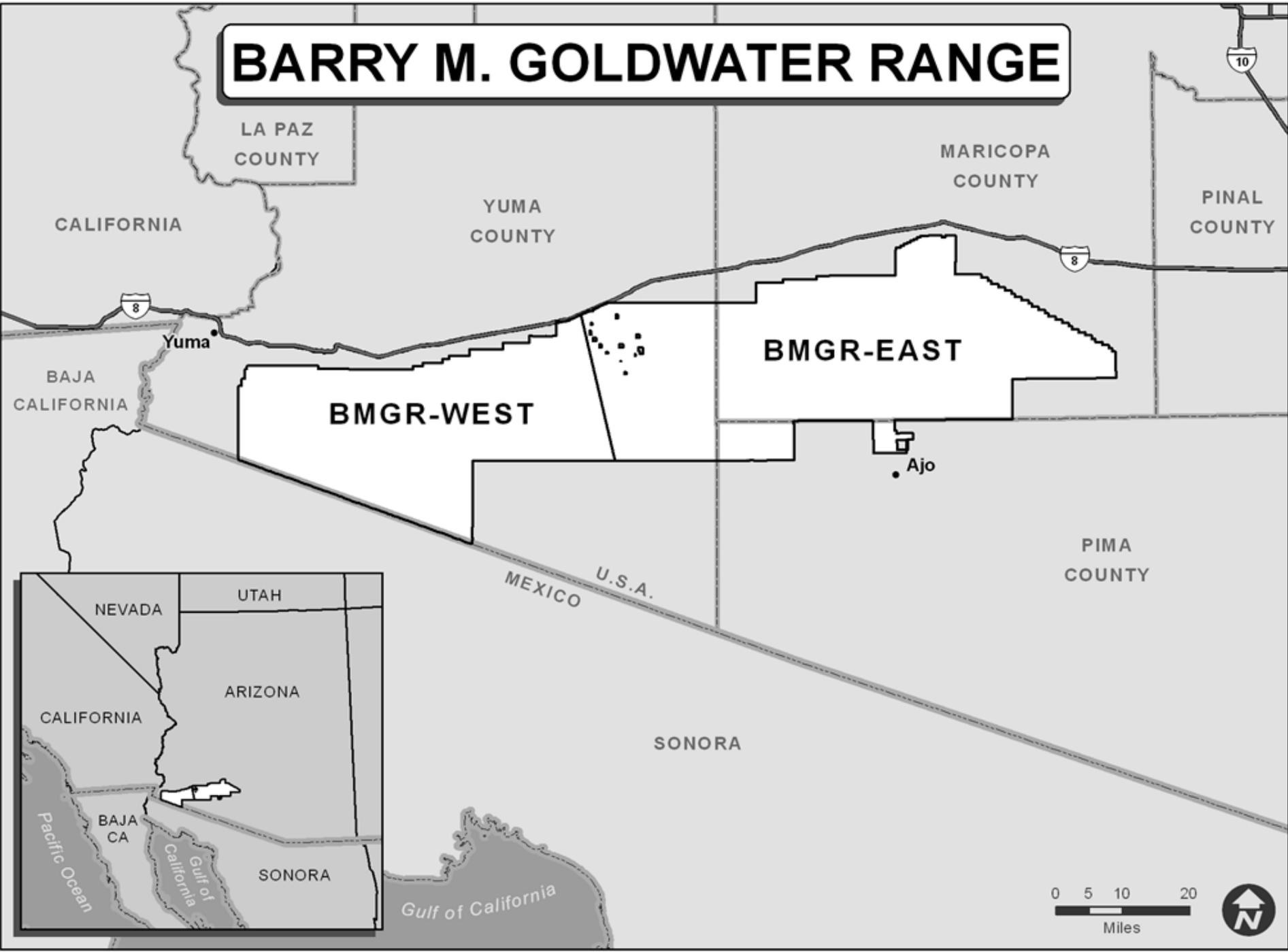


Modeling Soil Erosion Potential on the Barry M. Goldwater Range – West

Outline

- **Barry M. Goldwater Range – West (BMGR-West)**
- **Study Areas**
- **Universal Soil Loss Equation (USLE)**
- **Factors and Data**
- **Disturbed Areas**
- **Final Analysis**

BARRY M. GOLDWATER RANGE



Inventory and Monitoring Plan

- **Resource-Specific Management Goals**
 - Soil
 - Water
 - Vegetation
 - Wildlife
 - Visual Resources
 - Recreation
 - Transportation
 - Access



Prepared in cooperation with The University of Arizona, School of Natural Resources and the Environment, Naval Facilities Engineering Command, Nauman Geospatial, National Park Service, and the U.S. Marine Corps

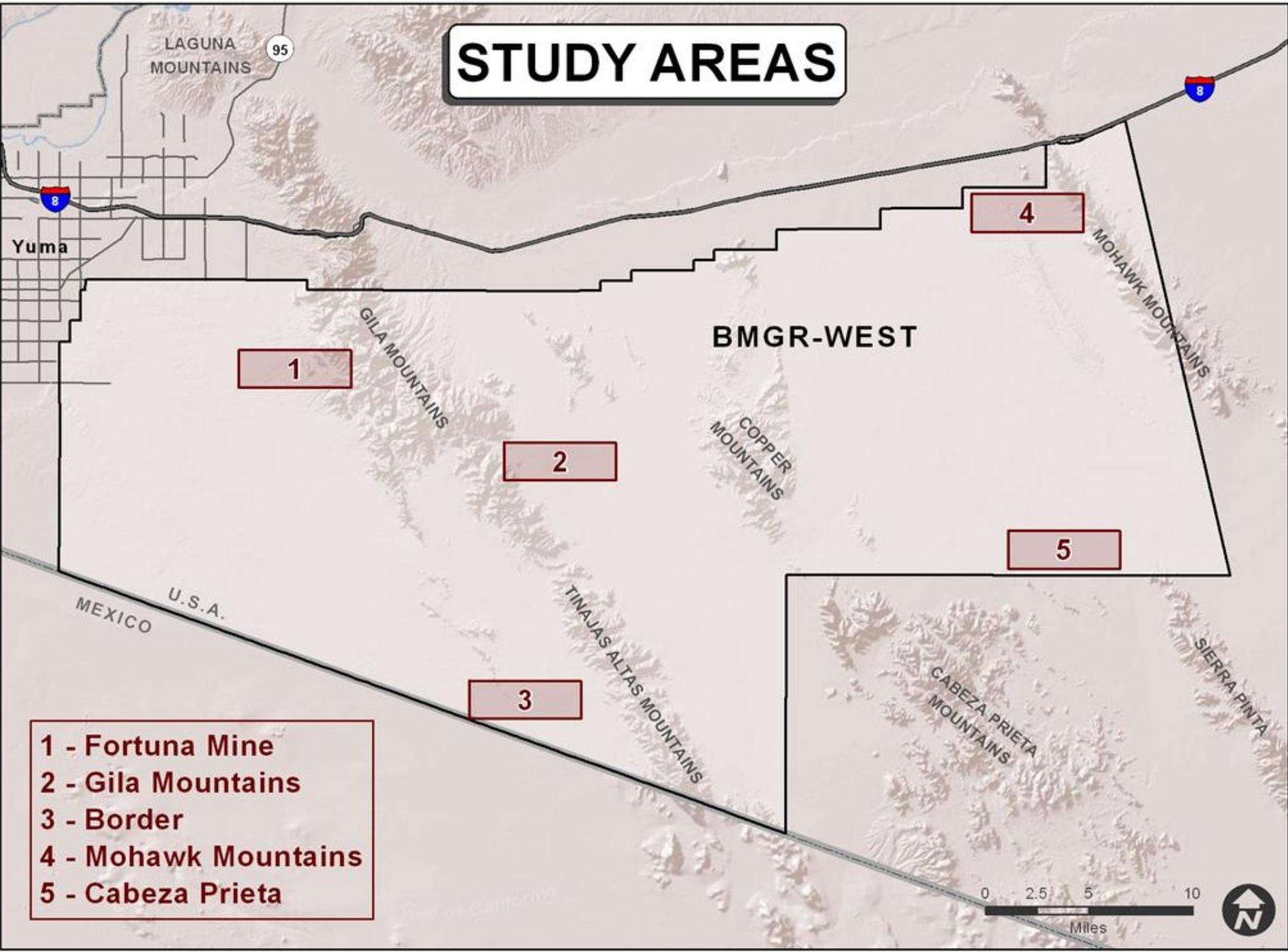
An Inventory and Monitoring Plan for a Sonoran Desert Ecosystem: Barry M. Goldwater Range–West



