Bow River Basin Council

Preserving Our Lifeline

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Working Together to Manage Phosphorus Inputs to the Bow River

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Phosphorus is an essential element to humans, animals and plants.

It is in almost everything we eat and drink, and is a common additive in fertilizers. Sources of phosphorus in the Bow River Basin include plant material, soil, animal waste, treated wastewater effluent, fertilizer in runoff water, sediment from eroding riverbanks, and dust fall (atmospheric deposition).

Phosphorus occurs naturally in many waterbodies and is generally not a problem. However, excessive phosphorus loadings can result in excessive plant and algae growth, which in turn can lead to water quality issues. Plants photosynthesize during the day and respire at night and, if there are too many plants, the total respiration over the course of a night can use up a significant proportion of the available dissolved oxygen in the river and cause stress to fish (Figure 1).

In addition to negatively impacting aquatic species, excessive plant and algae growth can result in blockages of water withdrawal systems and intakes, and negative impacts on river aesthetics, recreation opportunities, crop irrigation, livestock watering and other water uses.

History of Phosphorus in the Bow River

In the 1970s and early 1980s, high nutrient levels in the Bow River downstream of Calgary were a significant concern. Phosphorus loadings averaged from 800 kg/day to 1400 kg/day between 1970 and 1983 (Figure 2). In the early 1980s, additional controls put in place at Calgary's wastewater treatment plants significantly reduced the amount of phosphorus entering the river. Since then, water quality in the Bow River has much improved.

However, recent studies that have looked at phosphorus loadings to the Bow River indicate that the river can only assimilate 350 - 450 kg/day without potentially bringing dissolved oxygen below the levels required to protect fish (Figure 2). This means that there is little room for phosphorus loadings to increase without negatively affecting the river.

There has been significant population growth in Calgary and the surrounding area over the last decade, and continued growth is expected. Increasing populations place greater pressures on water resources. Therefore, the challenge is to maintain healthy phosphorus levels in the Bow River in the face of increasing population pressures.

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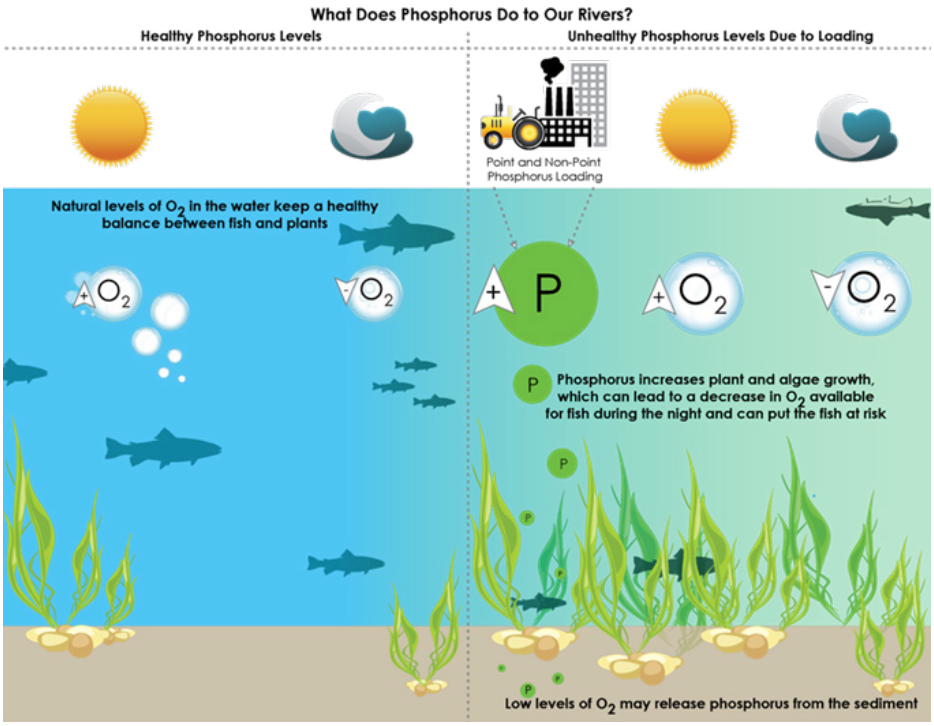

Figure 1. The left side of this schematic shows a balance of aquatic plants, nutrients and oxygen in a water body. The right side illustrates the effects of too much phosphorus in a water body resulting in an abundance of aquatic plants and a decrease in oxygen availability at night. Source: Bow River Phosphorus Management Plan.

