First Nations Integrated Watershed Planning

3. Knowing Your Watershed: All Our Relations

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INTRODUCTION

What does it mean to know your watershed? It means understanding all the environmental, social, economic and cultural elements that affect the watershed, such as:

- The physical and natural features of the watershed
- Waterbody and watershed condition
- The human uses of the watershed, including economic uses and the spiritual and cultural importance and uses of water resources
- Who is involved with managing the watershed and what those management practices are.

Water is a life force for all living things. Since all living things are related, watershed planning groups need to consider all living things that are connected to the watershed, which includes humans as well as plants, soils, and animals. The watershed itself needs a certain quality and quantity of water to function properly. When all the inhabitants of the watershed are taken into consideration (humans, plants, wildlife), and seen as equally deserving of their share of quality water resources, decisions can be made to promote the long term health of all our relations living in and connected to the watershed.

To know your watershed you will have to gather existing information and to collect new information. Good decisions require good information. In order to make a plan for the watershed, you will need to understand its current state – what are the good, degraded and beautiful aspects of this area? As you gather this information, you may want to compile it into a 'state of the watershed' report. This is an overview of the whole watershed – all the research you will be doing – that will give the readers of your final watershed plan an idea of the strengths and vulnerabilities of the watershed.

This guidebook provides you with an idea of what kinds of information will be required to *Know Your Watershed* and also gives suggestions on what you can do at the Nation level to contribute information required for a comprehensive state of the watershed report. This guidebook will not provide you with a step-by-step guide to developing a state of the watershed report. If you have the resources to do so, there are other resources/guides that can provide that technical guidance, which we have listed in our references section. This guidebook covers the following areas:

- Building technical capacity for environmental and watershed work
- Basic concepts about watersheds
- What is included in a state of the watershed report
- Preparatory steps to do before gathering your information
- Gathering existing and new information
- Analysing the information to assess the health of the watershed.

Getting Started

Compiling all the important information about your watershed and developing a state of the watershed report can often require significant technical environmental expertise and/or funding. Here are pieces your First Nation can do to get started, whether it has these resources in place or not:

- Build the technical capacity of your First Nation (page 3)
- Identify community concerns/priorities about the watershed (page 21)
- Decide on a watershed boundary that is right for your First Nation (page 33)
- Gather and organise existing information (page 51)
- Carry out research to document Indigenous Knowledge (IK) from your community (page 62)

Building Technical Knowledge and Capacity

As your First Nation gets involved with watershed planning, it will require environmental technical knowledge and capacity. This is essential for your First Nation in the short term to be able to gather and/or evaluate information and data about the watershed and to participate in a regional planning process. In the long term, it will allow your First Nation to better to protect and manage water and watershed resources on a long-term basis within your reserve or traditional territory. Your partners may already have a lot of the technical knowledge and capacity. You should draw from and build on this. At the same time, build your First Nation's capacity so you can participate more easily and more fully in the planning process.

This knowledge and capacity can be developed in various ways through:

- Having an environmental coordinator as band staff or even an environmental department within your First Nation
- Making use of technical organisations that work specifically with First Nations (e.g. Technical Services Advisory Group (TSAG) in Alberta, Ontario First Nations Technical Services Group (OFNTSC) in Ontario or the Unama'ki Institute of Natural Resources UINR in Cape Breton)
- Hiring consultants that you trust and incorporating technical capacity-building into the work (e.g. having a member accompany consultants on field trips)
- Encouraging your members to get higher level of university or college environmental education and training (for long term involvement in watershed management).

Since watershed planning is a long-term process, having ongoing capacity to address and respond to watershed concerns is key to being able to participate and make your First Nation's voice heard at a regional level.

Unama'ki Institute of Natural Resources

In Cape Breton the UINR is an environmental organisation that serves the five Mi'kmaq communities in Cape Breton. This organisation was "formed to address concerns regarding natural resources and their sustainability" (Unama'ki Institute of Natural Resources, 2010). Its three goals are:

1. "To provide resources for Mi'kmaq equal participation in natural resource management in Unama'ki and its traditional territory.
2. To strengthen Mi'kmaq research and natural resource management while maintaining our traditions and worldviews.
3. To partner with other groups sharing the same desire to protect and preserve our resources for future generations" (Unama'ki Institute of Natural Resources, 2010).

Story


SCALE

UNDERSTANDING WATERSHEDS

This section provides some introductory information on watersheds and how they work. Depending on your experience this may be new information or just good review. It begins with an overview of what a watershed is, and the services that watersheds provide. It goes on to describe the hydrologic cycle, and concludes with a look at some challenges facing waters.

What is a Watershed?

A watershed is an area of land where all of the water that is under it (groundwater, soil water), or drains off it (rain, melting snow or ice, streams) flows into the same place (a river, lake, wetland, ocean). The shape and size of a watershed is determined by the lay of the land. High points of land (e.g. hills, mountains, or even just slightly raised areas on plains) frame the watershed and create a catchment area for the precipitation. Watersheds can have different scales. For example, the watershed for the McKenzie River drains close to two million square kilometres, encompassing thousands of rivers and streams. Each of those rivers or streams would have its own, smaller, watershed.

The water that is held in soil and plant material is sometimes referred to as green water, and makes up 60 percent of the world's freshwater supply (Falkenmark and Rockström, 2006; Parkes et al., 2008). This water returns to the atmosphere from plants, through a process called 'evapotranspiration' (see definition in the introduction guidebook, *Getting Started*). This water can't be used for drinking water or piped for other human use. The water that flows over the land into streams, rivers and lakes and recharges groundwater is called blue water and makes up 40 percent of world's freshwater supply. It returns to the atmosphere through evaporation. This blue water is the water people use (Falkenmark and Rockström, 2006; Parkes et al., 2008). Canada has six and a half percent of the world's renewable freshwater.

Water and land cannot be separated. Land use has an impact on both blue and green water. Soil permeability/infiltration capacity (e.g. compaction of soil through overgrazing), amount of vegetation (e.g. removal of plants for development), and increased runoff generation (e.g. from the development of roads, cities) may affect green water and blue water levels. Land practices, such as forestry, oil and gas, mining or agriculture, can have an impact on blue water and green water by the leaching of contaminants through surface runoff. Contaminants attached to sediments can move with surface runoff into waterbodies or can be transported by wind.

An activity that affects water quality or quantity in one part of a watershed may also affect water quality and quantity downstream. All who live or work or play (e.g. communities, agriculture, industry) within a watershed can affect others with their actions. This connectivity means that within a watershed, what happens on the land is connected to the quality and quantity of water in rivers, streams, lakes, wetlands, and within the ground (groundwater). This affects the health of the overall watershed, and by extension, the health of those living beings that depend on the watershed.

Ecosystem Services

The term 'ecosystem' refers to interconnections of the plants, wildlife, insects, birds and fish that live within a particular area, along with the soil, water and other physical components. There are many different sizes and types of ecosystems. While watersheds refer to the physical movement of water through an area, ecosystems refer to the whole spectrum of life within that area.

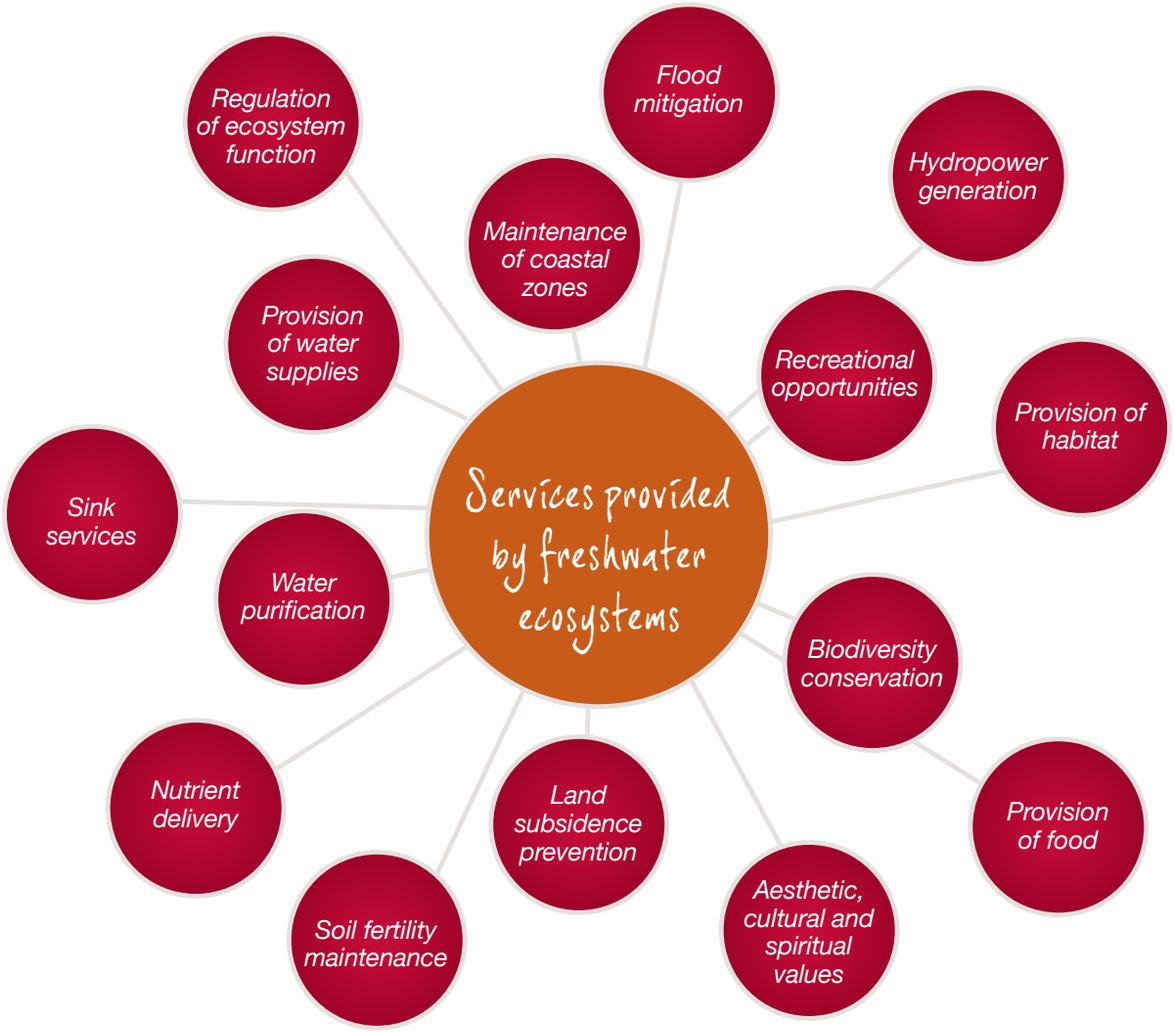
Freshwater ecosystems provide a wide variety of services for the humans, animals, plants, birds and fish that live within them. For one, they regulate water, by collecting and storing and slowly releasing water so it can be used by all living things, including humans. They also provide services such as climate moderation, clean and safe drinking water, wildlife habitat and biodiversity, waste treatment, a source of cultural and spiritual expression, recreation and tourism, a method of transportation, and water required for agriculture, fisheries, manufacturing, and energy production.

Quote

"If the deer or fish the hunter kills and consumes is tainted with toxins, then the hunter and his family will absorb those toxins into their bodies…In the past, the water we drank was considered medicine, but now it is hard to say whether it is a medicine or possibly poison we are putting in our bodies."

~ R.E.M. Bédard (2008, p.94)

These ecosystem services are essential to the health of the ecosystems within watersheds and the bigger ecosystems that watersheds are a part of. Healthy watersheds provide services, but when watersheds are not healthy, problems may arise. For example, watersheds that include larger areas of intact forests and wetlands have a strong capacity to filter and absorb water, reducing the amount of sediment and pollution that reaches waterbodies (Postel and Thompson, 2005). If wetlands and forests are removed or damaged, the capacity of the ecosystem to provide these services may also be compromised. See Appendix One for more detailed information about the many services ecosystems provide.



Adapted from Brandes et al., (2005)

More Details

Surface Runoff

is water that travels over the surface of land, some of which absorbs into the soil and some eventually feeds into surface waterbodies. Surface runoff picks up sediment, nutrients and contaminants from the land and distributes these throughout the watershed. The amount of surface runoff that happens in an area is partly influenced by climate, topography, soil qualities and land cover/vegetation.

Surface Water

includes overland flows, rivers, lakes, wetlands, estuaries, oceans. Surface waterbodies obtain their water through ground water, surface runoff and precipitation.

Groundwater

is a valuable resource that is poorly understood. It is very difficult to measure. Groundwater fills openings and spaces in the soil and therefore completely saturates the soil with water. It moves slowly and continuously based on underground pressure and is replenished or recharged through infiltration of surface water. The water table can be considered the 'surface' of groundwater, or, the boundary between saturated and unsaturated soils. Contaminants can get into groundwater either horizontally or vertically, moving through groundwater from higher elevations or moving from unsaturated soil down into groundwater.

Riparian Areas

are lands next to waterbodies and are important for soil conservation, their high biodiversity, and the influence they have on aquatic ecosystems. They help to slow and filter runoff water, prevent erosion of soil, and moderate the temperature of surface water in rivers and streams. The vegetation in these areas also capture and process pollutants in rain and runoff before the water enters the nearby surface waters.

Wetlands

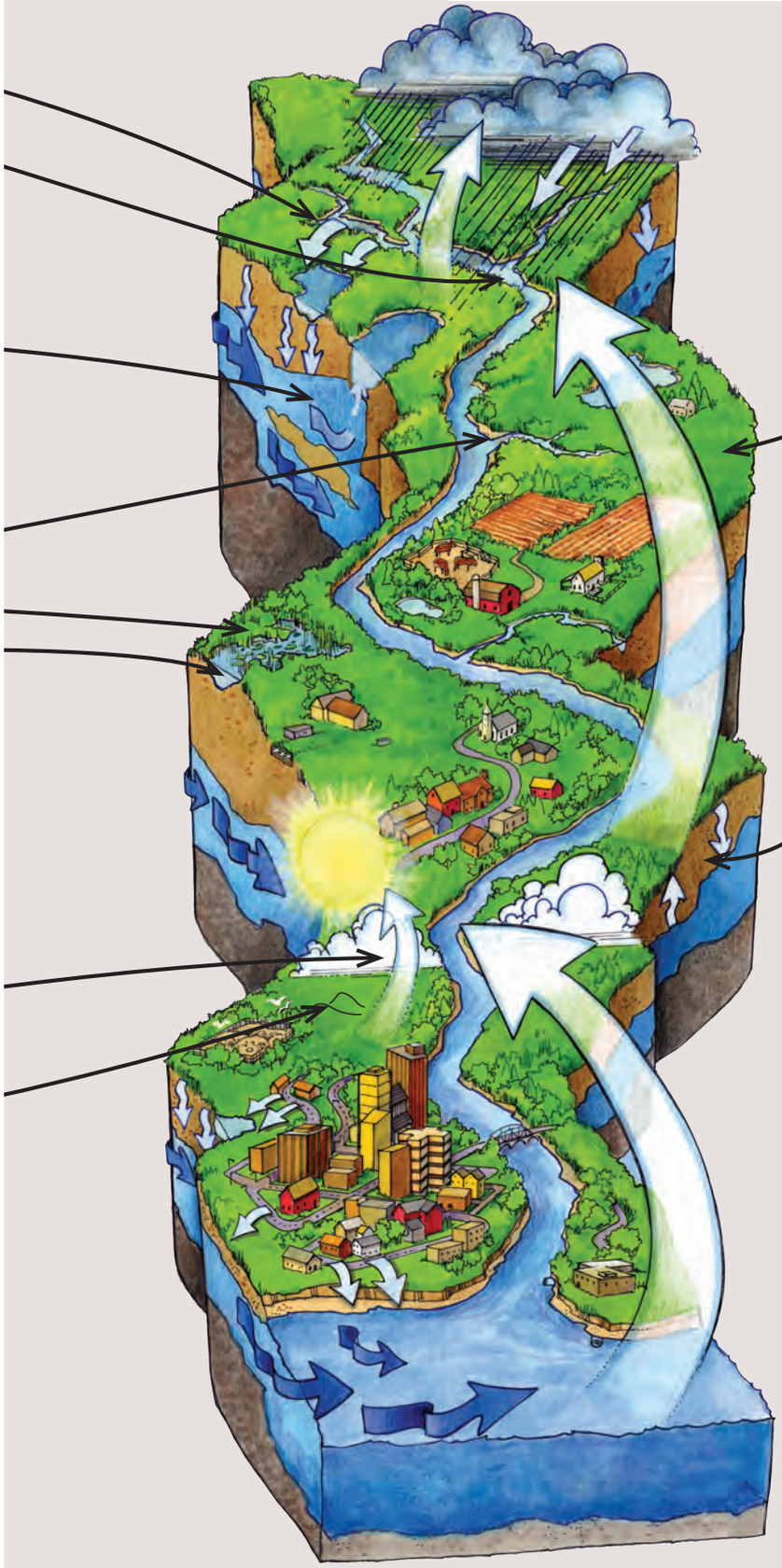
are some types of areas that are critical for water processes in an ecosystem. Wetlands, such as marshes and bogs, help protect water quality – they are like 'nature's kidneys' and keep the water clean. Wetlands also assist in moderating water quantity by collecting water in these areas during wet periods and then releasing during dry periods, which also helps to regulate surface flow of water. By helping to moderate water quantity, wetlands reduce flood intensity, improve groundwater recharge, and maintain water levels in aquifers.

