

Okanagan Fish and Water Management Tools (Ok FWMT): A Decision Support System to Balance Water Objectives in Real time.

Aquatic Science Forum, Osoyoos, B. C., Sept. 16, 2007.







Douglas County Public Utility District
 Department of Fisheries and Oceans Canada
 BC Ministry of Water Land and Air Protection
 Okanagan Nation Alliance

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Outline for This Talk

- Identify context, process and objectives for managing water supplies in the OLSRS.
- Comment on "audit" for water management compliance with fisheries requirements under the Okanagan Basin Agreement (OBA).
- Describe creation of Fish-and-Water Management Tools (FWMT) system to support "fish friendly" water management.
- Review experience with FWMT as an efficient information exchange, decision support utility.


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OLSR System Management Begins in the Headwaters of Okanagan Lake



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Okanagan Lake Dam at Penticton is the major control point in the system



Okanagan Lake Dam (Penticton)

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OKANAGAN LAKE HYDROLOGY

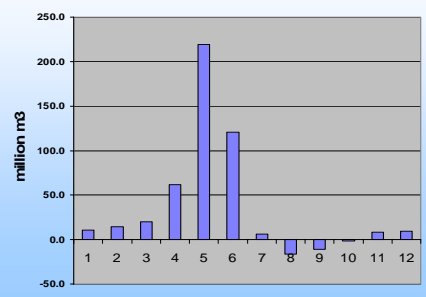


- Annual inflow hydrograph dominated by snowmelt runoff
- Large range of annual inflows:
 - 78 million to 1.4 billion m³
 - 0.23 m to 4.12 m stage change

Mission Creek
June 1, 1997

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Mean Monthly Inflows to Okanagan L. (85 % of inflow from Apr-Jun)



Month	Mean Monthly Inflow (million m³)
1	~10
2	~15
3	~25
4	~60
5	~220
6	~120
7	~10
8	~-10
9	~-10
10	~0
11	~10
12	~10

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How are Release Patterns Determined?

Okanagan Basin Agreement

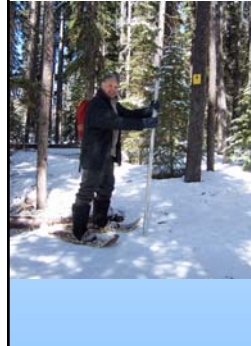
“The Comprehensive Framework Plan” provides general rules for operating the OLRs.



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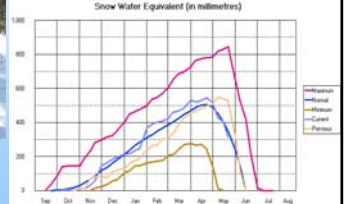
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Inflow Forecasts and Discharge Observations Drive Management Decisions



Inflow forecasts are based on seasonal precipitation, snow packs & tributary inflow data.

2003-04 Mission Ck. Snow Pillow @2F05P



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OLRS OPERATIONS

- OBA rules specify seasonal lake levels and flows.
- Operating plans/decisions reflect inflow forecasts.
- Decisions address competing objectives to satisfy: flood control, fisheries values, water storage/extraction, navigation, tourism, international agreements, etc.

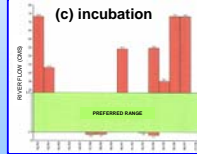
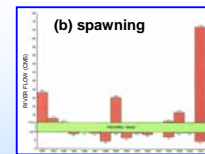
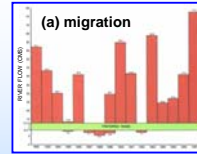
OPERATOR CHALLENGES

- Forecast uncertainty re: freshet inflow volumes and capacity to match lake spill or storage to spring inflows (“bathtub” analogy).
- Effects of environmental variability (water levels, flow, temp.) on risk assessments given competing economic, social & environmental demands of multiple “parties” & authorities.
- **OLRS decisions re: water storage or release based on rules of thumb, past experience & incomplete information.**

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Compliance with OBA Fishery Flows was low prior to 1997.



Legend:
█ OBA preferred flow range
█ Observed flow range

From 1982-1997 river discharge exceeded OBA fishery flows in:
 (a) 13 of 16 yrs for adult migration
 (b) 7 of 16 yrs for spawning and
 (c) 7 of 16 yrs for egg incubation & fry migration

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Competing “Rules”& Objectives Reduce Compliance



Rule 1: Don't fill Okanagan Lake above 342.56 meters (i.e. 10 cm rise above 342.56 incurs \$5-\$10 million in “property” losses.)

Rule 2: Try to avoid drafting to lake levels below 341.50 meters. (i.e. problems with docks, water intakes & vessel navigation become severe).

