River Health Report Card

Water Resources Commission

November 14, 2019

Alison Field-Juma, OARS Executive Director


Science-based Advocacy
Recreation • Education

Mystic River
WATERSHED ASSOCIATION

HOME THE WATERSHED THE WORK GET INVOLVED ABOUT US NEWS

JUNE 14, 2018

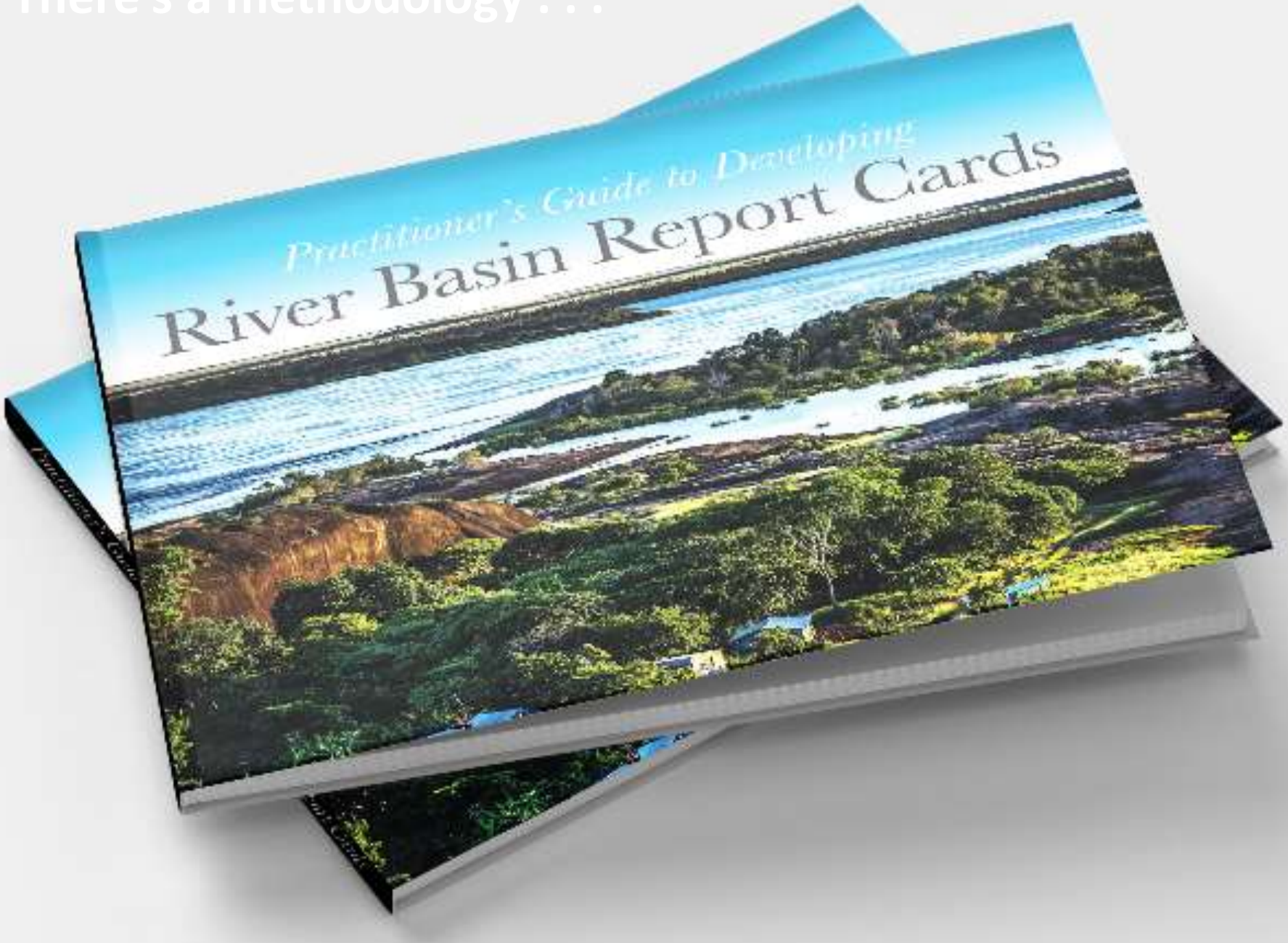
The Mystic River Made the Grade: A-

Go Out and Enjoy Your River & Lakes!

Together with the US Environmental Protection Agency (EPA), the Mystic River Watershed Association issued the 2017 Water Quality Report Card for the Mystic River watershed

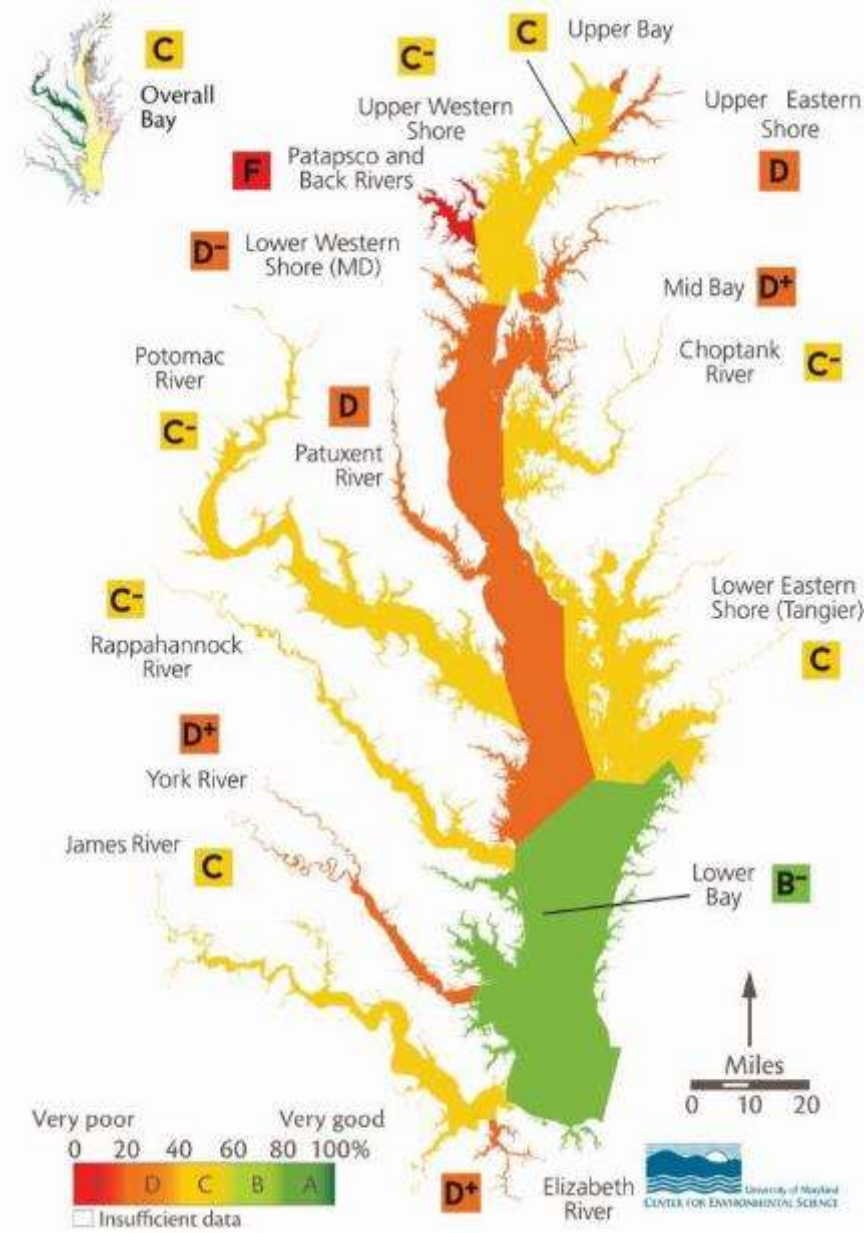
Iconic ecosystems around the world

There's a methodology . . .



What is a river health report card?

- Assessment of social, cultural and economic health of a river basin
- Based on defensible scientific data
- Synthesizes complex information
- Stakeholder-driven and engaging
- Provides a common vision



Many audiences

low
Information
high

high
Synthesis
low

Report card

Public & Policymakers

Summary reports

Stakeholders

Technical reports

Managers

Scientific literature

Scientists

How do you make a report card?

1 What is the big picture?

IDENTIFYING BASIN VALUES AND THREATS

2 What do we measure?

CHOOSING INDICATORS

3 What is healthy?

DEFINING THRESHOLDS FOR INDICATORS

4 How does it add up?

CALCULATING SCORES AND DETERMINING GRADES

5 What is the story?

COMMUNICATING RESULTS

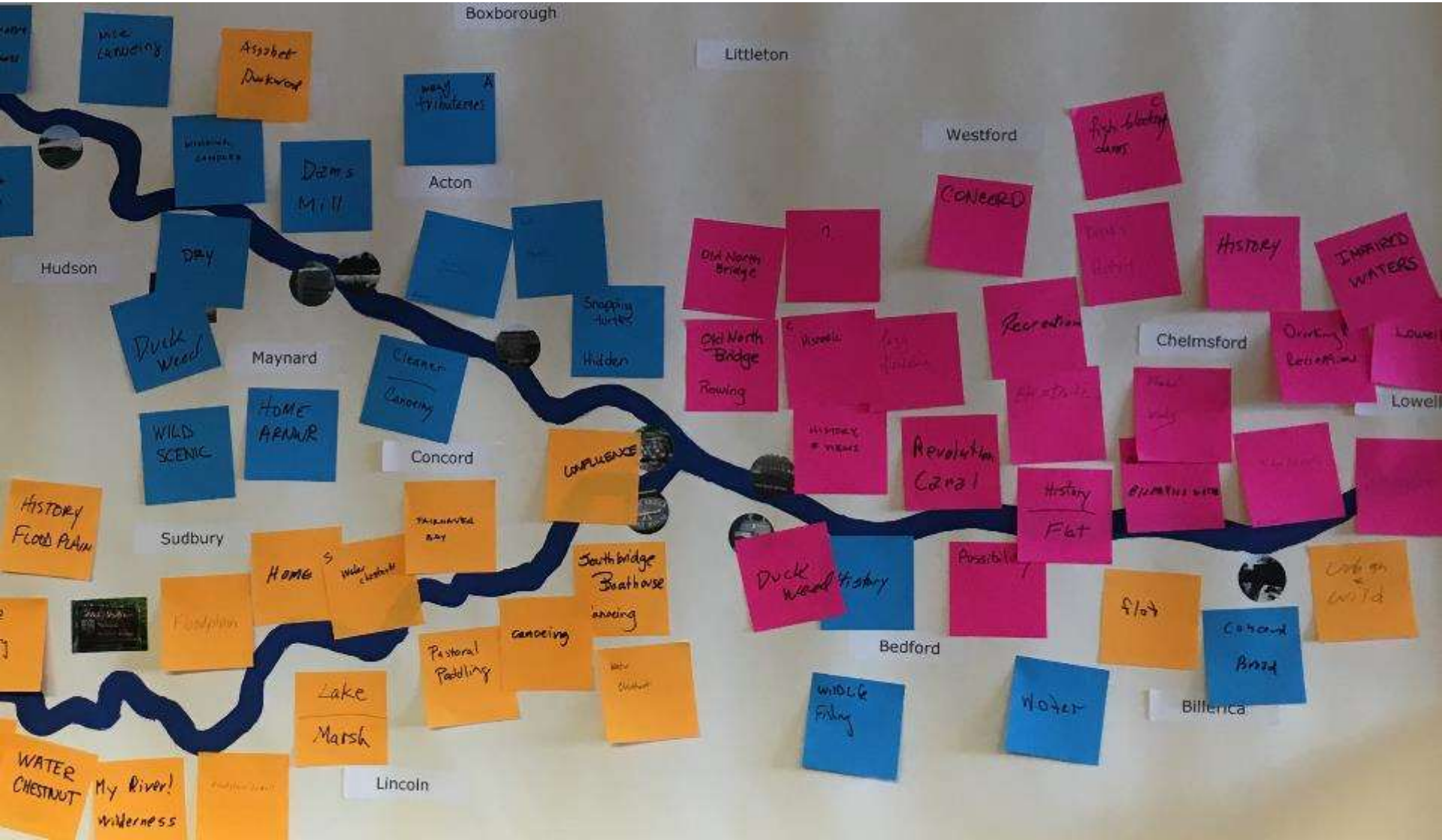
Step 1: What is the big picture?

