Effectively Understanding and Communicating Iowa's Corn Suitability Rating 2 (CSR2)

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Outline

Background Information

- My Background, Education, and Work Experience
- Current Employer
- My Family

Why I Chose A Module

- Topic Selection
- Why a Module?

Module

Quiz Questions

Questions

My Background, Education, & Work Experience

- Grew up in Cedar Rapids, Iowa
- Received Physics and Electrical Engineering degrees in 1983
- Worked at AT&T for 9 years as a customer support engineer and sales associate in Chicago and Indianapolis
- After getting an MBA in 1992, left AT&T for family business in Iowa – HandiMart Food Stores
- Family business was sold in 2006 to Casey's Convenience Store
- Bought my first farm in 2009 in Black Hawk county
- Started taking agriculture classes at Kirkwood Community College in 2011
- Entered ISU Agronomy Program in Fall of 2013

Current Employer

Nordstrom Family Farms LLC

- Two shareholders in the LLC
- Own four farms in Iowa – one in Black Hawk county and three in Fayette county
- Cash rent the farms
- Work with three different tenants
- Considering managing the farms myself

My Family

Nordstrom Family

- Carol – married 30 years
- Danny (28) – financial security lawyer in Denver
- Michael (24) – financial advisor in Boston
- Samuel (22) – senior at University of Iowa
- Maggie – soft-coated Wheaten Terrier

Topic Selection

Soil Productivity is Critical to Farmland Purchases

- Entered program to be a better landowner and farm manager
- Wanted to understand soil productivity inside and out – especially CSR2
- Wanted to do the creative component project on something useful for my work
- CSR and CSR2 were developed at ISU

Why A Learning Module?

Learning Module is an Interactive Learning Tool

- Guide is needed to show someone how to find the data and do the calculation
- Learning module is ideal for educating about a soil productivity ratings and explaining how to calculate CSR2
- CSR2 is a quantitative soil productivity index that uses online survey data for its calculation
- Wide audience for understanding CSR2 – farmers, landowners, investors, land assessment officials, realtors, and conservationists.

Module Content

Introduction

- Objective
- History of agricultural land classification in US
- Current Soil Productivity Indexes in the Midwest
- Soil Formation Background

Understanding CSR?

- Why is CSR important
- Technical Description of CSR

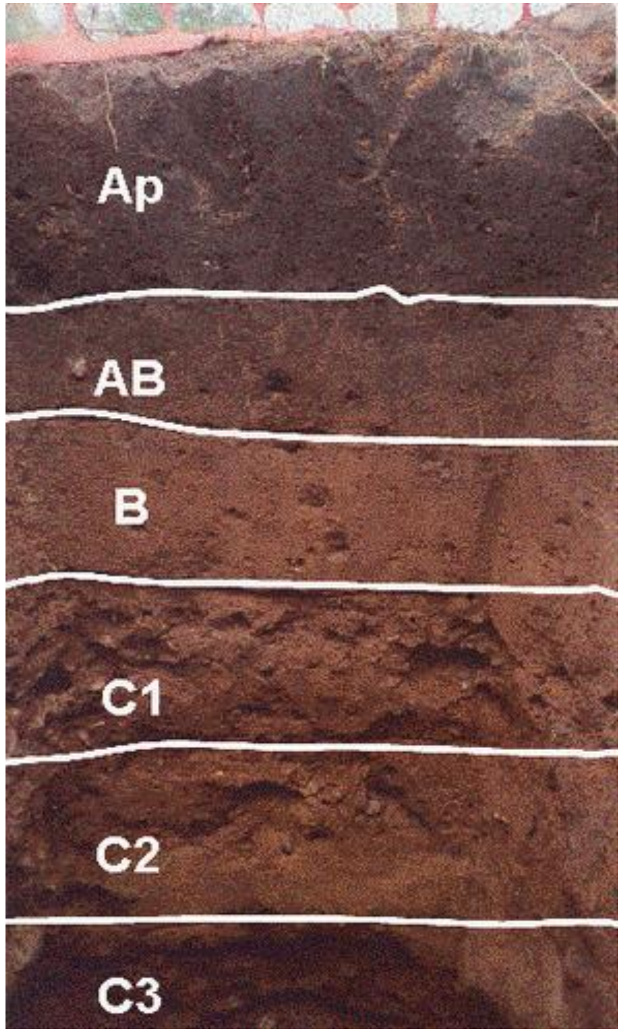
Reasons for changing from CSR to CSR2

Understanding CSR2?

- The CSR2 Equation and Technical Description
- Details of the CSR2 parameters
- Data for CSR2 Calculation
- Example calculation of CSR2

Differences between CSR and CSR2

Summary and Quiz



From - http://www.yukonenvirothon.com

Introduction

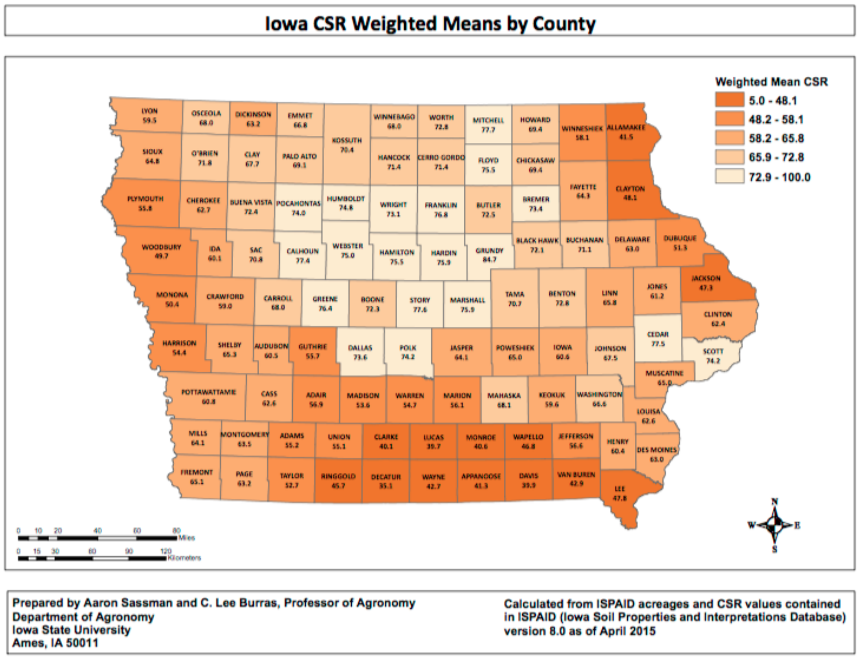
Iowa's Corn Suitability Rating (CSR) is a unique cropland rating system that measures Iowa's soil capability to grow corn. It is a soil productivity rating system that is only used in Iowa. It was developed by an Iowa State University (ISU) scientist in 1971 and has been used by Iowans for over four decades (ISU-IAHEES, 2013). Recently, CSR2 (second generation CSR) has been developed by the ISU scientific community to replace CSR. CSR2 was designed to closely replicate the original CSR result, and enhance it so that anyone can understand how the calculation of CSR2 is made. CSR2 was developed to use the latest soil science, be transparent, be easy to calculate, and be consistent with the original CSR values (Burras et al., 2010).

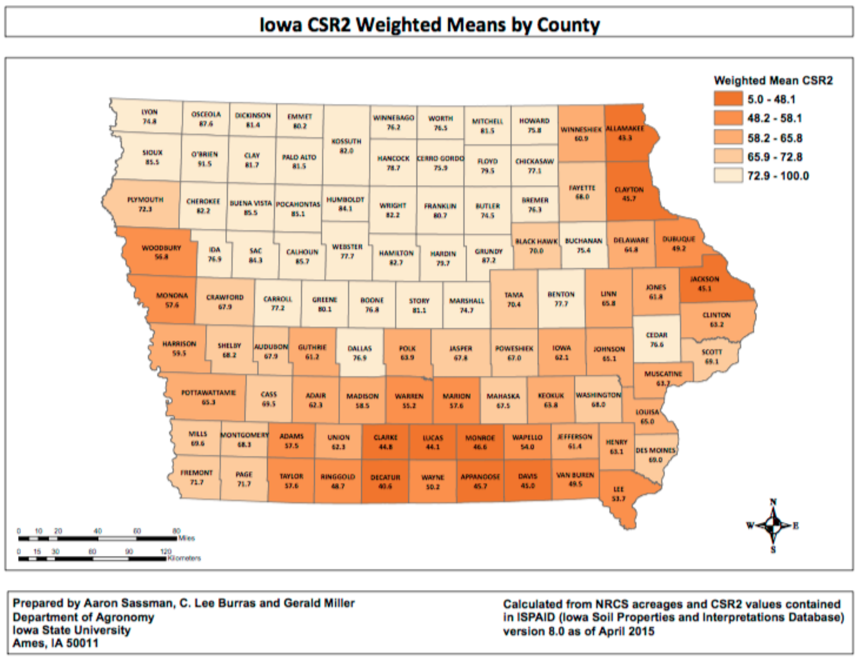
The objectives of this module are:

1. **To gain a perspective on the history of agricultural land classification and soil productivity ratings in the United States, and provide background information on the Jenny model of soil formation.**
2. **To understand of how CSR was developed, what it is, and why it is important.**
3. **To understand the reasons for developing CSR2.**
4. **To understand what CSR2 is, and to provide a guide for doing the actual calculation.**
5. **To highlight the differences between CSR and CSR2.**

Introduction

CSR2 is an amazingly easy to understand soil productivity index. It starts with a value that is defined by its taxonomic subgroup class for the dominant soil series. Then, soil productivity deductions are made for family particle sizes, increasing slopes, increasing May flooding and ponding, moderate and severe erosion classes, decreasing available water holding capacity in the top 60 inches, and less top soil depth (as measured by RUSLE T factors that are less than 5). Once you begin to understand CSR2 and see how it is calculated, you begin to easily see why CSR2 is a valuable soil productivity index and why Iowa's farms have different CSR2 values.





History of Agricultural Land Classification and Soil Productivity in US

Soil productivity rating systems in the United States have ranged between qualitative and quantitative throughout history. Qualitative soil productivity ratings can simply be descriptions of soils and the crops that best grow on them. Quantitative soil productivity ratings can use soil and landform properties (inductive) or use crop yield records (deductive) to define the soil productivity rating for a soil (Huddleston, 1983).

United States Department of Agriculture (USDA) created under President Lincoln

The USDA was created under President Lincoln in 1862. Lincoln was a farmer and understood its importance to the United States. Over 50 percent of the US population were farmers. The first Commissioner of Agriculture was Isaac Newton and during his first annual report he said that collecting agricultural data and analyzing soils was an objective of the USDA (Rasmussen, 1986).

From - http://globalfarmernetwork.org/wp-content/uploads/2014/11/lincoln-thanksgiving-farmer-360x240.jpg

History of Agricultural Land Classification and Soil Productivity in US

Government rated cropland since late 19th century

The US government has always wanted to rate agricultural soils land since the late 19th century. The main reason was the equalization of land values and tax assessments. The government needed to be able to rate the economic benefits of cropland so that the proper property taxes could be assessed (Huddleston, 1983).

From - http://www.millcitymuseum.org/wheat-fields

USDA created Division of Soils in 1894

Division of Soils first examined soil moisture and temperature in important soils. The first director, Milton Whitney, quickly moved the Division of Soils towards soil survey work (Huddleston, 1983). Early soil surveys in the U.S. began in 1896 (Soil Survey Division Staff, 1993).

History of Agricultural Land Classification and Soil Productivity in US

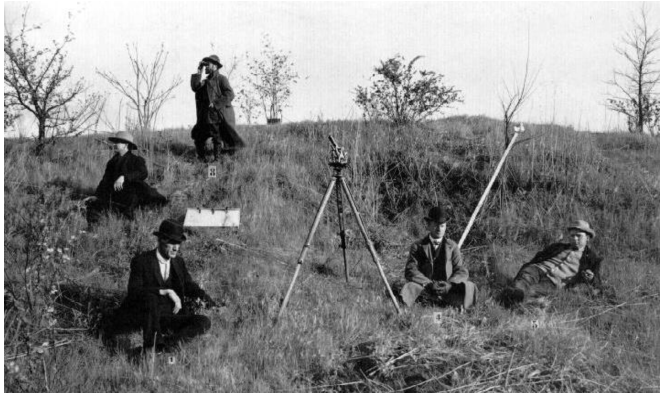
Division of Soils became USDA Bureau of Soils in 1901

Their main focus was creating qualitative soil surveys that showed some soil properties, such as texture and structure, but emphasized the best crops for the soil based on crop yields (Huddleston, 1983). The only way to do this was to survey soil throughout the United States. The first soil survey in Iowa was published in 1903 in the Dubuque County area (Fenton and Miller, 2011).

1920

After World War I, the USDA began to emphasize land classifications rather than soil productivity (Huddleston, 1983).

From -http://www.mngeo.state.mn.us/chouse/GLO/



From - http://www.public.iastate.edu/~fridolph/dnrglo.html

From - http://likesuccess.com/img4754138

History of Agricultural Land Classification and Soil Productivity in US

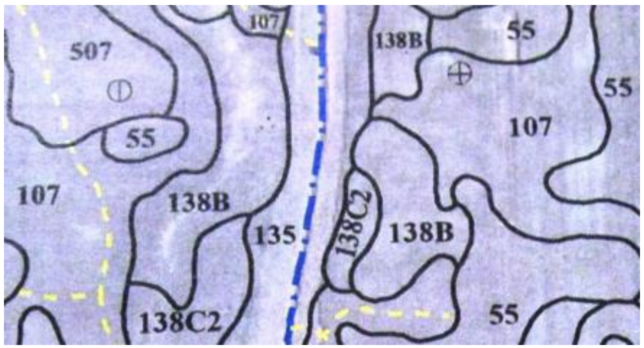
1934

The National Resources Board (NRB) was created to analyze the use of sub marginal land for agriculture that had occurred because of the Homestead Act and the economic depression (USDA-ERS, 1965). The NRB requested the USDA to help inventory the agricultural land of the country. This resulted in the USDA asking that state soil scientists provide data on the soils of their state. The result was the first effort at a national soil productivity rating system. Productivity ratings for major crops then began to show up in the USDA soil surveys by the mid-1930s.

1940

Crop yield data for soil types began to replace soil productivity ratings in soil surveys. By the 1950s, tables of estimated yields had replaced soil productivity ratings (Huddleston, 1983). Yield data was simply easier to understand.

https://www.nrcs.usda.gov/Internet/FSE_MEDIA/nrcseprd329815.jpg



http://www.extension.iastate.edu/soils/sites/www.extension.iastate.edu/files/soils/webstmap.jpg

https://www.nrcs.usda.gov/Internet/FSE_MEDIA/stelprdb1266583.jpg

History of Agricultural Land Classification and Soil Productivity in US

1950-1970

Over the next few decades, agronomists from individual states began to develop their own productivity rating systems for cropland based on the state's soil variations. Qualitative and quantitative soil productivity ratings were developed. <u>Because using only yield data for creating soil productivity ratings has limitations, most soil scientists began to use a combination of soil properties, landscape features, weather conditions, and yield data to determine soil productivity ratings for all soils</u>. Yield data was used to confirm the productivity potential of soils (Huddleston, 1983).

ISU Agronomists and Scientists Were Active in Developing Productivity Rating System

With extensive soil surveys and detailed crop yield data for most soils, agronomists at ISU developed a quantitative soil productivity rating system for Iowa soils. Dr. Thomas Fenton developed the Corn Suitability Rating in 1971 (ISU-IAHEES, 2013), which was in use until CSR2 was officially introduced. Dr. Lee Burras was given the task of updating CSR into CSR2 in 2010. CSR2 was officially rolled out in 2013.

History of Agricultural Land Classification and Soil Productivity in US

Current Soil Productivity Indexes in the Midwest

The Midwestern states in the corn belt have several versions of soil productivity indexes (Sassman and Burras, 2016). Each one has a slightly different angle. Some are quantitative and some are qualitative. Some are inductive and some are deductive. Iowa, of course, has CSR and CSR2, which is quantitative inductive.

- Iowa – CSR/CSR2 - Quantitative
- Minnesota – CPI (Crop Productivity Index) - Quantitative
- North Dakota – Soil Survey Productivity Index - Quantitative
- South Dakota – Soil Productivity Rating - Quantitative
- Wisconsin – Land Productivity Grade - Qualitative
- Illinois – OPI (Optimum Productivity Index) - Quantitative
- Missouri – Agricultural Land Grades - Qualitative
- Nebraska – Land Capability Groups (LCG) - Qualitative
- Indiana – Soil Productivity Ranking Factor (SRF) – Quantitative

Soil Formation Background

To create Iowa's soils, you begin with residual bedrock as the foundation that was formed billions of years ago (Prior, 1991). Then, you add parent material (glacial till and wind-blown loess), climate (temperature, precipitation, and wind), topography (slope and flatness), life organisms (plants, animals, microbes, and humans), and time (which allows for weathering of soil).   These five factors are from the Hans Jenny model that was published in 1941 (Schaetzl and Thompson, 2015).

From - http://kansasagnetwork.com/wp-content/uploads/2016/08/Farmland-3.jpg

Soil Formation Results from:

- Geology – Bedrock and Parent Material
- Climate – Temperature, Wind, and Precipitation
- Biota – Plants and Animals
- Relief – Catena Formation across the Landscape
- Time – 4.5 Billion Years of Soil Formation

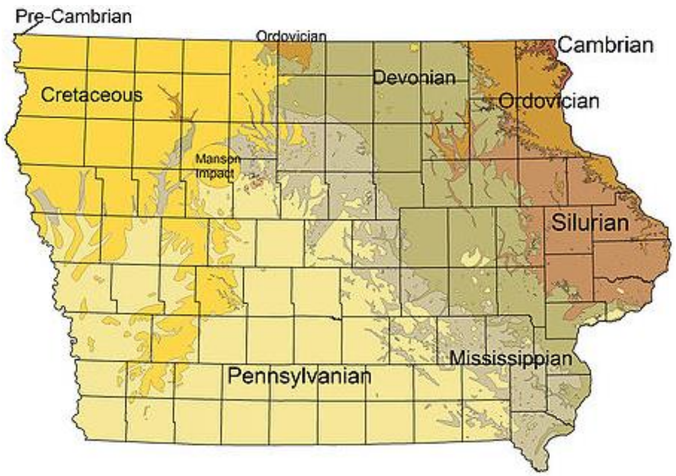
**More information is available at the "Basics of Soil Formation" module on the Crop Advisor Institute website (Anthofer, 2006).

From - https://tickertape.tdameritrade.com/investing/2015/06/investing-farmland-reit-19421

Soil Formation Background

Bedrock

The bedrock of Iowa consists of multiple layers of prehistoric sediment that was compressed into shale, dolomite, limestone, sandstone, and other sedimentary rock. The ancient sediment was from shallow seas, swamps, and deltas that once covered parts of Iowa. Some of the ancient rocks date back to the Precambrian period (0.545 – 4.5 billion years) (Prior, 1991).



