National Network of Reference Watersheds **11/28/12**

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Decisions to be Made:

1. Should we establish basic Reference Site Criteria?

   General Consensus: No, but if we do provide guidance it should be based on published criteria like the wadeable stream survey. If something goes to litigation we don't want the Council tagged as responsible.

2. What parameters should be included to let users define their own criteria?

   We will proceed with the current list and let it develop based on feedback and experience

   Current List: Area (range), Land Use %s, Data available, Data range, Ecoregion, Presence of Disturbances (flow alteration, pollutant discharge, water withdrawals)

3. What is the difference between an intensive watershed and a synoptic sampling site?

   We did not come to agreement on this question. Some suggestions are included on page 6 we are open to suggestions. If no suggestions are made we will create a definition and modify it based on feedback.

4. What is our Data Management Approach?

   We will create a site information database to store and retrieve site metadata and perform searches. Water quality (and other data) will be accessed through the original data source wherever possible and linked to the site metadata database through a primary site key. The QW portal will be one of the primary data sources.

   **Neil Kamman asked that the minimum data standards for the network do not exceed those for QWDX.

5. Should we institute data screening? How does this apply to data accessed through the QW portal?

   This is a difficult question to answer. We do not want to serve poor quality data, but the job of screening these data is immense. Since this is a question beginning to be addressed by the QW portal we will proceed in collaboration with that group and report back to the NNRW committee as the effort progresses.

Fundamentals:

1. What is the Goal of the Network?

- Current Mission Statement: Provide quality-assured data and information for use in understanding the effects of land use change, water use, atmospheric deposition, and climate change on freshwater ecosystems.
- Other Goals: Promote the value of reference watersheds; highlight the importance of assessing and tracking the health of natural ecosystems

2. Who is the target audience(s)?

We have not added anything to this list, but I have prioritized them based on our discussion

1. Network participants
2. Scientists
3. Resource Managers
4. The general public
5. Students

3. How many sites are reasonable to include in the network (intensive sites vs. synoptic sampling sites)?

We did not talk about this in our discussion, but 200 sites or less seems reasonable in terms of the intensive watersheds, there is probably no reason to put a limit on the synoptic sites

Reference Watershed Criteria

Considerations for compiling water-quality data from multiple sources

This approach is aimed at satisfying Task 2 in the NNRW workplan and would be implemented with task 3.

Defining minimum data elements (for data not available through the QW Portal):

- The minimum data elements that are defined as 'required' need to be carefully considered. Too many required data elements may dissuade users from sharing their data and too few data elements may yield water-quality records that are not appropriate for rigorous analysis.
- Through working with water resource managers, the USEPA has developed standards for water-quality data and the exchange of water-quality data. These standards include guidance on minimum data elements for the exchange of water-quality data, how these data elements may be defined, electronically received, stored, and exported for use. These established guidelines will be useful in the development of the NNRW.

Two stages to site submittal:

1. Submit Site/Watershed Information.
2. Upload site data (water, air, soil, biologic, etc) or link to a web services portal to access and deliver those data.

Site/Watershed Information Required

Submitter Information

1) Agency/Entity operating the site, Division (e.g., EPA Division of Climate) and Funding Source

~~2) Contact Name~~ Position Title

~~3) Contact email~~

4) Rationale for including the site in the NNRW

Site Information

1) Site Name

2) Latitude and Longitude (must be on an NHD flowline)

3) USGS Gaging Station Number (if it is a USGS Gage)

4) Other Agency or State Site Number

5) QWDX Site Identifiers

Data Availability (preliminary to uploading the actual data)

1) What type of data are available for the site (listed as a series of check boxes)
2) Flow Data?
3) Water Quality Data?
4) Aquatic biota?
5) Soils data?
6) Meteorological Data?

