# Stressor-identification in the Chesapeake Basin

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Update to the Non-tidal Workgroup

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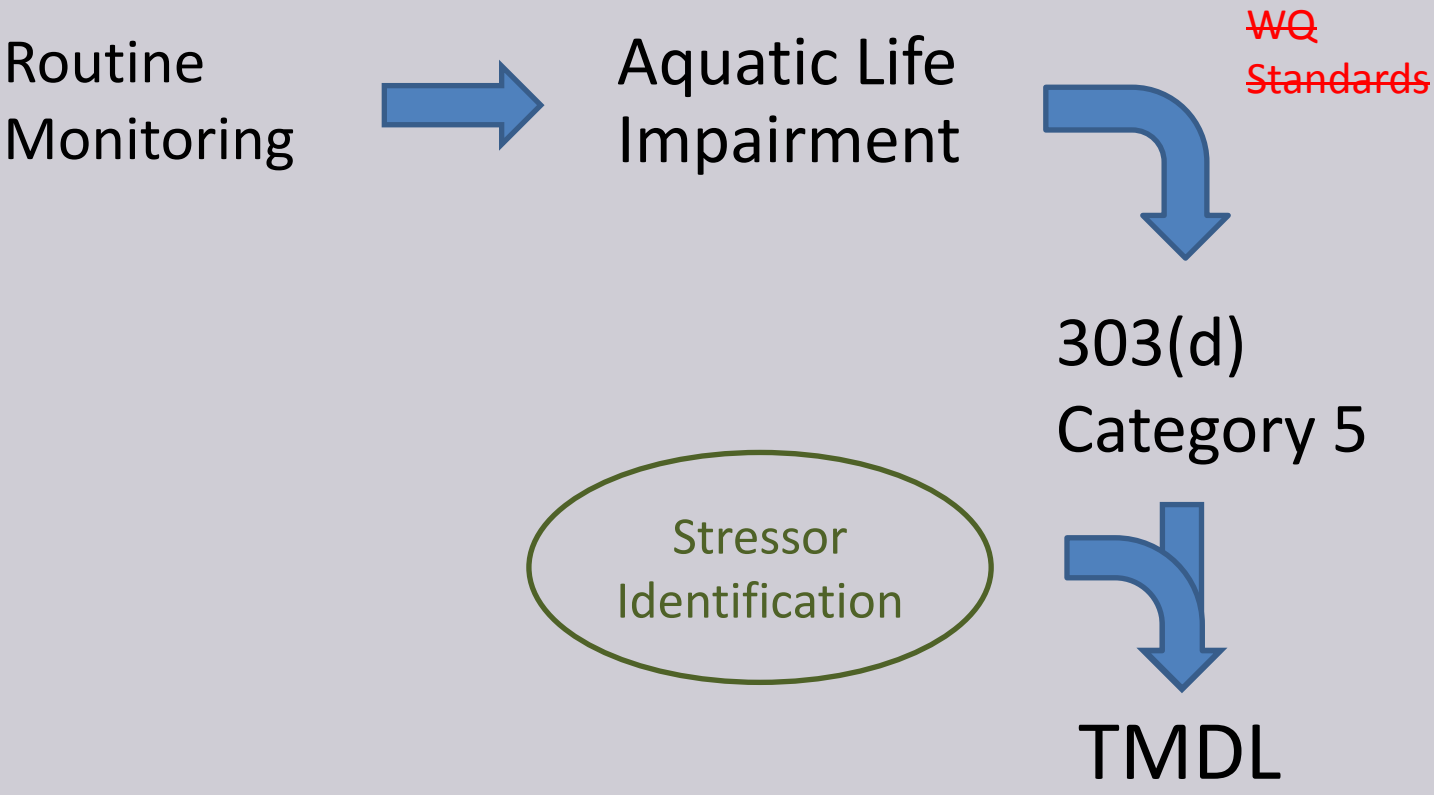
ICPRB

