Canadian Water Resources Association
British Columbia Branch

Okanagan Basin Water Board

One Watershed – One Water

October 21 to 23, 2008
Kelowna, BC

Full conference proceedings on CD
See inside back cover

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ISBN 978-1-896513-37-9

Acknowledgements

The One Watershed – One Water conference has been organized through the collective efforts of many individuals. The B.C. Branch of the Canadian Water Resources Association and the Okanagan Basin Water Board gratefully acknowledge the contributions of the following people and the support of their employers:

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The Canadian Water Resources Association and the Okanagan Basin Water Board gratefully acknowledges the following organizations that have generously sponsored the One Watershed – One Water conference.

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Welcome from Conference Chairs

On behalf of the Okanagan Basin Water Board (OBWB) and the B.C. Branch of the Canadian Water Resources Association (CWRA), we welcome you to the One Watershed – One Water conference.

Both hosting organizations have a keen interest in sustainable water management in the Okanagan Basin in British Columbia. The OBWB is focused on sustainable water management throughout the Okanagan Basin. The CWRA is a national organization dedicated to wise water management in every region of the country, and has representation on the Okanagan Water Stewardship Council of the OBWB.

The highly successful CWRA conference in February 2005 in Kelowna made several action-oriented recommendations for improving water management in the Okanagan Basin. Since then, considerable local, provincial, and national attention has been focused on the Basin. A few recent successes are highlighted here:

- Creation of the Okanagan Water Stewardship Council – providing scientific and policy advice to the OBWB. A long-term vision and plan for sustainable water management in the Basin has been developed by the OWSC, which will be presented at the conference;
- Completion of an Irrigation Demand Model covering all irrigated lands in the Basin. The model will allow prediction of the effects of future changes in climate on irrigation water use;
- Strong leadership on critical local water issues, such as groundwater management and source water protection, has been provided by the OBWB; and,
- The Province and the OBWB, along with many partners, have initiated Phase 2 of a comprehensive Okanagan Basin water supply and demand project (several papers on this work will be presented at the conference).

The 2008 One Watershed – One Water conference will showcase local water-related initiatives and relevant experiences in similar settings, explore current knowledge and models, focus on emerging science, and consider future management and governance challenges and solutions. We hope that it will help to strengthen our individual and collective commitment to achieving the vision of a sustainable Okanagan region.

Brian Guy
Canadian Water Resources Association

Nelson Jatel
Okanagan Basin Water Board

October 2008

Welcome from President of Canadian Water Resources Association – B.C. Branch and Chair of Okanagan Basin Water Board

On behalf of the Okanagan Basin Water Board and Canadian Water Resources Association – B.C. Branch, we would like to welcome presenters and delegates to the 2008 One Watershed – One Water conference. This conference marks an historic partnership between our organizations and an historic turning point in the management of water resources – in the Okanagan and beyond.

The last CWRA-BC conference in Kelowna, "Water – Our Limiting Resource – Towards Sustainable Water Management in the Okanagan" (2005) concluded with a call to action – to the community and to the Premier – for changing the course of water management in the Okanagan Basin. Presenters and delegates highlighted the need to prepare for global climate change and population growth, the need to undertake science-based assessments of water supplies, and the need to reinstate a system of monitoring networks for stream flow, water quality, and weather stations. Since that time an impressive amount of research and planning designed to answer these needs has been initiated.

The One Watershed – One Water conference reports back on the successes of the past three years and highlights next steps and a new call to action for water in the Okanagan.

Welcome to the Okanagan watershed.

John Slater
Chair, Okanagan Basin Water Board

Peter Morgan,
President, B.C. Branch of the
Canadian Water Resources Association

About the Canadian Water Resources Association

The Canadian Water Resources Association (CWRA) is a national organization of individuals and organizations from the public, private and academic sectors that are committed to raising awareness of the value of water and to promoting responsible and effective water resource management in Canada. CWRA membership consists of water users and water resource professionals including managers, administrators, scientists, academics, students and young professionals.

CWRA has branch organizations in most provinces and members throughout Canada and beyond. CWRA activities include hosting conferences, symposiums and workshops dealing with a wide range of water issues, quarterly publication of the Canadian Water Resources Journal and the newsletter, Water News, as well as publishing papers and reports.

For more information about CWRA membership, please contact:

CWRA Membership Office
280 Albert Street, Suite 900
Ottawa, ON K1P 5G8
Phone: (613) 237-9363
Fax: (613) 594-5190
Email: services@AIC.ca

Additional information about CWRA is available at: http://cwra.org/default.aspx.

About the Okanagan Basin Water Board

The purpose of the Okanagan Basin Water Board (OBWB), established in 1969, is to provide leadership to protect and enhance quality of life in the Okanagan Basin through sustainable water resource management. The OBWB delivers a variety of services including the Eurasian watermilfoil control program, the wastewater treatment grant program, and a water management function that includes water research project management and a water conservation and quality improvement grant program. The OBWB provides the following essential functions:

- **Implementing basin-wide programs** for watermilfoil control, wastewater infrastructure funding, water research and management – benefiting all Basin residents
- **Advocating and representing** local needs to senior government planners and policy makers – protecting Okanagan interests
- **Providing science-based information** on Okanagan water to local government decision makers and water managers – for sustainable long-term planning
- **Communicating and coordinating** between government, non-government, universities and businesses – increasing the effectiveness of water projects and research
- **Building funding opportunities** by providing leverage grants, securing external dollars and identifying cost-sharing partners – expanding local capacity

Additional information about the OBWB is available at: http://www.obwb.ca.

Table of Contents

Technical Sessions

Invited Presentations

Poster Presentations

Modelling Evaporation from Lake Okanagan, Mainstem Lakes, Upland Lakes and Reservoirs Based on Existing Databases

William M. Schertzer and Bill Taylor

Abstract

A model capable of using a limited existing database is required for quantification of evaporation from Okanagan Lake, mainstem lakes, and for small upland lakes and reservoirs. Nineteen models, grouped according to input data requirements, (e.g. energy budget, combination, mass transfer, solar radiation-temperature, temperature or daylength methods), were assessed for computation of daily lake evaporation from six of the largest Okanagan Basin lakes (1996-2006). The models were forced with "existing" land-based meteorology, modeled water surface temperature, and limited heat content values. Results were compared to the mass transfer technique derived from eddy correlation (ETR: Trivett, 1984) and also used here as the reference evaporation. Cumulative daily evaporation ranged from ~ 350 mm/yr to 1000+ mm/yr depending on model used. Mass transfer formulations ETR (Trivett, 1984) and EQN (Quinn, 1981) produced annual evaporation in the range (350 – 450 mm/yr). Significantly higher evaporation derived from the other methods was attributed to database limitations and assumptions. Considering the limitations of the "existing" database, the ETR model is recommended for the six largest Okanagan lakes. Using ETR, the 11-year average water loss from Okanagan Lake is 169.8 $x10^6$ m^3 yr^{-1}. Kalamalka, Skaha, and Osoyoos Lakes have water losses in the order 6.78 $x10^6$, 8.82 $x10^6$ and 5.53 $x10^6$ m^3 yr^{-1} respectively. The smaller lakes, Wood and Vaseux, have average evaporative losses of 2.63 $x10^6$ and 1.01 x 10^6 m^3 yr^{-1}, respectively.

Computation of evaporation for upland lakes and reservoirs is hampered because of a paucity of meteorological and lake data. Since air temperature has been extrapolated over the Okanagan Basin (500m x 500m) grid for climate scenario computations, a generalized 2nd order polynomial relationship between 11-year lake evaporation (ETR) vs. air temperature is derived (correlations: r = 0.79 – 0.95). A grouped "small" lake formulation is recommended for application over the small upland lakes and reservoirs.

Intensive multi-year in-lake investigations are required on all six Okanagan lakes to provide quality data for rigorous model testing and to derive lake to land transformations, which can enable more efficient use of the land-based meteorology for computation of lake evaporation.

Keywords: lake evaporation, evaporation models, surface temperature, heat content, radiative fluxes, Okanagan lakes, upland lakes

William M. Schertzer[1] and Bill Taylor[2]

[1] Water Science and Technology Directorate, National Water Research Institute, Canada Centre for Inland Waters, Burlington, ON
Corresponding Author: william.schertzer@ec.gc.ca, 905-336-4770,
[2] Meteorological Service of Canada, Pacific and Yukon Region, Environment Canada, Vancouver, BC

Mountain Pine Beetle and Watershed Hydrology: A Synthesis focused on the Okanagan Basin*

Todd Redding, Rita Winkler, David Spittlehouse, R.D. Moore, Adam Wei, and Pat Teti

* Portions of this document have been reproduced or drawn from, with permission, BC Ministry of Forests and Range, Research Branch, Extension Note 88, *Mountain pine beetle, forest practices, and watershed management*.

Abstract

As the mountain pine beetle (MPB) infestation expands into the southern interior, changes to British Columbia's lodgepole pine forests will affect stand water balances, hillslope hydrology and streamflow in many watersheds. The large spatial extent of this disturbance has prompted research from the stand- to watershed-scales to address uncertainty about the hydrologic effects of MPB, such as an increased potential for flooding, changes in water yield, peak flows, and low flows, slope and channel changes associated with increased runoff, as well as the effects of hydrologic change on aquatic habitat and drinking water. This paper will summarize the key hydrologic changes expected and will highlight the results of long-term research in the Okanagan, such as the Camp Creek and Upper Penticton Creek watershed experiments, as well as new research underway throughout the B.C. Interior and other regions to quantify changes in hydrologic processes and potential effects of MPB-related stand mortality and salvage logging.

Todd Redding[1], Rita Winkler[2], David Spittlehouse[3], R.D. Moore[4], Adam Wei[5], and Pat Teti[6]

[1] FORREX, Nanaimo, BC,
Corresponding Author: todd.redding@forrex.org, 250-713-1184,
[2] MFR, Kamloops, BC
[3] David Spittlehouse, BC MFR, Victoria, BC
[4] R.D. Moore, UBC, Vancouver, BC
[5] Adam Wei, UBC Okanagan, Kelowna, BC
[6] Pat Teti, BC MFR, Williams Lake, BC

Agricultural Water Management in the Okanagan Basin

Ted W. Van der Gulik and Denise Neilsen

Abstract

The Okanagan watershed, covering 8,000 km^2 in the south-central interior of British Columbia, is characterized by a north-south running main valley at an elevation of about 300 m, surrounded by a plateau at elevations between about 1,500 and 2,000 m to the east and west. It is a relatively small and arid watershed, with annual precipitation averaging only about 300 mm in the dry valley-bottom areas to over 700 mm in some high elevation plateau areas.

The CWRA conference in February 2005 "Water – Our Limiting Resource – Towards Sustainable Water Management in the Okanagan" identified a need to improve water management in the Okanagan and implement mechanisms that encourage more efficient use. Agriculture uses 70% of the water currently licensed in the basin. It is estimated that 90% of the water available in the basin has been allocated and spoken for. Urban growth in this region is one of the highest in Canada, expecting to triple to one million over the next thirty to forty years. Agricultural land locked in the Agriculture Land Reserve is of little value without water and climate change will require additional water to irrigate what is currently farmed. Additional agricultural lands could be irrigated. Competing demands between fish, agriculture, recreation and urban growth has led to a realization that a water-in, water-out balance should be done for the basin.

The authors have initiated a project to determine agricultural water requirements in the basin now and in the future. This paper will outline the process that has been developed to accurately determine agricultural water requirements and how improved water management will be accomplished.

Ted W. Van der Gulik[1] and Denise Neilsen[2]

[1] Senior, Engineer, Resource Management Branch, Ministry of Agriculture and Lands, Abbotsford, BC
[2] Ph.D., Research Scientist, Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada, Summerland, BC

The Upper Penticton Creek Watershed Experiment: Integrated Water Resource Research on the Okanagan Plateau

R. Winkler, D. Spittlehouse, D. Allen, T. Redding, T. Giles, G. Hope, B. Heise, Y. Alila, and H. Voeckler

Abstract

Understanding the complex interactions between forests, forest land-use, natural disturbances, streamflow, and groundwater is essential to sustainable water resource management. Throughout the dry southern interior of British Columbia (BC), both the security of water supplies and the protection of aquatic habitat are issues of ongoing concern, particularly in areas where water is limited relative to demand. In response to these concerns, the Upper Penticton Creek (UPCr) Watershed Experiment was established in 1984. The goals of this experiment are to improve our understanding of hydrologic processes on the Okanagan Plateau and to develop effective forest practices guidelines that help to sustain both timber and water resource values. This paper provides an overview of the UPCr Watershed Experiment, results, relevance to water resource management in the Okanagan, and future directions.

