GeoWEPP ArcGIS 10.1

Development Team

Haoyi Xiong – Application leading developer (haoyixio@buffalo.edu)

Jonathan Goergen - Application co-lead developer

Misa Yasumiishi - Webpage developer

Martin Minkowski - GeoWEPP ArcGIS 9.x developer (ESRI Project Engineer now)

Chris Renschler - Project Leader

LESAM Lab Team

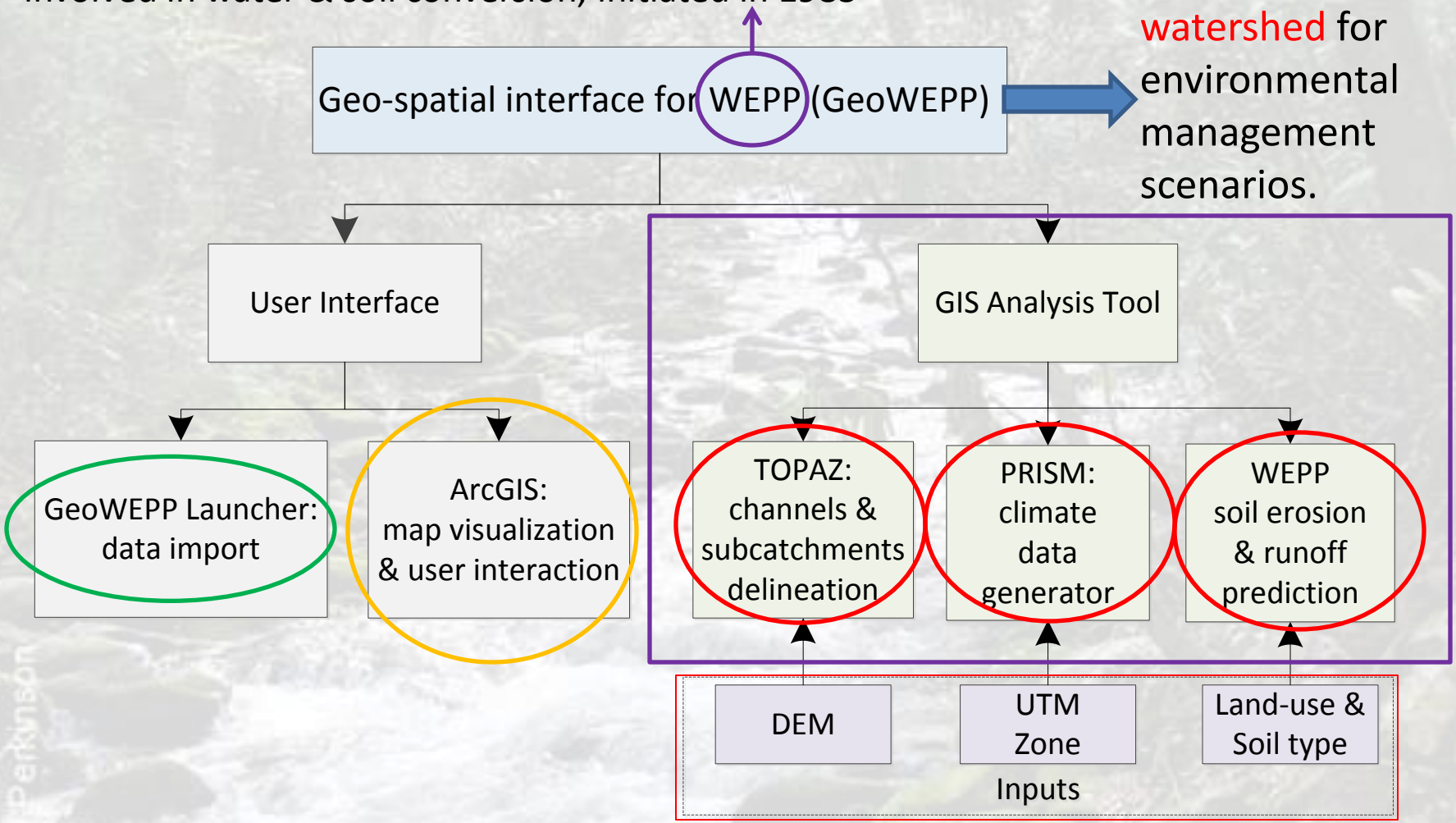
Contents

- 1. GeoWEPP introduction
- 2. GeoWEPP for non-structural management
  - Vegetation Buffer Strip (Strip Cropping), Reforestration
- 3. GeoWEPP for structural management
  - Culvert (Impoundment), Terrace (Road, parking lot)

Introduction

A process based soil erosion model for federal agencies involved in water & soil conversion, initiated in 1985

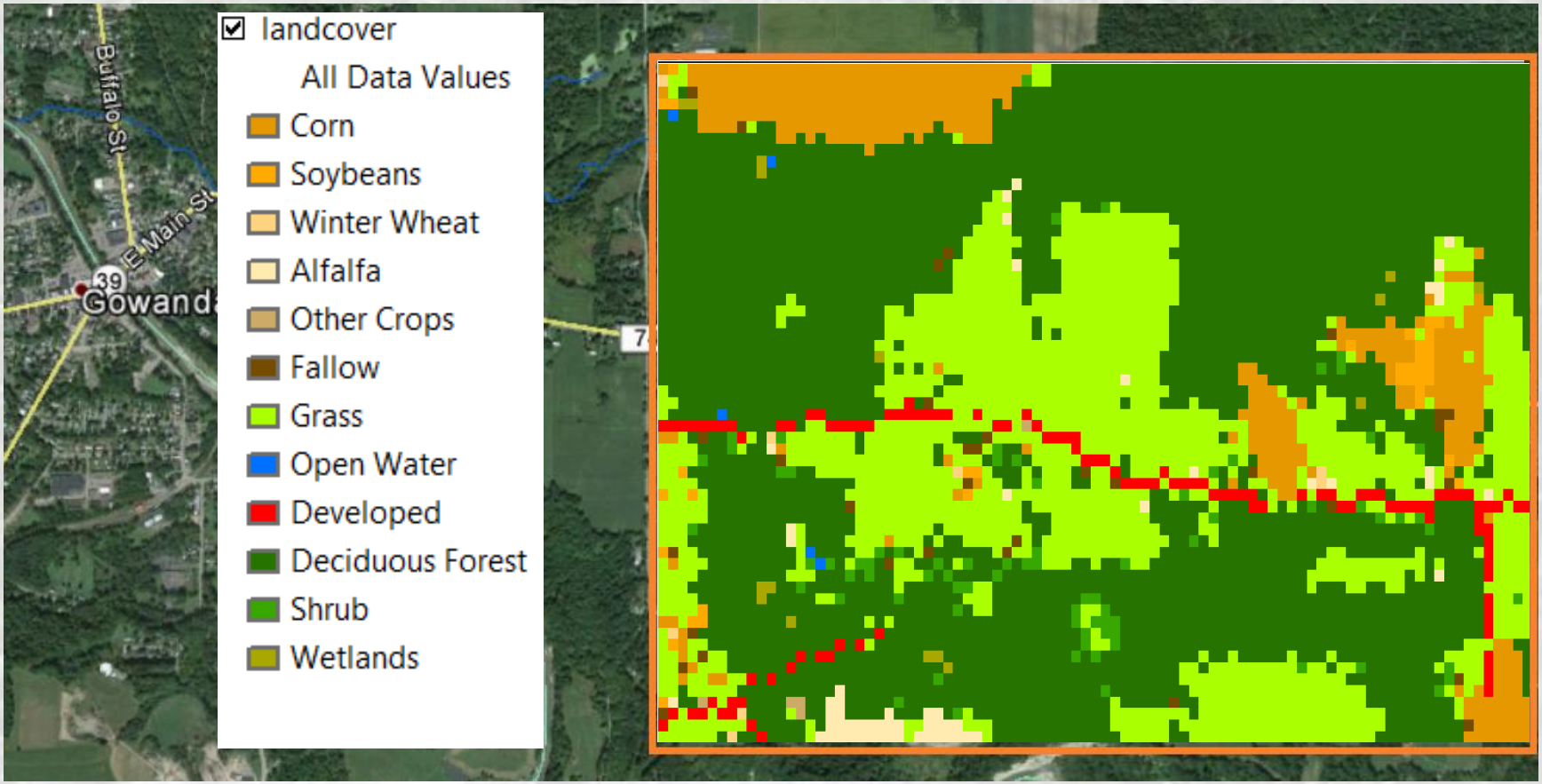
Predict soil erosion & runoff in a small watershed for environmental management scenarios.



GeoWEPP Toolbar

- 1. Delineate channels
- 2. Delineate subcatchments
- 3. Generate climate data for WEPP input
- 4. Generate erosion pattern by accepting watershed
- 5. Show reports from WEPP
- 6. Save project
- 7. Remap with different tolerable value
- 8. Get Hillslope Info
- 9. Change associated land use and soil in a hillslope
- 10. Rerun WEPP to get new erosion pattern
- 11. Load a single hillslope to WEPP
- 12. Go to WEPP to load watershed project
- 13. Save project and exit