Site Data

1) Site Name
2) Site Number
3) Sample date
4) Sample time
5) Sample medium (water, air, soil, biologic, etc)
6) Collection Method
7) Parameter Name
8) Parameter
9) Result remark or qualifier
10) Approved NEMI Method of analysis
11) Reporting limit

There are two primary tasks necessary to incorporate site results into the network:

1) Define the minimum data elements that need to available for responsible use of results.
2) Develop a process by which the minimum data elements of results can be acquired into a database in a standardized manner.

Information to be provided/developed by NNRW about the watershed

The following parameters would be calculated automatically:

1. Watershed shape file: this can either be required from the user or we could create our own watershed shape file using the latitude and longitude snapped to the closest NHD flowline although this would require confirmation from the user submitting the site – if we create the shape files it assures consistency among all sites. We could also use a hybrid approach where users could submit a shape file if available, but if not could go through the process of having one created.

2. Hydrologic Disturbance Index (or some other such disturbance index) as calculated for GAGES I & II (Falcone and others, 2010), " based on seven variables: presence of major dams in the watershed, change in reservoir storage from 1950-2009, percentage of streamlines coded canals/ditches/pipelines in the watershed, road density in the watershed, distance of stream gage to nearest major pollutant discharge site, county-level fresh-water withdrawal estimate, and fragmentation of undeveloped land in the watershed."

3. Land use characterization based on 2006 Land Use Land Cover Dataset

4. Forest type Characterization based on Forest Service Forest Type Map

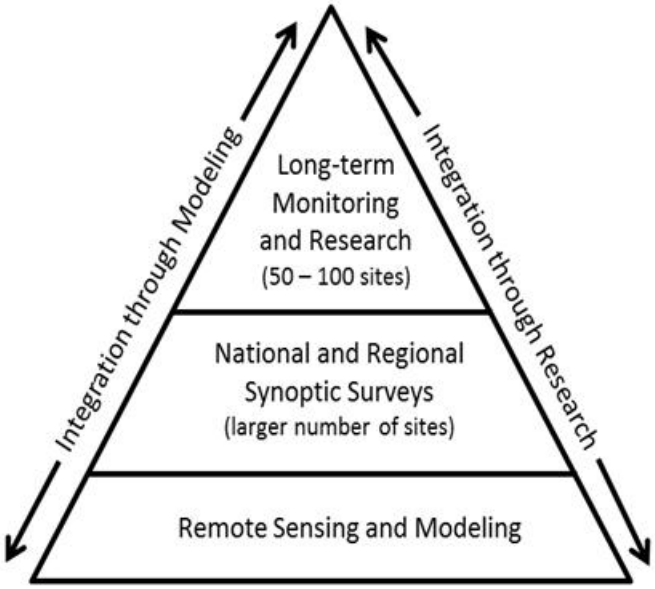
5. Watershed soils description from NRCS National Soils Map.

6. Data available and periods of record based on data uploaded to the site

Falcone, J.A., Carlisle, D.M., and Weber, L.C., 2010a. Quantifying human disturbance in watersheds: variable selection and performance of a GIS-based disturbance index for predicting the biological condition of perennial streams. Ecological Indicators, 10(2), pp 264-273.

Network Design

The network is envisioned as a multi-tiered monitoring framework. Sites will be divided into long-term monitoring and research intensive sites and spatially extensive national and regional synoptic survey sites. Remote sensing and modeling can be used to link data between the tiers. Although we suggest the network be as inclusive as possible, we must set some criteria to distinguish between intensive watersheds and synoptic sites.



These are some possible criteria to separate sites between the two tiers

Intensive Watersheds will meet the following criteria:

1. Flow is monitored at the site
2. Water quality is collected seasonally and through the range in flow conditions.
3. Daily Precipitation amount is available
4. There are stream biotic data available

Is one goal of the network to make remote sensing data available for the intensive watersheds?