R. Winkler[1], D. Spittlehouse[2], D. Allen[3], T. Redding[4], T. Giles[5], G. Hope[6], B. Heise[7], Y. Alila[8], and H. Voeckler[9]

[1] Ministry of Forests and Range, Kamloops, BC,
Corresponding Author: Rita.Winkler@gov.bc.ca, 250-828-4162
[2] Ministry of Forests and Range, Victoria, BC
[3] Simon Fraser University, Burnaby, BC
[4] FORREX, Nanaimo, BC
[5] Ministry of Forests and Range, Kamloops, BC
[6] Ministry of Forests and Range, Kamloops, BC
[7] Thompson Rivers University, Kamloops, BC
[8] University of British Columbia, Vancouver, BC
[9] SFU, Department of Earth Sciences

Regional Characterization of Groundwater in the Okanagan Basin

Remi Allard, Doug Geller, Jacqueline Foley, Marta Green

Abstract

A significant goal of the Phase 2 Okanagan Basin Water Supply and Demand Project is to develop an overall basin water balance that incorporates groundwater. This paper presents an overview of the groundwater portion of the water balance study, specifically the methodology used to characterize aquifers in the Basin as well as to quantify monthly flow and changes in storage over a ten year period from 1997 to 2006. When the Project began in early 2008, approximately 80 alluvial and bedrock aquifers in the basin had been identified and mapped by the Ministry of Environment, representing approximately 20 % of the geographic area. The Study Team developed a concept to assess aquifers across 100% of the basin and re-mapped alluvial and bedrock aquifers based on geology and surface water catchment relationships. As the majority of the bedrock aquifer areas lacked hydrologic and hydrogeologic data, it was necessary to conduct a regional analysis to infer key spatial water balance relationships.

Where data existed, for example at discrete observation well hydrograph locations, aquifer hydraulic data from drilling and pumping tests at well locations and at stream flow hydrograph locations, the Study Team assessed aquifer recharge and discharge relationships based on regional climate data and literature sources. This enabled spatial relationships to be developed specifically for the Basin, relating surface runoff to groundwater recharge and net water availability as a function of precipitation, elevation and evapotranspiration. The Study developed individual water balances for over 300 separate bedrock and alluvial aquifers and the sensitivity of various input parameters in the water balance calculations, including hydraulic conductivity, gradient and saturated thickness were analyzed to determine relative influence.

The output of this study increased the level of understanding of potential aquifer yield and surface water/groundwater relationships throughout the Basin. The information could be used for the development of more detailed conceptual and numerical groundwater flow models in selected areas, as well as a tool to support water management planning in the Basin.

Remi Allard[1], Doug Geller[2], Jacqueline Foley[3], Marta Green[4]

[1] M.Eng., P.Eng., Senior Hydrogeologist, Golder Associates Ltd.
Corresponding Author: rallard@golder.com
[2] P.Geo., Senior Hydrogeologist, Summit Environmental Consultants Ltd.
[3] M.Sc., Senior Hydrogeologist, Golder Associates Ltd.
[4] P.Geo., Project Hydrogeologist, Summit Environmental Consultants Ltd

The International Osoyoos Lake Board of Control and the Osoyoos Lake Orders

International Osoyoos Lake Board of Control (Kirk Johnstone)

Abstract

The *1909 Treaty between the United States and Great Britain Relating to Boundary Waters and Questions Arising Between the United States and Canada* was designed to prevent and resolve disputes over our shared waters—particularly those related to water quantity. The Treaty established an International Joint Commission (IJC) comprised of three members from each country and gave it jurisdiction over the use, obstruction and diversion of those shared waters. With such an obstruction on the Okanogan River in Washington, Zosel Dam, which affects water levels in Osoyoos Lake in British Columbia, the Commission wrote an Order governing the operation of the dam and created a Board of Control to oversee the implementation of the Order. Similar to the Commission, the Board is comprised of three members from each country. The Members are water resource specialists drawn from federal, provincial and state agencies, working for the Commission in their professional capacity. The Order sets out an allowable range of water levels for winter, summer, and summer under drought conditions. Further, it establishes drought criteria for the lake based on the forecast freshet response of the Similkameen River and Okanagan Lake. It also sets a conveyance standard for the outlet of the lake to assure that Zosel Dam remains in functional control of water levels. The Osoyoos Lake Order is one of few IJC Orders that has an expiry date: February 22, 2013. The Board of Control is currently working to provide the Commission with information that will inform a replacement Order.

Kirk Johnstone[1]

[1] Canadian Co-Chair of the International Osoyoos Lake Board of Control, Environment Canada. Vancouver, BC kirk.johnstone@ec.gc.ca, 604 664-9120

Water Management and Use Study

Don Dobson

Abstract

The Water Management and Use Study is the first project in Phase 2 of the *Okanagan Water Supply and Demand Project*. This paper summarizes the "state of the basin" regarding current water use and how it is managed.

The study objectives were:

1. To develop a thorough understanding of water use and management in the Okanagan Basin and prepare a report that describes the current state of the basin in this regard; and
2. To develop a database reflecting water use and management at each node in the Okanagan Basin (i.e. 81 points of interest) on a weekly basis for 1996 to 2006.

The results from the study were to be used to support a water balance model to be developed for the Basin.

There are 3,981 active water licenses in the Basin, 493,236 ML for off-stream use, 26,550 ML for instream (conservation) use, and 212,236 ML for storage. The total surface water used in 2006 was approximately 238,410 ML. In 2006, irrigation use was 63% and domestic use was 37% of the licensed volumes.

Groundwater use data were compiled for 24 water suppliers that operated 72 active wells. The groundwater use in 2006 was 19,083 ML.

Water use for 2006 was determined for six end-uses: agriculture, golf courses, parks/open space, domestic (indoor and outdoor), institutional, commercial, and industrial (ICI), and unaccounted for water (losses).

It was recommended that:

- The water license system be reviewed and revised.
- The water license system should reflect the way water is used in the basin.
- There should be a standardized system for the collection, review and archiving of water data.
- The hydrometric/climate network in the Basin requires immediate upgrading.

To manage water effectively in the Basin in the future will require a commitment by the agencies and water managers to collect better water data and more water and climate data in a consistent manner and to an established standard. The quality of the output from the Water Balance Model will only be as good as the input data.

Don Dobson[1]

[1] PEng., Dobson Engineering Ltd., ddobson@dobsoneng.com, 250-861-5595

Potential Impacts of Climate Change on Life History Events of Okanagan Salmonids

Kim Hyatt, Margot Stockwell, and D. Paul Rankin

Abstract

The Intergovernmental Panel on Climate Change (IPCC) has made a compelling case that atmospheric warming is well underway and virtually certain to affect all regions of the globe within less than a single human generation. Warming is expected to be especially pronounced in the north-temperate zone in which the Okanagan basin is situated. Global Climate Models (GCM's) are commonly used in association with regional data sets to provide plausible projections of future conditions with respect to annual or seasonal temperature and precipitation in a given location. GCM projections of future conditions have been used in recent studies to explore the impacts of climate change on agricultural production and water consumption in the Okanagan. We are currently using projections from the same suite of GCM's (HadCM3-A22, CGCM2-A21 and CSIRO MK2 A21) centred on the year 2050 to assess potential, climate change impacts on key life history stages of important coldwater fishes (sockeye and kokanee salmon, lake whitefish) resident in river and lake habitats of the Okanagan valley. Climate change impacts have been assessed by comparing observations of the frequency of occurrence, timing or magnitude of a given life history event during a base period (1961-1990) versus projected outcomes for the same events during the future 2050's period (i.e. 2035-2065). Results from our analysis are highly consistent across all GCM projections and suggest: (a) adult migration delays for Okanagan sockeye salmon will increase from an average of 40 days (base-case) to an average of between 71-81 days (2050 case); (b) 2050 spawn timing for salmonids may be delayed by 2-3 weeks relative to current timing; (c) 2050 egg hatch will occur 1-2 weeks later; (d) 2050 fry emergence will occur 1-2 weeks earlier; and (e) The frequency and severity of climate induced losses of seasonal rearing habitat for juvenile sockeye and adult whitefish in Osoyoos Lake will increase greatly. We conclude that interactions among climate change and life history events identified here will exert a profound influence on future production trends, manageability and the probability of long-term persistence of salmon and other coldwater fishes in British Columbia's southern interior.

Kim Hyatt[1], Margot Stockwell[1], and D. Paul Rankin[1]

[1] Pacific Biological Station, Science Branch, Fisheries and Oceans Canada, Nanaimo, BC
Corresponding Author: Kim Hyatt, hyattk@pac.dfo-mpo.gc.ca, 250-756-7217

Climate Surfaces for the Okanagan Basin Water Supply Demand Project

Guy Duke, Denise Neilsen, Bill Taylor, Alex Cannon, Ted Van der Gulik, Nathanial Newlands, Grace Frank, and Scott Smith

Abstract

The diverse terrain of the Okanagan Basin has a strong localizing influence on climate. Model development for water supply and demand requires climate data inputs that reflect this complexity. The Okanagan Climate Data Model has been developed to provide climate information at a suitable scale for modelling climate dependent processes. Using GIS interpolation methodology and all available climate data from a number of sources, basin-wide 500m x 500m gridded surfaces for daily minimum, maximum temperatures and precipitation have been generated for the period 1960 to 2000. Future daily climate data, up to the year 2100, have also been generated using output from six Global Climate Models (GCM) and three SRES scenarios reflecting high and low greenhouse gas emissions. GCM output has been downscaled to climate grid cells using a combined synoptic map typing and weather generator approach.

The Okanagan Climate Data Model has been used to drive the Okanagan Irrigation Water Demand Model, which provides calculations of Penman Monteith reference ET and a range of agro-climatic indices for each climate grid cell in addition to crop and terrain based irrigation water demand.

Guy Duke[1], Denise Neilsen[2], Bill Taylor[3], Alex Cannon[3], Ted Van der Gulik[4], Nathanial Newlands[5], Grace Frank[2] and Scott Smith[2]

[1] University of Lethbridge, Lethbridge, AB.
[2] Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre, Summerland BC
Corresponding Author: Denise Neilsen, neilsend@agr.gc.ac, 250-494-6417
[3] Environment Canda, Pacific andYukon Region, Vancouver, BC
[4] BC Ministry of Agriculture and Lands, Abbotsford, BC
[5] Agriculture and Agri-Food Canada, Lethbridge, AB

Okanagan River Restoration Initiative (ORRI)

Camille Rivard-Sirois, Karilyn Long, and Chris Bull

Abstract

The Okanagan River Restoration Initiative will return part of the channelized river back into a natural meandering path connected to its historic floodplain. Dykes will be set back, river meanders will be restored, and pool/riffle sequences will be created. On the re-established floodplain, riparian vegetation will be restored. The creation of complex and diverse natural habitat will provide high quality spawning habitat for all species and rearing for steelhead, rainbow trout and possibly Chinook. Reconnection with the floodplain should decrease silt loads in the main channel. Egg to fry survival is expected to increase dramatically and rearing sites will be established where there are presently none. The project is designed to be self-sustaining and ecosystem based.

Camille Rivard-Sirois[1], Karilyn Long[1], Chris Bull[2]

[1] Okanagan Nation Alliance, Fisheries Department, Westbank, BC
Corresponding Author: Camille Rivard-Sirois, crivard@syilx.org, 250-490-9779 ext 303
[2] Glenfir Resources, Penticton, BC, Glenfir@shaw.ca

Hydrologic Networks in the Okanagan

Bruce Letvak and Don Dobson

Abstract

This presentation will review hydrologic networks in the Okanagan, with emphasis on the hydrometric network. Content will include:

- Uses of monitoring networks in the Okanagan,
- The recently completed review of hydrometric network requirements for the Okanagan, including method and results,
- Climate monitoring stations: uses, linkage with hydrometric network, current project to coordinate climate networks,
- New provincial funding for hydrologic monitoring, relation to Okanagan
- Thoughts on future management of networks.

Bruce Letvak[1] and Don Dobson[2]

[1] BC Ministry of Environment, Science and Information Branch, Victoria, BC
Corresponding Author: Bruce.Letvak@gov.bc.ca, 250-387-9477
[2] Dobson Engineering Ltd., Kelowna, BC
250-861-5595, ddobson@dobsoneng.com

Fish Passage at McIntyre Dam, Okanagan River

John van der Eerden and Duane Hendricks

Abstract

Over the last half century, man-made structures built for flood control purposes along the Okanagan River have deprived a number of fish species access to their native habitat and spawning grounds. This paper presents work conducted by the Okanagan Nation Alliance and Associated Engineering to design fish passage solutions for the McIntyre Dam.

McIntyre Dam, constructed in 1954, is located on the Okanagan River approximately 1.8 km south of Vaseaux Lake, and approximately 19 km north of Osoyoos Lake. McIntyre Dam is a barrier to upstream fish migration. Should the dam be decommissioned or altered to facilitate fish passage, a net gain of approximately 9 km of fish habitat in the Okanagan River will be realized, including Vaseaux Lake. The next upstream barrier to fish passage is the Skaha Lake Outlet dam at Okanagan Falls.

Fish passage in an upstream direction is prevented by high flow velocities exiting under the dam's vertical lift gates. Fish passing through the dam in a downstream direction also experience very high velocities under the existing gates. Furthermore, a drop of about 40cm onto a downstream array of energy dissipating concrete baffle blocks causes a further hazard and fish mortality.