Open-File Report 2011–1232

U.S. Department of the Interior
U.S. Geological Survey

STUDY AREAS



- 1 - Fortuna Mine
- 2 - Gila Mountains
- 3 - Border
- 4 - Mohawk Mountains
- 5 - Cabeza Prieta



Universal Soil Loss Equation

- **Universal Soil Loss Equation (USLE)**
 - 1965 – USDA Agricultural Handbook 282
 - 1978 – USDA Agricultural Handbook 537
- **Modified Universal Soil Loss Equation (MUSLE)**
 - 1976
 - Storm Events, Peak Stream Discharge
- **Revised Universal Soil Loss Equation (RUSLE)**
 - 1992 – Computerized
 - RUSLE2 – Current, Windows Version

Universal Soil Loss Equation

- Empirically-Based
- Soil Loss from Agricultural Sites
 - Raindrop Impact
 - Surface Runoff
- Standard Unit Plots
 - 72.6 Feet Long
 - Uniform 9% Slope
 - Fallow



Universal Soil Loss Equation

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

A = Average Annual Soil Loss (ton/acre)

R = Rainfall-Runoff Erosivity Factor
(100 foot-ton-inch/acre-hour)

K = Soil Erodibility
(0.01 ton-acre-hour/acre foot-ton inch)

