2022 OSOYOOS LAKE WATER SCIENCE FORUM

NK'MIP (OSOYOOS LAKE)

THE HEART OF THE WATERSHED

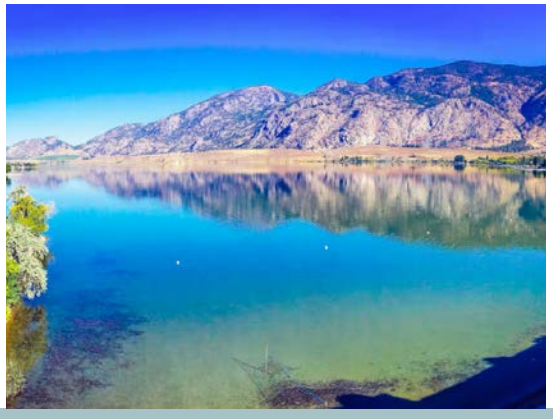
FINAL REPORT

BRIDGING INDIGENOUS AND WESTERN APPROACHES TO KNOWLEDGE, SCIENCE AND MANAGEMENT

HOSTED IN SW' IW'S (OSOYOOS) B.C.

OCTOBER 27 – 29, 2022

TABLE OF CONTENTS



NOTE: Find PowerPoint presentations at https://www.obwb.ca/olwsf/

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International Joint Commission

Okanagan Basin Water Board

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ECCC - Environment and Climate Change Canada
IJC - International Joint Commission
IOLBC - International Osoyoos Lake Board of Control
OBWB - Okanagan Basin Water Board
OIB - Osoyoos Indian Band
ONA - Okanagan Nation Alliance
RDOS - Regional District of Okanagan-Similkameen
USGS - U.S. Geological Survey

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Author's Note

This forum summary report was prepared for the Okanagan Basin Water Board by Synapse Strategies. The report is based on observations at the welcome reception, listening to forum presentations (including review of presentation slides or recordings), forum report-outs and a sampling of the many organized and informal conversations at the forum. We also conducted a small number of follow-up interviews with forum participants to explore emerging key themes.

This is a representative summary of the forum, which was focused on relationship-building amongst diverse participants and exploring shared understandings. The forum, including the emerging themes summarized in this report, was a significant step towards greater shared understanding of the watershed. It will be exciting to see how this understanding continues to evolve, year-to-year and generation-to-generation.

About the Authors

Synapse Strategies is an international strategic sustainability and management consultancy founded by Principals Katie Pease and David Waldron. Centred around the three interrelated concepts of foresight, strategy and regeneration, Synapse helps clients from the government, business, civil society and higher education chart more strategic pathways towards a just, flourishing and ecologically sustainable future. The principals of Synapse have extensive expertise with planning processes, program development, project management, facilitation of complex gatherings and preparation of reports and white papers. We are grateful for the opportunity to participate in the 2022 forum. For more about Synapse, refer to: www.synapse-strategies.com.

INTRODUCTION

Background and Context

The 2022 Osoyoos Lake (nk'mip) Water Science Forum was hosted by the Osoyoos Indian Band and the Town of Osoyoos, October 27 - 29, 2022, in sẃiẃs (Osoyoos, B.C.) The forum was presented by the Okanagan Basin Water Board, the International Joint Commission, the Okanagan Nation Alliance, along with many other partners with an interest in the Okanagan/ Okanogan watershed.

This was the fourth in a series of Osoyoos Lake Water Science Forums (previous ones were held in 2007, 2011 and 2015). The theme for 2022 was "Bridging Indigenous and Western Approaches to Knowledge, Science and Management."

Field trips, exhibits, informal conversations, and the forum itself provided an opportunity for participants to come together, build relationships and learn about important, water-related issues for Osoyoos Lake and the broader Okanagan/ Okanogan[1] watershed. It was a unique opportunity for Indigenous (*Syilx* Okanagan) people and non-Indigenous people to come together in a collaborative manner to share values and ideas about the past, present, and future of Osoyoos Lake.

A unique strength of the forum was the great diversity of presenters and participants, including Indigenous and non-Indigenous people, representatives from various levels of government (e.g. First Nations, international, national, state, provincial, regional and local governments), Indigenous and non-Indigenous scientists, researchers, watershed advocates, specialists, experts, students and concerned local citizens. Presenters and participants came from various agencies, community organizations and stakeholders who shared traditional knowledge and approaches, scientific findings, challenges, and goals, along with better ways of promoting transboundary lake and watershed stewardship.

Encouraged by *Syilx* Okanagan facilitators and the Four Food Chiefs approach, forum participants were encouraged to think in different, yet complementary, ways to understand the watershed better and consider new approaches to planning and decision-making. Indigenous and non-Indigenous worldviews and approaches were described and discussed, compared and contrasted. Specific scientific discoveries were introduced within a wider, holistic lens on the overall health of the watershed. Many fascinating forum presentations and conversations led to new ways of understanding the watershed. They are described below.

An emerging understanding of the changing watershed – and people's relationship with it – is summarized in the "key" summary at the end of this report.

1 Okanagan is the Canadian spelling, and Okanogan is the American spelling of the watershed and river system.

Additional Special Forum Events

Additional events on Oct. 27th and in the evening of Oct. 28th provided gave forum participants an opportunity to connect in informal settings and experience the local watershed, including *Syilx* cultural traditions, and worldviews.

This included the choice of a pre-forum field trip to Nk'Mip Desert Cultural Centre or kłlilx^{w} (Spotted Lake), a sacred site to the *Syilx* Okanagan people, to hear from a *Syilx* Elder about its historical, cultural and spiritual significance. Visitors not only could learn about the lake, but also directly experience being in a sacred part of the watershed. Attendees were also invited to attend the WaterWays Exhibit at the Osoyoos and District Museum and Archives, which highlights *Syilx* cultural values for water, making the teachings more accessible for non-Indigenous audiences. These shared, immersive experiences helped to build relationships and understand the watershed in new ways.

The pre-conference welcome reception was held at the *Nk'Mip* Desert Cultural Centre, with welcoming comments from the hosts and conference chairs. Osoyoos Indian Band Chief Clarence Louie explained that while Osoyoos Lake and the larger watershed crosses an international boundary (Canada/USA), from an Indigenous perspective, it is one watershed and one Okanagan people, the 'Salmon People.' The *Syilx* Okanagan People were never involved with establishing the boundary and remain focused on protecting the "relatives" of the watershed (i.e. the water, the land, four-legged animals, the salmon...then humans).

Mayor Sue McKortoff emphasized the importance of learning about water and the watershed and the conference theme of bridging Indigenous and western approaches to knowledge, science and management.

Arnie Marchand from the *Syilx* Nation and a member of International Osoyoos Lake Board of Control, spoke of the water as "my relative" and the watershed as the heart of the Okanagan (and, now, the *Sylix* people are also using western science to help manage and protect the water).

Anna Warwick Sears, Executive Director of the Okanagan Basin Water Board, explained that the intention is for bridging to be helped during the forum through (1) keynote talks that focus on bridging; (2) Indigenous facilitation by Kelly Terbasket and Aaron Derrickson and purposefully de-centering ourselves in the conversation about the watershed and (3) spending time together and sharing understanding.

The reception included a tribute to Dr. Kim Hyatt (a B.C.-based research scientist with the federal Department of Fisheries and Oceans). Dr. Hyatt was a tireless and well-loved advocate for the salmon and restoration of salmon habitats in the Okanagan. His long-standing and selfless efforts have been instrumental in helping support the return of many salmon species, including Sockeye.

> "I still stand in amazement at the lessons the salmon have taught us about the resilience of the natural world when it is given half a chance to recover."
>
> Kim Hyatt, PhD

Conference Overview, Objectives and Theme

The forum was presented by the Okanagan Basin Water Board, the International Joint Commission, and the Okanagan Nation Alliance, with many other partners. The hosts for the forum were the Osoyoos Indian Band (Chief Clarence Louie) and the Town of Osoyoos (Mayor Sue McKortoff).

The forum was co-chaired by Arnie Marchand and Anna Warwick Sears.

The forum was facilitated by Kelly Terbasket (IndigenEYEZ and a member of the Lower Similkameen Indian Band) and Aaron Derrickson (a member of Westbank First Nation). With full support of the forum's hosts and organizers, Kelly and Aaron facilitated the forum with a *Syilx* Okanagan perspective and planning process, particularly inspired and guided by the *Syilx* Water Strategy and the *Syilx* governance framework, *enowkinwixw*, while allowing significant time to hear a series of science-based presentations.

The hosts, organizers and facilitators acknowledged and thanked the volunteers and attendees for their important roles and contributions to the conversations about the watershed. Participants' areas of focus ranged from very specific local issues to the International Joint Commission with oversight of the transboundary Osoyoos Lake and Okanagan/Okanogan watershed.

FOUNDATIONS

Overview

In their welcoming comments, the hosts and facilitators invited everyone at the Forum to "take off their hats" of position (whether mayor, or scientist, or resident). Everyone was invited to explore and co-discover new knowledge and understandings about the entirety of the Osoyoos Lake watershed and beyond; past, present and future:

> "Nobody knows everything, everyone knows something. Learning is relational, learning is participatory."
>
> Kelly Terbasket

Hosts and facilitators recognized the students attending, representing our descendants ("the people to come"). Participants were asked "what do we want to leave our descendants?" Similarly, multiple generations of ancestors were recognized along with the strengths, knowledge and resilience they bring.

Forum participants were invited to share one strength they bring. Some of the answers focused on perseverance, curiosity, humility and humour.

The forum's shared exploration was organized around:

- informative and inspiring keynote presentations;
- multiple scientific and other panel presentations, by Indigenous and non-Indigenous presenters; and
- a mix of diverse conversations facilitated by Okanagan (*Syilx*) facilitators, using the Four Chiefs Framework, which led to:
- multiple and diverse conversations and relationships with old and new acquaintances, and the emergence of new perspectives.

The Four Food Chiefs, Setting the Foundation for Learning and Community Building

Presentation by Facilitator Aaron Derickson, from the Westbank First Nation

Aaron Derickson shared the *Syilx* (Okanagan) *chaptikʷɬ* (cultural story/traditional knowledge) about the Four Food Chiefs. The Four Food Chiefs story is about 'How Food was Given' and provides a cultural foundation for better understanding and making decisions. The overall perspective is holistic: it includes the land, the water, and all living things, including humans.

In the story, the four chiefs: *Skəmxist* (Black Bear) *Siya* (Saskatoon Berry), *Spiƛ'əm* (Bitter Root), *Ntyxtix* (King Salmon) came together and made a plan for how to feed the *Stelsqilxw* (people to be). In the process, Chief Black Bear laid down his life for the survival of the *stelsqilxw*, thereby setting the standard that allows humans to survive. The story tells how the differing perspectives of the four chiefs were brought together to inform the discussion, the problem solving, the decision making and plan for taking action.

The four food chiefs, their perspectives and the questions they inspire, constitute a holistic framework for planning by considering issues through four distinct, yet interrelated lenses. It can be described as follows:

Chief Skəmxist (Black Bear). Chief Black Bear represents "what is" – i.e. how things have been or are currently done. Chief Black Bear is concerned with the traditions, laws and cultural practices related to all life forms. He is concerned with the concept of reflection and contemplation through ceremonies on "what is" as informed by an understanding of the past and how that is connected to the future.

The question inspired by Chief Black Bear that was posed to participants during the Forum was: "*What are some existing structures, policies, items that could help?*"

Chief Ntyxtix (King (Chinook) Salmon). Chief King Salmon represents the traditions and cultural practices related to all life forms. Chief King Salmon is related to the duty to carry out actions, to protect, provide and preserve, i.e. to make a list and get things done! The focus is on readiness, determining the objective, and then taking action, overcoming obstacles, linearity, and directionality.

