National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

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TALU 201

Application of the Biological Condition and Human Disturbance Gradients for Making Aquatic Life Beneficial Use-Support Determinations in Montana

Presented by

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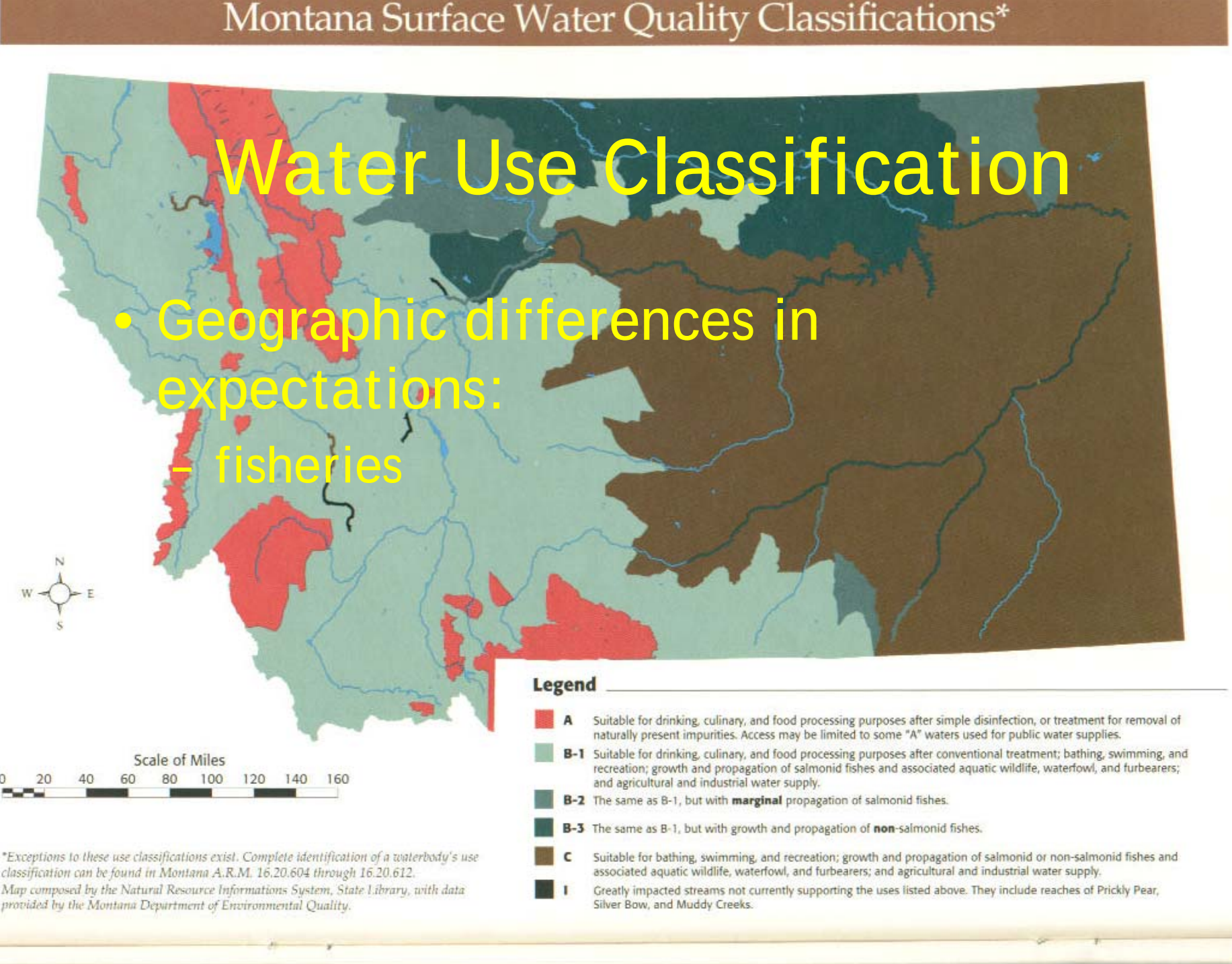
ALUS Determinations

- Briefly explain how we interpret Montana's water quality standards for making ALUS determinations
- Explain how we use the biological condition and human disturbance gradient to assess ALUS
- Provide examples of how Montana conducts ALUS assessments and discuss how we could incorporate tiered ALU concepts.
- Discuss issues that Montana needs to consider for developing and implementing ALU tiers.

Water Quality Standards

- **How does Montana link aquatic life use support determination to water quality standards?**


Montana Surface Water Quality Classifications*
Water Use Classification
• Geographic differences in expectations:
– fisheries
N
W
E
S
Scale of Miles
0 20 40 60 80 100 120 140 160
Legend
A Suitable for drinking, culinary, and food processing purposes after simple disinfection, or treatment for removal of naturally present impurities. Access may be limited to some "A" waters used for public water supplies.
B-1 Suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic wildlife, waterfowl, and furbearers; and agricultural and industrial water supply.
B-2 The same as B-1, but with marginal propagation of salmonid fishes.
B-3 The same as B-1, but with growth and propagation of non-salmonid fishes.
C Suitable for bathing, swimming, and recreation; growth and propagation of salmonid or non-salmonid fishes and associated aquatic wildlife, waterfowl, and furbearers; and agricultural and industrial water supply.
I Greatly impacted streams not currently supporting the uses listed above. They include reaches of Prickly Pear, Silver Bow, and Muddy Creeks.
*Exceptions to these use classifications exist. Complete identification of a waterbody's use classification can be found in Montana A.R.M. 16.20.604 through 16.20.612.
Map composed by the Natural Resource Informations System, State Library, with data provided by the Montana Department of Environmental Quality.

Aquatic Life Beneficial Use

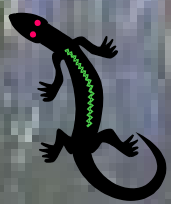
- ***Waters are suitable for the growth and propagation of fish and associated aquatic life, waterfowl and furbearers*.**
  - ***"Human activities must not restrict a water body from providing the habitat and water quality necessary for the survival and reproduction of desirable fish and associated aquatic life"***

Aquatic Life Beneficial Uses

- Shifts in biological communities must be linked to probable habitat or water quality degradation to be considered a violation of water quality standards (stressors).
- Shifts in biological communities resulting from fishing pressure, the introduction of desirable species, wildlife management activities, etc. are not considered a violation of water quality standards.
- Invasive species are considered a fish & wildlife management issue - not a water quality issue....but may be considered a water quality issue in the future.

Numeric Criteria

- Chronic and acute aquatic life standards.
- Changes in pH, turbidity and temperature are limited.



Narrative Criteria

- No increases are allowed above **"*naturally occurring*"** concentrations of sediment, settleable solids, floating solids, etc. which are ***harmful, detrimental, or injurious to birds, fish or other wildlife.***

- Prohibition of undesirable aquatic life

- Pollution resulting from non-point sources, including agriculture, construction, logging, and other practices must be minimized.

Naturally Occurring

- Refers to the chemical, physical and biological conditions or materials present from which man has no control, or from developed land where **"reasonable"** land, soil, and water conservation practices have been applied (17.30.602(18) ARM).

"Reasonable" Land, Soil, and Water Conservation Practices

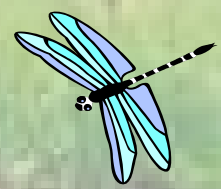
- Means methods, measures or practices that protect existing and designated beneficial uses (17.30.602(23) ARM).
- Often determined by using reference condition

Reference Condition

- References condition is the ***greatest potential*** for a water body to support all of its beneficial uses given the ***historic land use***.
- used to interpret narrative criteria and numeric criteria that limit how much a parameter can change from what would be **naturally occurring.**

Reference Condition
(Primary Approach)

- Collecting baseline data from least impaired water bodies within the same region having similar geology, hydrology and morphology
- Evaluating historical data



- Using internal references or a paired watershed approach

Reference Condition
(Secondary Approach)