L = Slope Length Factor

S = Slope Steepness Factor

C = Cover-Management Factor

P = Support Practice Factor

Universal Soil Loss Equation

$$A = R \cdot K \cdot (LS) \cdot C$$

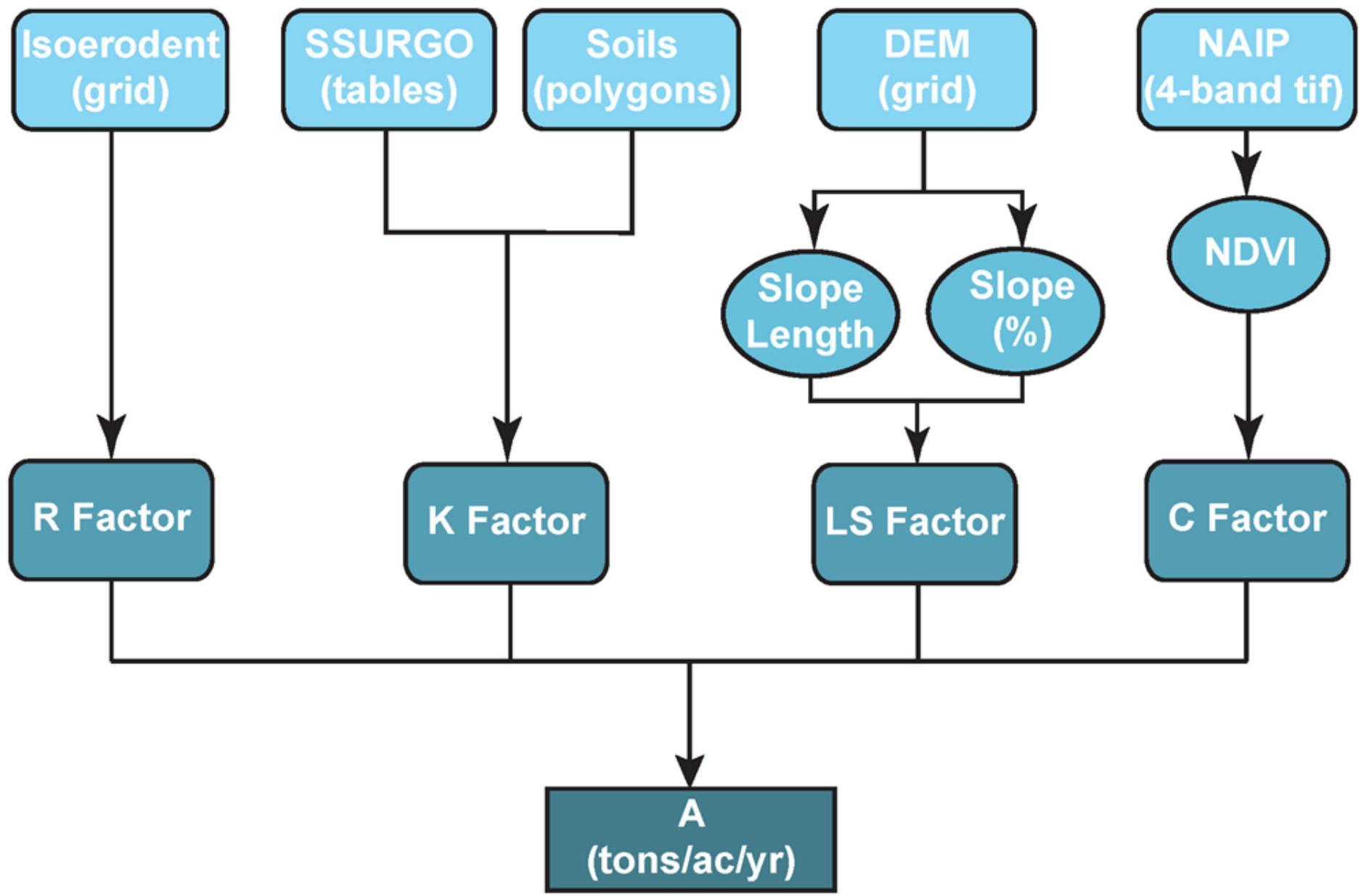
A = Average Annual Soil Loss

R = Rainfall-Runoff Erosivity Factor

K = Soil Erodibility

LS = Topographic Factor

C = Cover-Management Factor

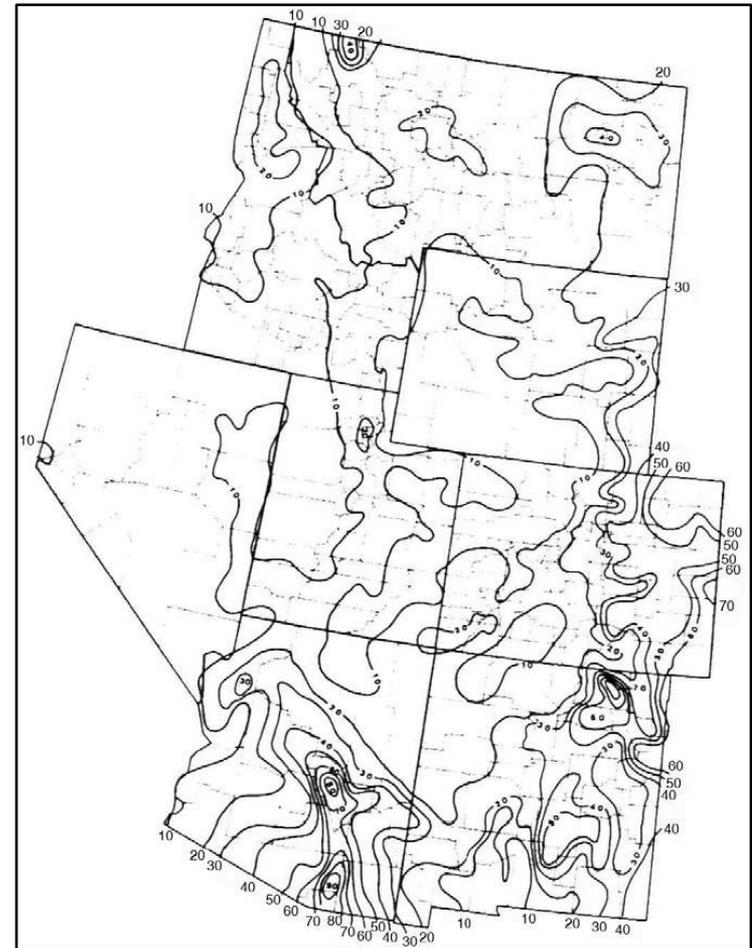


Data

- **Marine Corps Air Station-Yuma (MCAS-Yuma)**
 - Vector Geodatabase
 - 5-Foot Resolution DEM Geodatabase
 - 1-Foot Resolution Aerial Imagery (November 2008)
 - NAD 1983 StatePlane Arizona West FIPS 0203 Feet

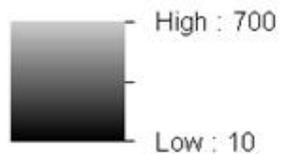
R Factor

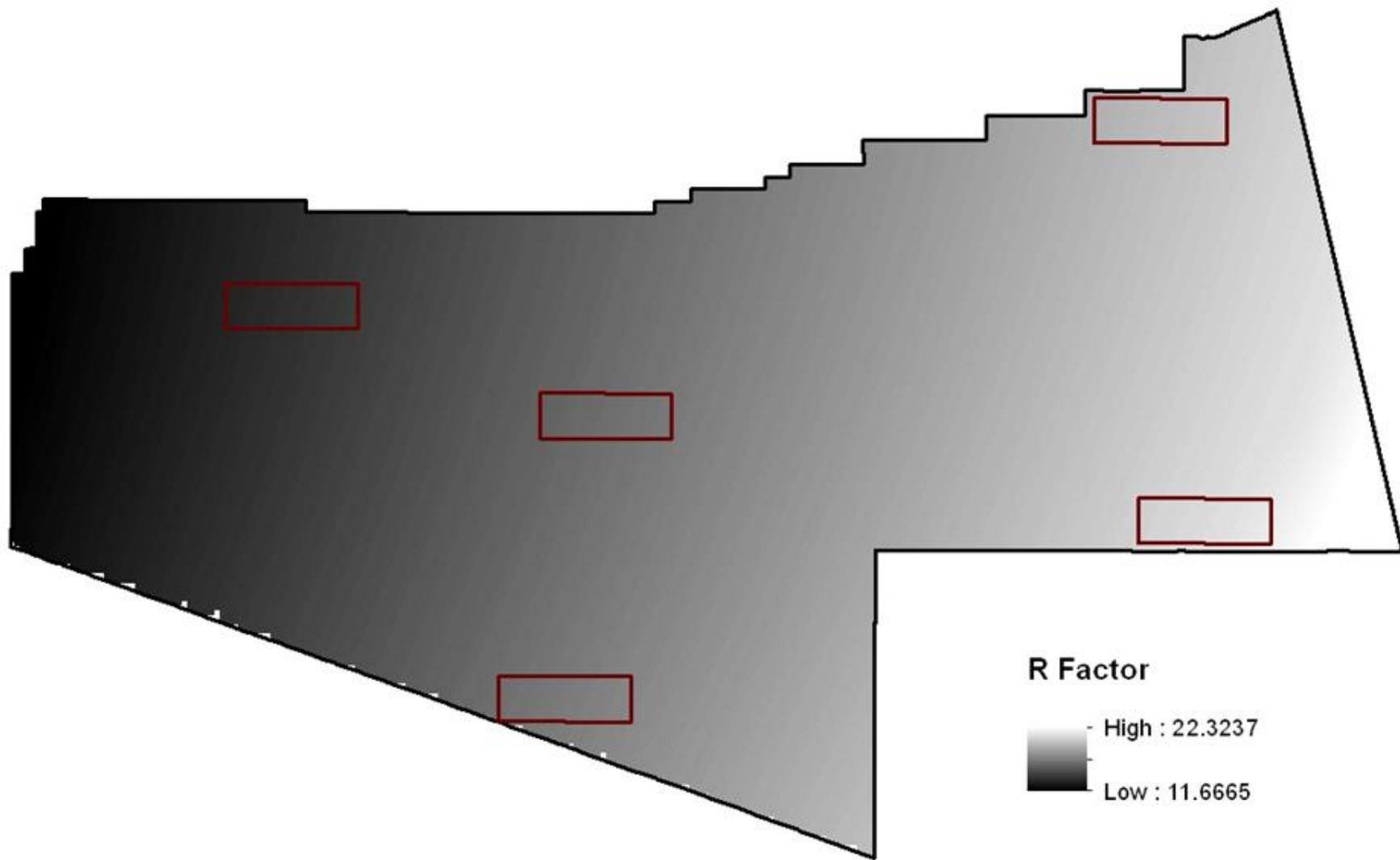
- **Rainfall-Runoff Factor**
 - Storm Energy
 - Storm Intensity
 - Runoff
- **Isoerodent Map**



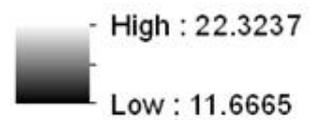


R Factor





R Factor



K Factor

- Soil Erodibility Factor
- Soil Polygons
 - Nauman Geospatial
- Soil Survey Geographic Database (SSURGO)
 - Kf Value
 - RUSLE2 Related Attributes
- Most Limiting Value

RUSLE2 Related Attributes
Luke Air Force Range, Arizona, Parts of Maricopa, Pima and Yuma Counties
[This report shows only the major soils in each map unit]