The question inspired by Chief King Salmon that was posed to participants during the Forum was: "*What are ways that we can make something happen immediately?*"

Chief Spiƛ'əm (Bitterroot). Chief Bitterroot represents relationships and the interconnectedness among all living things, including the people, the animals, the plants, the land, the air, and the *siwɬkʷ*. Chief Bitterroot is related to emotions, nurturing, and community building. Its roots create networks and reach out to gather the resources they need to create that flower on top.

The question inspired by Chief Bitterroot that was posed to participants during the Forum was: *"What are some relational ties that could be built or strengthened?"*

Chief Siyaʔ (Saskatoon Berry). Chief Saskatoon Berry embodies the spirit of creative energy, vision, and innovation that can be associated with youth or the future. This chief is focused on the youth, the children, the seeds of our future who—like a sweet Saskatoon berry—have to be protected and enclosed in sweetness, have to have a place to land, and have water and sunshine to grow.

The question inspired by Chief Saskatoon Berry that was posed to participants during the Forum was: *"What are some new ideas and innovations that could be explored?"*

While seemingly separate, the four differing perspectives (*Siyaʔ, Spiƛ'əm, Skəmxist , Ntyxtix*) work well together: forming a collective and holistic approach to long term planning and decision-making. It could be said that the following principles/actions are actually embedded within in the process:

- Consensus and Establishment of Common Ground
- Protocols for discussion
- Full participation
- Commitment to see the process to its end, regardless of the time involved
- Differing perspectives that have a defined place: Innovators, Traditional, Action, and Relationships.

The decision-making process is complete when an action and implementation plan incorporating all views is in place.

Figure 1. An Illustration of the Syilx Okanagan approach to water and planning. Combining the Four Food Chiefs in this way illustrates a collaborative and holistic approach to long term planning. Source: IndigenEYEZ

Syilx siwɬkʷ (Water) Strategy

Part of the foundation for the Forum was The Syilx siwɬkʷ (Water) Strategy. It was introduced and described for Forum participants by Tessa Terbasket, Syilx community member, and Brian Holmes, Councillor from the Upper Nicola Band.

The presentation outlined how the *Syilx* Water (*siwɬkʷ*) Strategy came to be, its key components, directives and next steps. The presenters reaffirmed *Syilx* inherent and traditional right to protect the *siwɬkʷ* (water) as their relative and 'that which gives us life' (*nxʷəlxʷəltantət*).

The *Syilx siwɬkʷ* (Water) Strategy is rooted in place and founded on *Syilx* inherent rights. It is a call to action that outlines how the *Syilx* (Okanagan) Nation intends to care for their territory and work to ensure that *siwɬkʷ* (water) is properly respected and available for all living things. The Strategy begins with the 'Okanagan Water Declaration' and is endorsed by the Okanagan Nation Alliance Chiefs Executive Council, in 2014. It is a call to action.

The strategy is a 'living document' and includes:

VISION AND PURPOSE. The purpose is focused on

- ***Education***, particularly awareness of *Syilx* Okanagan rights and knowledge.
- ***Stewardship***, particularly *Syilx* Okanagan governance, rights, and responsibility to care for water (*siwɬkʷ*), and
- ***Collaboration***, increased with non-Indigenous neighbors and partners.

ORIENTATION AND CONTEXT. The strategy has a strong ethical and values-based orientation to *Syilx* people and water (i.e. an orientation to language and the intergenerational history and oral record of the *Syilx* Okanagan People (*captikʷɬ*)). There is a particular emphasis on the story (*captikʷɬ*) of the four food chiefs as well as the *Syilx* Okanagan People's inherent right to protect water (*siwɬkʷ*).

ACTION PLAN. The Action Plan is focused on six main priorities:

1. Develop *Syilx siwɬkʷ* laws in alignment with the *Syilx siwɬkʷ* Declaration
2. Assert *Syilx siwɬkʷ* authority
3. Protect and restore *siwɬkʷ*
4. Take the lead on *Syilx* research related to *siwɬkʷ*
5. Engage in *Syilx* adaptation planning for *siwɬkʷ*
6. Build collective *siwɬkʷ* consciousness

The presenters explained that many actions are already being taken in these six priority areas, including working collectively, engaging with the *Syilx* people, communities, knowledge keepers, the Okanagan Nation Alliance's Natural Resource Committee, and Partners to develop workplans and actions.

More information and updates are available here: https://www.syilx.org/wp/wp-content/uploads/2022/04/Syilx-Water-Strategy-2022-Edition.pdf

The Intersection of Indigenous Knowledge and Western Science

Reconciliation in ecological management: Ethical Space; Science, and Indigenous Knowledge

Presented by Gwen Bridge, Gwen Bridge Consulting

This presentation emphasized the importance of holding different worldviews and ways of knowing when addressing natural resource decisions. Gwen Bridge is an environmental scientist and member of the Saddle Lake Cree Nation. She presented Ethical Space Framework to deepen our understanding by reflecting on, structuring and combining Indigenous and non-Indigenous (western) worldviews.

The Ethical Space provides a framework for "two-eyed seeing." It compares and contrasts the Indigenous and non-Indigenous systems of laws and assumptions about where humans get their authority for natural resource decision-making. In so doing, the roots of historical conflict were illustrated: e.g., western worldview where God said: "use the earth/animals, etc." versus the Indigenous worldview where the Creator said: "animals/living things decide the fate of humans." A move to two-eyed seeing incorporates both Indigenous and non-Indigenous knowledge in a collaborative way. Exploring the two worldviews together in the Ethical Space helps to develop better relationships, resolve conflicts and develop creative solutions.

The importance of the United Nations Declaration of the Rights of Indigenous People (UNDRIP) was emphasized as a way of informing the Ethical Space. UNDRIP provides the highest level of international guidance endorsed by Indigenous peoples. This includes the right of Indigenous people to build, refine and rehabilitate economic systems. Canada endorsed UNDRIP in 2016 (Bill C-15), and the Province of B.C. passed its own Declaration of the Rights of Indigenous Peoples Act (DRIPA) in 2019 and, in 2022, released its DRIPA Action Plan. These layers of policy are instructive for recognizing Indigenous rights and improving conservation and sustainable management of natural resources in the Okanagan/Osoyoos watershed.

This includes, for example, the right to conservation of plants and animals; spiritual relationships to traditional lands and waters; and recognition of Indigenous people's laws, traditions, customs, and land tenure systems.

On one side of the Ethical Space framework (figure 2), as presented by Gwen Bridge, the dominant western view emphasizes a "God-given" authority over natural systems as exercised through historical federal constitutions of countries like Canada and the U.S., followed by legislation and historical government policies. These determine the historical and dominant science and management structures. On the other hand, the Indigenous world view (and more recent policies aligned with UNDRIP) describe the highest-level authority, the Creator, followed by the Earth and all living things. "Story" is the way that Indigenous cultures relate to the Earth, which in turn informs and guides their protocols, management principles and ways of living (see figure 2 on the next page).

The presentation demonstrated a way of holding in mind the two worldviews with a structured exploration into both the fundamental differences in the worldviews and the potential combination or integration. Better understanding, reconciliation and integration is possible by recognizing the unique hierarchy of ideas within each worldview and reconciling the worldviews at the right level (e.g. Indigenous relationship with Earth and Story guiding Western Science/ Management, but not vice versa).

The intention is to use two-eyed seeing to explore and re-imagine solutions within the Ethical Space, leading to creative new ideas for the collective well-being of all living things.

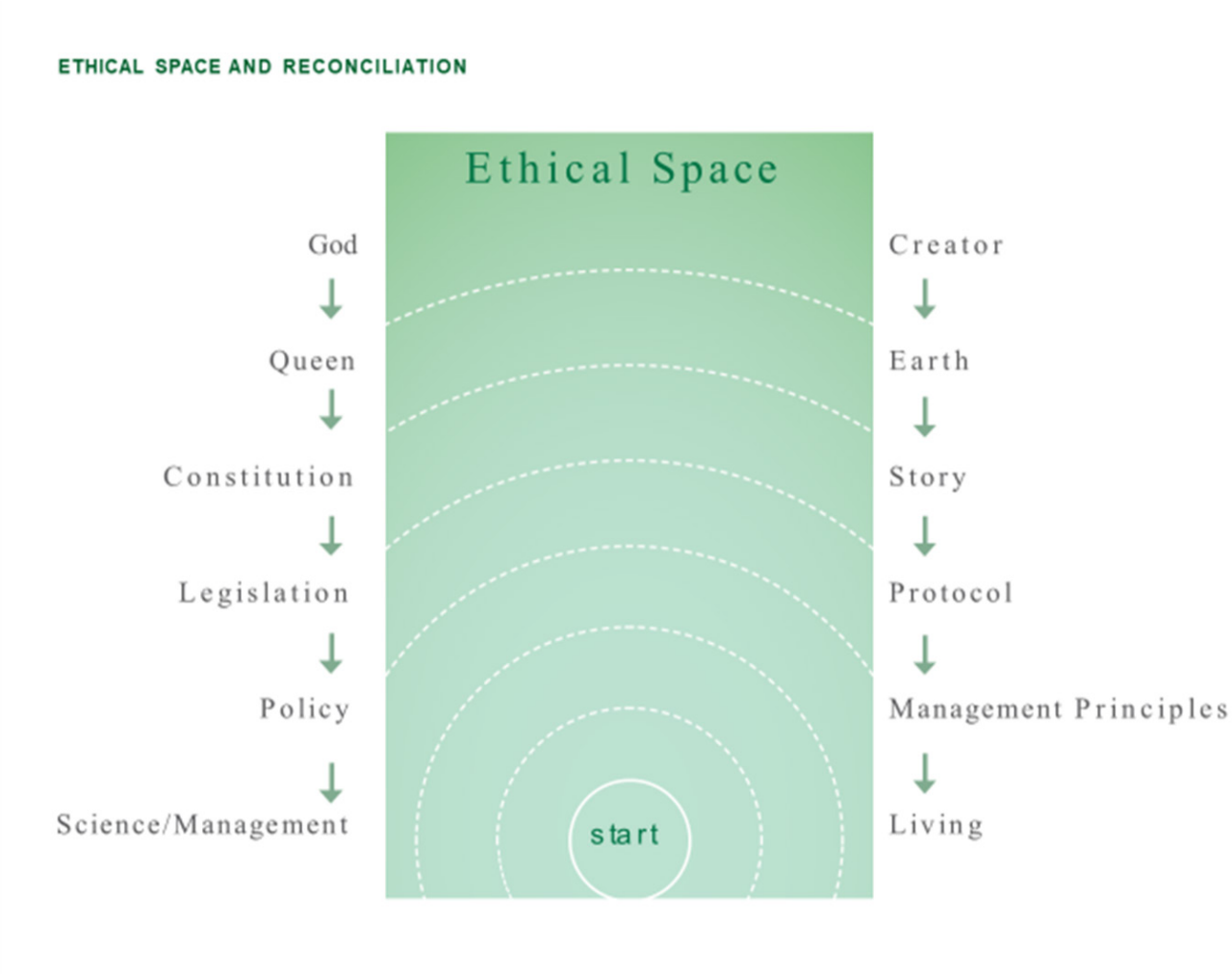

Figure 2. An Ethical Space Framework. Presented by Gwen Bridge and adapted from Dr. Reg Crow Shoe. See also Voices of Understanding – Looking Through the Window, 2017, Alberta Energy Regulator. https://static.aer.ca/prd/documents/about-us/VoiceOfUnderstanding_Report.pdf[2]

One of the conversations that followed this presentation was about whether there is actually more common ground (or overlap) between western and Indigenous worldviews than is illustrated by the Ethical Space framework. In addition, there were questions about why "Science" is positioned below "Policy" (in the western worldview) and whether this can unnecessarily subjugate important scientific discoveries about the earth/natural systems.

