Digital Data Analysis of the National Wetlands Inventory (NWI) and Correlation with Wetland Delineation Procedures

NATIONAL SYMPOSIUM – WETLANDS 2007
AUGUST 29, 2007

Alexis E. Sandy, CPSS¹,², Dr. John M. Galbraith², John H. Brooks III, PWD¹, and Pete Johns³
(1) Resource International, Ltd.; (2) Virginia Polytechnic Institute and State University; (3) New Kent Vineyards
Overview

● Introduction
● Objectives
● NWI Functional Descriptor Digital Data Analysis
  ➢ Materials & Methods
    • Data Collection
    • Statistical Analysis
  ➢ Results & Discussion
    • Future Considerations
● Case Study – New Kent Vineyards
  ➢ Materials & Methods
    • Off-site Wetland Determination
    • On-site Field Delineation
  ➢ Results & Discussion
Introduction

- The NWI is a project of the US Fish and Wildlife Service (USFWS) that has produced wetland maps for approximately 90 percent of the coterminous United States (USFWS, 2002).

- Characteristics emphasized include vegetation, hydrology, salinity, soils and substrates, and human impacts.

- They are attempting the addition of hydrogeomorphic and other characteristics that are needed for assessment of wetland functions.

- Updating process is still conducted manually.
NWI Classification Shortcomings

- Shortcomings of the current classification system:
  - No landscape position
  - No landform
  - No water flow direction

All of these parameters are important for assessing wetland functions
Needs for Enhancing the NWI Database

- Improve characterizations of wetlands for the national wetland database
- Perform landscape-level functional assessments
- Assess significance of wetland losses
- Predict functions expected from potential wetland restoration sites
Addition of New Descriptors to the NWI Database

- Landscape Position - relationship between a wetland and an adjacent waterbody or not*
- Landform - shape or physical form
- Water Flow Path - directional flow or water

*Denotes NWI Descriptor used in study
Landscape Position Classification

- Lotic River
- Lotic Stream
- Lentic
- Pond
- Terrene
- Estuarine

Data Reference: U.S. Department of Agriculture, Natural Resources Conservation Service MrSID Mosaic, Virginia
Objectives

- The overall objective of this research was to assign landscape position descriptor codes to NWI wetlands and correlate wetland properties for each class with public domain soils, hydrography, vegetation, and topography data. Specific objectives of research include:

  1. Develop a field key and diagnostic methods to assign a landscape position code to NWI wetlands;

  2. Compile a set of 30 field-validated wetlands for each code;

  3. Summarize the environmental properties that define each of the 6 landscape position codes and statistically compare the property values between each code; and

  4. Use public domain terrain, hydrography, soil, and vegetation data to identify and predict landscape position codes and extent of NWI wetlands.
NWI Functional Descriptor
Digital Data Analysis
Materials & Methods:

Study Area
Materials & Methods:
Data Collection

- Virginia Base Mapping Program (VBMP)
  - Elevation
    - Value Range
      » 0 – 246 m
Materials & Methods: Data Collection

- Virginia Base Mapping Program (VBMP)
  - Slope Curvature
    - Value Range
      » -185.229 to +209.142 (unitless)
Materials & Methods: Data Collection

- USGS National Hydrography Dataset (NHD)
  - Flow
    - Value Range
      » 0 = No Flow
      » 1 = Flow
Materials & Methods: Data Collection

- **USGS National Hydrography Dataset (NHD)**
  - **Waterbody**
    - **Value Range**
      - 0 = No Waterbody
      - 1 = Waterbody
Materials & Methods: Data Collection

- Soil Survey Geographic Data Base (SSURGO)
  - Hydric Soil Component Percent
    - Value Range: 0 – 100 %

Legend
- High: 100 %
- Low: 1 %
Materials & Methods: Data Collection

- National Land Cover Data (NLCD)
  - Wetland Vegetation
    - Value Range:
      » 0 = Absence of wetland vegetation
      » 1 = Presence of wetland vegetation
Materials & Methods: Data Collection

- National Wetlands Inventory (NWI)
  - Cowardin Classification
    - Value Range:
      » 0 = Upland, No Data
      » 1 = Estuarine
      » 2 = Lacustrine
      » 3 = Palustrine
      » 4 = Riverine
Materials & Methods: Data Collection

- Field-validated wetlands were extracted from all data source grids

- 100 pixel sub-samples were extracted from each individual wetland database for analysis

  - wetlands containing > 100 pixels, a ArcGIS random selection tool was used to select 100 pixels from the wetland databases
  - wetlands containing < 100 pixels were extracted in their entirety
Cluster analysis is an exploratory data analysis tool which aims at sorting wetlands into groups in a way that the degree of association between two wetlands is maximal if they belong to the same landscape position class and minimal otherwise.

