Turkey Creek Watershed Soil Erosion Rates

Using the Universal Soil Loss Equation to determine the sustainability of Turkey Creek's soil erosion

Background

Although it is a natural process, soil erosion can be negatively exacerbated by intensive agricultural practices, deforestation, overgrazing, urban development, and climate change (Julien, 2010). This degradation of the landscape leads to reduced fertility of the soil, lower agricultural productivity, and pollution in aquatic ecosystems from sedimentation (Queensland Government, 2013). The rate of soil's natural regeneration can be estimated at 0.45 tons/acre/year in tropical or temperate climatic conditions but can be substantially lower depending on climate and soil type (Pimentel, 1993). Soil loss tolerance; however, is defined as "the maximum amount of soil loss in tons per acre per year that can be tolerated and still permit a high level of crop productivity to be sustained economically and indefinitely." This rate is evaluated at 1 to 5 tons/acre/year, far greater than the rate at which soil replaces itself. These definitions for sustainable soil loss will be used as a comparison to determine whether the study area's soil erosion rates are sustainable or whether the watershed will require the implementation of

Study Area

Turkey Creek is a small, ephemeral stream that feeds into what becomes the Rio Guadalupe, a tributary of the Jemez River. The watershed covers approximately 2 square miles and lies 10 miles west of the Valles Caldera National Preserve in the Jemez Mountains. The watershed contains infrequently utilized unofficial trails and unpaved roads that have caused the lower portion of the watershed to lose vegetative cover and remain barren.

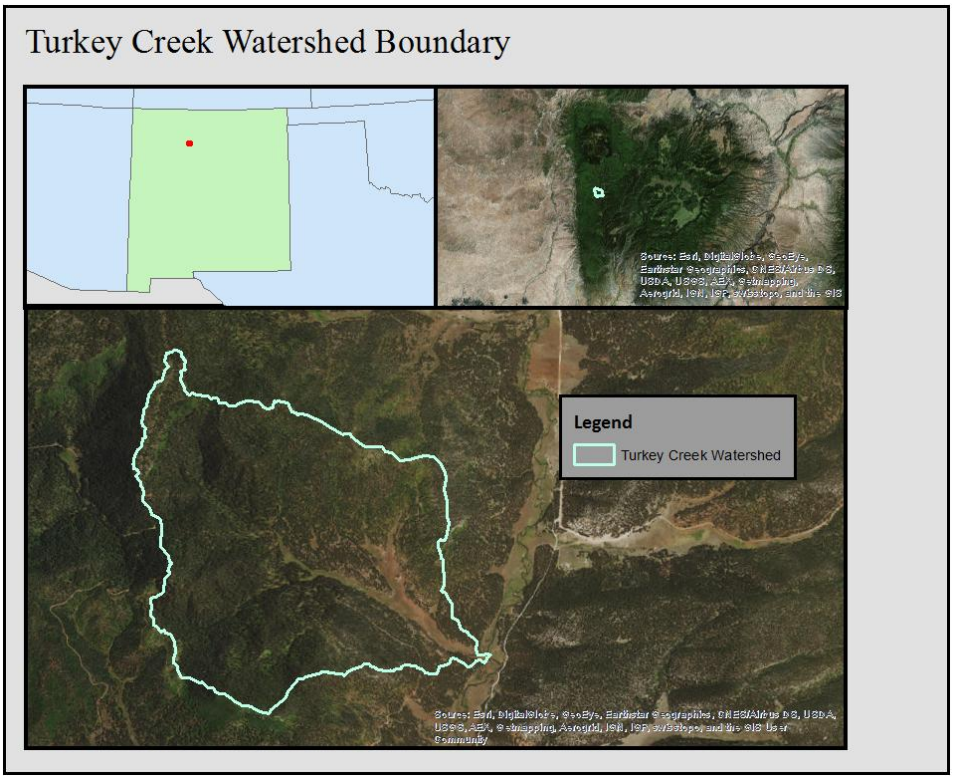

Figure 1. Turkey Creek Watershed

The Universal Soil Loss Equation

A = R x K x LS x C

A = estimated average soil loss in tons/acre/year

R = Rainfall-runoff erosivity factor

K = Soil erodibility factor

LS = Slope length-steepness factor

C = Cover management factor

(Institute of Water Research, 2002)

