



# **Soil Erosion Calculator**

## **User Manual**

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**Table of Contents**

1. Introduction .....	4
2. Program Interface.....	5
3. Single Site Calculation.....	5
3.1 Rainfall Factor Calculation (R) .....	5
3.2 Soil Erodibility Factor Calculation (K) .....	6
3.3 Slope Factor Calculation (SL) .....	8
3.4 Crop/Vegetation and Management Factor Calculation (C) .....	9
3.5 Support Practice Factor Calculation (P) .....	11
3.6 System Output.....	13
4. Batch Processing.....	15
5. Software Activation .....	19
6. References .....	20

## 1. Introduction

The current practice of soil erosion calculation is based on the multi-step procedure recommended by RUSLEFAC – A Handbook for Estimating Soil Loss from Water Erosion in Canada. Recommended approach includes extensive manual, table-based and nomograph-based calculations. It requires a lot of time and can lead to inaccurate calculations and data output. Soil Erosion Calculator software automates the process of soil erosion calculation, reduces the time required for calculations, and increases the quality of results. The software is based on the information and equations provided in the RUSLEFAC handbook. The software supports single site calculations and batch file processing for multiple sites.

The rate of the soil loss for the specific site can be estimated based on the Revised Universal Soil Loss Equation for Application in Canada (RUSLEFAC). RUSLE-based soil loss has the following representation:

$$A = R \times K \times LS \times C \times P$$

Where:

A - Annual soil loss due to erosion [tonnes/(hectare\*year)].

R – Rainfall factor [Megajoule\*millimeter/(hectare\*hour\*year)]

K – Soil erodibility factor [tonne\*hectare\*hour/(hectare\*Megajoule\*millimeter)]

LS – Slope steepness and slope length factor (dimensionless)

C – Crop/vegetation and management factor (dimensionless)

P – Support practice factor (dimensionless)

Five erosion classes are defined in RUSLEFAC handbook and in use by default in this software:

Soil Erosion Class	Potential Soil Loss tonnes/hectare/year
1 Very low (i.e. tolerable)	<6
2 Low	6-11
3 Moderate	11-22
4 High	22-33
5 Severe	>33

**Note.** The technical requirements for soil loss can be different for different site types and soil erosion classes might not be applicable for them.

## 2. Program Interface

Program interface is tab-based. There are 4 different tabs defined:

- Single Site Calculation
- Batch Calculation
- Help
- Software Activation

## 3. Single Site Calculation

Single site calculation screen contains 6 separate areas: 5 RUSLE parameters calculation areas and the output area.

For a soil loss calculation for the single site the preliminary calculation of all 5 RUSLE parameters is required

### 3.1 Rainfall Factor Calculation (R)

R factor in RUSLE is a measure of the erosion force of rainfalls for the specific area.

R factor calculation section has the following calculation options:

**Predefined Value**

Rainfall & Runoff Factor (R)

☒ Predefined Value

☐ Geo-Based Value (Alberta)

R Value: 320

The R value can be obtained from RUSLEFAC handbook or other official sources.

**Geo-Based Value (Alberta only)**

Rainfall & Runoff Factor (R)

☐ Predefined Value

☒ Geo-Based Value (Alberta)


Legal Description: TWP 22 - RGE 29 - M W4

☒ Adjustment for Winter Conditions

R Value: 320

Calculate button (circular arrow icon)

Provide township (TWP), range (RGE) and meridian (M) value, and click **Calculate** button

 to get the R value. If *Adjustment for Winter Conditions* checkbox is checked, the calculated value is a sum of R and Rs values. Both values are based on the isoerodent maps provided in RUSLEFAC handbook.

**Note.** If the specified location is not found in the database, the value will be 0. Use the predefined value obtained from other sources in this case.

**3.2 Soil Erodibility Factor Calculation (K)**

The soil-erodibility factor (K) in RUSLE accounts for the influence of soil properties on soil loss.

K factor calculation area has the following calculation options:

### Predefined Value

Soil Erodibility Factor (K)

☒ Predefined Value  
☐ Textural Classification Code Based  
☐ Calculated Value

K Value: 0.044

### Textural Classification Code Based

Soil Erodibility Factor (K)

☐ Predefined Value  
☒ Textural Classification Code Based  
☐ Calculated Value

Texture Class: Clay Loam

Percent Organic Matter: < 2%

K Value: 0.044

Select *Texture Class* and *Percent of Organic Matter* from drop-down lists. The K value will be populated automatically.

### Calculated Value

Soil Erodibility Factor (K)

☐ Predefined Value  
☐ Textural Classification Code Based  
☒ Calculated Value

Percent Silt & Very Fine Sand: 45

Percent Sand: 25

Percent Organic Matter: 0.0

Soil Structure Code: 4 - Blocky, Platy, Massive

Profile Permeability Class: 4 - Slow to Moderate

K Value: 0.044

The calculated K value is based on the soil-erodibility equation with adjustments for soils with silt fraction over 68% and soils with low erodibility (Foster, 2005). The maximum percent of organic matter in calculation is limited to 4% (Auerswald, Fiener, Martin, and Elhaus, 2014). When organic matter exceeds 4% value, the message **"4% OM Limit Applies!"** shows up.

Provide *Percent of Silt and Very Fine Sand*, *Percent of Sand*, and *Percent of Organic Matter*.