Identifying basin values and threats

Stakeholder Workshop #1

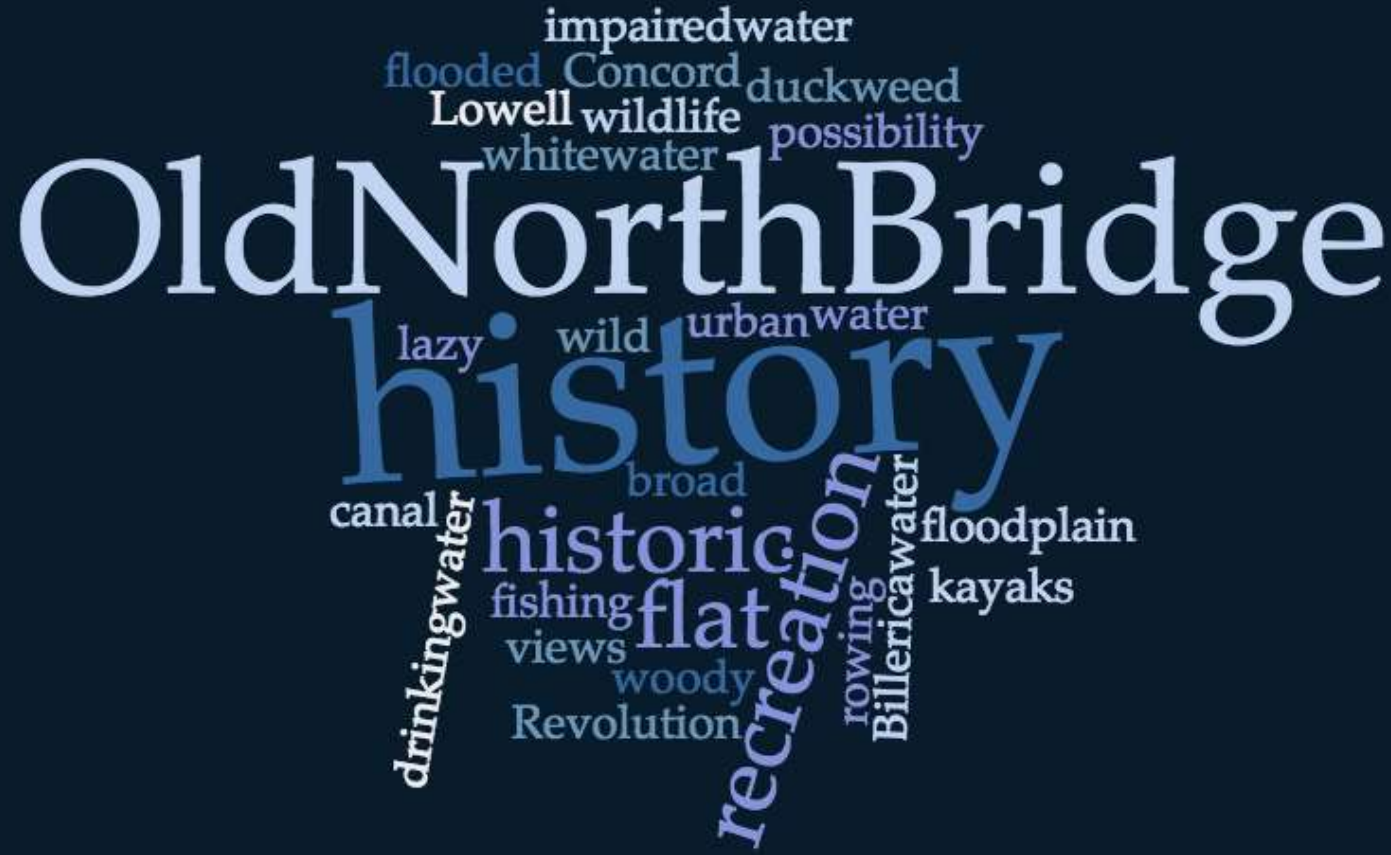
Step 1: What is the big picture?

Describe each river



Assabet River

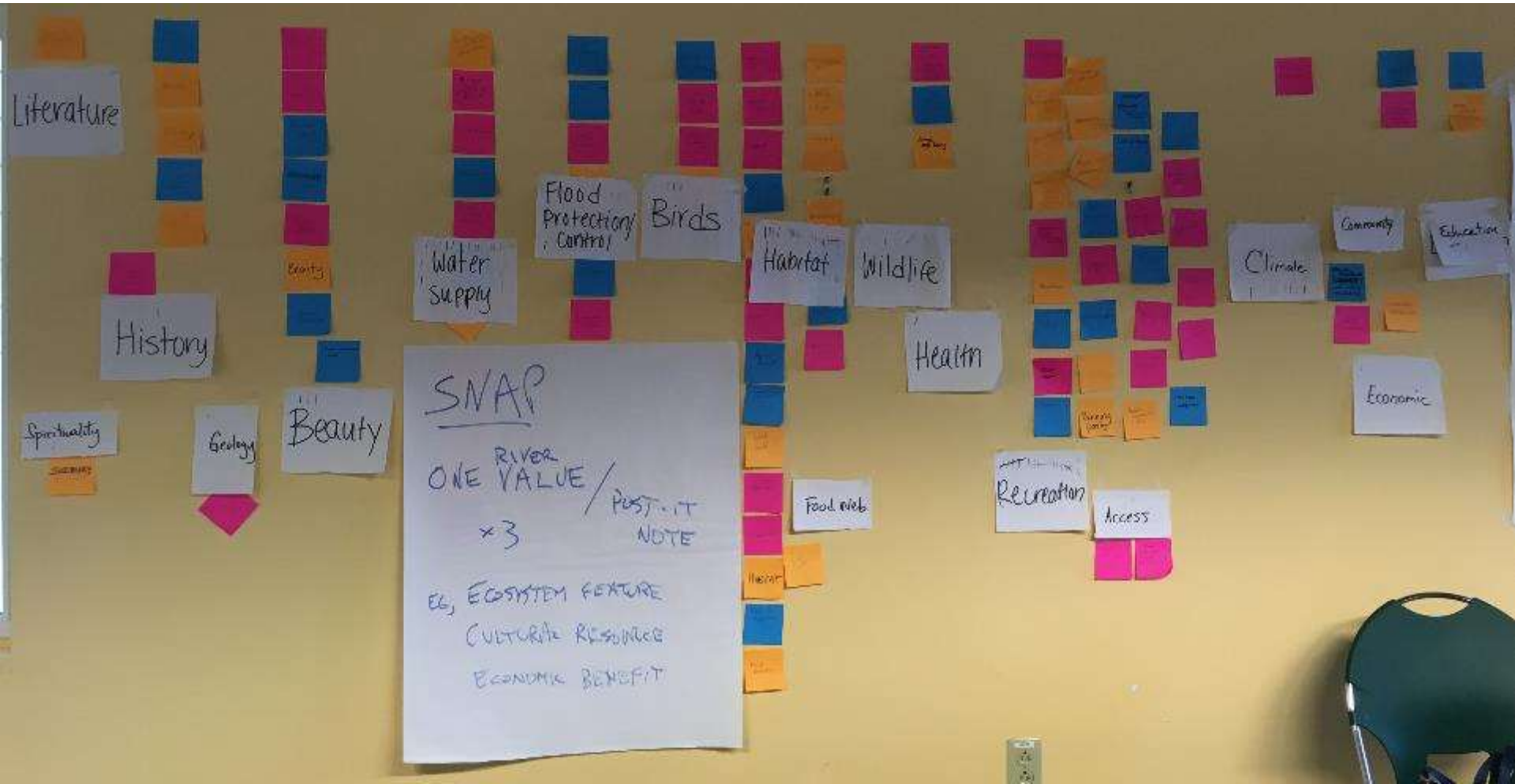
Concord River



Step 1: What is the big picture?

Identifying basin values and threats

SNAP - Values



Values for the watershed—first cut

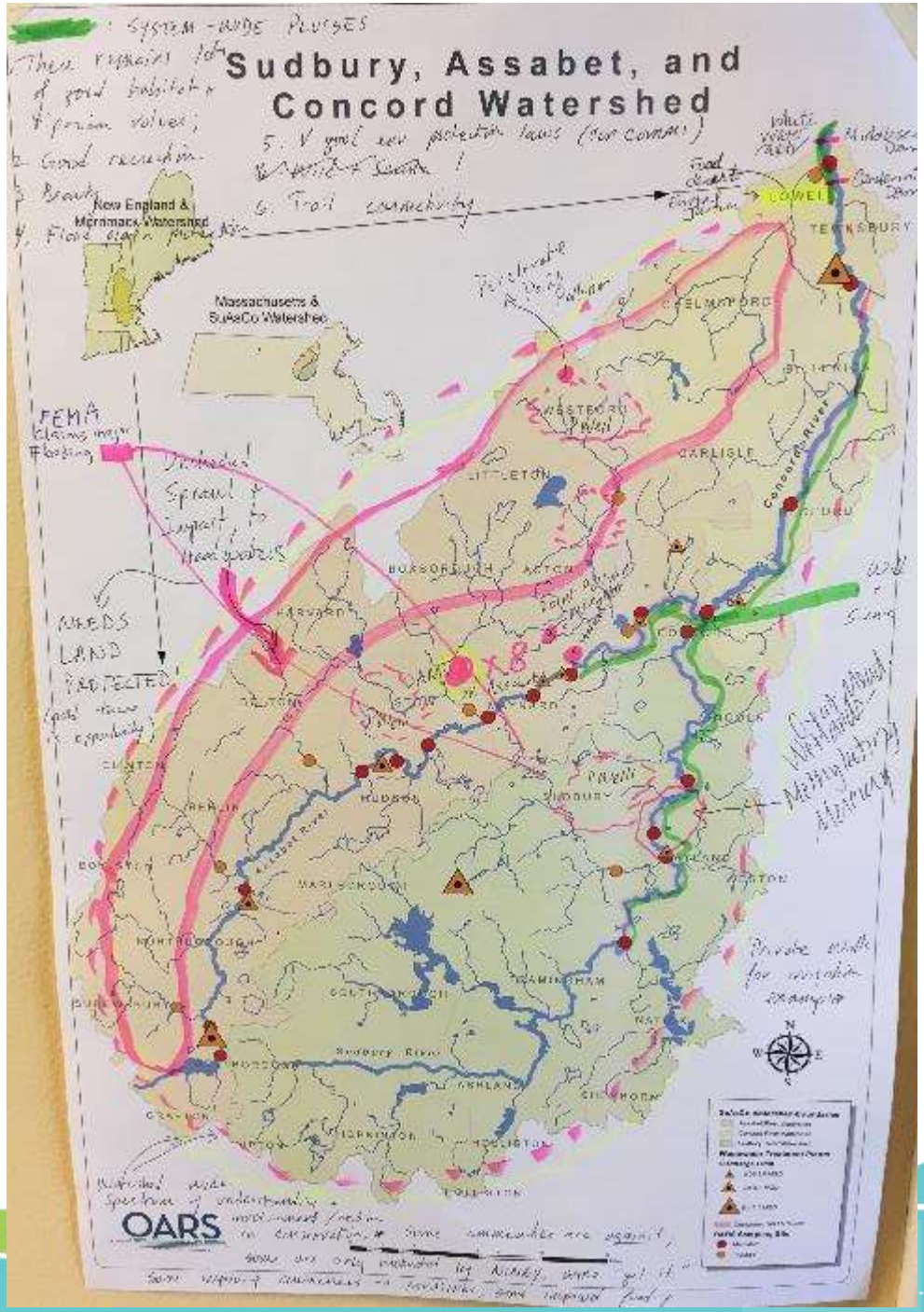
1. **Water quality, quantity**
2. **Ecological (habitat/wildlife)**
3. **Public health/safety**
4. **Cultural/scenic**
5. **Recreation**
6. **Economy**

Climate vulnerability and building resilience

Step 1: What is the big picture?

Identifying basin values and threats

Watershed features and threats



Step 2: What do we measure?

Choosing indicators

Stakeholder workshop #2

Step 2: What do we measure?

