Conservation Effects Assessment Project (CEAP)-Grazing Lands

Rangeland Soil Vulnerability Index for Water Erosion Risk

(rSVI-water)

User Guide

Version 1.0, January 22, 2024
Soil Science and Resource Assessment Deputy Area
Resources Inventory & Assessment Division – Resource Assessment Branch
Conservation Effects Assessment Project – Grazing Lands

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Introduction

Soil erosion by water or wind can have detrimental effects on ecological resources, such as forage amount, quality, plant health, air and water quality. To aid initial resource assessments to determine potential risks of soil loss on rangelands, the Conservation Effects Assessment Project – Grazing Land (CEAP-GL) component developed the rangeland Soil Vulnerability Index for water erosion risk (rSVI-water). This geospatially-based index was developed using research and modeling estimates from the Rangeland Hydrology and Erosion Model (RHEM) on water erosion that occurs on rangeland. The index pairs specific soil characteristic values with NRCS SSURGO soil data to determine a risk class by soil component for water erosion.

Because the rSVI ratings are based on dry, unvegetated soil conditions, use may be limited to helping producers understand the importance of maintaining vegetation cover within their adaptive grazing plans. CEAP-GL is also developing a rangeland Ecological Vulnerability Index (rEVI) geospatial layer that will incorporate various vegetation cover and distribution thresholds onto the rSVI, offering risk categories of water erosion for different vegetated conditions by soil component. The rEVI layer is expected to be ready for State review in the near future.

Purpose

This User Guide was prepared to document the 1.0 version of the CEAP Rangeland Soil Vulnerability Index for water erosion risk(rSVI-water). This document provides basic information about how the CEAP rSVI-water was prepared and how it can be used.

The rSVI rules were developed to improve the work for the CEAP Soil Vulnerability Index for Cultivated Cropland (SVI-cc). The rules are intended to be applied to detailed soil survey data as it is released each fiscal year to create the rSVI-water dataset that is intended to assist in conservation decision making during that fiscal year. Definitions of terms and descriptions of CEAP rSVI-water 1.0 rulesets with examples are included.

The rSVI-water web tool makes use of the October 2023 SSURGO and gSSURGO data for the Lower 48 states, Hawaii, Alaska, and territories/protectorates where SSURGO data exists. The SSURGO and gSSURGO data sources are available at: Soil Survey Geographic Database (SSURGO) | Natural Resources Conservation Service (usda.gov) and Description of Gridded Soil Survey Geographic (gSSURGO) Database | Natural Resources Conservation Service (usda.gov), respectively.

Supporting map layers include a non-rangeland mask, Major Land Resource Areas (MLRA; Soil Survey Staff, USDA NRCS 2022), state, county, hydrologic units, and federally-owned and tribal land boundaries (e.g., BLM, DOD), the National Land Cover Database (NLCD; USGS 2019), and a global erosivity layer that can be turned on/off (Panagos 2017).

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Background

Rangeland Soil Vulnerability Index for Water Erosion Risk (rSVI-water) 1.0

The rangeland soil vulnerability index for water erosion risk (rSVI-water), version 1.0, is intended to offer an initial geospatial, multi- scale assessment of inherent soil vulnerability, or risk, to water erosion. This assessment provides risk classes for dry**, unvegetated** soil conditions on rangelands.

SVI and CEAP-Grazing Land Studies

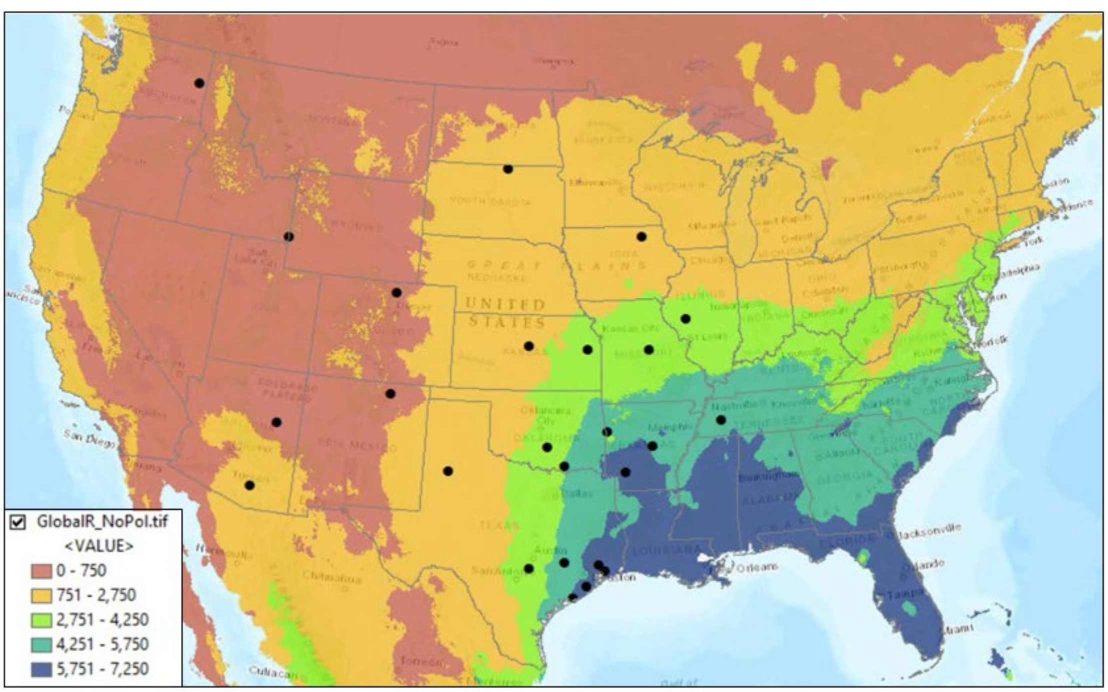
Water Erosion Risk, rSVI-water

The original intent of the rSVI-water was to use the same three common soil parameters chosen for SVI-cc: hydrologic soil group (HSG), Kw factor (whole soil erodibility factor including rock fragments), and slope. These three parameters would make it possible to classify all detailed soil map units on rangelands to create a CEAP-GL rSVI water erosion risk map layer for areas in the United States where gridded soil survey (gSSURGO) data exist.

