U.S. Environmental Protection Agency
Recovery Potential Screening

The U.S. Environmental Protection Agency (EPA) developed the Recovery Potential Screening (RPS) methodology and tools to enable states and other restoration planners to systematically compare relative differences in the restorability of individual hydrologic units (HUC12s) or water bodies using readily-available GIS data and other georeferenced monitoring information. The tool can be applied by users to compare differences among watersheds or streams within larger geographic units (e.g., HUC8s, ecoregions, states) based on assessments of ecological capacity, stressor exposure, and social context – the three major driving forces affecting restoration success. These three indices can be combined to obtain an overall recovery potential integrated (RPI) score, which summarizes the general restorability of each watershed or impaired water body as compared to the others being assessed. Originally developed to support the prioritization of restoration projects as part of Total Maximum Daily Load (TMDL) and impaired waters listing programs, the tool may also be applied to support a variety of other programs including nonpoint source control, healthy watersheds protection planning, and fisheries management.

OVERVIEW

Lead developer(s): Doug Norton, EPA Office of Water; Jim Wickham, EPA Office of Research and Development (ORISE); and Tatyana DiMascio, ORISE.[1]

Year developed: 2009.[1]

Geographic area: To date, the tool has been applied in Maryland (Fig. 1), Massachusetts, Pennsylvania, Michigan, Minnesota, Illinois and Vermont to individual watersheds (e.g., HUC12s) as well as lakes and streams (e.g., 303(d) listed waters). It has also been applied to regional areas (e.g., mid-Atlantic states, southeastern states).

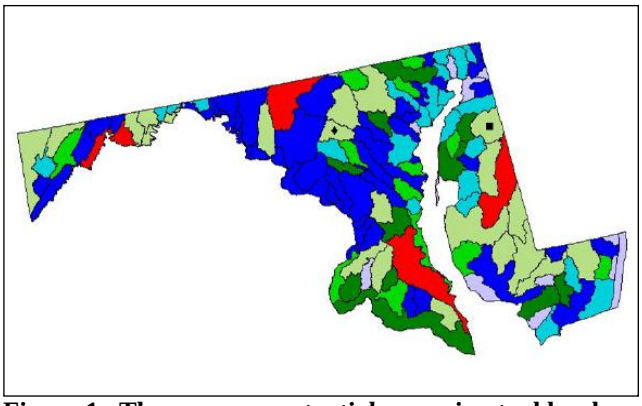


Figure 1. The recovery potential screening tool has been applied for Maryland at two different watershed scales. The tool has also been applied in a variety of other regions and states. Used with permission of U.S. EPA.

Resource types: Watersheds or water bodies (all types).[1]

Restoration/conservation: Restoration (reestablishment and rehabilitation), preservation/protection, and risk reduction.[1]

Stakeholders: The primary target audience has been surface water programs at the state level due to EPA's frequent role as technical assistance to state-delegated CWA programs. Watershed groups may represent a larger additional audience. Federal environmental agencies likewise may develop useful RPS applications to public lands management.[1]

Updated: 5/8/2012

Current status: RPS originated as a technique to address restorability of impaired waters or watersheds through comparative assessment in a non-regulatory, strategic planning sense. Its applicability has broadened with use to include assessment of factors relevant to protection and risk reduction among healthy watersheds. The RPS is currently being implemented: EPA's RPS website is now active (see www.epa.gov/recoverypotential), EPA's Office of Water is actively supporting RPS development and project management activities, EPA funding is supporting technical (GIS and facilitation) assistance for state screening projects, and several new state project startups took place in 2012. Among other uses, screening results have been used by Massachusetts to revise statewide strategies for applying Clean Water Act (CWA) 319 nonpoint source funding to watersheds, by Maryland (in conjunction with other sources) to inform priorities for TMDL and 319 programs, and by Pennsylvania to successfully advocate for subwatershed fisheries restoration proposals.[1]

PRIORITIZATION ANALYSIS

Determination of prioritization objectives: The central objective of most RPS users is to learn more about restorability differences among watersheds or water bodies and the factors that explain these differences. Most users are driven by the desire to improve functions and values in more places by considering restorability differences more systematically and making strategic decisions about investments of limited resources on this basis. As a highly flexible methodology, user-identified objectives are numerous and varied. RPS generally uses a roundtable facilitation approach through which stakeholders within workgroups identify the initial objectives. However, a project can also start with a single targeted objective.[1]

Determination of input factors/weightings: After identifying initial stakeholder objectives, EPA then solicits stakeholder feedback to identify relevant input factors and weightings to be applied by the RPS prioritization tool. RPS indicators are developed based on published literature linking parameters to restorability differences in case studies. RPS routinely uses reference healthy watersheds along with impaired watersheds to validate the performance of individual indicators and all multi-metric indices.[1]

Input data QA/QC: All projects develop and follow a required QA/QC plan that addresses evaluation of data sources, although generally the producers of the most commonly used GIS data have already undertaken a quality assurance process before finalizing their data.[1]

Landscape prioritization tool(s): The Recovery Potential Screening Tool compares differences in the likelihood of impaired waters to return to a desired condition by calculating three multi-metric indices: ecological capacity, stressor exposure, and social context. Each of these can be used independently, but the user also obtains an overall recovery potential score for each unit by adding each watershed's 'ecological capacity' score with its 'social context' score and dividing by its 'stressor exposure' score. The tool calculates ecological, stressor, and social indices for each unit based on a variety of indicators, examples of which are provided in Tables 1-4. The results are compared within the population of units being assessed. By assessing subwatershed units within HUC8s, for example, the tool identifies areas that might be targeted for restoration either based on their own restorability alone, or to achieve the largest improvement in condition for the HUC8 as a whole.

While the simplest form of screening often provides useful insights about general differences in restorability, further analysis of results is possible by evaluating more homogeneous subsets of the full population of waters or watersheds being compared. For example, you can screen pathogen-impaired watersheds with a narrower selection of ecological, stressor, and social indicators that best address pathogen impairment and recovery factors, or, you can screen urban watersheds separately from agricultural watersheds. Correlation analysis can be carried out to support indicator selection by reducing the number of redundant or highly correlated metrics.[1]

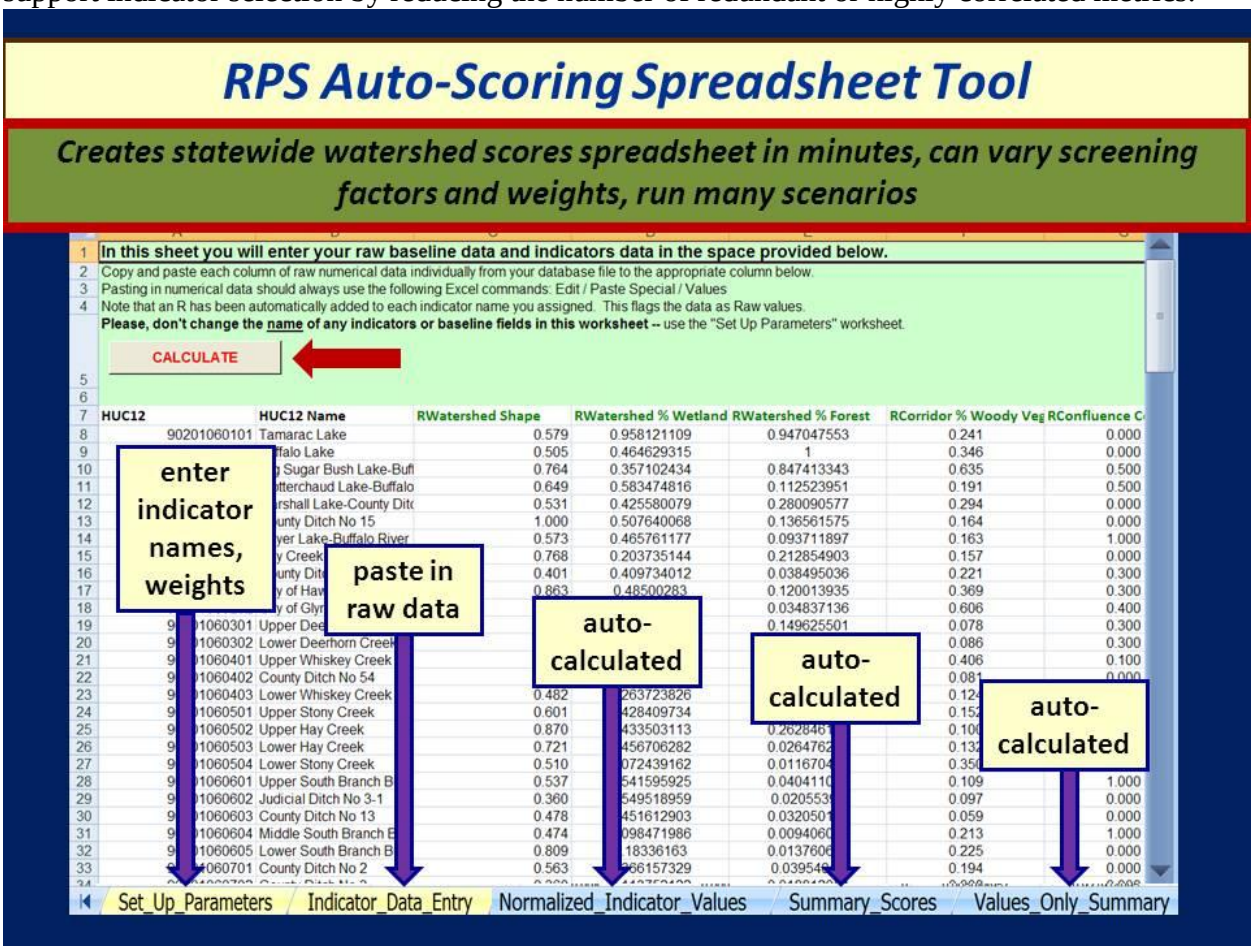


Figure 2. In this auto-scoring spreadsheet developed by EPA, users can enter ecological, stressor, and social indicator raw values for each HUC12 to obtain recovery potential index scores and rank-ordering across HUC12s.[2] Used with permission of U.S. EPA.

Ecological capacity tool: This tool evaluates the ecological condition (and if possible, capacity to regain functions) of hydrologic units in terms of physical/biotic structure and key natural processes.[2] Examples of factors and associated data sources used to assess ecological capacity are provided in Table 1.

Prioritization objectives assessed:

- Habitat quality

Table 1. EPA scores hydrologic units for 'ecological capacity' using the factors and data sources listed below.[3]

Factor used in analysis	Data source(s)
Watershed natural structure	
Watershed percentage natural cover	NLCD[4]; NRCS WBD[5]; NHDplus catchments[6]; statewide land cover data from state-specific sources
Watershed percentage forest	NLCD[4]; NRCS WBD[5]; NHDplus catchments[6]; statewide land cover data from state-specific sources
Watershed percentage wetlands	NLCD[4]; NWI[7]; NRCS WBD[5]; NHDplus catchments[6]; statewide land cover data from state-specific sources
Watershed percentage woody vegetation	NLCD[4]; NRCS WBD[5]; NHDplus catchments[6]; statewide land cover data from state-specific sources
Watershed topographic complexity	USGS NED[8]; USGS EDNA[9]; NHD plus flowline elevation data[6]
Watershed forest patch mean area	NLCD[4]; NRCS WBD[5]; NHDplus catchments[6]
Watershed soil resilience	NRCS Soil Data Mart[10]; statewide digital soil survey data
Watershed percentage stream length unimpaired	EPA geospatial data CWA §303(d) impaired waters listings[11]
Watershed shape (more elongated watersheds score higher)	NRCS WBD[5]
Watershed size (watersheds with smaller areas score higher)	NRCS WBD[5]; NHDplus catchments[6]
Corridor and shorelands stability	
Bank stability/soils (percentage of stream length passing through highly erosive soil types)	NRCS Soil Data Mart[10]
Bank stability/woody vegetation (percentage of bank length with woody vegetation)	NLCD[4]; NOAA Coastal Change Analysis Program coastal area land cover data[12]; NHDplus flowline land cover flowline attribute data[6]
Corridor percentage forest	NLCD[4]
Corridor percentage woody vegetation	NLCD[4]; NOAA Coastal Change Analysis Program coastal area land cover data[12]
Corridor percentage wetlands	NLCD[4]; NWI[7]
Corridor slope	USGS EDNA[9]
Corridor soil erosion potential	NRCS Soil Data Mart[10]
Corridor soil types (soils better for nitrogen processing, stability/erosion resistance, and other factors score higher)	NRCS Soil Data Mart[10]
Shoreline percentage forested	NLCD[4]
Shoreline percentage woody vegetation	NLCD[4]
Flow and channel dynamics	
Natural channel form (linear percentage of total reach length in natural channel form	NHD[8]; state/locally compiled channelization metrics

Corridor groundwater level (average depth to water table over a specific size area)	Not often available as continuous landscape data[13]
Channel slope (change in elevation over channel length)	USGS EDNA[9]
Sinuosity (channel segment length divided by straight line length)	NHD[8]
Confinement ratio (valley floor width divided by stream channel width)	Aerial photography; field data
Channel evolution status	Spatial data for this factor are unlikely to be found but guidance on evaluating successional status is available from EPA[14]
Fine sediment transport capacity	High-resolution NHD[8]; field measurements
Natural flow regime	Data on flow regime are limited. Using specific measures of one or more of the five flow regime components is more feasible than a single metric to summarize flow regime overall.
Median flow maintenance (departure from median monthly flow with reference to natural streamflow regimes)	Gauging station data
Low flow maintenance (annual 7-day minimum flow or frequency and duration with which flow drops below a given threshold)	N/A
Stahler stream order	NHDplus value-added attributes data[6]; Mid-Atlantic Landscape Atlas[15]
Biotic community integrity	
Biotic community integrity	State monitoring datasets (e.g., Benthic IBI for Puget Sound Lowlands[16] or NatureServe ecologic integrity assessment data[17])
Rare taxa presence	NatureServe Explorer[18]; USDA Plants Database[19]; USFWS Critical Habitat Portal[20]
Trophic state (measured categorically with weights assigned between eutrophic and oligotrophic extremes)	Standard data sources usually do not exist unless compiled through state monitoring programs or special studies.
NFHAP fish habitat condition index	NFHAP map viewer[21]
Aquatic connectivity	
Confluence density (count of confluences per mile of watershed total stream length	NHDplus Strahler stream order data[6]
Unimpaired confluences density (count of confluences of unimpaired channels per mile of impaired segments)	Impaired segment shapefiles from ATTAINS[22]; NHDplus Stahler Order data[6]
Watershed stream density	NHDplus[6]
Contiguity with green infrastructure corridor	Statewide data for intact and ecologically functional stream corridors and larger natural habitat "hubs" (e.g., data for Maryland[23] or California[24])
Proximity to green infrastructure hub (GI	Statewide data for intact and ecologically functional

hub percentage of watershed/stream segment)	stream corridors and larger natural habitat "hubs" (e.g., data for Maryland[23] or California[24])
Recolonization access (count of confluences with +/-1 Strahler stream order unimpaired channels per mile of impaired segment)	Impaired segment shapefiles from ATTAINS[22]; NHDplus Strahler stream order data[6]; dam location data where available
Ecological history	
Maintenance of percentage natural cover (change in total percentage of land area in watershed within forest, shrubland, wetlands, grasslands, desert, and barren land categories)	NLCD[4]; statewide land cover data from state-specific sources
Ratio current/historic percentage forest	NLCD[4]; statewide data on potential natural vegetation cover that provide an approximation of pre-settlement vegetation types and distribution
Ratio current/historic percentage wetlands	NLCD[4]; NWI[7]
Historical species occurrence	USFWS Critical Habitat Portal[20]; historical information available through State Fish and Wildlife Service (e.g., Oregon[25]).
Species range	USFWS Critical Habitat Portal, historical information available through State Fish and Wildlife Service (e.g., Oregon[25])

NLCD = National land cover database; NRCS WBD = Natural Resource Conservation Service Watershed Boundary Dataset; NHD = National Hydrography Dataset; USGS NED = United States Geological Survey National Elevation Dataset; NWI = United States Fish and Wildlife National Wetland Inventory; NFHAP = National Fish Habitat Action Partnership; ATTAINS = Assessment TMDL Tracking and ImplementatioN System

Stressor exposure tool: This tool evaluates ecological condition in terms of stressors and their sources for each hydrologic unit. Examples of factors and associated data sources used to assess stressor exposure are provided in Table 2.

Prioritization objectives assessed:

- Aquatic resource condition

Table 2. EPA scores hydrologic units for 'stressor exposure' using the factors and data sources listed below.[26]

Factor used in analysis	**Data source(s)**
Watershed-level disturbance	
Watershed percentage agriculture	NLCD 1992[27]; NLCD 2001[28]; NLCD 2006[29]; various state sources for land cover data; USGS cropland data by county[30]; NHDplus catchments[6]; USDA national GIS crop dataset[31]; BLM dataset on range allotments and pastures[32]
Watershed percentage steep slope agriculture	NLCD 1992[27]; NLCD 2001[28]; NLCD 2006[29]; various state source for land cover data; USGS cropland data[31]; USGS NED[8]; USGS EDNA[9]; NHDplus flowline elevation data[6]
Watershed number of CAFOs	State records mapping CAFO locations and

	livestock species and numbers
Watershed number of septic systems (zones of potential septic usage and assumed partial failure rates)	Non-sewered area maps; Municipality-level individual septic records; Septic failure rate coefficient from watershed studies and TMDLs
Watershed percentage impervious cover	NLCD 2001[28]; NLCD 2006[29]; NHDplus catchments[6]
Watershed percentage tile-drained cropland	State-level digital soil survey data; NRCS Soil Data Mart[10]; NLCD 1992[27]; NLCD 2001[28]; NLCD 2006[29]; various state sources of land cover data; USGS cropland by county[30]; USDA national GIS crop dataset[31]
Watershed percentage U index (percentage anthropogenic cover types)	NLCD[4]; statewide land cover data from state-specific sources
Watershed percentage urban	NLCD[4]; statewide land cover data from state-specific sources
Watershed road density (mean road length per watershed square mile)	Transportation GIS datasets; National road and stream data from the National Atlas[33]; ESRI roads dataset[34]
Other percentage of watershed stressors (e.g., surface mining for some watersheds)	Dependent upon additional stressors identified
Corridor and shoreland disturbance	
Corridor percentage impervious cover	NLCD 2001[28] and 2006[29] data for impervious and urban land cover; NHDplus catchments[6]
Corridor percentage tile-drained cropland	State-level digital soil survey data; NRCS Soil Data Mart[10]; NLCD 1992[27]; NLCD 2001[28]; NLCD 2006[29]; various state sources of land cover data; USGS cropland by county[30]; USDA national GIS crop dataset[31]
Corridor percentage U-index (percentage anthropogenic land cover types)	NLCD[4]; statewide land cover data from state-specific sources
Corridor percentage urban	NLCD[4]; statewide land cover data from state-specific sources
Corridor percentage agriculture	NLCD 1992, NLCD 2001; NLCD 2006; various state sources for land cover data; USGS cropland by county[30]; USDA national GIS crop dataset[31]; BLM data on range allotments and pastures[32]
Linear percentage of channel through agriculture (percentage total stream length through agricultural land use or percentage agricultural area adjacent to stream)	Stream hydrography data; land cover data
Corridor road crossings	National road and stream data from the National Atlas[33]; Landsat data for roads and stream from USGS Earth Explorer[35]; ESRI roads dataset[34]; data for unimproved road crossings in remote parts of federal lands from land management agency.
Corridor road density	National road and stream data from the National

	Atlas[33]; ESRI roads dataset[34]
Hydrologic alteration	
Aquatic barriers (count per watershed or relative isolation of specific stream segment of similar Strahler order)	Aquatic barriers to fish passage from the USFWS Decision Support System[36]; major dams mapping by the USACE National Inventory of Dams[37]; NHD data on dams and divergence structures[8]
Channelization (percentage of total impaired stream length artificially straightened)	USGS NHD[8]; local resources; channelization attribute data for 303(d) listed streams included in EPA ATTAINS data system[22]
Hydrologic alteration (scores waterbody segments downstream of dams or withdrawals based on dam size, active status, role on flow alteration and feasibility of flow management)	Aquatic barriers to fish passage from the USFWS FPDSS[36]; major dams mapping by the USACE National Inventory of Dams[37]; NHD data on dams and divergence structures[8]; State data on water withdrawal locations (e.g., Michigan[38])
Relative net water demand	Gauging station records, which may be used to develop natural flow estimators and calculate water demand relative to natural flow
Water use intensity	Gauging station records, which may be used to develop natural flow estimators and calculate water demand relative to natural flow
Biotic or climatic risks	
Elevation (mean elevation of the watershed or specific stream segment)	USGS NED[8]; USGS EDNA[9]; NHDplus flowline elevation data[6]
Invasive species risk	USGS Non-Indigenous Aquatic Species Information Resource[39]; Non-Indigenous Species Database Network range maps[40]; USDA National Invasive Species Information Center[41]
Severity of pollutant loading	
Number of 303d listed causes	ATTAINS[22]
Number of permits	EPA's national geospatial dataset on permits
CSO or MS4 areas	Spatial data available at state and municipal level
Age of sewer infrastructure	Spatial data available at municipal level
Severity of loading (compares current loading with TMDL target loading calculation for percentage reduction needed)	ATTAINS data on 303(d)-listed waters[22]; loading estimates from TMDLs or watershed models (e.g., from EPA's website)[42]
Stressor persistence	Project specific
SPARROW nitrogen loading estimate	Water quality data from EPA's NPDAT website[43]; regional modeling data from the USGS decision support system[44]
SPARROW phosphorus loading estimate	Water quality data from EPA's NPDAT website[43]; regional modeling data from the USGS decision support system[44]
Watershed stream miles impaired	EPA ATTAINS data on 303(d)-listed waters[22]
Watershed water body acres impaired	EPA ATTAINS data on 303(d)-listed waters[22]
Modeled watershed aerial N deposition	N/A

Updated: 5/8/2012

Modeled watershed aerial Hg deposition	REMSAD; CMAQ; range of likely impacts from foreign sources[45]
Other stressor-specific severity factors	Project-specific stressor data
Legacy of past, trajectory of future use	
Land use change trajectory	NLCD 1992[27]; NLCD 2001[28]; NLCD 2006[29]; USGS Land Cover Trends Project[46]; USGS Temporal Urban Mapping project[47]; USGS Historical Topographic Map Collection[48]
Legacy land uses	USGS Land Cover Institute[49]; NLCD 1992[50]; NLCD land use change between 2001 and 2006[27]; Historical Topographic Map Collection[48]
Watershed percentage legacy agriculture	USGS Land Cover Institute[49]; NLCD 1992[50]; NLCD land use change between 2001 and 2006[27]
Watershed percentage legacy urban	USGS Land Cover Institute[49]; NLCD 1992[50]; NLCD land use change between 2001 and 2006[27]; Historical Topographic Map Collection[48]
Corridor percentage legacy agriculture	USGS Land Cover Institute[49]; NLCD 1992[50]; NLCD land use change between 2001 and 2006[27]
Corridor percentage legacy urban	USGS Land Cover Institute[49]; NLCD 1992[50]; NLCD land use change between 2001 and 2006[27]; Historical Topographic Map Collection[48]

NLCD = National Land Cover Dataset; NHD = National Hydrography Dataset; USGS = United States Geological Survey; NED = National Elevation Dataset; USDA = United States Department of Agriculture; BLM = Bureau of Land Management; USACE = United States Army Corps of Engineers; ATTAINS = Assessment TMDL Tracking and ImplementatioN System; NPDAT = Nitrogen and Phosphorus Pollution Data Access Tool; SPARROW = SPAtially Referenced Regressions On Watershed attributes; REMSAD = Regional Modeling System for Aerosols and Deposition; CMAQ = Community Multi-scale Air Quality Model

Social context assessment: Unlike the 'ecological capacity' and 'stressor exposure' tools described above, this tool does not evaluate ecological condition. Instead, it assesses factors known to influence restoration success in each hydrologic unit (Table 3).

Prioritization objectives assessed:

- Feasibility of restoration
- Sustainability of restoration

Table 3. EPA scores hydrologic units for 'social context' using the factors and data sources listed below.[51]

Factor used in analysis	**Data source(s)**
Leadership, organization, and engagement	
Watershed organization leadership (number of watersheds located in each 303(d) watershed)	EPA-ADOPT online database of watershed groups[52]
Watershed collaboration	Presence/absence of a multi-interest organization or use of a group process to rank watersheds
Corridor owner-occupied residential	Local-level property ownership data
Government agency involvement	Stakeholder input on positive agency involvement
Participation rate in land conservation	State-specific sources of spatial data on participation

programs	in conservation programs[53]
Large watershed management potential (scores watersheds based on number of impaired waters within them)	Watershed boundary GIS; 303(d) impaired waters; waters with finalized TMDLs[54]
University proximity	Statewide coverage of university from UnivSource[55] or American Universities[56]
Political support	Available on a statewide basis
Protective ownership or regulation	
Watershed percentage protected land	GAP stewardship data[57]
Applicable regulation	ATTAINS 303(d)-listed waters; EPA identification of impaired waters and waters with completed TMDLs affected by point sources, non-point sources only, or mixed[42]; state-specific regulations; coastal regulations documented by NOAA's Legislative Atlas[58]; EPA list of regulations[59]; zoning maps from county/state sources.
Level of information, certainty, and planning	
Certainty of causal linkages (number of 'cause unknown' waters from 303(d) data; percentage of waters with unknown causes of total length of impaired waters)	ATTAINS cause information in attribute tables linked to 303(d) shapefiles for each state's impaired waters[22]
Percentage identified stressor sources	ATTAINS probable source information[22]; other state estimates of probable sources if available
Certainty of restoration practices (from 'no restoration technique applicable' to 'known technique highly applicable and feasible')	Expert judgment; various stream restoration techniques are available by region through the NRRSS[60] and other online sources
TMDL or watershed plan	National mapped dataset of waters with completed or approved TMDLs from ATTAINS[22,54] or RAD[61]
Watershed education level	U.S. Census educational attainment data[62]
Ratio #TMDLs/#impairments	Number of finalized TMDLs from ATTAINS[22,54] and RAD[61]; Number of impairments from ATTAINS[22,54]
Percentage of stream miles assessed	ATTAINS assessed waters GIS national dataset[22,54]
Percentage of lake acres assessed	ATTAINS assessed waters GIS national dataset[22,54]
Restoration cost, difficulty, or complexity	
Estimated restoration cost	Expert judgment based on impairment type and number and system type/size; NRRSS cost data for stream restoration projects[60]
Jurisdictional complexity (total number of cities, counties, and towns within an impaired watershed)	EPA-BASINS city/county polygon shapefile[63]; ArcGIS online national administrative boundaries[34]; data for other jurisdictions involved in land use decisions and restoration actions
Landownership complexity (presence of over half public ownership; percentage public/private ownership; number of low, medium, and high density urban land cover	Public/private land ownership polygon data; intensity of urban development polygon data

polygons per unit area)	
Recovery time frame (indicated by watershed or waterbody size; number of upstream HUCs)	NRCS WBD[5]
Socio-economic considerations	
Environmental justice area of concern	Project-specific
Local socio-economic stress (based on measures developed by Sonoran Institute)	U.S. Department of Commerce Bureau of Economic Analysis (long and short term employment change, per capita income, housing affordability)[64]; Bureau of Labor Statistics (unemployment rate, natural disaster risk)[65]; Census Bureau (population change, families living under poverty, educational attainment)[66]; NOAA spatial trends for coastal areas[67]; ArcGIS online socio-economic data[68]
Human health, beneficial uses, recognition, and incentives	
Watershed population	U.S. Census Bureau[66]
Recreational resource (water body location relative to recreation land category)	State GIS shapefiles including State Conservation Areas, State Forests, State Fish and Wildlife Areas, State Parks, and other recreational areas; Protected Areas Database[69]; ArcGIS online recreational areas[70]
Watershed number of drinking water intakes	EPA national data relating drinking water intakes to HUC-12 watersheds
Watershed percentage source water protection area	EPA national data relating drinking water intakes to HUC-12 watersheds
Valued ecological attribute (formal recognition by one of several programs aligned with protecting biodiversity, aesthetics, recreational sport, etc.)	NatureServe rarity and biodiversity spatial data[18]; State natural heritage databases[71]; Wild, Scenic, and Recreational Rivers[72]; CWA Outstanding Natural Resource Waters; ArcGIS online Cultural Datasets[73]
Funding eligibility	Active project information or implied eligibility determined from existing spatial data (e.g. agricultural activities, abandoned mines)
Human health and safety	Site-specific monitoring data from hazardous waste, mining, or other programs; Flooding and storm risk data; Beach closings information[74]; Searchable data as part of the Toxics Release Inventory[75]; Hazardous waste geographical queries through the Resource Conservation and Recovery Act[76]
Iconic value of resource	Data obtained from local sources
303(d) schedule priority	303(d)-listed waters

ATTAINS = Assessment TMDL Tracking and ImplementatioN System; GAP = Gap Analysis Project; NRRSS = National River Restoration Science Synthesis (database); TMDL = Total Maximum Daily Load; RAD = Reach Address Database; NRCS WBD = Natural Resource Conservation Service Watershed Boundary Dataset

Recovery potential integrated assessment: Ecological capacity, stressor exposure, and social context indices are combined to obtain an overall recovery potential integrated (RPI) score,

which summarizes the general restorability of each watershed or impaired water body in comparison with the others being assessed.[1]

Prioritization objectives assessed:

- Aquatic resource condition
- Habitat quality
- Feasibility of restoration
- Sustainability of restoration

Table 4. EPA scores hydrologic units for recovery potential integrated score using the factors and data sources listed below.[77]

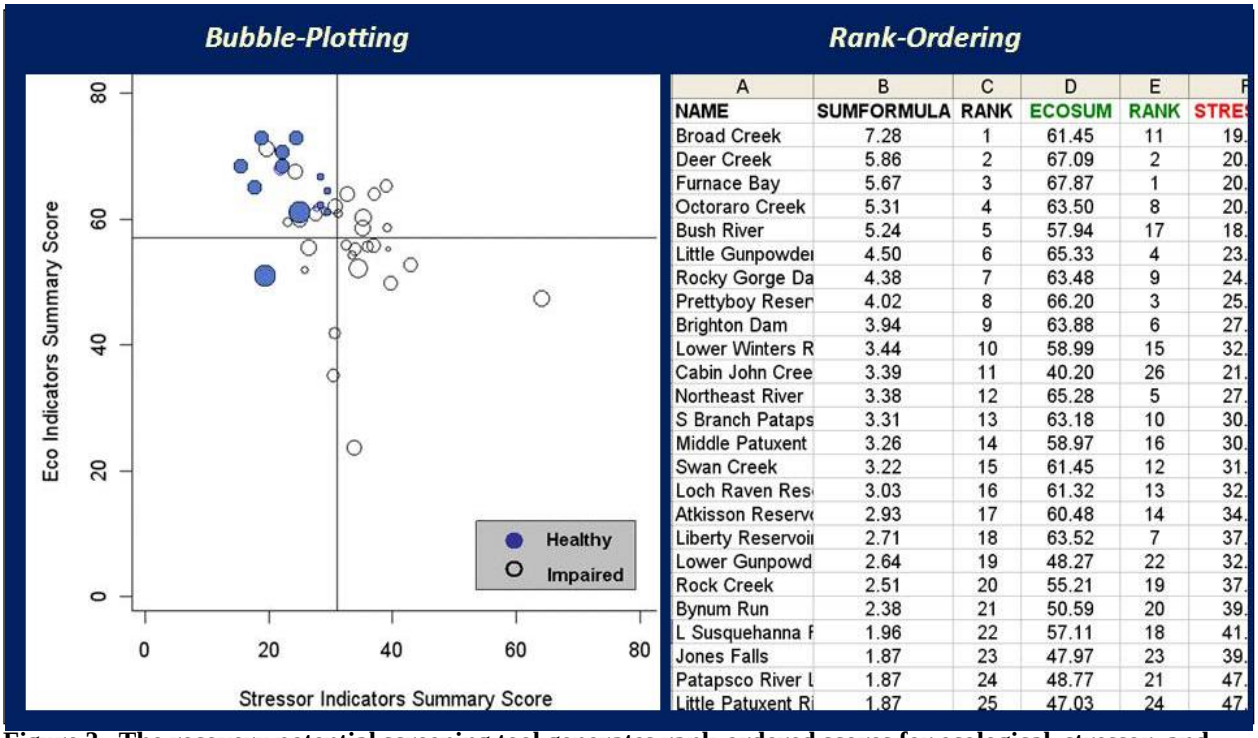
Factor used in analysis	Data source(s)
Ecological capacity	See above
Stressor exposure	See above
Social context	See above

Validation of the landscape prioritization tool(s): Because full recovery watersheds are rare and highly variable, rigorous validation will remain infeasible until sufficient numbers of similar watersheds with screening results and subsequent restoration investments have had time to recover.[1]

Prioritization products: EPA supports Recovery Potential Screening through public availability of a tools and resources website (www.epa.gov/recoverypotential) that contains step-by-step screening directions, indicator and data source reference materials, and downloadable tools. The tools include an "auto-scoring spreadsheet," in which users can enter the indicator values for each hydrologic unit (e.g., from a spatial database file) and press "calculate" to obtain recovery potential scores across units (Fig. 2).[78] This tool automates calculation of the three indices and integrated RPI index, rank-orders each index, and formats data for further use by other RPS tools in bubble plotting and mapping applications.[1]

The user visualizes recovery potential scores using bubble plots that graph ecological index against stressor index with dot size related to social index score (Fig. 3). Mapping the scores may also be used to visualize spatial relationships among HUC12s. For example, the map of Maryland shown in Figure 4, in which HUC12s are color-coded by ecological indicator score, can be used to identify HUC12s in which restoration may be most effective for building larger healthy watershed patch size and establishing healthy corridors by targeting impaired but restorable watersheds in key locations (indicated by the red arrows).[1]

EPA includes step-by-step instructions for applying the RPS tools on its website at: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/methodology.cfm#screeningexample.



A	B	C	D	E	F
NAME	SUMFORMULA	RANK	ECOSUM	RANK	STRES
Broad Creek	7.28	1	61.45	11	19.
Deer Creek	5.86	2	67.09	2	20.
Furnace Bay	5.67	3	67.87	1	20.
Octoraro Creek	5.31	4	63.50	8	20.
Bush River	5.24	5	57.94	17	18.
Little Gunpowder	4.50	6	65.33	4	23.
Rocky Gorge Da	4.38	7	63.48	9	24.
Prettyboy Reser	4.02	8	66.20	3	25.
Brighton Dam	3.94	9	63.88	6	27.
Lower Winters R	3.44	10	58.99	15	32.
Cabin John Cree	3.39	11	40.20	26	21.
Northeast River	3.38	12	65.28	5	27.
S Branch Patapsc	3.31	13	63.18	10	30.
Middle Patuxent	3.26	14	58.97	16	30.
Swan Creek	3.22	15	61.45	12	31.
Loch Raven Res	3.03	16	61.32	13	32.
Atkisson Reserv	2.93	17	60.48	14	34.
Liberty Reservoi	2.71	18	63.52	7	37.
Lower Gunpowd	2.64	19	48.27	22	32.
Rock Creek	2.51	20	55.21	19	37.
Bynum Run	2.38	21	50.59	20	39.
L Susquehanna F	1.96	22	57.11	18	41.
Jones Falls	1.87	23	47.97	23	39.
Patapsco River L	1.87	24	48.77	21	47.
Little Patuxent Ri	1.87	25	47.03	24	47.

Figure 3. The recovery potential screening tool generates rank-ordered scores for ecological, stressor, and social context indicators for each HUC12 watershed (*right*). These may be used to visualize restorability differences among impaired watersheds using bubble plots (*left*), which may also display reference healthy watersheds as determined from field-based assessment data. Used with permission of U.S. EPA.

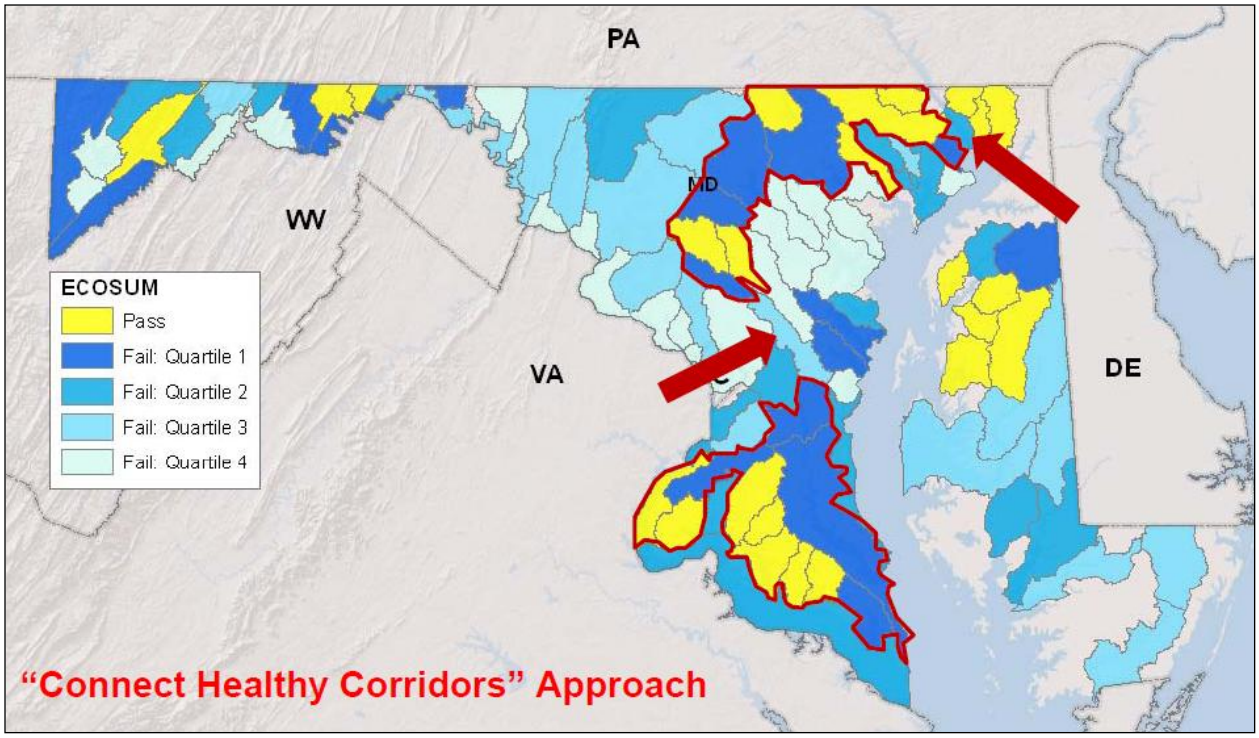


Figure 4. Output scores from the recovery potential screening tool can be visualized using color-coded maps. For example, this map shows "passing" watersheds (yellow) as well as those that "failed" in field-based assessments (blue) but display various degrees of recovery potential (darker blue = better recovery potential). Visualizing watersheds in this way allows users to identify watersheds in which restoration may be most effective in increasing the size of contiguous healthy watershed patches and connecting healthy patches into large-scale corridors by targeting impaired but restorable watersheds in key locations (indicated by the red arrows).[2] Used with permission of U.S. EPA.

Regulatory/non-regulatory programs and applications:

- TMDL/303(d) prioritized schedule:
  - Provide input to a nutrient reduction strategy for the state.[1]
  - Use RPS and nutrient-related indicators to identify the watersheds most affected by nutrients and their relative difficulty of restoration.[1]
  - Identify relative differences in restorability among nutrient-impacted watersheds, also considering their relative impact on major downstream waters.[1]
  - Help plan where TMDL implementation can be targeted for best results.[1]
  - Given a downstream impact with a TMDL, identify upstream monitoring locations to identify contributors and reference streams.[1]
  - Identify reference streams for TMDL waters by using RPS to screen for similar but less impaired waters?[1]
  - Identify small healthy watersheds surrounded by impaired waters.[1]
  - Provide a general screening basis to discern broad categories of likely watershed conditions such as "healthy," "threatened," and "impaired."[1]
  - Set priorities for urban waters.[1]
  - Compare multiple perspectives regarding priority watersheds and look for common ground.[1]
  - Identify high recovery potential watersheds linked with drinking water sources.[1]

    - Given a high quality water, are there upstream or downstream subwatershed ideas for prioritization work?[1]
    - Identify high recovery potential waters adjacent to healthy waters in order to build contiguous healthy watershed zones.[1]
    - Evaluate relative risks and factors facing the more at-risk healthy watersheds.[1]
- Implementation of 319 water quality programs:
    - Help inform the 319 planning phase 1 process (HUC10 or 12?).[1]
    - Help inform the 319 process phase 2 (HUC14).[1]
    - Reveal suitable criteria for 319 evaluations and determine how to measure social concepts.[1]
    - Help in prioritizing among 319 criteria.[1]
    - Help to learn about recovery factors and differences among watersheds in coal fields.[1]
    - Determine what kinds of projects are in the water program and how they can be leveraged.[1]
    - Reference reach concept enhancement.[1]
- EPA's Healthy Watersheds Initiative (HWI):
    - Screen watershed prospects to find impaired waterbodies now meeting Water Quality Standards (Strategic Plan measure 10).[1]
    - Screen for prospective watersheds in which conservation actions could be targeted to improve water quality with watershed approach achieve (Strategic Plan measure 12).[1]
    - Screen for prospective watersheds in which conservation actions could be targeted to improve non-point source-impaired waterbodies, as called for by measure WQ-10 under EPA's National Water Program Guidance.[1]
- Monitoring programs:
    - Success monitoring: Identify areas for verification of the likelihood of recovery or healthy conditions[1]
    - Use RPS screenings of under-assessed or non-assessed watersheds to guide volunteer monitoring assistance.[1]
    - Compliance monitoring.[1]
    - Provide ideas on locations for industry to monitor.[1]
    - Setting priorities for Municipal Separate Storm Sewer System (MS4) monitoring.[1]
- Section 404 wetland compensatory mitigation:
    - So far, the RPS has not been used for Section 404 but recent startups have indicated interest in this possibility.1
    - Prioritize restoration associated with 404 stream actions and possible approaches for mitigation.[1]
- Help stretch funding for restoration/conservation activities.[1]

Transferability:

- The RPS is transferable at a screening level, provided that data are available at the desired spatial scale for comparison. EPA's emphasis on flexibility and efficient use of systematic comparison (user-driven screening objectives, indicator selection and weighting, and ease of altering and repeating screening scenarios) is a result of EPA's intention to design this method as a broadly applicable tool for states, tribes, territories and watershed. Over half of the states have either expressed interest in using this tool or

have used it to some degree. In fact, 48 states, 17 federal agencies and 150 local watershed/local government participants attended the February, 2012 webinar on RPS.[1]

Data gaps:

- Some potentially powerful metrics, such as measures of flow alteration and channelization, would improve the breadth of RPS assessments if nationally available.[1]
- Although data currently exist to measure many recovery-relevant factors, increasing our understanding of those factors would be a very valuable arena for research investment.[1]
- Some indicators widely accepted by practitioners could be better documented or tested, particularly in the social category.[1]
- Indicators that address current condition (as it affects future restorability) could be enhanced by indicators that are more predictive of future condition.[1]
- Some data gaps will always exist, but no RPS project has ever been abandoned due to data gaps.[1]

Barriers:

- The predominant barrier to wider application is the substantial budgetary decreases in many state and federal programs seen during the economic downturn; reducing the staff and funding available to apply any new tool let alone sustain existing activities. RPS has had some success despite this barrier, because it presents an approach for systematically planning for better restoration investments with limited resources.[1]
- In cases where RPS results have been obtained but not used, barriers have included competing objectives for use of restoration funds, lack of consensus on multiple decision process alternatives, and limited staff/time of staff to learn and apply the methods.[1]
- Obstacles to developing the RPS have included technical capacity, time, and money.[1]
- Barriers to monitoring the ecological success of aquatic resource restoration/conservation have included limited funding, the time frame that would be needed to observe recoveries (i.e., several years), and the fact that monitoring is beyond the project scope. Nevertheless, state users will probably be able to observe over time whether RPS assessments were generally accurate about recovery prospects.[1]

Future goals:

- More thoroughly documented indicators.[1]
- Nationally calculated indicator library on HUC12s that can support the full range of user-driven applications at state, watershed, or other scales.[1]
- Post more creative application examples on the website as a primary user support product.[1]
- An increased number of researchers and practitioners sharing their experiences and papers that build lines of evidence about specific indicators documented on the website; more staff and time to assist users.[1]
- Obstacles to achieving these goals include data and staff.[1]

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[1] Feedback received on 4/6/2012 from Doug Norton, USEPA Office of Water.
[2] Webinar: "Recovery Potential Screening: A tool for comparing impaired waters restorability" by Doug Norton and Tatyana DiMascio. Accessed from: http://water.epa.gov/learn/training/wacademy/upload/2012_02_22_slides.pdf.

[3] http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/indicatorsecological.cfm#biocomminteg
[4] http://www.mrlc.gov/finddata.php
[5] http://datagateway.nrcs.usda.gov
[6] http://www.horizon-systems.com/nhdplus/
[7] http://www.fws.gov/wetlands/index.html
[8] http://nhd.usgs.gov/index.html
[9] http://edna.usgs.gov/
[10] http://soildatamart.nrcs.usda.gov/
[11] http://www.epa.gov/waters/data/downloads.html
[12] http://www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html
[13] http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/upload/RP1corrgroundwater1109.pdf
[14] http://water.epa.gov/scitech/datait/tools/warsss/rrisc_box18.cfm
[15] http://www.epa.gov/emap/html/cdrom/maia_dlg/
[16] http://www.cbr.washington.edu/salmonweb/bibi/
[17] http://www.natureserve.org/getData/eia_integrity_reports.jsp
[18] http://www.natureserve.org/explorer/
[19] http://plants.usda.gov/
[20] http://criticalhabitat.fws.gov/crithab/
[21] http://www.nbii.gov/far/nfhap/
[22] http://www.epa.gov/waters/ir/
[23] http://www.dnr.state.md.us/greenways/gi/gi.html
[24] http://imaps.dfg.ca.gov/viewers/biospublic/app.asp?zoomtoBookmark=2335
[25] http://www.fws.gov/oregonfwo/Species/Data/
[26] http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/indicatorsstressor.cfm
[27] http://www.epa.gov/mrlc/nlcd.html
[28] http://www.epa.gov/mrlc/nlcd-2001.html
[29] http://www.mrlc.gov/nlcd06_data.php
[30] http://landcover.usgs.gov/cropland/index.php
[31] http://datagateway.nrcs.usda.gov/GDGHome.aspx
[32] http://www.geocommunicator.gov/GeoComm/
[33] http://nationalatlas.gov/
[34] http://www.arcgis.com/home/item.html?id=3b93337983e9436f8db950e38a8629af
[35] http://edcsns17.cr.usgs.gov/EarthExplorer/
[36] http://fpdss.fws.gov/home
[37] http://www.usace.army.mil/Library/Maps/Pages/NationalInventoryofDams.aspx
[38] http://michigan.gov/deq/0,1607,7-135-3313_3677_3704-72931--,00.html
[39] http://nas.er.usgs.gov/default.aspx
[40] http://www.nisbase.org/nisbase/index.jsp
[41] http://www.invasivespeciesinfo.gov/resources/databases.shtml
[42] http://www.epa.gov/waters/tmdl/expert_query.html
[43] http://www.epa.gov/nutrientpollution/npdat/
[44] http://cida.usgs.gov/sparrow/
[45] http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/techsupp.cfm
[46] http://landcovertrends.usgs.gov/download/overview.html
[47] http://landcover.usgs.gov/urban/umap/
[48] http://nationalmap.gov/historical/
[49] http://landcover.usgs.gov/cropland/index.php
[50] http://landcover.usgs.gov/natllandcover.php
[51] http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/indicatorssocial.cfm
[52] http://cfpub.epa.gov/surf/locate/index.cfm
[53] http://www.nrcs.usda.gov/wps/portal/nrcs/detail/?ss=16&navtype=SubNavigation&cid=nrcs143_021421&navid=21010000000000000&pnavid=210000000000000&position=Not%20Yet%20Determined.Html&ttype=detail&pname=Regional%20Boundaries,%20State%20Offices%20&%20Centers%20%7C%
[54] http://www.epa.gov/waters/data/downloads.html

[55] http://www.univsource.com/region.htm
[56] http://www.globalcomputing.com/CollegesContent.htm
[57] http://www.protectedlands.net/dataportal/find.php
[58] http://csc-s-maps-q.csc.noaa.gov/legislativeatlas/index.html
[59] http://www.epa.gov/regulations/envtopics/index.html
[60] http://nrrss.nbii.gov/
[61] http://epamap32.epa.gov/radims/
[62] http://www.census.gov/hhes/socdemo/education/data/index.html
[63] http://www.epa.gov/waterscience/BASINS/b3webdwn.htm
[64] http://www.bea.gov/
[65] http://www.bls.gov/data/
[66] http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml
[67] http://www.csc.noaa.gov/digitalcoast/data/stics/index.html
[68] http://www.arcgis.com/home/gallery.html
[69] http://www.protectedlands.net/dataportal/find.php
[70] http://www.arcgis.com/home/search.html?q=recreation&t=content
[71] http://www.natureserve.org/getData/programData.jsp#A
[72] http://www.rivers.gov/maps.html
[73] http://www.arcgis.com/home/search.html?q=cultural&t=content
[74] http://iaspub.epa.gov/waters10/beacon_national_page.main
[75] http://www.epa.gov/tri/tridata/index.htm
[76] http://www.epa.gov/enviro/html/rcris/rcris_query_java.html
[77] EPA. 2012. Recovery Potential Screening: Tools for Comparing Impaired Waters Restorability. URL: www.epa.gov/recoverypotential. Accessed 4/4/2012, last updated 3/6/2012.
[78] The scoring spreadsheet can be downloaded from: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/upload/TMDL-Scoring-Spreadsheet_v5_final.xls.