

September 2021

SOURCE WATER

Protection Toolkit



www.SourceWaterProtectionToolkit.ca



KEY MESSAGES

A healthy watershed is central to clean and abundant source water.

- Establishing setbacks, restoring riparian buffer zones along watercourses, and acquiring watershed segments can save money by preventing costly impacts to source water.
- Roads often have the greatest impact on water quality, so they require careful long-term planning.

British Columbia legislation related to source water protection is complicated, and the Government of British Columbia does not have a lead water agency. Local action supported by stable funding and consistent and coordinated approaches is imperative to maintaining source water quality.

Collaboration is essential to protect source waters for today and for generations to come. Our collective efforts will bring cumulative benefits.

We are all downstream.

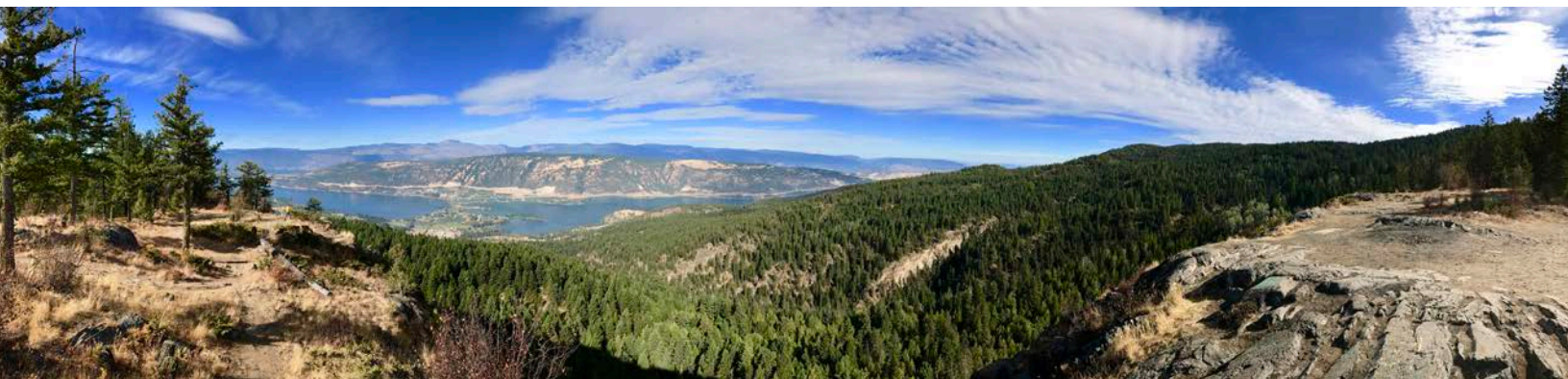


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Toolkit Authors

Heather Larratt, H BSc, RP Bio.
 Jamie Self, H BSc, RP Bio.
 Kellie Garcia, BSc, PAg
 Nicole Louiseize, MSc

Graphic Design

Rebecca Massey
 Karen Christensen

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Technical Advisory Committee Members

NAME	ORGANIZATION	NAME	ORGANIZATION
Andrew Reeder	Regional District of Okanagan-Similkameen	Laura Code	B.C. Ministry of Agriculture
Andrew Petersen	B.C. Ministry of Agriculture	Marni Turek	University of British Columbia Okanagan
Angela Lambrecht	Regional District of Central Okanagan	Michael Firlotte	City of Penticton
Anna Warwick Sears	Okanagan Basin Water Board	Nelson Jatel	Okanagan Basin Water Board
Bob Hrasko	Black Mountain Irrigation District	Nicole Penner	Associated Environmental Consultants Inc.
Brent Magnan	City of West Kelowna	Patti Meger	District of Lake Country
Brittany Lange	Regional District of Central Okanagan	Ray Crampton	B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Cory Labrecque	Regional District of Okanagan-Similkameen	Renee Clark	Independent
Dan Ricciuti	City of West Kelowna	Rob Hillis	City of West Kelowna
Danielle Noble-Brandt	City of Kelowna	Rob Dinwoodie	B.C. Ministry of Forests, Lands and Natural Resource Operations and Rural Development
Dave Tamblyn	First Nation Health Authority	Rob Birtles	Interior Health Authority
Dennis Einarson	B.C. Ministry of Environment and Climate Change Strategy	Rob Fleming	First Nations Health Authority
Desni Bachmann	City of Kelowna	Robyn Laubman	Splatsin First Nation
Devon van der Meulen	District of Summerland	Scott Boswell	Okanagan Collaborative Conservation Program
Don Dobson	Dobson Engineering	Scott Smith	Eterna Consulting
Ian McLellan	B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Shawn Grundy	District of Peachland
Jing Niu	City of Vernon	Tessa Terbasket	Okanagan Nation Alliance
Kat Zimmer	B.C. Ministry of Health	Tracy Guidi	City of Kelowna
Krista Derrickson	Westbank First Nation	Tricia Brett	Regional District of North Okanagan
Laura Frank	Regional District of North Okanagan	Tyler McNeill	Township of Spallumcheen
Lorne Davies	B.C. Wildlife Federation		

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INTRODUCTION

Clean water – essential and irreplaceable

Drinking water is of paramount importance and concern to British Columbians, and rightly so. Water is central to everything in B.C. – the survival of plants and animals, the well-being of residents, the health of the economy, and the beauty of the natural landscapes. Watersheds and aquifers are wonderfully resilient systems, and will provide quality water for present and future generations if we look after them.

Water suppliers use a multi-barrier approach (MBA) – an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap – to minimize risks to public health. The MBA includes selecting the best available water source and protecting it from contamination ('source water protection'), using effective water treatment, and preventing water quality deterioration in the distribution system. Coordinated and collaborative actions upstream of water treatment help communities not only effectively achieve drinking water goals, but

also delivers cumulative socio-economic benefits and ecological services. This toolkit provides a road map and tools for source protection, and is intended for local government, irrigation and improvement district, and First Nations staff who are responsible for providing drinking water to their communities in B.C.

It is important to acknowledge that local governments and water suppliers are operating in the traditional and unceded territories of Indigenous peoples. In the Okanagan, these are the Syilx/Okanagan Nation and the Splotsin territories. Water is a key aspect of reconciliation, and local governments can play an important role in building positive relationships with Indigenous communities based on mutual respect, understanding, and a common vision for the future. Source protection planning processes are strengthened when Indigenous values, knowledge, and leadership are included from the start. The *siwtk*[™] (Water) Declaration included on the next page can help local governments and water

suppliers improve their cultural understanding and engagement with Indigenous peoples.

The Okanagan Nation Alliance also recently released their [Syilx *siwtk*[™] \(Water\) Strategy](#). The strategy is a call to action that outlines how the Syilx Nation intends to care for their territory and work to ensure that *siwtk*[™] is properly respected and available for all living things.

This toolkit shows that the case is clear: water suppliers have an excellent opportunity to develop and carry out robust, watershed-scale source water protection programs. Most often, these programs are built from the ground up through locally driven initiatives with provincial government support, not the other way around. We can draw from the successes of others, and gain insight from their lessons learned. The benefits of source water protection start immediately, and the long-term dividends are vast.

[Let's get started.](#)

Syilx/Okanagan Nation *siwᑦk*^w (Water) Declaration

The following is an excerpt from the *siwᑦk*^w (Water) Declaration. [Click here](#) for the full version of the declaration.

SIWᑦK^w - WATER

- ▶ *siwᑦk*^w is a part of us and a part of all life.
- ▶ *siwᑦk*^w must be treated with reverence and respect. Our relationship with *siwᑦk*^w is not taken lightly; we are responsible to ensure that our relation can continue to maintain the health and resiliency of our *tmxw ulaxw* and *timixw*.
- ▶ *siwᑦk*^w is the lifeblood of our *tmxw ulaxw* and our *timixw* and we as Syilx People recognize *siwᑦk*^w as a sacred entity and relative that connects all life.
- ▶ *siwᑦk*^w comes in many forms and all are needed for the health of *tmxw ulaxw* and for the *timixw*.
- ▶ *siwᑦk*^w is our most sacred medicine: *siwᑦk*^w nourishes, replenishes, cleanses, and heals. Any use of *siwᑦk*^w should be an act of reverence and a commitment to our responsibilities to all life: now and to come, as Syilx People.
- ▶ *siwᑦk*^w comes from the sky and the highest places yet it never willfully rises above anything. It will always take the lowest path in its humility, yet of all the elements, it is the most powerful.
- ▶ Our sacred *siwᑦk*^w water teaches us that we have great strength to transform even the tallest mountain while being gentle, soft, and flexible.
- ▶ *siwᑦk*^w will always find a way around obstructions: under, over and through. It teaches us that anything is possible.
- ▶ *siwᑦk*^w movements, pathways, resiliency and power teach us who we are and who we can be as people.

Drivers of Reconciliation

The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) was adopted by the UN General Assembly in 2007, and is currently the most comprehensive international instrument on the rights of Indigenous peoples. It establishes a universal framework of minimum standards for the survival, dignity, and well-being of Indigenous peoples and elaborates on existing human rights standards and fundamental freedoms. Water is only specifically mentioned in UNDRIP twice, but references to Indigenous “lands, territories and resources” throughout UNDRIP are interpreted to include water.

Canada's Truth and Reconciliation Commission (TRC) was a 6-year undertaking, engaging thousands of Indigenous and non-Indigenous Canadians. The final report, released in 2015, includes 10 Principles of Reconciliation and 94 Calls to Action to redress the legacy of residential schools and advance the process of Canadian reconciliation.

In 2016, the Government of Canada announced its commitment to adopt and implement UNDRIP. It accepted all of the TRC's Calls to Action, including the call for all levels of government to adopt and fully implement UNDRIP as the framework for reconciliation. The Government of British Columbia declared its commitment to UNDRIP in 2017 and in November 2019, passed legislation establishing a process to implement UNDRIP. Bill 41 – 2019 Declaration on the Rights of Indigenous Peoples Act was developed in collaboration with the First Nations Leadership Council. The intent of the legislation is to bring all B.C. laws into alignment with UNDRIP over time as laws are modified or created.

Purpose of the Toolkit

Source water protection is a broad topic, with different purposes, responsibility, and resourcing needs at the local, regional and watershed-scale. This toolkit was crafted to simplify the source protection planning process, and to inspire a more holistic approach to drinking water management – one where we work together to take care of the land so that it can take care of the water.

Water suppliers in the Okanagan and beyond have taken important steps towards improving drinking water quality over the last 20 years. While enhanced treatment, staff training, monitoring, and reporting have reduced outbreaks, upstream source water protection measures must be added to these actions to meet existing and expected challenges to drinking water quality.

Best management practices and policies that better protect drinking are already being used in logging, ranching, and recreation, as well as by governments at the provincial, regional, and municipal levels.

Nonetheless, more action is required throughout B.C.'s watersheds, from the headwaters in the mountains, to rural and urban areas, and down to the mainstem lakes. A coordinated, collaborative, and consistent approach is needed. This toolkit is your guide to getting there.

A Cautionary Tale

A mere 40 years ago, residents on Okanagan lakes were selling their properties because of the smelly, algae-filled water along the shorelines.

Hard to imagine today, when residents and visitors are impressed with the clear water of our mainstem lakes, and when lakeshore property is very expensive.

But this is a cautionary tale. What happened before can happen again. As Okanagan populations increase and as watershed resiliency decreases, our safety margins shrink.

We need to pull together to protect source water for present and future generations.



How to use the Toolkit

Good news – you don’t have to read the whole toolkit! Each section is stand-alone. Refer to Table 1 to see what sections interest you. Figure 1 will also help you navigate through the toolkit.

Table 1: Guide for using the Source Water Protection Toolkit

	IF YOU...	START AT:	FOR:
Are:	A water supplier	<u>“PART 1: ROADMAP TO SOURCE WATER PROTECTION”</u> and tools of interest in <u>“PART 2: THE TOOLS”</u>	<ul style="list-style-type: none"> ▶ What to do to protect drinking water sources and how to do it ▶ Regulatory tools that you can use to protect drinking water
	A planner	<u>“TOOL 3. Policies, plans, and bylaws”</u>	<ul style="list-style-type: none"> ▶ Why you should buy in – the economics of why it makes sense
	An elected official	<u>“3.1 Regulatory framework”</u> <u>“3.2 Economic benefits of source water protection”</u>	<ul style="list-style-type: none"> ▶ Your responsibilities for source water protection
Need to:	Complete a source water assessment	<u>“PART 1: ROADMAP TO SOURCE WATER PROTECTION”</u>	<ul style="list-style-type: none"> ▶ The 5 main steps to follow to develop and carry out a source protection plan
	Build a response plan	<u>“PART 2: THE TOOLS”</u>	<ul style="list-style-type: none"> ▶ Best practices and case studies to help you carry out your plan
	Improve your plan, address threats to your supply system	<u>“PART 2: THE TOOLS”</u>	
Lack:	Finances	<u>“TOOL 2. Funding”</u>	<p>How to:</p> <ul style="list-style-type: none"> ▶ Generate short- and long-term funding
	Capacity or knowledge	<u>“TOOL 1. Collaboration”</u> <u>“TOOL 4. Education and engagement”</u> <u>“TOOL 8. Monitoring and reporting”</u>	<ul style="list-style-type: none"> ▶ Build relationships, share resources and workloads ▶ Leverage community assets to alleviate resource gaps
	Political or community support	<u>“TOOL 4. Education and engagement”</u> <u>“3.2 Economic benefits of source water protection”</u>	<ul style="list-style-type: none"> ▶ Collect, find, and use data ▶ Inform audiences on the economic value and cumulative benefits of source protection
Need to:	Overcome jurisdictional barriers	<u>“TOOL 1. Collaboration”</u>	<ul style="list-style-type: none"> ▶ A list of stakeholders and authorities to work with and best practices for how to do it
	Understand jurisdiction	<u>“TOOL 3. Policies, plans, and bylaws”</u> <u>“3.1 Regulatory framework”</u>	<ul style="list-style-type: none"> ▶ A breakdown of responsibilities and a list of Acts that involve drinking water protection
Need to:	Improve communication, coordination, and collaboration	<u>“TOOL 1. Collaboration”</u> <u>“TOOL 4. Education and engagement”</u>	<ul style="list-style-type: none"> ▶ Tips on connecting with audiences ▶ BMPs on how to advance source protection despite varying interests
Want to:	Read success stories	See list of case studies in the Table of Contents	<ul style="list-style-type: none"> ▶ Case studies highlighting practical examples for each tool in PART 2 The Tools

Go to **“PART 1: ROADMAP TO SOURCE WATER PROTECTION”** – for guidance on how to prepare a source protection plan.

The Roadmap to Source Protection describes the steps to help you get started or continue your source protection journey, from bringing partners together, completing a source water assessment, preparing a response plan, and putting the response plan into action, to evaluating your source protection plan.

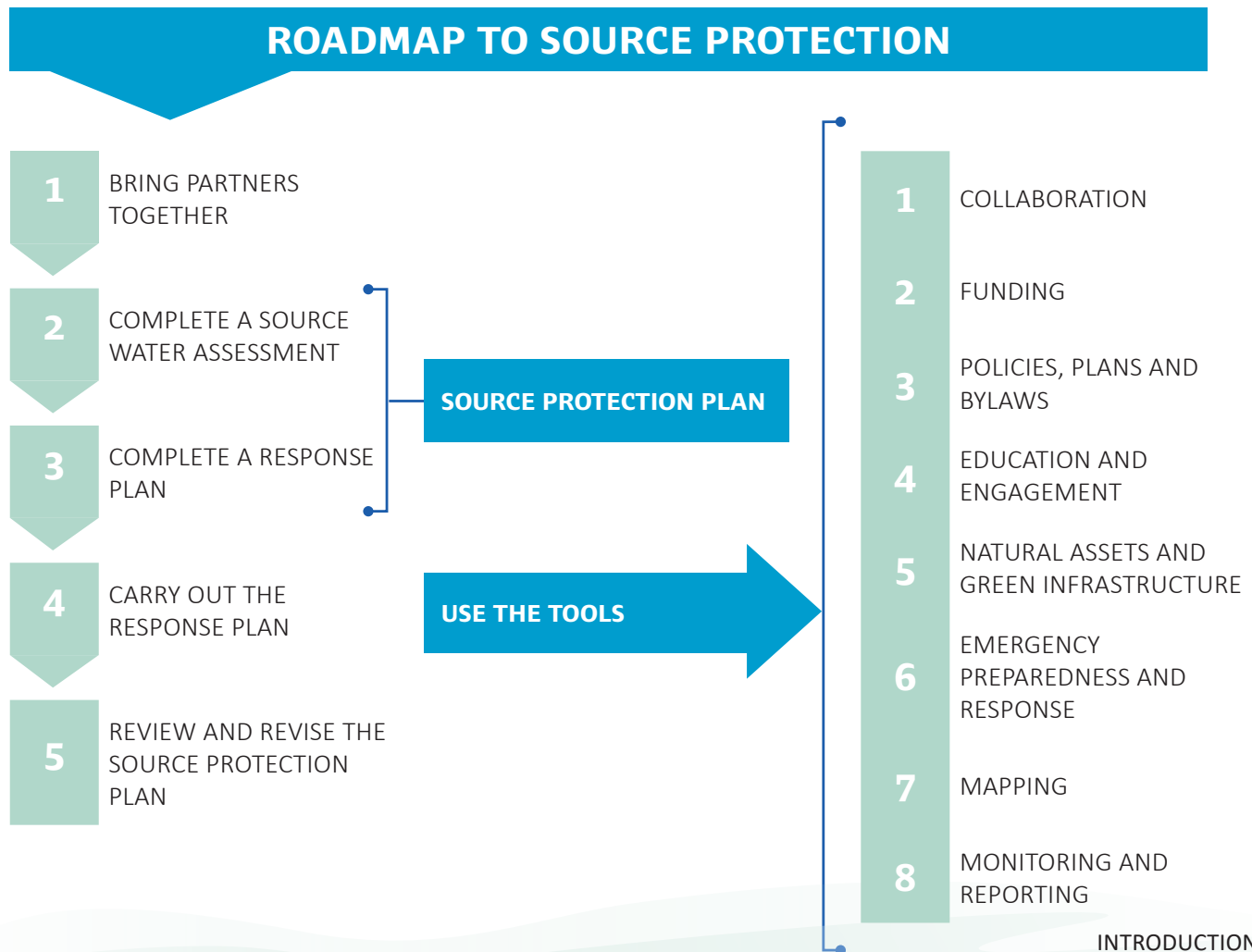
Go to **“PART 2: THE TOOLS”** – for guidance on how to successfully carry out a source protection plan.

The Tools are the core elements to aid you in a successful source protection plan. Each tool provides information on its importance, the actions needed to implement it, its opportunities and challenges, and case studies of successful implementation. Use and combine the tools that apply to your situation. Part 2 is also beneficial for those who want to improve on existing source protection efforts.

Go to **“PART 3: ADDITIONAL INFORMATION AND RESOURCES”** – for useful information, resources and templates to help you along your journey in source protection planning.

Here, you’ll learn more about the regulatory regime in B.C., the economic benefits of source water protection, and the top obstacles to source water protection and innovations to overcome them. Part 3 can help fill in the gaps in new and in existing source protection efforts. And, if you want to further explore the information used to develop the toolkit, check out the resources listed in Part 3 (user beware: there are many rabbit holes for you to follow should you have the time and curiosity!). You can also access templates for source water assessments and response plans.

Figure 1: Steps to completing a source protection plan and tools to consider for the plan





PART 1: ROADMAP TO SOURCE WATER PROTECTION

This section describes the five main steps in the source protection planning process (see Table 2).

Table 2: Roadmap to effective source water protection in five steps

1. Partner	2. Assess	3. Plan	4. Act	5. Evaluate
<p>Bring partners together</p> <p>Organize a technical advisory committee (TAC)</p>	<p>Hire a qualified professional to conduct a source water assessment (the first piece of your source protection plan)</p> <p>Work with the TAC to identify issues and solutions</p>	<p>Prepare your response plan (the second piece of your source protection plan)</p> <ol style="list-style-type: none"> 1. Set goals – plan S.M.A.R.T. 2. Identify authorities and stakeholders 3. Determine and secure resources 4. Develop budget and timeline 5. Establish metrics 	<p>Carry out your response plan</p> <p>Overcome barriers to implementation</p> <p>Track progress of plans</p>	<p>Monitor your source protection plan and revise as needed</p> <p>Use the metrics established within your source protection plan to gauge success</p> <p>Modify the plan as needed to continuously improve the plan</p>

STEP 1. Partner

Collaboration is essential to source water protection. Start by forming a technical advisory committee (TAC) with representation from provincial and local governments, health agencies, First Nations, and stakeholders. See [“TOOL 1. Collaboration”](#) for tips on who to include on your TAC and how to foster collaboration.

Start by establishing a common understanding that all groups, despite potential competing interests, share a responsibility in protecting the source waters. Together, formalize a vision of source water protection using the end goal (enhanced protection of drinking water) in mind. The role of the TAC is to provide collaborative guidance on your source water assessment and to help carry out the response plan.

PRO TIP: Build trust and credibility with partners that have possible conflicting goals early in source water protection discussions to make them your biggest advocates.



STEP 2. Assess

A source water assessment provides you with details on the hazards observed in your watershed, a risk ranking of the hazards, and a strategy covering how to improve or protect water quality before it enters the system. The assessment is the first part of a source protection plan (the second part is the response plan described in STEP 3), and is usually completed by a qualified professional under the guidance of the water supplier and TAC. [The British Columbia Comprehensive Drinking Water Source-to-Tap Assessment Guideline](#) outlines the process to follow for a source water assessment and the roles and responsibilities of participants and regulatory agencies in completing the assessment.

The Source-to-Tap Guideline includes eight modules. Modules 1, 2, 7 and 8 apply to source water assessments, and are described below.

▶ **Module 1:** Delineate and characterize drinking water sources. A description and assessment of natural features of the water source and source area of a water supply is completed. For surface water sources, the boundary of the source assessment area is ideally that of the catchment that drains to the intake, or it may be a more focused zone such as the immediate vicinity of the intake, within a time-of-travel to the intake or an arbitrary radius from the intake. Consider mapping areas of high vulnerability ([“TOOL 7. Mapping”](#)). For groundwater sources, capture zones may be delineated using one or more of the following methods: 1) arbitrary fixed radius, 2) modified arbitrary fixed radius, 3) calculated fixed radius, 4) analytical equations, 5) hydrogeologic mapping, or 6) numerical modeling. The methods are described in Appendix 1G of the Source-to-Tap Guideline.

▶ **Module 2:** Conduct contaminant source inventory. A contaminant source inventory identifies and describes land uses, human activities, and other potential contaminant sources that could affect source water quality. Contaminants in water include substances that are physical (e.g., sediment), chemical (e.g., fuels, pesticides), or biological (e.g., pathogens). When these substances are not normally found in drinking water or exist in excess of natural concentrations and have the potential to impact the viability of a water supply

system, they become an agent of harm and a hazard to drinking water. It is important to periodically re-evaluate and redefine potential contaminant sources given continued changes in the landscape from land-use, natural events, and climate.

▶ **Module 7:** Characterize the risks from source to tap. A risk level is assigned to each of the hazards identified in Modules 1-6 based on a matrix of likelihood to impact a system and magnitude of consequence. The primary strengths, weaknesses, major threats and key opportunities for significantly improving drinking water protection are assessed for the water system.

▶ **Module 8:** Recommend and prioritize management actions. The assessment team collectively identifies actions for each risk identified in Module 7. The recommendations include hazard(s) addressed, protective barriers enhanced, accountability and timelines for implementation. Priorities for source water protection are informed by the risk level of the hazards. Ideally, management actions should address hazards of very high and high risk first; however, implementation may be prioritized based on resource availability or ease of application.

A source water assessment template is provided in [“3.5 Templates”](#). The issues identified and actions recommended in the assessment will be the foundation of the response plan you create in Step 3.

STEP 3. Plan

After your source water assessment is complete, the next step is to prepare your response plan. A response plan is a living document that clearly outlines the actions needed to manage drinking water threats and track progress. Collaborate with your TAC to refine and categorize the issues and actions from your source water assessment. In doing so, you may find that a variety of issues can be addressed through overarching solutions, including programs dedicated to education and engagement ([“TOOL 4. Education and engagement”](#)), land use planning and management ([“TOOL 3. Policies, plans, and bylaws”](#)), or monitoring ([“TOOL 8. Monitoring and reporting”](#)). A great example to look at is the Regional District of Nanaimo Drinking Water and Watershed Protection Action Plan.

