Watershed Management: The Whole Picture…and the St. Mary example

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What is there to manage?

- Opinion Poll: What is our most precious natural resource?
- 96% of respondents agree = freshwater, over both oil and gas, and forests and trees. (federally and provincially)
- Canadians are the world's second largest consumers of freshwater (2nd to the U.S.).
- There is a myth – Canada freshwater is in apparent abundance and no tap runs dry.
- Our public perception needs to change in order to manage our most precious resource more effectively.

What is a watershed?

- An area of land where all of the water under it, and falling as precipitation onto it drains into one single water body (large river, lake or ocean).
- Drainage occurs through overland runoff (ditches, streams, creeks, wetlands, and rivers) and underground flow

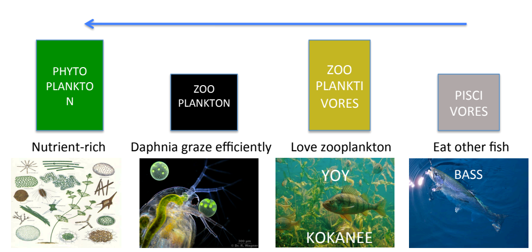
Watershed Management Planning

- Understanding how activities on the landscape influence water quality and quantity
- Respectful upstream/downstream activities
- Whole system approach = "Integrated"
- An IWMP is developed co-operatively by government and watershed residents, environmental interest groups.

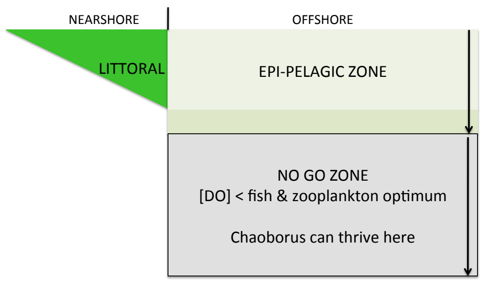
Structure and Function in a Watershed

- Biodiversity and Natural Environment:
  - S- geology and soils (minerals, organic content)
  - S-terrestrial and aquatic and wetland species
  - S-bacteria, algae, mosses, lichens, fungi, plants, animals
  - F-living and non-living component interactions
  - F-flow pattern from high points to lower points
  - F-temperature pattern, rainfall pattern
  - F – soil moisture regime
  - S-year-round creeks and wetlands
  - S-spring freshets
- Built Environment: anthropogenic
  - S-land forms like driveways, berms and swales
  - S-septic or sewer collection
  - S-stormwater collection

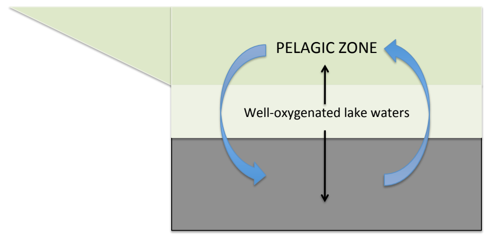
High Phytoplankton Aquatic Food Chain- 4 trophic levels



SML SUMMER



SML WINTER

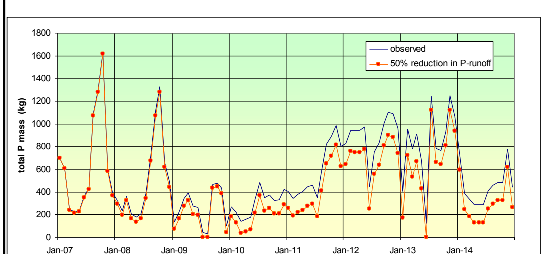


St. Mary Lake Stats

- 182 ha
- Depth – 16.7 m max. but mean 8.8 m (30% littoral zone, 60% pelagic)
- Annual inflow 3.27 million m^3
- Temp: Jan 2015 – end April = approx 2 deg. C higher than any of previous 8 yrs
- Rainfall: generally lower than average Feb-Apr 2015
- Time to replace – 15 years!
- Monomictic (stratified 8 months of yr, mixed 4 mos.)
- Naturally eutrophic Algal blooms common and natural
  - (cyanobacteria, brown and green algae, diatoms)
- Large amt sediment, nutrient release and re-sedimentation depends on several factors

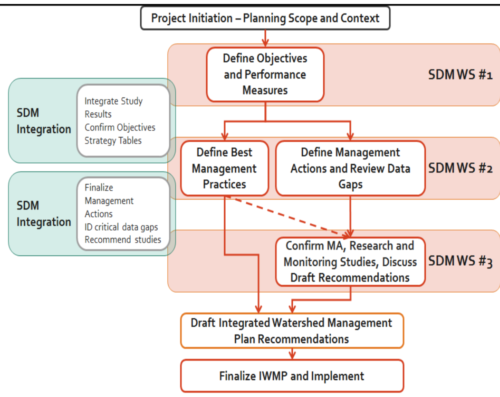
Phosphorus Budget at St Mary

- Septic
  - **nil** (2014-2015 data)
- Atmospheric deposition (in rain)
  - **20Kg/yr** (lit. estimate)
- Internal Loading from Sediment
  - **100kg – 200kg /yr** (2015 Squires and Sprague, respectively)
- Stormwater/runoff
  - **90 – 175 kg/yr**



