Celebrating Soils of Our National Park Lands

National Park Service Centennial

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National Soil Survey Center
USDA-NRCS
May 2016 NSSC Seminar

NRCS Natural Resources Conservation Service

NATIONAL PARK SERVICE

Introduction

Integrating soil science into the National Park visitor experience is one way we can increase natural science literacy and further the recognition of soil science as a discipline

Introduction

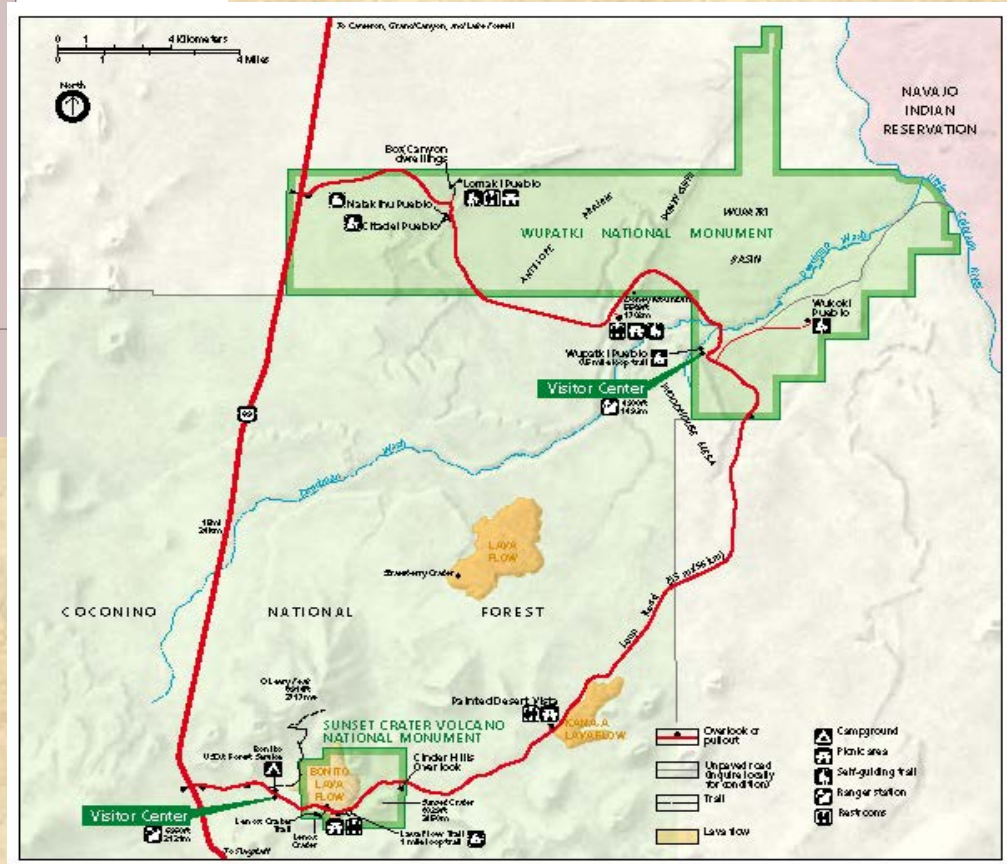
“I don’t know the words to use”

“Soils seems so complicated”