Choosing indicators

pH

Flow

water quality/ quantity

Nutrients

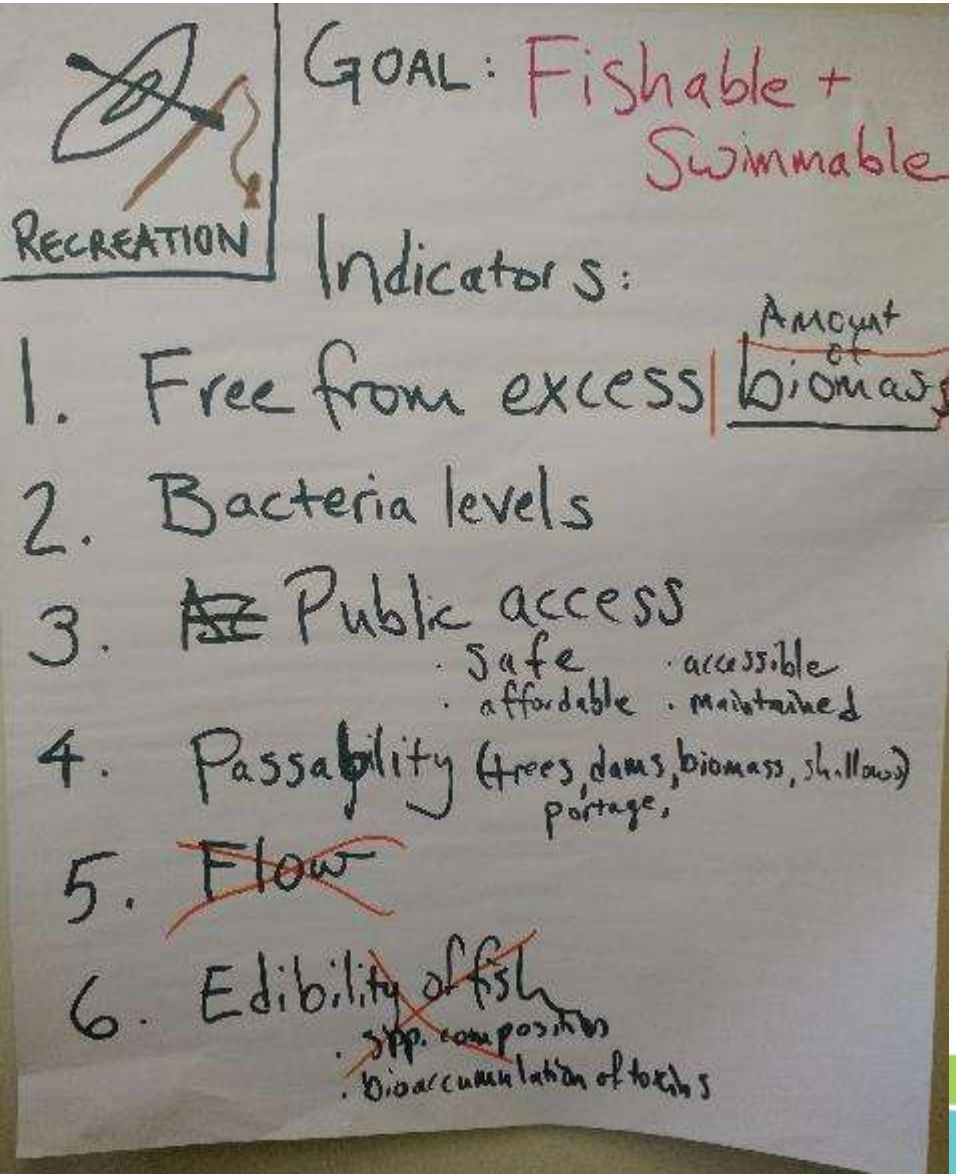
Dissolved oxygen

Temperature

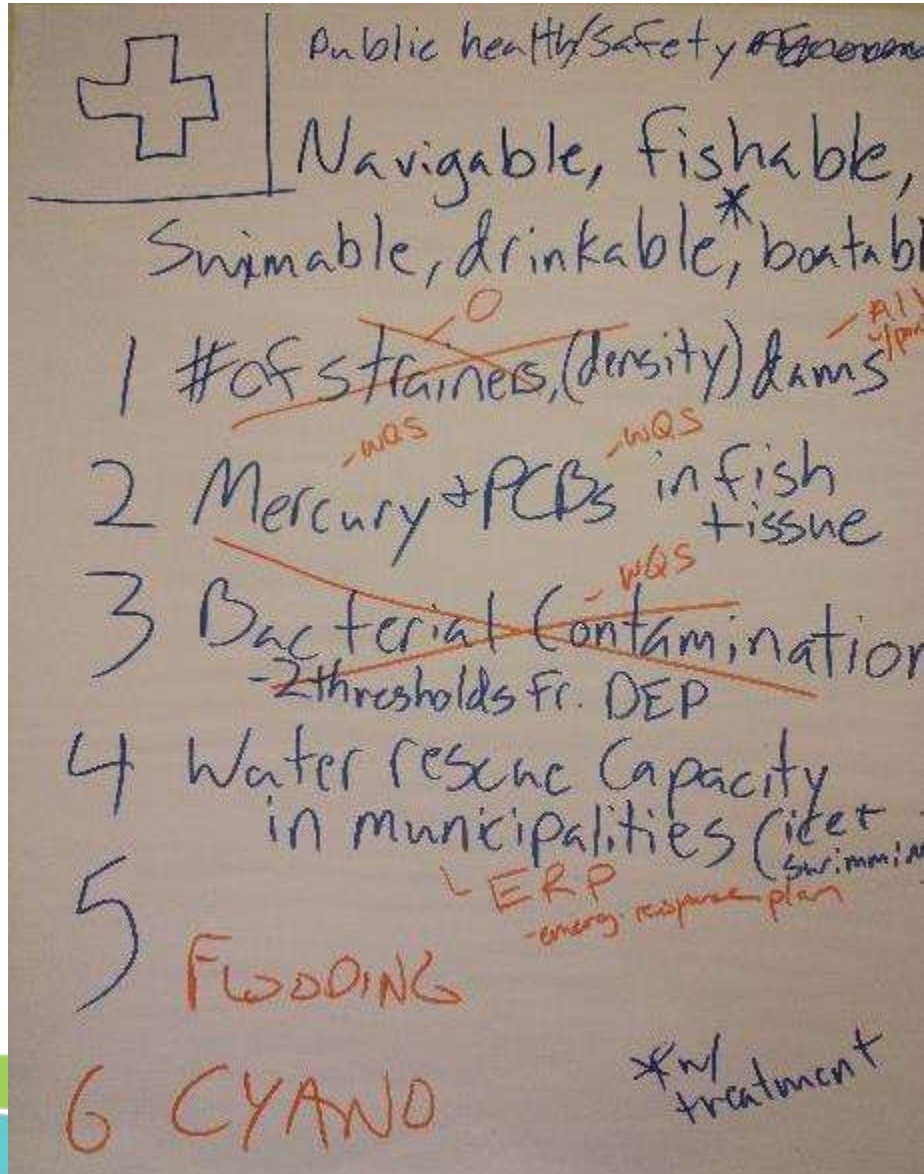
Contaminants

Potential indicators—first cut

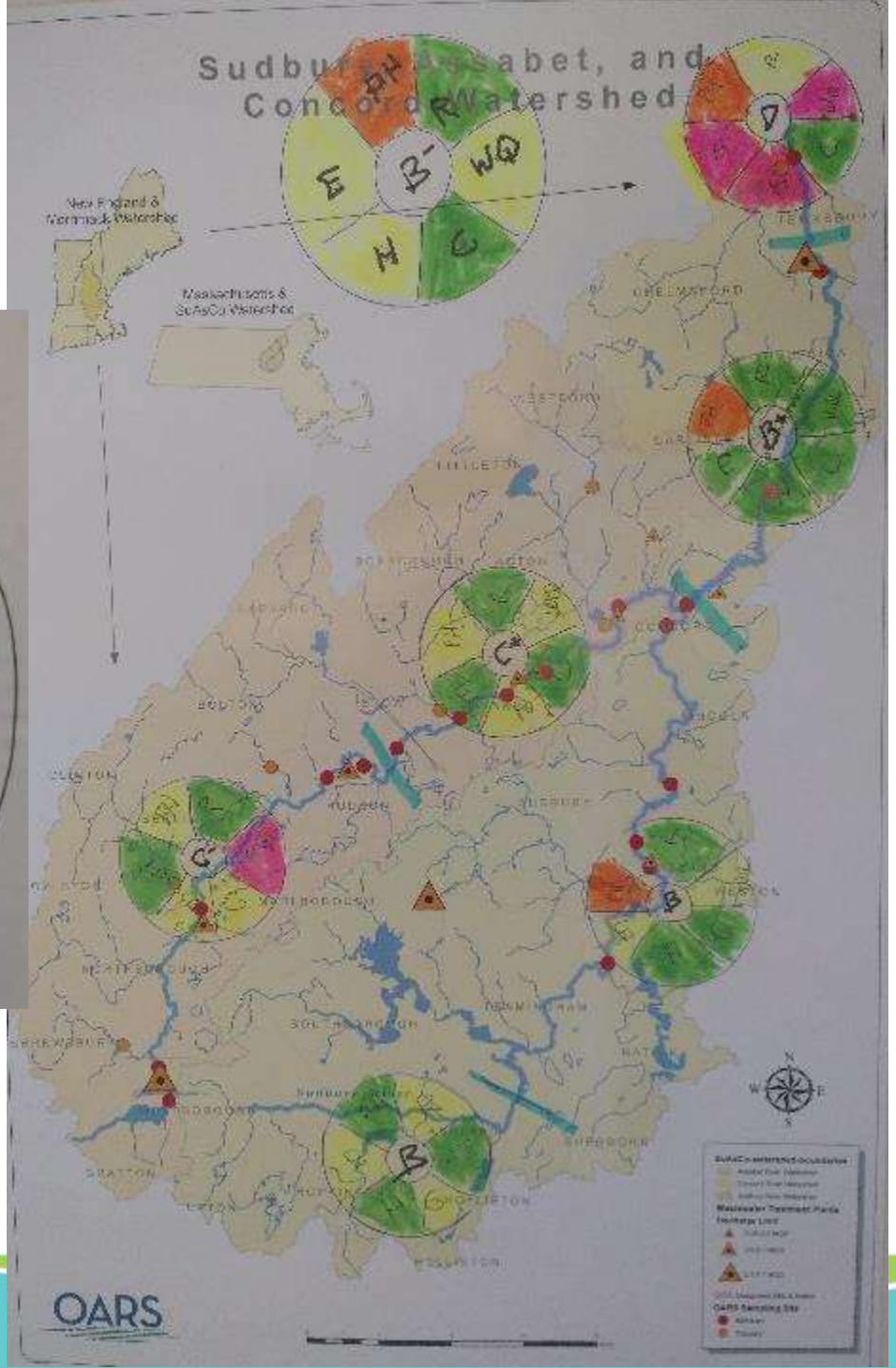
Recreation



Public health/safety



Test run!



Identified the need to divide analysis into upper and lower segments of each river

Step 3: What is healthy

Defining thresholds for indicators

Caution

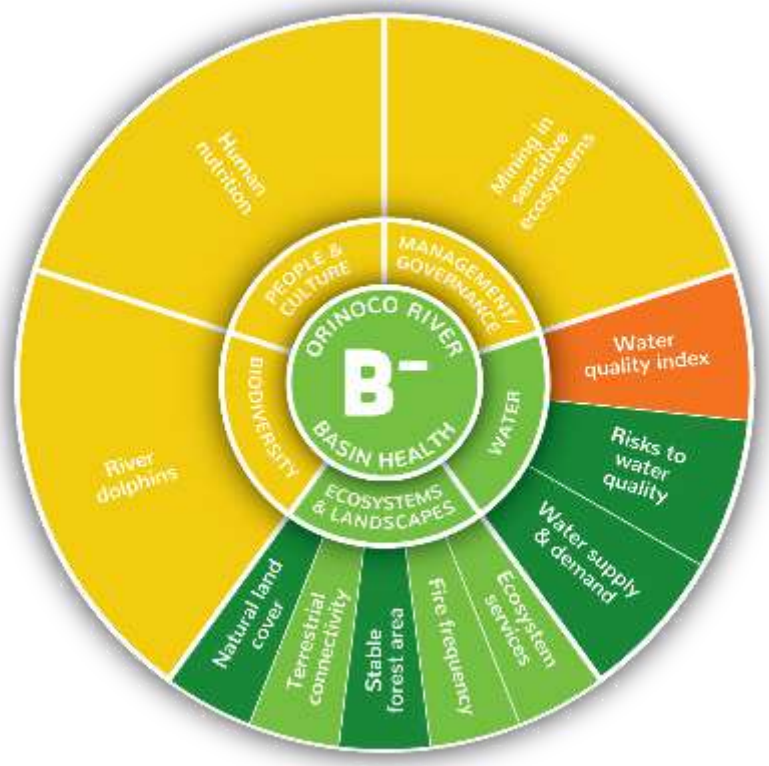
Good

Danger

Insufficient data

Step 4: How does it add up?

Calculating scores and determining grades



Step 4: How does it add up?