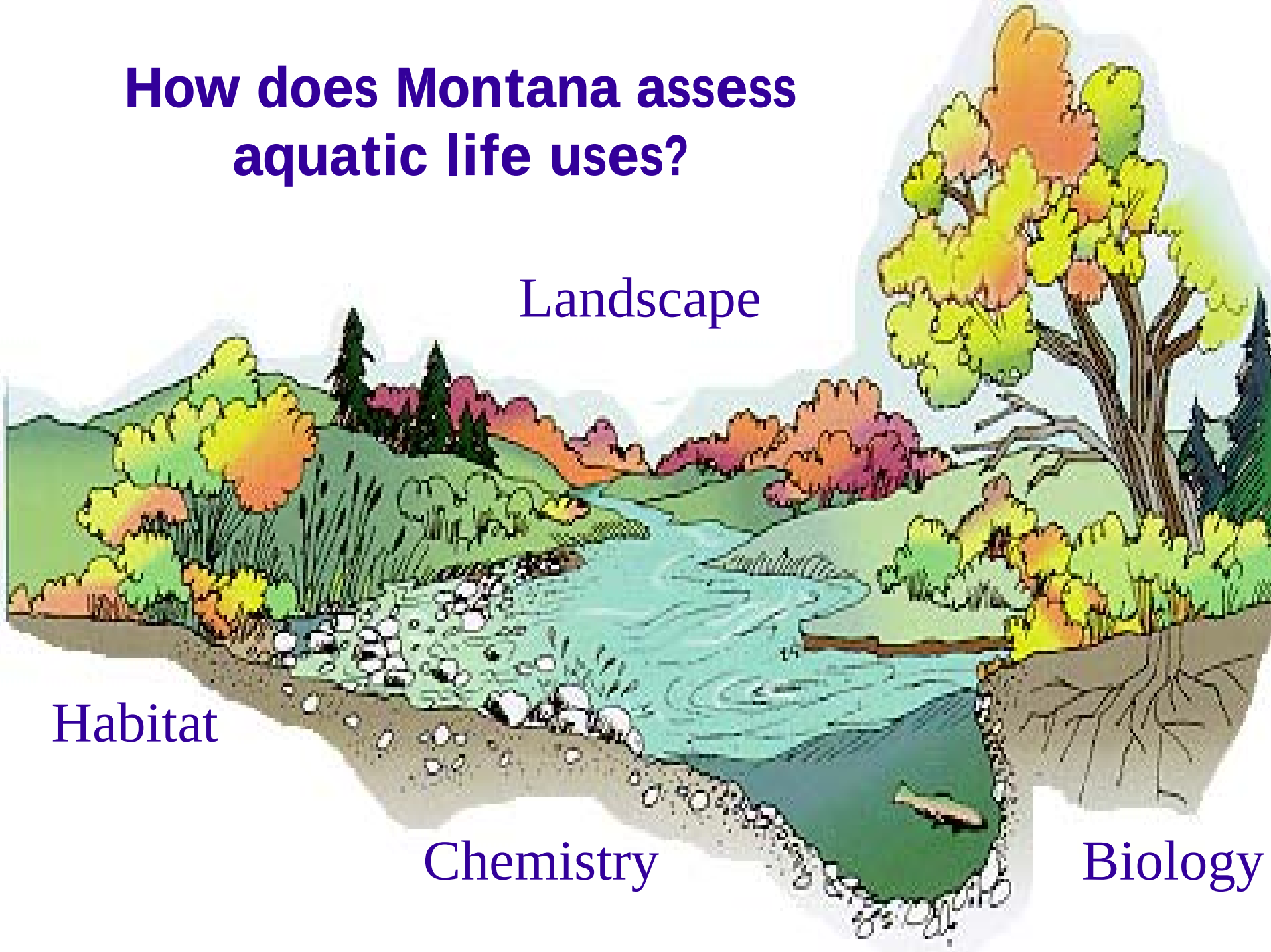
- Reviewing existing literature
- Expert Opinion
- Quantitative Models

Reference Data Collection

- **Biological Condition**
  - community structure
  - Population densities
  - biomass (i.e., chlorophyll)
- **Chemical Condition**
  - nutrients, salinity, sediment metals, bioaccumulation, etc.
- **Physical Condition**
  - geomorphology, habitat, clean sediment, etc.

- **What type of data and information does Montana consider for making aquatic life use support determinations?**

How does Montana assess aquatic life uses?



Sufficient Credible Data

"….***chemical, physical, or biological monitoring data,*** alone or in combination with narrative information, that supports …… whether a water is achieving compliance with applicable water quality standards" (75-5-103(30) MCA)

….Must use all readily available data.

Aquatic Life Use Support Determination
"Ecological Integrity"

Biological Condition (Response Variable)

Chemical Condition
(Stressor)

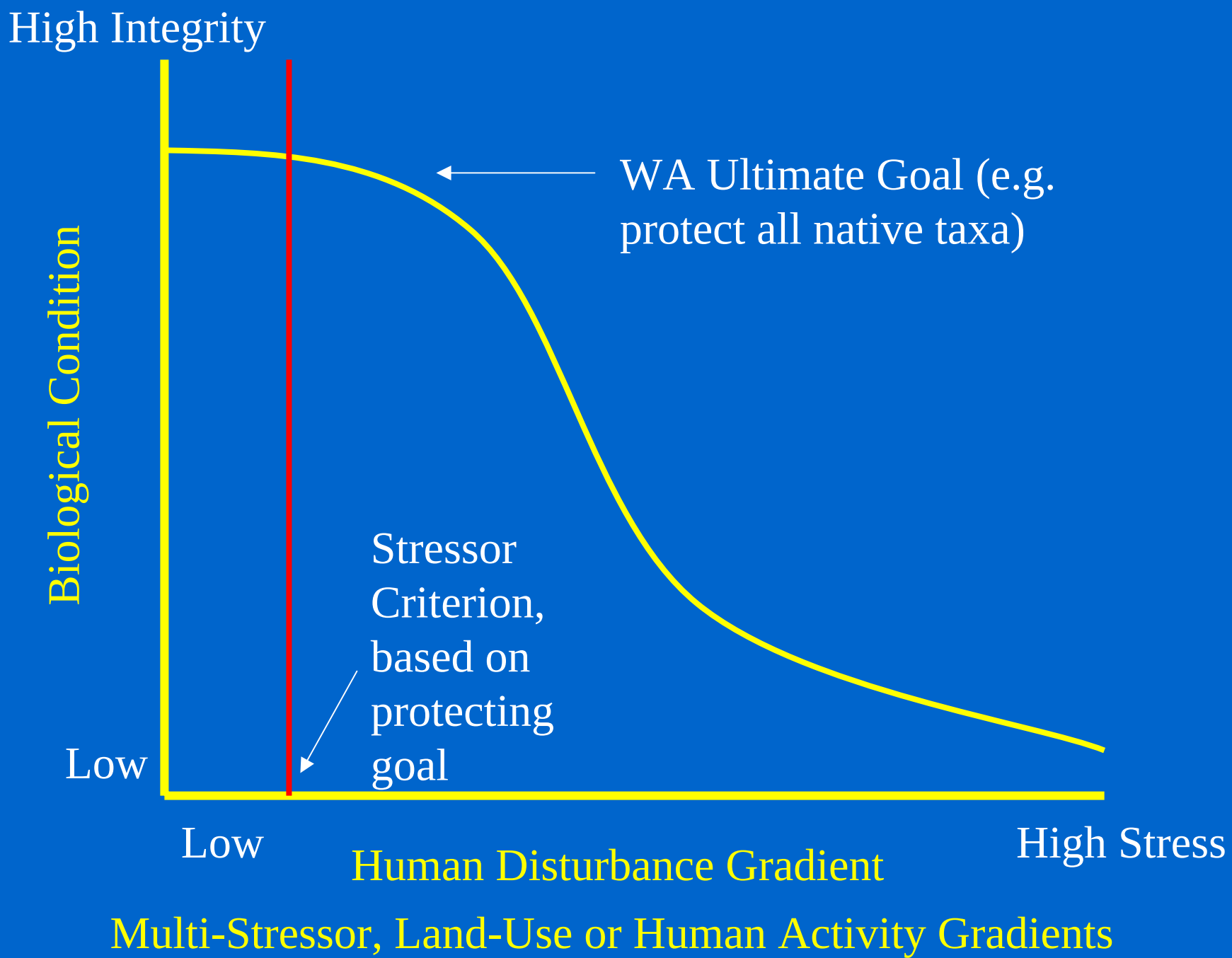
Physical Condition
(Stressor)

ALUS

- ALUS is a measure of ecological condition
- Ecological integrity can only be achieved when there is biological, chemical and physical integrity.
- biological integrity is dependant on chemical and physical integrity
- Chemical and physical integrity are often independent variables

