

***A Recovery Potential Screening Method
for
Impaired Waters Priority Setting***

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Plymouth, MA ~ May 2010**



1: USEPA Office of Water, Washington, DC

2: USEPA Office of Research and Development, RTP NC

“Recovery potential should be a primary consideration in restoration programs whose main aim is to bring about recovery.”

EPA TMDL Program Results Analysis Web Site,
May 2009

“We are undertaking a multi-year initiative to target watershed restoration resources to biologically degraded non-tidal streams with high recovery potential. Our objective is to remove waters from Maryland's 303(d) list.”

Jim George, Manager
MDE WQ Protection & Restoration Program

What is Recovery Potential Screening?

A method to help impaired waters restoration planners compare restorability

- Origins in TMDL/303(d) impaired waters program priority setting
- Flexible, indicator-based
- Largely GIS-driven
- Landscape and monitoring metrics

Recovery potential *is the likelihood of an impaired water to reattain Water Quality Standards or other valued attributes, given its*

- *ecological capacity,*
- *exposure to stressors, and*
- *the social context affecting efforts to improve its condition.*

Recovery Potential Screening

Tools for Regions and States: Literature Database

- Tool: open, user-modifiable restoration literature database in MS Access that will be downloadable from our web site

- Over 1600-citation database, papers relevant to restoration success factors
- Original source of candidate recovery potential indicators



Restoration and Recovery Literature Database

This searchable database is an annotated bibliography of scientific literature compiled by the EPA Office of Water to help water quality managers improve the technical basis for watershed restoration efforts. Its main themes include Recovery Potential, Restoration Effectiveness, Critical Areas/Processes, Cumulative Impacts, and Invasive Species.

Database Last Updated

- Instructions
- Open Citations Database
- Edit/Add Citations
- Exit Database

Recovery Potential Screening

Tools for Regions and States: *Indicator Summaries*

- Tool: 60 recovery potential indicator reference sheets w/bullets from literature
 - Ecological, Stressor, and Social Metrics
 - Developed from literature and practice, demonstrated in pilot studies
 - Describe relevance to recovery
 - Measurable from widely available data

Recovery Potential Metrics Summary Form

Indicator Name: CONTIGUITY WITH GREEN INFRASTRUCTURE CORRIDOR

Type: Ecological Capacity

Rationale/Relevance to Recovery Potential: Based on extensive documentation of the importance of connectivity among suitable habitats and habitat size/extent supporting more diverse and resilient ecological communities. Corridors increase effective habitat size and access, afford migration and movement to avoid temporary stressors, and aid recruitment and ~~recognition~~ of impaired areas. Basically, impaired water segments near, or ~~hydrologically~~ connected to, functionally intact waters identified as important corridors by a green infrastructure (GI) mapping effort have greater recovery potential than isolated impaired waters for the reasons above. Generally, GI corridors have relatively unimpaired aquatic systems and relatively uninterrupted, naturally vegetated riparian corridors.

How Measured: Relative differences in this metric can be summarized as follows. Each impaired water segment would fall somewhere in the following classes (worst to best):

0. no hydrologic connection to green infrastructure corridor
1. no proximity to green infrastructure corridor (e.g., connected ~~hydrologically~~ but > 2 km from corridor terminus)
2. proximate to green infrastructure corridor (e.g., connected ~~hydrologically~~ and < 2 km from corridor terminus)
3. Connected to green infrastructure corridor
4. Connected to and bridging two or more green infrastructure corridors

Geo-Spatial Data Source: Green Infrastructure (McMahon and others) mapping at statewide and other large scales has established criteria by which the more intact and ecologically functional stream corridors and larger natural habitat 'hubs' are identified.

Applicability: Widely applicable but somewhat limited to states that have mapped Green Infrastructure and have defined criteria for corridors. Potentially can be applied also where GI mapping has not occurred but criteria for GI corridors (e.g., ~~minimum~~ % naturally vegetated corridor, minimum length, and absence of listed impairments) can be separately applied to available datasets.

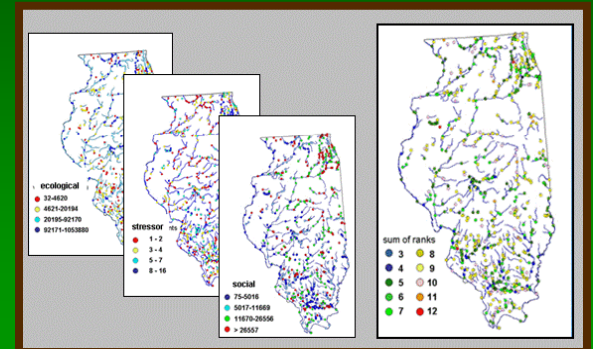
Status/Comments: Operational where GIS datasets are available ~~that have~~ designated green corridors by specific criteria as above.