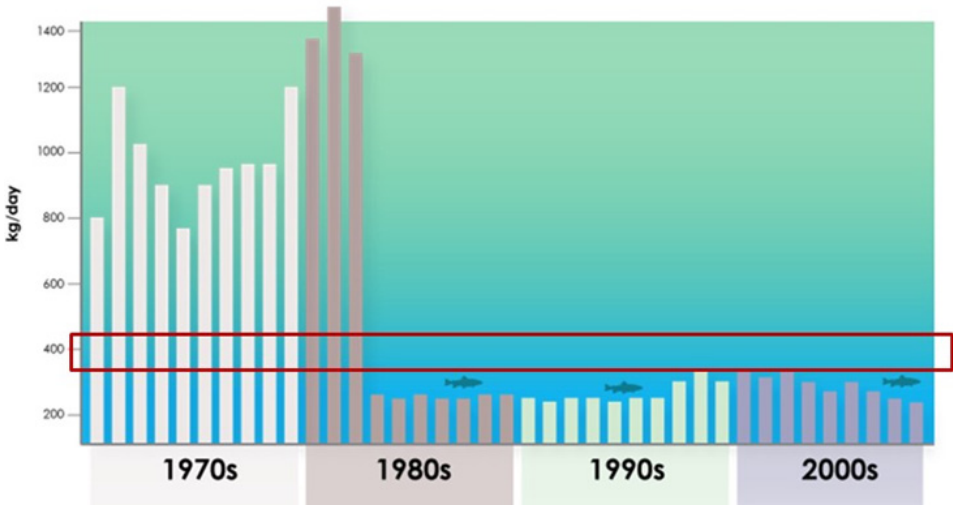

Figure 2: Historical phosphorus loadings to the Bow River at Calgary. The red box represents the river's capacity to assimilate phosphorus. Source: Bow River Phosphorus Management Plan.

Bow River Phosphorus Management Plan

The Bow River Phosphorus Management Plan (BRPMP) is a strategic plan initiated in 2011 to address sources of phosphorus in the Bow River between the Bearspaw and Bassano dams. The desired outcome identified in the BRPMP is to ensure that "phosphorus inputs to the Bow River are managed to provide for a healthy aquatic ecosystem while meeting the needs of those who rely on clean water."

A Pilot Initiative

The BRPMP serves as a pilot project for the implementation of cumulative effects management in Alberta. The planning area was chosen as it is the most densely populated area in the Bow River Basin, it is subject to increasing population pressure, and it has experienced elevated levels of phosphorus in the past.

The South Saskatchewan Region Surface Water Quality Management Framework (the framework) establishes triggers and limits for different water quality parameters at nine monitoring stations in the South Saskatchewan Region, including four stations in the Bow River Basin.

When a trigger or limit is exceeded, a management response is initiated to investigate the cause of the exceedance and, when needed, identify management actions to address the exceedance.

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"There are many things that individuals can do to help reduce phosphorus inputs into nearby waterbodies. "

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Although no exceedances of the framework's triggers or limits for phosphorus have occurred in the Bow River to date, the BRPMP serves as a pilot project to help us understand what a management response might look like when a future trigger or limit exceedance occurs.

Multi-Stakeholder Process

The BRPMP process was led by a Steering Committee comprised of various parties and a cross-section of decision makers who have an influence on the management of phosphorus in the planning area. Additionally, multi-stakeholder task teams convened to look at communications, data, urban non-point sources, rural non-point sources, and urban point sources. Many of the participating stakeholders continue to be involved with the BRPMP through their work on the Implementation Committee.

The Implementation Committee functions primarily as a coordinating body that tracks projects and activities that contribute to achieving the desired BRPMP outcome (i.e., phosphorus inputs are managed to provide for a healthy aquatic ecosystem while meeting the needs of those who rely on clean water). The Implementation Committee also tracks project progress, identifies new projects and activities, and identifies synergies between projects to ensure the best possible use of available resources.

Members of the Implementation Committee describe the primary benefits of their participation as:

- Networking: Working with others on the committee helps to build relationships and trust for when challenging decisions need to be made.
- Information Sharing: Hearing about projects that are underway helps committee members to identify projects, policies and regulations that relate to the work of their organizations.
- Influence: Influencing policies and regulations is more effective when it comes from a group.
- Collaboration: Projects and activities that move the needle on water quality issues require collaboration if they are to be effective.