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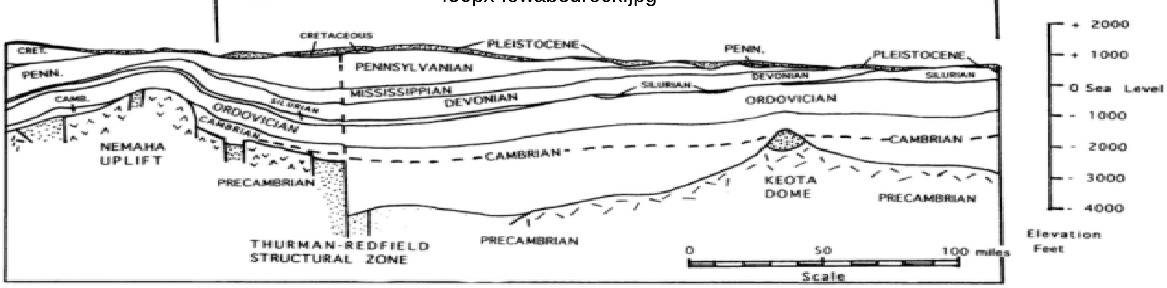
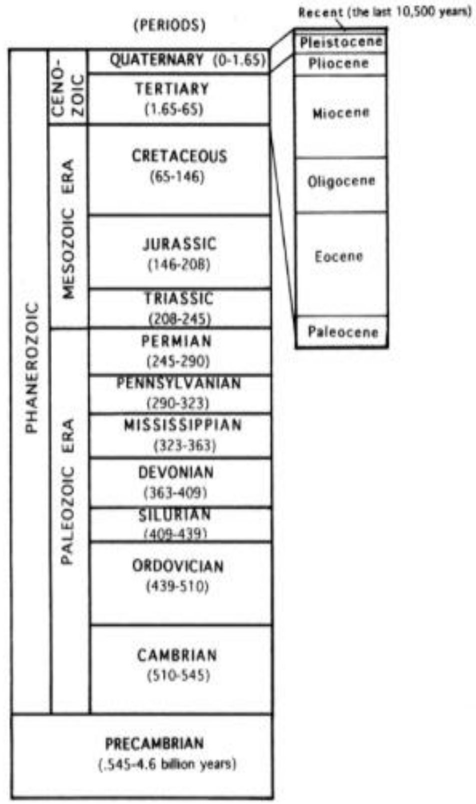


Iowa's geological cross section
From – Iowa's Geological Past (Anderson, 1998)

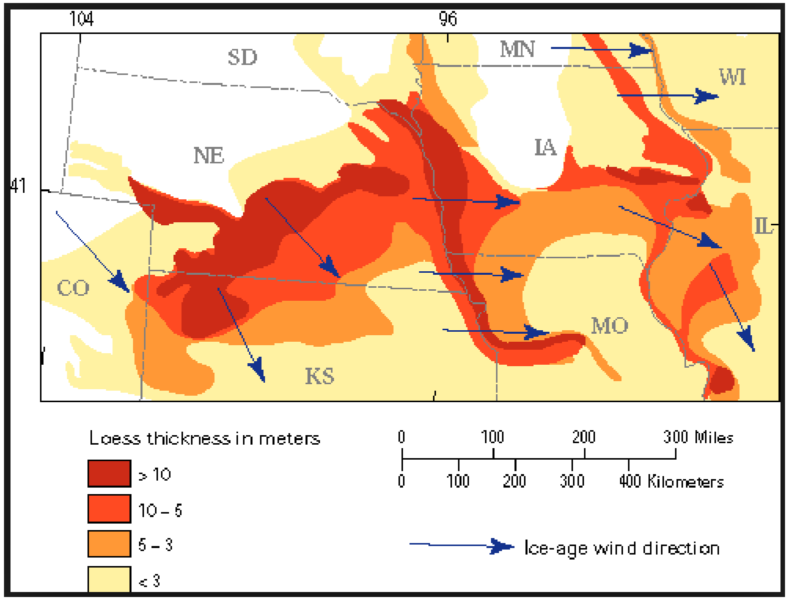


The geologic time scale
From – Iowa's Geological Past (Andersen, 1998)

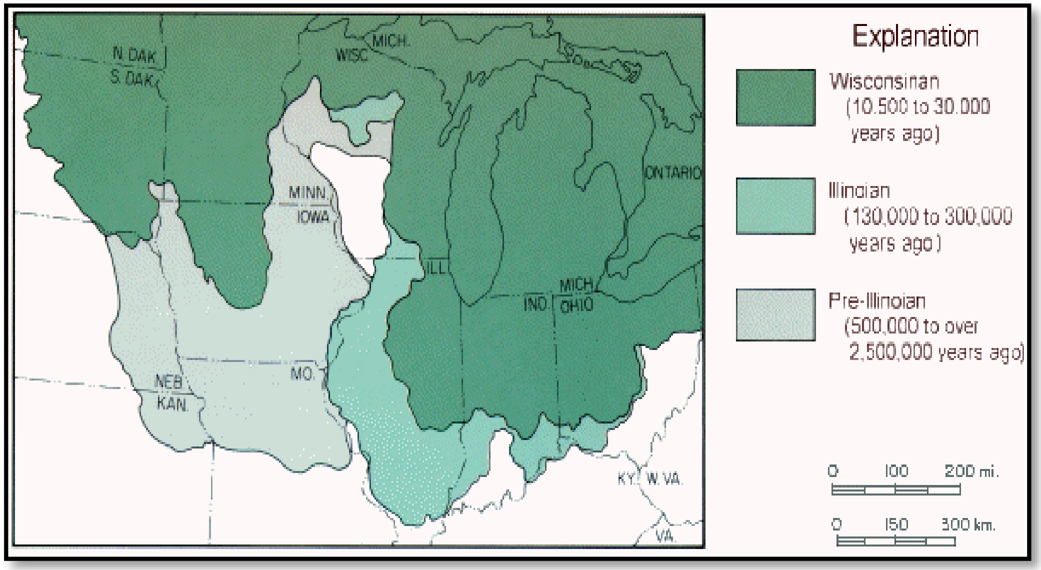
Soil Formation Background

Parent Material

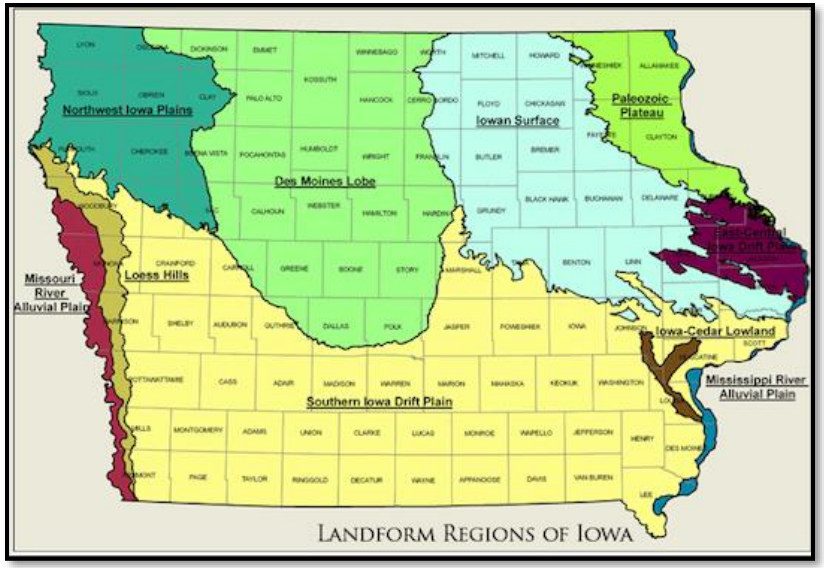
Transported parent material consists of unconsolidated deposits. Glacial ice sheets that once covered Iowa and wind-blown soils (loess material) from the Missouri River Valley and glacial areas played a huge role in Iowa's soils. Glaciers moved rocks and other material from northern territories into Iowa and other Midwestern areas. This glacial till covered sedimentary and metamorphic bedrock that had formed over time when volcanoes flowed and shallow ocean water covered Iowa (Prior, 1991).



Midwest Loess Deposits
From - http://skywalker.cochise.edu/wellerr/students/glacial-iowa/project.htm



Areas of Glaciation –
From http://skywalker.cochise.edu/wellerr/students/glacial-iowa/project_files/image001.gif



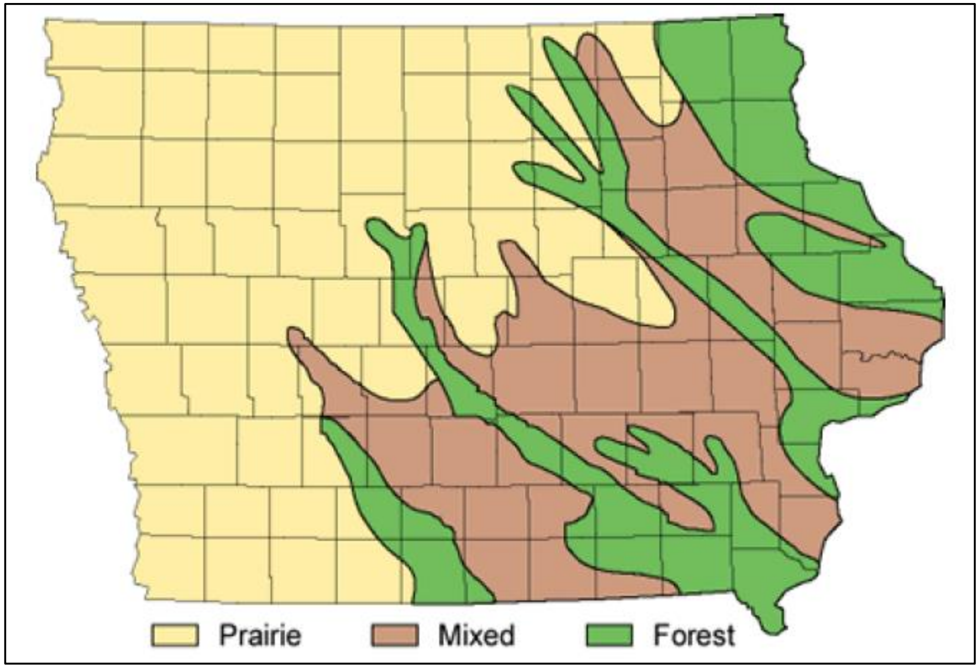
From - http://www.iowadnr.gov/Conservation/Wildlife-Stewardship/Iowa-Wildlife-Action-Plan/Landform-Regions-of-Iowa

Soil Formation Background

Biota

The natural vegetation that formed in the early soils of Iowa included prairies and forests. The decayed roots and decayed plant materials on the surface contributed to the soil's organic matter that formed in the upper profiles. Micro fauna and micro flora also added organic matter to the soil. Because of the large amount of prairie vegetation that originally grew in Iowa, rich black fertile soil was formed in the A horizon (Brady and Weil, 2008).

Loess Hill
From - http://inhfblog.org/wp-content/uploads/2016/07/Landscape-View.jpg



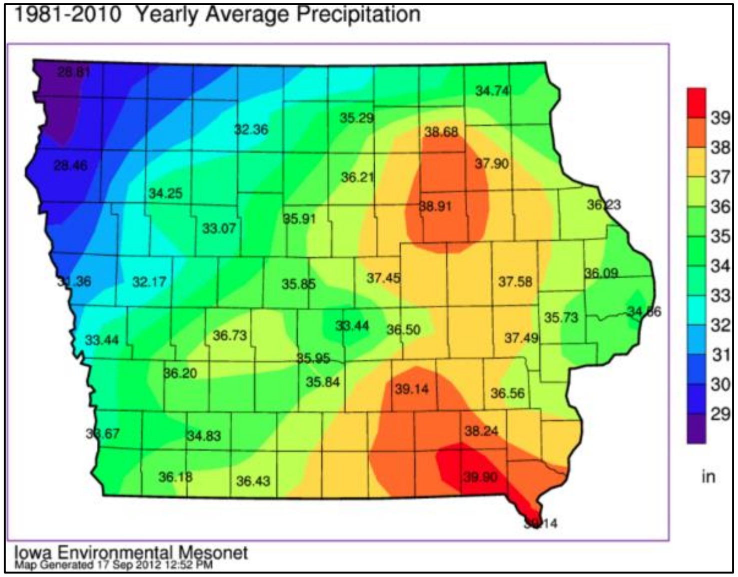
Iowa's Native Vegetation
From https://masters.agron.iastate.edu/classes/502/lesson01/1.1.1.htmi

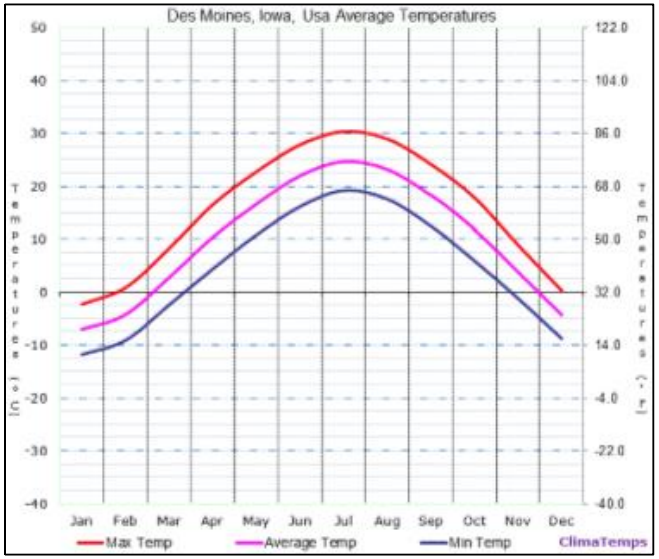
Soil Formation Background

Climate

The three climatic processes that affect soil formation include precipitation, temperature, and wind.

- Measurable precipitation causes plant growth, chemical reactions, erosion, and translocation of minerals.
- Warmer temperature causes plant growth, soil life, chemical reactions, and faster organic matter decay periods. Intermittent freezing temperatures cause freezing and thawing, and helps break rocks and compacted soil (USDA-NRCS, 2010).
- Higher wind speeds cause light dry soil particles to be moved to new locations.



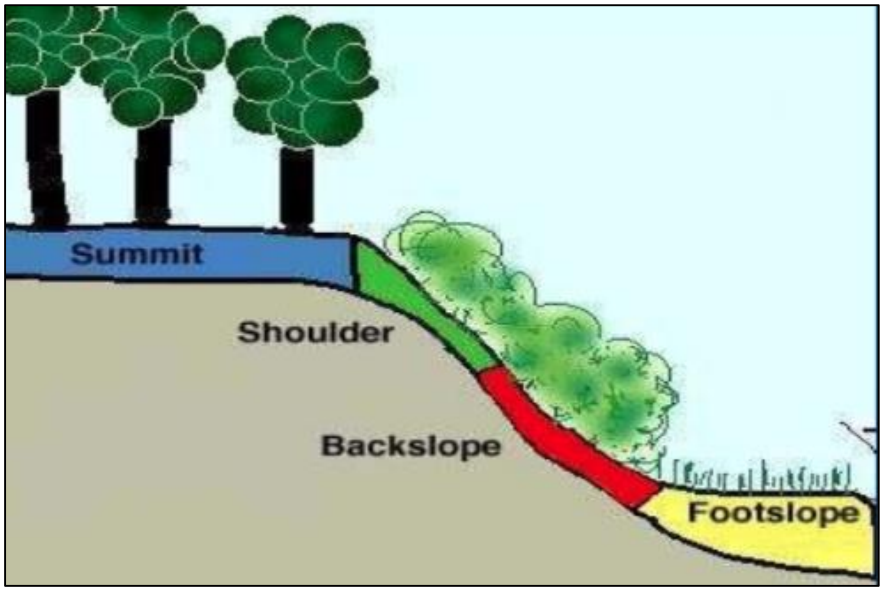


http://www.des-moines.climatemps.com/temperatures.php

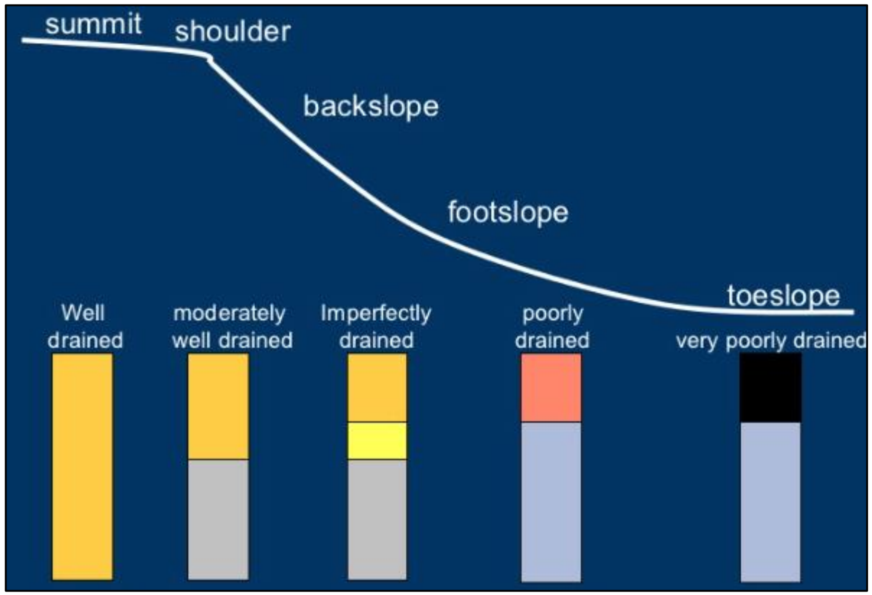
Soil Formation Background

Relief (Topography)

The topography of the land helps to determine the type of soil that forms. Generally, the slope and location point on the landscape influences the drainage and the erosion. Erosion occurs more readily on a steep hill than on a flat footslope. Moisture will runoff slopes more readily than low lying areas (USDA-NRCS, 2010). Erosion and drainage of sloped landscape influences the formation of the soil and their horizons.



Drawing by Greg D. Pillar

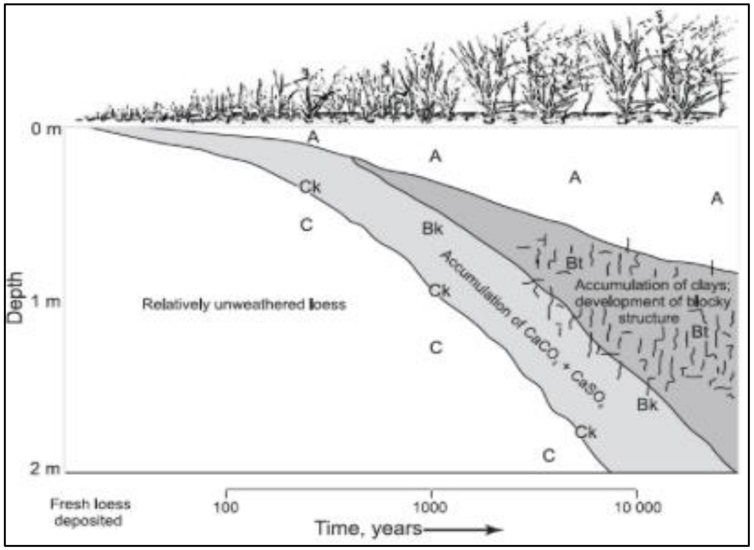


Drawing by Greg D. Pillar

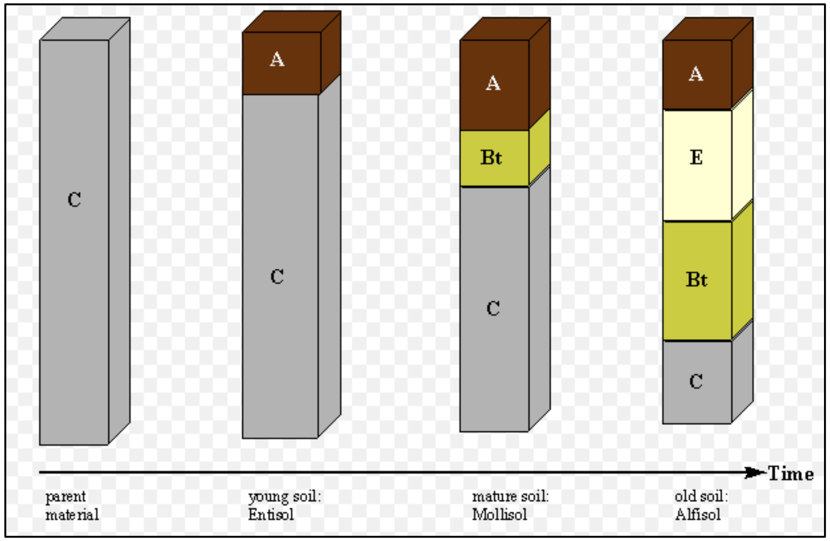
Soil Formation Background

Time

The earth is approximately 4.5 billion years old. Iowa's oldest known bedrock dates back to the Precambian period (0.54 - 4.5 billion years ago). Iowa's ancient bedrock is buried by the glacial till and wind-blown loess from the Pleistocene Epoch (10,500 – 1.65 million years). The last glacial ice to cover parts of Iowa was the Wisconsin glacier (10,500 to 14,000 years ago). Thus, Iowa's soils have been forming and evolving for thousands of years (Prior, 1991). Time allows for the weathering of soil and the consolidation of the horizon layers. The figures below illustrate the effects of time on changing soil horizon profiles.



