USDA NRCS National Easement Assessment Project

Leveraging Geospatial Technologies for Ecological Monitoring of NRCS Conservation Easements

Gabriel D. Upchurch[1], Katherine E. Edwards[1], Matthew J. Gray[1], John Glover [2], Javier E. Ruiz[3], Greg Pipkin[3], Heath M. Hagy[1], Douglas C. Osborne[1], William B. Sutton[1], Zhimei Guo[1]

[1]University of Tennessee Institute of Agriculture, Department of Forestry, Wildlife and Fisheries, Knoxville, TN, 37996

[2] USDA, Natural Resources Conservation Service, Easement Programs Division, Washington, DC 20250

[3]USDA, Natural Resources Conservation Service, East Remote Sensing Lab, Greensboro, NC 27401

The goal of the NRCS National Easement Assessment Project (NEAP) is to review and develop strategies for monitoring, adaptively managing, and ensuring compliance on NRCS easements. Effective science-based monitoring is the first step to ensuring proper management of NRCS easements, achievement of program objectives, and ultimately, successful landscape-scale conservation. To conduct effective monitoring while leveraging agency resources, we are developing a 3 stage monitoring strategy that utilizes GIS and remote sensing technologies.

Stage 1: Implemented Restoration Plan Map

- **Purpose:** Establish a geospatial record of the location and extent of planned restoration as implemented on NRCS easements.

- **Methods:**
  - Delineate polygons of planned and implemented habitat types by walking boundaries with GPS receiver or heads-up digitizing on annually acquired high resolution aerial photography.
  - Assign attributes to polygons according to planned habitat types using standardized classification systems such as a modified version of Cowardin's (1979).

- **Data Management:** Restoration plan maps are stored centrally in a national geodatabase. Topological rules and standardized attribution choices are employed to help maintain data quality and consistency.

- **Products:** Geospatial data and maps depicting the location and extent of planned habitat types.

Implemented Restoration Plan

NRCS Easement

Current Year Habitat Types
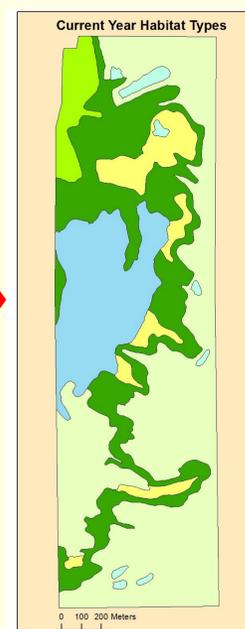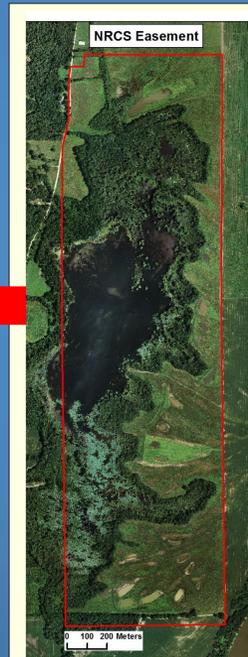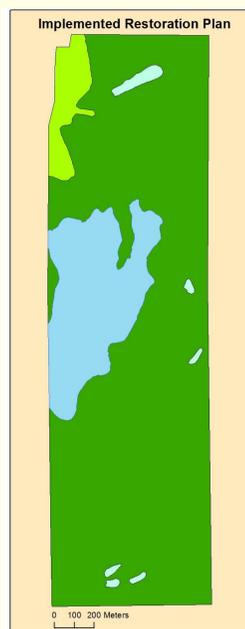
### Stage 2: Status & Trends Monitoring

- **Purpose:** Annually inventory habitat types on NRCS easements and monitor changes over time.

- **Data Sources:** Annually acquired high resolution aerial photography serves as the primary source of data. Secondary data sources include NRCS soils data, USGS Digital Raster Graphics, and on-site data for vegetation, soils, and hydrology collected from the targeted easement or similar easements.

- **Methods:** This strategy employs methods similar to those developed by NRCS National Resources Inventory (USDA 2009) and USFWS National Wetlands Inventory (Dahl and Bergeson 2009).

  - Remote sensing analysts use visual interpretation techniques in conjunction with primary and secondary data sources to delineate and classify polygons of existing habitat types to serve as an initial inventory of an easement after enrollment and restoration occurs.

  - For subsequent years of monitoring, analysts edit the data from the previous year to account for any changes identified in imagery from the current year and secondary data sources. Polygon boundaries are adjusted to reflect changes in extent. Polygons are deleted or created to reflect gained or lost habitat patches. Polygon classifications are changed to reflect conversions to different habitat types. The result is an updated inventory of easement habitat types.

  - To assess trends in habitat types, the inventory from the current year is compared to past years of inventories to identify changes in extent, rates of change, and underlying causes.