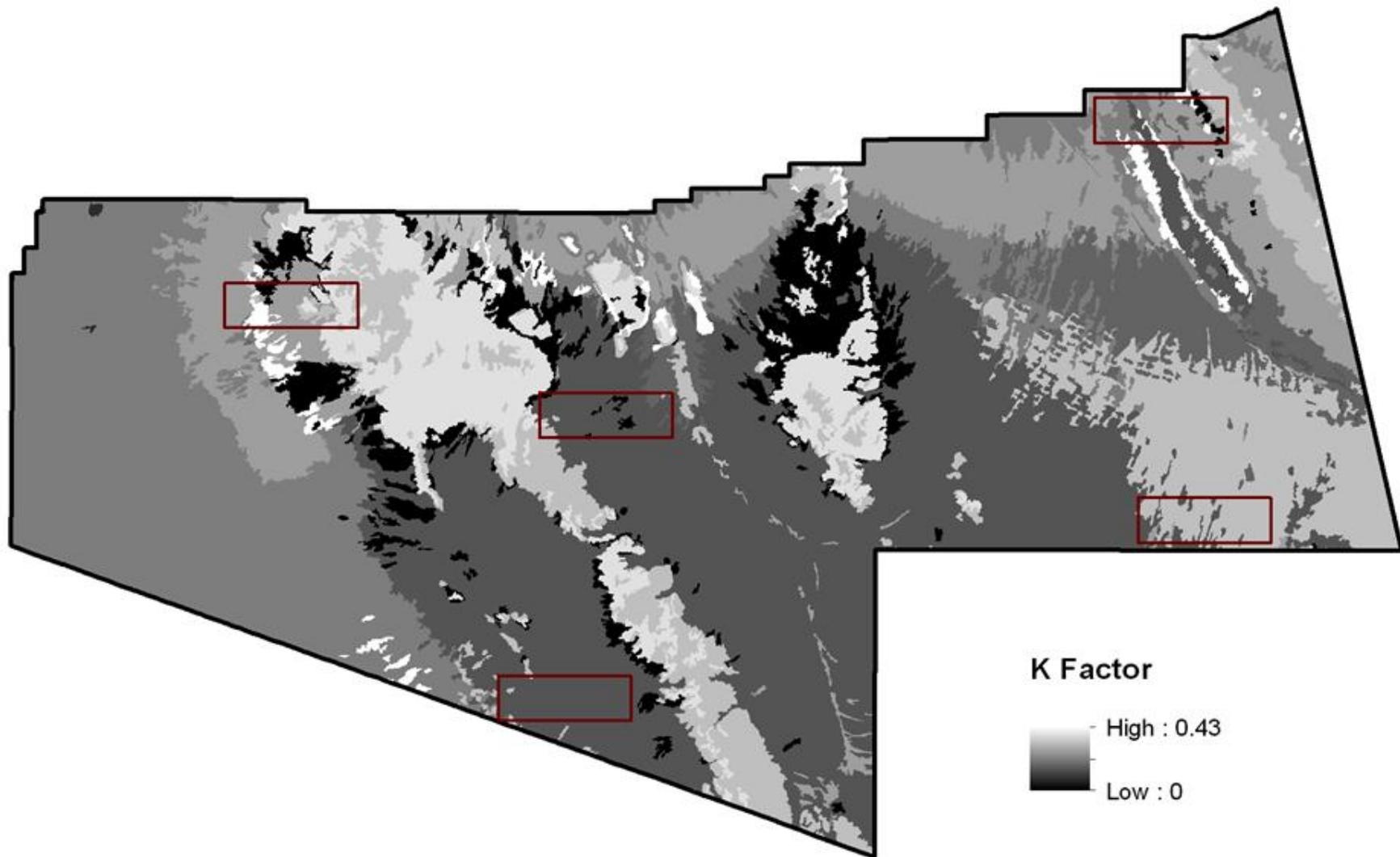
Map symbol and soil name	Pct. of map unit	Hydrologic group	Kf	T factor	Representative value		
					% Sand	% Silt	% Clay
50. Gunsight	45	B	.24	5	66.9	23.1	10.0
Pinamt	35	B	.32	5	42.1	37.9	20.0
Carrizo	15	A	.15	5	78.3	17.7	4.0

Gunsight Kf = 0.24

Pinamt Kf = 0.32

Carrizo Kf = 0.15

USDA Natural Resources Conservation Service
Survey Area Version: 8
Survey Area Version Date: 10/14/2008
Page 1



K Factor



LS Factor

- **Slope Length and Slope Steepness Factors**

$$LS = (n + 1) \cdot (A_s / 72.6)^n \cdot (\sin \theta / 0.0896)^m$$

A_s = catchment area

θ = slope (degrees)