Stages of Soil Development
From - Brady, N.C. and Weil, R.R. 2008. The Nature and Properties of Soil. Pearson Prentice Hall.

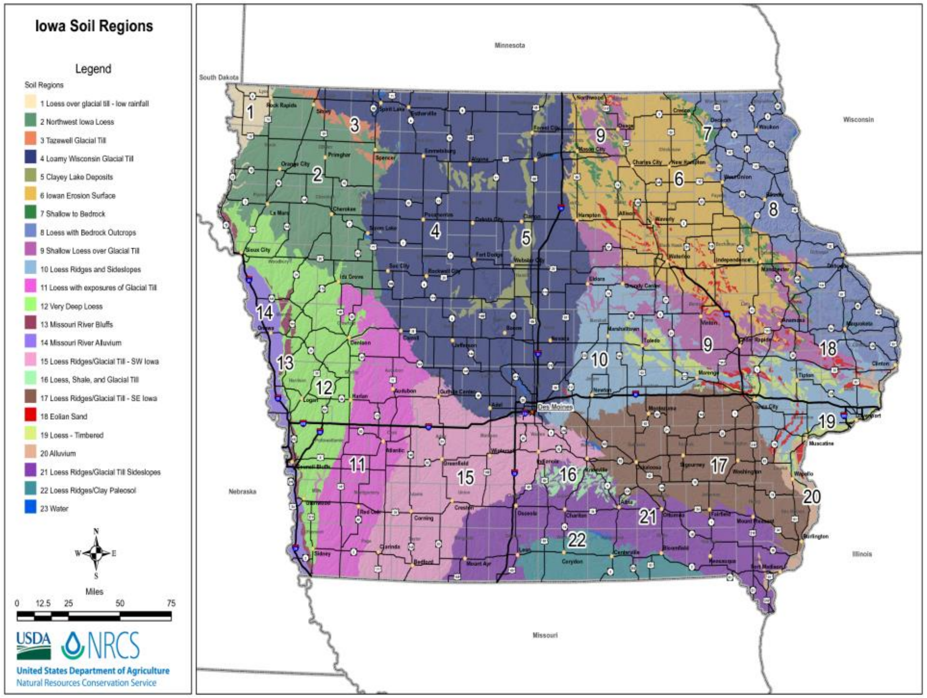


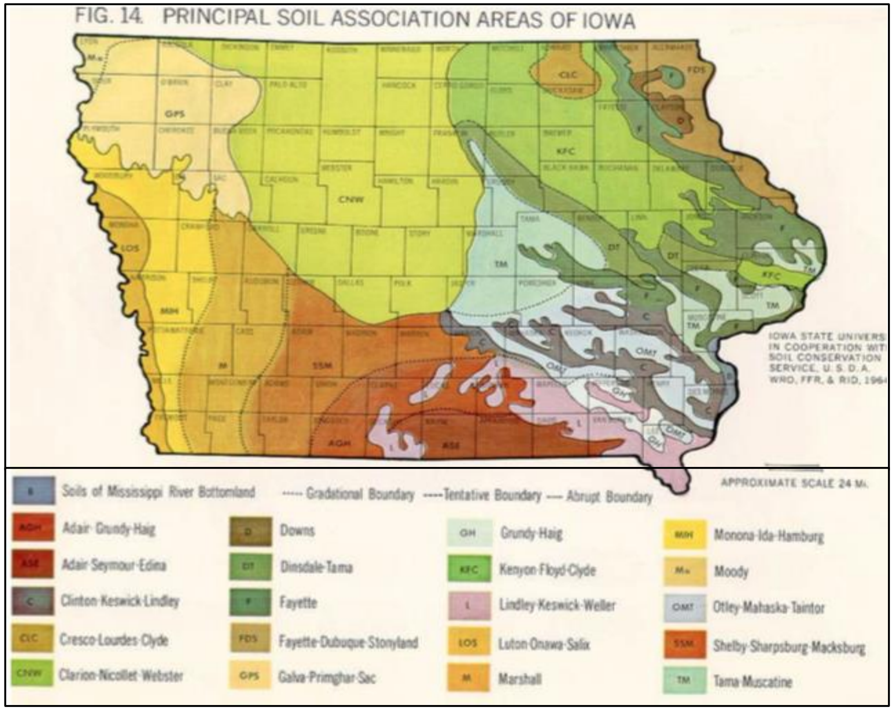
Stages of Soil Development
From -
https://soils.ifas.ufl.edu/faculty/grunwald/teaching/eSoilScience/formation.shtml

Soil Formation Background

Soil Association Results

The final results of the soil formation processes are soil regions of Iowa (lower left figure) that translate into soil association areas of Iowa (lower right figure). The soil association areas show the principal soils that formed in the different regions of Iowa, which are the result of parent material, biota, climate, relief, and time (Burras, 2014) The CSR and CSR2 take into account the morphological characteristics of these soils.





From - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006361.pdf

Understanding CSR?

Brief Description

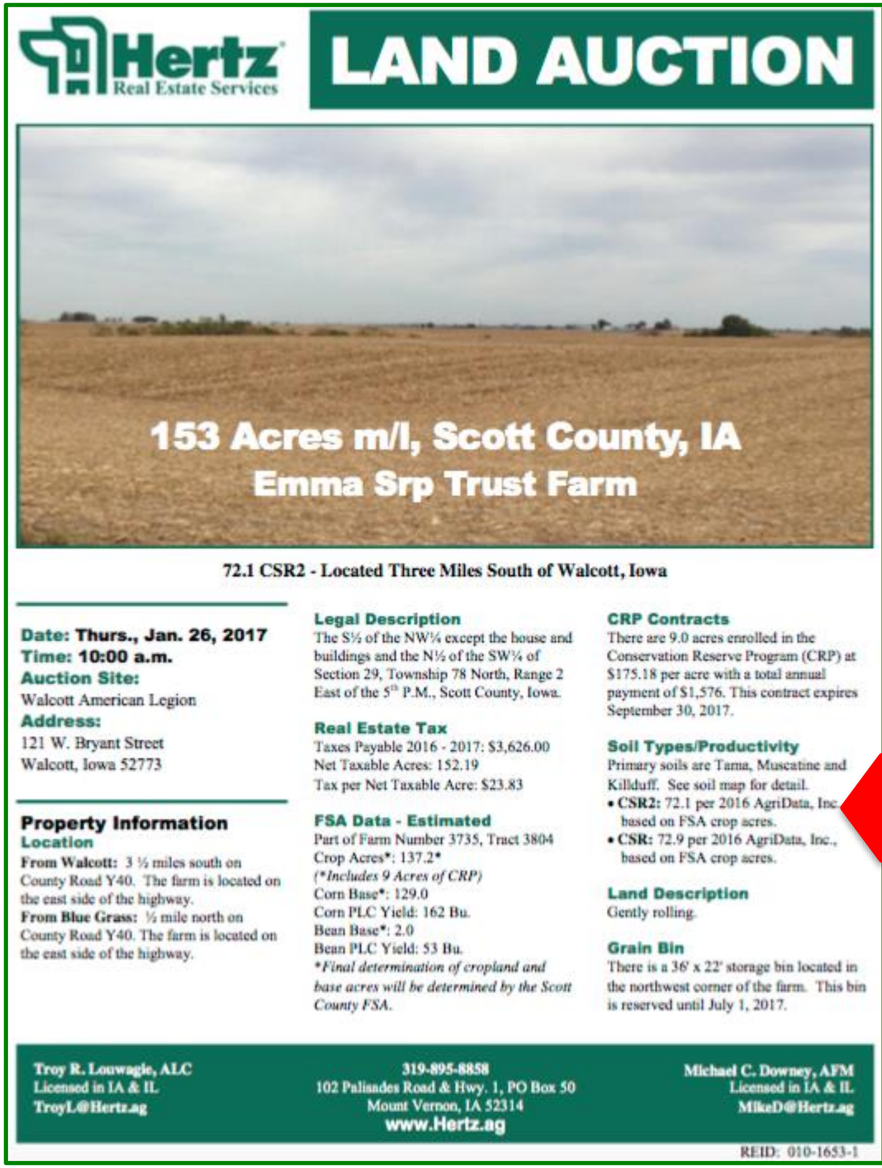
- CSR is a soil productivity index that rates each soil mapping unit (SMU) in Iowa for its potential corn row-crop productivity. CSR values range from 5 to 100 with 100 being the best (Fenton et al. 1971).
- Dr. Thomas Fenton and his team from Iowa State University developed CSR in 1971.
- As Dr. Burras puts it, they used a statistical approach linking crop yields to pedological features of 290 of Iowa’s soil series and phases.
- The yields came from the 15 test farm study sites across Iowa, and the pedological features came from the NRCS soil survey.
- Expert interpretation was used.

Understanding CSR?

Importance of CSR

Over the past 40 years CSR has been used to help determine land values for property taxation, evaluate land values for sales, help predict yields, negotiate cash rents with tenants, and help plan for conservation planning (Miller, 2005).

- ➢Determine land values for property taxation
- ➢Evaluate land values for sales
- ➢Predict yields
- ➢Negotiate cash rents
- ➢Plan for conservation planning



From - http://realestate.hertz.ag/LandForSale

Understanding CSR?

Technical Description of CSR

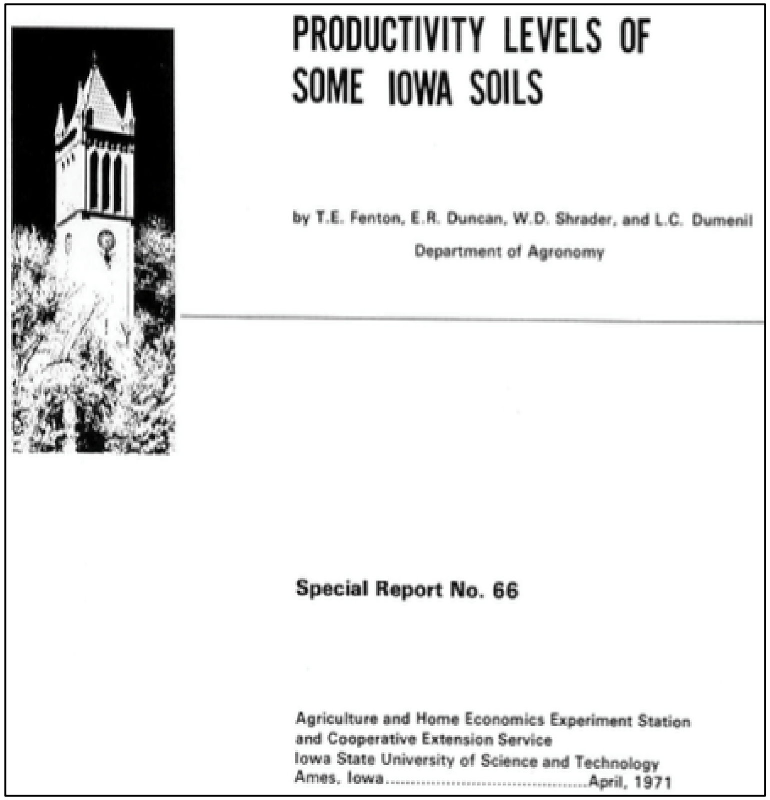
- Historical yield data, weather, and soil property data were used to assign CSR index values to soil mapping units.
- The quantitative system that Dr. Fenton developed starts with 100 for the best soil with high corn yields in normal weather conditions and then subtracts amounts for various soil and weather conditions. The Tama and Muscatine silty clay loam soil types were the only soils assigned a CSR value of 100 (Fenton et al., 1971).
- The CSR of 100 was assigned to benchmark soils that had high yield data, had no physical limitations, were located in the areas of the most favorable weather conditions in Iowa, could be continuously row cropped, and occurred on minimal slopes (Fenton et al., 1971).
- Eleven adjustments are made for the non-benchmark soils.

Understanding CSR?

Technical Description of CSR

CSRs for non-benchmark soils are based on 11 parameter deductions. This list shows the actual 11 CSR parameter deductions that Dr. Fenton used to penalize non-perfect soils. The parameters that could affect the CSR value the most included slope, erosion, depth phase, parent material, and wetness (Fenton et al., 1971).

1. Slope (Slope Groups - A through G)
2. Erosion (Erosion Groups - 1 through 3)
3. Biosequence (Prairie, Prairie/Forest, Forest)
4. Wetness (Landscapes and Drainage)
5. Calcareous soils (Calcareous soils have lower CSRs)
6. Depth Phase (Soils with thin solums have lower CSRs)
7. Sandy or gravelly soils
8. Precipitation factors for Iowa (Western and NW Iowa have lower CSRS)
9. Deposition and special soil modifiers
10. Parent materials (Glacial till soils have lower CSRs than loess soils)
11. Muck and peaty soil


PRODUCTIVITY LEVELS OF SOME IOWA SOILS

by T.E. Fenton, E.R. Duncan, W.D. Shrader, and L.C. Dumenil
Department of Agronomy

Special Report No. 66

Agriculture and Home Economics Experiment Station
and Cooperative Extension Service
Iowa State University of Science and Technology
Ames, Iowa ....April, 1971

Reasons for Changing from CSR to CSR2

Reasons for CSR2 Development

The main problem with CSR was that it was not easily understood and could not be replicated by anyone other than a soil scientist (Jensen, 2013).

Current soil knowledge and mapping techniques have improved dramatically since the early 1970s (Jensen, 2013).

The current national soil taxonomy classification system was not used in developing CSR (Burras et al., 2013). This national soil taxonomy classification system was published in 1975. Dr. Fenton used the 1938 classification system.

CSR assumed a pure soil type and did not measure the soil variability within the soil-mapping unit (Burras et al., 2010). CSR2 in the Web Soil Survey uses an area-weighted average including dominant and minor soils (USDA-NRCS, 2013).

The intent of developing CSR2 was to make it fully transparent and easily calculated using online soil survey data from the NRCS, which includes dominant and minor soils in each soil mapping unit (Burras et al., 2010). The intent was also to use the same pedological principals and be comparable to CSR.

A final reason for the development of CSR2 was the desire to be able to calculate CSR2 values on any soil in the United States (Jensen, 2013). Currently, there are multiple productivity indexes throughout the United States.

Understanding CSR2?

The CSR2 Equation

The calculation of CSR2 is somewhat similar to CSR. Instead of 11 parameter deductions, CSR2 uses a starting parameter and 5 parameter deductions (Burras et al., 2015) :

CSR2 = S – M – F – W – D +/- EJ, where:

- S is the taxonomic subgroup class of the soil series
- M is the family particle size class
- F refers to the field conditions of a particular SMU (slope, May flooding, May ponding, and erosion class)
- W is the available water holding capacity
- D is a soil depth and erosion factor RUSLE T (soil resiliency)
- EJ is deductions based on parent materials

Understanding CSR2?

The Method used by Dr. Burras and his team

- Used the Soil Taxonomy publication of 1975 to classify Iowa's soil series.
- Used statistical analysis and evaluation of CSR values to determine the appropriate CSR2 component deduction values.

Used the taxonomic subgroup class (S) of the soil series to group them into a starting productivity parameters. ***The S factor represents the parent material, biosequence, wetness, and calcareous soil of CSR***.

Used family particle size (M) to represent *soil parent material, texture, wetness, sandy or gravelly soils of CSR*.

Used field conditions (F) to *represent slope, erosion, and wetness of CSR*.

Used available water holding (W) capacity to represent *wetness of CSR*.

Used soil depth and tolerable rate of soil erosion (D) to *represent erosion and depth phase of CSR*.

Used expert judgment (EJ) to represent unusual soil scenarios, such as extremely sandy or clayey conditions.

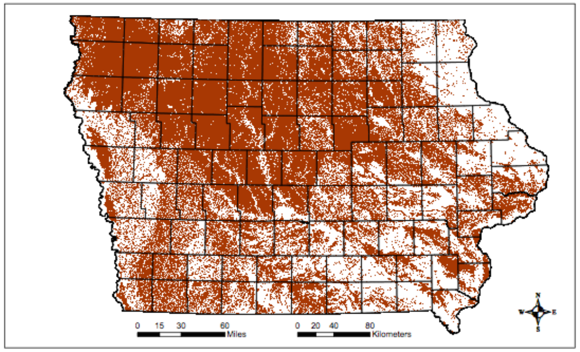
Understanding CSR2? Details of the Parameters

Taxonomic Subgroup Class of the Soil Series - S

The CSR2 equation starts by rating the taxonomic subgroup class of the soil series (S). The taxonomic subgroup class includes the taxonomic order, suborder, great group, and subgroup of Iowa's soils (Burras et al., 2015). Iowa's soil orders include Mollisols, Alfisols, Entisols, Inceptisols, Histosols, and Vertisols (Fenton and Miller, 2011). The top 3 soil orders in Iowa are Mollisols (67.7%), Alfisols (20.5%), and Entisols (6.9%). The highest S factors in Iowa start with a Mollisols soil order in a humid region (Udolls). These soils were formed from glacial till and wind-blown loess, and developed under tall prairie grasses with plenty of moisture for plant growth. They have a thick, soft Mollic epipedon with an accumulation of organic matter.

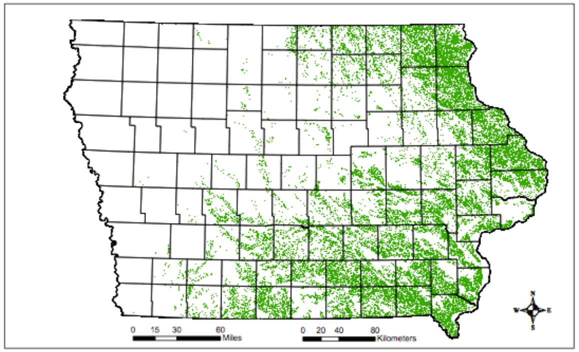
The highest S factors (100) are Typic Hapludolls, Typic Argiudolls, Aquic Hapludolls, Oxyaquic Argiudolls, Oxyaquic Hapludolls, Pachic Argiudolls, and Pachic Hapludolls (Burras et al., 2015). The lowest S factors (42) include Lithic Hapludolls and Lithic Hapludalfs, because of the stone diagnostic horizons (Burras et al., 2015). Iowa currently has about 100 taxonomic subgroup classes for the soil series (Burras et al., 2015). Dr. Burras used statistical analysis of the CSR values of the 500 soil series in Iowa to determine these S values (Burras et al., 2010).