The steps for preparing a response plan are presented in Table 3 and a response plan template is provided in [“3.5 Templates”](#). This template has a ‘demonstration example’ tab to give you an idea of how to use the template and what a response plan can look like.

Table 3: Steps to prepare a source water protection response plan

Set goals and objectives

For each goal, develop objectives with a list of associated actions that show how you will achieve those goals. Plan S.M.A.R.T (specific, measurable, achievable, relevant, and time-bound).

Identify authorities & stakeholders

Collaborate with the TAC you established for your source water assessment and invite others to participate as needed.

Determine and secure resources

Identify staff, finances, data, partners, and other necessary resources required to carry out each action.

Develop budget and timeline

Create a budget and timeline for each action. List obtained and potential funding sources.

Establish metrics of success

Decide how you will measure success of each action. Use metrics and a monitoring program to measure progress. Think S.M.A.R.T

PRO TIP: The responses for the high and very high risks are best developed by the stakeholder responsible for that risk – not the water supplier or their consultants. The stakeholder’s responses should include what will be done, how and when it will be done, and an estimated cost. That way, the stakeholder takes ownership for the result and reports back to the TAC.

We all know there will be resistance to change, particularly where expenditures or revenue loss for the next fiscal year(s) is involved. Follow the advice in Table 4 when preparing your source water response plan to turn common planning challenges into successes.

Table 4: How to turn common planning challenges into successes

Actions are planned for too large of an area.

Plan actions/mitigations at the sub-catchment scale.

Plan is too long or complex.

Keep the response plan S.M.A.R.T (see Table 5). Develop break-out plans for each stakeholder.

Stakeholder involvement and issue ownership/resolution is lacking.

Prioritize support for TAC financial commitments to prevent/remediate source water issues.

Plan is not seen as a living document that must be revisited and updated.

Adopt a long-term management process, with long-term commitments from stakeholders.

Land use management issues are ignored.

Advocate for land use policies, bylaws, and BMPs that protect source water.

Monitoring or knowledge of local response thresholds is lacking.

Monitor trends, compare to research elsewhere and use adaptive management strategies.

Your response plan should include measurements and timelines for each of your actions. Consider employing elements from the list below that suit your source water protection project.

Formulate evaluation questions such as:

- 1. Process evaluation questions** to identify planning and implementation issues; they indicate if staff, budget requirements, resources, and management actions are performing as expected while the activity is taking place and after. Example questions:
 - ▶ Are actions being implemented correctly, on time, and within budget?
 - ▶ Is the intended audience receiving the message?
- 2. Impact evaluation questions** to measure goal attainment; they indicate the environmental and social outcomes of the management actions on short, medium, and long terms. Example questions:
 - ▶ Did lakeshore residents adopt landscaping BMPs?
 - ▶ Did water quality parameters in the last five years improve from the historical baseline?
- 3. Context evaluation questions** to understand what parts of the plan are working or not; they indicate the function of the management action within the community's economic, social, and political climate. Example questions:
 - ▶ What demographic of the community supported the management action?
 - ▶ Did financial or social barriers preclude community members from participation?
- 4. Determine data needs & collection methods.** Quantitative data methods range from water quality sampling, flow measurements, mapping/GIS/LiDAR, and other sampling. Common qualitative data collection methods include interviews, surveys, focus groups, observations, and document review⁴.
- 5. Set milestones.** Define a schedule for implementing and reviewing management actions.

S.M.A.R.T. charts abound. Table 5 has been custom developed for source water protection TACs. You can refer to it throughout your source protection process.

PRO TIP: Do not set too many projects within a goal even if they are all individually attainable.

Table 5: Guide for S.M.A.R.T source water protection processes

S	SPECIFIC	<p>Define expectations. Avoid generalities. This isn't an explicit how-to, but make sure to answer the following:</p> <p>WHO – who needs to be involved?</p> <p>WHAT – what exactly are we trying to achieve?</p> <p>WHEN – set a realistic timeframe.</p> <p>WHERE – decide location of relevant event.</p> <p>WHICH – determine key obstacles or requirements.</p> <p>WHY – define the reason for the goal.</p>
M	MEASURABLE	<p>What metrics are planned to meet the goal, track progress, and measure success?</p> <p>Set milestones.</p> <p>How can we measure the cost benefit of achieving the goal?</p> <p>Can we estimate the cost-consequence of inaction?</p> <p>Can the data be used to assess environmental thresholds?</p>
A	ACHIEVABLE	<p>Keep challenging goals within reason.</p> <p>Are new skills required and achievable?</p> <p>Are changing attitudes required? Does the team have capacity and resources?</p> <p>Are tasks assignable?</p> <p>Identify what is beyond the team's control.</p>
R	RELEVANT	<p>Link the goals to the broader community needs.</p> <p>Consider impact on neighbours. Make sure the goal is ethical and positively stated.</p> <p>Consider historical context (three generations before us), our generation, and our legacy (three generations after us).</p> <p>How can the team keep the goal and its context in view?</p>
T	TIME-BOUND	<p>Set a realistic target date or set a realistic timeframe for the goal.</p> <p>Is there a deadline? How will it be tracked?</p>

STEP 4. Act

The assessment and response plan developed in steps 2 and 3 make up your source protection plan. Implementation of the source protection plan is usually led by the water supplier, but the TAC must be actively involved because their activities often impact source water and/or they have jurisdiction in the source watersheds. Annual meetings and watershed tours with your TAC are essential. Your transition from planning to action will have hurdles. The most common hurdles are described in Table 6, along with solutions that other water suppliers have used.

Table 6: How to turn common source water protection action plan challenges into successes

Constraint	Solution	Go to Tool(s)
Unreliable funding: funding sources aren't sustainable, or change over time.	Create a fund sustained by system rates, parcel taxes, or fees. Multipurpose a project that also fulfills other objectives (e.g., habitat restoration) to tap into otherwise unavailable grants. Partner with groups whose activities overlap with source water protection. Develop corporate partnerships. Apply for grants.	<u>2</u>
Lack of capacity: staffing challenges make it hard for water suppliers to devote efforts to source protection.	Hire a watershed coordinator. Share resources with other suppliers. Collect data at low-cost with citizen science. Involve universities or colleges. Focus on one solution at a time. Address high-risk issues first, or start with the easiest and plan to address more complex problems in the long term.	<u>1, 3 & 4</u>
Inaccessible information: data are scattered or not easily accessible.	Make these your go-to sources: EcoCat for documents; iMapB.C. for GIS; OBWB for water quality database . Share data.	<u>7 & 8</u>
Jurisdictional limitations: water suppliers have no authority and are subject to a patchwork of legislation that protects industry.	Identify responsible authorities to collaborate with, and hold each other accountable by forming a TAC with a terms of reference. Meet annually or more to measure progress.	<u>1 & 3</u>
Collaboration: multiple agencies and stakeholders are involved with source protection.	See immediately above. Consider other perspectives and choose mutually beneficial measures. Take initiative. Identify champions who could take the lead on an issue or solution. Hire a watershed coordinator. Meet with your TAC once or twice a year.	<u>1</u>
Lack of political will: hard to get local government buy-in for change.	Educate elected officials on the value of water. Assign costs/benefits to show economic value to source protection. Invite First Nations involvement from the onset.	<u>4 & 5</u>
Emergencies: floods, droughts and fires can impact water quality.	Have an up-to-date emergency response plan. Ensure adequate staff and training.	<u>6</u>

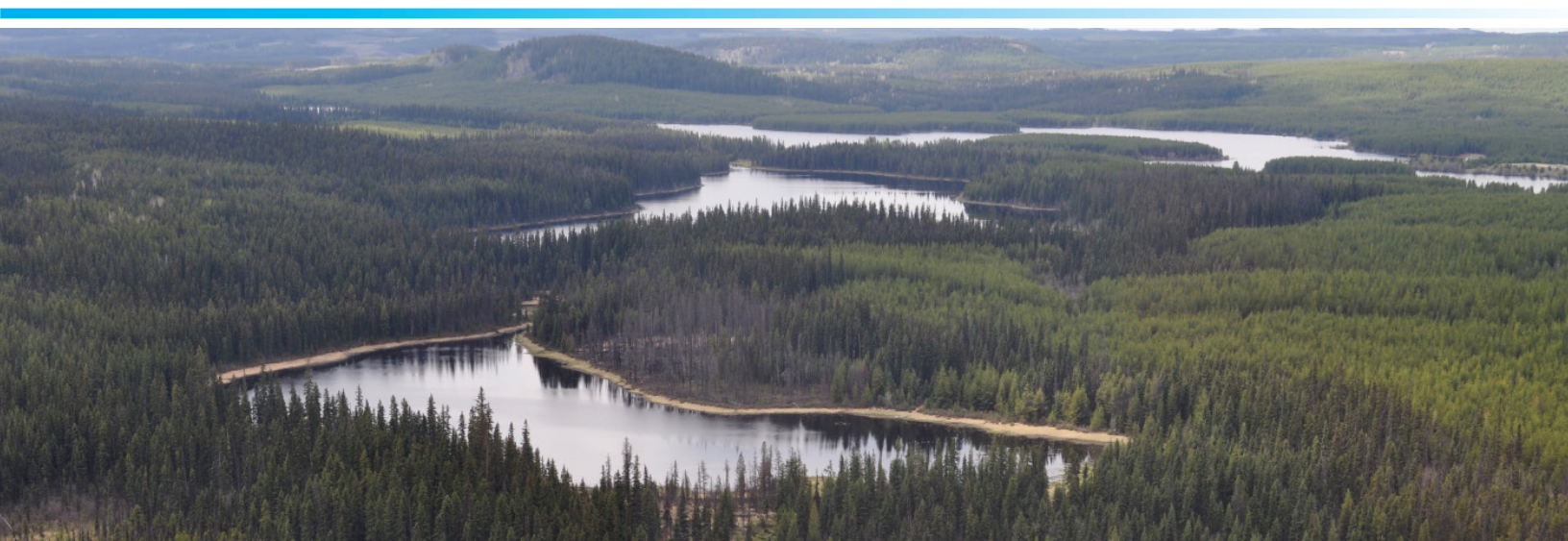
STEP 5. Evaluate

Your source protection plan will need regular progress tracking and periodic evaluation – that’s how you’ll know if existing efforts are effective and if dollars spent on your actions are worth it. Progress tracking is built into the source response plan template provided in “3.5 Templates”. This will allow your team to track what components are effective, what ones need improvement or can be eliminated, and what new opportunities can be explored so that the plan can continuously improve. Table 7 outlines the steps you can follow to evaluate your source protection plan.

Check out the [Regional District of Nanaimo 10 year review](#) for inspiration.

Table 7: Steps to evaluate your source protection plan

DESIGN A PERFORMANCE CHECKLIST	For each plan objective, organize the list of actions and measurement criteria in a spreadsheet along with a progress checklist to facilitate tracking. Format cells that calculate the cumulative percentage of actions in progress and completed, so that progress can be readily monitored each time the checklist is updated. Decide who will manage the checklist.
TRACK PROGRESS	Record the date when an action is started and completed. Engage your TAC in tracking the actions. Prepare annual reports that detail progress made on the actions, including if they were completed according to schedule or are ongoing.
REVIEW THE PLAN	Review your response plan each year before the annual TAC meeting. How did the plan perform overall? What was accomplished, and which goals fell short? What successes can be built on and where are improvements needed? Undertake a comprehensive review and update of your full source protection plan (i.e. assessment and response plan) every 5-years or after any major event in the watershed that might impact water.
REVISE THE PLAN	Use the results of your evaluation to make adjustments to the plan to ensure that source water protection continues to improve.



PART 2: **THE TOOLS**

This section provides practical tools to help you carry out your source protection plan.

Use and combine the tools that apply to your situation. These tools can help water suppliers to implement source water protection measures or to improve existing source protection efforts, and help local governments to support source water protection through bylaws and policies that protect drinking water sources.

Each tool contains the following information:

- ▶ Description of the tool
- ▶ How to use the tool
- ▶ Case studies of successful source water protection planning

TOOL 1. Collaboration

Description

This tool guides you in the development of collaborative partnerships across jurisdiction, sectors, departments, and geographic areas. Strong and lasting partnerships are essential to source water protection. While water suppliers do not have jurisdiction to directly act in upland watersheds, you can develop positive, working relationships with other agencies, companies, and organizations to influence practices within and outside their scope of authority. Pooling resources—ideas, information, knowledge, efforts, and funding — leads to more shovels in the ground and better source protection overall (see Figure 2 to learn about more benefits of collaboration).

For local governments, collaboration with other departments within your organization—planning, parks and recreation, engineering, public works, finance, information technology, communications, and emergency management—also helps to realize the mutual benefits of source protection.

Good collaboration for source protection requires good coordination. Water suppliers can take a leading role in coordination through their technical advisory committees and source protection plans (“[PART 1: ROADMAP TO SOURCE WATER PROTECTION](#)”).

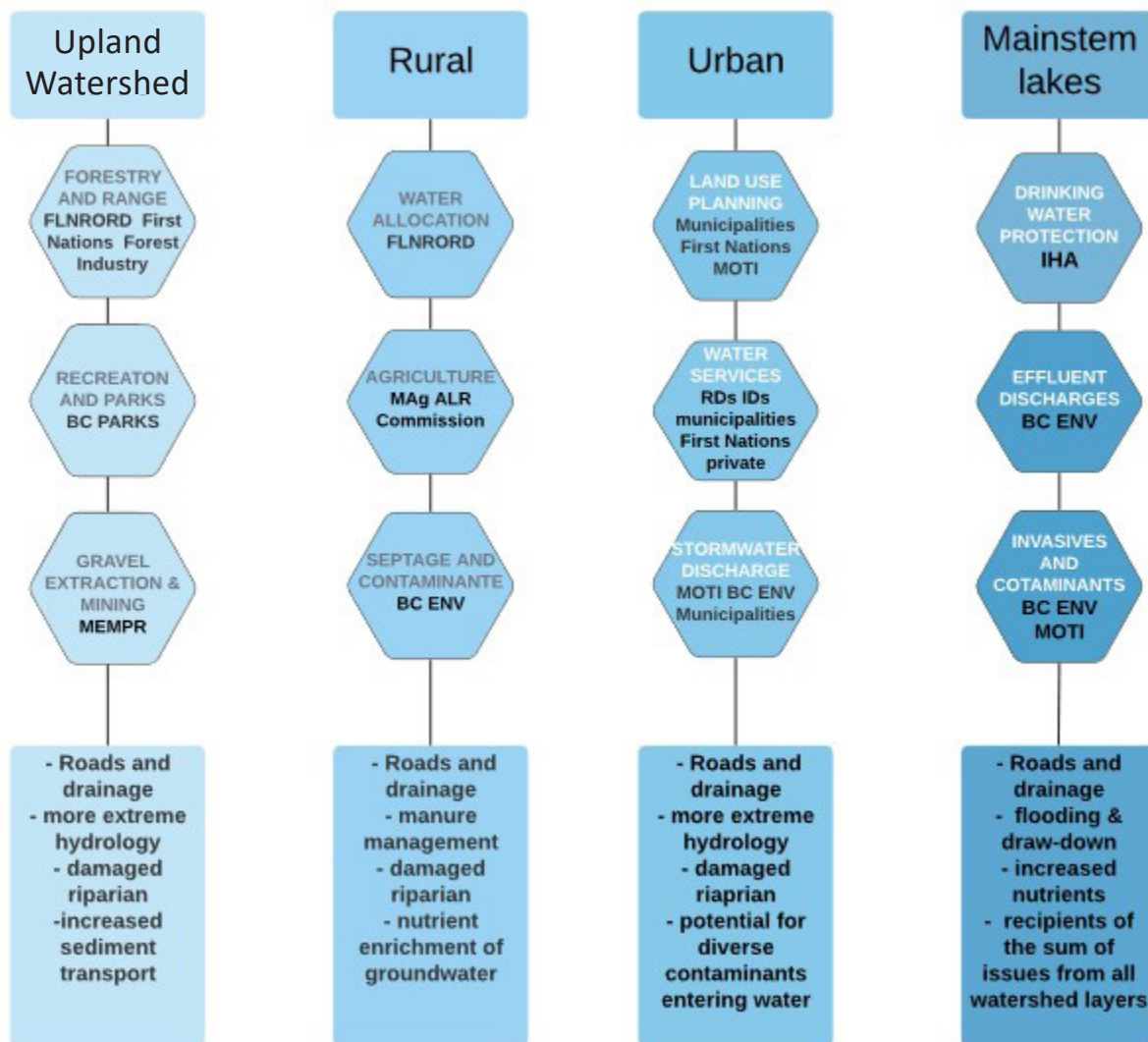
Figure 2: Benefits from collaboration



How to use the tool

The first step is to organize a technical advisory committee (also see Step 1 in [“PART 1: ROADMAP TO SOURCE WATER PROTECTION”](#)). Your source protection plan tells you the issues you need to address, and the guide below can help you identify who to work with for each issue. You can also find industry stakeholders in your watershed using [B.C.’s Natural Resources Online Service](#). Once you have identified partners, work cooperatively to carry out the actions in your source protection plan. This way, the cumulative benefits of collaboration can be realized. Figure 3 shows which partners you should consider inviting to participate on your TAC.

Figure 3: Who to consider for your TAC (entities involved in regulating source water concerns)



NOTE: Also consider academia, fisheries, industry & business sectors, not-for-profit groups, conservation groups and recreation clubs.

Use the best management practices in Table 8: Collaboration guide for source water protection to facilitate an efficient collaborative process.

Table 8: Collaboration guide for source water protection

1	PURPOSE	Create a shared goal for better source protection. Define the issue and point to solutions rather than pointing fingers.
2	PARTICIPATION	Actively involve groups with a significant interest in the issues and outcomes. Select representatives in a fair and open manner. Choose members with the knowledge, skills, influence, and ability to act. Ensure the timeline and budget accommodates adequate participation and engagement.
3	COMMITMENT	Ask all parties to commit to the process from the beginning through to implementation and monitoring. Create a response plan for the group. Hold meetings regularly (at least twice a year).
4	OPPORTUNITY	Provide an equal and balanced opportunity for effective participation by all parties.
5	ACCOUNTABILITY	Operate using principled negotiation, including mutual respect, trust, and understanding. Use progress reports and other metrics established as part of your source protection plan to keep members accountable.
6	GROUND RULES	Establish terms of reference and operating procedures that clarify the realities and expectations of roles, responsibilities, decision-making processes, and budget.
7	INFORMATION	Share information willingly and cooperate to gather necessary information. Incorporate high-quality information into decision-making.
8	FLEXIBILITY	Design flexibility into the process to allow for adaptation and creativity in problem solving.
9	NEGOTIATION	Understand that everyone has something to gain. Operate with mutual respect, trust, and understanding. When addressing issues, consider other perspectives and compromise on mutually beneficial solutions.
10	COORDINATION	Have an experienced facilitator to run meetings, resolve conflicts, keep the group organized and working toward goals, and keep members in sync. Add a timekeeper to ensure everyone gets their say. Plan meetings that focus on creating tangible deliverables. Take notes at each meeting that clearly outline action items and distribute them in a timely fashion. Establish and manage realistic milestones and deadlines.

Case Studies

Regional District of North Okanagan - Greater Vernon Water, Duteau Creek Watershed Assessment Response Plan

Source water for the Regional District of North Okanagan (RDNO) and Greater Vernon Water (GVW) utility faces threats from forest service roads, range use, and public use of its upland watershed. The [Duteau Creek Watershed Assessment Response Plan](#) identifies specific action items to address the hazards and risks to the source water. The Plan is a fine example of how water suppliers can overcome jurisdictional barriers to protect source water by using collaboration and compromise for good land use management.

The Duteau Creek Watershed Technical Advisory Committee (TAC) was established in February 2009. Comprehensive Terms of Reference were established in August 2010 to provide guidance to the TAC on its role, composition, meetings, and reporting. The role of the TAC is to provide RDNO/GVW staff with comments and recommendations on objectives, strategies, policies, and land use legislation that may be considered to protect water quantity and quality and the implementation of the protection plan. The TAC comprises representatives from government agencies (responsible for forest management, small-scale salvage, timber sales, forest road engineering, range use, drinking water protection, water stewardship, environmental protection, fisheries, energy and mines, compliance/natural resource enforcement, and recreation sites and trails), First Nations representatives (Splatsin and Okanagan Indian Band), forest licensees, range tenure holders, and RDNO/GVW staff.

The TAC meets twice per year, at a minimum. The first meeting of the year (February/ March) is to review the previous year's report, develop actions for the coming year, and review possible grant applications (members to provide grant information to Chairperson). Meeting agendas and minutes are provided to TAC members. An annual Response Plan is prepared, which assigns actions to ministries and licensees with the appropriate jurisdiction and authority to complete the actions.

Patti Meger of the District of Lake Country and Renee Clark (formerly with GVW) both attest that progress is made when collaborating members share the common goal of protecting source water and focus on the solutions—no finger pointing allowed. By discussing future works, members can identify how to help each other out.

Regional District of Nanaimo, Drinking Water and Watershed Protection Program

The Regional District of Nanaimo (RDN) established an exemplary Drinking Water and Watershed Protection Program (DWWP) in 2009 after six years of careful planning and staff dedication. The DWWP spans seven major basins, involves four member municipalities, relies on participation and collaboration of numerous parties, and is sustained financially through a parcel tax as well as rebates that incentivize source water protection activities.

The overarching theme of the DWWP is water collaboration: to develop productive, long-term, and collaborative partnerships across jurisdictions, sectors, departments, and geographic areas to leverage resources for implementing initiatives that support effective water management and stewardship. Experts and stakeholders that represent key water interests in the region guide program implementation through the DWWP TAC. An Interdepartmental Working Group that includes RDN staff from planning, wastewater, parks, emergency services, and community development also helps guide the program.

The RDN's [2020 DWWP Response Plan 2.0](#) continues to build on past accomplishments to ensure better source water protection in the future.

Cowichan Watershed Board

The [Cowichan Watershed Board](#) (CWB) is a local governance entity that promotes water and watershed sustainability in the Cowichan/Koksilah watersheds, ancestral home of the Quw'utsun First Nation. The CWB is co-chaired by the Chief of Cowichan Tribes and the Chair of the Cowichan Valley Regional District, with 10-12 other members appointed jointly by those partners, including nominees from the federal and provincial governments.

The CWB was formed in 2010 to carry out the [Cowichan Basin Water Management Plan](#) (2007), which includes goals, objectives, and actions concerning water conservation, supply management, quality, habitat and biodiversity, governance, and communications. The CWB represents a unique partnership between First Nations and local government. Through this model, Cowichan Tribes and the CVRD work together to advance whole-of-watershed health, demonstrating a commitment to moving down the path of reconciliation.

Syilx Forestry Standards

Sn'pink'tn (Penticton Indian Band) signed a Forest and Range Opportunity Agreement with the Government of British Columbia in 2007 and has begun managing two Non-Replaceable Forest Licences within the Okanagan Nation traditional territory. As well, Sn'pink'tn has a working partnership with Gorman Brothers Lumber Ltd., developing cutting permits and assisting with timber cruising (measuring timber volume and quality). Sn'pink'tn and the Syilx Nation have created forestry standards that apply during all phases of proposing, designing, planning, in-field assessment, implementation, and post-harvest auditing in Syilx territory. Through its community-based, bottom-up decision-making process, the Syilx community will determine where forest development activities can and cannot take place. The Agreement was developed through direct consultation with Syilx Knowledge Keepers, Elders and land users. It incorporates Syilx Knowledge that has been passed down for hundreds of generations and expresses that Knowledge in a contemporary western format so that it can be used by foresters and those part of the environmental planning process in collaboration with the Syilx people to ensure that Syilx Territorial lands are taken care of in the right way, for the good of all, for all time. More information about this initiative is available [here](#).



TOOL 2. Funding

Description

This tool helps you obtain funding to support long-term source protection. Continuous funding is critical to meeting source water protection goals. Your source protection plan should identify ways to secure funding for each proposed activity. You must first obtain buy-in from leadership in your organization, because many funding bodies require political sign-off or support. Collaborating through multipurpose projects can provide access to otherwise unavailable grants, charities, lotteries, donations, and corporate partnerships.

Sustained funding allows programs to build over years, and it allows for long-term planning of projects, knowing that funding is going to be in place. However, benefits from the funding must be continually communicated to keep political will, or funds can be diverted. Building a business case for source protection ([“TOOL 4. Education and engagement”](#)) is essential.