Early discussions, research, and careful consideration indicated that HSG and Kw are not appropriate parameters to use for a vulnerability index on rangelands. The Hydrologic Soil Group (HSG) is an interpretation, and using an interpreted parameter to create another interpretation such as rSVI is not as credible as using actual soil property data. However, we did use the concept of HSG soil texture groupings to reflect how we ultimately could group soil textures. The K factor was developed as an erodibility factor under crops, whereas rSVI is meant for natural systems. It was decided surface coarse fragment cover, not Kw, is applicable as a co-predictor of water erosion vulnerability on rangelands.

There was agreement that some form of an erodibility factor was needed for the matrix. The rainfall erosivity factor ("R") from RUSLE2 (Revised Universal Soil Loss Equation) was evaluated as a property to drive the matrix values. Ultimately the decision was made to use "R" as a reference to select climate station data as input for model runs to determine our vulnerability classes, and not as a property in the matrix because it is a climatic factor and not a soil property (Figure 1). The Rangeland Hydrology and Erosion Model (RHEM, USDA-ARS and University of Arizona) was selected to aid in our determination of water erosion vulnerability classes and thresholds based on soil and landscape factors in each of the five R-factor regions (Fig 1).

Figure 1. Location of Rainfall Erosivity Regions and Climate Stations used for rSVI-water matrix development, lower 48 states.



rSVI and Conservation Planning in USDA-NRCS

Traditional soil survey soil interpretations (SSURGO and Web Soil Survey) as well as RUSLE2, WEG, Land Capability Classification System, and other models that simulate potential losses of sediment or nutrients are for cultivated fields and rank soils according to their vulnerability to these losses. The Rangeland Hydrology and Erosion Model (RHEM) is recognized by NRCS as the appropriate model for estimating rangeland soil loss, sediment yield and runoff, but aside from this rSVI-water, no spatially-continuous soil vulnerability layer for water erosion risk has been developed.

Likewise, a spatially-continuous soil vulnerability layer for rangeland wind erosion risk is currently lacking, and using the Aeolian Erosion (AERO) model to aid in the production of that layer yields a suitable risk analysis for horizontal and vertical flux of airborne soil particles. A rSVI-wind for wind erosion risk is in process based on model results from the Aeolian Erosion (AERO) model, which captures dust emissions (vertical flux) and saltation (horizontal flux). rSVI-wind will be released for review in 2024.

The CEAP-GL rSVI-water is intended to complement local knowledge of soils, grazing practices, and conservation activity, and to support the role local conservation staff have in planning the delivery of conservation on rangelands. It is important to note that the rSVI-water 1.0 is a "simple screening tool" for soil vulnerability for surface losses of sediment or runoff due to water erosion. Watershed, ranch, and field/pasture-level conservation level assessments must further scrutinize the landscape to identify and protect source water or air quality attainment considerations that may fall within these landscapes and be vulnerable to the impacts of management on rangelands.

Also, because the rSVI ratings are based on **dry, unvegetated** soil conditions, use may be limited to helping producers understand the importance of maintaining vegetation cover within their adaptive grazing plans. CEAP-GL is also developing a rangeland Ecological Vulnerability Index (rEVI) geospatial layer that will incorporate various vegetation cover and distribution thresholds onto the rSVI, offering risk categories of water erosion for different vegetated conditions by soil component. The rEVI layer is expected to be ready for State review in the near future.

The Role of rSVI-water in Conservation Planning

The rSVI-water is a tool designed to add efficiency to the planning process by highlighting portion(s) of the ranch where potential concerns related to water erosion could exist. The rSVI-water places a soil into one of four classes for vulnerability to surface losses (sediment, runoff) by water. This allows for rapid spatial landscape interpretation by a planner who may not be intimately familiar with each detailed soil map unit component. In this way, rSVI-water is considered a screening tool that can help direct the conservationist to the next logical step in conservation planning.

Although soil scientists who prepare soil surveys encourage planners to use all their information, improving delivery of soil survey information for use in conservation decision making can result in more effective delivery of NRCS assistance, both technical and financial. The rSVI-water is an attempt to aid the conservation planner by interpreting the available detailed soil survey information into the most basic soil properties.

Every tool, model or interpretation has both strengths and weaknesses. Caution should be used when applying results from rSVI-water. Local experts such as soil scientists and rangeland conservationists should be asked to review any interpreted values and/or model outputs before land management decisions are made.

Definitions

Conservation Effects Assessment Project (CEAP)

CEAP is a multi-agency effort to quantify the environmental effects of conservation practices and programs and develop the science base for managing the agricultural landscape for environmental quality. The goal of CEAP-Grazing Lands is to assess and report conservation effects in terms that represent recognizable outcomes, such as cleaner water, healthier plants and animals, improved water infiltration and storage, and soil quality enhancements that will result in more sustainable and profitable production over time.

Soil Vulnerability

CEAP researchers have chosen the term "soil vulnerability" to describe the capacity of soil resources to withstand potential impacts of environmental conditions across the landscape by influencing soil movement from lands into surface waters or airsheds. Soil movement/erosion by water can impair water quality in the agroecosystem and diminish soil and plant productivity. CEAP-Grazing Lands (CEAP-GL) examines the impacts of these vulnerabilities at multiple scales (field scale, watershed, and MLRA).

Soil Interpretation

According to the USDA NRCS National Soil Survey Handbook, Part 617.0, "Soil survey interpretations predict soil behavior for specified soil uses and under specified soil management practices. They can be used for establishing criteria for laws, programs, and regulations at local, State, and national levels. They assist the planning of broad categories of land use, such as cropland, rangeland, pastureland, forestland, or urban development. They are used to assist in preplanning and post planning activities for national emergencies. Soil survey interpretations also help plan specific management practices that are applied to soils, such as irrigation of cropland or equipment use." (USDA-NRCS, 2017). The rSVI rating is considered a crisp classification soil interpretation (has four distinct classes). The applicability of the rSVI rating is restricted to the rangeland portion of the soil landscape when used in regional and national assessments.