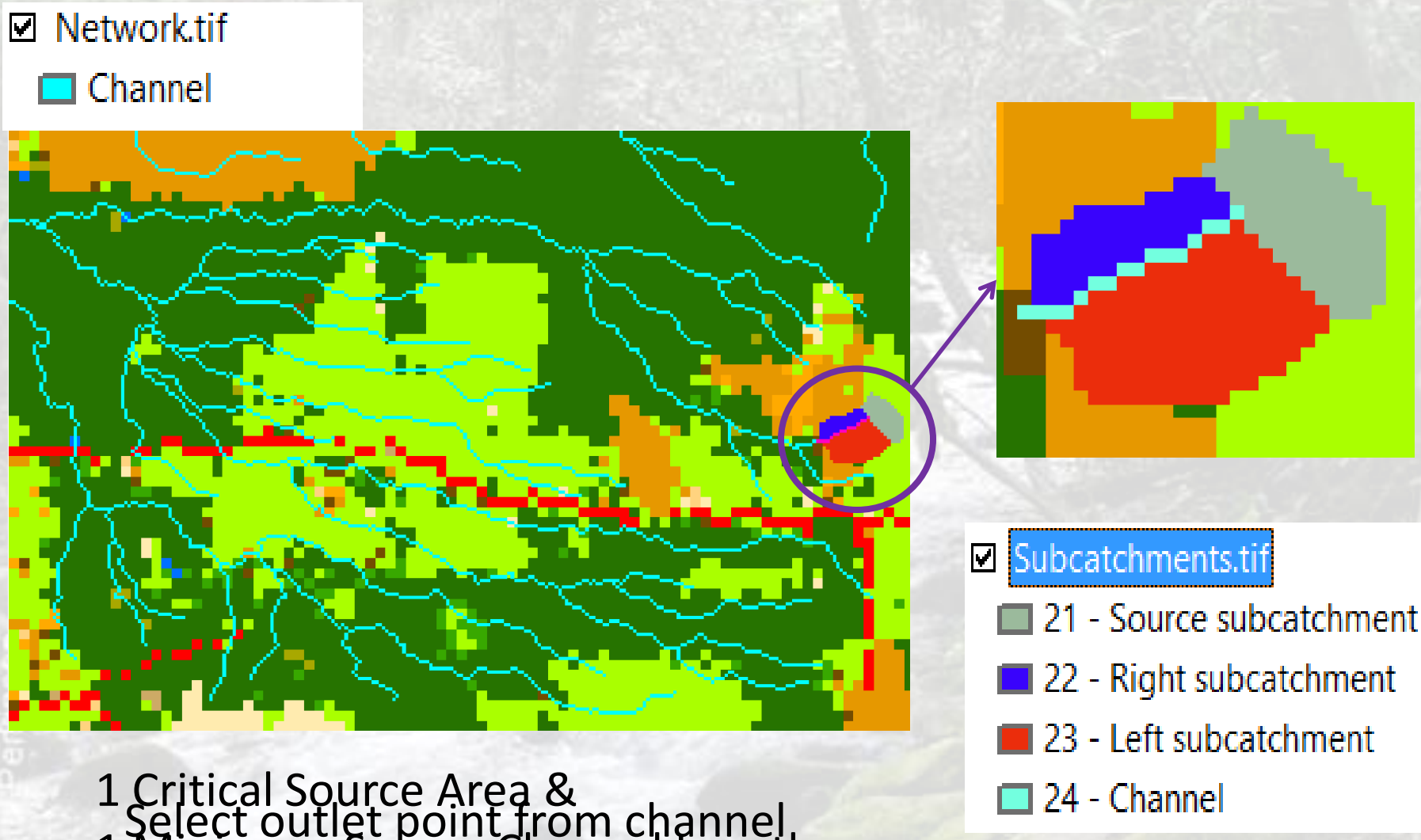
Example site



East of Gowanda, NY

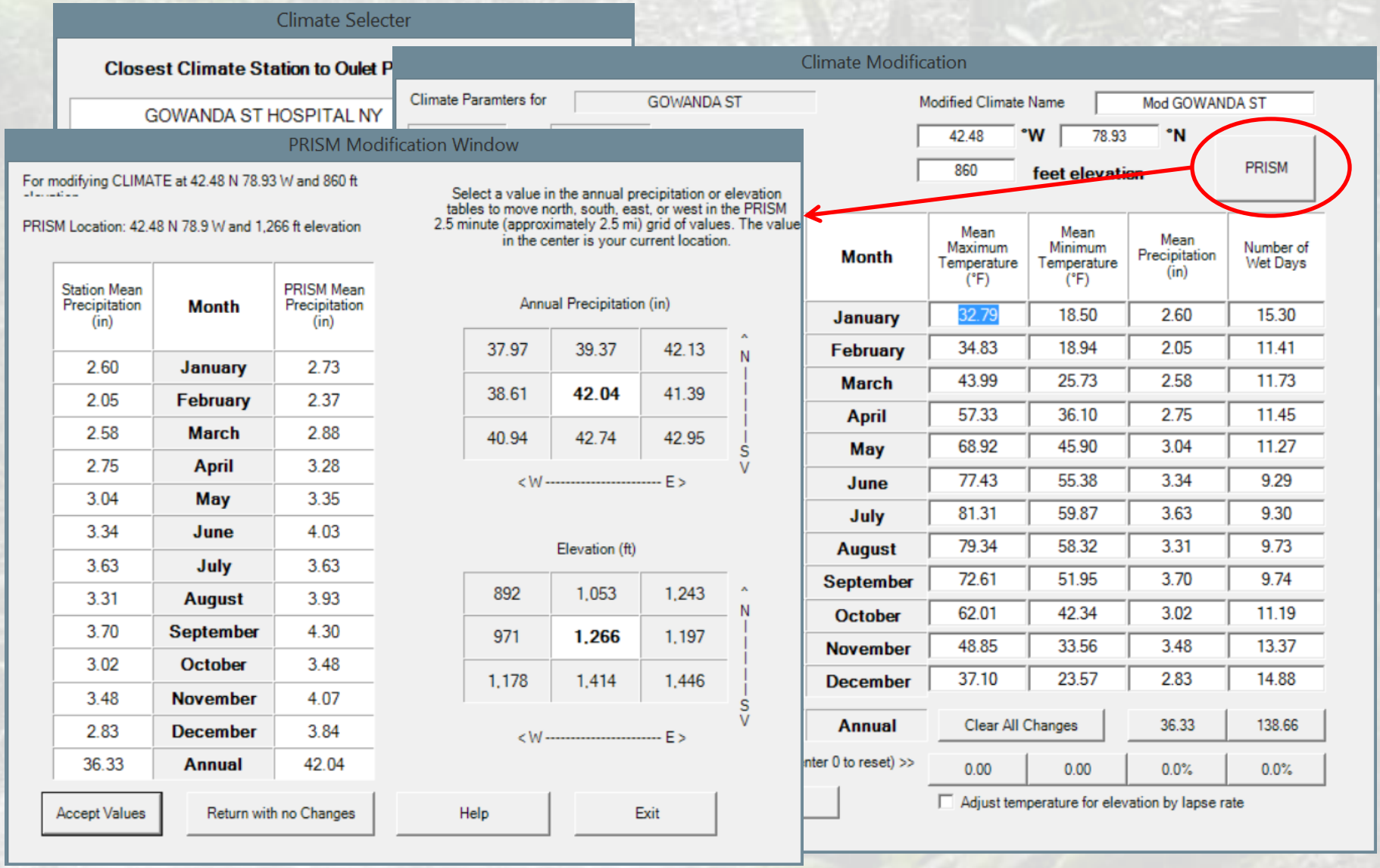
Data are from USDA

Channels & Subcatchment delineation - TOPAZ

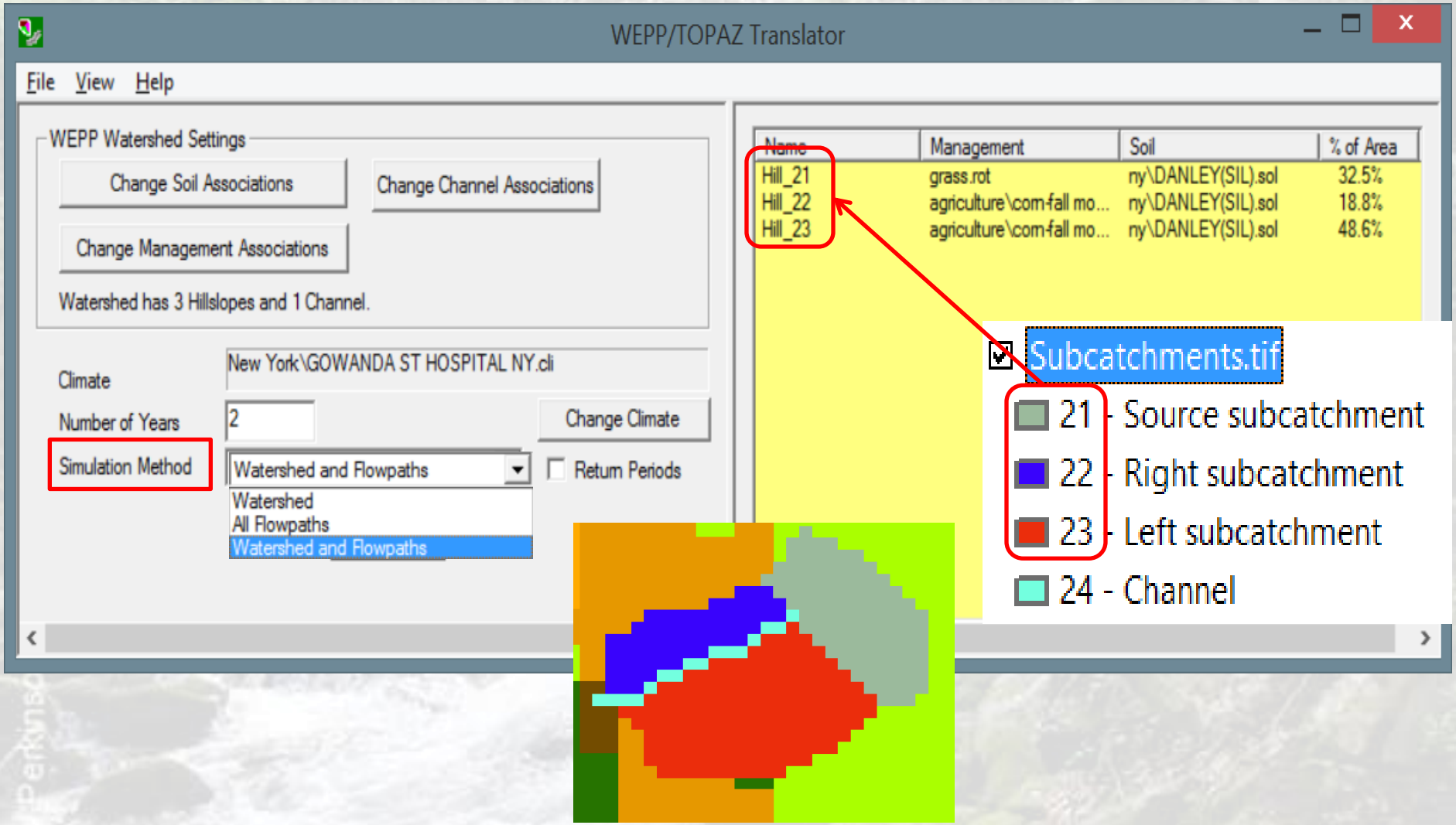


1 Critical Source Area &
Select outlet point from channel
1 Minimum Source Channel Length

Generating climate for WEPP- PRISM



Accept watershed to predict erosion



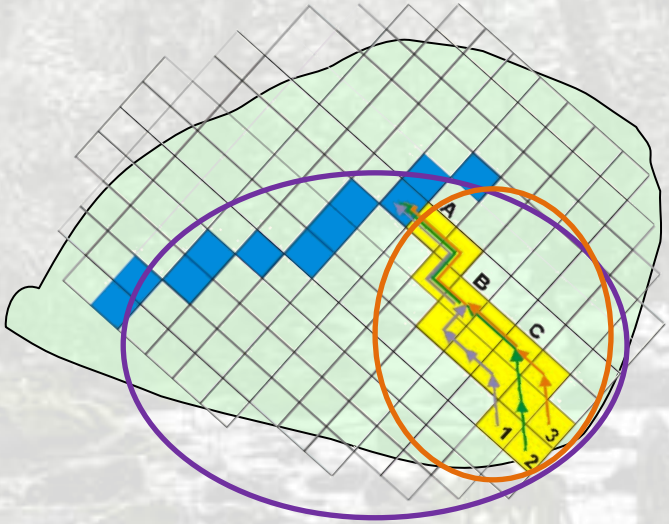
Soil erosion prediction - WEPP

Deposition < 1T
0T <= Soil Loss < 1/4T
1/4T <= Soil Loss < 1/2T
1/2T <= Soil Loss < 3/4T
3/4T <= Soil Loss < 1T
1T <= Soil Loss < 2T
2T <= Soil Loss < 3T
3T <= Soil Loss < 4T
Soil Loss > 4T

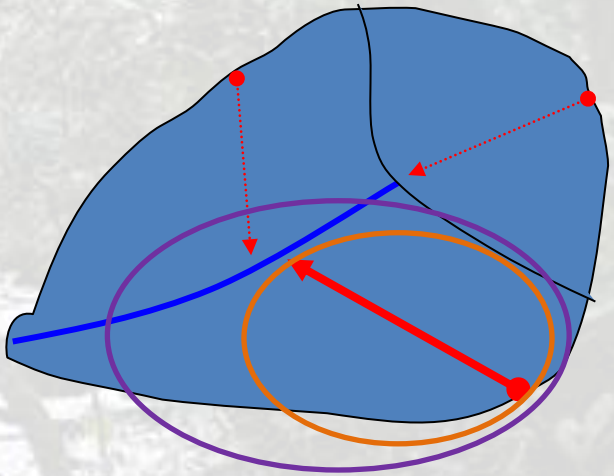