# Project

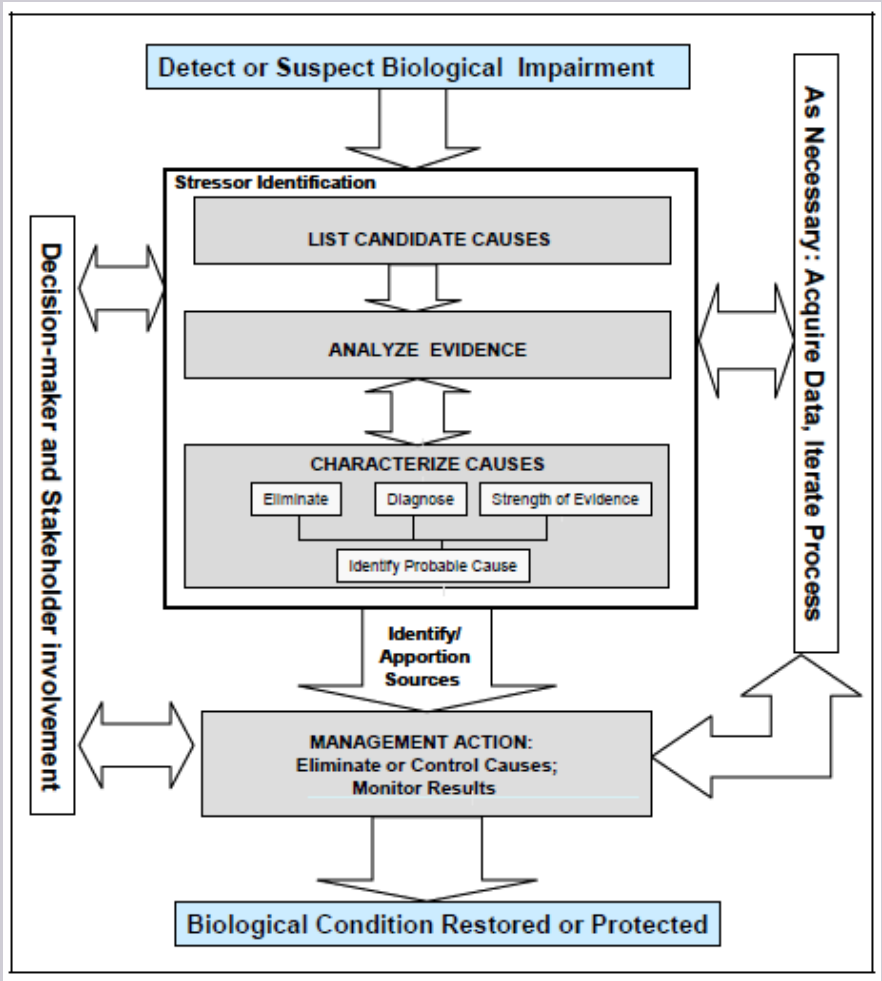
- What stressor ID approaches are employed in the basin?
- What about them is similar or different?
- What is the federal guidance on stressor ID?
- Could jurisdictions benefit from additional resources?

# Stressor Identification



# EPA 2000 guidance

- Weight-of-evidence
- Data-driven
- Iterative framework
- Most Bay states follow this in some fashion