Calculating scores and determining grades

Steps 2-4 Feedback: Indicators, Thresholds and Scoring

Stakeholder Workshop #3

Value Categories

1. Water Quality
2. Streamflow
3. Habitat
4. ~~Economy~~
5. Recreation
6. Scenery
7. ~~Public Health~~

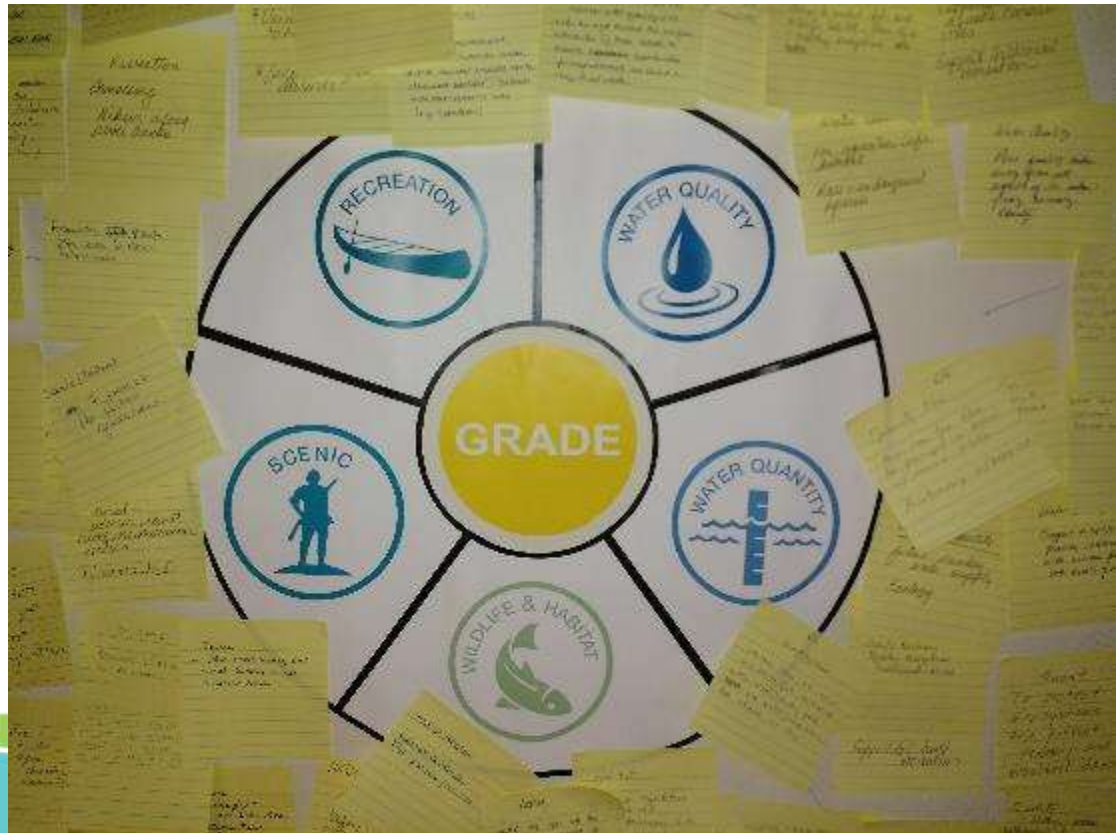
Statements for each Value

SCENIC

The scenery of rivers provides joy and serenity in our hectic lives. This is available to everyone for free and should be available to future generations. It changes constantly especially with the seasons—from subtle to dramatic—always something new to inspire us.

RECREATION

Recreation is how people connect to the river and is important for public wellbeing and local economies. These rivers should be a destination for hiking, biking, boating, fishing, swimming and birdwatching and accessible to everyone.



It's all in the Methods Report

2018 Sudbury-Assabet-Concord River Report Card

In 2017, OARS, the watershed organization for the three rivers, brought together funding and 52 key stakeholders and technical experts to help create the first Sudbury-Assabet-Concord River report card. Guided by the University of Maryland Center for Environmental Science and OARS, the team of experts and stakeholders identified key indicators of river health and the data needed to measure the status of each indicator. The Report Card was released in June 2019 in both on-line and printed versions. Download the printed Report Card or explore this website to learn more about the health of the Sudbury, Assabet and Concord rivers, and what you can do to make them better. You can also request a printed copy from OARS. [upload pdf]

River Report Card Methods Report

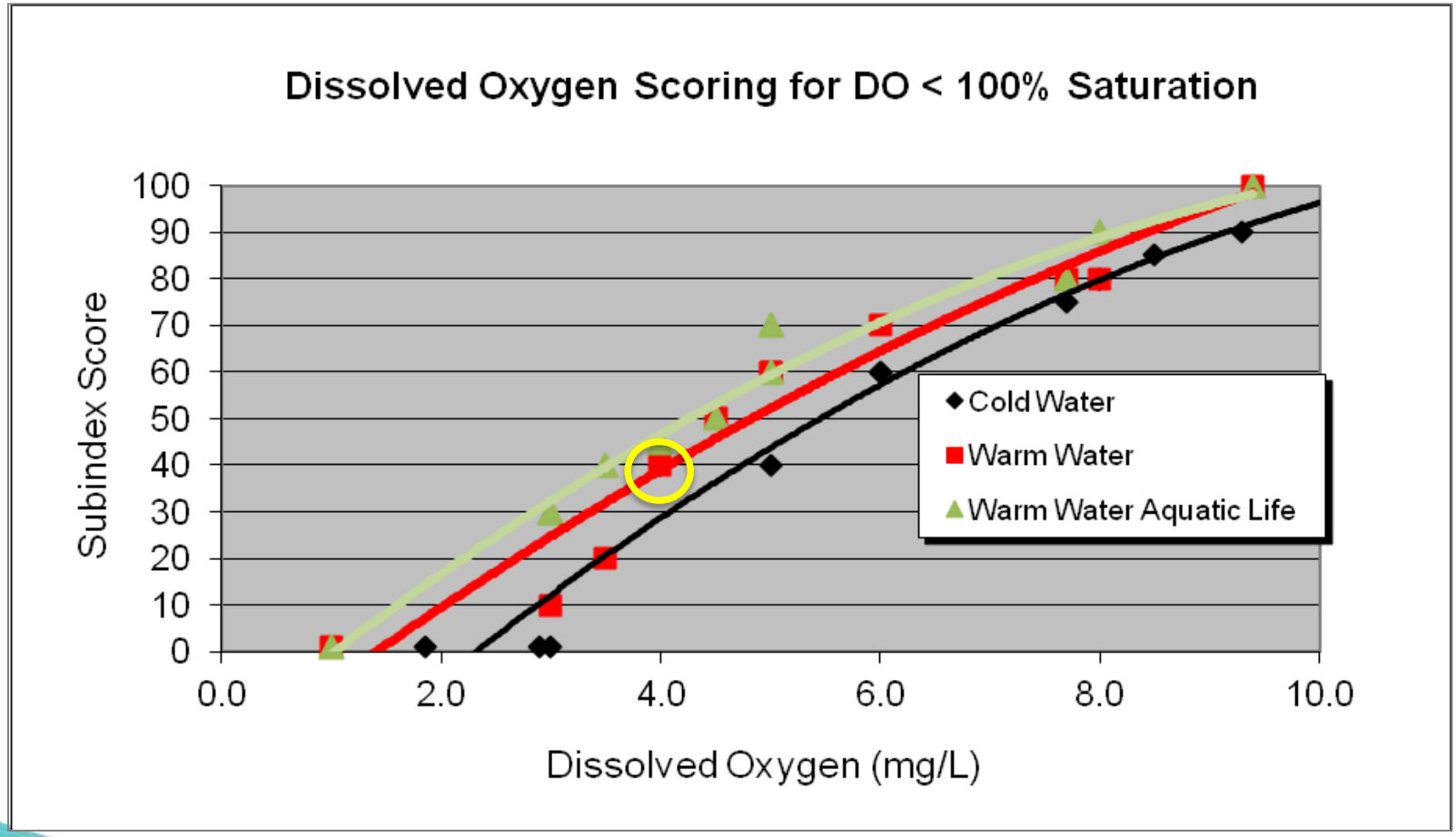
The Methods Report for the Sudbury, Concord and Assabet River Report Card describes in detail how each indicator was measured and corresponding grades calculated. [upload pdf]

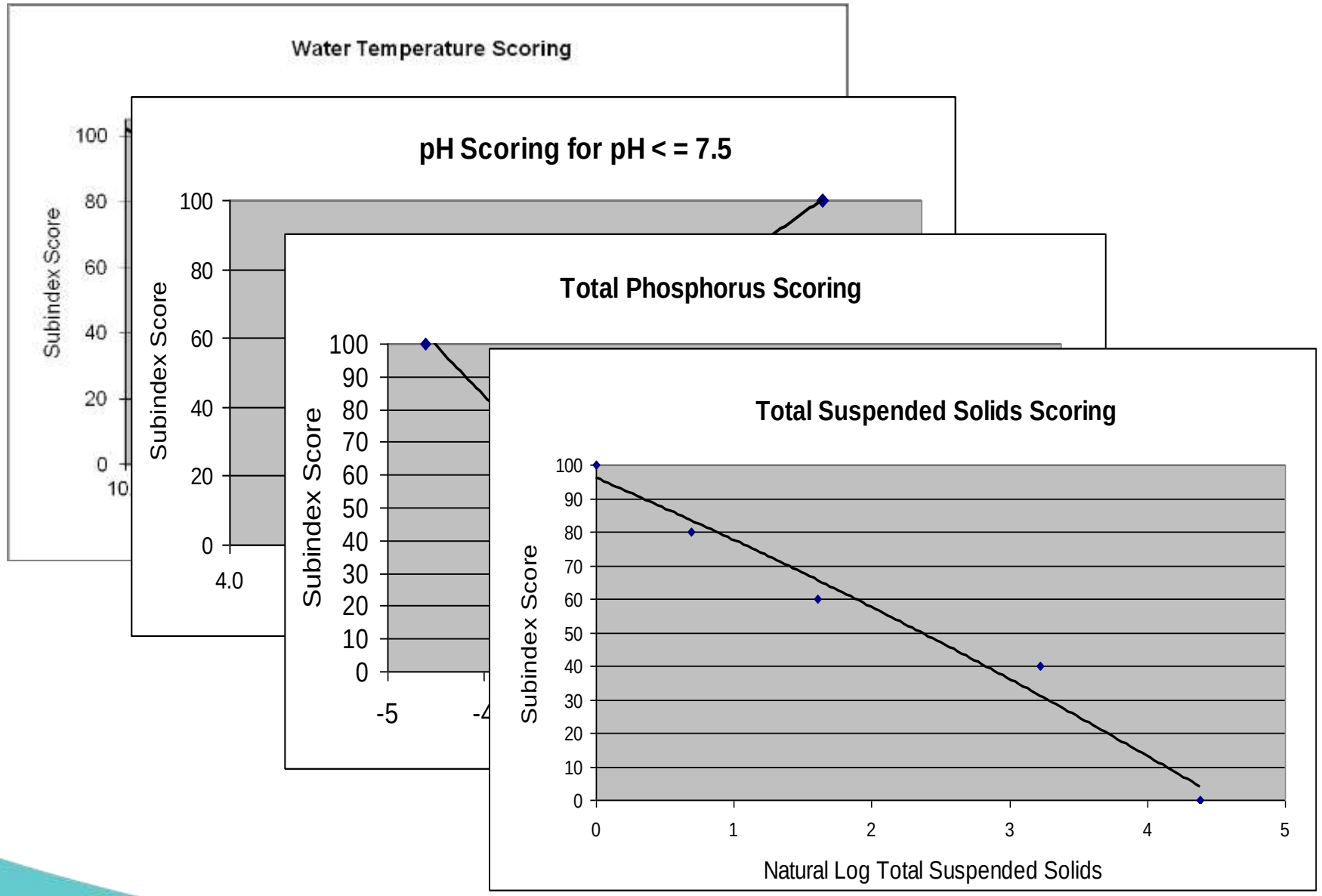

B
RECREATION
WATER QUALITY
HABITAT
STREAMFLOW
SCENERY
Passability
Access
Trails
Bacteria
Fish edibility
Floating biomass
Dissolved oxygen
Suspended solids
Temperature
Nitrates
Phosphorus
Aquatic connectivity
Habitat connectivity
Ecological integrity
Impervious cover
Summer streamflow
Streamflow alteration
Channel flow
Groundwater level
Cultural importance
Visual quality

Water Quality

Value	Indicator	Scoring Criteria (on a scale of 1 - 100)
Water Quality	DO concentration (min.)	Massachusetts Water Quality Standards (WQSs) for cold water fisheries and warm water fisheries; fish tolerances; EPA criteria; EPA Ecoregion XIV data
	DO % saturation (min.)	
	Temperature	Mass WQSs for cold and warm water fisheries, published fish tolerances
	~~pH~~ FLOATING BIOMASS	OARS biomass assessment for Assabet River only
	Total phosphorus	EPA Ecoregion XIV data
	Nitrates	EPA Ecoregion XIV data
	Total Suspended Solids	Washington data Region 1; published fish tolerances; Mass DEP criteria