Recovery Potential Screening

Tools for Regions and States: *Demonstration Projects*

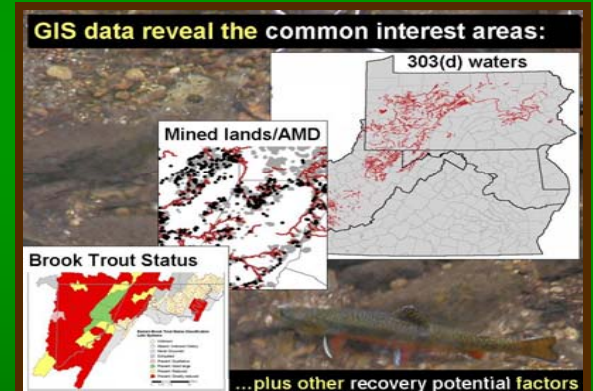
Illinois 303(d) list prioritization pilot study

- 303(d) list 'prioritized schedule' support tool
- 104 ecological, stressor and social indicators



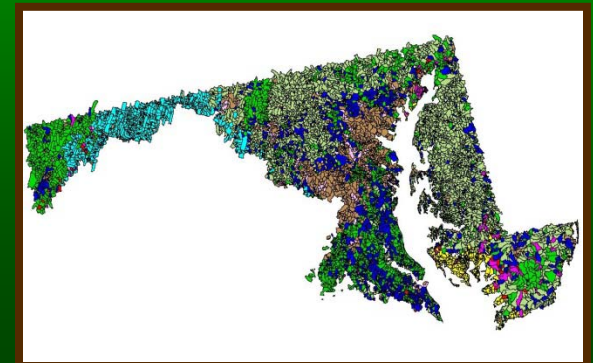
Mid-Atlantic states recovery screening

- narrowly focused on native trout recovery factors
- rapidly completed by states, EPA Region 3



Maryland impaired watersheds screening

- addressed restorability at two scales
- which are the most restorable?
- which would improve larger watershed's condition?



Recovery Potential

Contact Us

Recovery Potential Home

Overview

Screening Method

Tools and Resources

Literature Database

Indicators

Scoring Guidance

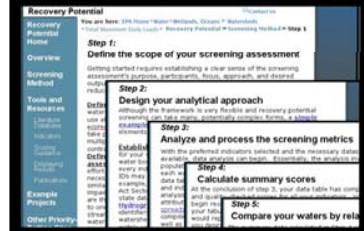
Displaying Results

Publications

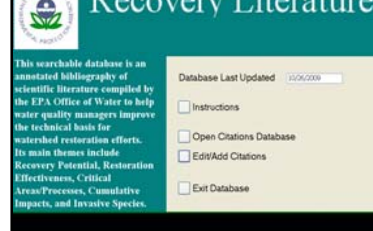
Example Projects

You are here: [EPA Home](#) » [Water](#) » [Wetlands, Oceans & Watersheds](#) » [Total Maximum Daily Loads](#) » Recovery Potential

Step-by-Step Instructions

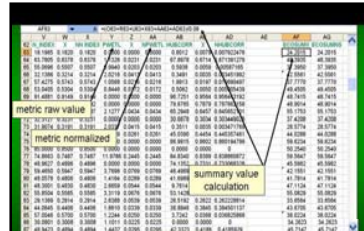


Recovery Literature

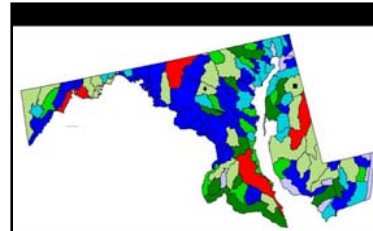


Recovery Potential Indicators

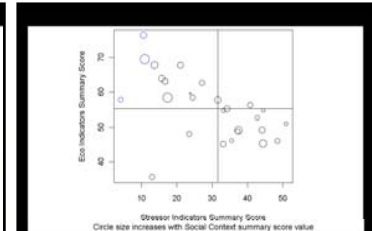
Ecological Capacity Metrics	Stressor Exposure Metrics	Social Context Metrics
stream channel form	stream species richness	watershed % protected land
restoration access	channelization	appliance regulation
streamer stream order	hydrologic alteration	funding eligibility
sea level presence	aquatic barriers	2002 wetlands priority
historical species occurrence	connector road crossings	estimated restoration cost
species range factor	connector road density	watershed of coastal lagoons
erosion	connector % timber	TRIS, or other plan existence
connector % forest	connector % agriculture	watershed proximity
connector % woody vegetation	connector % urban	watershed of restoration practices
connector slope	connector % impervious surface	watershed organizational leadership
bank stability/woody vegetation	watershed % U index	watershed collaboration
watershed stream	watershed road density	large watershed management potential
watershed size	watershed % agriculture	government agency involvement
watershed % forest	watershed % the drained cropland	local socio-economic conditions
proximity to green infrastructure hub	watershed % urban	watershed complexity
continging stream infrastructure	watershed % impervious surface	watershed % forest
estuarine community integrity	severity of 2002 listed causes	proximity to green infrastructure hub
soil resilience properties	severity of loading	continging stream infrastructure
	cost and use change trajectory	estuarine community integrity
		soil resilience properties