My motto: Data isn’t knowledge until it’s analyzed, translated, used

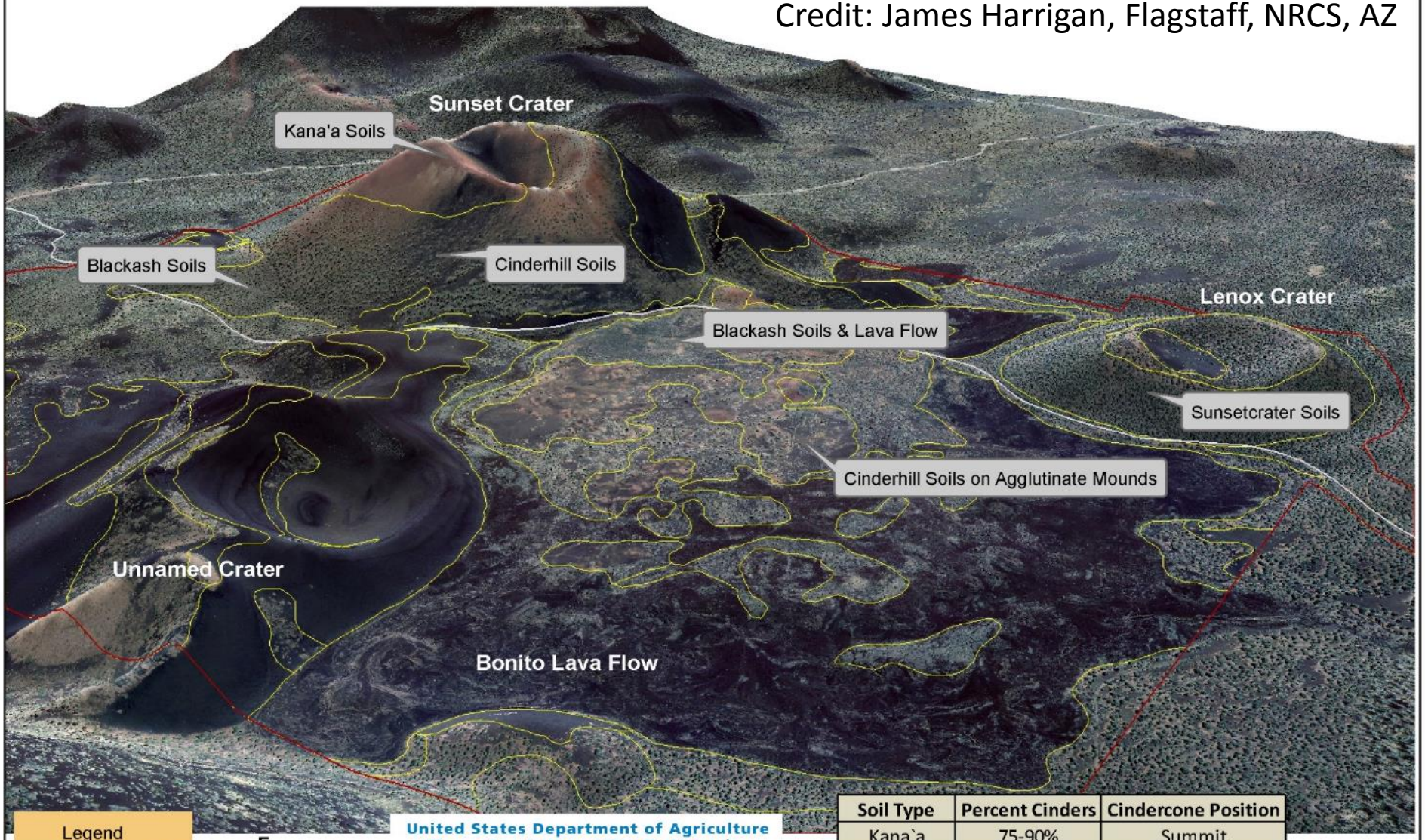
~1100 CE

Wupatki and Sunset Crater National Monuments, Arizona



Sunset Crater Volcano National Monument 3D Soil Types

Credit: James Harrigan, Flagstaff, NRCS, AZ



Legend
- Park Boundary
- Soil Map Units
- Roads

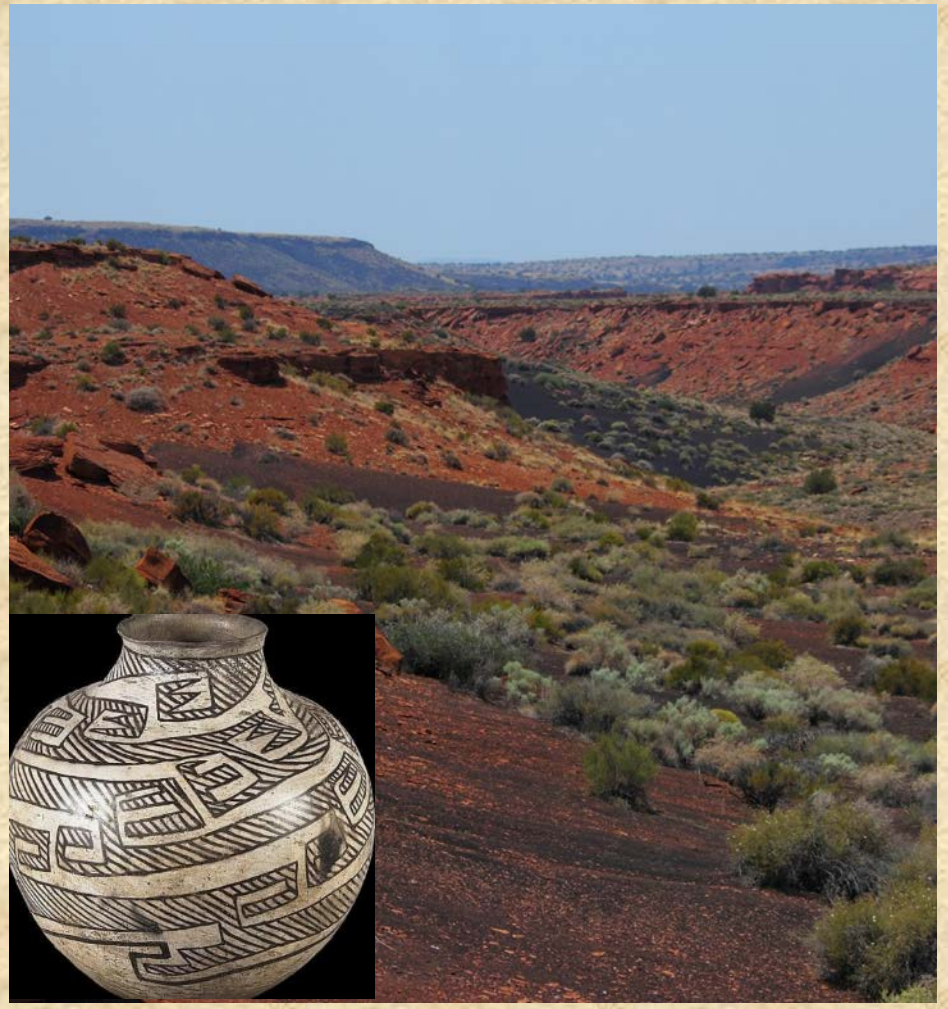
E S N W

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Soil Type	Percent Cinders	Cindercone Position
Kana`a	75-90%	Summit
Sunsetcrater	35-80%	Backslope
Cinderhill	35-75%	Backslope
Blackash	20-35%	Footslope

~1100 CE

Natural and Cultural Landscapes of Wupatki National Monument, AZ



Wupatki Pueblo ruins

Ashy over loamy, glass over mixed, superactive, nonacid, mesic Vitrandic Torriorthents

Surficial ash and cinder layers, may act as a water-retaining and temperature moderating mulch (Cook, 1981) (Shoji, 1993) (Lightfoot, 1996) (Ort, 2008).

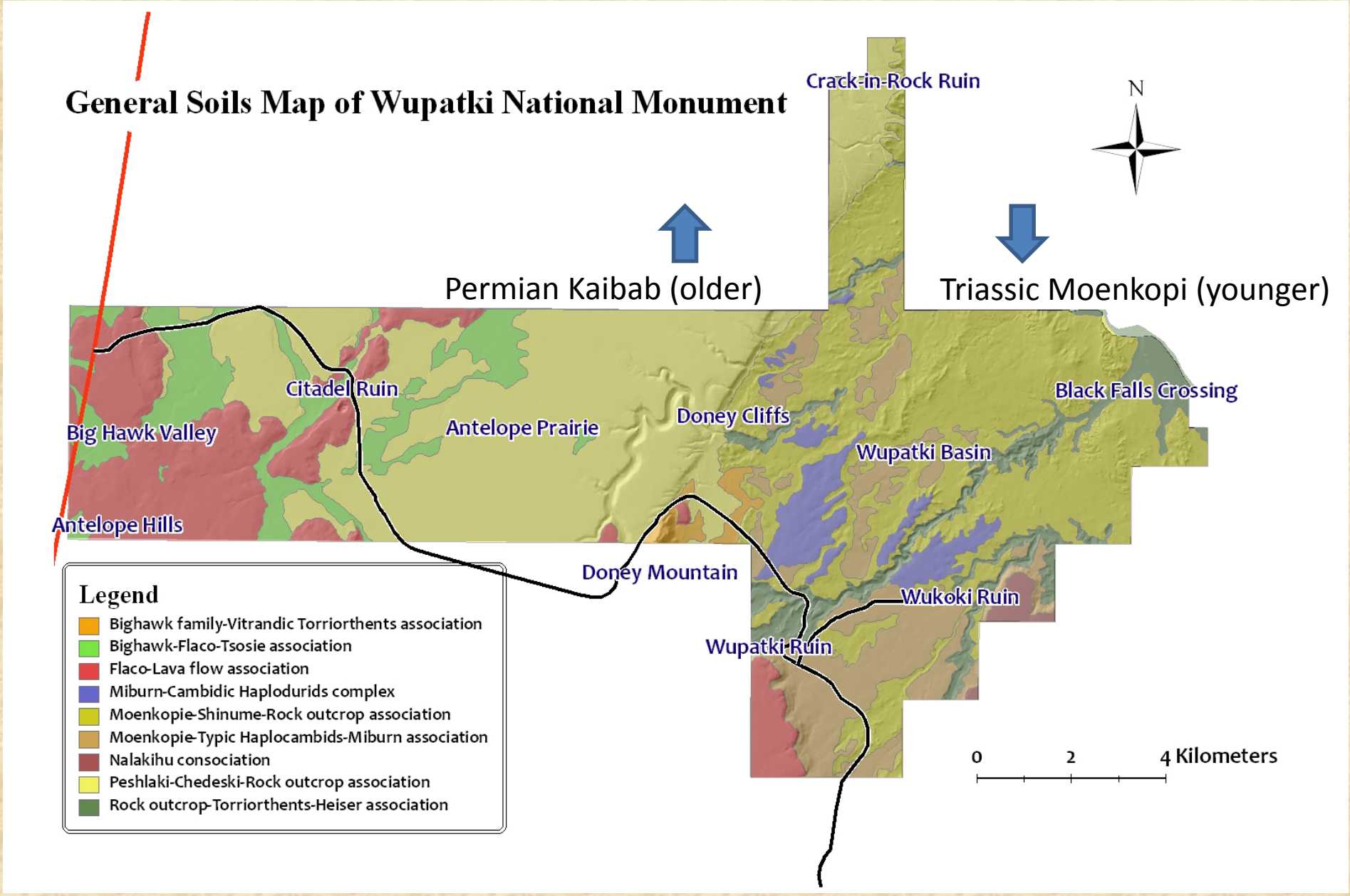
1. Mulching increases water infiltration and retention due to pore size.