- Hierarchical
  - Ward’s Linkage Method
    - Analysis of variance approach to evaluate distances between clusters
### Results:

#### Cluster Analysis

**Cluster Group** | **Number of Field Validated Wetlands**
---|---
1 | 15
2 | 20
3 | 25
4 | 30
5 | 35
6 | 40

**Cluster Group**
- **Cluster Group 1**
  - Estuarine: 3
  - Lentic: 2
  - Lotic Stream: 1
  - Lotic River: 2
  - Pond: 1
  - Terrene: 2

**Cluster Group 2**
- Estuarine: 5
- Lentic: 3
- Lotic Stream: 2
- Lotic River: 4
- Pond: 3
- Terrene: 2

**Cluster Group 3**
- Estuarine: 10
- Lentic: 5
- Lotic Stream: 5
- Lotic River: 5
- Pond: 5
- Terrene: 5

**Cluster Group 4**
- Estuarine: 1
- Lentic: 1
- Lotic Stream: 1
- Lotic River: 1
- Pond: 1
- Terrene: 1

**Cluster Group 5**
- Estuarine: 1
- Lentic: 1
- Lotic Stream: 1
- Lotic River: 1
- Pond: 1
- Terrene: 1

**Cluster Group 6**
- Estuarine: 1
- Lentic: 1
- Lotic Stream: 1
- Lotic River: 1
- Pond: 1
- Terrene: 1
Introduction

This study has revealed that SSURGO hydric soil component percent has the greatest variance when compared to VBMP elevation and slope curvature, NHD flow and waterbody, NWI Cowardin classification, and NLCD wetland vegetation.

- Future consideration: binary dataset with 1 = hydric soil, 0 = non-hydric soil

NHD flow also presents limitations that minimize its use and viability modeling functional descriptors. Flow is an important feature of many wetland systems and is a deterministic component of several landscape position classes.

- Future consideration: buffers, intersection of NWI polygon and NHD flow line

NLCD data limitations included poor quality resolution and classification of cover types.

- Future consideration: high resolution multispectral/hyperspectral imagery, determining buffers and distances between vegetation edges, determining intersection map elements, species distribution or diversity

The VBMP source used in this analysis to obtain elevation and slope curvature is the only high resolution resource of elevation data available in Virginia.
Digital Data Correlation with Wetland Delineation Procedures

Case Study: New Kent Vineyards – Land Bay I
Materials & Methods:

Study Area
Materials & Methods:
Data Collection

- Offsite Determination
  - Data Sources
    - Ortho-rectified, false color infrared aerial photography
    - Digital Light Detection and Ranging (LIDAR) topography
      - ½ foot contour intervals
    - United States Geologic Survey (USGS) topography
    - NWI
    - Soil Survey
Materials & Methods: Offsite Wetland Determination

Offsite Determination

Objective

- Map the general extent of wetlands on the property in order to assist planners and engineers in the layout of each land bay
- Demonstrate avoidance and minimization of wetland impacts in compliance with Section 404(b)1 Guidelines of the Clean Water Act

Procedure

- Wetlands (i.e. lotic stream, pond, lentic) defined by the undulating piedmont topography were identified using infrared aerial photography, soils and NWI and traced to the upper-most extent

NOTE: All procedures were conducted in accordance with the Corps of Engineers Wetland Delineation Manual (Manual), 1987, Routine Determinations, and subsequent regulatory guidance.
Materials & Methods:

Offsite Wetland Determination
Materials & Methods: Onsite Wetland Delineation

● Onsite Delineation

➢ Objective
• To quantify impacts and further show avoidance and minimization of wetland impacts

➢ Procedure
• Headwater wetlands and areas of impact were delineated
  – Wetland impacts were delineated to allow 200 feet on either side of impact area to allow planners the option to move or reduce overall wetland impacts
• A report detailing delineation methods and locations of the boundary flags was prepared and submitted to the US Army Corps of Engineers (Corps)
  – The wetland delineation was approved and a Jurisdictional Determination (JD) was issued
Results & Discussion:
Onsite Wetland Delineation

Legend
- Impact Areas
- Wetlands Boundary (Surveyed)
- Golf Course (Proposed)

1 inch equals 400 feet
Results & Discussion: Wetland Delineation

- Land Bay I encompasses approximately 1,200 acres. In total:
  - 0.51 acres of wetlands are proposed as permanent impacted
  - <99.9% of wetlands will be avoided by the development

- Wetland delineation procedures were implemented and accepted among all Land Bays

- Wetland delineation was completed in order to design and plan an environmentally sensitive development

- Total cost savings
  - 30-50% over a traditional wetland delineation
Questions... Comments...

Thank You...