
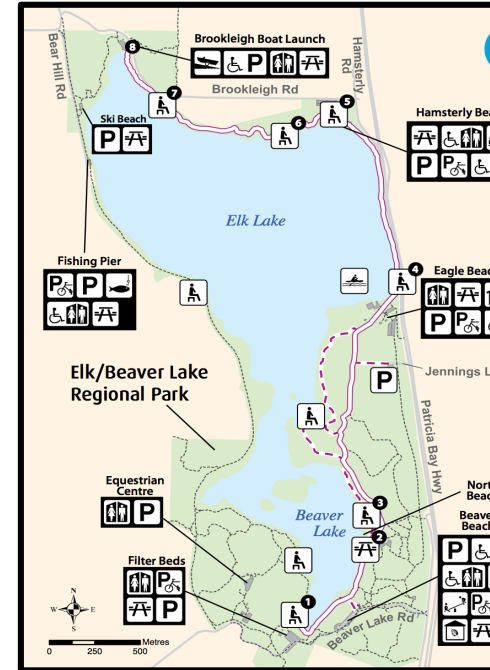


- 
- What's going on in Elk/Beaver Lake?
 - How do we “fix” Elk/Beaver Lake?
 - What are the next steps?

ELK / BEAVER LAKE

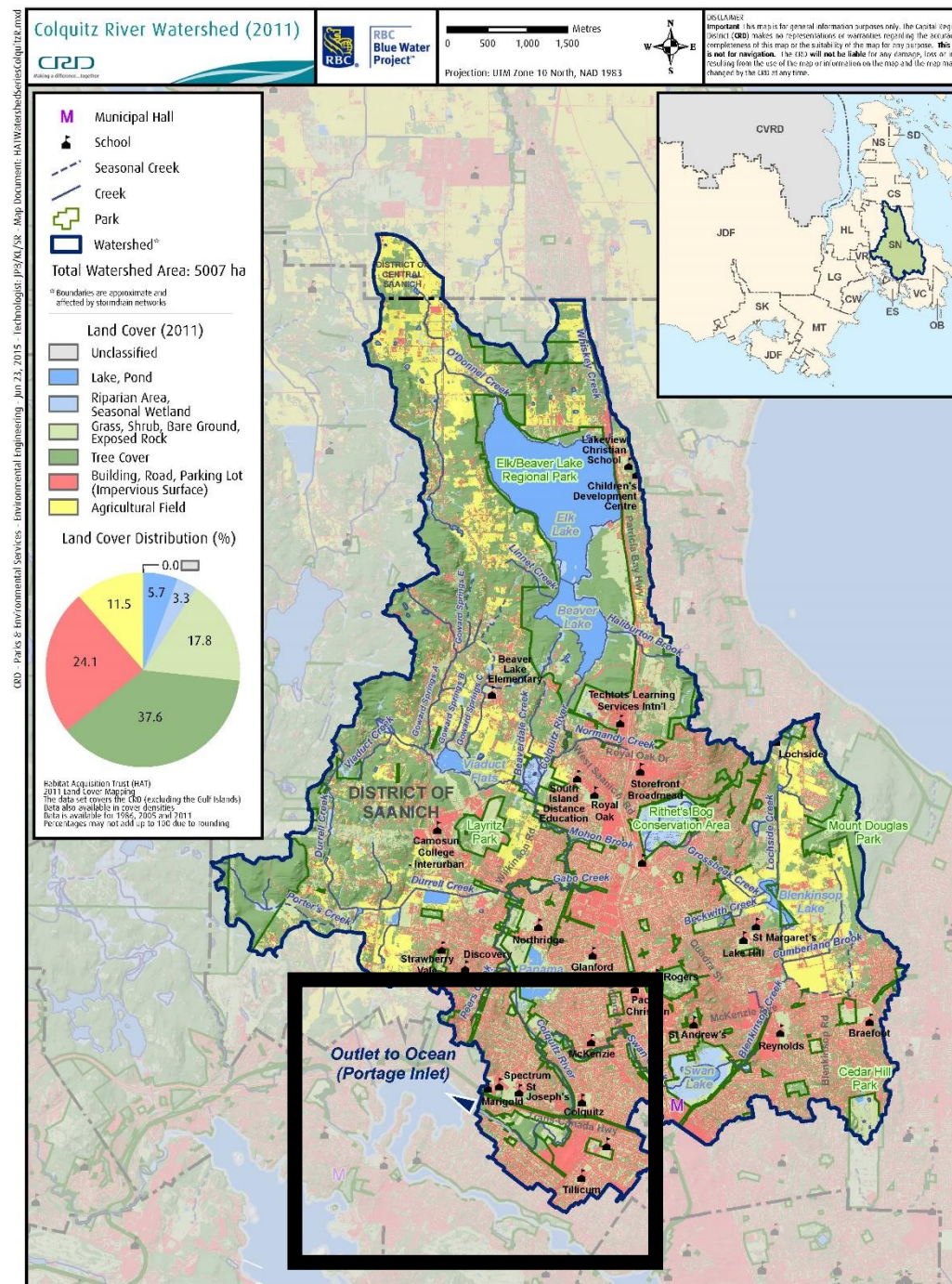
Recreational Values

- Popular recreation destination 1920s to present
- Visitors: annual use 1.5 million user days
- Fishers: the most fished lake on Vancouver Island (~15,000 angler days)
- Rowers: national, UVic and local rowing facilities
- Hiking, running, swimming, triathlon
- Canoe/kayaking club
- Social/community events
- Education/outreach/nature house
- Equestrian Society

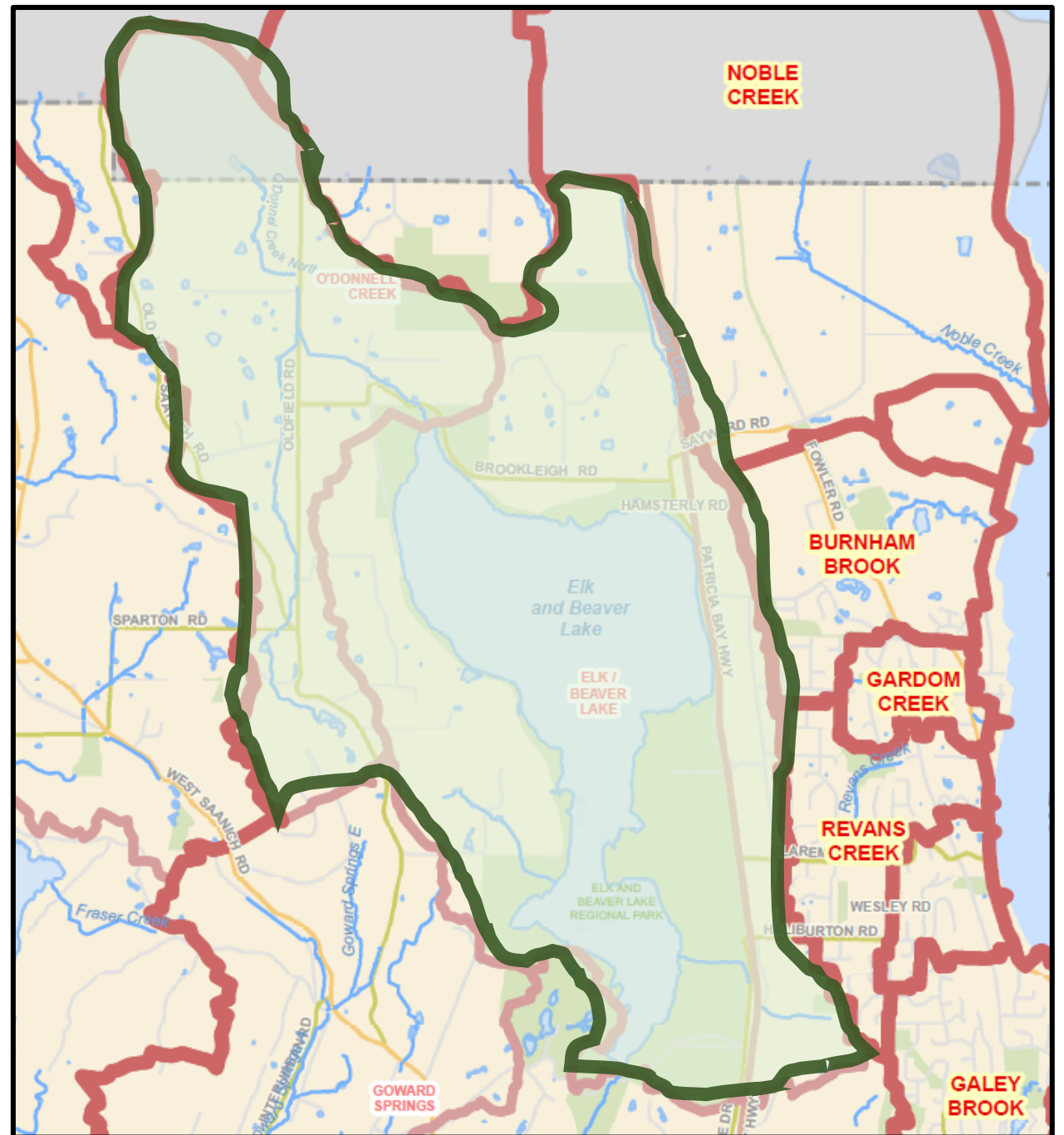


Environmental Values

- largest watershed in the region
- Downstream values: cutthroat trout
- Habitat for many species, including Species at Risk
- Ecosystem Services: flood mitigation, pollution control, nutrient cycling, carbon sequestration