$n = 0.4$

$m = 1.3$

LS Factor

- L Factor

- $L = (A_s / 72.6)^n$

- $L = (250 / 72.6)^n$

- $L = 1.63984$

- S Factor

- Process DEM

- Flow Direction

- Sink

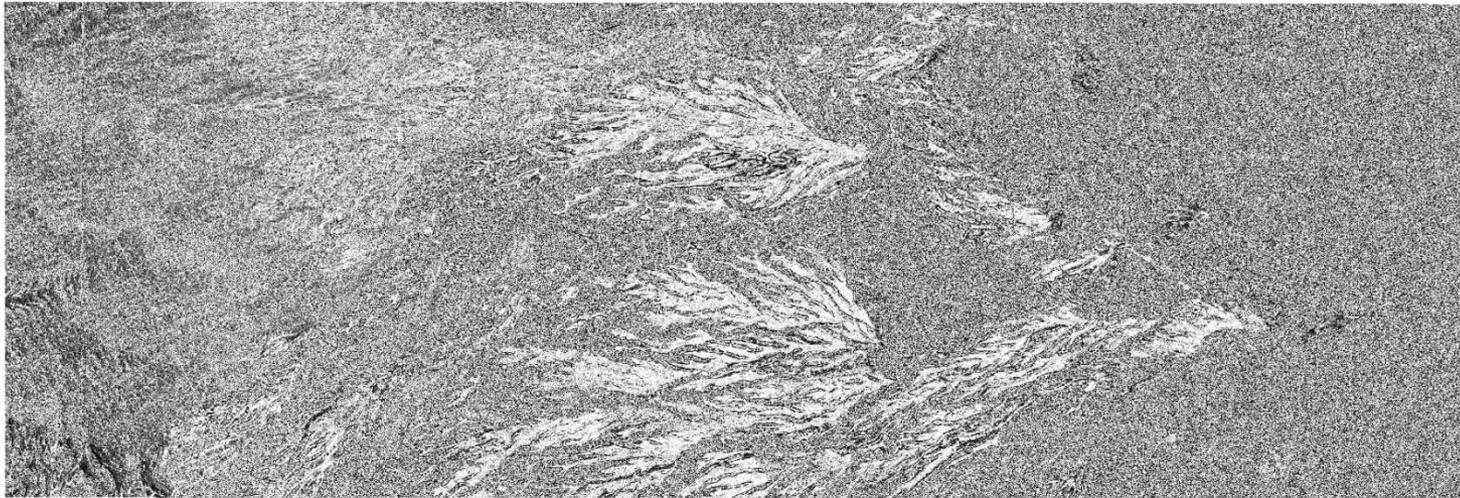
- Fill

- Slope

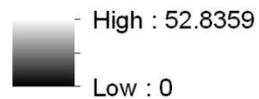
- $S = (\sin \theta / 0.0896)^m$

LS Factor

$$LS = (1.4) \cdot (L \text{ Factor}) \cdot (S \text{ Factor})$$



LS Factor - Study Area 1



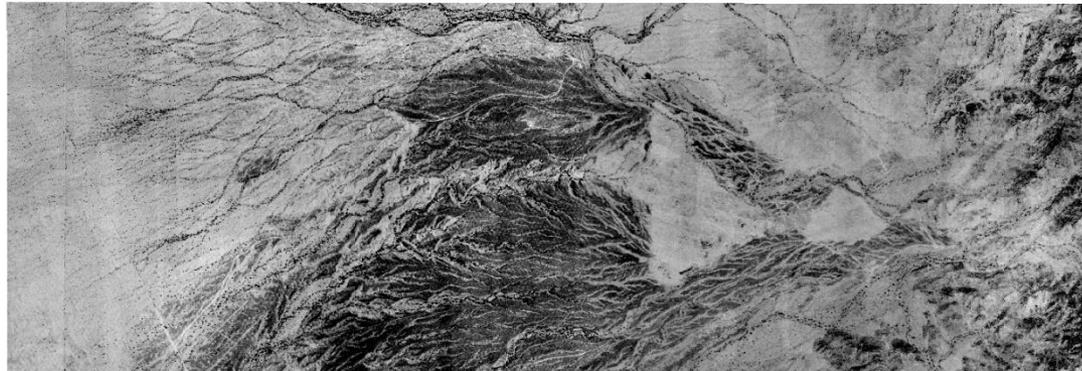
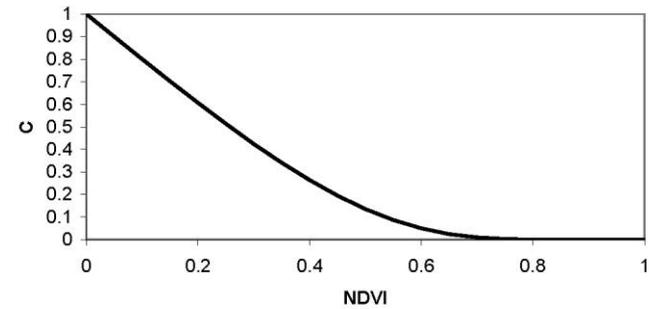
C Factor

- **Cover-Management Factor**
- **2010 1-meter NAIP**
- **ERDAS Imagine 9.3**
 - NDVI
 - 0 = Bare Land
 - 1 = Full Cover
- **C Factor**
 - 0 = Full Cover
 - 1 = Bare Land

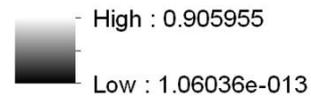


C Factor

$$C = e^{(-2 \cdot (NDVI / (1-NDVI)))}$$

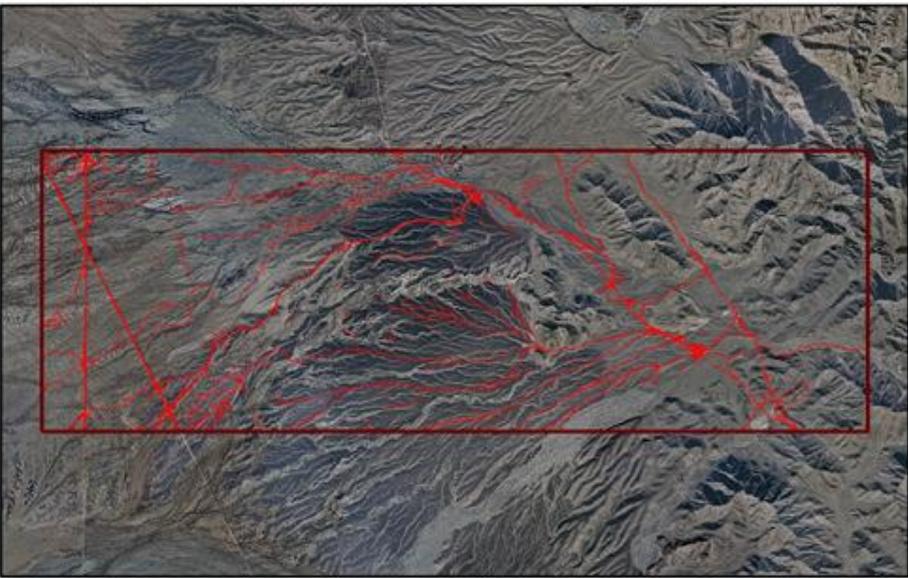


C Factor - Study Area 1



Disturbed Areas

- **Off-Road Vehicle Use**
- **1-Foot Resolution Aerial Photography (November 2008)**
- **Purpose:**
 - Inventory Disturbed Areas
 - Highlight Disturbed Areas in C Factor
 - Effect on USLE Final Analysis