Climate

is the long term averaged and extreme weather conditions of a region. This includes temperature, precipitation and wind. The duration and intensity of precipitation are important. For example, short intense storms lead to greater surface runoff because less time is available for water to filter into the ground. Climate will affect the amount of runoff and surface water, the level of the water table, and the type of plant species that grow in an area. Therefore water resources and climate are inseparable. This is why climate change is so important to consider when creating a watershed management plan.

Topography

has a big impact on a watershed. It determines where water moves, how fast it will move through an area and how much surface runoff will occur. Generally, the most runoff will take place on steep slopes; the least will take place on flat ground. Topography can also affect the amount of moisture in an area. As clouds meet mountains, valleys and large hills, they are forced upward into cooler parts of the atmosphere. As they rise, they drop their moisture as precipitation, which creates wetter conditions on one side of the mountain and dryer conditions on the other.



Vegetation

provides a number of beneficial services to an ecosystem such as maintaining soil stability, preventing soil erosion, and providing nutrient and energy cycling. Vegetation also serves to capture and slowly release water. Vegetation types and amount of cover, as well as soil texture and structure, will affect infiltration rates in an area.

Soil

helps regulate the drainage, flow and storage of water. For example, coarse-grained sand allows water to infiltrate very quickly. Clay soils have high water-holding capacity. When vegetation is removed (e.g. for development) the natural drainage, flow and storage of water can be altered, and often greater surface runoff occurs.

Image: Conservation Ontario

Tip

Find out where your First Nation gets its drinking water. Is the source surface or groundwater, or both (e.g. some houses draw their water from a groundwater wells, and others get their water from a treatment plant that draws from surface water)? Have there been problems with the quality of drinking water? (To learn more about drinking water and boil water advisories, check out Health Canada's website: www.hc-sc.gc.ca/fniah-spnia/promotion/public-publique/water-eau-eng.php).

The Hydrologic Cycle

Water is constantly recycled in an ecosystem through a process called the hydrologic cycle, or water cycle. **Precipitation** (rain, snow, hail) develops from the clouds, which are formed by condensed water vapour. When clouds cool, the air becomes saturated with water, and the water falls as rain, snow, etc. When rain falls, it is taken up by the soil and plants or flows over the surface of the land (**surface runoff**). It can also soak into the soil and become groundwater (**infiltration**).

Water gets back into the ocean and lakes through streams, rivers, groundwater, and surface runoff. Water then returns to the atmosphere through **evaporation** caused by the sun's energy. This is either through the surface of water bodies or through exposed surfaces, animals, and plants (**evapotranspiration**).

In order to understand the hydrologic cycle of a system you need to look at the entire process of circulation/movement of water both above (**surface water**) and below (**groundwater**) in that ecosystem. This includes how much water there is, when it flows, how fast it moves, where it moves, etc. As water moves through the hydrologic cycle, it is linked through processes that take place on the ground to atmospheric processes/ changes. This basic information helps to determine the way that human changes to the land and water have affected the quantity, quality, timing, and velocity of water runoff and flow throughout a watershed.

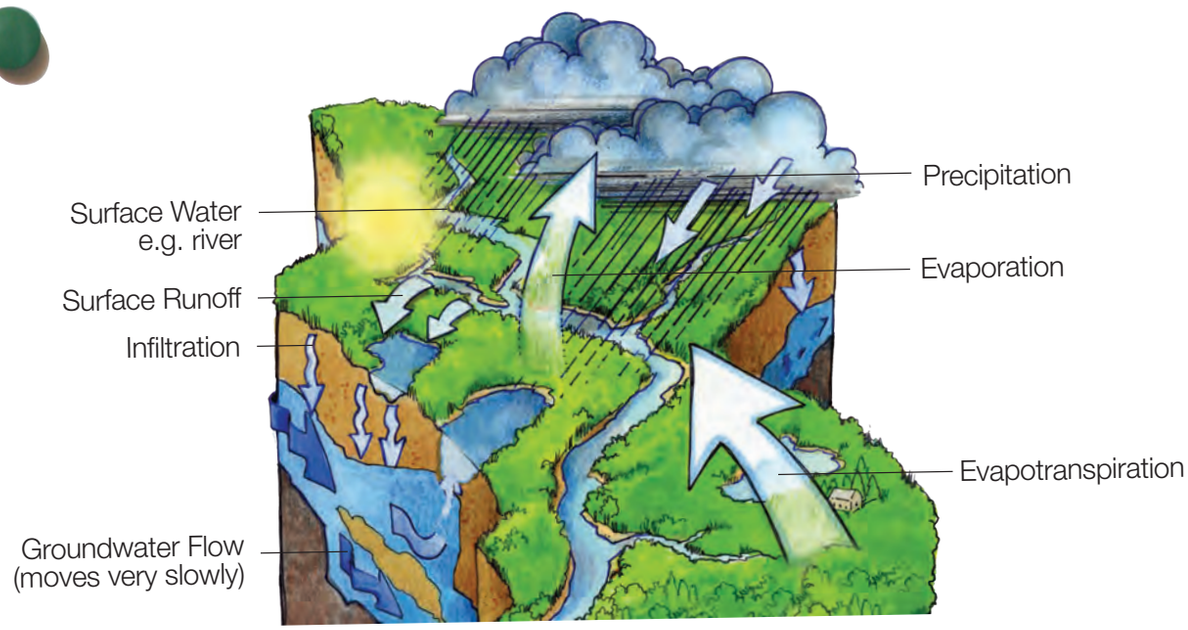
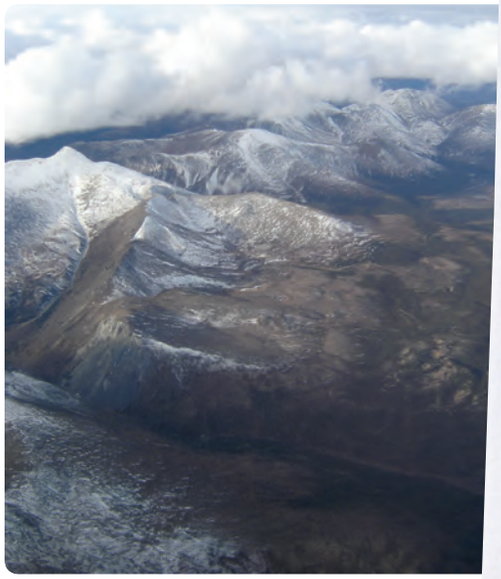


Image: Conservation Ontario



Quote

"The first raindrop means a great deal, because, once the salmon start spawning, they certainly have to have water that is absolutely clean. Also, the water is coming down the mountain with the nutrients that they need. We need to understand that water carries all vital nutrients, for many life forms, it's gathering up the nutrients for all the living things that live in the water. We as human beings, live on those things that live in water, all the living elements that survive on water."

~ Chief Simon Lucas
(2002, quoted in
Sanderson 2008 p.98).

E-flows and Instream Flows

Environmental flows (e-flows) are the waters that an ecosystem needs to maintain its own health, including both surface and groundwater. Too often humans use water without considering the needs of the ecosystem, and all the living beings that depend on the water. The health of the ecosystem suffers as a consequence, eventually leading to social and economic problems for humans and human settlements.

Instream flows are the waters that flow within a river or stream. They are similar to e-flows, but are more specific to the needs of the plant and animal communities that life within the stream itself (e.g. fish populations).

Guidebook Four: *Achieving Consensus on the Plan* discusses e-flows and instream flows in the context of watershed plan.

More Details

Challenges Facing Water

Water faces a number of challenges, all of which, in turn, affect the overall health of the watershed. Each watershed will face its own array of challenges, depending on its particular context. Some of the challenges you may see in your watershed are:

- overconsumption
- overallocation
- hydromodification
- drawdown of aquifers
- climate change
- acidification of marine waters
- eutrophication
- invasive species
- species at risk
- pollution

Vulnerabilities in a Watershed

These challenges can affect the health of a watershed, and can make it more vulnerable to poor health. Human activity can result in an increase in one or more of the challenges listed in this section. Even if the ecosystem seems to be in good health, if these activities are present, its health may be at risk in ways that are not obvious. Some examples of activities that increase vulnerability in watershed health include:

Landscape modification:

- Removal of forest or plant cover
- Draining of wetlands
- Building of roads and bridges
- Increase in impervious surfaces (i.e. paving)

Improper agricultural management:

- Overuse of fertilizers, herbicides and insecticides
- Unrestricted livestock grazing
- Inefficient irrigation practices

Unsafe industrial practices:

- Acid draining from abandoned mines
- Direct industrial discharges to surface waters

Improper wastewater management:

- Runoff from motor vehicles, failed septic systems, stormwater discharges
- Malfunctioning sewage treatment plants

Hydromodification and Infrastructure

- Dams
- Channel modification (e.g. straightening, widening, deepening of rivers)

See Appendix Two for more detail on factors that can affect the vulnerability of a watershed.

More Details

Overconsumption

Canadians are among the highest per capita users of water in the world, using more than 300 litres of water per person per day for domestic use (Conference Board of Canada, 2010). However, domestic use only makes up twenty percent of all water used in Canada; the rest is used by industry (68 percent) and agriculture (twelve percent) (EarthTrends, 2007). Much of this water is not recycled or returned to the watersystem, or is returned in a degraded state.

Although the threats to water in Canada are often disregarded, they are already being felt in some areas. Between 1994 and 1999, just over a quarter of Canadian municipalities with water supply systems experienced water shortages caused by drought, infrastructure problems, or increased consumption (Environment Canada, 2004). Overconsumption of water and the lack of a conservation approach to water management, combined with the need for infrastructure upgrades, exacerbate the challenges facing Canada's water supplies.

Overallocation

Water rights are allocated through a variety of different systems across Canada. The most common in western Canada is the prior allocation or 'first in time, first in right' system, which means that those who were there first had the first option of rights to use the waters ('first', in this case, refers to settlers, not to the First Nations who may have been living there since time immemorial). Other systems include permits for water use allocated by public authorities (in the territories), riparian rights that allow the owner of riparian land to use the surface waters (Ontario), and permits granted by provincial departments (Quebec). In some cases the water rights can be traded, sold with land, or transferred, but in other cases they cannot be traded or transferred.

None of these systems offer comprehensive oversight of ecosystem health in considering how water rights should be allocated. As a result, rights are often overallocated, leading to overuse of water resources and conflicts among users of the water. In addition, most of these systems do not take ecosystem needs into account, resulting in damage to ecosystem health and eventually to social and economic challenges for the communities within the watershed.

Myth of Abundant Water in Canada

Water supplies are varied across Canada in terms of quantity and quality, but consistent across Canada is the myth that Canada has a plentiful and inexhaustible supply of freshwater. The popularity of this myth has resulted in policies that do not take limitations or challenges to the water system into account, and are often wasteful rather than conserving of water. Consequently, in many areas, water is consumed at a faster rate than it is replenished, often as a result of overallocation of water rights.

More Details

Hydromodification

Hydromodification is the process of altering waterbodies with the intent of providing benefits to humans. Examples of hydromodification include dams to control water flow, reduce flooding and create hydro power, or straightening rivers to create canals and channels. These modifications often have unintended negative consequences for humans and ecosystems.

These consequences can include:

- Loss of wetlands
- Forced removal of populations in the creation of a reservoir
- Flooding of lands, soils, ecosystems, sacred or cultural sites, in the creation of a reservoir
- Blocking fish access to rivers and river systems (from older dams)
- Changes in water temperature
- Negative impacts on flood-dependent plants and animals.

Over the last few decades, a better understanding of the impact that dams and other hydromodifications are having on ecosystems has developed, and adaptations to address these impacts are being created (e.g. newer dams are build with fish ladders). However, in many areas, existing hydromodifications continue to cause problems for the ecosystem.

Drawdown of Aquifers

Groundwater can be found in many types of soils. An aquifer is formed when water saturates an underground area that contains gravel or other loose material. In many parts of Canada, groundwater aquifers provide water for human uses. However, the laws pertaining to groundwater are substantially different from those pertaining to surface water. When using surface water, users must consider the rights of downstream users; however, when using groundwater, no such regulations apply (Nowlan, 2007).

One of the biggest challenges facing groundwater use is that mapping groundwater is very challenging, and has not been done in a systematic way in Canada. As a result, it is difficult to know how much water is available in aquifers in Canada. Groundwater aquifers are recharged through precipitation that seeps through the soils. Sometimes this happens very slowly, and in these cases the aquifers should not be considered as renewable resources.

As a result of these two factors, the lack of regulation and the lack of knowledge about the extent of groundwater aquifers, aquifers are in danger of being overdrawn. This can cause problems such as land subsidence (when the land collapses in on itself), increased concentration of contaminants, as well as social and economic challenges for the human inhabitants of the watershed who can no longer access the water they need.

Climate Change

Climate change is the difference in weather patterns that has been taking place over the last few decades. Signs of climate change include changes in the average annual or seasonal temperatures within a region, in precipitation, in drought and flood patterns, and in extreme weather events.

Climate change can have big impact on watersheds. Changes in precipitation and temperatures can stress plant and animal communities, by altering habitat and making it easier for invasive species to move into an area, displacing native species. In coastal regions, rising sea levels can increase erosion, and can change the salinity of estuaries and groundwater. Changes in flooding and drought patterns also have an impact on species and habitat, and affect agriculture and other human land uses. In many cases, climate change also exacerbates the effects of other challenges facing the watershed, such as pollution, overconsumption, and invasive species.

Many impacts of climate change are already visible in Canada. The glaciers are melting and winters are becoming warmer, with less snow cover and ice cover on waterbodies. River and lake levels are changing, and the prairies are experiencing both drought and flooding at unexpected times of the year. The effects of these changes are also being felt by human settlements, as weather becomes less predictable. Infrastructure and policy have generally been designed based on historic trends, and as these change, the infrastructure and policy may no longer be adequate to address new concerns.

Acidification of Marine Waters

As marine waters absorb increased levels of carbon dioxide from the atmosphere, the oceans are acidifying. The total amount of carbon dioxide in the atmosphere is increasing due to human activity, including the release of greenhouse gasses from transportation and industrial sources. About one third of the carbon dioxide produced through human activity in the last 200 years has been absorbed by the oceans. This is of particular concern in the Arctic Ocean, where carbon dioxide is absorbed more quickly, and the waters are acidifying more quickly, because of the colder temperatures.

The acidification of marine waters can have a serious impact on the health of fish and shellfish in the oceans. The pH levels are high enough in some areas that they can dissolve the shells of ocean snails and other shellfish, affecting the food supply for fish. In addition, many fish are sensitive to the effects of acidified waters. Overall, however, there is much that is unknown about the impacts of acidification on fish and shellfish species, including whether the fish and shellfish species will have the capacity to evolve and adapt to the changes in ocean acidity.

Eutrophication

Although eutrophication can occur because of natural causes, it happens most often (and is of most concern) due to human causes. Eutrophication occurs when nutrients (such as nitrogen or phosphorus) are added to a waterbody, leading to excessive growth of algae or phytoplankton. The nutrients that cause eutrophication are often found in fertilisers and raw sewage, and find their way to waterbodies through field runoff, inadequate treatment of sewage or sewer overflows due to major storm events.

This can have severe negative effects on the fish and other species that live in the water. Algal blooms are sometimes poisonous, and the toxins can be passed up the food chain, leading to health concerns for animals and humans. In the worst scenario, algal blooms may consume too high a proportion of the dissolved oxygen, leading to hypoxia (oxygen depletion). If there is not enough dissolved oxygen in the water, fish and shellfish cannot survive.

Invasive Species

Invasive species are species that have moved into a new area, whether they are introduced intentionally or accidentally, and that take over the ecological niches occupied by other species. Because of how globalised the world is today, it is difficult to control the arrival and movement of new species in an area. New species can arrive in shipments of wood or resources, on boats or vehicles, or even as bait dumped into the lake after a fishing expedition.

Invasive species can have a severe impact on the ecosystem, as they become a dominant species. In many cases, the invasive species is better adapted to an ecosystem and has fewer natural predators than native species. Eventually, invasive species may out-compete these native species, or change the ecosystem to the point where native species can no longer survive, which then become ‘species at risk’.

Invasive species can also have serious social and economic consequences for humans. Many First Nations have special relationships with particular plant, fish or animal. If these species are at risk due to an influx of invasive species, this relationship – and the social and cultural health of the First Nation, by extension – may also be at risk. Invasive species can also wreak havoc in forestry, fishing, agriculture, and other resource-based economic activities.

Species at Risk

Species at risk include species that are threatened (at risk of becoming endangered), endangered (at risk of becoming extinct), extirpated (locally extinct), or extinct (no members of the species remain). Although species may go extinct for natural reasons, the rate of extinctions has accelerated dramatically in recent centuries.

