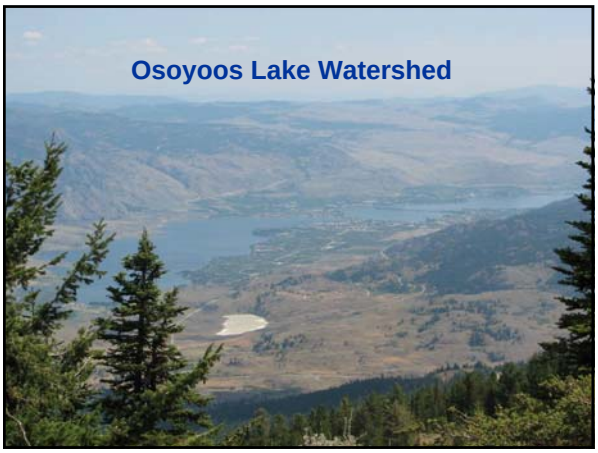
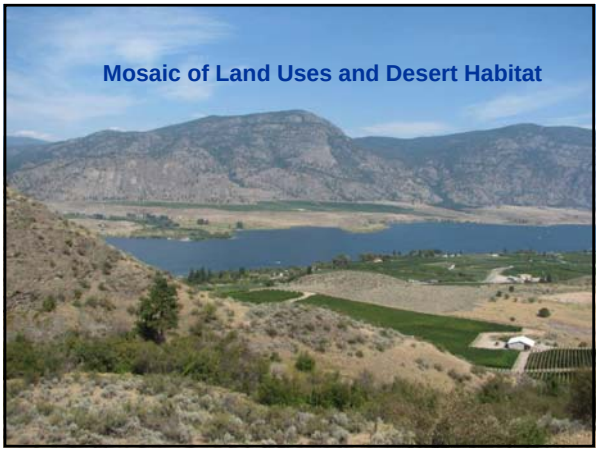
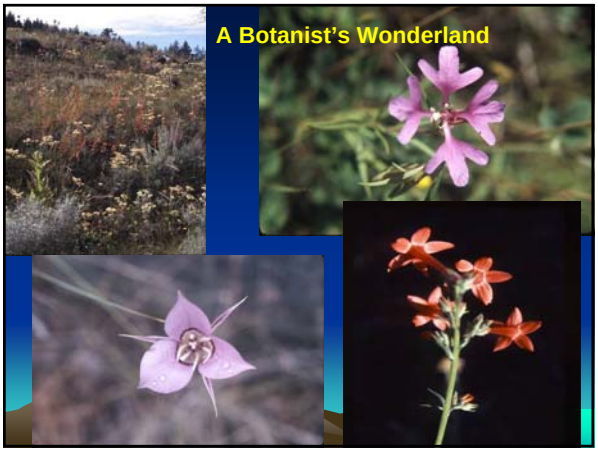






Contents of Presentation

- Eutrophication of a Lake
- Point vs Non Point Sources of Pollution
- Non Point Source Pathways to Osoyoos Lake
- Nutrient From Humans
- Stabilization Lagoons
- Septic Systems
- Urban Stormwater Runoff
- Other Contaminants of Concern
- Climate Change
- Summary

Eutrophication

- Definition: Nutrients and their impacts on the aquatic environment.
- **Excess Nutrients (N & P)** **Nutrient Imbalance (N/P)** → Phytoplankton Growth (Blue-green Algae) → Algae Bloom Collapse → Oxygen Depression (Fish Die-off)

Sources of Water Pollution

- **POINT SOURCES**
- 1. Discrete pipe discharge
- 2. Flow relatively constant
- 3. Examples: sewage treatment plant, industrial discharges
- **NON-POINT SOURCES (NPSP)**
- 1. Originates from disperse sources
- 2. Pollutant transport highly variable
- 3. Unique challenge for control
- 4. Examples: Urban storm water runoff, agricultural runoff

Non-Point Pollution Pathways to Osoyoos Lake

- 1. Municipal Sewers → Stabilization Lagoons → Irrigation → Groundwater → Lake
- 2. Septic Tank → Tile Field → Groundwater → Lake
- 3. Urban Stormwater → Impervious Surfaces → Surface Runoff/Groundwater → Lake
- 4. Agricultural Runoff → Pervious Surface (Soil) → Surface Runoff/ Groundwater → Lake
- 5. Motorboats → Lake

Contaminants from Humans

- Nitrogen: 13 g/day
- Phosphorus: 2 g/day
- Biochemical Oxygen Demand (BOD): 54 g/day
- Population: approx. 7000
- Therefore must manage: 91 kg N/day, 14 kg P/day and 378 kg BOD/day in domestic wastewaters in Canadian Osoyoos watershed + tourist input

Stabilization Lagoons and Golf Course Irrigation

Osoyoos Golf Course

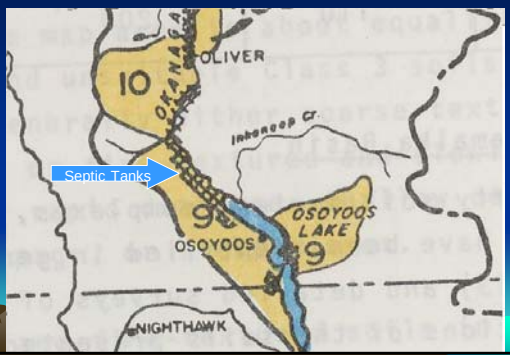
Stabilization Lagoons and Irrigation Treatment

- Sizing is important: Handle loading of 2.8-3.9 g BOD/m^2.d. So for population of 7000, need 126,000 m^2 of lagoon.
- Can usually get 90-95% BOD removal in summer (under ice 50% removal)
- Suspended solids removal down to 50-80 mg/L
- Nutrient removal variable, so land irrigation recommended. However, soils can become saturated.