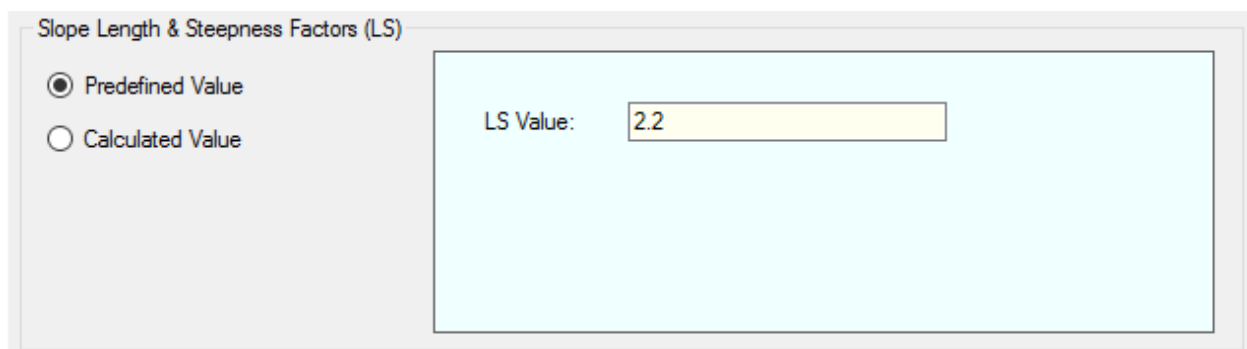
Then select *Soil Structure Code*, *Profile Permeability Class*, and click Calculate button to get the K value.

### 3.3 Slope Factor Calculation (SL)

RUSLE topographic SL factor reflects a combined impact of slope steepness (S) and slope length (L) on soil erosion.

SL factor calculation area has the following calculation options:

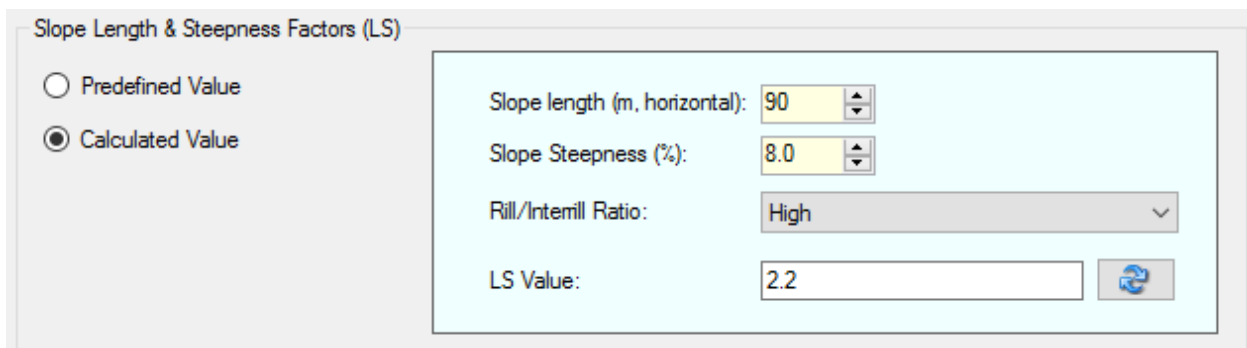
#### Predefined Value



The screenshot shows a form titled "Slope Length & Steepness Factors (LS)". On the left, there are two radio buttons: "Predefined Value" (which is selected) and "Calculated Value". To the right of these buttons is a large light blue rectangular area. Inside this area, the text "LS Value:" is followed by a text input field containing the number "2.2".

The LS value can be entered manually with the Predefined Value option.


#### Calculated Value



The screenshot shows the same "Slope Length & Steepness Factors (LS)" form, but now the "Calculated Value" radio button is selected. The light blue area on the right contains four input fields: "Slope length (m, horizontal):" with a value of "90", "Slope Steepness (%):" with a value of "8.0", "Rill/Interill Ratio:" with a dropdown menu set to "High", and "LS Value:" with a text input field containing "2.2". To the right of the "LS Value:" input field is a small blue circular button with a white refresh icon.

The calculated value is based on table values for topographic factor LS provided in RUSLEFAC handbook. It is calculated as a bilinear interpolation of table values. Slope length range is from 2 to 300 meters. Slope steepness range is from 0.2 to 60%.



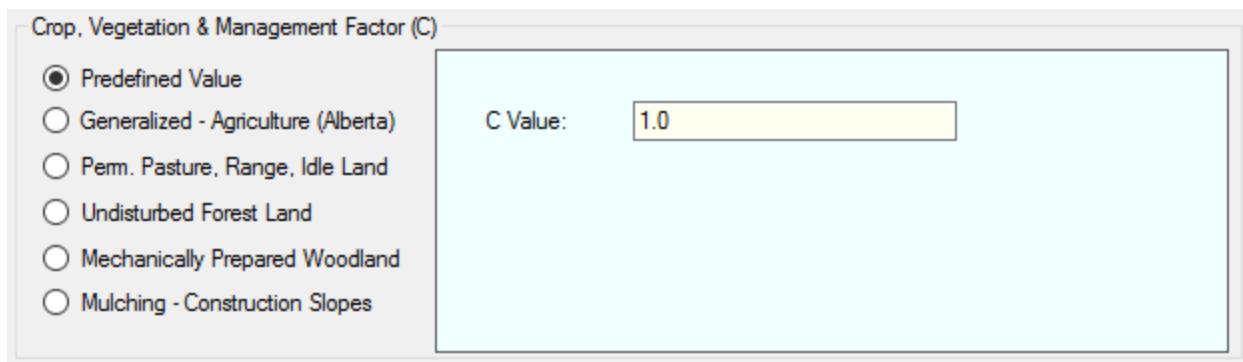
To run the calculation, enter slope length in meters, slope steepness %, select rill/interrill erosion ratio from the drop-down, and click Calculate button  to get the LS value.

