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Identifying and Protecting Healthy Watersheds

References, Acronyms & Abbreviations, Appendix A, Appendix B, Appendix C, and Back Cover

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Acronyms & Abbreviations

AES	Aquatic Ecological System
ANR	Agency of Natural Resources
BBASC	Basin and Bay Area Stakeholder Committee
BBEST	Basin and Bay Expert Science Team
BASINS	Better Assessment Science Integrating point & Nonpoint Sources
BCG	Biological Condition Gradient
BMP	Best Management Practice
CADDIS	Causal Analysis/Diagnosis Decision Information System
CHT	Channel Habitat Type
CRAM	California Rapid Assessment Method
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Security Program
CWA	Clean Water Act
CWAM	California Watershed Assessment Manual
CWSRF	Clean Water State Revolving Fund
DCR	Department of Conservation and Recreation
DEM	Department of Environmental Management or Digital Elevation Model
DEP	Department of Environmental Protection
DEQ	Department of Environmental Quality
DES	Department of Environmental Services
DNR	Department of Natural Resources
DWSRF	Drinking Water State Revolving Fund
EDU	Ecological Drainage Unit
EEA	Essential Ecological Attribute
ELOHA	Ecological Limits of Hydrologic Alteration
EMAP	Environmental Monitoring and Assessment Program
EMDS	Ecosystem Management Decision Support System
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
EQIP	Environmental Quality Incentive Program
ESRI	Environmental Systems Research Group
FDC	Flow Duration Curve

FEH	Fluvial Erosion Hazard
FEMA	Federal Emergency Management Agency
FPZ	Functional Process Zone
FRCC	Fire Regime Condition Class
FWS	Fish and Wildlife Service
GAP	Gap Analysis Program
GDE	Ground water Dependent Ecosystem
GIS	Geographic Information System
GMA	Growth Management Act
GPD	Gallons Per Day
GPS	Global Positioning System
GRP	Grassland Reserve Program
HAT	Hydrologic Assessment Tool
HEFR	Hydrology-based Environmental Flow Regimes
HHEI	Headwaters Habitat Evaluation Index
HIP	Hydroecological Integrity Assessment Process
HIT	Hydrologic Index Tool
HSPF	Hydrologic Simulation Program Fortran
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IC	Impervious Cover
ICLUS	Integrated Climate and Land Use Scenarios
IFIM	Instream Flow Incremental Methodology
IHA	Indicators of Hydrologic Alteration
ILWIS	Integrated Land and Water Information System
INSTAR	Interactive Stream Assessment Resource
IIPCC	Intergovernmental Panel on Climate Change
ITI	Index of Terrestrial Integrity
KDHE	Kansas Department of Health and the Environment
LID	Low Impact Development
L-THIA	Long-Term Hydrologic Impact Assessment
MBSS	Maryland Biological Stream Survey
mIBI	Modified Index of Biotic Integrity
MMI	Macroinvertebrate Multimetric Index
MRB	Major River Basins
NARS	National Aquatic Resource Surveys
NAWQA	National Water Quality Assessment

NCDC	National Climatic Data Center
NED	National Elevation Dataset
NEMO	Nonpoint Education for Municipal Officials
NFHA	National Fish Habitat Assessment
NFIP	National Flood Insurance Program
NFPP	National Fish Passage Program
NHD	National Hydrography Dataset
NLA	National Lakes Assessment
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRSA	National Rivers and Streams Assessment
NSPECT	Nonpoint Source Pollution and Erosion Comparison Tool
NWI	National Wetlands Inventory
NWIS	National Water Information System
ONRW	Outstanding National Resource Water
ORAM	Oregon Rapid Assessment Method
ORBIC	Oregon Biodiversity Information Center
OWEB	Oregon Watershed Enhancement Board
OWOW	Office of Wetlands, Oceans, and Watersheds
PAD	Protected Areas Database
PCA	Principal Components Analysis
PFC	Proper Functioning Condition
PHI	Physical Habitat Index
PHWH	Primary Headwaters Habitat
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RASCAL	Rapid Assessment of Stream Conditions Along Length
RCC	River Continuum Concept
RES	Riverine Ecosystem Synthesis
ReVA	Regional Vulnerability Assessment
RIVPACS	River Invertebrate Prediction and Classification System
RPST	Recovery Potential Screening Tool
RPT	Regime Prescription Tool
RSRA	Rapid Stream and Riparian Assessment
RTE	Rare, Threatened, or Endangered
SAB	Science Advisory Board

SABS	Suspended and Bedded Sediments
SGA	Stream Geomorphic Assessment
SDWA	Safe Drinking Water Act
SPARROW	Spatially Referenced Regressions On Watershed Attributes
SSURGO	Soil Survey Geographic Database
STORET	STOrage and RETrieval
SWAP	Source Water Assessment Program
SWMM	Storm Water Management Model
SYE	Sustainable Yield Estimator
TCEQ	Texas Commission on Environmental Quality
TALU	Tiered Aquatic Life Use
TDR	Transfer of Development Rights
TEA	Targeted Ecological Area
TIFP	Texas Instream Flow Program
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TPL	Trust for Public Land
UMRB	Upper Mississippi River Basin
USA	United States of America
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
VCLNA	Virginia Conservation Lands Needs Assessment
VSP	Visual Sample Plan
VST	Valley Segment Types
WAM	Watershed Assessment Manual
WAT	Watershed Assessment Tool
WATERS	Watershed Assessment, Tracking & Environmental ResultS
WHIP	Wildlife Habitat Incentives Program
WQI	Water Quality Index
WQS	Water Quality Standards
WQX	Water Quality Exchange
WRP	Wetlands Reserve Program
WSA	Wadeable Streams Assessment
WWF	World Wildlife Fund

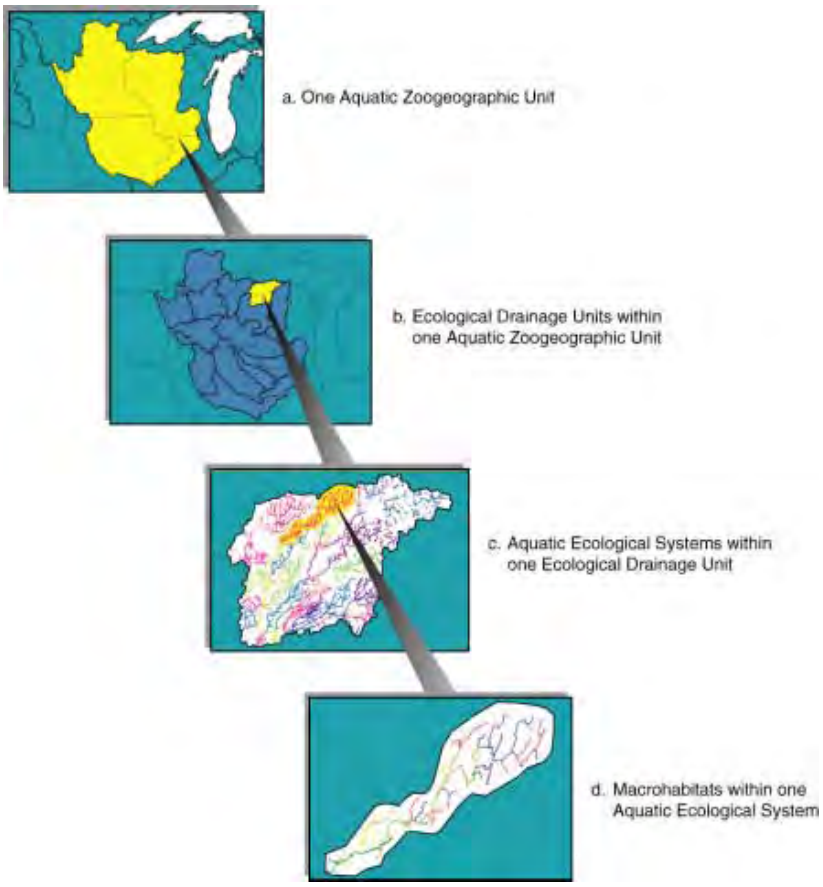
Appendix A. Examples of Assessment Tools

Classifying Freshwater Ecosystems

Developer: The Nature Conservancy

More Information: http://www.conservationgateway.org/topic/ecoregional-assessment

Freshwater systems are comprised of a variety of ecosystems that differ in geophysical, hydrological and ecological characteristics. Classifying and mapping these distinctions is critical to defining the variety of habitats and processes that comprise a large and complex freshwater system. Classification products are used in biodiversity planning as "coarse-filter" conservation elements to "capture" many common, untracked, and unknown species, and to identify the variety of environments and processes that support species and natural communities across a region of interest. They can also be used to identify specific ecosystem attributes for targeting strategies to protect and restore watershed health, such as identifying areas of high ground water potential, or areas that provide high water yields from surface runoff and are sensitive to a variety of land uses.



The Nature Conservancy's Freshwater Classification System (Weitzell et al., 2003).

MapWindow

Developer*:* Idaho State University Geospatial Software Lab

More Information: http://www.mapwindow.org/

The MapWindow application is a free GIS that can be used for the following:

- As an alternative desktop GIS.
- To distribute data to others.
- To develop and distribute custom spatial data analyses.

MapWindow is free to use and redistribute to other users. Unlike other free tools, MapWindow is more than just a data viewer; it is an extensible geographic information system. This means that plug-ins can be created to add additional functionality (e.g., models, special viewers, hot-link handlers, data editors, etc.) and these can be passed along to other users.

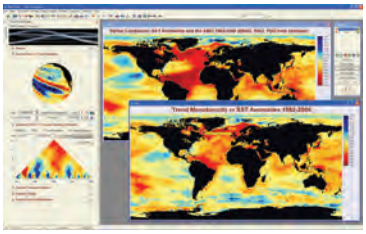
ArcGIS

Developer: Environmental Systems Research Institute (ESRI)

More Information: http://www.esri.com/index.html

ArcGIS is software for visualizing, managing, creating, and analyzing geographic data. Using ArcGIS, one can understand the geographic context of data, allowing the user to see relationships and identify patterns.

IDRISI Taiga



Developer: Clark Labs

More Information: http://www.clarklabs.org/products/product-features.cfm

IDRISI Taiga is an integrated GIS and Image Processing software solution providing nearly 300 modules for the analysis and display of digital spatial information. IDRISI offers an extensive set of GIS and Image Processing tools in a single package. With IDRISI, all analytical features come standard—there is no need to buy add-ons to extend research capabilities.

Integrated Land and Water Information System (ILWIS)

Developer: World Institute for Conservation and Environment

More Information: http://52north.org/

ILWIS is free remote sensing and GIS software, which integrates image, vector, and thematic data in one unique and powerful desktop package. ILWIS delivers a wide range of features including import/export, digitizing, editing, analysis and display of data, as well as production of quality maps. ILWIS software is renowned for its functionality, user-friendliness and low cost, and has established a wide user community over the years of its development.

Ecosystem Management Decision Support (EMDS)

Developer: U.S. Forest Service, InfoHarvest, Rules of Thumb, The Redlands Institute (University of Redlands)

More Information: http://www.institute.redlands.edu/emds/

The EMDS system is an application framework for knowledge-based decision support of environmental analysis and planning at any geographic scale. EMDS integrates state-of-the-art GIS, as well as knowledge-based reasoning and decision modeling technologies to provide decision support for the adaptive management process of ecosystem management.

NetMap

Developer: Earth Systems Institute

More Information: http://www.netmaptools.org/

NetMap is a community based watershed science system comprised of a digital watershed database, analysis tools, and forums. The state-of-the-art desktop GIS analysis tools, containing approximately 50 functions and 60 parameters, address watershed attributes and processes such as fluvial geomorphology, fish habitat, erosion, watershed disturbance, road networks, wildfire, hydrology, and large woody debris, among others. NetMap is designed to integrate with ESRI ArcMap 9.2. Key features include:

- **Decision support**. NetMap can inform fish habitat management, forestry, pre and post fire planning, restoration, monitoring, research, and education.
- **Uniform data structure**. Channel segments (and tributary confluence nodes) are defined as the spatial relationship between segments and hillsides. All watershed information is routed downstream revealing patterns of watershed attributes at any spatial scale defined by stream networks.
- **Universal, region-wide database**. A large and expanding region-wide watershed database allows users easy access to hundreds of watersheds for rapid analyses and to facilitate comparative analyses across landscapes, states and regions.
- **A new analysis paradigm and methods framework**. In the context of watershed analysis, software tools are distributed with the analysis allowing stakeholders to conduct custom analyses as new questions arise, as new data becomes available (or as more accurate data becomes available), or as watershed conditions change (wildfires or land use activities).
- **A "living analysis."** NetMap watershed databases do not become dated over time because "field link" tools allow rapid validation of predicted attributes and thus databases are made more accurate with use.
- **NetMap is community based**. As new watershed databases are developed and new tools are created, they become immediately available to all users.

Analytical Tools Interface for Landscape Assessments (ATtILA)

Developer: U.S. Environmental Protection Agency

More Information: http://www.epa.gov/esd/land-sci/attila/index.htm

ATtILA is an easy to use ArcView extension that calculates many commonly used landscape metrics. By providing an intuitive interface, the extension provides the ability to generate landscape metrics to a wide audience, regardless of their GIS knowledge level. ATtILA is a robust, flexible program. It accepts data from a broad range of sources and is equally suitable for use across all landscapes, from deserts to rain forests to urban areas, and may be used at local, regional, and national scales.

Impervious Surface Analysis Tool

Developer: NOAA Coastal Services Center and the University of Connecticut Nonpoint Education for Municipal Officials (NEMO) Program

More Information: http://www.csc.noaa.gov/digitalcoast/tools/isat/

The Impervious Surface Analysis Tool is used to calculate the percentage of impervious surface area of user-selected geographic areas (e.g., watersheds, municipalities, subdivisions). The tool is available as an ArcView 3.x, ArcGIS 8.x, or ArcGIS 9.x extension.

Land Change Modeler

Developer: Clark Labs

More Information: http://www.clarklabs.org/products/Land-Change-Modeler-Overview.cfm

The Land Change Modeler is land cover change analysis and prediction software that also incorporates tools that allows one to analyze, measure, and project the impacts on habitat and biodiversity. Land Change Modeler includes a suite of tools that address the complexities of change analysis, resource management, and habitat assessment while maintaining a simple and automated workflow. The Land Change Modeler is included within the IDRISI GIS and Image Processing software and is available as a software extension for use with ESRI's ArcGIS product.

CommunityViz

Developer: Placeways

More Information: www.placeways.com/communityviz

CommunityViz planning software is an extension for ArcGIS Desktop. Planners, resource managers, local and regional governments, and many others use CommunityViz to help make planning decisions about development, land use, transportation, and conservation. A GIS-based decision-support tool, CommunityViz "shows" the implications of different plans and choices. Both flexible and robust, it supports scenario planning, sketch planning, 3-D visualization, suitability analysis, impact assessment, growth modeling, and other popular techniques. Its many layers of functionality make it useful for a wide range of skill levels and applications.

NatureServe Vista

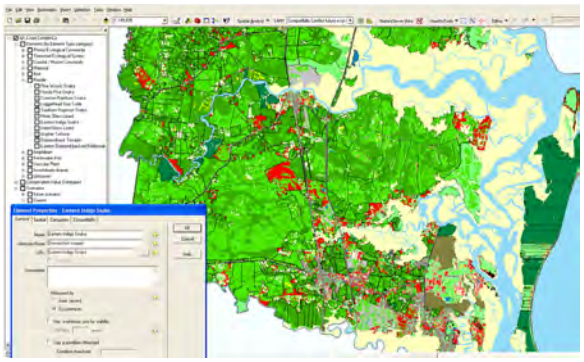
Developer: NatureServe

More Information: http://www.natureserve.org/prodServices/vista/overview.jsp

NatureServe Vista is a powerful, flexible, and free decision support system that helps users integrate conservation with land use and resource planning of all types. Planners, resource managers, scientists, and conservationists can use NatureServe Vista to:

- Conduct conservation planning and assessments.
- Integrate conservation values with other planning and assessment activities, such as land use, transportation, energy, natural resource, and ecosystem-based management.
- Evaluate, create, implement, and monitor land use and resource management scenarios designed to achieve conservation goals within existing economic, social, and political contexts.

Version 2.5 of NatureServe Vista now integrates interoperability with NOAA's Nonpoint Source Pollution and Erosion Comparison Tool (NSPECT), as well as other hydrologic models to support integrated land-water assessment and planning. NatureServe Vista operates on the ESRI ArcGIS platform. NatureServe Vista supports quantitative and defensible planning approaches that incorporate science, expert opinion, community values, and GIS. It works with a number of other useful software tools to incorporate land use, economics, and ecological and geophysical modeling. The flexible approach and structure of Vista is suitable for planning and GIS experts, as well as those with minimal training and support.



Miradi

Developer: Conservation Measures Partnership

More Information: http://www.miradi.org

Miradi is a user-friendly program that allows nature conservation practitioners to design, manage, monitor, and learn from their projects to more effectively meet their conservation goals. The program guides users through a series of step-by-step interview wizards, based on the Open Standards for the Practice of Conservation. As practitioners go through these steps, Miradi helps them to define their project scope, and design conceptual models and spatial maps of their project site. The software helps users to prioritize threats, develop objectives and actions, and select monitoring indicators to assess the effectiveness of their strategies. Miradi also supports the development of workplans, budgets, and other tools to help practitioners implement and manage their project. Users can export Miradi project data to reports or, in the future, to a central database to share their information with other practitioners.

Habitat Priority Planner

Developer: National Oceanic and Atmospheric Administration (NOAA)

More Information: http://www.csc.noaa.gov/digitalcoast/tools/hpp/

The Habitat Priority Planner is a spatial decision-support tool (for ArcGIS) designed to assist users in identifying high-priority areas in the landscape or seascape for land use, conservation, climate change adaptation, or restoration action. The Habitat Priority Planner packages several landscape-based spatial analyses for the intermediate GIS user. Scenarios can be easily displayed and changed, making this a helpful companion tool when working with a group. In addition to the scenarios, the tool also generates reports, maps, and data tables.

Causal Analysis/Diagnosis Decision Information System (CADDIS)

Developer: U.S. Environmental Protection Agency

More Information: http://cfpub.epa.gov/caddis/

CADDIS is an online application that helps scientists and engineers find, access, organize, use, and share information to conduct causal evaluations in aquatic systems. It is based on EPA's Stressor Identification process, which is a formal method for identifying causes of impairments in aquatic systems.

Better Assessment Science Integrating Point and Nonpoint Sources (BASINS)

Developer: U.S. Environmental Protection Agency

More Information: http://water.epa.gov/scitech/datait/models/basins/index.cfm

BASINS is a desktop-based, multipurpose environmental analysis system designed for use by regional, state, and local agencies in performing watershed and water quality-based studies. This system makes it possible to quickly assess large amounts of point source and nonpoint source data in a format that is easy to use and understand. BASINS allows the user to assess water quality at selected stream sites or throughout an entire watershed. This tool integrates environmental data, analytical tools, and modeling programs to support development of cost-effective approaches to watershed management and environmental protection.

Visual Sample Plan (VSP)

Developer: U.S. Department of Energy

More Information: http://vsp.pnl.gov/index.stm

VSP is a software tool that supports the development of a defensible sampling plan based on statistical sampling theory and the statistical analysis of sample results to support confident decision making. VSP couples visualization capabilities with optimal sampling design and statistical analysis strategies.

Nonpoint Source Pollution and Erosion Comparison Tool (NSPECT)

Developer: National Oceanic and Atmospheric Administration (NOAA)

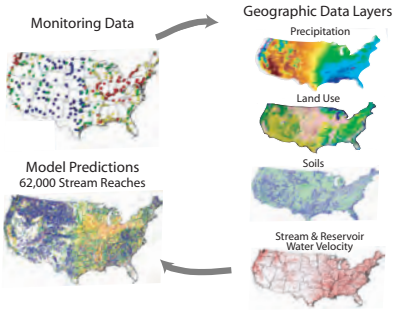
More Information: http://www.csc.noaa.gov/digitalcoast/tools/nspect/

NSPECT helps predict potential water quality impacts to rivers and streams from nonpoint source pollution and erosion. Users first enter information about their study area (land cover, elevation, precipitation, and soil characteristics) to create the base data layer. They can then add different land cover change scenarios (such as a new developed area) to obtain information about potential changes in surface water runoff, nonpoint source pollution, and erosion.

Spatially Referenced Regressions On Watershed Attributes (SPARROW)

Developer: U.S. Geological Survey

More Information: http://water.usgs.gov/nawqa/sparrow/



SPARROW is a modeling tool for the regional interpretation of water quality monitoring data. The model relates instream water quality measurements to spatially referenced characteristics of watersheds, including contaminant sources and factors influencing terrestrial and aquatic transport. SPARROW empirically estimates the origin and fate of contaminants in river networks and quantifies uncertainties in model predictions.

ArcHydro

Developer: University of Texas at Austin Center for Research in Water Resources

More Information: http://resources.arcgis.com/content/hydro-data-model

The ArcHydro Data Model can be defined as a geographic database containing a GIS representation of a Hydrological Information System under a case-specific database design, which is extensible, flexible, and adaptable to user requirements. It takes advantage of the next generation of spatial data in Relational Database Management Systems, the geodatabase model. Conceptually, it is a combination of GIS objects enhanced with the capabilities of a relational database to allow for relationships, topologies, and geometric networks. ArcHydro facilitates a variety of GIS-based hydrologic analyses including watershed delineation, stream network mapping, and watershed modeling.

Indicators of Hydrologic Alteration

Developer: The Nature Conservancy

More Information: http://www.nature.org/initiatives/freshwater/conservationtools/art17004.html

IHA is a software program that provides useful information for those trying to understand the hydrologic impacts of human activities or trying to develop environmental flow recommendations for water managers. This software program assesses 67 ecologically-relevant statistics derived from daily hydrologic data. For instance, IHA can calculate the timing and maximum flow of each year's largest flood event or lowest flows, then calculate the mean and variance of these values over a selected period of time. IHA's comparative analysis can then help statistically describe how these patterns have changed for a particular river or lake, due to abrupt impacts such as dam construction, or more gradual trends associated with land and water use changes.

Water Budget Tools

A water budget is a conceptual model for understanding different water inflows and outflows of any given system. It can be developed in order to evaluate the relative importance of surface water and ground water inflows and outflows to a particular aquatic ecosystem or a conservation area as a whole. The relationships between the system and its inflows and outflows are depicted using a figure to represent the system and arrows pointed toward or away from the figure and scaled in size to match their direction and magnitude, respectively. Where flow values have not been measured, estimates can be developed from sources such as local climate stations, flow gaging stations, the Parameter-elevation Regressions on Independent Slopes Model (PRISM), or monthly average reference evapotranspiration values from the U.S. Bureau of Reclamation. In the case of wetland water budgets, for example, there are four potential water inputs, each of which has a corresponding potential output:

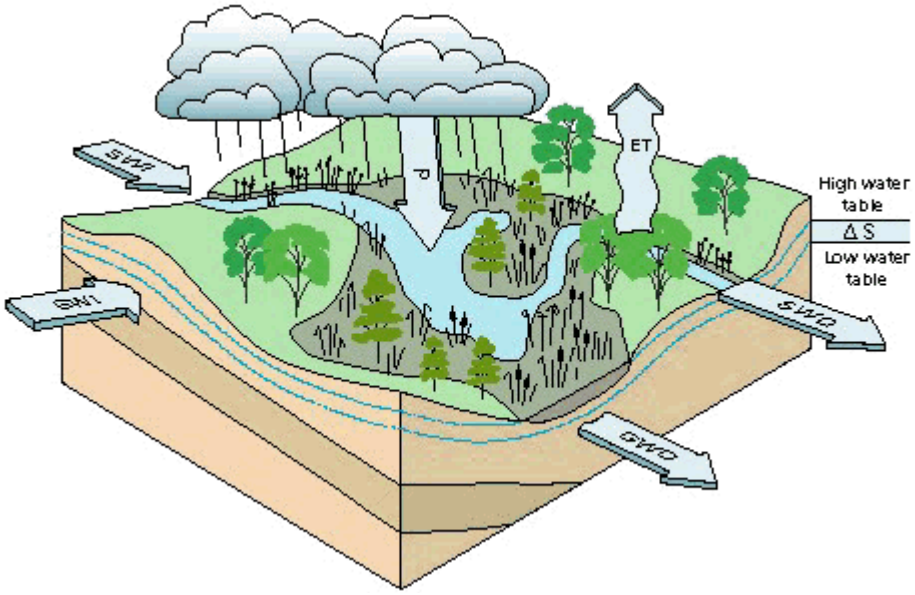
Inputs:

1. Surface water inflow (SWI).
2. Ground water inflow (GWI).
3. Tidal inflow (TI).
4. Precipitation (P).

Outputs:

1. Surface water outflow (SWO).
2. Ground water outflow (GWO).
3. Tidal outflow (TO).
4. Evapotranspiration (ET).

Although a water budget alone typically does not incorporate enough detail to form the basis for management plans or policy decisions, a water budget can be a helpful tool for identifying data gaps and research needs and planning future directions for resource management (Brown J., Wyers, Aldous, & Bach, 2007).



Components of the wetland water budget. (P+SWI+GWI=ET+SWO+GWO+ΔS, where P is precipitation, SWI is surface water inflow, SWO is surface water outflow, GWI is ground water inflow, GWO is ground water outflow, ET is evapotranspiration, and ΔS is change in storage (Carter, 1996).

Hydrologic Engineering Center Regime Prescription Tool (HEC-RPT)

Developer: The Nature Conservatory, U.S. Army Corps of Engineers

More Information: http://www.nature.org/initiatives/freshwater/conservationtools/hecrpt.html

HEC-RPT is a visualization tool that is designed to complement existing software packages by facilitating entry, viewing, and documentation of flow recommendations in real-time, public settings. The software was developed in support of the Sustainable Rivers Project, a national partnership between the U.S. Army Corps of Engineers and TNC to improve the health of rivers by changing the operations of Corps dams.

Hydrologic Engineering Center Geospatial Hydrologic Modeling Extension (HEC-GeoHMS)

Developer: Army Corps of Engineers

More Information: http://www.hec.usace.army.mil/software/hec-geohms/

The HEC-GeoHMS has been developed as a geospatial hydrology toolkit for engineers and hydrologists with limited GIS experience. HEC-GeoHMS uses ArcView and the Spatial Analyst extension to develop a number of hydrologic modeling inputs for the Hydrologic Engineering Center's Hydrologic Modeling System, HEC-HMS. Analyzing digital terrain data, HEC-GeoHMS transforms the drainage paths and watershed boundaries into a hydrologic data structure that represents the drainage network. The program allows users to visualize spatial information, document watershed characteristics, perform spatial analysis, and delineate subbasins and streams. HEC-GeoHMS' interfaces, menus, tools, buttons, and context-sensitive online help allow the user to expediently create hydrologic inputs for HEC-HMS.

The Hydroecological Integrity Assessment Process (HIP) Tools

Developer: U.S. Geological Survey

More Information: http://www.fort.usgs.gov/Resources/Research_Briefs/HIP.asp

USGS scientists developed the HIP and a suite of tools for conducting a hydrologic classification of streams, addressing instream flow needs, and assessing past and proposed hydrologic alterations on stream flow and/or other ecosystem components. The HIP recognizes that stream flow is strongly related to many critical physiochemical components of rivers, such as dissolved oxygen, channel geomorphology, and water temperature, and can be considered a "master variable" that limits the disturbance, abundance, and diversity of many aquatic plant and animal species.

The HIP is intended for use by any federal or state agency, institution, private firm, or nongovernmental entity that has responsibility for or interest in managing and/or regulating streams to restore or maintain ecological integrity. In addition, the HIP can assist researchers by identifying ecologically relevant, stream-class-specific hydrologic indices that adequately characterize the five major components of the flow regime (magnitude, frequency, duration, timing, and rate of change) by using 10 nonredundant indices. The HIP is developed at a state or other large geographical area scale but is applied at the stream reach level.

StreamStats

Developer: U.S. Geological Survey

More Information: http://water.usgs.gov/osw/streamstats/

StreamStats is a web-based GIS that provides users with access to an assortment of analytical tools that are useful for water resources planning and management, and for engineering design applications, such as the design of bridges. StreamStats allows users to easily obtain monthly stream flow statistics, drainage basin characteristics, and other information for user-selected sites on streams. StreamStats users can choose locations of interest from an interactive map and obtain information for these locations. If a user selects the location of a USGS data collection station, the user will be provided with a list of previously published information for the station. If a user selects a location where no data are available (an ungaged site), StreamStats will delineate the drainage basin boundary, measure basin characteristics and estimate monthly stream flow statistics for the site. These estimates assume natural flow conditions at the site. StreamStats also allows users to identify stream reaches that are upstream or downstream from user-selected sites, and to identify and obtain information for locations along the streams where activities that may affect stream flow conditions are occurring.

Massachusetts Sustainable Yield Estimator

Developer: U.S. Geological Survey

More Information: http://pubs.usgs.gov/sir/2009/5227/pdf/sir2009-5227-508.pdf; http://ma.water.usgs.gov/sarch/software/sye_mainpage.htm

The Massachusetts Sustainable-Yield Estimator is a decision-support tool that calculates a screening-level approximation of a basin's sustainable yield, defined as the difference between natural stream flow and the flow regime required to support desired uses, such as aquatic habitat. A spatially-referenced database of permitted surface water and ground water withdrawals and discharges is used to calculate daily stream flows at ungaged sites; however, impacts from septic-system discharge, impervious area, non-public water-supply withdrawals less than 100,000 gpd, and impounded surface water bodies are not accounted for in these stream flow estimates. Because this tool was developed with considerations specific to the hydrology of Massachusetts, it can potentially be adapted for use in other New England states, but may not be applicable outside this geographic region.

Tools for Understanding Ground Water and Biodiversity

Developer: The Nature Conservancy

More Information: http://www.srnr.arizona.edu/nemo/WebDocs/Groundwater%20Methods%20Guide%20TNC%20Jan08.pdf

This appendix offers a brief discussion of several tools that can be used with the assistance of experts in the field to develop an understanding of the relationship between ground water and biodiversity. The tools discussed address the following topics: modeling recharge areas, seepage runs, base flow as a percentage of annual stream flow, water table data, Forward Looking Infrared Remote Sensing, water chemistry analysis, and environmental tracer analysis. Both motivations and data requirements for using these tools as well as the limitations of the tools are considered.

Long-Term Hydrologic Impact Assessment (L-THIA)

Developer: Local Government Environmental Assistance Network

More Information: http://www.ecn.purdue.edu/runoff/lthianew/

The L-THIA model was developed as an online tool to support the assessment of land use changes on water quality. Based on community-specific climate data, L-THIA estimates changes in recharge, runoff, and nonpoint source pollution resulting from past or proposed development. As a quick and easy-to-use approach, L-THIA's results can be used to generate community awareness of potential long-term problems and to support planning aimed at minimizing disturbance of critical areas. L-THIA assists in the evaluation of potential effects of land use change and identifies the best location of a particular land use so as to have minimum impact on a community's natural environment.

Low Impact Development (LID) Urban Design Tools Web site

Developer: Low Impact Development Center (through a cooperative assistance agreement with EPA)

More Information: http://www.lid-stormwater.net/index.html

The LID Urban Design Tools website was developed to provide guidance to local governments, planners, and engineers for developing, administering, and incorporating LID into their aquatic resource protection programs. LID technology is an alternative comprehensive approach to stormwater management. It can be used to address a wide range of wet weather flow issues, including combined sewer overflows, stormwater runoff, and pollutant loading.

GeoTools

Developer: Brian Bledsoe

More Information: http://www.engr.colostate.edu/~bbledsoe/GeoTool/

To improve watershed management in the context of changing land uses, GeoTools estimates long-term changes in stream erosion potential, channel processes, and instream disturbance regime. The models include a suite of stream/land use management modules designed to operate with either continuous or single event hydrologic input in a variety of formats. The tools can also be used as a post-processor for the Storm Water Management Model (SWMM) and Hydrologic Simulation Program Fortran (HSPF) model (included in EPA's BASINS), as well as for any general time series of discharges. Based on the two input channel geometry and flow series, the various modules can provide users with estimates of the following characteristics for pre and post land use change conditions: (1) the temporal distribution of hydraulic parameters including shear stress, specific stream power, and potential mobility of various particle sizes; (2) effective discharge/sediment yield; (3) potential changes in sediment transport and yield as a result of altered flow and sedimentation regimes; (4) frequency, depth, and duration of bed scour; and (5) several geomorphically relevant hydrologic metrics relating to channel form, flow effectiveness, and "flashiness."

Regional Vulnerability Assessment (ReVA) Environmental Decision Toolkit

Developer: U.S. Environmental Protection Agency

More Information: http://amethyst.epa.gov/revatoolkit/Welcome.jsp

EPA's ReVA program is designed to produce the methods needed to understand a region's environmental quality and its spatial pattern. The objective is to assist decision makers in making better-informed decisions and in estimating the large-scale changes that might result from their actions.

Appendix B. Sources of National Data

Watershed Boundary Dataset

Source: U.S. Geological Survey and Natural Resources Conservation Service

More Information: http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/

Watershed boundaries define the aerial extent of surface water drainage to a point. Hydrologic Unit Codes (HUCs) are used to identify each hydrologic unit and are organized in a hierarchical fashion. The first level of classification divides the nation into 21 major geographic areas, or regions. The second level of classification divides the 21 regions into 221 subregions. The third level of classification subdivides the subregions into 378 hydrologic accounting units. The fourth level of classification subdivides the hydrologic accounting units into 2,264 cataloging units. The fifth level of classification subdivides these into watersheds and the sixth level subdivides watersheds into sub-watersheds. A hydrologic unit has a single flow outlet except in coastal or lakefront areas. However, multiple hydrologic units must be combined to represent the true hydrologic watershed in many instances.

National Hydrography Dataset (NHD)

Source: U.S. Geological Survey

More Information: http://nhd.usgs.gov/


Subbasin 02070010 covering Washington DC

The NHD is a comprehensive set of spatial data representing the surface water of the United States using common features such as lakes, ponds, streams, rivers, canals, and oceans. These data are designed to be used in general mapping and in the analysis of surface water systems using GIS.

National Elevation Dataset (NED)

Source: U.S. Geological Survey

More Information: http://ned.usgs.gov/

The NED replaces Digital Elevation Models (DEMs) as the primary elevation data product of the USGS. The NED is a seamless dataset with the best available raster elevation data of the conterminous United States, Alaska, Hawaii, and territorial islands. The NED is updated on a nominal two month cycle to integrate newly available, improved elevation source data. All NED data are public domain. The NED is derived from diverse source data that are processed to a common coordinate system and unit of vertical measure. NED data are available nationally (except for Alaska) at resolutions of 1 arc-second (about 30 meters) and 1/3 arc-second (about 10 meters), and in limited areas at 1/9 arc-second (about 3 meters).

Soil Survey Geographic Database (SSURGO)

Source: Natural Resources Conservation Service

More Information: http://soils.usda.gov/survey/geography/ssurgo/

SSURGO is the most detailed level of soil mapping performed by the NRCS. The soil maps in SSURGO are created using field mapping methods based on national standards. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships, and county natural resource planning and management. The user should be knowledgeable of soils data and their characteristics.

National Land Cover Database (NLCD)

Source: Multi-Resolution Land Characteristics Consortium

More Information: http://www.mrlc.gov/

NLCD is a national land cover database with several independent data layers, which allow users a wide variety of potential applications. The data are provided at a resolution of 30 meters and include 21 classes of land cover, estimates of impervious cover, and tree canopy cover.

Fire Regime Condition Class (FRCC)

Source: U.S. Department of the Interior

More Information: http://frcc.gov/

LANDFIRE Rapid Assessment FRCC delineates a standardized index to measure the departure of current conditions from reference conditions. FRCC is defined as a relative measure describing the degree of departure from the reference fire regime. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics; fuel composition; fire frequency, severity, and pattern; and other associated disturbances. These data can be downloaded for any region of the country to evaluate the degree of departure from the natural fire regime.

National Climate Data Center (NCDC)

Source: National Oceanic and Atmospheric Administration

More Information: http://www.ncdc.noaa.gov/oa/ncdc.html

NCDC is the world's largest active archive of weather data. NCDC produces numerous climate publications and responds to data requests from all over the world. Accurate weather data are required by many watershed modeling programs and can be obtained from NCDC.

Climate Wizard

Source: The Nature Conservancy, University of Washington, University of Southern Mississippi

More Information: http://www.climatewizard.org/

ClimateWizard enables technical and non-technical audiences alike to access leading climate change information and visualize the impacts anywhere on Earth. The first generation of this web-based program allows the user to choose a state or country and both assess how climate has changed over time and to project what future changes are predicted to occur in a given area. ClimateWizard represents the first time ever the full range of climate history and impacts for a landscape have been brought together in a user-friendly format.

Integrated Climate and Land Use Scenarios (ICLUS)

Source: U.S. Environmental Protection Agency

More Information: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=205305

ICLUS is an ArcGIS extension that derives land use change projections that are consistent with Special Report on Emissions Scenarios (SRES) driving global circulation models and other land-use change modeling efforts. The residential housing and impervious surface datasets provide a substantial first step toward comprehensive national land use/land cover scenarios, which have broad applicability for integrated assessments as these data and tools are publicly available.

Water Quality Exchange (WQX)

Source: U.S. Environmental Protection Agency

More Information: http://www.epa.gov/storet/wqx/index.html

EPA developed the National STOrage and RETrieval (STORET) Data Warehouse in 2001 to store and make available water quality data collected by federal agencies, states, tribes, watershed organizations and universities. A chief goal of the national data warehouse has always been to encourage data sharing and to support national, regional, and local analyses of water quality data collected around the country. Until now, to upload water quality data into STORET, users needed to operate the Oracle-based STORET database. This was cumbersome and difficult for many users. The Water Quality Exchange (WQX) is a new framework that makes it easier to submit and share water quality monitoring data over the Internet. EPA will continue to maintain STORET to ensure that data of documented quality are available across jurisdictional and organizational boundaries. However, with WQX, groups who collect water quality data no longer need to use STORET to submit their information to the National STORET Data Warehouse. Ease of use will encourage more groups to transfer their data to the Warehouse, where it will be of value to federal, state, and local water quality managers as well as the public.

National Water Information System (NWIS)

Source: U.S. Geological Survey

More Information: http://waterdata.usgs.gov/nwis/help?nwisweb_overview

The USGS maintains a distributed network of computers and fileservers for the acquisition, processing, review, dissemination, and long-term storage of water data collected at over 1.5 million sites around the country and at some border and territorial sites. This distributed network of computers is called the National Water Information System (NWIS). Many types of data are stored in NWIS, including comprehensive information for site characteristics, well construction details, time-series data for gage height, stream flow, ground water level, precipitation, and physical and chemical properties of water. Additionally, peak flows, chemical analyses for discrete samples of water, sediment, and biological media are accessible within NWIS. NWISWeb provides a framework to obtain data on the basis of category, such as surface water, ground water, or water quality, and by geographic area. Further refinement is possible by choosing specific site-selection criteria and by defining the output desired. NWIS includes data from as early as 1899 to present.

Distribution of Native U.S. Fishes by Watershed

Source: NatureServe

More Information: http://www.natureserve.org/getData/dataSets/watershedHucs/index.jsp

NatureServe has compiled detailed data on the current and historic distributions of the native freshwater fishes of the United States, excluding Alaska and Hawaii. Lists of the native fish species of each small watershed (8-digit cataloging unit) are provided to facilitate biological assessments and interpretation.

Protected Areas Database of the United States (PAD-US)

Source: National Biological Information Infrastructure

More Information: http://www.protectedlands.net/padus/

The PAD-US is a national database of federal and state conservation lands. The protected areas included in the PAD-US include lands that are dedicated to the preservation of biological diversity and to other natural, recreational and cultural uses, and managed for these purposes through legal or other effective means. These lands are essential for conserving species and habitat. The lands in PAD-US also include other types of publicly owned open space areas, whether used for recreational, managed resource development, water quality protection, or other uses.

NatureServe Data

Source: NatureServe

More Information: http://www.natureserve.org/getData/index.jsp

NatureServe and its network of member programs are a leading source for reliable scientific information about species and ecosystems of the Western Hemisphere. This site serves as a portal for accessing several types of publicly available biodiversity data including the Natural Heritage data for all states.

The Nature Conservancy's Spatial Data Resources

Source: The Nature Conservancy

More Information: http://maps.tnc.org/

Spatial data and related information plays a vital role in conservation at The Nature Conservancy. A wealth of data are generated across the organization throughout various parts of the process from setting priorities through ecoregional assessments to developing strategies, taking action and tracking results as part of conservation projects to managing information on properties they purchase to protect. The primary purpose of this site is to make this core conservation data publically available through easy-to-use web map viewers for non-GIS users, as well as in raw form via map services for more experienced GIS professionals.

FactFinder

Source: United States Census Bureau

More Information: http://factfinder.census.gov/home/saff/main.html?_lang=en

American FactFinder is an online source for population, housing, economic and geographic data that presents the results from four key data programs:

- Decennial Census of Housing and Population - 1990 and 2000.
- Economic Census 1997 and 2002.
- American Community Survey - 2005-2007.
- Population Estimates Program - July 1, 2003 to July 1, 2007.

Results from each of these data programs are provided in the form of datasets, tables, thematic maps, and reference maps. These data can be useful for identifying threats to watershed ecosystems.

Watershed Assessment, Tracking & Environmental ResultS (WATERS)

Source: U.S. Environmental Protection Agency

More Information: http://www.epa.gov/waters/

WATERS is an integrated information system for the nation's surface waters. The EPA Office of Water manages numerous programs in support of the Agency's water quality efforts. Many of these programs collect and store water quality related data in databases. These databases are managed by the individual Water Programs and this separation often inhibits the integrated application of the data they contain. Under WATERS, the Water Program databases are connected to a larger framework. This framework is a digital network of surface water features, known as the National Hydrography Dataset (NHD). By linking to the NHD, one Water Program database can reach another, and information can be shared across programs.

LandScope

Source: NatureServe, National Geographic

More Information: http://www.landscope.org/

LandScope America is an online resource for the land protection community and the public. By bringing together maps, data, photos, and stories about America's natural places and open spaces, LandScope's goal is to inform and inspire conservation of land and water.

National Atlas

Source: U.S. Department of the Interior

More Information: http://www.nationalatlas.gov/index.html

The National Atlas is an online map containing data layers available for viewing and download for the entire United States. These data layers include agricultural, biological, climate, political, economic, environmental, geological, historical, and other major categories. It is a convenient source of data for many watershed assessment applications.

National Fish Habitat Action Plan Spatial Framework

Source: National Fish Habitat Action Plan

More Information: http://fishhabitat.org

The Science and Data Team of the National Fish Habitat Action Plan has developed a national spatial framework to facilitate summary and sharing of available national datasets in support of conservation and management of fish habitats in the conterminous United States. The framework is based upon the National Hydrography Dataset Plus (NHDPlus), and data are summarized for local and network catchments of individual stream reaches. Currently, 17 natural and anthropogenic disturbance variables have been attributed to local catchments and aggregated for network catchments and are available across various geographic extents incorporated into the spatial framework.

Appendix C. Cited Assessment and Management Examples

Assessment and Management Examples Organized Nationally and by State

National
http://water.epa.gov/healthywatersheds
Biological Condition Gradient and Tiered Aquatic Life Uses http://www.epa.gov/bioindicators/html/bcg.html
Ecological Limits of Hydrologic Alteration http://www.conserveonline.org/workspaces/eloha
Enabling Source Water Protection www.landuseandwater.org
Index of Biotic Integrity (IBI) http://www.epa.gov/bioiweb1/html/ibi_history.html
Interagency Fire Regime Condition Class http://frames.nbii.gov/documents/frcc/documents/FRCC+Guidebook_2008.10.30.pdf
Process for Assessing Proper Functioning Condition ftp://ftp.blm.gov/pub/nstc/techrefs/Final%20TR%201737-9.pdf
National Fish Habitat Assessment www.fishhabitat.org
NatureServe's Natural Heritage Program Biodiversity Assessments http://www.natureserve.org/aboutUs/network.jsp
The Nature Conservancy's Approach to Setting Freshwater Conservation Priorities http://www.conservationgateway.org/topic/setting-freshwater-priorities
Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin http://www.natureserve.org/library/uppermsriverbasin.pdf
The Nature Conservancy's Active River Area http://conserveonline.org/workspaces/freshwaterbooks/documents/active-river-area-a-conservation-framework-for/view.html
The Nature Conservancy's Ground Water Dependent Ecosystem Assessment http://tinyurl.com/GDE-Workspace
U.S. Environmental Protection Agency's National Lakes Assessment http://water.epa.gov/type/lakes/lakessurvey_index.cfm
U.S. Environmental Protection Agency's National Rivers and Streams Assessment (NRSA) http://water.epa.gov/type/rsl/monitoring/riverssurvey/riverssurvey_index.cfm
U.S. Environmental Protection Agency's Recovery Potential Screening Tools http://www.epa.gov/recoverypotential
U.S. Environmental Protection Agency's Regional Vulnerability Assessment Program http://www.epa.gov/reva/
U.S. Geological Survey's Aquatic GAP Analysis Program http://www.gap.uidaho.edu/projects/aquatic/default.htm
U.S. Geological Survey's Regional and National Monitoring and Assessments of Streams and Rivers http://water.usgs.gov/nawqa/studies/mrb/

California
California Healthy Streams Partnership http://www.swrcb.ca.gov/mywaterquality/monitoring_council/meetings/2011jun/hsp_outreach.pdf
California Rapid Assessment Method http://www.cramwetlands.org/
California Watershed Assessment Manual http://cwam.ucdavis.edu/
Connecticut
Connecticut Department of Environmental Protection's Least Disturbed Watersheds http://www.ct.gov/dep/lib/dep/water/water_quality_management/ic_studies/least_disturbed_rpt.pdf
Delaware
Delaware River Basin Commission's use of Antidegradation http://www.state.nj.us/drbc/spw.htm
Kansas
Kansas Department of Health and Environment's Least Disturbed Watersheds Approach http://www.kdheks.gov/befs/download/bibliography/Kansas_reference_stream_report.pdf
Maine
Enabling Source Water Protection in Maine http://www.landuseandwater.org/index.htm
Headwaters: A Collaborative Conservation Plan for the Town of Sanford, Maine http://swim.wellsreserve.org/results.php?article=828Conservation%20Strategy%20September%207,%202010.pdf
Maine Department of Environmental Protection's Tiered Aquatic Life Uses http://www.maine.gov/dep/water/monitoring/biomonitoring/index.html
Maryland
Anne Arundel County's Greenways Master Plan http://www.aacounty.org/PlanZone/MasterPlans/Greenways/Index.cfm
Cecil County, Maryland Green Infrastructure Plan http://www.conservationfund.org/sites/default/files/CecilCounty01.22.08.pdf
Maryland Department of Natural Resources Green Infrastructure Assessment http://www.greenprint.maryland.gov/
Maryland Department of Natural Resources' Physical Habitat Index for Freshwater Wadeable Streams http://www.dnr.state.md.us/irc/docs/00014357.pdf
Michigan
Michigan's Natural Rivers Program http://www.michigan.gov/dnr/0,1607,7-153-30301_31431_31442---,00.html
Michigan's Regional Scale Habitat Suitability Model to Assess the Effects of Flow Reduction on Fish Assemblages in Michigan Streams http://www.michigan.gov/documents/dnr/RR2089_268570_7.pdf
Michigan's Water Withdrawal Assessment http://web2.msue.msu.edu/bulletins/Bulletin/PDF/WQ60.pdf

Minnesota
Minnesota Department of Natural Resources' Fen Protection Program http://www.dnr.state.mn.us/eco/wetlands/index.html
Minnesota Department of Natural Resources Watershed Assessment Tool http://www.dnr.state.mn.us/watershed_tool/index.html
Minnesota Healthy Watersheds Program http://files.dnr.state.mn.us/aboutdnr/reports/legislative/2010_healthy_watersheds.pdf
Minnesota National Lakes Assessment http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/lakes/lake-water-quality/national-lakes-assessment-project-nlap.html?menuid=&redirect=1
Missouri
The U.S. Forest Service and Trust for Public Land's Lower Meramec Drinking Water Source Protection Project http://cloud.tpl.org/pubs/landwater-lowermer-swp-brochure.pdf
North Carolina
National Wild and Scenic Rivers: Lumber River, North Carolina http://www.rivers.gov/wsr-lumber.html
Ohio
Ohio Environmental Protection Agency's Primary Headwaters Habitat Assessment http://www.epa.state.oh.us/dsw/wqs/headwaters/index.aspx
Ohio Environmental Protection Agency's Statewide Biological and Water Quality Monitoring and Assessment http://www.epa.state.oh.us/dsw/bioassess/ohstrat.aspx
Ohio Rapid Assessment Method http://www.epa.ohio.gov/dsw/wetlands/WetlandEcologySection.aspx#ORAM
U.S. Geological Survey's Ohio Aquatic GAP Analysis: An Assessment of the Biodiversity and Conservation Status of Native Aquatic Animal Species http://pubs.er.usgs.gov/usgspubs/ofr/ofr20061385
Oklahoma
Oklahoma National Rivers and Streams Assessment http://www.owrb.ok.gov/studies/reports/reports_pdf/REMAP-OKStreamRiver_ProbMonitorNetwork.pdf
Oregon
Identifying GDEs and Characterizing their Ground Water Resources in the Whychus Creek Watershed http://tinyurl.com/GDE-Workspace
Oregon Department of Environmental Quality's Oregon Water Quality Index http://www.deq.state.or.us/lab/wqm/wqimain.htm
Oregon Natural Heritage Information Center http://orbic.pdx.edu/
Oregon Watershed Enhancement Board's Oregon Watershed Assessment Manual http://www.oregon.gov/OWEB/docs/pubs/OR_wsassess_manuals.shtml#OR_Watershed_Assessment_Manual
Pennsylvania
Pennsylvania Natural Heritage Program's Aquatic Community Classification and Watershed Conservation Prioritization http://www.naturalheritage.state.pa.us/aquaticsIntro.aspx
Tennessee
Beaver Creek Green Infrastructure Plan (Knox County, TN) http://ww2.tdot.state.tn.us/sr475/library/bcgitdot.pdf

Texas
San Antonio River Basin Instream Flow Assessment http://www.twdb.state.tx.us/instreamflows/sanantonioriverbasin.html
Texas Instream Flow Program http://www.tceq.state.tx.us/permitting/water_supply/water_rights/eflows/resources.html
The Central Texas Greenprint for Growth: A Regional Action Plan for Conservation and Economic Opportunity http://envisioncentraltexas.org/resources/GreenprintMkt.pdf
Utah
Rapid Stream Riparian Assessment http://wildutahproject.org/files/images/rsra-ug2010v2_wcover.pdf
Vermont
Geomorphic Assessment and River Corridor Planning of the Batten Kill Main-Stem and Major Tributaries, Vermont http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_geoassess.htm
Vermont Agency of Natural Resources River Corridor Protection Program http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_restoration.htm
Vermont Agency of Natural Resources' Stream Geomorphic and Reach Habitat Assessment Protocols http://www.vtwaterquality.org/rivers/htm/rv_geoassess.htm
Virginia
Green Infrastructure in Hampton Roads, Virginia http://www.hrpdc.org/PEP/PEP_Green_InfraPlan2010.asp
Virginia Conservation Lands Needs Assessment Vulnerability Model http://www.dcr.virginia.gov/natural_heritage/vclnavulnerable.shtml
Virginia Department of Conservation and Recreation's Healthy Waters Program www.dcr.virginia.gov/healthywaters
Virginia Department of Conservation and Recreation's Interactive Stream Assessment Resource (INSTAR) http://instar.vcu.edu
Virginia Department of Conservation and Recreation Natural Landscape Assessment http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml
Virginia Department of Conservation and Recreation Watershed Integrity Model http://www.dcr.virginia.gov/natural_heritage/vclnawater.shtml
Virginia Land Conservation Data Explorer www.vaconservedlands.org
Watershed-Based Zoning in James City County, Virginia http://www.jccegov.com/environmental/index.html
Washington
Washington's Critical Areas Growth Management Act http://www.commerce.wa.gov/site/418/default.aspx
Wyoming
Wyoming Department of Environmental Quality's Aquifer Sensitivity and Ground Water Vulnerability Assessment http://waterplan.state.wy.us/plan/green/techmemos/swquality.html
The Wyoming Joint Ventures Steering Committee's Wetlands Conservation Strategy http://gf.state.wy.us/habitat/WetlandConservation/Wyoming%20Wetlands%20Conservation%20Strategy%20September%207,%202010.pdf

Assessment Examples

Landscape Condition
Anne Arundel County's Greenways Master Plan http://www.aacounty.org/PlanZone/MasterPlans/Greenways/Index.cfm
Beaver Creek Green Infrastructure Plan (Knox County, TN) http://ww2.tdot.state.tn.us/sr475/library/bcgitdot.pdf
Green Infrastructure in Hampton Roads, Virginia http://www.hrpdc.org/PEP/PEP_Green_InfraPlan2010.asp
Interagency Fire Regime Condition Class http://frames.nbii.gov/documents/frcc/documents/FRCC+Guidebook_2008.10.30.pdf
Maryland Department of Natural Resources Green Infrastructure Assessment http://www.greenprint.maryland.gov/
The Nature Conservancy's Active River Area http://conserveonline.org/workspaces/freshwaterbooks/documents/active-river-area-a-conservation-framework-for/view.html
Virginia Department of Conservation and Recreation's Natural Landscape Assessment http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml
Virginia Land Conservation Data Explorer www.vaconservedlands.org
Habitat
California Rapid Assessment Method http://www.cramwetlands.org/
Maryland Department of Natural Resources' Physical Habitat Index for Freshwater Wadeable Streams http://www.dnr.state.md.us/irc/docs/00014357.pdf
Ohio Environmental Protection Agency's Primary Headwaters Habitat Assessment http://www.epa.state.oh.us/dsw/wqs/headwaters/index.aspx
Ohio Rapid Assessment Method http://www.epa.ohio.gov/dsw/wetlands/WetlandEcologySection.aspx#ORAM
Process for Assessing Proper Functioning Condition ftp://ftp.blm.gov/pub/nstc/techrefs/Final%20TR%201737-9.pdf
Rapid Stream Riparian Assessment http://wildutahproject.org/files/images/rsra-ug2010v2_wcover.pdf

Hydrology
Ecological Limits of Hydrologic Alteration http://www.conserveonline.org/workspaces/eloha
Identifying GDEs and Characterizing their Ground Water Resources in the Whychus Creek Watershed http://tinyurl.com/GDE-Workspace
Michigan's Regional Scale Habitat Suitability Model to Assess the Effects of Flow Reduction on Fish Assemblages in Michigan Streams http://www.michigan.gov/documents/dnr/RR2089_268570_7.pdf
San Antonio River Basin Instream Flow Assessment http://www.twdb.state.tx.us/instreamflows/sanantonioriverbasin.html
Texas Instream Flow Program http://www.tceq.state.tx.us/permitting/water_supply/water_rights/eflows/resources.html
The Nature Conservancy's Ground Water Dependent Ecosystem Assessment http://tinyurl.com/GDE-Workspace
Geomorphology
Vermont Agency of Natural Resources' Stream Geomorphic and Reach Habitat Assessment Protocols http://www.vtwaterquality.org/rivers/htm/rv_geoassess.htm
Geomorphic Assessment and River Corridor Planning of the Batten Kill Main-Stem and Major Tributaries, Vermont http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_battenkillreport.pdf
Water Quality
Oregon Department of Environmental Quality's Oregon Water Quality Index http://www.deq.state.or.us/lab/wqm/wqimain.htm
Biological Condition
Biological Condition Gradient and Tiered Aquatic Life Uses http://www.epa.gov/bioindicators/html/bcg.html
Index of Biotic Integrity (IBI) http://www.epa.gov/bioiweb1/html/ibi_history.html
Maine Department of Environmental Protection's Tiered Aquatic Life Uses http://www.maine.gov/dep/water/monitoring/biomonitoring/index.html
Natural Heritage Program Biodiversity Assessments http://www.natureserve.org/aboutUs/network.jsp
Ohio Environmental Protection Agency's Statewide Biological and Water Quality Monitoring and Assessment http://www.epa.state.oh.us/dsw/bioassess/ohstrat.aspx
Oregon Natural Heritage Information Center http://orbic.pdx.edu/
U.S. Geological Survey's Aquatic GAP Analysis Program http://www.gap.uidaho.edu/projects/aquatic/default.htm
U.S. Geological Survey's Ohio Aquatic GAP Analysis: An Assessment of the Biodiversity and Conservation Status of Native Aquatic Animal Species http://pubs.er.usgs.gov/usgspubs/ofr/ofr20061385
Virginia Department of Conservation and Recreation's Interactive Stream Assessment Resource (INSTAR) http://instar.vcu.edu

National Aquatic Resource Assessments
Minnesota National Lakes Assessment http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/lakes/lake-water-quality/national-lakesassessment-project-nlap.html?menuid=&redirect=1
Oklahoma National Rivers and Streams Assessment http://www.owrb.ok.gov/studies/reports/reports_pdf/REMAP-OKStreamRiver_ProbMonitorNetwork.pdf
U.S. Environmental Protection Agency's National Lakes Assessment http://water.epa.gov/type/lakes/lakessurvey_index.cfm
U.S. Environmental Protection Agency's National River and Streams Assessment (NRSA) http://water.epa.gov/type/rsl/monitoring/riverssurvey/riverssurvey_index.cfm
U.S.Geological Survey's Regional and National Monitoring and Assessments of Streams and Rivers http://water.usgs.gov/nawqa/studies/mrb/
Integrated Assessments
California Watershed Assessment Manual http://cwam.ucdavis.edu/
Connecticut Department of Environmental Protection's Least Disturbed Watersheds http://www.ct.gov/dep/lib/dep/water/water_quality_management/ic_studies/least_disturbed_rpt.pdf
U.S. Environmental Protection Agency's Recovery Potential Screening Tool www.epa.gov/recoverypotential/
Kansas Department of Health and Environment's Least Disturbed Watersheds Approach http://www.kdheks.gov/befs/download/bibliography/Kansas_reference_stream_report.pdf
Minnesota Department of Natural Resources' Watershed Assessment Tool http://www.dnr.state.mn.us/watershed_tool/index.html
National Fish Habitat Assessment http://fishhabitat.org/
Oregon Watershed Enhancement Board's Watershed Assessment Manual http://www.oregon.gov/OWEB/docs/pubs/OR_wassess_manuals.shtml#OR_Watershed_Assessment_Manual
Pennsylvania Natural Heritage Program's Aquatic Community Classification and Watershed Conservation Prioritization http://www.naturalheritage.state.pa.us/aquaticsIntro.aspx
Virginia Department of Conservation and Recreation's Watershed Integrity Model http://www.dcr.virginia.gov/natural_heritage/vclnawater.shtml
Vulnerability
U.S. Environmental Protection Agency's Regional Vulnerability Assessment Program http://www.epa.gov/reva/
Virginia Conservation Lands Needs Assessment Vulnerability Model http://www.dcr.virginia.gov/natural_heritage/vclnavulnerable.shtml
Wyoming Department of Envrionmental Quality's Aquifer Sensitivity and Ground Water Vulnerability Assessment http://waterplan.state.wy.us/plan/green/techmemos/swquality.html

Management Examples

National
Enabling Drinking Water Source Protection http://www.landuseandwater.org/
The Nature Conservancy's Approach to Setting Freshwater Conservation Priorities http://www.conservationgateway.org/topic/setting-freshwater-priorities
U.S. Environmental Protection Agency's Healthy Watersheds Initiative Website http://water.epa.gov/healthywatersheds
State/Interstate
California Healthy Streams Partnership http://www.swrcb.ca.gov/mywaterquality/monitoring_council/meetings/2011jun/hsp_outreach.pdf
Delaware River Basin Commission's use of Antidegradation http://www.state.nj.us/drbc/spw.htm
Enabling Source Water Protection in Maine http://www.landuseandwater.org/maine.html
Maryland's GreenPrint Program www.greenprint.maryland.gov
Minnesota Department of Natural Resources' Fen Protection Program http://www.dnr.state.mn.us/eco/wetlands/index.html
Minnesota Healthy Watersheds Program http://files.dnr.state.mn.us/aboutdnr/reports/legislative/2010_healthy_watersheds.pdf
NatureServe's Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin http://www.natureserve.org/library/uppermsriverbasin.pdf
Michigan's Natural Rivers Program http://www.michigan.gov/dnr/0,1607,7-153-30301_31431_31442---,00.html
Michigan's Water Withdrawal Assessment http://web2.msue.msu.edu/bulletins/Bulletin/PDF/WQ60.pdf
The Wyoming Joint Ventures Steering Committee's Wetlands Conservation Strategy http://gf.state.wy.us/habitat/WetlandConservation/Wyoming%20Wetlands%20Conservation%20Strategy%20September%207,%202010.pdf
Vermont Agency of Natural Resources River Corridor Protection Program http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_restoration.htm
Virginia Department of Conservation and Recreation's Healthy Waters Program www.dcr.virginia.gov/healthywaters
Washington's Critical Areas Growth Management Act http://www.commerce.wa.gov/site/418/default.aspx

Local
Cecil County, Maryland Green Infrastructure Plan http://www.conservationfund.org/sites/default/files/CecilCounty01.22.08.pdf
Headwaters: A Collaborative Conservation Plan for the Town of Sanford, Maine http://www.wellsreserve.org/blog/63-headwaters_a_collaborative_conservation_plan_for_the_town_of_sanford
National Wild and Scenic Rivers: Lumber River, North Carolina http://www.rivers.gov/wsr-lumber.html
The Central Texas Greenprint for Growth: A Regional Action Plan for Conservation and Economic Opportunity http://envisioncentraltexas.org/resources/GreenprintMkt.pdf
The U.S. Forest Service and Trust for Public Land's Lower Meramec Drinking Water Source Protection Project http://cloud.tpl.org/pubs/landwater-lowermer-swp-brochure.pdf
Watershed-Based Zoning in James City County, Virginia http://www.jccegov.com/environmental/index.html

U.S. Environmental Protection Agency
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