Soil Map Unit

Soil map units are designed to efficiently deliver soil information to meet user needs for management and land use decisions. Map units can appear as individual areas (i.e., polygons), points, or lines on a map. A map unit is a collection of areas defined and named the same in terms of their soil components, miscellaneous areas, or both. Each map unit differs in some respect from all others in a survey area and is uniquely identified on a soil map. A map unit description is a written characterization of the component within a map unit and the relationship of one map unit to another. Soil map units for USDA's detailed soil maps (gSSURGO or gridded-Soil Survey Geographic Database as accessed in the Web Soil Survey) represent the smallest geographic soil concept that can be mapped using a *vector* polygon at map scales (map fractions) ranging from 1:12,000 to 1:24,000 in the conterminous U.S. Coarser map scales (smaller map fractions) are used in more remote parts of the U.S.

When gSSURGO is used to map the rSVI-water using GIS (desktop or web map applications), generally the rSVI-water rating is illustrated for the dominant condition using the map legend color. This means the rSVI-water class that is believed to cover the largest percent of the soil map unit was selected for on-screen mapping (Figure 2).

Soil Map Unit Component

Within the context of a soil map unit, a component is an entity that can be delineated at some scale. It is commonly a soil but may be a miscellaneous area. Components consisting of soil are named for a soil series or a higher taxonomic class. Those that are miscellaneous areas are given an appropriate name, such as “Rock outcrop” or “Urban land.” Each component that makes up a map unit can be identified on the ground and delineated separately at a sufficiently large scale. Map unit components describe the properties of natural bodies of soils, or miscellaneous areas of nonsoil, in a particular landscape. Components can be major or minor in extent, depending upon the kind of map unit and percent composition. Designation of components as major or minor in soil databases is helpful for interpretive groupings. Typically, only major components are used in a map unit name (Soil Survey Division Staff, 2017).

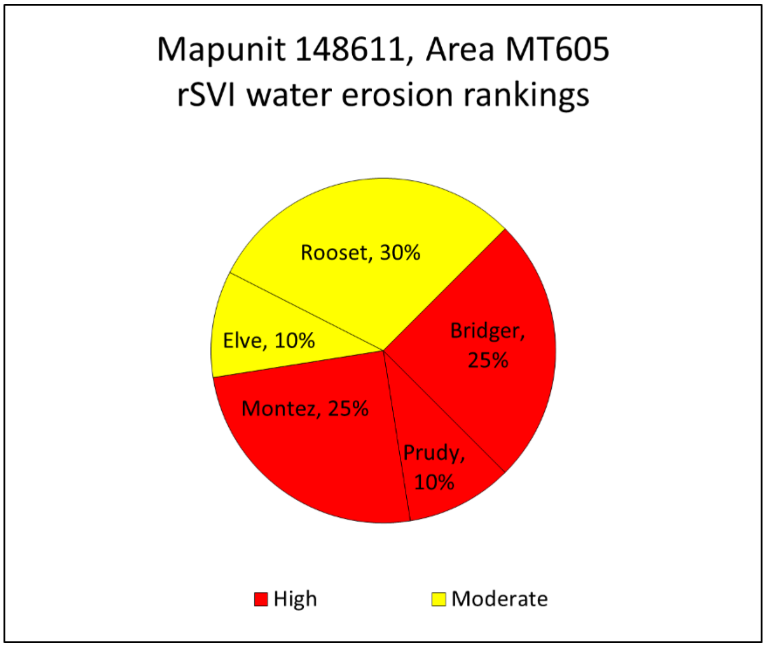
Each component makes up a fraction of the total area of the soil map unit. This fraction is called the component percentage and generally totals to 100 percent for each soil map unit. The component percentage is used to help summarize or bin components into one of the four rSVI classes (or an “unclassified” condition when data is insufficient) for each soil map unit.

Detailed Soil Survey Mapping

The most detailed vector soil survey map product is known as the Soil Survey Geographic Database or more often by its acronym SSURGO (“sir-go”). SSURGO data are developed and maintained by the USDA NRCS with annual updates accessible through the Web Soil Survey and the USDA Geospatial Data Gateway. For a more in-depth description of SSURGO, visit Soil Survey Geographic Database (SSURGO) | Natural Resources Conservation Service (usda.gov).

For information on the gridded equivalent of SSURGO, called Gridded SSURGO (gSSURGO), visit Description of Gridded Soil Survey Geographic (gSSURGO) Database | Natural Resources Conservation Service (usda.gov)

Figure 2. Example of contrasting map unit composition, and how rSVI-water risk level is determined for map units with multiple components.



Each soil component within a map unit is rated separately (individual component ratings are available in Appendix A). Components with the same rating are summed together for purposes of determining a rating for the overall map unit. In this case, the final map unit Water Erosion Risk rating (rSVI-water) is High Risk, because 60% of the components within the map unit rated High, while only 40% of the components rated as Moderate Risk.

Data Sources Used

Detailed Soil Survey Data (SSURGO/gSSURGO)

The rSVI-water classifications rely on three soil properties that are provided by the SSURGO/gSSURGO data sources (Soil Survey Staff 2023). These properties are determined for each soil map unit component and include:

1. Surface Soil texture
2. Slope percentage, representative value
3. Surface coarse fragment cover, percentage, representative value

Land Resource Regions (LRRs), Major Land Resource Areas (MLRAs), 2022

As published in 2022, LRRs and MLRAs are provided as a reference map layer to assist scientists with a regional soil landscape review of rSVI as it extends in the soil landscape beyond state and basin/watershed boundaries. The MLRA Geographic Database serves as the geospatial expression of the map products presented and described in Agricultural Handbook 296 (USDA-NRCS 2022).

Land resource categories historically used at state and national levels are land resource regions, major land resource areas, and land resource units. Land resource regions are a group of geographically associated major land resource areas. They are based on approximate broad agricultural market regions (e.g., LRR A is the Northwestern Forest, Forage, and Specialty Crop Region).