2. Color influences albedo and therefore soil temperature and increases moisture retention (thru condensation)

3. Surface has reduced turbulent air flow thus reducing wind erosion and soil desiccation.

4. Decreased salinization (reduced evap)

~1100 CE


General Soils Map of Wupatki National Monument
Crack-in-Rock Ruin
N
Permian Kaibab (older)
Triassic Moenkopi (younger)
Citadel Ruin
Big Hawk Valley
Antelope Prairie
Doney Cliffs
Black Falls Crossing
Wupatki Basin
Antelope Hills
Doney Mountain
Wukoki Ruin
Wupatki Ruin
Legend
Bighawk family-Vitrandic Torriorthents association
Bighawk-Flaco-Tsosie association
Flaco-Lava flow association
Miburn-Cambidic Haplodurids complex
Moenkopie-Shinume-Rock outcrop association
Moenkopie-Typic Haplocambids-Miburn association
Nalakihu consociation
Peshlaki-Chedeski-Rock outcrop association
Rock outcrop-Torriorthents-Heiser association
0
2
4 Kilometers

~1100 CE

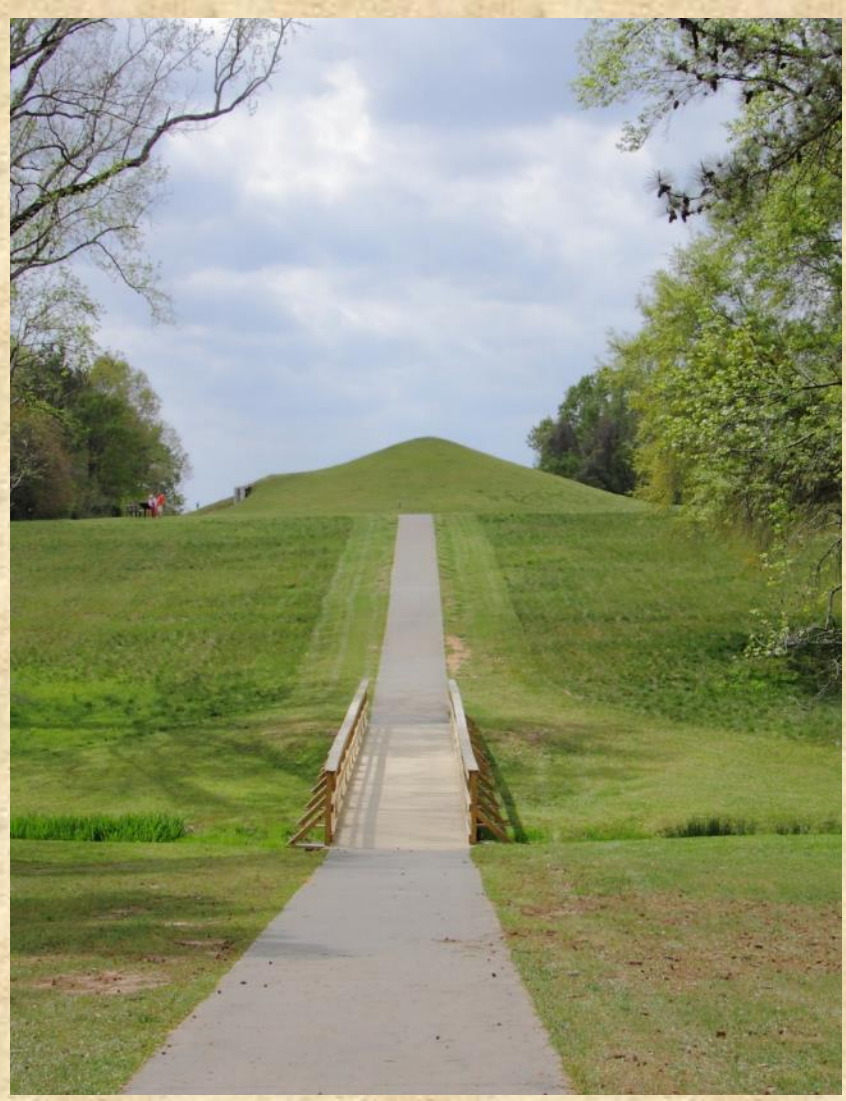
Around 1250 CE the Wupatki settlements were abandoned. Tree-ring and archeological evidence suggests an increasingly dry, semi-arid climate reduced soil water availability. (Colton, 1932, 1946) (Downum, 1990).

LESSON: Physical and chemical soil properties of cinder mulched soils most likely aided the Sinagua people to farm lands that were formerly not arable prior to Sunset Crater eruptions. Soils can change quickly or slowly over time. Climate change affects soils.