How to use the tool

Use a combination of the following options to secure funding for source water protection:

- ▶ Create a source protection fund.
- ▶ Collaborate to access funds from grants, donations, and charitable lotteries.
- ▶ Develop corporate partnerships.
- ▶ Earn conservation compensation credits.
- ▶ Earmark development permit fees.
- ▶ Earn activity-specific revenue.
- ▶ Obtain grant funding.



Option 1. **Create a Source Protection Fund, adapted from the [Conservation Fund Guide](#)**

▶ **Bring partners** together

- Build a network of support with partners from the watershed, including First Nations, water suppliers, and governments. Create a committee (or use your TAC) with terms-of-reference and identify a champion to lead coordinated efforts. Together, create a vision and plan to establish a new source protection fund.

▶ **Determine priorities (from your source water protection plan, but get specific now)**

- Identify the types of source protection measures that the fund will help implement. These can be land acquisitions, incentive programs, education and community engagement, green infrastructure, or other initiatives. Gauge the community's support and priorities using opinion polls and focus groups.

▶ **Identify and select best funding options**

● **Establish a new service area (local governments)**

Local government water suppliers can establish a new service area either within your jurisdiction, or cooperatively through a regional approach. [Read how the RDN did it](#) and go to pg. 28 of their [original Response Plan](#) to learn about the benefits of a cooperative approach and their reasons to fund the service area through a flat rate parcel tax instead of a property assessment tax, fee, or charge.

● **Seek approval to increase revenue from existing streams of income**

Improvement and irrigation districts, water user communities, and water utilities can seek approval to increase revenue from existing streams of income (e.g., taxation, fees, rates, or a combination of) on the basis that the increase will be earmarked to fund source protection.

▶ **Gain support and approval**

Make a compelling case to convince the service users and any entity involved in the process of approving budgeting amendments. First, get approval from your council, board, or other governing body. Second, focus on the users—educate and engage them on the intent of the fund, how it will be financed, and how they will benefit from it. Third, present a separate case to any entity involved in the process of approving budget amendments. Make sure to present quantitative evidence of existing support from users.

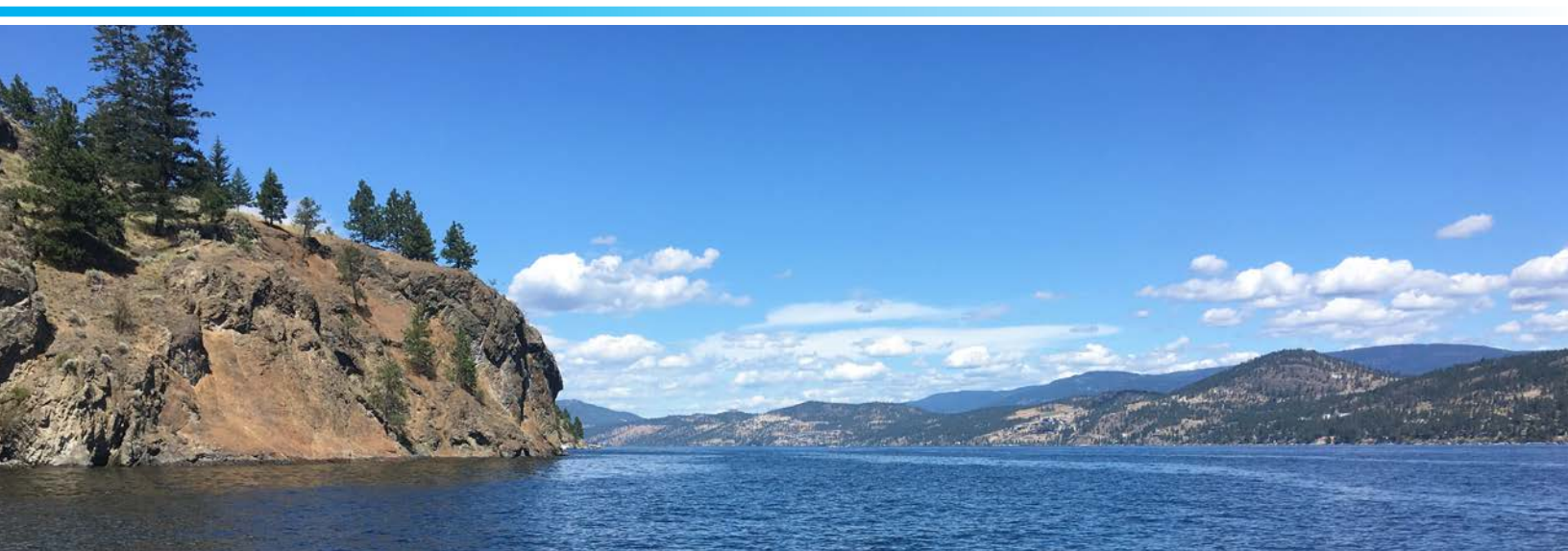
Option 2. Collaborate to Access Funds from Grants, Donations, and Charitable Lotteries

First, recognize that stakeholders with competing interests are valuable partners even if their activities impact source water. Industry stakeholders and government ministries can have funding and permission to carry out work where your organization may not, and they can help implement solutions outside of your jurisdiction (this is why it is important to establish a TAC with stakeholder representation during “[STEP 1. Partner](#)” of “PART 1: ROADMAP TO SOURCE WATER PROTECTION” and to follow the tips provided in “[TOOL 1. Collaboration](#)”). They may not directly fund a project, but their contributions in labour or other resources can reduce your costs.

Second, work together to find solutions. Also involve government agencies that regulate stakeholder activities because they can provide seed money from their annual budgets for collaboration ([read pg. 7 of the the Duteau Creek Watershed Assessment Response Plan](#) to see the RDNO’s success in collaborating with forestry, ranching, and FLNRORD to improve cattleguards in the watershed).

Tap into otherwise unavailable funds with multipurpose projects that satisfy the goals of source protection along with those of another group. Various groups contribute financial resources, volunteer labour, or equipment to specific causes—leverage that using a project that fulfils mutual needs. For example, collaborating with financial institutions, environmental societies or community groups, and schools provides access to funds such as the [EcoAction Community Funding Program](#), [RBC Tech for Nature grant](#), and [WWF-Canada, Stewards of the Future](#)—all the more reason to develop new relationships, strengthen existing partnerships, and help each other out with mutually beneficial projects.

PRO TIP: To find ideas for a multipurpose project, research available grants from various subject areas at civicinfo.bc.ca/grants, or conduct an online search of societies in your town to identify other community needs that could align with a source protection project. For example: an engineered wetland could be developed to also provide accessible bird viewing platforms and paths; a land purchase that protects greenspace could also be revitalized with native, edible vegetation and promoted as a foraging reserve for residents.





\$140 million dollars are available annually through [B.C.'s Community Gaming Grant](#) for not-for-profit groups that deliver community programs and services. Environmental societies and not-for-profit environmental groups that seek to revitalize, protect, or provide education about the environment can also raise money through donations, charitable lotteries, and other grants. Further, essential services such as healthcare receive millions of dollars in donations from charitable groups. While we don't want to take donations from healthcare, we should assert that water is an essential service too.

Approach environmental societies or not-for profit groups to form a collaborative partnership using the steps below and the BMPs from "[TOOL 1. Collaboration](#)":

- ▶ Determine what you want to **achieve**.
- ▶ Identify **asks** (what do you need) and **gives** (what can you contribute to create beneficial exchange).
- ▶ Find the **fit**. Search for organizations at the local, regional, and national levels with overlapping goals who can help implement solutions.
- ▶ Make the **connection**. When reaching out to new potential partners, find a shared connection who can help facilitate the introduction (via [LinkedIn](#)), for example this will increase the odds of being well received compared to reaching out as a stranger. Call or email the shared connection, asking if they know the potential partner well enough to introduce you to them, and provide a succinct memo that describes who you are, why you want to chat about a partnership, and how they can reach you.
- ▶ Formalize an **agreement**. Together, identify a common goal and create a plan that outlines how you'll collaborate, what other groups might be involved, and what resources each partner will commit. This is a good opportunity to formalize the details on donations and charitable lotteries, such as, how much money is needed for a shared project, how much of it will be funded through donations and lotteries, among others.

PRO TIP: Launch a [peer-to-peer campaign](#) to increase the odds of success. People are more likely to support a cause if they've been encouraged to by someone they know.

Option 3. **Develop Corporate Partnerships**

Businesses recognize the benefits of having a good environmental reputation. Many participate in programs to minimize or compensate for their environmental impacts because it increases their social licence to operate. Increasingly, citizens expect that businesses operate not only according to regulatory permission, but also to social standards; governments recognize this and are more willing to [grant operational permits or licences to businesses with popular support](#).

Focus on developing corporate relationships with businesses whose community program goals align with your source water protection endeavours. They may be willing to volunteer labour and equipment or direct funds to a partnering environmental group.

Option 4. **Earn Conservation Compensation Credits**

Municipalities can create a compensation and credit system whereby fees are paid by developers when ecological services are disturbed due to construction, and credits are generated through the restoration and/or protection of habitat such as wetlands, riparian areas, and floodplains.

Option 5. **Earmark Development Permit Fees**

Municipalities could mandate environmental protection standards or rehabilitation as part of development permits. They could also earmark fees from development permits so that DPs cover more than just the staff time to manage them.

Option 6. **Earn Activity-Specific Revenue**

Municipalities could instigate a User-Pay-To-Play system to collect fees, such as boat launch fees. Municipalities could formalize an agreement to apply a standard rate at all major lakes for one of annual launch passes, daily launch passes, parking lot charges, or a combination pass.

[A 2008 study](#) of 27 boat launches found that 52,820 boats were launched between May 16 and September 14, averaging 429 boats/day in the Okanagan. Major boat launches in the Okanagan charge for parking, but some are currently free of charge. [Port Moody](#) charges \$21.10/day + tax for launch access and parking. Annual passes are available to residents at \$169.15 + tax and to non-residents for \$269.75 + tax. If this user fee system was applied to the Okanagan, it could generate funds to support programs that protect the mainstem lakes such as, [Don't Move A Mussel](#).

Option 7. **Obtain Grant Funding**

Grants are a good source of short-term or supplemental funds but should not be relied on for long-term because programs usually operate for a short duration—hence frustration with unreliable funding.

Short-term funds are available from these providers: [Infrastructure Planning Grants](#); [Okanagan Basin Water Board](#); [Green Municipal Fund](#); [Civic Info](#); [B.C. Economic Development and Funding Grants](#); [Real Estate Foundation of B.C.](#); [Government of Canada Environmental Funding](#); and [Clean Water and Wastewater Fund Program](#).

PRO TIP: Prepare regular annual or biannual 1-page updates and brief (3 minute) presentations of source water protection wins that received sustained funding to maintain interest of funders and stakeholders.

Case Studies

Residents Approve Parcel Taxes to Fund the Regional District of Nanaimo's Drinking Water and Watershed Protection Program

The Regional District of Nanaimo collects upwards of \$500,000 per year to fund their Drinking Water and Watershed Protection (DWWP) program thanks to a parcel tax (\$7.50) implemented by member municipalities and electoral areas. Prior to the creation of the DWWP program, staff at the RDN engaged community members in numerous public meetings to build support. Community members approved the DWWP program and cost recovery in a referendum for Service Area Establishment across all RDN electoral areas. The parcel tax is applied evenly through all member municipalities.

Building Permits for Vulnerable Areas Fund Source Protection in York Region, Ontario

In the York Region of Ontario, developments in vulnerable zones such as Wellhead Protection Areas require a Source Water Protection Permit. B.C. Municipalities could implement similar permits in groundwater recharge areas to contribute funds towards source water protection.

Monthly Meter Fees go Towards Land Acquisition for Central Arkansas Water

[Central Arkansas Water](#) (CAW) began funding its watershed protection program using a \$0.45 monthly meter fee, which they displayed on bills to increase customer knowledge of watershed protection. The fee generated over \$1 million annually and was used primarily to purchase land and conservation easements, but also for other watershed activities that protected or improved water quality. CAW eventually added fee levels based on the meter size, which now range from \$0.75 for 5/8" and 3/4" meters to \$60 for 10" meters⁴. Private and municipal water purveyors in B.C. could begin engaging with citizens to gain support on implementing a fixed source water protection fee.

Pops for Parks Funding Mechanism in the United States

New York, Connecticut, Massachusetts, Maine and Michigan fund environmental programs by claiming deposit fees from unrecycled beverage containers, which otherwise remains as a profit with the beverage industry. In B.C., there were 16 million dollars' worth of unclaimed bottle deposits in 2014. The B.C.-based Ancient Forest Alliance organization's [Pops for Parks Report](#) states that there are no legal or financial barriers to implementing the program in B.C.—only a lack of political will. Eighteen major B.C. conservation organizations are already asking the Government of British Columbia to establish a similar system. Water suppliers in B.C.'s community watersheds could support these conservation alliances by adding their voice, and in return could share the benefits from conservation lands.

TOOL 3. Policies, plans, and bylaws

Description

A common challenge in source protection is that water suppliers often do not have authority in source watersheds. This tool provides guidance on the plans, policies and bylaws that are within local government jurisdiction, which can be used to support source water protection. Table 9 describes the legislative and policy tools available to municipalities, regional districts and improvement/irrigation districts.

Table 9: Comparison of characteristics for local roles and responsibilities

Characteristics	Municipality	Regional District	Improvement District
Main legislation	Community Charter and Local Government Act	Local Government Act	Local Government Act, Part 17
Reporting to the public	<ul style="list-style-type: none"> ▶ Council meetings and minutes ▶ Public notices ▶ Annual report 	<ul style="list-style-type: none"> ▶ Board meetings and minutes ▶ Public notices 	<ul style="list-style-type: none"> ▶ Board meetings and minutes ▶ Annual general meeting
Bylaws involved in water provision	<ul style="list-style-type: none"> ▶ Official Community Plan ▶ Zoning Bylaw ▶ Subdivision and Servicing Bylaw ▶ Water Bylaw 	<ul style="list-style-type: none"> ▶ Regional Growth Strategy ▶ Official Community Plans ▶ Zoning Bylaws ▶ Subdivision Servicing Bylaws ▶ Local Area Service Bylaws 	<ul style="list-style-type: none"> ▶ Restricted to bylaws that regulate the services operated by the Improvement District
Forms of revenue to finance water	<ul style="list-style-type: none"> ▶ Property taxes ▶ Local service area taxes ▶ Development cost charges ▶ Fees and charges ▶ Reserve funds ▶ Latecomer charges and cost recovery for excess or extended services ▶ Grant programs 	<ul style="list-style-type: none"> ▶ Local service area taxes ▶ Development cost charges ▶ Fees and charges ▶ Reserve funds ▶ Latecomer charges and cost recovery for excess or extended services ▶ Grant programs 	<ul style="list-style-type: none"> ▶ Taxes on the basis of parcels, values, or areas ▶ User rates and charges ▶ Developer charges (capital expenditure charges) ▶ Reserve funds ▶ Sinking funds ▶ Connection charges ▶ Latecomer charges and cost recovery for excess or extended services

(adapted from the [AGLG Perspective Series Booklet](#))

Note: Regional governments can also indirectly protect source water via the Riparian Areas Protection Regulation (RAPR), although its applicability across watershed levels is limited. The RAPR does not apply to: farming activities; mining; hydro facilities; forestry activities; federal and First Nation lands; parks and parkland; and institutional developments.

How to use the tool

Refer to Table 10 to learn how common local government plans, policies, and bylaws can be used to protect drinking water sources. If your community already has many of these documents in place, use the information provided to add or improve source water protection measures during updates.

Table 10: Local government plans, policies, and bylaws to support source water protection

Type of plan, policy or bylaw	How to use for source water protection
Regional Growth Strategy (RGS)	<p>WHAT IT IS:</p> <ul style="list-style-type: none">▶ Directs long-term planning (minimum 20 years) for regional district and municipal official community plans▶ Sets commitments made by a regional district and its member municipalities on social, economic, and environmental goals and priority actions▶ Promotes efficient use of water resources to support and enhance regional sustainability and resilience.▶ Supports data collection and mapping <p>USE IT TO:</p> <ul style="list-style-type: none">▶ Include policies related to source water protection in RGS chapters focused on land, water resources, health, climate and ecosystems▶ Designate urban growth boundaries and concentrate a high percentage of development where water is available▶ Coordinate the acquisition and protection of sensitive ecosystems of regional significance▶ Integrate the management of shared watersheds▶ Discourage development in areas where water quantity or quality is insufficient▶ Encourage watershed and aquifer mapping, groundwater and surface water monitoring, and watershed management plans▶ Designate groundwater recharge areas or aquifer protection areas▶ Encourage the adoption of water conservation bylaws and demand management programs▶ Promote rainwater infiltration <p>STRENGTH: Promotes consensus and coordination among communities</p> <p>LIMITATION: Lacks specificity and enforceability</p>

PRO TIP: Check out this [database](#) of toolkits and guides that provide more detail on bylaws and regulatory approaches to ecosystem protection available to local governments. Make sure to review the [Green Bylaws Toolkit](#), which presents a series of local government policy and planning tools for ecosystem protection and a collection of sample bylaw wording from around B.C. that can be used by communities developing their own bylaws.

**Official
Community Plan
(OCP)**

WHAT IT IS:

- ▶ Describes the long-term vision of the community
- ▶ Sets a general direction for objectives and policies that guide decisions on planning and land use management

USE IT TO:

- ▶ Map sensitive ecosystems and designate environmentally sensitive areas (ESAs)
- ▶ Provide policies on the areas that impact source waters:
 - Natural environment – describe how the local government will protect existing natural ecosystems, lakes, streams, wetlands, groundwater, and sensitive drainage areas, and restore degraded ecosystems
 - Climate change – describe how to adapt to changes in water quantity and quality
 - Infrastructure – describe stormwater, drinking water, wastewater, water intake zones, flooding, and green infrastructure plans for the community
 - Growth – designate land uses and prescribe densities that concentrate development in areas away from sensitive ecosystems; establish amenity bonus and density policies; and protect green infrastructure
 - Commit to a collaborative and integrated watershed management approach to coordinate action on the community water supply, rainwater management, green infrastructure, and government regulations
 - Specify site design that maintains natural hydrological cycles
 - Require development proposals to conform to BMPs
 - Set out policies for land acquisition
 - Include designations of environmental Development Permit Areas (see below) their justifications and detailed guidelines for development in these areas (e.g., environmental assessment process, riparian setback, erosion and sediment control, vegetation protection, and landscaping requirements)

STRENGTH: Contains policies with which regulatory bylaws must not be in direct conflict (e.g., an OCP that addresses water protection is a good foundation for bylaws that contain specific and enforceable standards and policies that protect water)

LIMITATION: Often treated as a policy that does not have direct impact on daily operations; typically, does not apply to Crown lands where many of the headwaters and key areas for source protection are located



**Development
Permit Area (DPA)**

(designated within
Official Community
Plans)

WHAT IT IS:

- ▶ Designates area(s) where special guidelines apply through an OCP
- ▶ The Local Government Act enables local governments to designate DPA(s) for one or more of the following purposes that could act to protect source waters:
 - Protection of the natural environment, its ecosystems and biological diversity
 - Protection of farming
 - Protection of development from hazardous condition (e.g., flooding)
 - Establishment of objectives to promote water conservation

USE IT TO:

- ▶ Regulate development around streams, lakes, wetlands, sensitive drainage areas, and groundwater protection zones
- ▶ Prohibit site disturbance before development approval
- ▶ Specify area(s) of land that must remain free of development, except in accordance with any conditions contained in the permit
- ▶ Require construction of works to preserve, protect, restore or enhance natural watercourses or other specific natural features
- ▶ Specify protection measures, including planting or retaining vegetation to conserve, protect, restore or enhance sensitive ecosystems, or control drainage and erosion
- ▶ Require an environmental impact assessment and specialized information before the permit is issued
- ▶ Create guidelines for BMPs

STRENGTH: Specifies how development can occur on a site, while protecting the natural environment; more fine-grained tool than standard zoning

LIMITATION: Requires additional staff expertise and time to review applications and set permit conditions

Zoning Bylaw

WHAT IT IS:

- ▶ Regulates the use, density, and development standards of property
- ▶ Sets standards on aspects of development that impact water resources on the site or in the area

USE IT TO:

- ▶ Preserve large lots located outside of designated urban area
- ▶ Set density bonuses for specific zones
- ▶ For each zone, establish the maximum percentage of the land area that impermeable material may cover
- ▶ Include requirements for parks, density bonuses, and clustering of new house sites in rezoning.

STRENGTH: Provides several ways (e.g., lot sizes, density, setbacks, permitted uses) to direct development away from sensitive ecosystems, including watercourses and aquifers

LIMITATION: Lacks details to respond to site-specific ecological conditions

Subdivision and Development Servicing Bylaw

WHAT IT IS:

- ▶ Sets the standards and specifications for works and services, and sets out the application procedures in connection with the subdivision and development of land within local government boundaries

USE IT TO:

- ▶ Provide stormwater runoff (drainage and infiltration) requirements: include a rainwater management design and policy manual; require that post-development site runoff match pre-development levels; include standards for erosion and sediment controls; require the inclusion of climate change in projections
- ▶ Include rural landscaping and road design requirements that protect ecosystems: no curbs; shallow drainage swales; narrow pavement; significant revegetation
- ▶ Require wells to be closed when property gets connected to community water system (this can also be done by independent bylaw)
- ▶ Require bonding for future operations and maintenance of larger systems
- ▶ Adopt policy and design manuals focused on rainwater infiltration, low impact development, and green infrastructure

STRENGTH: Can support water protection by including standards for on-site infiltration, erosion control, low impact development, and water conservation practices and requesting additional information in support of an application (e.g., environmental assessment)

LIMITATION: Does not respond to site-specific ecological considerations and only triggered when new subdivision or development occurs

Regulatory Bylaw(s)

WHAT IT IS:

- ▶ Establishes parameters for how a landowner may carry out an activity

USE IT TO:

- ▶ Regulate landscaping, soil deposit and removal, tree protection, watercourse protection, pesticide use, invasive species, well closure, sanitary sewer storm drain, drainage, and flood hazards

STRENGTH: Are proactive and reactive; can require landowners to obtain permits before carrying out activities that have an environmental impact and can enable staff to enforce the bylaw(s) through ticketing or court action

LIMITATION: Potential for standards to be too stringent and costly to administer and can be difficult to enforce

Type of plan, policy or bylaw

How to use for source water protection

Master Plan(s)

WHAT IT IS:

- ▶ Provides a road map of projects and programs for local governments to undertake in the short, medium and long term to make sure a community keeps pace with population growth, delivers adequate services, and protects public health and the environment
- ▶ Examples include water, stormwater and drainage, liquid waste, asset management, and parks and recreation

USE IT TO:

- ▶ Identify and prioritize projects that will help improve water quality and protect sources

STRENGTH: Gives the community the ability to make informed decisions that uses financial and other resources effectively

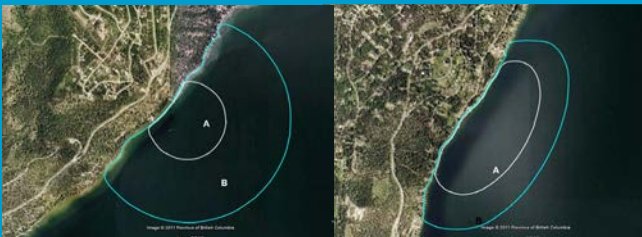
LIMITATION: Can lead to problems if not well conceived or too inflexible

Other Water-Related Plans

- ▶ Standalone plans such as water conservation plans, rainwater management plans, drought management plans, integrated lake management plans, and floodplain management plans can be used to protect water sources.

Intake Protection Zones

An Intake Protection Zone (IPZ) is developed based on typical water travel times at a specific intake to provide 2 hours of travel time between a potential contaminant and the intake. IPZs were developed as part of Okanagan mainstem lake source assessments at the encouragement of Interior Health. However, gaining legal recognition has been slow. Marinas and hazardous land uses continue to be built within IPZs in the Okanagan. If a Licence of Occupation (LoO) is sought, the Government of British Columbia usually requires that the management of all dock licensing within the LoO also be managed by the municipality. Nonetheless, inclusion in an Official Community Plan and municipal mapping have also been pursued to help guide development and activities within IPZs. For example, the City of Kelowna has included four IPZs in their 2040 OCP.



