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Core Factors of Reference Site Designation for Streams in the Central Plains:

Developing multi-state criteria for use in screening candidate reference sites

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Level III Ecoregions for EPA Region VII

Introduction and Goals of Workgroup

- Central Plains Center for Bioassessment - USEPA Region VII - 21 total members (10 from state agencies in Kansas, Missouri, Nebraska, Iowa, - 3 from Native American agencies - 5 from federal agencies - 3 from municipal, academic & other)
- Facilitate communication among aquatic biologist and water quality experts in order to promote scientifically defensible water quality studies and the development of biological criteria
- Discussions are lead by a neutral facilitator and decisions are made by consensus
- Voting members as well as other experts attend meetings

Process for Determining Core Reference Factors

- **Meeting 1** - Discussion of reference sites and conditions - 36 factors were identified by which reference conditions had been evaluated by workgroup members
- **Meeting 2** -

  Objective 1 = Agree on intended uses of reference sites

  Objective 2 = Narrow the reference site selection factors to a core set
- **Meeting 3** - Address definitions of each core factor and describe potential qualitative and quantitative measures for each parameter

Factor	Description	Factor	Description
01	Wastewater Treatment Facilities and other point sources	19	Dewatering and water diversion
		20	Threatened or Endangered Species
02	Concentrated Animal Feeding Operations	21	Species “in need of conservation”
03	Channelization	22	Crossover Sites (streams occurring in multiple ecoregions)
04	Impoundments	23	Stream Gradient
05	Fish Kills	24	Springs
07	Habitat, Riparian	25	Level III and Level IV Ecoregion Maps
08	Fish Surveys	26	Aquatic Life Classification
09	LU/LC, Broad Scale	27	Natural Salinity
10	LU/LC, Site Specific	28	Migration Barriers/Influences
11	Urban and Suburban Development	29	Natural Anomalies (rare or unique sites)
12	Hazardous Waste Contaminants	30	Geological Anomalies (atypical segments)
13	Mining	31	Habitat Anomalies (e.g. car bodies)
14	Road Density	32	Flow Regime Anomalies
15	Physical and Chemical Water Parameters	33	Artificial Waterbodies
16	Biological Metrics	34	Wadeable Streams
17	Identified Critical Habitat	35	Oil Field Coverage
18	Faunal Assemblages	36	Center Pivot Irrigation

Objective 1 - Intended Uses of Reference Sites

For a given ecoregion in the Central Plains, "reference streams" should represent a population of streams that:

- Accurately characterize the range of variability present in healthy natural systems
- Provide an objective definition of what waterways should be
- Provide a barometer, ruler, benchmark, or reference against which we can measure the extent of degradation of other waterways
- Provide a regulatory yardstick to identify "biological integrity" with respect to the Clean Water Act

In addition, selection of reference streams may assist in:

- Identifying streams worthy of protection
- Identifying appropriate pollutant-specific conditions for purposes of criteria development (specifically nutrient criteria)

Objective 2 - Narrow the reference site selection factors to a core set

- Wastewater treatment plants and other point sources
- Confined animal feeding operations
- Instream habitat
- Riparian habitat
- Land use and land cover, broad scale
- Land use and land cover, site specific
- Physical and chemical water parameters
- Biological metrics
- Faunal assemblages
- Altered hydrologic regime
- Representativeness

Wastewater Treatment Plants and Other Point Sources

Wastewater treatment plants and other point sources are human disturbances that must be accounted for in the selection of reference conditions. The obvious preference is to have absolutely no point sources within the watershed. In reality, the states within EPA Region VII are fairly populated within the rural areas and many small towns and regulated entities exist. So, while there is a preference for no point source contributions to the watershed, in practicality this would eliminate all but a handful of streams. The following qualitative and quantitative factors should be examined when watersheds do have point source discharges: discharge effects are minimal; low number, density, and size of facilities; site not in close proximity to point source (well below effective mixing zone); effluent to stream flow ratio low; no impairment of aquatic life beneficial uses due to point source discharge and; existing point sources have record of compliance.