Major land resource areas are geographically associated land resource units. They have unique soils, climate, water resources and land use as well as physiography, geology, and biological resources. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional, and national planning.

Land resource units (LRUs) are the basic units from which major land resource areas (MLRAs) are determined. They are also the basic units for statewide land resource maps. LRUs are typically coextensive with state general soil map units, but some general soil map units are subdivided into LRUs because of significant geographic differences in soils, climate, water resources, or land use. Some states have also chosen to use “conservation management unit (CMU)” interchangeably with LRU.

Base Maps

ArcGISTM base map sources provide county boundaries, hydrologic units, photo base map imagery, landform, and other basic reference map materials for rSVI peer review. Additional map layers provided include the following:

Non-Rangeland Mask Layer 2020

A custom CEAP rangeland map layer was prepared by the NRCS Resources Inventory and Assessment Division (RIAD) Resource Analytics Lab staff for use in CEAP and various National Resources Inventory (NRI) projects. This custom non-rangeland mask is used to “mask-out” non-rangeland geographic areas so that only rangeland areas and soils will appear in the resulting rSVI soil interpretations. The mask consists of NLCD categories for water, developed land, forest, and planted/cultivated land covers (National Land Cover Database 2019 (NLCD2019) Legend | Multi-Resolution Land Characteristics (MRLC) Consortium); Land Resource Regions K, L, M, N, O, P, R, S, portions of T not in Texas and Louisiana, and portion of F in Minnesota.

Federally-Owned Lands & Tribal Lands

Various layers representing lands owned and managed by the federal government are provided, as those lands are classified as "rangeland" and can have grazing allotments with renewable permits used for livestock production. Those lands are also typically included in the NRCS conservation planning process and eligible for Farm Bill funding. Common layers include Bureau of Land Management (BLM), Department of Defense (DOD), United States Forest Service (USFS), Army Corps of Engineers (ACOE), Bureau of Reclamation (BOR), and National Park Service (NPS). Tribal lands are also represented. These layers are provided courtesy of the ESRI Living Atlas, additional information available at https://livingatlas.arcgis.com/en/home/.

National Land Cover Database

The 2019 National Land Cover Database (2001 for Hawaii) from the U.S. Geological Survey is provided as a background layer and used in the development of the Rangeland Mask layer described above. More information about the NLCD is available at https://www.mrlc.gov/.

Global Erosivity Map

The Global Erosivity Map was created from the Global Rainfall Erosivity Database at ~1 km based on a Gaussian Process Regression (GPR) and is reported in MJ mm/ha h yr. The map is from rainfall erosivity (R-factor, the combined effect of rainfall duration, magnitude and intensity) for 3,625 stations covering 63 countries. It is an extensive data collection of high temporal resolution rainfall data from the maximum possible number of countries in order to have a representative sample across different climatic and geographic gradients (Panagos 2017). Information about the map and data download can be found at https://esdac.jrc.ec.europa.eu/themes/global-rainfall-erosivity.

Preparation of rSVI-water 1.0

The CEAP-Grazing Lands Rangeland Soil Vulnerability Index for water erosion risk (rSVI-water) is a "crisp set" soil survey interpretation (classifies vulnerability into sets or classes with non-fuzzy boundaries). This is the same method used for the CEAP Soil Vulnerability Index for Cultivated Croplands (SVI-cc). This soil interpretation uses a set of rules designed to be applied to each soil map unit component mapped on rangelands using the most recent SSURGO and gSSURGO data (October 2023). The rSVI will be updated with each new official SSURGO and gSSURGO annual refresh. Subsequent versioning of rSVI will be updated with the SSURGO data year, followed by the rSVI-water matrix iteration.

Methodology: rSVI-water

The water erosion risk matrix of the Rangeland Soil Vulnerability Index (rSVI-water) was developed from 6,000 model runs using the ARS Rangeland Hydrology and Erosion Model (RHEM; https://apps.tucson.ars.ag.gov/rhem/). RHEM is an event-based runoff and water erosion model best suited for application to rangelands of the western U.S. (Nearing 2011).

RHEM input parameters included multiple climate stations selected in different rangeland geographic areas in the U.S. to represent increasing rainfall erosivity (R-factor) when moving from west to east (Figure 1) (Panagos 2017). All scenarios used a 25-year, 24-hour storm event to simulate soil loss, sediment yield, and runoff volume. Eight predominant soil surface textures (sand, loamy sand, sandy loam, silt loam, loam, silty clay loam, sandy clay loam, and clays), slope steepness (6 slope classes; median percent), and surface coarse fragment cover (5 cover classes; median percent) were entered as input values. All scenarios were run with no vegetation cover (bare earth) and dry soil conditions.

The RHEM output produced average soil loss rates (Mg/ha/yr) for each of the 6,000 scenarios. Model output was analyzed to first determine the thresholds for each soil property in the matrix, and then rank each soil component for vulnerability to soil loss from water. The percent of total soil lost (Mg/ha/yr) for each scenario was then used to determine four water erosion risk classes: Low; Moderate; Moderately High; and High (Table 1). Surface soil textures were grouped as shown in Table 1.

Table 1. Surface soil textures as aligned into groups corresponding with estimated soil loss rates from 6,000 RHEM scenarios formed the basis for rSVI-water risk classes. Modeling assumed dry soil conditions and no vegetative cover.

Surface Soil Texture	RHEM Soil Loss rate (Mg/ha/yr)	rSVI Water Erosion Risk Class
VFS, FS, LVFS, LFS. LS, COS, LCOS, S	0-2.52	4-Low
VFSL, FSL, SL, COSL	2.52-20.91	3-Moderate
L, SIL, CL, SICL, SCL, SI	20.92-120.00	2-Moderately High
SC, SIC, C	>120.00	1-High

The same three soil properties used in the RHEM runs (surface soil texture, slope percent and surface coarse fragment percent cover categories) were used to develop the rSVI-water matrix (Table 2). There are scenarios in which more information was needed to appropriately address water erosion risk for **dry, unvegetated** soil conditions. Soils with organic “in lieu of texture” terms (i.e., muck, peat) at the soil surface, or volcanic soils with ashy, medial or hydrous texture modifiers for surface textures, were identified separately in the water matrix due to unique characteristics which change their vulnerability to erosion compared to mineral soil textures (Warkentin, 1985; van Breda Weaver, 1991; McDaniel and Wilson, 2007; Ekwue and Harrilal, 2009; Robichaud et al., 2016).

