

A Suite of Tools for Monitoring and Assessing Impacts of Roads Networks and Off-Road Vehicle Activity on Rangelands

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Background

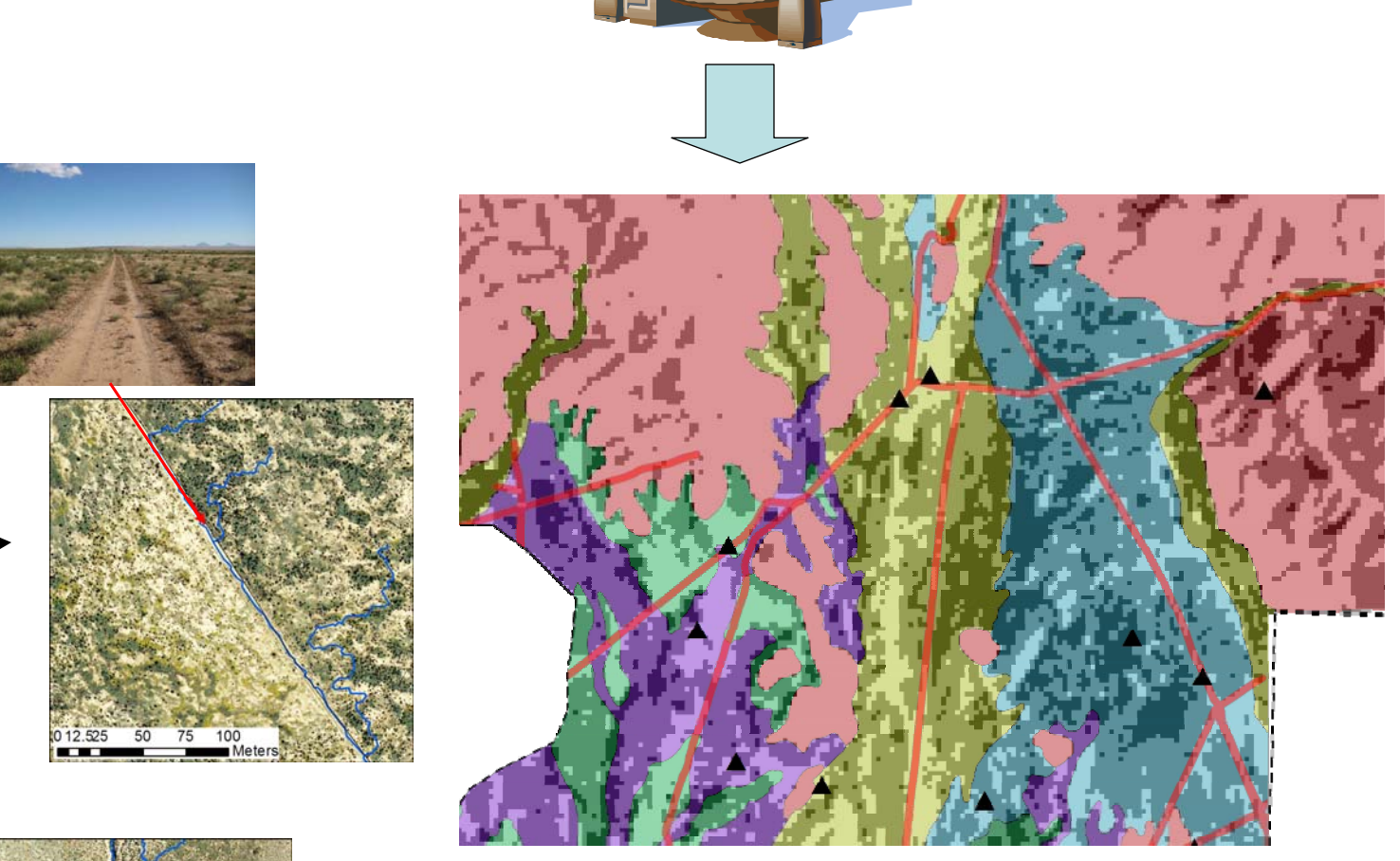
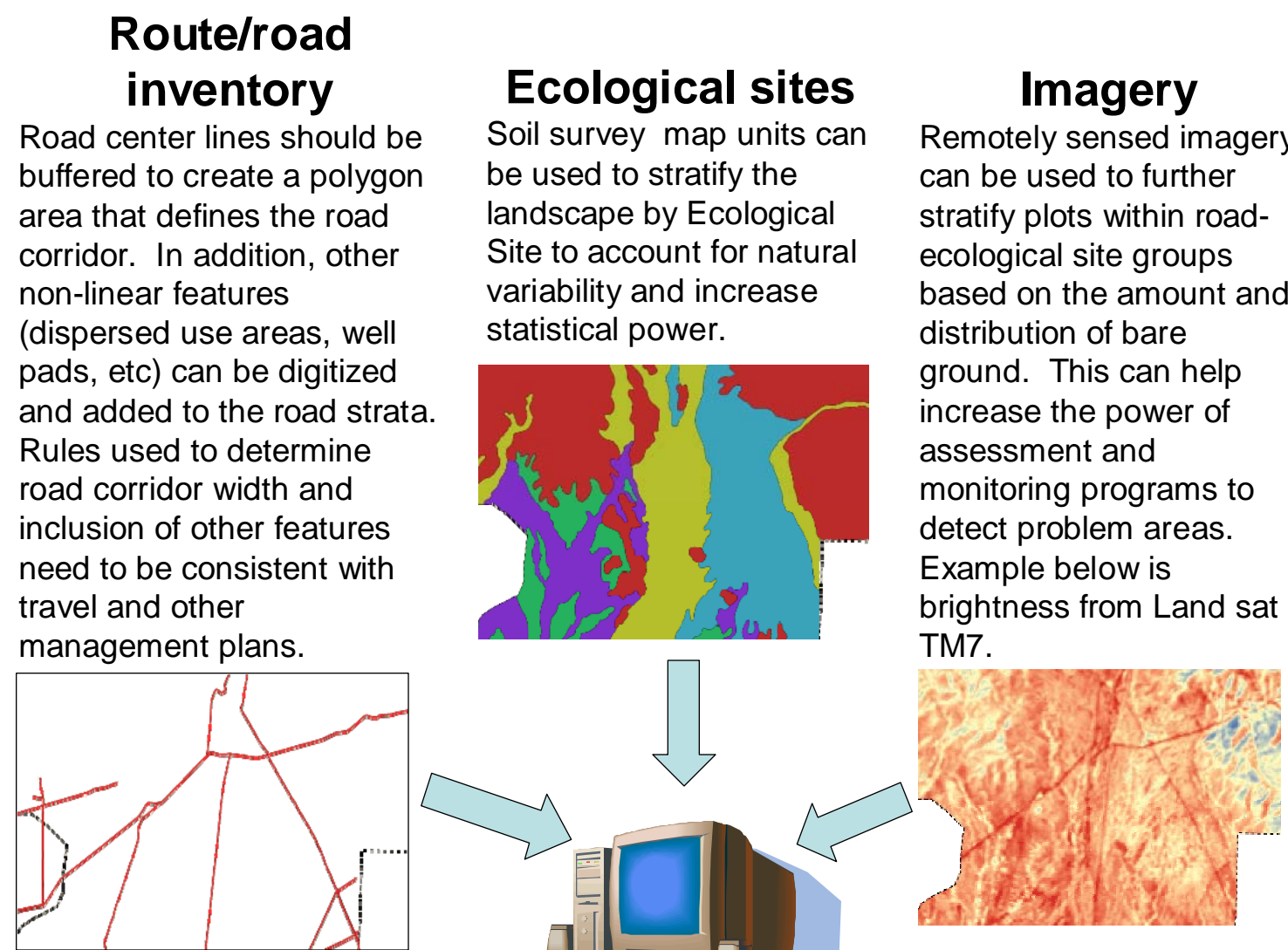
Despite increasing transportation related activities on rangelands globally, few tools exist for assessing and monitoring impacts of roads, road networks and off-road vehicle traffic. This is in part due to an historical emphasis on grazing issues and the complexity of monitoring and assessing impacts on rangeland health and productivity. We present strategies for applying new and existing tools for monitoring and assessment of road and off-road vehicle impacts. The suite of tools can increase the ability to detect road and vehicle associated impacts at multiple spatial scales.