Confined Animal Feeding Operations

Confined animal feeding operations are human induced disturbances that must be accounted for in the selection of reference conditions. The obvious preference is to have absolutely no confined animal feeding operations within the watershed. In reality, the states within EPA Region VII have a large number of animals within their rural areas. Once again, while there is a preference for no confined animal feeding operations within a reference watershed, reality may make it impractical. The following qualitative and quantitative factors should be examined when watersheds do have confined animal feeding operations: animal access to stream; influence and potential degradation to stream is minimal; number of facilities in watershed is low; number of animal units in watershed low; reference not in close proximity to feeding operation; reference not in close proximity to land application of confined animal waste and; no impairment of aquatic life beneficial uses due to livestock impacts.

Instream Habitat

Under reference conditions, instream habitat is characterized by the highest quality and diversity of instream habitat relative to stream type, considering: no excessive sedimentation or embeddedness; no riprap; and no unnatural (manufactured) substrates.

Riparian Habitat

Under reference conditions, riparian habitat would provide an effective buffer which maximizes instream habitat potential. Measurements of riparian conditions should account for: no row crops; no removal of riparian vegetation ; preference to natural riparian conditions and; width, length, and quality of riparian area.

Land Use and Land Cover, Broad Scale

Land use and land cover should consider two-steps.

Step one should characterize the ecoregion or sub-region at a broad scale using the following LU/LC categories: row crops; forest; grass/herbaceous vegetation; artificial cover (e.g. buildings, impervious surfaces); water; barren (e.g. mines, quarries, etc.) and; land treatment.

Step two should summarize the LU/LC percentages by 12-digit HUC's (10-40 thousand acres) to develop summary statistics for the range of each LU/LC category.

Land Use and Land Cover, Site Specific

For a candidate reference site and its watershed, determine the LU/LC percentages for each category. Percent of land cover that is natural and/or land in treatment (e.g. application of BMP's and appropriate land management) exceeds that of the broad scale ecoregion. Some site specific land use measures have the capacity to cross over to other core factors. For example, some aspects of riparian conditions could easily be measured through the current LU/LC data.

Physical and Chemical Water Parameters

Reference sites should reflect best attainable physical and chemical conditions within an ecoregion and classification scheme as well as meeting or exceeding long term aquatic life protection standards.

Biological Metrics

Biological metrics are probably not a good choice for selecting reference sites, but good checks on the validity of the site being considered as reference. The validation process is data driven and should determine if the site is a valid reference site by insuring that the index of metric scores is among the highest for a defined population in an ecological region.

Faunal Assemblages

Biotic diversity should be consistent with both historical assemblages (where available) and current distributions. When faunal conditions are altered from natural the following factors should be considered: presence of rare or unique communities; limited number of exotics; temporal variations; few native species lost; presence of threatened or endangered species; stream classification and size and; migration barriers that can prevent recolonization of reaches (dams, reservoirs, drainage divides, etc.).

Altered Hydrologic Regimes

Reference conditions should reflect minimal indirect effects from channelization. References should not be under the hydrologic influence of dams, bridges, or crossings. They should be located away from the hydrological effects of outfall structures (storm sewers and drainage tiles), impervious surfaces, and urban runoff. There should be no influence from anthropogenic dewatering.

Representativeness

Reference sites should represent a range of biological, physical, and chemical conditions of the ecoregion. These sites should be minimally disturbed by anthropogenic activities. A sufficient number of sites should be selected to adequately represent different stream classes (e.g. cold water, saline, large, small, etc.) and capture the natural variability within specific classes. Classification can be addressed in different ways, but eventually needs to be addressed in some manner.

Quantitation of Some Aspects of Six Core Factors from Missouri Department of Natural Resources Wadeable/Perennial Reference Stream

Wastewater treatment plants and other point sources

Confined animal feeding operations

Riparian Habitat

Land Use/Land Cover , broad scale

Land Use/Land Cover, site specific

Biological Metrics

Discussion Topics

There are challenges to collecting and communicating regional reference data within ecological based frameworks that cross political boundaries

- **Iterative process and not everyone is at the same stage**
- **Data consistency problems**
  - quantitative methods of measurement
  - complete and current
  - format
- **Data interpretation problems**
  - statistical methods
  - scale
  - expertise
  - expense
  - tools
  - criteria application
- **Solution**
  - cooperative agreements
  - multi-agency workgroups
  - facilitation
  - consensus