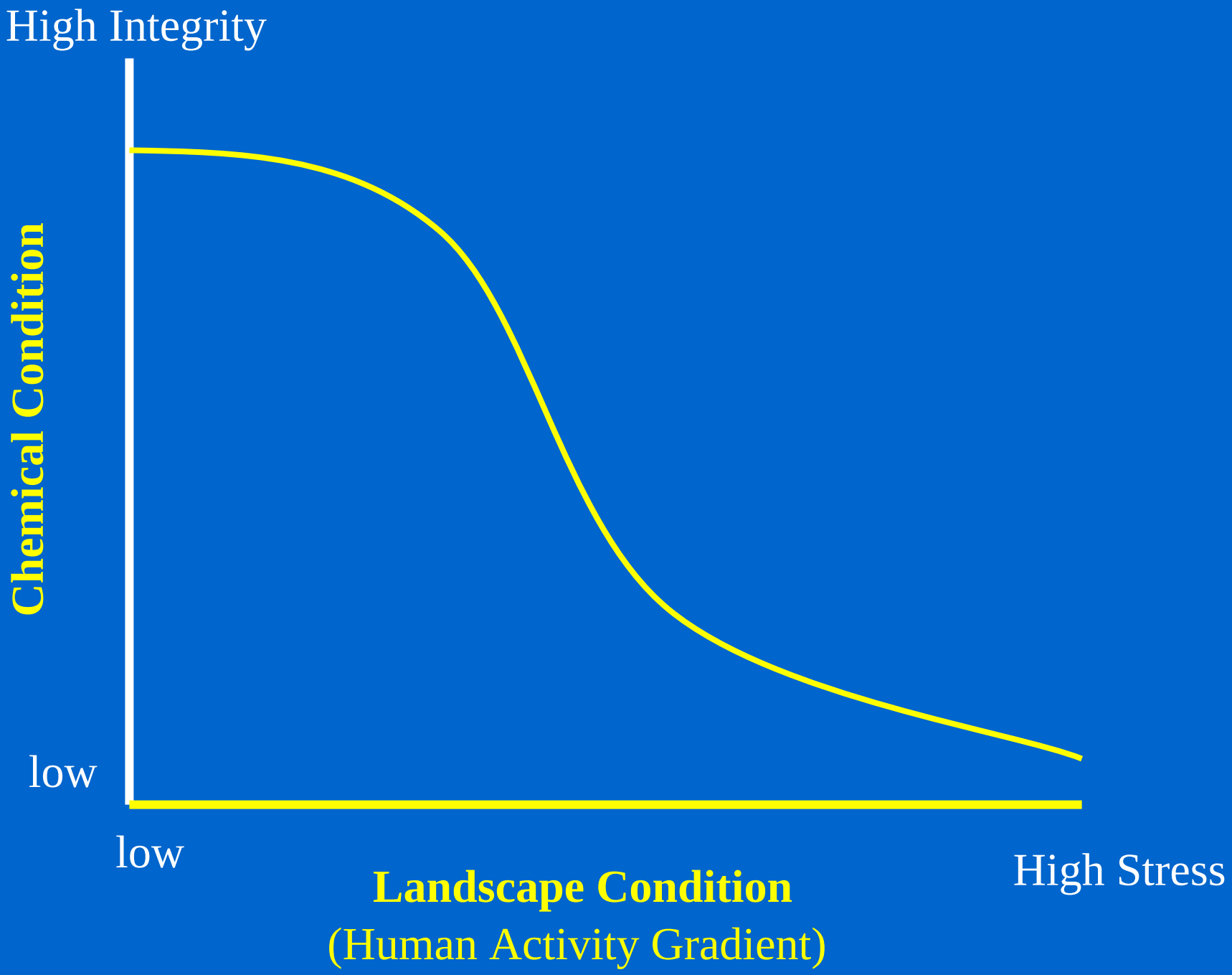
ALUS/Ecological Integrity

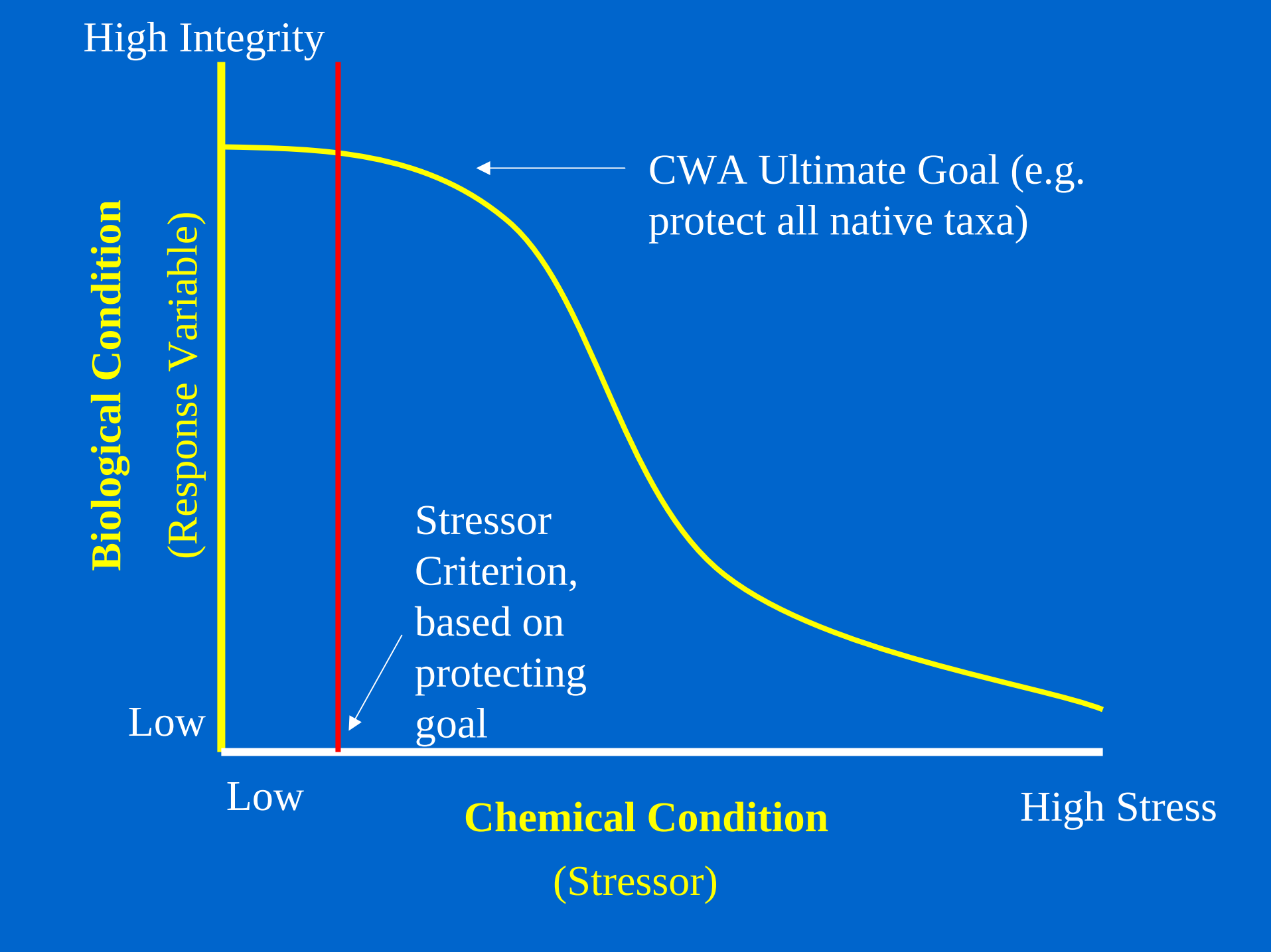
- In Montana, ALUS is determined by assessing:
  - **response variable** (biological condition) to determine impairments and full support.
  - **stressors** (physical and chemical conditions) to determine impairment.
- A combination of biological, chemical and physical conditions are usually assessed
- **Human activities** are evaluated to identify the probably sources of impairment

