Protocol Development Summary (PDS)

ERMN Protocol Name: Landscape Dynamics (*last updated: August 17, 2007*)

Vital Signs Included in the Protocol: Landscape Dynamics (Land cover and use; Landscape Pattern)

Related Vital Signs: Forest, Woodland, Shrubland, and Riparian Vegetation; Rare Riparian Plant Communities; Water Chemistry – Core Parameters, Water Chemistry – Expanded Parameters; Surface Water Hydrology; Air Quality; Weather and Climate; Louisiana Waterthrush.

ERMN Parks where protocol will be implemented: All: Delaware Water Gap National Recreation Area (DEWA), Upper Delaware National Scenic and Recreational River (UPDE), Allegheny Portage Railroad National Historic Site (ALPO), Johnstown Flood National Memorial (ALPO), Fort Necessity National Battlefield (FONE), Friendship Hill National Historic Site (FRHI), New River Gorge National River (NERI), Gauley River National Recreation Area (GARI), and Bluestone National Scenic River (BLUE).

Justification/Issue being addressed:

Many of the parks in the ERMN are subject to encroaching residential, urban, and in some cases agricultural development, and recognize that these landscape issues are closely linked to park ecosystem functionality. Thus, land cover and use and landscape pattern change are given a high priority for long-term monitoring within and around the ERMN. Long-term monitoring of landscape-level indicators of relevant land use change over time that represent the ecological impacts of these changes can help managers to determine patterns in land use change which may threaten future ecological integrity within parks.

Specifically, landscape patterns related to disturbance, fragmentation, buffers, and land cover change have been shown to affect the abundance of rare and endangered species, levels of biodiversity, potential for invasion by exotic plants, habitat for birds, amphibians and other animals, water quality, and in-stream habitat for fish and other aquatic organisms. To address such concerns, aerial photography and satellite imagery (collectively, remote sensing) can be used to monitor the spatial extent of changes in land cover (i.e., conversion) or land condition. The benefit of remote sensing for monitoring is that it provides complete spatial coverage compared to point or plot samples. Remote sensing therefore complements survey data by providing information on the context of data sampled at points while also facilitating extrapolation of point measurements across landscapes. The results from remote sensing change detection analyses can also be used to identify areas of rapid change to target management efforts. Because remote sensing data and analysis methods are changing rapidly with evolving technologies, protocols are essential to ensure consistent data sources and analytical practices.

The ERMN also recognizes that human behaviors and activities are significant drivers of landscape dynamics and can be represented by socioeconomic indicators. The ERMN is therefore also interested in monitoring long-term local, regional and national trends in population

characteristics and human behaviors, as well as potential consequences of human activities, within and around ERMN ecosystems.

Management objective:

Detect long-term local, regional and national trends in human population characteristics, land use, and behaviors, as well as the potential ecological consequences of human activities, within and around ERMN parks.

Specific monitoring questions and objectives to be addressed by this protocol:

Objective 1. Document long-term changes in land cover within and adjacent to ERMN park lands (i.e., how much land of a major cover type has changed over time?).

Objective 2. Document long-term trends in habitat conversion to urban/suburban landscapes, creation of edge effects, reduction of functional ecosystem size, and elimination of important habitats.

Objective 3. Document in what way(s) did landscape pattern change (contextual change) within and adjacent to park lands (i.e. what are average patch sizes, densities, edge/core areas, inter-patch distances, etc.)?

Objective 4. Document local, regional and national trends in population characteristics and human behaviors as represented by a suite of socio-economic indicators.

Basic approach: Several other I&M Networks have made substantial progress developing Landscape Dynamics protocols, the objectives of which are likely to be very similar to ERMN objectives. In FY07, the ERMN will seek a cooperator to help network staff evaluate several recently approved Landscape Dynamics protocols in terms of applicability and relevance to ERMN needs. Part of this effort will be to modify/develop/refine specific monitoring objectives and guidance relative to landscape analysis, such as what type of imagery to purchase for future analysis, appropriate scale, and classification standards. The project will necessitate a significant cooperation between NPS and the cooperator to ensure that the indicators recommended reflect the needs of the ERMN monitoring program, and that the protocols developed reflect the specific monitoring objectives identified by ERMN. This project will also identify how monitoring land-use change is linked with other vital signs.

One aspect (Objective 4) of the overall Landscape Dynamics protocol is underway as of FY06. ERMN and park staff are working closely with Dr. Cynthia Brewer, Penn State University, to choose approximately 10-12 socioeconomic indicators (from a list of 67 previously identified by McKendry et al., 2004), that are most relevant to ERMN park ecosystems. The cooperator will write a step-by-step monitoring SOP detailing the information that a skilled GIS user would need to carry out the protocol methods. This protocol may include websites, addresses and contacts for data acquisition; methods for manipulating and error-checking data; techniques for data presentation; screen-captures of important steps; specific software commands and system configuration; methods of updating data; and recommendations for repeat-time intervals for

protocol implementation. The protocol will be based on use of ESRI's ArcGIS software and will incorporate a template-based, project centric approach whereby as many indicators as is feasible will be presented in one standard ArcMap project that can be updated through time as new data becomes available. This standard ArcMap project template will include visual and tabular representations of the data as is appropriate. It will incorporate schemes to make information presentation (for example, map and table labeling) as easy and automatic as possible. Upon completion of the protocol, the ERMN should be able to plan for and design a program to conduct long-term monitoring of socioeconomic indicators in an efficient fashion. This effort also includes conducting a "dry-run" of the protocol/SOP for DEWA.

Principal investigators and NPS lead: Kristina Callahan, ERMN Data Manager, will be the lead NPS contact for this protocol. Dr. Cynthia Brewer, Pennsylvania State University, is the lead PI for Objective 4 – developing and applying socio-economic indicators. A cooperator for the remainder of this protocol development will be sought in FY06.

Key Citations:

Forman, R.T.T. 2000. Estimate of the area affected ecologically by the road system in the United States. Conservation Biology 14:31-35.

Li, H. & Wu, J. 2004. Use and misuse of landscape indices. Landscape Ecology 19:389-399.

Trombulak, S.C. & Frissell, C.A. 2004. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

Turner, M.G., Pearson, S.M., Bolstad, P. & Wear, D.N. 2003. Effects of land-cover change on spatial pattern of forest communities in the Southern Appalachian Mountains (USA). Landscape Ecology 18:449-464.

Wear, D.N. & Bolstad, P. 1998. Land-use changes in southern Appalachian landscapes: spatial analysis and forecast evaluation. Ecosystems1:575-594.