In June 2022, the Implementation Committee is planning to host a Stakeholder Advisory Group workshop in collaboration with the Bow River Basin Council. Stay tuned for more information!

Indicators of Success

Based on statistical trend analyses, there has been no significant increase in phosphorus concentrations during the past decade despite increasing population pressures. Water quality in the Bow River continues to be of high quality, providing for sustainable ecosystem health while meeting recreational, industrial and agricultural needs.

The Implementation Committee is currently working on a detailed summary of lessons learned over the past seven years.

Find Out More

More information on the BRPMP, including a link to the plan, a 5-year update, fact sheets and a video series, can be found at Bow River Phosphorus Management Plan | Alberta.ca.

Take Action!

There are many things that individuals can do to help reduce phosphorus inputs into nearby waterbodies. If you are interested in taking action to reduce phosphorus, here are a few ideas:

- When considering fertilizers, aim to use phosphorus-free fertilizers and apply as directed by the instructions. Choose a slow-release fertilizer variety. This will feed your plants slowly over time instead of the short burst of nutrition quick-release fertilizers provide. Be careful not to overwater your lawn after fertilizing or apply fertilizer before you expect it to rain – this can cause nutrients to leach off your lawn and down the storm drain, and eventually into our rivers. Instead of using a hose to clean fertilizer from driveways and sidewalks, use a broom to sweep fertilizer pellets back onto the lawn so they can be absorbed by the soil.
- Consider adding at least one foot of topsoil when building a new home or updating your landscaping. This layer of topsoil will help to prevent runoff of excess water and fertilizers into stormwater drains.

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- Consider reducing the amount of lawn on your property and replacing it with natural landscapes requiring less water and nutrients.
- Consider getting a rain barrel. This will help you save some money while protecting Alberta's lakes and rivers from phosphorus runoff.
- Picking up after pets helps to prevent runoff of excess nutrients into nearby waterways and storm water drains.
- Reduce your use of products containing phosphorus when possible (e.g., laundry and dishwashing detergents, cleaning products, shampoo and soap).
- Wash cars in car washes, not in your driveway. When you wash your car in the driveway or street, the soap, together with the dirt, grime, grease and oil, washes from your car and flows into nearby storm drains. Some soaps may also contain phosphates, which can cause excess algae to grow in local waterways.
- In the fall, be sure to clean the leaves off driveways and along the edges of streets. As leaves decompose, they release nutrients into rivers and other areas.
- Understand the negative impacts of the installation and use of garburators. Most food wastes are quite high in phosphorus, especially potato peels and meat products. The ground-up particles from these wastes increase phosphorus concentrations in the wastewater.

The UCalgary Bow River Ecosystem Health Assessment Project:

Understanding the Impacts of Municipal Wastewater and Stormwater

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The UCalgary Bow River Ecosystem Health Assessment Project (the Project) is a multi-phased, long-term initiative to develop an adaptive, effects-based monitoring framework for wastewater and stormwater in the Bow River Basin.

The project involves an interdisciplinary team of faculty, graduate, and undergraduate researchers from The University of Calgary and partner institutions (The City of Calgary, InnoTech Alberta, and universities of Alberta, Waterloo, Florida and McMaster). There are also significant partnerships under development with the RiverWatch Institute of Alberta, Environment and Climate Change Canada, Alberta Environment and Parks, and the Bow River Trout Foundation. The project will also engage First Nations along the Bow and Elbow rivers, working collaboratively on community-based participatory approaches to research. The Bow River Basin Council represents an important avenue for discussions with stakeholders, and for understanding the many other efforts underway in the basin.

Members of the UCalgary Bow River Ecosystem Health Assessment Project.
Photo: UCalgary Bow River Ecosystem Health Assessment Project

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"Understanding the fate and transport of ESOCs introduced via wastewater and stormwater in the system are integral to evaluating potential cumulative effects." Page 5

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There is currently a wide variety of important and ongoing monitoring and research programs in the basin, including The City of Calgary's intensive monitoring and management program for wastewater effluent quality. Provincial wastewater regulations, which focus on a specific set of compounds in wastewater discharges, guide many of these programs. Emerging substances of concern (ESOCs), however, are new compounds (or those not previously considered) that can potentially impact the Bow and Elbow rivers. These compounds include pharmaceuticals, consumer products and industrial chemicals, and may enter the river systems through point or non-point mechanisms. Understanding the fate and transport of ESOCs introduced via wastewater and stormwater in the system are integral to evaluating potential cumulative effects. Accordingly, biological markers of appropriate sensitivity have been identified for response characterization, to discern the extent and magnitude of potential changes across ESOC exposure gradients in the basin.