### 3.4 Crop/Vegetation and Management Factor Calculation (C)

The Crop/Vegetation and Management Factor estimates the effect of the ground cover condition of the soil and the general management practices of the area of concern. The areas free of vegetation and surface sealing or crusting are assumed to have a C factor equal to 1.

C factor calculation area has the following calculation options:

#### Predefined Value



Crop, Vegetation & Management Factor (C)

☒ Predefined Value

☐ Generalized - Agriculture (Alberta)

☐ Perm. Pasture, Range, Idle Land

☐ Undisturbed Forest Land

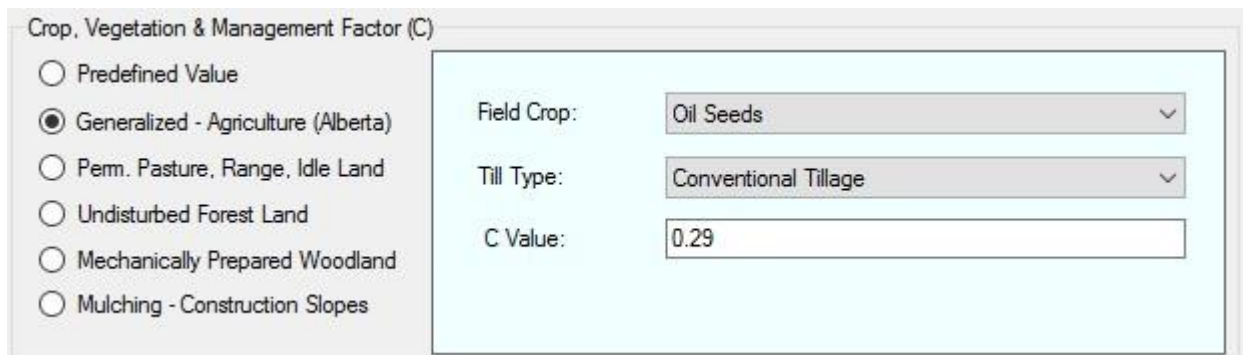
☐ Mechanically Prepared Woodland

☐ Mulching - Construction Slopes

C Value:

The C value can be entered manually with the Predefined Value option.

#### Generalized – Agriculture (Alberta)



Crop, Vegetation & Management Factor (C)

☐ Predefined Value

☒ Generalized - Agriculture (Alberta)

☐ Perm. Pasture, Range, Idle Land

☐ Undisturbed Forest Land

☐ Mechanically Prepared Woodland

☐ Mulching - Construction Slopes


Field Crop:

Till Type:


C Value:

Select field crop and till type from drop-downs. The C value will be populated automatically. The value is based on Table C-2a Generalized C Values for Alberta, RUSLEFAC Handbook.

**Permanent Pasture, Range, and Idle Land**

Crop, Vegetation & Management Factor (C)	
<input type="radio"/> Predefined Value <input type="radio"/> Generalized - Agriculture (Alberta) <input checked="" type="radio"/> Perm. Pasture, Range, Idle Land <input type="radio"/> Undisturbed Forest Land <input type="radio"/> Mechanically Prepared Woodland <input type="radio"/> Mulching - Construction Slopes	Vegetative Canopy Type: Tall weeds or short brush with avg. drop fall height of 20 inches (50 cm) ▾ Vegetative Canopy Percent Cover: 25% ▾ Soil Surface Cover Type: G - grasses ▾ Soil Surface Percent Ground Cover: 20% ▾ C Value: 0.17 

The calculation of value is based on *Table C-5: C Values for Permanent Pasture, Range, and Idle Land*, RUSLEFAC Handbook. Linear interpolation is used for calculated values that are not listed in the table.

To obtain a C factor value, select ***Vegetation Canopy Type and Height, Vegetative Canopy Percent Cover, Soil Surface Cover Type, Soil Surface Percent Ground Cover***, and click Calculate button .


**Undisturbed Forest Land**

Crop, Vegetation & Management Factor (C)	
<input type="radio"/> Predefined Value <input type="radio"/> Generalized - Agriculture (Alberta) <input type="radio"/> Perm. Pasture, Range, Idle Land <input checked="" type="radio"/> Undisturbed Forest Land <input type="radio"/> Mechanically Prepared Woodland <input type="radio"/> Mulching - Construction Slopes	Percent of Area Covered by Canopy of Trees & Undergrowth: 70% ▾ Percent of Area Covered by Duff At Least 2 Inches Deep: 85% ▾ C Value: 0.002

The calculation of value is based on *Table C-6: C Values for Undisturbed Forest Land*, RUSLEFAC Handbook.

Select ***Percent of Area Covered by Canopy of Trees and Undergrowth*** and ***Percent of Area Covered by Duff at least 2 Inches Deep*** from drop-downs. The C value will be populated automatically.