Rule 3: Minimize draw-down of Okanagan L. between the time of kokanee spawning and 100% fry emergence (i.e. minimize dewatering kokanee eggs & fry but don't risk violation of “rules” 1 or 6,7,8, & 9)

Rule 4: Minimize the number of buildings flooded at Penticton

Rule 5: Provide summer flows for recreation if possible

Rule 6: Sox. Migration – maintain flows (@ Oliver) between 8.5 & 12.7 cms during Aug 1 to Sept 15 to allow “easy” passage of VDS.

Rule 7: Sox. Spawning – maintain flows between 9.9- 15.6 cms during Sept 16- Oct 31 to maximize “good” spawning habitat.

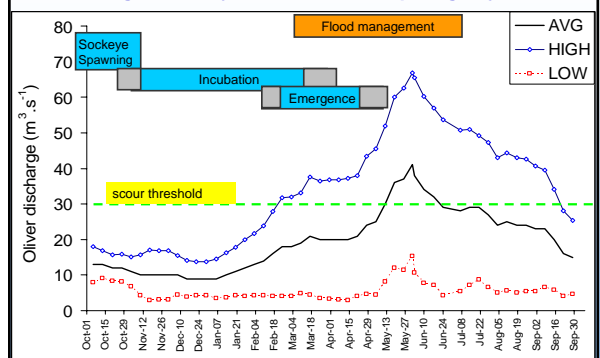
Rule 8: Sox Incubation- flows at 5.0- 28.3 cms during Nov 1- Feb 15 i.e. egg incubation flows greater than or equal to 50 % of spawning flows & must not exceed 28.3 cms to avoid redd desiccation & scouring.

Rule 9: Sox. Fry emergence-migration- flows during Feb16- Apr 30 at 5.0- 28.3 cms.

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Event timing & natural variations determine whether fish-and-water managers satisfy OBA rules & competing objectives



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FWMT-System & Software developed between 1998-2007 to clarify issues & objectives & to "do the math" !

- 1998-2000: assemble and review Okanagan water management issues, objectives and rules (issues, conflicts, management rules, community concerns e.g. agriculture-fisheries-urban water demand and supply tradeoffs).
- 2001: Develop conceptual model, identify funding sources and write proposal: (involved Government, Industry, NGOs working through COBTWG; DCPUD chose to fund the work).
- 2002: Develop/design sub-models: Assemble study team comprised of water supply-hydrology experts and managers; water licensees; fish and habitat managers. Address issues raised by government, (including First Nations), industry and NGOs.
- 2002-2004: Build and link sub-models into decision support system: Convert conceptual sub-models into "software" by completing computer-code, graphical user interface, internal reporting functions etc.
- 2005-2006: Train line mgrs for initial deployment, testing and refinement of FWMT: Resource managers & technical experts.
- 2007: Complete 2nd version of FWMT-software user guide and launch routine operational use of FWMT-Okanagan. Technical experts and resource managers.
- >2007: Use FWMT-DSS but also monitor and evaluate outcomes. Resource managers with periodic input by technical experts.

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Structure & Science Foundations of the FWMT Decision Support System

(A) Geographic Scope: Okanagan Lake → Okanagan River at Penticton → Okanagan River at Oliver → Osoyoos Lake

(B) FWMT Components:

- 1 Climate - Hydrology Sub-model (Summit Env. Ltd.)
- 2 Okanagan Water Mgt. "Rules" (Symonds et al.)
- 3 Climate and Water Temp. Sub-model (Hyatt et al.)
- 4 Kokanee egg to fry emergence sub-model (Andrusak et al.)
- 5 Sockeye sub-model (Hyatt et al.)
- 6 Model coupling, coding, debugging & database issues (ESSA Technologies)