~1100 CE

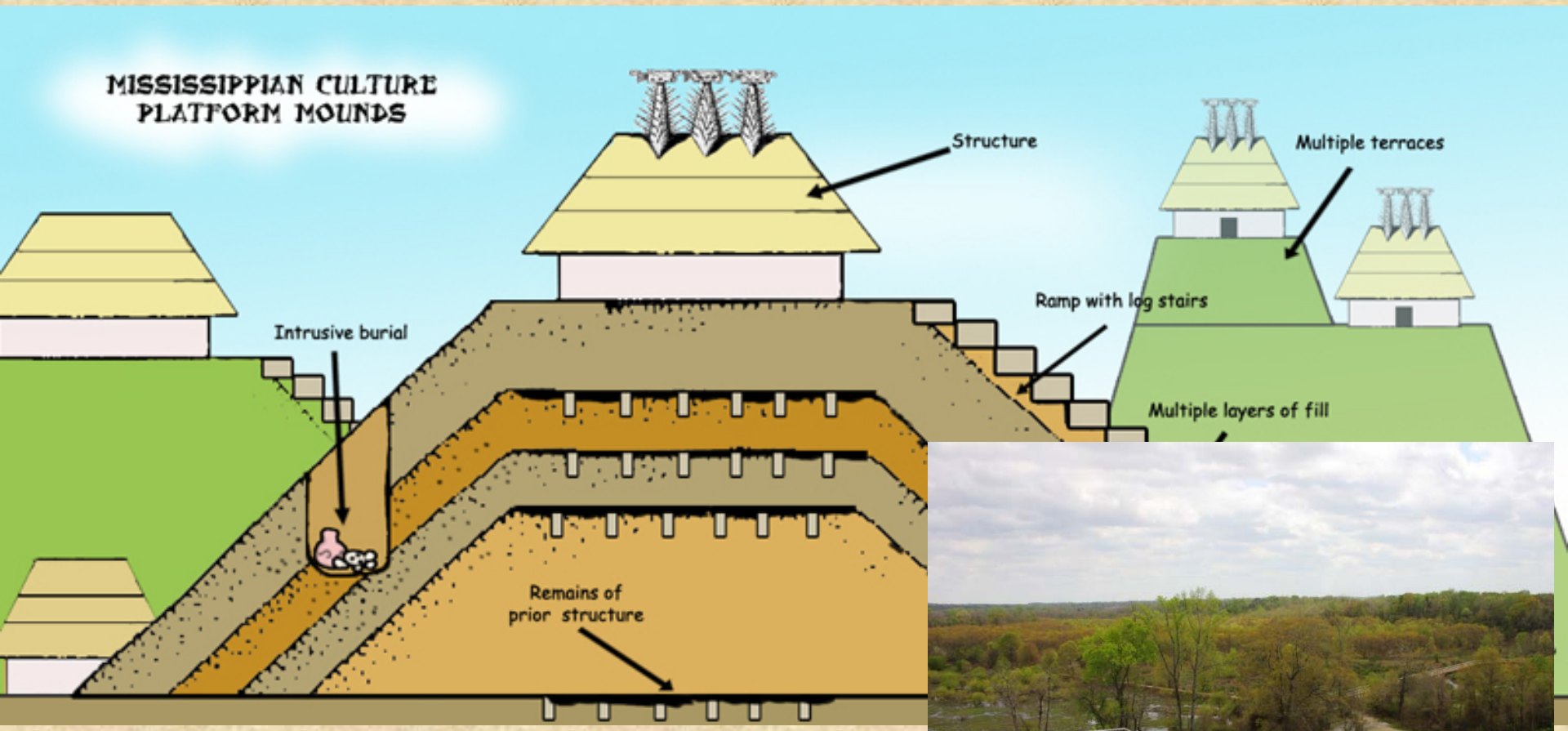
Ocmulgee National Monument, Georgia

1100 CE
Ocmulgee National Monument, Georgia



1100 CE

Ocmulgee National Monument, Georgia

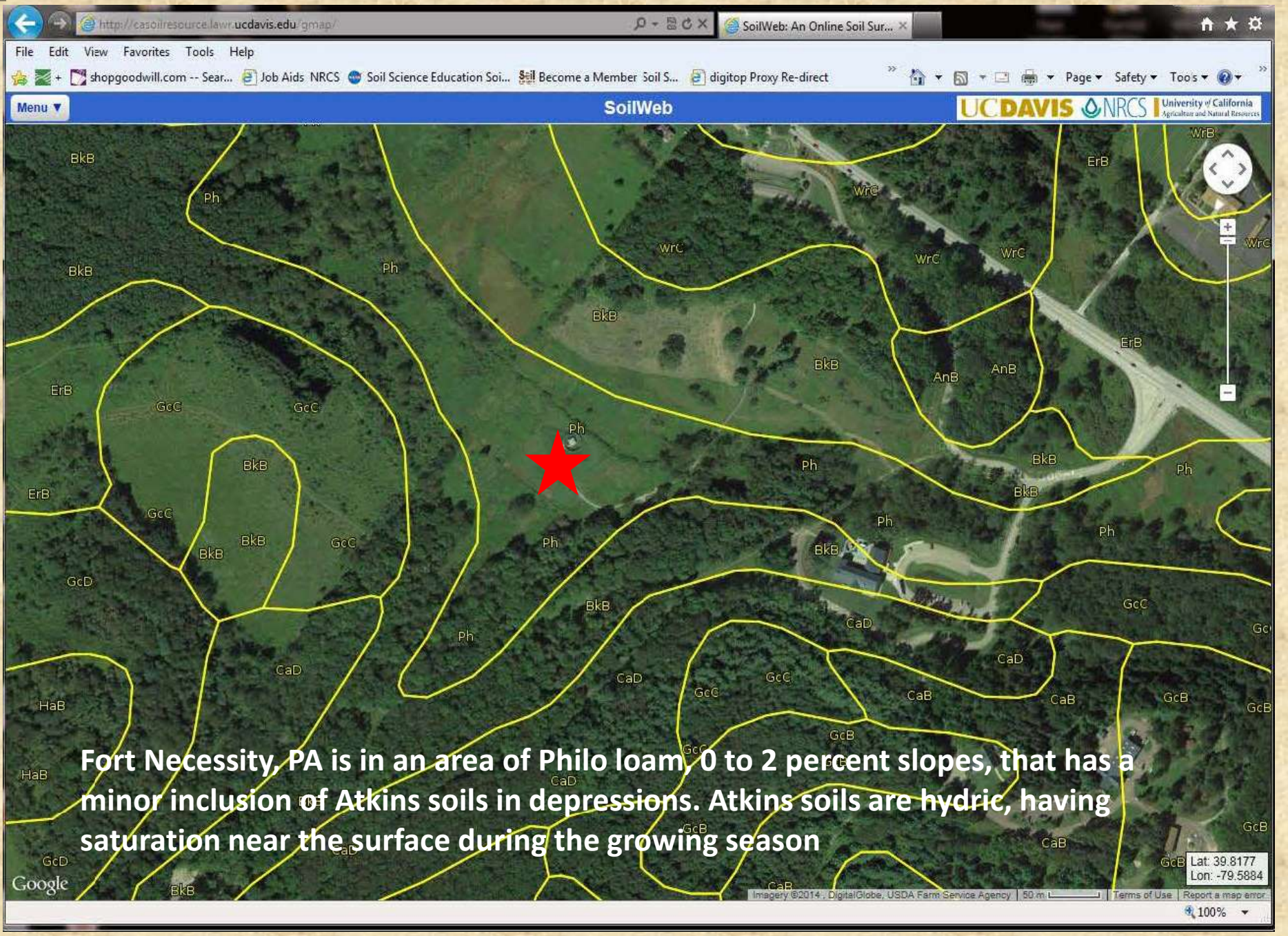


1100 CE

Ocmulgee National Monument, Georgia

And Fort Frederica National Historic Site, Georgia

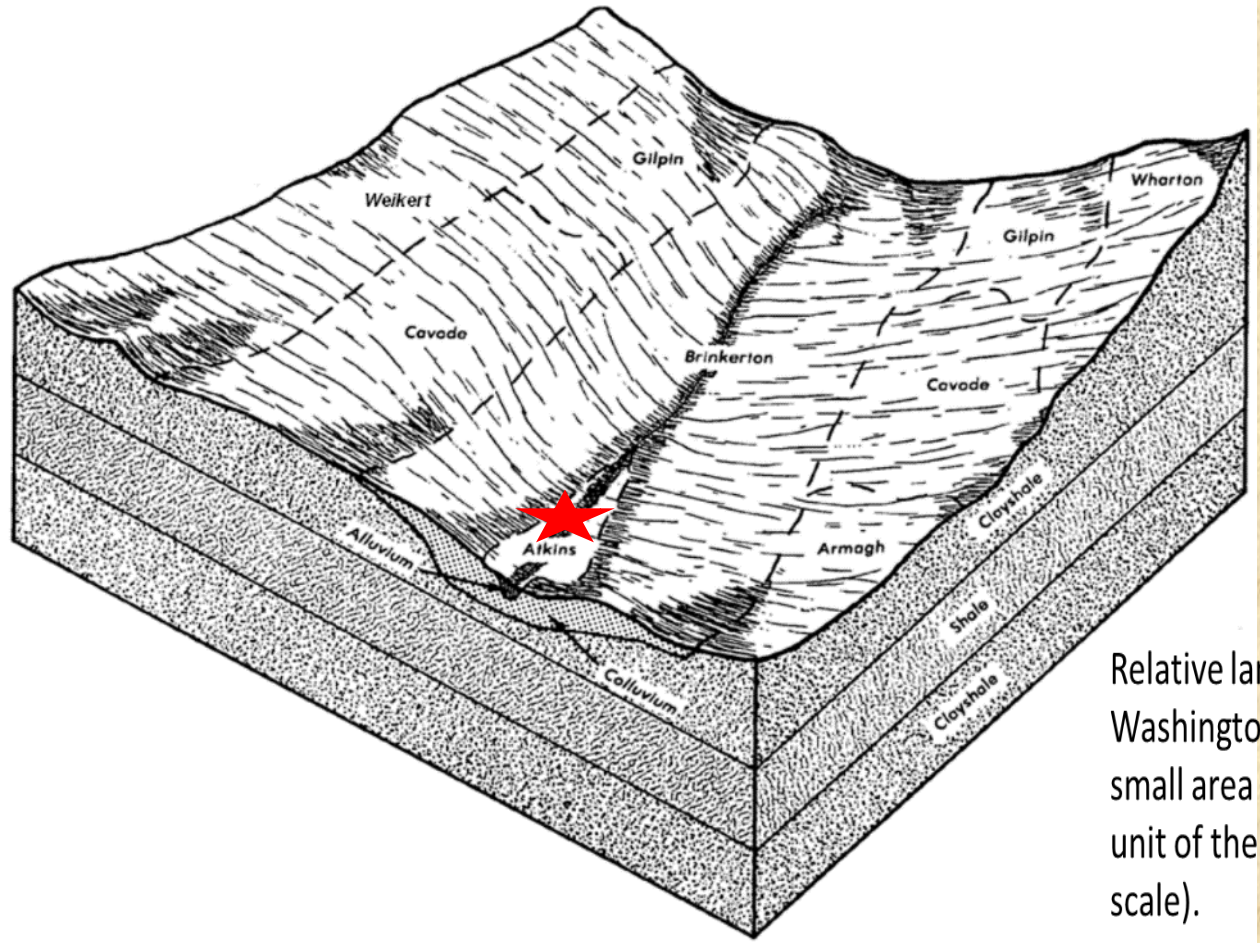
1754
Fort Necessity National Battlefield, Pennsylvania



Fort Necessity, PA is in an area of Philo loam, 0 to 2 percent slopes, that has a minor inclusion of Atkins soils in depressions. Atkins soils are hydric, having saturation near the surface during the growing season

1754

These soils became inundated during summer thunderstorms, with the water table near or at the surface, where the ramparts were excavated and ammunition stored



Relative landscape positions of the soils near Washington's log fort. The fort was located in a small area of Atkins soils, included in the soil map unit of the Great Meadows. (Diagram is not to scale).