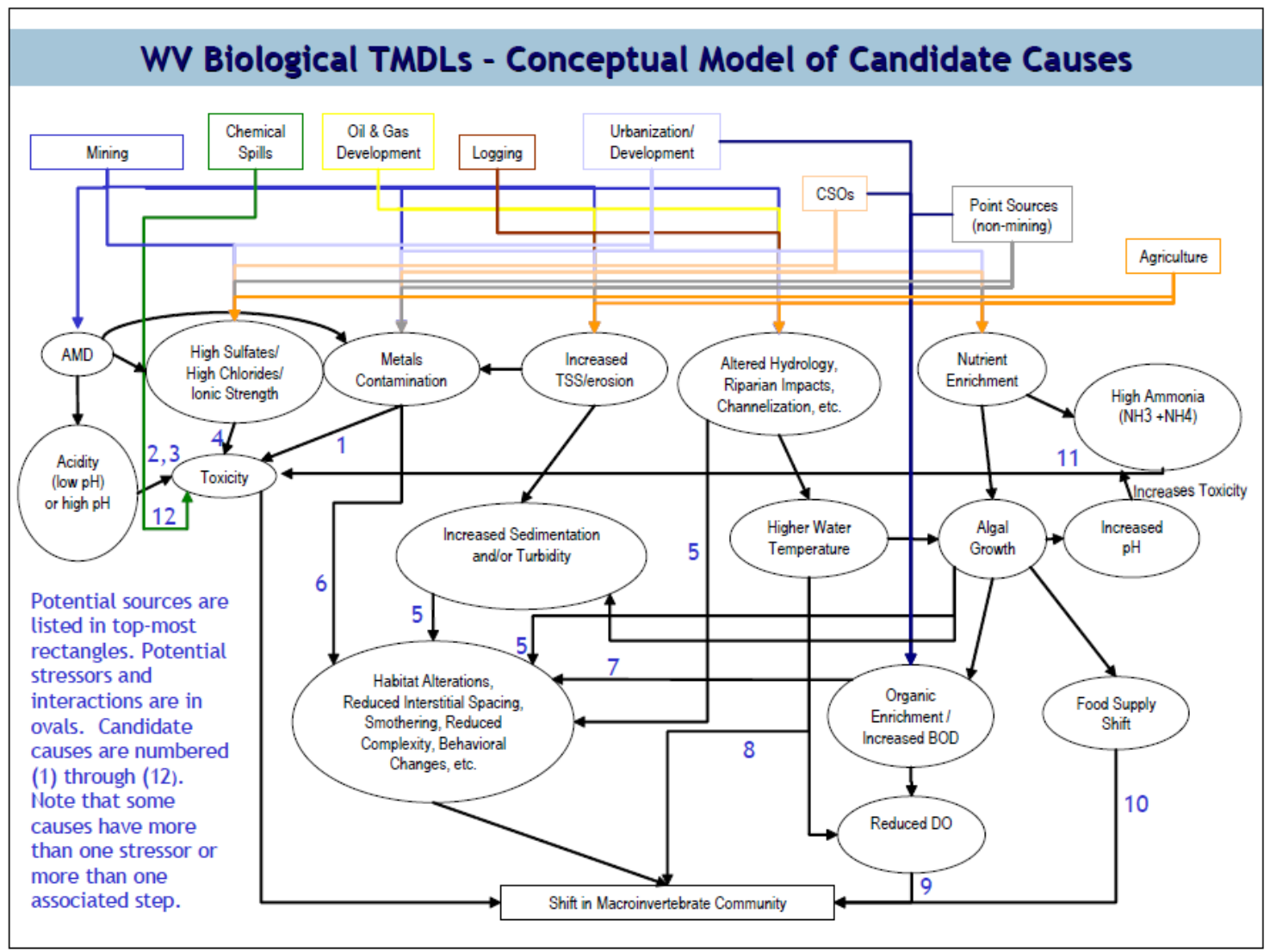
# Virginia

- Guidance document in preparation?
- Process generally follows the 2000 guidance
  - Data-driven, iterative process
- Some stressor-threshold development
- Thresholds for unlikely, likely, and most probable stressor for certain pollutants
- Details were unavailable at the time

# West Virginia

- Document: TMDL document for streams in the Elk River and Lower Kanawha River watersheds (2011)
  - Outlines the SI process used
  - Most closely follows EPA 2000 guidance
  - Conceptual stressor model

# West Virginia



# West Virginia

- Also developed multiple stressor thresholds
  - WVSCI vs. Stressor
  - 5 best-fit lines (quantile regression?)
  - Classified stressors as
    - Excluded
    - Equivocal
    - Weak
    - Possible
    - Likely
    - Definite