Distribution of Mollisols in Iowa



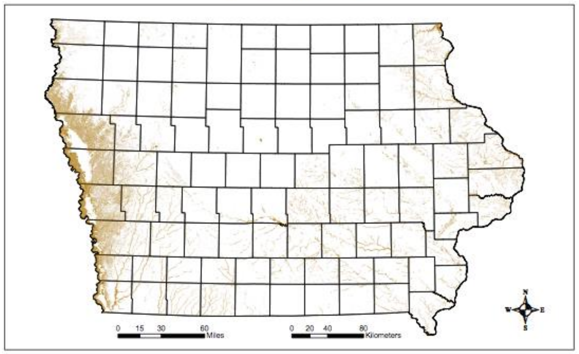
Catherine DeLong, Burras Pedology Group
Department of Agronomy
Iowa State University
Source: Natural Resource Conservation Service (2013) and Iowa Soil Properties and Interpretations Database (7.3)

Distribution of Alfisols in Iowa



Catherine DeLong, Burras Pedology Group
Department of Agronomy
Iowa State University
Source: Natural Resource Conservation Service (2013) and Iowa Soil Properties and Interpretations Database (7.3)

Distribution of Entisols in Iowa

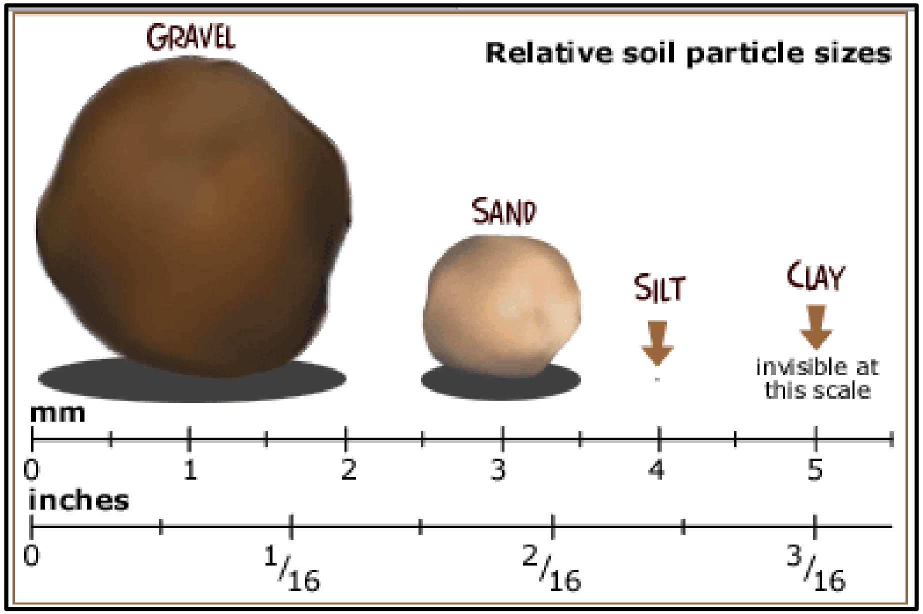


Aaron Sassman and Catherine DeLong, Burras Pedology Group
Department of Agronomy
Iowa State University
Source: Natural Resource Conservation Service (2014) and Iowa Soil Properties and Interpretations Database (7.3)

Understanding CSR2?

Family Particle Size - M

The CSR2 equation then makes a deduction based on the average family particle size (M). The deductions are based on the decreasing ability of the larger soil particles to hold water and nutrients, and to have an adequate drainage rate (Burras et al., 2010). Basically, the particle classes are divided into 4 general family particle size classes for Iowa soils. The fine-silty and organic classes have zero deductions. The fine-loamy and clayey classes have a deduction of 4. The coarse-loamy and coarse-silty classes have a deduction of 12. Finally, the sandy classes have a deduction of 35 (Burras et al., 2015).



Relative Soil Particle Sizes
From https://school.discoveryeducation.com/schooladventures/soil/name_soil.html

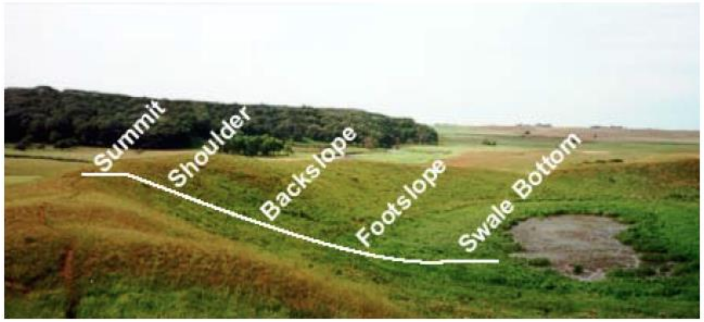
Particle-size Class	Description
Sandy-skeletal	Have 35 percent or more (by volume) rock fragments *and* a fine-earth fraction with a texture of sand or loamy sand, including less than 50 percent (by weight) very fine sand
Loamy-skeletal	Have 35 percent or more (by volume) rock fragments *and* less than 35 percent (by weight) clay
Clayey-skeletal	Have 35 percent or more (by volume) rock fragments and don't meet criteria for sandy-skeletal or loamy skeletal
Sandy	Have a texture of sand or loamy sand, including less than 50 percent (by weight) very fine sand in the fine-earth fraction.
Loamy	Have a texture of loamy very fine sand, very fine sand, or finer, including less than 35 percent (by weight) clay in the fine-earth fraction (excluding Vertisols)
Coarse-loamy	Have, in the fraction less than 75 mm in diameter, 15 percent or more (by weight) particles with diameters of 0.1 to 75 mm (fine sand or coarser, including rock fragments up to 7.5 cm in diameter) *and*, in the fine-earth fraction, less than 18 percent (by weight) clay.
Fine-loamy	Have, in the fraction less than 75 mm in diameter, 15 percent or more (by weight) particles with diameters of 0.1 to 75 mm (fine sand or coarser, including rock fragments up to 7.5 cm in diameter) *and* 18 to 35 percent (by weight) clay (Vertisols are excluded).
Coarse-silty	Have, in the fraction less than 75 mm in diameter, less than 15 percent (by weight) particles with diameters of 0.1 to 75 mm (fine sand or coarser, including rock fragments up to 7.5 cm in diameter) *and*, in the fine-earth fraction, less than 18 percent (by weight) clay
Fine-silty	Have, in the fraction less than 75 mm in diameter, less than 15 percent (by weight) particles with diameters of 0.1 to 75 mm (fine sand or coarser, including rock fragments up to 7.5 cm in diameter) and, in the fine-earth fraction, 18 to 35 percent (by weight) clay (Vertisols are excluded).
Clayey	Have between 35 – 60 percent or more (by weight) clay in the whole soil (more than 30 percent in Vertisols)
Fine	Have between 35 – 60 percent (by weight) clay in the fine-earth fraction
Very-fine	Have 60 percent or more clay

Common Particle-size classes for Agricultural Soils
From https://masters.agron.iastate.edu/classes/502/lesson01/1.1.1.html

Understanding CSR2?

Field Condition of the Mapping Unit - F

The CSR2 equation then makes a deduction based on the field condition of the mapping unit (F). These are factors that affect productivity, but are not part of the soils inherent geomorphology (Burras et al., 2010). This includes deductions for <u>increasing landscape slope</u> (representative values), <u>increasing flooding and ponding in May</u>, and having a <u>moderately eroded erosion class</u> (Burras et al., 2010). Increasing slopes and moderately eroded topsoil generally lead to a reduction in productivity due to a narrower A horizon. The increase in flooding and ponding in May results in less oxygen in the soil, a restricted crop emergence time period, and denitrification, which translates into a reduction in productivity.



From https://masters.agron.iastate.edu/classes/502/lesson01/1.1.1.html

Sheet and rill erosion in Iowa, USA.
Image Credit: Lynn Betts, USDA-NRCS, 1999

Ponded Corn Field
From - https://www.agry.purdue.edu/ext/corn/news/timeless/pondingyoungcorn.html

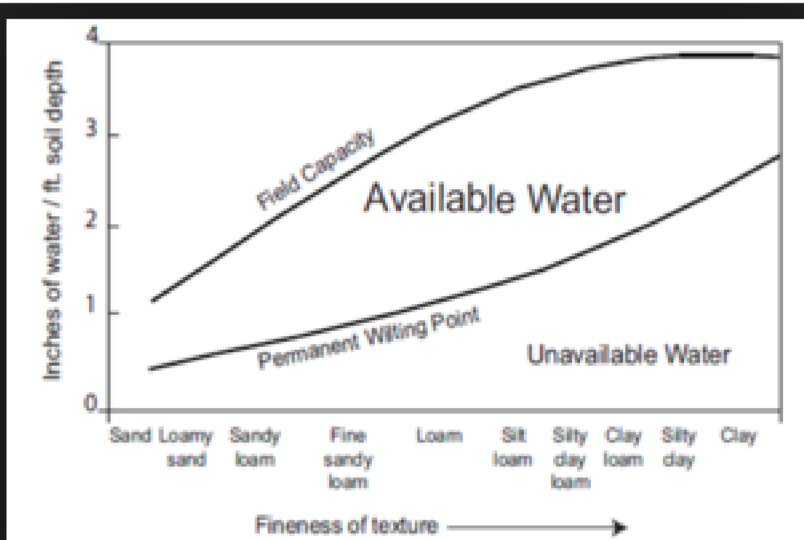
Understanding CSR2?

Available Water Holding Capacity (AWC) - W

The CSR2 equation then makes a deduction based on the available water holding capacity of top 60 inches of soil (W) (Burras et al., 2010). <u>Water accessibility for plant growth is very important and the water storage capacity of soil is critical.</u> As Dr. Burras puts it, "the W factor integrates four properties: texture, organic matter content, structure, porosity throughout the rooting zone" (Burras et al., 2010). <u>As the AWC of the soil decreases, the W deduction increases (or the soil productivity decreases)</u>. As you can see from the two illustrations, silt loam soils have the highest available water holding capacities.

Textural class	*Water holding capacity, inches/foot of soil*
Coarse sand	0.25 - 0.75
Fine sand	0.75 - 1.00
Loamy sand	1.10 - 1.20
Sandy loam	1.25 - 1.40
Fine sandy loam	1.50 - 2.00
Silt loam	2.00 - 2.50
Silty clay loam	1.80 - 2.00
Silty clay	1.50- 1.70
Clay	1.20 - 1.50

Water Holding Capacity Varies by Soil Texture
From - https://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1130447039&topicorder=10&maxto=10



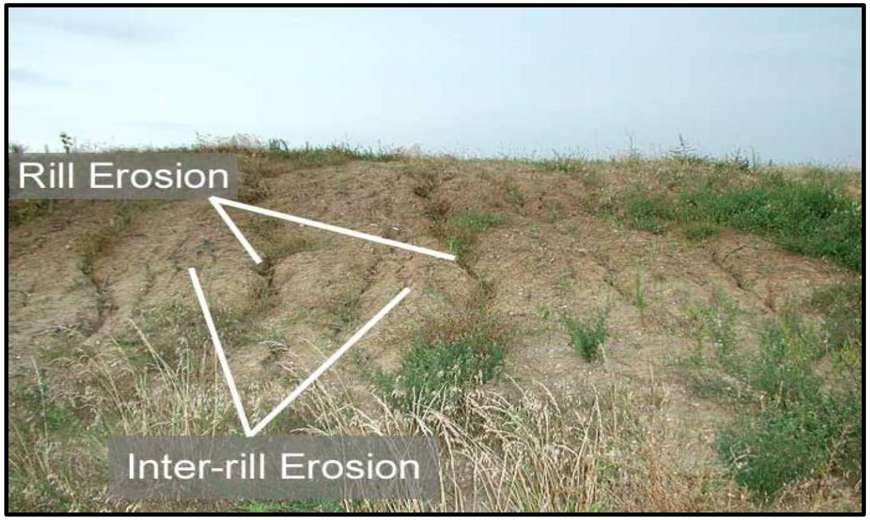
Available Water Capacity over a Range of Soil Textures
From - https://stormwater.pca.state.mn.us/index.php/

Understanding CSR2?

Soil Depth and Tolerable Rate of Soil Erosion - D

The CSR2 equation then makes a deduction based on the RUSLE (Revised Universal Soil Loss Equation) T value, which predicts the tolerable amount of soil loss from a field without hindering crop productivity (D) (Schober, 2013). Dr. Burras states that the T value is really the measure of the resiliency of the soil to erosion. The higher the T value, the lower the CSR2 equation deduction. If a soil series has a T value of 5 tons per acre, the CSR2 deduction is zero (Burras et al., 2010). This implies the soil can tolerate up to 5 tons of annual sheet and rill erosion, and still not lose any productivity. If a soil series has a T value of 1 ton per acre, the CSR2 deduction is 40 (Burras et al., 2010). This implies the soil can only tolerate up to 1 ton of annual sheet and rill erosion, and still not lose any productivity. Because the average soil erosion in Iowa is 5 tons per acre per year, a low T value of 1 ton per acre implies a reduction in crop productivity.

Sheet Erosion
From - http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1086025423&topicorder=18&maxto=7



Rill Erosion
From - http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1086025423&topicorder=18&maxto=7

Understanding CSR2?

Expert Judgment - EJ

The CSR2 equation then makes a deduction or an addition based on a complex soil property that requires a crop productivity adjustment. This adjustment is made by mutual consensus between NRCS soil scientists and the ISU representative to the Iowa Cooperative Soil Survey (ISU-IAHEES, 2013). . Shallow soils or soils with rock and gravel in stratified layers are the most common soils that need adjustment, because of the difficulty in determining soil productivity (Burras et al., 2010).

Understanding CSR2?

Data for CSR2 Calculation

- The Web Soil Survey website (http://websoilsurvey.sc.egov.usda.gov) can automatically calculate the CSR2 value for any piece of property in the state of Iowa. Instructions for this are found at https://www.extension.iastate.edu/agdm/wholefarm/html/c2-87.html (Johanns, 2014).

- If you wanted to find the actual data that is used to make the CSR2 calculation, this section explains how this is done. The soil survey data is gathered by the NRCS and compiled in the Web Soil Survey website. The data used is gathered from soil surveys that occur on all agricultural land. As the surveys are updated, the data is automatically uploaded into the Web Soil Survey website once a year (Jensen, 2013). *This section assumes that the reader is versed in the use of the Web Soil Survey website*.

From - https://websoilsurvey.sc.egov.usda.gov

Understanding CSR2?

Data for CSR2 Calculation

- As we stated before, the data we need to calculate the CSR2 equation includes:

  CSR2 = S – M – F – W – D +/- EJ, where:

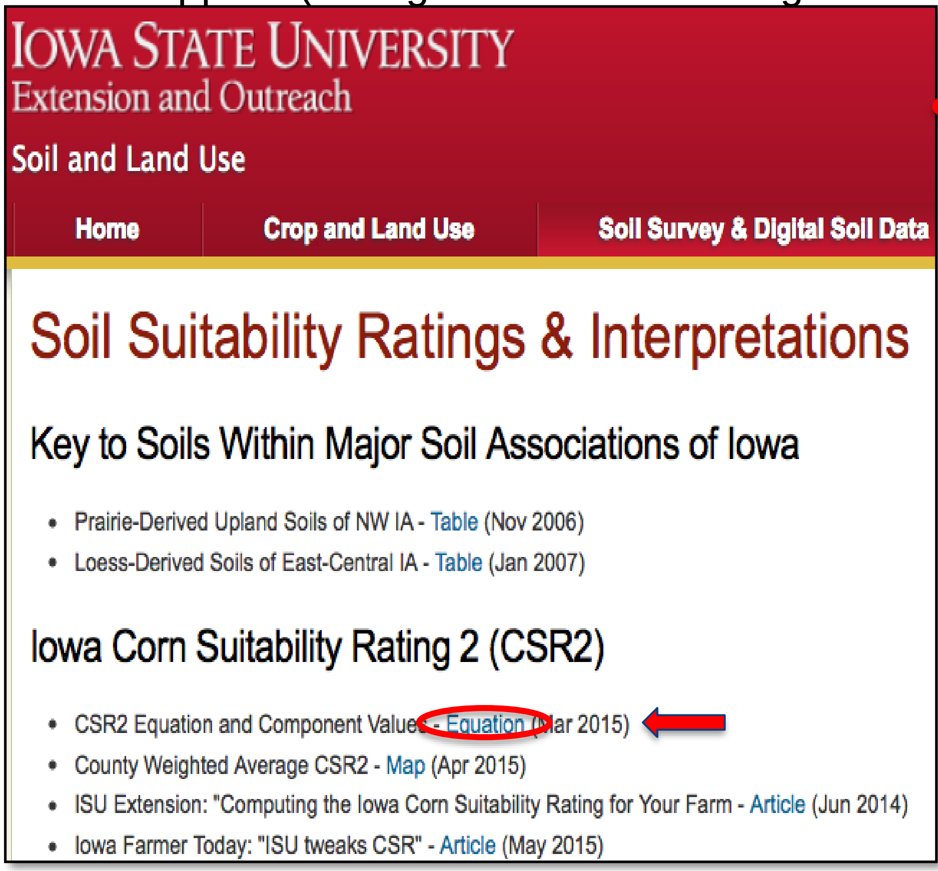
  - S is the taxonomic subgroup class of the soil series
  - M is the family particle size class
  - F refers to the field conditions of a particular SMU (slope, flooding, ponding, and erosion class)
  - W is the available water holding capacity
  - D is a soil depth and erosion factor RUSLE T value
  - EJ is deductions based on parent material

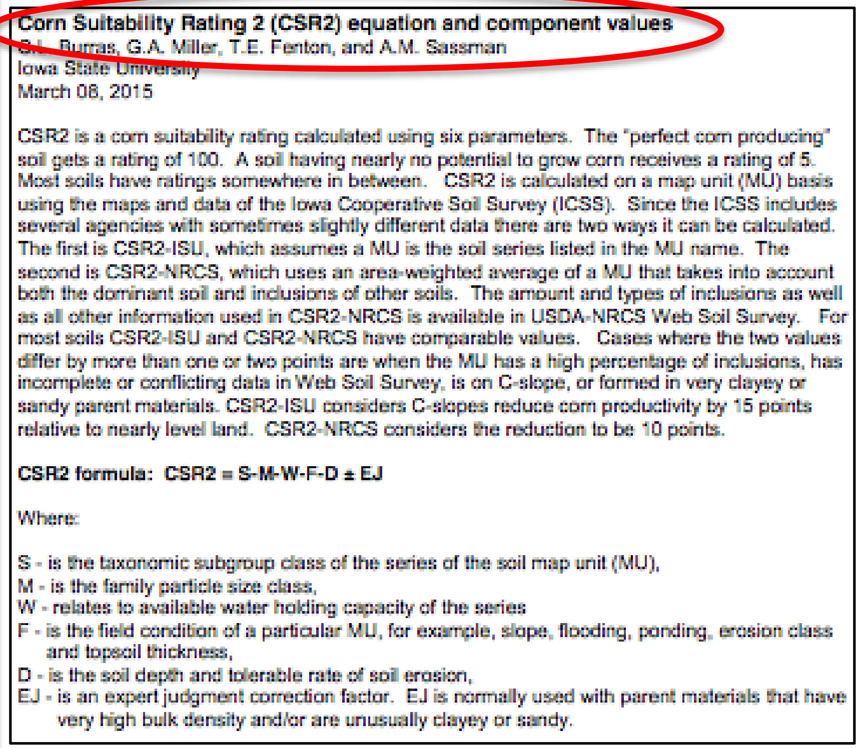
- The steps to find the data and calculate the CSR2:
  1. **find the *CSR2 component values* worksheet,**
  2. ***identify the land* (*area of interest*) and soil map units,**
  3. ***get the surveyed data* for the soil map units, and**
  4. ***calculate the CSR2 rating* using the appropriate component values.**

Understanding CSR2?