Auto-scoring Spreadsheet



Example Assessments



3D Plotting Program

Recovery Potential Screening

Tools for Priority-Setting in Impaired Waters Restoration

Monitoring programs under the Clean Water Act have identified tens of thousands of US water bodies that do not meet Water Quality Standards and are in need of restoration. This site provides technical assistance for restoration programs to help them consider where to invest their efforts for greater likelihood of success, based on the traits of their own geographic area's environment and communities.

Draft Web Site Now Accessible At:

http://hudson.tetrattech-ffx.com/RECOVERY_POTENTIAL/home.html

Recovery Potential Screening in Maryland Watersheds

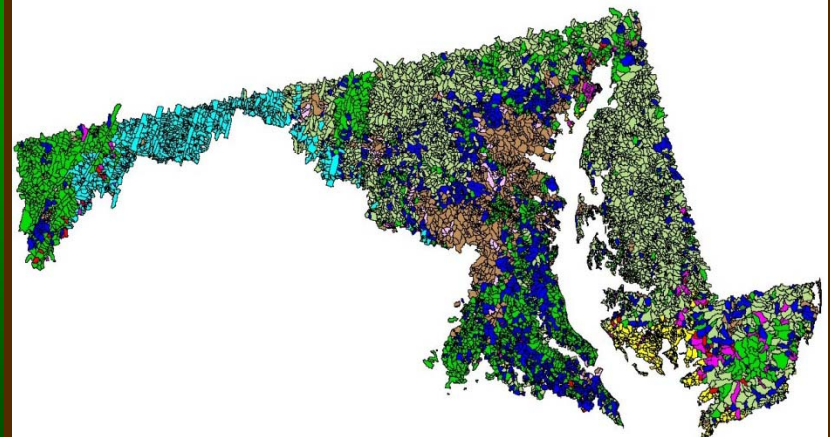
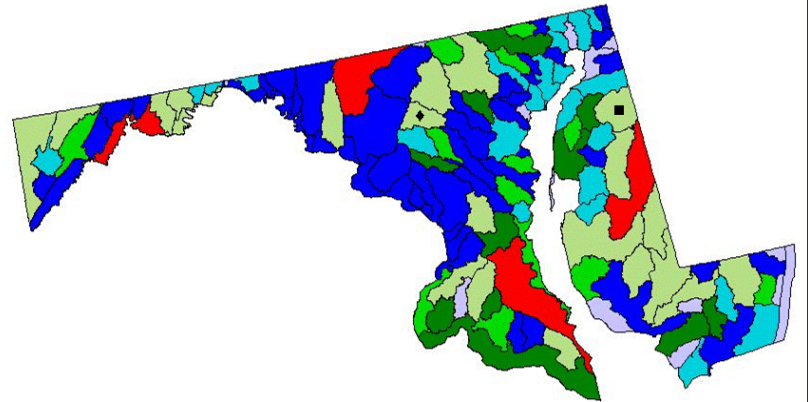
Two scales of interest

- **94** MD HUCs, 303(d) listing level screening statewide

➔ *which HUCs are the most restorable?*

- **1367** catchments, compared within individual HUCs

➔ *which catchments' restoration would most likely improve a specific HUC's condition?*



HUC	Name	Score	Rank	Pass	Fail		
120000	Island East	17.8	7	1,121	Pass	2,300	2,300
120001	Ilion Mt East	24.4	20	1,127	Pass	4,100	2,300
120002	Jones Bay	24.2	1	1,131	Pass	4,100	2,300
120003	Kelley Bay	41.8	13	1,132	Pass	2,400	2,400
120004	Pelican Bay NE	31.2	13	1,133	Pass	4,100	4,100
120005	King East	11	17	1,135	Pass	2,400	4,170
120006	King N East	24.2	10	1,138	Pass	2,400	4,100
120007	St. Charles Bay	46.7	12	1,143	Pass	2,400	2,400
120008	Mad Bay	18.8	12	1,144	Pass	2,700	2,700
120009	East River	18.1	14	1,145	Pass	2,400	2,400
120010	Ballast Bay	11	14	1,145	Pass	2,700	4,120
120011	Mad Bay	11	7	1,145	Pass	2,400	4,100
120012	River Bay	121.5	11	1,145	Pass	4,100	4,100
120013	Mad Bay	18.1	27	1,151	Pass	2,400	10,220
120014	St. Charles Bay	24.2	27	1,151	Pass	2,400	10,220
120015	Mad Bay	24.2	12	1,152	Pass	2,400	10,220
120016	Mad Bay	24.2	19	1,152	Pass	2,400	10,220
120017	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120018	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120019	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120020	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120021	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120022	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120023	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120024	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120025	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120026	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120027	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120028	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120029	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120030	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120031	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120032	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120033	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120034	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120035	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120036	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120037	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120038	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120039	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120040	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
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120045	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120046	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120047	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120048	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120049	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
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120057	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120058	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120059	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120060	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120061	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120062	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120063	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120064	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120065	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120066	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120067	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120068	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120069	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120070	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120071	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120072	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120073	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120074	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120075	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120076	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120077	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120078	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120079	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120080	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
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120082	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
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120084	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120085	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120086	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120087	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120088	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120089	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120090	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120091	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120092	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120093	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120094	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120095	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120096	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120097	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120098	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120099	Mad Bay	24.2	10	1,153	Pass	2,400	10,220
120100	Mad Bay	24.2	10	1,153	Pass	2,400	10,220