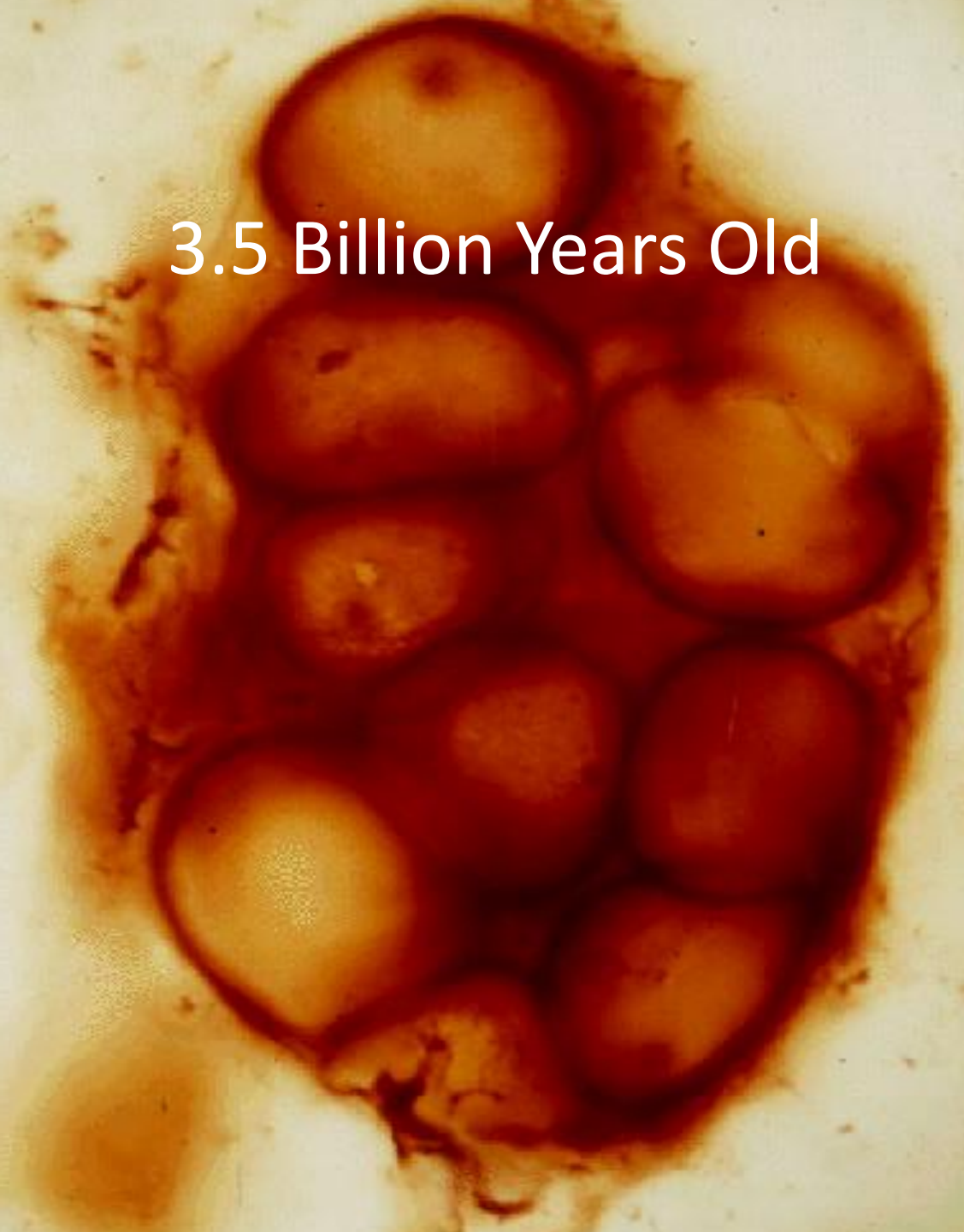
SCOPE



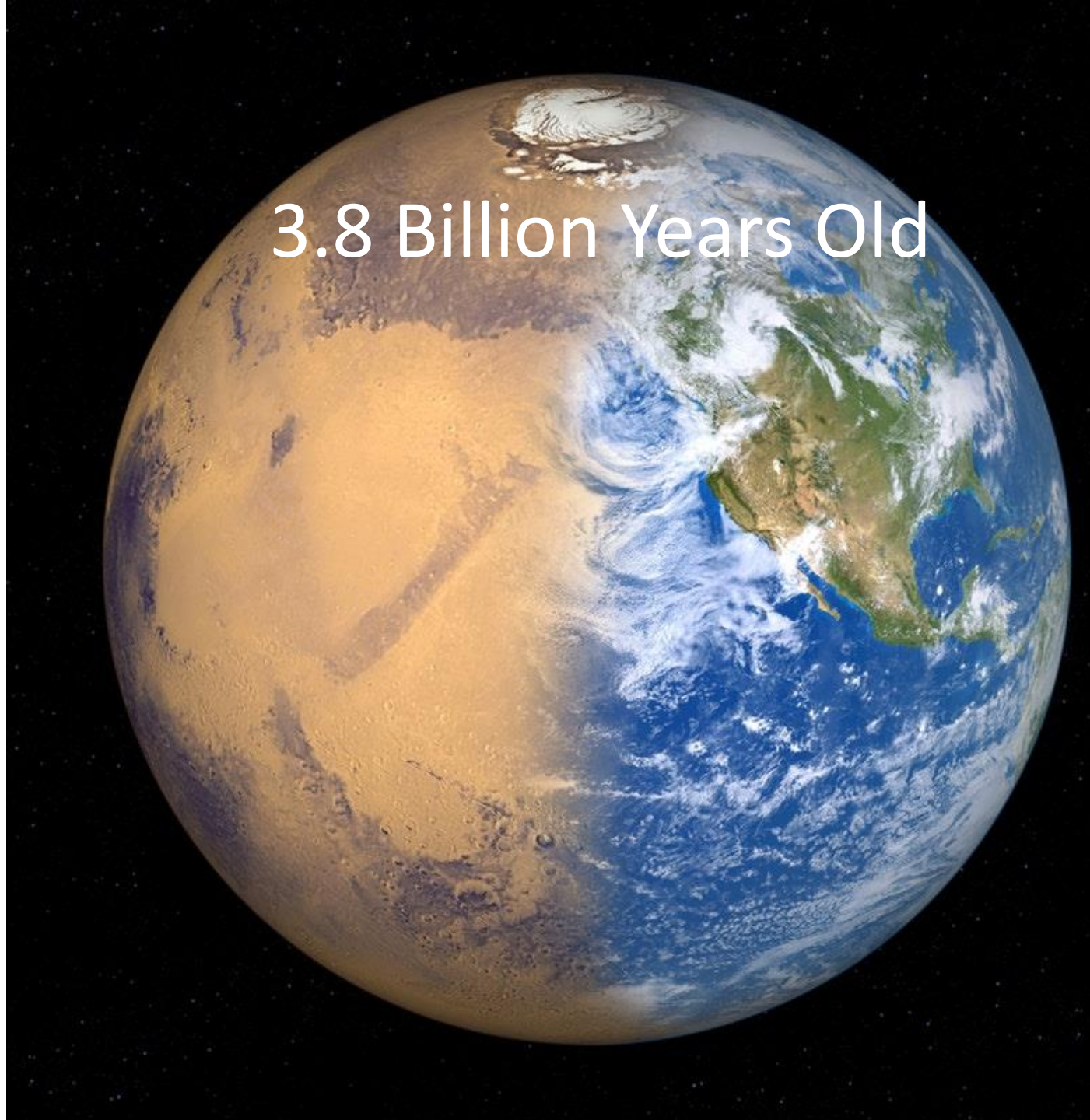
What's the big problem?