2 See also Voices of Understanding – Looking Through the Window, 2017, Alberta Energy Regulator. https://static.aer.ca/prd/documents/about-us/VoiceOfUnderstanding_Report.pdf

Three-Eyed Seeing and Water: A Framework for Using *Anishinaabemowin* as Indicators for Aquatics Monitoring

Presented by Myrle Ballard, PhD, Environment and Climate Change Canada / University of Manitoba

This presentation introduced a three-eyed seeing framework that is premised on Anishinaabe laws – *ona'ko'nikay-wiinan*. Examples based on *Anishinaabemowin* / Indigenous place/ space/ landforms were used to explain the framework. The idea of three-eyed seeing is connected directly to Indigenous science, western science and relations. Indigenous science was elaborated on and includes:

- Natural Law (the original purpose of waters, lands, air, flora, fauna and natural cycles);
- Language Law (the science embedded in language);
- Mother Earth Law (balance and harmony of all life on Earth); and
- Traditional Law (various teachings of all Nature Laws)

Professor Ballard suggested that Language Law (Anishinaabemowin) is important to use as an indicator and biomonitoring tool. For example, Indigenous names reflect the natural law of the land. Some of the examples she presented illustrated the limitations of western science and the value of Indigenous science. For example, some observations of fish patterns and water flows can't be explained by western science while some knowledge regarding water and its character can be explained by Indigenous science. Indigenous science requires talking to the local people and finding out about oral history to understand the watershed (e.g. the way the fish tastes during a flood or where the moose comes from by how it tastes).

Dr. Myrle Ballard is an Anishinaabe scholar, a Professor at the University of Manitoba and Canada's first Director of Indigenous Science at Environment and Climate Change Canada. Dr. Ballard is in the process of developing a new, Indigenous Science Division team within Environment and Climate Change Canada, with a mandate to bridge, braid, and weave Indigenous science with western science approaches to inform and enhance decision-making.[3]

3 More information available here: https://www.canada.ca/en/environment-climate-change/services/science-technology/indigenous-science.html

Okanagan Lake Regulation System. Why Does the Okanagan Lake Regulation System Need Modernizing, and How Should We Do It?

Presented by Brian Guy, Associated Environmental Consulting (Keynote #4)

This presentation was delivered near the end of the forum and provided a comprehensive overview of the current state of – and suggested future studies for – the Okanagan Lake Regulation System (ORLS). While the presentation was predominantly from a western science and policy perspective, it emphasized the need for not only a more comprehensive approach to the overall regulation system but also the value of an Indigenous (i.e. *Syilx*) approach to improve watershed understanding and decision-making processes.

The ORLS, (including regulation of Osoyoos Lake), is a series of dams and other structures located on major lakes and the Okanagan River between Penticton and Osoyoos Lake in the southern Okanagan Valley. The ORLS assets (infrastructure) were developed primarily to control flooding, based on application of western science. Operation of the system has become increasingly challenging as the Okanagan hydrologic regime responds to the changing climate and the OLRS assets approach end of life.

In 2020, the Province of B.C., which owns these assets, working with the Okanagan Basin Water Board, began a study to assess the information available and knowledge needed to support modernization. The study, called 'Plan of Study for Modernizing the Okanagan Lake Regulation System,' recommended 18 additional studies to fill information gaps, including reasons for modernizing.

The presentation highlighted the potential to not only modernize the regulation system but also to restore aspects of the lake, river, floodplains and watershed to be more resilient. Some restoration has already occurred, and more is likely to be feasible and desirable. Thanks to ONA leadership and collaboration across all levels of government, the restoration has not adversely affected other OLRS benefits. More of this kind of restoration most likely can, and should, be carried out.

The presentation closed with a reminder that society's values have changed since the original ORLS was established and the OLRS should therefore change with them. Society today places more value on the environment, and there is an expectation of more comprehensive and inclusive processes for decision-making. The *Syilx* people - who've been in this valley for thousands of years and have sophisticated processes for participatory decision-making – should and will be involved going forward. This includes not only the scientists at ONA but also the broader *Syilx* (Okanagan) society.

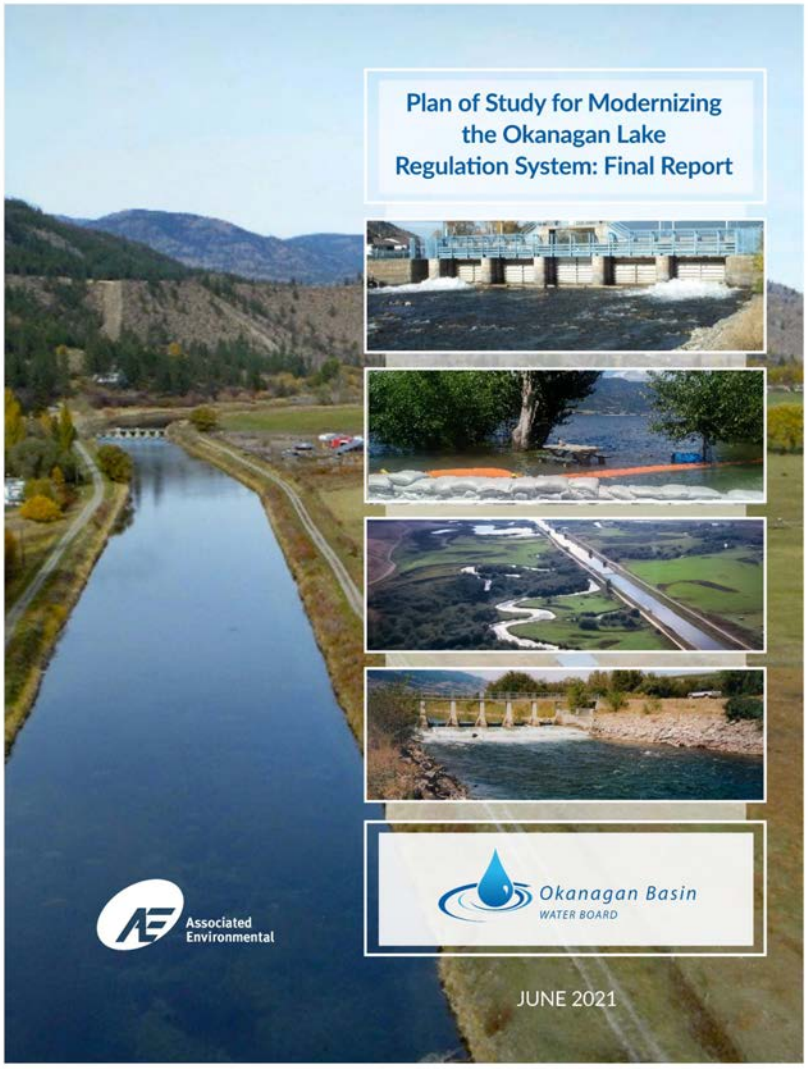

Figure 3. The Plan of Study for Modernizing the Okanagan Lake Regulation. This play lays out a multi-year series of plans, studies and engagements that will be needed to arrive at a new more comprehensive approach to Okanagan Lake and the Okanagan watershed.

The Plan of Study report and a list of the studies and their current status is available here: https://www.obwb.ca/lakelevelmanagement/.

SESSION 1: NK'MIP (OSOYOOS LAKE) MANAGEMENT

Overview

The first themed session of the forum was management of Nk'mip (Osoyoos Lake), particularly lake water levels. The moderator was Al Josephy, Washington State Dept. of Ecology (Retired). He emphasized that this session focused on some basics of water management, from both a policy and a physical/mechanical side. However, water is also a finite resource ("we're not making more of it") and going forward, management will have to grapple with changing weather patterns, climate change, irrigation changes, manufacturing, municipalities, legal and historical allocations.

Session 1 included two panel presentations:

- Zosel Dam and Okanogan River Operations (Craig Jordan), and
- How to Consider and Respond to Osoyoos Lake Climate Change Impacts (Jeremy Fyke).

After the presentations, the forum participants were asked by the facilitators to reflect on the issue of climate change and Osoyoos Lake through the four lenses described by the four food chiefs (see Foundations, page 10). At this stage, participants were asked to find other people who self-identified with the same food chief(s) as they did. They were asked questions like "since we know climate change will change flows, why not re-think/re-design Zosel Dam?" And: "what do the younger generations think about future lake level/dam management?" (Chief *Siya?* Saskatoon Berry).

Some of the issues raised included:

- The need for increased provincial government attention to changing water management requirements, especially due to anticipated climate change and climate impacts.
- The future needs (and funding) for major projects such as changes to and maintenance of channels, sedimentation basins, dams and dikes.
- The importance of collaboration in any decisions: e.g. "if you want to go fast, go alone, if you want to go far, go together."
- The recognition that relationships are not only between people but also between people and land, people and water, and between watershed components (e.g. dams, lakes, rivers, rivers, salmon).
- The disproportionate influence of "the 1%" over how the water levels and watershed are managed.

Zosel Dam and Okanogan River Operations

Presented by Craig Jordan, Washington State Department of Ecology

This presentation reviewed the history of the Okanogan[4] River dam at Oroville (Zosel Dam), planned dam improvements and how Osoyoos Lake water levels are managed. The dam was constructed in 1927 and reconstructed in 1988 for today's lake level management. Lake levels are ultimately as directed by the International Joint Commission and the International Osoyoos Lake Board of Control (IOLBC).[5] The dam is operated to manage water levels in Osoyoos Lake to not exceed a certain maximum during high flows nor go below a minimum level during droughts.

The discharge at the dam to achieve design levels is influenced by a range of operational parameters, including Similkameen River flows, Okanagan Lake inflow and Okanagan Lake levels. Recent high-water levels (e.g. the Similkameen River in 2021) have made dam operation challenging. Very high flows from the Similkameen can flow upstream into Osoyoos Lake. Ice build-up has occasionally caused problems with dam operations. Additionally, very low discharge rates during droughts can increase the risks to spawning salmon. Wishful work for improving the dam itself included: upgrading the lifting mechanism, additional heated spillway gates and a new emergency generator. Major changes needed to Zosel Dam management would be established by the IJC and IOLBC.

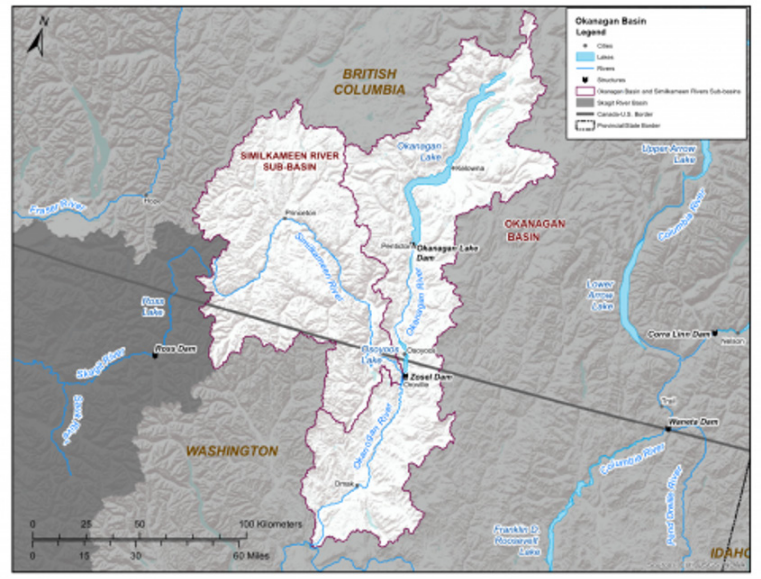

Figure 4. Okanagan Watershed, including Similkameen Sub-Basin. Source: Craig Jordan, Dam Safety Office, Water Resources Program, Department of Ecology, State of Washington.