Structured Decision-Making

- Funding Real Estate Foundation BC, Philip and Muriel Berman Foundation
- Sept 2014 – Sept 2015
- Alongside monitoring program funded by CRD gas tax funds:
  - Septic wells on three properties next to lake
  - Several depths and sampling sites in-lake, quality parameters DO, TP, Turbidity, pH (need chl, Fe)
  - plankton abundance and id, phyto- and zoo-
  - Some creek monitoring



SDM Process

- Collaborative, co-operative, step-wise, iterative
- **Criteria for assessment of actions:**
- **Effectiveness** – under most conditions the management action is likely to help reduce the amount of Phosphorus available in the lake water or sediments.
- **Technical viability** – under most conditions the management action is technically sound, feasible, and manageable on an ongoing basis (if need be) and/or has proven successful in other jurisdictions.
- **Governance** – the management action is applicable under existing laws and policies or could be implemented under new bylaws or amendments to bylaws.

Draft IWMP Actions

- Preliminary screening removed potential physical works or chemical treatments

1. **BMPs and educational programs for stewardship**
   - Ecological inventory of the lake (SHIM, CABIN)
   - Workshops (limnology, riparian, hydrology, etc.)
   - WQ signage, Water Fair, Homeowner packages (septic and products)
   - Youth stewardship (elementary, secondary?)
   - Grant-writing assistance for non-governmental groups to take the lead
2. **Agricultural runoff education**: (partner SSIAA)
   - Group EFP, island-wide not just SML
   - Keyline
   - Toolkits (Cowichan farm water pilot)
     - Increase resiliency against increasingly variable and extreme weather
     - Minimize nutrient runoff and leaching, maximize gw recharge
3. Development Permit Area regulations – just to link to Riparian Area Regulations passed by Local Trust Committee in May 2015.
4. **Stormwater Monitoring** (phase 1, possibly phase 2 design of settling ponds or other earthworks)
5. **Future Studies** – stormwater, septic nutrient verification study, water quality at turnover, Sediment Pore Water Profile Study: quantify iron, phosphorus, manganese, and sulphur chemistry of lake sediment (Not likely, but listed: Aerator engineering, Waterfowl empirical nutrient inputs)

Land-based management

- Can be considered on whole watershed basis, and property level
- Native vegetation – filtering nutrients, solids
- Wetlands
- Maximize water resources on piece of land
  - Keypoint – lower, flatter portion of valley– called a point of inflection; plot a line on contour (same elevation); plough parallel to shift runoff and sink rain in
  - (Yeomans) scale of permanence considers the structures or elements: climate, landscape, water supply, road access, trees, structures, subdivision fences, soil

Design for:
- slow, spread and sink – ditches/swales
- ploughing or cultivation with curves – contour
- subsoil aeration (ripping) –infiltration of water into soil
- gravity-fed irrigation, drought-proofing
- reduce evaporation and runoff
- helps with deeper rooting, less compaction, soil creation

Water Sustainability Act

- Last May 2014, WSA came into a new law
- Much depends on the drafting, funding, implementation and monitoring of upcoming regulations
- Jan 2015, very low rates for gw use; 130K sig. petition
- "Key areas" for gw and environmental "flows" are being determined by BC gov, released next 9 months
- Public input is critical for a strong and fair set of regulations
- Water rates that account for "full cost" of using water is needed
- At this time of drought and restrictions on water use, public engagement is essential

Raising the weir 30 cm

- Provide for current customer base in the water districts
- Impacts on the NE and NW corners, and the S end of the lake where slopes are not steep.
- At risk species: Invasives may colonize where willow seeds or root fragments not available for recruitment in newly flooded zones
  - Annual forbs, grasses, horsetail and sedges
  - ***Overall species diversity declines***

Changes to plant communities

- Lower slopes more susceptible to flood intolerance and species replacements
- NE corner, S end, NW corner
- All riparian species replaced / upslope migrate
- Portions of S end hayfields likely to be converted to swamp/permanent wetland.
- Increases in invasives that adapt to wet soils (Canada thistle Cirsium arvense)
- Reed canary grass replace cattail, bulrush, sedge
- Will not survive: Douglas firs NW, NE, S; Red alders NE
- Some authors state that Alders, Cedars and Willows can send oxygen to the rhizosphere (lenticels), thus reducing the toxics that kill saturated roots
- Traits for flood tolerance: secondary roots, aerenchyma tissues, new roots at dieback portions, adventitious roots (maples, alders, willow)

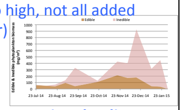
Rejected Actions?

- Biomanipulation
- Dredging the sediment (removal)
- Additions of alum, Fe, phoslock (clay and labdanum compound) or other capping materials

Could biomanipulation lower phytoplankton algal biomass at SML?

SUMMER phytoplankton biomass appears to low - high summer phyto during may occur 1/decade (zooplankton active in summer)
Maybe biomanipulation could lower summer phytoplankton biomass

WINTER both nutrient supply & phytoplankton bio high, not all added phyto is edible (typically zooplankton rest in winter)



Reducing winter phyto bio might require decreasing nutrient loading

Data gaps: gillnet net data 2000's; day & night time, and near & offshore zooplankton sampling; depth-stratified summer phyto sampling

Warning: Desired outcomes of biomanipulation rarely achieved
Unintended consequences just as likely