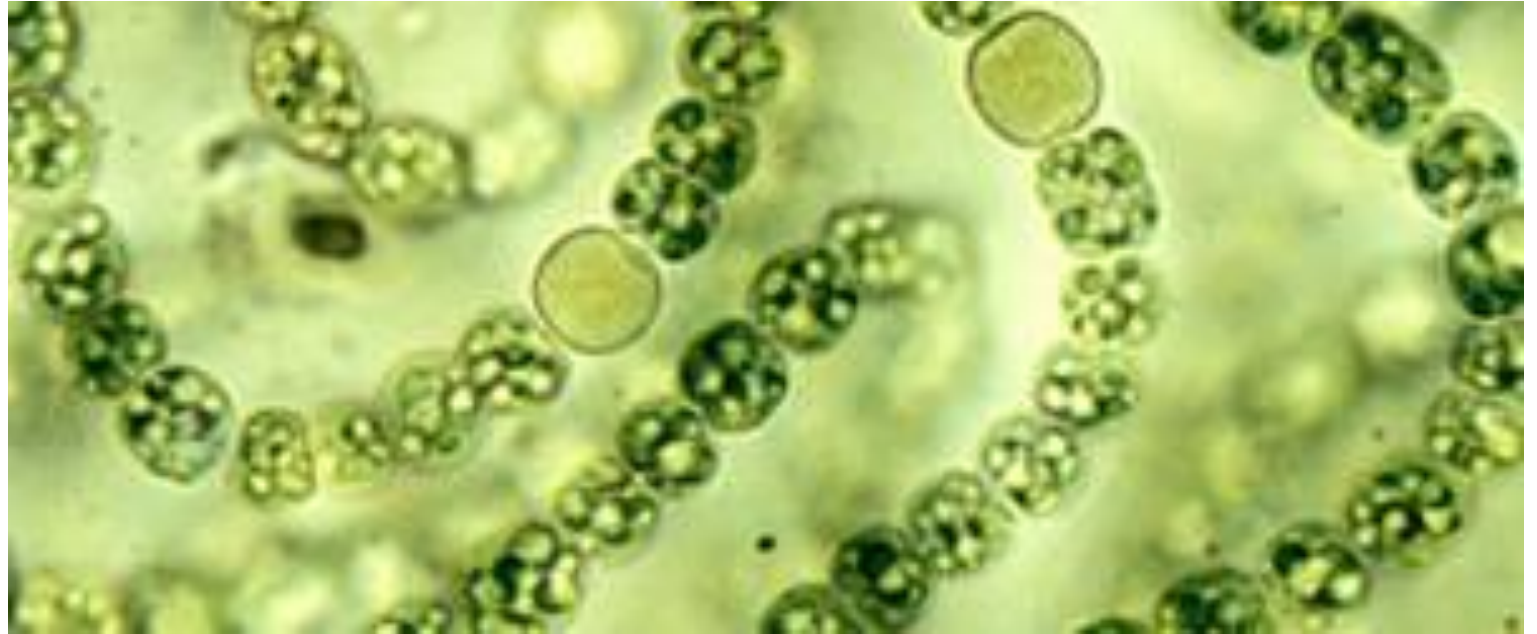


3.5 Billion Years Old



3.8 Billion Years Old





Public Health Advisory Blue-Green Algae



This lake is subject to blooms of blue-green algae, which occur naturally as part of the lake's ecosystem. Be alert for a visible blue-green scum, which appears as surface scum on the lake.

Blooms may contain HARMFUL TOXINS.

They typically occur between November and March. Ensure your safety by avoiding contact with visible bloom material in these areas.



Ensure your pet's safety by keeping animals on a leash to prevent them from ingesting lake water.

For information visit www.crd.bc.ca/parks.



Blue-green Algae



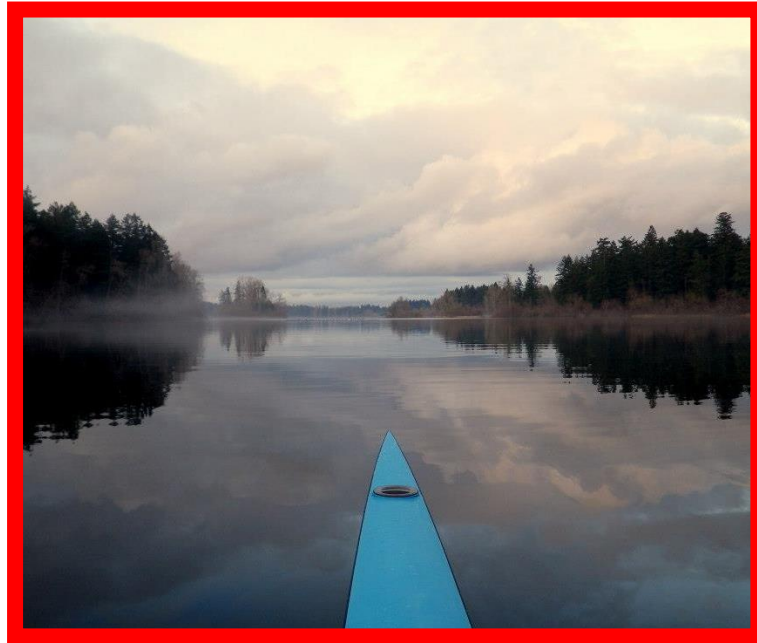
Eurasian
watermilfoil



Weedy Water



Eurasian
watermilfoil



Weedy Water



Eurasian
watermilfoil



Weedy Water

Aquatic plant Surveys

- Aquatic Plant Surveys conducted in 2016
- Identified 11 species (4 invasive)
- Eurasian milfoil was 90% of aquatic plant coverage
- Aquatic plants have been actively managed for last 50 years – largely by **weed harvesting**
- 300-450 tonnes removed per year by weed harvester





Where are the
fish?

Fish Communities

- Initial Fish Community
Coastal cutthroat trout,
Threespine stickleback and Prickly
sculpin
- Current Fish Community
Rainbow Trout (stalked), Carp,
Sunfish, Black Bullhead, Brown
Bullhead, Yellow perch, LM and
SM Bass



Fish Surveys

1973 – 2001

- Primarily non-native species

2017

- No native species captured
*except signal crayfish
- Elk lake deep water: no fish caught (12m)



Property IGFA (Artist Duane Raver)

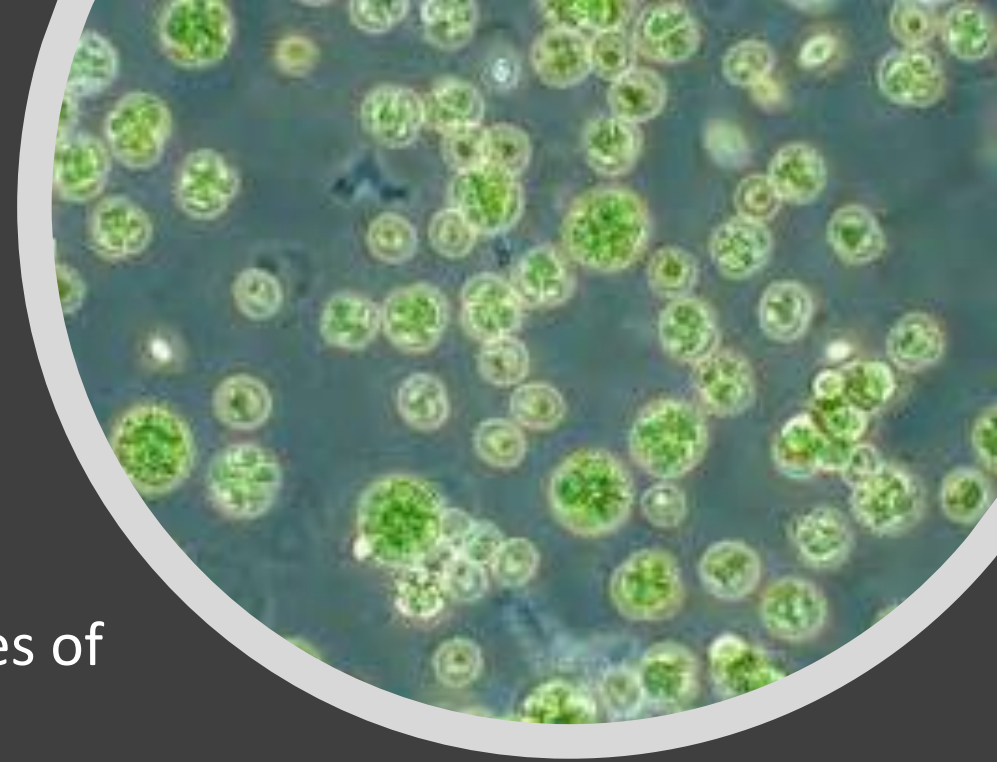


Pamphlet • Lepomis gibbosus © 1998 • 1/1000



Plankton Communities

- **Phytoplankton:** Cyanobacteria are dominant species of phytoplankton
- **Zooplankton:** Low numbers of zooplankton – likely due to poor food quality & heavy predation by fish



Benthic Community

Species that live on/in the bottom sediments (worms/crustaceans)