4 American spelling of Okanagan.

5 Additional information about the International Osoyoos Lake Board of Control available here: https://ijc.org/en/olbc#

How to Consider and Respond to Osoyoos Lake Climate Change Impacts

Presented by Jeremy Fyke, Canadian Centre for Climate Services, Environment and Climate Change Canada

Climate change is impacting and will continue to impact the water quality and quantity of Osoyoos Lake and the surrounding watershed. Jeremy Fyke encouraged the forum audience to step back and think about climate change, the future climate and what it could mean for water management in the future. His presentation described overall climate change affecting the watershed along with specific climate events and climate impacts by comparing and contrasting historical and predicted future impacts. Climate change is changing both the severity and frequency of extreme climate events ("drivers"). This leads to multiple climate impacts (damage from floods, wildfires, etc.).

Quantitative models are being used to better understand climate change in the region and to identify climate impacts and their link back to extreme climate events. These models can now be used to estimate a long-term time series of the severity and frequency of projected future drivers/impacts which provides better, climate change-informed parameters for decision-making.

The central idea of Fyke's presentation was to draw from best scientific tools and approaches to reframe modelling results (e.g. a range of possible futures) away from uncertainty and towards exploratory modelling for robust decision making. In so doing, the climate/hydrology modelling results become more useful when integrated into robust decision making. These tools can then support both western and Indigenous approaches to water and watershed management.

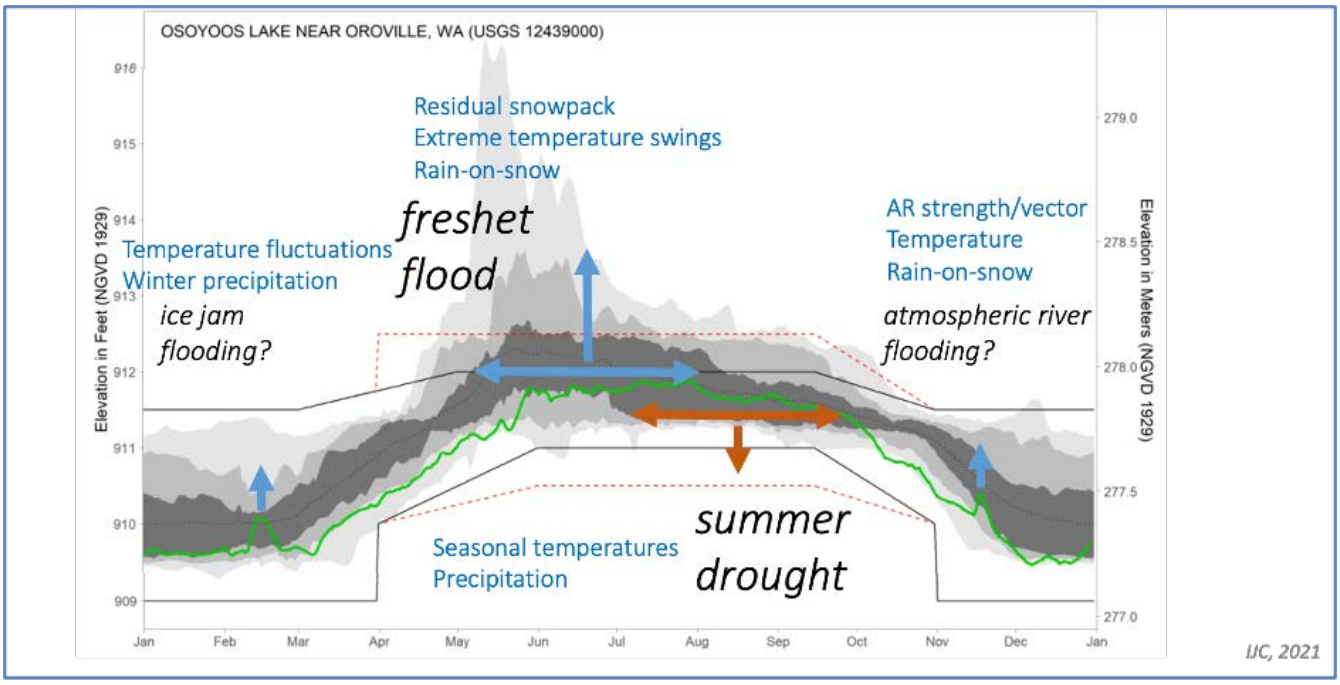

Figure 5. Identifying climate impacts and the links back to climate drivers. Different kinds of historic – and likely future – climate drivers (e.g. rainfall, extreme weather events, etc.) can lead to specific climate impacts (e.g. freshet flood, etc.) (Fyke, 2022).

SESSION 2: CLIMATE CHANGE

Overview

This session provided additional information about climate change and its past, present and potential future impacts on the Okanagan and Osoyoos water levels and watersheds. Presentations focused on

- Okanagan Mainstem Floodplain Mapping (Sarah North)
- Topobathymetric Lidar and a 2021 Topobathymetric Survey (Sven Cowan)
- Water Banking in Washington State (Tom Tebb).

Following on the presentations, forum participants were asked to reflect on the topics presented through the same food chief lenses as the previous session. Perspectives shared included:

- The realization that the relationship between the Similkameen and the Okanagan flows is important and that they affect each other, but the solutions are not obvious, in terms of relationships (i.e., *Siyaʔ* / Saskatoon).
- The importance of being able to translate between different specialists and expertise (incl. models and meta-models) (*Spitlʼəm* / Bitterroot/relationship-builders).
- articipants were curious about what the floodplain studies mean in terms of regulation and floodplain management (*Spitlʼəm* / Bitterroot).

Okanagan Mainstem Floodplain Mapping

Presented by Sarah North and Piotr Kuraś, Northwest Hydraulic Consultants

This presentation described recent high flows and flooding in the Okanagan Valley mainstem. Flood mapping was completed from 2020 to 2022 as part of an Okanagan Flood Study conducted by Northwest Hydraulic Consultants (NHC). The presentation concluded with a summary of the new flood mapping available (see links below).

Record-setting high flows in the Okanagan Valley in 2017 with flooding, followed by high flows in 2018, prompted the Okanagan Basin Water Board (OBWB), and the Okanagan regional districts, to commission the Okanagan Flood Study, in partnership with local municipalities, the Okanagan Nation Alliance and member Indigenous communities. Northwest Hydraulic Consultants (NHC) carried out floodplain mapping of the Okanagan River from Penticton to Osoyoos Lake (Nk'mip), along with the shoreline of Okanagan River's mainstem lakes: Ellison/Duck, Wood, Kalamalka, Okanagan, Skaha, Vaseux, and Osoyoos.

Resulting map layers include flood inundation extents, depths, and flood construction levels (FCLs). Information is available for several flood scenarios, including for current operating conditions of the Okanagan Lakes Regulation System (OLRS) and for modified operations proposed to mitigate the future impacts of climate change.

Maps are available at www.obwb.ca/flood/.

The Okanagan Flood Story is available at www.okanaganfloodstory.ca.

Figure 6. Osoyoos Lake Flood Construction Level (FCL) Zone (Inundation Extent). Example of 200-year design flood, gates open + mid-century climate change and freeboard. Source: Okanagan Flood Study. Northwest Hydraulic Consultants. 2022.

The 2021 Topobathymetric Survey of the Okanagan Lakes

Presented by Sven Cowan, Quantum Spatial Consulting (pre-recorded presentation)

This presentation provided a brief introduction to topobathymetric LiDAR and its application to Okanagan lakes. In fall 2021, NV5 Geospatial was contracted by the Okanagan Basin Water Board (OBWB) and the International Joint Commission (IJC) to perform a topobathymetric survey of Ellison, Wood, Kalamalka, Okanagan, Skaha, Vaseux and Osoyoos lakes.

Topobathymetric LiDAR is a technology that enables large-scale mapping below the water surface enabling mapping of nearshore and riverine bathymetric environments (i.e. underwater topography). The airborne LiDAR is particularly useful in mapping large areas of zero-metre to 10 metre water depths. The presentation described sensor technology, planning considerations, applications and illuminating mapping results for Okanagan lakes, including Osoyoos Lake and a portion of the Okanogan River channel in Washington State.

While topobathymetric LiDAR sensor and processing technology has advanced rapidly, some limitations still exist. These include water turbidity, heavy aquatic vegetation/variable bottom reflectivity. These conditions vary by season. This means LiDAR flights need to be appropriately timed to minimize the limits to data collection. That said, the 2021 Okanagan Lakes topobathymetric LiDAR survey successful met or exceeded expectations.

Water Banking in Washington State

Presented by Tom Tebb, Washington State Department of Ecology (remote online presentation)

This presentation overviewed the practice of water banking in Washington State. Water banking involves "banking" of unused existing water rights to be held in trust (e.g. for instream benefit, partly depending on ecology).

The Washington Department of Ecology, through the Office of Columbia River (OCR) and Water Resources Program, has established several water banking mechanisms to facilitate the use of scarce water resources within existing allocated water rights. The goal of OCR is to aggressively pursue water supply development for both instream and out-of-stream uses. Water Banking is a key water supply development tool.

Recent Washington State legislation (2021) provided $15 million for Water Banking pilot grant funding. Funding is available for acquiring water rights and developing locally governed water banks. The intent is to support local communities concerned with downstream water right transfers. The Washington State Department of Ecology has received three applications in the past 10 months (since the program began) totalling less than $5 million.

Looking forward, once OCR's water supply options are fully allocated, other public or private water banks will likely be needed to address water supply needs. The Washington Department of Ecology hopes to learn more about how water banking should be structured through the pilot program. Local governments, municipalities, Tribes and other stakeholders are encouraged to contact the department with their perspectives.

More information is available here: https://apps.ecology.wa.gov/publications/SummaryPages/2111023.html.

SESSION 3: WATERSHED INFLUENCES

Overview

This session focused on some of the major watershed influences such micro-plastics and on ways of better understanding watershed landscapes (i.e. new wetlands mapping approaches, including the use of LiDAR data). Specific presentations included:

- Classifying Wetlands Using Remote Sensing Techniques in the Okanagan Basin (Tina Deenik)
- Microplastics in Okanagan Lake: A Process of Discovery (Ryan Cope)

Following the presentations, the forum audience was asked to reflect on the information in groups of five without attention to one particular food chief. By embracing the various perspectives people were encouraged to come together to find something new, recognizing that science alone doesn't necessarily lead to solutions. People were asked:

- *"What rises to the top after these presentations?"*
- *"Where do the lines come together?"*
- *"What should we do about it?" "What can I do that becomes a pebble that "causes ripples?"*

Forum participants suggested moving away from the idea of "them and us" and focus only on the collective "us." They suggested that many 'settler' and Indigenous worldviews may be closer together than is often expressed. Participants also offered these 'hashtags' to sum up some perspectives:

- Relationships are changing over time, within organizations and within settler communities;
- Collaboration and inquiry;
- No more fleece, refuse plastics;
- Change occurs at the speed of trust;
- Connecting nervous excitement;
- Everything is connected with everything;
- Humility and ownership;
- We're going upstream (Salmon); and
- Learn from the past to move forward with the future.