Soils with stratified surface soil textures were parsed out and unique rules were applied to these situations, as described in the Rulesets section, below.

Rulesets

A ruleset with soil property thresholds was used to create the rSVI-water classifications. The ruleset used soil properties that relied on surface horizon or representative attributes for SSURGO map unit components. Each SSURGO component was evaluated and given an rSVI classification for each soil map unit where gSSURGO is available (October 2023 gSSURGO/SSURGO). Resulting rSVI classifications using all components were included in the descriptions and mapping. The rSVI information in the rSVI web application is done using the map unit majority rSVI classification for all components rated in the map unit. Details of the rSVI rulesets are below.

rSVI-water 1.0 Soil Properties, Thresholds and Risk Classes

The rSVI-water properties and thresholds are provided in Table 2: surface soil textures, percent slope, and surface coarse fragment cover (percent). Table 2 shows the thresholds of each soil property for each of the four rSVI-water risk classes. Soil properties used are in the column headers, and each row indicates the threshold conditions that define the vulnerability class.

Soil property thresholds are grouped by resulting rSVI-water class and represented by a specific color. Each color corresponds to the rSVI class colors that are used in GIS mapping. Class 4 (green) indicates a Low Vulnerability for water erosion, Class 3 (yellow) indicates a Moderate Vulnerability for water erosion, Class 2 (orange) indicates a Moderately High Vulnerability for water erosion, and Class 1 (red) indicates a High Vulnerability for water erosion.

Notes:

1. Soils with organic materials at the surface will have low to moderate water erosion risk with slopes greater than 7% as the deciding property.
2. Steeply sloped soils (Slopes >30%) with ashy or medial modified surface textures are placed into either Moderately High or High risk classes, as determined by the surface coarse fragment cover percent.
3. Special rules for stratified soils were developed. If a stratified soil texture had several textures then the first one in the list (with coarse fragment modifier or not) was the texture used in the matrix, but if the textures included organic materials anywhere in the list then the organic materials took precedence over mineral soil textures. Example: a SR-COS S FS GR-COS FSL MPT surface soil is placed into the matrix as a COS surface with mucky peat also identified. The mucky peat organic material will take precedence over the COS, and then surface coarse fragment cover (%) and slope % from Table 2 would be used to place the soil component into a risk class.
4. Additionally, where SSURGO reports a texture modifier such as "gravelly", "channery" or "stony" for the surface texture, but the SSURGO value for "surface coarse fragments" is null, we default to the median value for the modifier range (e.g., a value of 28% cover is the median of the range for those soils with 15 to 35% percent coarse fragment cover). When "very" modifies the fragments for the surface texture the median value of 43% cover is used (the median of the range for the "very" modifier (35-60%)). Likewise, when the modifier for the fragments is "extremely" a value of 70% was used (the median of the range for "extremely" modifier (60 to 100%)). When the soil surface is impermeable (i.e., duripan, consolidated permafrost, etc), the surface coarse fragment cover is considered to be 100%. If no textures or "texture in lieu" were listed, 0% fragments were assumed just as for soils with compositional textures (e.g., volcanic material (e.g., ashy), organic materials (e.g., grassy), highly organic materials (e.g., peaty) or limnic materials (e.g., marly) identified in the surface texture (e.g., ashy silt loam)).

Table 2. Soil properties and thresholds for four classes of rSVI -Water Erosion Risk.

Water Erosion Risk on Rangeland (rSVI-water)			
Surface Soil Textures [1/]	**Slope %**	**Surface Coarse Fragment Cover %**	**Water Erodibility Risk Class [2/ 3/]**
All	<= 1	Any	**Low**
Any Organic surface textures: MPT, MUCK, MPM, MK, HPM, SPM, HO, MAT, HM, PEAT	<= 7	Any	**Low**
Any Organic surface textures: MPT, MUCK, MPM, MK, HPM, SPM, HO, MAT, HM, PEAT	> 7	Any	**Moderate**
Ashy or Medial modifier, any texture[3/]	> 1 to 7	Any	**Low**
Ashy or Medial modifier, any texture [3/]	> 7 to 30	>20 to 100	**Low**
Ashy or Medial modifier, any texture [4/]	> 30	>=85	**Moderately High**
Ashy or Medial modifier, any texture [4/]	> 30	<85	**High**

Water Erosion Risk on Rangeland (rSVI-water), *continued…*			
Surface Soil Textures [1/]	**Slope %**	**Surface Coarse Fragment Cover %**	**Water Erodibility Risk Class [2/ 3/]**
Ashy, Medial when modifiers to any of these mineral surface textures: COS, S, FS, LCOS, LS, LFS	> 7 to 30	<=20	**Low**
Ashy, Medial when modifiers to any of these mineral surface textures: VFS, LVFS, COSL, SL, FSL, VFSL, C, CL, L, SC, SCL, SI, SIC, SICL, SIL	> 7 to 30	<=20	**Moderate**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 1 to 4	<= 100	**Low**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 4 to 7	> 20 to 100	**Low**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 7 to 30	> 45 to 100	**Low**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 4 to 7	<= 20	**Moderate**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 7 to 30	> 20 to 45	**Moderate**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 30 to 50	> 45 to 100	**Moderate**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 7 to 30	<= 20	**Moderately High**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 30 to 50	> 20 to 45	**Moderately High**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 50 to 100	> 45 to 100	**Moderately High**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 30 to 50	<= 20	**High**
COS, S, LCOS, LS, FS, VFS, LFS, LVFS	> 50 to 100	<= 45	**High**
COSL, SL, FSL, VFSL	> 1 to 4	<= 100	**Low**
COSL, SL, FSL, VFSL	> 4 to 15	> 45 to 100	**Low**
COSL, SL, FSL, VFSL	> 4 to 7	> 4 to 45	**Moderate**
COSL, SL, FSL, VFSL	> 7 to 15	> 20 to 45	**Moderate**
COSL, SL, FSL, VFSL	> 15 to 30	> 45 to 100	**Moderate**
COSL, SL, FSL, VFSL	> 30 to 50	> 75 to 100	**Moderate**
COSL, SL, FSL, VFSL	> 4 to 7	<= 4	**Moderately High**
COSL, SL, FSL, VFSL	> 7 to 15	<= 20	**Moderately High**
COSL, SL, FSL, VFSL	> 15 to 30	> 4 to 45	**Moderately High**
COSL, SL, FSL, VFSL	> 30 to 50	> 20 to 75	**Moderately High**
COSL, SL, FSL, VFSL	> 50 to 100	> 45 to 100	**Moderately High**