1754

On July 3, 1754, Louis Coulon de Villiers, a French army captain, surrounded Washington's Great Meadows fort to avenge the Battle of Jumonville Glen, where Washington's troops had earlier killed the captain's brother.

Heavy rain aided the French as Washington's fort became inundated and his ammunition became wet and useless. There was no place to divert water from the Atkins hydric soil area given its depressional landscape position.

Washington was quickly surrounded by French troops located on adjacent high ground. The very first battle of the French and Indian War ended with George Washington's one and only military surrender.

1754

Washington learned to pay attention to landscape position and soil drainage that he always "took the high ground" while later commanding the War for Independence

Valley Forge National Historic Park, PA

1777

Morristown National Historic Park, NJ

1779

1849

Golden Gate National Recreation Area, California

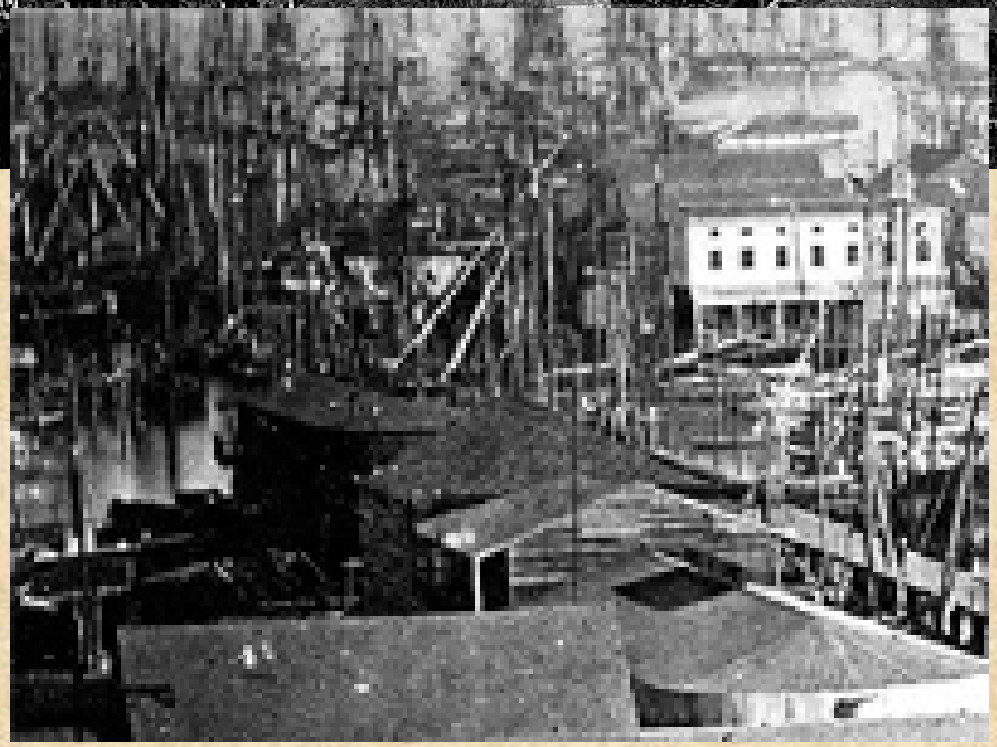
Fort Baker

1849

“A Venice built of pine instead of marble. It is a city of ships, piers, and tides. Large ships with railings, a good distance from the shore, served as residences, stores, and restaurants. I saw places where the tide had flowed down the street, turning the interior of houses into lakes. The whole central part of the city swayed noticeably because it was built on piles the size of ship’s masts driven down into the mud”.