The factors which contribute to species becoming threatened or endangered include loss of habitat, as human settlements, infrastructure, and impact on the environment has changed the amount and type of habitat available. Forest fragmentation, where a forested area is divided into smaller parcels by roads or hydro lines, is a particular concern because some species can only find habitat in deep woods. These species, and others where the available habitat is not large enough to support a significant population, may become genetically isolated and thus more vulnerable to disease and other potential disasters. Pollution also puts many species at risk, whether by damaging the species directly or by affecting its food source.

Photo credit: US Fish and Wildlife Service

When one part of an ecosystem is at risk, even just one small species, it is a sign that the health of the whole watershed is at risk. It is likely that the cause of the risk to the species (e.g. habitat loss, pollution) poses a greater risk to the ecosystem, which has perhaps not yet been recognised.

Quote

"Having cared for the waterways of the human body (the heart and blood vessels) as a former cardiac nurse, I have an appreciation for the value of science and its contribution to health… If a person has a healthy lifestyle, his or her body will reflect those practices. In the same way, if Mother Earth is treated with respect, and she is cared for in a traditional manner, she will regain her health."

~ Darlene Sanderson, a Cree woman who lives in Coast Salish Territory, compares the rivers and waterbodies of the earth to the blood vessels of the human body. (2008, p.6).

Pollution

Many watershed plans focus on dealing with pollution, as this can be a significant stressor to ecosystems. If pollution is a concern in your watershed, identifying its source(s) is essential in developing a plan to address or mitigate it. There are two kinds of pollution: point source and non-point source. Nutrients, microorganisms and sediment are the most common components of pollution, and are found in both point and non-point pollution.

Point source pollution is pollution that can be traced to a single point, such as a sewer line, discharge pipe or smokestack. The most common point source pollutants in surface water are:

- microorganisms
- nutrients
- toxic chemicals
- thermal pollution.

Non-point source pollution is pollution that can't be traced back to a single origin or source such as stormwater runoff, water runoff from urban areas and multiple failed septic systems. Non-point source pollution most often occurs when water from rain, snow or irrigation water runs over the surface of the land, picks up pollutants and carries them to surface or groundwater. It is a major contributor to water pollution. The most common types of non-point source pollution include:

- sediments
- nutrients
- microorganisms
- salts
- toxic chemicals
- thermal pollution.

Air Pollution

Although it may seem counter-intuitive, air pollution can also have a detrimental impact on water quality. Industrial and agricultural processes, and the transportation of both humans and things, as well as natural processes such as forest fires and volcanic eruptions, can send particulates into the air, which then, over time, fall back to earth. These particulates may fall directly onto waterbodies, or may be carried to a waterbody through runoff. In either case, because they are airborne, they can travel long distances before coming back to earth, and they can damage the ecosystem in the same way that waterborne pollutants can.

"Aboriginal land use activities and ways of life are still very much a part of First Nations peoples' lives today. Such ways of life and the values they support depend heavily upon healthy ecosystems, including clean water... Water quality and quantity, then, is not just an environmental concern, it is a matter of cultural survival."

~ Chiefs of Ontario (2006, p.6)

Sediments

Sediment, in the form of silt, sand, dirt, and gravel, is another common component of non-point pollution. Sediment is carried by surface water runoff and ends up in streams and lakes. It can cloud the water, reduce amount of sunlight for aquatic plants and decrease the availability of healthy aquatic habitat (e.g. clog gills of fish, smother fish larvae). It can also interfere with drinking water purification systems. Sources of sediment include eroding stream banks, poorly protected construction sites, and lack of plant cover on urban and rural land agricultural fields.

Nutrients

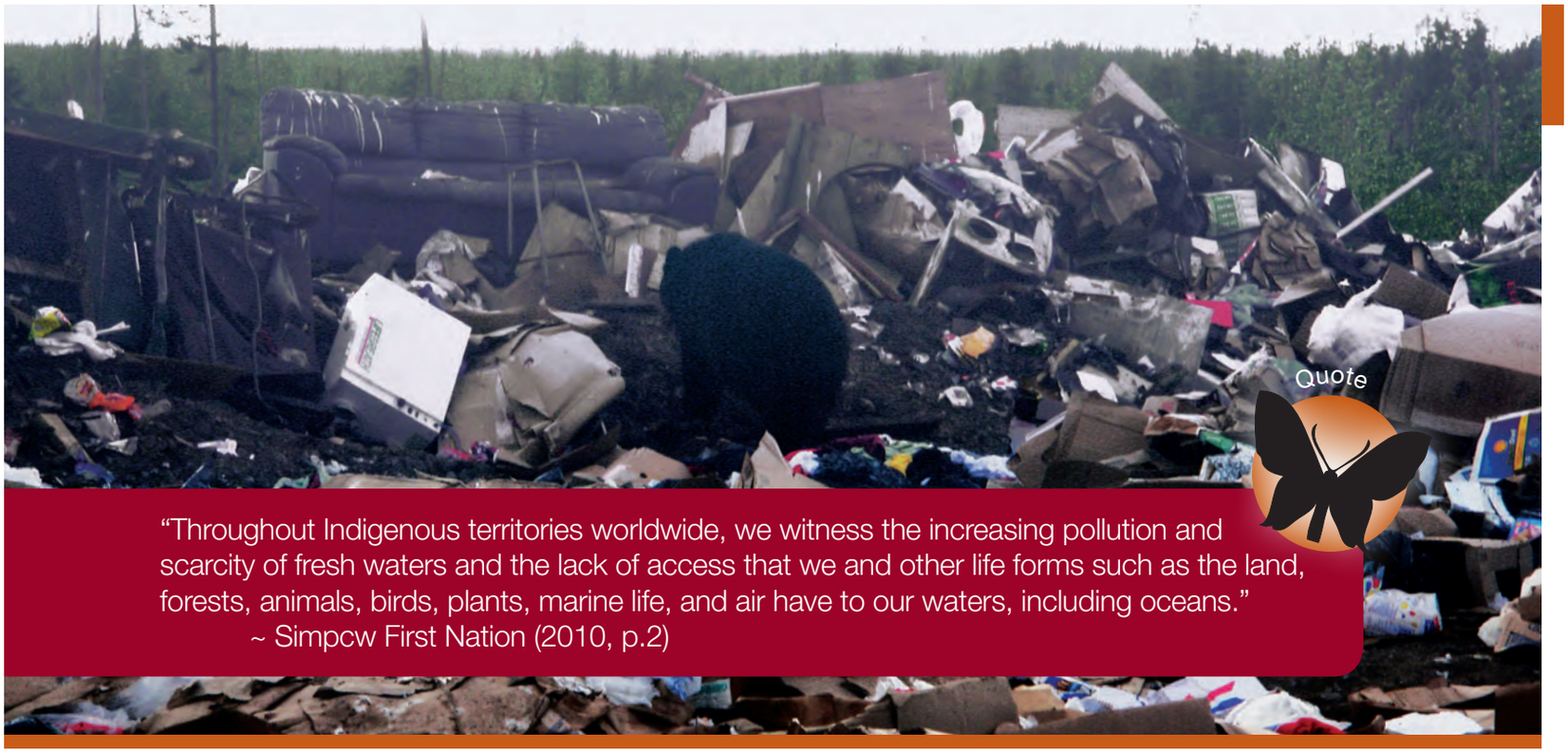
Nutrients, most commonly nitrogen and phosphorous, are a significant component of both point and non-point source pollution. Excess nutrients in surface waters can cause massive algae blooms. Algae uses up available dissolved oxygen and can be toxic. It can lead to increased incidence of fish kills and loss of desirable fish species. It can also result in decreased water transparency and problems with the colour and smell of the water. Excess nutrients can lead to decreased biodiversity, changes in species composition and dominance, and toxicity effects in aquatic ecosystems. Nutrient sources include agricultural fertilizers, septic systems, home lawn care products, and yard and animal waste.

Microorganisms

Microorganisms include pathogens, bacteria, viruses, and protozoans, and are components of both point sources and non-point sources of pollution. They can cause illnesses in humans such as typhoid and dysentery, if they reach drinking water sources. Common sources for microorganisms include untreated sewage, storm drains, faulty septic systems, poorly managed livestock operations, runoff from farms, and improper handling of pet waste.

Salt

Large amounts of salt are used in Canada and in northern climates each year on roads and pavement to reduce and remove ice during the winter. However, as the snow and ice melts, and during spring storms, the salt can run off into waterbodies. This has a negative effect on plants and animals that cannot cope with such high levels of salt, particularly in freshwater areas. Salt runoff can also contaminate the groundwater.



Quote

"Throughout Indigenous territories worldwide, we witness the increasing pollution and scarcity of fresh waters and the lack of access that we and other life forms such as the land, forests, animals, birds, plants, marine life, and air have to our waters, including oceans."
~ Simpcw First Nation (2010, p.2)

Toxic Chemicals

Toxic chemicals include pesticides, industrial pollutants and oil and gasoline. Pesticides are used both in agricultural operations and in urban areas to manage plant and insect populations, but often have negative impacts on species other than their target. Industrial pollutants, including heavy metals, are produced through factories and other industrial processes, often as byproducts, and may be released into waterways. Oil, grease and gasoline are among the toxic chemicals leaked or released by vehicles, which can make their way through run-off to waterways.

Once toxic chemicals reach waterbodies, they may have negative effects on the plant and animal species there. In many cases the chemicals are ingested by animals, and may make their way up the food chain, including through biological magnification (as smaller prey are eaten by bigger predators, the pesticide accumulate in greater amounts up the food chain).

Thermal Pollution

Thermal pollution occurs when the average temperature of water increases by human inputs. Thermal pollution is caused by changes in the landscape of the riparian zones, for example when vegetation is removed from riverbanks, reducing shade and increasing sunlight on the river's surface. As well, many industrial processes use water as a coolant, and water is cycled through water treatment and wastewater treatment systems for human uses; when the water is released, it is usually at a higher temperature than the temperature of the waterbody. If the difference in temperature is substantial enough, plants and fish may experience 'thermal shock', which can kill them. Even when the temperature difference is less substantial, warmer waters have lower amounts of dissolved oxygen, which can affect the kinds of species that can survive in a given area, leading to changes in biodiversity.

IDENTIFYING COMMUNITY CONCERNS, PRIORITIES

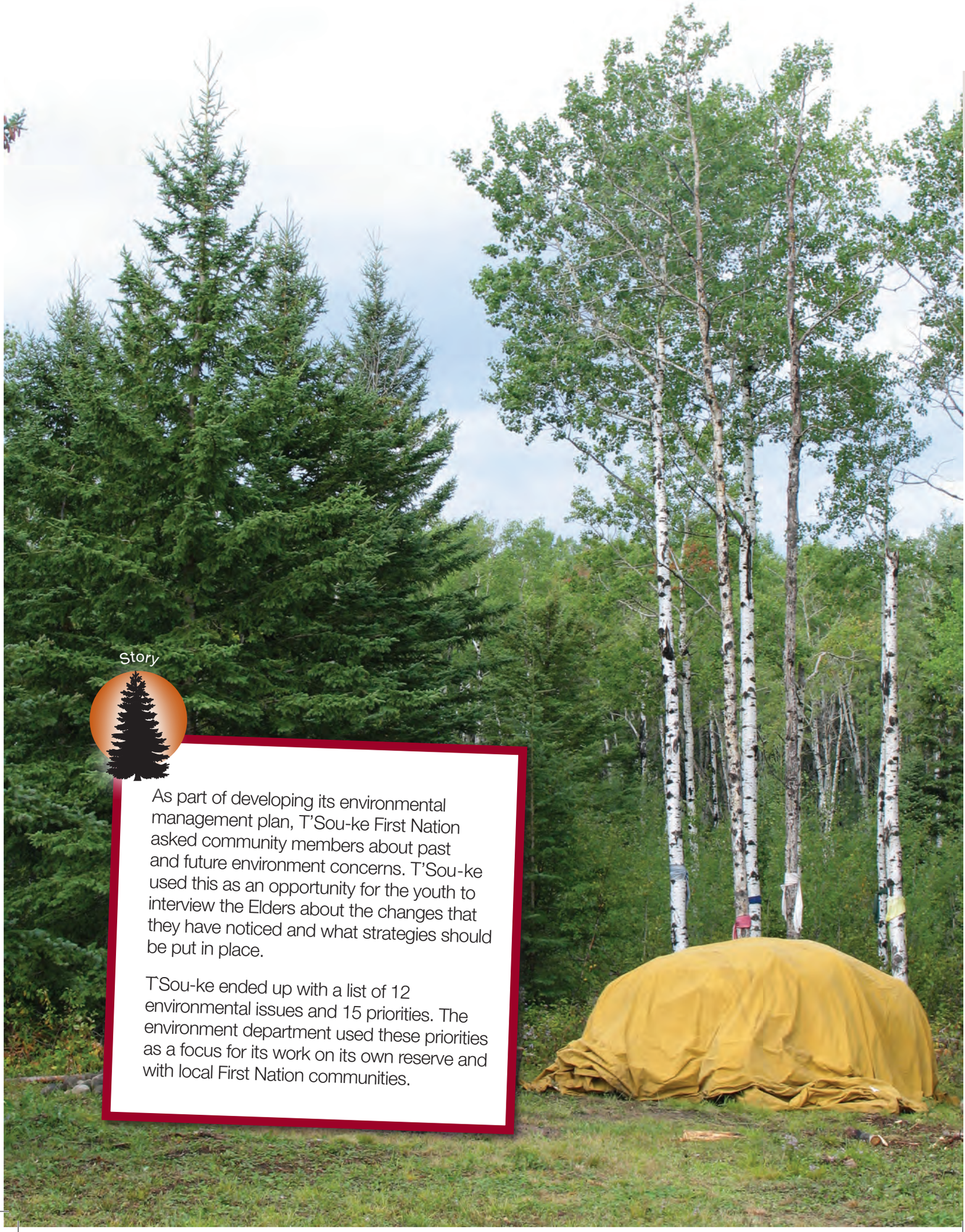
In the first guidebook, *Describing Your Approach*, you spent a lot of time talking with community members about their values and vision for the watershed. You developed some initial thoughts about what a 'catalyst' issue might be to focus interest in your watershed planning process – the water-related issue that the membership are concerned about. Now is a time to build on that information, to see if people have additional concerns for the watershed, and to determine what the priorities should be to address these concerns.

Although you're working with the Steering Committee, it's still important to talk directly with your First Nation membership. This way, you can bring the membership's concerns to the Steering Committee and speak with a stronger voice about your First Nation's priorities. Each of the members of the Steering Committee should also be gathering information from their constituents, although each government or organisation may have its own way of doing this.

As you talk to people in your First Nation about their concerns and priorities, remind them that the information is intended to support the First Nation within the bigger context of the watershed. People may have varying concerns and priorities relating to themselves, to their families, to the First Nation, to the broader region, and someone's priority for their family may not be the same as their priority for the First Nation. Although it is good to hear all the concerns to gather as comprehensive a list as possible, when it comes to prioritising the concerns, the focus should be on what is best for the First Nation.

There may be conflict among these varying levels of priorities. What's best for one family may be different from what's best for another family, or for the First Nation, and what's best for the First Nation may not be the same as what's best for the region. As you talk with people in the First Nation, remind them to focus on the First Nation level – what are the priorities that are most important to your First Nation?

When you bring the concerns to the Steering Committee, and all the concerns raised by all members of the Steering Committee, the focus will change to look at what's best for the region. Having a solid understanding of your First Nation's concerns and priorities will mean that you will be able to speak to these concerns with the group, and will know what is most important to the First Nation, and what your First Nation might be willing to compromise on.



Story

As part of developing its environmental management plan, T'Sou-ke First Nation asked community members about past and future environment concerns. T'Sou-ke used this as an opportunity for the youth to interview the Elders about the changes that they have noticed and what strategies should be put in place.

T'Sou-ke ended up with a list of 12 environmental issues and 15 priorities. The environment department used these priorities as a focus for its work on its own reserve and with local First Nation communities.

Connecting priorities and rights

Take some time to consider how these priorities connect with your First Nation's rights, so that when you share these priorities with the Steering Committee, you will also be able to speak to your First Nation's rights and priorities. If these conflict with others' priorities in the region, you will have a strong foundation in your rights to argue for your First Nation's priorities. For example, if a regional priority is to develop land along the waterbody for cottages, but your First Nation is concerned about the impact this might have on fish habitat, you could speak to your right to fish to ensure that the cottage development doesn't happen, or happens in a way that protects fish habitat.

How to gather people's concerns and priorities

To learn about people's concerns and priorities, you could go door to door to talk to the membership or host a workshop. For the purposes of getting a broad scan of what the priorities are in your First Nation, it might be best to start with an open house format. This type of event will allow as many members as possible to participate and gives everyone a chance to come together and talk about the issues collectively. If your First Nation has a different way of talking to the membership, use the format that your membership is most comfortable with.