Classifying Wetlands Using Remote Sensing Techniques in the Okanagan Basin

Presented by Tina Deenik, UBC Okanagan

This presentation highlighted the importance of wetlands as critical components of healthy functioning landscapes and for their provision of valuable ecosystem services. In the semi-arid region of the Okanagan Basin, wetlands are rare biodiversity hotspots (only 2-7% of the landscape) and provide critical habitat for many species. While wetlands are a critical part of healthy watersheds, they are being lost at alarming rates.

Comprehensive inventories are needed for conservation and management of wetlands. However, the vast spatial coverage and their dynamic nature make wetlands challenging to map with field-based methods. Remote sensing technology provides a cost-effective way to identify wetlands at regional scales.

A random forest machine learning model was applied to the Okanagan Basin using an existing wetland database along with remote sensing and LiDAR data. The model identified and classified new wetlands with a comprehensive inventory using a replicable approach. The wetland model predicts major wetland classes (including fen, marsh, open-water, shallow-water and swamp) with a high level of accuracy and small ephemeral wetlands at a high spatial resolution.

It is the first probabilistic inventory of wetlands in the Okanagan, providing new opportunities for ecological monitoring along with more informed conservation and management.

Microplastics in Okanagan Lake: A Process of Discovery

Presented by Ryan Cope, Seven in the Ocean

In 2021, a small team embarked on a scoping study to understand if microplastics were present in Okanagan Lake and in Kelowna's municipal wastewater. Unsurprisingly, they found microplastics, though in very small concentrations.

Working in collaboration with Okanagan College, the team carried out surface water trawling at five sample sites near Kelowna, BC. They analyzed these results along with the samples collected from the influent and effluent of the Kelowna Wastewater Treatment Plant. They found microplastics in all samples but at low levels. The microplastic found in Okanagan Lake came in the form of fragments, fibres and films, but primarily microfibres.

Phase II goals are to establish long-term sampling protocols to inform mitigation and reduction strategies. The study has also inspired broader interest in moving beyond Okanagan Lake to understand downstream impacts. For more information refer to: https://microplasticsokanagan.com.

SESSION 4: RESPONSIBILITY PLANNING

Overview

Responsibility Planning opened the agenda on the second day of the forum. Participants were encouraged by the facilitators to accept the "*imperfect*" and to create new patterns and experiences together. Drawing from the *Syilx* worldview, they were asked questions like: *"'What is our relative, water, feeling? What adventures did it encounter to get here? What are its needs and wants?"*

Participants then engaged in small group conversations with the guiding question: "... and, before that...?" They began with "water in the tap" and then followed the water upstream and historically, always asking "and, before that...?" Reports from participants on their experience traced the many complex pathways of the water cycle, locally and regionally.

Not only did participants trace the water cycle hydrologically and historically but the experience of the participatory exercise also revealed for many people the shared and integrated nature of water, the water cycle and the people of the watershed. This corresponds to the *Syilx* idea of "we are sharing one skin" (snaqsilxw).

This session included:

- A presentation on the development of the *Syilx*-led Okanagan Lake (*kɬúsx̌nítkw*) Responsibility Planning Initiative (with Tessa Terbasket and Scott Boswell).
- A presentation on International Watershed Initiative (led by International Joint Commissioners Merrell-Ann Phare and Lance Yohe).

Both presentations emphasized the importance of greater engagement with diverse communities and a more holistic, integrated ecosystem-based and adaptive approach to working with the watershed.


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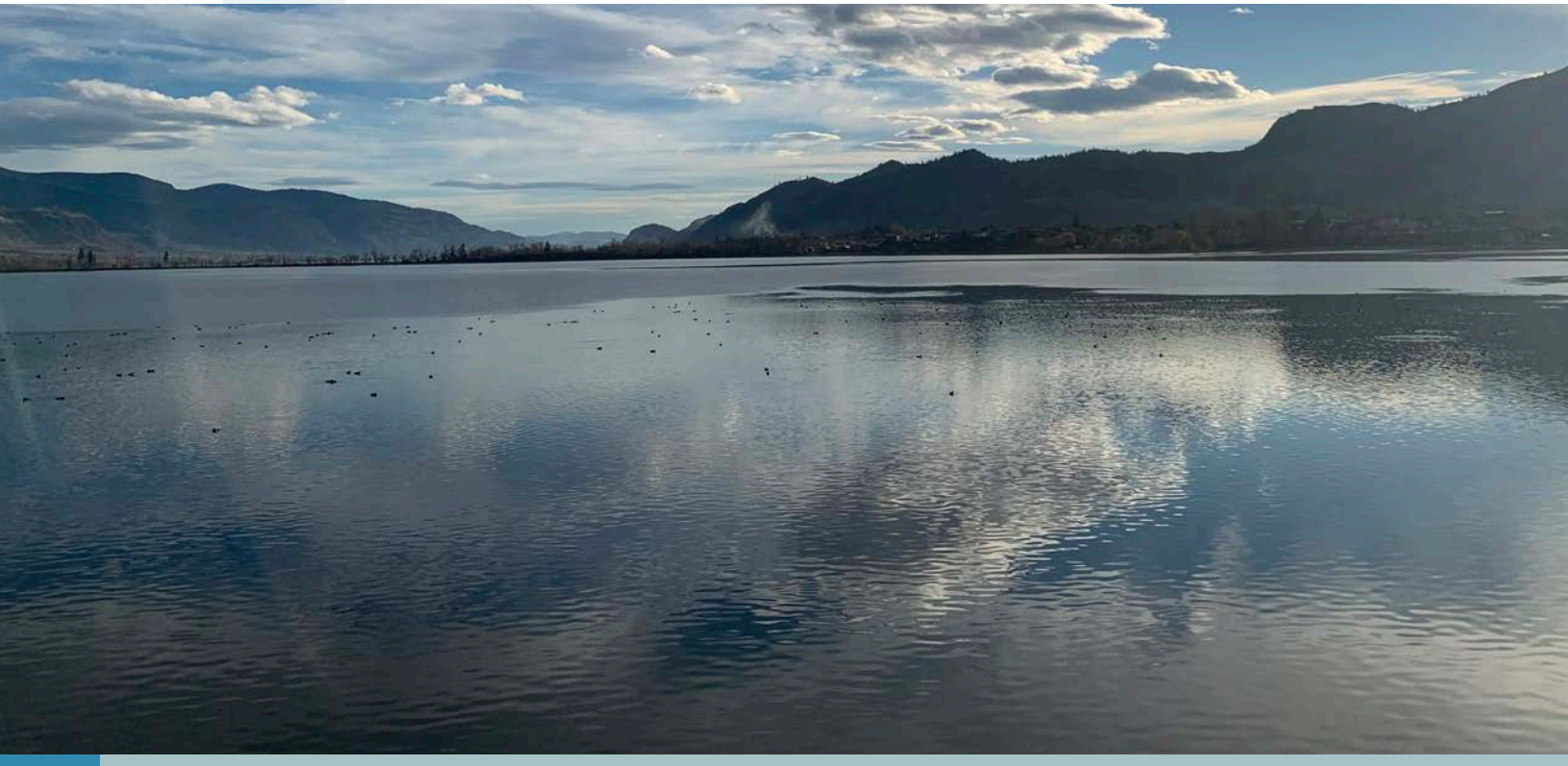
Okanagan Lake Responsibility Plan

Presented by Tessa Terbasket, Syilx Community Member & Scott Boswell, Okanagan Collaborative Conservation Program

This presentation described the planning and engagement process for the Okanagan Lake (*kɬúsx̌nítkʷ*) Responsibility Planning Initiative. The purpose of the initiative is to bring *Syilx* and non-*Syilx* people together around common goals for protecting the water and land. It anticipates new directions for land use decision making processes, policies, and practices that draws upon *Syilx* knowledge and leadership.

This is a *Syilx*-led process, based on the *nʕawqnwixʷ* process. As such, it includes: a commitment to including differing perspectives according to the Four Food Chiefs (i.e. Innovators, Traditions, Actions and Relationships), consensus, full participation and a commitment to see the process to its end regardless of the time involved. To date, the process has engaged 50 people representing 27 organizations, including formal resolutions of support from the Okanagan Nation Alliance (ONA) Chiefs Executive Council, three Regional Districts and seven municipalities along with provincial and federal agencies. To date, there have been 11 workshops and 37 one-on-one interviews.



The five main themes emerging from the process to date include:

Pursuing Truth and Reconciliation. Truth and Reconciliation needs to come first, including healing from the trauma and misinformation. Given the time it will take, truth and reconciliation will also need to be integrated with planning and action timelines.

Re-imagining Water Governance. Create new, shared decision-making processes, enabled by revised institutional structures (to give equal powers and accountability) and working locally from the bottom up to build alliances with local government.

Using *Syilx* Traditional Ecological Knowledge (TEK). *Syilx* TEK needs to be considered at technical, policy, jurisdiction, and decision-making levels. It includes principles, protocols and worldviews. TEK can be thought of as intergenerational knowledge of *Syilx* natural laws that teach us how to act as caretakers of *nxʷəlxʷəltantət* (that which gives us life).

Upholding Rights and Responsibilities. Respecting *Syilx* rights and responsibilities (stłtałt) means that *Syilx* water law must be upheld and traditional *Syilx* ceremonies are recognized as important.

Capacity bridging. Non-Indigenous communities need cultural knowledge and education to understand *Syilx* people, laws, protocols, and legal traditions. Indigenous communities need increased capacity to play a meaningful role, including resources for language and TEK, restoring place-based knowledge and TEK and reinvigorating traditional decision-making.

The presenters recognized the importance of BC's Declaration on the Rights of Indigenous Peoples Act and Action Plan. Going forward, they suggested there is a need to co-develop strategic-level policies and initiatives for stewardship and to collaborate on strategies for sustainable water management and support for Indigenous water stewardship.

In 2023, the *siwɬkʷ* (water) Responsibility Plan (*kłusxnitkʷ*) process will focus on completing TEK community engagement and facilitating *Syilx*-led workshops to refine Plan actions.

More information on this planning initiative is available here: https://www.Syilx.org/projects/kłusxnitkʷ-okanagan-lake-responsibility-planning-initiative.

International Watershed initiative

Presented by Commissioners Merrell-Ann Phare & Lance Yohe, International Joint Commission (IJC)

This presentation focused on the International Joint Commission's (IJC's) International Watersheds Initiative (IWI) to phase in an integrated, ecosystem approach to water management.

The IJC was established in 1909 by the U.S. and Canadian governments to prevent and resolve disputes involving shared waters, like Osoyoos Lake. By engaging with and learning from communities along the international border, the Commission is increasingly embracing a more integrated, ecosystem approach to water management.

In 1998, the IJC introduced an International Watersheds Initiative (IWI) to better assist parties meet 21st century environmental challenges and better respond to complex local and regional challenges. The

IWI approach includes engaging local communities by adding more diverse board membership including Indigenous and local members. Phasing in an integrated ecosystem approach will take some time for learning about and managing several interconnected issues, including:

- Water quantity (levels, flows, apportionment),
- Water quality (nutrient enrichment, pollutants), and
- Aquatic ecosystem health (aquatic invasive species, fish habitat, climate change impacts).

The IJC has established international cross-boundary boards for each of the transboundary lakes along the U.S.-Canada border. These historic IJC control boards tended to focus on water quantity, water quality, or water apportionment separately. Since 2005, "watershed boards" are being established. With implementation of the IWI, the IJC is motivated to work with local boards and communities, build trust and advance an integrated ecosystem approach. They hope all control boards will become watershed boards within about 10 years. To date, three international watershed boards (and one pilot) have been established.