1T = 1 ton/hectare/year

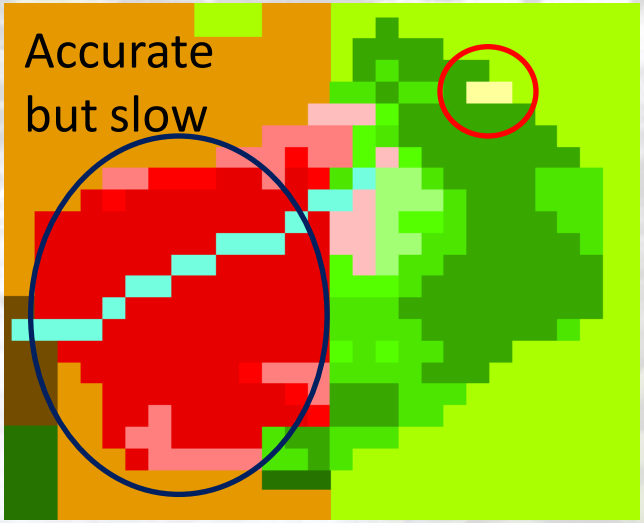
Subcatchments.tif
21 - Source subcatchment
22 - Right subcatchment
23 - Left subcatchment
24 - Channel

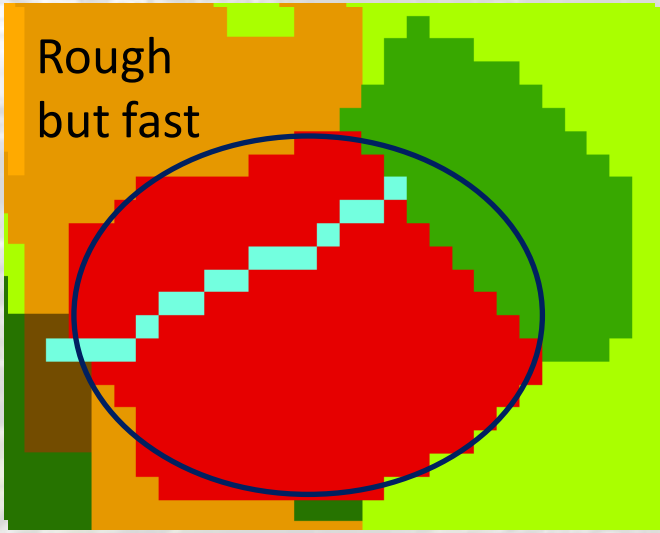
Flowpath Method



Watershed Method







GeoWEPP Reports

Watershed Method

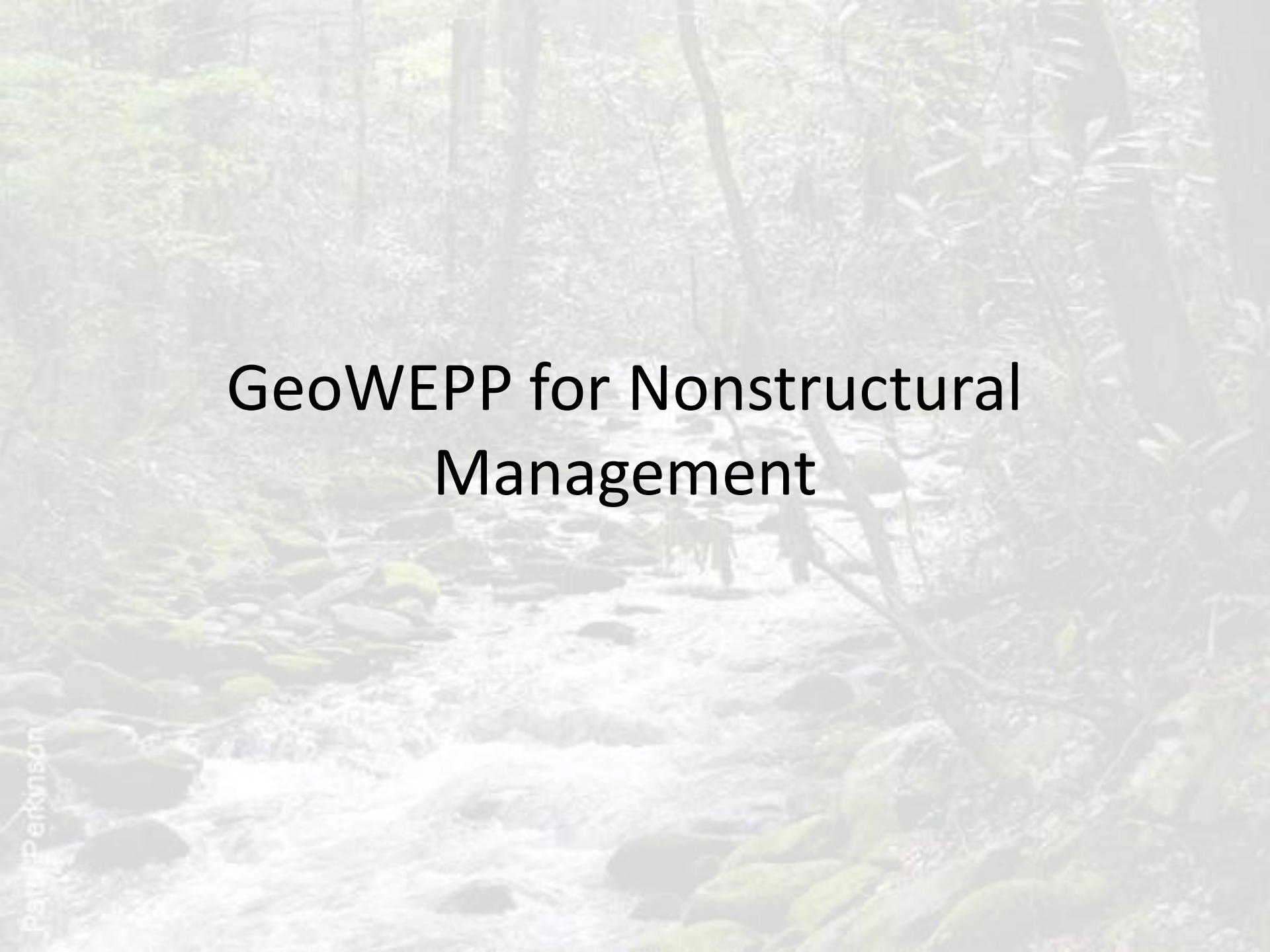
Hillslopes WEPP	TOPAZ	Runoff Volume (m^3/yr)	Soil Loss (tonne/yr)		Sediment Yield (tonne/yr)	Soil Loss (tonne/ha/yr)	*Mapped Sediment Yield (tonne/ha/yr)
1	21	847.3	0.1	=	0.1	0.1	0.1
2	22	604.9	2.9		2.9	4.6	4.6
3	23	1682.4	14.6		14.6	9.1	9.1

Channels NUM	WEPP	TOPAZ	Discharge Volume (m^3/yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Length (m)
1	1	24	3152.9	n.a.	14.3	189.0

