7.21

**STANDARD OPERATING PROCEDURE
FOR THE SELECTION OF REFERNECE AND IMPAIRED
SITES FOR BIOLOGICAL MONITORING IN NORTH DAKOTA**

## Summary

The North Dakota Department of Health (NDDoH) utilizes reference (least disturbed) and impaired (most disturbed) physical conditions to provide an estimate of natural and human induced variability in biological community structure and in stream habitat quality. Sites are also used to draw thresholds and develop Indices of Biological Integrity (IBI). When selecting reference/impaired conditions the Surface Water Quality Management Program must account for natural and climatic variability across the state of North Dakota. To accomplish this task an approach based on United States Geological Survey level three ecoregions has been adopted.

The first step in site selection involves a remote sensing component utilizing an ArcView Geographic Information System (GIS) extension and GIS data layers. The extension allows users to easily calculate many common landscape parameters including: landscape characteristics, riparian characteristics, human stressors and physical characteristics. Grouped metrics are used to estimate anthropogenic stressors in a circular 1 km buffer around potential sampling locations that are situated at perennial lotic waters of the state. A final score is calculated for each site based on these metrics with the highest and lowest scoring sites held for further evaluation.

Step two requires evaluation of additional GIS layers including but not limited to: roads; aerial photos; public and private land ownership plot maps; township, range and section grids; county boundaries; dam structures; etc.

The third step involves site reconnaissance, also known as 'ground truthing'. During this step, Surface Water Quality Management personnel visit each site to determine if they meet reference or impaired criteria. Evaluation of the stream is done using best professional judgment. Some important features to consider while 'ground truthing' are stream geomorphology, stream habitat alterations (rip-rap, etc.) and other human influences at or near site locations.

## Software and Data Layers/Sources

___ ArcView 3.1 or later with Spatial Analyst Extension
___ Analytical Tool Interface for Landscape Assessments (ATtILA2004v1.0) Extension (EPA)
___ Buffer Theme Builder Extension
___ Display Points Lat/Long Extension
___ Divided line by adding points evenly Extension
___ Grid & Theme Projector version 2 Extension
___ XTools Extension (9/15/03)
___ National Land Cover Data (NLCD) (USGS)
___ National Hydrography Dataset (NHD) (USGS)

___ National Elevation Dataset (NED) (USGS)
___ Eco Regions GIS Layer (USGS)
___ State and County Roads GIS Layer (North Dakota GIS Hub)
___ National Agriculture Imagery Program (NAIP) 2005 Aerial Photography (NRCS) or Digital Orthophoto Quarter Quadrangles (DOQQ) (USGS)
___ Township, Range and Section Grid

## Procedures

### Step 1: Remote Sensing

1. Create a new ArcView GIS project. Set the map coordinate system to Universal Transverse Mercator (UTM) zone 14N (North). Set map coordinate units to decimal degrees. Set map distance units to meters.

2. Create a shapefile of stream reaches in the study area from an NHD shapefile. Perennial streams should be selected using the F_CODE field in the NHD attribute table.

3. Add points along the NHD shapefile features at intervals of 2000 meters.

4. With the map coordinate system set to UTM zone 14N, add Latitude and Longitude coordinates to the point shapefile's attribute table for each point.

5. Create a shapefile with a 1000 meter buffer around each point in the point shapefile. This shapefile is similar to the boundary file or assessment unit used in original IBI metric selection calculations. Is this needed?

6. Created a slope grid in percent from a statewide NED grid. Used the map calculator in spatial analyst and the function *[grid].slope (zFactor, percentRise)* to derive slopes where *zFactor* is the conversion factor if x, y, and z are in different units and *percentRise* equals true for percent slope and false for degree slope.

7. Calculate all metrics for the category groups: landscape characteristics, riparian characteristics, human stressors and physical characteristics.

8. Use Non-metric Multidimensional Scaling (NMA) statistical analysis to investigate metric sensitivity and preliminarily select metrics for further use.

9. Once the most sensitive metrics are chosen, use ATtILA to calculate an index score for each assessment unit (1000 meter buffer around points). Scores are based on a summation of quantile rankings. The number of quantiles is user-defined.

10. Select the assessment units with the lowest and highest index scores. Lowest scores will be the "best available" or reference assessment units in the study population and the highest scores will be the most impaired sites.

**Step 2: Digital Media Screening**

11. Use aerial photography, GIS layers and best professional judgment to place sites within the selected assessment unit.

GIS Layers used:
- National Agriculture Imagery Program (NAIP) 2005 Aerial Photography (NRCS) or Digital Orthophoto Quarter Quadrangles (DOQQ) (USGS)
- State and County Roads
- Public Lands Grid
- Township, Range, and Section Layer
- Dam Structures

**Step 3: Site Visitation and Verification**

12. Visit site locations and examine land use along with stream geomorphology. Use aerial photos, county maps, landowner atlases. Check RGA from to examine features in a potential sampling reach.

Site Characteristics to Evaluate
- Primary Bed material
- Bed/bank protection
- Degree of incision
- Degree of constriction
- Stream bank erosion
- Stream bank instability
- Established riparian woody-vegetation cover
- Occurrence of bank accretion
- Stage of channel evolution