WATER QUALITY ASSESSMENT FRAMEWORKS FOR THE 21ST CENTURY

CONNECTING THE DOTS AND ADAPTING TO CHANGE

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OFFICE OF WATER

WATER QUALITY PRIORITIES

- NUTRIENTS
- HARMFUL ALGAL BLOOMS
- SEDIMENTS
- STORM WATER
- EMERGING CONTAMINANTS

EXISTING US NATIONAL FRAMEWORKS

- USGS - NAWQA
  - HTTP://WATER.USGS.GOV/NAWQA/
- USEPA / STATES - NATIONAL AQUATIC RESOURCE SURVEYS
  - HTTP://WATER.EPA.GOV/TYPE/WATERSHEDS/MONITORING/AQUATICSURVEY_INDEX.CFM

NATIONAL WATER QUALITY ASSESSMENT PROGRAM

STRENGTHS

- ROBUST INTEGRATED NETWORK
- STANDARDIZED COLLECTION AND ANALYTICAL METHODS
- LINKED TO FLOW
- GOOD TEMPORAL COVERAGE

LIMITATIONS

- GREATER UNCERTAINTY IN HEADWATERS
- LIMITED SPATIAL COVERAGE *OUTSIDE OF STUDY UNITS
- LIMITED HISTORICAL RECORD (1991)

NATIONAL AQUATIC RESOURCE SURVEYS

STRENGTHS

- PROBABILISTIC DESIGN
- PARTNERSHIP
- NATIONAL COVERAGE
  - SMALL STREAMS
  - LAKES
  - OCEAN
  - WETLANDS
  - LARGE RIVERS
- CONSISTENT METHODS

LIMITATIONS

- LIMITED TEMPORAL DATA
- LIMITED NUMBER OF SITES
- 10 YEAR RECORD WITH 5 YEAR SAMPLING FREQUENCY

LARGE SCALE MODELS

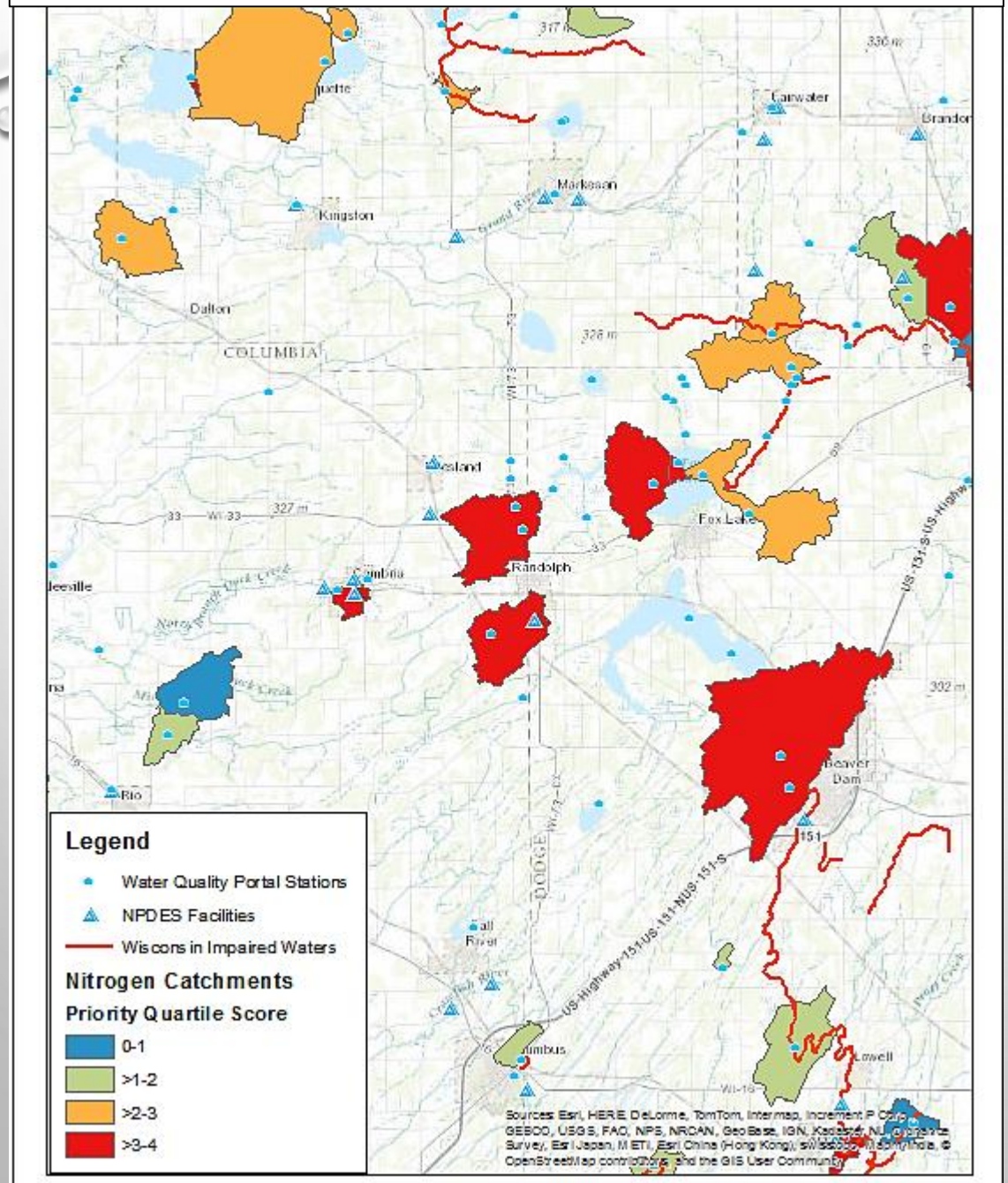
- SWAT / HAWQS
  - HTTPS://EPAHAWQS.TAMU.EDU/
- SPARROW
  - HTTP://WATER.USGS.GOV/NAWQA/SPARROW/
- LONG PERIODS OF RECORD REQUIRED FOR CALIBRATION/ VALIDATION WITH THE DEGREE OF UNCERTAINTY RISING WITH THE UPSTREAM DISTANCE FROM THE MONITORING STATIONS.