The International Osoyoos Lake Board of Control (IOLBC) is working on several IWI projects including an ongoing climate change assessment and a study to look at ice jams upstream of Zosel Dam. A recent IJC survey indicated that the IOLBC is relatively well-prepared to address climate change impacts. There is now a good opportunity to establish a 'Watershed Board' for Osoyoos/ Okanagan in the near future and it is the hope of the IJC that this will happen. IJC support and IWI funding is available to the existing IOLBC to support projects and further develop local capacity.

Numerous benefits to establishing international watershed boards were listed including, but not limited to a more holistic mandate; more inclusive and diverse membership including Indigenous people; further enabling local boards and community trust-building; improved information sharing; more nimble, adaptive and effective responses to emerging issues; and the ability to better leverage local resources.

The IJC's approach to the IWI, and phasing in an integrated ecosystem approach including guiding principles and funding criteria, is available here: https://www.ijc.org/en/what/iwi

Information and updates about the International Osoyoos Lake Board of Control, including on an Annual Public Meeting planned for Fall 2023, will be available here: https://www.ijc.org/en/olbc

SESSION 5: FISHERIES RESTORATION

Overview

This session focused on the multiple dimensions of fisheries habitat trends and restoration in the Osoyoos Lake and larger Okanagan/Okanogan watershed and beyond. Presentations included:

- Okanogan Basin Monitoring and Evaluation Program (OBMEP) Habitat Status and Trend Monitoring (John Arterburn),
- Habitat Rehabilitation in the Okanogan Sub-basin in Response to Changing Environment Conditions (Chris Fisher),
- Salmon Restoration in the Okanagan Basin (Karilyn Alex), and
- Restoring *sq̓awsitkw* (Okanagan River)'s Ecosystem Health by Putting Back Salmonid Floodplain Habitat (Natasha Lukey).

Okanogan Basin Monitoring and Evaluation Program (OBMEP) - Habitat Status and Trend Monitoring

Presented by John Arterburn, Confederated Tribes of the Colville Reservation

This presentation summarized the results of the Okanogan[6] Basin Monitoring and Evaluation Program (OBMEP) that has been collecting fluvial habitat data on both sides of the border for almost 20 years.

An Ecosystem Diagnosis and Treatment model (EDT), which is a life-cycle based habitat model, translates complex data into quantitative metrics that can guide decision-making. This data collection and modelling continues to inform the conservation and recovery of the declining Pacific salmon and steelhead in the Pacific Northwest.

The integration of modelling results with long-term research, monitoring, and evaluation in the Okanogan River Basin can inform ongoing conservation and recovery of steelhead listed under the U.S. Endangered Species Act. The lessons learned demonstrate the value of the OBMEP approach as an adaptive management tool that is both effective and transferable. Modeling allows one set of habitat data to be used across changing landscapes, changes in policy, different time periods, different species of fish, hatcheries and habitats.

6 American spelling of Okanagan.

Habitat Rehabilitation in the Okanogan Sub-basin in Response to Changing Environment Conditions

Presented by Chris Fisher, Colville Tribes Fish and Wildlife

This presentation focused on habitat rehabilitation in the Okanogan River sub-basin, its impact on steelhead populations and how this rehabilitation may be influenced by climate change.

The floodplain of the Okanogan River Basin is wide, making the valley floor favorable for agricultural development. Many of the tributaries of the Okanogan River have been reduced in flow from irrigation withdrawals or diversions. This has led to water temperatures in the Okanogan River main channel to become too warm for steelhead survival.

As a result, habitat rehabilitation efforts for anadromous salmonids have focused on the cold-water tributaries. Unfortunately, blockages and water diversion for agriculture in these tributaries leading to warmer water temperatures have compromised habitat quality. As a result, salmonids inhabiting these streams have suffered.

Since the mid-1990's the Colville Tribes have initiated efforts to rehabilitate habitat within these tributaries by increasing flow and providing passage at man-made barriers. Though these efforts have been successful, climate change models predict water temperatures in the lower reaches of these tributaries will exceed lethal threshold for spring Chinook salmon and summer steelhead. As a result, habitat rehabilitation efforts are now focusing on reaches higher in elevation and removing barriers to fish passage to these upper reaches. Cooler water temperatures in these upper reaches, even with climate change, are expected to be more hospitable.

Salmon Restoration in the Okanagan Basin

Presented by Kari Alex, Okanagan Nation Alliance

This presentation reviewed historical degradation of the salmon habitat, and its effects on different fish species, and then outlines recent and planned efforts to improve salmon habitat. It is premised on bridging Indigenous and western science. The presenter also recognized that *Syilx* are inherently Salmon People so bringing back the salmon is essential.

Construction of dams, channelization, urban encroachment, industrial agriculture and historic water management practices have all contributed to depletion and extinction of Okanagan fish stocks. Major hydro-electric dams on the Columbia River, along with Okanagan River disruptions (channelization for irrigation and flood control, dramatic shortening of overall channel length, 88% reduction of wetlands) have greatly simplified habitat and dramatically reduced historic fish populations. For example, coho and lamprey are considered extirpated, chinook and steelhead are rare, kokanee and rainbow trout have declined. Notably, sockeye salmon populations have recently rebounded. Along with the decline of many native species, some invasive species and habitat degradation for native species has increased such as Carp, Mysis shrimp and Eurasian watermilfoil.

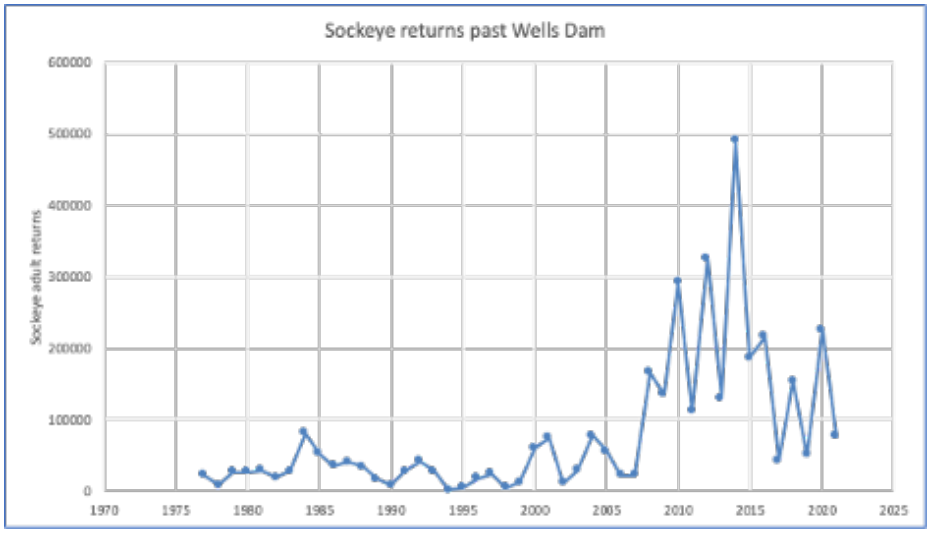


Figure 7. Historic Sockeye Salmon returns at Wells Dam. Wells Dam is located just downstream of the confluence of the Okanogan and Columbia Rivers.

The ONA's restoration initiatives follow a holistic approach to restoration that includes the land, water and wildlife. The ONA is actively involved in the conservation, protection, restoration, and enhancement of fish stocks, in particular for Okanagan River sockeye salmon. Projects to date have included a fish-water management tool, re-introduction of sockeye based on 12 years of implementation and research followed by monitoring and evaluation of reintroduced fish. Physical projects have included fish passage construction at McIntyre, Skaha and Okanagan dams and selective reintroduction of meander sections, side channels, spawning beds and floodplain reconnection.

These efforts have led to significant rebound of sockeye salmon returns, increasing from less than 3,000 sockeye returns in the mid-90's to typically more than 100,000 returns – and as many as 480,000 returns – between 2010 and 2021. The Okanagan run now makes up about 90% of all Columbia River sockeye.

Restoring Okanagan River's (sq̓awsitkʷ) Ecosystem Health by Putting Back Salmonid Floodplain Habitat

Presented by Natasha Lukey, Okanagan Nation Alliance

This presentation described recent projects to restore salmonid floodplain habitat, led by the *Syilx* Okanagan Nation Alliance and their many collaborators.

The overall goal of the projects is the conservation, protection, restoration, and enhancement of Indigenous fisheries (for anadromous and resident fish) and the aquatic resources within Okanagan Nation Territory. The approach to 'bring back the fish' has been to balance Indigenous knowledge and western science to manage, protect and restore aquatic habitat and Indigenous fisheries resources.

The Okanagan's salmon species require a range of habitat types, all which once combined to form a healthy, diverse Okanagan River and lake system. These habitats included engaged floodplains and cottonwood riparian forests, connected side channels, riffle-pool sequences, and a diversity of substrates dependent on specific depths and velocities. Restoring this diversity for salmon means restoring the aquatic habitat form and functions. This will improve water quality and habitat structure for all living beings, including people.

Recent projects in the Okanagan Valley, in *Syilx* Territory, are not only aimed at restoring salmonid floodplain habitat but also contribute to restoring the river system's water quality, flood capacity, and capacity to support all Okanagan creatures, including ourselves.

These projects are the result of multiple collaborations. Underlying the success of all is the engagement and guidance of *Syilx* Traditional Ecological Knowledge Keepers. Knowing the past guides the present and future. The *Syilx* Okanagan Nation hopes that by sharing these experiences, the important work of bringing back the health of the Okanagan River (*sq̓awsitkʷ*) river system will continue.

Figure 8. ORRI Phase I, II and VDS 13. Restoration of oxbows, a side channel and parts of an historic floodplain. Source: Okanagan Nation Alliance.

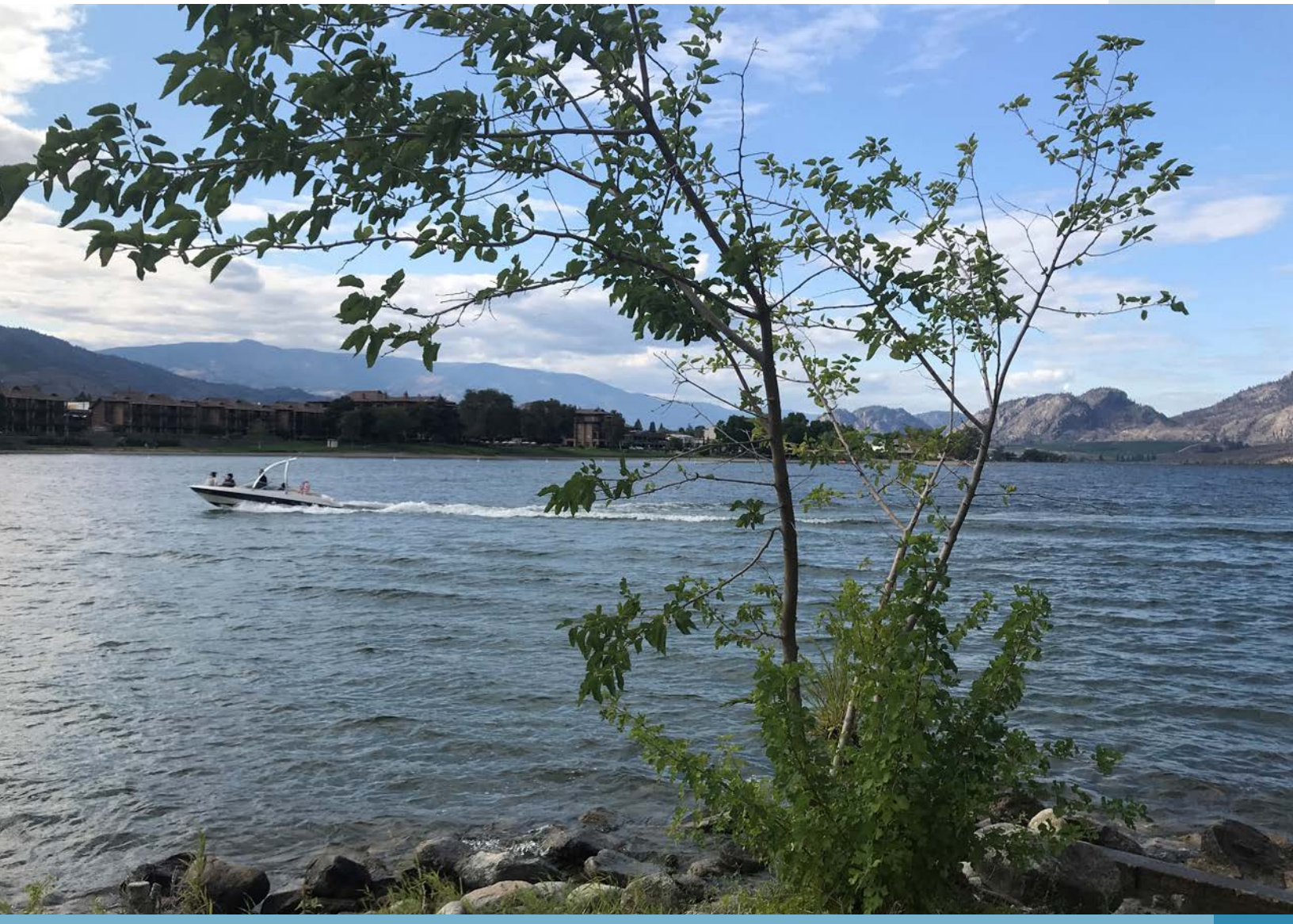
Figure 9. Okanagan River Restoration Collaborators. The *Syilx*-led Okanagan River System restoration projects have attracted many Indigenous and non-Indigenous collaborators.