Case Studies

Metro Vancouver 2040 Shaping our Future Regional Growth Strategy

Metro Vancouver's [Regional Growth Strategy](#) sets out Conservation and Recreation areas, which are intended to protect significant ecological and recreation assets, including drinking water. Goal 3 Protect the Environment and Respond to Climate Change Impacts includes strategies to protect those conservation and recreation lands (3.1) and to protect and enhance natural features and their connectivity (3.2).

Comox Valley Regional District Regional Growth Strategy

The Comox Valley Regional District [Regional Growth Strategy](#) has a strong emphasis on protecting drinking water and managing stormwater. Objective 5-B and its five policies call for professional reports that outline potential development impacts to water quality and quantity, support plans that protect drinking water, require collaboration with stakeholders and agencies to protect aquifers, and require an aquifer protection development permit for electoral areas at time of subdivision. Objective 5-C and its supporting policies work to manage stormwater in a way that preserves ecosystem and watershed health through regulation of impervious surfaces.

District of Highlands Official Community Plan

The District of Highlands [Official Community Plan](#) states that all land use decisions must consider water (Section 2.1). Numerous sections in the OCP provide objectives and policy direction related to source water protection, including:

- ▶ Section 3.3- water features and riparian areas as environmentally sensitive areas,
- ▶ Section 3.5- watershed and groundwater management,
- ▶ Section 3.8- soil and water pollution,
- ▶ Section 7.2- water supply and well protection, and
- ▶ Section 7.5- surface water drainage and the importance of managing stormwater.

Official Community Plan Policies Supporting Climate Resilience

The [Official Community Plan Policies Supporting Climate Resilience](#) guide provides local government with guidance and examples for putting climate resilient policies into official community plans and development permit areas guidelines. Section 2.3.3 covers stormwater management, Sections 2.5 and 3.1, and 3.4.1 discuss the natural environment, and water conservation is addressed in Section 3.3.2. Other source protection-related topics are covered in Section 2.12 Emergency Management and 3.2.3 Flood Hazard.

Village of Cumberland Development Permit Area for Groundwater Protection

The Village of Cumberland [DPA 2 – Groundwater Protection](#) (p. 99) regulates development in a manner that protects,

sustains, or enhances the quality and quantity of ground water sources for drinking, irrigation, and other approved uses and the overall health of the natural environment and water ecosystem. To develop in this area, the applicant is required to provide a report from a registered professional that includes an examination of pre-development water quality and quantity on the site, a statement that the proposed development will not have a negative impact on the aquifer and recommended measures that are required to ensure the aquifer is protected.

City of Nanaimo Official Community Plan and Zoning Bylaw Watercourse Leave Strips

The City of Nanaimo protects watercourse riparian areas using two regulatory mechanisms. Section 6.3 of the City of Nanaimo [Zoning Bylaw](#) prohibits the development or the alteration of a leave strip of predetermined width depending on the size and type of watercourse. The leave strip is the protected riparian area land adjacent to the sea or on each side of the watercourse. Watercourses and their leave strips are designated as Development Permit Areas for environmental protection under Development Permit Area 1 – Watercourses in the Official Community Plan. Disturbance of vegetation, movement of soil, or other disturbance of land or water is not permitted in these areas without a development permit issued in accordance with the guidelines in Development Permit Area 1. (Note that the City’s OCP is currently undergoing a comprehensive review.)

Enhancing climate resilience of Subdivision and Development Servicing Bylaws in the Columbia Basin

The [Enhancing Climate Resilience of Subdivision and Development Servicing \(SDS\) Bylaws in the Columbia Basin: A guidance document](#) was designed to assist communities in the Columbia Basin in updating their subdivision and development servicing (SDS) bylaws to increase their resilience to a range of climate change impacts. The guide first outlines the context and provides an overview of potential climate impacts for the region, and also outlines the legal requirements and financing considerations of SDS bylaws. Designed to be paired with the [model subdivision and development services bylaw](#), the guide then walks through each bylaw section, outlining the purpose for each, as well as important considerations and pertinent examples. The guide closes with acknowledgement of the role of adaptive capacity in overall community resilience, and summarizes key considerations in implementing one’s own bylaw.

City of Kelowna Well Regulation Bylaw

The [City of Kelowna Well Regulation Bylaw](#) regulates the disconnection and closure of wells on properties connected to the City Water Utility. The bylaw includes options for water well owners to professionally decommission their wells in order to connect to the City utility or, for those wishing to keep their wells for personal or irrigation use, to register them with the Province providing they are completely disconnected from City water sources. The closure of these private wells reduces the potential for contamination of the City system, and in turn protects the health and safety of residents and the natural environment.

City of Metchosin Protection and Management of Rainwater Bylaw

The City of Metchosin [Bylaw for the Protection and Management of Rain Water](#) regulates the use and development of land to minimize the impact on a watershed by emphasizing the conservation and balance of water in and over the land. The performance requirement is to address 90% of rainfall on-site. A minimum depth of 300 mm of topsoil is required for lawn and other landscaped areas is required.

District of North Vancouver Environmental Protection and Preservation Bylaw

The District of North Vancouver [Environmental Protection and Preservation Bylaw](#) regulates the protection, preservation and conservation of the natural environment and ecological systems including watercourses, trees, soils, and lands. It regulates development in aquatic areas (Part A) and on sloping terrain (Part B), soil removal and deposit (Part C).

City of Burnaby Streamside Protection and Enhancement Areas and Guide for Developing Near Streams

The City of Burnaby Zoning Bylaw defines the [Streamside Protection and Enhancement Area](#) (see 6.23 on page 18), which mandates setbacks for development from streams, ravines, wetlands and lakeshores. In situations where development is proposed within a streamside protection and enhancement area, an application must be made to the Environmental Review Committee for a variance to the setback. The Director of Planning and Building reviews and approves the committee's recommendations for setback variance. The City's Guide for Developing Near Streams outlines the streamside development review process.

Lake Windermere Management Plan

The [Lake Windermere Management Plan](#) was initiated by the Regional District of East Kootenay (RDEK) in November 2008 to address concerns that increasing development and use could lead to a degradation in drinking water quality and other values. The Plan guides long-term management of the lake and directs local government planning for the lake and shoreline. It considers and integrates the environmental, anthropogenic, cultural, and biological factors and values associated with Lake Windermere. The Lake Windermere Ambassadors, a group of citizens representing a broad sector of the community, provide the RDEK and the District of Invermere with advice and guidance on plan implementation.



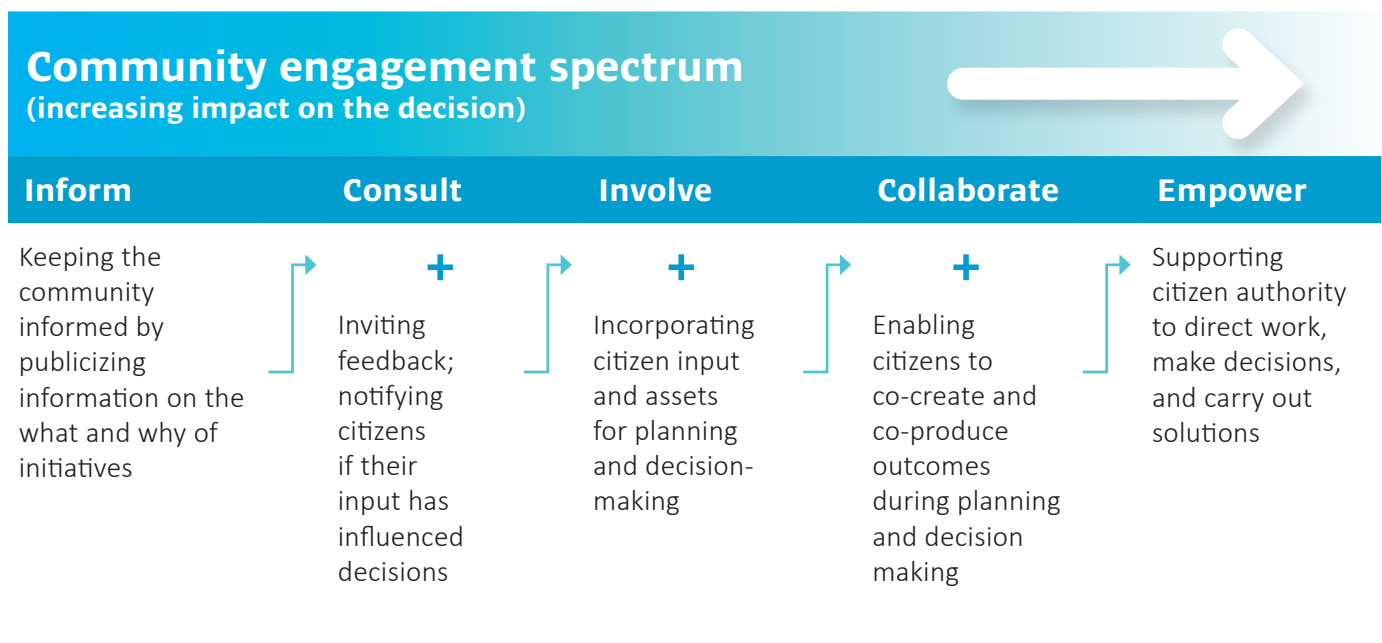
TOOL 4. Education and engagement

Description

This tool is intended to help you maximize political and public support for and involvement in protecting drinking water sources. Source water protection needs committed and engaged champions to be effective. Water suppliers and local governments can help people understand where their water comes from, why it needs protection, and what they can do to help. When people understand and care about a cause or are incentivized to act, they are empowered to get involved, and change often follows.

Community engagement can mean different things to different people in different parts of an organization (e.g. planning, community development and services, communications and marketing). This section does not argue for a particular definition. Instead it gives you general principles and best practices to consider when engaging the community in source water protection. According to the [International Association for Public Participation](#), engagement happens on a continuum, starting with informing the community about what you are doing and ending with empowering them to make the final decision (see Table 11).

Table 11: Levels of community engagement



How to use the tool

Engagement of elected officials, upper management, and other decision-makers will look different than engagement of the broader community. They will be interested in seeing a business case that clearly articulates the value and benefits of source water protection, as well as the costs. Your business case will also be needed to secure funding for your source protection initiatives (see “[TOOL 2. Funding](#)”). Use the best practices in the Table 12 to prepare your business case and refer to the American Water Works Association [Source Water Protection Justification Toolkit](#) for more information.

Table 12: How to build and deliver a business case for source water protection

1	ARTICULATE THE PURPOSE	Share the overall vision and short-and long-term goals for your program. If the business case focuses on a particular activity or set of activities be sure to emphasize that.
2	STATE THE BENEFITS	<p>Draw attention to the cumulative environmental, social, and financial benefits brought on by source water protection. These may include:</p> <ul style="list-style-type: none"> ▶ Public health protection ▶ Improved water quantity and quality ▶ Environmental stewardship and accountability ▶ Habitat and ecosystem services protection ▶ Enhanced aesthetic quality of the watershed, which can help increase property values ▶ Potential for reduced treatment costs ▶ Social benefits from collaboration and partnership-building ▶ Enhanced regulatory compliance ▶ Improved long-term management of natural infrastructure, such as forests ▶ Improved preparedness and response capacity for emergency events ▶ More robust data on watershed health, and opportunities for sharing that data
3	PRESENT THE OPTIONS	Present the actions/activities that you would like to carry out and show how each may positively and negatively impact stakeholders using quantitative and qualitative evidence (use that field data!).
4	CHART THE COURSE	Show the steps needed to carry out the actions/activities. Present a timeline, a budget with immediate and long-term costs, the funding options, and any barriers with solutions.
5	DELIVER THE MESSAGE	Keep the main message consistent across all audiences, but personalize it for individual audiences by emphasizing the information that is most relevant and making it meaningful in a real-world situation. If possible, conclude with examples of how the solutions succeeded elsewhere.

PRO TIP: Take your elected officials or other decision makers on watershed tours (where permitted) to help them see what happens in their watershed. Keep tour groups small and focused.

The methods you use to engage the broader community will depend on the source water protection challenges you are facing and the goals of your plan (see “[STEP 3. Plan](#)” in “PART 1: ROADMAP TO SOURCE WATER PROTECTION” for how to create your plan). Here is a list of example subjects and audiences to help get you started:

- ▶ **Did you know this is a water resource?** Generally targeted.
- ▶ **Source to Tap. Do you know where your water comes from?** Generally targeted.
- ▶ **Leave light footprints.** Targeted at upland watershed recreators.
- ▶ **Signage** such as “If you notice questionable activities in our Community Watersheds, **Report All Poachers and Polluters** (RAPP) and violations to the Conservation Officer Service 24-hour **hotline: 1-877-952-7277**, or **#7277** on the TELUS Mobility Network.” Targeted at upland watershed recreators.
- ▶ **Naturalize your landscape.** Targeted at riparian landowners.
- ▶ **Minimize stormwater contamination.** Targeted at subdivisions.
- ▶ **Keep wakes down.** Targeted at powerboat impacts on intakes.
- ▶ **Annual hands-on Watershed Day.** Targeted at local schools and the community.

Follow the steps in the United States Environmental Protection Agency [Getting in Step Guide for Conducting Watershed Outreach Campaigns](#) below to engage your community.



1. Define

- ▶ **Driving forces** – What is the pressing source water protection challenge? For example, is it impacts from forestry, ranching and/or recreation in the upper watersheds? Or potential contamination from stormwater in urban areas?
- ▶ **Goals** – What is the broad focus of your effort?
- ▶ **Objectives** – What actions will you take?

2. Identify target audience

Focus on discrete audiences to make implementing and evaluating your education program more manageable. What motivates them? What is their knowledge of the issue?

3. Tailor-make message

Create a beneficial exchange between the audience and campaign objective using an action statement, rewards or incentives.

- ▶ **FRAME IT** – to elicit the desired response
- ▶ **BRAND IT** – use a consistent slogan or logo
- ▶ **HOOK IT** – use something memorable (e.g., lighthearted humour, a jingle, a compelling question)
- ▶ **KEEP IT SIMPLE** – to avoid diluting the core idea

4. Distribute

- ▶ **Piggyback**: Attach your message to the existing efforts of groups that relate to the target audience, be it through their newsletter or event.
- ▶ **Social diffusion and pressure**: Link visuals to willing members of the audience to promote the desired source water protection actions (e.g., rainwater gardening, responsible motorized recreation) as the new norm. Aim for 15% adoption by willing members.
- ▶ **Personal contact**: When appropriate, use phone calls or face-to-face methods. Connect with respected locals, organizations, or businesses who can directly spread the message to their peers.
- ▶ **Focus on shared values**: Connect the dots on why source water protection should matter to people. Watch this TED talk [The most important thing you can do to fight climate change: talk about it](#) for tips.
- ▶ **Program delivery**: If lack of resources poses a barrier to developing an outreach and education plan make use of already developed materials within the US EPAs [Nonpoint Source Outreach Toolbox](#).

5. Evaluate

Evaluate your efforts and aim for continual improvement. Evaluate the process, its impact, and context using water quality and core social metrics.

Table 13 describes a range of tools you can use for community engagement.

Table 13: Education and engagement tools and how to use them

TOOLS	IMPLEMENTATION IDEAS AND EXAMPLES
Social and traditional media	Create and maintain websites as well as Twitter, Instagram, and Facebook accounts to communicate important messages such as water quality notices, scheduled repairs, tips on how to protect water at home, or initiatives that require widespread community involvement. Advertise with local radio stations, on Spotify, or on a billboard.
Kiosks and signage	Erect kiosks or signage that inform community members on how they can help protect source water at popular recreation sites, upon entering groundwater recharge zones, by upland reservoirs, at boat launches, or in areas of concern.
Letters and annual reports	Mail out letters to residents on lakeshores, in groundwater recharge areas, and on creek/riverfronts, informing them of ownership and responsibility, BMPs on how to keep pollutants out of source water, and initiatives that require their participation. Describe ongoing and planned source water protection efforts in annual reports and newsletters. Display an annual watershed protection fee on monthly bills.
Workshops	Invite stakeholders who are impacted by proposed management actions or whose activities impact source water to participate in an educational workshop. Examples groups to work with include: an Agricultural Advisory Committee on agricultural BMPs to reduce stormwater runoff and protect groundwater resources; the homebuilders association or construction association on BMPs for green infrastructure; the Okanagan Trail Riders Association and similar groups on responsible recreation; the B.C. Cattlemen’s Association to implement the Farmland-Riparian Interface Stewardship Program; and local government officials on bylaws or policies that protect natural assets.
Schools	Provide curricula for teaching source water protection in junior, middle, and high schools, as well as water testing kits and information on in-class competitions to engage students. Or, contact your local school district and request time for a dedicated source water protection staff to deliver a presentation on protecting the source water in their watershed, either at the school or through a tour of your water treatment facility.
Demonstration projects	Incorporate demonstration projects as part of a workshop. Host interactive tours in collaboration with owners of residential or commercial properties that use BMPs, including graywater and rainwater collection, treatment, and reuse systems, waterfront-friendly landscaping, exemplary farms, among others. Provide signage to promote these exemplary properties.
Outreach teams	Pool resources with other water suppliers to form an outreach team that make use of existing efforts, such as OBWB, or form your own. Outreach teams can focus on bolstering public awareness and education. They can engage in direct interpersonal contact and are necessary for reaching out to folks who are not tuned into social or traditional media.

TOOLS

IMPLEMENTATION IDEAS AND EXAMPLES

Citizen science

Fill data gaps in a cost-effective manner with citizen science. Identify data needs and local stewardship groups. Collaborate with organizations that facilitate community-based monitoring, such as Living Lakes Canada or Water Rangers, B.C. Lake Stewardship Society or B.C. Wetlands Institute, to train participants on standard-operating procedures for data collection and to develop agreements on data management. Acknowledge their contributions where applicable (e.g., reports, meetings). See citizenscience.gov and Developing a Citizen Science Program for implementation tips and considerations.

Public meetings

Be transparent with your plans; it will help gain support. Invite the community to public meetings on proposed management actions and funding mechanisms that may affect them. Notify senior government leaders, local residents, provincial governments, First Nations, industry professionals, and community groups.

Check-in programs

For initiatives that require citizen-implemented BMPs, deploy staff to conduct property assessments for voluntary home and business participants. Solicit buy-in using the tools in Outreach and Education. Check-in programs can be developed to help you achieve goals in water consumption reduction, stormwater management, or other objectives that necessitate heavy community engagement.

Incentives

Use financial rewards or social pressure to achieve objectives that necessitate significant community participation and financial expenditure. See the RDN's rebate programs for ideas. Further incentivize participation by asking citizens who've implemented source water protection BMPs to display signs, like Okanagan WaterWise, LakeSmart, or Environmental Farm Plan. Reward signs can inspire change at the community level, especially after 15% participation. The upper watersheds need help too; incentivize responsible behaviour by rewarding folks who report damage (see Community-Based-Monitoring in Monitoring and Reporting).

Stewardship programs

Identify ecological services in need of restoration or with heavy public use. Ecological services play an important role in source water protection. Stewardship activities ensure those services work for us, plus, they offer a tangible means for citizen involvement. Erect "Adopt Me" signs near those ecological services, informing people of where to seek further information on the program. Encourage interested citizens to choose adoption sites near their neighbourhoods, businesses, schools, or club meeting sites. Designate an area to work within, a minimum time requirement, and necessary tasks such as litter pickup, restoration and rehabilitation works, among others. Collaborate with organizations like Pacific Streamkeepers Federation to train groups on how to undertake rehabilitation activities. Supply the necessary equipment.

Case Studies

Source Protection Education in Ontario

In Ontario, education is primarily delivered through dedicated drinking water source protection [websites](#); one exists for each source protection region and all use the same logo. Partnering organizations distribute fact sheets, videos, and guides through websites and provide education through [watershed management](#) and conservation programs.

Prioritizing Education and Outreach Proves Successful for the Regional District of Nanaimo

The success of the Regional District of Nanaimo’s source water protection program is largely a result of effective outreach and education efforts—599 of them between 2011 and 2018—that included:

- ▶ maximizing the use of the already established Team WaterSmart program with website enhancements, contests and campaigns, publications and media coverage, reports, and irrigation checkups.
- ▶ coordinating information and education resources such as school field trips and presentations, display booths, workshops, and events.
- ▶ providing demonstration projects including tours featuring water conservation technologies such as greywater and rainwater collection, treatment, and reuse; xeriscaping; rain gardens; and
- ▶ supporting volunteer and non-profit groups – annual water quality monitoring training and meetings for the Community Watershed Monitoring Network; and stewardship seed funding.

The delivery of the outreach program was a success on its own but also led to major accomplishments in water conservation, collaboration and the development partnerships, and public participation.

Outreach and education continues to be a focus of the RDN’s source water protection program and builds on the lessons learned in the [10 year review](#). A few of the proposed improvements include: the transition from “information overload” or highly detailed and technical outreach campaigns to more “best-in-class” methods that deliver simpler, more emphasized messages; and the need for brand and logo consistency among partnering municipalities, water programs and communications (to keep the message and vision clear throughout the region).



LakeSmart Stewardship Program Drives Community-Level Behavioural Change

In Maine, USA, direct interpersonal contact between [LakeSmart](#) staff and citizens kick-started an effective voluntary lake protection program. The LakeSmart Program was designed with the following tools:

- ▶ Landscaping BMP workshops. These both spread knowledge on how to minimize nutrient runoff and solicited participation among residents. BMP focal areas included: driveways; structures and septic systems; recreation areas and footpaths; and riparian areas and water access. The workshops demonstrated easily implemented BMPs (to kick-start participation) and more complex ones (to exemplify commitment to the LakeSmart design). Workshops later evolved into interactive “Walk’n Talk” tours to properties that exemplified the appearance and function of lake-friendly landscaping BMPs.
- ▶ Convenient on-site evaluation. Teams were deployed to assess properties for existing runoff problems, to suggest mitigation strategies, and to issue award signs for exemplary land management, all at the homeowner’s convenience. Participating homeowners received feedback from their assessment, with illustrated instructions for implementing the BMPs. Volunteers were eventually trained to take over this role, which enabled the program to expand.
- ▶ LakeSmart signage. These were awarded to residents who implemented LakeSmart practices. The signs, displayed on the road and lakesides of LakeSmart properties, exerted social pressure on neighbours to join the program by promoting LakeSmart practices as the apparent norm in the community and reminded awardees to continue the practices that awarded them.

Citizen Columbia Basin Groundwater Monitoring Program

The goal of the [Columbia Basin Groundwater Monitoring Program](#) is to increase knowledge about groundwater resources in the Columbia Basin and the climate impacts on them in order to effectively inform sustainable water management and meet the needs of people and nature. The foundation of the Program is the well owners who volunteer their wells for monitoring. These include municipalities, First Nations, and private landowners.

The objectives of the Program are to:

- ▶ Collect groundwater level data across a range of geological, topographical, climatic, hydrological, and water use intensity conditions to determine how levels change seasonally and from year to year;
- ▶ Increase knowledge and awareness about groundwater by engaging partners and citizens in the collection of data, providing training, and sharing knowledge;
- ▶ Collaborate with watershed stakeholders, decision makers, and water users to ensure data are informing on-the-ground action, policy, and decisions; and
- ▶ Share data publicly so they can be used by water users, water managers, researchers, decision makers, policy makers, and others to protect and manage water resources.

The Program collects groundwater level data similar to the [Provincial Groundwater Observation Well Network](#), which has a limited number of observation wells in the Columbia Basin. As of September 2021, the Program was monitoring 22 Volunteer Observation Wells across the Columbia Basin. Data are available on the [Columbia Basin Water Hub](#) and [BC Real-time Water Data](#).

Visit the [Program’s webpage](#) for more information including a brochure for volunteer well owners and recent reports.