R factor = 25

K factor = 0.2 or 0.4

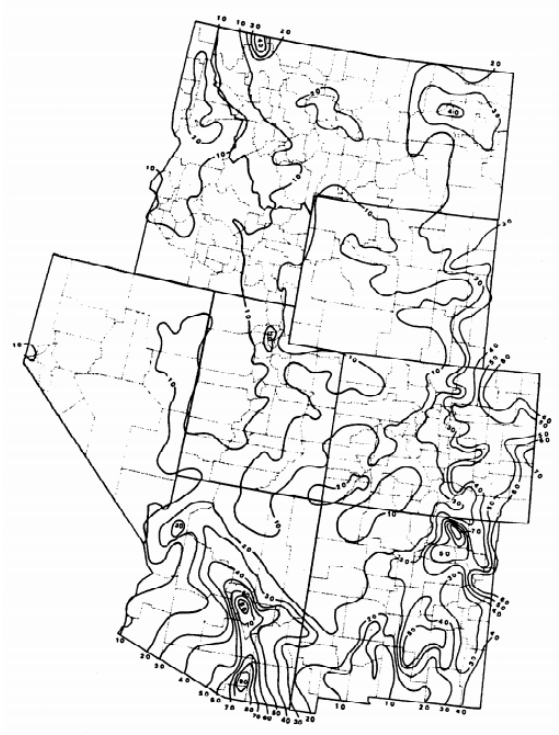

Figure 2. EPA's Isoerodent Map of the Western United States

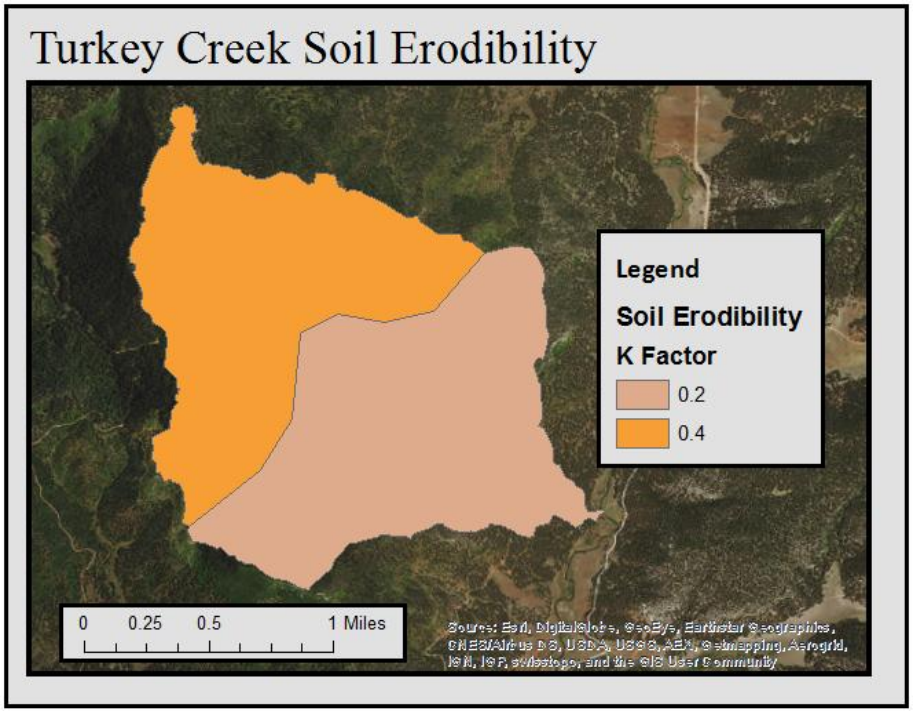

Figure 3. Soil Erodibility Map

LS Factor = 0.5 to 25

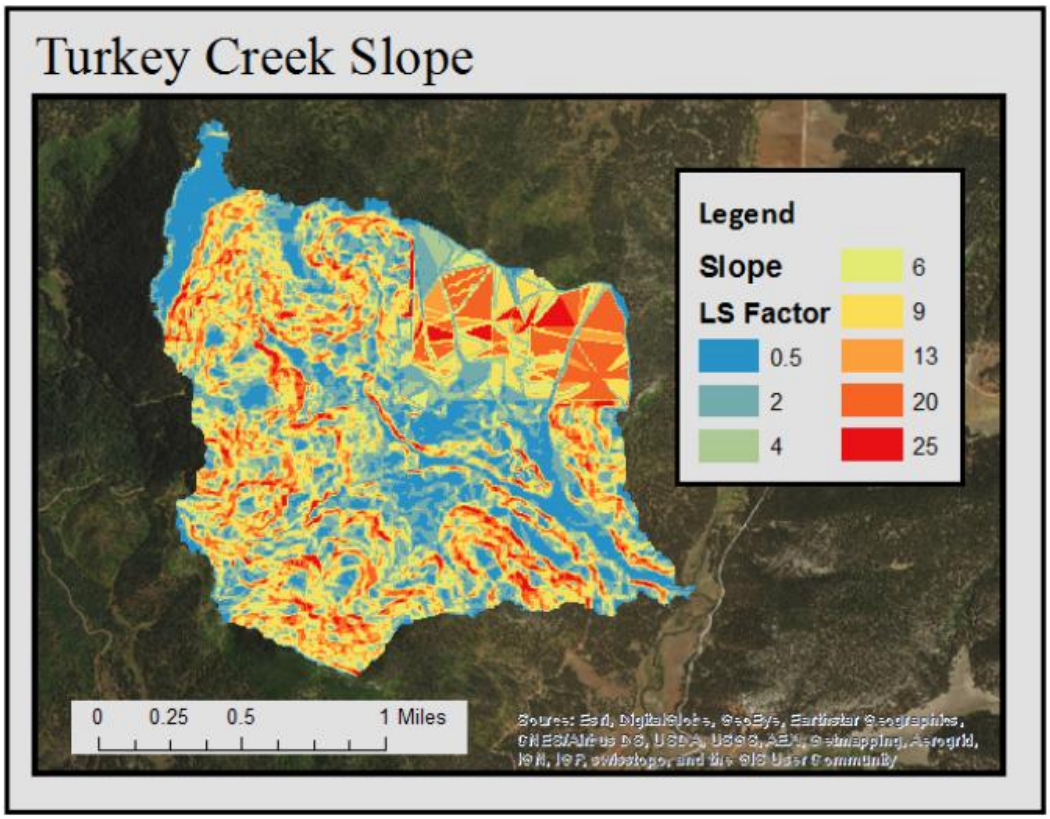

Figure 4. Turkey Creek Slope

C Factor = 0.0005 to 0.2

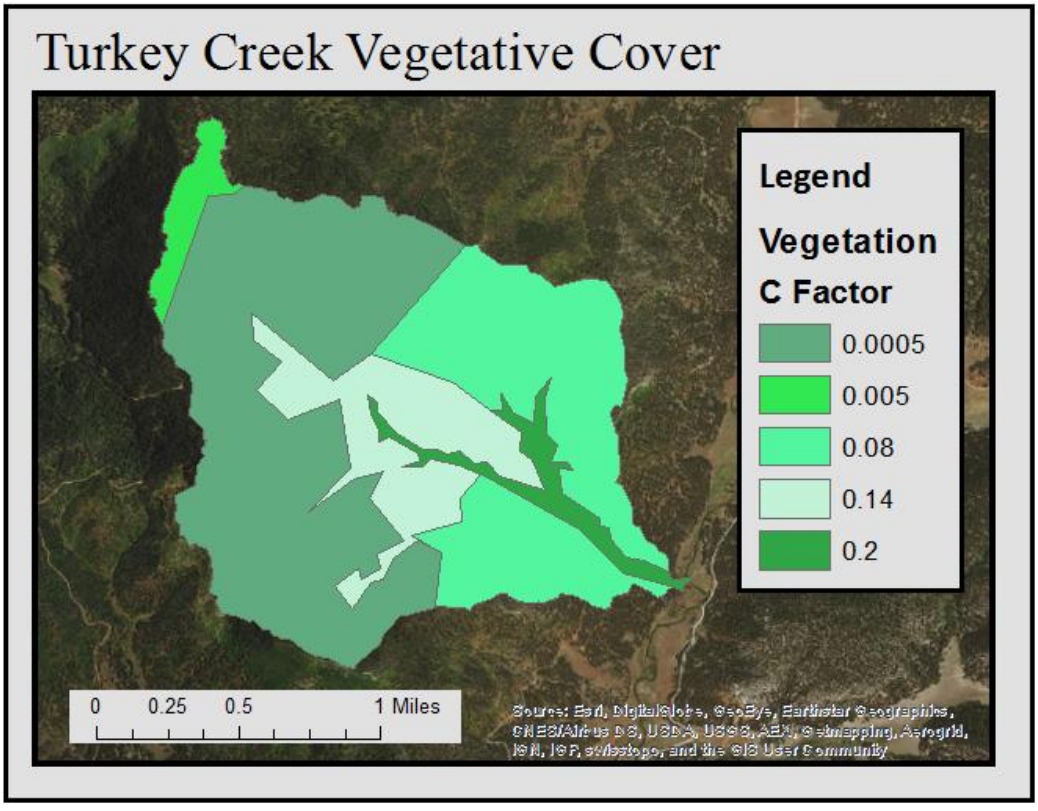

Figure 5. Turkey Creek Vegetative Cover

Results