- Low diversity and abundance of benthic community



Invasive/Introduced Species

- Fish
- Bullfrogs
- Turtles
- Geese

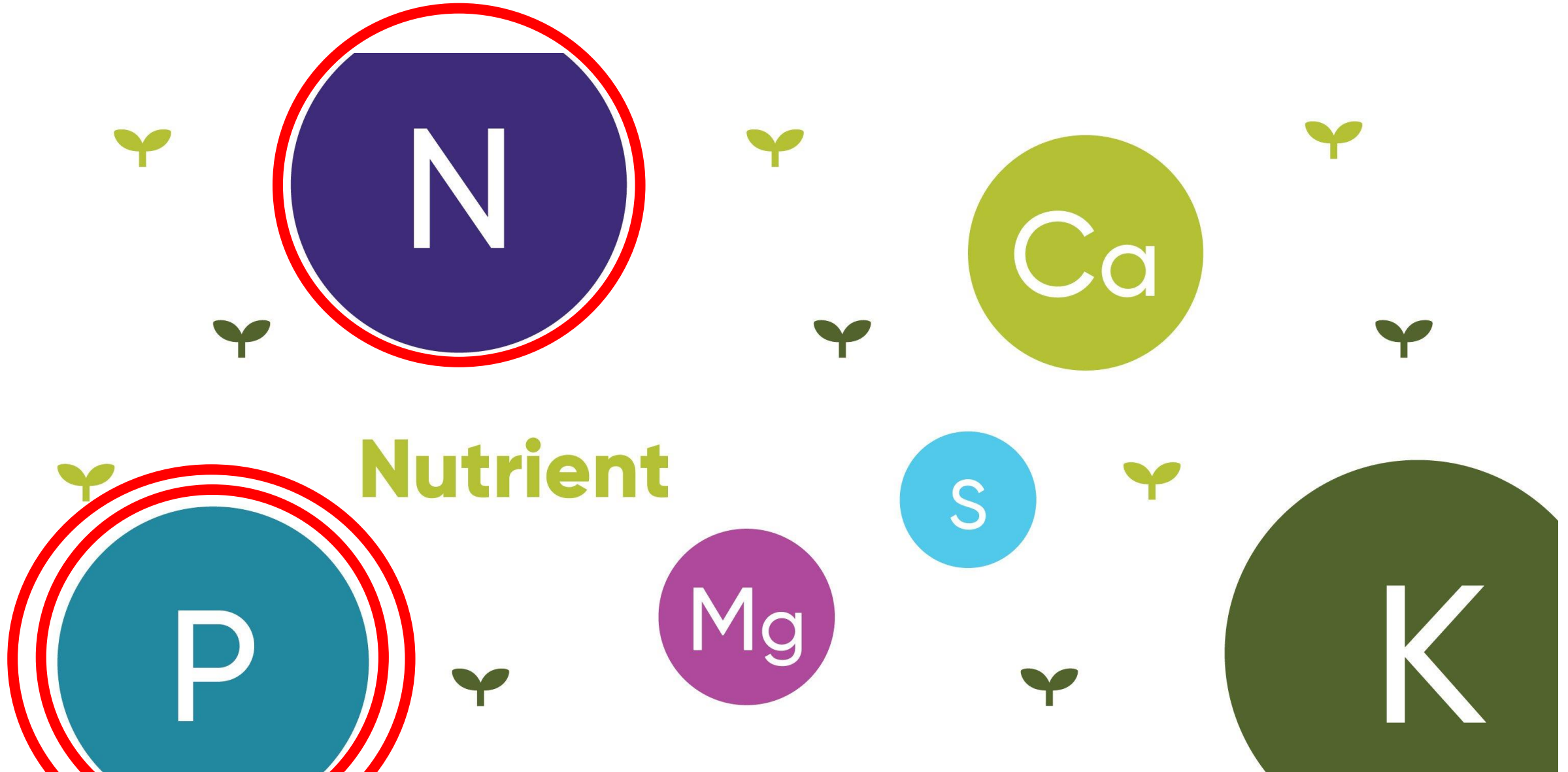


What's going on?

- Frequent Algal blooms (cyanobacteria) which pose a serious health risk
- Dense aquatic plant growth (Eurasian milfoil)
- Decline in recreational fishing success and satisfaction (anecdotal) and low numbers of fish below 12 m
- Low diversity/abundance of benthic community
- Low diversity phytoplankton (Blue-green Algae)
- Low diversity/abundance in zooplankton



What is the underlying issue?



Development History

- Significant forest removal in the 1800s
- Three Dams at the Beaver Lake outlet raised the lake level 5 m in 1874 (Victoria drinking water)
 - Lake volume increased from 7.87 to 18.82 million m³
 - Lake surface area increased from 141 to 246 ha
 - Residence time reduced to 7 years
- Intensive urban development (1950s)
- Pat Bay Highway built to service Swartz Bay ferry terminal 1960

Hamsterley Lakeside

On BEAUTIFUL ELK LAKE

The FRESHWATER PLAYGROUND

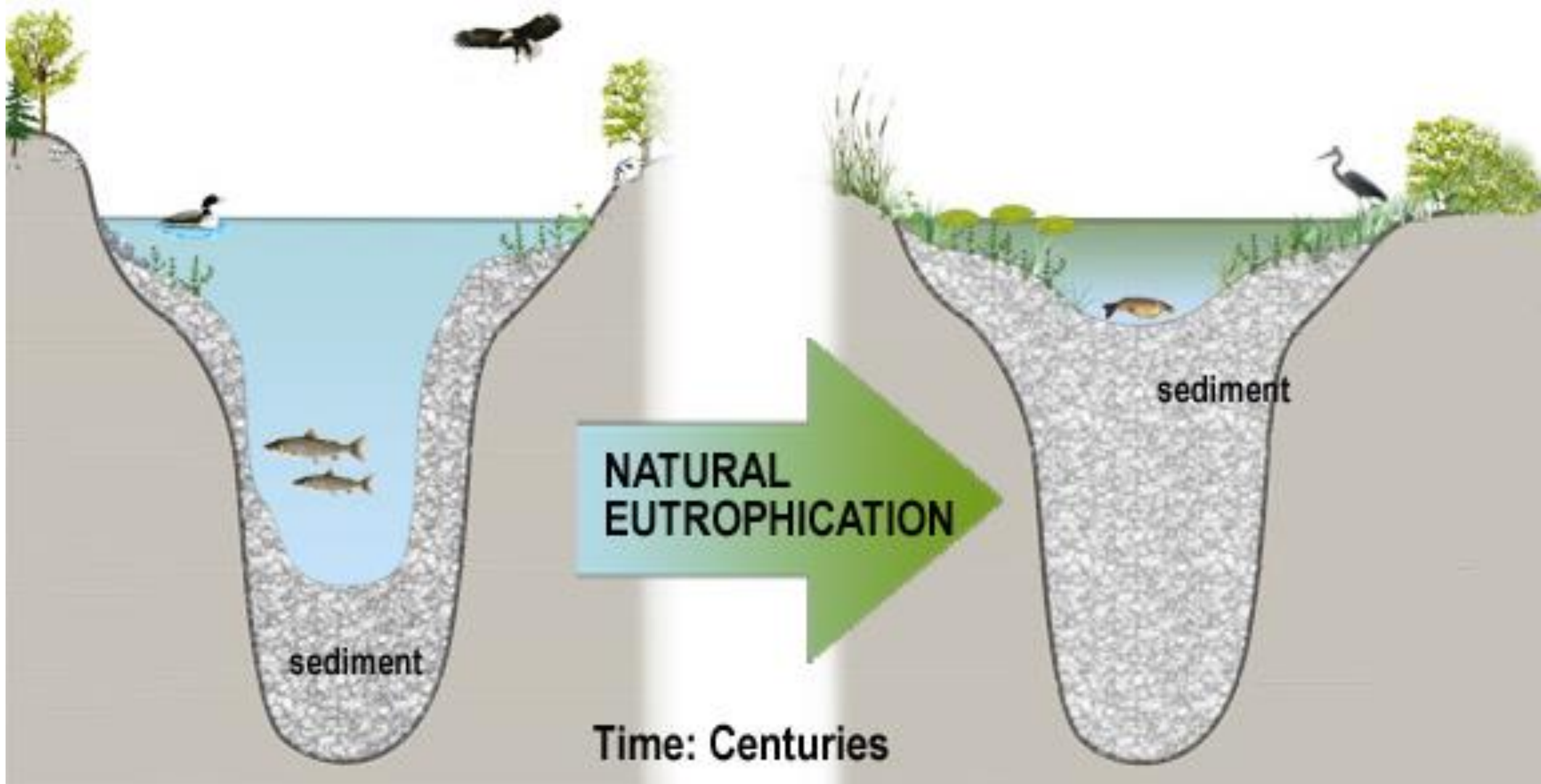
OF

VICTORIA, B.C.

CANADA

"Where I wish that I was when I'm not!"

