Prioritizing Agricultural Nonpoint Source Management Areas through the use of LiDAR and GIS

Watershed Professionals Network
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Light Detection and Ranging (LiDAR)

- Highly accurate elevation data (within ~15 cm)
- Allows us to make extremely accurate digital elevation models (DEM)
- Useful in looking at how water moves over the landscape
- Becoming more widely available
LiDAR Derived DEM
Cell Size: 1 meter sq
Vertical Error: 15 cm
1.5 million points / sq mile

USGS Standard DEM
Cell Size: 30 meter sq
1600 points / sq mile

1 Varies based on project specifications
2 http://edc.usgs.gov/guides/dem.html
Tim Loesch, MNDNR
Terrain Analysis: Approach

- DEM Reconditioning
- Non-Contributing Analysis
- Hydrologically Reconditioned DEM
  - Stream Power Index
  - RUSLE Spatial Analysis
  - Watershed Ranking

Adjust raw LiDAR data to remove inaccuracies and show how water moves over landscape
Removing ‘Digital Dams’
Impacts of Reconditioning

![Map showing waterway and culvert location](image_url)
Impacts of Reconditioning

Point of Interest
Impacts of Reconditioning

13.5 Acre Watershed

Culvert not accounted for
Impacts of Reconditioning

6.6 Sq. Mile Watershed
Terrain Analysis: Approach

DEM Reconditioning

Non-Contributing Analysis

Hydrologically Reconditioned DEM

Stream Power Index

RUSLE Spatial Analysis

Watershed Ranking

Accounting for areas of landscape that do not contribute to flow during certain events (e.g., 10-year, 24-hour storm)
Contributing vs. Non-Contributing Areas

Drainage area under 100-year event
Terrain Analysis: Approach

DEM Reconditioning

Non-Contributing Analysis

Hydrologically Reconditioned DEM

Stream Power Index

RUSLE Spatial Analysis

Watershed Ranking

Very accurate representation of how water moves over landscape (field scale; under certain hydrologic event)
Hydrologically Reconditioned DEM

Yellow - Field Scale Catchment

Green - Field Scale Pour Point
Terrain Analysis: Approach

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  - RUSLE Spatial Analysis
- Watershed Ranking
Stream Power Index (SPI)

Measurement of potential energy of water as it flows over bare ground

\[ SPI = \ln[(\text{flow accumulation}) \times (\text{slope})] \]

- Amount of water expected
- Slope of flow path

Purpose: Identify locations with high potential for gully erosion

Photo credit: http://www.flickr.com/photos/soilscience
SPI Example
Revised Universal Soil Loss Equation (RUSLE)

- Developed by USDA
- Estimate soil erosion from fields due to raindrop impact and surface runoff

Where,  
- R = Rainfall and Runoff Factor
- K = Soil Erodibility Factor
- LS = Length-Slope Factor
- C = Cover and Management Factor
- P = Support Practice Factor

Photo credit: http://www.flickr.com/photos/soilscience
RUSLE Inputs

Assume P Factor = 1
Results:
Averaged Across Subwatersheds

Subwatersheds with Most Erosive Flows

Subwatersheds with Most Erodible Landscape
Combined Results

Reported at the Subwatershed Scale

Mean Score
- High: 0.87
- Low: 0.093

Ranked Flowpaths
- Extremely Low
- Low
- Moderate
- High

Reported by Flowpath
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Thank you.

Questions?