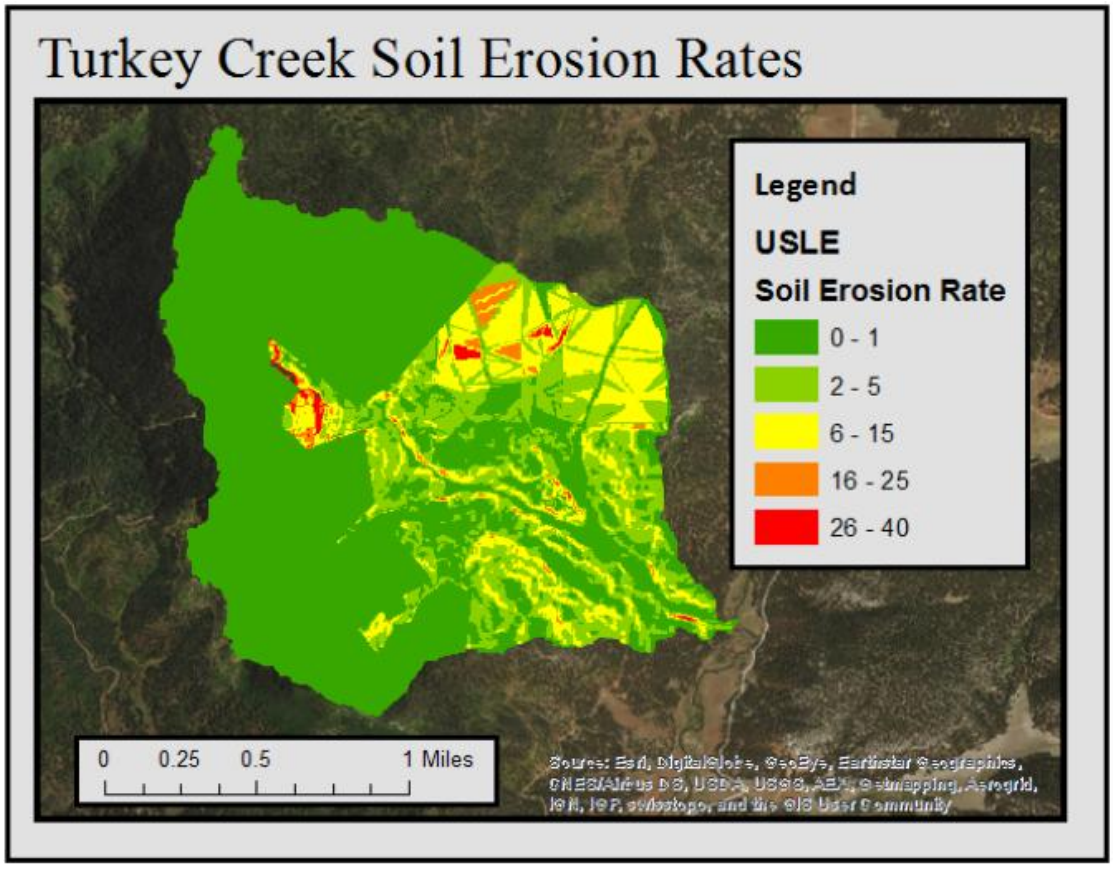

Figure 6. Turkey Creek Soil Erosion Rates in tons/acre/year

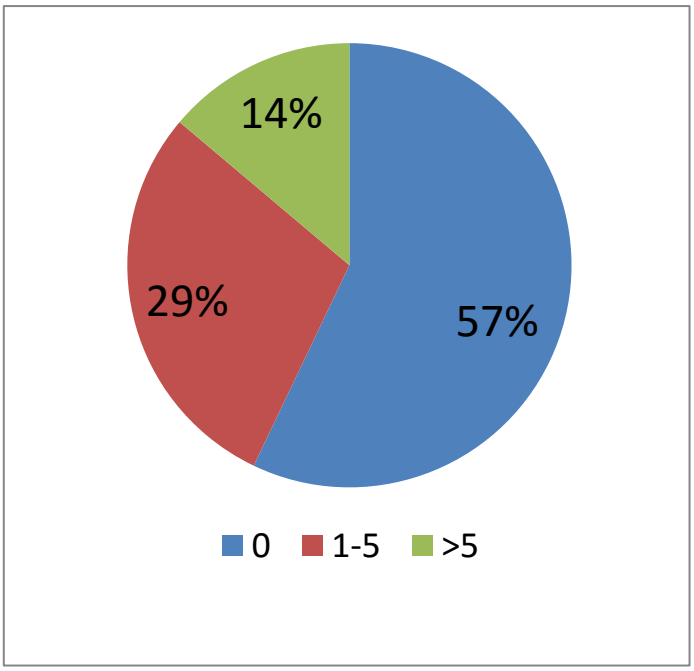

Figure 7. Percentage of Total Area by Soil Erosion Rate

Conclusion

The final soil erosion rate overlay demonstrates the effectiveness of vegetative cover in reducing soil loss. Out of the 1,421 acres within the Turkey Creek watershed boundary, 29% experience a soil loss erosion rate between the 1 ton/acre/year and 5 tons/acre/year soil loss tolerance level. Only 14% of the landscape erodes at an unsustainable rate greater than 5 tons/acre/year. While slope, soil erodibility, and rainfall intensity all have significant impacts on the soil erosion rate, the only variable that can be manipulated is the vegetative cover. This factor plays a very important role in reducing soil loss to sustainable levels.