Water Erosion Risk on Rangeland (rSVI-water), *continued…*			
Surface Soil Textures [1/]	**Slope %**	**Surface Coarse Fragment Cover %**	**Water Erodibility Risk Class [2/] [3/]**
COSL, SL, FSL, VFSL	> 15 to 30	<= 4	**High**
COSL, SL, FSL, VFSL	> 30 to 50	<= 20	**High**
COSL, SL, FSL, VFSL	> 50 to 100	<= 45	**High**
L, SIL, SI, CL, SICL, SCL	> 1 to 7	> 45 to 100	**Low**
L, SIL, SI, CL, SICL, SCL	> 7 to 15	> 75 to 100	**Low**
L, SIL, SI, CL, SICL, SCL	<= 4	<= 45	**Moderate**
L, SIL, SI, CL, SICL, SCL	> 4 to 7	> 20 to 45	**Moderate**
L, SIL, SI, CL, SICL, SCL	> 7 to 15	> 20 to 75	**Moderate**
L, SIL, SI, CL, SICL, SCL	> 15 to 30	> 45 to 100	**Moderate**
L, SIL, SI, CL, SICL, SCL	> 4 to 7	<= 20	**Moderately High**
L, SIL, SI, CL, SICL, SCL	> 7 to 15	> 4 to 20	**Moderately High**
L, SIL, SI, CL, SICL, SCL	> 15 to 30	> 21 to 45	**Moderately High**
L, SIL, SI, CL, SICL, SCL	> 30 to 50	>45 to 100	**Moderately High**
L, SIL, SI, CL, SICL, SCL	> 50 to 100	>75 to 100	**Moderately High**
L, SIL, SI, CL, SICL, SCL	> 7 to 15	<= 4	**High**
L, SIL, SI, CL, SICL, SCL	> 15 to 30	<= 20	**High**
L, SIL, SI, CL, SICL, SCL	> 30 to 50	<= 45	**High**
L, SIL, SI, CL, SICL, SCL	> 50 to 100	<= 75	**High**
SC, SIC, C	> 1 to < 4	> 45 to 100	**Low**
SC, SIC, C	4 to 15	> 75 to 100	**Low**
SC, SIC, C	< 4	<= 45	**Moderate**
SC, SIC, C	4 to 7	> 20 to 75	**Moderate**
SC, SIC, C	> 7 to 15	> 45 to 75	**Moderate**
SC, SIC, C	> 15 to 30	> 45 to 100	**Moderate**
SC, SIC, C	4 to 7	<= 20	**Moderately High**
SC, SIC, C	> 7 to 15	> 4 to 45	**Moderately High**
SC, SIC, C	> 15 to 30	> 20 to 45	**Moderately High**
SC, SIC, C	> 30 to 50	>45 to 100	**Moderately High**
SC, SIC, C	> 7 to 15	<= 4	**High**
SC, SIC, C	> 15 to 30	<= 20	**High**
SC, SIC, C	> 30 to 50	<= 45	**High**
SC, SIC, C	> 50 to 100	<= 100	**High**

[1/] Surface Texture Codes (Schoeneberger et al., 2012)

1/ Surface Texture Code (organics)	Texture Name
HM	Hemic material
HO	Highly organic
HPM	Highly decomposed plant material
MAT	Material
MK	Muck
MPM	Moderately decomposed plant material
MPT	Mucky peat
MUCK	Muck
PEAT	Peat
SPM	Slightly decomposed plant material
1/ Surface Texture Code (mineral)	**Texture Name**
COS	Coarse sand
S	Sand
FS	Fine sand
VFS	Very fine sand
LCOS	Loamy coarse sand
LS	Loamy sand
LFS	Loamy fine sand
LVFS	Loamy very fine sand
COSL	Coarse sandy loam
SL	Sandy loam
FSL	Fine sandy loam
VFSL	Very fine sandy loam
C	Clay
CL	Clay Loam
L	Loam
SC	Sandy clay
SCL	Sandy clay loam
SI	Silt
SIC	Silty clay
SICL	Silty clay loam
SIL	Silt Loam

[2/] Risk Classes relate back to the Priority for Treatment Needs, and are as follows:

Priority 1 = High Risk
Priority 2 = Moderately High Risk
Priority 3 = Moderate Risk
Priority 4 = Low Risk