Scoring Equation




Water Temperature Scoring
Subindex Score
100
80
60
40
20
0
10
pH Scoring for pH < = 7.5
Subindex Score
100
80
60
40
20
0
4.0
Total Phosphorus Scoring
Subindex Score
100
90
80
70
60
50
40
30
20
10
0
-5
Total Suspended Solids Scoring
Subindex Score
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
Natural Log Total Suspended Solids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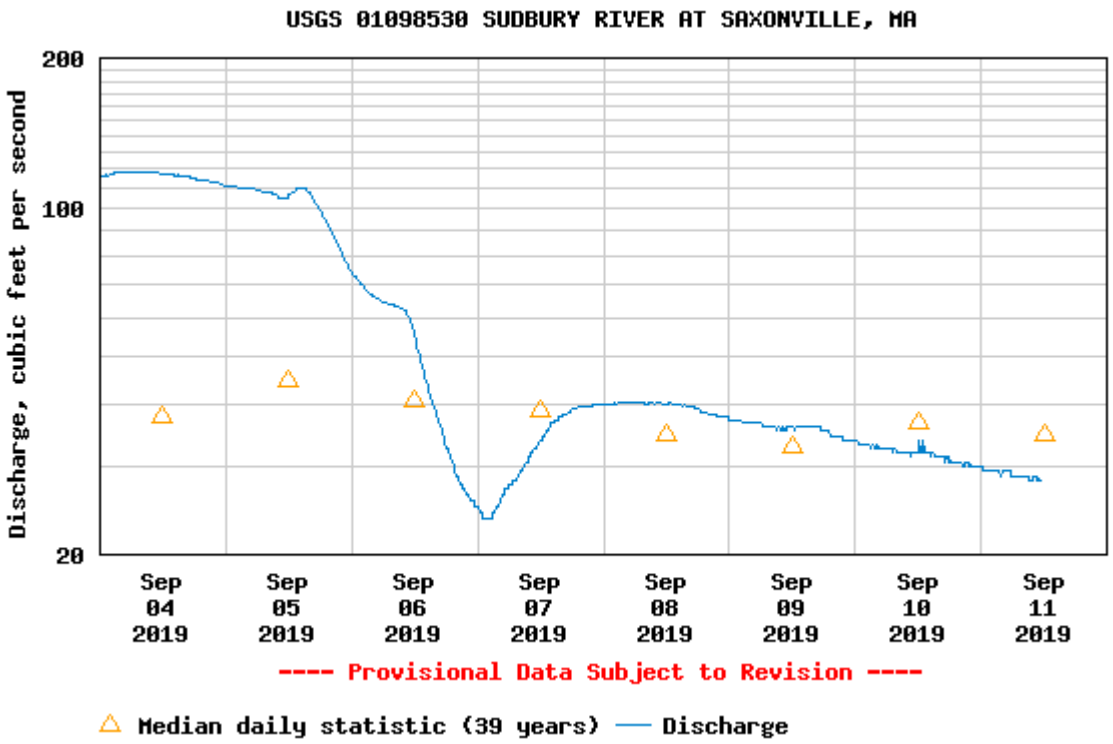
Streamflow

Value	Indicators	Scoring Criteria (on a scale of 1 - 100)
Streamflow	Summer Streamflow	Tennant method flow recommendations for summer conditions; 40%, 30%, and 10 % of mean annual discharge (Q_{MA}) create "good," "fair," and "poor" habitat conditions, respectively (Tennant , 1976).
		StreamStats-calculated August median flows "good"
		StreamStats-calculated 7Q10 flows "very poor"
		R2Cross criteria (SITE SPECIFIC – this was done for tributary sites); 3/3 criteria and 2/3 criteria
	Streamflow Alteration	TNC's Indicators of Hydrologic Alteration (to assess flow durations, flood volume and frequency, rates of change) compared to a natural flow (Squannacook River).
	Groundwater levels online readings of USGS Acton well	Long term records for the Acton well; quartiles of the monthly statistics
	Channel flow status	Rapid Bioassessment from OARS WQ monitoring

Annual Stream Flows

How to assess flow duration, flood volume and frequency, rates of change?

Used TNC's Indicators of Hydrologic Alteration—compares our rivers with a relatively natural river (Squannacook).



Groundwater: Acton USGS groundwater well

Groundwater levels scoring curve for Acton MA-ACW 158 Acton, MA (period of record Jan 1965 – Sept 2001)						
Historic Ground water level statistics	groundwater level (ft below surface)					
	June	July	August	Sept	**June - Sept**	Score
Highest monthly reading	15.55	16.56	17.71	18.60	**15.55**	100
Upper quartile	17.48	18.15	18.97	19.50	**18.56**	80
Median	18.06	18.89	19.43	19.85	**19.16**	60
Lower quartile	18.85	19.40	19.85	20.15	**19.63**	20
Lowest monthly reading	20.34	20.62	21.00	21.36	**21.36**	1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HABITAT
Impervious cover
Ecological integrity
Habitat connectivity
Aquatic connectivity

Habitat

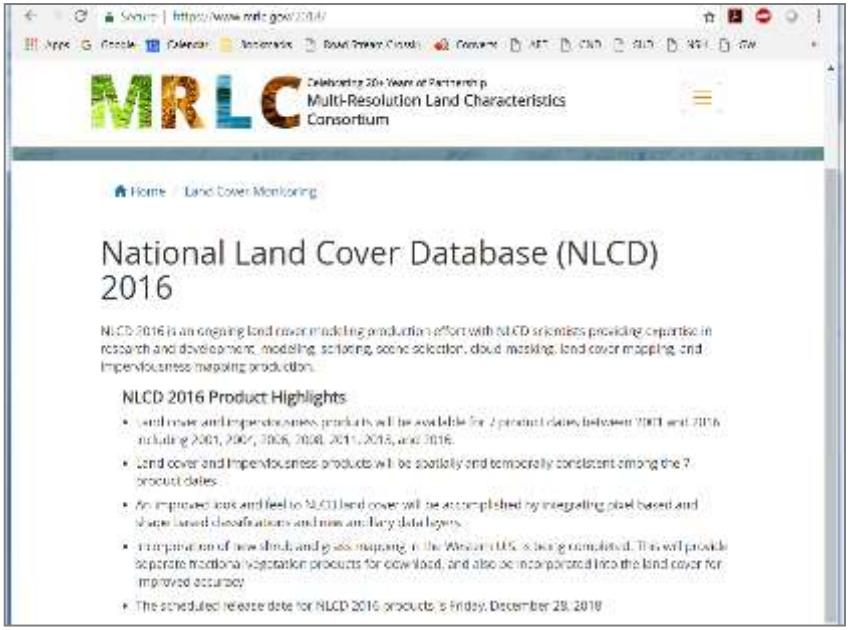
CAPS Index [illegible] tegrity

- Over 40 [illegible] many [illegible] health
  - esti[illegible]
  - total i[illegible]
  - % imperv[illegible] adjacent to we[illegible]
  - road traffic,
  - dams,
  - habitat connectedness,
  - aquatic habitat connectivity,
  - flow gradient and volume,
  - and development

Collaborate with your local land trust!

Percent Impervious

- Using the NLCD
- 2016 data just about to be issued
- Other years available: 2001, 2004, 2006, 2008, 2011, 2013

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Scenery

Visual Resource Inventory

National Park Service methodology—first use on rivers!

Graded 11 views in the watershed

Indicators:

- Visual Quality
- Cultural Importance

- Webinar training
- 2 days of fieldwork
- Lots of thought . . .

Upper Assabet: Hudson Library

Scenic Quality: C
View Importance: 4
Overall score: Low

Lower Assabet: Maynard, Ice House Landing

Scenic Quality: B View Importance: 3
Overall score: High

Lower Sudbury: Sherman's Bridge

Scenic Quality: A View Importance: 2

Overall score: Very High

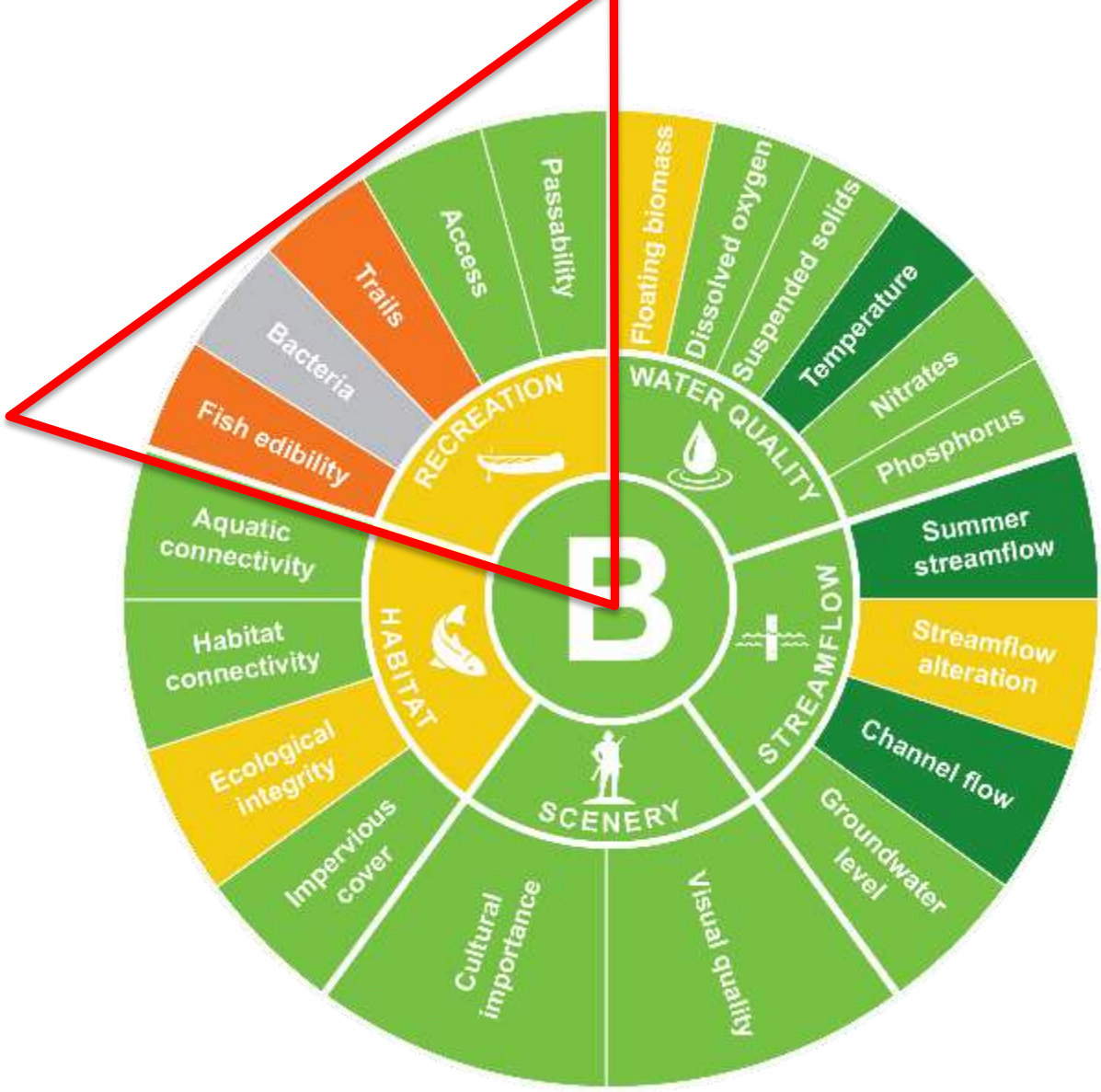
Lower Sudbury: Fairhaven Bay

Scenic Quality: B View Importance: 3

Overall score: High

Upper Concord: Billerica dam
Scenic Quality: C+
View Importance: 4
Overall score: Medium

Lower Concord: Lowell, E. Merrimack St.
Scenic Quality: C+ View Importance: 4
Overall score: Medium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Recreation

Indicators :

- Boating access: # put-ins/rivermile
- Passage: dams/rivermile + ease of portage
- Fish edibility: Fish Consumption Advisories
- Swimmability: bacteria—greyed out for now

SCORECALC_Overall - Excel

Report Card Scoring - 2018

Section	Summer Water Quality: Nitrates	TP	TSS	DO	pH	Temp	WATER QUALITY INDEX (harmonic mean)	WATER QUALITY GRADE	Streamflow: Minimum Summer Streamflow (2018)	Annual Variability (2008 - 2018)	Channel Flow Status (summer) 2018	Groundwater 2018	STREAMFLOW	STREAMFLOW GRADE	Habitat: Percent Impervious	Index of Ecological Integrity	Habitat Connectivity	Aquatic Connectivity	HABITAT	HABITAT GRADE	Scenic & Cultural: Scenic Quality	Cultural Importance	SCENIC & CULTURAL	SCENIC & CULTURAL GRADE	Recreation: Passability (dams/mile)	Access (Access points per mile)	% River with walking trails near	Bacteria	Fishing advisories (Hg+)	RECREATION	RECREATION GRADE	OVERALL: SECTION GRADE (GRAND AVERAGE)	LETTER GRADE
Upper Assabet	60	82	78	94	100	78	54	C	92	72	86	81	83	A-	71	50	67	47	58	C+	68	42	55	C	61	72	28	NA	70	58	C+	62	B-
Lower Assabet	41	77	74	87	100	91	72	B	92	72	90	81	84	A-	78	57	79	51	66	B	79	49	64	B-	67	70	88	NA	70	74	B	72	B
ASSABET (area weighted)	41	80	76	89	100	84	63	B-	92	72	88	81	83	A-	74	54	73	49	62	B-	73	46	60	C+	64	71	57	NA	70	66	B	67	B
Upper Sudbury	NA	NA	NA	NA	NA	NA	NA	NA	89	26	NA	81	65	B-	67	52	62	94	69	B	NA	NA	NA	NA	28	41	24	NA	10	25	D-	53	C
Lower Sudbury	94	83	68	57	95	93	74	B	89	26	95	81	73	B	65	42	49	60	54	C	85	76	81	A-	84	66	24	NA	10	46	C	65	B-
SUDBURY (area weighted)	94	83	68	57	95	93	74	B	89	26	95	81	69	B	66	47	55	75	61	C+	85	76	81	A-	58	55	24	NA	10	37	D+	60	C+
Upper Concord	85	70	63	68	99	88	73	B	93	28	91	81	74	B	64	46	33	81	56	C+	79	81	80	B+	85	61	36	NA	50	58	C+	68	B
Lower Concord	49	72	60	87	100	86	70	B	93	28	97	81	75	B	37	21	17	69	36	D+	81	47	64	B-	61	40	36	NA	70	52	C	59	C+
CONCORD (area weighted)	81	70	62	70	99	87	74	B	93	28	93	81	74	B	61	45	30	82	54	C	78	78	78	B+	83	59	36	NA	52	57	C+	68	B
WATERSHED (area weighted)	69	80	71	71	98	89	69	B	91	47	91	81	76	B+	69	49	62	82	60	C+	79	65	71	B	64	63	40	NA	45	55	C	64	B-