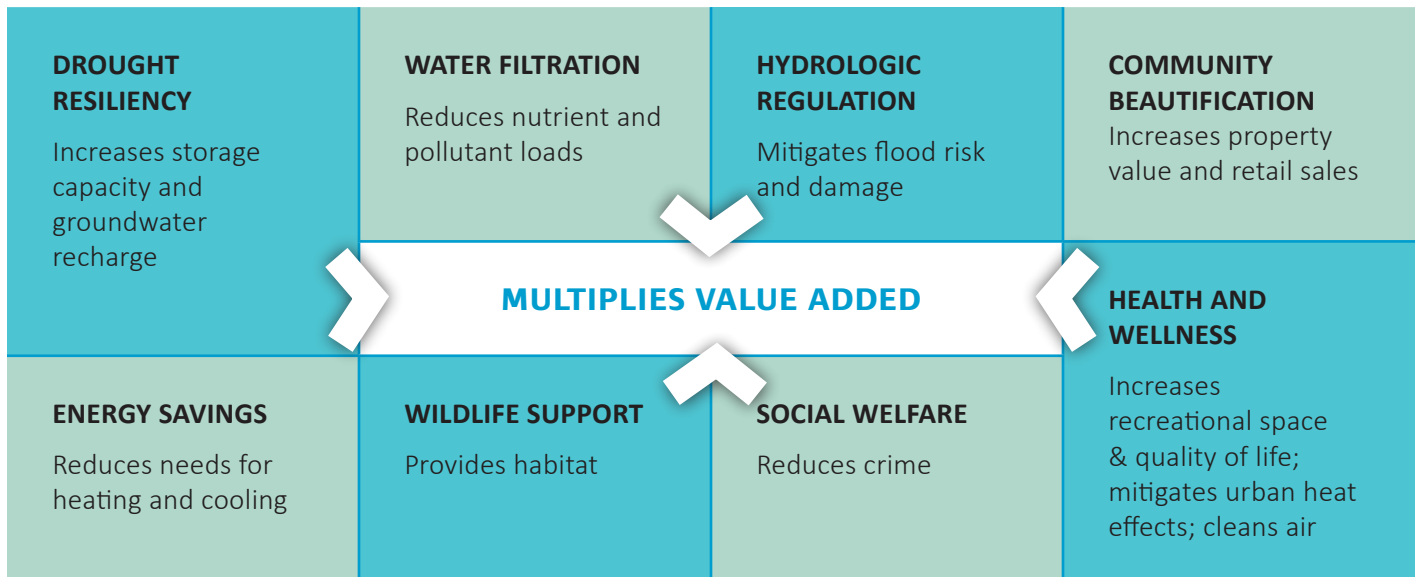
TOOL 5. Natural assets and green infrastructure

Description

This tool will help you identify and value green infrastructure and natural assets in your community. Source water protection is about protecting and restoring the forests, riparian areas, wetlands, waterways, floodplains, and soils that provide natural filtration and hydrologic regulation in watersheds ('natural assets'). It is also about creating rain gardens, bioswales, green roofs, treatment ponds, and other enhanced and engineered ecological assets to manage stormwater in cities ('green infrastructure'). Green infrastructure and natural assets can also provide aesthetic, cultural, recreation, and tourism benefits and opportunities for harvesting of food and medicine (see Figure 4 to learn about more benefits).

Asset management processes have traditionally been applied only to engineered infrastructure. This tool provides information on how to map, inventory, value, and monitor the natural assets that provide ecological and hydrological functions and processes for managing water in your community. Significant strides have been made in natural asset valuation and management in B.C. and across Canada. Learning from other communities will contribute to your success. More information on valuation is provided in ["3.2 Economic benefits of source water protection" on page 64.](#)

Figure 4: Benefits of green infrastructure and natural assets



How to use the tool

Including natural assets in asset management processes is not about treating engineered and natural assets in exactly the same way. An inventory of engineered assets may include different attributes than an inventory of natural assets; depreciation of natural assets and engineered assets will not be determined in the same way—and in some cases, natural assets can appreciate over time. The aim is to include information about natural assets in your overall asset management process so you can evaluate trade-offs between service, cost, and risk.

The [Municipal Natural Assets Initiative](#) (MNAI) offers a methodology to help local governments identify, value, and manage natural assets within traditional financial and asset management planning frameworks. As of 2021, 11 communities have piloted the MNAI approach, and some of their stories are included in the case studies at the end of this section. Other urban communities in B.C. have focused on green infrastructure planning—the City of Vancouver’s [Rain City Strategy](#) and Metro Vancouver’s [Connecting the Dots: Regional Green Infrastructure Network Report](#) are excellent examples.

If your community is evaluating natural assets or green infrastructure, or both, follow this general 5-step process.

PRO TIP: Prioritize the protection and restoration of riparian areas. They can serve multiple functions for drinking water protection, and the costs avoided from keeping them functional will save money in the long run. See “[3.2 Economic benefits of source water protection](#)” on page 64 for important information on how to do this.

Natural systems have ecological limits. When hydrology is altered through wildfire, loss of forest canopy, increase of impermeable surfaces, removal of wetlands, or loss of riparian vegetation, ecosystem services are diminished. The result is more intense floods, poor water quality—and communities ultimately pay.

For example, an improperly designed road and a storm resulted in a slope failure in the Belgo watershed that caused turbidity to soar at Black Mountain Irrigation District’s Mission Creek intake in May 2017.



Step 1. Develop a Policy and Set Goals

Develop an asset management policy, bylaw, or financial statement that includes green infrastructure and natural assets and define how they will help accomplish stormwater management or other source protection goals. See [“3.2 Economic benefits of source water protection”](#) for ideas. Identify collaborative opportunities within your organization and within the broader watershed to maximize the benefit to other community services. Include internal and external subject matter experts and stakeholders with varying views on ecosystem services (including cultural services) from the beginning.

Step 2. Inventory and Map Green Infrastructure and Natural Assets and Identify Services

Create an inventory and map of green infrastructure and natural assets within your supply area—even where you don’t have jurisdiction such as upper watersheds. While it may not be feasible to map small-scale green infrastructure like rain barrels and cisterns, larger elements like trees, parks, and ponds should be included. Think about the services the green infrastructure and natural assets provide. Compile the information into an asset register like you would do for engineered assets. See this [Primer](#) for an example of an asset register.

Step 3. Determine Condition and Value

Identify the current and future risks to the green infrastructure and natural assets. Assess activities that have degraded, or will likely degrade, the function of ecological services provided by key assets (e.g., riparian area grazing, land development plans, wildfire, resource extraction, urban landscape lacking vegetation) and how they impact source protection goals. Determine the condition of your green infrastructure and natural assets by looking at existing studies (e.g., stormwater master plans, drainage studies, source water assessments) and by gathering existing monitoring data (e.g., flow monitoring, surface level monitoring, groundwater monitoring, data on soil types). Assign value to your natural assets (see [“3.2 Economic benefits of source water protection”](#) for ecosystem valuation and techniques).

Step 4. Rank and Prioritize

Rank the natural assets based on identified risks and source protection goals. This will help you determine which initiatives to prioritize. See this [Primer](#) for an example of an asset ranking.

Step 5. Look for Opportunities and Implement Actions

Step 5 involves three possible action paths:

- ▶ Identify and carry out the actions needed to improve the function of high-risk natural assets and green infrastructure;
- ▶ mitigate the future degradation of priority natural assets and green infrastructure; and
- ▶ increase the capacity of the natural assets and green infrastructure to meet source protection goals.

Potential actions could include the development of stringent bylaws, restoration of key habitats, acquisition of lands, incentive programs to encourage on-site water harvesting, and riparian fencing projects in upland watersheds and rural areas.

Case Studies

The Town of Gibsons' Experience in Financial Planning and Reporting

The Town of Gibsons was North America's first community to experiment with strategies to integrate natural assets into asset management and financial planning. They started in 2009 by valuing the aquifer that filters and stores water to supply the town and future projected populations with clean drinking water and are now working on a project that will consider natural assets in the entire watershed through the [Source to Sea Project](#).

Gibsons learned through experience that, while there are hurdles and limits to including natural assets in financial planning and reporting, these challenges should not be overestimated. Section 3.1 of their report [Advancing Municipal Natural Asset Management: The Town of Gibsons' experience in financial planning and reporting](#) provides a succinct explanation of how Gibsons was able to include natural assets in their financial statements while still complying with Public Sector Accounting Board guidelines and without capitalizing the natural assets. Annex 1 of the document is an excerpt from Gibsons' financial statements referencing natural assets.

Measuring the Value of Natural Assets in Saskatoon

The City of Saskatoon completed a pilot project to assign measurable value of the ecosystem services provided by its natural assets. The project had three phases: (1) compile an inventory and choose the natural assets to focus on, (2) identify the ecosystem services, and (3) assign value to those ecosystem services. The City used a value transfer method to calculate average value per hectare. The project roughly estimated the total annual value of the natural assets in the City's inventory at \$48.2 million per year. The City learned that getting started on a natural asset management plan, even when you are not ready to complete an ambitious set of goals, can yield tangible progress, generate valuable knowledge, and lay the groundwork for next steps.

Comox Lake Initiative Strengthens Role of Nature in Protecting Drinking Water

In 2019, several Comox Valley communities and the K'òmoks First Nation launched a multi-year initiative with the Municipal Natural Assets Initiative (MNAI) to help better understand, measure, and manage critical drinking water services provided by nature. The Comox Valley Regional District (CVRD), City of Courtenay, Town of Comox, Village of Cumberland, and K'òmoks First Nation signed a memorandum of understanding with the MNAI to value natural assets in the Comox Lake watershed, which provides safe, reliable drinking water, and environmental, cultural and economic benefits to the valley. The project will include a watershed-scale inventory and condition assessment of natural assets and modelling of scenarios such as climate change, different management strategies, in-fill, land acquisition, or other variables.

City of Kelowna Roadside Bioretention

The City of Kelowna is looking at new ways to use green infrastructure to manage water on roadways. Rather than typical curb-and-gutter systems used along most Kelowna roadways now, the City will replace them with bioretention bump-outs (curb extensions) and bioswales. Instead of water flowing into stormwater drains, it will slowly filter back into the ground. The cost, over an 80-year timeframe, will be substantially lower, according to City staff. [A 70-lot case study](#) showed that construction, maintenance and renewal over that timeframe would cost \$1.8 million, compared to the \$2.4 million cost of the traditional approach. The City's Development Cost Charge and zoning bylaws are expected to be updated in 2021, providing an opportunity to integrate green infrastructure policy and design into those plans.

[Click here to read other case studies related to municipal natural asset management.](#)

TOOL 6. Emergency preparedness and response

Description

This tool is intended to help you prepare an Emergency Response and Contingency Plan (ERCP). Under section 10 of the *Drinking Water Protection Act*, water suppliers must have a written ERCP in place in the event of an emergency that might pose a health threat. No source water protection plan is complete without ERCPs and staff training. ERCPs should include wildfire, flooding and drought, spills, water system emergencies/failures, and dam failures (see the Government of B.C.'s [Emergency Response and Contingency Planning for Small Water Systems](#) step-by-step guide for more information).

For many emergency events, incident command is established through a Regional Emergency Operations Centre. Get to know the Emergency Operations Coordinator near you. Get to know where there are waste discharge permits and what is being discharged. Get to know your contacts on Crown land, such as FLNRORD, road permit holders, forest fire contact and Dam Safety contact. Update your contact list each year.

Annual training of staff and review of ERCPs are also important. Finally, it is important to set up a tracking and reporting system to make sure the incident is followed through to the end and lessons learned are reported.

PRO TIP: Reach out to emergency personnel to form a relationship before an emergency happens.

How to use the tool

Developing and using an ERCP should include the actions listed in Table 14.

Table 14: Quick guide to emergency response and contingency plans

General Action	for Wildfire	for Flooding/Drought	for Spills
Develop early warning detection system and notification protocols	Connect with B.C. Wildfire Service , Regional Emergency Planning, and local fire department to request notifications of fires within your supply area	Monitor water resources in your supply area and the River Forecast Centre for flood warnings	Request notifications of spills within your supply area
Coordinate with and update contact information for staff, emergency responders, and vulnerable populations	Fire department; Health Authority; FortisBC; BC Hydro; long-term care facilities	Health authority; FortisBC; BC Hydro; long-term care facilities	Fire department; Health Authority; ENV; MOTI; local marinas

General Action	for Wildfire	for Flooding/Drought	for Spills
Review and increase monitoring frequency as needed	Based on wildfire duration, consider adding new temporary sampling sites where beneficial to inform impact on supply area	Increase monitoring sites and frequency as needed to cover affected water resources	Include new parameters to monitor; consider adding new temporary sampling sites where beneficial to inform impact on supply area
Develop an incident command system with operational guidelines for emergency responders and water supply staff			
Establish criteria that define tiers or severity of emergencies, to inform response protocol	Based on: wildfire size and proximity to supply area potential impacts on important infrastructure, known hazards (e.g., chlorine tanks), and water quality/ quantity	Based on: potential impacts on important infrastructure, known hazards, and water quality/ quantify	Based on: spill type (e.g., chemical, oil, sewerage) spatial and temporal proximity to water supply area potential impacts on infrastructure, known hazards, and water quality/ quantity
Identify sources of relief funding	Seek government relief funds (B.C. Disaster Financial Assistance) Follow financial best management practices Develop an emergency fund Obtain insurance		
Identify alternate water sources or means of bypassing poor water quality	Truck in water for residents or provide a water collection station Connect to alternate reservoirs Divert poor quality water		
Other	Collaborate with FLNRORD, ENV, B.C. Wildfire Service , local fire department, and First Nations on strategies to reduce wildfire risks and mitigate post-wildfire threats in supply area	Work with FLNRORD, BCTS to maintain tree canopy in community watersheds and to restore ecological services Implement water restrictions, reduction goals, and leak detection and repair programs Educate users on water conservation measures	Have a spill kit at marinas and fire departments Identify nearby industrial or commercial properties and activities that could contaminate source water (Contaminated Sites Regulations Schedule 2), and work with owners to develop response plan

The [B.C. Emergency Response and Contingency Planning For Small Water Systems](#) is a step-by-step guide for creating an emergency response and contingency plan—designed to be used by operators of small water systems but also useful for larger supply systems. First Nations may also refer to the [Emergency Response Plan for Drinking Water Systems in First Nations Communities](#) guide for emergency examples and response templates. See the [RDN’s Water System Emergency Plan](#) for examples of emergency response action plans and templates on post-incident reports. Check your contacts and revise your contact list annually. Plan to revisit the ERCP every five years or more frequently if needed.

PRO TIP: Make sure B.C. Wildfire Service, FLNRORD, and your local fire department know where your chlorine gas and other flammables are stored in forest interface zones.

Table 15: Quick response sheet for emergencies

ILLEGAL ACTIVITY	<p>Call Report All Poaches and Polluters (RAPP) 24-hour hotline at: 1-877-952-7277 (RAPP) or #7277 on the TELUS Mobility Network</p> <p>Or 911 if this is an emergency</p> <p>Go to https://bcwf.bc.ca/initiatives/conservation-app/ to take geo-referenced, time-stamped photos or videos and to report issues related to illegal use or abuse of natural resources. The app works both in and out of service using your phone’s GPS. Reports are sent to a secure server and forwarded automatically to the appropriate enforcement agency.</p>
UNUSUAL ACTIVITY	<p>Go to https://www.cordemergency.ca/ OR https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/emergency-management-bc</p>
IMMINENT DANGER	<p>For observations of deterioration or unusual conditions, slumping, vandalism at a dam, unusual cracks in a steep slope, culvert blocked, etc., Do Not Proceed Alone.</p> <p>Call 911 and ask for Fire.</p>
SPILLS	<p>When a spill occurs, or there is a risk of one occurring, report the spill immediately.</p> <p>Call 1-800-663-3456 OR</p> <p>Go to https://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/report-a-spill</p>

Case Studies

Rose Valley Reservoir Watershed Wildfire in 2015

In the past two decades, there have been four wildfires (2005, 2009, 2015 and 2020) caused by recreational carelessness in the tiny Rose Valley Reservoir watershed. This is a terminal reservoir for the City of West Kelowna, with no further opportunities for natural purification. The distribution system commences at the reservoir. The 2015 fire was kept small thanks to first responders, although it burned within 100 m of the pumphouse which stored chlorine cylinders under its tar roof. B.C. Wildfire Service was unaware of the chlorine risk during their initial attack on the fire. A City staff member and a firefighter raced into the fire zone to start a sprinkler system on the roof of the pumphouse. Had the cylinders leaked or blown, the lives of the downslope firefighters would have been threatened and the chlorine gas evacuation zone would have involved thousands of residences.

Fuel Spill into Coldstream Creek

A fuel spill occurred at a gas station in Coldstream in November 2015. The operators were aware of storm drains that were directed to Coldstream Creek, so they barricaded them effectively. This action demonstrates the importance of staff training on the hazards to the water source and how Emergency Response Plans support those actions during an emergency.

Where There's Smoke

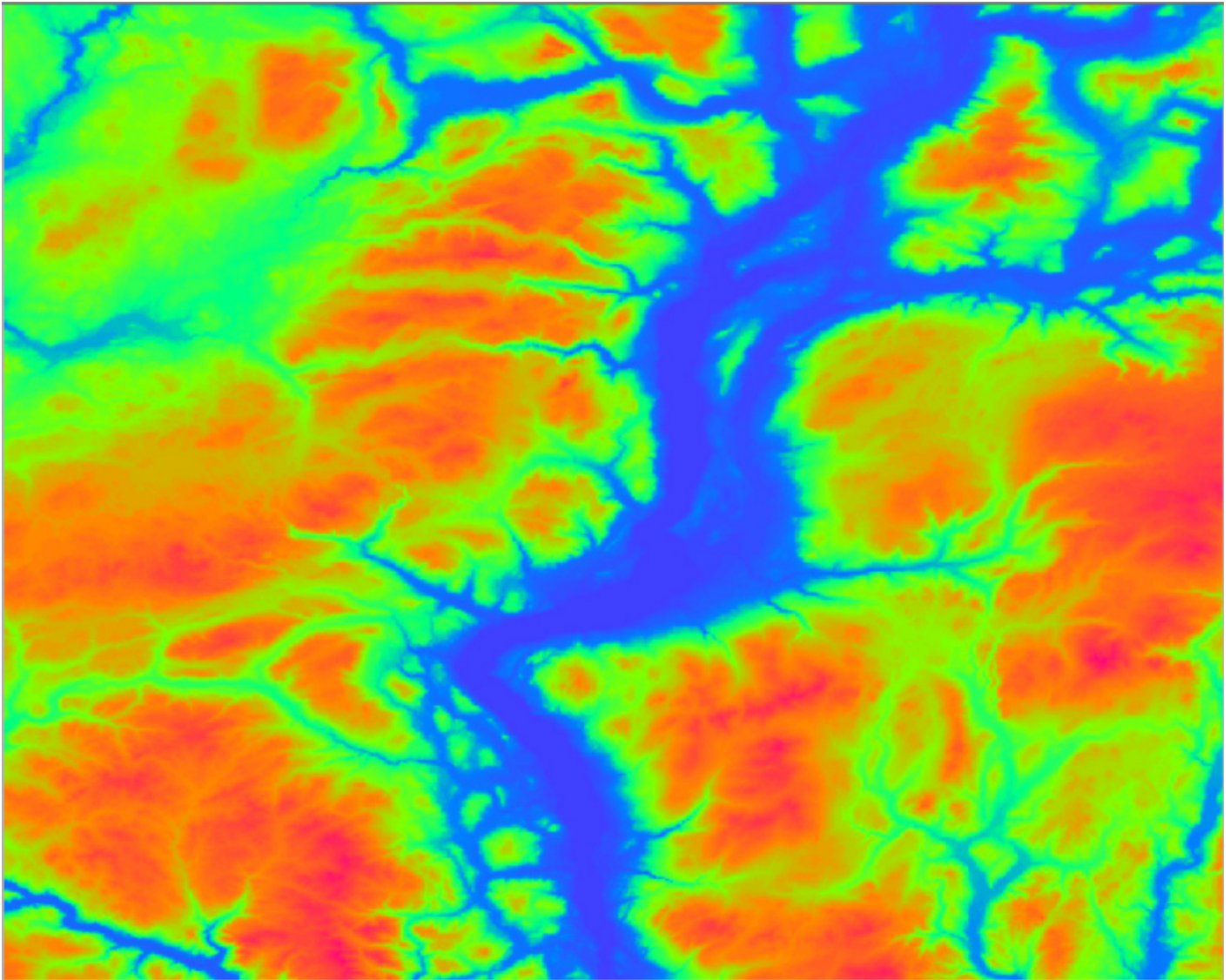
A composite water sample through ash accumulation on Okanagan Lake from 0 to 1 m depth had 100x the typical phosphorus concentration. Intense fires create hydrophobic soils that can shed (not infiltrate) water for years.



TOOL 7. Mapping

Description

This tool is intended to help you understand how to use mapping for source water protection. Source water and watershed protection relies on geospatial data. For example, vulnerability mapping that shows very high to low risks can help when assessing source water protection in your upland watershed. Other stakeholders can layer the vulnerability mapping into their mapping and planning. Mapping allows geo-referenced data presentations, which are well suited to watershed protection activities. However, GIS analysis involves large files with high computation requirements and it requires technical expertise.



How to use the tool

Mapping is a powerful tool to visualize geographic patterns and plan future land-use activities. There are many sources of high quality publicly available geospatial data that are well suited for source water protection and analyses. Table 16 is not comprehensive but contains some of the most useful sources of geospatial data for British Columbia. Mapping tools specific to the Okanagan are provided in Table 17; similar links are likely available for other communities in B.C.

Table 16: Mapping tools applicable to B.C.

MAPPING TOOL	DESCRIPTION	PROVIDER	LINK
GeoBC	Provincial government index of geospatial data: GIS layers for roads, waterways, forestry, etc. LiDAR for most of southern B.C. and has a goal to acquire LiDAR for the whole province.	Government of British Columbia	https://www2.gov.bc.ca/gov/content/data/about-data-management/geobc/geobc-products
Google Earth Timelapse	Time lapse of annual satellite images of any location on Earth for last 30 years. Useful for viewing large-scale changes over time (e.g., watershed deforestation, urban sprawl).	Google	https://earthengine.google.com/timelapse/
Sentinelhub Playground	Web portal for near-real-time satellite imagery of Earth. Useful for viewing conditions in remote locations or cataloguing recent or sudden changes within a watershed.	Sentinel Hub	https://apps.sentinel-hub.com/sentinel-playground/
B.C. Government Google Earth Layers	Several layers of geospatial data relevant to water suppliers and watershed management, viewable in Google Earth and updated daily.	Government of British Columbia	http://bit.ly/BC_Gov_Google_Earth_Layers
UBC Geographic Information Centre, Air Photo Collection	The largest provincial air photo collection. The GIC will loan air photos from their library, dated from the 1922 to 2009.	UBC	https://gic.geog.ubc.ca/resources/air-photo-collection-and-services/

Table 17: Mapping tools specific to the Okanagan

MAPPING TOOL	DESCRIPTION	PROVIDER	LINK
RDCO Historical Air Photos	Web portal with high resolution air photos of RDCO since 1951. Excellent for cataloguing and comparing current and pre-urban landscapes.	Regional District of Central Okanagan	https://rdco.maps.arcgis.com/apps/ImageryViewer/index.html?appid=b8b05a87dedd4ca3a7c2e794724b5754#
Open Data Portals	Web portals for access to public geospatial data.	City of Kelowna	https://opendata.kelowna.ca/
		Regional District of Central Okanagan	https://hub.arcgis.com/datasets/7e864ea93bbf4e9f8abd469298fd2a8a
		City of Penticton	https://open.penticton.ca/
		City of West Kelowna	https://www.westkelownacity.ca/en/building-business-and-development/open-data.aspx
		City of Vernon	https://www.vernon.ca/government-services/maps-gis/open-data-deep
		District of Lake Country	https://www.lakecountry.bc.ca/en/living-in-our-community/maps-and-open-data.aspx
		District of Summerland	https://www.summerland.ca/planning-building/gis-mapping
		Regional District of North Okanagan	http://www.rdno.ca/index.php/maps/digital-data
		Regional District of Okanagan-Similkameen	https://hub-rdos.opendata.arcgis.com/
Regional District of Central Okanagan	https://hub.arcgis.com/datasets/7e864ea93bbf4e9f8abd469298fd2a8a		

TOOL 8. Monitoring and reporting

Description

This tool is intended to help you understand the importance of data collection and reporting and how to do it. Good data are the foundation of source water protection, as they inform assessments of impacts from land use and natural events on source water quality and quantity. Good, useable surface water, groundwater, and hydrometric data necessitate the following:

- ▶ **Consistent methods.** Carefully choose best methods for data collection from the start to avoid a need to change methods mid-study that can cause a “jog” in the data.
- ▶ **BACI (before/after control/impact) monitoring.** Conduct water quality monitoring before and after activities to determine if source protection actions are working, using control and impacted sites.
- ▶ **Analysis.** Extract and demonstrate meaning from data using statistical analyses, graphs (e.g., time series, tables), and comparisons when appropriate.
- ▶ **Proper documentation.** Use standard operating procedures for data management, analysis, and review.
- ▶ **Management.** Organize the data using third-party software or in-house systems. Consider digitizing old datasets to incorporate with new, digital ones.
- ▶ **Quality control and assurance.** Review data upon collection and after processing to ensure they are of useable quality. Make sure duplicates/blanks are collected for water samples.
- ▶ **Outcomes.** Make sure the monitoring and reporting meets expectations and is understood by the target audience. Take time to craft graphics that clearly illustrate the outcomes demonstrated by your data.