The Okanagan Nation Alliance secured funding from the Habitat Conservation Plan Tributary Funds to retrofit the existing dam. The retrofits involve replacing the existing vertical lift gates with overshot gates. This will reduce the high flow velocities experienced by downstream migrating fish. However, overshot gates on their own will not resolve the hydraulic drop and potential fish impact on the baffles downstream of the dam. Construction of a downstream rock riffle will increase the tail water level at the dam outlet. This will reduce the hydraulic drop onto the concrete baffle blocks and reduce the need for energy dissipation at the base of the dam. The backwater riffle will also create a deeper plunge pool downstream of the dam. This is beneficial for both upstream and downstream fish migration. Design of the dam retrofit is currently underway.

John van der Eerden[1] and Duane Hendricks[2]

[1] M.Eng., P.Eng., Manager, Water Resources, Associated Engineering (BC) Ltd., Burnaby, BC
Corresponding Author: vandereerdenj@ae.ca
[2] P.Eng., Water Resources Engineer, Associated Engineering (BC) Ltd, Burnaby, BC
hendricksd@ae.ca

The Use of Stable Isotope Techniques to Assess the Regional Hydrology of the Southern Okanagan Basin

Pana Athanasopoulos, M.J. Hendry, and Leonard I. Wassenaar

Abstract

A rapidly increasing population in the Okanagan Basin is expected to put additional stress on surface water and groundwater systems in the region. As a result, important issues such as water supply and demand, surface water and groundwater protection, surface water-groundwater interaction, and water quality will need to be addressed. The use of stable isotopes, particularly when coupled with geochemical and physical parameters, is an effective method of addressing these issues in a region of complex hydrological, hydrogeological and climatological systems.

Here we present the results of two years of research conducted in the southern Okanagan Basin, where isotopic methods were used to assess the regional hydrogeology of the southern Okanagan Basin, and, in particular, to identify the source(s) of groundwater recharge in the region. Stable isotope analysis of ^{18}O and ^{2}H was conducted on: monthly precipitation samples from three sites in the basin (Kelowna, Osoyoos and Anarchist Mountain) (*n = 37*), shallow and deep groundwaters in the alluvial valley bottom (*n = 122*), groundwater in the bedrock of the upland areas (*n = 22*), and monthly samples of surface waters collected at 10 stations along the Okanagan River system (which supply irrigation water to local agricultural users) (*n = 134*). Subsequently, tritium-helium ($^{3}H/^{3}He$) age dating was conducted on shallow groundwaters in the valley bottom (*n = 9*), and enriched tritium (^{3}H) and carbon-14 (^{14}C) isotope analysis was conducted on the deep groundwater system in the valley bottom and the groundwater in the upland areas (*n = 4*), to determine the ages of the respective waters.

These data were used to: (1) create a local meteoric water line for the Okanagan Basin; (2) define the source(s) and ages of groundwaters in the southern Okanagan Basin; and (3) develop a conceptual model of flow and residence times of groundwaters in the Basin. The results of this research, conducted in one region of the valley, may be generally applicable over the entire Okanagan Basin.

Research for this project was funded by the Canadian Water Network, BC Ministry of Environment, Geological Survey of Canada, NSERC and Environment Canada.

Pana Athanasopoulos[1], M.J. Hendry[1], and Leonard I. Wassenaar[2]

[1] University of Saskatchewan, Saskatoon, SK
Corresponding Author: Pana Athanasopoulos, Panagiota_Athanasopoulos@golder.com
[2] Science and Technology Branch, Environment Canada, Saskatoon, SK

Endocrine Disruptors in the Okanagan Basin

P. Jeff Curtis, Tricia Brett, Rob O'Brien, Sandra Mecklenburg

Abstract

Effects of endocrine disrupting substances discharged in wastewater pose unknown risks to water supplies and ecosystems of receiving waters in the Okanagan Basin. Among urban regions of Canada, the Okanagan Basin is arguably at exceptional risk to endocrine disruptors for several important reasons. First, we have one of the smallest per capita water supplies in Canada. Thus, potential dilution of wastewater is limited. Second, much of our water use is consumptive (evaporative uses) further reducing the dilution volume. Finally, water supplies to a large portion of our population receive wastewater. In scoping the risks, we calculated worst-case levels of the most potent endocrine disruptors from wastewater – estradiols – for low flows in the Okanagan River (Penticton). Calculated concentrations were in ranges that generally cause endocrine disruption, and are within a factor of five of levels that caused fish population collapse in the Experimental Lakes Area study.

We have embarked on a study of estradiols in the Okanagan Basin wastewaters and waste receiving waters. Over the next two years, samples of wastewater will be collected from wastewater treatment plants (WWTPs) in Vernon, Kelowna and Penticton characterized instrumentally. Wastewater is discharged by the cities of Vernon, Kelowna and Penticton into a reservoir for spray irrigation, into Lake Okanagan, and into the Okanagan River, respectively. We propose to use differences in discharge practices and receiving water properties among the Okanagan WWTPs to infer loss rates of estradiols in the environment. Because of the differences in discharge practices among WWTPs, this study might identify relatively quickly best practices for discharge, and means to mitigate estradiol risks to the water supplies and aquatic ecosystems.

P. Jeff Curtis[1], Tricia Brett[1], Rob O'Brien[2], and Sandra Mecklenburg[2]

[1] Department of Earth & Environmental Sciences, UBC Okanagan, Kelowna, BC
[2] Department of Chemistry, UBC Okanagan, Kelowna, BC

Evaluation of the hydrogeology of valley-fill aquifers in the Northern Okanagan using geochemical and modeling methods

Jianhua Ping, Craig Nichol, Adam Wei, Trina Koch, Oleg Ivanov

Abstract

Groundwater resources in the North Okanagan were investigated using an integrated physical, geochemical and numerical approach. The North Okanagan Groundwater Characterization and Assessment (NOGWCA) project began with an investigation of the geology and hydrostratigraphy of the North Okanagan region. The Deep Creek and Fortune Creek watersheds were found to contain multiple valley-fill aquifers. Seismic surveys and borehole data were used to reconstruct the aquifer system.

The main valley is composed of several confined aquifers. The first, Spallumcheen A, ranges from 30 m to 90 m depth and is 45 m to 90 m thick. This is the main aquifer utilized in the valley for domestic, municipal, commercial and irrigation supply. It is recharged from both the adjacent highlands via mountain system recharge (MSR) and via direct recharge in the valley bottom. The aquifer grades into unconfined aquifers in the Hullcar/Sleepy Hollow and Okeefe areas to the West of the main valley stem. Detailed hydrometric data from nine stations deployed on both creeks indicates groundwater recharge within the alluvial fan of Fortune Creek, and discharge to groundwater in the lower reaches of Deep Creek. Valley side recharge at alluvial fans generates artesian conditions in the valley center in the City of Armstrong area. A second continuous confined aquifer is found at depths of 200 m to 350 m. Additional discontinuous aquifers are found between 90 m and 200 m, as well as at depths below 350 m in the main valley north of Armstrong.

Groundwater and surface water geochemistry and isotopic character were used to determine the overall groundwater flow regime, and reveal that groundwater within the Fortune Creek watershed flow southwards into the Deep Creek watershed. Chloride mass balance was used to estimate recharge in the valley bottom and within the mountain bedrock system. Additional recharge information was derived from an interpolated climate dataset and from data on agricultural irrigation and wastewater irrigation. Efforts to accurately quantify and understand MSR are hampered by sparse data on the geochemical character of bedrock aquifers. Analysis of the groundwater chemistry has assisted in detailing the aquifer interactions. Conservative elements and deuterium/oxygen isotopes were used in a mixing cell model (MCM) approach to assess groundwater flow between aquifers

Jianhua Ping [1], Craig Nichol[1], Adam Wei[1], Trina Koch[2], Oleg Ivanov[2]

[1] Earth and Environmental Sciences, Barber School of Arts and Sciences, University of British Columbia Okanagan, Kelowna, BC

Corresponding Author: Craig Nichol, Craig.Nichol@ubc.ca, 250-807-8087

[2] British Columbia Ministry of the Environment, Water Stewardship Division, Penticton, BC

FEFLOW is being used for numerical simulation of the groundwater system. The first stage of the aquifer assessment will determine steady state conditions within the system in anticipation of integrated surface water and groundwater modeling to be carried out in the future. The groundwater flow modeling will contribute to subsequent water management decisions at the watershed scale. Climate change and economic change scenarios will be considered in the integrated surface water and groundwater modeling.

Keywords: valleyfill aquifers; geochemistry; isotopes; Mountain System Recharge; aquifer properties; Feflow

Developing Performance Standards for Nutrients, Sediments and Instream Flows for Agricultural Watersheds in Canada: An Overview for the Okanagan

Daniel Peters, Donald Baird, Glen Benoy, Patricia Chambers, Joseph Culp, and Laura Maclean

Abstract

Excessive inputs of nutrients and sediments to aquatic ecosystems can result in a variety of deleterious changes in abundance and diversity of aquatic plants, invertebrates and fish. Similarly, alterations to a stream's natural flow regime via changes in land-cover, land-use and/or flow regulation can have negative consequences for riverine ecosystems. The goal of the National Agri-Environmental Standards Initiative (NAESI) Water Theme was to develop a number of environmental standards to help protect surface waters from deleterious effects of agricultural practices on nutrients, sediments, microbial pathogens, and unsustainable water use across Canada. As part of a national program to define benchmarks of ecological condition in agricultural streams, Environment Canada analyzed a combination of new and existing chemical, physical, biological and discharge data to characterize relationships between water quality and quantity and various measures of aquatic community health. Several statistical approaches were then employed, including a percentile approach and a threshold approach, to define desired performance standards for good ecological condition for agricultural streams across Canada. The purpose of this paper is to present the NAESI Water Theme program and outline the environmental performance standards with a focus on the Okanagan Valley. A number of non-regulatory agri-environmental standards are recommended for total nitrogen, total phosphorus, suspended and deposited sediments and ecological instream flow needs. Achievement of these standards is predicted to result in good ecological condition in the aquatic community in the absence of other stressors.

Daniel L. Peters[1], Donald J. Baird[2], Glen Benoy[3], Patricia A. Chambers[4], Joseph M. Culp[2], and Laura Maclean[5]

[1] Environment Canada, Water & Climate Impacts Research Centre, University of Victoria, Victoria, BC
Corresponding Author: Daniel.Peters@ec.gc.ca, 250-363-8954
[2] Environment Canada, Canadian Rivers Institute, Department of Biology, University of New Brunswick, NB
[3] Environment Canada, Potato Research Centre, Fredericton, NB
[4] Environment Canada, National Water Research Institute, Burlington, ON
[5] Environment Canada, Vancouver, BC

Assessing One Side of the Water Budget: How Can Groundwater Recharge Be Predicted Across the Okanagan Basin?

Brian D. Smerdon, Jessica E. Liggett, and Diana M. Allen

Abstract

Determining the role of groundwater in meeting future water supply needs will rely on understanding spatial distribution and rates of groundwater recharge. Accurate recharge estimates are critical for effective groundwater management; however, recharge is difficult to quantify, especially over large, mountainous regions. For the Okanagan Basin, different approaches for predicting groundwater recharge are required that consider the wide range in data availability between valley bottom and headwater areas, large changes in elevation, and complex groundwater conditions. This paper presents findings from an assessment of recharge at the BX Creek watershed, and an investigation of broad-scale groundwater recharge mapping for the entire Okanagan valley bottom. For the entire BX Creek watershed, groundwater recharge was determined from a combination of flow models (MIKE-SHE and MODFLOW) and simple water budget calculations. Groundwater recharge was found to vary from 0 to 20 mm/yr at lower elevations, and from 20 to 50 mm/yr at higher elevations. Modelling of the complete watershed-scale flow system illustrated that 57% of the groundwater recharge to the valley bottom aquifers is from upland source water that flow through a relatively narrow alluvial fan, which extends to the valley bottom. The remaining recharge is nearly equally divided between groundwater flow through the less permeable mountain block (20%) and direct to the valley bottom (22%). Results of the BX Creek study were compared with regional-scale estimates of groundwater recharge for the entire Okanagan Basin valley bottom, which were made with the widely-used HELP model. Using identical data sources, estimates from the HELP model match the spatial distribution for the BX Creek area, but predict higher rates of groundwater recharge in this semi-arid area. These results suggest that the HELP model systematically over-predicted groundwater recharge, and that additional refinement would be necessary to provide accurate results for the entire Okanagan Basin. This paper illustrates the challenge of predicting groundwater recharge in semi-arid, mountainous regions, which is a major component of basin-wide water-budget analyses.

Brian D. Smerdon[1], Jessica E. Liggett[1], and Diana M. Allen[1]

[1] Department of Earth Sciences, Simon Fraser University, Burnaby, BC
Corresponding Author: Brian Smerdon, brian.smerdon@gmail.com

Source Protection and the Future of Safe, Clean, Reliable Tap Water in the Okanagan Valley

J. Ivor Norlin* and Mike Adams*

* The views expressed in this document are those of the authors and not necessarily of Interior Health. Any errors are the sole responsibility of the authors'.