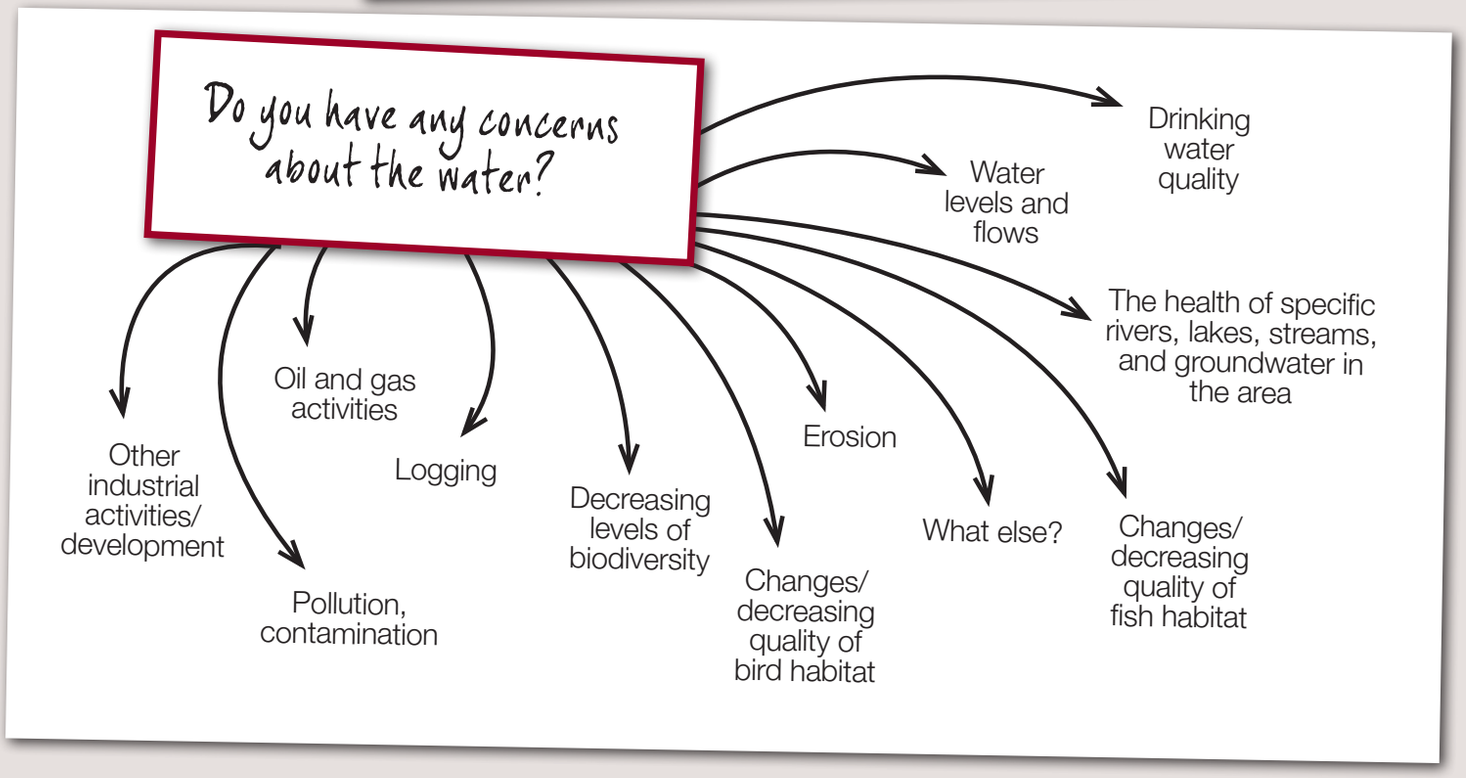
In some cases, people may want or need more information before they can say what their priorities or concerns are. They may not know about all the activities taking place in their territory and how it may be affecting the water and watershed. In this case, it would be important to incorporate awareness-building components into this stage of identifying concerns (as discussed in *Guidebook One*). One option might be to host a gathering that includes information booths about the watershed, hydrology and how human activities affect the water so that members can get the information they need.

As you hear people's concerns and priorities, keep track of them. This list will inform the areas you will focus on in your data gathering. For example, if fish health is a priority, you would research fish habitat, water quality, and so on. If flooding is a priority, you would research water flows. The list of concerns and priorities will also be useful in later stages of the plan, when the Steering Committee will be developing priorities for the watershed plan.

Activity

Bringing People Together to Identify Concerns

This is a chance to continue the community engagement you have already initiated about the watershed in *Guidebook One*. Gather your members and try asking these kinds of questions to generate discussion and information sharing.



Once you have brainstormed a list of concerns, have everyone examine them to see if there are themes or common ideas. You may want to consider:

- Which topics go together (e.g. same area, same kind of concern, same impact)?
- If there are gaps or concerns that weren't mentioned (e.g. development taking place in the watershed, particular regions in the watershed, impacts on how water is used in your First Nation)?

You can write categories on a new piece of chart paper or a clear section of whiteboard, or you can move the sticky notes around to group them. There may be one or more clear concerns that stand out right from the beginning, or there may be a number of important areas, depending on your context.

You can gather information on priorities in a group setting by using an exercise called 'dotmocracy'. To do this, list all the known concerns on large sheets of chart paper placed around the room, leaving enough empty space on each page for additional suggestions. Give each participant a set number of stickers (e.g. five each) or give everyone a combination of green (immediate), yellow (short-term), and red (long-term) to add timelines to the prioritising exercise. Participants can place their stickers next to the concerns that are most important to them, and can write in new concerns if they notice a gap or want to add something.

Once everyone has placed their stickers, look to see which areas have the most stickers. Share this with the group to get confirmation that these priorities represent the group's concerns. It is important to note that concerns that are not a high priority may still be valid, but may not be as urgent. These concerns should be noted, as they may become important priorities later. In the meantime if you find information relating to these priorities, you can flag it for later review.

Using pictures to show people's concerns in a visual way can help to illustrate and add richness to conversations about watershed planning. You can bring maps of your reserve or traditional territory to meetings with the membership, and invited people to point, write, draw, or mark up the map with sites or areas that are particularly important to them. Many people enjoy talking about maps, and it can offer a new way for people to share stories and engage with each other as they talk about the watershed.

WRITING THE STATE OF THE WATERSHED REPORT

Tip

While you will likely not be the one gathering and analyzing information, it's good to know what kind of information is included in a State of the Watershed report, to know what to ask of the person designated or hired to write it.

This guidebook walks you through the process of gathering information about your watershed. The concerns and priorities identified by your First Nation, and by the other communities represented on the Steering Committee, provide a starting point for the research, but it is likely that other concerns and information will arise as the research takes place. This information will be put together into the 'State of the Watershed' report. This kind of report provides an overview of the health of the lands and waters in the watershed, and is often included in or attached to the watershed plan.

The State of the Watershed report can be used as a benchmark tool, setting out current measures of watershed health to use as a baseline in the future to evaluate if the actions undertaken as part of the watershed plan are benefiting the watershed or not. It also provides an opportunity to confirm and explain more about concerns raised by community members, as well as to add more detail to the challenges facing the watershed.

This report is substantial, and will require technical expertise to complete. When the Steering Committee begins working on the State of the Watershed report, you may want to create a sub-committee for this task. Their responsibilities will likely include hiring a consultant to research and write the report. The sub-committee can be filled with technical experts and knowledge holders who will be able to address the particular research needs of your watershed.

In general, there are two sections in State of the Watershed reports: a watershed characterization and an assessment of watershed health. The characterization can also be understood as an inventory or description of the watershed. It describes in general terms the qualities of the watershed being assessed, e.g. the physical (e.g. soil and climate), biological (plants, animals), and cultural (demographics, cultural sites) environment. The information sources would include western science and IK. The next section of the report, the assessment, will look at the condition or health of the watershed. To understand the challenges facing the watershed, the assessment section will compare any new or current information to data gathered previously, guidelines, or data from other watersheds. As this information is compared, a picture about the effect of land and water uses on the health of the watershed will emerge. An overview of the information required in this report is outlined in this guidebook.

In many cases, state of the watershed reports use indicators as a way of assessing changes in the health of the watershed. Indicators are measurements or factors that are observed in a consistent way that show change within an ecosystem (e.g. levels of dissolved oxygen in water, soil erosion, fish populations). Certain animal species or plant species are used as 'indicator species', in that the health of their population size can provide information about the health of the ecosystem as a whole. To be effective, indicators should be comparable across time and space, meaning that it should be possible to compare the information gathered with similar historic and future studies, as well as with other watersheds. They should also be clear, and demonstrate change related to the goals that are set out in the watershed plan.

Overall, the State of the Watershed report should connect the challenges facing the watershed with the reasons why the challenge is present. This report will set out the basic context of why the challenges exist, which will make it easier to identify the solutions. As the Steering Committee moves further in the planning process, it will begin to develop solutions to address these challenges.

For more detail on developing the State of the Watershed report, see

Handbook for State of the Watershed Reporting:
A Guide for Developing State of the Watershed Reports in Alberta
available at: environment.gov.ab.ca/info/library/8044.pdf

- Overview of how to put together a State of the Watershed report.
- Excellent appendix with details about where to find specific kinds of information

Saskatchewan Watershed Authority State of the Watershed Reporting Framework
available at www.swa.ca/Publications/Documents/SOWReportFramework.pdf

- Types of information to include in report
- Recommends a 'report card' style of indicators, and explains how to develop this.

Handbook for Developing Plans to Restore and Protect Our Waters, Chapter 5
available at www.epa.gov/nps/watershed_handbook/pdf/handbook.pdf

- Types of information to include in report
- How to find some of the information you need

Planning as a Process: A community guide to watershed planning, Chapters 2 and 4
available at www.ecy.wa.gov/biblio/9901.html

- Types of information to include in report
- How to synthesise and assess the information you have gathered

More Details

Below is a sample table of contents for a State of the Watershed report. You don't have to include all these categories in your report – pick the elements that are relevant to your context and watershed.

Introduction

Purpose of report

What is the intended function of the report? Who would read it?

Scope

What does the report cover?

Methods

How did you gather the information in this report?

Characterisation of Watershed

Geography

What are the watershed boundaries? Are there subwatersheds that will also be looked at in the report?

What information is known about:

- Climate?
- Land cover?
- Biodiversity of plants and animals (including species at risk)?
- Geology?
- Soils?
- Topography?
- Hydrology?

What information is known about aquatic resources?

- Surface water – quality and quantity
- Groundwater – quality and quantity
- Fish and other water organisms
- Riparian zones and wetlands
- What are the ecological flow needs of the ecosystem (how much water the ecosystem needs to be healthy)?

Social history

History of First Nations

- Treaties and other agreements as appropriate

History of non-First Nations

History of water management

- Both First Nation and non-First Nation management practices

Land use, development, economics

What are the major land uses in the watershed? Where are they located?

- What are the practices relating to each kind of land use that could affect the watershed (e.g. agricultural nutrient management, urban wastewater management, industrial uses of water)

Development

- Are there projects underway or in the planning stage that will have an impact on the watershed?
- What is the projected population growth for the area? What is the projected urban growth (or growth in the built environment) for the area?

Economics

- What are the main economic activities or drivers? How do these activities use water or affect the lands and waters?

Current water management practices

What is the current management regime that affects water health?

What policies, programs, or plans are in place to manage water?

How are water rights determined in the watershed? What are the current consumption levels and allocations?

Community awareness and Involvement

What concerns do the various communities have about the watershed?

Are there organisations or groups that are involved in watershed management, restoration, or other practices relating to the water?

Other considerations:

What other factors might affect watershed health?

Watershed Assessment

Summary and conclusions

Based on the information above, what is the current state of the watershed?

What are the watershed's strengths?

What are the major concerns or challenges facing the watershed?

Management considerations/recommendations

What are the recommendations for action that should be included in the watershed plan?

References

Appendices

More detailed information on specific topics as needed

More Details

PREPARING FOR INFORMATION GATHERING

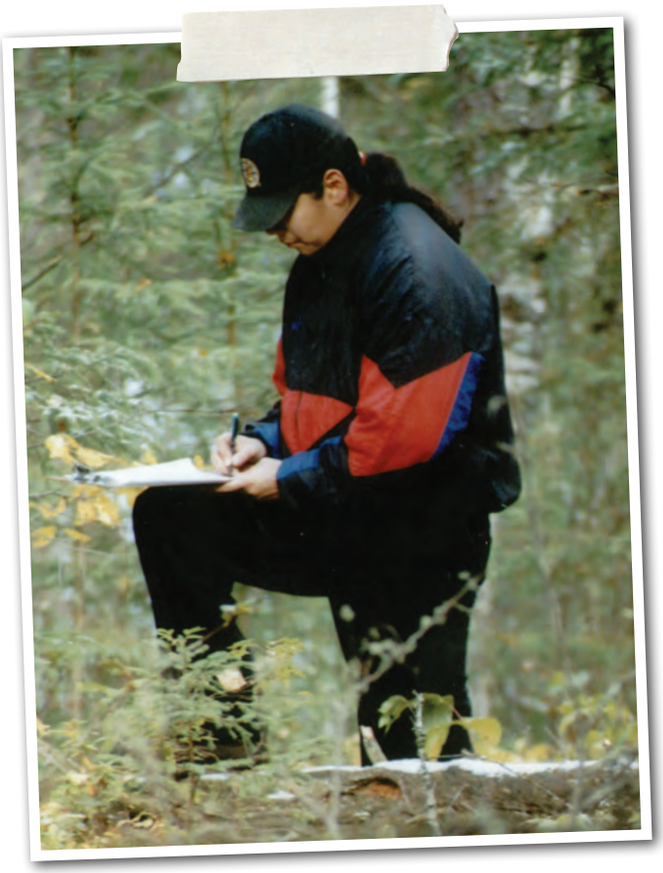
Now that you have a basic understanding of what a watershed is and how it works, and about the kinds of information that you could include in a State of the Watershed report, there are a few preparatory steps the Steering Committee (or your First Nation) can take to prepare for the information gathering stage. These steps will ensure that the information you look for reflects what is meaningful for your First Nation and the other communities in the watershed, and will establish an appropriate process to help collect new information. To prepare for the information gathering stage, you will need to:

- Set out a research agenda, including research questions, the scope, and where to find information
- Determine how Indigenous Knowledge should be included
- Develop a simple method of organising your information.

The information gathering stage is an essential part of the planning process. It will provide you with the information you need to be able to make good plans and to manage the watershed well. However, gathering all this information will take time. The Steering Committee will continue to meet to hear updates about the research. As the information comes in, the Steering Committee can consider it and can begin to analyse it and develop a big picture of the strengths and challenges facing the watershed.

The Steering Committee will direct the research process to make sure that the information gathered is relevant for what it needs. It may be a sub-committee doing the work (or overseeing consultants who do the work), but the responsibility to make sure the information is accurate and clearly presented lies with the Steering Committee.

As you gather available studies and data, you may identify gaps in the information. Sometimes the information you need exists and either you haven't been able to find it or it is poor quality data. Sometimes the information hasn't yet been gathered. Make notes about what is still missing and what questions still need to be answered. With the Steering Committee, consider how important the data is and how complicated it would be to gather this data. Remember, although certain information may be required, you can still move ahead with planning even though you don't have all the information. Using a precautionary approach can help you make the best decisions for the watershed even if you don't have all the



Story

The Precautionary Principle

When do you have 'enough' information to make a sound decision? What type of information 'counts' as sufficient evidence? The Precautionary Principle helps account for this by suggesting decision makers take actions to avoid or diminish harm, even if it's not 'proven' that the harm is certain to occur. Staff at the Unama'ki Institute of Natural Resources use this approach in their decision making related to actions around the Bras d'Or Lakes. Another way of understanding this approach is to accept that if we don't have enough information about the environmental impacts of something we are thinking of doing, that maybe we should exercise caution and not engage in that activity until we can be certain that it will not cause environmental harm. This is not how most decisions are currently made, but changing to this standard of approach would get us much further towards long-term sustainability.

According to the United Nations, the Precautionary Principle suggests that... "when human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm. Morally unacceptable harm refers to harm to humans or the environment that is

- Threatening to human life or health, or
- Serious and effectively irreversible, or
- Inequitable to present or future generations, or
- Imposed without adequate consideration of the human rights of those affected." (UNESCO, 2005, p.14)

Set Out A Research Agenda

Before jumping into looking for information about your watershed, take some time to set out your research agenda – in other words, figure out what you are looking for, and develop a plan to help you find it. To do this, you'll need to figure out some research questions, develop the scope for the research, and identify sources of information.

Gathering Information About Plants and Animals

Mikisew Cree First Nation developed a guidebook to describe the plants and animals that are culturally significant to its members. The goals of this work were to preserve Elders' knowledge, inform youth and other community members of this knowledge, and assist Mikisew Cree First Nation in decision making regarding the value of these plants and animals to the community. Through the development of this guidebook, Elders described a number of uses for culturally significant plants and animals, values and concepts that described their relationship to the land as well as concerns about the health of the land. This ecological Indigenous Knowledge would be an important contribution to the State of the Watershed report, and can assist the Mikisew Cree First Nation in articulating its relationship to the watershed.

Story

Developing Research Questions

Research questions are the questions that a study tries to answer. In this case, as you develop the state of the watershed report, the research questions will guide you as you determine what kind of information to look for and what to include or not include. Having research questions set out ahead of time will help ensure you to find the 'right information' needed for the watershed plan.