Reporting keeps the public informed when water quality risks arise. Reporting also fulfills a legal obligation from health authorities. Keep the community informed ([“TOOL 4. Education and engagement”](#)), and publicly share data using Okanagan-specific [OBWB water quality database](#), as well as B.C. [ECOCAT](#) and [B.C. Share Your Water Data](#). You can also access hydrometric data at Water Survey of Canada records and services.

Monitoring and reporting are vital, but go beyond that. Use the data to justify monitoring program improvement and, if needed, to justify a case for added source water protection measures. Note that provincial legislation such as the *Forest and Range Practices Act* and legal tools such as Water Sustainability Plans operate on a results-basis, not a protective one.

Monitoring and reporting create a vital, permanent record. It is hard to assemble an engaging report, but it’s worth the challenge. Otherwise, decision-makers do not know what has been learned through your monitoring program.

How to use the tool

Refer to Table 18 to learn how to design and carry out a monitoring plan.

Table 18: A guide to designing and carrying out a monitoring plan

MONITORING TYPE	PURPOSE	IMPLEMENTATION
Notifications of proposed activities (within the source water protection area)	To minimize potential hazards from land use activities by providing written concerns during the public consultation period or by planning for anticipated stakeholder activities.	Request notifications of proposed activities in your watershed (e.g., harvesting plans, range use) within a designated area from FLNRORD and FrontCounter B.C. For activities in municipal and regional jurisdictions, collaborate with planning departments; define criteria for which you want to receive notifications.
Water resources monitoring: <ul style="list-style-type: none"> ▶ hydrometric, ▶ water quality, ▶ snow, ▶ groundwater, ▶ water intakes ▶ and sewer outfalls 	To help support better public understanding; inform decisions on infrastructure requirements, operational plans, and land use management; identify relationships between water sources and demand; and identify need for new monitoring sites.	Compile and map existing data (B.C. Real-Time Water Data ; Water Survey of Canada ; OBWB water quality database ; municipal liquid waste management plans/maps and Okanagan Master Wastewater Management Plan). Identify collaborators to assist in data collection/compilation (ENV, FLNRORD, local governments and groups). Establish means of managing data (e.g., in-house or externally, data management software). Collect new data (consultants or citizen science) where needed.
Mapping	To develop a spatial understanding of knowledge gaps, ecological services, and water supply infrastructure as well as activities (e.g., ongoing monitoring, land developments) that impact the supply system.	Decide what data to collect and identify necessary tools, software, and sources of existing data. Compile and map existing data (" TOOL 7. Mapping "). Collect and review data for quality assurance. Build new or improve upon existing maps. Resources: GIS ; LiDAR ; iMapBC

MONITORING TYPE	PURPOSE	IMPLEMENTATION
Field inspections	To identify hazards and measure effectiveness of proposed solutions.	Collaborate with stakeholders to help monitor for new/existing potential hazards (e.g., compromised road drainage, slope failures, grazed riparian areas, damaged range fences). Establish a documentation system for reporting problems and tracking solutions (e.g., monthly meetings or electronic uploads to a database). Conduct field trips with stakeholders to evaluate/document usefulness of solutions (e.g., did salt licks and off-stream watering keep cattle out of streams? were trail/road closures adhered to?).
Community-based monitoring	To alleviate temporally and financially prohibitive monitoring efforts and encourage responsible behaviour through social pressure.	For scientific data collection, see Citizen Science. For difficult-to-monitor threats (e.g., polluters, irresponsible recreation, cattle in streams, unattended fires), identify opportunities for crowd sourcing. Use appropriate platforms in Education and Outreach to inform people of rewards and how to report (RAPP; B.C. Wildlife Federation Conservation App).



Case Studies

Water Supplier uses Sampling Results to “Cattle-ize” Ministerial Action in Lake Country

The District of Lake Country used complaints, substantiated by sampling results and watershed monitoring, to improve source water protection in the Oyama Creek Community Watershed. Complaints by the District to the Interior Health Authority (IHA) regarding the impact of ranching practices on water quality prompted the IHA to request that FLNRORD develop and implement BMPs for ranchers. The BMP measures to protect water quality (e.g., identifying and monitoring vulnerable zones, improving communication to range licences, and limiting cattle concentration in riparian areas) were implemented in future range use plans (RUPS).

City of West Kelowna Long-Term Monitoring Identified Unprecedented Turbidity

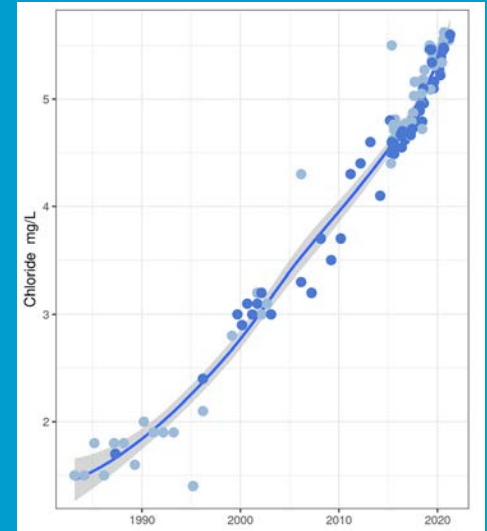
Long-term data helped identify the cause of abrupt high turbidity in a reservoir that had been stable for 32 years of monitoring. This case involved a change in the amount of nitrogen delivered from the Lambly watershed. Without this dataset, the cause (and potential solutions) would remain a mystery.

Kalamalka Lake Monitoring Program

Monitoring of Kalamalka Lake has been ongoing for 20 years. This extensive database has enabled water suppliers to identify changes in their water supply and quickly address them. One example involved identifying the impacts of boating on drinking water quality by comparing raw water turbidity against long-term averages to flag unusual results and correlating that to long-weekend boat traffic.

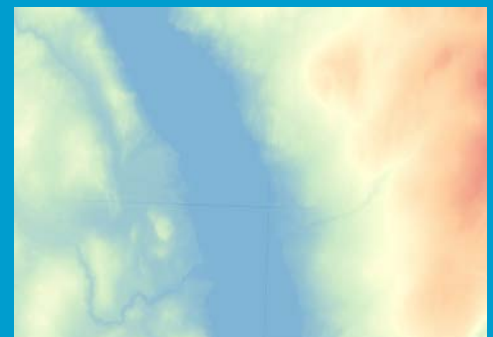
Data Hunting And Gathering

Citizen Science: Although professionals have their place in data collection, citizen science is a reliable and cost-effective way to fill data gaps while also engaging the community in source water protection.



Data Sharing: Sharing data through open-data platforms or local resources such as the [OBWB Water Quality Database](#) fosters collaboration across departments and within or between organizations. Data collection methods need to be the same, so use provincially or nationally established standard operating procedures.

LiDAR: During 2018-2019, OBWB and GeoBC collected LiDAR data of the entire Okanagan watershed.



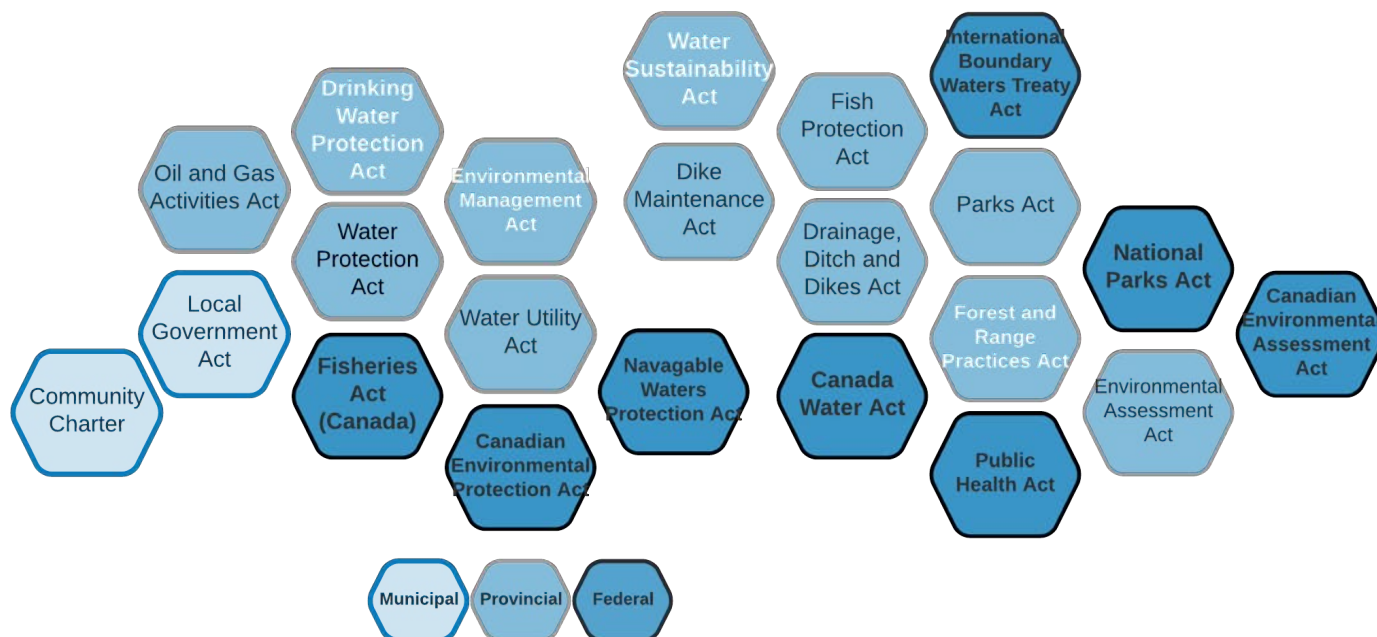
PART 3: ADDITIONAL INFORMATION AND RESOURCES

3.1 Regulatory framework

The governance of water use, protection, conservation, and sustainability in B.C. involves 22 pieces of legislation and various ministries and agencies at the federal, provincial, and local levels (see Figure 5). See Chapter 2 of the Provincial Health Officer’s 2019 [Clean, Safe, and Reliable Drinking Water](#) report for more information on roles and responsibilities in drinking water protection in B.C.

Figure 5: Legislation relevant to water in B.C. by level of government - 2021

Key legislation are in white lettering



Key legislation related to source water protection

Of all the laws and regulations associated with drinking water protection, the *Drinking Water Protection Act* (DWPA), *Water Sustainability Act* (WSA), *Forest Range and Practices Act* (FRPA), and *Environmental Management Act* (EMA) have the most influence on source water protection.

Drinking Water Protection Act

The DWPA provides the legislative tools to respond to drinking water health hazards that can occur in watersheds and aquifers (it has the strongest powers to protect drinking water). All health authorities in B.C. employ Drinking Water Officers and Environmental Health Officers who provide education, advocacy, and enforcement of the DWPA. The health authorities work with B.C. ministries, local governments, water suppliers, and other stakeholders to improve source water protection and to reduce risk for residents and visitors.

Under section 29 of the DWPA, persons concerned about threats to drinking water can request that a DWO investigate the matter. Threats could include activities that are a contravention of the DWPA or activities that are determined to be a Drinking Water Health Hazard. Once a written request detailing the specific, factual reasons for investigation has been submitted, the

DWO must review it and consider if an investigation is warranted. Under section 25 of the DWPA, a DWO may issue hazard abatement and prevention orders if they have reason to believe that a drinking water health hazard exists—meaning, any condition or thing related to drinking water that does or is likely to endanger public health, or prevent or hinder the prevention or suppression of disease.

Finally, Part 5 of the DWPA allows for the creation of a Drinking Water Protection Plan (DWPP). This is a last resort legislative source protection tool that may designate local authorities with powers to control activities in areas of concern. DWPPs have stringent requirements and are only be considered when all other options to address or prevent threats have been exhausted, including other plans or regulatory tools.



Water Sustainability Act

The WSA is the main law for managing the use and diversion of water. Under the WSA, water dedicated for agriculture can be protected in Agricultural Water Reserves, established as part of Water Sustainability Plans. The WSA also enables the establishment of water objectives for a watershed, stream, aquifer, or other specified area or environmental feature to sustain water quantity and quality for specific uses or to sustain aquatic ecosystems. There is also now a legal requirement under the WSA to set aside enough water for the health of riparian areas and the aquatic environment. [Advancing Freshwater Protection](#) summarizes how to use Water Sustainability Plans and other tools within the WSA to advance water sustainability.

Forest and Range Practices Act and Forest Planning and Practices Regulation

The FRPA is the most pertinent legislation impacting source protection on Crown lands. It outlines how all resource-based activities are to be conducted. The FRPA regulates the activities of forest companies and ranching operations on Crown land, including in Community Watersheds, through 12 regulations that detail government objectives to safeguard water and set practice requirements to protect water quality, riparian areas, and soils. Government objectives in Community Watersheds only apply after water treatment has occurred and to the extent that it does not unduly reduce the supply of timber or ranching area in B.C.'s forests.

Under the FRPA, requirements for the protection of drinking water vary by forest and range practice and by the type of licence. For example, forest licensees who must prepare a forest stewardship plan have different requirements than forest licensees who hold a woodlot licence. Some requirements may only apply to community watersheds¹ while others may apply generally to all watersheds. Each activity has rules contained in applicable regulation, including objectives and practice requirements for various values. The

objectives define what government wants to achieve for the protection of specific values, and the practice requirements are rules that must be followed on the ground.

When they are working in a community watershed, a forest licensee must include results or strategies in their forest stewardship plan about how they will address government's objective for community watersheds. The objective is stated in [section 8.2 of the Forest Planning and Practices Regulation](#). Typically, forest licensees will commit to retaining a professional hydrologist to prepare an assessment about how the harvesting of cutblocks and the construction of roads will affect water.

The primary practice requirement for the protection of drinking water is contained in section 59 of the Forest Planning and Practices Regulation. This rule requires forest licensees to ensure that practices do not cause material(s) that are harmful to human health to be deposited in, or transported to, water that is diverted for human consumption by a licensed waterworks (e.g., petroleum products, fertilizers). Under subsection 60(1), forest licensees must also ensure their practices do not cause damage to a licensed waterworks. Both requirements apply to all 'licensed waterworks', whether or not they are located within or outside a community watershed. Also, section 84 requires that licensees must give at least 48 hours notice to a water supplier before building a road in a community watershed.

Environmental Management Act

The EMA protects drinking water by regulating pollutants and industries that may contaminate water supplies. Under the Act, ENV works to prevent pollution and to promote and restore environmental quality, through the development of ambient water quality guidelines and water quality objectives and through the authorization to discharge waste subject to requirements to ensure the discharge adequately protects human health and the environment.

1 These are watersheds where government has decided that special forest management is required to protect water used for drinking. The Okanagan has the highest number of community watersheds in B.C..

Legislative obstacles and how to overcome them

The myriad of regulations and agencies involved in water management creates obstacles to source water protection. Legislative obstacles and ideas on how to overcome them are presented in Table 19.

Table 19: Legislative obstacles and innovations to help overcome them

Obstacles	Innovations
No clear hierarchy of authority or lead agency for source water protection on Crown lands; no inter-agency coordination in areas of jurisdictional overlap	Identify a lead agency that is responsible for integration of water legislation and has authority over source water protection. Develop inter-agency coordination in areas of jurisdictional overlap.
Uncertainty around provincial direction	Request a progress report on source water protection from the Province.
No long-term (20-year) Response Plan on source water protection	Develop a clear actionable timeline and plan for source water protection with clear lines of responsibility and effective inter-agency collaboration.
No universal source protection metrics	Collate metrics and identify consistent indicators of safe drinking water that align with the multiple-barrier approach. Follow Quality Standards provided in Guidelines for Canadian Drinking Water Quality and the CCME standards .
Inconsistent funding for watershed planning and protection	Establish stable funding for watershed planning and protection. Consider user-pay.
Heavily entrenched groups and interagency groups have disbanded	Improve and maintain regular communications among all tenure holders and stakeholders, using shared risk and responsibility accounting.
Accountability, communication, and collaboration gaps among stakeholders	Improve and maintain regular communications among all stakeholders, using shared risk and responsibility accounting.
Vagueness of DWPA on time-delayed and cumulative contaminants	Further develop tools to assure that the WSA and DWPA align with Canadian Drinking Water Standards.

References: [Okanagan Water Stewardship Council 2020](#); [Brandes et. al. 2017](#); [Auditor General for Local Government 2018](#).

3.2 Economic benefits of source water protection

Valuation of freshwater ecosystems

Everyone is interested in return on their investment. The benefits of source water protection extend beyond public health protection and better drinking water quality. These benefits, which are mutual, cumulative, and synergistic, include:

- ▶ Lower treatment costs through upstream ecosystem restoration and water-centric land use.
- ▶ Increased water awareness, collaboration, and environmental stewardship.
- ▶ Improved data collection and sharing to support decision-makers.
- ▶ Improved emergency preparedness and response.
- ▶ Healthier, more resilient watersheds through the protection of habitat and ecosystem services.
- ▶ Increased property value through multi-purposed urban beautification measures.

Divorcing the cost of water treatment from resource extraction sectors results in no accounting for the extra costs incurred by the water purveyor due to watershed activities. True cost accounting must compare the revenue streams from watershed activities against the ecosystem services that naturally protect drinking water. As part of this cost accounting, ecosystem services valuation assigns a monetary value to ecological services, such as filtration, biochemical contaminant removal, water temperature stabilization, and flow modulation, to be set against the cost of protecting the core areas of these resources.

But how much is a watershed worth? As an example, according to [Parrott and Kyle 2014](#) the total monetary value of ecosystem services provided by the Okanagan landscape likely exceeds \$6.7 billion annually (in 2007 international dollars²). The total value of \$6.7 billion/year for the Okanagan likely represents a minimum rather than a maximum value because some services have non-monetary values that are difficult to quantify. These services include aesthetics, First Nation cultural values, value of habitats that support rare or endangered species and these are not accounted for in the calculation due to the difficulty of attaching a monetary value to them. Table 20 provides some of the economic components that are factored in this type of analysis. An update of this table would be an asset to Okanagan source water protection.

2 The international dollar is a hypothetical unit of currency that has the same purchasing power parity that the U.S. dollar had in the United States at a given point in time.



Table 20: Land cover areas in the Okanagan and values of ecosystem service flows

Land Cover	Area (hectares)	Unit Value (2007\$/ha/yr) *	Total Value (2007\$/yr)
Crops	7820	\$ 5,567	\$ 43,535,610
Pasture	15520	\$ 4,166	\$ 64,654,904
Water	64108	\$ 12,512	\$ 802,121,298
Wetlands	12219	\$ 25,681	\$ 313,792,030
Forest	1629744	\$ 3,137	\$ 5,122,507,587
Grasslands	90626	\$ 4,166	\$ 377,549,249
Total			\$ 6,714,160,678

*The value for forests is based on the estimate provided by [Constanza et al.](#) for temperate forests and the value for wetlands is based on the estimate for swamps/floodplains. Since Constanza et al. do not provide a value for pasture, the grassland value is attributed to this land cover type ([Parrott and Kyle 2014](#)).

Putting a value on ecological services is difficult but do-able. The preceding table is an initial estimate based on land valuations elsewhere. To tune this estimate to Okanagan realities, [Dr. John Janmaat](#), Associate Professor of Economics at the University of British Columbia, suggested the following:

Some of these land values may be underestimates, and for others, overestimates. For those types that are scarce, such as valley bottom natural grasslands and wetlands, the per hectare values used by Parrott and Kyle may be too low. These are landscapes that rare and endangered species in our valley rely on, and there is no substitute. These landscapes also provide substantial aesthetic, recreational, and cultural values. In comparison, forested areas that are far from a waterbody and not critical habitat may not have much value beyond carbon storage and primary production of trees, or of game species that could be harvested. Unfortunately, without spatial mapping of the ecological services provided across the landscape, we can't do much better than applying averages to what we do know, which is land cover types.

A freshwater ecosystem analysis should:

1. Start with identifying the ecosystem services of interest and frame the major effects of multiple drivers and pressures on the ecological status of waterbodies.
2. Involve a biophysical quantification of the natural capacity, actual flow, and social benefit of water ecosystem services, and can use proxies/indicators based mainly on hydrological models or data.
3. Assess a sustainability (or efficiency) index that estimates the flow of service that can be sustained with a certain capacity to avoid overexploitation.

This is a large undertaking that could be spearheaded by UBCO and/or OBWB, with support from water purveyors, municipalities First Nations and their TACs. An Okanagan-wide TAC has been broadly advocated for, and could be instrumental here.

Quantifying the benefits of ecosystem services that nature provides would help justify the investments in conservation and restoration of aquatic systems. Stakeholders can have different values and perspectives. Therefore, similar to the entire source water protection effort, involving all stakeholders in the valuation process is vital. This exercise can highlight hidden benefits for society and raise awareness among users and stakeholders.

The definitions of value should not be restricted to monetary value but embrace sociocultural and ecological values as well. The co-benefits of these less-tangible values and nature-based solutions should be accounted for in ecosystem services valuation. For example, protection of less-tangible aesthetic/social/spiritual values can still cause economic impact such as mental health/addiction treatment costs.

Economic valuation of aquatic ecosystems can be used for assessing the benefits of conservation and restoration. It can integrate all the economic, environmental, and social benefits and losses associated with resource extraction and development and with new water plans and investments. Several

mathematical methods are available in the literature to estimate economic values of freshwater ecosystem services: [Koundouri et al. 2015](#); [Grizzetti et al. 2016](#); [Costanza et al. 2014](#); [Kennedy and Wilson 2009](#).

The approaches can be divided into: 1) cost-based approaches that consider the costs from the provision of services; and 2) preference-based approaches that refer to techniques using data on individual preferences for a marketable good, which includes environmental attributes and preferences for non-market environmental goods. Table 21 provides B.C. examples of aquatic ecosystem valuation approaches and methods.

Table 21: Aquatic ecosystem valuation approaches and methods – B.C. examples

Valuation method	Description / Spatial scale	Use it to evaluate:
Avoided Cost:	Estimates the value of an ecological service and the cost avoided by preserving that service. Example: protection of key watershed areas for flood control.	Flood control, erosion protection, pest and disease control, soils protection/formation
Replacement Cost:	Estimates the value of an ecological services and the cost of projects or programs that would be needed to replace it. Example: watershed or urban region nutrient uptake and cycling can only be replaced with costly treatment plants.	Fish populations, fishing/hunting, wildlife habitats, water purification, air quality regulation, flood protection, erosion prevention, resource extraction in riparian zones
Cost-Benefit Analysis:	Compares the benefits of ecosystem uses and extractions with the costs to society and government; use market pricing and asset production. Example: logging watershed impacts versus impacts of altered hydrograph.	Logging, mining, micro-hydro generation
Net Factor Income:	Ecological services can enhance incomes. Example: watershed-wide water quality improvements decrease treatment costs and maintain fisheries and aesthetic values for recreational incomes.	Water treatment, fisheries, recreational use, parks, aesthetics, tourism-based businesses

COST-BASED APPROACHES

Valuation method	Description / Spatial scale	Use it to evaluate:
Travel Cost:	Estimates the value of a service by calculating the time and money spent by individuals travelling to enjoy or experience the service. Example: travel to enjoy B.C. lakes and backcountry.	Recreation, spiritual and symbolic appreciation, intellectual and aesthetic appreciation, parks and reserves
Hedonic Pricing:	Estimates the value of an ecological service by comparing property values of multiple properties controlling for other factors, to determine the impact of that service on property value. Example: local housing prices along the lakeshore exceed the prices at other locations.	Recreation, real estate
Contingent Valuation:	Estimates the value of a service with surveys that ask respondents how much they would be willing to pay to protect an ecological service, or how much they would be willing to pay to forego a service using a valuation of land-use alternatives. Example: This method is often used for less tangible services such as shoreline biodiversity or wildlife habitat.	Wildlife habitat, shoreline habitat, carbon sequestration

Adapted from [Wilson 2008](#), [Kennedy and Wilson 2009](#) (refer to Appendix 6 of that report for more ecosystem valuation), and Grizzetti et al. 2016



PRO TIP: A practical way to value ecosystem services when data and/or funds are limited is the **benefit transfer** approach, where the benefit estimated for one area or policy is adapted and used to assign benefit or value to other comparable situations.