# West Virginia

| | Stressor Classification Thresholds | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Exclusion** | **Equivocal** | **Weak** | **Possible** | **Likely** | **Definite** |
| Periphyton (Qual. Ranking) | 0 | 1 | 2 | 3 | 4 | 5 |
| Fecal coliform (counts/100mL) | < 150 | 150.1 - 400 | 400.1 - 1400 | 1400.1 - 1900 | 1900.1 - 2300 | > 2300.1 |
| Iron Flocculation (mg/L) | ≤ 0.49 | 0.5 - 0.7669 | 0.767 - 1.0169 | 1.017 - 1.3669 | 1.367 - 1.8669 | > 1.867 |
| % Fines | ≤ 34.9 | 35 - 44.9 | 45 - 49.9 | 50 - 59.9 | 60 - 69.9 | > 70 |
| RBP: Embeddedness | 16 - 20 | 11 - 15 | 9 - 10 | 6 - 8 | 3 - 5 | 0 - 2 |
| RBP: Sediment Deposition | 16 - 20 | 11 - 15 | 9 - 10 | 6 - 8 | 3 - 5 | 0 - 2 |
| RBP: Cover | 16 - 20 | 11 - 15 | 9 - 10 | 6 - 8 | 3 - 5 | 0 - 2 |
| RBP: Riparian Vegetation | 16 - 20 | 11 - 15 | 9 - 10 | 6 - 8 | 3 - 5 | 0 - 2 |
| RBP: Total | ≥ 110.1 | 100.1 - 110 | 85.1 - 100 | 75.1 - 85 | 65.1 - 75 | ≤ 65 |
| Sediment Index | 90 - 100 | 80 - 89.9 | 70 - 79.9 | 60 - 69.9 | 50 - 59.9 | ≤ 49.9 |
| Aluminum (mg/L) | < 0.1049 | 0.105 - 0.1819 | 0.182 - 0.2269 | 0.227 - 0.3069 | 0.307 - 0.4419 | > 0.442 |
| pH (low) | ≥ 6.3 | 6.29 - 6.0 | 6.59 - 5.3 | 5.29 - 5.0 | 4.99 - 4.3 | < 4.29 |
| pH (high) | ≤ 8.39 | 8.4 - 8.69 | 8.7 - 8.79 | 8.8 - 8.89 | 8.9 - 9.09 | > 9.1 |
| Conductivity (µmhos) | ≤ 326.9 | 327 - 516.9 | 517 - 766.9 | 767 - 1074.9 | 1075 - 1532.9 | > 1533 |
| Sulfates | ≤ 56.9 | 57 - 119.9 | 120 - 201.9 | 202 - 289.9 | 290 - 416.9 | > 417 |
| Chlorides (mg/L) | ≤ 60.0 | 60.1 - 80.0 | 80.1 - 125.0 | 125.1 - 160 | 160.1 - 229.9 | > 230 |
| Dissolved Oxygen (mg/L) | > 7.0 | 6.99 - 6.3 | 6.29 - 5.4 | 5.39 - 4.4 | 4.39 -3.2 | ≤ 3.19 |
| Temperature (°C) | < 25.69 | 25.7 - 26.69 | 26.7 - 27.69 | 27.7 - 28.89 | 28.9 - 30.59 | > 30.6 |
| Nitrite-Nitrate (mg/L) | < 0.6829 | 0.683 - 0.9829 | 0.983 - 1.549 | 1.55 - 2.0829 | 2.0830- 2.649 | > 2.65 |
| Total Nitrogen (mg/L) | < 2.1169 | 2.117 - 2.7329 | 2.733 - 3.3669 | 3.367 - 4.0329 | 4.033 - 4.9 | > 5.0 |
| Total Phosphorous (mg/L) | < 0.1319 | 0.132 - 0.1929 | 0.193 - 0.2829 | 0.283 - 0.369 | 0.37 - 0.509 | > 0.51 |
| Ammonia (mg/L) | < 0.99 | 1.0 - 1.09 | 1.1 - 1.19 | 1.2 - 1.349 | 1.35 - 1.649 | > 1.65 |

# Maryland

- Document: Biological Stressor Identification (BSID) Method
  - Case-control, risk-based approach
  - "Possible stressor" thresholds
    - Land-uses, habitat, water chemistry, and acid sources
    - Most derived from 90$^{th}$ pctl of a high-IBI control group