**Mechanically Prepared Woodland**

Crop, Vegetation & Management Factor (C)	
<input type="radio"/> Predefined Value <input type="radio"/> Generalized - Agriculture (Alberta) <input type="radio"/> Perm. Pasture, Range, Idle Land <input type="radio"/> Undisturbed Forest Land <input checked="" type="radio"/> Mechanically Prepared Woodland <input type="radio"/> Mulching - Construction Slopes	Site Preparation: <input type="text" value="Disked, raked, bedded"/> Mulch Cover (%): <input type="text" value="10%"/> Soil Condition: <input type="text" value="Fair"/> Weed Cover: <input type="text" value="NC - no live vegetation"/> C Value: <input type="text" value="0.54"/> 

The calculation of value is based on *Table C-7: C Values for Mechanically Prepared Woodland Sites*, RUSLEFAC Handbook.

**Mulching – Construction Slopes**

Crop, Vegetation & Management Factor (C)	
<input type="radio"/> Predefined Value <input type="radio"/> Generalized - Agriculture (Alberta) <input type="radio"/> Perm. Pasture, Range, Idle Land <input type="radio"/> Undisturbed Forest Land <input type="radio"/> Mechanically Prepared Woodland <input checked="" type="radio"/> Mulching - Construction Slopes	Type of Mulch: <input type="text" value="Straw or hay, tied down by anchoring and tacking equipment"/> Mulch Rate: <input type="text" value="1 US ton/Acre - 2.24 Tonne/Hectare"/> Land Slope %: <input type="text" value="8"/> Length Limit: <input type="text" value="100 feet - 30 meters"/> C Value: <input type="text" value="0.2"/>

The calculation of value is based on *Table C-8: Mulch Values and Length Limits for Construction Slopes*, RUSLEFAC Handbook.

**3.5 Support Practice Factor Calculation (P)**

The RUSLE P-factor reflects the impact of support practices on the average annual erosion rate. In the absence of any support practice, P assumes unity and equals 1 (RUSLEFAC Handbook).

The program supports only manual entry for the support practice factor. The value can be entered as a single value (Predefined Value) or as a multiplication of different P factors (Calculated Value).

**Predefined Value**

Support Practice Factor (P)

☒ Predefined Value  
☐ Calculated Value

P Value:

**Calculated Value**


Support Practice Factor (P)


☐ Predefined Value  
☒ Calculated Value


Practice Type

Comment

P Value:



	Type	Comment	Value
	Surface roughening		0.9
	Sediment basins		0.6

P Value:  


To add a support practice factor, select practice type from the *Practice Type* dropdown, enter P value, and click **Add** button:


Support Practice Factor (P)


☐ Predefined Value  
☒ Calculated Value

Practice Type

Comment

P Value:  

	Type	Comment	Value
	Surface roughening		0.9
	Sediment basins		0.6

P Value:  

The **Practice Type** dropdown contains the most popular erosion control and sediment control practices:

Practice Type

- Cross slope cultivation
- Contour farming
- Stripcropping
- Terracing
- Erosion control blankets
- Fiber rolls
- Sediment basins
- Surface roughening
- Silt fence
- Other

If the practice is not listed, it can be added as **Other** with the comment provided:

Support Practice Factor (P)

☐ Predefined Value  
☒ Calculated Value

Practice Type: Other

Comment: Straw bale barrier

P Value: 0.8

Type	Comment	Value
Surface roughening		0.9
Sediment basins		0.6

P Value: 0.54

The P value textbox on the right side of the form shows combined support practice factor value, calculated as a multiplication of all added practices.

### 3.6 System Output

To calculate the annual average soil loss, enter manually or calculate each of 5 soil erosion equation factors (R, K, LS, C, and P) and click **GO!** button:

Soil Erosion Calculator (RUSLEFAC)

Single Site Calculation Batch Calculation Help Software Activation

**Rainfall & Runoff Factor (R)**

☒ Predefined Value  
☐ Geo-Based Value (Alberta)

R Value: 320

**Crop, Vegetation & Management Factor (C)**

☒ Predefined Value  
☐ Generalized - Agriculture (Alberta)  
☐ Perm. Pasture, Range, Idle Land  
☐ Undisturbed Forest Land  
☐ Mechanically Prepared Woodland  
☐ Mulching - Construction Slopes

C Value: 1.0

**Soil Erodibility Factor (K)**

☐ Predefined Value  
☐ Textural Classification Code Based  
☒ Calculated Value

Percent Silt & Very Fine Sand: 45 Percent Sand: 25  
Percent Organic Matter: 0.0  
Soil Structure Code: 4 - Blocky, Platy, Massive  
Profile Permeability Class: 4 - Slow to Moderate  
K Value: 0.044

**Support Practice Factor (P)**

☒ Predefined Value  
☐ Calculated Value

P Value: 1.0

**Slope Length & Steepness Factors (LS)**

☐ Predefined Value  
☒ Calculated Value

Slope length (m, horizontal): 90  
Slope Steepness (%): 8.0  
Rill/Inter-rill Ratio: High  
LS Value: 2.2

R Value - Predefined  
R Value = 320  
K Value - Calculated Value  
Percent Silt & Very Fine Sand: 45  
Percent of Sand: 25  
Percent of Organic Matter: 0  
Soil Structure Code: 4 - Blocky, Platy, Massive  
Profile Permeability Class: 4 - Slow to Moderate  
K Value = 0.044  
LS Value - Calculated Value

Save GO!