Abstract

Safe, clean, and reliable tap water is essential for the prosperity and health of all communities in the Okanagan Valley. A multiple barrier approach is the best means of addressing the numerous challenges to supplying safe drinking water in this fast growing, water limited region of British Columbia. A multiple barrier approach recognizes and applies efforts at all points where risks to drinking water and public health can be reduced. Source protection is a core element of the multiple barrier approach. As is the case for most regions in British Columbia, the needs of Okanagan communities make exclusion of human activity and dedication of entire watersheds for the sole purpose of providing drinking water typically unfeasible. Thus, successful source protection for most hinges on integrated watershed management to control potential threats to drinking water and public health. The ultimate vision is that everyone (including water suppliers, industry, land-use agencies, and the public) has the information and opportunity they need to be empowered stakeholders in drinking water management. Collaborative efforts of water suppliers, government, and other watershed stakeholders have resulted in improvements. However, without source-to-tap water system assessments to characterize health risks and support a comprehensive approach to drinking water management, efforts to protect drinking water sources in the Okanagan will undoubtedly fall short.

J. Ivor Norlin[1] and Mike Adams[2]

[1] Source Protection Officer, Interior Health – Health Protection,
Corresponding Author: jivor.norlin@interiorhealth.ca, 250-833-4100
[2] Senior Drinking Water Officer, Okanagan Health Service Area, Interior Health – Health Protection,
mike.adams@interiorhealth.ca, 250-549-5714

Water Sustainability under Climate Change and Increasing Demand: a One-Water Approach at the Watershed Scale

Adam Wei

Abstract

Water will become Canada's foremost ecological crisis early in this century (Schindler 2001). A watershed based approach for water management is repeatedly suggested to address water sustainability issues. However, full implementation of such an approach is seldom realized. Achieving a full understanding of total water resources (climate, surface water, shallow and deep groundwater etc.) and their interactions at a watershed scale is a major barrier. We have recently obtained NSERC strategic funding to take a one-water perspective to evaluate watershed sustainability under climate change and increasing socio-economic drivers of water demands (agriculture and population) in the Deep Creek watershed (306 km^2) located in the Okanagan basin of the semi-arid southern interior of British Columbia. The suitable watershed size and significant water conflicts among water users make this watershed an ideal place for this interdisciplinary research. The purpose of this presentation is to describe our methodology and the research significance.

A combination of geo-chemistry and integrated watershed modelling (MIKE SHE or others) will be used to quantify the total water resource, surface water – groundwater connections and the watershed response to various water stressors. A Canadian Land Surface Scheme (CLASS) model will be used to improve estimation of spatially varied groundwater recharge for model calibration. In addition, future agriculture water demands will be projected using both environmental and economic drivers (changes in product prices, climate, water pricing policies, and water use regulations) rather than based on simpler trend projections. This study is novel in its quantitative integration of the physical and human dimensions of water use at a watershed scale, enabling adaptive management responses to climate change and increasing demand impacts.

Adam Wei[1]

[1] Ph.D., Associate Professor and Watershed Research Chair, University of British Columbia, Kelowna, BC
adam.wei@ubc.ca, 250-8078750

Water Markets and Good Watershed Governance: An Inherent Conflict?

John Janmaat

Abstract

From Alberta to Australia, watershed governance is incorporating greater degrees of individual responsibility, sometimes expanding the scope for trading water rights. While the British Columbia Water Act does not preclude the trading of water rights, the current distribution of those rights rules out this option for most water users. However, following the Australian example, Okanagan water purveyors can facilitate water trading among those they service, providing water users with greater flexibility in managing their water use. Among irrigators, most are very uncomfortable with the idea of selling water, and are uncertain about how it could be implemented. However, they also realize that there is a need for policy change, and support the use of incentives similar to those that a market for trading water rights would provide.

John Janmaat[1]

[1] Economics, IK Barber School of Arts and Sciences, University of British Columbia Okanagan, Kelowna, BC
john.janmaat@ubc.ca, 250-807-8021

Cumulative Effects of Economic Growth on Watershed Ecosystems in the Okanagan Valley

Barry Wilson

Abstract

The Okanagan Valley is experiencing tremendous economic growth and this trend is expected to continue. This growth will bring about a suite of cumulative effects - changes to environmental, social and economic values caused by activities in combination with other past, present, and reasonably foreseeable human activities. Water is a common thread across all components of the triple bottom line and the need for strategic level cumulative effects assessments including watershed impacts is increasing rapidly with pressures from mountain pine beetle damage, new transportation infrastructure, urban growth, foreshore development, ALR withdrawals and climate change to name a few.

Simulation models can be used to help quantify the effects of human activity in concert with natural disturbance events. These models help planners and decision makers to understand the consequences (both opportunities and risks) of defined land use scenarios, appreciate those variables (environmental, economic, social) that "drive" watershed performance and the consequences of various land use trajectories. When effectively used, these tools provide the opportunity to explore strategies that lead to maximizing favorable outcomes and minimizing unfavorable footprint effects. Anthropogenic disturbances simulated include tourism and recreation, agriculture, forestry, energy, transportation, surface and subsurface water use, human populations and settlements. Natural systems simulated include fire, insect outbreaks, climate change, flooding, avalanches and succession.

This paper provides an overview of these tools, examples of how they have been used in other jurisdictions and how they can be used in the Okanagan.

Barry Wilson[1]

[1] R.P.F., Manager, Environmental Planning and Analysis, Silvatech Consulting Ltd.
Skype: barrysilvatech, 250-832-7360, web: www.silvatech.ca

A Comparison of Stormwater Runoff Reduction by Green Roofs Between Kelowna and Vancouver

Daniel Roehr, Yuewei Kong, and Jon Laurenz

Abstract

This research focuses on the contribution of green roofs towards reducing stormwater runoff in the cities of Kelowna and Vancouver. As these areas have disparate climatic conditions, they are ideal for analysing and comparing the effects of green roofs on stormwater runoff. The Curve Number Method (Technical Release-55) and Crop Coefficient Method are used to quantify the existing stormwater runoff and the potential runoff reduction of green roofs using local climatic data, such as rainfall, snowfall, evaporation and temperature. Two selected sites are analysed, including both commercial and residential buildings in Kelowna and downtown Vancouver, and are compared to show the particular effects of stormwater management in different climatic zones. This research also includes previous studies conducted, among others, in Berlin, Germany; Ottawa, Toronto and Vancouver, Canada; Chicago, Portland and Seattle, USA. The findings and calculated results are then used to develop the most effective green roof systems for Kelowna and Vancouver.

Due to the high rainfall and moderate evapotranspiration rates in Vancouver, extensive green roofs could reduce rooftop runoff by 29% if growing with drought tolerant plants like sedum, and by 49% with moderate water-use plants like sea pink (*Armaria maritime*). If 30% of the existing rooftop areas on the case study areas are greened, the total runoff could be reduced by 4%.

Because of the low rainfall and high evapotranspiration rates in Kelowna, extensive green roofs grown with sedum could achieve zero rooftop runoff by planting only 44% of the existing roof areas. The total runoff could be reduced by 24% if 30% of the existing rooftop areas on the case study areas are greened, and by 36% when planting 44% of the existing roof areas.

Keywords: stormwater runoff, green roofs, green streets, evapotranspiration

Daniel Roehr[1], Yuewei Kong[2], Jon Laurenz[3]

[1] Founder of the greenskinslab, Design Centre for Sustainability [DCS], School of Architecture and Landscape Architecture [SALA], UBC, Vancouver, BC, roehrd@interchange.ubc.ca, 604-827-4056
[2] Researcher. greenskinslab, DCS, SALA, UBC, Vancouver, BC, kevin.kong@shaw.ca, 604-827-4056
[3] Co-founder and researcher of the greenskinslab, DCS, SALA, UBC, Vancouver, BC, jonlaurenz@yahoo.com, 604-827-4056

Using the Forest and Range Evaluation Program (FREP) Water Quality Protocol to assist in the management of Community Watersheds

David Maloney and Brian Carson

Abstract

Water purveyors want to determine the effects of forestry operations on water quality. Should negative impacts be confirmed, watershed managers want to be able to prioritize actions that will economically mitigate those impacts. The Water Quality Effectiveness Evaluation procedure described here evaluates the fine sediment generating potential of common disturbed forestry sites within watersheds (slope failures, road stream crossings, windblown riparian zones etc.) Forest Licensees on the coast and in the interior have adopted this FREP Water Quality Evaluation methodology as an integral part of their environmental monitoring program. The method is relatively simple, takes a technician around 20 minutes to evaluate one site and provides a clear inventory of forestry induced sediment sources in a watershed and how they might be better managed.

Preliminary provincial data from 540 watershed sites collected in 14 forests districts in 2007 found that 71% of the sites had a low or very low potential to generate fine sediment, 22 % had a moderate potential and 6 % had a high potential to generate fine sediment. Opportunities for reducing fine sediment generation centered around paying more attention to planning road alignments near streams, increasing culvert density and improving placement during design and enhancing maintenance operations while road is actively used. This presentation introduces the FREP Water Quality evaluation methodology and provides examples of how it can improve management of B.C.'s community watersheds.

David Maloney[1] and Brian Carson[2]

[1] Ministry of Forest and Range, Prince George, BC
Corresponding Author: David.Maloney@gov.bc.ca, 250-565 4413,
[2] Private consultant, Roberts Creek, BC
604-886-3282, brian_carson@dccnet.com

Landscape and Irrigation Standards for Water Efficiency

Neal Klassen

Abstract

The City of Kelowna is located in British Columbia's southern interior, an area noted for its long summers and semi-arid climate. Watering requirements for landscape irrigation creates a summer demand as high as 7:1 over winter. Conservation efforts begun in 1996 have focused almost entirely on assisting residents to reduce landscape irrigation.

Early work revealed three clear challenges for reducing outdoor irrigation: 1) the poor soil in the area is not conducive to moisture retention; 2) a proliferation of poorly designed and maintained automatic irrigation systems contribute to water waste; and 3) many landscaping choices are not suitable for the area.

Conservation efforts to address these challenges at existing homes have been successful. In 1998, total utility water production for the year was 15.3 million Cubic Meters. In 2007, total water production was 15.6 million Cubic Meters, an increase of around 2% - despite a 25% increase in population over the same period.

In 2007, Kelowna adopted a Water Sustainability Action Plan that calls for a 15% reduction in water use over and above those reductions already achieved. To meet this target, conservation efforts had to go beyond remediating the challenges present at existing homes, to preventing those issues from occurring in the first place.

This paper examines the process by which Kelowna developed landscape and irrigation standards for water efficiency in all new development. Based on similar development bylaws in California and Nevada, these may be the first of their kind in Canada. The standards ensure that all new developments include: 1) adequate soil; and 2) irrigation systems and landscape plans that meet pre-set standards for water efficiency.

The City of Kelowna has had a bylaw requiring low-flow shower and toilets since the early 1990s. This ensures that water efficiency is "built in" to each home. The new landscape and irrigation standards ensure that water efficiency is now also "built out."

This presentation will be of interest to those concerned with reducing peak flows created by residential irrigation.

Neal Klassen[1]

[1] MA, Water Smart Coordinator, City of Kelowna, Kelowna, BC
neal@getwatersmart.com, 250-868-3339

Delegating Water Governance: Issues and Challenges in the BC Context

Linda Nowlan and Oliver Brandes

Abstract

The UBC Program on Water Governance published a report on evolving approaches to water governance in Canada, focusing on BC, commissioned by the BC Water Governance Project, a partnership of the Fraser Basin Council, BC Ministry of Environment, Fraser Salmon and Watershed Program, Georgia Basin Living Rivers Program and Fisheries and Oceans Canada in 2007. The paper is intended to provide useful information and tools for government and other stakeholders participating in the ongoing dialogue on water governance in the province of British Columbia. It presents an independent, academic analysis of select water governance issues, focusing on 'delegated' (also known as 'devolved' or 'shared' or 'distributed') water governance.

The analysis is predicated upon a recognition that water governance has undergone dramatic changes in Canada over the past decade, characterized by three key trends: the introduction of new watershed-based delegated governance management models in a number of Canadian provinces; legislative and policy reform setting higher standards for drinking water supply in a number of Canadian jurisdictions; and greater citizen involvement in environmental policy-making and environmental management. These trends have occurred for several reasons: a shift in the view of the role and mandate of governments; new legal requirements (particularly with respect to First Nations, and also mandated by a new generation of environmental laws); awareness of the expertise available outside of government, particularly in the context of decreased government resources; new approaches to citizen participation; increased emphasis on integrated management of environmental issues and watershed based management; and concern over the implications of climate change for both water resources and supply.

With this context, the paper examines the advantages and disadvantages of delegated water governance, and discusses the questions:

- What are the barriers to delegating water governance?
- Do the potential advantages of delegating water governance to lower scales outweigh the disadvantages?
- Which issues/aspects of decisions about water should be delegated, and which should not?