Grades	Points
A+	96-100
A	86-95
A-	81-85
B+	78-80
B	66-75
B-	61-65
C+	58-60
C	46-55
C-	41-45
D+	36-40
D	26-35
D-	21-25
F	0-20

Notes: the individual scores for metrics have been entered by hand on this sheet (find the scores on the Value Scoring Excel Files)
Averages in each category per section are calculated here, **EXCEPT** the Water Quality Index scores for each section - those are calculated as the harmonic mean of the individual metric scores in the water quality database and hand-entered here
Area-Weighted averages for the rivers and watershed are calculated on this sheet using the formulas in rows 6, 9, 12, and overall weighted average in row 13.
Conditional formatting (look under Home/Conditional Formatting) is applied to each of the colored cells according to their grade) i.e. they should change automatically
Grades have been hand-entered from the grading scheme (to the right) and numeric score

Sheet1

Ready

MA00337

MA01108

IHA Metrics not used in Report Card Index

	Medians	Coeff. of Disp.	Normalized Medians
Mean annual flow	198.8		217.6
Annual C. V.	1.01		
Flow predictability	0.37		
Constancy/predictability	0.64		
% of floods in 60d period	0.28		
Flood-free season	4		
November	126	1.262	137.9
December	199	1.221	217.8
February	216	0.706	236.4
March	305	0.5246	333.8
May	177	0.7062	193.7
June	122.5	1.176	134.1
July	61.4	0.7818	67.2
September	37.15	1.521	40.7

	Medians	Coeff. of Disp.	Normalized Medians
Mean annual flow	201.1		220.1
Annual C. V.	1.05		
Flow predictability	0.38		
Constancy/predi	0.57		
% of floods in 60	0.26		
Flood-free seas	7		
November	101	1.497	110.5
December	136	1.907	148.8
February	177	0.8475	193.7
March	322	0.8602	352.4
May	176	0.6761	192.6
June	142	1.363	155.4
July	63	0.7333	68.9
September	24.3	3.715	26.6

	Medians	Coeff. of Di
Mean annual flo	197.2	
Annual C. V.	1.09	
Flow predictabilit	0.44	
Constancy/predi	0.48	
% of floods in 60	0.25	
Flood-free seas	7	
November	94.2	
December	124	
February	196.5	0.
March	305	
May	126	0.
June	122.5	0.
July	57.4	0.
September	24.3	

Innovation for a better future
University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

There's a website—see the indicators!

ECO HEALTH REPORT CARDS

HOME HEALTH INDICATORS REGIONS ISSUES PUBLICATIONS TAKE ACTION ABOUT

HOME / REPORT CARDS / SUDBURY, ASSABET & CONCORD RIVERS / HEALTH

BY VALUES |

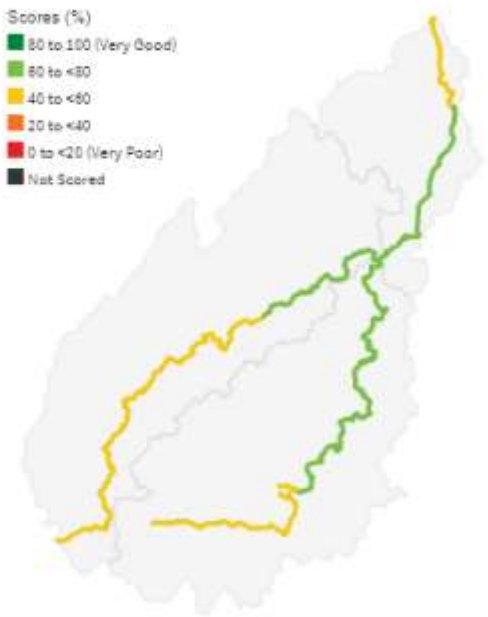
Water Quality | Streamflow | Scenery | Habitat | Recreation

BY INDICATOR |

Overall Health Index | Dissolved Oxygen | Temperature | Suspended Solids | Phosphorus | Nitrates | Floating Biomass | Streamflow Alteration | Groundwater Level | Channel Flow | Summer Streamflow

Visual Quality | Cultural Importance | Impervious Cover | Aquatic Connectivity | Habitat Connectivity | Ecological Integrity | Passability | Access | Trails | Fish Edibility | Bacteria

BY REGION | Overall



And a simpler version as a tri-fold card.

OARS

Step 5: What's the story?

Communicating Results

- What is the message?
- What actions?

Launched: June 26, 2019

NEWS

Waterway Health: River grades revealed

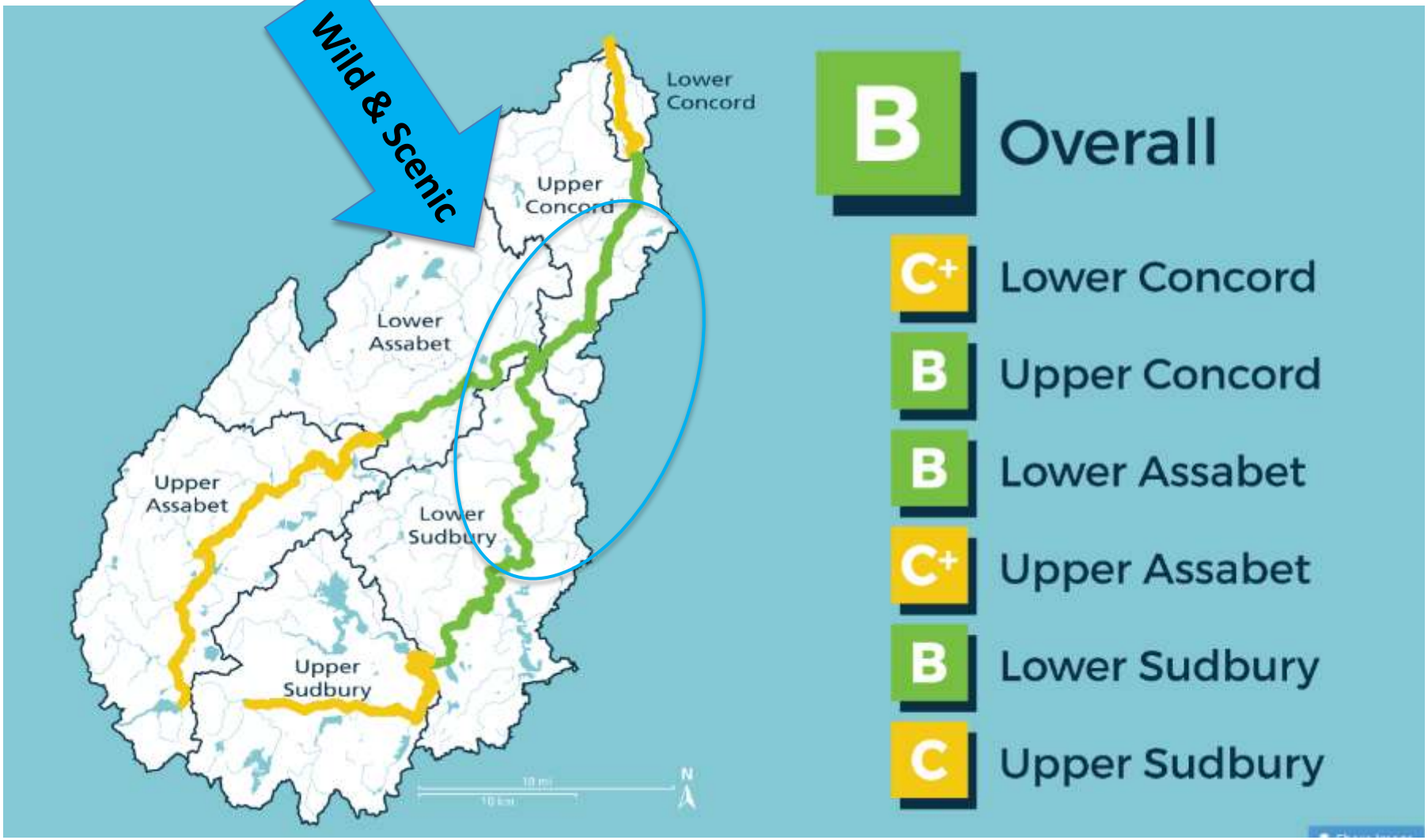
By ELIZABETH DOBBINS | edobbins@lowellsun.com | Lowell Sun

PUBLISHED: July 6, 2019 at 12:00 am | UPDATED: July 11, 2019 at 12:00 am

School may be out, but the grades are just now rolling in for the region's rivers.

This year, for the first time ever, a local organization that seeks to protect the rivers graded the Lower Concord River from North Billerica to Lowell.

It received a C+ based on factors like water quality, stream flow, scenery, habitat and recreation. The larger region — including the Assabet and Sudbury rivers, which feed into the Concord River — received a B from OARS, a watershed organization for the three rivers.



Our health scale

Very good — A (100) — B (80) — C (60) — D (40) — F (20) — (0) Very poor

? Future indicator

Innovation for a better future

University of Maryland Center for Environmental Science

OARS

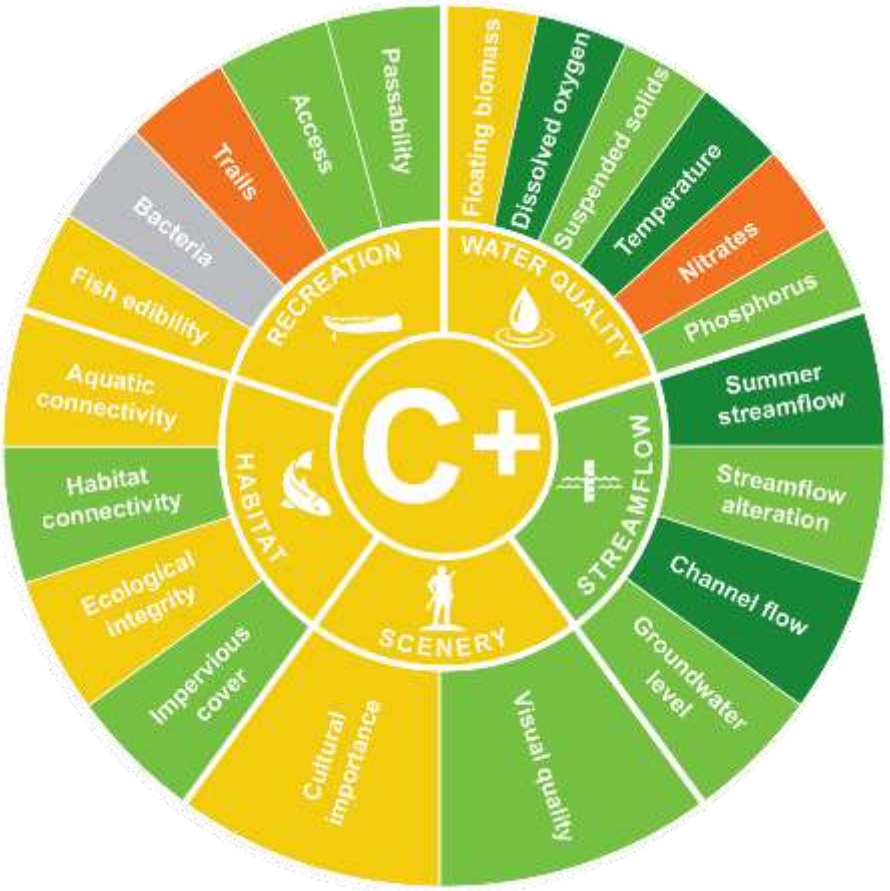
ECO HEALTH REPORT CARDS

HOME HEALTH INDICATORS REGIONS ISSUES PUBLICATIONS TAKE ACTION ABOUT

HOME / REPORT CARDS / SUDBURY, ASSABET & CONCORD RIVERS / REGIONS / UPPER ASSABET RIVER

Upper Assabet River

- No drought in 2018!
- Big wastewater influence
- Floating biomass problems
- Good number of put-ins
- Few trails along the river
- Room for improvement!