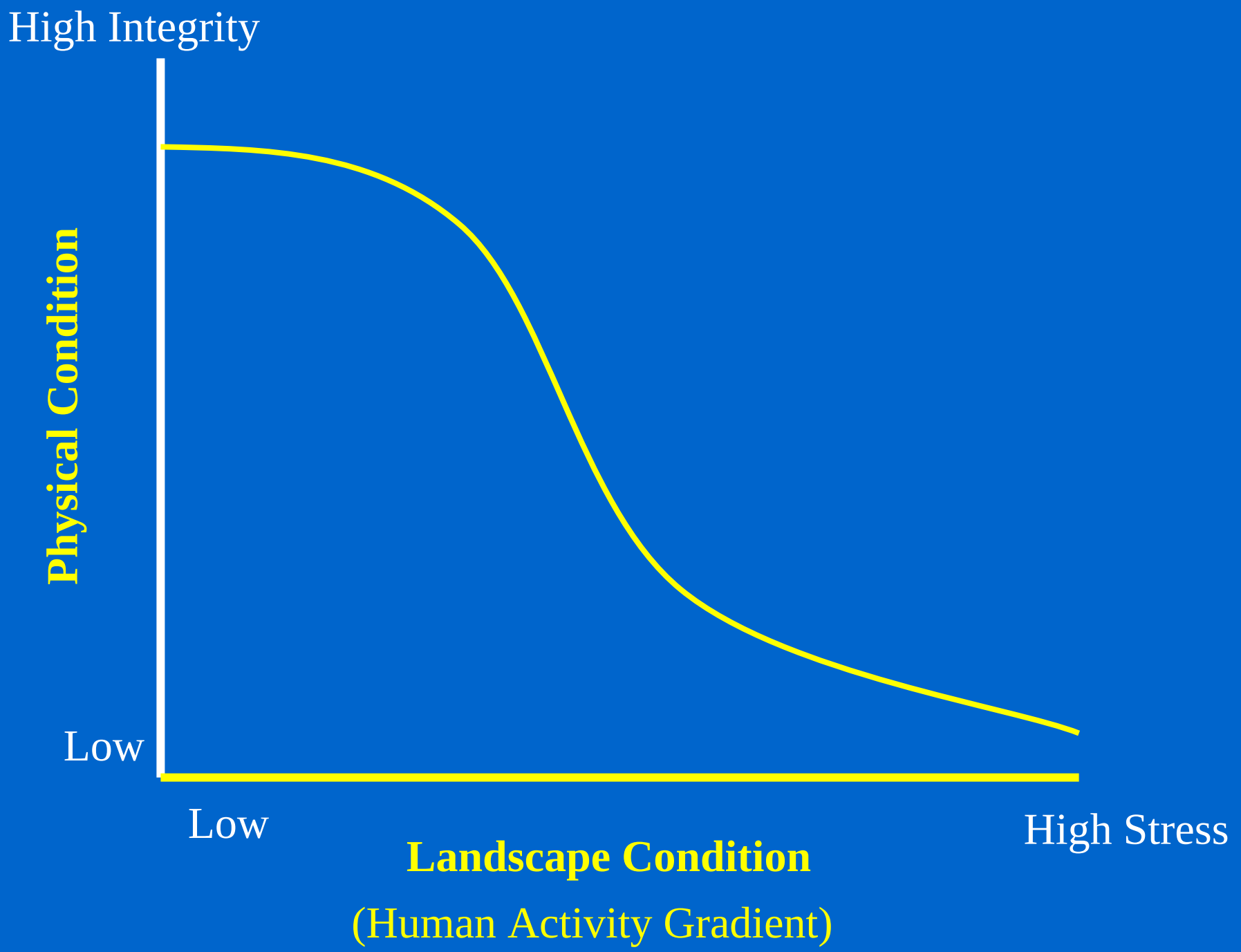

High Integrity
Biological Condition
WA Ultimate Goal (e.g. protect all native taxa)
Stressor Criterion, based on protecting goal
Low
Low
High Stress
Human Disturbance Gradient
Multi-Stressor, Land-Use or Human Activity Gradients

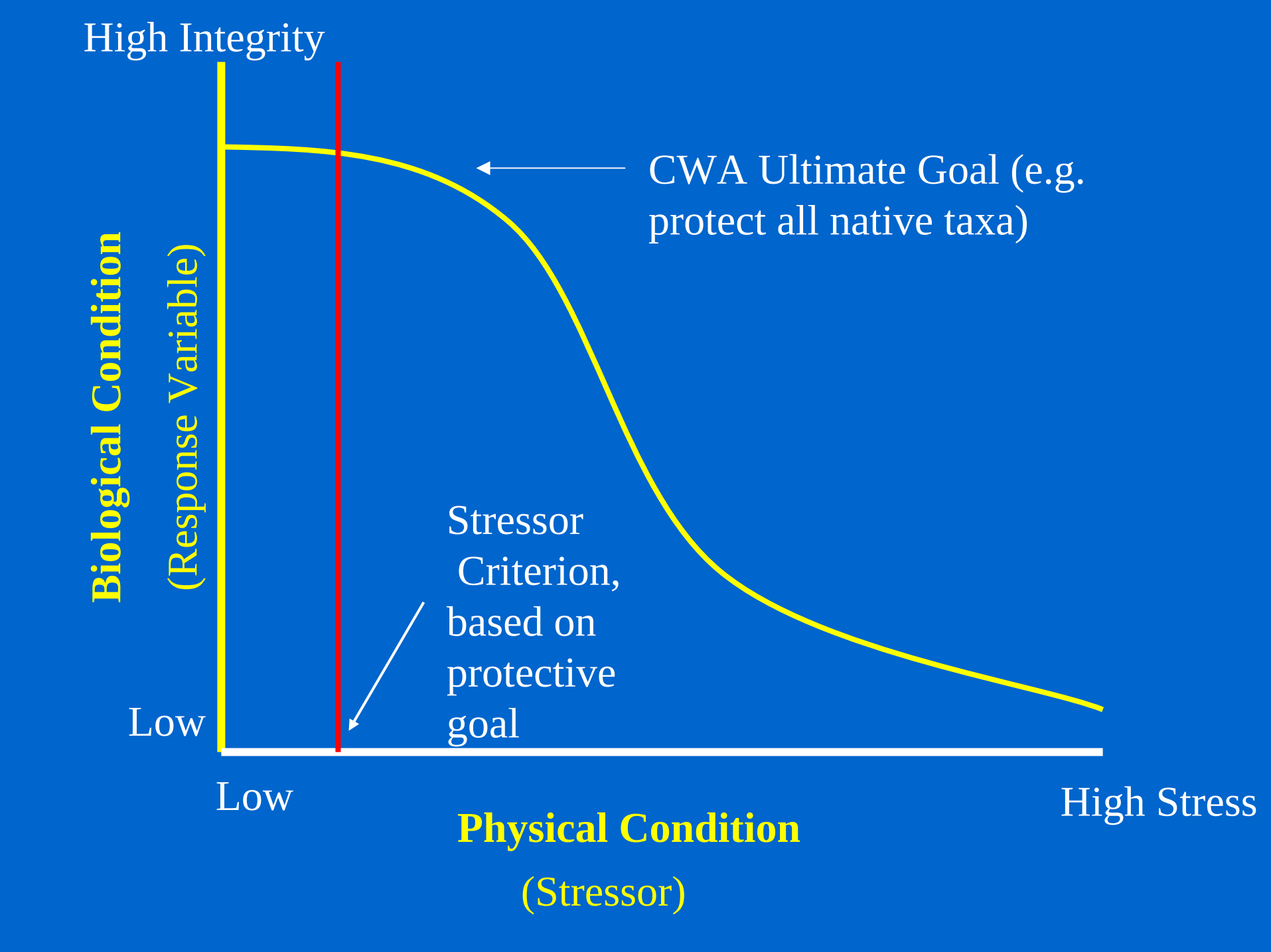
Ecological value

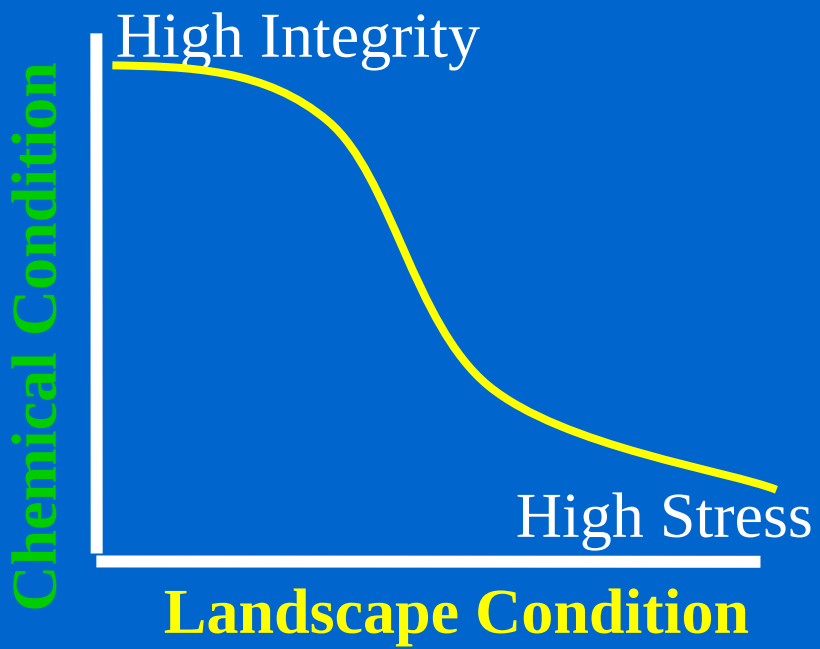
- Ecological integrity is often effected by human activities that occur on the landscape
- Ecological value is dependant on the biological, physical and chemical conditions