Screening among AND within HUCs in MD:

Several **borderline-impaired MD HUCs** (left) seem to stand out from bioassessment screening metrics alone as good targets for restoration.

What might further illuminate HUC recovery potential if **more comparison metrics** are used –

- to compare one HUC to another?
- to compare smaller catchments within each HUC?

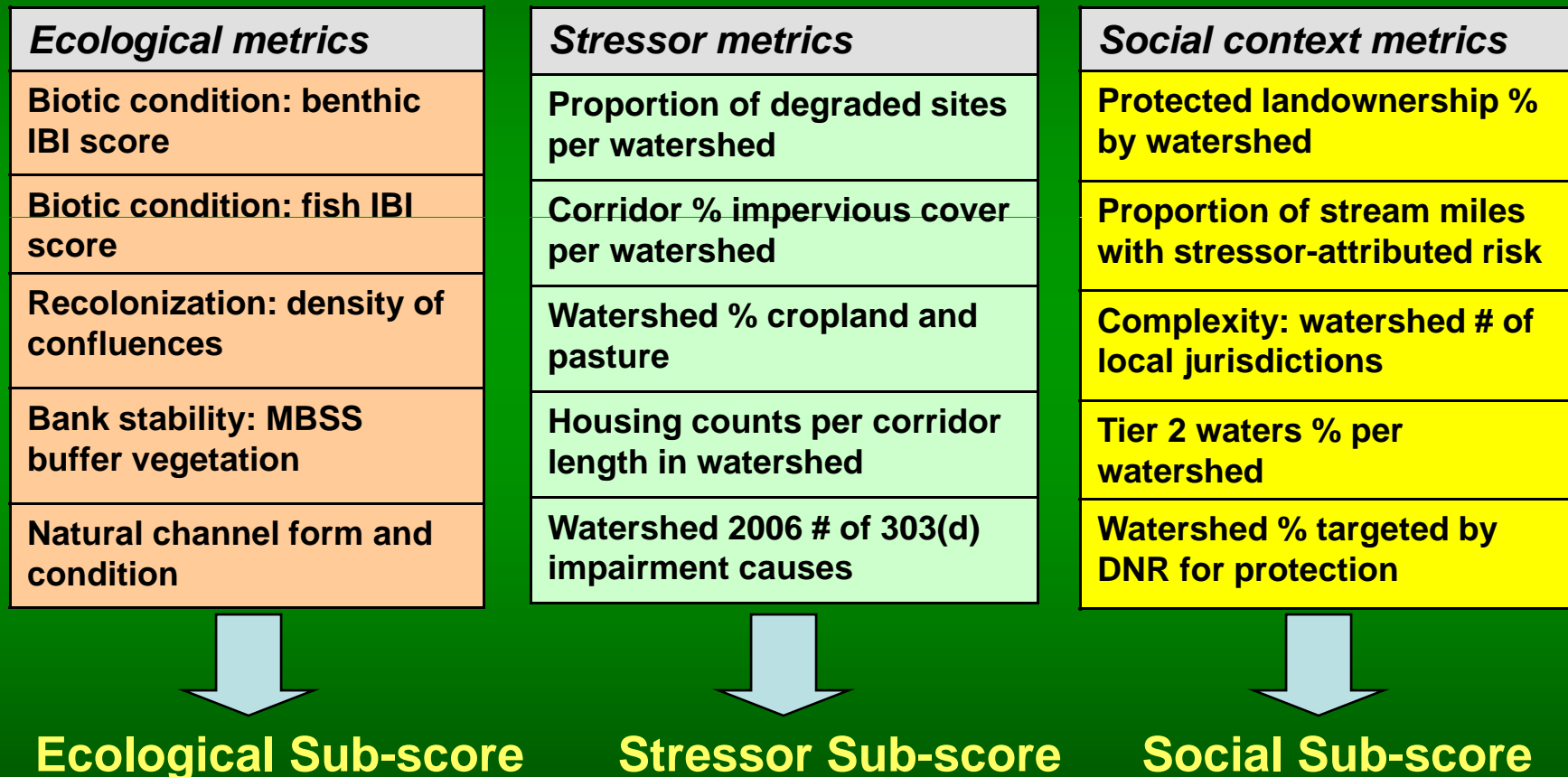
Recovery Potential Screening of 94 MDE Watersheds