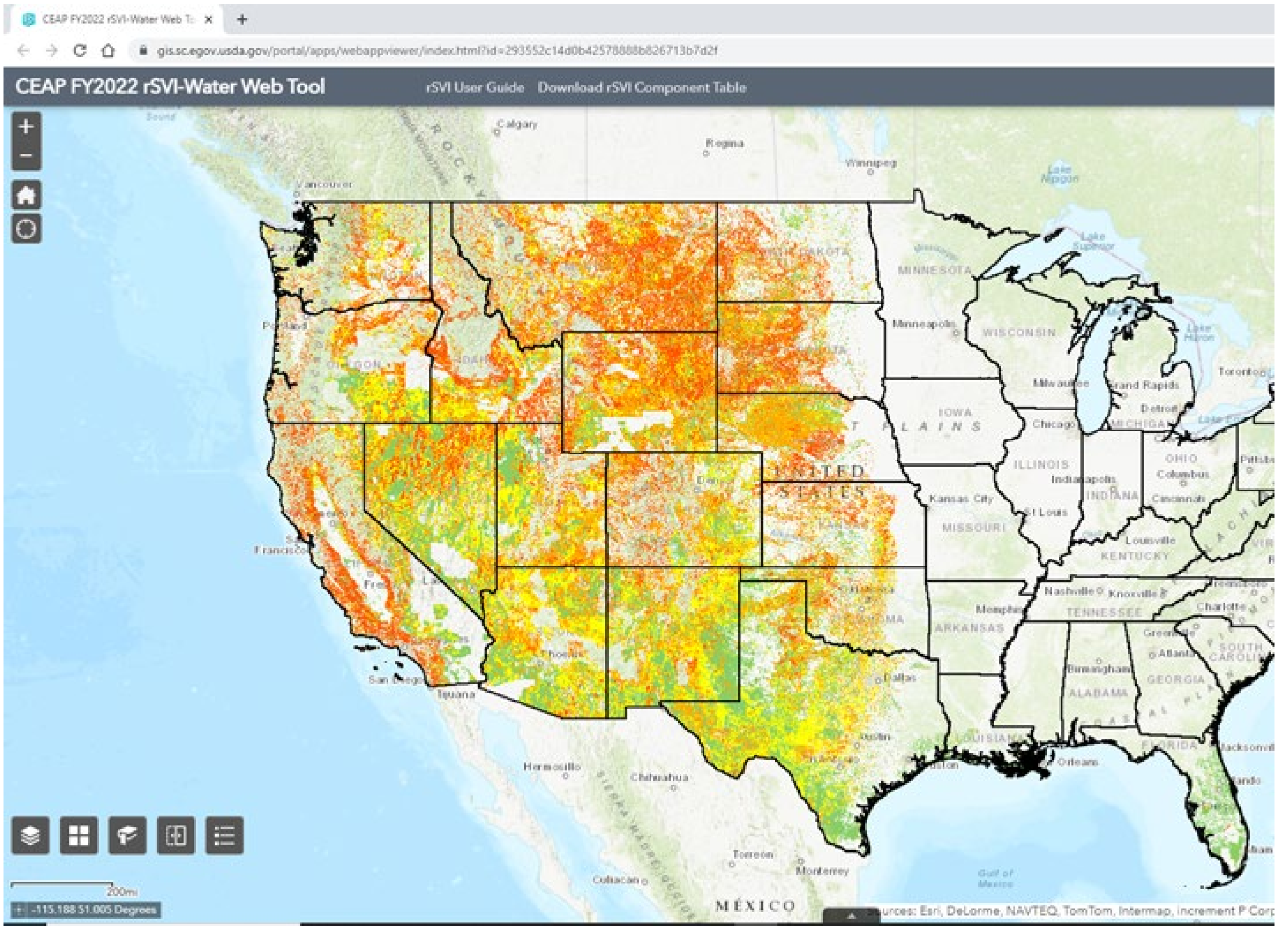
[3/] For soils with hydrous volcanic modifier. They will rate one class more favorable based on rating for surface soil texture.

[4/] For soils on slopes >30% with “ashy” or “medial” modifiers, slope is the driving factor then surface coarse fragment cover, regardless of soil surface texture (Warkentin, 1985).

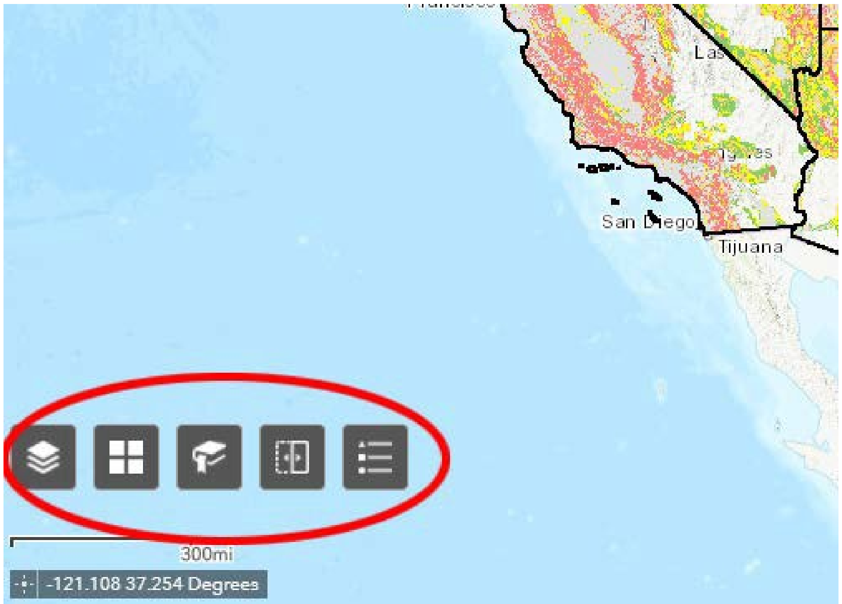
Using the rSVI-Water Web Tool

The rSVI 1.0 web tool can be reached at: https://nrcs.maps.arcgis.com/apps/webappviewer/index.html?id=614d600e9016451ba6249eab3fa0dae7

This initial screen displays the rSVI for water erosion (rSVI-water), and only the areas that are colored (non-gray) are rated, as this is a rangeland water erosion risk tool.



Controls for the web tool are located in the lower left corner of the screen.



 Layer List:

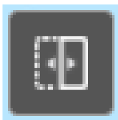
This button brings up a list of all layers available through the web tool with check boxes in order to turn the layers on and off. By default, the state boundary layer and the rSVI for water erosion will be turned on. Other boundary layers available include counties, 2006 MLRAs, watersheds, and SSURGO map polygons. Note that the visibility of some of the boundary layers will change based on your current zoom level. Additional mask layers are available for Federal and Tribal lands. There are separate rSVI layers available for Alaska, Hawaii, and the Caribbean. Also available for comparison are land cover (2019 NLCD) and erosivity layers and access to the SSURGO component table. Layers will always be drawn in the order listed, with layers at the top of the list drawn above layers lower down the list. Layers at the bottom of the list will become obscured if too many layers are turned on.