The Bow and Elbow rivers within Calgary are highly urbanized and provide for a range of different uses and ecosystem services, including drinking water, recreation, and a flourishing sport fishery. Calgary residents are increasingly familiar with drought and flood conditions, which are becoming more frequent. Surrounding Indigenous communities have also been heavily impacted by flooding and drought in the basin. As these conditions can potentially magnify the impacts of wastewater and stormwater on the Bow and Elbow rivers, understanding potential environmental and human health implications are critical for protection measures to be considered.

Kicknet sampling in the Bow River near Canmore (Aphra Sutherland pictured). Photo: UCalgary Bow River Ecosystem Health Assessment Project.

ESOCs enter municipal wastewater infrastructure via household and industrial chemical use, and from human excretion of partially metabolized pharmaceuticals and natural hormones. As well, new substances are regularly detected in waste streams as new chemical products achieve commercial production and use levels, and as analytical chemistry methods improve. Despite modern treatment infrastructure and processes currently in operation, some of these compounds have the potential to discharge into rivers either partially or entirely unchanged.

With mutual areas of interest (including ESOCs), The City and the University of Calgary have made significant investments at the Advancing Canada's Wastewater Assets (ACWA) research facility at the Pine Creek Wastewater Treatment Plant. Research activities include developing tools and understanding response mechanisms to ESOC exposure in ACWA experimental streams, as well as initial scoping studies on the Bow River itself.

A unique feature of the project is that it considers the relative importance of municipal wastewater and stormwater influences on the Bow River food web. City staff are assisting with sample collection, data from their sampling programs, and additional resources.

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"...we are interested in hearing from potential partners and stakeholders to determine how best to integrate our work with existing efforts and programs"

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An effects-based approach drives this research: areas of concern are identified by looking at the responses of organisms themselves, along with a site's cumulative ecological state. These responses are then compared with organism responses in less impacted sites or in sites of known concern. Where differences exist among sites, these differences are considered in the context of relevant ecological thresholds and environmental quality guidelines (limits). Most importantly, long-term data from the project is used to develop triggers or performance thresholds to establish current environmental states, and to set target levels for monitoring future performance.

Much of the initial project work has involved comparing methodologies and developing tools that will be critical for the long-term studies. So far work has been initiated at various sampling sites, consistent with previous studies in the river, ranging from upstream of Canmore down to McKinnon Flats. Several students and researchers are conducting studies: a) summarizing historical monitoring data on ESOCs and characterizing the ACWA streams; b) caging fish and using artificial substrates for benthic invertebrates and periphyton for characterizing the ACWA streams and comparing different methods of assessment; and c) comparing methods for initial characterization of the lower food web, the benthic invertebrate community, and fish responses as the river passes through Calgary.

Studies related to fish focus on small-bodied species as they are less mobile and tend to reflect localized impacts more than species that are more commonly of interest, such as rainbow trout. To date, caging studies at ACWA have included longnose dace, trout-perch and spoonhead sculpin to develop indicators to characterize exposures in fish in the river. These studies characterize the physiological responses of fish to effluents by measuring the responses of tens of thousands of genes to these exposures. The results will be used to identify key gene targets for characterizing fish exposures and responses in the river system. Additionally, there are comparisons between the responses of caged and wild longnose dace at sites along the river with known wastewater and stormwater inputs. These studies focus on developing the tools, methods, current baselines, and targets for future studies.

Sculpin in a net. Photo: UCalgary Bow River Ecosystem Health Assessment Project.

As this research project is in its early stages, we are interested in hearing from potential partners and stakeholders to determine how best to integrate our work with existing efforts and programs. We are specifically interested in:

- What are the priority issues and geographic areas of concern?
- Where and when are measurements currently being taken?
- What are the data gaps and information needs?
- How can we jointly accomplish common goals?

If you know of or are working on a related project or initiative, please reach out to the lead investigators, Dr Kelly Munkittrick (Kelly.Munkittrick@ucalgary.ca) or Dr Fred Wrona (FrederickJohn.Wrona@ucalgary.ca) to discuss further!

Climate of Change - What is Climate Change?