Selected Indicators

<i>Ecological metrics</i>	<i>Stressor metrics</i>	<i>Social context metrics</i>
Biotic condition: benthic IBI score	Proportion of degraded sites per watershed	Protected landownership % by watershed
Biotic condition: fish IBI score	Corridor % impervious cover per watershed	Proportion of stream miles with stressor-attributed risk
Recolonization: density of confluences	Watershed % cropland and pasture	Complexity: watershed # of local jurisdictions
Bank stability: MBSS buffer vegetation	Housing counts per corridor length in watershed	Tier 2 waters % per watershed
Natural channel form and condition	Watershed 2006 # of 303(d) impairment causes	Watershed % targeted by DNR for protection

Recovery Potential Screening of 94 MDE Watersheds

Selected Indicators



Recovery Potential Screening of 94 MDE Watersheds

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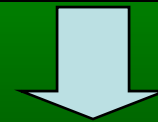
<i>Ecological metrics</i>	<i>Stressor metrics</i>	<i>Social context metrics</i>
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Ecological Sub-score



Stressor Sub-score



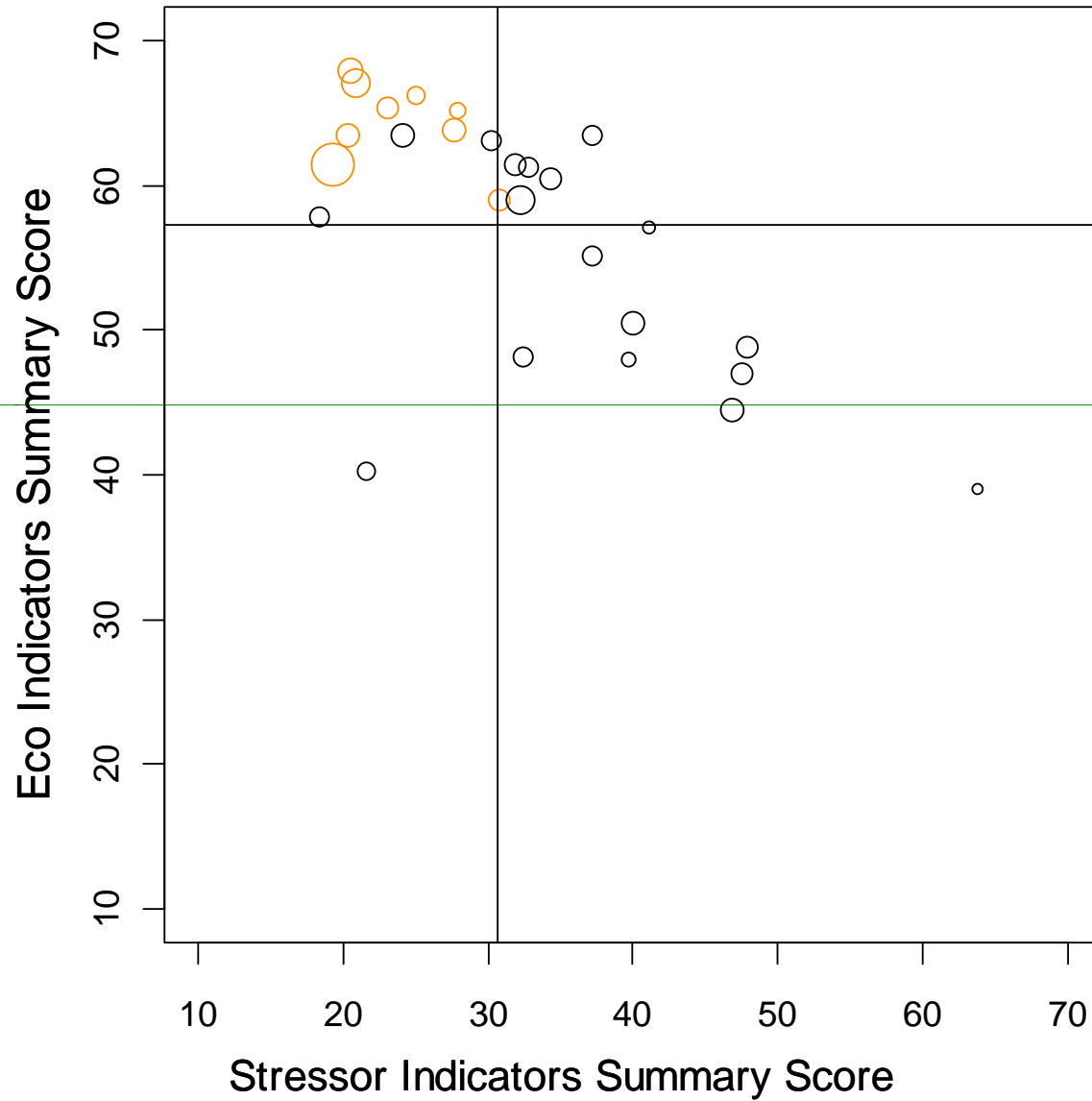
Social Sub-score

(Ecological + Social)

Stressor

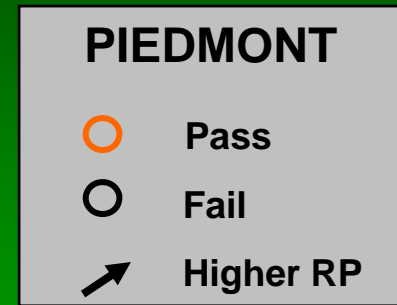
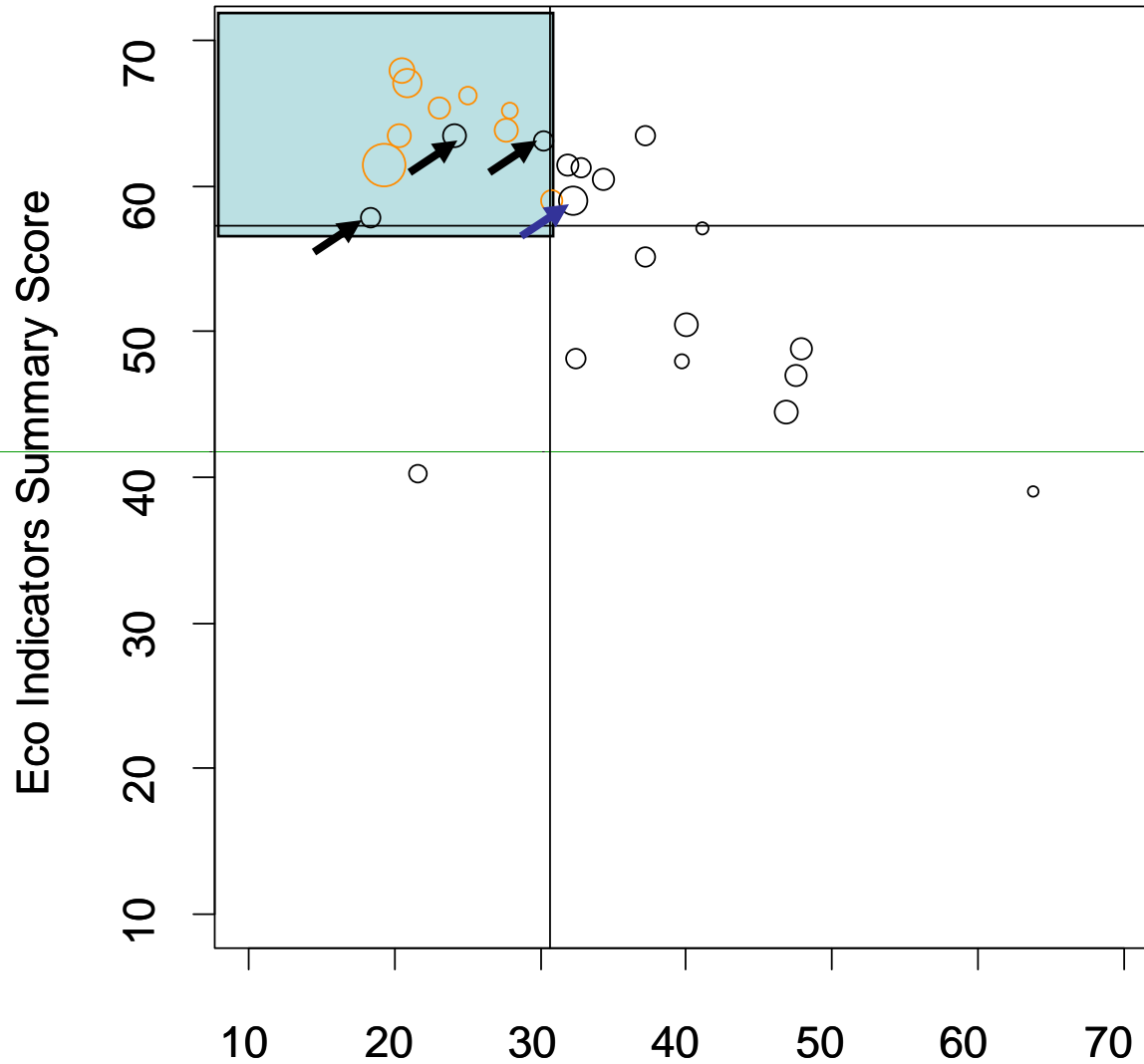
MDE RECOVERY POTENTIAL SCREENING, PIEDMONT ECOREGION SUMMARY