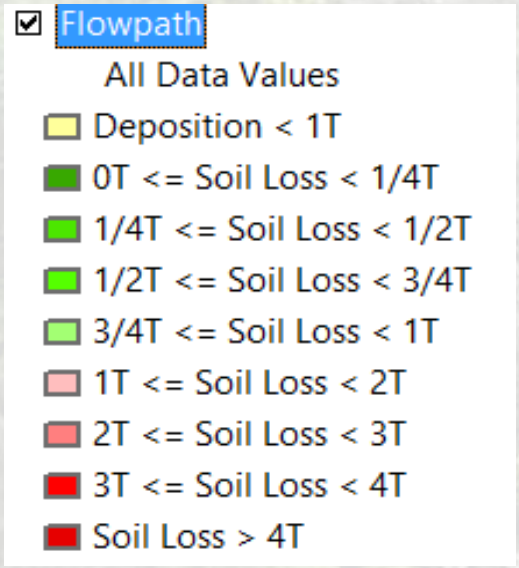
Flowpath Met

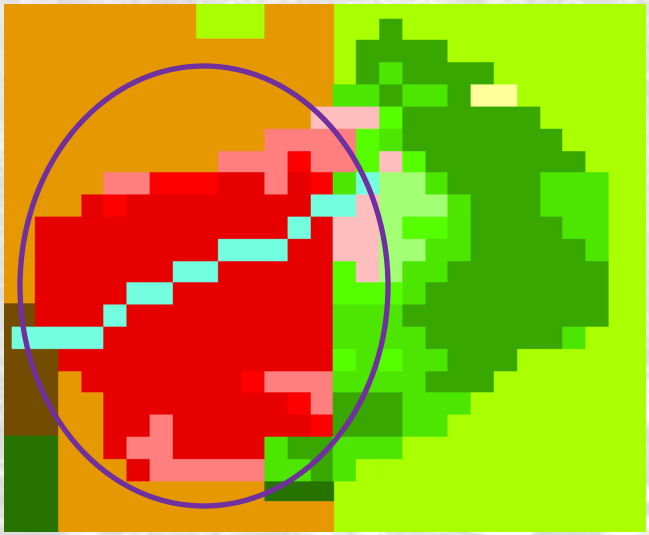
Hillslopes WEPP	TOPAZ	Runoff Volume (m^3/yr)	Soil Loss (tonne/yr)		Sediment Yield (tonne/yr)	*Mapped Soil Loss (tonne/ha/yr)	Sediment Yield (tonne/ha/yr)
1	21	944.5	0.4	=	n.a.	0.3	n.a.
2	22	586.0	10.3		n.a.	16.7	n.a.
3	23	1064.5	13.0		n.a.	8.1	n.a.

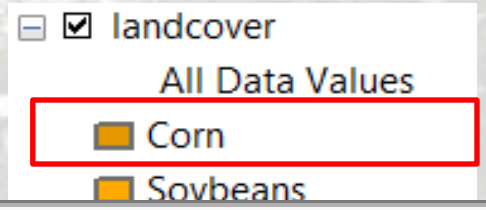
GeoWEPP for Nonstructural Management



Vegetation Buffer Strip



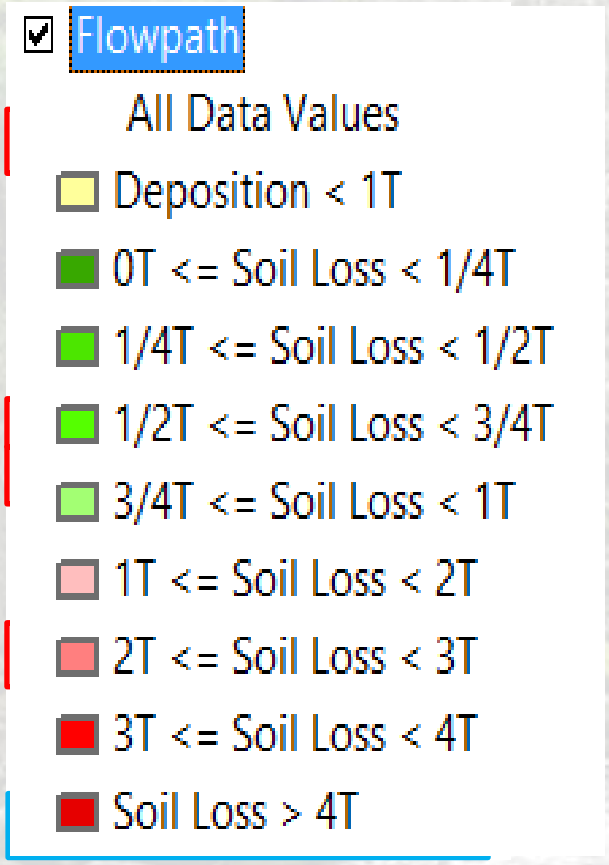


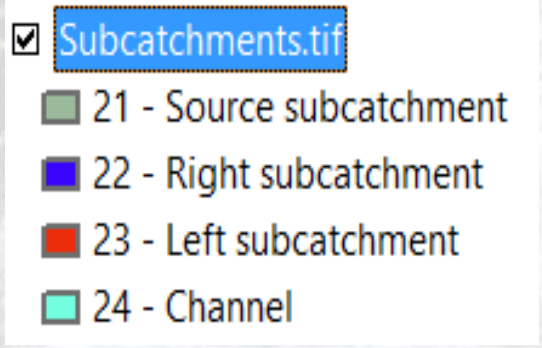


Area	GIS Landuse	WEPP Management
3.5%	Fallow	fallow.rot
42.6%	Grass	grass.rot
47.0%	Corn	agriculture\corn-fall moldboard plow.rot
7.0%	Deciduous Forest	GeoWEPP\Forest Perennial.rot

How much run-off will vegetation Buffer Strip reduce?