1. Find the CSR2 Component Values Worksheet

<u>To find the CSR2 Component Values</u>, go to the ISU Extension website - http://www.extension.iastate.edu/soils/suitabilities-interpretations, and click on ***equation*** under Iowa Corn Suitability Rating 2 (CSR2). A four page document will appear (the figure below on the right is from the first page of the document)





Corn Suitability Rating 2 (CSR2) equation and component values
C.L. Burras, G.A. Miller, T.E. Fenton, and A.M. Sassman
Iowa State University
March 08, 2015

CSR2 is a corn suitability rating calculated using six parameters. The "perfect corn producing" soil gets a rating of 100. A soil having nearly no potential to grow corn receives a rating of 5. Most soils have ratings somewhere in between. CSR2 is calculated on a map unit (MU) basis using the maps and data of the Iowa Cooperative Soil Survey (ICSS). Since the ICSS includes several agencies with sometimes slightly different data there are two ways it can be calculated. The first is CSR2-ISU, which assumes a MU is the soil series listed in the MU name. The second is CSR2-NRCS, which uses an area-weighted average of a MU that takes into account both the dominant soil and inclusions of other soils. The amount and types of inclusions as well as all other information used in CSR2-NRCS is available in USDA-NRCS Web Soil Survey. For most soils CSR2-ISU and CSR2-NRCS have comparable values. Cases where the two values differ by more than one or two points are when the MU has a high percentage of inclusions, has incomplete or conflicting data in Web Soil Survey, is on C-slope, or formed in very clayey or sandy parent materials. CSR2-ISU considers C-slopes reduce corn productivity by 15 points relative to nearly level land. CSR2-NRCS considers the reduction to be 10 points.

CSR2 formula: CSR2 = S-M-W-F-D ± EJ

Where:

S - is the taxonomic subgroup class of the series of the soil map unit (MU),
M - is the family particle size class,
W - relates to available water holding capacity of the series
F - is the field condition of a particular MU, for example, slope, flooding, ponding, erosion class and topsoil thickness,
D - is the soil depth and tolerable rate of soil erosion,
EJ - is an expert judgment correction factor. EJ is normally used with parent materials that have very high bulk density and/or are unusually clayey or sandy.

Understanding CSR2?

Find the CSR2 Component Values Worksheet

All parameter values for S, M, W, F, D, and EJ are found in this document. Statistical analysis of the CSR values related to the soil series map unit characteristics was used to create the values in the table (Burras et al., 2010).

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F - is the field condition of a particular MU, for example, slope, flooding, ponding, erosion class and topsoil thickness,
D - is the soil depth and tolerable rate of soil erosion,
EJ - is an expert judgment correction factor. EJ is normally used with parent materials that have very high bulk density and/or are unusually clayey or sandy.

Note: Unless specified otherwise in Table 1 to 5, the minimum CSR2 rating is 5. This means that even if the CSR2 formula for a MU results in a rating of less than 5 that rating is automatically readjusted to 5.

Table 1. Map units (MU) with conditions that negate the use of the regular CSR2 formula.

FORMULA OVERRIDES	
Condition:	**Assigned MU CSR value:**
Any component in an Urban Land Complex map unit	5
Component Name is "Gullied Land"	5
Component Name is "Urban Land"	5
Frequent long flooding	5
Frequent very long flooding	5
Very frequent flooding, any duration	5
Land Capability Class 5W	25
Miscellaneous Area	0

Table 2. S factors used in the CSR2 formula.

Taxonomic Subgroup:	S factor	Taxonomic Subgroup:	S factor	Taxonomic Subgroup:	S factor
Aeric Chromic Vertic Epiaqualfs	54	Fluventic Hapludolls	85	Typic Argiudolls	100
Aeric Endoaqualfs	68	Glossic Hapludalfs	86	Typic Calciaquolls	78
Aeric Fluvaquents	79	Lamellic Udipsamments	67	Typic Calciudolls	84
Aeric Vertic Epiaqualfs	54	Limnic Haplosaprists	72	Typic Endoaqualfs	66
Aquents	50	Lithic Endoaquolls	45	Typic Endoaquerts	70
Aquertic Argiudolls	83	Lithic Hapludalfs	42	Typic Endoaquolls	94
Aquertic Chromic Hapludalfs	79	Lithic Hapludolls	42	Typic Eutrudepts	78
Aquertic Hapludalfs	79	Lithic Haplustolls	48	Typic Fluvaquents	80
Aquertic Hapludolls	92	Mollic Endoaqualfs	85	Typic Haplohemists	64
Aquertic Udifluvents	84	Mollic Epiaqualfs	80	Typic Haplosaprists	64
Aquic Argiudolls	85	Mollic Fluvaquents	83	Typic Hapludalfs	89
Aquic Cumulic Hapludolls	93	Mollic Hapludalfs	95	Typic Hapludolls	100
Aquic Hapludolls	100	Mollic Oxyaquic Hapludalfs	90	Typic Natraquerts	52
Aquic Pachic Argiudolls	98	Mollic Udifluvents	88	Typic Paleudalfs	88
Aquic Pachic Hapludolls	98	Oxyaquic Argiudolls	100	Typic Quartzipsamments	58
Aquic Udifluvents	98	Oxyaquic Dystrudepts	42	Typic Udifluvents	95
Aquic Udipsamments	60	Oxyaquic Eutrudepts	42	Typic Udipsamments	58
Aquic Udorthents	84	Oxyaquic Hapludalfs	85	Typic Udorthents	72
Aquollic Hapludalfs	90	Oxyaquic Hapludolls	100	Udertic Haplustolls	80
Aquolls	50	Oxyaquic Haplustolls	81	Udic Haplustolls	80
Argiaquic Argialbolls	80	Oxyaquic Udifluvents	88	Udic Ustorthents	74
Chromic Vertic Albaqualfs	74	Oxyaquic Vertic Argiudolls	97	Udifluvents	50
Cumulic Endoaquolls	84	Oxyaquic Vertic Hapludalfs	79	Udollic Endoaqualfs	90
Cumulic Hapludolls	99	Pachic Argiudolls	100	Vertic Albaqualfs	80
Cumulic Vertic Endoaquolls	79	Pachic Hapludolls	100	Vertic Argialbolls	80
Cumulic Vertic Epiaquolls	81	Pachic Haplustolls	78	Vertic Argiaquolls	90
Dystric Eutrudepts	97	Psammentic Hapludalfs	67	Vertic Endoaquepts	78
Entic Hapludolls	90	Terric Haplosaprists	87	Vertic Endoaquolls	75
Fluvaquentic Endoaquolls	83	Thapto-Histic Fluvaquents	85	Vertic Epiaqualfs	81
Fluvaquentic Hapludolls	88	Typic Albaqualfs	87	Vertic Epiaquolls	79
Fluvaquentic Vertic Endoaquolls	93	Typic Argialbolls	77	Vertic Fluvaquents	67
Fluvaquents	50	Typic Argiaquolls	82		

Table 3. M, W, and F factors used in the CSR2 formula.

Family Particle Size Class	M factor
coprogenous	0
fine-silty	0
fine-silty over clayey	0
organic	0
clayey	4
clayey over loamy	4
fine	4
fine-loamy	4
fine-loamy over clayey	4
very-fine	4
fine-loamy over sandy	4
coarse-loamy	12
coarse-loamy over clayey	12
coarse-silty	12
coarse-silty over clayey	12
loamy	12
mesic	35
mixed	35
sandy	35
sandy over clayey	35
sandy over loamy	35
sandy-skeletal	35
all other classes containing "skeletal"	12
calcareous	5**
** calcareous deductions are added on to any other M factor.	

FLOODING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Flooding conditions:	**F factor - flood**
flooding frequency is none, rare or NULL, or flooding duration is NULL	0
frequent brief	20
frequent very brief	10
occasional brief	6
occasional very brief	4
occasional long	10
frequent extremely brief	5
occasional very long	34
occasional extremely brief	2
frequent long OR frequent very long No deduction, Automatic component CSR2 of 5	

Slope values:	F factor - slope
slope is NULL	0
slope RV < 2	0
slope RV < 5	5
slope RV < 9	15
slope RV ≥ 9	3 * slope RV

Other F factor Conditions:	F factor - local
Component Local phase is "channeled"	40
Component erosion class is "2" - moderately eroded	3

AWC CALCULATED TO 60 INCHES, ROUNDED TO TWO DECIMAL PLACES.	
Available Water Capacity (AWC, inches of water)	**W factor**
No AWC populated	99
AWC < 3.01	24
AWC < 6.00	12
AWC < 9.00	6
AWC ≥ 9.00	0

PONDING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Ponding conditions:	**F factor - pond**
Frequency is none or NULL	0
frequent brief	20
frequent very brief	20
occasional brief	20
occasional very brief	20
frequent long	44
frequent very long	44
occasional long	44
occasional very long	44

Table 4. D values used in CSR2.

RUSLE T values *	D factor
Any Histosols	0
T factor 5	0
T factor 4	10
T factor 3	20
T factor 2	30
T factor 1	40
* T values provided by NRCS, September 2014	

Table 5a. EJ factors that reduce CSR2 values.

Paleosol Deductions	
Series	**EJ Deduction**
Adair	10
Armstrong	10
Ashgrove	10
Bucknell	10
Clarinda	15
Clearfield	20
Donnan	20
Galland	15
Keswick	10
Lagonda	5
Lamoni	10
Lineville	20
Malvern	20
Mystic	15
Northboro	15
Rinda	15

Dense Till Deductions	
Series	**EJ Deduction**
Cresco	5
Cresken	5
Protivin	5
Jameston	5
Lourdes	5
Riceville	5

Sandy Deductions	
Series	**EJ Deduction**
Farrar	15
Olin	10

Clayey Loess Deductions	
Series	**EJ Deduction**
Appanoose	15
Kniffin	15
Seymour	10
Rathbun	15

"Old" clay loam till Deduction	
Series	**EJ Deduction**
Shelby	5
Gara	5
Lindley	5

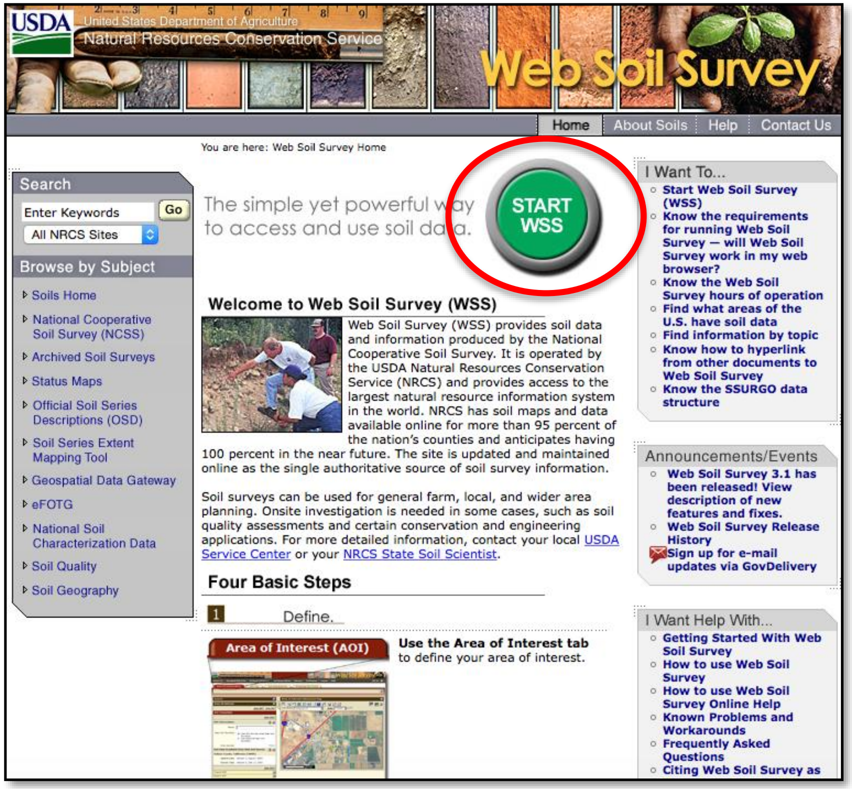
Table 5b. EJ factors that increase CSR2 value.

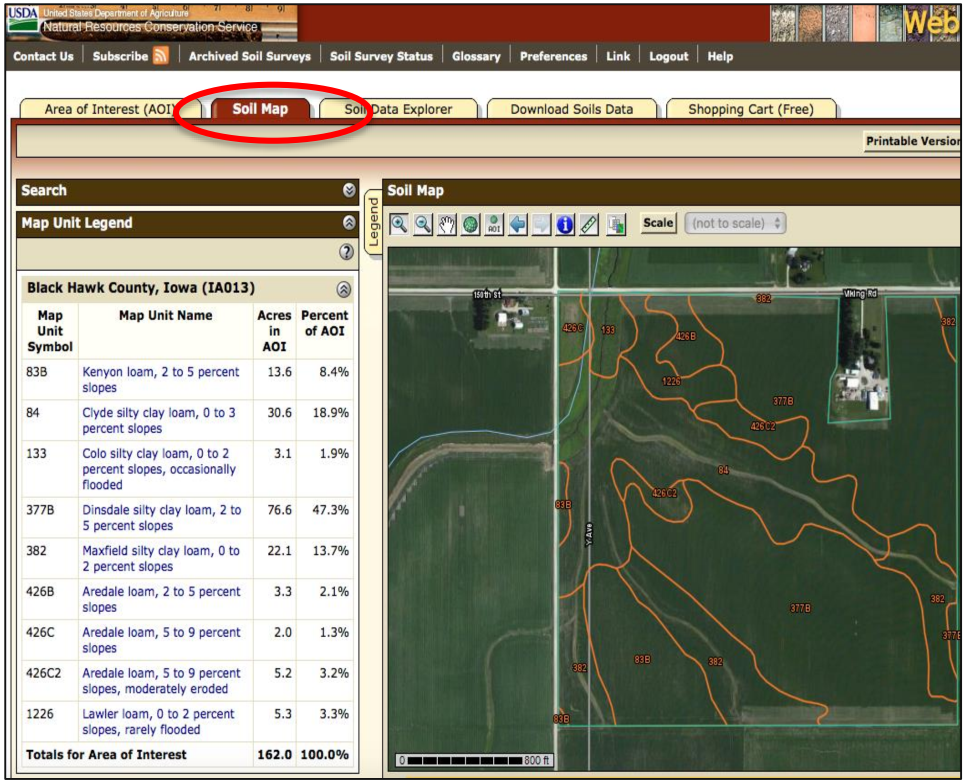
Series or Map unit symbol	EJ Addition
Macksburg	15
Mahaska	15
Kalona	10
Rowley	10
All components in map units 221B	10
Waukee	10

Understanding CSR2?

2. Identify the Land (area of interest) and Soil Map Units

To identify the land and soil map units, go to the web soil survey at http://websoilsurvey.sc.egov.usda.gov and click on the green button (Start WSS). *Access your area of interest.* Once your area is defined and you click on the soil map tab, you are able to see the different soil map units for your land. The calculation of CSR2 requires finding parameter data of the soil map unit in the web soil survey, and determining the translation factor to use in the CSR2 Equation and Component Value (Burras et al., 2015).



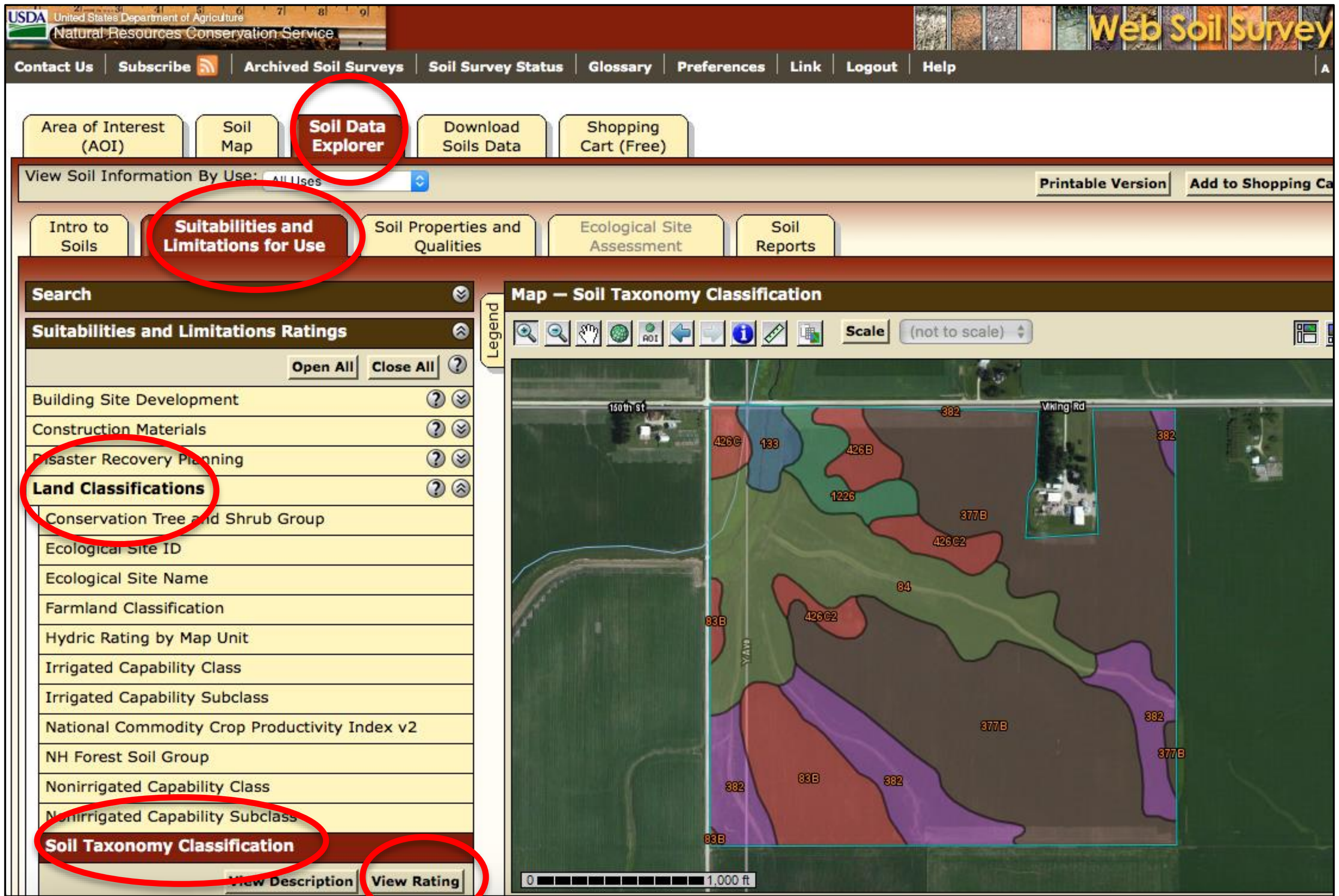


Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
83B	Kenyon loam, 2 to 5 percent slopes	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	5.2	3.2%
1226	Lawler loam, 0 to 2 percent slopes, rarely flooded	5.3	3.3%
Totals for Area of Interest		162.0	100.0%

Understanding CSR2?

3. Get the Surveyed Data for the Soil Map Units

<u>To find S and M</u> - go to Soil Data Explorer tab for your AOI and then to Suitabilities and Limitations for Use tab. Look at **<u>Soil Taxonomy Classification</u>** under Land Classification. View the **rating**:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

<u>To find S and M</u> - after clicking on the rating button for the **<u>Soil Taxonomy Classification</u>,** the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower two right figures).

