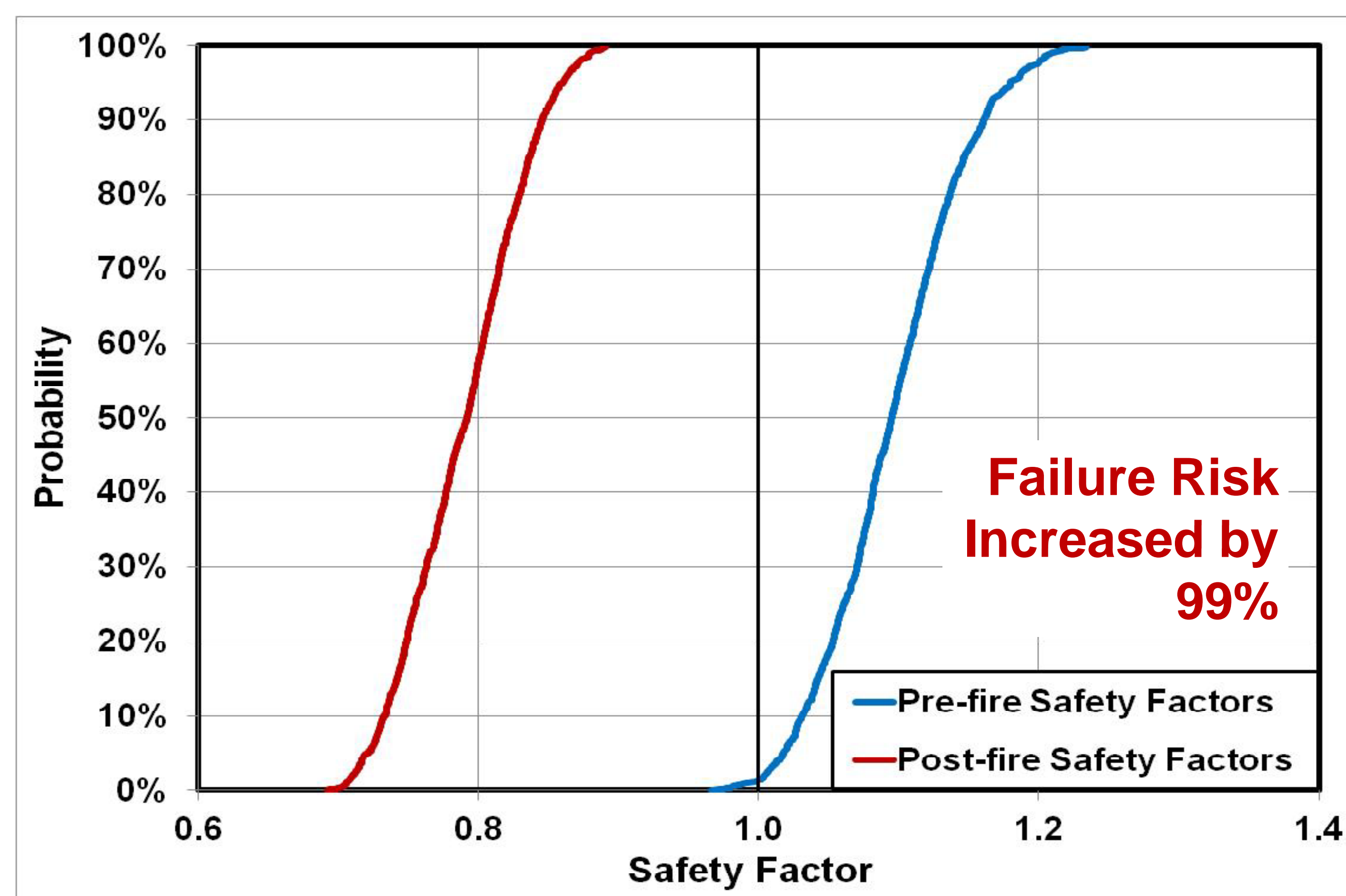


Figure 1. Safety factor change on a 50 degree slope due to a 50% reduction in soil cohesion (variability unchanged)