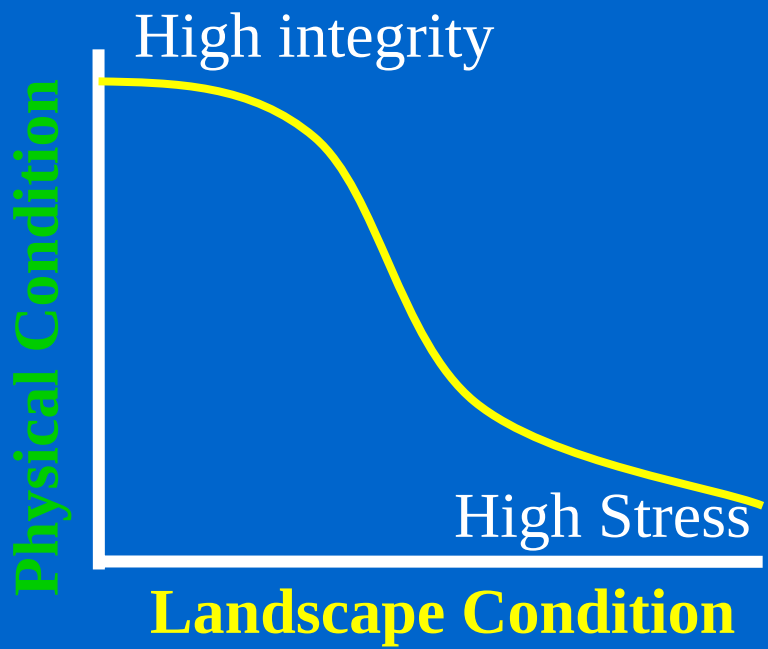

High Integrity
Chemical Condition
low
low
Landscape Condition
(Human Activity Gradient)
High Stress

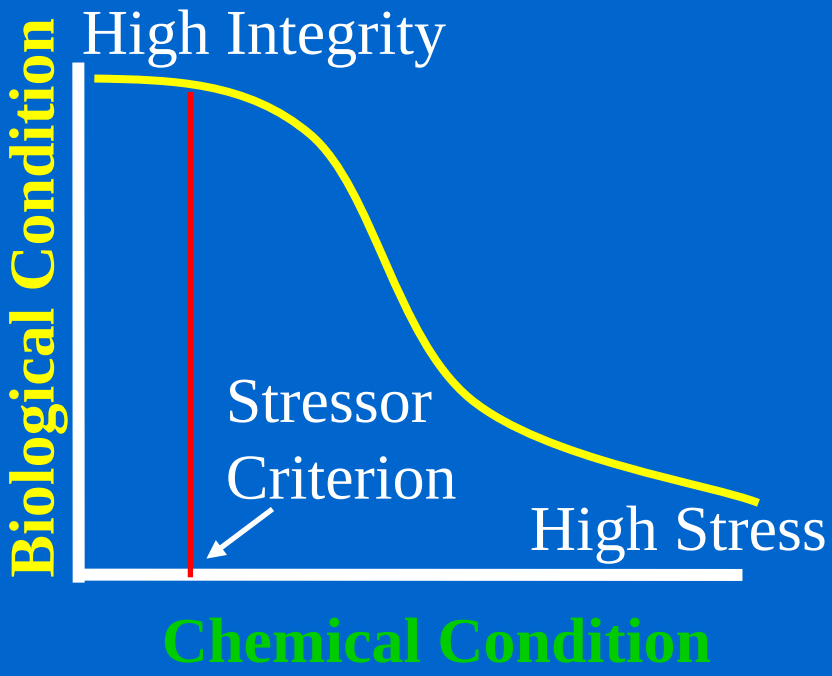

High Integrity
Biological Condition
(Response Variable)
CWA Ultimate Goal (e.g. protect all native taxa)
Stressor Criterion, based on protecting goal
Low
Low
Chemical Condition
(Stressor)
High Stress

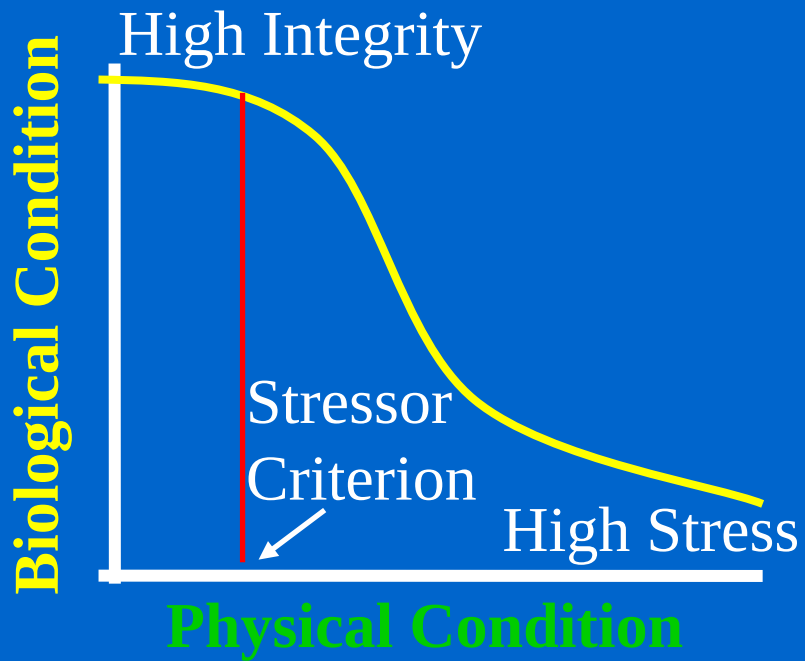

High Integrity
Physical Condition
Low
Low
High Stress
Landscape Condition
(Human Activity Gradient)