# Maryland

| | | Ecoregions | | |
|---|---|---|---|---|
| | **Potential Stressor** | **Highlands** | **Piedmont** | **Coastal Plain** |
| Water Chemistry | Total Phosphorous (mg/L) | 0.06 | 0.06 | 0.14 |
| | Ortho-Phosphate (mg/L)) | 0.02 | 0.02 | 0.02 |
| | Total Nitrogen (mg/L) | 3.0 | 3.0 | 3.0 |
| | Total Dissolved Nitrogen (mg/L) | 3.0 | 3.0 | 3.0 |
| | Dissolved Oxygen (mg/L) | < 5.0 | < 5.0 | < 5.0 |
| | DO Saturation | < 60% or > 125% | < 60% or > 125% | < 60% or > 125% |
| | Ammonia (mg/L) | CCC | CCC | CCC |
| | pH | < 6.5 or > 8.5 | < 6.5 or > 8.5 | < 6.5 or > 8.5 |
| | Acid Neutralizing Capacity (µeq/L) | < 50 , < 200 | < 50 , < 200 | < 50 , < 200 |
| | Chlorides (mg/L) | 50.0 | 50.0 | 50.0 |
| | Conductivity (µS/cm) | 500 | 300 | 300 |
| | Sulfates (mg/L) | 32.0 | 21.0 | 28.0 |

# Pennsylvania

- No formal SI document at this time
- Approach generally follows the 2000 guidance
- Routine sampling emphasizes ID of catchment pollutant sources
  - Field-biologists often perform “windshield surveys” of upstream catchment
  - Biologist understanding and judgment more heavily weighted
- Recent work to identify source-specific water chemistry thresholds

# Delaware

- Has not had much need for stressor identification
- Nearly all TMDL waters have been listed for nutrients or bacteria
- The few Category 5 waters were handled by outside contractors
  - Generally followed the EPA 2000 guidance

# New York

- Document: *Standard Operating Procedure: Biological Monitoring of Surface Waters in New York State* ; (Riva-Murray et al 2002)
- Impact Source Determination (ISD) Method
- Similar to a Percent Model-Affinity Approach
- 6 overall impact-source classes
  - Nonpoint nutrients, siltation, toxic, organic, complex, and impoundments.

# New York

- Several “model communities” exist under each impact-stressor class (over 62 as of 2002)
- Sample-model agreement (taxonomic composition) of 50%+ indicate similarity
- New model communities are described as needed, including natural communities.

# State Summary

- Overall, great differences in SI methods across Bay jurisdictions
- MD and NY have developed formal methods to ID stressors
- All other states employ iterative weight-of-evidence or best-judgment approaches
  - Follow 2000 guidance
  - Can be time-consuming to repeat

# State Summary

- Stressor-thresholds have not been developed consistently
- No stressor-response methods – instead are correlative, based upon state IBI scores.
- Many thresholds vary widely between states

| "Possible" Stressor | MD threshold | WV threshold |
|---|---|---|
| TP | 0.06 mg/L | 0.193 – 0.2829 mg/L |
| Sp. Cond. | 500 µS (Highlands) | 767 – 1064.9 µS |
| Chlorides | 50 mg/L | 125.1 – 160 mg/L |
| TN | 3.0 mg/L | 3.367 – 4.0329 mg/L |

# CADDIS

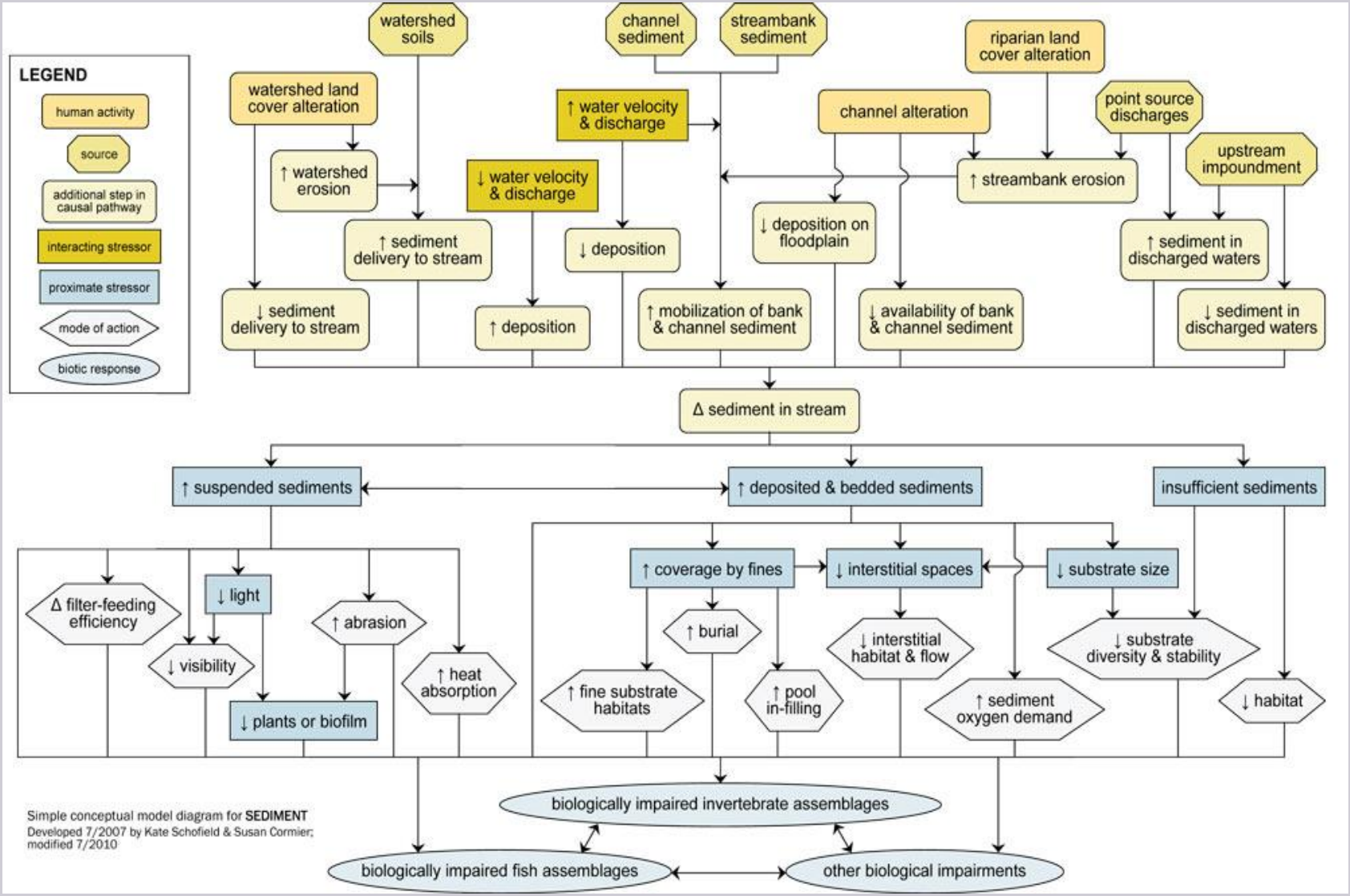
- Causal Analysis/Diagnosis Decision Information System (CADDIS)
- Designed to supersede the 2000 guidance
- Greatly expanded and moved online
- It can be unwieldy
- Currently, no Bay state is employing CADDIS

# CADDIS

- CADDIS Website arranged into 5 volumes
  - Volume 1 – The SI process
  - Volume 2 – Review of candidate stressor literature
  - Volume 3 – Analytical examples
  - Volume 4 – Statistical methods
  - Volume 5 – Literature database and interactive conceptual models

Sediment

# CADDIS



# Common Approach for the Bay

- Employ the CADDIS approach for the Bay Watershed
- Develop a suite of candidate-stressor criteria
  - "Non-stressor", "Possible", "Probable"
  - Developed over appropriate classifications
  - Could be applied to multiple tiers of waters
    - Useful for anti-deg
    - Protective thresholds for high-quality waters

# Feedback

- Did we summarize your state approach correctly?
- How would your state benefit from this type of analysis?
- What would make stressor-thresholds more useful to you?
- Report is still draft – we'd like to finalize

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