The output text area will contain a detailed calculation log with the A value and Soil Erosion Class at the end:

R Value - Predefined

R Value = 320

-----

K Value - Calculated Value

Percent Silt & Very Fine Sand: 45

Percent of Sand: 25

Percent of Organic Matter: 0

Soil Structure Code: 4 - Blocky, Platy, Massive

Profile Permeability Class: 4 - Slow to Moderate

K Value = 0.044

-----

LS Value - Calculated Value

Slope Length: 90 m

Slope Steepness: 8%

Rill/Inter-rill Erosion Ratio: High

LS Value = 2.2

-----

C Value - Predefined

C Value = 1

-----

P Value - Predefined

P Value = 1

-----

$A = 320 * 0.044 * 2.2 * 1 * 1$

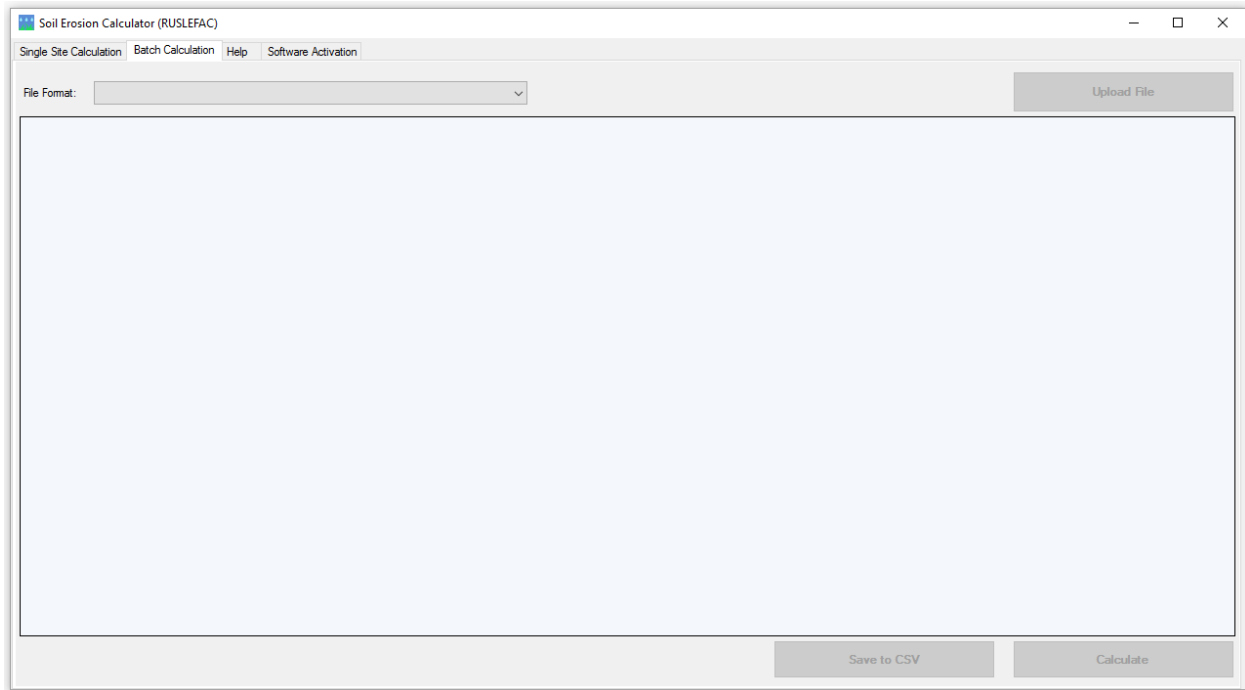
A = 30.976 tonnes/hectare/year

Soil Erosion Class: 4 High

You can edit the output log, copy and paste it to another file (using Ctrl+C, Ctrl+V), or save the output to the txt file (using **Save** button).

#### 4. Batch Processing

In addition to single site calculation, Soil Erosion Calculator supports a batch processing for multiple sites. For batch processing, open Batch Processing application tab:



The input information for batch calculation should be provided as a CSV file (Comma Separated Values). The current version of the software supports two input formats:

- Simple (5 input parameters)
- K-LS calculated (11 input parameters)

Sample Input files for both formats are stored in the *Examples* folder in the default *Input* application directory.

The input file with the simple format has the following structure:

```
#SiteId,R,K,LS,C,P
s1,320,0.042,1.47,1,1
s2,320,0.046,1.02,1,1
```

First line started with the hash sign (#) is the comment.

Other lines are comma-separated values for Site ID, R, K, LS, C, and P parameters.

Site ID is any unique ID associated with the site.

K-LS calculated input file has the following structure:

```
#SiteId,R,Silt and vfs (%),Sand (%),Organic Matter (%),Soil Structure
Code ,Profile Permeability Class,Slope Length (m),Slope Steepness
(%),Rill/Interrill Ratio (0-3),C,P
```

```
s1,320,10,15,2,3,4,120,5,2,1,1
```

```
s2,320,20,30,1,4,5,150,3,0,1,1
```

First line started with the hash sign (#) is the comment.