http://mua.apps.uri.edu/in_the_field/jd1.shtml

1849



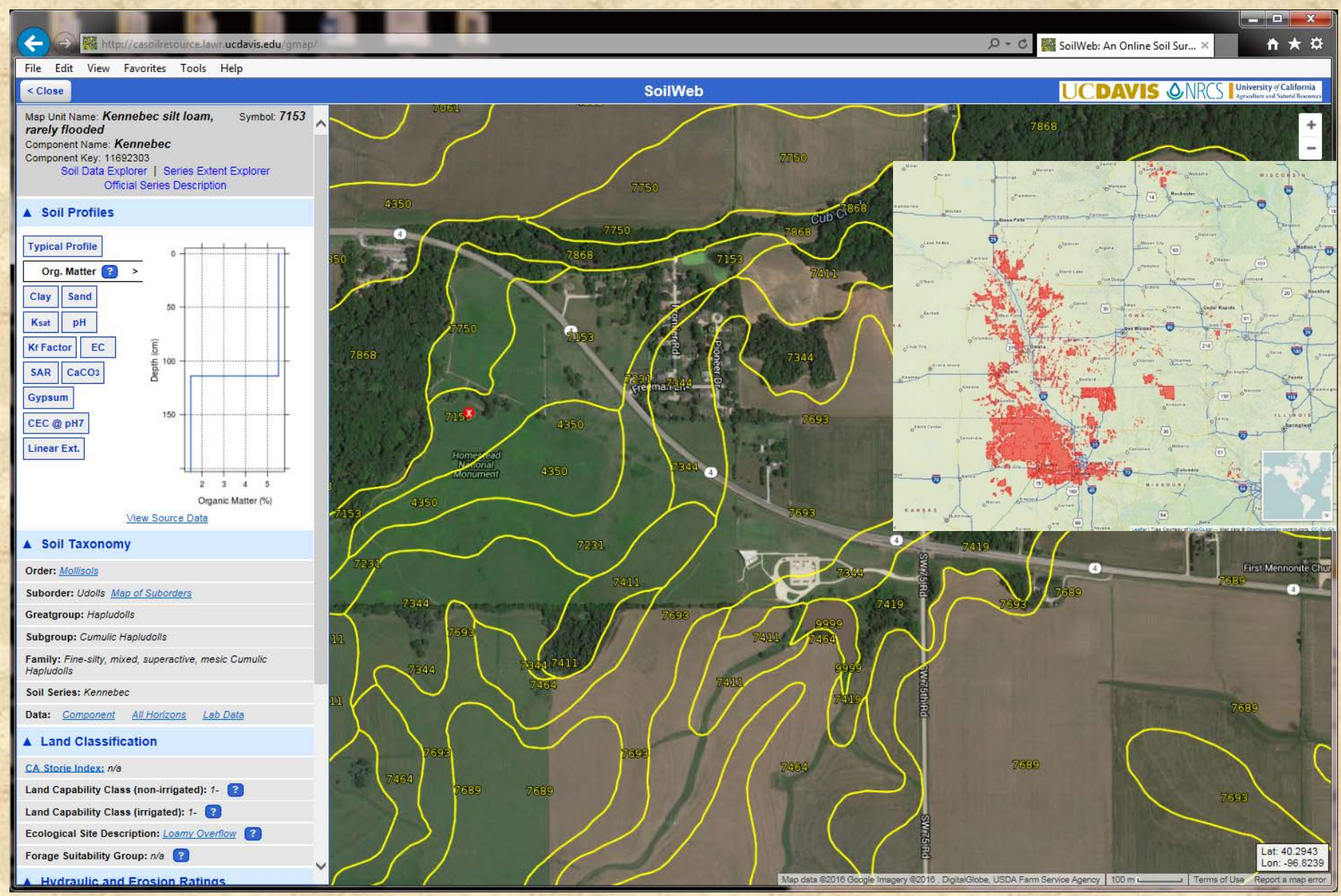
1849 to today

Chronicle / Brant Ward

1862

Homestead National Monument of America, Nebraska

1862



http://casoilresource.lawr.ucdavis.edu/gmap/
SoilWeb: An Online Soil Sur...
File Edit View Favorites Tools Help
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SoilWeb
UCDAVIS NRCS University of California Agriculture and Natural Resources
Map Unit Name: Kennebec silt loam, rarely flooded
Symbol: 7153
Component Name: Kennebec
Component Key: 11692303
Soil Data Explorer | Series Extent Explorer
Official Series Description
Soil Profiles
Typical Profile
Org. Matter
Clay
Sand
Ksat
pH
Kf Factor
EC
SAR
CaCO3
Gypsum
CEC @ pH7
Linear Ext.
Depth (cm)
Organic Matter (%)
View Source Data
Soil Taxonomy
Order: Mollisols
Suborder: Udolls Map of Suborders
Greatgroup: Hapludolls
Subgroup: Cumulic Hapludolls
Family: Fine-silty, mixed, superactive, mesic Cumulic Hapludolls
Soil Series: Kennebec
Data: Component All Horizons Lab Data
Land Classification
CA Storie Index: n/a
Land Capability Class (non-irrigated): 1-
Land Capability Class (irrigated): 1-
Ecological Site Description: Loamy Overflow
Forage Suitability Group: n/a
Hydraulic and Erosion Ratings
Homestead National Monument
Cub Creek
Pioneer Dr
Freeman Dr
SW 75th Rd
First Mennonite Chur
Lat: 40.2943
Lon: -96.8239
Map data ©2016 Google Imagery ©2016 , DigitalGlobe, USDA Farm Service Agency
100 m
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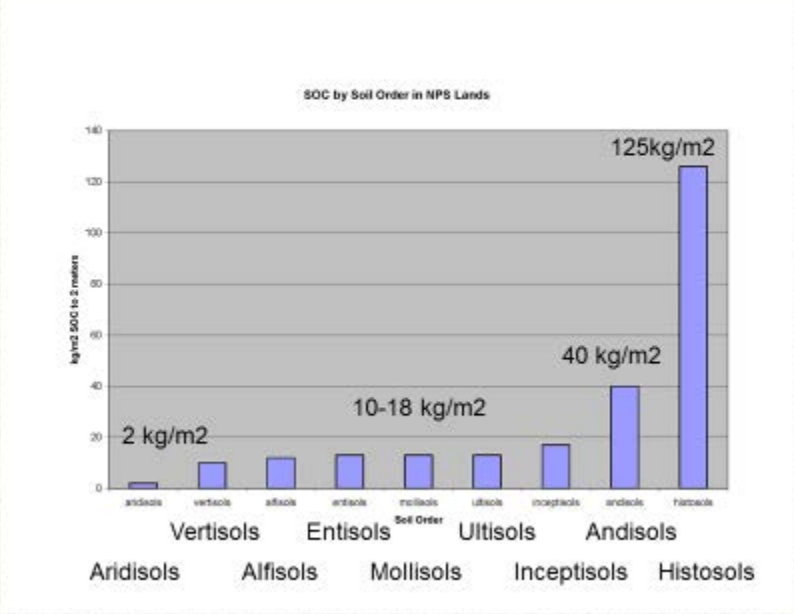
1862

Kennebec SOC ranges from 55 to 65 kg/m2 to 2 meters which is the highest SOC content of any Mollisols within the NPS lands