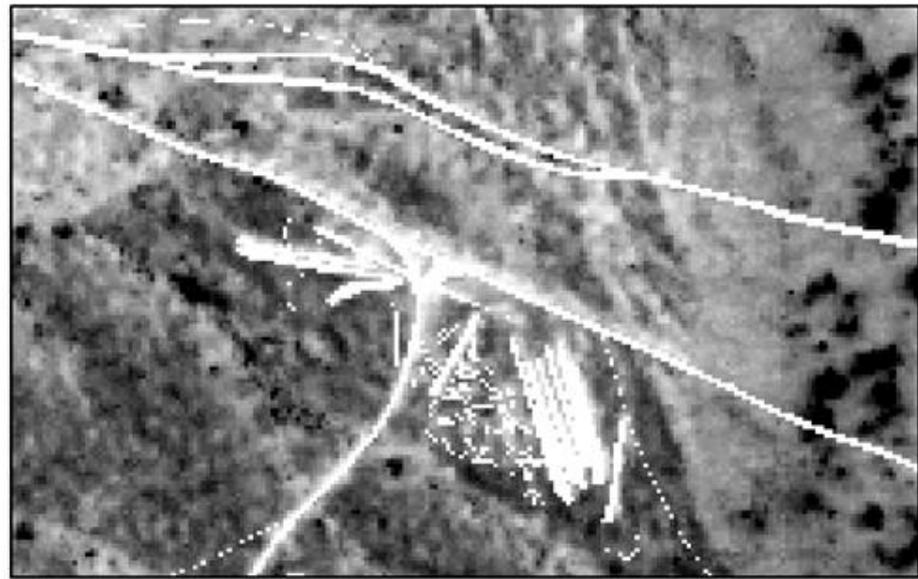
Digitized and Buffered



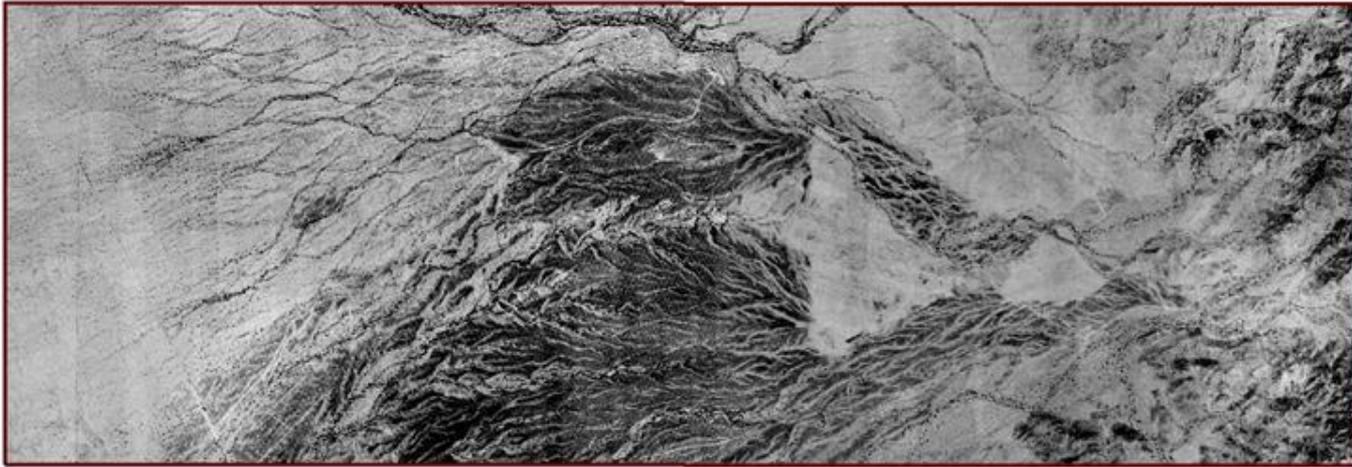
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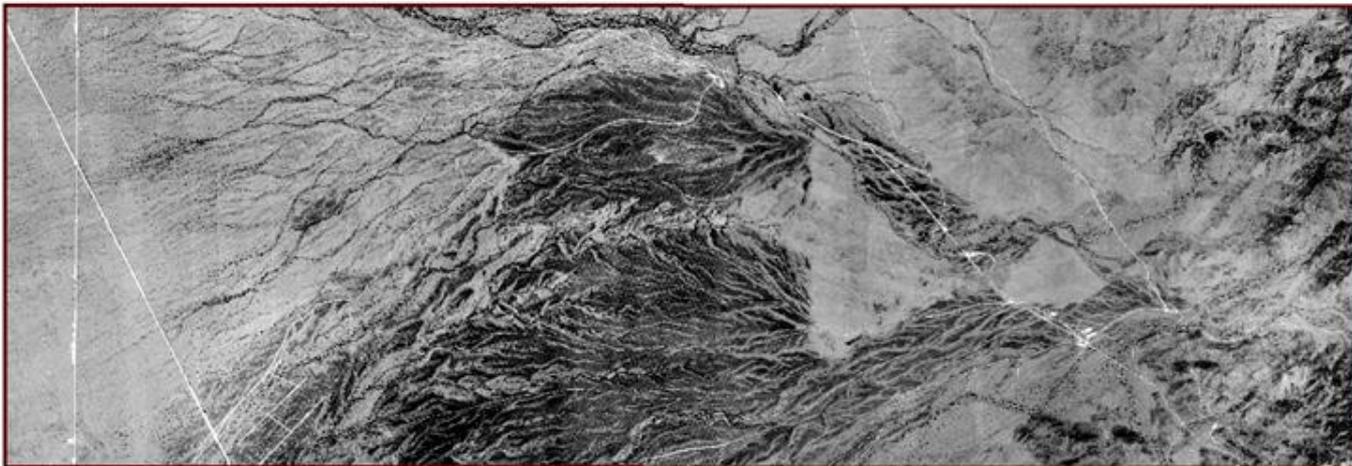
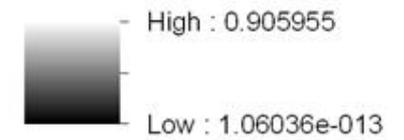
Rasterized and Value Assigned