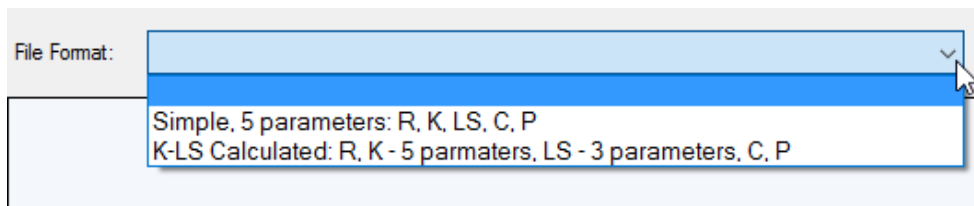
Other lines are comma-separated values for the following input parameters:

Site Id	-	any unique ID associated with the site;
R	-	rainfall factor value;
Silt (%)	-	% of silt and very fine sand for K factor calculation;
Sand (%)	-	% of sand for K factor calculation;
Organic Matter (%)	-	% of organic matter for K factor calculation;
Soil Structure Code	-	soil structure code for K factor calculation (from 1 to 4);
Profile Permeability Class	-	profile permeability class for K factor calculation (from 1 to 6);
Slope Length (m)	-	slope length in meters for LS factor calculation;
Slope Steepness (%)	-	slope steepness % for LS factor calculation;
Rill/Interrill Ratio (0-3)	-	rill/interrill erosion ratio code value: 0 – Low; 1 – Moderate; 2 – High; 3 – Thawing Soils;
C	-	crop/vegetation and management factor value;
P	-	support practice factor value.

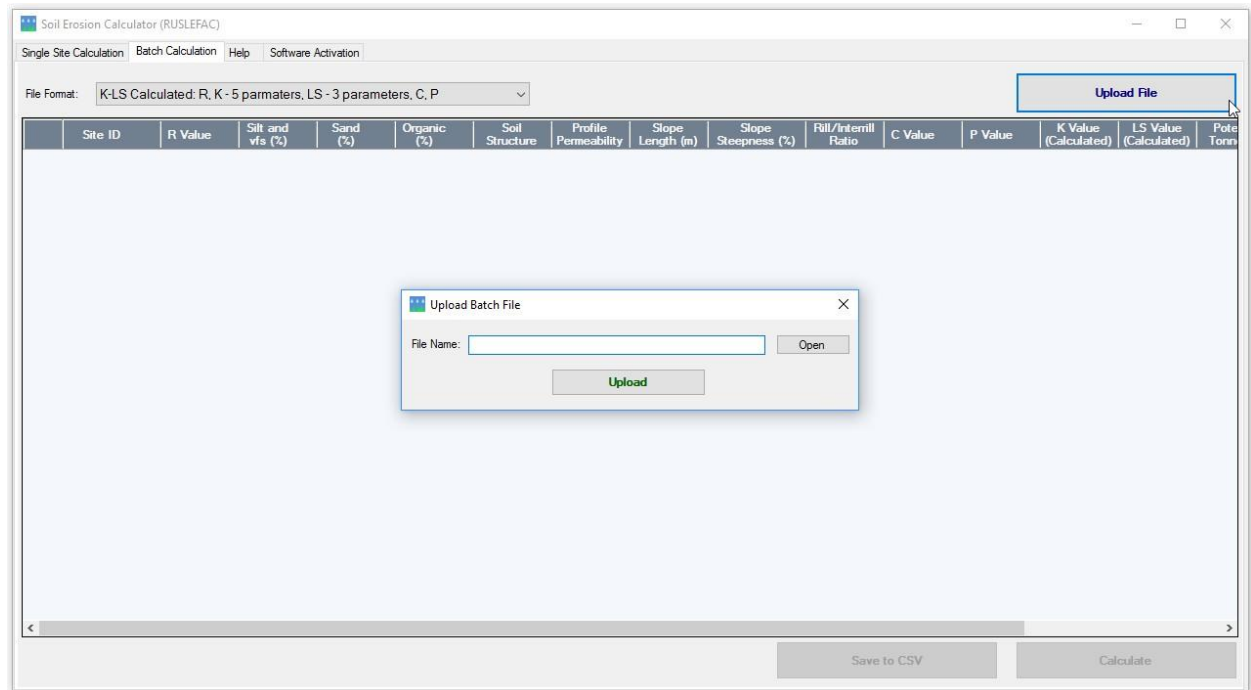
To run the batch file calculation:

1. Select file format from the dropdown list

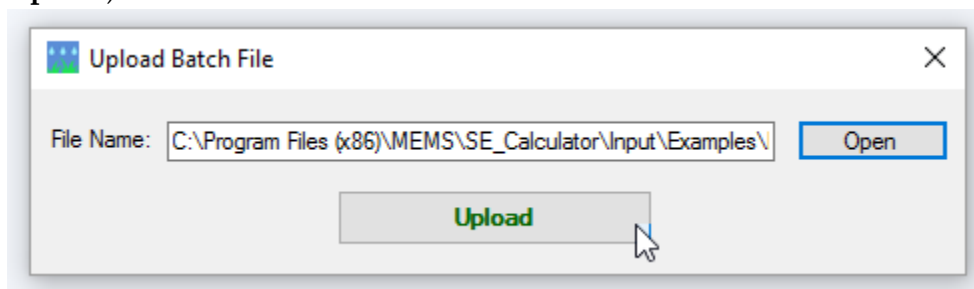




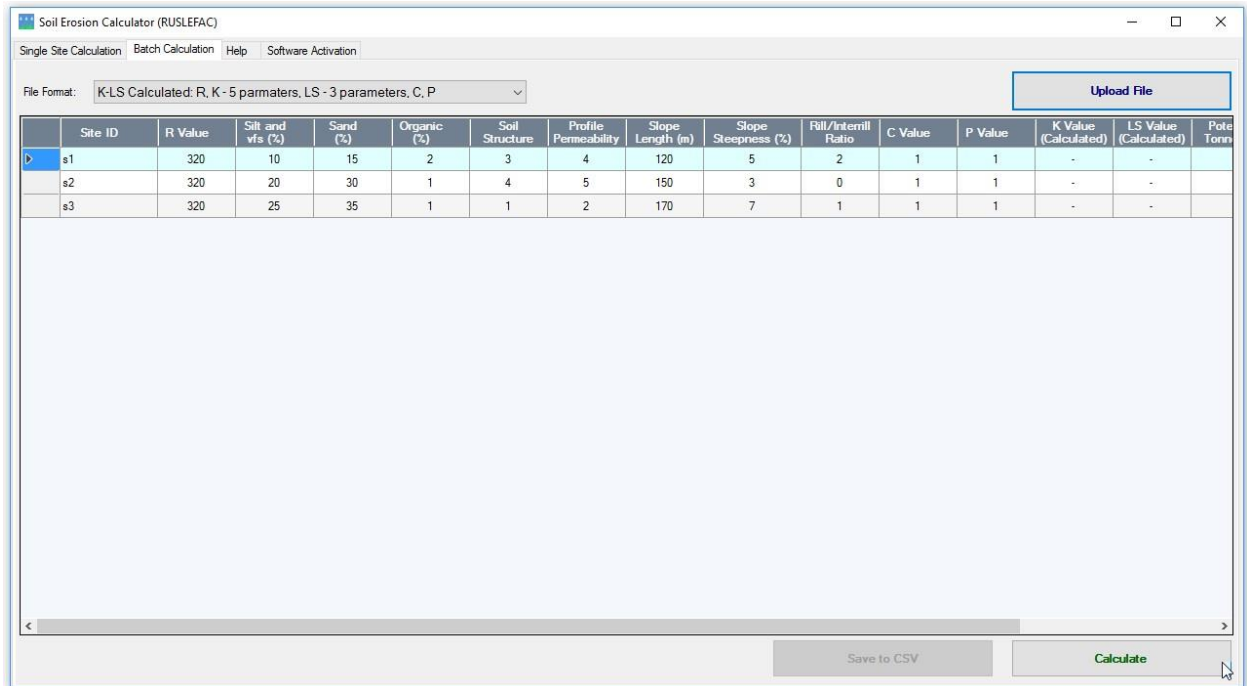
2. Click on **Upload File** button



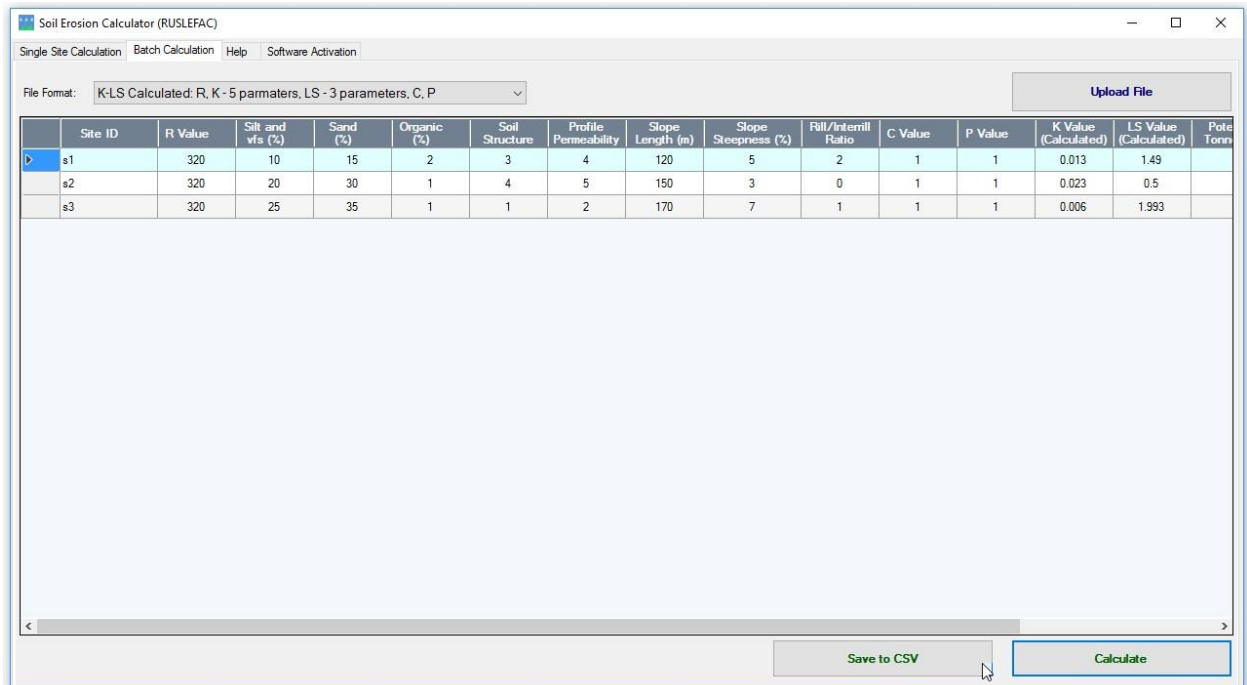
3. Open the file of the specified format (click **Open** button, select the file, then click **Upload**):



4. The file information will be shown in the grid. Click **Calculate** button to start the calculation:



5. Save results to CSV file using **Save to CSV** button:



Values calculated in a batch for simple (5 input parameters) format:

- A – potential annual soil loss due to erosion [tonnes/(hectare\*year)];
- Soil Erosion Class (RUSLEFAC).