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When extreme weather events occur, like the heavy rainfall and subsequent flooding that inundated British Columbia, people talk about climate change. But, an average citizen may not understand what "climate change" means. First, what is a "climate"? Second, how can we tell if the climate is changing?

Society needs an agreed-upon, scientifically rigorous definition of climate. We also need to agree upon climate variables that can be monitored to establish climate patterns over time. Without these, we cannot have a meaningful discussion about the realities of climate change and how it may be affecting our communities.

Defining climate is not simple. It is not just the "weather," and there is no one-size climate that fits everywhere in the world. Climate patterns have to be determined at different scales in different biogeoclimatic regions over time – in most cases over at least 30 years.

In *On Defining Climate and Climate Change*, Charlotte Werndl explained various problems with the definitions of "climate" available in 2016. After reviewing definitions and associated climate models, Werndl proposed that climate means "the finite distribution of the climate variables over time relative to a regime of varying external conditions." If you are confused, so am I.

Contemporary definitions of climate are much easier to understand. For example, on the Climate.gov website, climate is "determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year."

Simpler still, Dictionary.com defines climate as "the composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years." So, these are some of the climate variables that climatologists monitor over time that Werndl was talking about.

Unfortunately, when we speak of climate change, people often refer to "global warming": the concept that emerged in the mid-1980s to describe an established pattern of increased temperatures around the globe. Global warming is a very complex emergent phenomenon. If the entire planet is getting hotter, then climate patterns at all scales around the globe are changing: the planet's atmosphere is adapting to increased temperatures and new climate patterns are evolving over time in all biogeoclimatic regions.

Climatologists are working on climate modelling at all scales, trying to predict new climate patterns and determine when severe weather conditions will prevail. However, many severe weather conditions, such as the flooding in the Calgary region in 2013 and the province-wide flooding in BC, were not predicted – they were unpredictable given the knowledge available at the time.

While many of us long-term residents of Cochrane agree that the climate in this community has changed since the mid-1970's, none of us can put a finger on when the changes became noticeable. We have always had variable precipitation, temperatures, chinooks, dust storms, high and low water tables, wildfires, etc. However, over the years since 1970, generally speaking, the snowfall in Cochrane for this time of year has been severely reduced, while the temperature has steadily increased.

In the 1970s we were able to cross-country ski in many places in the community from late November until March, and we needed warm winter clothes during those months. Over the past ten years, at this time of year we often go walking in spring jackets in our runners. Of course, there are exceptions to these trends. If you think back to September 2021, we didn't have an early frost like we always had back in the 70s. Generally, except during chinooks when we expect windy conditions, there seem to be more windy days.

Scientists have determined that human activities on the planet have contributed to global warming and climate change, but it is difficult to understand how our daily activities are contributing to a planetary change in temperature or even to increased unpredictable severe weather events. Whether or not we believe the scientists, climate change is real: the

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unpredictable but more frequent severe weather conditions will continue until the atmosphere adapts and evolves to a more stable state.

There are many things we can do to adapt to climate change in our communities. We might consider new land use policies that keep people's homes and businesses away from known flood hazard areas. We might understand how to share water, food and other resources during times of floods, droughts and wildfires. We might become flexible enough to respond in times of emergencies. We might have emergency preparedness kits for ourselves and our family members so that we are ready to evacuate the community on short notice.

Furthermore, we might rethink how much energy we use and how much carbon emissions our daily activities release into the atmosphere. We might shift our priorities from being resource consumers of all products from anywhere in the world, to being local shoppers who consider the ecosystem before buying products with excessive packaging.

Mostly, we need to educate ourselves and share our knowledge, skills and resources with one another. Somewhere, somehow, the conversations about humanity and climate change must begin. No one can afford to be an ostrich.

Editor's Note: This article originally appeared in the Cochrane Times, November 2021.

BRBC Quarterly Educational and Networking Forum (Microsoft Teams) March 9, 9:00 - noon

FORUM SPEAKERS

Emma Stroud and Shana Barbour
Friends of Fish Creek

Dr. Sonya Jakubec and Anne Robillard
Canadian Association of Physicians for the Environment (CAPE)

Jill Bloor and Tanya Carlson
Calgary Region Airshed Zone

Christine McLaren and Reece Mecham
University of Calgary students
Haskayne School of Business

To register, please visit this link.

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The next BRBC newsletter will be released in June.

If you would like to submit an article, please contact Andrea Czarnecki at: aczarnecki@brbc.ab.ca