Vegetation Buffer Strip – Flowpath method

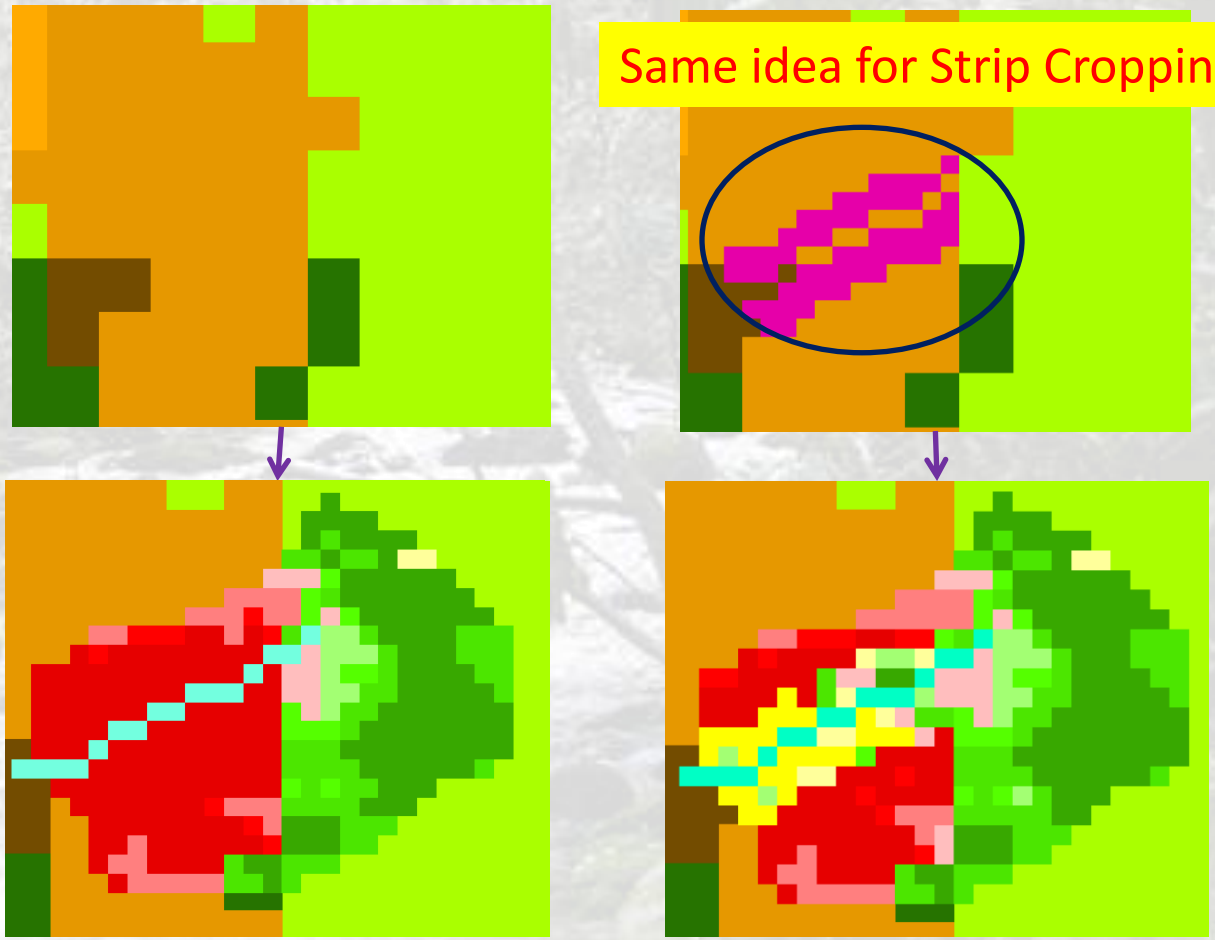




Original

With Vegetation Buffer Strip

Same idea for Strip Cropping

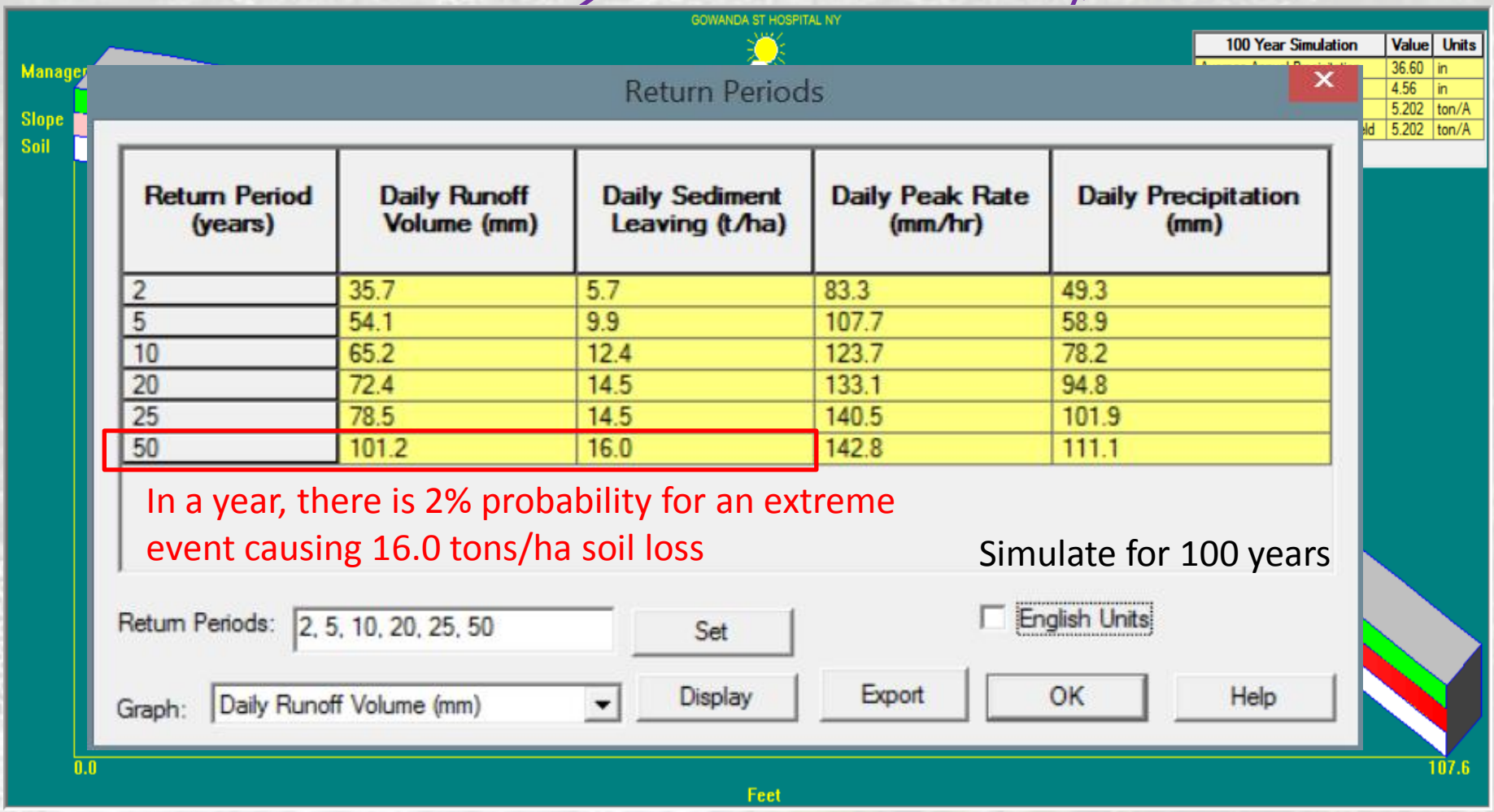


Run off: $2595\,^{m^3}/_{yr}$ $\xrightarrow{-457\,^{m^3}/_{yr}}$ $2138\,^{m^3}/_{yr}$

Soil Loss: $23.7\,^{ton}/_{yr}$ $\xrightarrow{-13.2\,^{ton}/_{yr}}$ $10.5\,^{ton}/_{yr}$

Return Period Analysis - Extreme Event

Load a single hillslope to WEPP



Vegetation Buffer Strip – Return Period Analysis

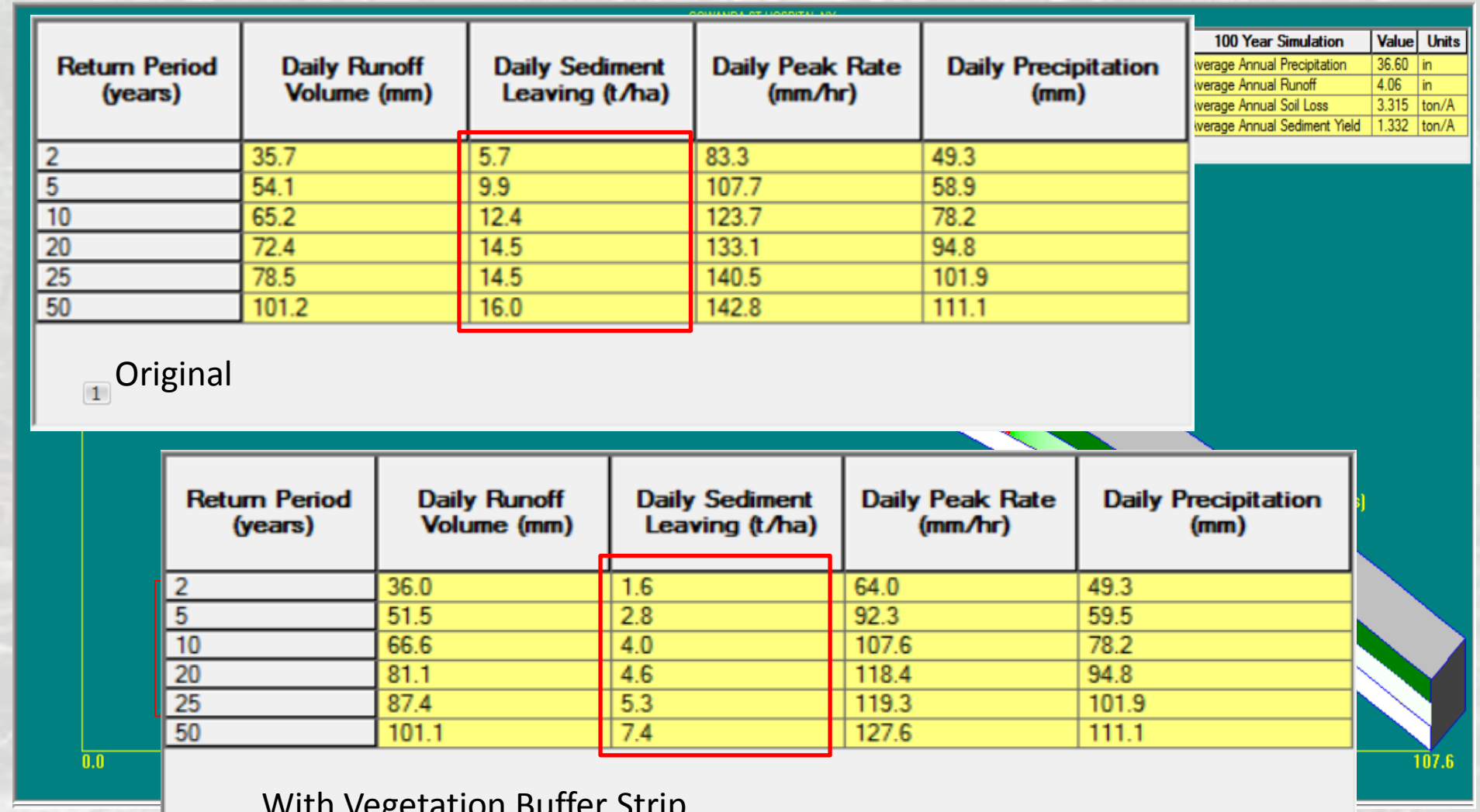
Return Period (years)	Daily Runoff Volume (mm)	Daily Sediment Leaving (t/ha)	Daily Peak Rate (mm/hr)	Daily Precipitation (mm)
2	35.7	5.7	83.3	49.3
5	54.1	9.9	107.7	58.9
10	65.2	12.4	123.7	78.2
20	72.4	14.5	133.1	94.8
25	78.5	14.5	140.5	101.9
50	101.2	16.0	142.8	111.1

Original

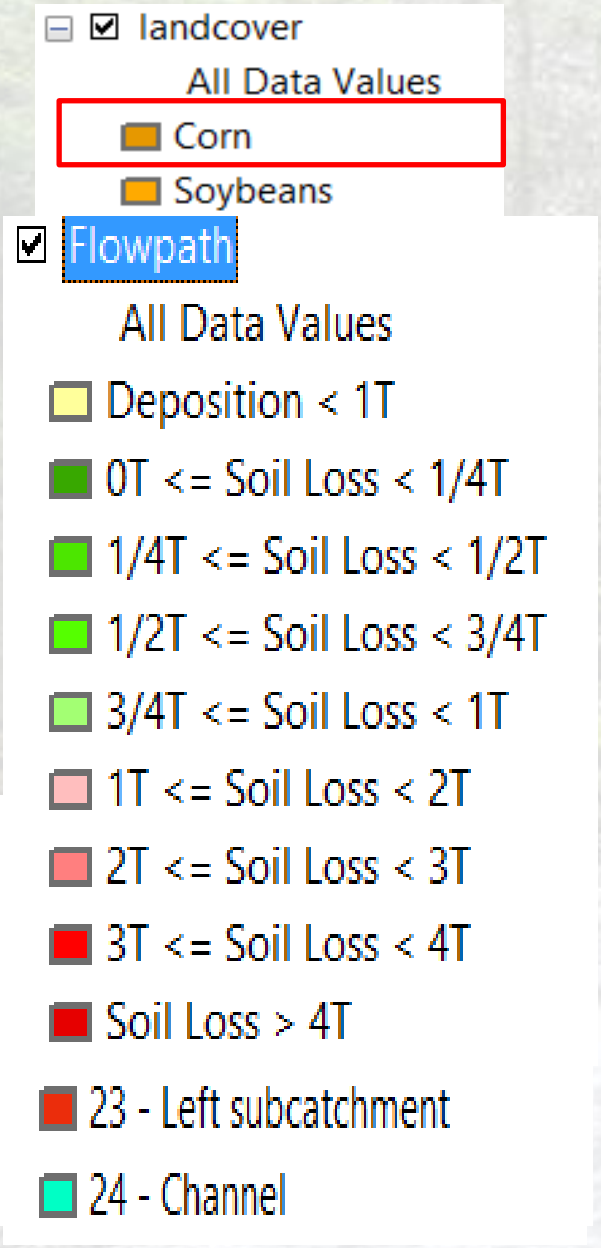
100 Year Simulation	Value	Units
verage Annual Precipitation	36.60	in
verage Annual Runoff	4.06	in
verage Annual Soil Loss	3.315	ton/A
verage Annual Sediment Yield	1.332	ton/A