To figure out your research questions, start with a brainstorm of what you need to know. You'll need to include basic background information about the climate, geography, hydrology, and plants and animals in the watershed, as well as about the social and economic factors affecting the watershed. You may also want to gather information about specific topics, such as smaller areas within the watershed, factors affecting watershed health or particular species of plants or animals. At this point you've talked to community members, and have a good idea about the concerns and priorities of your First Nation (and hopefully of other communities as well); these concerns will be a good starting place to identify information you will need about the watershed.

To turn all this brainstorming into questions, figure out the general areas covered by the ideas you've come up with. For example, maybe the major topics are geography, water quality, climate change impacts and impacts of population growth. What are the questions, or what information do you need about each topic?

These are your research questions. For example:

- What is the geographic context of the watershed (e.g. climate, hydrology, geology, soils, etc)?
- What is the water quality of the waters in the watershed? What are the factors affecting water quality?
- What are the current and projected impacts of population growth in the watershed?

Don't have too many questions – each question is likely to be a big one, and will take time to research. Three to five research questions is a good number; remember that the idea is to have a good overview of the whole watershed.

Setting the Scope

Once you have developed questions to guide your research, determine the scope of the research. You could spend months learning everything there is to know about one small aspect of the watershed, or trying to learn everything about every aspect of the watershed, but that probably wouldn't be a good use of your time or resources. What are the things you really need to know? You need to figure out what is not relevant to this study, and you also need to determine the boundaries for the watershed.

Tip

This Environment Canada website provides information about watersheds across Canada: map.ns.ec.gc.ca/kyw/

Relevant or Not?

As you begin reading about your watershed, you may find all kinds of interesting information. However, to avoid wasting time and resources, you need to keep asking yourself "Is this relevant?" If you've defined your research questions, you can check back to see if the new information contributes to an answer to those questions. If not, then it probably isn't relevant.

The exception to this is that sometimes you may not know what you are looking for until it jumps up in front of you. For example, if you are researching the three questions asked above, and find a report that details critical projected climate change impacts for the waters in your watershed, you may decide that this is an area that should be explored in the State of the Watershed report. In this case, you would expand your scope by adding a new question: "What are the current and projected impacts of climate change in the watershed?"

Deciding on a Boundary

When gathering information, it is important to know the boundaries of the geographic area being considered in the watershed plan, because the research you conduct will be within this boundary. The watershed concept can be applied to a scale as small as a tributary to large rivers and lakes or to larger scales of river basins. Watershed boundaries are dependent on topography, so watersheds tend to be bigger on flat land and smaller on more hilly land. First, find out what the watershed boundaries are in your area. Talk with government representatives, who may already have this information.

Tip

At the local level, in your own First Nation, discuss the scale and base map area with the watershed planning group. Discuss the watershed planning boundaries that the watershed planning group would like to work with. Are there particular considerations that this group would like to bring forward to the Steering Committee?

You may find that the boundaries suggested by your First Nation match up with those suggested by other stakeholders and rights-holders in the region, or you may find that they are quite different. If they are different, you may want to do some additional research on the areas not included in the regional study, or you may want to find out if there are other watershed planning processes happening in these areas that your First Nation can also participate in to have a voice in the whole of the area that is important to your First Nation.

Maps, Maps, Maps

More Details

There are many different kinds of maps.
There are six general types of maps:

- Climate maps (information about weather patterns)
- Physical maps (information about the physical features, such as mountains, plains, rivers, and so on)
- Political maps (information about borders between or within countries)
- Road maps (information about transportation routes)
- Topographic maps (information about the elevation in an area)
- Social or economic maps (information about a range of topics, e.g. population, economic activity).

All of these maps are built on a 'base map', which is a map with basic information about the area in the map. A map should have a scale, so that distances can be accurately calculated, and a direction arrow, so that the map can be correctly oriented. Maps can show all kinds of information – anything spatial (that takes place in physical space) can be shown on a map.

Maps can be very useful in watershed planning. A lot of information can be conveyed through maps, including:

- The location and flows of waterbodies and wetlands
- Population distribution
- Land uses
- The health of various parts of the watershed
- Plant and animal populations
- Levels and types of water use
- Political oversight of different parts of the watershed.

As you consider the watershed and the boundaries for your research, looking at maps showing watershed and political boundaries may help to clarify discussions about where the boundary should be. To determine what maps you might need, consider what you want the maps to show, and the scale at which it should be shown (i.e. large scale maps show more area with fewer details, while small scale maps show a smaller area with more details).

As you discuss the watershed boundaries with the Steering Committee, you may find that there are a few different options for where the boundary can be set. Most watersheds are sub-watershed of larger watersheds, and it can be difficult to determine where the boundaries for the study (and the watershed plan) should be. Some considerations for your First Nation to include:

1. The boundaries used by an existing watershed planning process taking place in the region, because it may be easier to build a consensus and get information regarding the watershed within those already-defined boundaries.

2. The location of the source of the waters you use, because you may wish to protect these source waters.

3. Your traditional territory, treaty territory and/or reserve(s) boundaries, as these are areas of legal, cultural, economic, and historical significance. The watershed planning area will likely be larger than your reserve boundary. Traditional territories could be within a watershed or could contain more than one watershed. If you need to narrow down the area within your traditional territory, look to land use planning your First Nation has done in the area. You can focus on identified areas of highest use and/or value to your First Nation and see if these correspond with watershed boundaries.

4. The special areas that are of concern to your First Nation, because they may require your special attention to ensure they are protected.

5. Any areas that are under serious threat, because these areas may require immediate attention. For example, if a major concern for the watershed relates to forestry practices that take place a hundred kilometres from the river, then work within a watershed that incorporates this activity.

6. Available time and resources, as watershed planning processes require a commitment that may affect other activities and needs in the area or in your First Nation. What resources (time, money, people) are available to commit to watershed planning? A larger boundary is likely to include more factors that contribute to watershed health in your area, but larger areas require more resources to engage all interested parties and there is potential for creating a process that is difficult to manage. If the area is too small you may not be able to address significant sources of pollution that are outside the area. Find a balance to cover enough area to deal with the watershed's major issues but that is still manageable. One option is to break the bigger watershed area into sub-watersheds. Operating at this level will reduce the number of stakeholders and increase the level of detail that you can use in developing a plan. The US Environmental Protection Agency recommends 10,000 to 40,000 acres (4,047-16,187 hectares) as a good area to work with.

Where to look for information

Sometimes it is not difficult to gather information – for example, if a watershed planning process has already been undertaken for your area, there may be extensive information already collected (e.g. in a provincial public registry or municipal office) that simply requires verification and updating. However, if this is the first watershed planning process in your area, it can be difficult to access the information you'll need if it has not been organised for public use, so you may have to make special requests for information directly from the relevant government departments. Your watershed planning partners on the Steering Committee may also have access to information, or may know where to look for it.

What Information is Already Available?

As you think about the kind of information you would want to include in the State of the Watershed report, and as you are beginning to look for information about your watershed, you may find that some studies have already been completed that you can build on for your watershed inventory. Plans or reports that may relate to the watershed include:

- Scientific reports covering the whole watershed, or areas within the watershed (available from all levels of governments, universities, non-government organisations)
- Environmental impact assessment/inventory reports about the current health of the watershed, and how proposed projects may affect the watershed (available from provincial and local governments)
- Studies examining the health of local wildlife/vegetation populations, including fish studies and species at risk studies (available from federal, provincial and local governments, universities, non-governmental organisations)
- Planning documents (available from local governments, conservation districts)
- Restoration projects (e.g. for roads, bridges, dams or other structure on or near the waterbody involved) (available from local governments, non-governmental organisations).

See Appendix Three for more detail on the types of reports you might find.

More Details

The internet is a great place to start looking for information and reports about your watershed. Most government agencies have websites, and public registries, and many will post reports online. Many organisations have databases or links to studies or reports relating to their area of work or geographical area. This is a good way to get an initial overview of the basic information you need for your watershed plan.

As you begin to look for more specific information about your watershed, it will be helpful to talk to others who are also working on watershed planning. In developing partnerships, and through the Steering Committee you will have connected with many of these people in your own region, but if you know of other people or organisations that are working on watershed planning issues, you can ask if they have the information you are looking for or have tips about where you might find it. Here are some places you may want to look.

Your own First Nation and Tribal Council

Look for research or reports that have been carried out, or commissioned, by your First Nation. Talk to the Band Manager to see what watershed related work might have been done (e.g. environmental assessments completed in the area/your territory; water studies; animal/plant studies; etc). Your Tribal Council might also be involved in environmental research carried out in the region. Talk to the staff members that do water-related work (e.g. water operator) or are responsible for environmental issues and health issues. If your First Nation has a lands department, that would be a great place to start.

Your First Nation or Tribal Council may already have information that would contribute to the watershed inventory. Look in previous studies and reports to see if you have:

- Water quality, water level, water flow data
- Fish sampling and other biological data
- Interview transcripts (Indigenous Knowledge, relationship with and use of watershed and watershed inhabitants)
- Land use and occupancy maps and studies
- Information on water licences/ withdrawals, mining licences.

Also look at your First Nation's policies, band council resolutions, bylaws, and comprehensive community plans to see what kind of water management work your First Nation has undertaken. There may also be committees or working groups (e.g. in the lands or environment departments) that work on water-related topics.

Aboriginal Organisations

Many First Nation Aboriginal organisations may also have information about water and watershed planning, or may be able to provide support to you in finding or gathering information.

Assembly of First Nations (www.afn.ca): AFN has done a lot of work on water, especially drinking water and wastewater, and there are a number of resources on the AFN's website, particularly research and policy recommendations.

Technical Services Advisory Group (www.tsag.net) or the **Ontario First Nations Technical Services Corporation** (www.ofntsc.org): These are two examples of organisations that provide technical services on a range of topics, including water and water management. Technical service organisations are intended to support communities in areas where they may not have the required expertise, and can assist with research and data gathering.

Centre for Indigenous Environmental Resources (www.cier.ca): A national, First Nation-directed environmental non-profit organisation. CIER works with First Nations to build capacity to solve environmental problems affecting their lands and resources, including water and watershed planning.

Aboriginal Mapping Network (www.nativemaps.org): The AMN is a network of people both in Canada and internationally who use and create maps showing Indigenous knowledge and use. Their website offers information about mapping, and has a number of resources to support First Nations who are interested in mapping.

Other sources of information

Other possible sources of information include governments, universities, and non-governmental organisations (NGOs). You may already be connected with these groups through your partnership work with the Steering Committee, or this may be an opportunity to build new relationships.

Governments

Federal

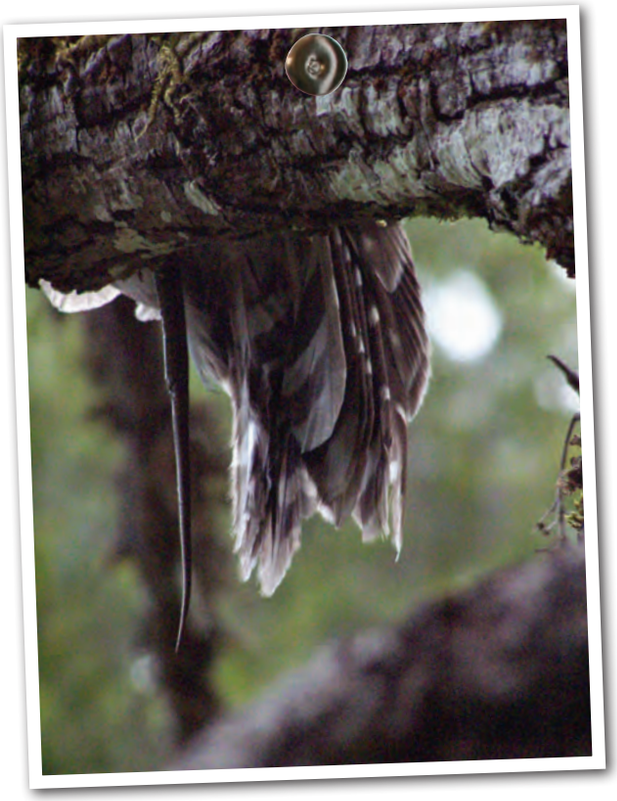
There are a number of federal departments and agencies that may have information related to your watershed, for example monitoring data or regulations affecting the watershed. Each department and agency is responsible for different areas of work. Here is a brief overview of each department's role:

Agriculture Canada (www.agr.gc.ca): Responsible for legislation and policies relating to agriculture and agricultural water management, including the Prairie Farm Rehabilitation Act. Gathers research and data about the relationship between water and agriculture, including water supply and management; watershed planning, with surface water and groundwater; and designing and implementing a surface water sampling program.

Department of Fisheries and Oceans (www.dfo-mpo.gc.ca): Responsible for legislation and policies relating to fisheries (including Aboriginal fisheries), oceans, shipping, and species at risk. Gathers research and data, including scientific studies about fish and fisheries in Canada. It also provides information about Aboriginal fisheries, recreational and commercial fishing, fish habitat management, in both freshwater and oceans.

Environment Canada (www.ec.gc.ca): Responsible for legislation and policies relating to protection of the environment, enforcement of wildlife and environmental laws, species at risk, migratory birds, protection of waters shared with the United States. Also responsible for the Canada Water Act, which describes how consultation and agreements relating to water will be negotiated with the provinces/territories. Gathers much information and resources on water and water-related issues, such as:

- Water management, including dams and diversions, water modelling, and environmental assessments
- Freshwater and marine water quality monitoring, including data for certain regions
- Water quantity, through the Water Survey of Canada, including data across Canada
- Wastewater management
- Reducing water consumption
- Policy and governance of waters within Canada.



Environment Canada's National Water Research Institute provides research on a wide range of water-related topics, including policy research. It also provides listings and contact information for experts in water-related areas.

Health Canada (www.hc-sc.gc.ca): Responsible for legislation and policies relating to environmental pollutants and toxic substances, and drinking water on First Nations. Provides information on water quality, as well as drinking water and drinking water protection. The First Nations Inuit Health Branch also provides information about drinking water in First Nations.

Aboriginal Affairs and Northern Development Canada (AANDC) (www.aandc-aadnc.gc.ca): Responsible for legislation and policies relating to treaties, land claims, the Indian Act, water and wastewater services, as well as climate change, resource management, environment and contaminants on First Nations. Provides information about water and water treatment on First Nations, as well as research on a variety of topics relating to the environment and natural resources. AANDC is responsible for water in the Northwest Territories and Nunavut (similar to a province).

Natural Resources Canada: Responsible for legislation and policies relating to pollution in arctic waters, oil and gas development, natural resources, gathers information on energy policy, including renewable sources of energy, and mining, including Aboriginal participation in mining.

Office of the Auditor General (www.oag-bvg.gc.ca): Produces reports for the Government of Canada and the Canadian public on a variety of topics including water, land, toxic contaminants, sustainable development, climate change, air, biodiversity and environmental assessments. Conducts independent legislative audits (including financial audits, performance audits and reviews of Crown corporations).

Parks Canada (www.pc.gc.ca): Gathers information on ecological restoration and ecosystem management in national parks, as well as biodiversity and species at risk.

Species at Risk Public Registry (www.sararegistry.gc.ca): Provides information about species at risk, including assessments and strategies for recovery.

Statistics Canada (www.statcan.gc.ca): Gathers demographic information every five years, and provides analyses information on demographics (e.g. population, income, occupation).

The federal government also manages a number of databases that gather information about water and watershed management. Here are five that may be particularly useful to you:

Know Your Watershed (map.ns.ec.gc.ca/kyw): Offers basic information and maps about watersheds across Canada. Find out about:

- What watershed you are in
- Other communities that are in your watershed
- Citizen-based groups working in the watershed
- Reports and websites about the watershed
- The other watersheds nearby that connect to your watershed.

RésEau – Building Canadian Water Connections (www.ec.gc.ca/reseau): Brings together a wide range of water-related information, including:

- Maps
- Satellite images
- Aerial photography
- Data to create or add to your own maps
- Data about water quality and water monitoring.

Much data is provided by Canadian governments, but the database also provides links to other organisations who may have the data you are looking for.

Canadian Aquatic Biomonitoring Network (CABIN) (ec.gc.ca/rcba-cabin): CABIN is a program developed by Environment Canada to assess and monitor freshwater ecosystems. It includes a standardised method for data gathering, and a database where the data can be compiled and used. Tools for analysis of the data are also provided. Training is required, and is provided through online courses and field certification offered by Environment Canada and the Canadian Rivers Institute at the University of New Brunswick.

Water Survey of Canada (www.ec.gc.ca/rhc-wsc): The Water Survey of Canada gathers data across Canada about water quantity. This data is available in a few different ways, including current real-time data from the monitoring stations (see www.wateroffice.ec.gc.ca). HYDAT is a database of all the data gathered through the National Hydrometric Program, and is updated quarterly (see www.ec.gc.ca/rhc-wsc).

National Hydro Network (www.geobase.ca/geobase/en/data/nhn/index.html): The Canadian Council on Geomatics coordinates this database, which is part of the GeoBase initiative. Data is provided by federal, provincial, territorial and municipal governments. It contains information on surface water in Canada, which can be combined with other information in the GeoBase databases to create maps.

Your First Nation may already have contacts in these departments, or in their regional offices. Often calling someone you know is a good way to start – even if they are not the right person, they will be able to direct you to the right person. Others in the same field (e.g. working for other local governments, or for environmental non-governmental organisations) may also have contacts that they can pass on to you.