Soil Taxonomy Classification— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
83B	Kenyon loam, 2 to 5 percent slopes	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	Fine-loamy, mixed, superactive, mesic Typic Endoaquolls	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	Fine-silty, mixed, superactive, mesic Cumulic Endoaquolls	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	Fine-silty, mixed, superactive, mesic Typic Argiudolls	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	Fine-silty, mixed, superactive, mesic Typic Endoaquolls	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Aquic Hapludolls	5.3	3.3%
Totals for Area of Interest			**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

Taxonomic Subgroup:	S factor
Typic Argiudolls	100
Typic Calciaquolls	78
Typic Calciudolls	84
Typic Endoaqualfs	66
Typic Endoaquerts	70
Typic Endoaquolls	94
Typic Eutrudepts	78
Typic Fluvaquents	80
Typic Haplohemists	64
Typic Haplosaprists	64
Typic Hapludalfs	89
Typic Hapludolls	100
Typic Natraquerts	52

From CSR2 Component Values Worksheet

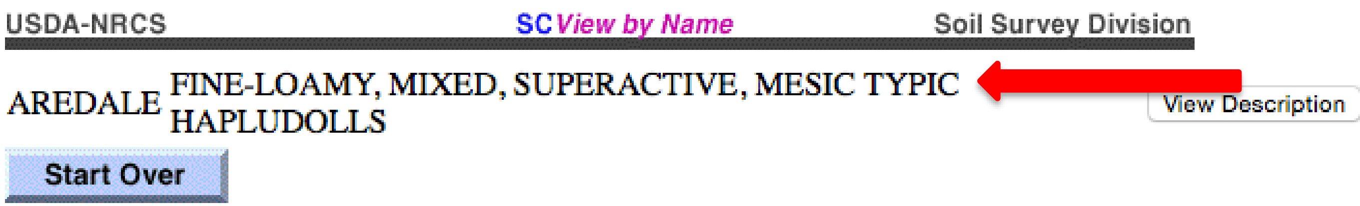
Family Particle Size Class	M factor
coprogenous	0
fine-silty	0
fine-silty over clayey	0
organic	0
clayey	4
clayey over loamy	4
fine	4
fine-loamy	4
fine-loamy over clayey	4
very-fine	4
fine-loamy over sandy	4

From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

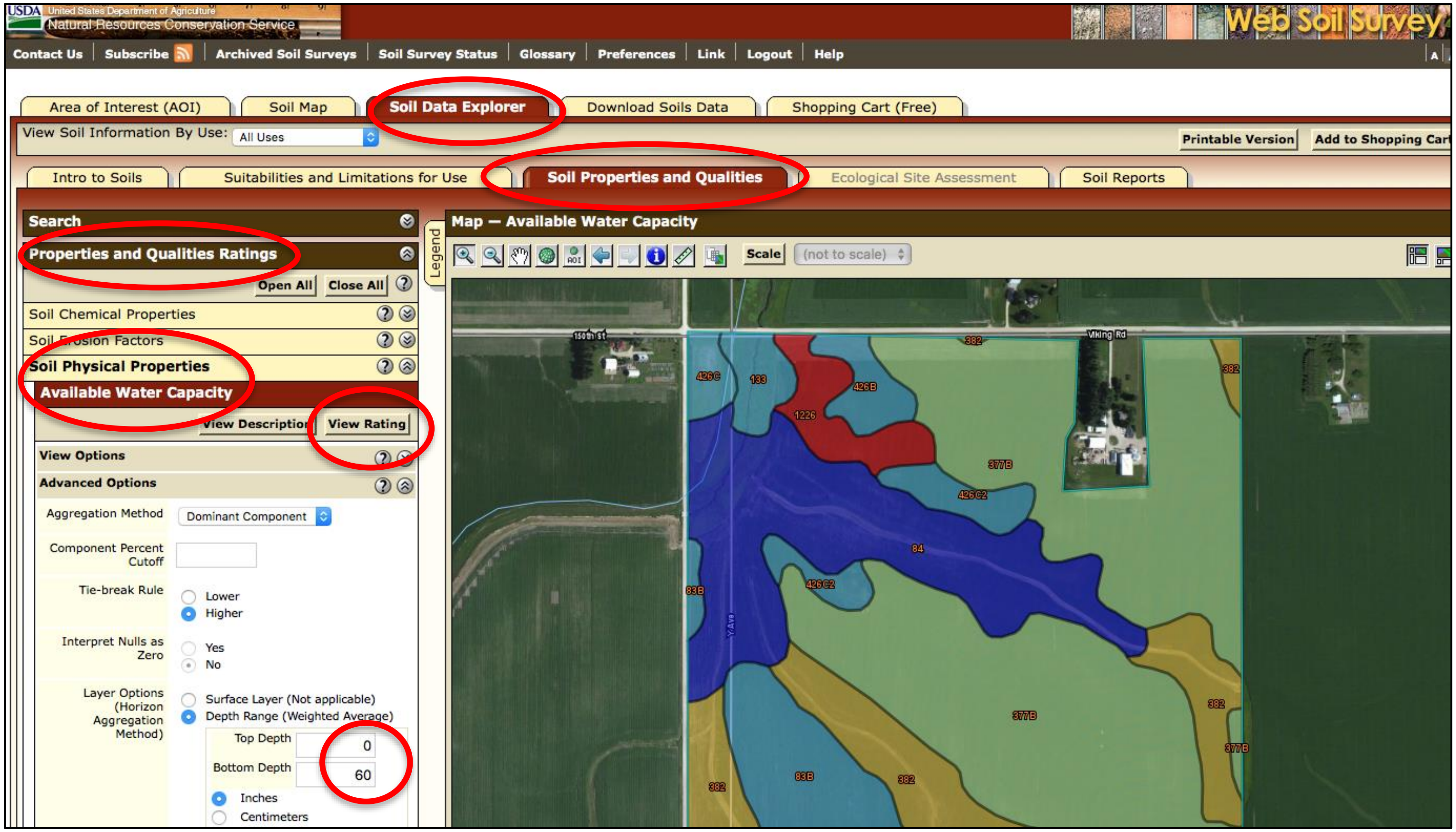
<u>Or another way to find S and M</u> - go to https://soilseries.sc.egov.usda.gov/osdname.aspx (USDA-NRCS, 2013). Enter the soil name (e.g., Aredale) and Find Series.



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

<u>To find W</u> - go to Soil Data Explorer tab and then to Soil Properties and Qualities tab. Look at the **<u>Available Water Capacity</u>** under Soil Physical Properties. Run the **rating** for 0 to 60 inches. The result is in cm/cm. So, multiply results by 60 inches to get AWC in inches.



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

To find W - after clicking on the rating button for the **Available Water Capacity,** the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure). The result is in cm/cm. So, multiply 0.17 by 60 inches to get AWC as 10.2 inches.

Available Water Capacity— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
83B	Kenyon loam, 2 to 5 percent slopes	0.17	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	0.19	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	0.21	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	0.19	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	0.19	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	0.17	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	0.17	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	0.17	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	0.14	5.3	3.3%
Totals for Area of Interest			**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

AWC CALCULATED TO 60 INCHES, ROUNDED TO TWO DECIMAL PLACES.	
Available Water Capacity (AWC, inches of water)	**W factor**
No AWC populated	99
AWC < 3.01	24
AWC < 6.00	12
AWC < 9.00	8
AWC ≥ 9.00	0

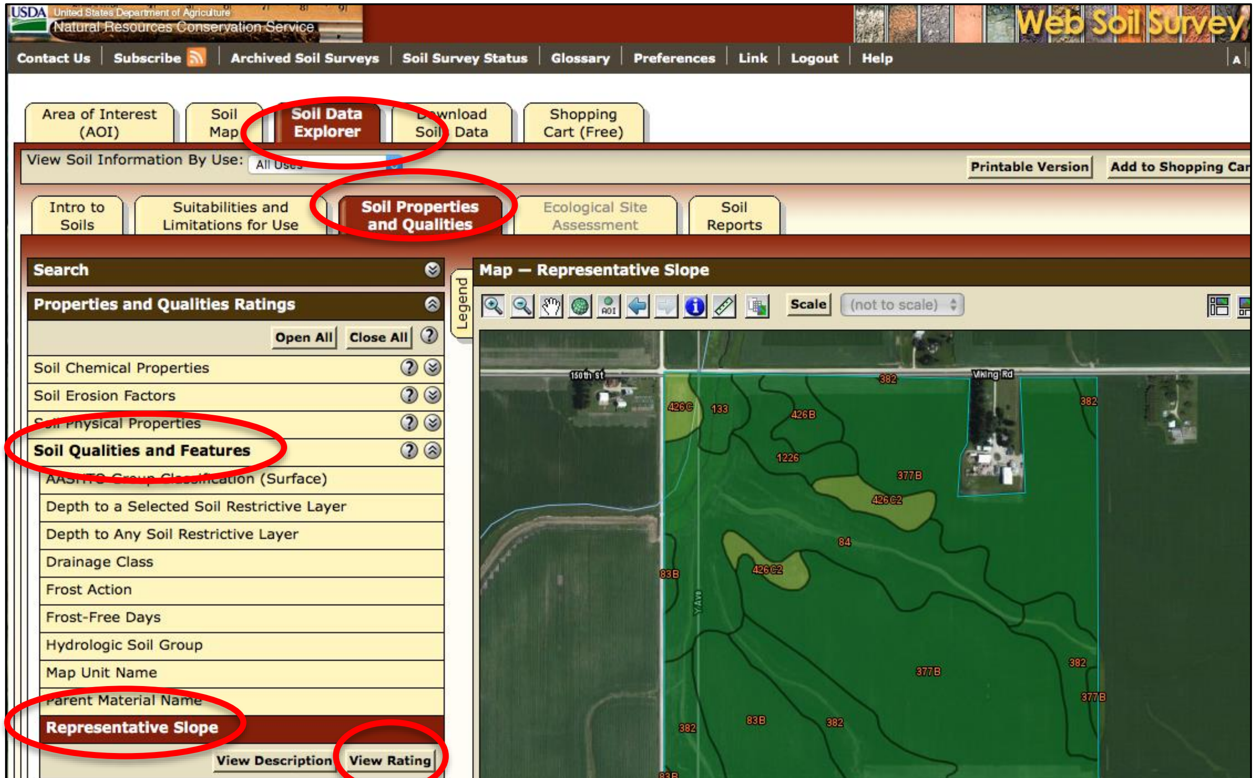
From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

<u>To find F</u>, we need to find the representative slope (F_{slope}), the flooding frequency for May ($F_{flooding}$), the ponding frequency for May ($F_{ponding}$), and the erosion class ($F_{erosion}$).

- **<u>To find F_{slope}</u>** - go to Soil Data Explorer tab and then to Soil Properties and Qualities tab. Look at **<u>Representative Slope</u>** under Soil Qualities and Features. View the **rating**:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **To find F_{slope}**- after clicking on the rating button for the **Representative Slope**, the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

Representative Slope— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
83B	Kenyon loam, 2 to 5 percent slopes	3.0	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	1.0	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	1.0	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	4.0	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	1.0	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	4.0	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	7.0	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	7.0	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	1.0	5.3	3.3%
Totals for Area of Interest			**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

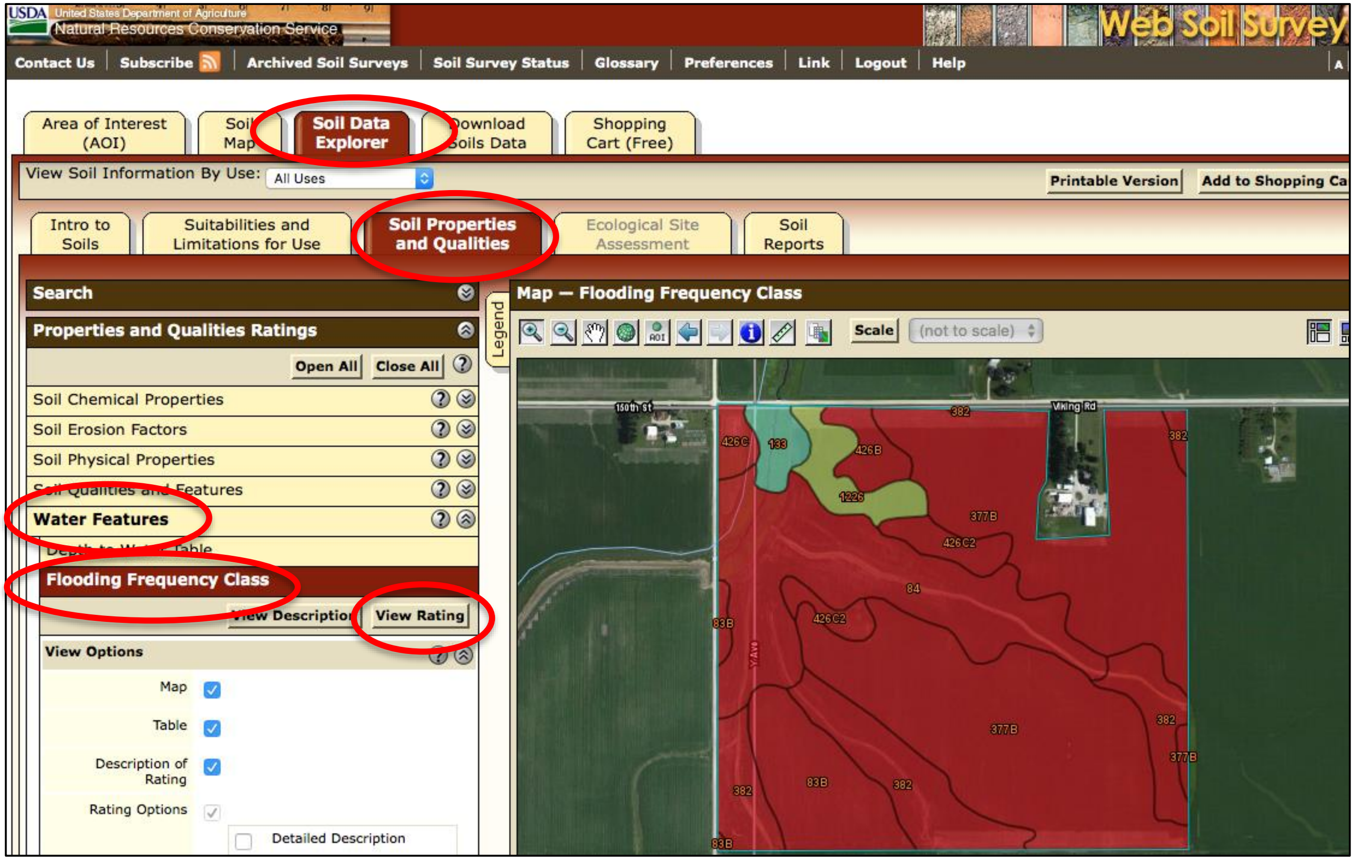
Slope values:	F factor - slope
slope is NULL	0
slope RV < 2	0
slope RV < 5	5
slope RV < 9	15
slope RV ≥ 9	3 * slope RV

From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **To find** $F_{flooding}$ - go to Soil Data Explorer tab and then to Soil Properties and Qualities tab. Look at **Flooding Frequency Class** under Water Features. View the **rating**:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **To Find $F_{flooding}$** - after clicking on the rating button for the **Flooding Frequency Class**, the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

Flooding Frequency Class— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
83B	Kenyon loam, 2 to 5 percent slopes	None	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	None	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	Occasional	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	None	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	None	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	None	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	None	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	None	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	Rare	5.3	3.3%
Totals for Area of Interest			**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

FLOODING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Flooding conditions:	**F factor - flood**
flooding frequency is none, rare or NULL, or flooding duration is NULL	0
frequent brief	20
frequent very brief	10
occasional brief	6
occasional very brief	4
occasional long	10
frequent extremely brief	5
occasional very long	34
occasional extremely brief	2
frequent long OR frequent very long No deduction, Automatic component CSR2 of 5	

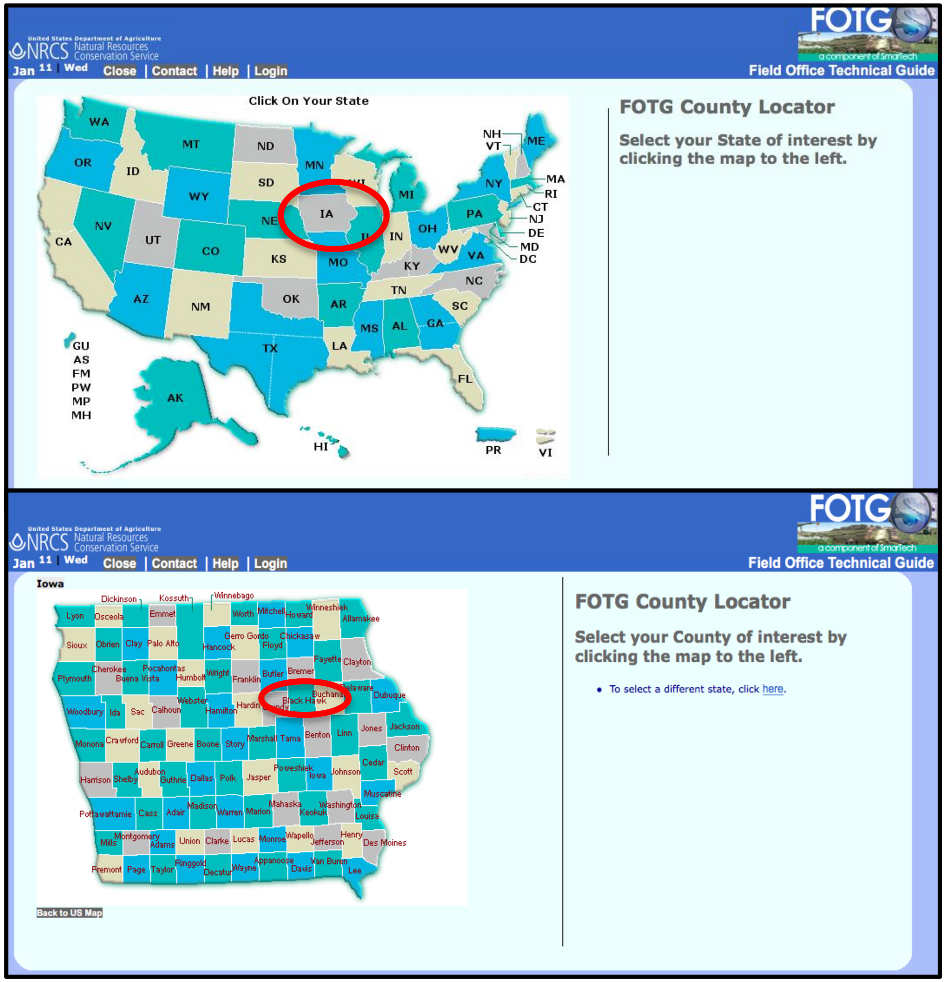
From CSR2 Component Values Worksheet

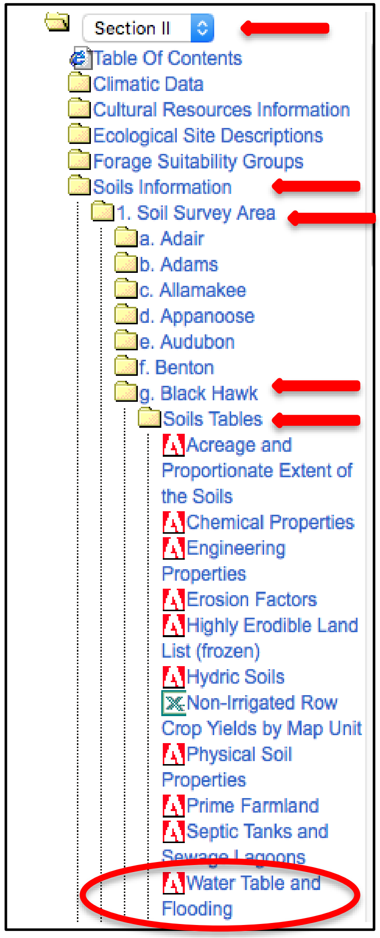
** Note – for occasional or frequent ratings, the modifier information is at the Iowa Field Office Technical Guide website (https://efotg.sc.egov.usda.gov). The next slide has the instructions to get to the form.

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

➢**To Find Occasional or Frequent Ratings** – go to the Iowa Field Office Technical Guide website https://efotg.sc.egov.usda.gov. Click on **Iowa** and then on **Black Hawk County**. Pull up **Section II**. Then, click on Soils Information, Soil Survey Area, Black Hawk, Soil Tables, and Water Table and Flooding.





From the Iowa Field Office Technical Guide website https://efotg.sc.egov.usda.gov.