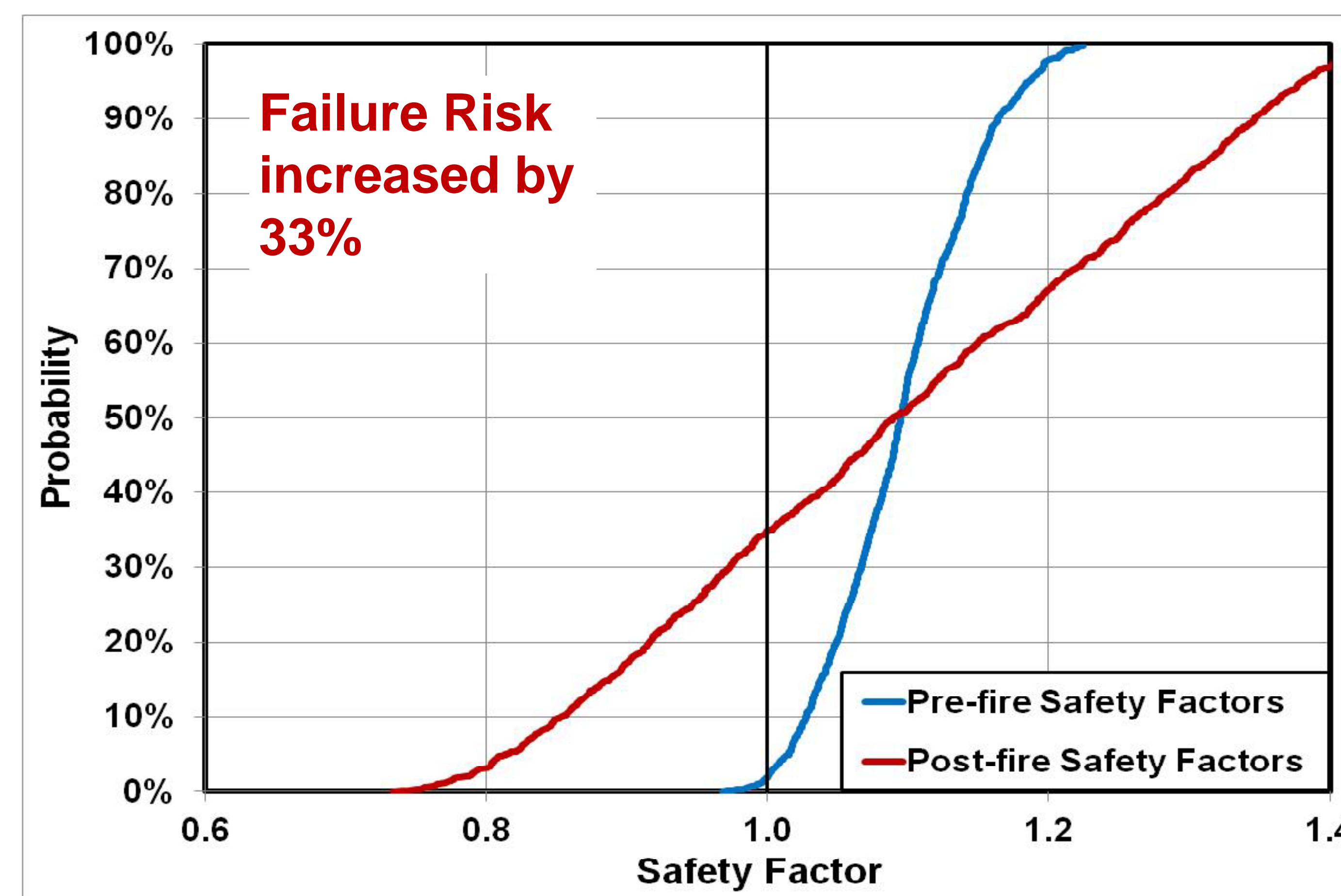


Figure 2. Safety factor change on a 50 degree slope with variable increased by 40% (cohesion magnitude unchanged)

Conclusions

Wildfires can adversely slope stability by simultaneously:

1. **REDUCING** soil strength and
2. **INCREASING** soil property variability.

Thus, an accurate slope stability analysis must account for both aspects.