Stabilization Lagoons and Irrigation

- Learn from the Vernon experience with spray irrigation onto pasture/hay fields of tricking filter effluent for nutrient retention.
- After several years of irrigation, 4 monitoring wells showed 0.1 to 0.4 mgP/L
- New well showed no P for first two years, but increasing from 0.05 to 0.1 mgP/L after that
- Okanagan Lake objective was 0.01mgP/L
- Soils can become saturated with P, highly dependent on soil characterisitics, organic matter content, soil texture.

High Density of Septic Tanks



Septic Tank Contamination

- "Generally, the sand and gravel aquifers in the valley bottom are more susceptible to contamination than the igneous and metamorphic aquifers in the valley uplands. This is mainly controlled by the shallow depth to water in the valley bottom along with high ratings assigned to aquifer media and aquifer conductivity" (B.C. ME, Carmichael, 2006)
- Septic Tank Effluent average values for 32 septic tank discharges:

Total Nitrogen – 32 mgN/L

Total Phosphorus – 7.8 mgP/L

Septic System Location: Distance of septic system to water course important

Maintenance of Septic Systems: Recommended that they be services every 3-5 years. However, a 1993 survey in Osoyoos area, found out of 20 households, 22 % never had their tanks serviced and 10% had no idea of the tile field location.

Urban Stormwater Runoff

Nutrients in Urban Runoff

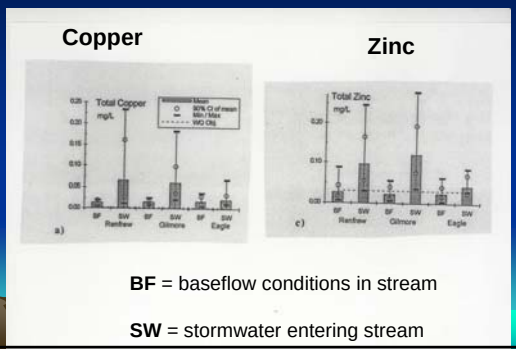
- Very few stormwater studies in Okanagan.
- A single Kelowna study monitored urban stormwater runoff quality.
- Per capita contribution of humans to nutrients in urban stormwater runoff can be calculated.
- Nitrogen 168 gN/yr
- Phosphorus 24 gP/yr

The Human Nutrient Footprint in the Okanagan

Other Contaminants in Stormwater Runoff and Sources

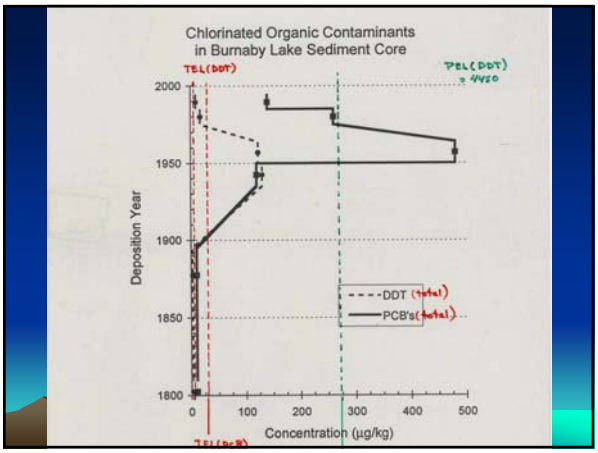
- Trace Metals: Vehicle corrosion and ware
- Oil and Grease: Leakage and spillage
- PAHs (polycyclic aromatic hydrocarbons): Combustion emmissions
- Pesticides: Gardening
- EDCs (endrocrine disrupting compounds): detergents, pesticides.

Trace Metals in Urban Runoff

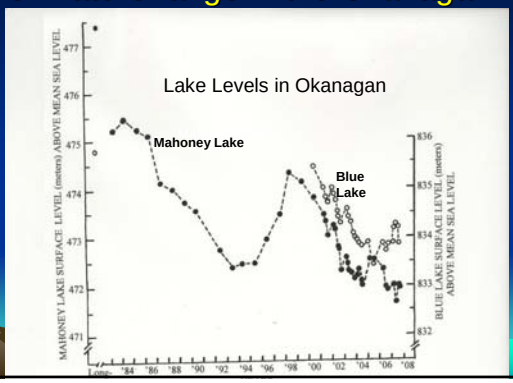


BF = baseflow conditions in stream

SW = stormwater entering stream



Climate Change in the Okanagan



Summary

- Eutrophication is one of main water quality concerns in Osoyoos Lake.
- Nutrients in domestic wastewaters transported through groundwater (irrigation, septic systems) could contribute to impaired water quality in Osoyoos Lake (quantitative data lacking).
- Stormwater is an important source of toxic and persistent contaminants (trace metals, organic pollutants) in the urban environment.
- Climate change with warmer water and more evaporation could add to the problems in managing water quality in Osoyoos Lake