If you don't have a contact, find a program or webpage on the department website that is relevant to your question or concern, and phone the number associated with that program or webpage, and ask who you should talk to. Some federal departments also have regional offices that work on local issues within a province/territory or region. You can also call the switchboard of the department, and ask the operator to assist you, or if, none of this works, talk to your member of parliament to ask who you should talk to. They will be able to put you in touch with someone – maybe even the minister of the department you need!

Tip

Provincial/territorial government departments

Each provincial or territorial government usually has a division dedicated to watershed or water quality issues as well as other offices dealing with related issues such as wastewater, mining, or air quality. These watershed or water-related departments often have guidance or support materials for watershed planning, which can provide background information, available data sources, regional and local government organisations, and various issues specific to the region (e.g., laws, unique environmental conditions). These departments also often collect biological, hydrological, and water quality information.

Every province and territory has a different approach and different departments to address water issues. In your province/territory, you may find that a different department has the information you need, but to start, the following departments may have information about:

- **Water**: everything and anything relating to water, including watershed planning, drinking water, wetlands, licenses and regulations
- **Environment/Conservation**: pollution, waste management, wildlife, parks, fisheries, biodiversity
- **Forestry**: forest management, wildfire protection
- **Agriculture**: agricultural management, animal husbandry, Crown land
- **Energy/Mines**: hydro, mining, oil, or other natural resource development
- **Transportation**: roads and bridges (including construction).

These departments will have research, policy and planning studies and reports relating to all these topics. In addition, they may have information about lands management, land use planning in rural areas, sustainability and climate change, though in some provinces this information is managed by a department of intergovernmental affairs. In the territories, this information is managed by Aboriginal Affairs and Northern Development Canada, particularly as it relates to First Nations.

Depending on your region, there may also be a regional water board that coordinates the administration of water issues within a particular area. Two examples are the Prairie Provinces Waterboard (www.ppwb.ca) and the Mackenzie River Basin Board (www.ec.gc.ca/eau-water/default.asp?lang=En&n=C92D49F5-1), which are cooperative partnerships among various provinces and territories to ensure that the waters within their respective regions are appropriately managed and protected.

Local/municipal government departments

Local and municipal agencies might be able to provide information related to land use, planning and zoning, water and wastewater, as well as monitoring data. Look for information from the following local government departments:

- **Planning**: development plans, zoning plans
- **Environmental**: water quality monitoring program
- **Economic development**: census data, demographic data
- **Water and waste**: maps of water infrastructure (e.g. intakes and sewer lines; stormwater plans), waste management plans
- **Public health**: records of illness from poor water quality
- **Transportation**: transportation plans, permits, information about roads and bridges

Conservation districts and **rural municipalities** may also have agricultural information, topographic maps, soil surveys, erosion control and more.

Municipal organisations

The Federation of Canadian Municipalities, or provincial associations of municipalities, often research and develop policy papers on topics, such as land management, environment and sustainability, that are important to municipalities and for remote, rural and northern municipalities. These policy papers and reports are available through the Federation of Canadian Municipalities website (www.fcm.ca) or by contacting your local provincial association.

Universities

Universities can also be a good source of information, both through faculty members and their libraries. Check university websites to find faculty members in science departments that may be doing current environmental research in areas such as hydrology. University libraries have a large amount of information in journals, student theses and books.

Universities may also be interested in developing a partnership with your First Nation to conduct research on the watershed and watershed issues. Maybe your First Nation has been involved in this kind of partnership in the past, or perhaps it currently is involved in one. Your First Nation should have a copy of the reports from these partnerships; if not, the university should have a copy in the library or in its archive.

Non-governmental organisations

There may be non-governmental organisations (NGOs) or non-profit organisations working in your First Nation's watershed region, such as watershed groups or lake and river associations. They may have already compiled existing information for the area, or hired someone to compile or collect additional information.

Examples of Non-governmental Organisations

Here are a few non-governmental organisations that work on water and watershed planning. There may be local organisations like these in your area too.

- The **Safe Drinking Water Foundation** works on ensuring safe drinking water in smaller centres and in rural areas, including both treatment and prevention of contamination. It offers educational resources and reports on drinking water concerns and solutions on its website. www.safewater.org
- The **Partners for the Saskatchewan River Basin**, an NGO based out of Saskatoon, has a number of resources for the Saskatchewan River Basin, including maps of the Saskatchewan River Basin and a State of the Basin report. www.saskriverbasin.ca
- The **Keepers of the Water** brings together Aboriginal communities, environmental groups, and communities in the North to protect the waters and ecosystems of the Arctic drainage basin. They have a gathering each year to discuss issues of concern and strategies to address them. www.keepersofthewater.ca
- The **Yukon Conservation Society** works on environmental issues in the Yukon. It offers resources on a variety of environmental issues, including water, climate change, and sustainable communities. www.yukonconservation.org
- **Ducks Unlimited** works across Canada on wetland conservation and habitat preservation for waterfowl. It conducts scientific research on environmental and wetland issues and develops policy recommendations. www.ducks.ca
- The **Canadian Water Resources Association** is a network across Canada, with local branches in many regions, that publishes reports and a journal and organises conferences and meetings on water-related topics. It brings together a range of people and organisations that are interested in water issues. www.cwra.org
- The **Centre for Sustainable Watersheds** connects scientists and policy-makers with communities interested in working on water-related issues. Its website includes links to databases and resources from across the country. www.watersheds.ca
- The **Living by Water Project** offers concrete suggestions for how to manage and improve the health of riparian zones, particularly where people live or work. It provides resources, materials and workshops on how individuals and groups can protect and restore shorelines. www.livingbywater.ca

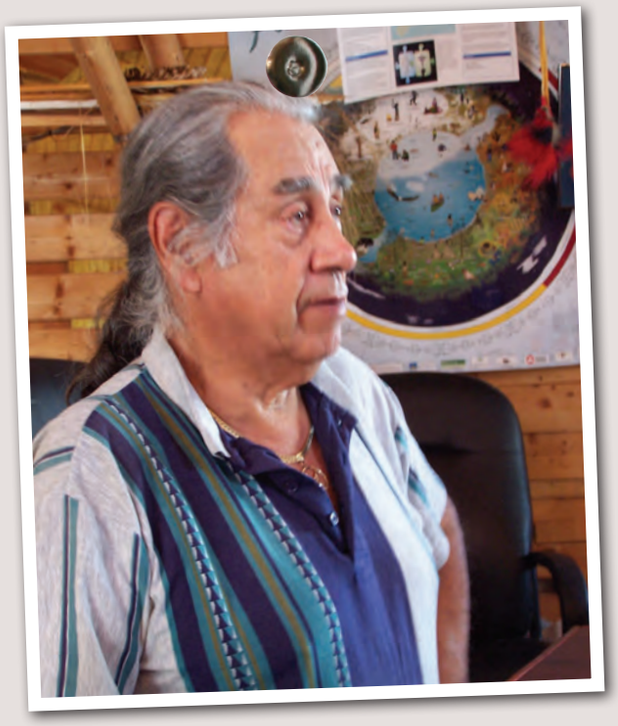
More Details

Tip

Including Indigenous Knowledge

Environmental knowledge of the watershed can come from western science, as well as from IK and local knowledge about the hydrology, the land and the species that call the watershed home. When you are gathering environmental knowledge about the watershed, look for western science as well as Indigenous and local knowledge. You can combine these knowledge systems to get a better, richer understanding of the watershed.

Indigenous people hold Indigenous Knowledge. Non-Indigenous people that work closely with the land and water and have a multi-generational relationship with a particular place have important knowledge that should also be included and this is often referred to as 'local knowledge' or 'community knowledge'.



Story

Two-Eyed Seeing

Albert Marshall, a Mi'kmaq Elder, coined the term 'two-eyed seeing' which describes a process of combining or weaving together Indigenous and western knowledge systems when developing approaches or solutions. Albert explains that two-eyed seeing is to "LEARN ... to see from one eye with the strengths of Indigenous Knowledges and ways of knowing, and from the other eye with the strengths of Western (or Eurocentric or mainstream) knowledges and ways of knowing … and to use both these eyes together, for the benefit of all" (date unknown, quoted in Marshall and Bartlett 2009). The idea and approach suggested by 'two-eyed seeing' can be applied when you are understanding all the elements of your watershed and developing the best ways to manage it.

There will be western scientific information documented for the watershed, but IK may not be documented. The Steering Committee will likely look to the First Nations for advice and direction on what IK is, the role it plays in the planning process, and on weaving it into the overall understanding of the watershed.

IK was discussed in detail in *Guidebook One: Describing Your Approach*, including how to develop an IK research protocol for your First Nation. If you have an IK protocol, review it to ensure any additional IK research you do is carried out in the proper way. Share it with the Steering Committee so that it is aware of how research will need to be conducted in your First Nation.

As you consider what information you will need to develop the State of the Watershed report, you will want to involve your First Nation's knowledge holders. There may be some knowledge holders who are no longer active resource users but have vast historical knowledge, while younger resource users might not have as much experience as an older member but do have current observations of the land and waters. These individuals can be valuable sources of information to support the '*Knowing Your Watershed*' stage of planning in a number of different ways:

- As a representative on the Steering Committee
- As sources of environmental information about the watershed
- As an advisory sub-committee of knowledge holders/resource users.

These individuals can also serve as participants or interviewees for any IK related research that you do in this stage of planning. They will also be an integral part of your First Nation's ability to communicate Indigenous ecological observations and understandings to the Steering Committee.

Establishing an advisory sub-committee of knowledge holders and resource users, whether to the Steering Committee or to your First Nation's watershed planning group, is a good way to ensure that IK is included as part of the watershed planning work. By involving knowledge holders and resource users in a more formal way, you can check in with them regularly as you work through the process of gathering information and developing a plan.

This sub-committee can provide direction to the research, and knowledge holders will be able to identify the proper ways to include IK in the 'State of the Watershed' report. The sub-committee can provide guidance on priority areas for the research, specific concerns about the areas of the watershed, and changes in the watershed over time. As well, its observations could identify specific impacts that could be investigated further by a scientific study, and it may also have ideas about how to go about the research that will save time, money and energy.

Information Management: Develop a Watershed Data Inventory

Information management is a way of tracking the information you have already gathered. While you will likely hire someone to research and write your state of the watershed report, you can use a simple system to organise any materials gathered by your First Nation. As you start to find and compile studies and resources about your watershed, having a watershed data inventory will ensure that you can find the resources you need, when you need them. In its simplest form, an inventory involves recording information about existing research in a spreadsheet program (e.g. Microsoft Excel) and tracking all the electronic and hard copy files in it. There also database programs that are relatively easy to use that could also be used to track the resources you find. The method you choose, and how complex it is, will depend on available human and financial resources, and would require a clear idea of how you want to use these resources now and in the future.

You may have a number of different kinds of resources to include in the inventory. If you are just beginning the process of gathering information about your watershed, you may want to look for:

- Scientific studies about your watershed
- Research about Indigenous Knowledge in your community
- Environmental impact studies for proposed projects in the region
- Books or articles about related topics (e.g. the concerns and priorities identified by your First Nation)
- Plans or policy papers produced by governments about the watershed or that affect the watershed.

More information about the types of information or data you may need is provided on page 52.

To better understand your information management needs, your First Nation will have to address the following questions:

- What are these documents used for currently?
- Who will have access to these documents? Will these people change and/or increase in number?
- Do you need to track who borrows these documents?
- Do you expect the number of resources in this collection to grow?
- What is your future vision for these documents and their use in your community?
- How many of these documents are confidential and need to be kept in a secure place?
- Where will you store these documents and who will take care of them?

Answers to these are important in order to track and make use of the documents and resources you gather in the most organised way. These questions also need to be addressed before researching, selecting and investing in a database software program for cataloguing and storing your documents.

The advantage to having this kind of inventory is that you can search by topic or type of resource to find all the resources you have on that topic. It can take some time to set up an inventory – especially if you already have a number of resources to catalogue – but it will be very helpful in the longer term.

Here is a suggested list of columns you can use for your watershed inventory. Create a simple Excel spreadsheet to get started (use consistent subject words, so you can sort the list using this column). Two entries are included to give you an idea of how you might fill in this kind of table.

Title	Author (last name)	Author (first name)	Year of Publication	Type of Resource (e.g. book, report, article, transcripts, audio, video, data)	Format of resource (hard copy or electronic)	Subject/ Topic covered #1	Subject/ Topic covered #2	Geographic area covered	Time Period covered
Living Proof: The Essential Data-Collection Guide for Indigenous Use and Occupancy Map Surveys	Tobias	Terry	2009	Book	Electronic	How to do a land use and occupancy study	Indigenous Knowledge and planning		
Handbook for Developing Watershed Plans to Restore and Protect Our Waters	United States Environmental Protection Agency		2008	Guide-book	Electronic	How to develop a watershed plan	Developing indicators		

Story

Mikisew Cree First Nation Indigenous Knowledge Database

Mikisew Cree First Nation (MCFN) has participated in or initiated a number of projects that involved collecting IK from its community members. Industry and government regularly asks MCFN to provide feedback on IK from the community. MCFN Government Industry Relations (GIR) decided to gather and organise all of the existing IK research that had taken place in its community to help deal with these requests, make the best use of previous research, and build on it in future studies.

MCFN GIR:

1. Did a search of pre-existing research involving MCFN members,
2. Made a list or inventory of its IK documents in an Excel sheet to keep track of what it had, what it needed, etc,
3. Tracked down available hard copies and/or electronic copies of the research,
4. Gathered the IK documents into one place (e.g. electronic documents organised into folders, and physical documents organised into boxes or shelves).

Now, when the staff at MCFN GIR need to find information related to a topic or an individual, they can use the search function available in Microsoft Excel. This is a simple way to organise documents while determining how to use the documents currently and in the future.

Tip

Community members' IK may not be part of existing research or documentation regarding your watershed. The work of gathering this information can be initiated by your community.

GATHER EXISTING INFORMATION

When looking for information, keep in mind that you can gather this information from both western science and IK sources. In *Guidebook One*, you compiled all the existing IK studies that have taken place in your First Nation, so you can build on previous work. There may already be inventories or monitoring activities happening in the region that you can use and build on. Between all the members of the Steering Committee, you should have a good overview of what studies are available, and where to find the information you need.

This section will give you an idea of the kinds of questions you might want to ask in order to know your watershed, including the physical and natural features of the watershed, human uses of the watershed, current management of the watershed, and the condition of the waters within the watershed.

And now – start gathering! Take a moment to go back to the research questions you set out earlier (page 32, to remind yourself of the focus for your research. When you gather information about your watershed you will need to compile the right information for your needs at the right level of detail. You will need to be focused since there is undoubtedly a large amount of information that exists. If you try to compile as much information as possible you run the risk of spending unnecessary time and resources. The research questions will help you to manage the information you gather, as you can always check back to make sure it is relevant.

Tip

There may be projects or research that have already taken place in your First Nation that can contribute to your watershed planning process. If data collection is already happening, try to coordinate this work so there isn't a duplication of research, which is not a good use of resources and could result in community members feeling frustrated and reluctant to participate.

Physical and Natural Features

Understanding the physical (non-human) environment is critical to making effective decisions about the watershed. This means describing, in general terms at minimum, the climate, hydrology, topography, soil, plants and animals in the watershed. The information you gather can be both contemporary and historical, to show how the watershed has changed over time.

Watershed Boundaries

- [ ] Geographic boundary you are assessing

Use this information:

- To define the area of for the research and the plan

Vegetation

- [ ] Common vegetation
- [ ] Biodiversity
- [ ] Protected / sensitive areas
- [ ] Rare and endangered species – critical habitat
- [ ] Invasive species

Use this information:

- To provide background context to the study
- To identify and protect vegetation with particular cultural significance
- To identify and protect rare and endangered species

Hydrology and Hydrogeology

- [ ] Locations of surface waterbodies – flowing waters, still waters
- [ ] Groundwater movement
- [ ] Water yield
- [ ] Water flow through watershed, flow rates
- [ ] Instream flow
- [ ] Runoff
- [ ] Seasonal and yearly fluctuations

Use this information:

- To provide background context to the study
- To understand how various waterbodies throughout the watershed are connected, as well as the flows of water throughout the whole watershed and connecting with neighbouring watersheds
- To develop predictive models for the watershed

Topography

- [ ] Physical features (hills, slopes)
- [ ] Slopes of stream segments and watershed areas
- [ ] Areas with steep slopes (i.e. high runoff potential)
- [ ] Altitude changes
- [ ] Form and depth of water channels

Use this information:

- To provide background context to the study
- To identify unstable soils or river banks
- To better predict changes in and impact of precipitation from one area to another

These checkboxes list some information that you need to have. Some may be more important to your region than others; some may not apply at all. Databases or Excel spreadsheets can assist you in keeping track of what information you already have, and in which areas you still need to build an understanding.