The report *Delegating Water Governance: Issues and Challenges in the BC Context* is available at: http://www.watergovernance.ca/Institute2/PDF/FBCwatergovernancefinal2.pdf.

Linda Nowlan[1] and Oliver Brandes[2]

[1] Faculty Research Associate, Institute of Resources, Environment and Sustainability, UBC, Vancouver, BC
Corresponding Author: lnowlan@ires.ubc.ca

[2] Associate Director and Water Sustainability Project Leader, POLIS Project on Ecological Governance, University of Victoria, Victoria, BC

An Optimist's View of Human Disturbance Regimes and the Future of Aquatic Ecosystems and Fisheries Resources in the Okanagan Valley

K.D. Hyatt, D. Paul Rankin, D.J. McQueen, V. Jensen, C. Alexander, M.M. Stockwell, P. Askey, and H. Wright

Abstract

Aquatic ecosystems in the Okanagan Basin have been subjected to "disturbance regimes" that are increasingly influenced by activities associated with global and local human population growth which shows no sign of abating. Disturbance regimes induced by global and local effects of human population growth and development increasingly threaten the integrity of "services" provided by aquatic ecosystems. Southern interior temperatures have warmed by approximately 1.5^{o}C over the past 50 years and recent year hydrographs have been characterized by lower average snow-pack and an extended period of late summer drought reflecting impacts of global climate change on local aquatic ecosystems. Virtually all portions of valley-bottom, aquatic ecosystems in the Okanagan exist on a continuum from moderately disturbed (e.g., pelagic zone of Okanagan lake) to severely degraded (e.g., riparian zone and channel of Okanagan River). This circumstance is attributable to decades of physical alterations to near-shore, riparian and wetland habitats; water regulation, changes to nutrient loading rates, and exposure to multiple waves of invasion by exotic species. Taken together, these changes have profoundly influenced cold-water fish populations and their associated fisheries over the past century. Most undesirable changes to aquatic ecosystems and the fish populations they support in the Okanagan are attributable to human impacts. Thus, management of the latter through directed interventions to conserve, protect and restore aquatic ecosystem elements is required if they are to retain some semblance of their historic character (e.g., healthy populations of anadromous and resident coldwater fish supporting sustainable use by human populations).

Development of an ecosystem based management (EBM) framework has been proposed as the key to maintenance of healthy aquatic ecosystems and the reversal of both fisheries declines and increasing risks of native species extinctions. Although development and maintenance of a truly effective EBM framework is constrained by physical, biological, social, economic and political realities, several recent initiatives provide encouraging signs that sufficient flexibility remains to adaptively manage combinations of these elements to achieve progress to this end in the Okanagan. Contributing factors to be discussed include: the recent emergence of improved collaboration among several levels of government, improved knowledge of cause and effect associations between human activities and aquatic ecosystem state, development of new resource management tools and the surprising resilience of some native fish species.

K.D. Hyatt[1], D. Paul Rankin[1], D.J. McQueen[2], V. Jensen[3], C. Alexander[4], M.M. Stockwell[1], P. Askey[3] and H. Wright[5]

[1] Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC
Corresponding Author: Kim Hyatt, hyattk@pac-mpo.gc.ca
[2] Professor Emeritus, York University
[3] BC Ministry of Environment
[4] ESSA Technologies Ltd.
[5] Okanagan Nation Alliance, Shannon Lake Road, Westbank, BC

The Okanagan Water Supply and Demand Project

Anna Warwick Sears

Abstract

Water availability has been a long-standing and contentious issue in the Okanagan, shaping land use and development patterns, and driving our economy. As we enter the 21st century, the Okanagan is experiencing one of the fastest population growth rates in Canada, and climate change projections indicate that the valley's already-arid environment will become more variable, with more frequent drought years. The goal of the Okanagan Basin Water Supply and Demand Project is to develop a water budget, using the best available science to estimate present and future water needs and availability, taking into account population expansion, climate change, land use change, preservation of the environment, and other factors. The last water evaluation of this magnitude was the Okanagan Basin Study in 1974. The project consists of a series of studies, reports and modeling efforts to describe water use and demand, surface water hydrology, groundwater, and climate scenarios for 81 separate nodes in the Basin. The results of this effort will have far-reaching impacts for water management, licensing and infrastructure planning and decision making. The project is being conducted as a joint partnership of eight different agencies representing four orders of government.

Anna Warwick Sears[1]

[1] Ph.D., Executive Director, Okanagan Basin Water Board, Coldstream, BC
anna.warwick.sears@obwb.ca, 250-550-3779

Water Information Management in the Okanagan Basin: Progress and Lessons

Clint Alexander

Abstract

The previous Okanagan Basin conference on water (CWRA 2005) called for the creation of a single Okanagan Basin Information Network (OBIN) to link existing data sources and make information readily available for decision makers. The mandate of the OBIN included an initial user needs assessment, establishing data quality standards, identifying priority gaps and a long-term funding plan. This paper focuses on information management progress since the 2005 conference, emphasizing products that will be generated by the 2007-2009 Water Supply and Demand Project. The paper emphasizes the discipline required to select, present and disseminate the most suitable data for multiple audiences, in addition to other success factors. Important water management questions exist at different scales and levels of detail, a fact that is often underestimated or 'lost in the excitement'. Here, information management projects too often attempt to be all things for all people, collapsing under the weight of their overgrown expectations. Instead, a distributed approach to information system development with standards coordination designed to connect up with value added synthesis tools is advocated. A highly collaborative OBIN service with sustained funding and a dedicated champion capable of staying in tune with its primary audience will go a long way toward enhancing regional understanding of current issues and future trends, truly helping to catalyze better water management decisions.

"Where is the knowledge in all the information?
Where is the wisdom in all the knowledge?"
- T.S. Elliot

Clint Alexander[1]

[1] B.Sc., M.R.M., ESSA Technologies Ltd., Kelowna, BC
calexander@essa.com, 250-860-3824

Communication and Trust Building: A Focus on Water Resource Management

Nelson R. Jatel

Abstract

Communication in the arena of water management, bridging science and policy, in the Okanagan evoke some interesting questions: Why is communicating water management ideas in the Okanagan challenging? What communication strategies were developed over the past 35 years? What unique and new communication strategies have been developed recently? What tools do we need to develop and implement in the Okanagan in order to successfully communicate important water issues? Communication at a fundamental level requires a sender, a receiver and an understandable message. The Okanagan Basin Water Board (OBWB), a unique local government water management body, has an opportunity to learn from previous locally developed communication strategies and create a new forward looking strategy based on trust and clarity. A communication strategy will take into account various audiences including, local government, senior governments and the public.

Communicating water management ideas in the Okanagan has layers of complexity as a result of a number of factors:

- within the semi-arid Okanagan, large mainstem lakes falsely portray abundant water;
- climate change impacts are likely to increase variability resulting in an increased periodicity of significant wet and dry years; and
- although there is one shared water in the Okanagan, precipitation varies from north to south and from valley bottom to the upper plateau – translating into a need for varied sub-basin responses to drought and storage opportunities.

In addition to the myth of abundance, the Okanagan, like many Canadian watersheds, is multi-jurisdictional. The Okanagan contains three regional districts, 14 municipalities and four aboriginal communities.

Compounding a multi-jurisdictional policy environment and spatial and temporal variation inherent to the Okanagan's hydrology is the multidisciplinary arena of Limnology that incorporates subjects that range from chemistry to biology to geology. These traditional disciplines operate in silos – with unique language and terminology has traditionally not provided for strong, unifying policy recommendations. In contract, the current Okanagan Supply and Demand project is one example where a multi-disciplinary scientific framework has been developed, complemented by strong project management and communication strategy to ensure the development of good water science to support policy in the Okanagan Basin. This project is one example of communication success.

Nelson R. Jatel[1]

[1] Director - Water Stewardship, Okanagan Basin Water Board
nelson.jatel@obwb.ca, 250-550-3758

During the Okanagan Basin Study in the early 1970s, it was identified that public input towards the planning and management of water and related resources in the Okanagan occurred in a haphazard way. As a means to develop a succinct communication strategy the1972 Basin Study implementation team developed a public involvement planning strategy called the Interested-based Planning Model (IPM). The IPM identifies a number of key findings including: strategic process elements, successes, areas for improvement and insights to support developing future Okanagan water communication strategies.

In the spring of 2005, the Canadian Water Resources Association hosted a significant water conference titled: Water – Our Limiting Resource, Towards Sustainable Water Management in the Okanagan. Outcomes of the communication strategy resulted in significant impacts to water management in the Okanagan and specifically created a new water management function for the OBWB.

Building on the lessons learnt from the IPM strategy developed in the 1970s and the recent 2005 communication models – a roadmap for considering future communication strategies is developing. Emphasis needs to be placed on integrating various activities including the Okanagan Sustainable Water Strategy, the Water Supply and Demand project and ongoing activities of the OBWB water management function. The OBWB has a historic opportunity to act on the recommendations put forward by the Water Stewardship Council and integrate lessons learned and best practices to build on old relationships – including aboriginal people, forge new ones and create and environment of open, ethical water management decision making. The OBWB's ability to demonstrate leadership and continue to develop proactive, adaptive management strategies is critically important. In the Okanagan there is an opportunity to ensure that water resource management responds to- and does not react to- future drought, climate change and the safe drinking water and water quantity needs of a growing population.

The Osoyoos Lake Water Science Forum

Clint Alexander

Abstract

The Osoyoos Lake Water Science Forum, held September 16-18, 2007 in Osoyoos, British Columbia, was attended by over 190 enthusiastic and concerned presenters and participants representing the scientific community, government, business and residents from both Canada and the United States. The Forum reflected the growing public concern for the sustainability of Osoyoos Lake, its water quantity and quality, and the growing sense among area residents that their quality of life is threatened. Concerns were raised over ongoing water quality problems in Osoyoos Lake, the potential for future wars over water supplies, the need for sustainable land-use planning, and the restoration of endangered habitats and species populations. Osoyoos Lake is one of the few water bodies in Canada that straddles the U.S. border, and requires formal international collaborative governance. There was recognition of the importance of both the Canada and US governments to continue working effectively together, and to involve the First Nations and Tribes as well as local residents in decision making. Climate change was recognized as a broad concern that will affect all aspects of lake health and management. The Forum produced a total of 16 candidate actions that regulators, planners and politicians should consider to promote Osoyoos Lake (and the Okanagan Basin's) environmental sustainability. Some of these have already begun to be implemented. The thoughtful participants of the Osoyoos Lake Water Science Forum are part of a growing water sustainability movement in the Okanagan, a movement that will hopefully inspire governments, planners and regulators to move more purposefully and more rapidly on the issues.

Clint Alexander[1]

[1] B.Sc., M.R.M., ESSA Technologies Ltd., Kelowna, BC
calexander@essa.com, 250-860-3824

The International Watersheds Initiative: An Integrated Approach to Canada-US Transboundary Waters and its Potential Relevance to the Okanagan Basin

J. Blaney, W. Brakel, I. Brooks, M. Laitta, and T. Yuzyk

Abstract

At the request of the governments of Canada and the United States, the International Joint Commission (IJC) is implementing the International Watersheds Initiative (IWI). The aim is to promote an integrated, ecosystem approach to issues arising in transboundary waters through enhanced local participation and strengthened local capacity. The IWI was conceived to facilitate the development of watershed-specific responses to emerging challenges such as intensified population growth and urbanization, global climate change, changing quantity and uses of water, pollution from air and land, and introductions of exotic species. The underlying premise is that local people, given appropriate assistance, are those best positioned to resolve many local transboundary problems. The initiative is being piloted in four river basins. In response to expressions of interest on both sides of the British Columbia/Washington State border, the IJC is ready and willing to facilitate a better integrated, binational approach to the Okanagan River/Osoyoos Lake basin. This paper describes the kinds of coordinated binational activities that might be feasible initially in Okanagan/Osoyoos area, and outlines the steps that, if locally desired, could lead eventually to the establishment of an international watershed board. A first map of the Okanagan drainage area, created using merged and harmonized Canadian and U.S. hydrographic data, is presented.