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

➢**To Find Occasional or Frequent Ratings** – after clicking on **Water Table and Flooding**, the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

Map symbol and soil name	Hydrologic group	Months	Water table: Upper limit	Water table: Kind	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
			Ft		Ft				
Nevin, rarely flooded----------	C/D								
		Jan	3.0-5.5	Apparent	---	---	---	---	None
		Feb	2.5-5.0	Apparent	---	---	---	---	None
		Mar	1.5-4.0	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Apr	1.0-3.5	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		May	1.5-4.0	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Jun	2.0-4.5	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Jul	3.0-5.5	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Aug	3.5-6.0	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Sep	4.0-6.5	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Oct	3.5-6.0	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Nov	2.5-5.0	Apparent	---	---	---	Brief (2 to 7 days)	Rare
		Dec	3.0-5.5	Apparent	---	---	---	---	None
133: Colo, occasionally flooded----------	C/D								
		Jan	2.0-3.5	Apparent	---	---	---	---	---
		Feb	1.5-3.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Mar	0.5-2.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Apr	0.0-1.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		May	0.5-2.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Jun	1.0-2.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Jul	2.0-3.5	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Aug	2.5-3.5	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Sep	3.0-4.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Oct	2.5-3.5	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Nov	1.5-3.0	Apparent	---	---	---	Brief (2 to 7 days)	Occasional
		Dec	2.0-3.5	Apparent	---	---	---	---	---

From the Iowa Field Office Technical Guide website https://efotg.sc.egov.usda.gov.

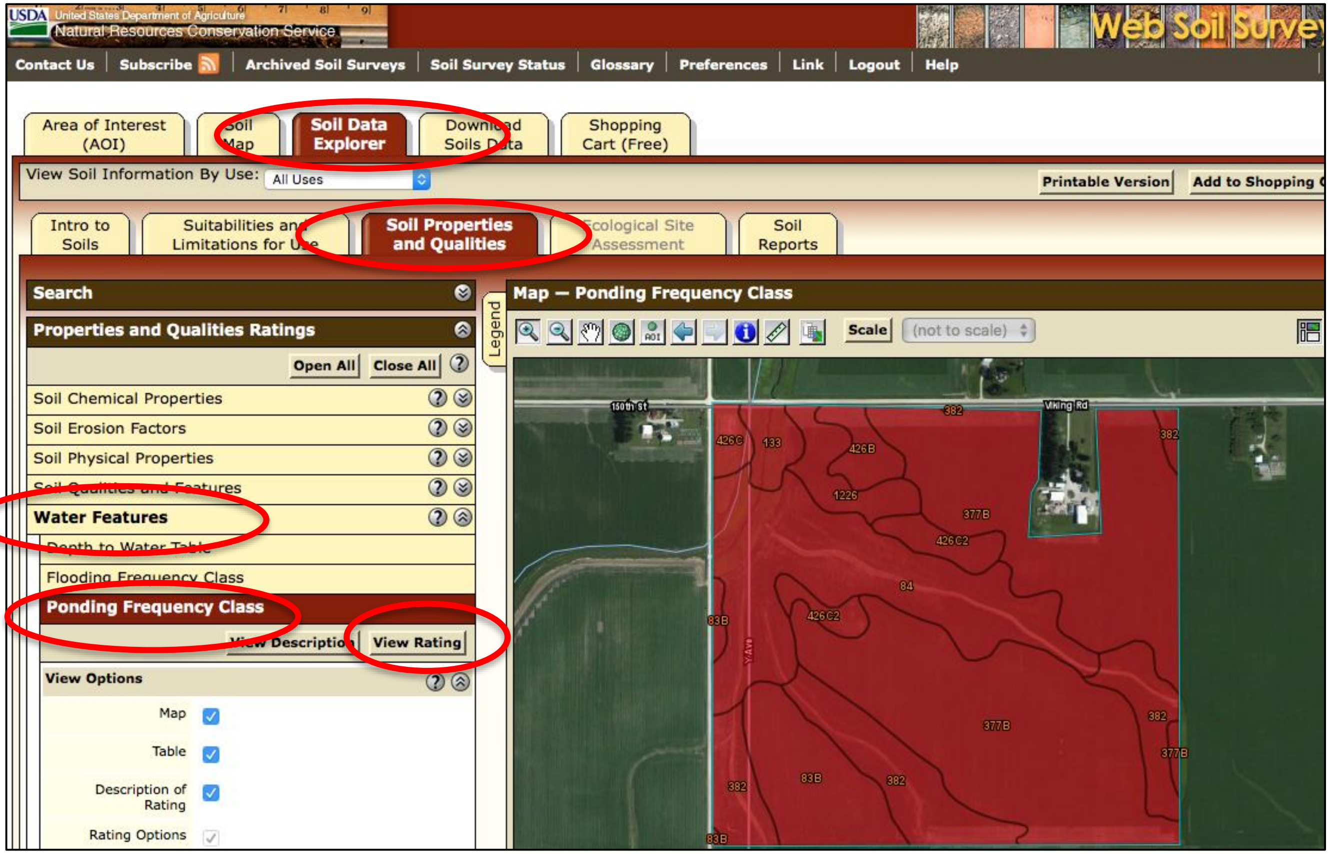
FLOODING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Flooding conditions:	**F factor - flood**
flooding frequency is none, rare or NULL, or flooding duration is NULL	0
frequent brief	20
frequent very brief	10
occasional brief	6
occasional very brief	4
occasional long	10
frequent extremely brief	5
occasional very long	34
occasional extremely brief	2
frequent long OR frequent very long No deduction, Automatic component CSR2 of 5	

From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **<u>To find</u> $F_{ponding}$** - go to Soil Data Explorer tab and then to Soil Properties and Qualities tab. Look at **<u>Ponding Frequency Class</u>** under Water Features. View the **rating**:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **To Find $F_{ponding}$** - after clicking on the rating button for the **<u>Ponding Frequency Class</u>**, the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

Ponding Frequency Class— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
83B	Kenyon loam, 2 to 5 percent slopes	None	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	None	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	None	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	None	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	None	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	None	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	None	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	None	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	None	5.3	3.3%
Totals for Area of Interest			**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

From the Web Soil Survey – soil taxonomy classification

PONDING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Ponding conditions:	**F factor - pond**
frequency is none or NULL	0
frequent brief	20
frequent very brief	20
occasional brief	20
occasional very brief	20
frequent long	44
frequent very long	44
occasional long	44
occasional very long	44

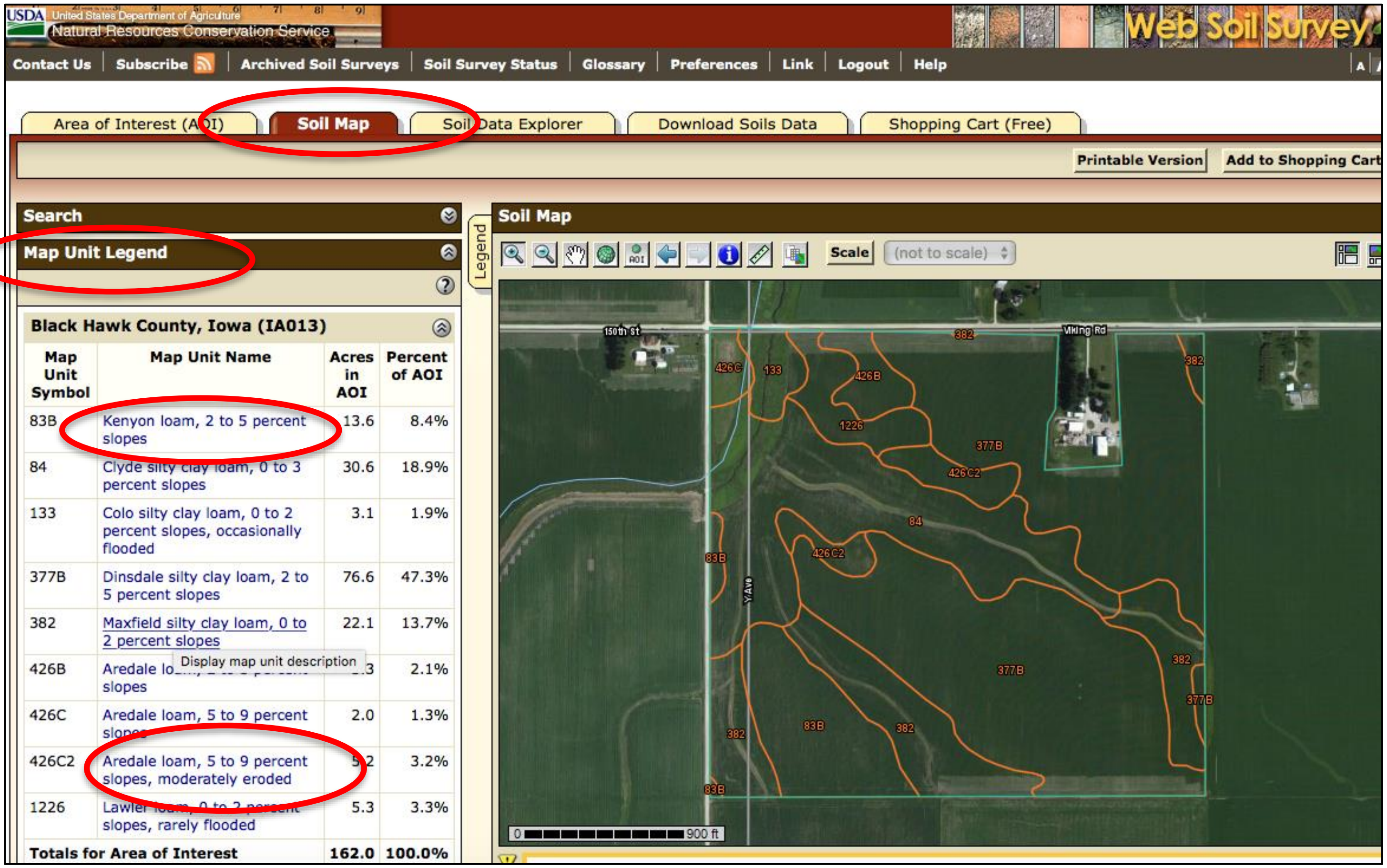
From CSR2 Component Values Worksheet

** Note – for <u>occasional or frequent</u> ratings, the detailed information is at the Iowa Field Office Technical Guide website (<u>https://efotg.sc.egov.usda.gov</u>). The previous slide (slide 53) has the instructions to get to the form.

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

- **<u>To find</u> F$_{erosion}$** - go to Soil Map tab and then to Map Unit Legend. Look at the Kenyon loam and Aredale loam soil map unit:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

➢ **To Find $F_{erosion}$** - after clicking on the Map Unit Legend for the AOI, the table on the bottom left will appear. Look at the **map unit name** and note if the term "**moderately eroded**" or "**channeled**" is included. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

Map Unit Legend

Black Hawk County, Iowa (IA013)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
83B	Kenyon loam, 2 to 5 percent slopes	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	22.1	13.7%
426B	Aredale lo... Display map unit description ...slopes	...3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	5.2	3.2%
1226	Lawler loam, 0 to 2 percent slopes, rarely flooded	5.3	3.3%
Totals for Area of Interest		**162.0**	**100.0%**

From the Web Soil Survey – soil taxonomy classification

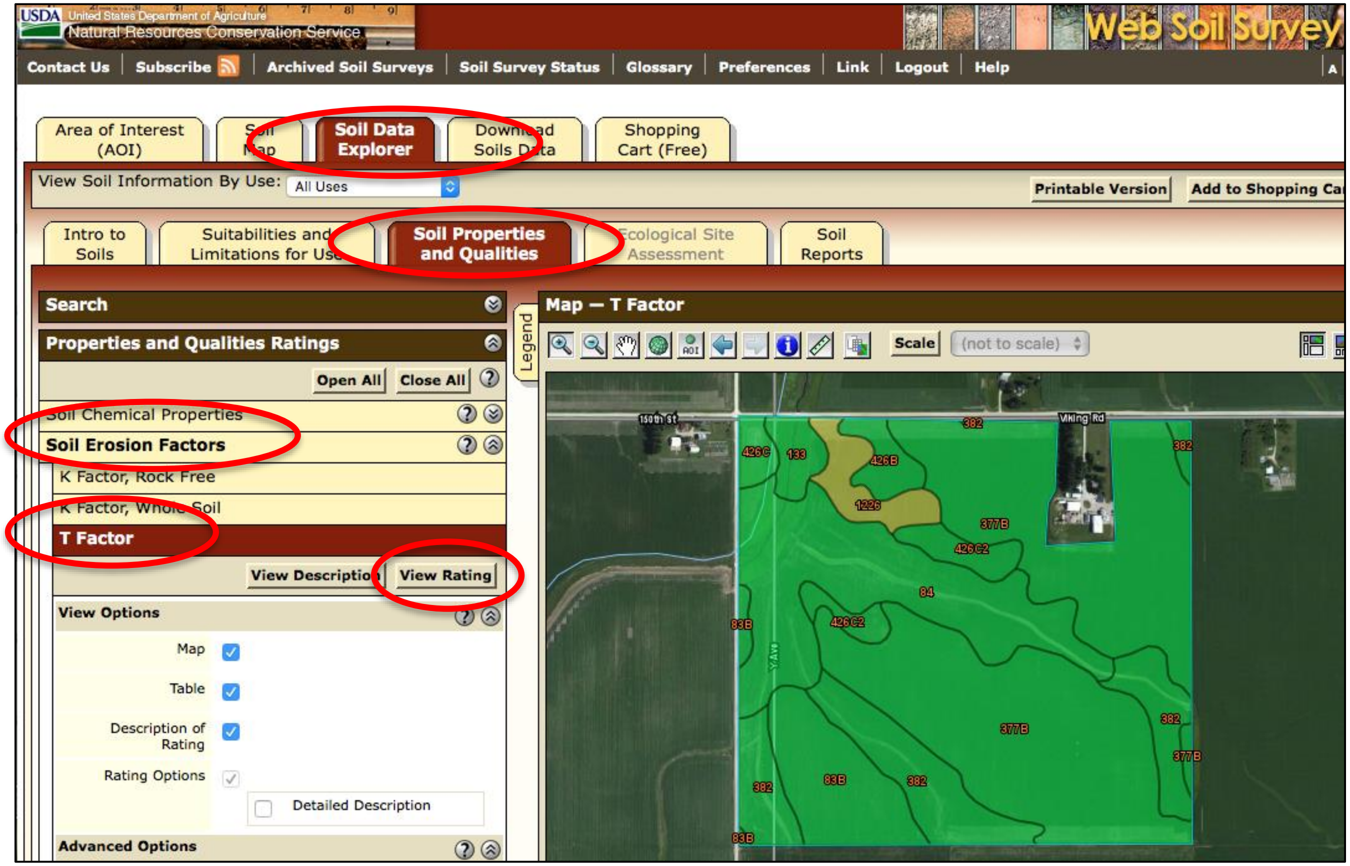
Other F factor Conditions:	F factor - local
Component Local phase is "channeled"	40
Component erosion class is "2" - moderately eroded	3

From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

To find D, go to Soil Data Explorer tab and then to Soil Properties and Qualities tab. Look at **T Factor** under Soil Erosion Factors. View the **rating**:



Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

<u>To find D</u>, after clicking on the rating button for the **<u>T Factor</u>**, the table on the bottom left will appear. Find the corresponding value on the CSR2 Equation and Component Values worksheet (the lower right figure).

T Factor— Summary by Map Unit — Black Hawk County, Iowa (IA013)				
Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
83B	Kenyon loam, 2 to 5 percent slopes	5	13.6	8.4%
84	Clyde silty clay loam, 0 to 3 percent slopes	5	30.6	18.9%
133	Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded	5	3.1	1.9%
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	5	76.6	47.3%
382	Maxfield silty clay loam, 0 to 2 percent slopes	5	22.1	13.7%
426B	Aredale loam, 2 to 5 percent slopes	5	3.3	2.1%
426C	Aredale loam, 5 to 9 percent slopes	5	2.0	1.3%
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	5	5.2	3.2%
1226	Lawler loam, 24 to 40 inches to sand and gravel, 0 to 2 percent slopes	3	5.3	3.3%
Totals for Area of Interest			162.0	100.0%

From the Web Soil Survey – soil taxonomy classification

RUSLE T values *	D factor
Any Histosols	0
T factor 5	0
T factor 4	10
T factor 3	20
T factor 2	30
T factor 1	40
* T values provided by NRCS, September 2014	

From CSR2 Component Values Worksheet

Understanding CSR2?

Get the Surveyed Data for the Soil Map Units

To find EJ, use the CSR2 Equation and Component Values worksheet. Go to Table 5a and 5b, and look to see if your soil series name is listed and has a deduction or addition. If the soil series name is not in Tables 5a and 5b, there is no EJ factor.

Table 5a. EJ factors that reduce CSR2 values.

Paleosol Deductions	
Series	**EJ Deduction**
Adair	10
Armstrong	10
Ashgrove	10
Bucknell	10
Cerlin	15
Clarinda	15
Clearfield	20
Donnan	20
Galland	15
Keswick	10
Lagonda	5
Lamoni	10
Lineville	20
Malvern	20
Mystic	15
Northboro	15
Rinda	15

"Old" clay loam till Deduction	
Series	**EJ Deduction**
Shelby	5
Gara	5
Lindley	5

Dense Till Deductions	
Series	**EJ Deduction**
Cresco	5
Cresken	5
Protivin	5
Jameston	5
Lourdes	5
Riceville	5

Sandy Deductions	
Series	**EJ Deduction**
Farrar	15
Olin	10

Clayey Loess Deductions	
Series	**EJ Deduction**
Appanoose	15
Kniffin	15
Seymour	10
Rathbun	15

Table 5b. EJ factors that increase CSR2 value.

Series or Map unit symbol	EJ Addition
Macksburg	15
Mahaska	15
Kalona	10
Rowley	10
All components in map units 221B	10
Waukee	10

From CSR2 Component Values Worksheet

Understanding CSR2?

4. Example Calculation of CSR2 Value of Kenyon Loam (83B 2-5% Slope)

- <u>Calculate the CSR2 value of Kenyon loam (83B 2-5% slope)</u>

- At this point, we have the soil series data (previous slides) for the CSR2 calculation. We also have the CSR2 component value sheets that lists the starting number (S) and the deductions (M,F,W,D).

Table 2. S factors used in the CSR2 formula.

Taxonomic Subgroup:	S factor
Aeric Chromic Vertic Epiaquolls	54
Aeric Endoaquolls	88
Aeric Fluvaquents	79
Aeric Vertic Epiaquolls	54
Aquents	50
Aquertic Argiudolls	83
Aquertic Chromic Hapludalfs	79
Aquertic Hapludalfs	79
Aquertic Hapludolls	92
Aquertic Udifluvents	84
Aquic Argiudolls	85
Aquic Cumulic Hapludolls	93
Aquic Hapludolls	100
Aquic Pachic Argiudolls	96
Aquic Pachic Hapludolls	98
Aquic Udifluvents	98
Aquic Udipsamments	60
Aquic Udorthents	84
Aquollic Hapludalfs	90
Aquolls	50
Argiaquic Argialbolls	80
Chromic Vertic Albaqualfs	74
Cumulic Endoaquolls	84
Cumulic Hapludolls	99
Cumulic Vertic Endoaquolls	79
Cumulic Vertic Epiaquolls	81
Dystric Eutrudepts	97
Entic Hapludolls	90
Fluvaquentic Endoaquolls	83
Fluvaquentic Hapludolls	85
Fluvaquentic Vertic Endoaquolls	93
Fluvaquents	50

Taxonomic Subgroup:	S factor
Fluventic Hapludolls	85
Glossic Hapludalfs	86
Lamellic Udipsamments	67
Limnic Haplosaprists	72
Lithic Endoaquolls	45
Lithic Hapludalfs	42
Lithic Hapludolls	42
Lithic Haplustolls	48
Mollic Endoaqualfs	85
Mollic Epiaqualfs	80
Mollic Fluvaquents	83
Mollic Hapludalfs	95
Mollic Oxyaquic Hapludalfs	90
Mollic Udifluvents	88
Oxyaquic Argiudolls	100
Oxyaquic Dystrudepts	42
Oxyaquic Eutrudepts	42
Oxyaquic Hapludalfs	85
Oxyaquic Hapludolls	100
Oxyaquic Haplustolls	81
Oxyaquic Udifluvents	88
Oxyaquic Vertic Argiudolls	97
Oxyaquic Vertic Hapludalfs	79
Pachic Argiudolls	100
Pachic Hapludolls	100
Pachic Haplustolls	78
Psammentic Hapludalfs	67
Terric Haplosaprists	87
Thapto-Histic Fluvaquents	85
Typic Albaqualfs	87
Typic Argialbolls	77
Typic Argiaquolls	82

Taxonomic Subgroup:	S factor
Typic Argiudolls	100
Typic Calciaquolls	78
Typic Calciudolls	84
Typic Endoaqualfs	66
Typic Endoaquerts	70
Typic Endoaquolls	94
Typic Eutrudepts	78
Typic Fluvaquents	80
Typic Haplohemists	64
Typic Haplosaprists	64
Typic Hapludalfs	89
Typic Hapludolls	100
Typic Natraquerts	52
Typic Paleudalfs	86
Typic Quartzipsamments	58
Typic Udifluvents	95
Typic Udipsamments	58
Typic Udorthents	72
Udertic Haplustolls	80
Udic Haplustolls	80
Udic Ustorthents	74
Udifluvents	50
Udollic Endoaqualfs	90
Vertic Albaqualfs	80
Vertic Argialbolls	80
Vertic Argiaquolls	90
Vertic Endoaquepts	78
Vertic Endoaquolls	75
Vertic Epiaqualfs	81
Vertic Epiaquolls	79
Vertic Fluvaquents	67

Table 3. M, W, and F factors used in the CSR2 formula.

Family Particle Size Class	M factor
coprogenous	0
fine-silty	0
fine-silty over clayey	0
organic	0
clayey	4
clayey over loamy	4
fine	4
fine-loamy	4
fine-loamy over clayey	4
very-fine	4
fine-loamy over sandy	4
coarse-loamy	12
coarse-loamy over clayey	12
coarse-silty	12
coarse-silty over clayey	12
loamy	12
mesic	35
mixed	35
sandy	35
sandy over clayey	35
sandy over loamy	35
sandy-skeletal	35
all other classes containing "skeletal"	12
calcareous	5**
** calcareous deductions are added on to any other M factor.	

FLOODING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Flooding conditions:	**F factor - flood**
flooding frequency is none, rare or NULL, or flooding duration is NULL	0
frequent brief	20
frequent very brief	10
occasional brief	6
occasional very brief	4
occasional long	10
frequent extremely brief	5
occasional very long	34
occasional extremely brief	2
frequent long OR frequent very long No deduction. Automatic component CSR2 of 5	

Slope values:	F factor - slope
slope is NULL	0
slope RV < 2	0
slope RV < 5	5
slope RV < 9	15
slope RV ≥ 9	3 * slope RV

Other F factor Conditions:	F factor - local
Component Local phase is "channeled"	40
Component erosion class is "2" - moderately eroded	3

AWC CALCULATED TO 60 INCHES, ROUNDED TO TWO DECIMAL PLACES.	
Available Water Capacity (AWC, inches of water)	**W factor**
No AWC populated	99
AWC < 3.01	24
AWC < 6.00	12
AWC < 9.00	8
AWC ≥ 9.00	0

PONDING FREQUENCY AND DURATION FOR THE MONTH OF MAY	
Ponding conditions:	**F factor - pond**
Frequency is none or NULL	0
frequent brief	20
frequent very brief	20
occasional brief	20
occasional very brief	20
frequent long	44
frequent very long	44
occasional long	44
occasional very long	44

Table 4. D values used in CSR2.

RUSLE T values *	D factor
Any Histosols	0
T factor 5	0
T factor 4	10
T factor 3	20
T factor 2	30
T factor 1	40
* T values provided by NRCS, September 2014	

Table 5a. EJ factors that reduce CSR2 values.

Paleosol Deductions	
Series	**EJ Deduction**
Adair	10
Armstrong	10
Ashgrove	10
Bucknell	10
Caplin	15
Clarinda	15
Clearfield	20
Donnan	20
Galland	15
Keswick	10
Lagonda	5
Lamoni	10
Lineville	20
Malvern	20
Mystic	15
Northboro	15
Rinda	15

Dense Till Deductions	
Series	**EJ Deduction**
Cresco	5
Cresken	5
Protivin	5
Jameston	5
Lourdes	5
Riceville	5

Sandy Deductions	
Series	**EJ Deduction**
Farrar	15
Olin	10

"Old" clay loam till Deduction	
Series	**EJ Deduction**
Shelby	5
Gara	5
Lindley	5

Clayey Loess Deductions	
Series	**EJ Deduction**
Appanoose	15
Kniffin	15
Seymour	10
Rathbun	15

Table 5b. EJ factors that increase CSR2 value.

Series or Map unit symbol	EJ Addition
Macksburg	15
Mahaska	15
Kalona	10
Rowley	10
All components in map units 221B	10
Waukee	10

Understanding CSR2?

Example Calculation of CSR2 Value of Kenyon Loam (83B 2-5% Slope)

- Correlate the NRCS data (parameters) to the CSR2 component values.

- Parameters **S and M** are determined from the **TAXONOMIC CLASS (slide 43-44).** For Kenyon loam (83B 2-5%):
  - Taxonomic subgroup class is **Typic Hapludolls,** and the family particle size is **Fine-loamy.**
    - For Typic Hapludolls, this translates to **S = 100**.
    - For Fine-loamy, this translates to **M = 4**.

- Parameter **W** is determined from the **available water holding capacity (AWC)** of the series in the top 60 inches of soil **(slide 46-47**). For Kenyon loam (83B 2-5%):
  - AWC is 10.2 inches (0.17cm/cm x 60 inches), and this translates to **W = 0**.

Understanding CSR2?

Example Calculation of CSR2 Value of Kenyon Loam (83B 2-5% Slope)

- Parameter **F** is determined by the **field condition** of the map unit. This includes the **representative value for slope**, the **flooding frequency for May**, the **ponding frequency for Ma**y, and the **erosion class (slides 48-57).** For Kenyon loam (83B 2-5%):
  - The representative value for slope is 3, and this translates to $F_{slope} = 5$.
  - The flooding frequency is none, and this translates to $F_{flooding} = 0$.
  - The ponding frequency is none, and this translates to $F_{ponding} = 0$.
  - The erosion class is not moderately eroded or channeled, and this translates to $F_{erosion} = 0$.
  - Therefore, $\underline{\mathbf{F}} = \mathbf{F}_{\underline{\mathbf{slope}}} + \mathbf{F}_{\underline{\mathbf{flooding}}} + \mathbf{F}_{\underline{\mathbf{ponding}}} + \mathbf{F}_{\underline{\mathbf{erosion}}} = \underline{\mathbf{5}}$.

Understanding CSR2?

Example Calculation of CSR2 Value of Kenyon Loam (83B 2-5% Slope)

- Parameter **D** is determined by the tolerable rate of soil erosion that can occur without affecting crop productivity (RUSLE T factor – **slide 58-59**). For Kenyon loam (83B 2-5%):
  - T factor is 5 tons per acre per year, and this translates to **D = 0**.

- Parameter **EJ** is determined by looking for the soil series name in tables 5a and 5b in the file – **Corn Suitability Rating 2 Equation and Component Values**. Click on equation under Iowa Corn Suitability Rating 2 (CSR2) - http://www.extension.iastate.edu/soils/suitabilities-interpretations. For Kenyon loam (83B 2-5%):
  - There are no EJ deductions or additions (Kenyon is not listed – **slide 60**), and this translates to **EJ = 0**.

- Finally, the **calculated CSR2** for Kenyon (83B 2-5%):
  - **CSR2 = S – M – F – W – D +/- EJ**

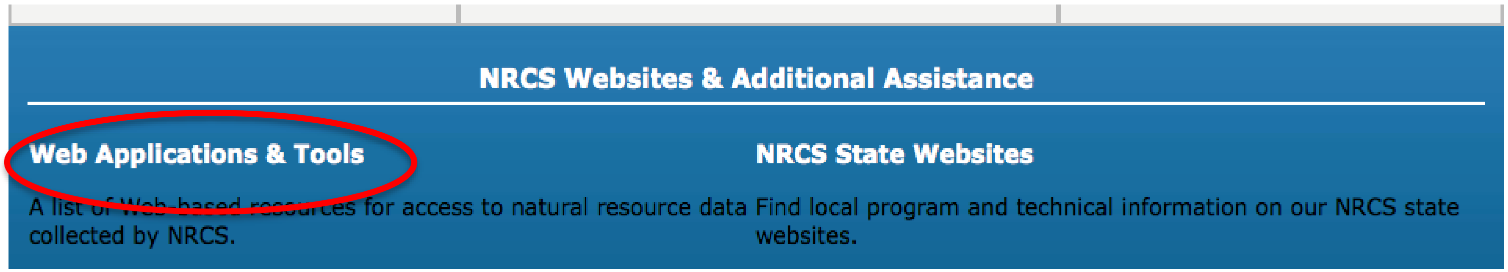
    = 100 – 4 – 5 – 0 – 0 +/- 0 = 91

Understanding CSR2?

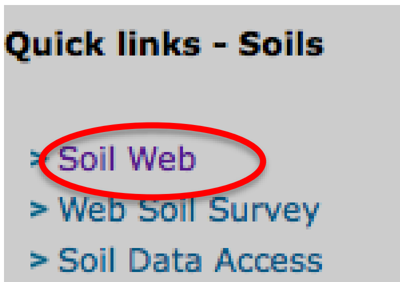
Another Method to Collect Data for CSR2 Calculation

<u>Another way to find the soil data</u> is to use Google Earth with the Web Soil Survey. Steps to set this up include:

1. Make sure Google Earth is running on your computer.
2. Go to http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/, and click on Web Application and Tools at the bottom of the screen.



3. Click on Soil Web in the quick links to get to UC Davis California Soil Resource Lab.



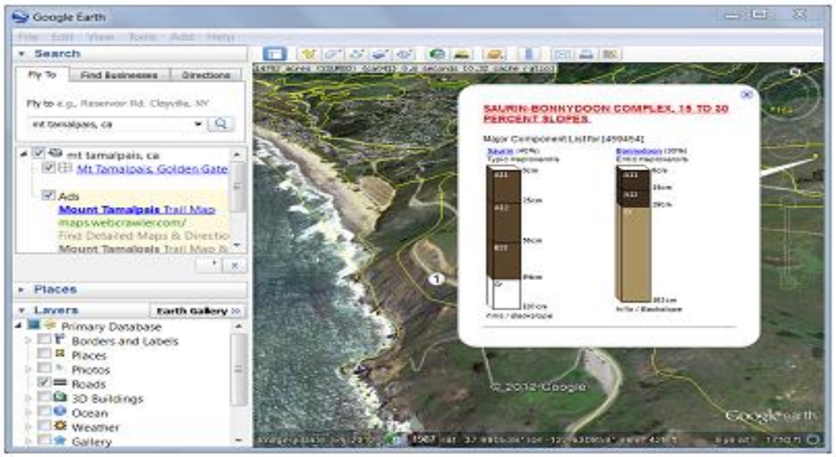
Understanding CSR2?

Another Method to Collect Data for CSR2 Calculation

Click on SoilWeb Earth and download Soilweb.kmz in Google Earth.

SoilWeb Earth

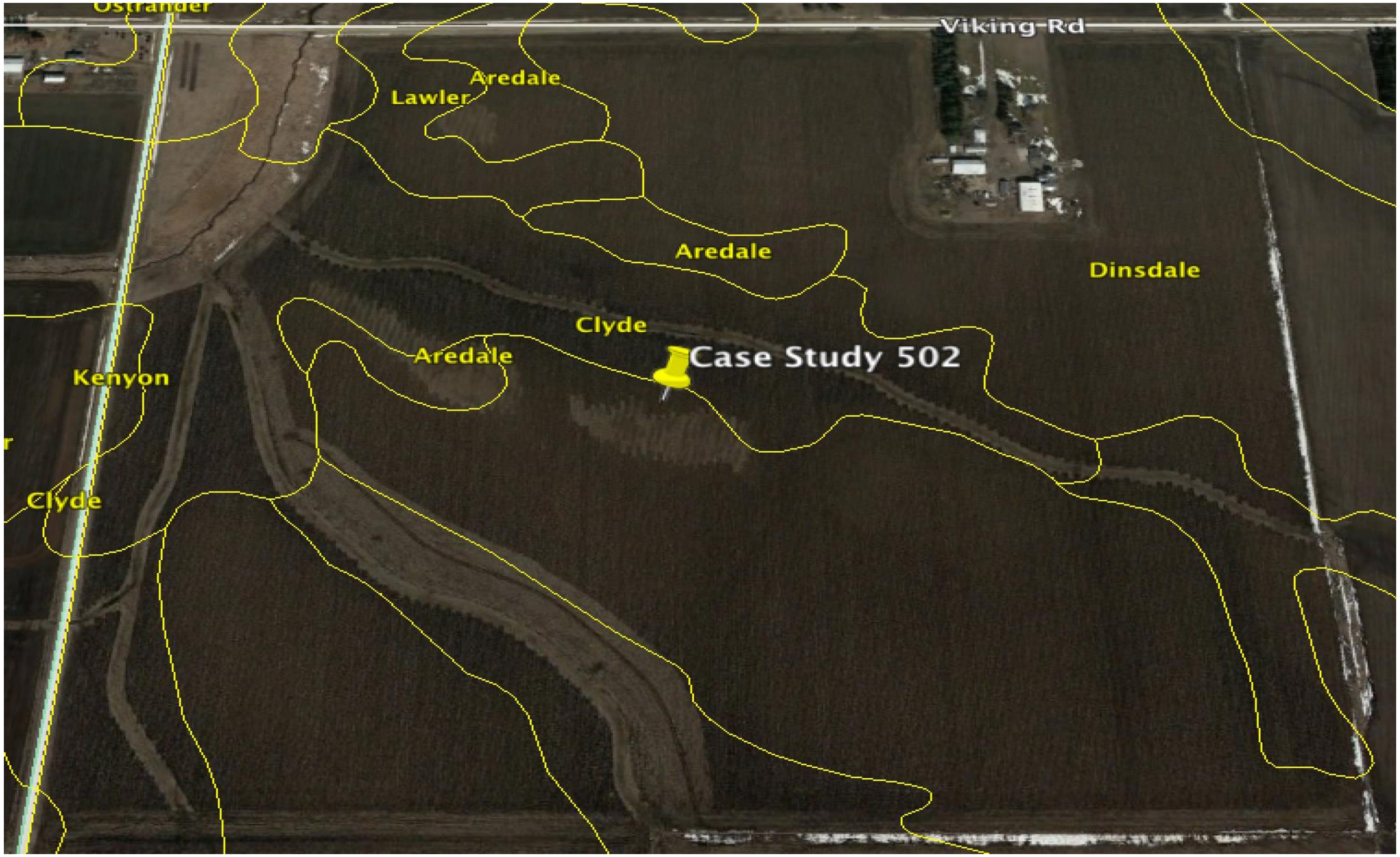
Soil survey data are delivered dynamically in a KML file, allowing you to view mapped areas in a 3-D display. You must have Google Earth or some other means of viewing KML files installed on your desktop computer, tablet, or smartphone.



Understanding CSR2?

Another Method to Collect Data for CSR2 Calculation

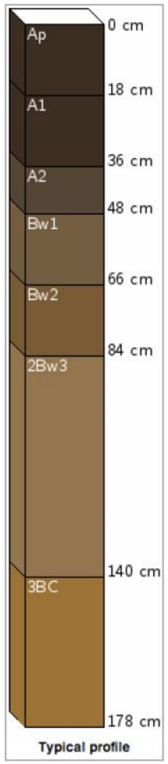
After loading Google Earth with Web Soil Survey, **search and pull up any piece of agricultural land in the US**. The soil map is overlaid on the Google Earth map.



Understanding CSR2?

Getting Data for CSR2 Calculation

<u>To find S, M, W and D</u>, click on any soil series and the soil data pops up. Then, click on the component name to get the component details. ***Currently, the field conditions, **F**, are not available with the Web Soil Survey overlay on Google Earth*.



Soil Taxonomy

Order:	Mollisols
Suborder:	Udolls [Map of Suborders]
Greatgroup:	Hapludolls
Subgroup:	Typic Hapludolls
Family:	Fine-loamy, mixed, superactive, mesic Typic Hapludolls
Soil Series:	Aredale (Link to OSD) (Soil Series Explorer)
Data:	[Lab Data]
Raw Data	Component All Horizons

Land Classification

Storie Index	NOT RATED
Land Capability Class [non-irrigated]	2-e
Land Capability Class [irrigated]	-
Ecological Site Description	n/a
Forage Suitability Group	n/a

Soil Suitability Ratings

Waste Related	Engineering
Urban/Recreational	Irrigation
Wildlife	Runoff

Hydraulic and Erosion Ratings

Wind Erodibility Group	6
Wind Erodibility Index	48
T Erosion Factor	5
Runoff	Low
Drainage	Well drained
Hydric Rating / Hydrologic Group	No [Group B]
Parent Material:	loamy sediments over subglacial till
Total Plant Available Water (cm):	30.12

Geomorphology

Landform	hillsides [Summit]
Landscape	uplands

Differences Between CSR and CSR2

- CSR2 can be calculated using available online data, while CSR values cannot
- CSR2 values are same statewide for a SMU, while CSR values vary by county (due to climate limitation in CSR)
- Climate limitation is not included in CSR2 (Sassman et al., 2015)
  - Under CSR, north and west counties were thought to be climate-limited
- CSR and CSR2 are statistically similar, but not always the same
  - Northern and Western counties will see an increase

Summary

- CSR2 is an amazingly easy to understand soil productivity index.
    - ✓ *It starts with a value that is defined by its taxonomic subgroup class for the dominant soil series. Then, soil productivity deductions are made for family particle sizes, increasing slopes, increasing May flooding and ponding, moderate erosion class, decreasing available water holding capacity in the top 60 inches, and less top soil depth (as measured by RUSLE T factors that are less than 5).*
- CSR2 is data driven, while CSR is more expert judgment based.
- CSR2 is calculated using online soil survey data from the NRCS, which includes dominant and minor soils in each soil mapping unit (Burras et al., 2010).
- CSR2 is calculated using weighted average of soil components of SMU.
- NRCS updated the Web Soil Survey in January, 2014 to include CSR2 values. CSR is not available on the Web Soil Survey anymore.
- CSR2 can be trusted.

Summary – Iowa Soil is Productive!

Picture by John Chehak

Quiz

1. The main reason that the US government wants to rate the soil productivity of cropland is to:

   a) Equalize land values for tax assessment. *
   b) Keep government workers busy.
   c) Keep statistics.
   d) Determine potential yields for pumpkins.

2. The Division of Soils, which was created by the USDA in 1894, first wanted to examine what soil conditions:

   a) Soil moisture and temperature. *
   b) Soil texture and particle size.
   c) The pH and CEC.
   d) Soil depth and erosion class.

3. Iowa's CSR was published and released in:

   a) 1971 *
   b) 1945
   c) 1934
   d) 2013

4. Which of the following is not an assumption for Iowa's CSR index:

   a) Terracing when needed *
   b) Adequate management
   c) Artificial drainage where required (tiling)
   d) Natural weather conditions

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