Soil

- [ ] Soil type
- [ ] Infiltration rates
- [ ] Water holding capacity
- [ ] Sub watershed boundaries (based on soil type)

Use this information:

- To provide background context to the study
- To identify areas with higher erosion rates or poor drainage
- To better understand water runoff, absorption, and other patterns
- To develop predictive models for the watershed

Climate

- [ ] Annual precipitation (amount of rain, snow, at what times)
- [ ] Rates of rainfall, rainfall-runoff processes
- [ ] Average temperature
- [ ] Airflows
- [ ] Natural hazards – floods, drought

Use this information:

- To provide background context to the study
- To provide baseline information for comparison with previous baselines, and future information
- To develop predictive models for the watershed

Landscape Habitat

- [ ] Land form/cover
- [ ] Ecozones
- [ ] Numbers and types of wetlands/ wetland inventory
- [ ] Forest age
- [ ] Sensitive/rare habitats
- [ ] Parks, wilderness areas, protected areas

Use this information:

- To provide background context to the study
- To better understand the types of habitat (for plants and animals) present in the watershed
- To identify areas that are at risk of habitat loss or damage

Wildlife

- [ ] Common wildlife
- [ ] Biodiversity
- [ ] Keystone species/ cultural keystone species
- [ ] Keystone species/ cultural keystone species
- [ ] Invasive species

Use this information:

- To provide background context to the study
- To identify and protect species with particular cultural significance
- To identify and protect rare and endangered species

Defining an Aboriginal Base Flow for a River: How Much Water Does a First Nation Need To Sustain its Livelihood and Treaty Rights?

Alberta Environment and the Department of Fisheries and Oceans Canada have been developing a Water Management Framework for the Lower Athabasca River in northern Alberta. Through this Framework, they aim to understand the minimum levels of water required (e.g. Instream Flow Needs) to achieve ecological protection and integrity of the Athabasca River and minimise impacts from human water use.

Mikisew Cree First Nation (MCFN) Government and Industry Relations (GIR) wanted to ensure that MCFN's uses of the Athabasca River were taken into consideration within the framework. MCFN carried out an Athabasca River Use and Traditional Ecological Knowledge Study to document MCFN knowledge of the Athabasca River, how the river has changed over past decades, and how MCFN's use of the river has changed as a result. Key issues raised by MCFN participants in the study include issues of lower water levels and reduced water quality.

Through the results of the study, MCFN GIR developed two thresholds that define the ability of MCFN members to access their traditional territories and to practice Aboriginal and treaty rights by water navigation. The first threshold, an Aboriginal Base Flow, reflects a water level on the Athabasca River, adjacent streams, delta, and tributaries where MCFN members are able to practice their rights and access their territories fully. The second threshold, an Aboriginal Extreme Flow, reflects a water level at which widespread and extreme disruption of treaty and Aboriginal rights occurs in the area due to a loss of access to traditional lands related to low waters. These thresholds were based on the traditional knowledge of MCFN members. The measures will also assist MCFN in communicating the impacts of the proposed water framework on its rights to the Crown.

Story

Human Context

There are likely a large number of people (and their governments and institutions and companies) that have an interest in the watershed area where you are located. Some of these interests may be legal in nature, such as a license to use water or land for a certain purpose, or government-level authorities and jurisdictions regarding aspects of land and water management in a watershed (see page 58 for more on current watershed management). You can ask:

- Who participates in life, work, and play in the area?
- How do these individuals, groups, municipalities, industries, etc. use the water?
- How much water do they use?
- What impact do these uses have on the quality and quantity of the water and where and how does the water re-enter the ecosystem?

The human context in the watershed includes the economic uses of the watershed, as well as the ways in which the waters are important to humans for spiritual and cultural reasons. It also includes demographic information, to give a fuller picture about the people who live in the watershed. Gathering all this information will help you understand all the different ways water is currently used in the region, which is necessary for identifying potential stressors on the watershed.

You may want to also include historical information in the state of the watershed, such as records of first human civilisation, archaeological records, and treaty history. Including this kind of information sets out an understanding of the relationships and people who are present in the watershed. It ensures that decisions made about the watershed aren't made in a vacuum, and are based on the histories and current realities of everyone within the watershed.

You may have talked with your First Nation already about how water is used by members of the First Nation. Water may be used in the same way, or in other ways, by other people in the watershed. When considering all of the human activities and how they may negatively or positively affect the watershed, you can assess the watershed condition based on the broader pressures the watershed is facing.

Develop a table to answer these questions about human uses of the watershed.

Human uses of your watershed
Land Uses
What are the major land uses in the watershed? Are there past land uses that continue to have an impact on the environment?
What is the total amount of land that has been modified for human use?
What and where are your First Nation's land holdings?
Where do the waters used by the population for drinking come from? Where are the water and wastewater treatment facilities? What processes are used?
Population Characteristics
What are the demographics of the watershed's population? What is the population and density of human settlements in the region?
What is the predicted population of rural and urban areas?
What are the social and economic characteristics of the population?
Uses of Water
What are the main economic activities within the watershed? How is water used for economic purposes? How many water diversions exist in the watershed? Why are these diversion there?
What plants and animals are significant to your community and to the general public, as foods and medicines or simple valued?
What are the social and cultural uses of the water, by your First Nation, other Aboriginal communities, and non-Aboriginal communities in your area?
What are the areas and activities within the watershed that have high economic value to the people that reside there?
What are the significant natural, cultural and historical features of watershed?
How much water is allocated (e.g. through water licences)?
How much is actually consumed (i.e. withdrawn and not returned to the water system)?

	What are they? For example…	Where in the watershed do they take place?
	Economic uses, human settlements, transportation, protected areas	
	Number of hectares, percentage of the watershed, estimated growth rate of modified land uses	
	Reserve lands, treaty land entitlements, traditional territories	
	Groundwater, lake or river, drinking water facilities, wastewater treatment facilities, lagoons, septic systems	
	Numbers, age, occupation	
	Urban centres, First Nations, rural farms, estimated growth rate, timeframe	
	Levels of employment, levels of education	
	Fisheries, aquaculture, forestry, mining, transportation, agriculture oil sands development, dams and diversions Dams, culverts, canals Hydroelectric power, industrial uses, fish hatchery uses, to ensure water supply during low flows	
	Particular species of fish, plants, animals	
	Swimming, ceremonies, traditional foods	
	Large and small industry, resource development, hunting and fishing, agriculture, tourism	
	Sacred sites, burial grounds, nesting areas for birds	
	Number of litres, surface water and ground water, private, communal and municipal water supplies, industrial, commercial and agricultural water	
	Number of litres, percentage of total flow	

Finding spatial data (e.g. maps) of this information will be the best way to look at locations of human uses and how they all fit together

Watershed Management

You will only be able to make a watershed plan when you understand how the watershed is currently being managed. You will need to consider whether the current management practices are the best management practices available, and, if needed, propose alternatives. This will involve different levels of government (municipal, provincial/territorial, federal, First Nations) and their related departments (e.g. environment, health, Aboriginal, industry, natural resources). (Check back to page 42 if you're not sure where to find this information.)

Some questions that should be answered include:

- What legislation, policies, regulations, or management plans exist related to water resources?
- What legislation, policies, regulations, or management plans exist related to land or land management?
- Which departments in each level of government are involved with land use and water use planning in your watershed?
- What are the inter-jurisdictional arrangements, relationships and policies related to water management in your watershed?
- What are the relevant First Nation policies, band council resolutions, bylaws, and comprehensive community plans related to water and land management?
- What bodies (e.g. committees, organisations, conservation districts) are involved in water and land management in your watershed and what are their roles? What responsibilities do they have (for example, under relevant legislation or management plans)?
- Are there any current litigation or conflicts/ disputes taking place in the region relating to water issues? To land uses?

More Details

The following federal government agencies are typically involved in water management on First Nation reserve lands:

- Aboriginal Affairs and Northern Development Canada funds the capital costs of plants and piped systems,
  and a portion of their operating and maintenance costs and enforces certain standards through funding agreements
- Public Works and Government Services assists with procurement and currently provides engineering advice and approvals
- Health Canada ensures the delivery of drinking water monitoring programs located south of the 60th parallel, either directly or in an oversight role
- Environment Canada is involved in source water protection through its powers to regulate wastewater discharge into federal waters or into water generally where water quality has become a matter of national concern, and to enforce standards for effluent discharge standards into water throughout Canada
- The Department of Fisheries and Oceans is involved in water and fish habitat issues.

Currently, there is no federal regulatory framework regarding water that applies to First Nation reserves. (Swain, Louttit and Hrudey, 2006).

What authorities and responsibilities do governments have in the watershed?

The responsibilities to manage watersheds are shared among the four levels of government that affect the lands and waters in the region. It is important to know about the legal authorities that others have in the watershed, in order to use resources more efficiently and to make sure the right people are involved whenever there are questions about particular aspects of watershed management.

Here are some examples of the authority of each level of government:

First Nations:

- Management of all water and lands within reserve areas
- Consultation and input on water and lands within traditional territory.

Municipal:

- Land use planning
- Water and waste management planning.

Provincial/Territorial

- Drinking water
- Forest management
- Transportation.

Federal

- Setting of limits for levels of waste effluent that may be discharged into waterways
- Regulating development of all kinds (mining, oil and gas, etc.)
- Monitoring environmental changes
- Managing fisheries.

Responsibilities are often shared between the province/territory and the federal governments (e.g. drinking water regulation), with each taking on a different part of the responsibility.

More Details

You can also include a history of watershed management planning in the area in the State of the Watershed report. This overview could include:

- Who has been involved and when?
- What have been the main issues regarding land and water management in the area?
- How have these issues been addressed (both proposed and implemented actions)?
- How successful were these actions?
- What issues remained to be addressed?
- What were the challenges or lessons learned from the management process over time?

By reviewing past management practices, the Steering Committee can learn from the successes and challenges of the past, understand any historical issues between different groups that still require attention, and build on the successes and best practices previously developed.

Story

Including a Planning History

The Jamestown S'Klallam Tribe lives along the Dungeness River in Washington State, USA. In 2007, the community created a watershed plan to identify goals and a management plan to address concerns relating to sources of pollution in the watershed.

The Dungeness River Management Team, which includes representatives from four levels of government (including the Jamestown S'Klallam Tribe) and a number of stakeholder organisations, acts as a forum for discussion about the watershed. Between 1988 and 2007, a number of watershed plans and processes were carried out in the Dungeness River watershed, and rather than starting from scratch, their 2007 plan drew on a number of existing planning processes and technical reports. These included a flood control plan, a watershed management plan, a water resources management plan, a comprehensive water conservation plan, and a salmon recovery planning process. Their 2007 plan reviews these processes to provide some historical context to the new plan, and it includes a reference list of key reports in an appendix (Jamestown S'Klallam Tribe, 2007).

The water ceremony is reflective of the long-standing belief in the spirit world that is part of all life. This teaching can be understood as one of the 'doorways' that opens to a lived world view in which gepmite'taquan (respect), ta'n telmi'wat'mg goqwei (giving thanks), and ta'n tel gegnu'mimajultimg (ceremony and protocol) are recognized as integral principles to the traditional Mi'gmaq ways of governing. Through ceremonies, we are reminded of our agreements with all beings – with the water, and with all the beings that depend upon the water.

~ F. (Gopit) Metallic (2008, p.64)

Quote

GATHERING NEW INFORMATION

After compiling the existing information, take some time to determine what new information can and should be collected about the watershed. This will involve reviewing the information you've gathered to identify gaps, and then gathering new data to fill in those gaps. This new information could be from IK or western scientific sources.

As you work through this section, go back to your research questions and the scope you set out (see page 32). Make sure that the information you gather answers the research questions, and stays within the scope of the research.

Bringing IK and western science together

Sometimes IK and western science can work together to increase the overall understanding of the watershed. For example, if western scientists have identified gaps in their knowledge about the watershed, IK can contribute additional information. It can also confirm or contradict the western scientific research, leading to stronger analysis and more in-depth studies. Similarly, if knowledge holders or resource users have identified a concern in the watershed, western science can provide an avenue to examine the concern at a different level (e.g. toxicological studies of fish tissues).

In both cases, the western scientist and IK holders should work together to identify the concern, issue, or gap that is to be addressed, as well as the process that will be used. If you undertake this kind of partnership study, make sure that it follows your First Nation's IK protocols. (See *Guidebook One* for information on developing an IK protocol)

Identifying Gaps

As you review these documents to determine what environmental information is available, identify any gaps that need to be filled in order to understand the state of the watershed. Keep in mind what the Steering Committee has identified as important information to collect, as well as the priorities and concerns of your First Nation, to look for gaps in existing research. Some questions to consider might include:

- What information (e.g. studies, reports, data, analyses) do we have?
- What topics does it cover? What is not covered?
- Does it go into enough detail? Do we need more details? About what?
- What geographic areas does it address?
- When was the information produced? Is it still current or is it out of date?

Any gaps you find will be filled in by gathering new information.

Tip

For example, perhaps you have information about the impacts of water quality on fish health and aquatic plant health. The fish studies were carried out 10 years ago and are out of date, but the aquatic plants study is only a year old and is very detailed. You don't have any data on land animals or human health. Your review of existing data tells you that you have good information about aquatic plants, but you need to update your fish studies, and develop studies about land animals and human health – those are gaps in your research.

Indigenous Knowledge

Use the background work you did in *Guidebook One* and in this guidebook to identify future studies that need to be completed to gather IK about the watershed. You may have identified some gaps or found that there are aspects of the watershed that haven't been explored and documented with the knowledge holders and resource users of your First Nation.

Story

Incorporating Traditional Ecological Knowledge

When the Collaborative Environmental Planning Initiative (CEPI) was developing its Environmental Overview and Assessment (EOA) Report for the Bras D'or Lakes area, in partnership with a contractor and the Department of Fisheries and Oceans, the group members were unsure how to incorporate Traditional Ecological Knowledge (TEK) into the document. They invited Elders from the five Mi'kmaq communities to come to a meeting to review the draft document and provide input on how TEK should be gathered. They suggested that CEPI host a workshop for Elders in the Bras d'Or area to discuss observations of ecological change. The workshop was held in May 2006 and the discussions of the Elders helped to "support the scientific literature and fill in gaps identified in the EOAR" (CEPI, 2006, p.6).

The TEK shared at the meeting included discussion of:

- Declines in a number of plant species, including eelgrass, wild berries, mint, hazelnuts, alder and black ash
- Changes in animal populations, including declines in deer, and increases in moose and coyote populations
- Declines in a number of fish species, including oysters, herring, cod, salmon and trout, as well as a reduction in the numbers of spawning grounds for fish
- Declines in the numbers of eels, due to construction of bridges
- Erosion and siltation along the shore and in the watershed
- Changes in the climate in recent decades, and the impact this has had on the plants and animals in the watershed. (CEPI, 2006).

The TEK Workshop Proceedings were incorporated into relevant sections of the EOA Report and the full document was added as an appendix.

You will also want to consider how the information you have found links up with the watershed priorities and concerns identified by the Steering Committee: what IK does the Steering Committee think is important to inform the watershed plan? If you have a sub-committee of knowledge holders/ resource users, work with them to determine what knowledge should be explored and the best way to gather and share this knowledge.

There are a number of different topics that can be explored with knowledge holders and/or resource users, such as:

- Observations of changes to the watershed
- Indigenous indicators for watershed health
- Community land uses (e.g. hunting, trapping, gathering, sacred sites, place names)
- Observations of plant/animal habitats/ behaviour.

You can do a number of activities to collect additional IK information such as:

- Community based monitoring
- Map biographies (i.e. "an account of a person's life on the land, sea or ice, as recorded on a map (and audio recording) during a face-to-face interview" (Tobias, 2009, p.38))
- One on one interviews or focus groups for particular topics
- Group workshops.

How you will gather the information will depend on what you are looking for and the methods of data collection that work best for the knowledge holders and resource users.

Tip

When you are gathering information from community members, talk about how it will be used. Ask permission to use the information for other water-related activities the Nation is involved in. Go back to people who have shared their knowledge in the past and confirm that you can use it for this new process so that they are aware of how they are contributing without having to answer the same questions again.

More Details

Showing IK and Relationships with the Land Through Mapping

One way to record and demonstrate IK about the watershed is to create maps that illustrate that knowledge. Land use mapping is a tool that many First Nations use to show where and how people have relationships with the land, whether in the past or currently. These maps can show locations for hunting, fishing, gathering of plants and materials, cabins, spiritual or sacred sites or areas, cultural sites or areas, and so on.

These maps can be used as part of land use planning processes, to manage resources, to address shared areas among First Nations, to support treaty and land claims with the federal government, and to understand and predict the impact of development. Carrying out this kind of research enables First Nations to prepare themselves for negotiations or discussions with governments or resource developers, and to participate in long-term planning to benefit the First Nation.

The process of gathering the information required for land use mapping can be quite involved, as it requires extensive interviews with resource members and knowledge holders. The information is gathered and compiled using GIS (geographic information systems) or other mapping software. The data can be used to create maps showing various kinds of information, and can be updated as needed.

In many cases the information collected from various knowledge holders may be confidential (e.g. a fisher may not want to share his or her best fishing spot, or a sacred site may not be for public knowledge). Although it is important to gather the detailed information, the information can be presented in a generalised way on public maps so that confidential information is not shared. Maps with more detailed information can be held in confidence by your First Nation, and only shared with others as required.