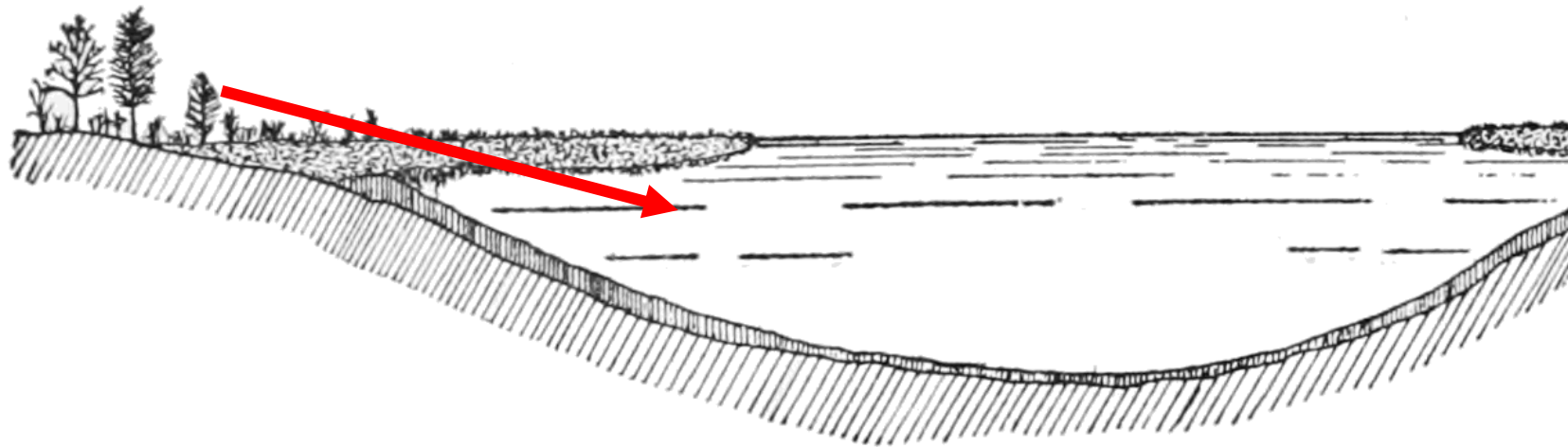






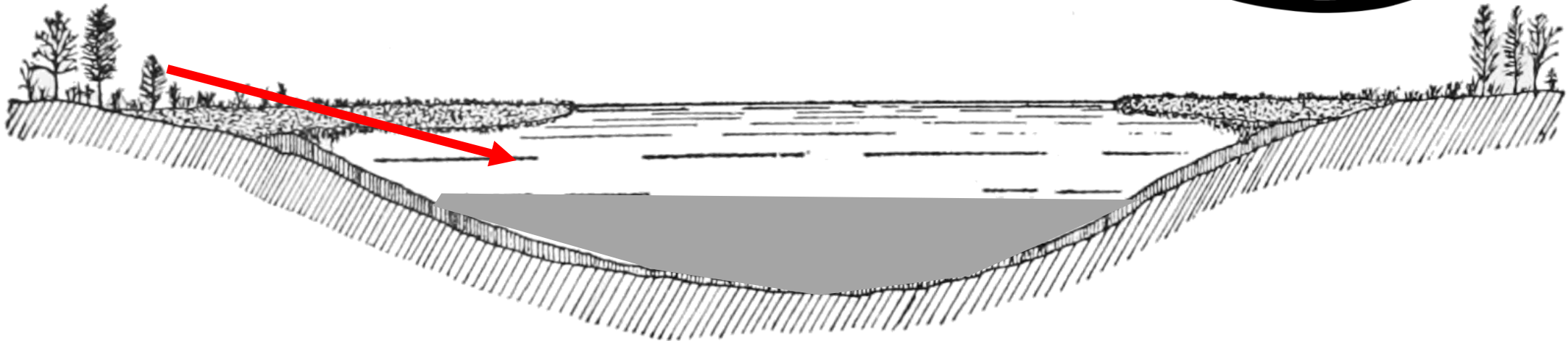
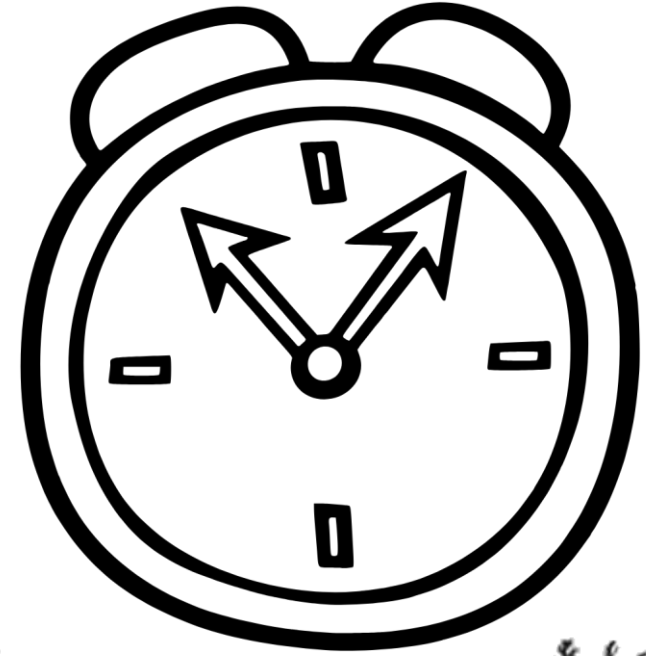
Eutrophication

External Nutrient Loading



Eutrophication

External Nutrient Loading



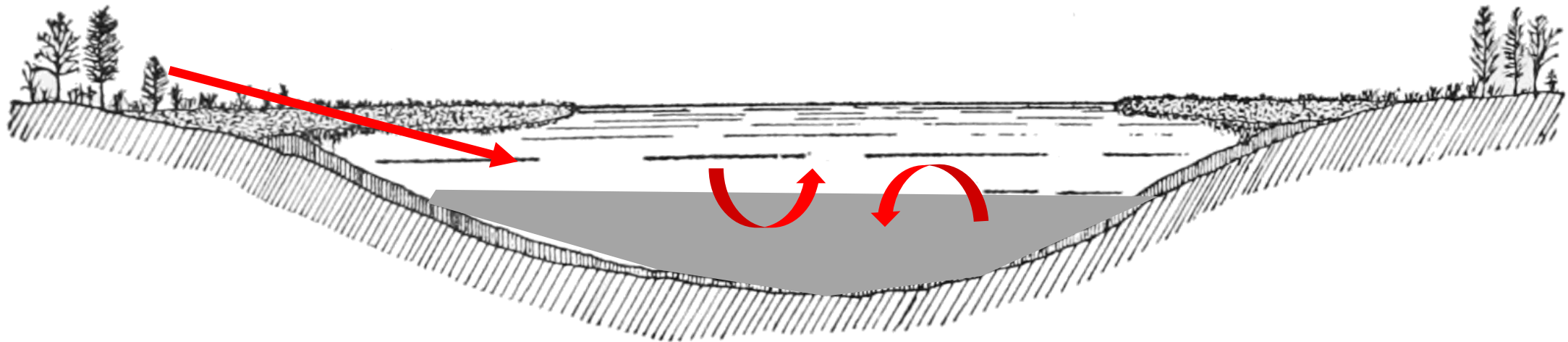
Eutrophication

External Nutrient Loading

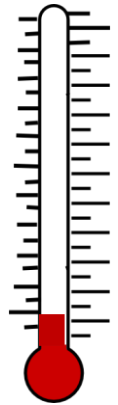
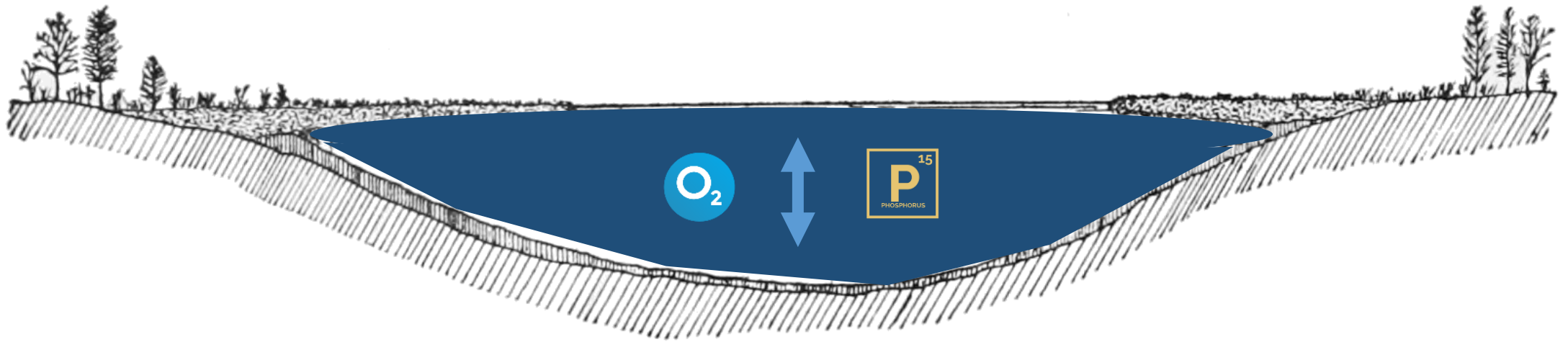
Atmospheric
Agriculture
Septic Tanks
Run-off
Wildlife

Internal Nutrient Loading

Resuspension/release from sediments



Elk Lake: November - February

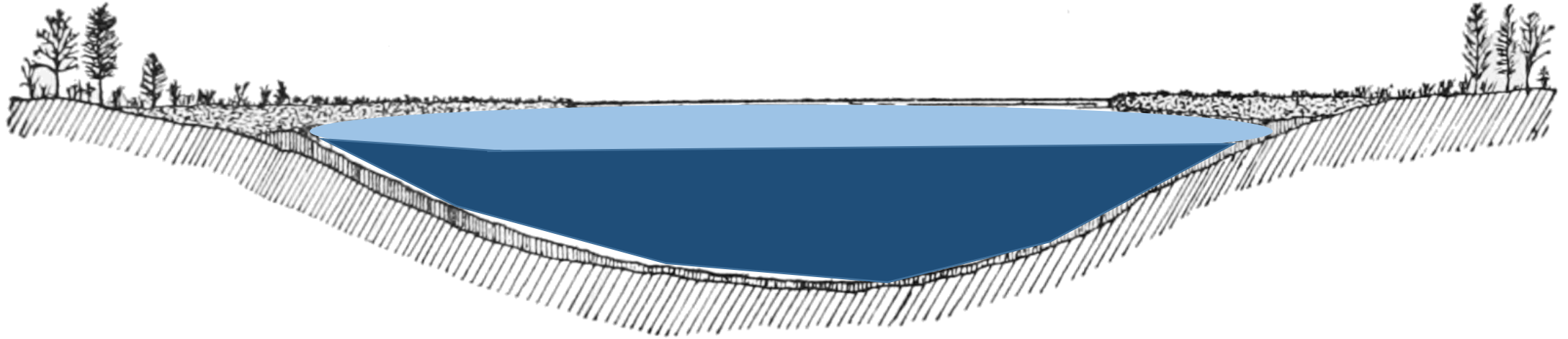


4 degrees

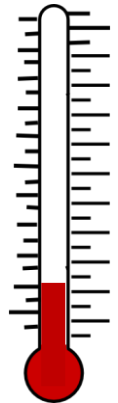
Elk Lake: March (thermally stratifies)



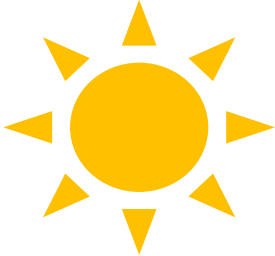
7-8 degrees



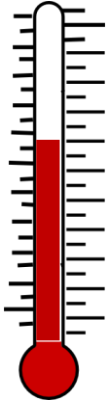
4-5 degrees



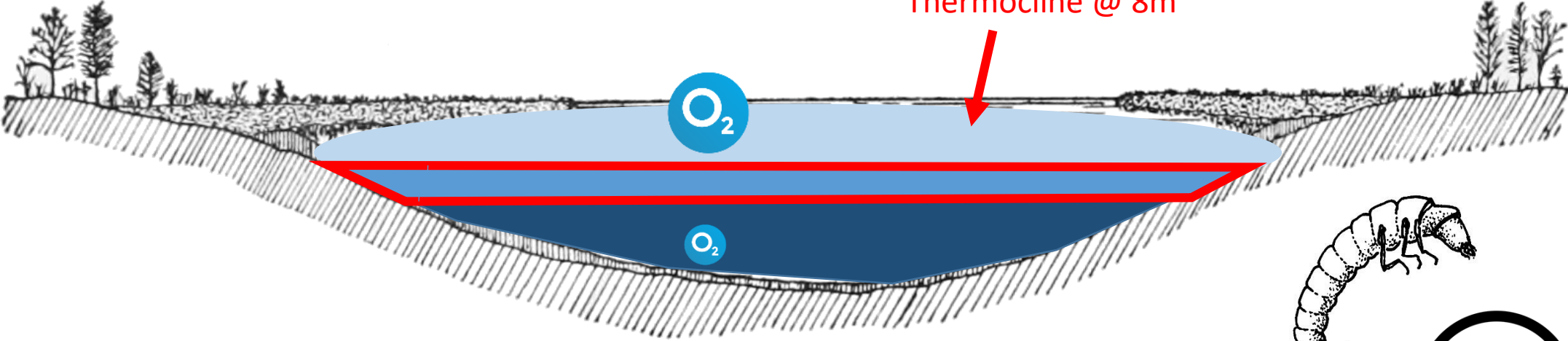
Elk Lake: April-August



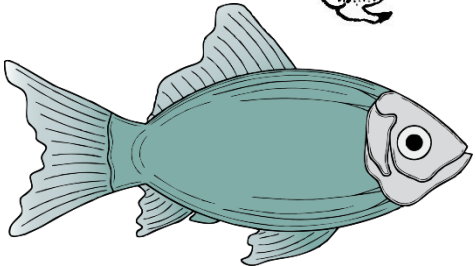
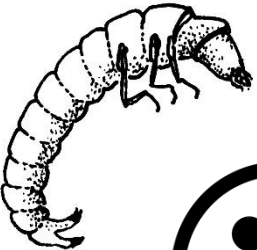
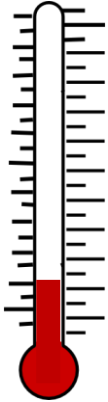
12-20
degrees



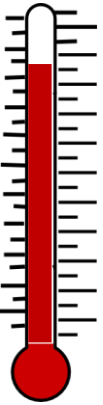
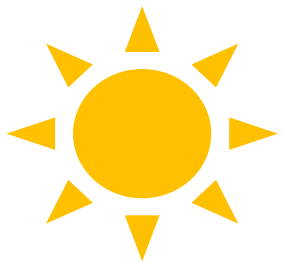
Thermocline @ 8m



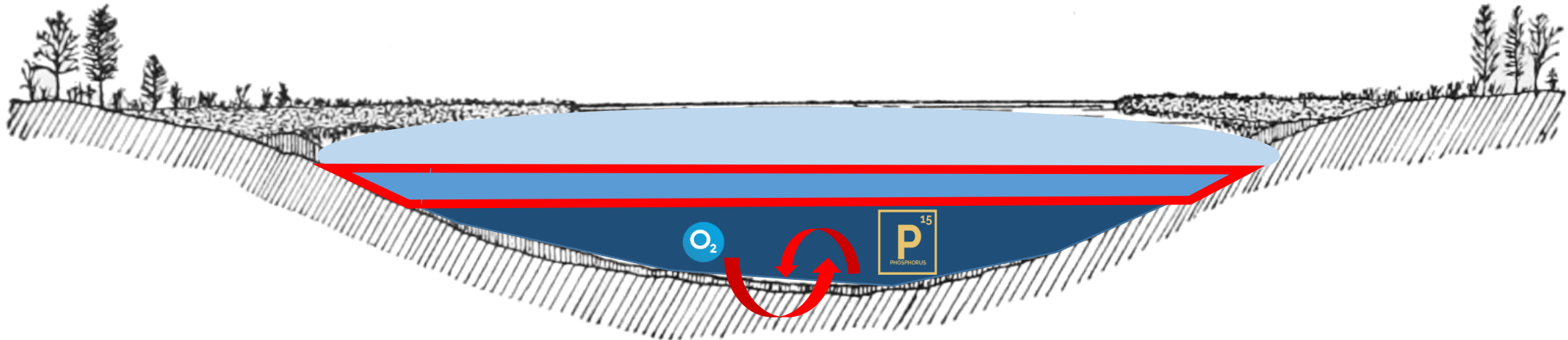
6-7
degrees



Elk Lake: June-August

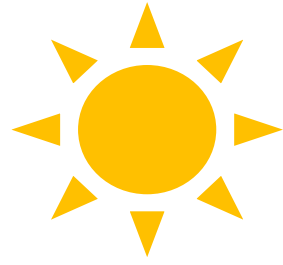


12-20
degrees

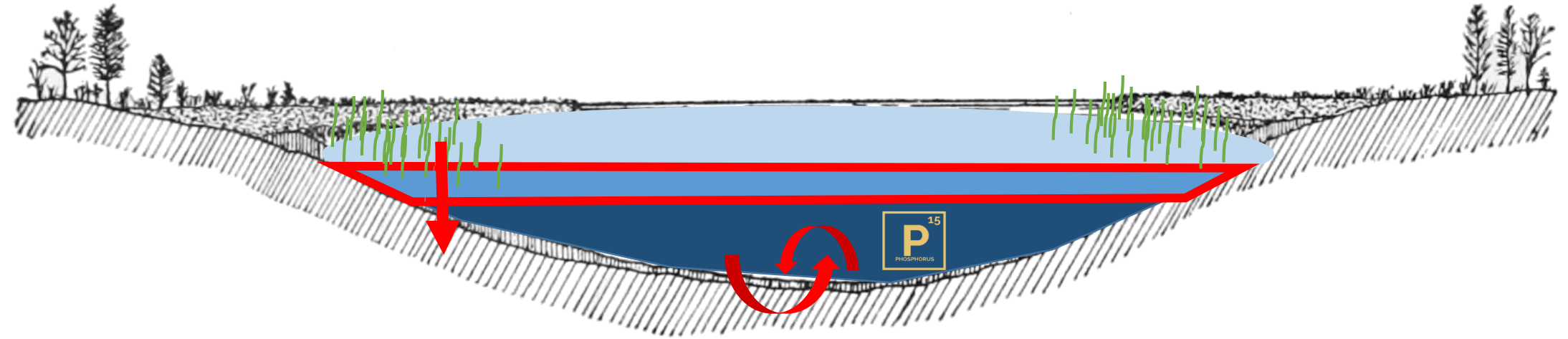


6-7 degrees

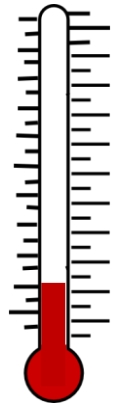
Elk Lake: June-August



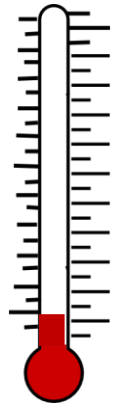
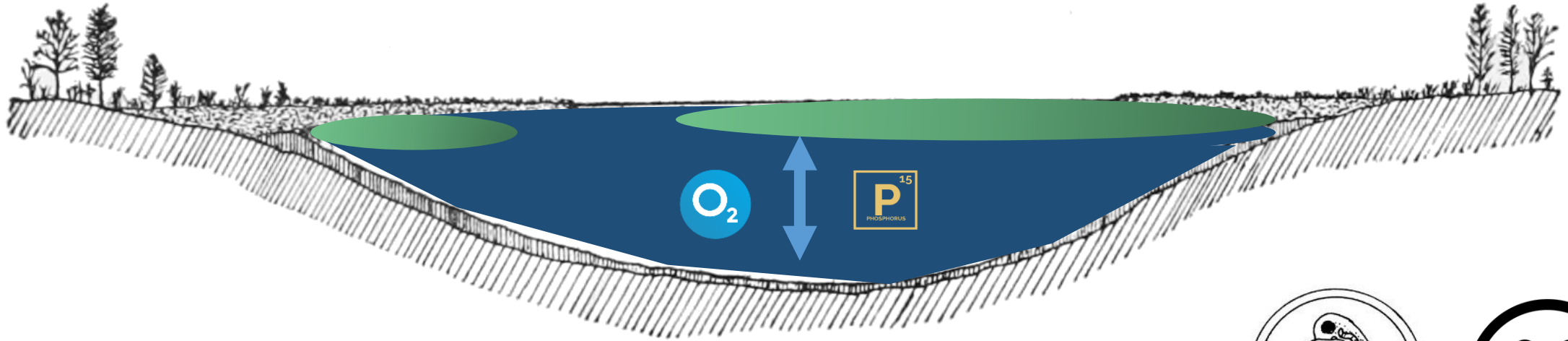
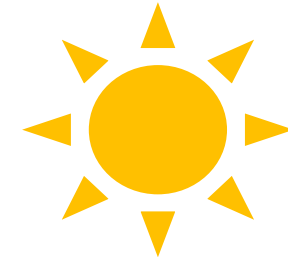
12-20
degrees



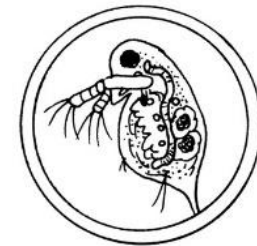
6-7 degrees

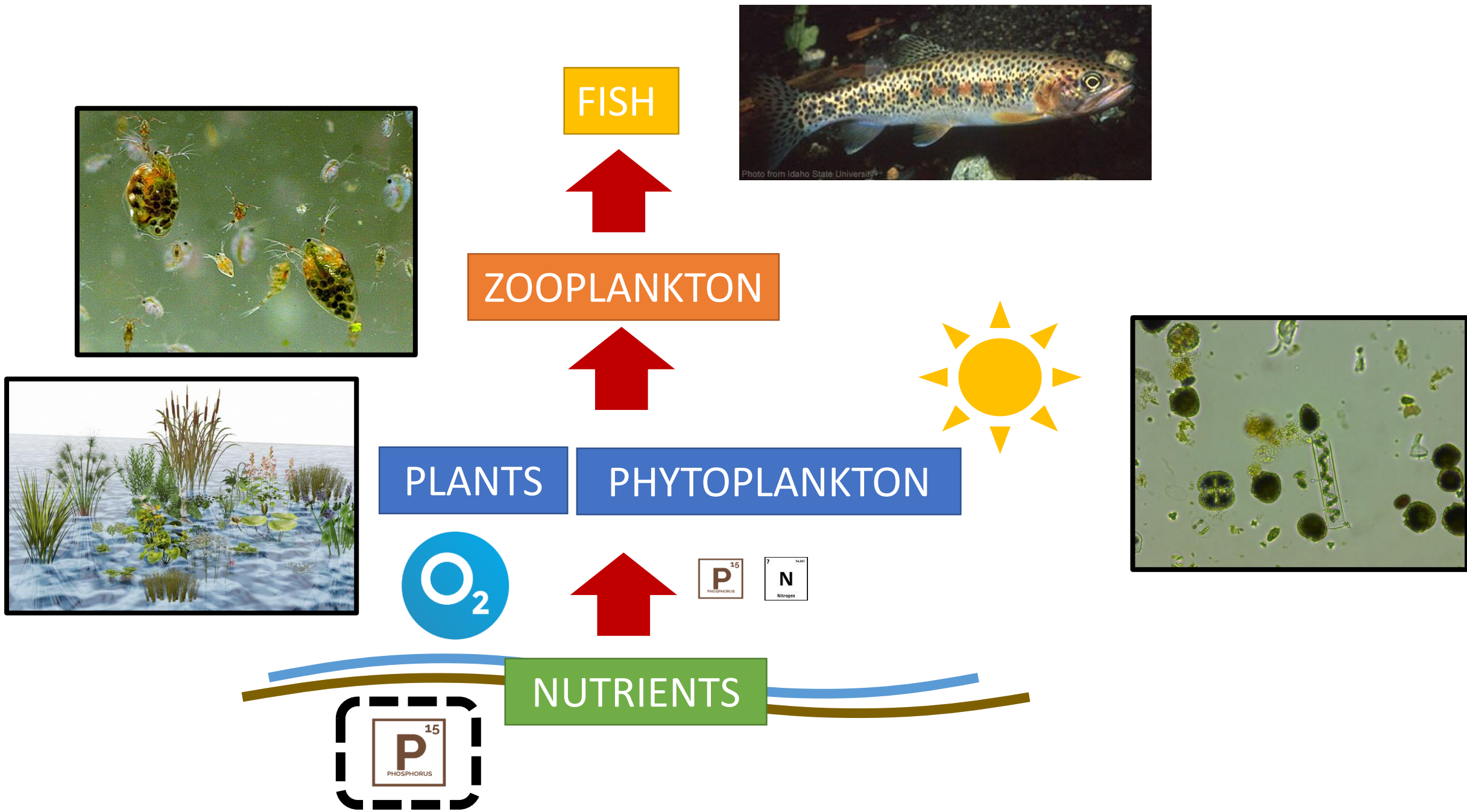


Elk Lake: November - February



4 degrees





FISH



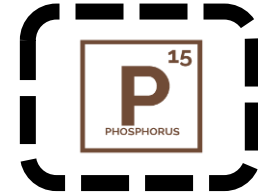
ZOOPLANKTON



PLANTS PHYTOPLANKTON



NUTRIENTS



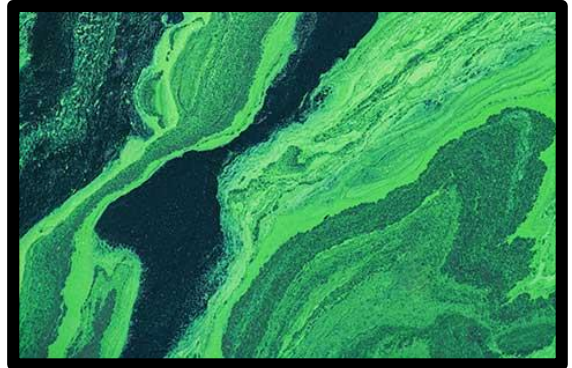


FISH

ZOOPLANKTON

PLANTS

PHYTOPLANKTON



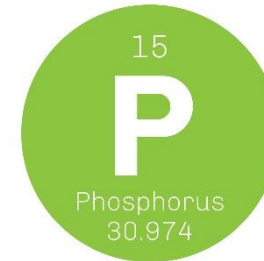
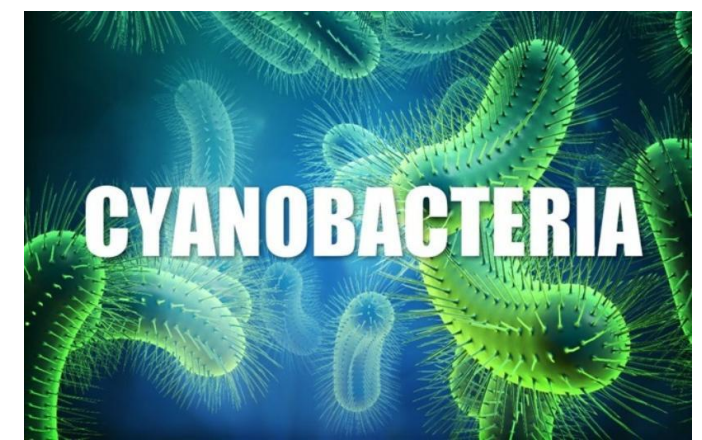
NUTRIENTS



Trophic Status

Eutrophic

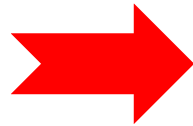
- High nutrient levels
- High freq of blue-green algae blooms
- High primary productivity
- Oxygen deficient in deep water
- Low species diversity



Trophic Status **Shift**

Eutrophic

- High nutrient levels
- High freq of blue-green algae blooms
- High primary productivity
- Oxygen deficient in deep water
- Low species diversity



Mesotrophic

- moderate nutrient levels
- moderate blue-green algae blooms
- Oxygen available in deep water
- High species diversity

How do we “fix” it?

SDA
OBJECTIVE

Public Health Advisory
Blue-Green Algae



The water in this area is classified as green algae, which have caused an outbreak of the blue-green algae. Be sure to avoid the water and avoid contact with the algae.

Protect the water quality

Do not use fertilizers, herbicides, and insecticides near water. Do not use herbicides and insecticides near water. Do not use herbicides and insecticides near water.



Do not walk on the water. Do not walk on the water. Do not walk on the water.

For information, visit www.sdapublichealth.org

CSO

CAUTION!



**BLUE-GREEN
ALGAE
PRESENT**

Intergovernmental Working Group

- Established in 2013 by MOE
- Members: Saanich, MOE, FLNR, VIHA, CRD
- **Objectives**
 - to address water quality issues: blue-green algae blooms, manage weed issues, improve fish habitat
 - Identify data gaps in knowledge
 - Recommend and support remediation actions to improve water quality

Elk/Beaver Lake Initiative (EBLI)

- Established in 2015 by CRD to implement actions
-

Work to date:

- Water sample data collection
- Sediment fractionation analysis
- Fish survey
- Aquatic plant survey
- Literature review of available in-lake remediation options analysis

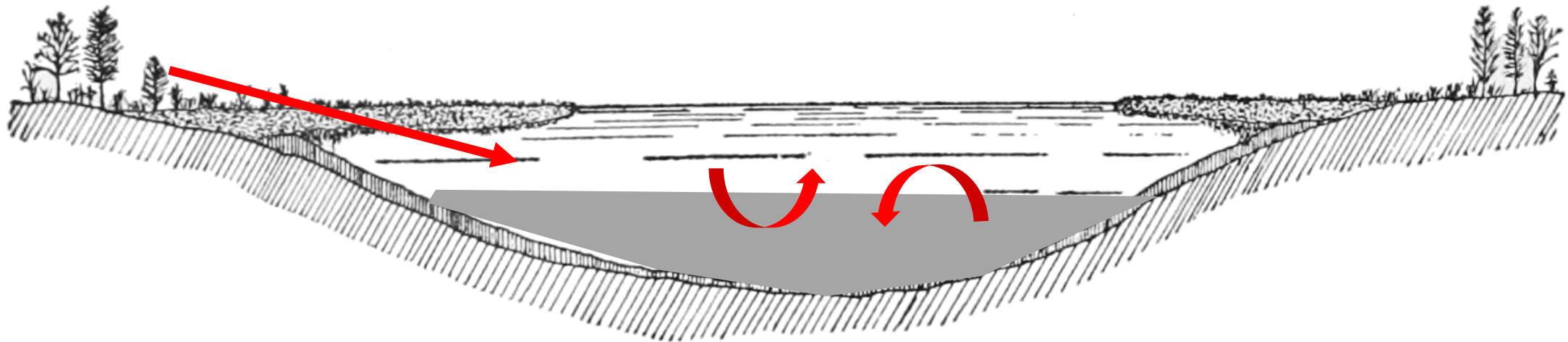
Approach

External Nutrient Loading

Atmospheric
Septic Tanks
Run-off
Birds

Internal Nutrient Loading

Resuspension/release from sediments

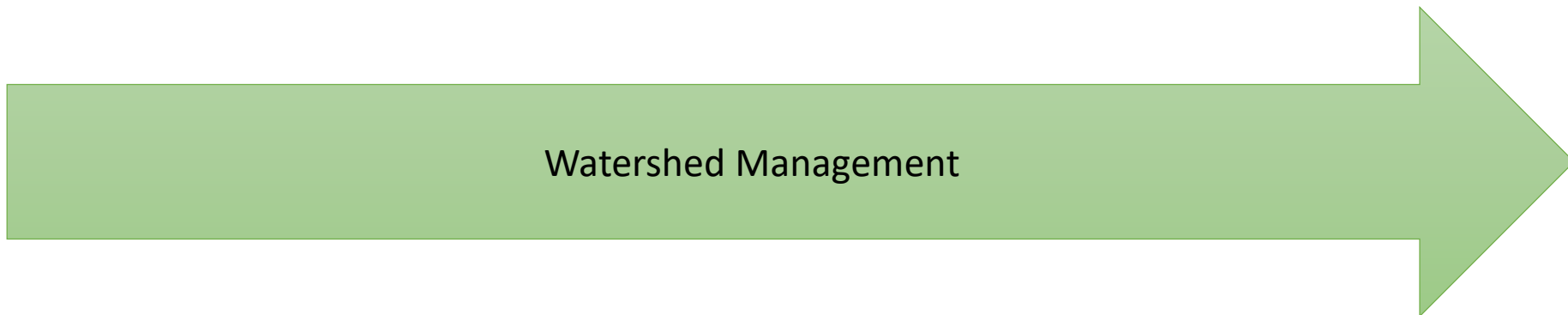


Approach

- Address internal loading issues (85%): in-lake remediation plan



- Address external loading issues (15%): watershed management plan



In-lake Remediation

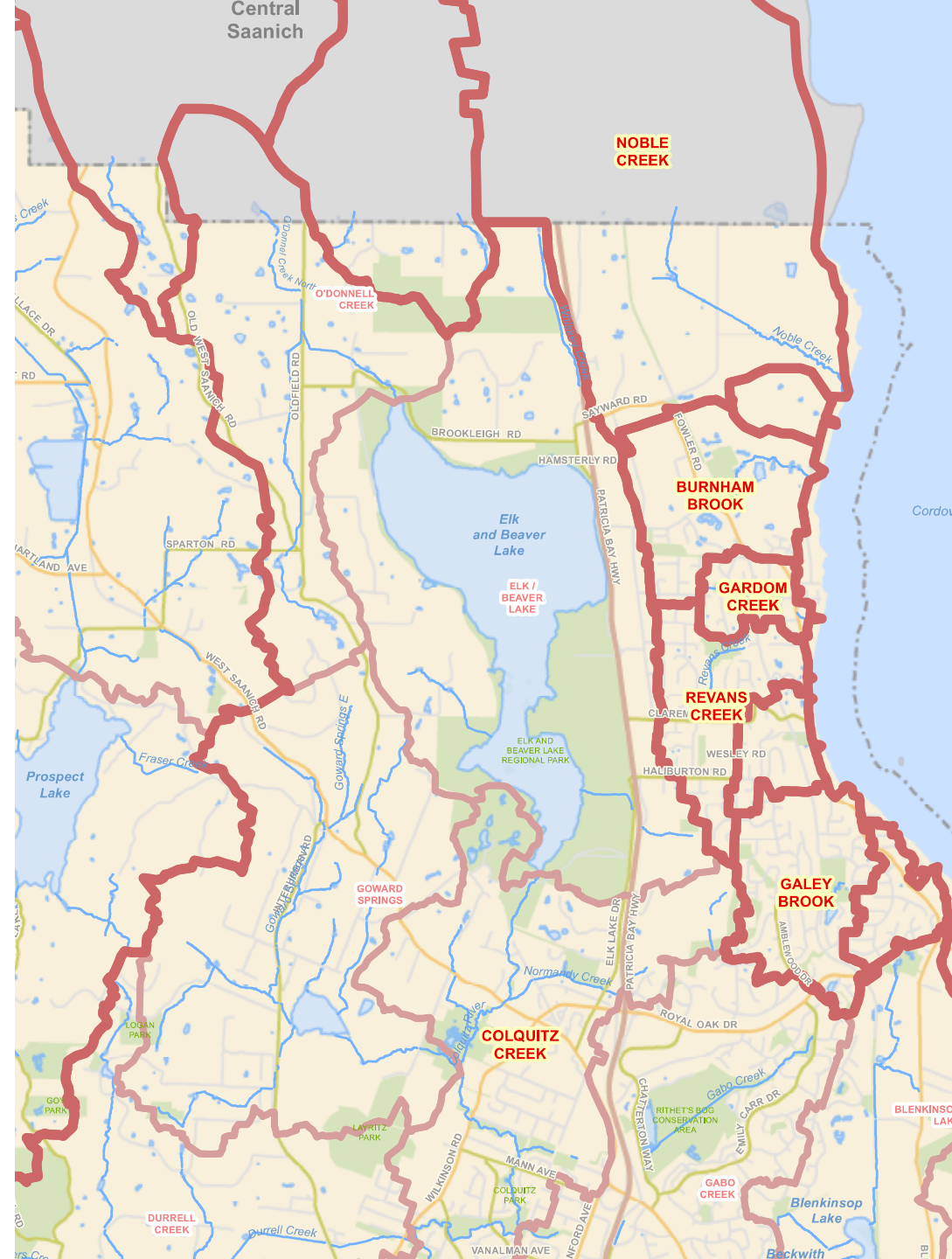
- Review and assess all data collected to date
- Identify data gaps and conduct additional studies
- Review options remediation analysis and develop in-lake remediation plan
- Install in-lake remediation system



Watershed Management Plan

Collaborate with government, First Nations, landowners, stakeholders, and interest groups to **address external nutrient sources**

- Reduce nutrient inputs into the watershed
- Mitigate nutrient impact on watershed



Goals

- Increase awareness of the Elk Beaver Lake Initiative
- Increase understanding of water quality issues and solutions
- Provide opportunities for public engagement to support development of **Watershed Management Plan**
- Increase awareness of skills and best practices to support a healthy watershed





Questions?