Return Period (years)	Daily Runoff Volume (mm)	Daily Sediment Leaving (t/ha)	Daily Peak Rate (mm/hr)	Daily Precipitation (mm)
2	36.0	1.6	64.0	49.3
5	51.5	2.8	92.3	59.5
10	66.6	4.0	107.6	78.2
20	81.1	4.6	118.4	94.8
25	87.4	5.3	119.3	101.9
50	101.1	7.4	127.6	111.1

With Vegetation Buffer Strip

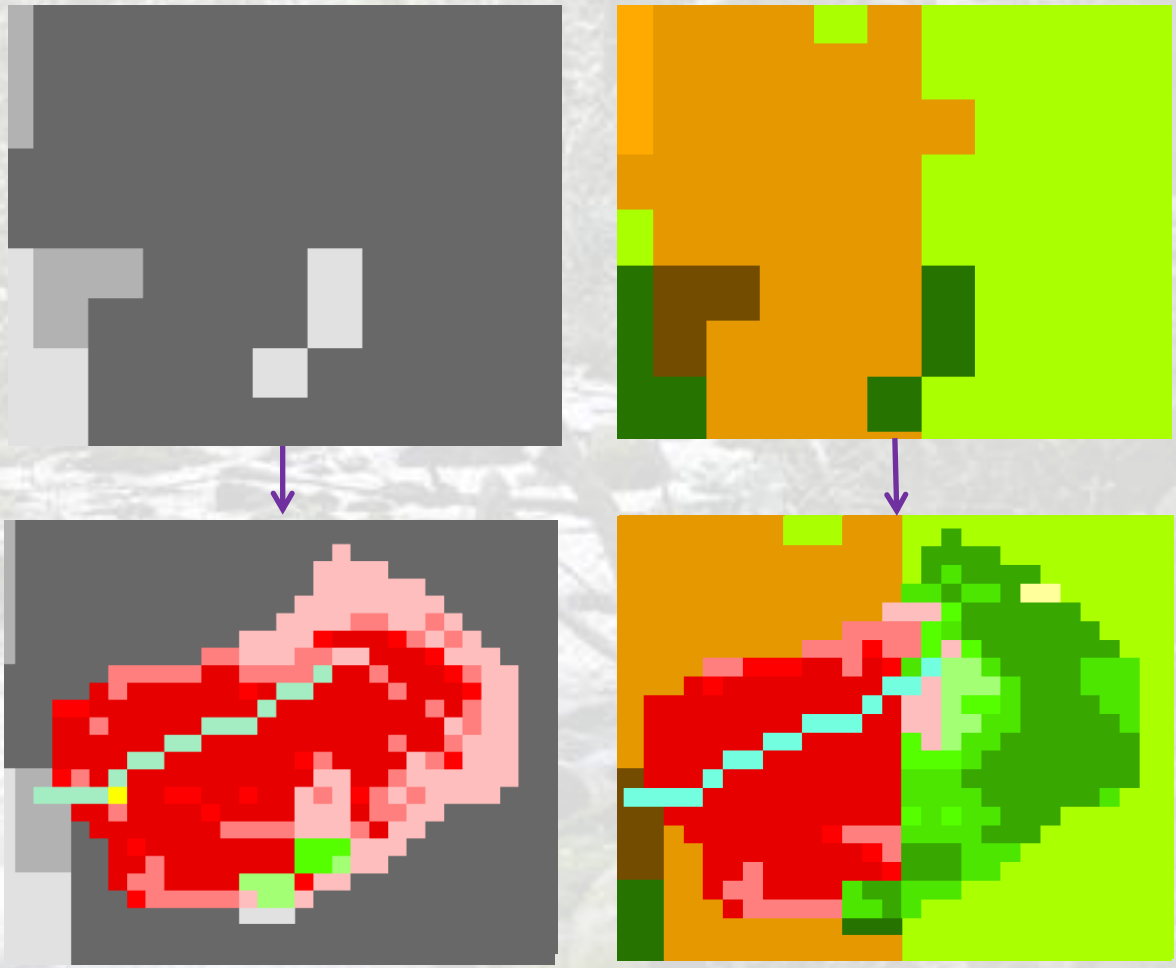


Reforestation



Post-Fire

Pre-Fire

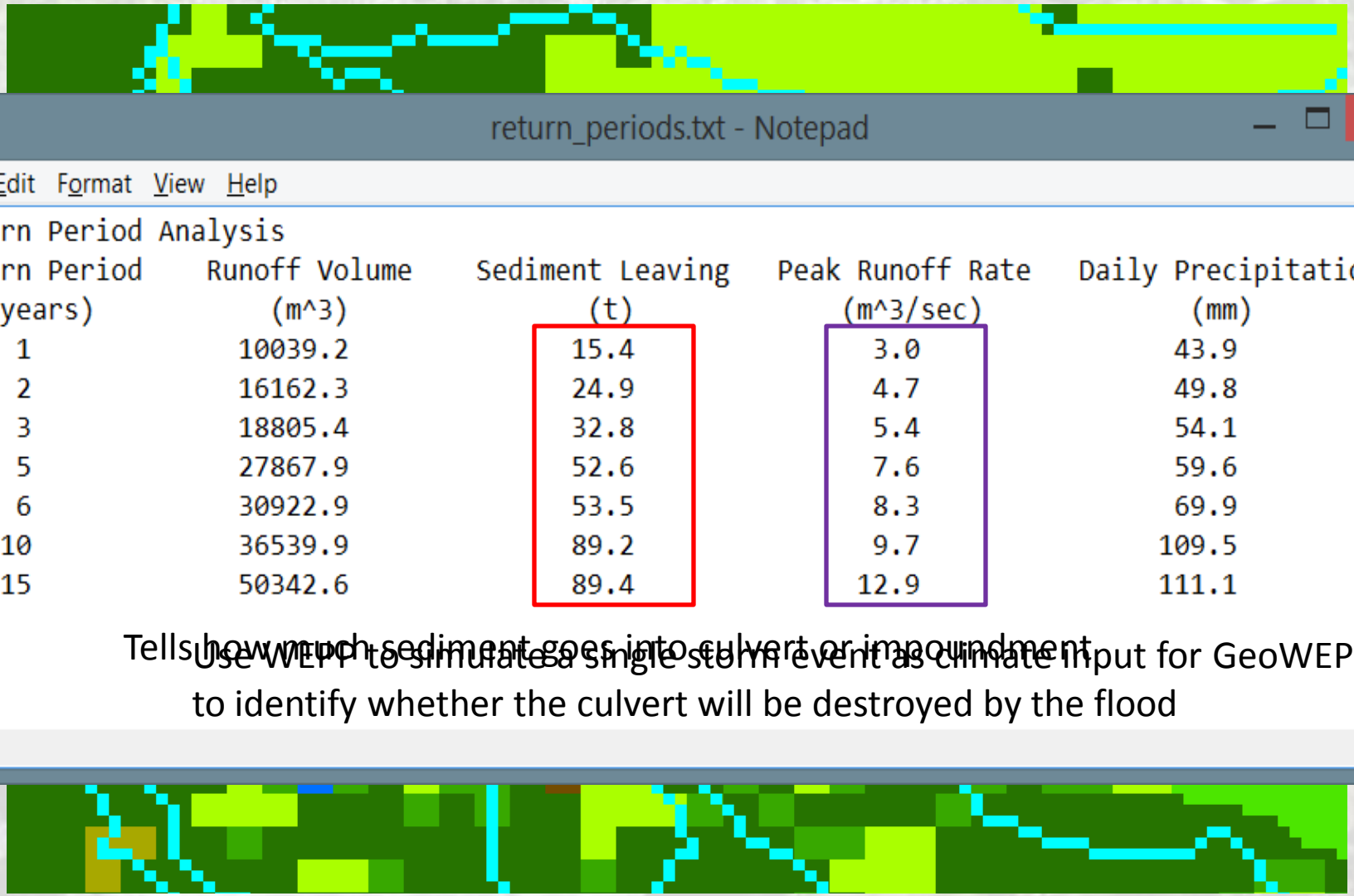


Run off: $3442.5\ ^{m^3}/_{yr}$ $\xrightarrow{-\ 847.5\ ^{m^3}/_{yr}}$ $2595\ ^{m^3}/_{yr}$

Soil Loss: $31.0\ ^{ton}/_{yr}$ $\xrightarrow{-\ 7.3\ ^{ton}/_{yr}}$ $23.7\ ^{ton}/_{yr}$