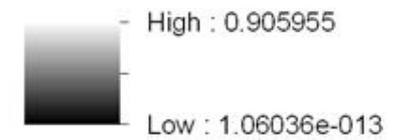
New C Factor

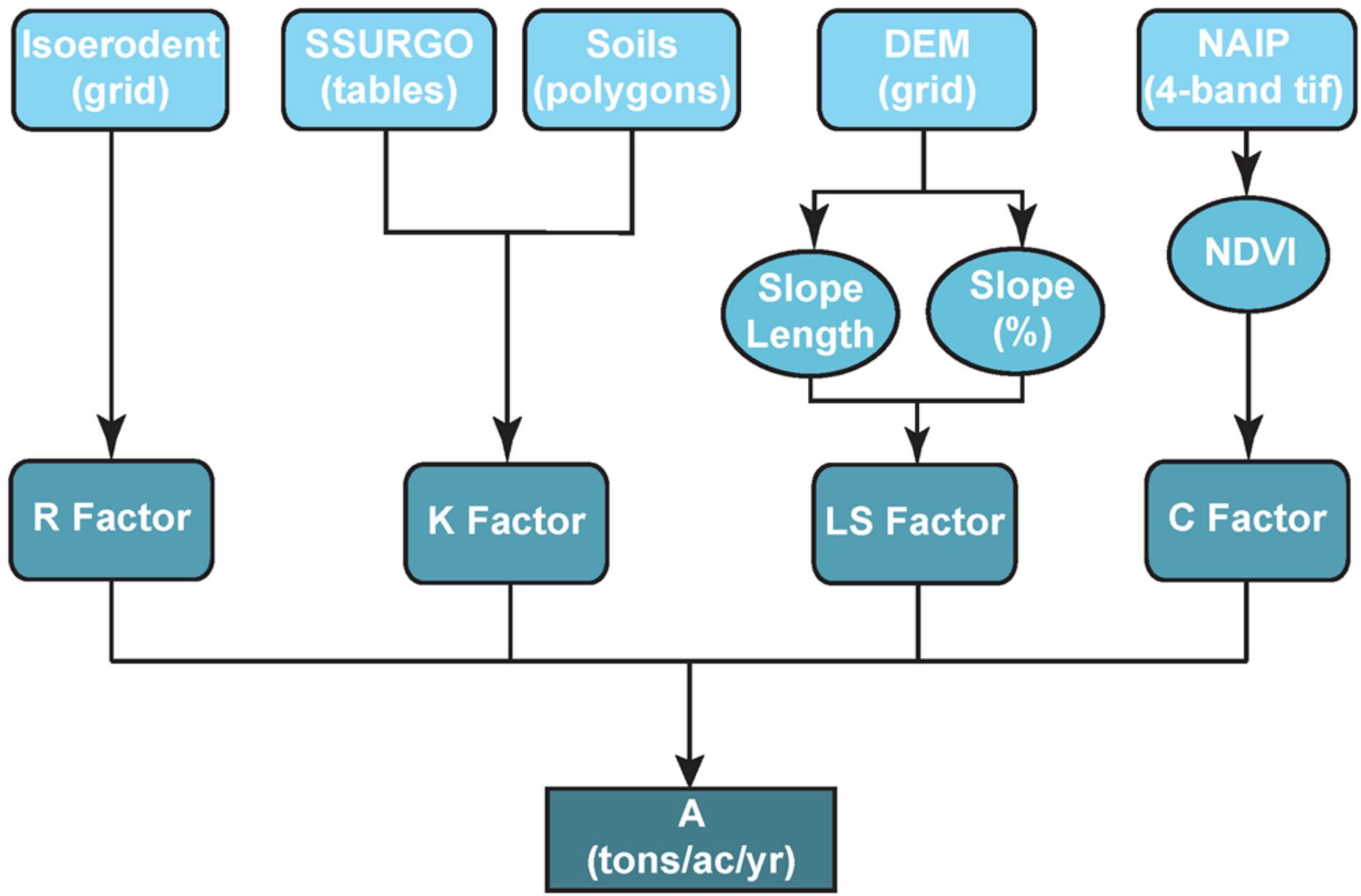


**Study Area 1
C Factor**



**Study Area 1
C Factor with
Disturbed Areas**



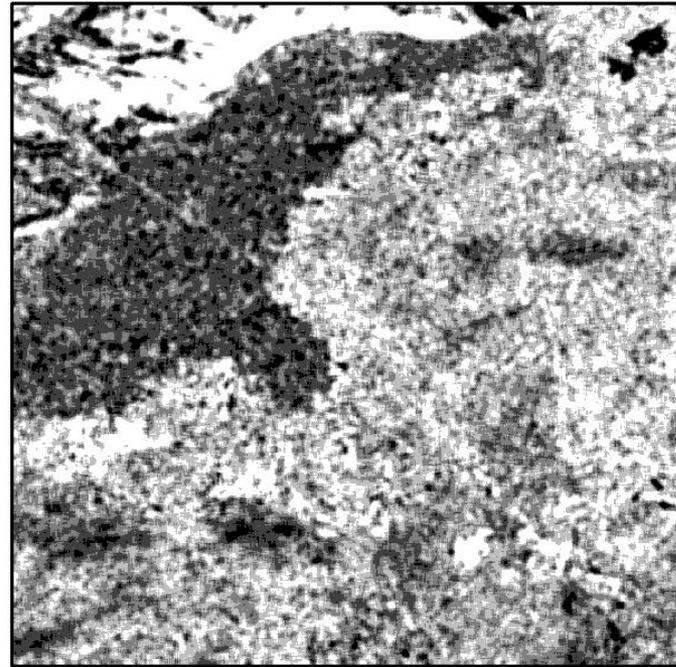


Analysis

$$A = R \cdot K \cdot (LS) \cdot C$$

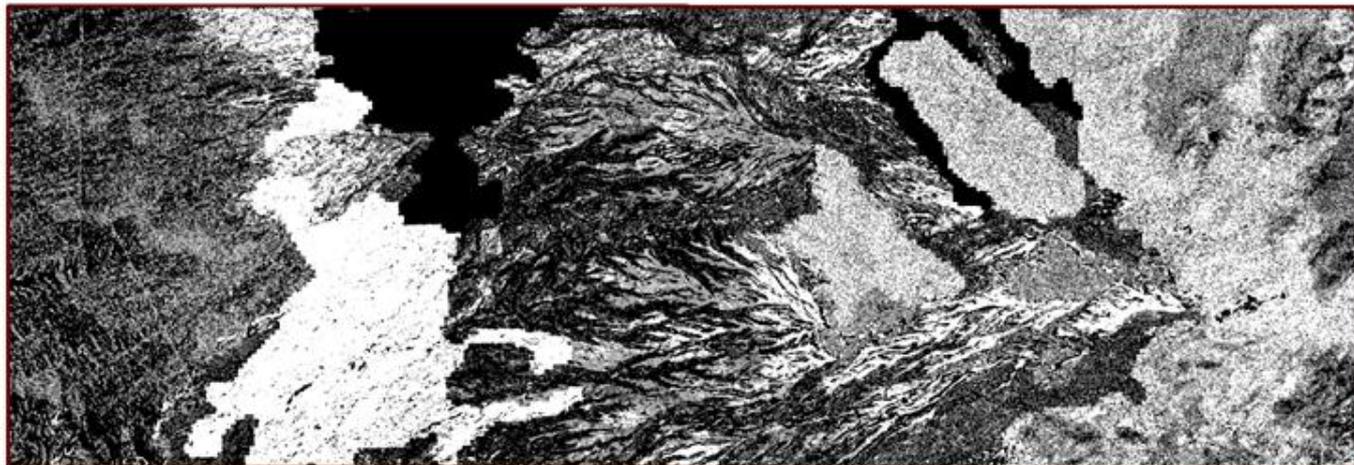


Original USLE



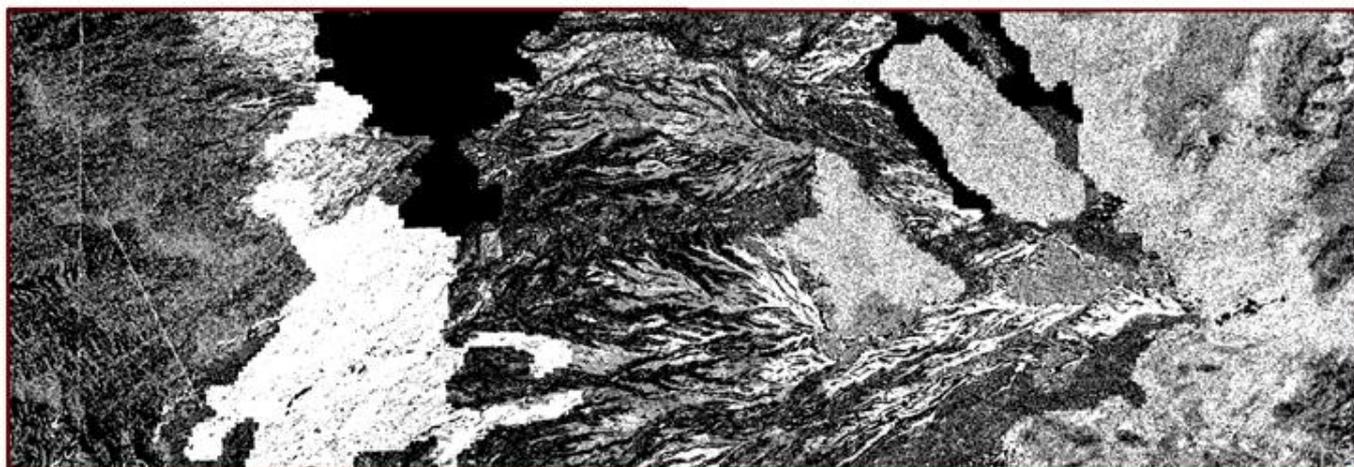
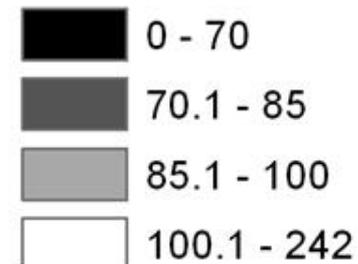
Focal Mean (7x7) Filter

Results



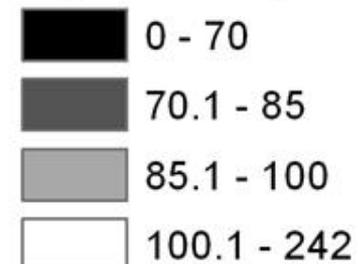
**Study Area 1
Fortuna Mine**

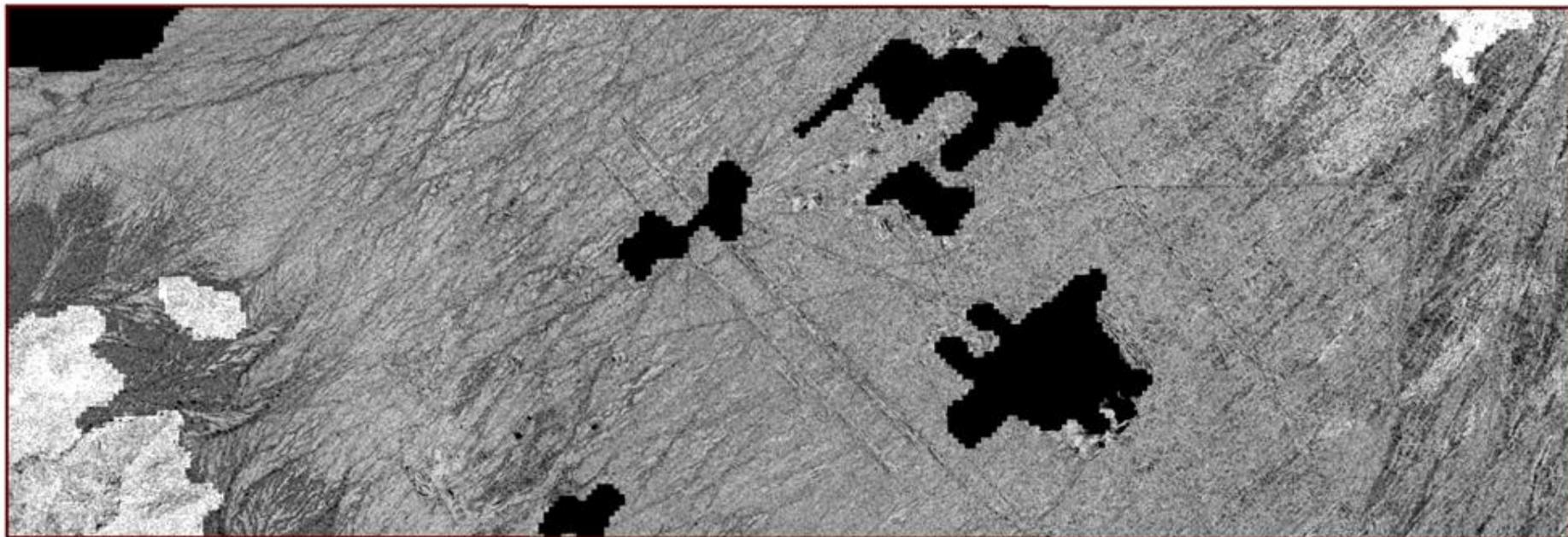
A (tons/acre/year)