ALTOPTION1 metrics



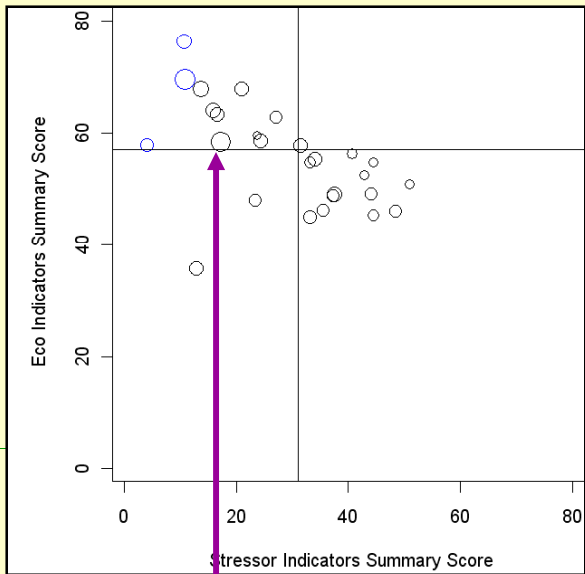
Circle size increases with Social Context summary score value

Focusing on more restorable watersheds



Stressor Indicators Summary Score
Circle size increases with Social Context summary score value

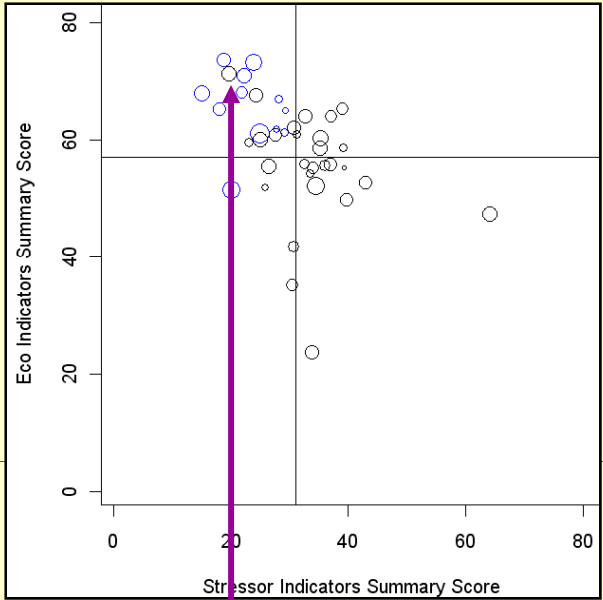
Where do *high-interest watersheds* fall out on the plots?



S. BRANCH PATAPSCO

SumRanks (of 18 fails)

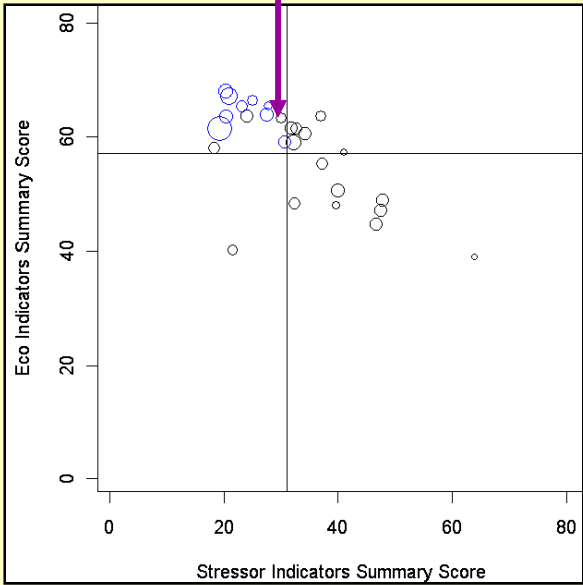
ECOSUM:	3
STRESSUM:	4
SOCIOSUM:	14
SUMFORMULA:	5



CASSELMAN RIVER

SumRanks (of 24 fails)