SESSION 6: WATER QUALITY

Overview

This session focused on water quality, including some key impacts on water quality, the many water quality parameters being monitored and the implications for fish habitat. It included the following presentations:

- Mobilization of Pollutants from Lake Sediments (Heather Larratt),
- The Value of Long-Term Monitoring Towards Understanding Changing Water Quality Conditions within the Osoyoos Lake Watershed (Lucie Thompson), and
- Osoyoos Lake Nutrient Dynamics from a Fisheries Perspective (Samantha Pham).



Mobilization of Pollutants from Lake Sediments

Presented by Heather Larratt, Larratt Aquatic Consulting

This presentation explained why lake sediments accumulate contaminants, where lake sediment contaminants accumulate, how sediment disturbance mobilizes pollutants, and suggests some solutions. It was based on a study of the Okanagan Watershed and included Osoyoos Lake sediment data.

Creeks and storm drains are the main source of lake sediments. The amounts of these sediments are affected by upstream sediment accumulation and events, including lands impacted by wildfires such as the White Rock Lake wildfire near Vernon. This can increase the release of sediments into streams, particularly during spring freshet or major precipitation events.

Different types of sediments settle differently and vary by lake location. Organic matter and fine particulates can settle very slowly or never, whereas some silt sediments (for example, in Wood Lake) settle very quickly. Sediment storage is a vital lake function particularly because settled sediments can store contaminants such as hydrocarbons, metals, pesticides, and fecal bacteria. The study showed that there are signs of increasing levels of contaminants being stored in lake sediments including hydrocarbons.

Sediment suspension and re-suspension can introduce contaminants to the lake water column. Power boating, and particularly wake boarding, can cause considerable damage due to re-suspension of contaminants. More generally, irresponsible power boating and ever-more powerful boats, can lead to increased shoreline erosion and habitat damage, contaminated discharge, acceleration of eutrophication and potentially introduce aquatic invasive species. While the impacts are measurable, power boaters may not be aware of the impacts they make.

One simple and effective response to the damages of powerboating would be regulations and/or behaviour change to ensure that power boats transit slowly across water less than 8 meters (25 feet) deep, to avoid re-mobilization of sediments into the water column. Lake depth, rather than distance from shore, should be the determining factor for boater speed zones. This rule would have additional benefits, including improved boating safety and overall lake and shoreline health.

Other recommendations focused on minimizing stormwater contaminants, marina contaminants and watershed protection (e.g. high-runoff mitigation and protection of upstream riparian zones).

The Value of Long-Term Monitoring Towards Understanding Changing Water Quality Conditions within the Osoyoos Lake Watershed

Presented by Lucie Thompson, B.C. Ministry of Environment and Climate Change Strategy

This presentation described the long-term trends of water quality in Osoyoos Lake and more generally the value of long-term water quality monitoring carried out by the B.C. provincial and federal governments.

Historically, Osoyoos Lake water quality has been attention since the rapid population growth beginning in the 1940's, followed by monitoring water and wastewater quality in the 60's, followed by basin-wide phosphorous control and continued water quality monitoring until today.

For Osoyoos Lake, the B.C. Ministry of Environment and Climate Change Strategy (ENV) in collaboration with Environment and Climate Change Canada (ECCC) maintain two buoys (in the north and south basins of the lake), that provide real time water quality data at multiple depths, and include sampling parameters such as temperature and dissolved oxygen. Additional sampling of shallow water (~1m) includes pH, Specific conductance and turbidity.

In addition, the BC Lake Monitoring Network (BCLMN) maintains water quality stations in Okanagan River (one station upstream of Osoyoos Lake) and in Osoyoos Lake (3 discrete water quality stations). These sample additional water quality parameters focus on dissolved oxygen, temperature, chlorophyll-a, secchi disk depth and total phosphorus.

Data indicate the following general trends:

- Mixed results for shallow water algal biomass (Chlorophyll a) from 1978 to 2022.
- Increasing water clarity and decreasing algae biomass (Secchi Disk Depth) from 1972 to 2022.
- Decreasing total phosphorous in shallow water (and mixed results for deep water samples) from 1974 and 2022.
- The presentation concluded with the following:
- The historical nutrient control of point sources has contributed to improvements in water quality in Okanagan River and Osoyoos Lake over the past 50 years.
- There is some evidence of internal nutrient loading in the central and south Osoyoos Lake basins.
- Non-point (diffuse) sources of nutrients are becoming increasing stressors on surface water quality worldwide (and are very difficult to manage).
- Impacts of climate change are unpredictable, exacerbating issues in already stressed systems.
- Lake column temperature and dissolved oxygen profiles at the north and south buoys indicate an increasing 'squeeze' on juvenile sockeye salmon and returning adults during summer months as salmon will want to be deep enough to get to water below 17C but not so deep that they experience dissolved oxygen below 4mg/L (see figure 10 and the next presentation summary).

This water quality information and trend results are based on data collected from two long- term focused surface water quality monitoring programs: (1) the BC Lake Monitoring Network operated by B.C. Ministry of Environment and Climate Change Strategy (ENV) and (2) the Canada-BC Water Quality Monitoring Program operated jointly by Environment and Climate Change Canada and ENV.

More information along with historical data is available on request here: msqeoperationswqmoperations@ec.gc.ca

Real time data is available here: http://aquatic.pyr.ec.gc.ca/realtimebuoys/Osoyoos.aspx

More information on the BC Lake Monitoring Network (BCLMN) is available here: www.gov.bc.ca/lake-monitoring

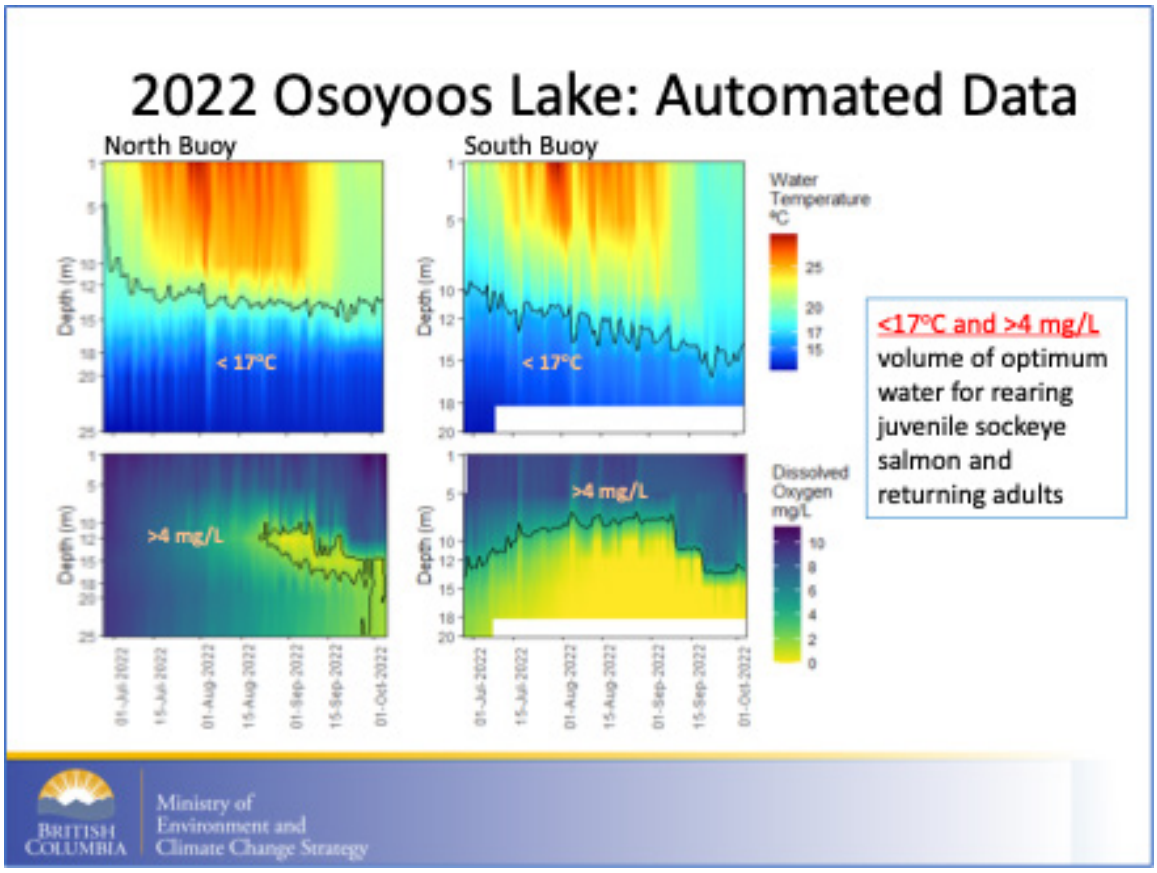


Figure 10. Osoyoos Lake water column temperature and dissolved oxygen trends for Summer 2022. Juvenile sockeye salmon optimal rearing habitat requires <17c and >4 mg/L dissolved oxygen, which significantly limits habitat area to the north basin (buoy) which is 'squeezed' to near zero optimum habitat in late summer. Source: BC Ministry of Environment and Climate Change Strategy.

Osoyoos Lake Nutrient Dynamics from a Fisheries Perspective

Presented by Samantha Pham, Okanagan Nation Alliance

This presentation provided a fisheries perspective on Osoyoos Lake water quality based on studies of the quantity and character of rearing habitat for sockeye salmon in Osoyoos Lake.

The Okanagan sockeye salmon (Oncorhynchus nerka) stock is the only remaining significant remnant stock of sockeye in the Columbia River Basin. From 1967-2004, total adult returns declined by nearly 50% despite drastically reduced annual exploitation in commercial and First Nations fishery in both Canada and the U.S.