**Study Area 1 with
Disturbed Areas
Fortuna Mine**

A (tons/acre/year)





**Study Area 2
Gila Mountains**

A (tons/acre/year)

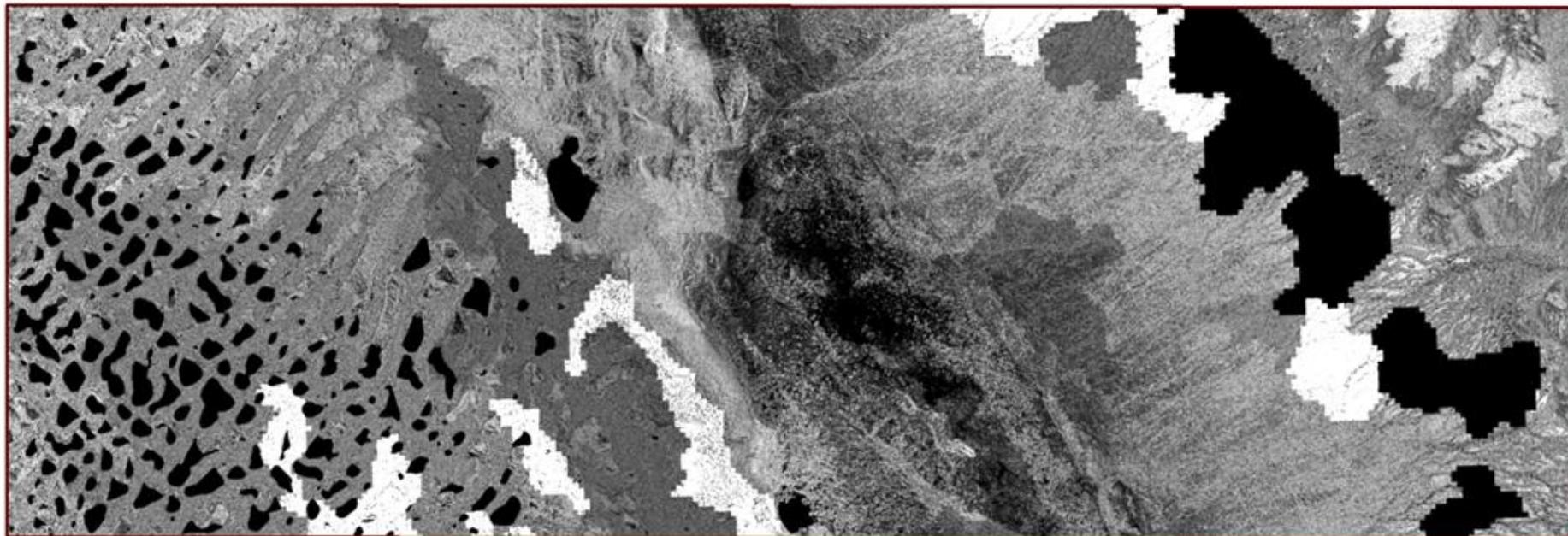




**Study Area 3
Border**

A (tons/acre/year)

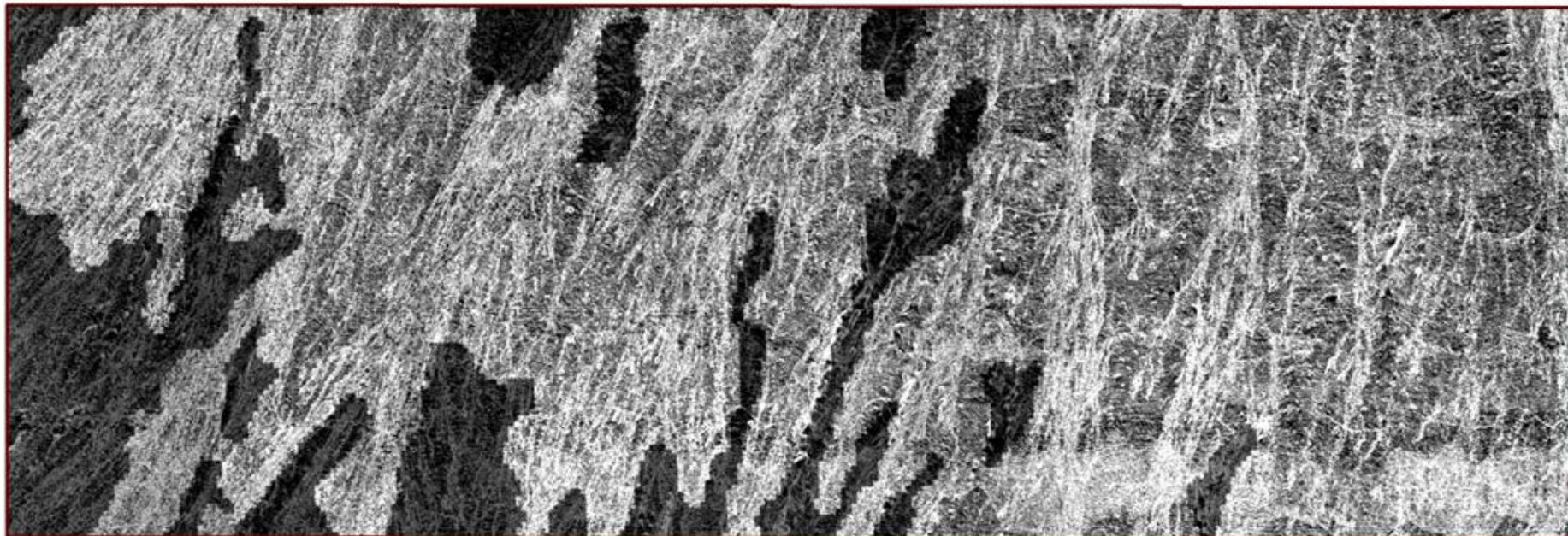




Study Area 4
Mohawk Mountains

A (tons/acre/year)





**Study Area 5
Cabeza Prieta**

A (tons/acre/year)



What's Next?

- **LS Factor**
- **Raster Cell Size**
- **Soils K Factor**
- **Disturbed Areas**

Questions?