GeoWEPP for structural management

Impoundment & culvert – Return period analysis



return_periods.txt - Notepad

File Edit Format View Help

Return Period Analysis

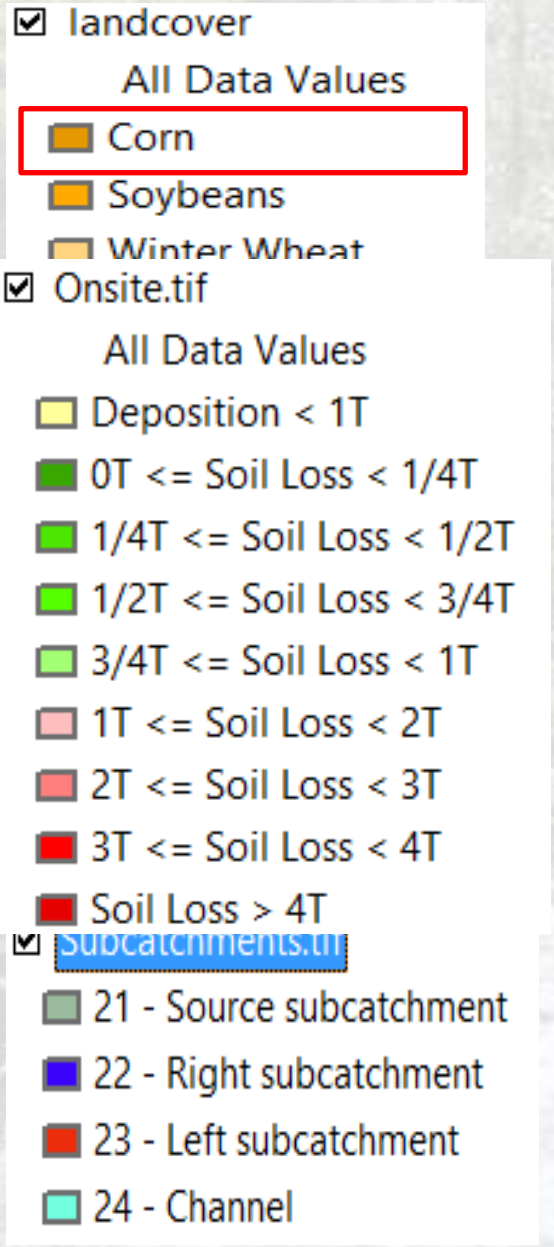
Return Period (years)	Runoff Volume (m^3)	Sediment Leaving (t)	Peak Runoff Rate (m^3/sec)	Daily Precipitation (mm)
1	10039.2	15.4	3.0	43.9
2	16162.3	24.9	4.7	49.8
3	18805.4	32.8	5.4	54.1
5	27867.9	52.6	7.6	59.6
6	30922.9	53.5	8.3	69.9
10	36539.9	89.2	9.7	109.5
15	50342.6	89.4	12.9	111.1

Tells how much sediment goes into culvert or impoundment

Use WEPP to simulate a single storm event as climate input for GeoWEPP to identify whether the culvert will be destroyed by the flood

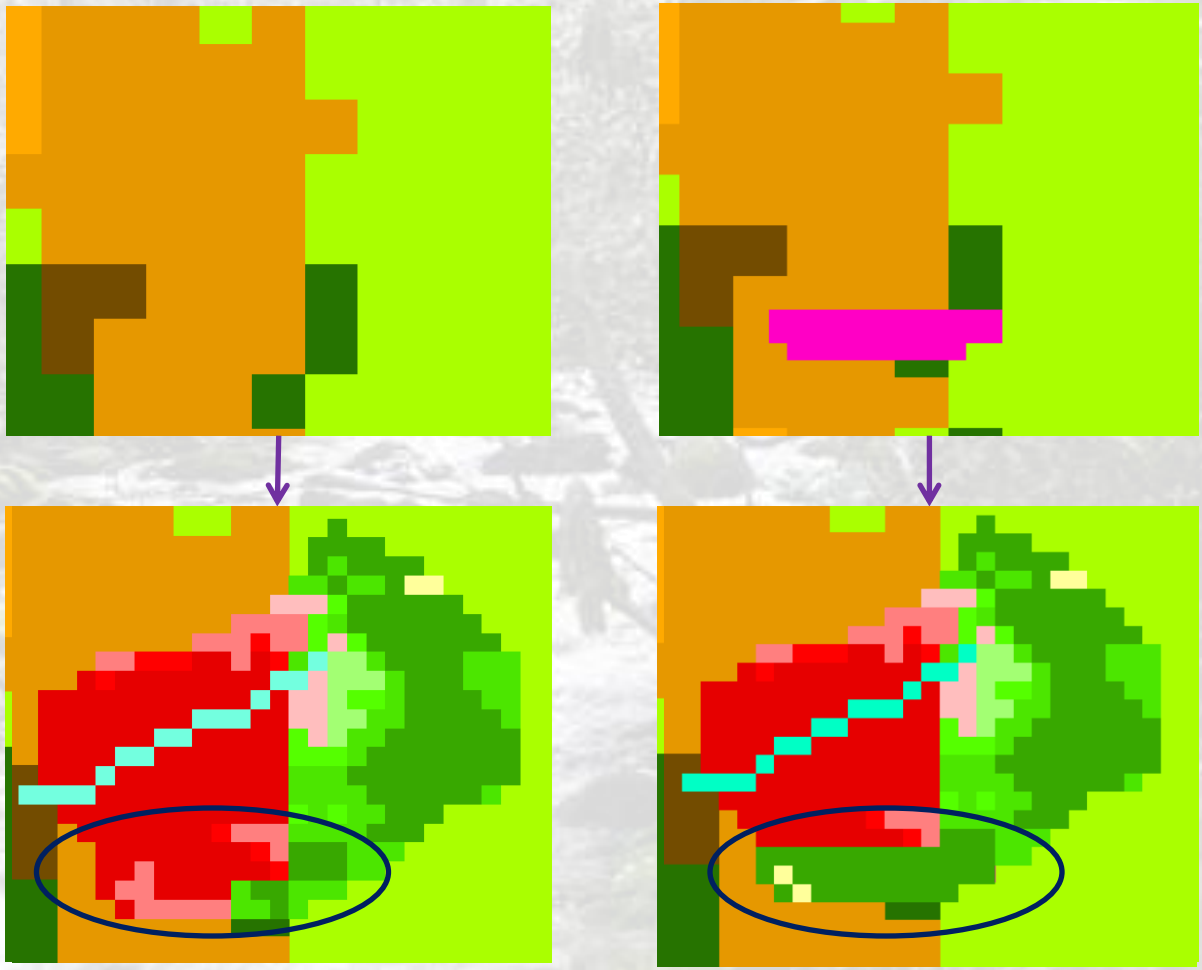
Read return period report from GeoWEPP for the watershed

Terraces / Roads / Parking lot



Original

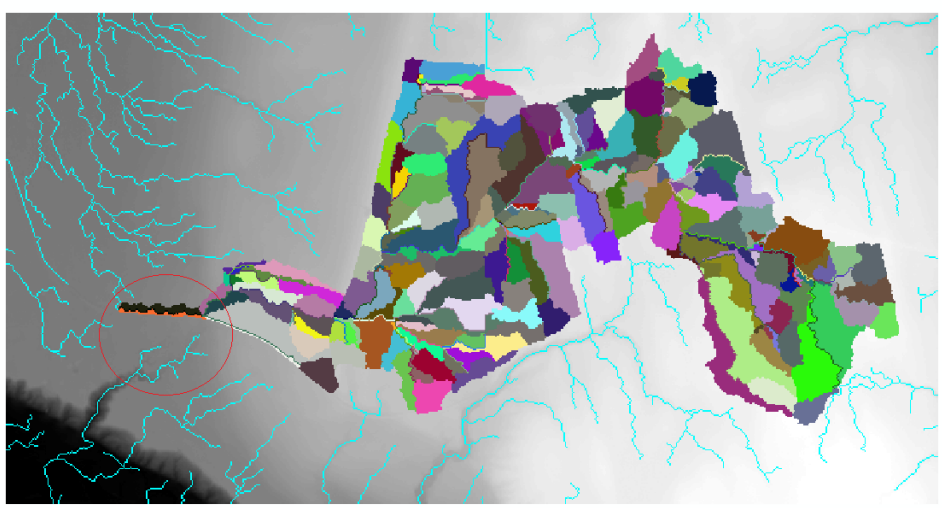
Terraces



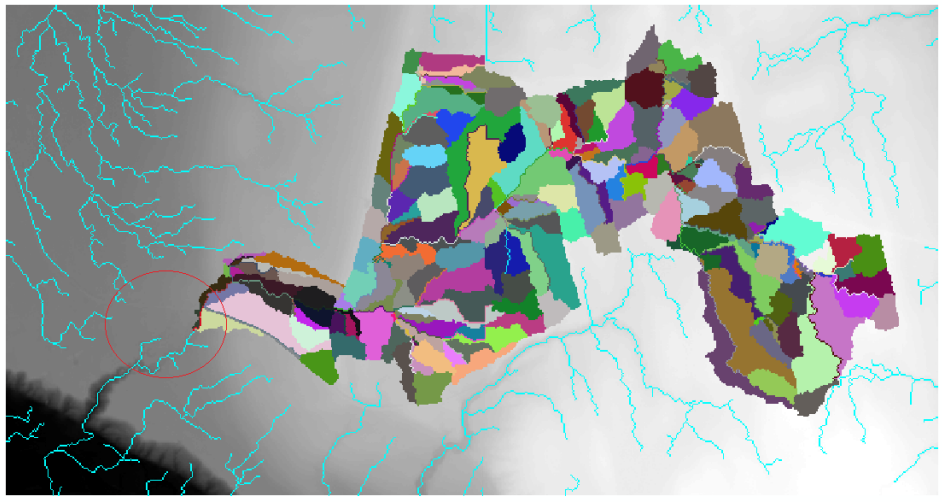
Run off: $2595\,^{m^3}/_{yr} \xrightarrow{+\,528.3\,^{m^3}/_{yr}} 3123.3\,^{m^3}/_{yr}$

Soil Loss: $23.7\,^{ton}/_{yr} \xrightarrow{+\,6.1\,^{ton}/_{yr}} 29.8\,^{ton}/_{yr}$