We did not discuss this question, ideally these types of data would be available, but this is not a primary goal in the initial stages of the network

Website Design

The NNRW website is setup as a web resource for the network as opposed to a data portal. Although data are available through the site that is only one of the primary purposes for the web resource.

These 2 Use Cases are provided for illustration

Scenario 1: A water resource manager visits the NNRW website to obtain mean nitrate concentrations for reference sites in her state (Minnesota) to compare to impaired sites.

The manager access the Reference Conditions area of the NNRW website. She selects Minnesota as her area of interest, selects nitrate as a parameter with method code 352.1, chooses a date range for the last 5 years, and uses the default reference criteria for the region. The website tells her that her search has returned 17 sites that match her criteria and a total of 107 samples. She views a summary table fo the results as well as the default reference criteria used to identify the sites. Satisfied with the results she chooses to display the results as bars at each sample point and prints the map to a jpeg file that she can pull into her report. She then selects a site upstream of a large dairy farm chooses to create a time series plot of nitrate for the entire period of record for that site.

Scenario 2: A scientists wants to download nutrient data for reference sites throughout the northeastern US that have also been sampled for aquatic macroinvertebrates during the last 7 years.

There is a search engine available for the site where the user can specify criteria for site selection, the scientists defines his / her own reference site criteria [Watersheds greater than 1 km^2 that have less than 5% residential or urban land use, no flow alterations, 7 years of nitrate and phosphorus data using comparable laboratory methods and flow records]. He further specifies sites that have aquatic macroinvertebrate data collected within the same 7- year period.

A map is displayed showing 150 sites across the northeastern US, but there are only a handful of sites in New Hampshire. The scientist broadens his search to encompass a 10 year period. This time the map shows 276 sites more equally distributed across the study area. The scientist chooses to overlay EPA Level II ecoregions to determine whether the sites fall within all northeastern ecoregions. Satisfied with the results he chooses to download the available data. All watershed characteristics, chemical data, and macroinvertebrate data are available for download. The data are delivered with a suggested reference [similar to the National Atmospheric Deposition Network] to be included in his paper.

There could also be a tool that allows users to put their sites into a disturbance continuum of all watersheds sites in the same ecoregion so the user can see how their selected sites fit into that continuum.

This is a list of Activities, Analyses, and Products contributed by the USGS Ad Hoc Committee to establish a Multipurpose National Network of Reference Watersheds and Monitoring Sites for Freshwater Streams in the United States

Suggested Activities, Analyses, and Products for a National Network of Reference Watersheds (NNRW)

Activities

1. Provide coordination for access to meta-data and data from other non-USGS federal agency reference water quality monitoring networks on a regional and national level.

2. Link hydrologic and climatic monitoring by adding co-located climate stations to NNRW basins.

3. Incorporate Remote Sensing Data into NNRW: Use Remotely Sensed data (e.g., NASA TOPS data) to characterize each watershed and describe ecosystem change and develop a capacity to track biogeochemical change.

4. Conduct synoptic water-quality sampling in un-impacted areas to place NNRW intensive watersheds into a regional context and to provide input data for statistical models of background concentrations of nutrients, carbon, and sediments. (**EPA wadeable stream survey?**)

5. Characterize the mercury concentration in soils and stream water within NNRW intensive watersheds every 5 years to allow comparisons of Hg concentrations between undisturbed and disturbed watersheds

6. Incorporate groundwater monitoring and water quality sampling into the network to define nutrient concentrations in shallow groundwater in minimally impaired watersheds.

7. Define the correlations among seasonal air temperatures, precipitation, and GW levels to define the sensitivity of GW levels to changes in climate.

8. Characterize the channel stability of each NNRW intensive watershed.

Analyses

1. The primary data analyses for the NNRW should be to characterize the magnitude, duration, frequency, and seasonal concentrations and calculate long term trends for the following parameters: streamflow, water temperature, major ions, nutrients, dissolved organic carbon, particulate carbon and nitrogen, water stable isotopes, and suspended sediment.