ECOSUM:	8
STRESSUM:	5
SOCIOSUM:	1
SUMFORMULA:	3



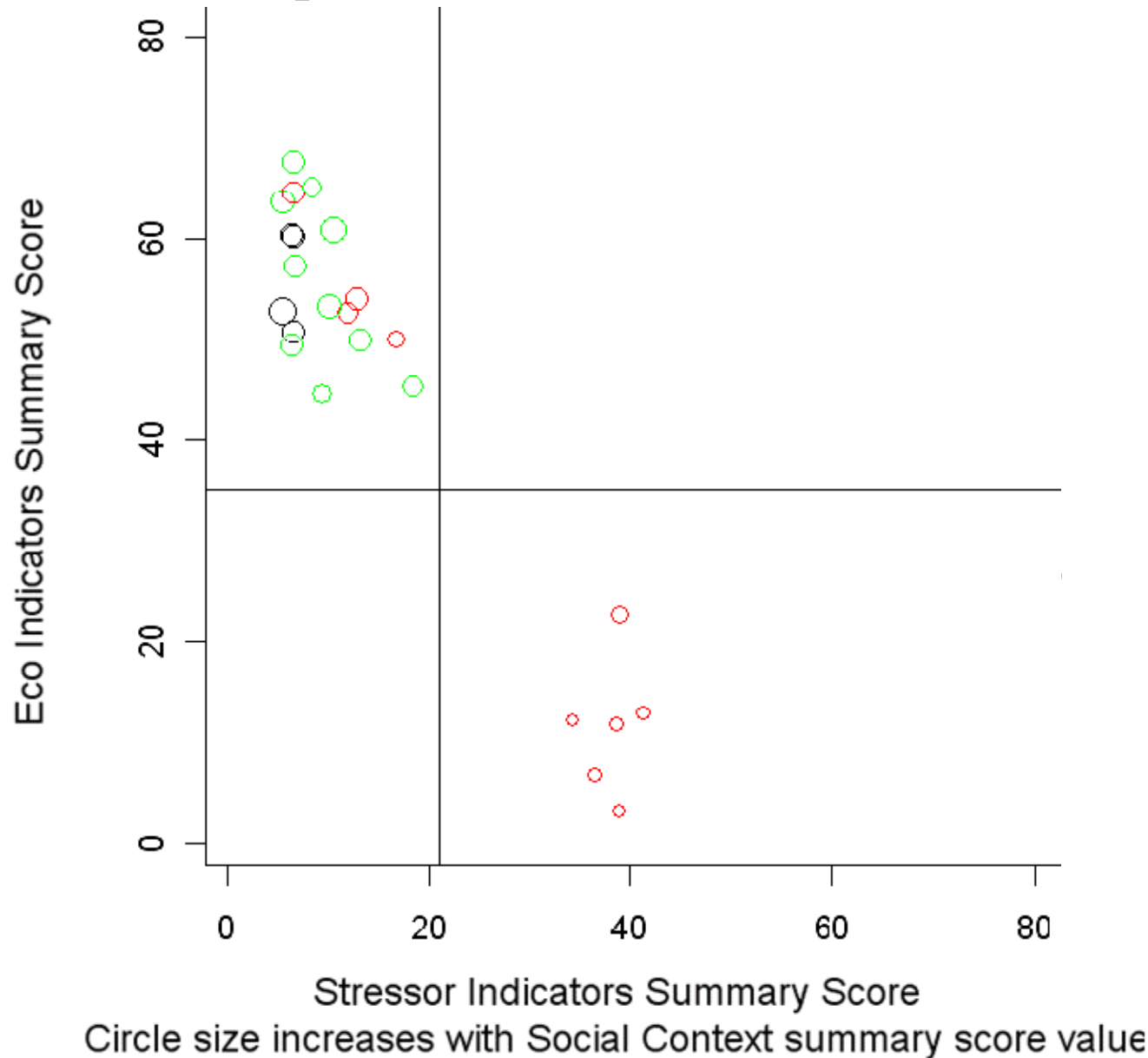
MATTAWOMAN RIVER

SumRanks (of 29 fails)

ECOSUM:	1
STRESSUM:	1
SOCIOSUM:	4
SUMFORMULA:	1

Screening subwatersheds in a priority watershed

Upper Monocacy River MBSS Screening, BIBI color scheme



Take-home messages about screening

- Priority setting for restoration is inevitable, affects track record and funding
- Priority decisions need systematic, transparent, science-based and user-selected tools
- Consistent comparisons can reveal surprising patterns, e.g., ecologically “worst” sites frequently also have a bad social context score
- We should work together to build up the scientific basis and tools for better prediction of restorability...

Recovery Potential Screening

Tools for Regions and States

Environmental Management
DOI 10.1007/s00267-009-9304-x

A Method for Comparative Analysis of Recovery Potential in Impaired Waters Restoration Planning

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Timothy G. Wade · Kelly Kunert ·
John V. Thomas · Paul Zeph

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Abstract Common decision support tools and body of knowledge about ecological recovery inform and guide large state and federal restoration programs affecting thousands of impaired waters. federal Clean Water Act (CWA), waters not meeting Water Quality Standards due to impairment by

Thank you for your time!

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Draft EPA Web Site Now Accessible At:

http://hudson.tetrattech-ffx.com/RECOVERY_POTENTIAL/home.html