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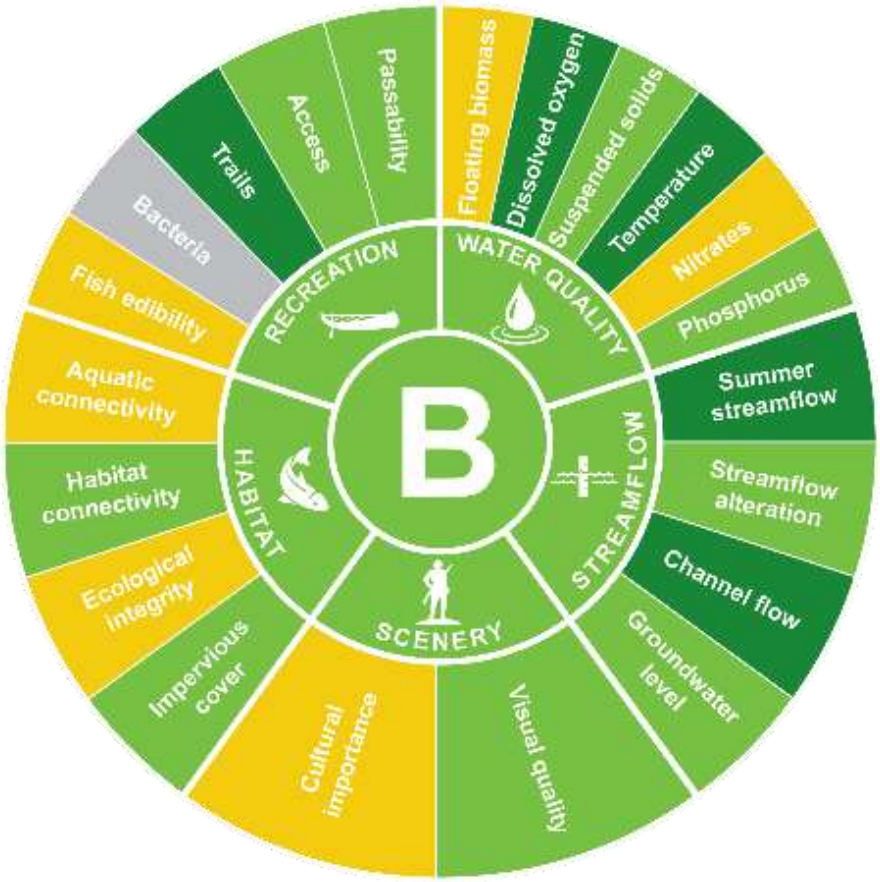
Lower Assabet River

- The Assabet always flows
- Less wastewater influence, but still a problem
- Good number of put-ins
- Great trails along the river
- Free-flowing sections good, impoundments worse

In detail . . .



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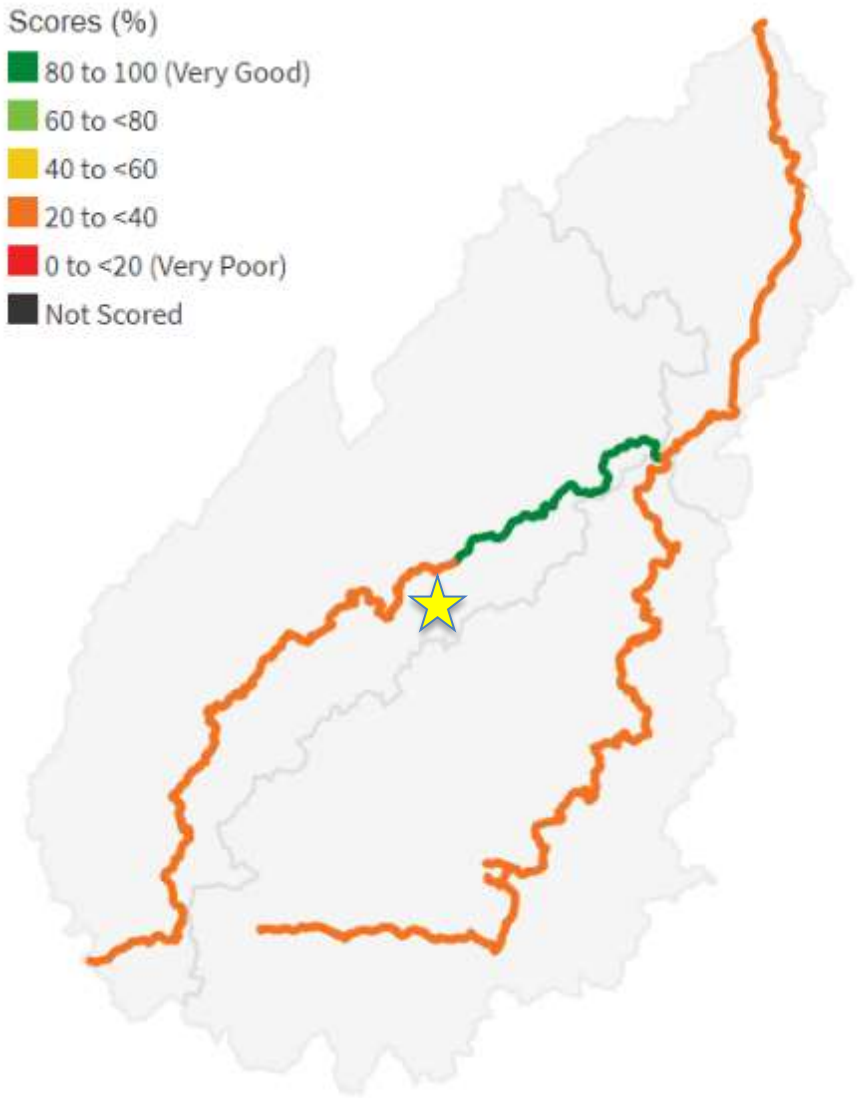
Example: Trails within 200 feet of the river

Scoring: Trails along 25% of the rivermiles is considered optimal.

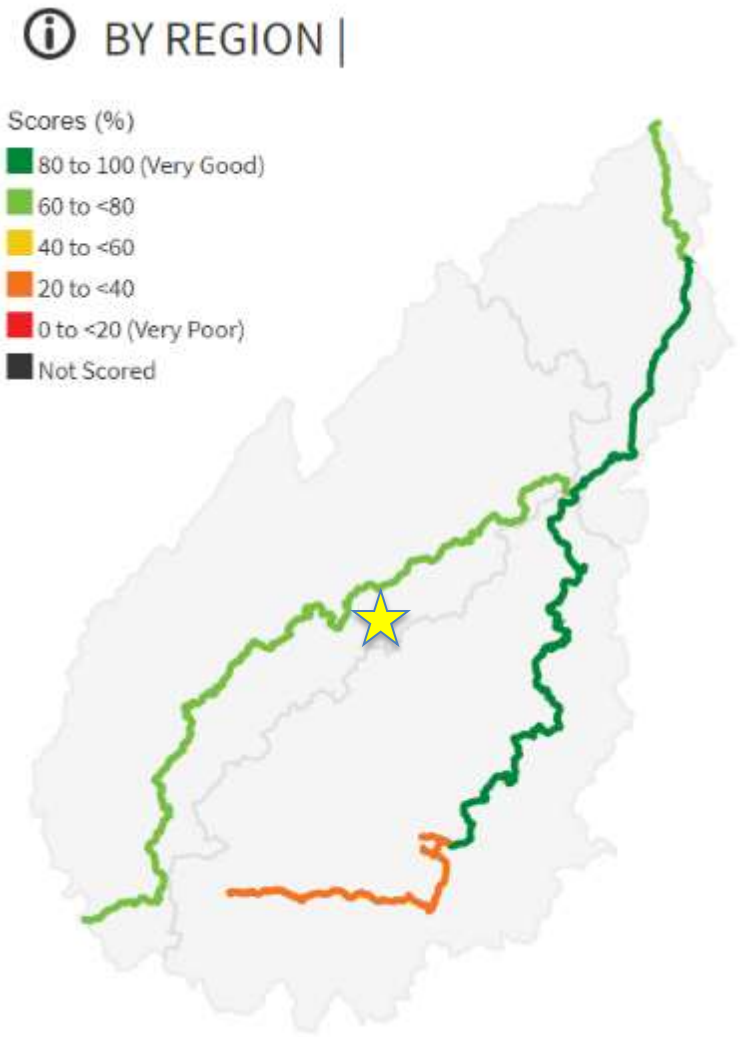
	Percent Rivermiles with trail	Score
Upper Assabet	7	28
Lower Assabet	22	88
Upper Sudbury	**6**	**24**
Lower Sudbury	**6**	**24**
Upper Concord	9	36
Lower Concord	9	36



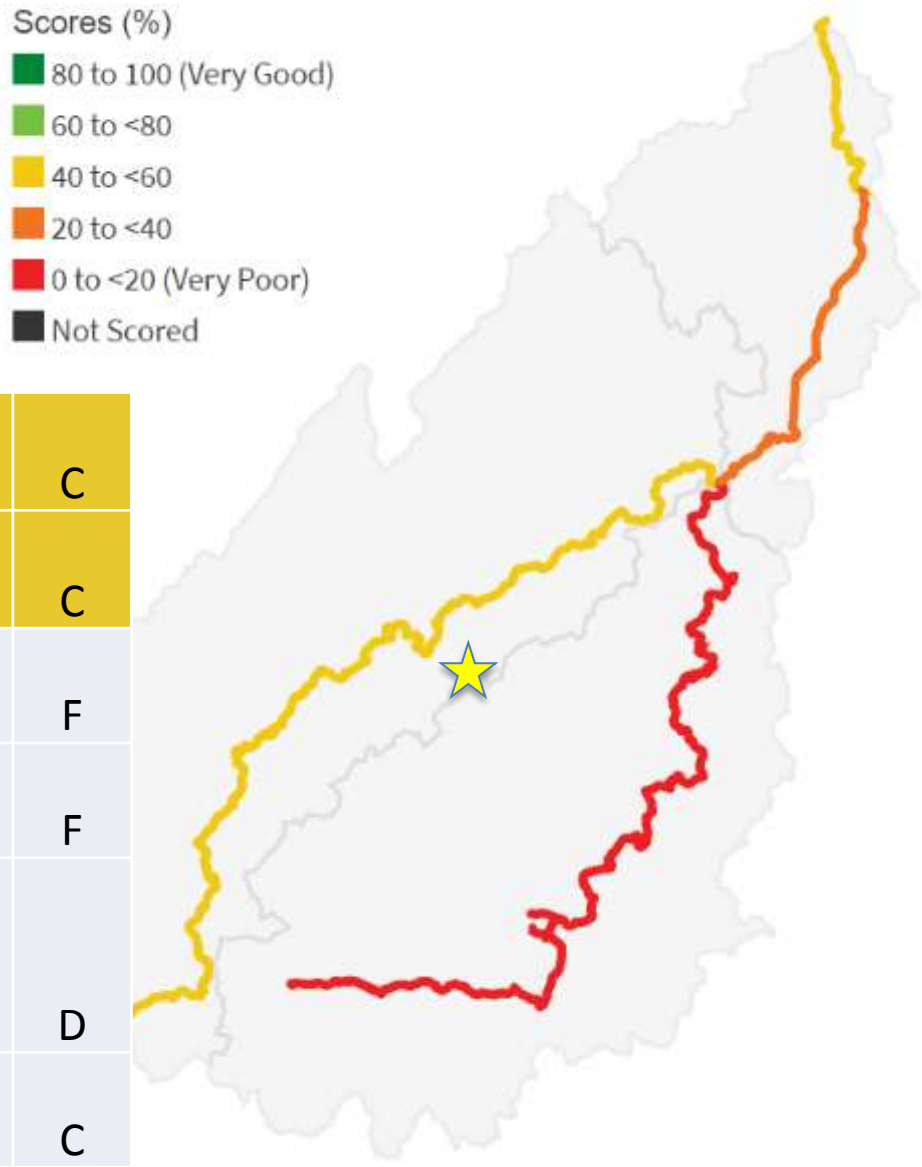
Example: Passability

Scoring: ownership, ease of access, length of portage, road crossings, and if breached. Scores summed and divided by number of river miles in the section