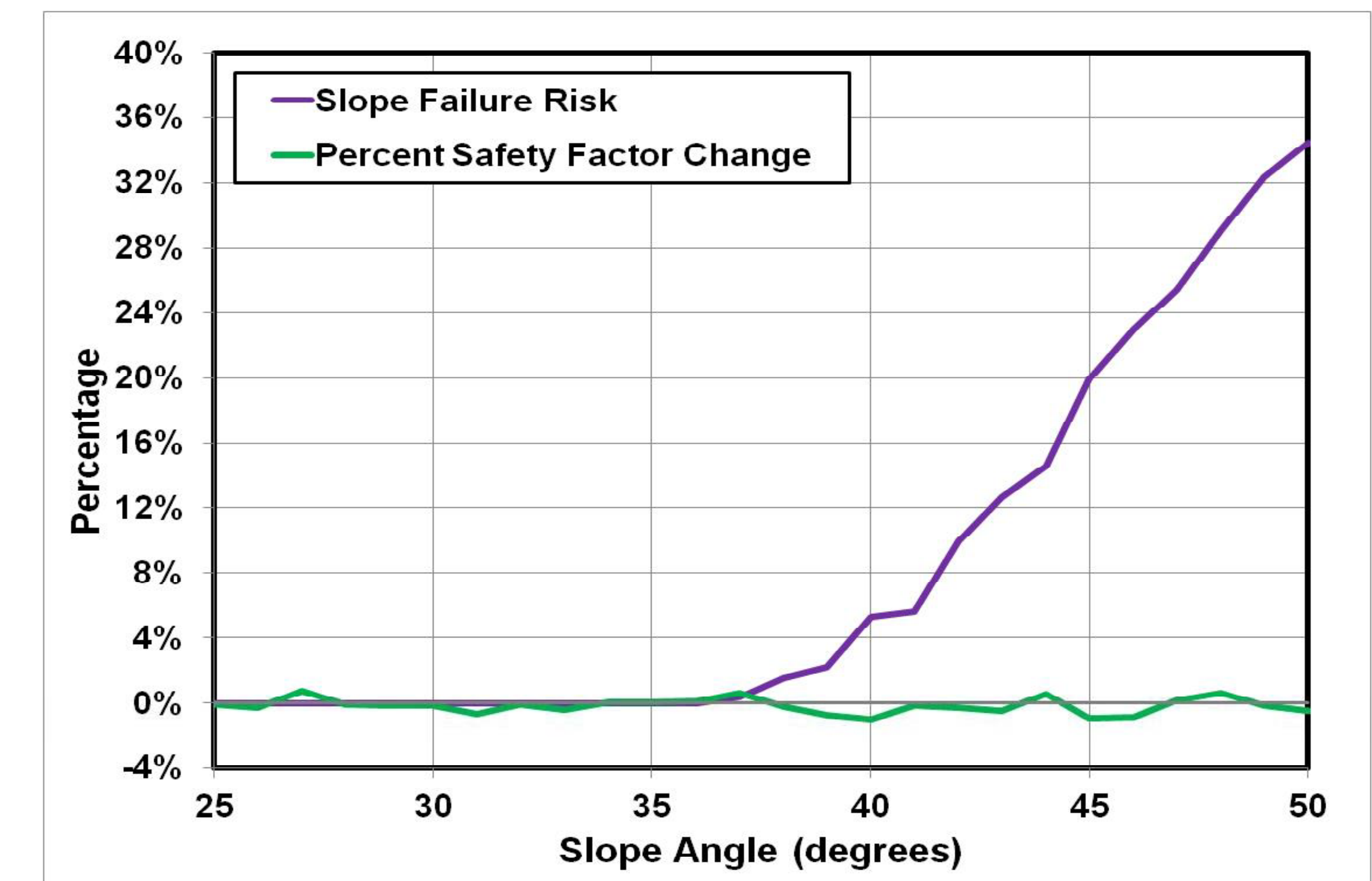


Figure 3. Slope failure risk and safety factor magnitude change for slopes between 25 and 50 degrees (cohesion variability increased by 40%; magnitude unchanged)

References

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