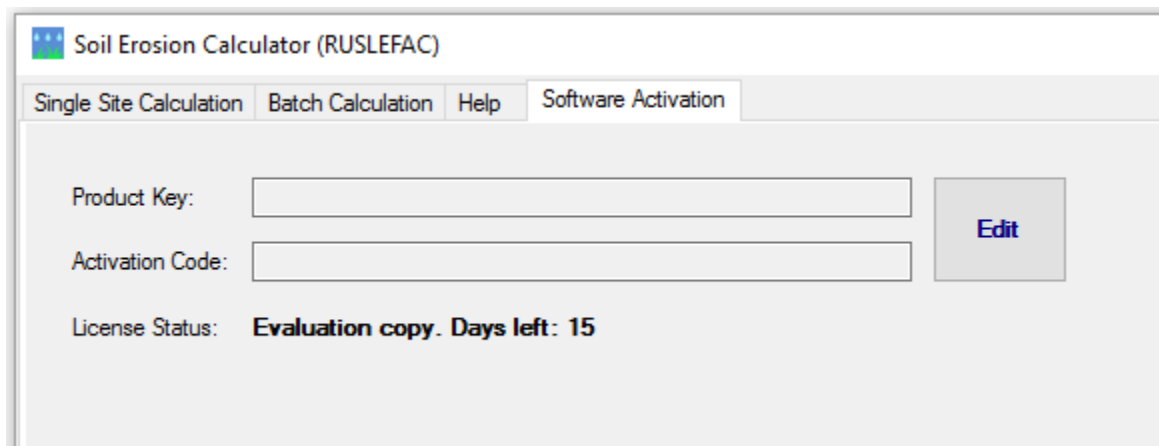
Values calculated in a batch for K-LS calculated (11 input parameters):

- K - soil erodibility factor [tonne\*hectare\*hour/(hectare\*Megajoule\*millimeter)];
- LS - slope steepness and slope length factor (dimensionless);
- A – potential annual soil loss due to erosion [tonnes/(hectare\*year)];
- Soil Erosion Class (RUSLEFAC).

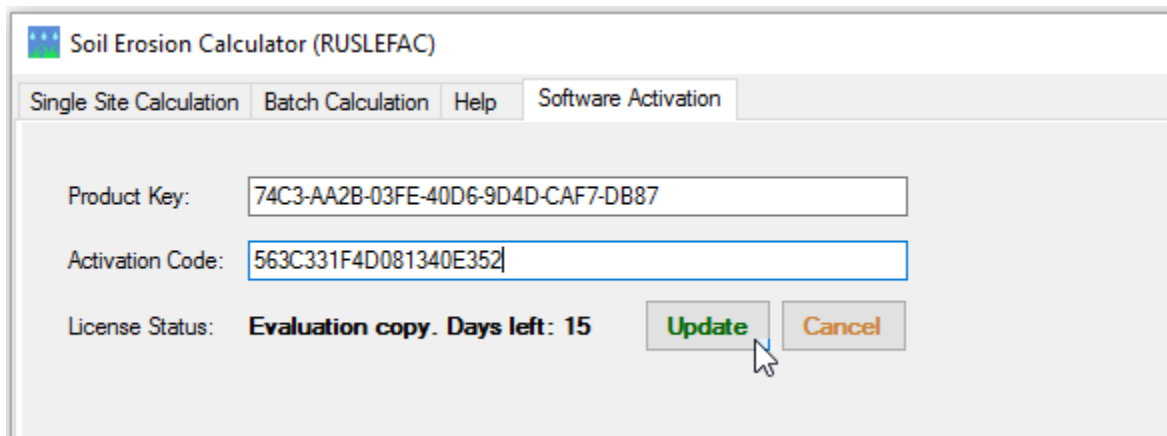
## 5. Software Activation

The initial installation of Soil Erosion Calculator is running as a 15-day fully functional trial version. In order to use the software after expiration of the trial period, you must purchase a license. To activate the software:

- Open the *Software Activation* tab



- Click **Edit** button and enter product key and activation code provided by manufacturer



- Click **Update** button to finalize the activation.

Software license is user-based. A product activation is required for each user of the software.

## 6. References

- Wall, G.J., Coote, D. R., Pringle, E. A., & Shelton, I. J. (Eds.). (2002). *RUSLEFAC — Revised Universal Soil Loss Equation for application in Canada: A handbook for estimating soil loss from water erosion in Canada*. Canada. Ottawa: Research Branch, Agriculture and Agri-Food Contribution No. AAFC/AAC2244E
- Soil Classification Working Group. (1998). *The Canadian system of soil classification* (3rd ed.).(Agriculture and Agri-Food Canada Publication). Canada. Ottawa.
- Wischmeier, W.H., Johnson, C.B. & Cross, B.V. (1971). A Soil erodibility nomograph for farmland and construction sites. *Journal of Soil and Water Conservation*, 26, 189-193.
- Foster, G.R., McCool, D.K., Renard, K.G., & Moldenhauer, W.C.. (1981). Conversion of the universal soil loss equation to SI metric units. *Journal of Soil and Water Conservation* 36, 355-359.
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- Auerswald, K., Fiener, P., Martin, W., & Elhaus, D. (2014). Use and misuse of the K factor equation in soil erosion modeling. *Catena*, 118, 220-225.