In summary, the economics of source water protection pay significant dividends to all stakeholders and they are additive—more investment yields better cumulative benefits. The economics of foregoing source water protection are clear—the cumulative liabilities of illness, costs of remediation, and costs of water treatment. We all need to invest in water protection.

Comparison of water treatment costs to source water protection costs

The trade-off between source water protection and water treatment should guide strategic investments in natural infrastructure or pollution reduction in the watershed rather than paying for more expensive water treatment. The problem is, we don't know where those trade-offs balance.

Researchers today can quantify the obvious: the benefits of forest cover directly impact the cost of water treatment. Using American Water Works Association (AWWA) data from 37 US water treatment plants to determine the effect of forest conversion on the cost of water treatment found a negative relationship between forest cover and turbidity, but no relationship between forest cover and total organic carbon ([Warziniack et al. 2017](#)). Increasing forest cover in a watershed by 1% reduces turbidity by 3%, and conversely, increasing development by 1% in a watershed increases turbidity by 3%. The impact of development was more consistent across their models than the impact of forest cover. They also found a large impact on turbidity from grazing in the watershed.

Looking only at turbidity treatment costs and no other impacts of watershed disturbance, an economic benefits function showed that a 1% increase in turbidity increases water treatment costs by 0.19%, and a 1% increase in total organic carbon increases water treatment costs by

0.46% ([Warziniack et al. 2017](#)). Even marginal improvements in source water quality led to modest reductions in treatment costs. Recent US- and Canada-based studies indicate that a 1% decline in turbidity leads to a 0.09–0.11% reduction in variable costs ([Price et al. 2017](#), [Heberling et al. 2015](#)). For example, with a \$1 million annual treatment cost budget, a water supplier could save \$3,300 per year if a 3% reduction in turbidity leads to a 0.11% reduction in treatment costs. These analyses could not factor in thresholds or disease vectors. For example, utilities with raw turbidity levels above 10 NTUs may exceed a threshold for water quality at which direct filtration methods are either not possible or not economical. Further, if supplies decline due to climate or watershed disturbance the cost of water treatment increases ([Heberling et al. 2015](#), [Renzetti 2001](#)). Water supply reliability can force an even greater increase in treatment costs than water availability (Renzetti 2001). Watershed disturbance from logging, gravel extraction and especially urbanization causes greater fluctuations in flows and timing of flows, adding to the impact of variable precipitation. Studies have shown that when there is a 1% increase in the amount of land clearing in a watershed, the costs of water treatment can go up by 3% ([Heberling et al. 2015](#), [Renzetti 2001](#), [AWWA 2016](#)). In the Okanagan, some watersheds approach >50% disturbance so this metric predicts a 150% increase in water treatment costs.

Water treatment can be more economical than source water protection; however, water treatment plants are prone to failure (e.g., Walkerton 2000, First Nations Marten Falls 2005 and Serpent River 2009), and insidious contaminants from the watershed can resist treatment. Further, the waterbodies on which other resources rely can be damaged by degraded source water areas.

Besides variable costs, source water quality affects expenditures on capital equipment. [McDonald et al. \(2016\)](#), for instance, found a positive correlation between the amount of sediment and nutrients entering source watersheds and the probability of adopting more sophisticated treatment technology. In addition, there are numerous instances where deteriorating source water quality has been anecdotally linked to capital upgrades ([Dunlap et al. 2015](#), [Davenport and Drake 2011](#), [Jones et al. 2007](#), [Oneby and Bollyky 2006](#)).

Valuation of riparian buffers

One of the most powerful ways to protect water quality is through recognizing, conserving, and enhancing buffer zones separating land activities from watercourses. This applies to all portions of a watershed, from the upland zones to urban areas, but the applications differ.

Riparian buffer zones can:

- ▶ Stabilize eroding banks or shorelines of adjacent waterbodies.
- ▶ Lower peak stormflows.
- ▶ Improve water quality (i.e., lower contaminants, nutrients, sediment through bio-filtration in rhizospheres).
- ▶ Provide habitat.

- ▶ Increase property values and aesthetic values.

The functions performed by buffer zones and leave strips along watercourses and shorelines are a direct function of their width, vegetation, and condition. Figures 6, 7 and 8 can be used as a general guide to decide a target width to achieve your source water protection goals using buffer zones. Clearly, the wider, the better for source water, but identifying target areas and giving them greater protection makes sense. For example, buffer zones can safely be far smaller on remote seasonal streams compared to mainstem lakes near headgates. The value of intact riparian buffer is estimated at \$7.50 CND/ha/yr per household (adapted from Rempel and Buckley 2018).



Figure 6. Comparison of filtration capacity of natural and disturbed shoreline

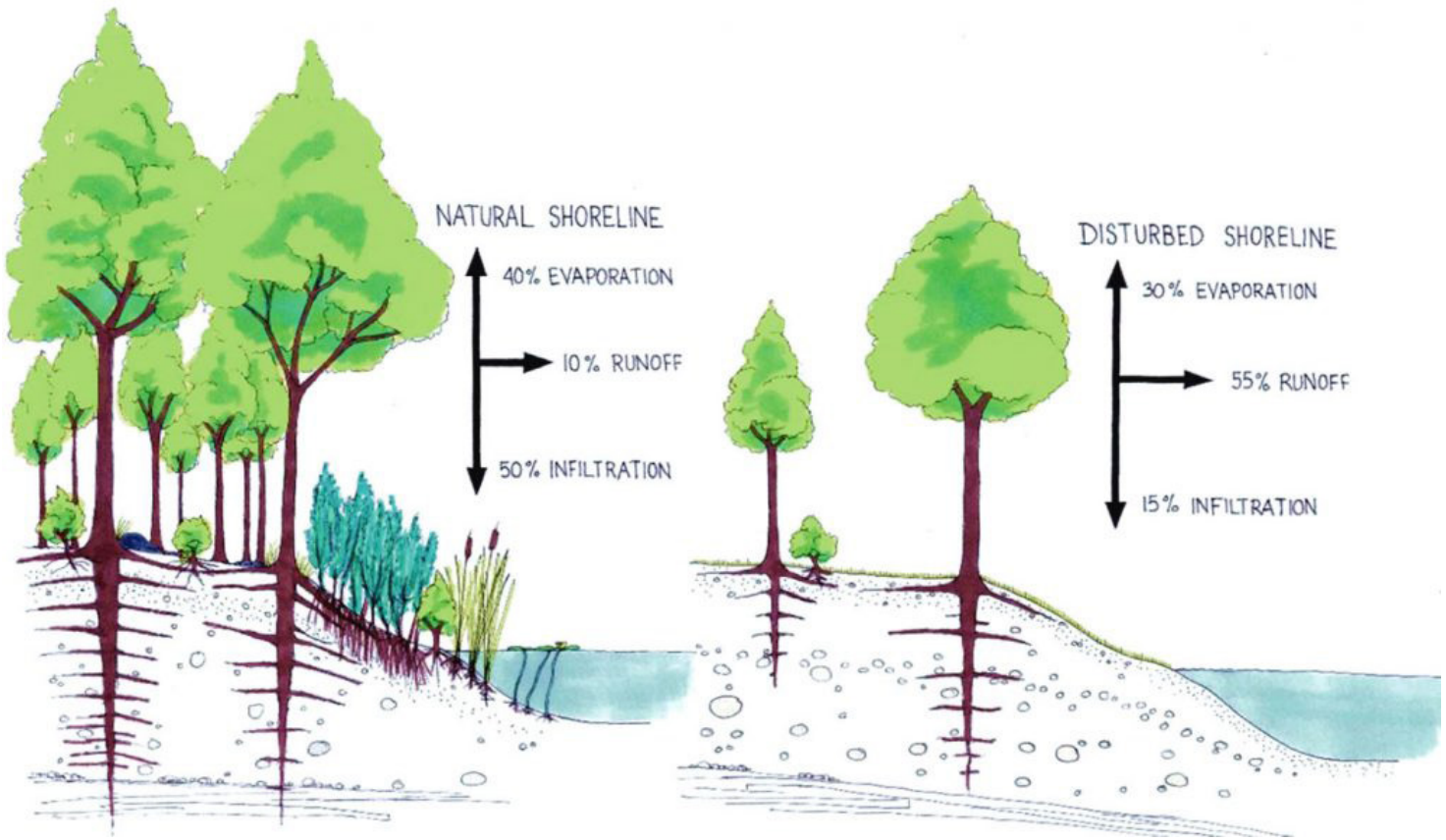


Figure 7: Services provided by varying widths of riparian buffer zones

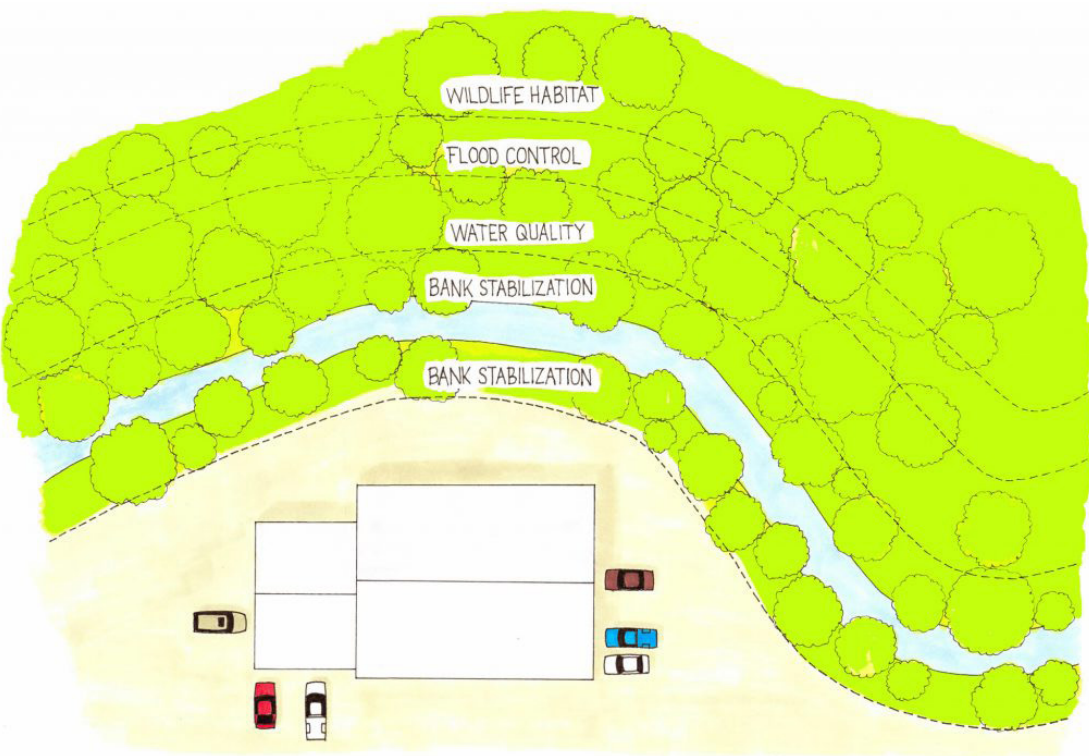
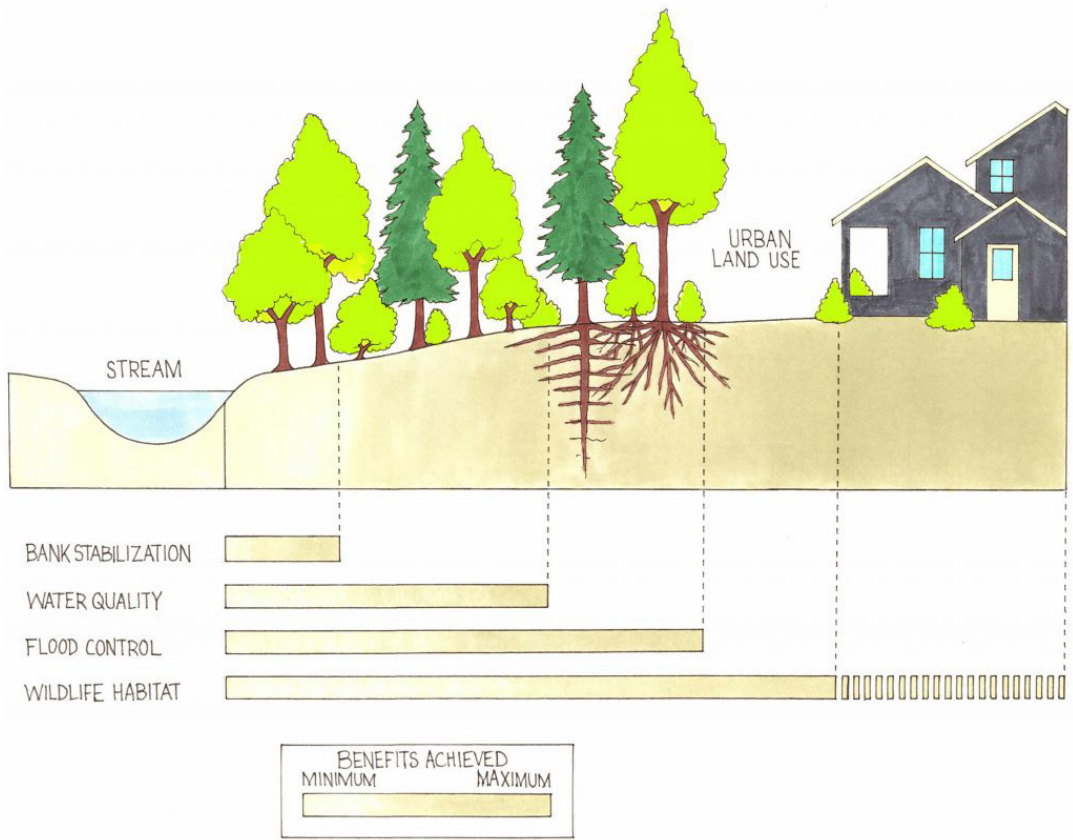
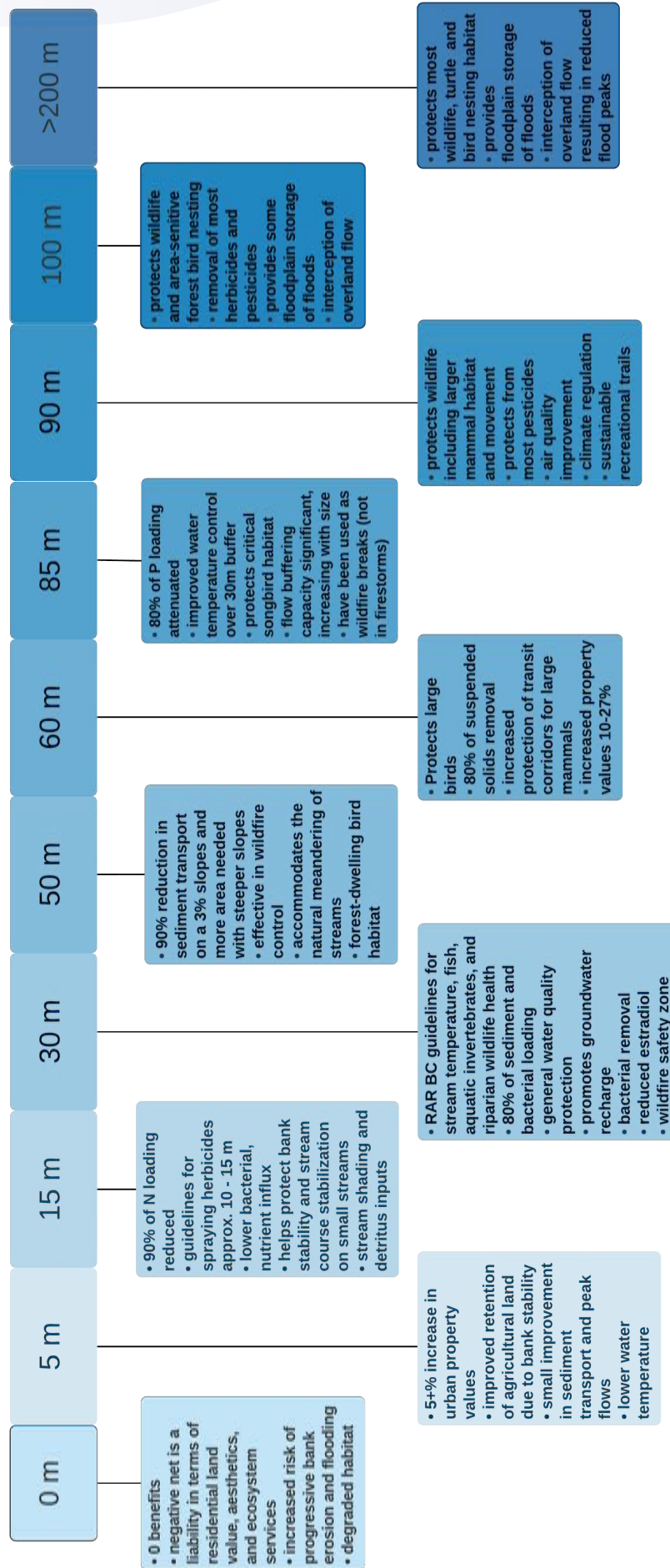


Figure 8: Riparian buffer benefits by width



Benefits accumulate with riparian buffer width and value increases dramatically after 50 m. All authors agree that the effectiveness of riparian setbacks at removing contaminants is directly related to their width. The values attached to each buffer width are dependent on slope, soil type, vegetation, climate and regulators

Case Studies that Demonstrate the Cost of Doing Nothing

Protecting source water is often easier and more cost effective than treatment alone or dealing with the aftermath of contamination events.

Canadian examples:

- ▶ \$65 million to deal with a PCB leak that contaminated a Niagara aquifer ([Office of the Auditor General of Ontario, 2014](#)).
- ▶ \$64 million on the Walkerton tragedy (7 deaths, 2300 illnesses) that involved an overwhelmed water treatment plant ([Drinking Water Review Panel, 2002](#)).

B.C. example:

- ▶ \$1 million to date on excessive nitrate from inadequate agricultural waste management affecting the Hullcar Aquifer, and remediation is ongoing ([University of Victoria Environmental Law Center, 2016; ENV, 2018](#)).

Okanagan examples:

- ▶ \$4 million on cleanup of chemical warehouse fire with runoff into Mill Creek during firefighting efforts in 2011 ([Kelowna Capital News, 2011](#)).
- ▶ \$450,000 and a \$18,400 fine plus the permanent loss of the water supply after waste manure from a dairy farm was spread on frozen fields contaminated the Antwerp Springs well in Lavington, B.C.
- ▶ \$150,000+ cleanup cost, which is more than 10 times the estimate to remove an abandoned house on the Mission Creek floodplain prior to its freshet wash-out.

Other Okanagan incidents where the economics have not been tallied:

- ▶ 2017 landslide, which affected Peachland water supply.
- ▶ Belgo Creek landslide in May 2017, which affected the Black Mountain Irrigation District water supply.
- ▶ Testalinden Creek dam failure in June 2010, which washed away multiple homes, blocked a provincial highway, and impacted both Osoyoos Lake and the drinking water intake used by the Town of Osoyoos.

3.3 Common threats to drinking water and how to overcome them

Throughout B.C.'s wide range of watershed types, common issues with watershed condition emerge. Watershed disturbance has resulted from activities including resource extraction, road construction, motorized recreation, range use, wildlife, slope failures, forest pests, and wildfire. In addition to impacting water quality, the disturbance has resulted in increased runoff that has altered channels, increased slope failures, and damaged infrastructure.

These threats to drinking water supplies are amplified by climate change. Warmer, drier summers followed by milder, wetter winters with more extreme storm events throughout the year are predicted in climate modelling. Warmer summers mean more wildfires, and greater demand on water resources with greater risk of drought. Milder, wetter winters can provide more water but storage has to be developed to make this useful. Extreme weather events increase the risk of flooding. These climate change effects combined with lowered watershed resilience put increased strain on water resources.

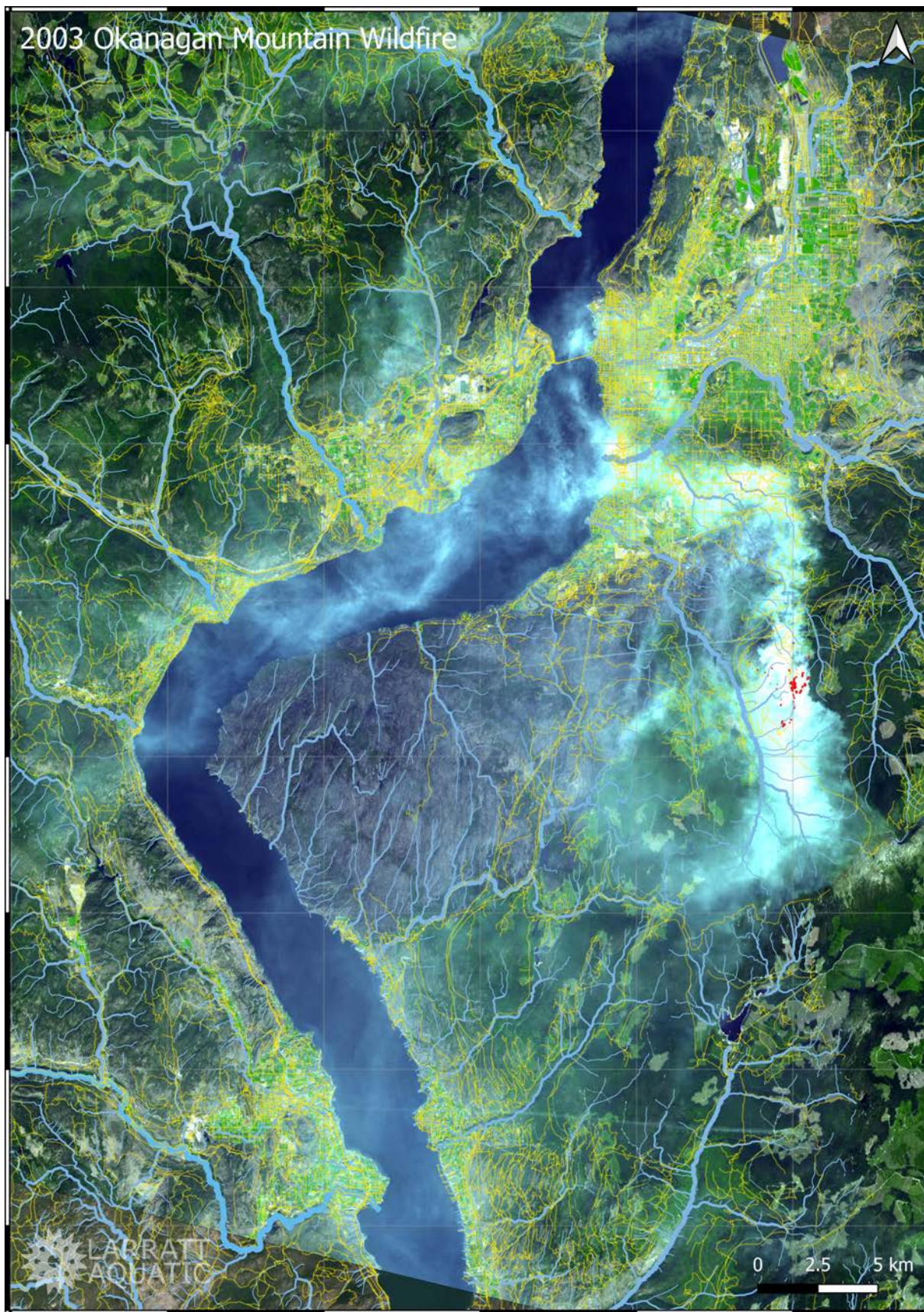
While threats are often thought of individually, their cumulative impacts must be considered. Source water protection not only addresses the cumulative impacts of these hazards, it can also lead to cumulative benefits for communities.

As an example, the aerial image below (Figure 9), taken during the 2003 Okanagan Mountain wildfire, shows the level of disturbance in the Okanagan watershed. This image demonstrates the levels of urban disturbance near Okanagan Lake as well as cut block disturbance further back in its watersheds. These watersheds have been altered hydrologically over time. Their altered hydrology reflects the amount of watershed disturbance (roads, cutblocks, trails, quarries) and the proximity of disturbance to source water resources.

PRO TIP: Use the [Google Maps time slider](#) to see the changes over the decades in your watershed.