Average SOC by Soil Order in NPS Lands



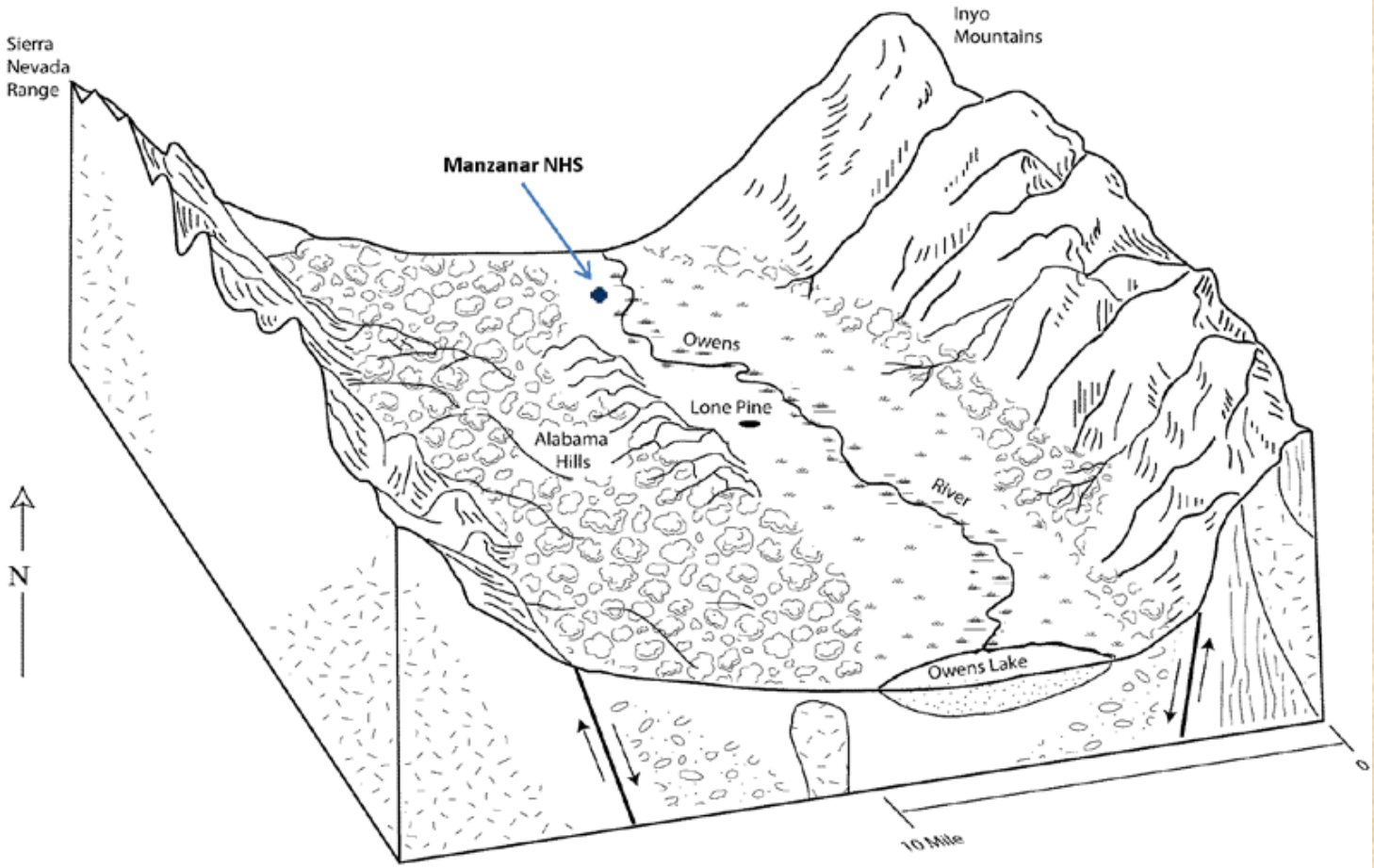
1942

Manzanar National Historic Site, California

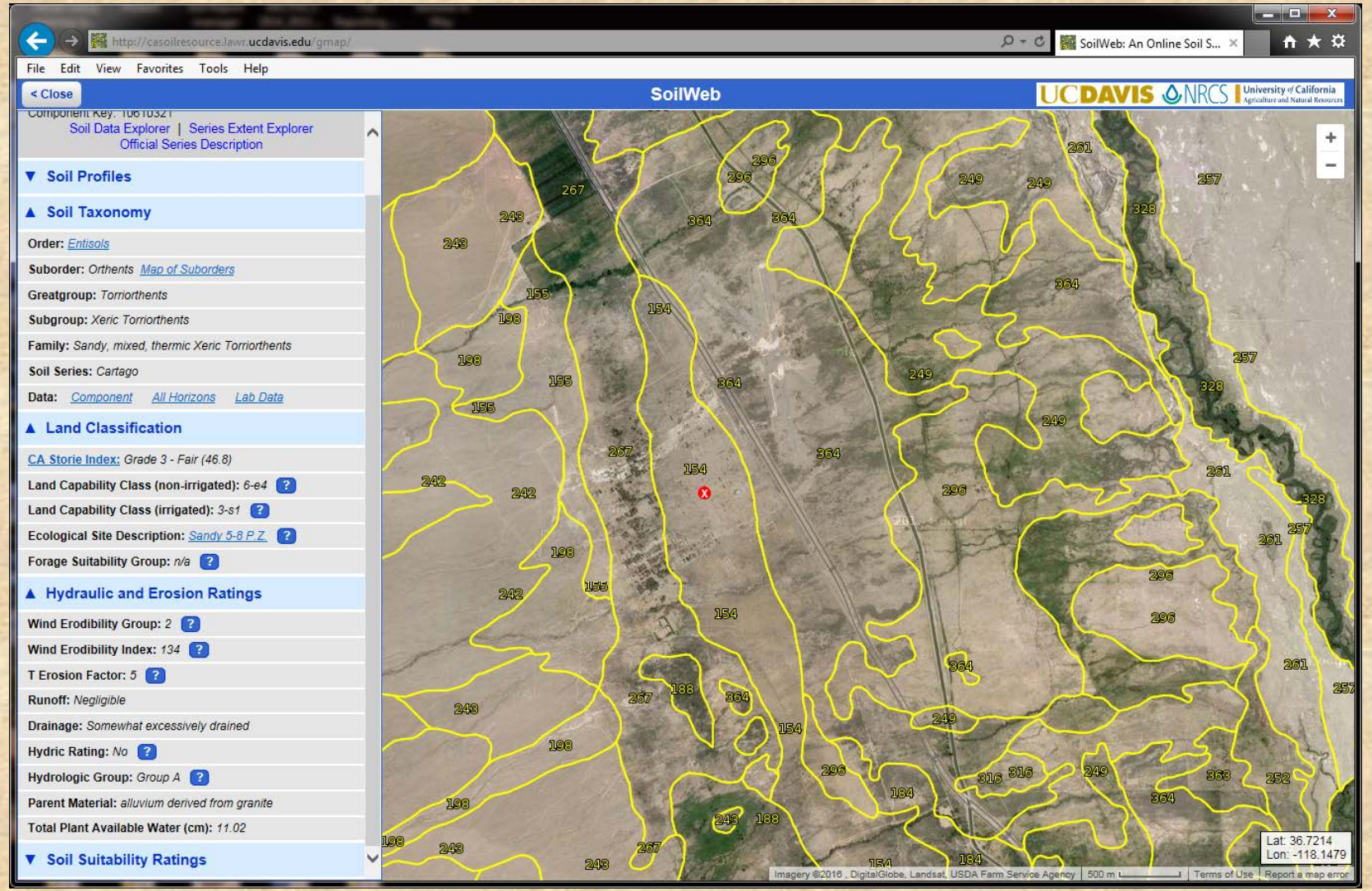
More than 10,000 people of Japanese heritage lived here between 1942 and 1945.
Ten camps collectively housed ~120,000 internees after the Pearl Harbor bombing

1942

A human-induced source of loess or PM10 in the vicinity of Manzanar is the exposed alkaline lake bed of Owens Lake, which was drained starting in 1913 by Owens River diversions. Salt-rich loess traveled both north and south on winds funneled through Owens Valley (Reheis, 2011). The alkaline loess or PM10 is composed of sodium chloride, sodium sulfate, sodium bicarbonate, and sodium carbonate



1942


http://casoilresource.lawr.ucdavis.edu/gmap/
SoilWeb: An Online Soil S...
File Edit View Favorites Tools Help
< Close
SoilWeb
UCDAVIS NRCS University of California Agriculture and Natural Resources
Component Key: 10610321
Soil Data Explorer | Series Extent Explorer
Official Series Description
Soil Profiles
Soil Taxonomy
Order: Entisols
Suborder: Orthents Map of Suborders
Greatgroup: Torriorthents
Subgroup: Xeric Torriorthents
Family: Sandy, mixed, thermic Xeric Torriorthents
Soil Series: Cartago
Data: Component All Horizons Lab Data
Land Classification
CA Storie Index: Grade 3 - Fair (46.8)
Land Capability Class (non-irrigated): 6-e4
Land Capability Class (irrigated): 3-s1
Ecological Site Description: Sandy 5-8 P.Z.
Forage Suitability Group: n/a
Hydraulic and Erosion Ratings
Wind Erodibility Group: 2
Wind Erodibility Index: 134
T Erosion Factor: 5
Runoff: Negligible
Drainage: Somewhat excessively drained
Hydric Rating: No
Hydrologic Group: Group A
Parent Material: alluvium derived from granite
Total Plant Available Water (cm): 11.02
Soil Suitability Ratings
Lat: 36.7214
Lon: -118.1479
Imagery ©2016 , DigitalGlobe, Landsat, USDA Farm Service Agency
500 m
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1942

“Farewell to Manzanar” by Jeanne Watasuki Houston:

“We woke…shivering and coated with dust that had blown up through the knotholes”

“….our cubicle looked as if a great laundry bag had exploded and then sprayed with fine dust”

…“his eyebrows were gray. He was looking at me, at my gray eyebrows and coated hair…”

“hey…you guys fall in the same flour barrel as us?”

…”icy gusts of wind were buffeting our barracks every few minutes, sending fresh dust puffs up through the floorboards”

1942

In order to sustain the camps, the United States War Department brokered a deal with LA Water and Power to divert some water to Manzanar for irrigation and household uses