2. Compute load calculations at all NNRW intensive watersheds for major ions, dissolved organic carbon, particulate carbon and nitrogen, and suspended sediment.

3. Primary analyses should also include the characterization of seasonal and long-term changes in aquatic biology.

4. Identify, describe, and explain the major factors that affect observations and trends in streamflow, water temperature, major ions, nutrients, dissolved organic carbon, particulate carbon and nitrogen, water stable isotopes, suspended sediment and stream habitat at each intensive watershed in the network.

5. Compute flow statistics to define the natural flow regime of each NNRW intensive watershed.

Products

1. Outreach: Develop a web-based delivery system for NNRW products. A map-based interactive tool that allows users to view trends, concentrations, loads and other network products.

2. Publish annual maps showing chemical, nutrient, and suspended sediment trends, the rate of change, and confidence level for each sampling site.

3. A website that features continuous near real-time nutrient concentrations at reference sites. This product would require installation and maintenance of continuous nutrient probes at each site.

4. Publish a report comparing reference conditions at reference sites to streams affected by human activities and estimate the degree to which streamflow and thermal alteration has affected aquatic ecosystems. This report could be expressed as an interactive tool targeted at a lay audience.

5. Publish a report on the effect of climate change on the timing, magnitude, and duration of peak flows and base flows for each site to determine shifts in the flow regime as well as the timing of snowmelt runoff in northern latitudes to provide water supply managers with information on water availability.

6. Reports and web tools which communicate the results of suspended sediment and channel stability studies at reference watersheds to be used by the regulatory community to assess whether suspended-sediment concentrations observed at given site have been affected by human activities.

7. Create computer models to predict how changes in streamflow (resulting from either natural conditions or climate change) could affect sediment loading and (or) stream channel morphology.

This is a list of Suggested Site Selection Criteria for sites in a National Network of Reference Watersheds. This list is a compilation of criteria for reference watersheds in USGS national programs and was assembled by the USGS Ad Hoc Committee to establish a Multipurpose National Network of Reference Watersheds and Monitoring Sites for Freshwater Streams in the United States

We are not suggesting using these, they are just included here for reference

The overarching goal of the site selection criteria is to produce a national network of reference watersheds that represents a diversity of conditions including geography, ecology (as represented by EPA ecoregions), climate, and hydrology.

1. Existing stream gages with historical data.
2. No significant regulation or diversions above the gage.
3. There is no basin area requirement, however a range in basin areas is desirable; larger basins are more representative of regional conditions while smaller basins are more responsive to change.
4. Natural basin conditions, i.e., basins that are minimally affected by human activity. In regions of intensive human influence, such as the mid-western agricultural belt, 'relative' reference sites may be selected (those having watersheds with some human development, but relatively less impairment than surrounding sites).
5. Stable land use, preferably in protected areas (e.g., national parks, wilderness areas)
6. No obvious point sources of contaminants.
7. Low impact of non-point source of contamination such as agriculture.
8. Sites with long-term of streamflow and water quality data. This criterion can be flexible, however sites with 20 plus years of measured (not estimated or "reconstructed") discharge values, regular water-quality sampling (including sediment), and aquatic biota samples would be highly desirable.

Suggested Site Selection Process

1. Characterize basins at the HUC10 scale.
2. Generate GIS-based human disturbance indicators [e.g., land cover, infrastructure, point sources, reservoir storage / density, etc., (Falcone et al. 2009) for an "index of the human footprint"] for all HUC10 watersheds and all potential reference site watersheds in every Level 2 Ecoregion to define the range of human impact for each region.
3. From a cumulative distribution of this disturbance measured across each region, select all sites in the lowest 10th percentile.
4. Repeat step 2 for different strata of natural factors such as stream order, ensuring that the 'reference' sites represent a range of natural conditions.
5. Use the site list generated through this process to identify sites that meet the reference site criteria listed above.