Figure 9: Okanagan Valley showing watershed disturbance (watercourses highlighted in blue)



Surface Water

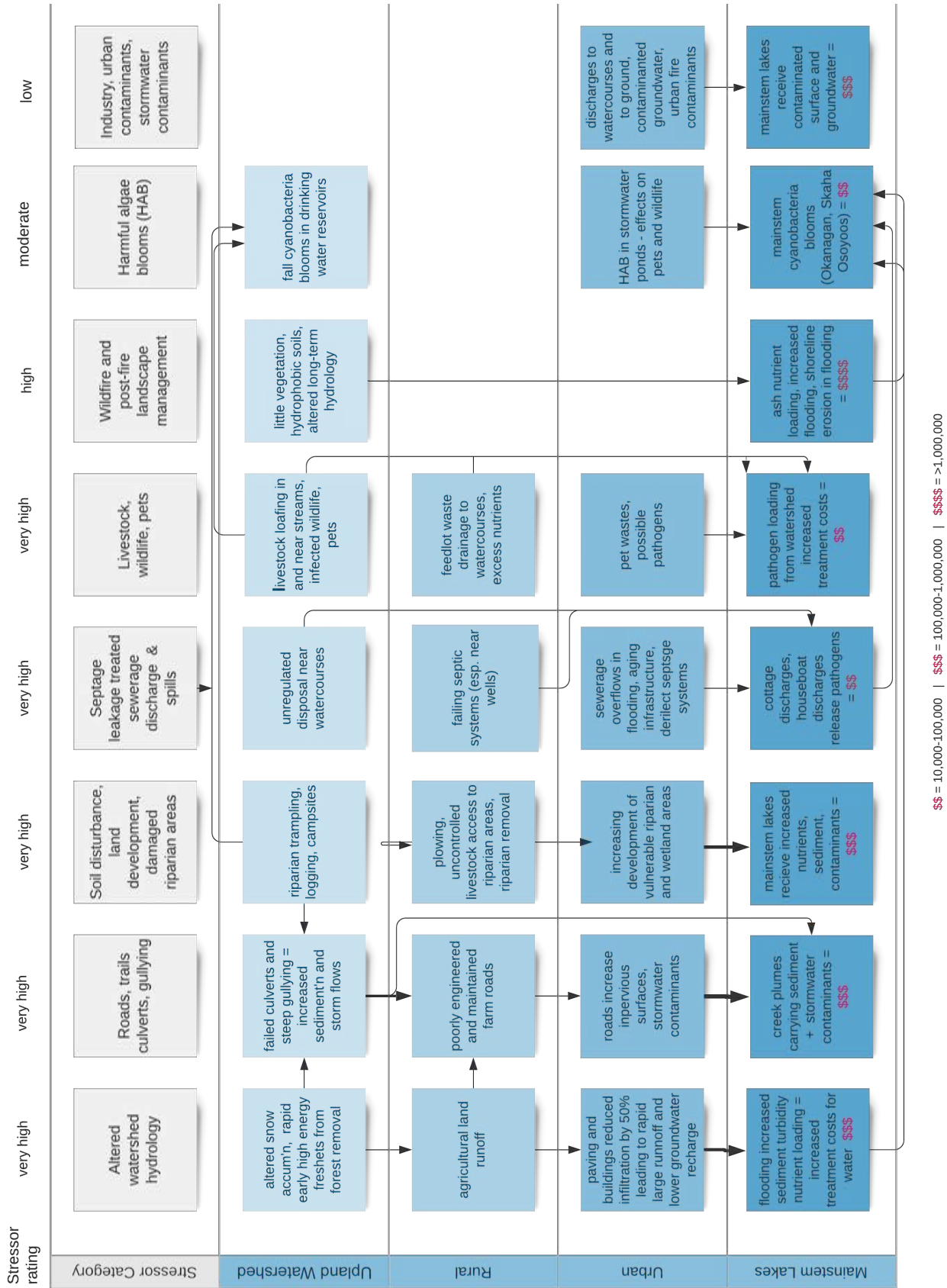
As source water flows through rural areas, contaminants are commonly introduced by agricultural runoff, grazed riparian areas, unmanaged stormwater/road runoff, and septage. Activities on the rural landscape also pose hazards to groundwater sources, as these lower lying areas often encompass recharge zones. In urban areas, source water may accumulate contaminants from transportation, light industrial and residential sources, as well as from new land developments. The hardened urban landscape is mostly impervious, which creates more runoff than undeveloped land, limits natural filtration of contaminants, and directs runoff to stormwater drains and ultimately mainstem lakes.

The mainstem lakes in the Okanagan bear the brunt of it all. Not only are these lakes subject to the quality of creek inflows and stormwater outfalls, they are also susceptible to adjacent land use, invasive species, algal blooms, marina activities, and boating impacts.

Threats to surface water that are common to most watersheds are summarized in [Table 22](#) and solutions to overcome them are provided in [Table 23](#).



Table 22: Cumulative effects of watershed stressors on surface water



Elevation layer

Table 23: Surface water – solutions to overcome watershed condition obstacles

Obstacle	Solution	Suggested Implementation
Altered watershed hydrology (e.g., increased peak flows due to loss of tree canopy; earlier freshets due to altered runoff from road network)	Cap percentage of active disturbance ranked by proximity to streams and cap total watershed area in disturbance, defined hydrologically.	Push for integrated watershed planning led by one lead water agency. Insist that hydrologic assessments are cumulative and consider all watershed disturbances through time.
Roads, trails, culverts, gullying	Fund permanent road closures that can't be reopened (e.g., deep cross-ditches, barricades, bridge removals).	Reach out to B.C. FPB for assistance locating forest licensee to provide your input to deactivation prescriptions. See Engineering Manual 2019 FLNRORD chpt 7 for BMP's.
Soil disturbance, land development, damaged riparian areas	Establish protected areas where stakeholders share responsibility to protect and benefits.	Develop policies, bylaws, agreements to protect key areas that have potential to impact the water supply. Demonstrate the long-term economics through natural asset valuation, and monitor success.
Septage, treated wastewater discharge, spills	Consider monitoring data to guide best disposal. Educate residents on what NOT to flush.	Consider package water treatment plants or composting toilets to replace shoreline septic in remote areas.
Livestock, wildlife, pets	Use fencing or other diversions to guide animals to safe off-stream watering area.	Install watering troughs and fence/ plant unstable slopes.
Harmful algae blooms	Reduce phosphorus reporting to the lake from its watershed.	Reduce nutrient applications to landscape. Install 'green belts' of willow, cottonwood, aspen, and/or poplar that rapidly uptake nutrients.
Industry / urban / stormwater contaminants	Assess monitoring data to prioritize stormwater treatment (e.g., treatment ponds, diversion, on-site water treatment, and on-site rainwater soak-away).	Using stormwater BMPs, start work with highest priority contaminant abatement. Monitor and report success. Incentivize rain gardens, rain barrels, soak-away zones where slopes allow.

Forest Practices Board investigation of Community Watersheds

The Forest Practices Board is an independent watchdog for sound forest practices in B.C. In 2014, the Board conducted a [special investigation of community watersheds](#) to evaluate how well forestry and range use provides for the protection of drinking water, as required under the *Forest and Range Practices Act*. The investigation found that range use has the potential to affect water quality in two ways. Livestock use can damage riparian vegetation and stream banks, reducing the effectiveness of riparian areas to filter water and causing erosion. Livestock can also cause pathogens to enter streams from fecal matter. If the pathogens are carried downstream to the intake, it can compromise the quality of drinking water. Water quality can also be affected by fine sediment due to resource extraction, mostly from forest roads. When sediment enters a stream, the water becomes turbid, increasing the risk that pathogens from wild and livestock and human sources will attach to the sediment particles. When water from the watershed reaches the intake, it must be treated so it is safe for human consumption. If the water is highly turbid, the treatment of water through ultraviolet light, chlorination and/or filtration is less effective.

Groundwater

Groundwater is an important part of the hydrologic cycle. It receives, stores, transports, and discharges precipitation and is intertwined with surface water. Extracting water from either supply can decrease the supply in the other source. As in most regions in B.C., much less is known about Okanagan groundwater than surface water.

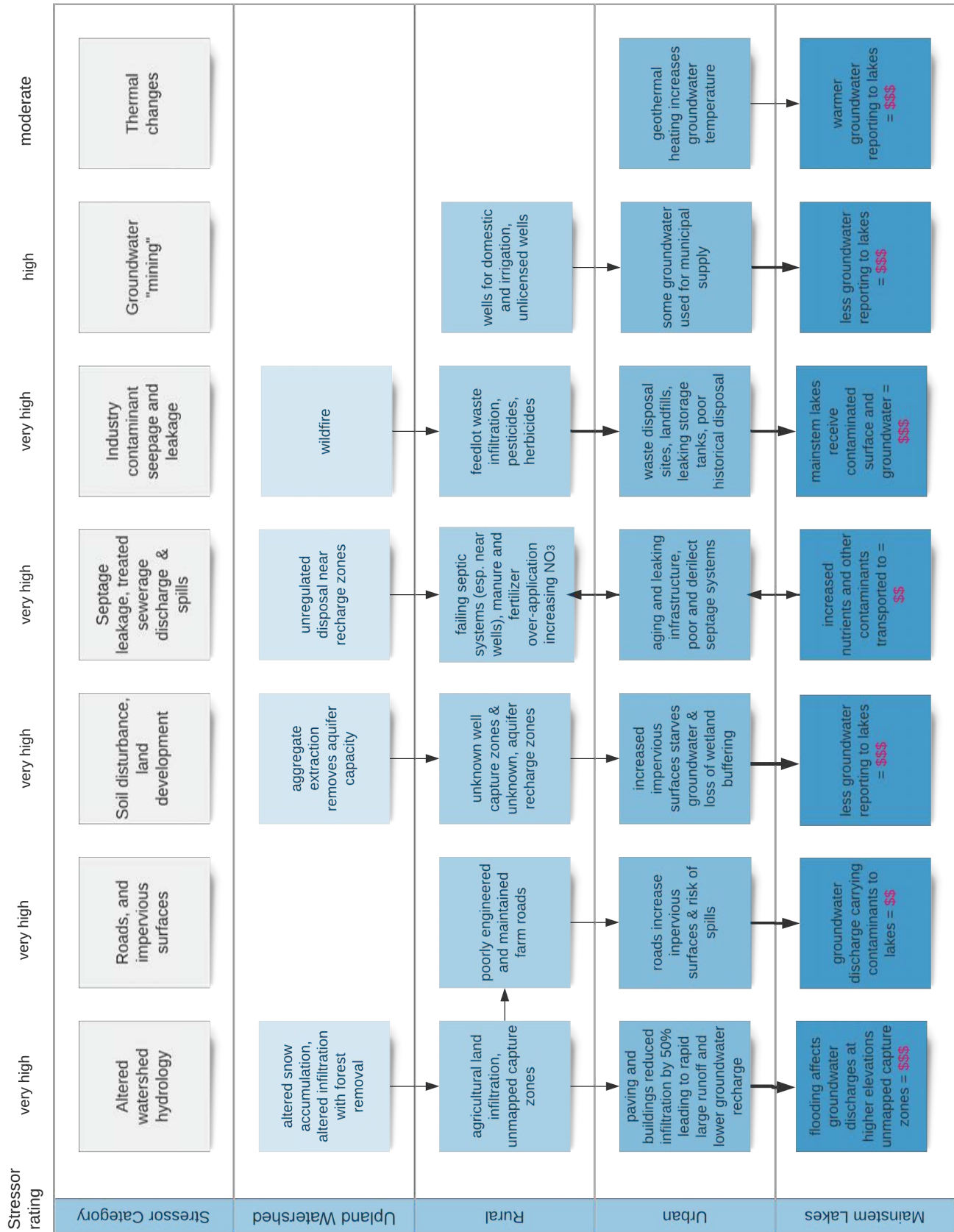
Information gaps include:

- ▶ Size of the aquifer and rate of recharge.
- ▶ Location and size of groundwater recharge zones.
- ▶ Water travel time in the aquifer.
- ▶ Type of aquifer (i.e., confined or unconfined).
- ▶ Vulnerability to contamination sources (e.g., agriculture; waste disposal sites, storage tanks, transportation routes).
- ▶ Potential for natural attenuation of contaminants within the groundwater.
- ▶ Contribution of groundwater to streams to maintain surface water baseflows during dry weather.

The biggest obstacle to effective groundwater protection is the lack of coordinated land use planning over aquifers. This is further complicated by a lack of accurate information on aquifer locations.

Threats to groundwater that are common to most watersheds are summarized in [Table 24](#) and solutions to address the threats are provided in [Table 25](#).

Table 24: Cumulative effects of watershed stressors on groundwater



Elevation layer

Table 25: Groundwater – solutions to overcome watershed condition obstacles

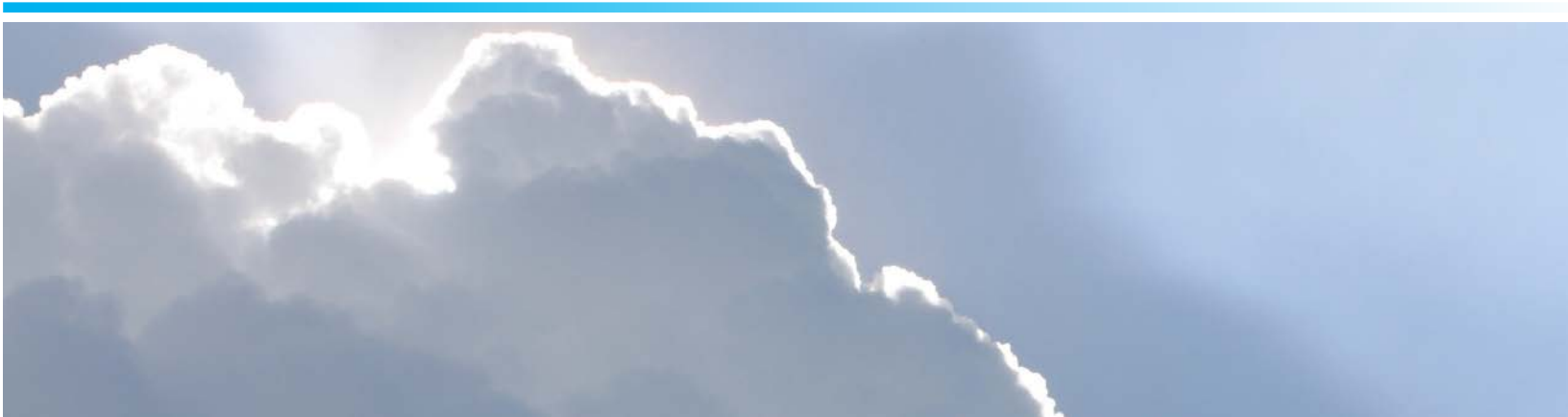
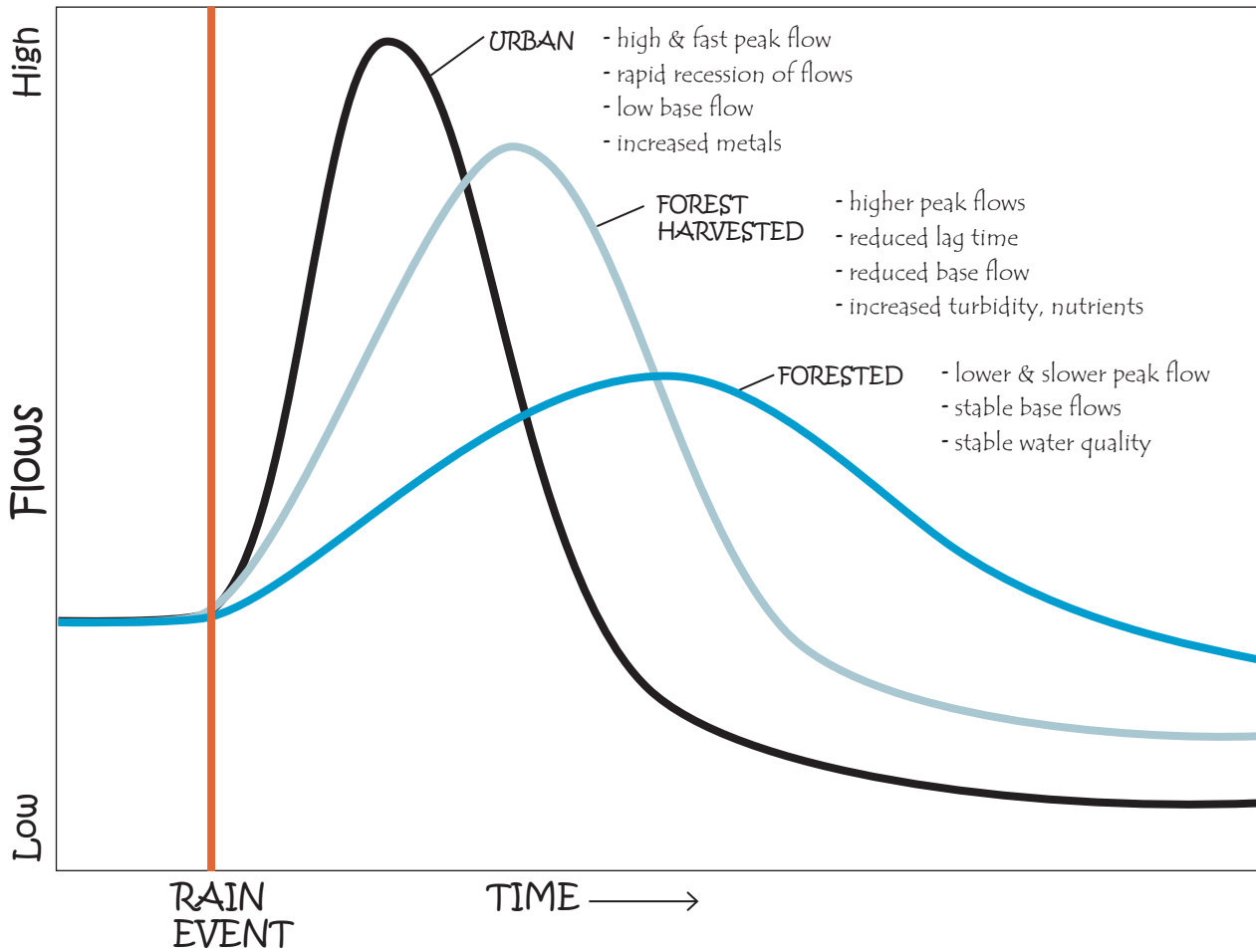
Obstacle	Solution	Suggested Implementation
Recharge zones not identified	Do groundwater studies to delineate recharge zones.	Local governments post signs showing maps of recharge zones and inform affected land-owners.
Gravel quarries in recharge zones	Limit new permitting, request compensation for lost hydrologic buffering.	MMPR can inform local governments when permit applications are received for recharge zone areas. Consult https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/contracting-with-the-province/documents/16925-2020/t3-2-aggregate-operators-best-management-practices-handbook-volume-1.pdf .
Wells not identified	Continue to support B.C.’s well registry program (1st in time – 1st in right).	Water supply associations and local governments can continue to supply links for well registry in their communications well registration form (PDF) .
Lack of quality and quantity data	Ask for permission to sample and for data donations from registered well owners.	Collaborate with IHA, FLRORD and other entities to help maintain/develop the groundwater well network: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers/groundwater-observation-well-network .
Historical disposal sites	Identify, map and address contaminant plumes via remediation (e.g., capping, contaminant removal, in-situ treatment).	For guidance and resources consult: https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources .

A special note on forest and range disturbances

Water supplies and watersheds are inseparable. Forest disturbance by harvesting, roads, fire, insects, disease or motorized recreation can result in a variety of hydrological effects through changes to snow accumulation, rainfall infiltration, and snowmelt rate. Depending on site conditions, high rates of disturbance can result in channel erosion, debris flows and floods, and these in turn affect the quality, quantity and timing of water reaching a water supply intake. Although a variety of forest disturbances can affect watershed hydrology, forest licensees can only control forest harvesting and access roads. Watershed hydrology determines water supply availability and reliability as explained in Figure 10.

Figure 10: Comparison of hydrographs in forested (upland watershed), forest harvested and urban watersheds

Most B.C. watersheds are somewhere between these lines because they are a variable mix of land uses.





Water suppliers can influence forest and range activities in source watersheds by doing the following:

1. Get to know the forest and range users operating in your source watershed. If you are unsure about who has a licence to conduct forest or range activities, contact the District Office in your [Natural Resource District of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development](#).
2. Develop working relationships with forestry and range users. Let them know the concerns you have about the protection of water quality and quantity in the watershed. Document your interactions.
3. Let forest licensees know that you would like to be notified when their forest stewardship plan (FSP) is up for renewal. (An FSP is a map-based, landscape-level plan of potential forest development activities that are intended to take place in the plan area. They have 5-year terms and may be renewed for additional terms.) Forest licensees are obligated to consider (but not required to act upon) water purveyor concerns about potential impacts on water quality.
4. Ask licensees to explain their planning process and when they hire a professional hydrologist to conduct a hydrological assessment. Let them know you would like to receive a copy of any hydrological assessment reports and to have an opportunity for review and comment (see Table 26). Every hydrological assessment should discuss whether, and to what extent, forest harvesting or road construction will affect water quality and quantity or timing of flow to the intake (i.e., where water is diverted for drinking).
5. Ask licensees to explain how they manage riparian areas, how they plan and design roads to minimize erosion, and how they practice erosion and sediment control on all roads.

Table 26: Elements to look for in a hydrological assessment

1	2	3	4	5
SCOPING	METHODS & ASSESSMENT	SYNTHESIS	CUMULATIVE HYDROLOGIC EFFECTS	SOLUTIONS & ADAPTIVE MANAGEMENT
<p>The report should include the full scope of potential impacts of cutblocks, roads, and stream crossings on water, soils, slope stability, channels, wildlife, vegetation, diversity.</p>	<p>The report should provide evaluation methods so the findings can be assessed. It should also provide monitoring protocols used to collect data, preferably using defined best management practises.</p>	<p>The report should consider climate change.</p> <p>Other land uses in the watershed should be considered.</p>	<p>The report should identify effects from all current and planned land uses in the watershed to provide context to proposed forest change, and to allow modifying harvest plans to protect water courses. This includes considering FRPA and pre-FRPA harvesting and Forest service roads – effects on surface and groundwater resources.</p>	<p>The report should describe ongoing monitoring, assessment of data, and a plan to revise practices based on those results. The monitoring should support adaptive management efforts, because continuous improvement of on-the-ground practices is the goal.</p>



3.4 Useful links

GENERAL

Considerations for Local Government Elected Officials: Primer on Drinking Water Management in B.C., published in 2018 by the Auditor General for Local Government. <http://www.aglg.ca/app/uploads/sites/26/2018/12/AGLG-Primer-on-Drinking-Water-Mgmt-Booklet.pdf>

Drinking Water & Watershed Protection Program: 10 Year Action Plan Implementation Review, published by the Regional District of Nanaimo in 2018. https://www.rdn.bc.ca/dms/documents/dwwp-reports/region-wide-reports/10_year_action_plan_implementation_review_-_september_2018.pdf

Well Protection Toolkit, published in 2000 by the Ministry of Environment. https://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/wells/well_protection/wellprotect.html

Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in B.C. and the Action Plan for Safe Drinking water in British Columbia, prepared in 2019 by the Provincial Health Officer. <https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf>

Hullcar (Clcahl) Aquifer Response Plan Report, prepared in 2018 by the Ministry of Environment & Climate Change Strategy. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-permitting-and-compliance/hullcar_review-docs/hullcar_aquifer_response_plan.pdf

The Protection of Drinking Water: An Independent Audit Report, published in 2019 by the Office of the Auditor General of British Columbia https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Protection-of-Drinking-Water_RPT.pdf

Auditor General for Local Government, 2018. Perspective Series: considerations for local government elected officials, primer on drinking water management in B.C.. <http://www.aglg.ca/app/uploads/sites/26/2018/12/AGLG-Primer-on-Drinking-Water-Mgmt-Booklet.pdf>

Advancing Freshwater Protection: Tools and opportunities in British Columbia's Water Sustainability Act, prepared in 2018 by the POLIS Project on Ecological Governance Water Sustainability Project. <https://poliswaterproject.org/files/2018/09/POLIS-WSATools-webfinal.pdf>

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3.5 Templates

Visit www.sourcewaterprotectiontoolkit.ca to access source water assessment and response plan templates.