ADDITIONAL AMBIENT SOURCES

- THE WATER QUALITY PORTAL
  - STORET
  - NWIS
  - HTTP://WATERQUALITYDATA.US/
- CONSORTIUM FOR THE ADVANCEMENT OF HYDROLOGICAL SCIENCE INCORPORATED
  - HTTPS://WWW.CUAHSI.ORG/WDC

Phosphorus Priority Catchments in Wisconsin

Quartiles Driven by Water Quality Data



Example of using “Big Data” concepts to identify potential hot spots from a combination of discharge information and ambient data

COMPLIANCE MONITORING

- CURRENT METHODS FOCUSED ON GRAB SAMPLES AND LABORATORY ANALYSIS
- DRINKING WATER
  - SOURCE WATER
  - FINISHED WATER
- DISCHARGE MONITORING
  - DISCHARGE MONITORING REQUIREMENTS (DMR) AND REPORTS

IN SITU WATER QUALITY SENSOR NETWORKS (EXAMPLES)

- RIVER AND ESTUARY OBSERVATORY NETWORK (CLARKSON)
  - HTTP://WWW.BIRE.ORG/RIVER-AND-ESTUARY-OBSERVATORY-NETWORK/
- INTELLIGENT RIVER (CLEMSON)
  - HTTPS://WWW.INTELLIGENTRIVER.ORG/

IN-SITU SENSORS

STRENGTHS

- LOW COST
- CONTINOUS SUREILLANCE
- REAL TIME
- POTENTIALLY FINE SPATIAL RESOLUTION
- STANDARDIZATION POSSBILE
- HIGH PRECISION
- POLLUTANT FLUXES

LIMITATIONS

- GENERAL PRECISION
- LIMITED SCOPE
- INSTALLATION AND MAINTENANCE COSTS
- METHODS STILL NEED TO BE DEVELOPED FOR REGULATORY USES

Adapted from in-situ water quality monitoring – Philipp Saile GEMS/Water Data Centre
http://www.geo-water-quality.org/libraries.files/Keynote-5_Data_in-situ_water_quality_monitoring.pdf

PULLING IT ALL TOGETHER

- CONTINUE TO SUPPORT LONG TERM FIXED STATION MONITORING (NAWQA) TO EXTEND PERIOD OF RECORDS. INCLUDE MORE SENSOR ARRAYS AT THESE STATIONS
- LEVERAGE / INCENTIVIZE DRINKING WATER AND WASTE WATER UTILITIES TO BECOME WATER QUALITY DATA PROVIDERS
- DEVELOP APPROPRIATE ANALYTICAL AND STATISTICAL METHODS FOR INTERPRETING SENSOR DATA – INCLUDE STUDIES ON METHODS OF COMBINING RESULTS FROM DIFFERENT NETWORKS
- CONTINUE TO PUSH FOR IMPROVED SPATIAL COVERAGE ESPECIALLY IN AREAS OF MIXED LAND USE UPSTREAM OF TRADITIONAL FIXED STATIONS
- ESTABLISH INTERNATIONAL WATER DATA AND META DATA STANDARDS

FILLING IN THE SPATIAL GAPS

- DEVELOPING INDICATORS BASED ON REMOTE SENSED INFORMATION IN CONJUNCTION WITH IN-SITU DATA AND CITIZEN SCIENCE MEASUREMENTS
  - WATER TEMPERATURE
  - NUTRIENTS
  - SOIL MOISTURE
  - SEDIMENTS
  - BEST MANAGEMENT PRACTICES
- MULTIVARIATE STATISTICS
- CROWD SOURCED CITIZEN SCIENCE DRIVEN FIELD MEASUREMENTS
  - TEMPERATURE
  - WATER LEVEL
  - SPECTROSCOPY ?