In response to these declines, the Okanagan Nation Alliance, in partnership with Canadian federal and provincial governments, and Grant and Chelan County Public Utility Districts, initiated studies to quantify and characterize the rearing habitat for sockeye salmon in Osoyoos Lake. Preliminary data from the 1990s showed that summer oxygen concentrations at deeper depths (hypolimnion) was below the optimal concentration of 4 ppm for growth and survival of juvenile sockeye salmon in the south and central basins of Osoyoos Lake, and temperatures in the upper layer (epilimnion) were too warm (>17C), causing a “squeeze” to the optimal habitat zone. Juvenile sockeye densities were reduced in these basins, and sockeye were rearing mostly in the colder, more oxygenated north basin.

Continued intensive monitoring and evaluation of limnological conditions and juvenile sockeye salmon growth and survival have shown that conditions in the north basin hypolimnion have been deteriorating in the late summer, and juveniles are forced to rear in the deeper colder waters where oxygen is less optimal during that time resulting in reduced growth. While studies are ongoing, the declining water quality and associated reduced growth and survival of juvenile sockeye in Osoyoos Lake might suggest that future projected climate warming and potential increasing loads of nutrients from human development requires further mitigation to reduce deep water anoxia (low dissolved oxygen) and aid in Okanagan sockeye salmon stock recovery.

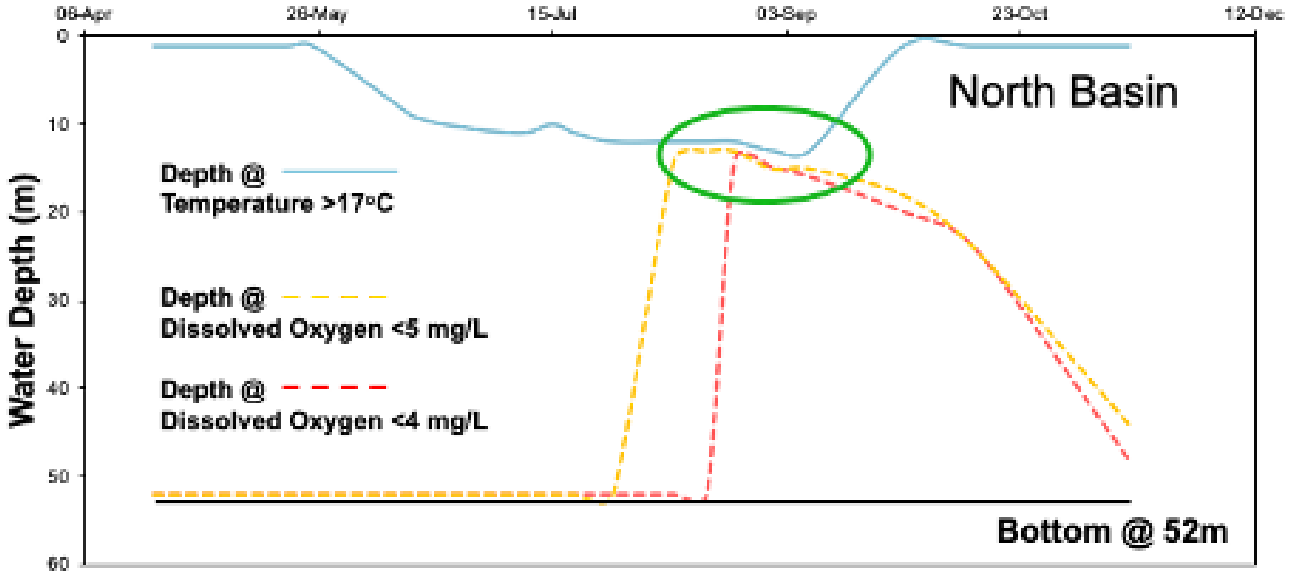


Figure 11.. Osoyoos Lake Temperature – Dissolved Oxygen 'Squeeze.' Results from monitoring temperature and dissolved oxygen concentrations in the Osoyoos Lake North Basin indicate a late summer squeeze that temporarily reduces and even eliminates a suitable rearing habitat water layer, where temperature is low enough (i.e. <17° C) and dissolved oxygen is high enough (i.e. >4 mg/L). With climate change and nutrient loading trends, this squeeze is likely to worsen without restorative measures.

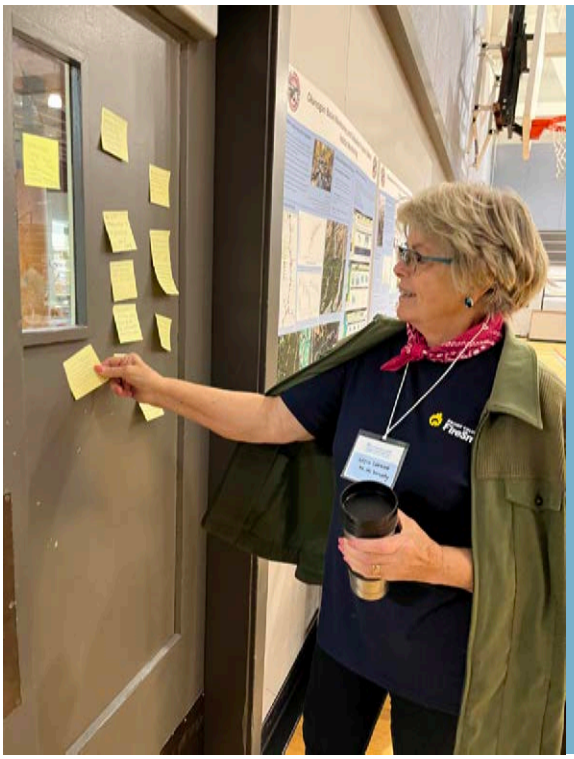
FORUM SUMMARY: EMERGING KEY THEMES

The following is a synthesis of some emerging key themes from the forum presentations, questions and answers and some of the many diverse conversations during the forum. Some themes seemed highly resonate with the forum plenary while others may be minority views yet are still important to describe.

Relationships

1. Conversations and Relationships. The OLWSF ("the Forum") provided many opportunities for cordial and positive conversations. While recognizing that relationship-building and trust-building takes time, the forum was a significant positive step.
2. New and Diverse Relationships (human to human). Including otherwise unlikely mixing of people (for example, IJC Commissioners with activists, First Nation community members with Western scientists, and students with policy makers).
3. Watershed Relationships. *Syilx* facilitators, presenters and conversations introduced and/or reinforced the reality that we are not only in relation with each other, but with the salmon, the water, the land, and all living things, upon which we depend.
4. Intergenerational Relationships. Forum participants were reminded in part through the Four Food Chiefs story, that we are an intergenerational "bridge" between our ancestors (and their wisdom) and our offspring (and our responsibility to them).

Discoveries



1. A Myriad of Discoveries. The high-quality keynotes, thoughtful stories, focused sessions and diverse conversation types created a multi-layered immersive experience. This led to multiple discoveries – not only information about the watershed – but also different ways of seeing and interpreting the information, connecting issues and imagining pathways forward. In short, there was so much to discover – past, present and future – about the watershed and the greater watershed community!
2. Discovering the Meaningful and Practical *Syilx* Approach. Story, worldview, the four food chiefs' approach, and exploring associated questions and insights demonstrated the usefulness of the *Syilx* approach. The messy, immersive and sometimes off-script conversations not only triggered important intellectual conversations but also evoked a more emotive and spiritual response, as intended.
3. Learning from Local and Indigenous Leaders. The presentations and conversations with the greater watershed community unleashed a wealth of knowledge and wisdom (e.g. through Traditional Ecological Knowledge (TEK) and Traditional Knowledge (TK)), including learning from ancestors past and present (not only learning from past mistakes but long-past successes) and advancing knowledge further through local and regional scientific studies.
4. Discovering New Ways of Listening. Through the multiple lenses of the different food chiefs, including taking on the role of the "opposite" chief to one's own affinity, people reported listening in new ways. It was not only listening to each other, but also 'listening' to the dynamic, ever-changing living systems (for example, listening to the river and the birds). This included the idea of learning from the salmon (an example of perseverance) and learning from the water (the ideas of "flow" and seeking the path of least resistance).
5. Self-Discovery. Through the many sessions and informal conversations, people reported a diversity of conversations, some more enjoyable than others. For some people, uncomfortable conversations (that were informed and softened by story) led to discoveries about themselves including re-thinking long-held beliefs and expressions. One could say that different people experienced different Forums.
6. Signs of a New Language. Some people spoke of changing the language they intend to use going forward (for example, the influence of "water as relative" as compared to "water as resource"). In line with two-eyed seeing and the "Ethical Space", Forum participants spoke of a new, shared language beginning to emerge.

Advancing Water Science

1. High Quality Science. The diverse scientific studies presented were recognized as generally very high quality by other scientists, engineers, and policy makers who had not previously seen the connections between the studies and had been missing a clear context or purpose for policy or action.
2. Science to Science. Science-focused presenters and representatives observed the Forum to be an excellent opportunity to learn about a multitude of watershed-relevant studies (e.g. about water quantity, quality, biota, climate change, etc.) and become much more familiar with the science of the Osoyoos Lake watershed.
3. Indigenous-Informed and Indigenous-led Science. Scientific studies conducted by *Syilx* and Okanagan Nation Alliance staff were of noticeably high quality, contextualized and relevant to watershed health. Scientific studies informed by the four chiefs tended to be more purposeful, better contextualized and connected with local conditions more oriented towards action (e.g. salmon habitat restoration).
4. Use Existing Policies and Structures. Rather than reinventing the wheel, Forum participants were reminded that multiple policies, governing structures, and management systems are in place which can be used as useful policy vehicles to phase in science-based watershed management improvements.
5. Understanding the "Squeeze." Some studies illustrated a kind of squeeze between the declining fish habitat quality (e.g. due to climate change) and the urgency to act before too many fish are lost. This evoked a more general notion of squeeze between the legacy of water management structures and the increasing impacts complicated by climate change and the necessity to make urgent changes to respond and adapt to the changing conditions.
6. Anticipating Climate Change and Impacts. Forum participants learned from sophisticated new scientific studies and models, that climate change is likely to lead to an ever-increasing number of extreme events (e.g. rainfall, floods, droughts, wildfires, etc.) with significant impacts and new extremes for river flows and lake levels (high and low) and lake temperatures – all with consequences for habitat quality, property, and infrastructure.

From Conversation To Action

1. Many Opportunities. By the end of the Forum, many participants saw "opportunities left and right" – many areas where actions can be taken, whether with policy, projects, planning, management systems or further studies.
2. Trusting relationships are a basis for action. Relationship and trust-building takes time but is critical to build the hope, collective knowledge and the confidence necessary for collaborative action.
3. Start with Indigenous. Begin with Indigenous guidance for effective collective action. The *Syilx* approach is inherently holistic and focused on relationship-building and restoration. Expanding access to *Syilx* knowledge in schools and post-secondary institutions is important to continue to build the foundations for relationships and actions.
4. Celebrate small steps. While solving all the watershed challenges over the long run can seem overwhelming, celebrating the actions that lead to big changes, like the return of the salmon (as a result of restoration projects) helps to build the human energy needed to continue.
5. Inspired to continue the conversation. Some forum participants expressed an interest in continuing the conversations they started at the forum and wondered what venues and platforms might help to facilitate such conversations.

sẁiẁs Provincial Park (Haynes Point) - Photo courtesy Destination Osoyoos

STAY CONNECTED!

We invite you to share your thoughts. Use the hashtag #OLWSF2022 and tag us.

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For more information, visit
https://www.obwb.ca/olwsf/