(C) Temporal Scope: START: Sept., Year n → END: Nov. 30, Year n + 1

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Dispersed delivery of FWMT

Client Layer: End Users (1 Web Browser, 2 Microsoft Excel) → Client Computers

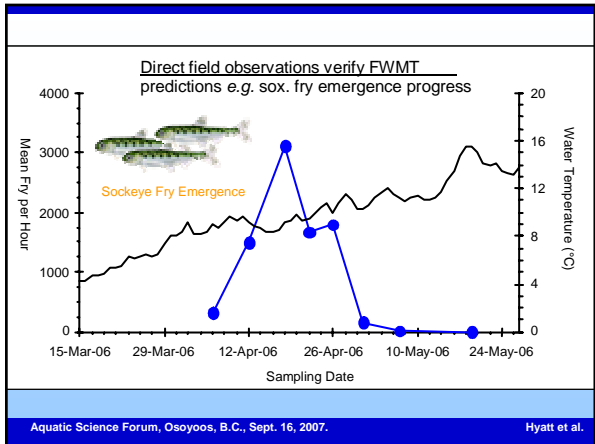
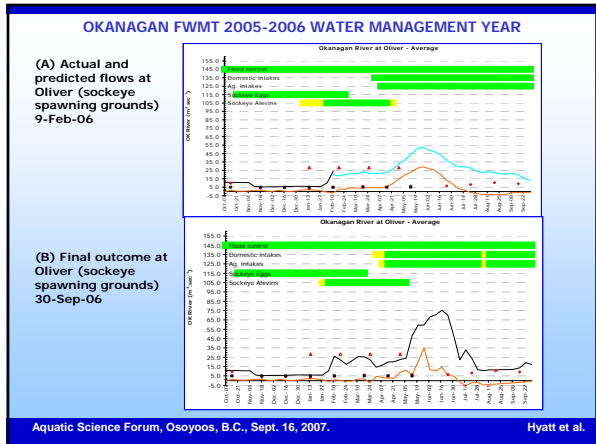
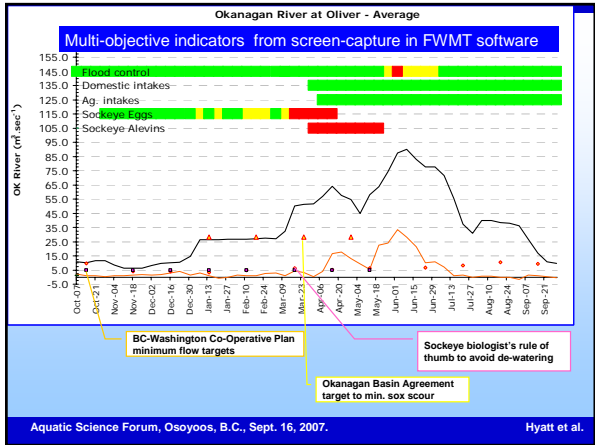
Deployment Layer: Internet

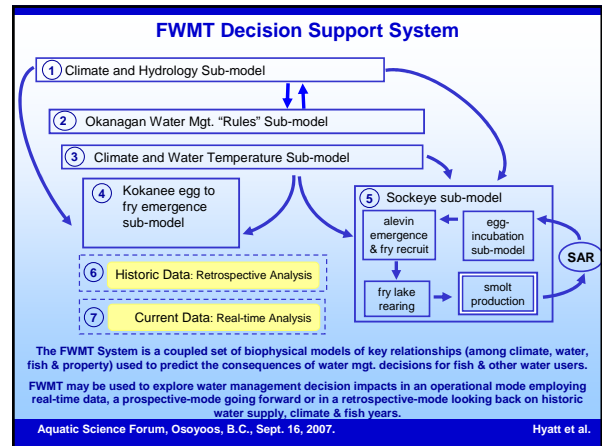
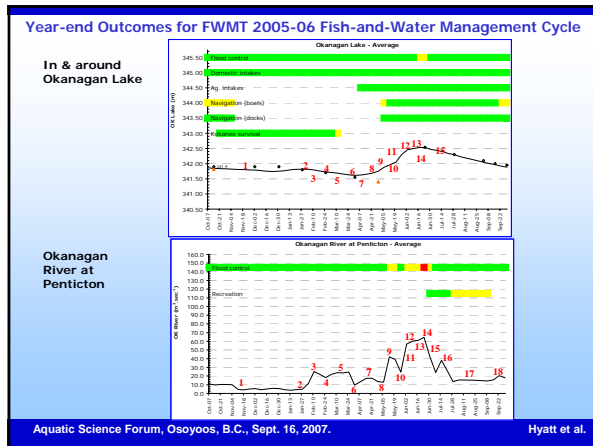
Application Layer: Server Computer (4 User Interface: .NET Web Forms, 5 Model: Visual Basic .NET)

Data Layer: OKFWM SQL Server Database (6)

Data "Feeds": Database Administrator / Automation (7) → Real-time / historical data (Lake elevation; temp. River flow; temp. Parameters/Lookup data)

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OK-FWMT Decision Support System

Management Philosophy Embedded in Ok-FWMT

- balances consideration of multiple objectives (*i.e.* social, economic, cultural, ecological)
- recognizes inflow forecast uncertainties,
- uses "rich" information sources refreshed in real-time (*i.e.* annual to daily data imports),
- facilitates input by limited pool of regional experts,
- accelerates training & access to diagnostics,
- provides common, "transparent" framework for "team" collaboration, synthesis & decisions,
- allows managers to "measure twice" & "cut once",
- provides record of annual strategy & outcomes to assess performance against multiple objectives.

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Questions ?

Fisheries and Oceans Canada / Pêches et Océans Canada

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