J. Blaney[1], W. Brakel[2], I. Brooks[3], M. Laitta[4] and T. Yuzyk[5]

[1] Commissioner, Canadian Section, International Joint Commission, Ottawa, ON
[2] Senior Adviser, U.S. Section, International Joint Commission, Washington, DC
[3] Chair, U.S. Section, International Joint Commission
[4] Geographic Information Systems Coordinator, U.S. Section, International Joint Commission
[5] Senior Science Adviser, Canadian Section, International Joint Commission

Lake Tahoe: Operating in a Bi-state, Multijurisdictional Watershed

Larry Benoit

Abstract

Lake Tahoe was formed 2 to 3 million years ago by down-dropped geologic fault blocks between the uplifted Sierra Nevada to the west and Carson Range to the east. It is considered the second deepest lake and it is the highest elevation lake of its size in the United States. Lake Tahoe's surface and watershed are approximately two thirds in California and one third in Nevada providing a bi-state and water dispute basis of management. Lake Tahoe occupies approximately two fifths of the total Tahoe Basin watershed area including two counties and one incorporated city in California, and three counties in Nevada. Disputes over Lake Tahoe water between the states and other parties such as the Pyramid Lake Piute Tribe have existed for over 100 years and are proposed to be finally resolved by the US Congress' ratification of the Truckee River Operating Agreement expected by 2010. Water rights that will be administered under the agreement were assigned to the California and Nevada portions of the Lake Tahoe Basin under the California / Nevada Truckee River Interstate Compact signed by the two states in 1970-71, but not ratified by Congress. The legal Lake Tahoe elevation by Federal Court decree is 6229.1 ft., and the top 6 feet to the natural rim of 6223 ft. is operated as a reservoir by the US Bureau of Reclamation with a dam at the Tahoe City, California outlet. Lake Tahoe is designated as an Outstanding National Resource Water. The bi-state / Federal Tahoe Regional Planning Compact (1969, and updated in 1980) authorized the formation of the Tahoe Regional Planning Agency as the planning and land use regulatory authority in the Tahoe Basin. The Compact also required the agency to establish environmental standards, adopt and enforce a regional plan and implementing ordinances which will achieve and maintain such standards, and provide opportunities for orderly growth and development consistent with such standards. A restrictive clause states "No provision of this compact shall have any effect upon the allocation, distribution or storage [of] interstate waters or upon any appropriate water right."

Larry F. Benoit[1]

[1] Ph.D., Water Quality Program Manager, Tahoe Regional Planning Agency, Stateline, Nevada
lebenoit@trpa.org, 775-588-4547 ext 227

Wastewater Treatment Plants as Sources of Contaminants in the Aquatic Environment

Chris Metcalfe

Abstract

Contaminants released into municipal wastewater include industrial chemicals, personal care products and pharmaceuticals, as well as natural hormones that are excreted by the human population. Once discharged into surface water, the contaminants from wastewater can have impacts on aquatic organisms. Examples of impacts on fish include bioaccumulation of synthetic musks to part per million levels, alternations to spawning behaviour, feminization of males and in severe cases, complete reproductive failure. Case histories that illustrate these responses include laboratory studies conducted with the aquarium fish, the Japanese medaka, whole lake addition studies that evaluated the effects of synthetic estrogen on the reproduction of fathead minnows and other native species, and sampling of white perch from the Great Lakes to determine whether there have been alterations to the gonadal development of males of this species. These studies all lead to the conclusion that contaminants carried in municipal wastewater have the potential to affect the development and reproduction of fish. The increased use of pharmaceuticals as a result of changing population demographics, the growth in populations in some areas and continued low investment in municipal wastewater treatment infrastructure in Canada may lead to greater impacts on aquatic resources in the future.

Chris Metcalfe[1]

[1] Ph.D., Professor, Environmental and Resource Studies, Trent University, Peterborough, Ontario

The Social Life of Water

John Wagner

Abstract

As water cycles through the Okanagan watershed, providing essential ecosystem services, it also flows through our houses, workplaces and sites of recreation, and as such acquires social as well as ecological and economic characteristics. Its social characteristics include, for instance, its capacity to transform less desirable, arid landscapes, into irrigated, more highly valued landscapes such as orchards, vineyards, and golf courses. Water views of lakes, rivers and creeks acquire aesthetic values and these values also become commoditized within real estate markets and recreational industries. As commodity and symbol, water thus mediates our social lives and becomes a source of conflict among different interest groups and among those who endorse quite different visions of what the Okanagan is and might become. From this perspective, choices about water management must be understood as choices about development, cultural values and social relations. In this paper I review some of the social, economic and political changes occurring in the Okanagan region today and analyze these changes in relation to water allocation practices and future policy options.

John Wagner[1]

[1] Assistant Professor, Cultural Anthropology, UBC Okanagan, Kelowna, BC
john.wagner@ubc.ca

POSTER PRESENTATIONS

Beyond Conservation – Applying Water Sensitive Urban Design to Vernon, B.C.

Jennifer Miles

Abstract

Current land use planning in Canada considers water to be in unlimited supply; that water will always be available to support new development. When limits are encountered, restrictions on use are instituted to ensure sufficient supply. Conservation based on restrictions cannot provide sufficient "new water" to meet demand, based on population growth and climate change projections. Water Sensitive Urban Design (WSUD) is a management approach that goes beyond use restrictions to understand how water is used by all aspects of a community and the local ecosystem it inhabits. WSUD offers an alternative mode of urban development, addressing supply shortfalls by maximizing the use of water (precipitation, stormwater, or greywater) within the urban distribution system, thereby reducing demand on high elevation reservoirs.

WSUD is being developed in Australia because of years of drought and concern over the allocation of water between human and ecological uses. An analysis of the potential for applying the WSUD approach to Vernon will be presented through a conceptual framework that identifies three key water management principles:

- Recognize connections between human social systems and ecological systems – collectively, the biosocial system – to determine shared needs;
- Develop resilient systems by encouraging functional diversity – use the right type of water for the need, diversify sources; and
- Recognize management limits – we cannot control complex ecological processes (e.g. climate) due to uncertainty but we can manage human interactions with those processes and take advantage of the ecological goods and services provided.

WSUD tools will be applied to Vernon to illustrate the potential of sustainability-based municipal water management to reduce stress on natural hydrologic systems as well as ageing utility infrastructure. Tool selection will be driven by the above principles, which require an understanding of the local biosocial system context. Barriers to implementing WSUD will be assessed to recommend priorities for intervention, based on the Vernon context as well as challenges faced by Australian water managers. This research will suggest how WSUD can help water managers move beyond restricting use (conservation) to help achieve Vernon's goals for long-term water security.

Jennifer Miles[1]

[1] B.Sc., MEDes. Candidate, Faculty of Environmental Design, University of Calgary, Calgary, BC
jamiles@ucalgary.ca, 250-307-5058

The Use of Stable Isotopes to Assess the Origin and Fate of Nitrogen in Shallow GW in Osoyoos, BC

Pana Athanasopoulos, M.J. Hendry, Leonard I. Wassenaar, and Denise Neilsen

Abstract

Elevated levels of nitrate are present in shallow groundwater throughout the Okanagan valley, and due in part to intense agricultural activities, primarily from the application of fertilizer.

Here we present the results of two years of research (funded by the Canadian Water Network, Agriculture and Agri-Food Canada, NSERC, Geological Survey of Canada, B.C. Ministry of Environment, and Environment Canada) conducted in one of these agriculturally intense areas, west of Osoyoos, where shallow groundwater beneath agricultural fields is collected in two tile drainage systems and discharged directly into Osoyoos Lake.

In addition to classical hydrogeological methods (drilling, piezometer installation, and water level measurements), isotopic and geochemical methods were used to characterize the potential source(s) of shallow groundwater and tile drainage water discharging into Osoyoos Lake and to confirm the origin and fate of nitrate present in the shallow groundwater and tile drainage waters. These analytical techniques included:

- field and laboratory measurements of major dissolved ions in the groundwater (*n = 105*) and tile drainage water (from 1997 to 2008, *n = 198*);
- stable isotope analysis of $\delta^{15}N$ and $\delta^{18}O$ of nitrate in the groundwater (*n = 32*) and in tile drainage water (from 1997 to 2006, *n =87*);
- stable isotope analysis of $\delta^{2}H$ and $\delta^{18}O$ of the groundwater (*n = 122*) and tile drainage water (from 1997 to 2008, *n = 153*);
- stable isotope analysis of $\delta^{18}O$ of dissolved oxygen in the groundwater (*n = 15*); and
- tritium/helium ($^{3}H/^{3}He$) age dating of groundwater (*n = 9*).

The results of this research were used to: (1) determine the extent of nitrate contamination of the shallow groundwater, (2) evaluate historical trends in nitrate concentrations; (3) determine the source and age of this nitrate contamination, and (4) estimate the impact of the groundwater and tile drainage systems on the quality of Osoyoos Lake.

Pana Athanasopoulos[1], M.J. Hendry[1], Leonard I. Wassenaar[2], and Denise Neilsen[3]

[1] University of Saskatchewan, Saskatoon, SK
Corresponding Author: Pana Athanasopoulos, Panagiota_Athanasopoulos@golder.com
[2] Science and Technology Branch, Environment Canada, Saskatoon, SK
[3] Ph.D., Agriculture and Agri-Food Canada, Summerland, BC

Cumulative Effects Monitoring of Okanagan Streams Using Benthic Invertebrates, 1999 to 2004

Vic Jensen

Abstract

Rapid bioassessment procedures often use benthic invertebrates as indicators of stream water quality thereby integrating physical, chemical and biological stressors associated with watershed disturbance. To date, Okanagan stream water quality assessments have relied on chemical and physical assessments which may not fully assess cumulative effects within this rapidly urbanizing landscape. Benthic invertebrates were collected from riffle habitats on 23 low elevation Okanagan stream sites between 1999 and 2004, and analyzed using the Benthic Index of Biological Integrity concept. Sites represented a range of watershed disturbance and expected stress. Stress levels were estimated using GIS at the watershed level, and field inspection at the site for in-stream and near stream habitat condition. Five benthic invertebrate measures, total taxa, number of plecoptera taxa, number of ephemeroptera taxa, number of intolerant taxa, and number of clinger taxa, responded predictably to cumulative stress. Scores were high for Equesis, Peachland, Shorts, Whiteman, Ellis upstream of Penticton, Chute, McDougall ups of Hwy 97, Coldstream, and Lambly Creeks. These sites had high biological diversity and many benthic invertebrate taxa sensitive to disturbance. Sites with much lower species diversity and fewer sensitive taxa were Mill in Kelowna, Ellis near Okanagan River, Vernon Creek in Vernon, Trout Creek near Hwy 97, Shuttleworth in Okanagan Falls, Eneas and Prairie in Summerland, and BX Creek in Vernon. Urban stream sediments were often elevated in PAH and are associated with reduced benthic scores. This information should be useful to stream and watershed protection initiatives, sustainability reporting, and stormwater management planning efforts in the Okanagan Basin.

E.V. Jensen[1]

[1] RPBio., Senior Impact Assessment Biologist, Ministry of Environment, Penticton, BC
Vic.Jensen@gov.bc.ca

The Soft Path for Water in a Nutshell

O.M. Brandes, D.B. Brooks, E. Reynolds

Abstract

Many Canadians believe that our fresh water resources are boundless. The truth is that only a small proportion of our water is renewable and located close to where most Canadians live. Continuing to take more and more water from nature while ignoring wasteful use at farms, factories and households will likely lead us to an "arid" future of our own making. The best way to secure the future for fresh water is to develop a plan that draws all "new" water from better use of exiting supplies (efficiency) and to change habits, attitudes and economic structures (conservation). This poster presentation will outline a new approach to water planning that has the potential to begin developing water sustainability in Canada. "Soft path" planning for freshwater management differs fundamentally from conventional, supply focused water planning. It starts by changing the conception of water demand. Instead of viewing water as an end product, the soft path views water as the means to accomplish certain tasks, such as sanitation or agricultural production. Soft path planning allows us to unleash the full potential of demand management strategies. It is an innovative planning approach that explores the changes that are needed today to move water management and policies onto a sustainable path for long-term ecological and social prosperity.

Soft Path for Water In A Nutshell
http://www.waterdsm.org/publications.htm

Keywords/phrases: soft path for water, water conservation, demand management, sustainable water management.

O.M. Brandes[1], D.B. Brooks[2], E. Reynolds[3]

[1] Senior Research Associate, The POLIS Project on Ecological Governance, University of Victoria, Victoria, BC.
[2] Director of Research, Friends of the Earth Canada, Ottawa, ON.
[3] Communications, The POLIS Project on Ecological Governance, University of Victoria, Victoria, BC.

Changing the Game: Harnessing Consumer Trends to Restore Habitat and Improve Water Quality in the Okanagan

Michelle Boshard and Larry Bailey

Abstract

How do we make it economically attractive to restore habitat and improve water quality, rather than destroy or degrade it? That is the question answered at the heart of Watershed Wealth. This poster/paper describes the goal and structure of this new coop-based social purpose enterprise, whose first pilot Delivery Agent is being developed in the Okanagan Basin. From site preparation to long-term monitoring and maintenance, every stage of a Watershed Wealth restoration site will generate income, and simultaneously support both local community environmental stewardship and economic development. The machinery, strategies and consumer-driven trends traditionally employed for profit by business will now be put to work to drive restoration of the physical world humans have destroyed.

Watershed Wealth is "the business of restoration" - it restores lost or degraded habitat in ecologically compromised areas using scientifically sound and locally appropriate native planting regimes that include commercially valuable species which will be selectively collected and marketed by certified program Delivery Agents. Basic principles will include preservation of ecosystem function, biodiversity and native species. There has been considerable encouragement from Provincial and Federal agencies.