- **Data Management**: Inventories for all years are stored in a centralized national geodatabase with built-in quality control measures. Additionally, any derived data sets and on-site data used for ground truthing, verification, and accuracy assessments are retained as well.

Stage 3: Indicator Extraction

Palustrine Forested Habitat
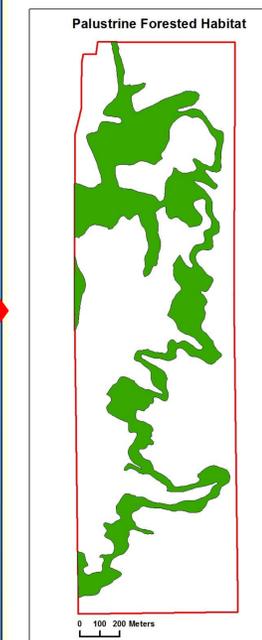
- **Purpose:** Enhance on-site monitoring activities through the incorporation of indicators extracted from remote sensing and derived geospatial data.

- **Data Sources**: Stage 2 inventory data, Landsat imagery, NWI wetland data, National Hydrography Database, land cover databases, and other available geospatial data sources.

- **Methods**:
  - Data sources will be used to conduct geospatial analysis for indicator extraction.
  - Two scales of analysis, within easement and outside easement, can be performed.
  - Depending on analysis scale different indicators will be measured. Within an easement indicators such as patch size, edge/area ratio, buffer width, and fragmentation will be measured. Outside an easement, indicators related to the surrounding landscape will be measured such as proportion of surrounding or contributing watershed cover types, fragmentation, and ...

- Currently, the NEAP team is in the process of identifying indicators that have a high likelihood of being related to ecological condition and is performing a pilot study that includes an examination of the relationship between remotely-sensed data and on-site monitoring.

Landsat Imagery of Surrounding Landscape
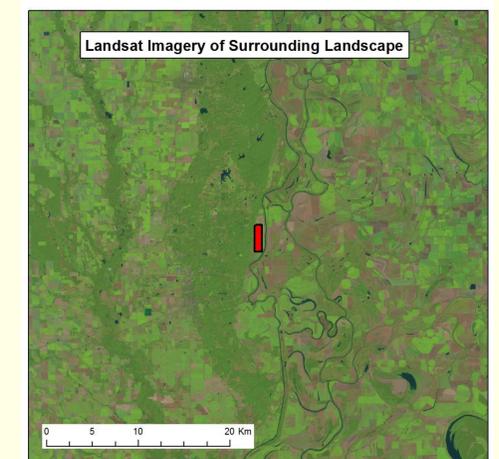
Mapping and Classification Standards

- Mapping standards will be established based on existing standards such as the FGDC Wetlands Mapping Standard (FGDC 2009).

- A nationally standardized classification system that meets NRCS' unique needs will be developed from federally endorsed classification systems. An example would be a modified Cowardin's (1979) system that aggregates certain wetland classes and incorporates upland and cultural classes (as seen on this poster).

- 100% of an easement will be mapped according to the established standards and all polygons will be attributed with the appropriate class, whether natural or cultural.

Habitat Types*

■	Lacustrine Open Water
■	Palustrine Emergent
■	Palustrine Forested
■	Palustrine Open Water
■	Palustrine Scrub-Shrub
■	Upland Herbaceous

* Only depicted classes are listed.

Linking Stages 1 and 2 for Assessing Restoration Efforts

- Purpose: Determine status of restoration efforts.

- Data Sources: Geospatial data for implemented restoration plan and current year's inventory of habitat types.

- Methods: Compare implemented restoration to existing habitat.

- Uses: Assess whether existing habitat types are progressing toward or reflect planned restoration to assist in management and planning and as a measure of success.

Stage 2 Products and Uses

- Annual inventory of the acreage of habitat types present on easement lands by easement, county, state, region, nation, easement program and other desired levels of stratification.

- Annual assessment of changes in acreage of habitat types due to losses, gains, and conversions.

- Identification of mechanisms resulting in changes in the acreage of habitat types (e.g., desired succession processes, fire, invasive species, non-compliant activities).

- A consistent historical record of easement change over time.

Literature Cited

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS–79/31.

Dahl, T.E. and M.T. Bergeson. 2009. Technical procedures for conducting status and trends of the Nation's wetlands. U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, Washington, D.C. 74 p.

Federal Geographic Data Committee Wetlands Subcommittee (FGDC). 2009. Wetlands mapping standard. Federal Geographic Data Committee. Accessed July 7, 2011. http://www.fws.gov/wetlands/_documents/gNSDI/FGDCWetlandsMappingStandard.pdf

U.S. Department of Agriculture (USDA). 2009. Summary report: 2007 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 pages. http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf