Recovery Potential Screening:

Online Tools for Assessing Impaired Waters Restorability

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May 3, 2012

What is Recovery Potential Screening?

A method to help states and watershed restoration planners compare restorability

- Origins in impaired waters program (TMDLs, 303(d) listing)
- Broader audiences now (watershed plans, nonpoint source control, fisheries, restoration)
- Systematic but very flexible approach
- Science-based, indicator-driven (GIS and field monitoring data)

Recovery potential *is the likelihood of an impaired water to reattain WQS or other desired condition, given its*

*- **ecological capacity**,*

*- **exposure to stressors**, and*

*- the **social context** affecting efforts to improve its condition.*

How Recovery Potential Screening Can Be Used

- **impaired waters prioritization**: Which watersheds (in a river basin or statewide) are more restorable and might recover quickly? What may be better done now vs. later?

- **revealing level of difficulty**: How do waters differ in recovery potential, and what factors are responsible? What am I up against?

- **TMDL implementation**: How do waters with TMDLs appear to differ in restorability? Which TMDLs are good prospects?

- **nonpoint source program strategies**: How can considering restorability factors help watershed plans or statewide strategies?

How Recovery Potential Screening Can Be Used (cont'd)

- **watershed/subwatershed planning**: Which subwatersheds could be targeted for restoration to help the greater watershed?

- **special interest projects**: E.g., how does restorability differ across all nutrient impaired waters? across all urban waters? for fish restoration? among threatened waters?

- **informing EPA/state/sub-state interactions**: How can restorability inform EPA/state or state/watershed dialogues on restoration strategies?

- **protection and restoration**: What synergies are possible through linking healthy watersheds protection and restorability methods?

Recovery Potential Screening - Basic Concept

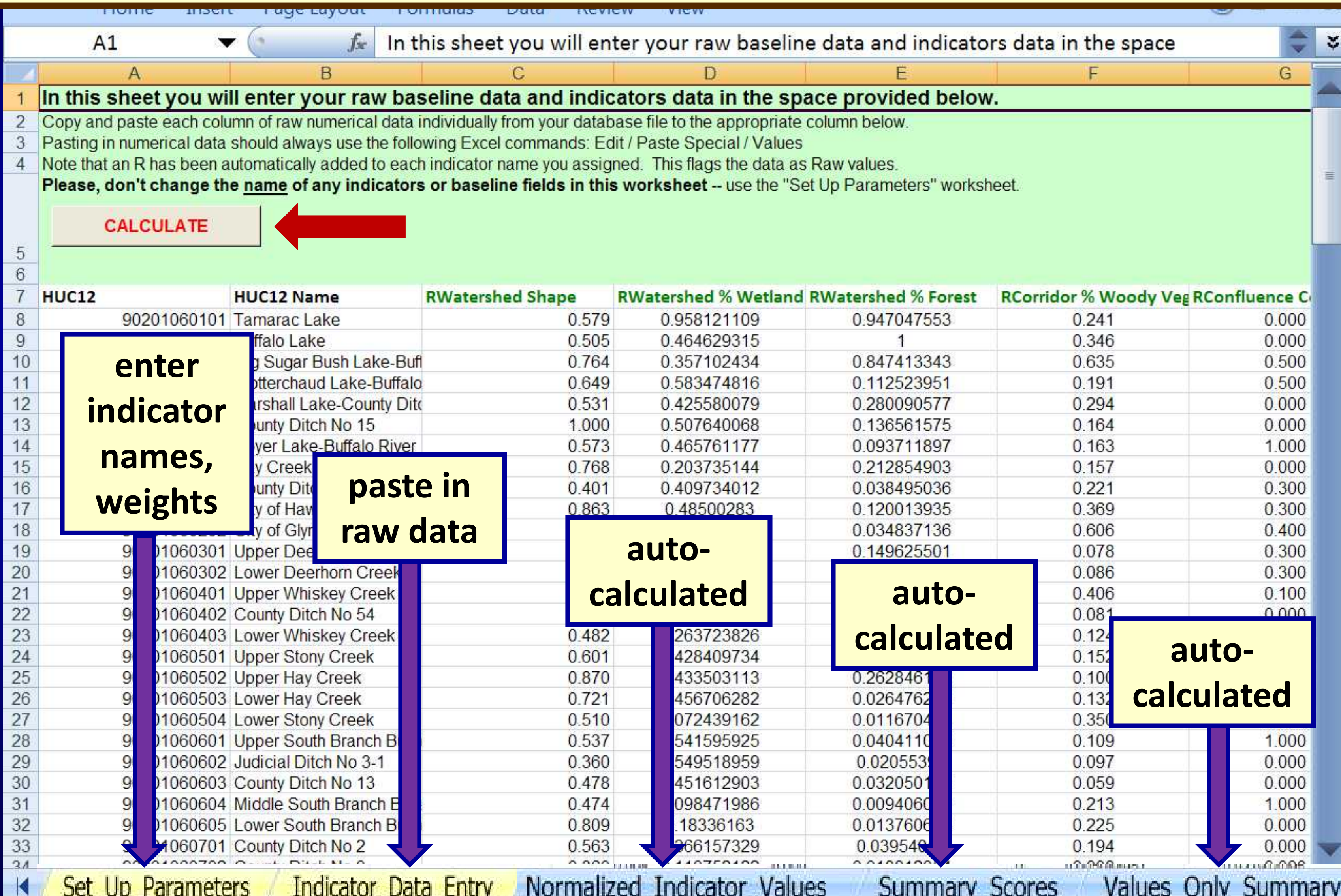
Ecological metrics	*Stressor metrics*	*Social context metrics*
Indicator 1	*Indicator 1*	*Indicator 1*
Indicator 2	*Indicator 2*	*Indicator 2*
Indicator 3	*Indicator 3*	*Indicator 3*
Indicator 4	*Indicator 4*	*Indicator 4*
Indicator 5….	*Indicator 5….*	*Indicator 5….*

Ecological Index **Stressor Index** **Social Index**

$$\frac{\text{(Ecological + Social)}}{\text{Stressor}}$$

Recovery Potential Screening Tools

Auto-scoring Spreadsheet



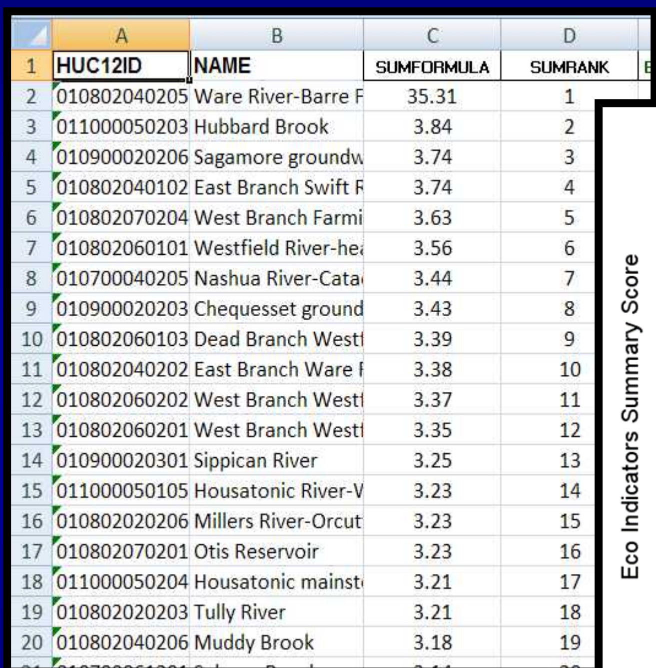
	A	B	C	D	E	F	G
7	HUC12	HUC12 Name	RWatershed Shape	RWatershed % Wetland	RWatershed % Forest	RCorridor % Woody Veg	RConfluence C
8	90201060101	Tamarac Lake	0.579	0.958121109	0.947047553	0.241	0.000
9		ffalo Lake	0.505	0.464629315	1	0.346	0.000
10		g Sugar Bush Lake-Buff	0.764	0.357102434	0.847413343	0.635	0.500
11		otterchaud Lake-Buffalo	0.649	0.583474816	0.112523951	0.191	0.500
12		rshall Lake-County Ditc	0.531	0.425580079	0.280090577	0.294	0.000
13		unty Ditch No 15	1.000	0.507640068	0.136561575	0.164	0.000
14		yer Lake-Buffalo River	0.573	0.465761177	0.093711897	0.163	1.000
15		y Creek	0.768	0.203735144	0.212854903	0.157	0.000
16		unty Dit	0.401	0.409734012	0.038495036	0.221	0.300
17		y of Haw	0.863	0.48500283	0.120013935	0.369	0.300
18		y of Glyn			0.034837136	0.606	0.400
19	9 1060301	Upper Dee			0.149625501	0.078	0.300
20	9 1060302	Lower Deerhorn Creek				0.086	0.300
21	9 1060401	Upper Whiskey Creek				0.406	0.100
22	9 1060402	County Ditch No 54				0.081	
23	9 1060403	Lower Whiskey Creek	0.482	263723826		0.124	
24	9 1060501	Upper Stony Creek	0.601	428409734		0.152	
25	9 1060502	Upper Hay Creek	0.870	433503113	0.2628461	0.100	
26	9 1060503	Lower Hay Creek	0.721	456706282	0.0264762	0.132	
27	9 1060504	Lower Stony Creek	0.510	072439162	0.0116704	0.350	
28	9 1060601	Upper South Branch B	0.537	541595925	0.0404110	0.109	1.000
29	9 1060602	Judicial Ditch No 3-1	0.360	549518959	0.020553	0.097	0.000
30	9 1060603	County Ditch No 13	0.478	451612903	0.0320501	0.059	0.000
31	9 1060604	Middle South Branch B	0.474	098471986	0.0094060	0.213	1.000
32	9 1060605	Lower South Branch B	0.809	.18336163	0.0137606	0.225	0.000
33	1060701	County Ditch No 2	0.563	366157329	0.03954	0.194	0.000

Three Types of Recovery Potential Screening Products

Compare differences

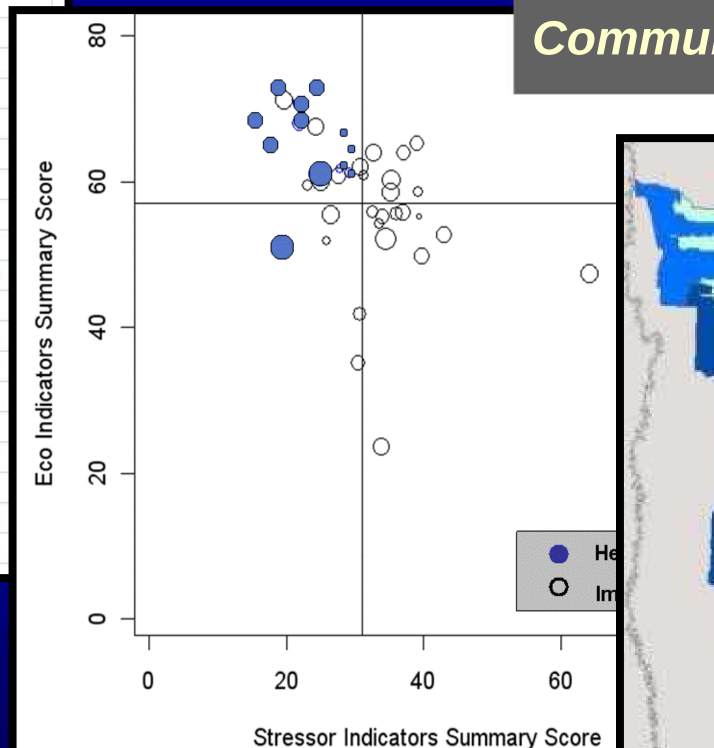
Inform plans and decisions

Communicate findings

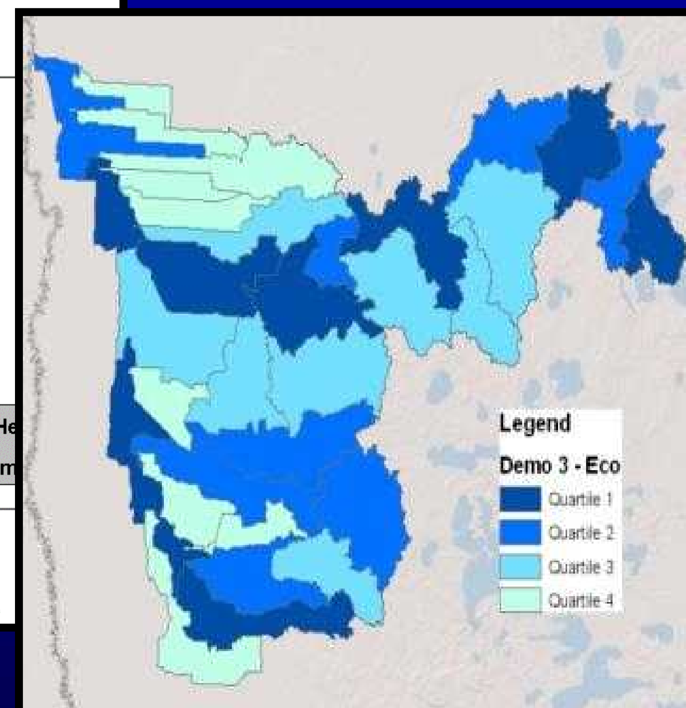


	A	B	C	D
1	HUC12ID	NAME	SUMFORMULA	SUMRANK
2	010802040205	Ware River-Barre F	35.31	1
3	011000050203	Hubbard Brook	3.84	2
4	010900020206	Sagamore groundw	3.74	3
5	010802040102	East Branch Swift R	3.74	4
6	010802070204	West Branch Farmi	3.63	5
7	010802060101	Westfield River-hea	3.56	6
8	010700040205	Nashua River-Catai	3.44	7
9	010900020203	Chequesset ground	3.43	8
10	010802060103	Dead Branch Westf	3.39	9
11	010802040202	East Branch Ware F	3.38	10
12	010802060202	West Branch Westf	3.37	11
13	010802060201	West Branch Westf	3.35	12
14	010900020301	Sippican River	3.25	13
15	011000050105	Housatonic River-V	3.23	14
16	010802020206	Millers River-Orcut	3.23	15
17	010802070201	Otis Reservoir	3.23	16
18	011000050204	Housatonic mainst	3.21	17
19	010802020203	Tully River	3.21	18
20	010802040206	Muddy Brook	3.18	19

Rank Ordering



Bubble Plotting



Mapping

- **Step-by-step instructions**
- **Indicator summaries**
- **Online RPS tools**

www.epa.gov/recoverypotential/

Screening Methodology | Recovery Potential | US EPA - Windows Inter

http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/methodology.cfm

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- Water Infrastructure
- What You Can Do

You are here: Water » Laws & Regulations » Laws & Executive Orders » Clea (303d) » Recovery Potential » Screening Methodology

Screening Methodology

Introduction | Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7

If you want to assess and compare the recovery potential of a group of water to help you plan for their restoration, this part of the website is for you. The above and the box at right each provide links through a seven step process f systematically comparing the restorability of potentially large numbers of wa Although this method provides structure and guidance, it is very flexible. At points in this procedure, your own choices can customize the assessment fo geographic area, environment, social settings, and restoration goals.

Each step is described briefly while also linking to tools and information in g detail. You may choose to browse all the steps at the general level first, whic should take about 30 minutes.

Going to the more detailed levels is necessary for obtaining specific instructi potential screening assessment. If you prefer instructions with detailed exam example (PDF) (12 pp, 842K, About PDF) of a real assessment that followed these screening checklist (PDF) (1 pp, 97K, About PDF) to keep track of your progress.

Next: Step 1: Define the scope

Quick Links

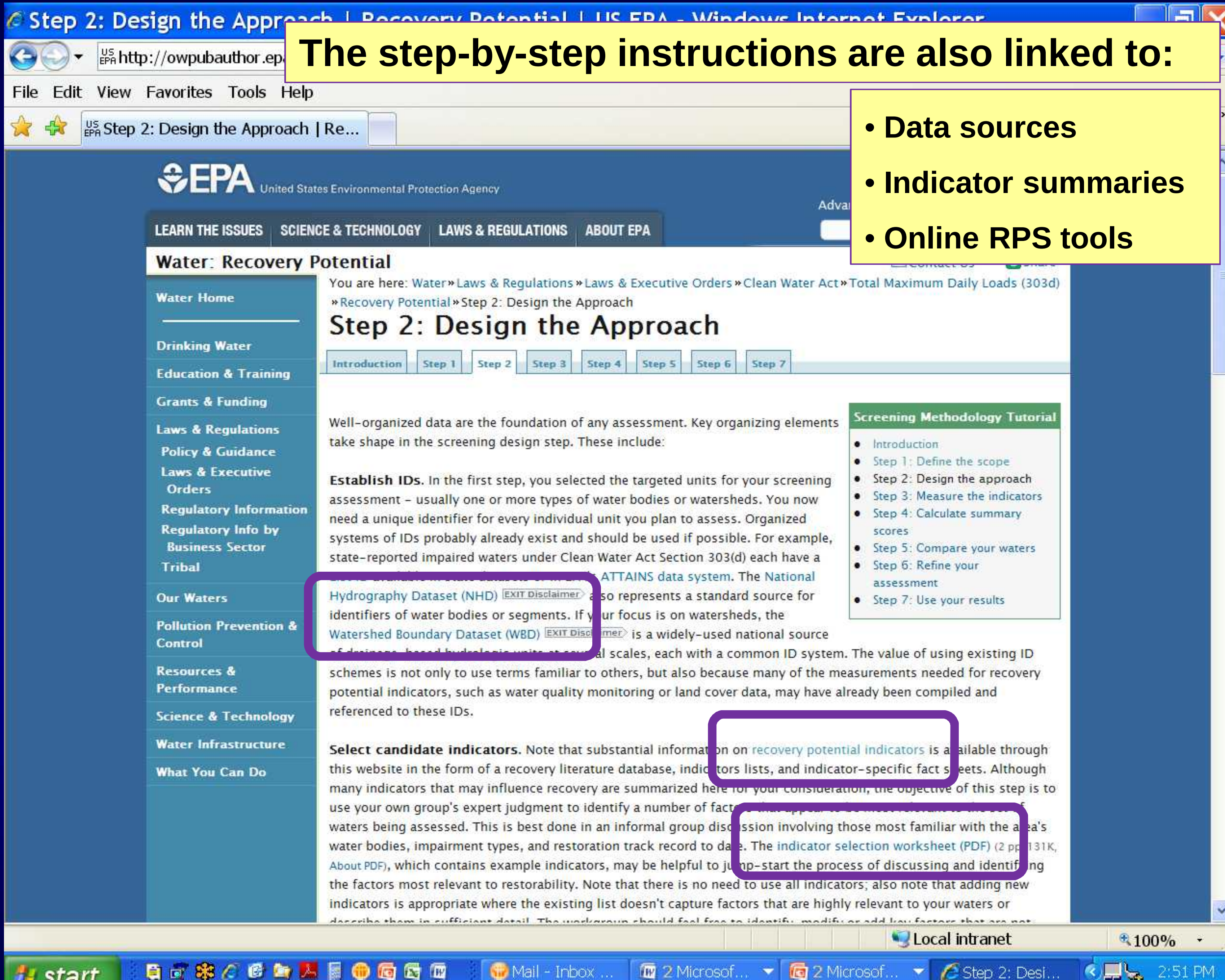
- Home
- Overview
- Screening methodology
- Step-by-step screening example
- Example projects
- Other priority-setting sites
- Recovery tools & resources
- Literature database
- Indicators & reference sheets
- Scoring techniques
- Displaying screening results
- Publications & training materials

Screening Methodology Tutorial

- Introduction
- Step 1: Define the scope
- Step 2: Design the approach
- Step 3: Measure the indicators
- Step 4: Calculate summary scores
- Step 5: Compare your waters
- Step 6: Refine your assessment
- Step 7: Use your results

The step-by-step instructions are also linked to:

- **Data sources**
- **Indicator summaries**
- **Online RPS tools**



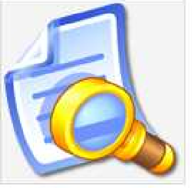
Review candidate indicators at desired level of detail:

- List
- Paragraph summary
- Reference sheet

Water: Recovery Potential

Recovery Potential Indicators

Overview: Selecting and Using Recovery Potential Indicators



This section of the website contains reference materials on recovery potential indicators: their definitions, relevance to restorability, data sources, measurement methods, and relevant points from the technical literature. Additional scientific information is always welcome from users who contact us.

Restoration research and practice have shown that many, very diverse factors affect the likelihood of restoration success, and these can be grouped on the basis of their ecological, stressor, and social influences on restorability. The Indicators Master List (MS Excel xlsx, 86K) identifies nearly 200 candidate recovery potential indicators that can be considered, but a screening assessment needs to select only a small number of the most relevant indicators in the ecological, stressor, and social context classes.

Selecting five to ten indicators in each of the three classes is not only influenced by what can be measured accurately with the available data, but also by the need to choose indicators that each provide a different 'piece of the puzzle.' Different types of indicators that are all related to restorability provide multiple lines of evidence for estimating recovery potential. An effort should be made to measure indicators that are not all related to the same key component of their indicator class (e.g., ecological indicator selection should include more than just different measurements of watershed land cover). It may not be possible to address all of the key components, but the selection of indicators should include as many as are feasible. Clicking on each component brings up related indicators.

For descriptions of all indicators, please download the Indicator Summaries Table (PDF) (49 pp, 565K, About PDF) or proceed to the ecological indicator summaries.

Key components for ecological indicator selection include:

Recovery Potential Indicators | Recovery Potential | US EPA - Windows Internet Explorer

http://owpubauthor.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/indicators.cfm

6. Ecological history

Key components for stressor indicator selection include:

1. Watershed level disturbance
2. Corridor or shorelands disturbance
3. Hydrologic alteration
4. Biotic or climatic risks
5. Severity of pollutant loading
6. Legacy of past, trajectory of future land use

Candidate stressor indicators

- corridor % impervious cover
- corridor % tile-drained cropland
- corridor % U-index (non-natural cover)
- corridor % urban
- corridor % agriculture
- linear % of channel through agriculture
- corridor road crossings
- corridor road density

Key components for social context indicator selection include:

1. Leadership, organization and engagement
2. Protective ownership or regulation
3. Level of information, certainty and planning

Candidate stressor indicators

- corridor % impervious cover
- corridor % tile-drained cropland
- corridor % U-index (non-natural cover)
- corridor % urban
- corridor % agriculture
- linear % of channel through agriculture
- corridor road crossings
- corridor road density

corridor % urban (PDF) (6 pp, 63.7K, About PDF)

Why relevant to recovery: As the intensity of urbanization increase tends to decrease. Developed land cover in riparian zones is associated more tolerant of pollutants. Increasing substrate embeddedness and bar been observed to increase in streams in developing areas. Significantly l often found downstream of highly developed corridors where not attribu plant discharges. Human shoreline development may lead to loss of litto Threshold responses to percentages of development found in corridors also at the watershed scale, indicating potentially greater significance of watershed effects from urbanization.

Data sources and measurement: Extracted from land cover mappi corridor width, and summarized as % developed (e.g., residential, comm urban center, etc) by area within the corridor. For land cover data, the N Database (NLCD) for 2006, 2001 and 1992 is accessible at http://www.mrlc.gov/finddata.php ; Exit Disclaimer statewide land cover map datasets are also available from state-specific sources.

USEPA Office of Water Recovery Potential Screening Website 09/01/2011
http://www.epa.gov/recoverypotential/

Recovery Potential Metrics
Summary Form

Indicator Name: CORRIDOR PERCENT URBAN

Type: Stressor Exposure

Rationale/Relevance to Recovery Potential: As the intensity of urbanization increases, biotic integrity tends to decrease. Developed land cover in riparian zones is associated with aquatic biota more tolerant of pollutants. Increasing substrate embeddedness and bank erosion have also been observed to increase in streams in developing areas. Significantly lower water quality is often found downstream of highly developed corridors where not attributable to treatment plant discharges. Human shoreline development may lead to loss of littoral habitats. Threshold responses to percentages of development found in corridors were not borne out also at the watershed scale, indicating potentially greater significance of corridor vs watershed effects from urbanization.

How Measured: Extracted from land cover mapping within a set corridor width, and summarized as % developed (e.g., residential, commercial, industrial, urban center, etc) by area within the corridor.

Data Source: Land cover sources include the National Land Cover Data from 1992 (See: http://www.epa.gov/mrlc/nlcd.html),2001 (See: http://www.epa.gov/mrlc/nlcd-2001.html), and 2006 (http://www.mrlc.gov/nlcd06_data.php), as well as various state sources at finer resolution. Temporal urban mapping is available from the USGS Land Cover Institute (See: http://landcover.usgs.gov/urban/umap/). Corridors can be generated from hydrographic data (See: http://www.horizon-systems.com/nhdplus/) using a set buffer width for delineation.

Indicator Status (check one or more)

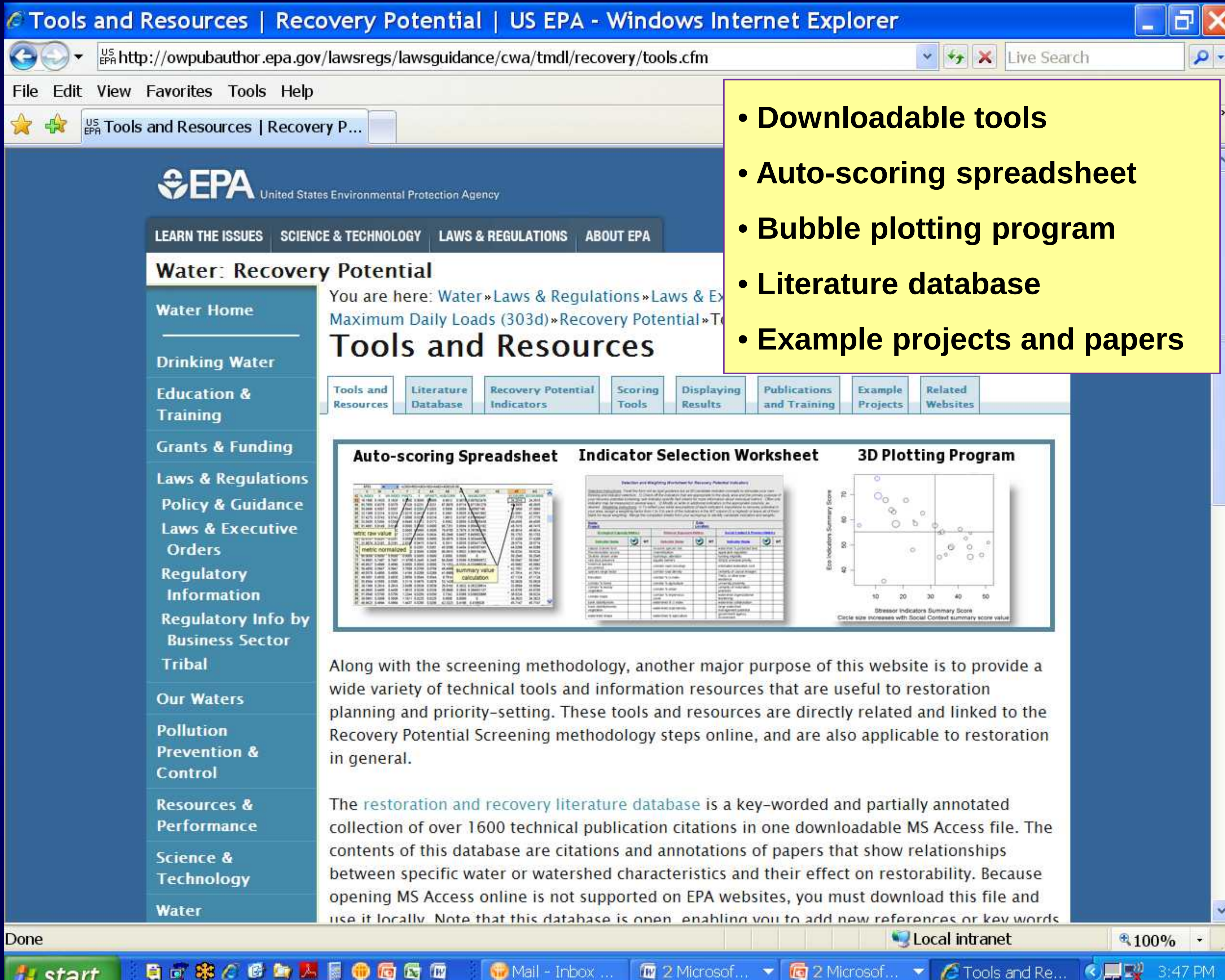
_____ Developmental concept.
_____ Plausible relationship to recovery.
_____ Single documentation in literature or practice.
_____ Multiple documentation in literature or practice.
_____ Quantification.

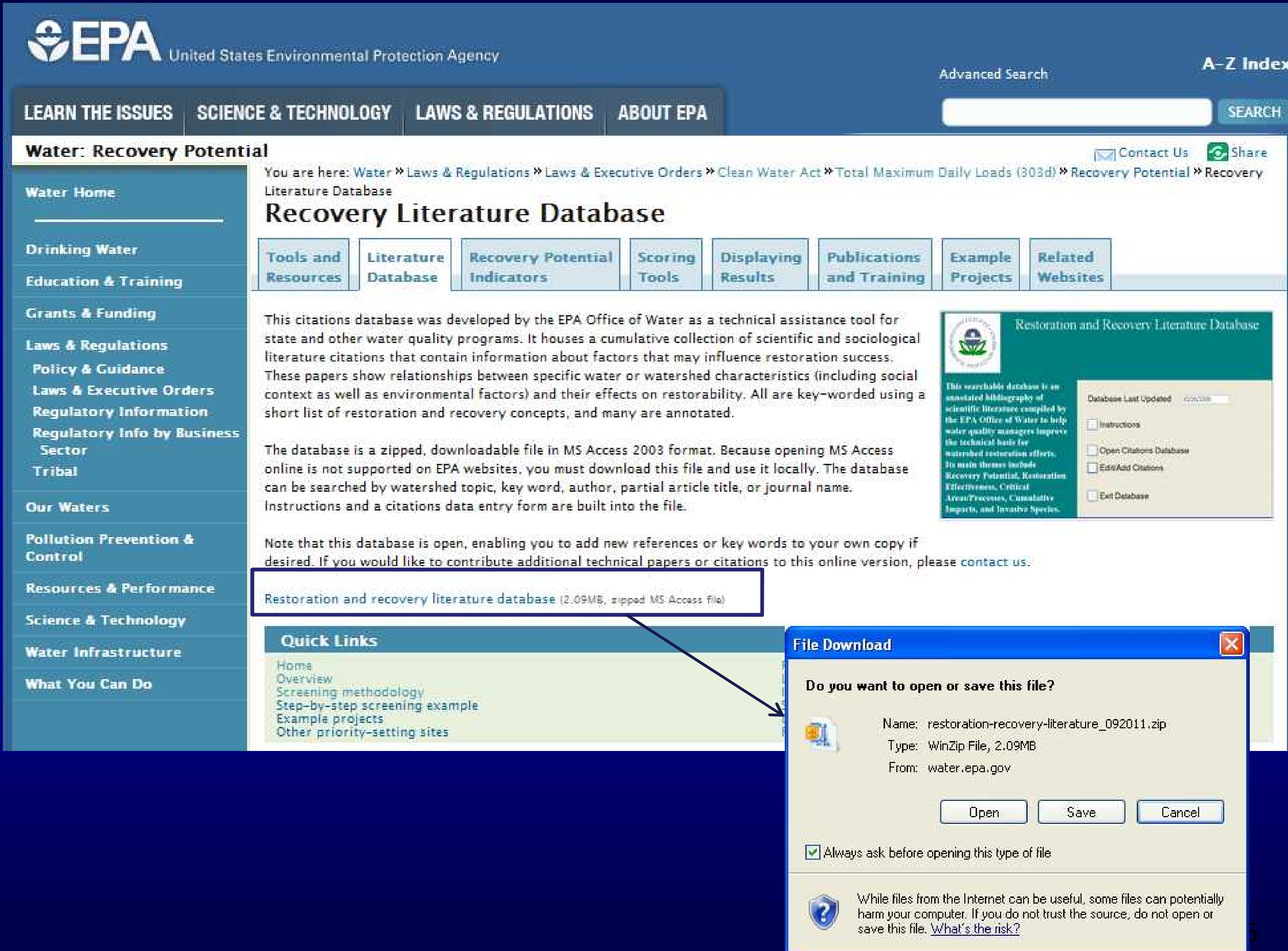
Comments: Operational, with wide applicability to flowing waters in all regions.

Examples from Supporting Literature (abbrev. citations and points made):

- (Potter et al 2004)The resulting vulnerability models indicate that North Carolina watersheds with less forest cover are at most risk for degraded water quality and stream habitat conditions. Studies have found strong positive relationships between diverse assemblages of stream benthic macroinvertebrates that are intolerant of water quality degradation and watershed-wide forested land cover (Lenat and Crawford 1994, Stewart and others 2001, Weigel and others 2003) or forested land cover within riparian zones (Basnyat and others 1999, Sponseller and others 2001, Stewart and others 2001, Weigel and others 2003). Meanwhile, research has shown less diverse and more intolerant macrobenthic communities to be correlated with agricultural land cover (Lenat and Crawford 1994, Richards and others 1996, Weigel and others 2000, Genito and others 2002) and urban land use (Lenat and Crawford 1994, Morley and Karr 2002, Morse and others 2003, Roy and others 2003, Volstad and others 2003, Wang and Kanehl 2003).
- (Potter et al 2004) Two of the three watershed land cover variables — percent agricultural and percent forested — exhibited somewhat strong relationships. The percent

- **Downloadable tools**
- **Auto-scoring spreadsheet**
- **Bubble plotting program**
- **Literature database**
- **Example projects and papers**

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Recovery Literature Database
Tools and Resources
Literature Database
Recovery Potential Indicators
Scoring Tools
Displaying Results
Publications and Training
Example Projects
Related Websites
This citations database was developed by the EPA Office of Water as a technical assistance tool for state and other water quality programs. It houses a cumulative collection of scientific and sociological literature citations that contain information about factors that may influence restoration success. These papers show relationships between specific water or watershed characteristics (including social context as well as environmental factors) and their effects on restorability. All are key-worded using a short list of restoration and recovery concepts, and many are annotated.
The database is a zipped, downloadable file in MS Access 2003 format. Because opening MS Access online is not supported on EPA websites, you must download this file and use it locally. The database can be searched by watershed topic, key word, author, partial article title, or journal name. Instructions and a citations data entry form are built into the file.
Note that this database is open, enabling you to add new references or key words to your own copy if desired. If you would like to contribute additional technical papers or citations to this online version, please contact us.
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Edit/Add Citations
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Water: Recovery Potential

Displaying Results

Recovery Potential Screening generates scores as a basis for evaluation, but numerical comparisons through ranki
be used to evaluate and communicate screening results. Sometimes, results are more effective when formatted in w
conditions in specific places relate to broader, general patterns. For most people, numerical data in tables alone do
numbers were the basis for a decision or strategy. This section of the website describes three alternative techniq
discussions and decisions and communicating recovery potential findings effectively: rank-ordering, mapping and plotting graphs.

Rank-ordering recovery potential scores. The simplest of comparison methods, rank-ordering organizes screened waters from highest to lowest recovery potential based on their scores. This is an easy and transparent method to identify a subset of more restorable specific number or a percentage of highly-ranked waters in consideration of available restoration resources and capacity its clarity and simplicity – some waters or watersheds simply score higher than others – which may help users move past decision criteria.

The flexibility in rank-ordering is in which scores to use. The RPI score is one option for a single overall score used to ran the indicators measured. In addition, each of the three summary indices are easy to rank-order to compare scores on a pu basis. It is also possible to examine the rank-ordering of a single indicator, if sufficiently important. It is crucial to remer used for rank-ordering, the **lowest** scores are rank-ordered as the highest recovery potential. For the ecological and so **highest** scores are associated with the highest recovery potential.

Although rank-ordering is useful in distinguishing major differences between very high and very low watershed scores, m screening probably does not support assuming that very small scoring differences are significant. For example, the 237th clearly less restorable than the 236th-ranked watershed. Users are advised not to overemphasize the significance of very small rank-order differences. One option for further organizing rank-ordered lists in a more generalized ranking is to group them by quantiles, which can be equal-size or separated by natural breaks in the range of values. See also ways to use rank-ordering (PDF) (5 pp, 727K, About PDF) in Re

Mapping recovery potential assessment results. Much if not most Recovery Potential Screening da Geographic Information Systems (GIS) that generate maps and related attribute information tables. Many o using GIS and compiled in a database file, with these values all linked as attributes to each water body or w features makes it possible to display all your indicators, singly or in combination, on a map basis.

Maps are highly effective at communication of environmental conditions and relative differences between g difficulty of displaying two or more parameters that each range in value. As Recovery Potential Screening affecting restorability (ecological capacity, stressor exposure and social context), the ability to map all thr On the other hand, maps based on a single summary score (e.g., the ecological, stressor or social index, th are generally clear and effective. For several examples of mapping techniques applied to analyzing and co ways to use mapping (PDF) (4 pp, 653K, About PDF) in Recovery Potential Screening.

Displaying results in 3D "bubble plots". This comparison method was adapted specifically for Recov relative influence of ecological, stressor and social context factors on restorability at the same time. A 3D waters (each one a 'bubble' on the graph), which are plotted relative to X (stressor index) and Y (ecological context index score. For example, this type of display might enable a user to identify those waters that hav indices by where they fall on the plot, and then further sharpen their focus on those that have larger dots

Bubble plots are ideally suited for displaying the ecological, stressor, and social context indices in a way that observers get a sense of the three scores at once. Unlike rank-ordering's simplicity, bubble plotting acknowledges that comparisons are often complex and offers a systematic way to observe and consider the relative influence of three major driving factors on restorability simultaneously. Additional information display concerning a fourth 'dimension' (such as healthy vs. impaired) is possible through use of multi-color bubble plots. See ways to use bubble plotting (PDF) (6 pp, 619K, About PDF) in Recovery Potential Screening for a discussion of how this technique can aid comparison and targeting decisions.

Using Rank-Ordering as a Recovery Potential Screening Tool

Rank-ordering, as used in Recovery Potential Screening (RPS) assessments, puts waters or watersheds into a sequential arrangement based on relative differences in a value or score that has been calculated for each of them. Along with bubble-plotting and mapping, rank-ordering offers a way to organize complex information about restorability, stimulate discussion and insights about differences, communicate about results and alternatives, or if desired, prescribe a clear basis for assigning priorities or decisions. In brief, ranking a set of objects provides a simple and straightforward method for their comparison.

Below are techniques and a few brief examples of how rank-ordering can be used in Recovery Potential Screening. These are hypothetical examples that may use real data for demonstration purposes, but they do not constitute final analyses, policies, or decisions by the US EPA or its collaborators.

Figure 1: RP Screening table with four alternative rank-orderings of the same set of watersheds.

	A	B	C	D	E	F	G	H	I
1	WATERSHED NAME	RPI SCORE	RPI RANK	ECO INDEX	ECO RANK	STRESSOR INDEX	STR RANK	SOCIAL INDEX	SOC RANK
2	Broad Creek	7.28	1	61.45	11	19.33	2	79.31	1
3	Deer Creek	5.86	2	67.09	2	20.83	5	54.95	2
4	Furnace Bay	5.67	3	67.87	1	20.46	4	48.14	4
5	Octoraro Creek	5.31	4	63.50	8	20.32	3	44.40	7
6	Bush River	5.24	5	57.94	17	18.35	1	38.26	16
7	Little Gunpowder Fal	4.50	6	65.33	4	23.08	7	38.43	15
8	Rocky Gorge Dam	4.38	7	63.48	9	24.10	8	42.02	8

Using Mapping as a Recovery Potential Screening Tool

Mapping is a versatile tool in Recovery Potential Screening assessments that allows users to visualize the distribution and location of watersheds as well as the relative differences in their scores. Along with bubble plots and rank-ordering, mapping offers a way to organize complex information about restorability, stimulate discussion and insights about differences, communicate about results and alternatives, or if desired, prescribe a clear basis for assigning priorities or decisions. Unlike bubble plots and rank-ordering, mapping allows a user to observe spatial relationships among waters or watersheds that may influence restoration strategies and priorities.

Below are techniques and a few brief examples of how mapping can be used in Recovery Potential Screening. These are hypothetical examples that may use real data for demonstration purposes, but they do not constitute final analyses, policies or decisions by the US EPA or its collaborators. Mention of commercial products or trade names does not constitute endorsement for use.

Figure 1(a): Displaying RPI Score with a random color scheme.

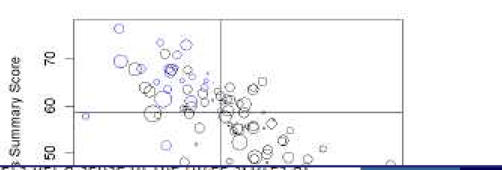
Figure 1(b): Displaying RPI Score with a gradient color scheme. The darker colors represent the higher RPI values.

Using Bubble Plotting as a Recovery Potential Screening Tool

Bubble plotting is a common technique for showing three or more dimensions of data in a flat, two-dimensional graph. Objects are plotted relative to conventional X and Y axes representing the first two variables, using circles (bubbles) as plotting symbols that vary in size with the value of the third variable. Assigning colors to the circles can add limited information on a fourth variable. As used in Recovery Potential Screening, bubble plotting is a way to visualize and compare multiple recovery potential scores of an entire set of watersheds simultaneously. Along with rank-ordering and mapping, bubble plotting offers a way to organize complex information about restorability, stimulate discussion and insights about differences, communicate about results and alternatives, or if desired, prescribe a clear and systematic basis for assigning priorities or decisions.

Below are techniques and a few brief examples of how bubble plotting can be used in Recovery Potential Screening. These are hypothetical examples that may use real data for demonstration purposes, but they do not constitute final analyses, policies or decisions by the US EPA or its collaborators.

Figure 1: The basic, standard recovery potential bubble plot.



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