Watershed Wealth is designed to be suitable for participation by farmers, small and large landowners, land developers, volunteer groups and various government departments at all levels, in both rural and urban landscapes. Implementation will be simplified and based on farming, forestry and wildcrafting skills, but the science informing the process will be of the highest order and include soil sciences, hydrology, the whole range of biological and ecological disciplines and the nutritional and pharmaceutical analysis of the end products for market. The enterprise will use cutting edge technologies, from nanotechnology to monitor plant growth, soil/water/plant/pollutant cycles, carbon sequestration and product chain of custody, to the newest online open-source community based social marketing techniques to promote and logistically support the program.

This program breaks down traditional barriers between the environmental and economic sectors, bringing together major partners who may have never previously considered their potential connections or collaboration. The poster / presentation describes background need and rationale, applications and benefits, and how it fits in the Okanagan and beyond.

Michelle L. Boshard[1] and Larry L. Bailey[2]

[1] Owner, Rural Resource Associates Ltd., Osoyoos, BC
Corresponding Author: michelle@ruralresource.com, 250-276-4181
[2] Business Manager, Rural Resource Associates Ltd., Osoyoos, BC

Salmonid Distribution in Relation to Stream Temperatures in Fortune Creek, British Columbia – The Influence of Surface and Groundwater Interactions

Elinor McGrath, Adam Wei, and Craig Nichol

Abstract

Surface water and groundwater interaction in a stream can greatly influence the physical and chemical characteristics of stream water (i.e. temperature, dissolved oxygen etc.), and consequently aquatic biology. In an attempt to quantify whether surface water and groundwater interaction affects salmonid use of Fortune Creek in the North Okanagan, British Columbia, the relationship between water temperatures and salmonid occurrences was explored. Over the summer of 2008, temperature data were collected at 22 sites along the creek, and weekly salmonid counting was conducted at eight sites. Piezometers were installed in the streambed in a known groundwater upwelling area to examine how the hydraulic gradient changes over the summer as streamflow is reduced and groundwater pumping pressure increases. Temperatures at the salmonid count sites were measured at 30–minute intervals in the air, the water, and at two depths below the streambed. The measurements in the streambed were intended to verify the presence of cool groundwater upwelling through the gravel. Piezometers were equipped with water level loggers and installed in the stream with the screen at 3 m below the streambed. In addition, a water level logger was installed in a nearby agricultural well to determine how pumping affects the hydraulic gradient in the creek. Water releases from a reservoir located on the headwaters of Fortune Creek were tracked along the length of the creek to assess whether they had an impact on stream temperatures. This data, together with water chemistry samples, was used to quantify mixing ratios of surface water and groundwater at several selected sites.

Salmonid counts of juvenile coho (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*) and rainbow trout (*Oncorhynchus mykiss*) were conducted weekly with baited minnow traps set over night. Preliminary results indicate that salmonids are absent in the lower valley bottom reaches of the creek during periods of high stream temperatures. Upper reaches of the creek, where temperatures are cooler, showed abundant salmonid numbers throughout the summer.

Elinor McGrath[1], Adam Wei[2], and Craig Nichol[3]

[1] M.Sc. Candidate, Irving K. Barber School of Arts and Sciences, University of British Columbia Okanagan, Kelowna BC.
Corresponding Author: elinorjochum@hotmail.com
[2] Associate Professor, Watershed Management Research Chair, Irving K. Barber School of Arts and Sciences, University of British Columbia Okanagan, Kelowna, BC
[3] Assistant Professor, Hydrogeology, Irving K. Barber School of Arts and Sciences, University of British Columbia Okanagan, Kelowna, BC

Inventory and Mapping - Okanagan Lake, Creeks and Wetlands

Michelle Kam

Abstract

Kelowna, placed in the heart of the Okanagan, borders Okanagan Lake and has a significant number of creeks and wetlands within its boundaries. As development continues to rise, the City of Kelowna recognizes the importance of accurately identifying, locating and creating an inventory of waterbodies and their associated habitats and attributes. Therefore, the City embarked on a journey to map the foreshore of Okanagan Lake, the creeks and the wetlands within Kelowna.

In 2004 the City of Kelowna and the Regional District of the Central Okanagan completed the Central Okanagan Foreshore Inventory and Mapping project. This project provides agencies with easily accessible inventory of land use, shore type, existing riparian condition and anthropogenic alterations throughout the study area.

In 2005, the City of Kelowna hired Ecoscape Environmental Consultants Ltd to conduct Sensitive Habitat and Inventory Mapping (SHIM) of both Mill and Bellevue Creeks. In 2006, the City was able to re-hire Ecoscape to complete an additional 52 kilometres of creek SHIM.

In 2007, the City of Kelowna hired Ecoscape Environmental Consultants Ltd to complete a Wetland and Inventory Mapping (WIM) project. It is estimated that over 85% of the valley bottom wetland and associated riparian habitats have been lost in the Okanagan. Many of the remaining wetlands are highly fragmented. A total of 278 wetlands including 172 previously unmapped wetlands were inventoried and mapped.

In 2008, SHIM will be completed on the remaining creeks within Kelowna. All of the SHIM and WIM data will be forwarded to the Community Mapping Network so it can be uploaded for other levels of government, the public and consultants.

Funding from City of Kelowna, Central Okanagan Regional District, Okanagan Basin Water Board, Real Estate Foundation and Ducks Unlimited has made the above projects feasible. This data and mapping has provided urban planners with up-to-date information, allowing for more informed planning decisions to better protect, improve or enhance remaining foreshore, creek and wetland ecosystems. Numerous departments including Environment, Drainage, Planning, Parks and the Fire Department are using the information to date.

Michelle Kam[1]

[1] Watershed Coordinator, City of Kelowna, Kelowna, BC
MKam@kelowna.ca, 250 469-8982

Managing Middle Vernon Creek for Humans and the Environment: Understanding a Highly Connected Surface and Groundwater System

Natasha Neumann, Lorne Davies, Adam Wei, and Jeff Curtis

Extended Abstract

The Oceola Fish and Game Club (OFGC) has been working on management issues in the Middle Vernon Creek watershed since 2000. The OFGC has implemented an adaptive management planning process that re-assesses its priorities as new information is collected and knowledge gained. This project, a partnership between the OFGC, the University of British Columbia Okanagan and the District of Lake Country (with support from First Nations, the local community and businesses), is the latest step in that planning process.

The southern portion of the Kalamalka-Wood Lake basin has been broken down into sub-watersheds for management purposes (Figure 1). The Swalwell (Beaver) Lake and Oyama Lake sub-watersheds in the headwater areas east of Winfield are important reservoirs. This project focuses on the Ellison (Duck) Lake, Middle Vernon Creek and Winfield Creek sub-watersheds, located in the valley bottom.

Upper Vernon Creek drains Swalwell (Beaver) Lake, flowing west into the main valley and into Ellison (Duck) Lake. Where Upper Vernon Creek enters the valley it flows over a highly permeable alluvial fan deposit. Considerable volumes of water infiltrate the ground where the creek flows over the fan, and it has been identified as a groundwater recharge zone (Le Breton, 1974). Ellison (Duck) Lake drains to the north through Middle Vernon Creek to Wood Lake. Spring-fed creeks on the west side of the valley contribute to Middle Vernon Creek along its path. At approximately halfway between Wood and Ellison (Duck) Lakes similar springs combine to create Winfield Creek which also flows north

Surface water sources (creeks and lakes) as well as groundwater are used in the Winfield area for domestic and irrigation water. At present priority water licencees on Middle Vernon Creek are not receiving water for irrigation during the summer months. There are over 200 wells in the valley bottom, ranging in depth from very shallow (10 feet or 3 metres) to more than 200 feet (61 metres). Most wells are used to support single-family domestic use, but there are a number of large capacity wells that supply trailer parks, resorts and suburban neighbourhoods.

Natasha Neumann[1], Lorne Davies[2], Adam Wei[1], and Jeff Curtis[1]

[1] Chemistry, Earth and Environmental Sciences, University of British Columbia Okanagan, Kelowna, BC
Corresponding Author: Natasha.Neumann@ubc.ca, 250-807-8779
[2] Geostream Environmental Consulting, Kelowna, BC

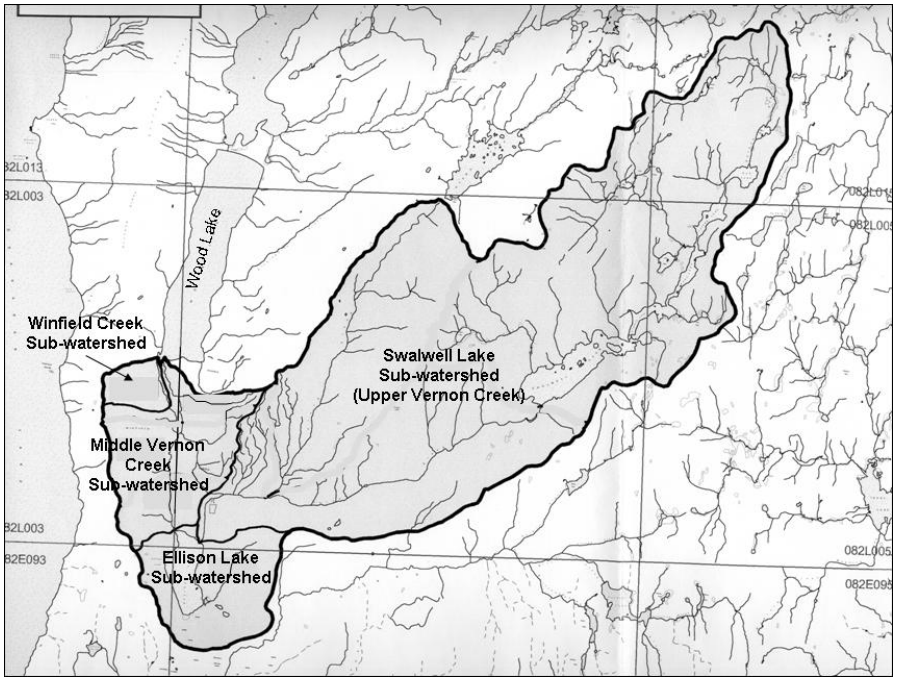

Figure 1: Map of southern Kalamalka-Wood Lake basin.

Middle Vernon Creek went dry in 2003 and 2004 due to low water levels in Ellison (Duck) Lake. The creek went dry again in 2007 and 2008 as a result of beaver dam construction in the upper reaches. Between 1972 and 1990 flow was augmented when the Hiram Walker Distillery released 5,000,000 m^3 of Okanagan Lake cooling water into Upper Vernon Creek. In 2007, urban development was responsible for reduced flows in Winfield Creek. Because this creek is an important Kokanee spawning channel, groundwater management has become an issue of concern in the local community.

The most comprehensive study of the surface and subsurface hydrology of the Winfield Flats area was conducted in the 1970s as part of the Okanagan Basin Study. It is apparent that groundwater and surface water are very closely connected in this area, and that to effectively manage one requires management of the other. Since the 1970 studies more data has become available on such things as the area's geology, and there has been an increase in water use as agriculture, industry and populations have expanded. The OFGC has concurrently been collecting hydrometric data and developing adaptive management strategies to address low flows in Middle Vernon and Winfield Creeks. Effective management requires cooperation by all users. It also requires an understanding of the regional hydrology, including the identification of sources, flow control structures, withdrawals and the flowpaths that connect surface and subsurface waters. This project was initiated to take advantage of the OFGC monitoring network and to address the need for a better understanding of the regional hydrology to support planning.

One of largest challenges to effective community watershed management is that management is based on jurisdictional boundaries, not watershed boundaries. The Middle Vernon Creek watershed spans the Duck Lake Indian Reserve No.7, the District of Lake Country, the City of Kelowna and the Regional District of the Central Okanagan. Other issues that complicate the

situation include the need to address First Nation water rights and source protection for both surface and ground water.

The main objectives for this project are to:

- Establish a network of surface water and shallow groundwater monitoring stations
- Complete a strategic well inventory and water quality sampling program
- Produce aquatic resource maps at different scales, ranging from the watershed to sub-watershed scale, and
- Develop terms of reference for a Water Use Plan (WUP) that incorporates both surface and ground water resources. The Mission Creek WUP is being used as a template

The OFGC has maintained a hydrometric monitoring network in the area for the past few years under their guiding principle that "you have to measure it to manage it". This network has been expanded for this study to identify where creeks gain from or lose to groundwater. These measurements will be enhanced by a study of the natural chemistry of the waters (surface and subsurface), which will refine our ability to identify the different sources of water to the creeks, and therefore the dependence of the creeks on these sources during periods of low-flow.

A series of aquatic resource maps will be generated, including community watershed boundaries, aquifer locations and more detailed point information on springs, major wells, major source water intakes and groundwater recharge and discharge zones. These maps are intended not only as management tools, but also for public education, to develop the community's awareness of its watershed and areas of sensitive habitat. The OFGC is very engaged with the community and puts considerable effort into outreach on resource and conservation issues. The club's experience and infrastructure will be critical in disseminating the results of this study. It will also be important to create a central repository of existing reports and data, to have ongoing discussions with community partners, and to make the results available to planners and managers.