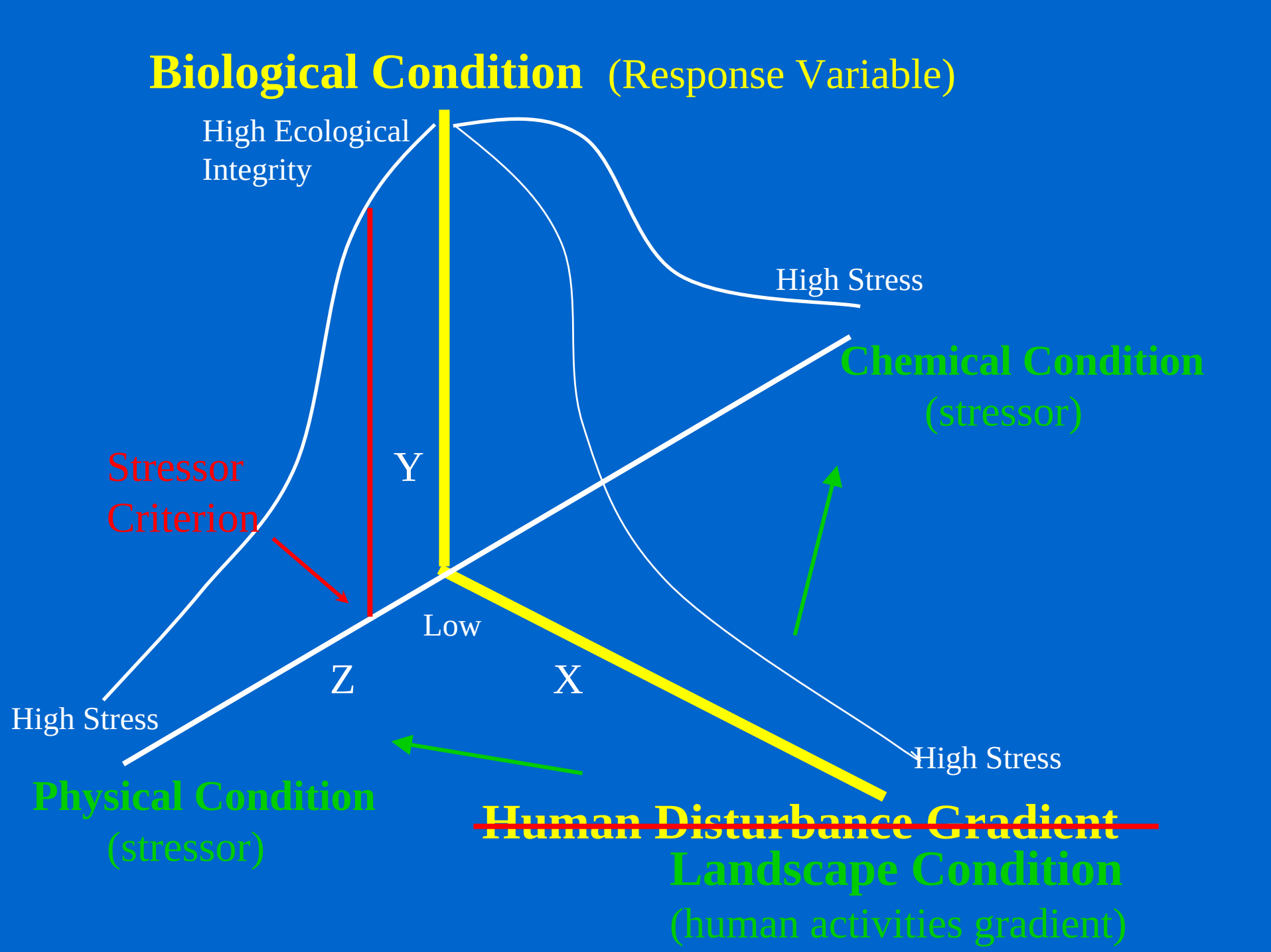

High Integrity
Biological Condition
(Response Variable)
CWA Ultimate Goal (e.g. protect all native taxa)
Stressor Criterion, based on protective goal
Low
Low
High Stress
Physical Condition
(Stressor)


High Integrity
Chemical Condition
High Stress
Landscape Condition


High integrity
Physical Condition
High Stress
Landscape Condition


High Integrity
Biological Condition
Stressor
Criterion
High Stress
Chemical Condition


High Integrity
Biological Condition
Stressor
Criterion
High Stress
Physical Condition


Biological Condition (Response Variable)
High Ecological Integrity
High Stress
Chemical Condition
(stressor)
Stressor Criterion
Y
Low
Z
X
High Stress
High Stress
Physical Condition
(stressor)
Human Disturbance Gradient
Landscape Condition
(human activities gradient)

How Does Montana use the biological and human disturbance gradients to make ALUS determinations?

Aquatic Life Use Support Determination

- **Independent Evidence Test**
  - small data set
  - >25% deviated from reference condition
- **Weight of Evidence Test**
  - large data set (must assess at least two biological assemblages)
- **Overwhelming Evidence Test**
  - exceedence of numeric aquatic life criteria
  - >50% deviation from reference condition

Examples of assessments that use the independent evidence test.

Intermountain Valley and Prairie Foothill Ecoregion
- Stream is recovering from grazing impacts

Physical Condition

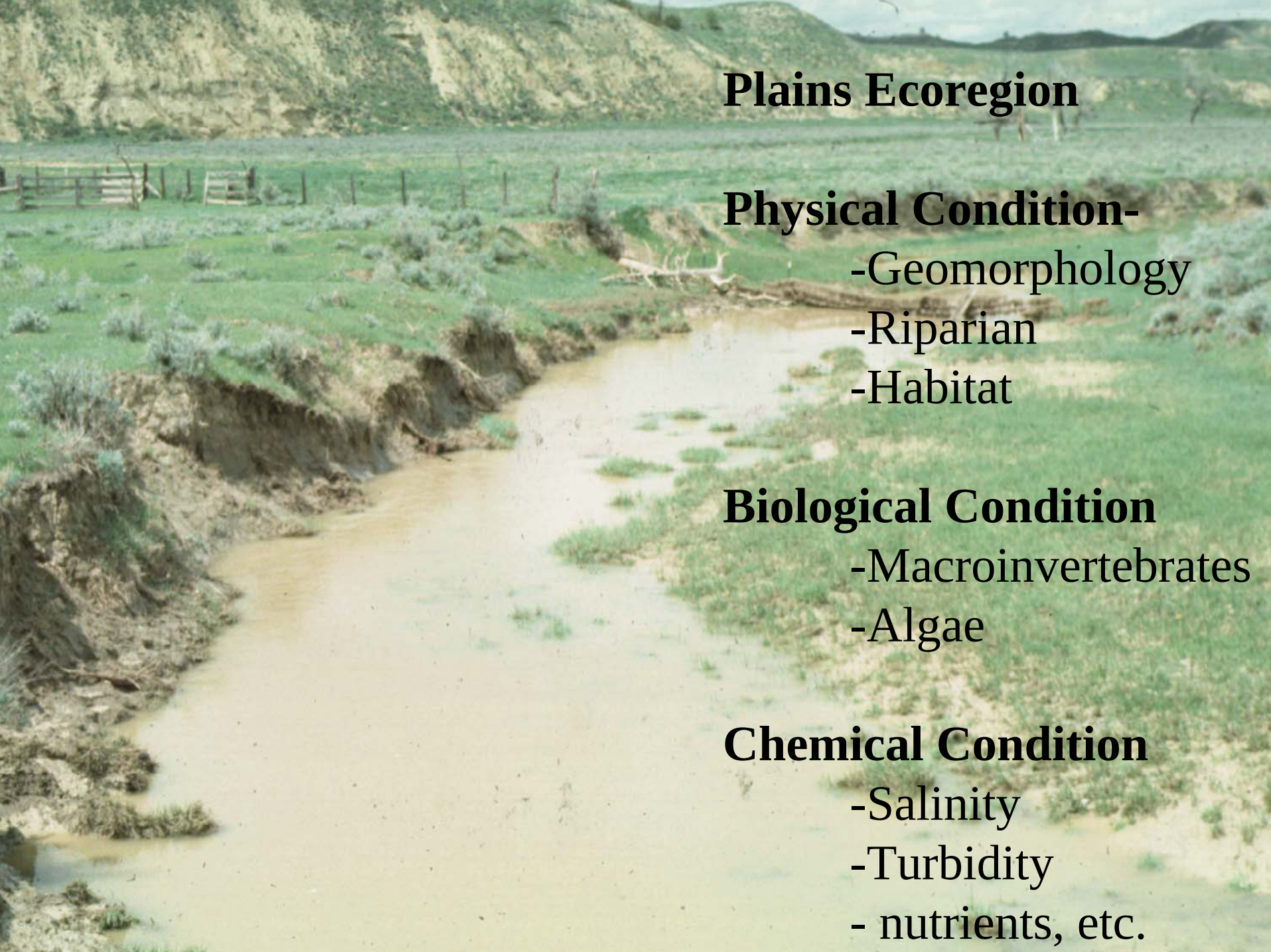
-Riparian

-In-stream Habitat

-Geomorphology

Biological Condition

-Macroinvertebrates



Plains Ecoregion

Physical Condition-

-Geomorphology

-Riparian

-Habitat

Biological Condition

-Macroinvertebrates

-Algae

Chemical Condition

-Salinity

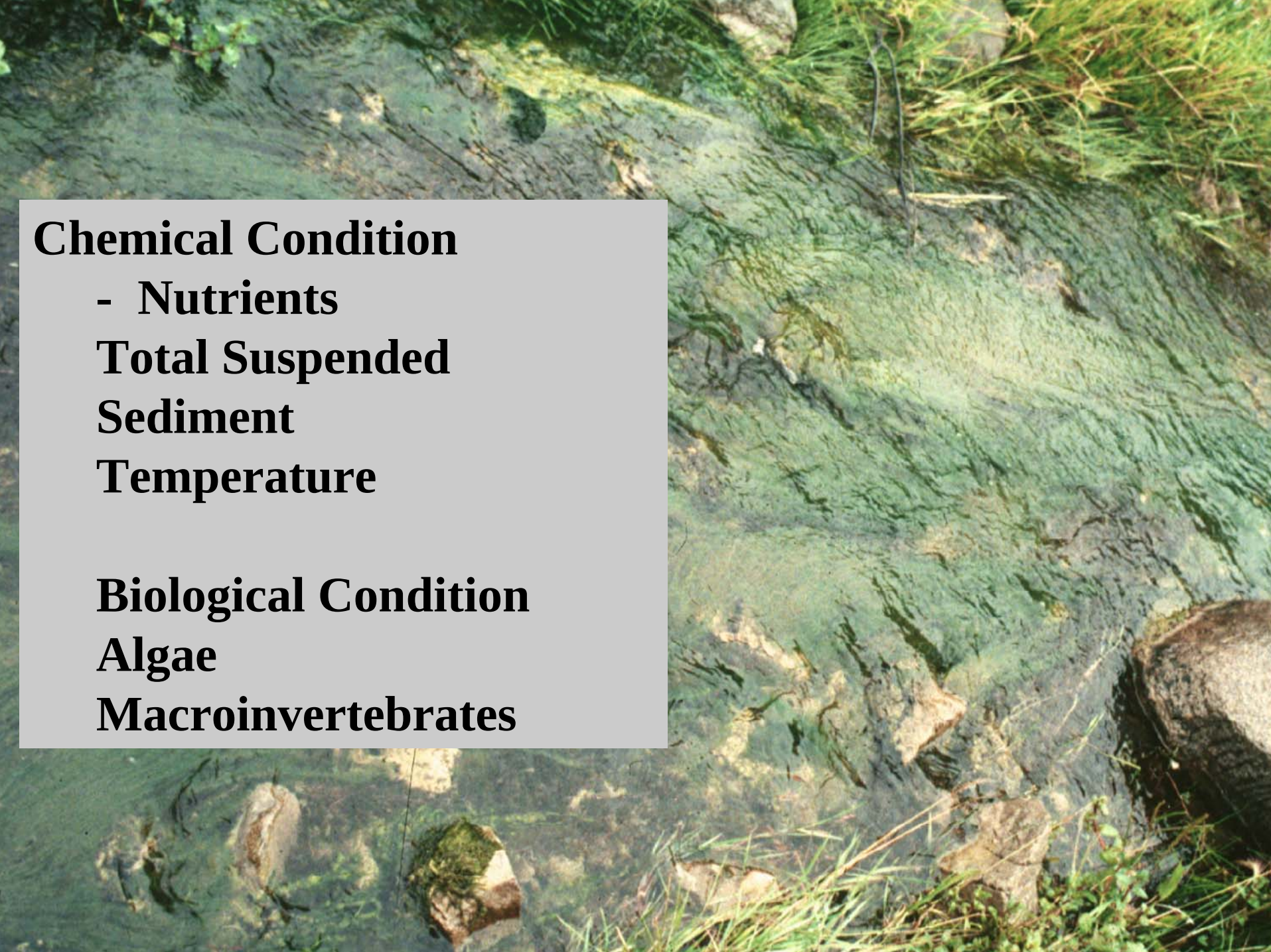
-Turbidity

- nutrients, etc.

Issues

- Need to convert our biological measures (multimetric scores, multivariate analyses, measures of fish populations and community structure) into ALU tiers .
- Need to have a process for determining ALU tiers when the assessment of different biological assemblages do not correlate.

Examples of Assessments that use weight-of-evidence



Chemical Condition

- **Nutrients**
- **Total Suspended Sediment**
- **Temperature**

Biological Condition

- **Algae**
- **Macroinvertebrates**

Physical Condition
Habitat
Assessment
Geomorphology

Rocky Mountain Ecoregion

Percent Area Clearcut
“Landscape Assessment”

Issues

- We need to be able to assess ALU's by using a combination of biological, physical and chemical data and information.
- We need to have a process for making decisions about ALU tiers when there is not a good correlation between the human disturbance and the biological condition gradients.

Examples of Assessments (Overwhelming Evidence)

Dry Fork Belt Creek Impairment Causes

- Violation of Acute and Chronic Aquatic Life Standards
  - metals
  - Zinc
  - Cadmium
  - Copper


Prairie Foothill Ecoregion
Overwhelming evidence
-inter-basin transfer of water
(Muddy Creek)

Example: Geomorphic reference data

Reach 3	VBW	VBG	Area
French Cr.	370 m	5.8 %	1256 Acres
Reference	350	5.1	1504

	Ent.	w/d	Sin	Grad	D50	W50	CS	BEHI
French Cr.	1.7	7.2	1.2	4.7	15	3.1	83	32.2
Reference	13.5	1.7	2.7	1.9	20	1.9	61	18.9

Impact is livestock grazing

High entrenchment and w/d ratio
Low sinuosity and high gradient
Channel stability is low and bank erosion hazard is high

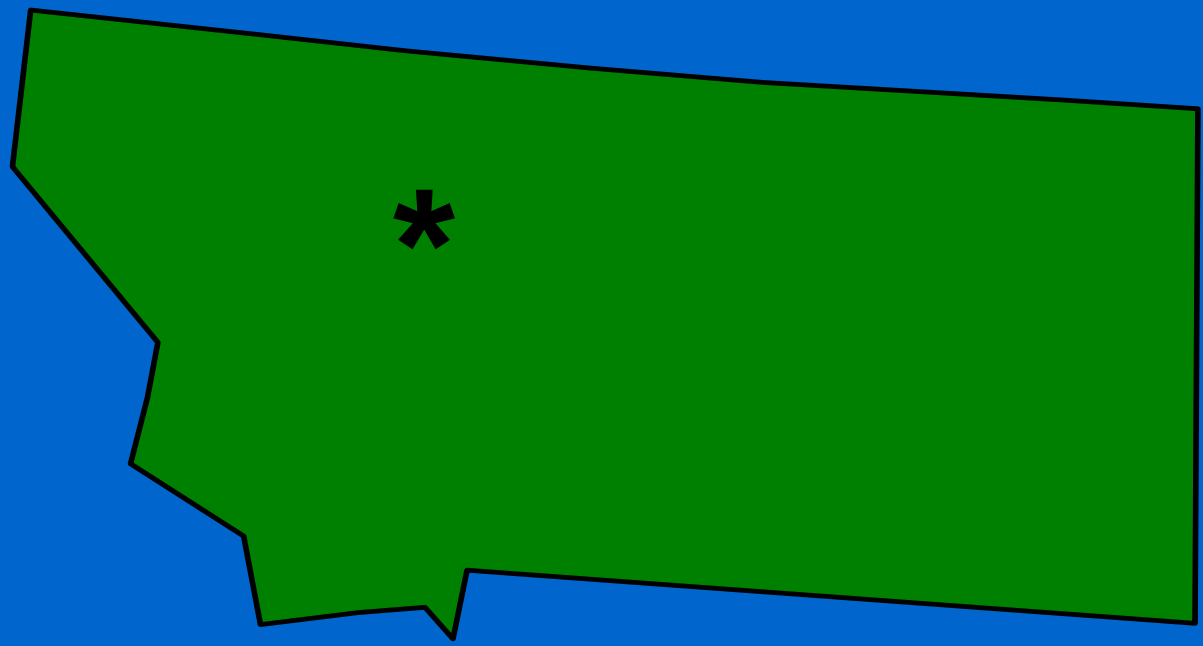
Issues

- Need ALU tiers to assess chemical and physical/habitat conditions (stressors)
- Need to develop a good understanding of how various stressors impact biological condition (response variable)

Application of ALU tiers

- Can be used for assessments that interpret Montana's existing designated aquatic life uses (Water Quality Standards)
- Setting restoration targets
- Communicating with EPA, other state and federal agencies, Congress and the public

Case Study
Benton Lake National Wildlife Refuge



Benton Lake National Wildlife Refuge

- 5,600 acre saline marsh created by a glacier
- Established in 1929 to provide habitat for up to 100,000 ducks, 40,000 geese and 5000 swans
- Currently receives a large portion of its water from irrigation drainage
- The marsh is currently divided into separate units that are periodically flooded.
- Because there is no surface outlet, salts and contaminants are concentrated in the water.

Benton Lake National Wildlife Refuge

(Example of Sufficient Credible Data)

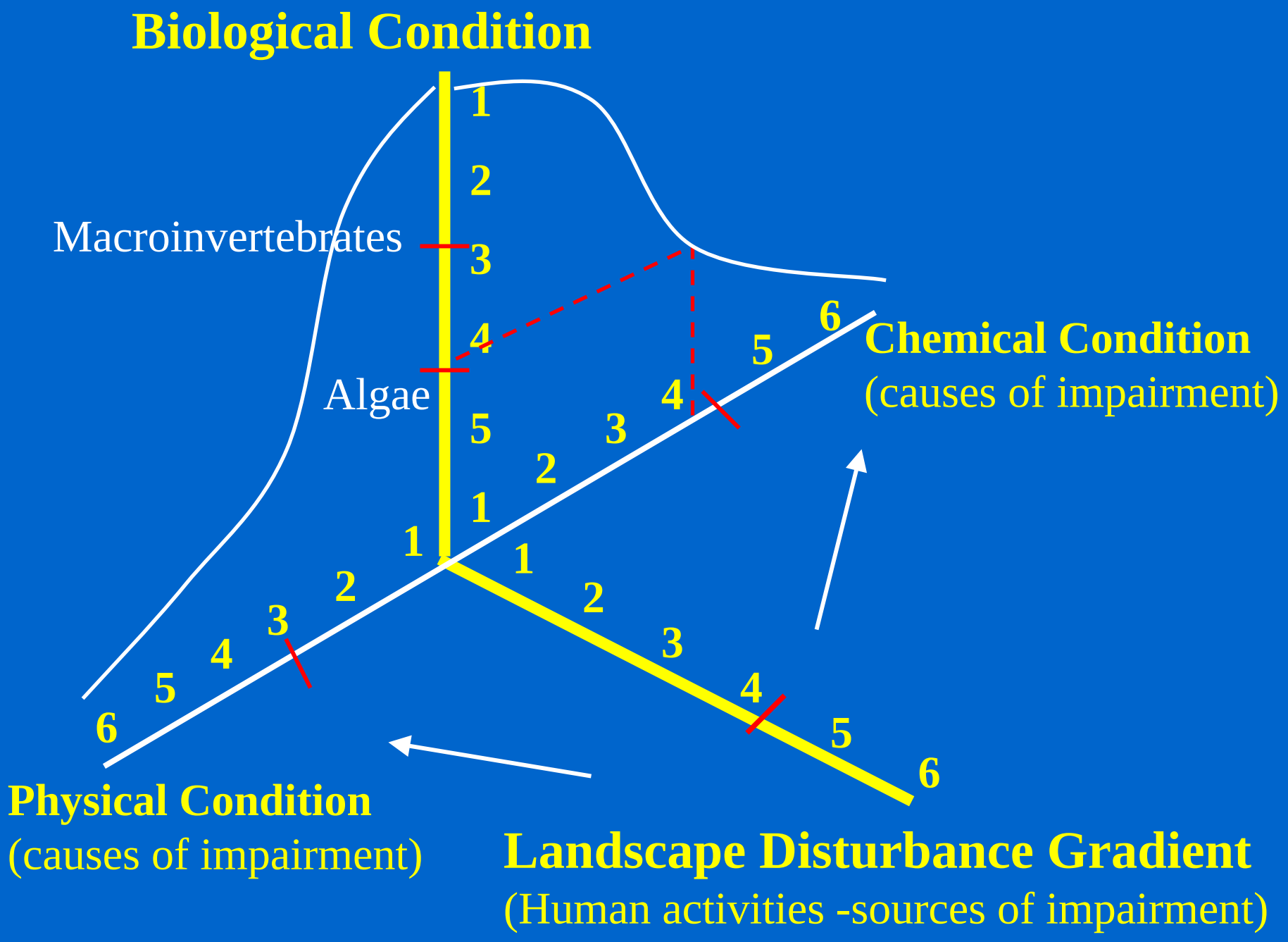
- **Chemistry** (Score 3 of 4)
  - **water column, sediment, and tissue data**
- **Physical/habitat** (Score 2 of 4)
  - **Visual habitat assessment with photo documentation and interpretations**
- **Biology** (Score 3 of 4)
  - **Macroinvertebrate and algae bioassessment**
  - **Substantial amount of waterfowl population data**
- **Total Score** = 8 (Sufficient Credible Data)

Benton Lake National Wildlife Refuge
(Example of Aquatic Life Use-Support Determination)

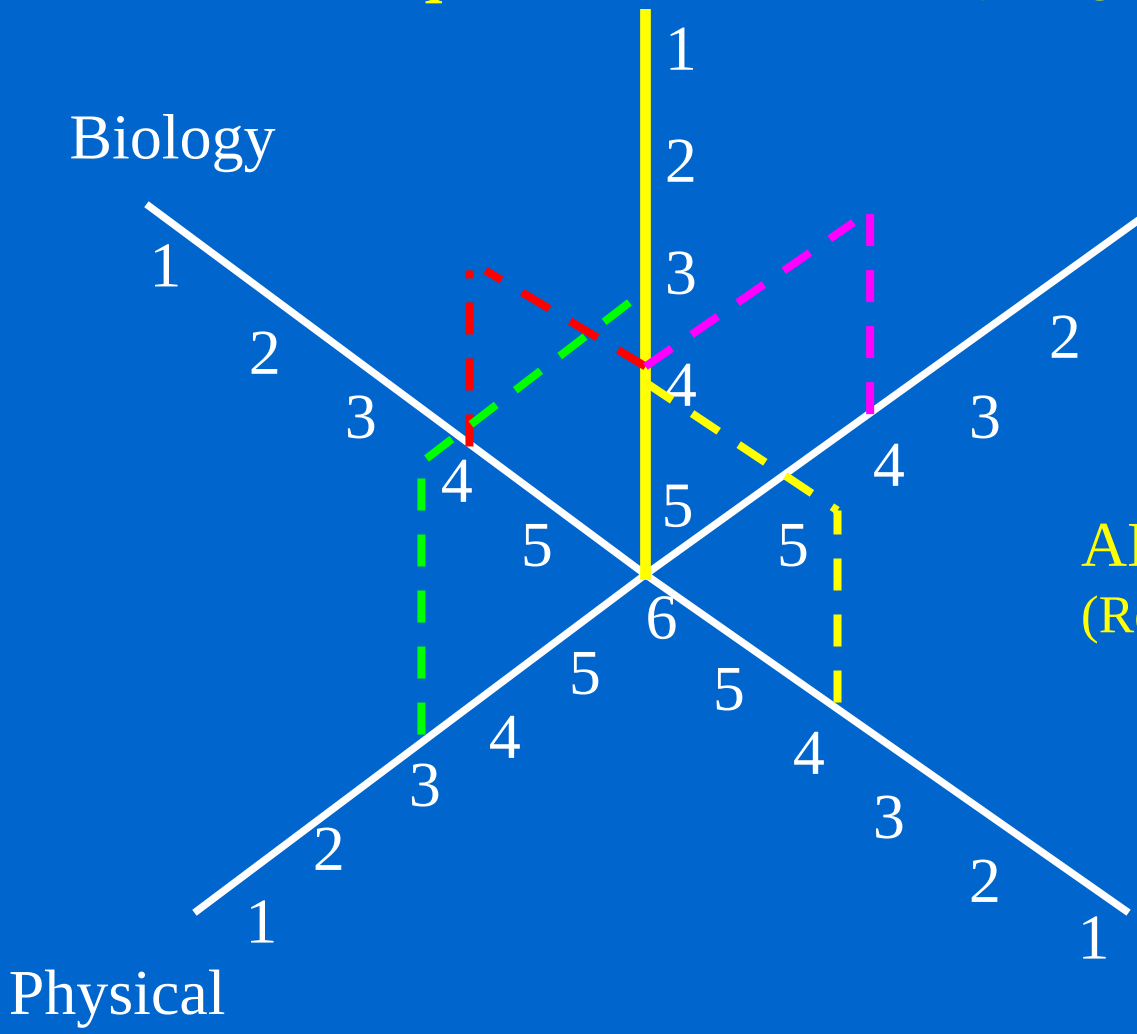
- **Chemistry**
  - High nitrates in water column
  - High selenium in sediment and tissue
- **Physical/Habitat/Landscape**
  - Saline seeps were found within the watershed
  - intensive agriculture occurs within watershed
  - Water levels intensively managed to control salinity
- **Biology**
  - Algae biocriteria indicates moderate impairment Macroinvertebrates indicate slight impairment

Benton Lake NWR
303(d) listing

- **Weight-of-Evidence Test**
  - **Chemistry and biology data indicate impairment**
  - **Landscape information identifies probable sources**
- **Partial Support of Aquatic Life Use**
- **Probable Causes of Impairment**
  - salinity, nutrients (nitrogen), selenium, noxious algae
- **Probable sources of impairment**
  - agriculture


Biological Condition
Macroinvertebrates
Algae
1
2
3
4
5
6
Chemical Condition
(causes of impairment)
Physical Condition
(causes of impairment)
Landscape Disturbance Gradient
(Human activities -sources of impairment)

Aquatic Life Use Tier (ecological integrity)



ALU Tier 4

(Restoration goal is tier 3)

Summary

- **Biological assessments** directly measure impacts to the aquatic life communities.
- **Physical/habitat and chemistry assessments** provide valuable information concerning the probable causes of impairment and can be used to assess ALUS.
- **Landscape Assessments** provide valuable information about the probable sources of impairment.
- Therefore, Montana's approach for making ALUS determinations includes the assessment of **physical, chemical and biological** data and information.
- For this reason, Montana needs to develop ALU tiers that can be used to assess biological, physical and chemical integrity **(ecological integrity).**