Stratification Tools

Landscape-scale analysis of road impacts requires a probability-based plot selection technique that allows for the comparison of the ecological function of areas near roads to areas of similar ecological potential and management but located far from roads and trails.

Lidar shows promise for incorporating road-landscape hydrologic interactions into plot stratification and impact analysis. Ground photos and aerial imagery (15cm) with overlaid water flow paths derived from Lidar (blue lines) show:

- road water diversion impacts on plant production and cover &
- road water channeling impacts on soil erosion, as indicated by active rills, gullies, and water flow patterns.



These tools generate a **stratified random sample** of road and non-road plots based on ecological potential and degradation.

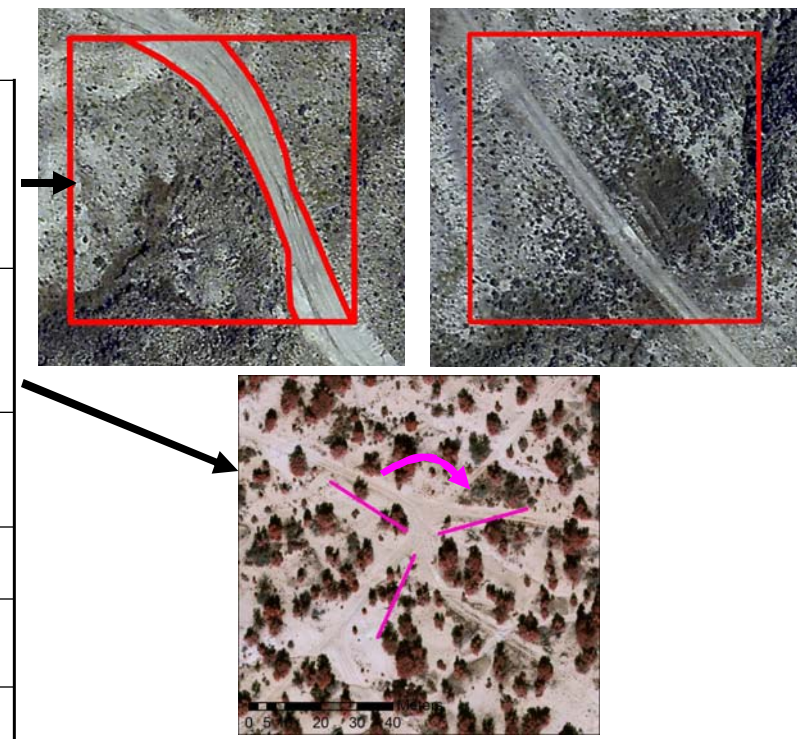
For more info see: landscapetoolbox.org

Field Tools

Method	Modification/Description
Interpreting Indicators of Rangeland Health ¹	May be helpful to either exclude travel way from evaluation (assume disturbances completely degraded) or complete separate evaluations for directly and indirectly impacted parts of the plot.
Line point intercept ²	Collect data on 3 transects in star-pattern with random orientation to avoid systematic alignment of transects with N-S or E-W roads.
Gap intercept ²	Same modification as LPI, plus record where transect crosses road for later splitting of points on and off travel way.
Penetrometer ³	No modification (careful of buried pipelines). See below
Soil Stability ²	No modification. Not appropriate for frequently bladed roads.
Linear Impact Hydrology Checklist [*]	Qualitative assessment designed to capture how road is altering landscape hydrology and the functioning of road drainage features.
Very Large Erosion Bridge [*]	Laser rangefinder affixed to rigid beam & tripods allows for monitoring of soil loss from road surfaces.



The Very Large Erosion Bridge pictured above uses a highly accurate (< 1 mm) laser range finder that rides in a small fabricated cart along a C-beam track. Tripods are placed over permanent markers. Heights are measured every 10 cm along the track, including an elevation monument (inset picture) to allow for monitoring of soil loss. The laser unit has a built-in tilt sensor, data logging capabilities, and Bluetooth connectivity.



The Linear Impact Hydrology Checklist* uses observations of IIRH hydrologic indicators (water-flow patterns, rills, and gullies) on the road margin and in the road to estimate:

- Where water is entering and leaving the road
- The relative erosive force of road-related water flows

*also available as digital data entry form

Comparison of Penetrometers

	Strain gauge		Dynamic (Impact)	
	Pros:	Cons:	Pros:	Cons:
	<ul style="list-style-type: none"> •Fast in field •Data logging & built in GPS capabilities on more expensive models 	<ul style="list-style-type: none"> •Generally more expensive •Results are operator specific (low repeatability among operators) •Must be recalibrated •Designed for a limited range of soil resistance (doesn't work in very gravelly or very dry soils) 	<ul style="list-style-type: none"> •Inexpensive •Simple to operate •Operator independent (high repeatability) •Works in a wide variety of soil conditions 	<ul style="list-style-type: none"> •More time consuming in field

¹Pellant, M., P. Shaver, D. Pyke and J.E. Herrick. 2005. Interpreting Indicators of Rangeland Health, Version 4. Interagency Technical Reference 1734-6. Bureau of Land Management, Denver, CO.

²Herrick, J.E., J.W. Van Zee, K.M. Havstad, L. M. Burkett and W.G. Whitford. 2005. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. USDA-ARS Jornada Experimental Range, Las Cruces, NM. Distributed by University of Arizona Press

³Herrick J. E., and T. L. Jones. 2002. A dynamic cone penetrometer for measuring soil penetration resistance. Soil Science Society of America Journal 66: 1320-1324

Web-Based Tools

The Rangeland Assessment and Monitoring Methods Guide is a web-based tool and resource that gives researchers and managers the information necessary to make informed decisions about which field and remote-sensing method or combination of methods could be most useful and cost effective for specific rangeland management needs, including roads and road networks.

- The website includes:
- A discovery tool that provides recommended field and remote-sensing methods for user-defined management questions or objectives
 - A wiki devoted to describing rangeland applications of each method



For more info see: rangelandmethods.org

This work was supported by the BLM, Ft. Bliss Army Base, and the Jornada Experimental Range.