The Middle Vernon Creek watershed is an example of a highly connected surface and groundwater system that supports a human population as well as a variety of aquatic and terrestrial ecosystems. Local, regional, provincial and First Nations governments, private industry, public interest groups, individual landowners and the UBC Okanagan are working together on this project to improve understanding of the regional hydrology, an important step towards developing a management plan that considers surface and subsurface water flowpaths as a single, interacting resource.

References

Davies, L.; D. Shanner. 2003. Biological and hydrological assessment of the Middle Vernon Creek watershed. Submitted to the Oceola Fish and Game Club: Winfield, British Columbia.

Le Breton, E.G. 1974. A hydrogeological study of the Kalamalka-Wood Lake basin. Water Investigations Branch, British Columbia Department of Lands, Forests and Water Resources: Victoria, British Columbia.

What is Happening to Wild Salmon in Your Community?

Camille Rivard-Sirois

Abstract

The ***Canadian Okanagan Basin Technical Working Group (COBTWG)*** is a tri-partite working group dealing with technical issues associated with management of salmon and resident fish stocks and their associated habitat requirements in the Canadian portions of the Okanagan River basin. Participants to the COBTWG include Fisheries and Oceans Canada, Okanagan Nation Alliance Fisheries Program and B.C. Ministry of Environment.

The ***Reintroduction of Sockeye Salmon into Skaha Lake project*** is a 12-year initiative to reintroduce and re-establish the indigenous sockeye salmon back into their historic habitat in Skaha Lake. This project reaches to stabilize and rebuild the declining wild Okanagan Sockeye population, to return sockeye to their former habitat and migration range, and to revitalize the Okanagan Nation salmon fishery.

The ***McIntyre Dam project*** is a plan to refit the actual gates at McIntyre Dam (Oliver) in order to allow sockeye salmon passage. With this modification, salmon will be able reach Vaseux Lake, an important historic habitat which they have been unable to access for the last several decades.

The ***Okanagan River Restoration Initiative project*** (ORRI) is a plan to re-naturalize one of the most biological sections of the Okanagan River. By re-creating a wider floodplain, restoring the riparian vegetation and re-meandering a part of the channelized river, ORRI will provide a better habitat for salmon and trout, reduce risk of flooding and improve water quality.

The ***Fish Water Management Tools project*** (FWMT) is a computer model developed specifically to help authorities manage water flows in the Okanagan River in a “fish friendly” manner. The model uses real time field data to make predictions and decisions witch benefit kokanee and sockeye salmon while respecting the needs of other water users.

Camille Rivard-Sirois[1]

[1] Fisheries Biologist, Okanagan Nation Alliance
crivard@syilx.org, 250-490-9779

Duteau Creek Watershed Assessment and Protection Plan

Tricia Brett and Renee Clark

Abstract

Source water quality is a primary concern for Greater Vernon Water (GVW) and it is the initial barrier in a comprehensive drinking water protection plan. GVW initiated a source assessment and watershed protection plan on Duteau Creek in July 2007 to comply with the water system operating permit issued by the Interior Health Authority (IHA) under Section 8 of the *Drinking Water Protection Act*. As Duteau Creek Watershed is a multi-use community watershed, it is also important to understand anthropogenic impacts, impacts of climate change, impacts of mountain pine beetle and to collect relevant information for evidence based action. The key elements that have been considered in this project are modules 1, 2, 7 and 8 of the *Comprehensive Drinking Water Source to Tap Assessment Guideline* released by the Ministry of Health and the Ministry of Water, Land and Air Protection (now Ministry of Environment) and the Interior Watershed Assessment Procedure (IWAP) that focused on drinking water.

GVW identified a need for a technical advisory committee which includes members from Ministry of Forests and Range, Ministry of Environment, UBC-Okanagan and IHA. Members of the committee bring expertise, background knowledge and a wealth of resources to the table which in turn will produce a superior product.

The threats to drinking water that have been identified are significant increases in forestry activity due to the Mountain Pine Beetle infestation, sediment/turbidity from anthropogenic activities, pathogenic organisms from human and animal waste and a significantly undersized intake pond. A recommendation has been made that GVW work with licensed stakeholders to use best management practices regarding operations within the watershed as well as provide education material to individuals using the watershed. Finally it has been recommended that the Source Protection Plan be a living document containing a monitoring and reporting plan that is looked at each year. Following these opening recommendations, a cattle impact reduction plan has been initiated with funding from the OBWB and in kind works from multiple partners, as well as the intake pond upgrades are being put into the capital works budget.

By working with a large network of people and multiple stakeholder meetings, a document is being produced which many people take ownership of and respect. This results in stronger working relationships within the community watershed and increased knowledge within the groups.

Tricia Brett[1] and Renee Clark[2]

[1] B.Sc, AScT, Water Quality Technologist, Greater Vernon Water, Coldstream, BC
[2] Senior Water Quality Technologist, Greater Vernon Water, Coldstream, BC

Long-Term Water Quality Trends in Okanagan Basin Lakes

Michael Sokal, Vic Jensen, and Hailey Goode

Abstract

The Okanagan Valley is one of the most rapidly developing regions in Canada. Widespread urban development along with extensive agricultural activities challenge water resource management of five large lakes (Wood, Kalamalka, Okanagan, Skaha and Osoyoos lakes) in the Okanagan basin. These water bodies provide important habitat for aquatic life, community drinking water, irrigation water to orchards and vineyards, and provide a variety of tourism and recreational opportunities. Consequently, protecting the water quality of these lakes is essential.

Phosphorus is a key nutrient driving the aquatic food chain and limits overall water clarity and quality in freshwaters. Decreasing water quality and nuisance algal blooms in the 1960's led to improved municipal sewage treatment and reduced phosphorus loading to Okanagan, Skaha, and Osoyoos lakes. The current Ministry of Environment monitoring program (Okanagan large lakes water quality monitoring program) was initiated in the 1970's to provide water quality data to decision makers within government, industry and to inform the public. These data are used to identify current status and trends in lake water quality within the Okanagan Basin, to determine success and challenges remaining in the control of excessive nutrient or other contaminant loading from point and non-point sources. Increasingly, this monitoring benefits from collaboration with senior and local governments, academic institutions and stewardship groups.

The monitoring shows that nutrient concentrations in Okanagan basin lakes have changed through time as a result of both natural and anthropogenic influences. Different watersheds, surface area, volume and land use, result in varying effects of nutrient enrichment or reduction. Phosphorus concentrations in all lakes show the influence of climate variation, however, trend assessment can be complex particularly in the two largest lakes, Okanagan and Kalamalka. For smaller lakes where phosphorus reduction actions have been implemented, there are marked decreasing trends. This is most evident in Skaha Lake which has significantly decreased phosphorus concentrations, increased water clarity and increased dissolved oxygen. Although not as apparent, Osoyoos Lake is also showing signs of improvement (decreasing phosphorus). These improvements can take decades to manifest themselves, re-enforcing the need to be proactive in identifying emerging water quality issues and working towards timely solutions.

Michael A. Sokal[1], Vic Jensen[1] and Hailey Goode[1]

[1] Environmental Protection Division, Ministry of Environment, Penticton, BC
Corresponding Author: Mike Sokal, mike.sokal@gov.bc.ca, 250-490-2284

Polybrominated Diphenyl Ether Flame Retardants in the Kelowna Wastewater Treatment Plant: Concentrations, Patterns, Influence of Treatment Processes, and Potential Effects on Okanagan Lake

Sierra Rayne

Abstract

Concentrations and patterns of the mono- through deca-substituted polybrominated diphenyl ether (PBDE) flame retardants were determined in all major unit operations/processes within the Kelowna wastewater treatment plant (WWTP). PBDEs do not appear to be substantially degraded or otherwise removed by wastewater treatment processes such as anaerobic, anoxic, and aerobic biological treatment, anaerobic digestion, dissolved air flotation, or sand-anthracite filtration. An overall removal efficiency of 93% was observed for PBDEs in the Kelowna WWTP due to sorption onto wastewater sludges, well below that predicted by equilibrium partitioning models. High levels observed in the resulting WWTP biosolids may contaminate a wider environment and pose a long-term risk to human and ecological health through their use as a soil amendment ("Ogogrow"). Lower concentrations of PBDEs contained within high volumes of the aqueous WWTP effluent may result in a large PBDE flux into receiving waters, posing a potential threat to both aquatic and terrestrial ecosystems. Subsequent modeling of Okanagan Lake examined the potential long term effects of various wastewater-derived PBDE loading scenarios on this unique aquatic system. If current environmental input patterns of these commercial flame retardants continue over the next three decades, total PBDE concentrations in the Okanagan Lake water column and in suspended and surficial sediments are expected to increase significantly. Following implementation of a hypothetic halt on PBDE releases into Okanagan Lake, PBDE concentrations in the water column and sediments decline by less than 35% over the ensuing 17 year modeling period after the ban, illustrating the potential long-term problems arising from persistent contaminants into this poorly flushed aquatic system. The results also suggest PBDEs likely represent one of the largest halogenated aromatic loadings to Okanagan Lake.

Sierra Rayne[1]

[1] Thompson Rivers University - Open Learning Division, Kamloops, BC
srayne@tru.ca, 250-852-7026

Balancing Demand Side Management in a Semi Arid Climate

Carolyn Stewart

Abstract

Identifying areas of opportunity in demand side management can be challenging, mostly due to inherent social needs linked to lush, green landscaping in our semi arid desert. Therefore, in order to reduce the impact of reaching maximum capacity on the Penticton Water Treatment Plant as well as infrastructure upgrades, the water conservation program was created in 2004. The focus of this poster is on measurable outcomes when establishing effective, results driven demand side management programs.

The objective of this poster is to provide details on social marketing drivers such as developing a reward based program by identifying positive behaviours as well as modifying behaviours by introducing eye catching signals targeted to induce acceptable behaviour changes, and measuring how these behaviours affect Summer Demand, Peak Day Demand and Annual Demand.

Penticton's downward trend in water consumption can be attributed to the three following factors which were identified and classified as those which influence behaviours;

- Predisposing factors – knowledge, beliefs, values and attitudes,
- Enabling factors – barriers
- Reinforcing factors – feedback and rewards, both positive and negative

Using any or all of these three factors, many barriers have been quenched in order to celebrate the water conservation program's numerous successes including Peak Day plummeting from 54 million litres (2003) to 42 million litres (2007) and Average Daily Demand dipping from 700 lpcd (2003) to 610 lpcd (2007). These results indicate Penticton effectively provides solutions which are adopted by the community at large.

As the City of Penticton water conservation program advances, many assessment response tools have been favoured. With the use of various media, voluntary watering scheduling and education, annual water demand has been trimmed by 604 million litres (2003/2007), despite increases in our population base.

This poster will provide innovative practices which can be adopted by any community including those under limited budgets and reduced labour force.

Carolyn Stewart[1]

[1] BBA, Program Coordinator, Water Conservation and Cross Connection Control, City of Penticton, Penticton, BC Carolyn.Stewart@Penticton.ca, 250-490-2562

Ellis Creek Flow Measurement Project

Brent Edge

Abstract

Watershed Management provides a comprehensive tool, incorporating land and water uses in a sustainable community. Therefore, the City of Penticton in collaboration with Dobson Engineering, are evaluating the Ellis Creek irrigation demand and creek flow in isolation as one of many water balance projects in our semi arid region.

This project was conducted using a range of stage and discharge magnitudes (freshet and low flow conditions) to determine flow triggers over the spillway as well as irrigation and creek flow trends. Taking seasonal variances into consideration, a total of four creek profiles were explored over six days in order to establish baseline data for statistical analysis. Upon project completion, automation will enhance real time watershed management tools.

With the assistance of $15 000 in OBWB grants, the City contracted Dobson Engineering Ltd. to design[1] a hydrometric station on Ellis Creek in order to reach the City's goal of becoming better water stewards. Several locations along the creek were reviewed, and the stream reach near Industrial Avenue had the most optimal conditions for analyzing the dynamics of flow.

The stage and discharge data will be used to manually create a stage/discharge curve which correlates water levels in Ellis Creek to discharge values. These flow dynamics create a stage discharge table which cross references variances (mm) in water level to the corresponding discharge value. Although this task is currently in progress, once completed the stage discharge table will be incorporated into the City's SCADA system allowing established baseline flow data to integrate real-time low flow alarms below the City's intake. A permanent reference gauge installed in the streambed provides visual verification when referencing stream flow.

Prior to receiving grant approval from OBWB, monitoring of Ellis Creek involved manually manipulating irrigation flow. Upon completion of Ellis Creek Monitoring project, total creek flow will be monitored under various conditions improving watershed management during peak irrigation season as well as assessing the creek's impact on land and water use in the Okanagan Water Basin.

Ministry of Environment, Land and Parks, *Manual of Standard Operating Procedures for Hydrometric Surveys in B.C.* Retrieved from http://ilmbwww.gov.bc.ca/risc/pubs/aquatic/hydro/index.htm

Brent Edge[1]

[1] Water Quality Supervisor, City of Penticton, Penticton, BC
Brent.Edge@Penticton.ca, 250-494-2564