Culvert Tool for flow direction



Original



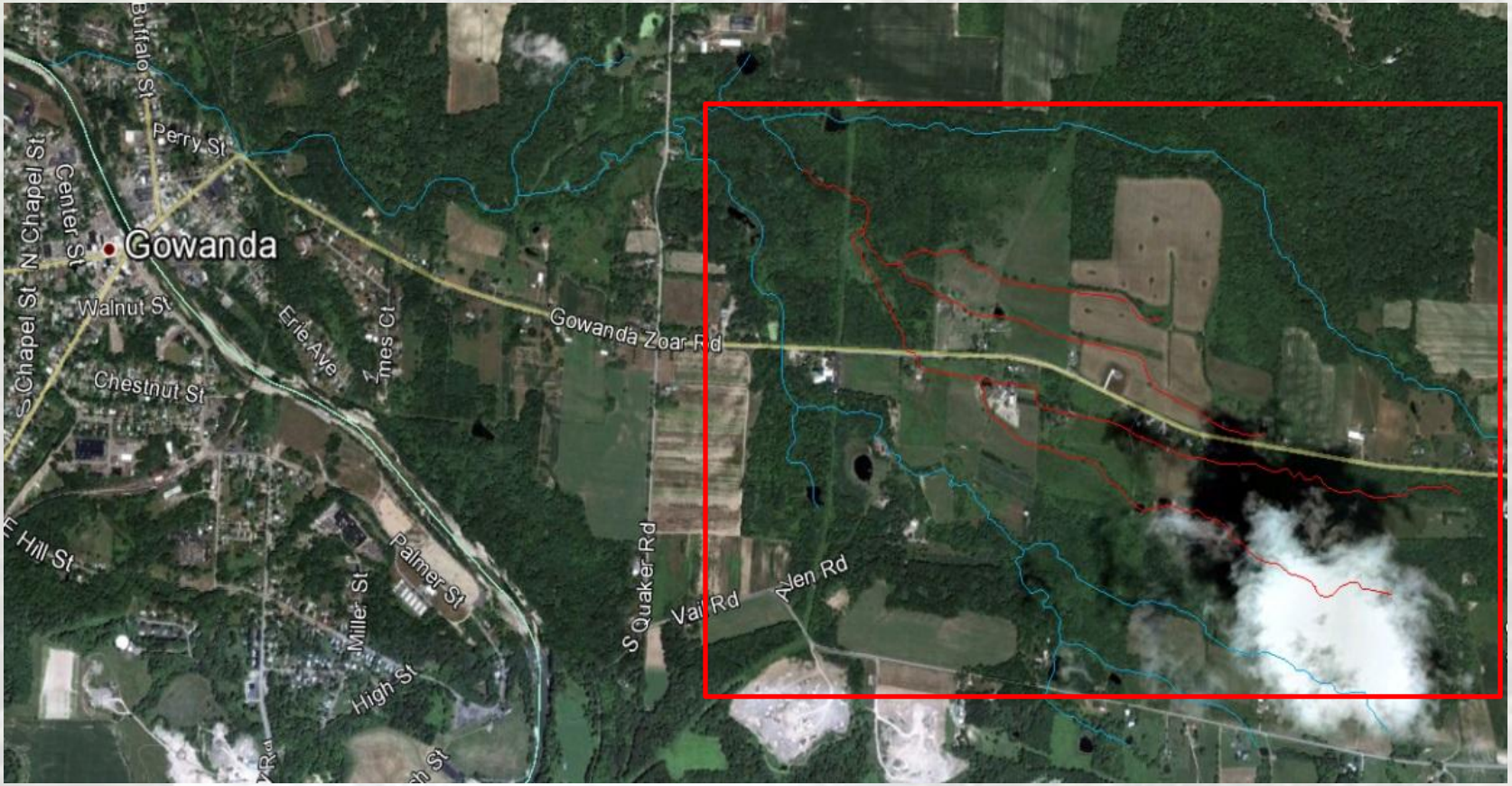
Culvert

Since culvert under road change the flow direction, DEM may record elevation of the road, which is above culvert and leads to incorrect flow direction.

Noted that DEM resolution may greatly influence flow direction

5m DEM for another study site Developed by Brian Clarkson

Stream Customization – GeoWEPP Extension

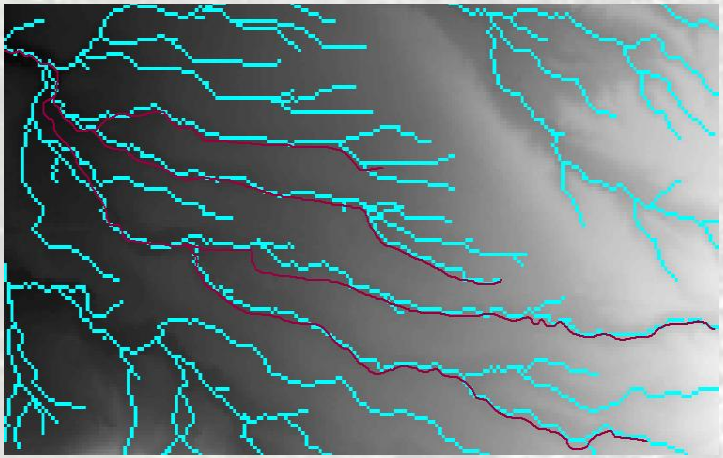


Select a point in channel to specify where the channel start

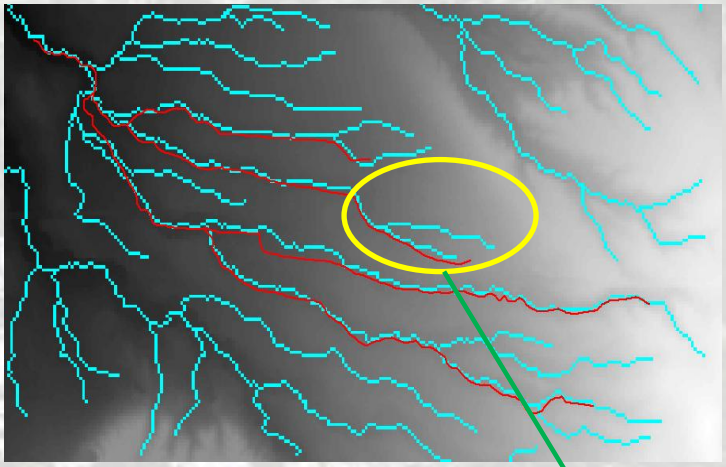
Make sure that hydrology in model is correct for further process.

Stream Customization – GeoWEPP Extension

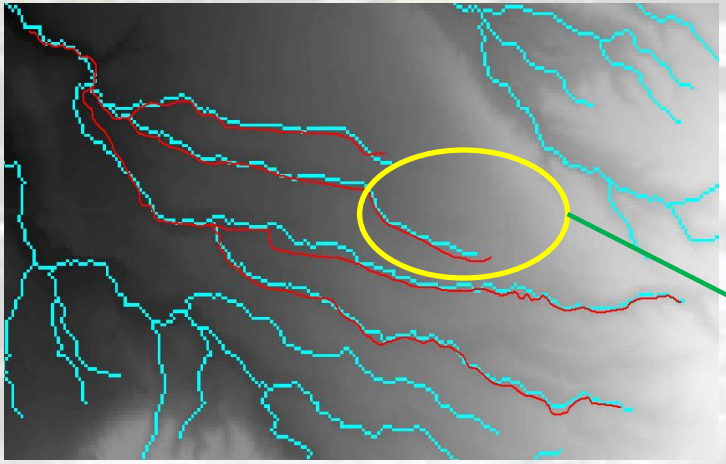
ArcMap Hydrology Tools

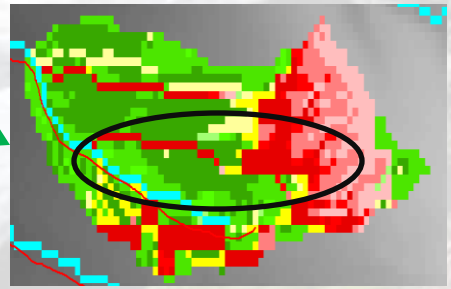


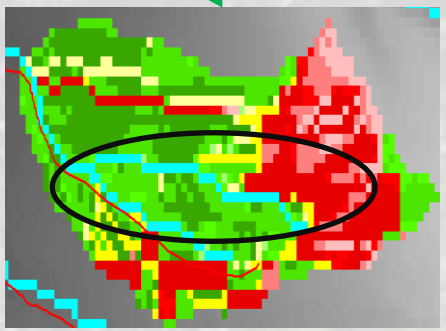
GeoWEPP without customization



GeoWEPP with Customization







http://geowepp.geog.buffalo.edu/

References

- **GeoWEPP:**
- Renschler, C.S. (2003) Designing geo-spatial interfaces to scale process models: The GeoWEPP approach. Hydrological Processes 17, p.1005-1017.
- **WEPP:**
- Laflen, J.M., L.J. Lane, and G.R. Foster. 1991. WEPP—a next generation of erosion prediction technology. Journal of Soil Water Conservation 46(1): 34–38.
- Flanagan, D.C., and M.A. Nearing (eds.). 1995. USDA-Water Erosion Prediction Project (WEPP) Hillslope Profile and Watershed Model Documentation. NSERL Report No. 10, National Soil Erosion Research Laboratory, USDA-Agricultural Research Service, West Lafayette, Indiana.
- **GeoWEPP Applications:**
- Flanagan, D.C., J.R. Frankenberger, T.A. Cochrane, C.S., Renschler, and W.J. Elliot (2013) Geospatial Application of the Water Erosion Prediction Project (WEPP) Model. *Transactions of the ASABE* (in press)
- Renschler, C.S., and D.C. Flanagan (2008) Site-Specific Decision-Making Based on GPS RTK Survey and Six Alternative Elevation Data Sources: Soil Erosion Prediction. *Transactions of the ASABE* 51(2):413-424.*[2009 ASABE Superior Paper Award]*
- Renschler, C.S., and Lee, T. (2005) Spatially distributed Assessment of Short- and Long-term Impacts of Multiple Best Management Practices in Agricultural Watersheds. Journal of Soil and Water Conservation 60(6):446-456.
- Renschler, C.S., Flanagan, D.C., Engel, B.A., Kramer, L.A., and Sudduth, K.A. (2002) Site-Specific Decision-Making Based on GPS RTK Survey and Six Alternative Elevation Data Sources: Watershed Topography and Delineation. Transactions of the ASAE 45(6):1883-1895.
- Renschler, C.S., and J. Harbor (2002) Soil erosion assessment tools from point to regional scales – The role of geomorphologists in land management research and implementation. Geomorphology 47, p.189-209.