 Basemap Gallery

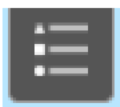
The web application has been built using ArcGIS which includes its own set of available basemaps. This button can be used to change the basemap. By default it will be on the World Topo Map, but other layers available include satellite imagery, aerial photography (NAIP), and a shaded relief elevation map.

 Bookmarks

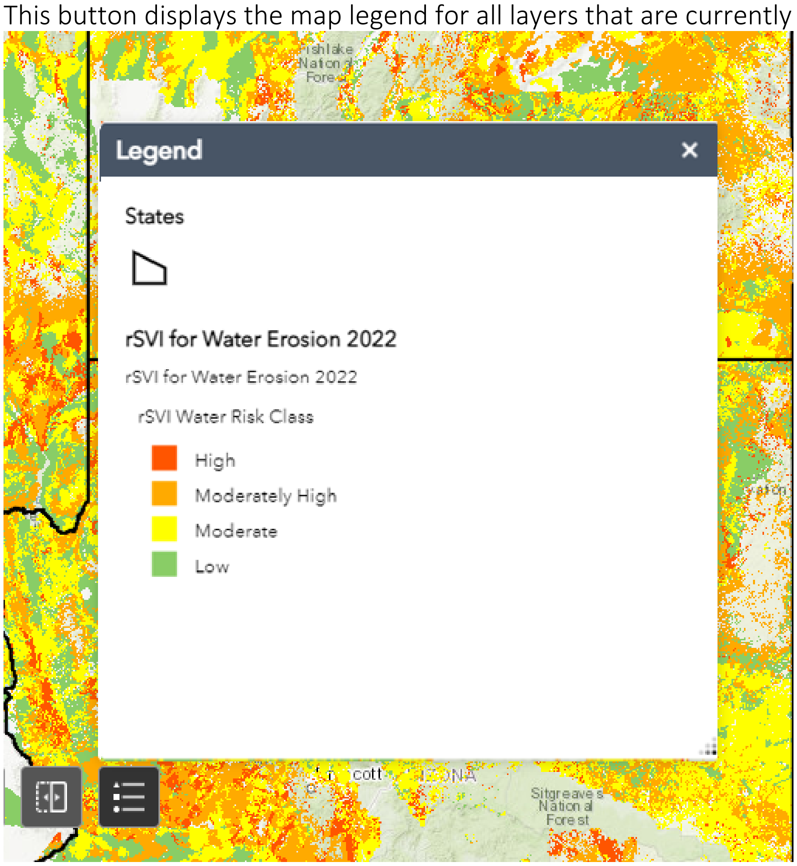
This button uses web browser cookies to save a specific view (location and zoom level) so that it can easily be returned to. There is no limit to the number of bookmarks and all bookmarks are specific to each user's web browser.

Swipe Layer

This button will split the view screen separating the right and left sides of the screen with a movable swipe bar and allow the designation of one currently viewable layer to become the Swipe Layer. That layer will be viewable to the left of the swipe and not viewable to the right of the bar. This allows comparison of the swipe layer to layers that are being displayed below it.

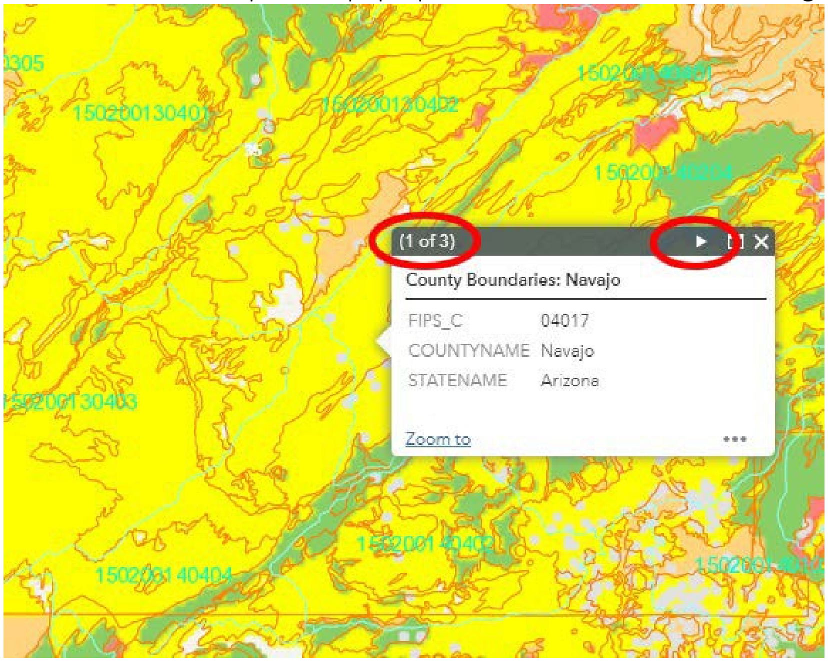
Legend

This button displays the map legend for all layers that are currently viewable.



Query

The visible boundary layers can be queried by clicking on the map. If multiple boundary layers are visible the resulting pop-up box will show how many layers were found at the clicked location and the small arrow icons at the top of the pop-up box can be used to scroll through the results for each layer.



Questions

Questions about using the web tool can be directed to Karl Musser at Karl.Musser@usda.gov.

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Appendix A. List of Soil Map Unit Components and Water Erosion Risk Classes (rSVI-water)

A table of component information is available within the rSVI-water web viewer application. It is on the toolbar at the top of the website and is labeled “Download rSVI Component Table.” The user can click on this “button” and will be given the opportunity to save a compressed (zipped) file for the component data. It is a MS Access file with the data used to assign soil components to the risk classes.

Note for table columns in the file:

“Texture” refers to the 12 main soil texture choices (from the soil texture triangle, <2mm).

“Mod” denotes the presence and degree of fragments >2mm (e.g., gravelly, cobbly, extremely stony), or man-made, organic, or other unique properties.