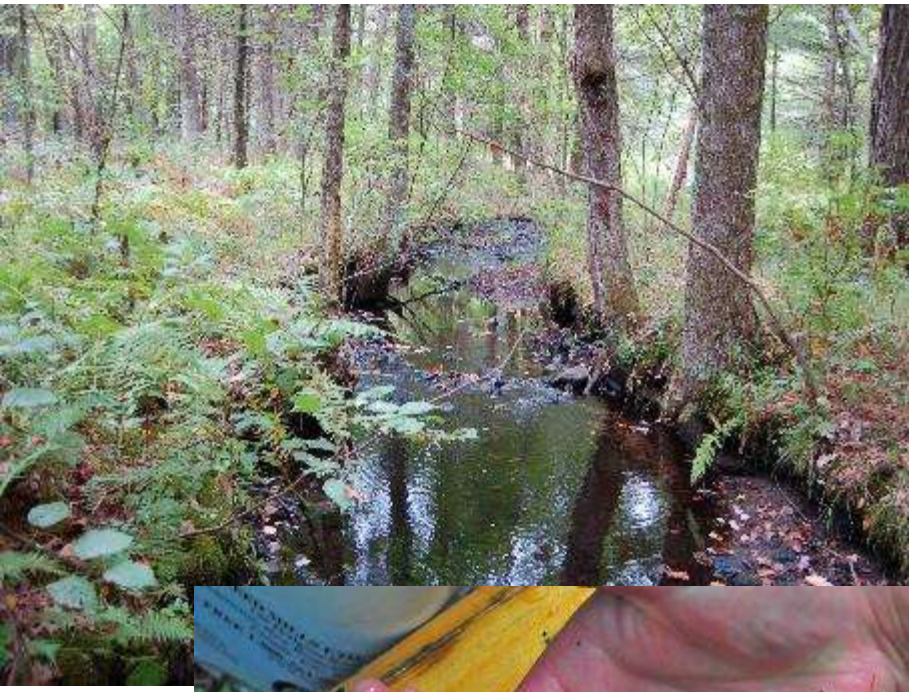
	# River miles	# Dams	Avg. miles between dams	Average dams/ rivermile	Score
Upper Assabet	25.8	6	4.30	0.23	77
Lower Assabet	9.5	2	4.75	0.21	79
Upper Sudbury	**12.9**	**8**	**1.61**	**0.62**	**38**
Lower Sudbury	22.1	2	11.05	0.09	91
Upper Concord	13.2	1	13.20	0.08	92
Lower Concord	6.7	2	3.35	0.30	70



Example: Fish edibility



Upper Assabet	P1—No children and women of reproductive age	C
Lower Assabet	P1—No children and women of reproductive age	C
Upper Sudbury	P6—No one	F
Lower Sudbury	P6—No one	F
Upper Concord	P4, P2—No LMB, no children and women of reproductive age, others 2/mo.	D
Lower Concord	P1	C



ACTIONS

- Add **trails along the river**
- Support **invasive aquatic plant management** and **pull water chestnut**
- Water quality and passage: Consider **dam removal**
- **Clean and recharge stormwater**
- **Protect coldwater streams**
- **Conserve water during droughts**
- Support controls on **mercury emissions** from coal-burning power plants

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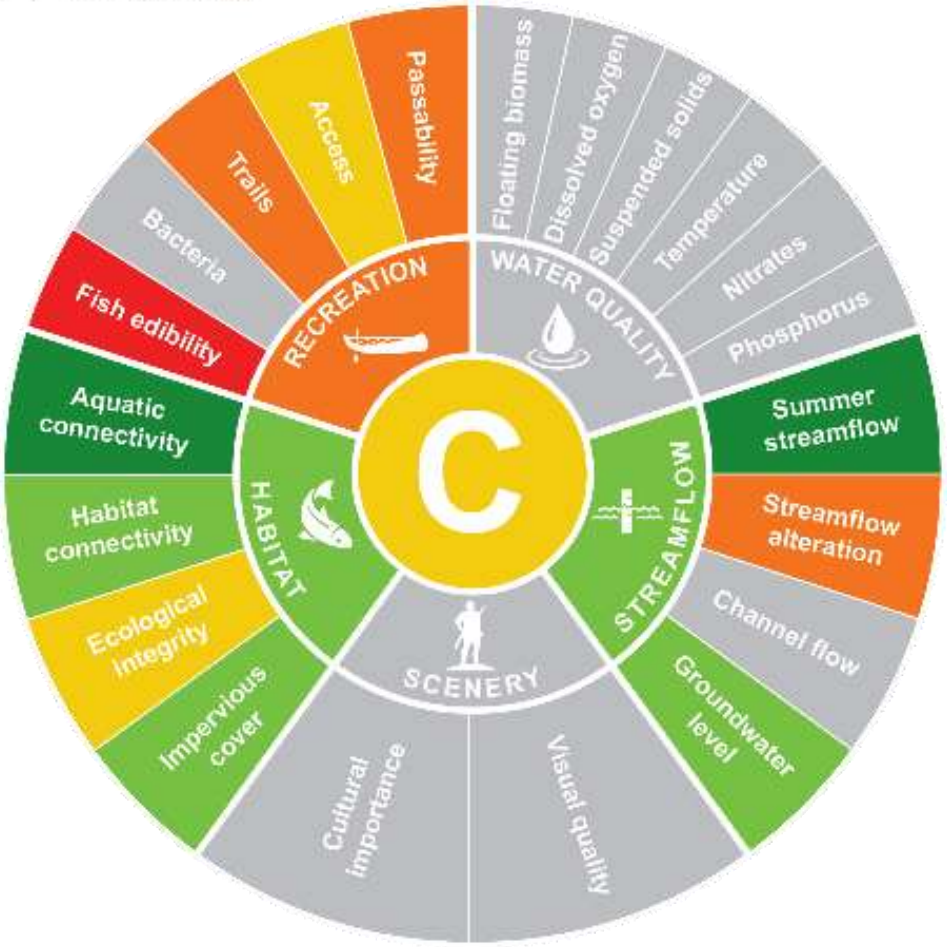
Upper Sudbury River

- Lack of data!
- Work needed on recreation access
- Minimum streamflows are far lower than natural
- Mercury contamination—no one can eat the fish



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Lower Sudbury River

- Minimum streamflows are far lower than natural
- Low dissolved oxygen
- Little wastewater pollution
- Free flowing—few dams
- Mercury—no one can eat the fish
- Few trails along the river
- Great scenery!

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Upper Concord River

- Very good water quality
- Minimum streamflows are lower than natural and maximum flows are higher than natural
- More trails needed along the river
- Fish—men and older women: two meals per month max., nobody eat largemouth bass
- Beautiful and historic scenery

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Lower Concord River

- Need to mitigate urban impacts on wildlife habitat
- Work needed on recreation access
- Flows are not natural
- Statewide mercury contamination—children and childbearing women should not eat any fish

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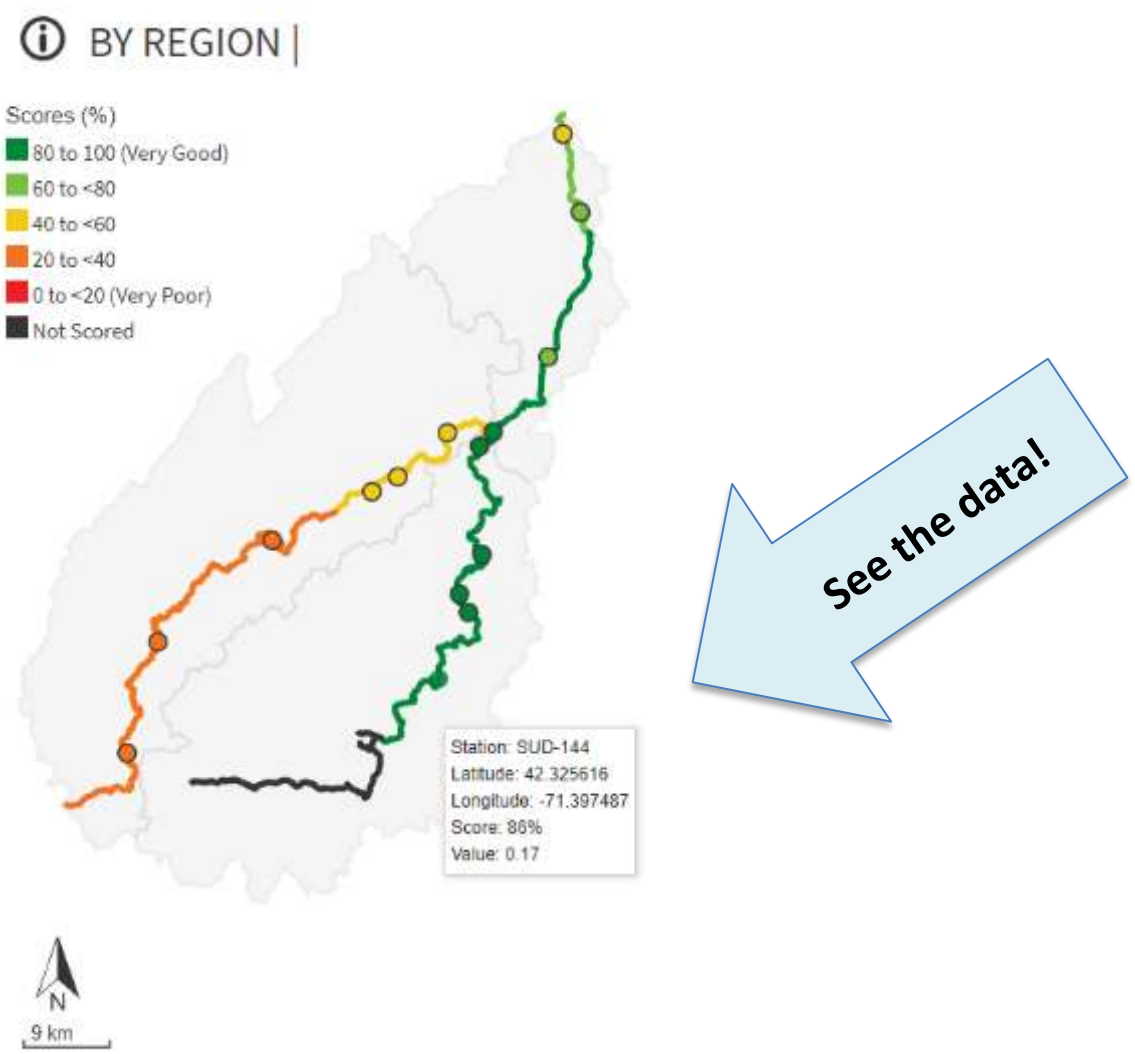
River Report Card


BY REGION |
Scores (%)
80 to 100 (Very Good)
60 to <80
40 to <60
20 to <40
0 to <20 (Very Poor)
Not Scored
Station: SUD-144
Latitude: 42.325616
Longitude: -71.397487
Score: 86%
Value: 0.17
See the data!
N
9 km
SHOW STATIONS | Scores
No Stations
Station Scores
Station Data
Indicator: Nitrates

Sudbury, Assabet and Concord River Issues

Our rivers each have their own character and they change as they flow from south to north, passing over old dams in mill towns, and meandering past wetlands, forests and homes. Each segment has its own character and set of challenges.

Invasive aquatic plants: water chestnut

Excessive nutrients, sedimentation and slow flow in impounded sections provide ideal conditions for invasive water chestnut and other invasive aquatic plants. Introduced in the 1870s in the Sudbury River, water chestnut (*Trapa natans*) is rapidly spreading to the other rivers, lakes and ponds in the watershed, indeed across the country. A rapidly-reproducing annual plant, the hard nuts can lie dormant in the sediment for 10-12 years. Only consistent removal of the plants every year prior to dropping their nuts can keep it at manageable levels. A management plan for the watershed guides efforts by OARS, other non-profits, the US Fish and Wildlife Service and municipalities. Methods of mapping are being developed so that progress can be

Become a citizen scientist or advocate

Find out who is working for river health and join in! Join OARS and other groups working for clean water, climate resilience, and healthy habitats in your neighborhood or community. Become a member, attend an event, or make a donation to show your support. You can help collect valuable water quality data by becoming a Citizen Scientist, or volunteer in other ways to keep this important work going! Sign up for Action Alerts by OARS and other organizations to let you know how to impact critical legislation or policy. Decision-makers need to hear from us--we are the voice of our rivers.

Organizations in the watershed:

Assabet River National Wildlife Refuge
Great Meadows National Wildlife Refuge
Minute Man National Historical Park
Native Plant Trust (New England Wildflower Society)
OARS For the Assabet, Sudbury and Concord Rivers
Sudbury, Assabet and Concord Wild & Scenic River Stewardship Council

Thank you:

Massachusetts Environmental Trust

The Sudbury Foundation

Wild & Scenic River Stewardship Council

Project partners: EPA Region 1, MassDEP, Mass. Rivers Alliance, Mass. Division of Ecological Restoration

AND

All the Stakeholders and OARS Staff and Board

The Stakeholder workshop participants

- **Towns:** Acton, Bedford, Billerica, Concord, Hudson, Maynard, Sudbury and Wayland
- **Cities:** Framingham and Marlborough
- **State agencies**: MassDEP
- **Federal agencies**: US Geological Survey, US Fish & Wildlife Service, EPA
- **Watershed organizations:** Charles, Ipswich, Merrimack, Mystic, Nashua and Neponset Rivers; Mass Rivers Alliance
- **Land trusts**: Sudbury Valley Trustees; Lowell Parks & Conservation Trust; Westborough Land Trust, Mass Audubon
- **Local groups**: Green Acton, Friends of Saxonville, Concord BioCAN
- **Regional planning**: Metropolitan Area Planning Council, MassBAYS
- **Consulting firms**: CEI, Geosyntec, HydroAnalysis.