Ansel Adams image of internee

Meditation garden today

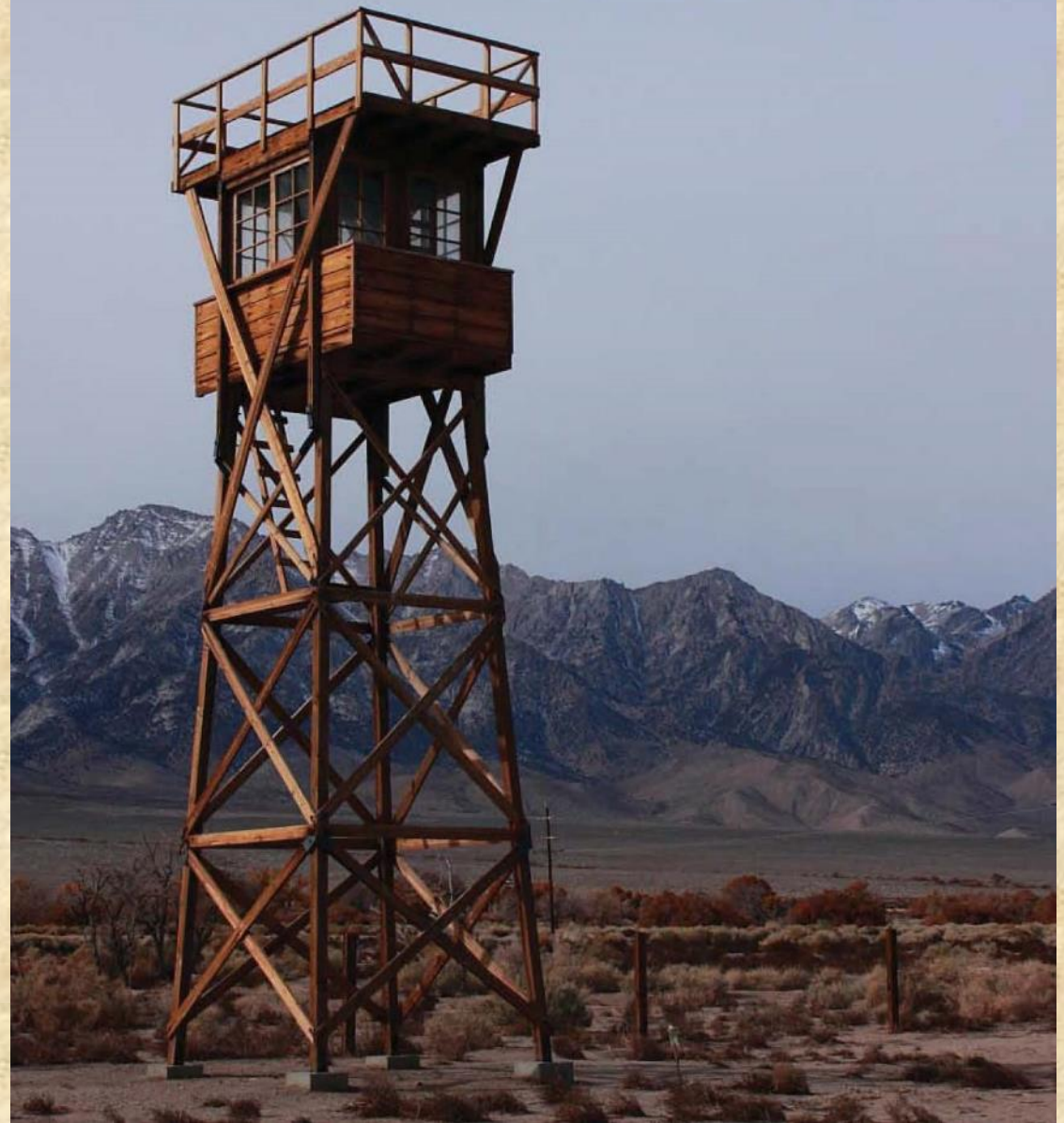
United States Department of Agriculture

United States Department of the Interior

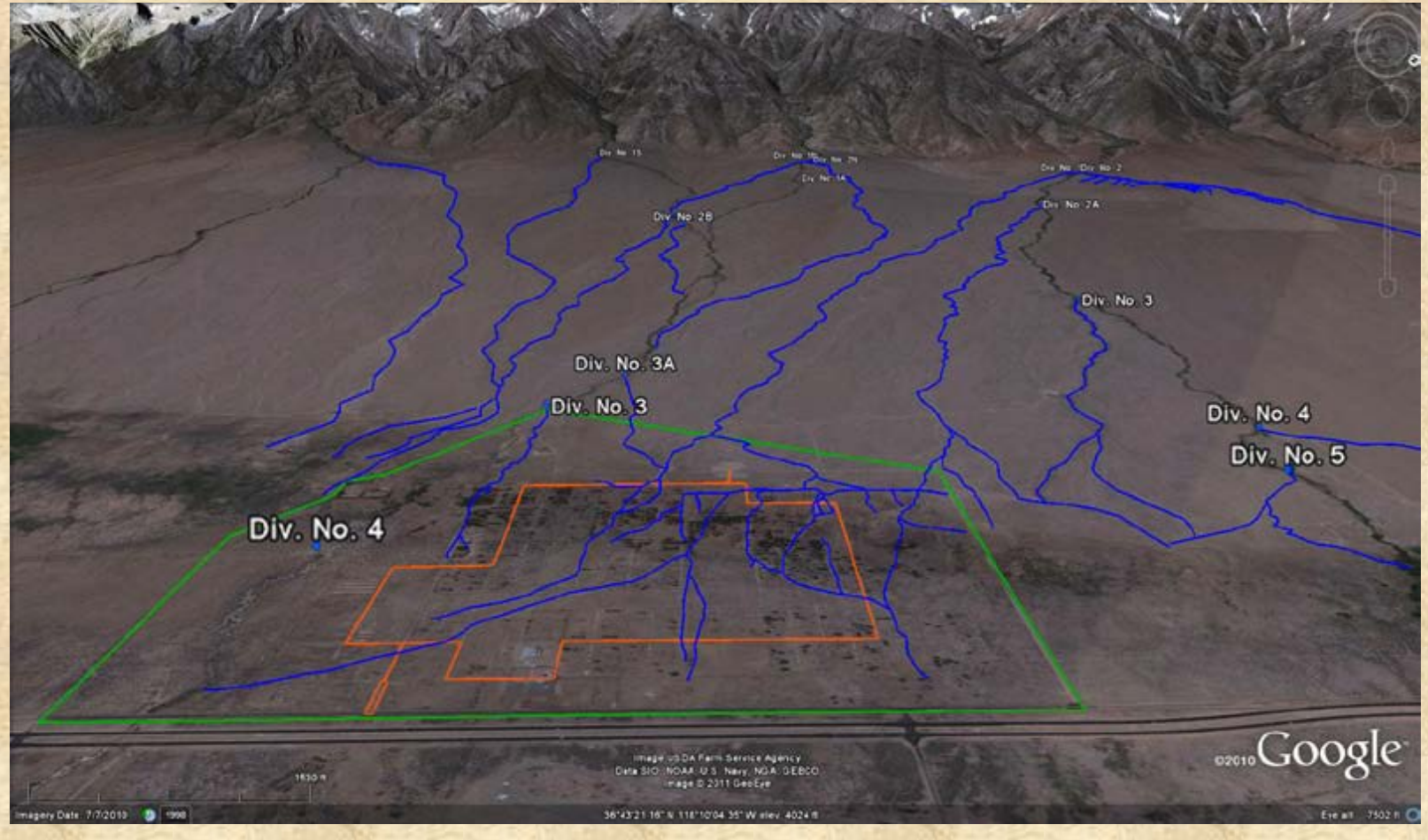
Natural Resources Conservation Service

National Park Service

Soil Survey of Manzanar National Historic Site



1942 to Today



A system of water diversions (in blue) that has altered the hydrology of all the soils in Manzanar National Historic Site.

1942 to Today

Modern day emergency water releases from diversions have resulted in breached and eroded meditation garden cultural resources built on and from highly erodible soils

Soils of our National Parks

How soils affected people and culture

Wupatki and Sunset in AZ: people knew their soils, “farming the argillic”; cinder mulching, albedo effect, pore space and condensation with thermal protection affecting plant growth; climate change affecting soils properties soils…soils became too dry to farm so people left. Used pottery for water collection. Volcanism and soil formation, uplift and exposure of different geologic formations results in different soils in short distances, sandy soils of Moenkopi vs fertile of Kaibab limestone

Ocmulgee, GA: Native tribes understood their soils, farming methods (flooding) to enrich soils, and construction practices. They used soils for farming and shelter, ceremonial purposes and pottery. What was someone else’s trash (middens) became part of the soils and someone else’s treasure (tabby construction)

Fort Necessity in PA: deposition of alluvium, landscape position and wetness, hydrologic processes were important for excavations and drainage, landscape position is everything – ”taking the high ground”, need for scoping out beforehand, decisions need to consider the environment

Soils of our National Parks

Golden Gate, CA- coastal faulting, and post glacial submergence with resultant lack of deep ports, lagoonal sediments and shallow water, requiring use of fill for creation of "made-land", people's reasons to pursue something (lumbering and trade) can quickly change (Gold Rush); present day earthquake subsidence and liquefaction consequences due to low soil strength

Homestead, NE: Homesteading and plowing, eventually the Dust Bowl Days; use for sheltering, soil compaction preserved seeds; translocation of carbon to depth by roots, resulting in carbon sequestration

Manzanar, CA – PM10 generation from draining Owens Lake with soil carbonates and salts in arid climates; harvesting soils of the fault seep for increasing fertility on low fertility sandy soils; artificial water application and erosion; existing laws governing natural resources do not always take in to consideration harm to environmental and cultural resources; erosion of coarse soils formed from granite

Thank you!