For more information about land use mapping, see *Chief Kerry's Moose: A guidebook to land use and occupancy mapping, research design and data collection* and *Living Proof: The essential data-collection guide for Indigenous use and occupancy map surveys*. (Terry Tobias, available at http://www.ecotrust.org/publications/chiefkerrysmoose.html and http://www.ecotrust.ca/first-nations/new-book-use-and-occupancy-map-surveys-now-available).

Western Science

Western science is accepted and even required by the Western policy and decision-making world. Although it is very important that your First Nation document its IK, there are a number of benefits to also collecting western science data, both with the Steering Committee and for your First Nation.

Western science uses different tools from IK to gather information, and gathers and analyses data at physical levels that IK doesn't. Implementing projects to gather information through western scientific methods can serve as a way of increasing awareness among the First Nation membership about western science methods for monitoring the watershed. This could also be a great opportunity to build environmental technical capacity (as discussed on page 3). In some cases where the First Nation's membership is concerned about the validity of data from other sources, gathering your own data using western science methods can give the members greater confidence in this information.

As you reviewed the scientific reports and data gathered about the watershed, there were undoubtedly questions or gaps that came up that will need to be addressed. The type of study that you will use will depend on the issue or gap (e.g. water quality monitoring, bio-accumulation of toxins in fish). Talk to biologists, hydrologists or other science specialists to determine the best strategies to use, how to set up this kind of research project, and to see if there are ways to incorporate students, knowledge holders and resources users (e.g. provide training) in your First Nation in the studies.

For example, it may be possible to develop a regular water monitoring program where students from the elementary school learn about watershed health and spend a few days a year gathering water samples from certain areas. Or it may be possible to hire resource users to note when or where they see or harvest particular animals, fish, or plants, or to collect samples of animals, fish or plants for testing.

Starting a Community-Based Monitoring Program

Shelley Denny, a biologist at Unama'ki Institute of Natural Resources (UINR) is leading a long-term community-based monitoring program to investigate biodiversity in the shallow waters of the Bras d'Or Lakes. The Community Aquatic Monitoring Program (CAMP) is a Fisheries and Oceans program that is carried out in the Gulf of St. Lawrence. CAMP provides community members with the opportunity to learn about the lake and take responsibility for its health. Members from Membertou First Nation, Eskasoni Fish and Wildlife, Stewards of River Denys Basin, Collaborative Environmental Planning Initiative, UINR, students from an Eskasoni First Nation Grade Six class and local representatives from the Department of Fisheries and Oceans attended the training for the CAMP.

In 2009, participants were trained as CAMP volunteers and carried out a CAMP program in the Bras d'Or. During the summer, participants began monitoring six sites to gather information about fish, crustacean and vegetation populations, salinity levels, water temperatures, and dissolved oxygen levels. Shelley notes that this program is helping UINR in many ways:

- "It gets us into the communities, building relationships with fisheries staff and community volunteers
- It allows us to see what beautiful sea life is just outside our communities at different times of the year
- It allows us to develop skills for fish identification, seaweeds, and invertebrates and transfer that knowledge to the volunteers
- It provides baseline data for what is there now and will provide an early warning system if things change because we will know what is the norm
- This area of the shoreline is the most impacted from land based activities. It needs to be studied in a respectful manner over time to give us the best picture.
- It provides an opportunity to develop relationships with the species that we find. We are more respectful of the water and the land when we know what we are affecting and are more aware of our actions" (S. Denny, personal correspondence, January 11, 2011).

This knowledge and the process of monitoring increased the community's ability to react to changes in the ecosystem and articulate the actions needed to protect the health of the watershed. The participating community members gained awareness of the species that are found just outside their communities and of the responsible actions needed to protect these species and habitats. UINR hopes that this will be a continuous monitoring program with their communities.

Story

BRINGING IT ALL TOGETHER

Most of the information you've gathered so far is for the first part of the State of the Watershed report, characterising the watershed, as it describes the physical aspects of the watershed. The next section, assessing the health of the watershed, is an analysis of the information to determine the current condition and health of the watershed. (See page 28 for more about what goes into the State of the Watershed report).

Once you have basic information on the physical and natural environment and how it is used and managed, you can integrate your analyses of this information to come to conclusions about the level of overall health of the watershed. These conclusions are necessary to identify the kinds of restoration or changes in management processes that the watershed plan will require. Some aspects of the watershed may be in better health than others, and this final analysis will help to pinpoint the aspects that the plan should focus on.

As you write up your conclusions, you may begin thinking about solutions to address the concerns and challenges facing the watershed, or about further research that will be needed to focus on particular concerns. These solutions and further research will be incorporated into the watershed plan itself.

Quote

Water does not exist solely for human beings. All of life has access rights to the use of the water and its gifts. Exploiting the water to human ends will ultimately mean the break with the relationships to other parts of Creation: the animals, the land, plants, the birds, land and sky.

~ R.E. Mzinegiizhigo-kwe Bédard (2008, p.98)

Analysing Water Health

Here are some questions to consider concerning the health of the waters in your watershed.

Water Quantity

- What are the current surface water levels in the watershed? How do these compare with historic levels?
- What is the impact of the current water levels on the health of the watershed (i.e. is there sufficient water available to maintain ecosystem health)?
- What are the current groundwater levels in the watershed? How do these compare with historic levels?
- Is groundwater being replenished at the same rate that it is being consumed? Are the aquifers recharging?
- Are water levels managed to control flow (e.g. through dams)? If so, how does this affect the water levels? Where in the watershed is this infrastructure located?
- Are any, and if so which, areas of the watershed experiencing stress due to current practices of removing water from the watershed?

Water Quality

- How is water quality determined? What are the indicators or water quality? What tests are performed? Are tests performed at the local, regional, or watershed scale?
- What is the level of water quality? Is it different throughout the watershed? What is the quality of water required for ecosystem function?
- Is the water drinkable for the human populations in the watershed? For the non-human populations?
- Are there areas of surface water or groundwater within the watershed that are known to be contaminated? That are suspected to be contaminated? If so, what types of contaminantes?
- What are the point sources of pollution (e.g. industrial discharge, wastewater discharges) and the non-point sources of pollution in the watershed (e.g. run-off from roads, septic field discharges)?
- Are there historic sources of pollution that continue to have an impact on watershed health today (e.g. an factory that has closed, previous forestry practices)?
- What is the impact(s) of the pollution or contamination on the health of the humans in the watershed? On the plants and animals?
- What is the cumulative effect of pollution from human activities on the watershed?

Water Flow

- What are the effects of human changes to the environment (e.g. paved surfaces, clearcutting) on water flows?
- Have changes in land use (e.g. from forest and wetlands to farms and urban areas) altered the way water flows?
- Have critical habitats for a healthy watershed been destroyed (e.g. drained wetlands, removal of vegetation? Where in the watershed has this taken place?
- What has been the impact on the water flow and the overall health of the watershed?
- What hydromodification has taken place in the area? Where?
- What has been the impact of these modifications on water and watershed health?

Watershed Management

- Have previous plans, policies, regulations or legislation addressed the watershed concerns identified above?
- What has been the approach to address these concerns, whether individually or holistically?
- How successful have previous plans, policies, regulations, or legislation been at addressing these concerns?

More Details

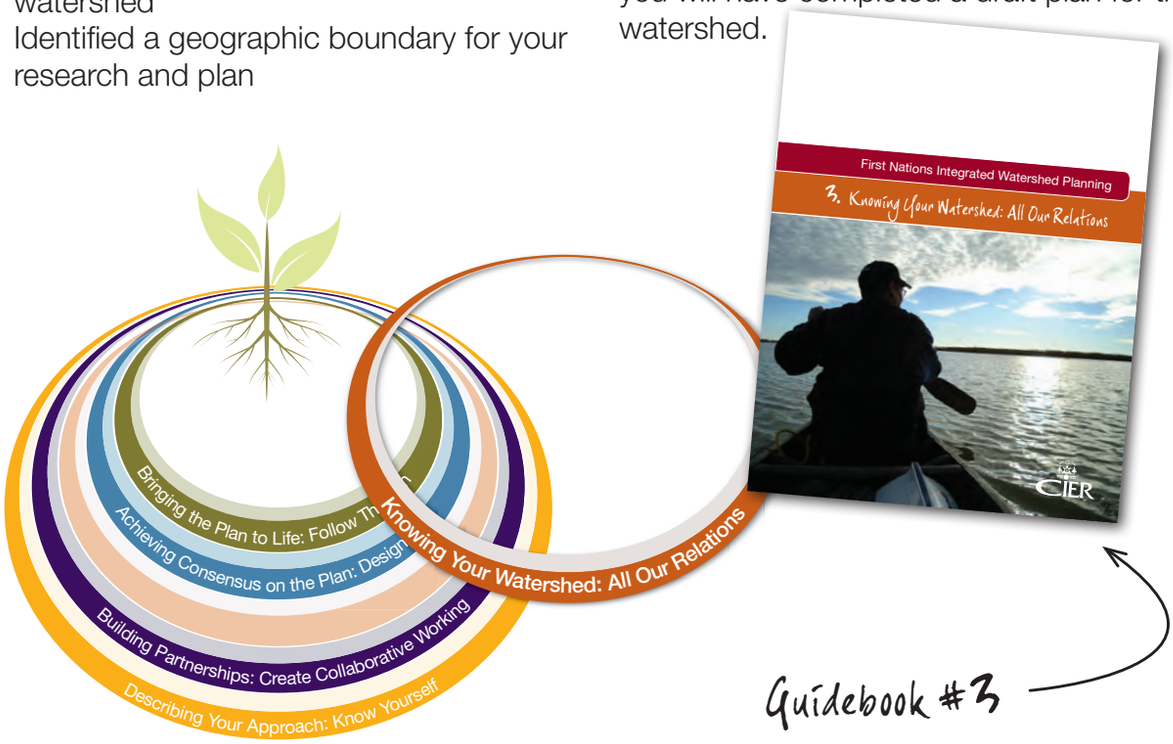
CONCLUSION

This guidebook focused on the technical information required to develop a watershed plan. Beginning with an overview of basic concepts in watershed planning, it then described what a State of the Watershed report looks like and considerations for preparing to gather information, gathering existing and new information and bring all the information together to assess the watershed.

At this point, if you've worked your way through this guidebook, you will have:

- A basic understanding of what a watershed is, the services it provides, and how the hydrologic cycle works
- Compiled a list of concerns and priorities, based on community input
- Involved knowledge holders in the development of your research plan
- Research questions about your watershed
- Identified a geographic boundary for your research and plan
- Developed a database to track information as you find it
- Identified a number of potential sources of information
- Have an idea of the information on the physical and natural features of the watershed, the waterbody and watershed condition, human uses, and watershed management processes that you will need.

The next guidebook, *Achieving Consensus on the Plan*, looks at the steps to complete the watershed plan. Beginning with a vision for the watershed, it takes you through the development of goals, priorities, objectives and actions, as well as indicators and an evaluation plan. Building on the work you have completed through the first three guidebooks, and the relationships developed here, by the end of the next guidebook you will have completed a draft plan for the watershed.



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Appendix 1: Ecosystem Services

Services provided by freshwater ecosystems (from Brandes et al 2005)

Service	Importance
Provision of water supplies	Greater than 99 percent of industrial, irrigation and residential water supplies worldwide come from natural freshwater systems
Regulation of ecosystem function	Ensures essential ecological processes and fundamental life support systems continue
Flood mitigation	Functionally intact freshwater systems buffer stormwater flows, reducing flood damage
Drought mitigation	Functionally intact freshwater systems absorb rainwater, slow runoff and help recharge groundwater
Maintenance of coastal zones	Freshwater flows maintain the salinity gradients that are critical to the biological diversity and productivity of deltas and coastal marine environments
Recreational opportunities	Freshwater ecosystems are sites for swimming, fishing, hunting, boating, wildlife viewing, and so on
Hydropower generation	Flowing freshwater ecosystems provide opportunities for both conventional hydropower generation and more environmentally sensitive micro-hydro options
Provision of habitat	Rivers, streams, floodplains and wetlands provide habitat and breeding sites for numerous aquatic, avian and terrestrial species
Biodiversity conservation	Freshwater and riparian ecosystems harbour diverse assemblages of species that support many of the services in this table and also conserve genetic diversity for future generations
Provision of food	Fish, shellfish and waterfowl are important food sources for people and wildlife
Sink services	Healthy freshwater systems possess an ability to absorb and neutralise pollution. For example, micro-organisms play a critical role in groundwater purification breaking down organic wastes, including petroleum hydrocarbons and synthetic halogenated organic compounds
Water purification	Wetlands filter and break down pollutants, enhancing water quality
Nutrient delivery	Freshwater systems store and transport nutrients within the watershed
Soil fertility maintenance	Functional river-floodplain systems constantly renew the fertility of surrounding soils
Land subsidence prevention	Groundwater stored in aquifers prevents land subsidence and reduces erosion through absorption of runoff
Aesthetic, cultural and spiritual values	Natural freshwater systems are sources of inspiration and deep cultural and spiritual values

Appendix 2: Factors Affecting The Vulnerability Of The Watershed

Provision of Human activity	Factors that can contribute to an unhealthy water system	Concern
Agriculture	Landscape modification (cropland, wetlands drained, trees removed)	Increased runoff, reduced/eliminated habitat, erosion
	Improperly managed agricultural lands	Sediment
	Overuse of fertilizers, herbicides and insecticides	Nutrient and toxic chemical pollution
	Unrestricted livestock grazing	Bacteria and nutrient pollution, reduced plant cover, reduced food supply for birds, mammals, etc
	Inefficient irrigation practices	Salt, selenium build-up, erosion/ sediment
Forestry	Landscape modification (clearing logs, building roads)	Increased runoff, forest fragmentation, reduced nutrients to aquatic system
	Improperly managed forests	Sediment, erosion from loss of trees
	Loss of tree cover	Change to water temperature
Mining	Acid draining from abandoned mines	Toxic chemicals
	Direct industrial discharges to surface waters	Toxic chemicals, thermal pollution
	Gravel extraction	Channel separation, erosion, sedimentation, fish mortality
Oil and gas	Landscape modification/habitat fragmentation (cutting seismic lines, constructing roads and pipelines, installation of extraction facilities)	Erosion, forest fragmentation
	Release of pollutants	Oil, grease and toxic chemicals
Urban Development	Landscape modification (concrete – impervious surface, removal of trees and vegetation, drained wetlands)	Increased runoff that can lead to higher flows in storm events, reduced plant and animal habitat, non-point source pollution
	Urban runoff from motor vehicles, failed septic systems, stormwater discharges, road salts, roof shingles, motors, lawn and garden care	Pollution, including oil, grease, toxic chemicals, bacteria, nutrients, heavy metals, fertilizers, herbicides, insecticides
	Water heated on dark surfaces	Thermal pollution
	Malfunctioning sewage treatment plants	Release of nutrients, bacteria
	Power plants, factories, trucks, automobiles	Atmospheric deposition of pollutants
	Improperly managed hazardous, municipal and private land-fill sites	Pollution

Appendix 2 (continued)

Provision of Human activity	Factors that can contribute to an unhealthy water system	Concern
Infrastructure/ hydro-modification	Improperly managed construction sites	Sedimentation and toxic chemicals
	Dams	Altered flows, changes to temperature or dissolved gases, increased sedimentation, increased mercury levels, disruption of plant and animal habitats
	Channel modification (e.g. straightening, widening, deepening, and clearing channels of debris and sediment)	Increased delivery of pollutants to the water, can lead to higher flows in storm events, increased risk of flooding
	Construction of levees/dykes	Constricted access to side channels, constricted water flow, increased velocity and depth of flows, reduced groundwater contribution to stream
	Development of roads, highways and bridges	Constricted access to side channels and floodplain, inhibited sediment transport, floodplain function, pollution from construction materials, reduced/eliminated wetland habitat and filtration function, sedimentation and toxic chemicals
	Culverts installed (with roads)	Restricted flows, reduced sediment transport, contribute to flooding, impact on fish habitat
Marinas and boating	Boat maintenance, fueling operations, parking lots	Pollution (including discharge of sewage from boats, stormwater runoff, nutrients), decreased oxygen (eutrophication), high levels of pathogens, physical destruction of sensitive ecosystems and bottom-dwelling aquatic communities.

Appendix 3: Plans or Reports That May Relate to the Watershed Plan

Reports covering whole area
Watershed analysis/ improvement needs
Climate change impact analysis/scenarios

Assessment/inventory reports
Nonpoint Source Assessment Report
Industry environmental assessments
Instream flow needs assessment
Hydrologic assessment
Water resource inventory
Culvert inventory

Documents on wildlife/vegetation
Fish/Shellfish/Salmon protection/recovery plan; spawning area protection plan; habitat protection plan
Invasive species removal
Geomorphic/habitat assessments

Planning documents
Water quality management plan
Irrigation management plan/program
Water conservation plan (at multiple levels; household, agriculture, ditches, drainage/seepage)
Wellhead protection plan
Source water protection plan (more extensive than wellhead only)
Drought response plan
Flood control management plan
Flood response/preparedness plan
Industry sector plans (e.g. forestry management plan)

Restoration projects (e.g. for roads, bridges, dams or other structure on or near the waterbody involved)

Local/Traditional Knowledge
Local land use studies
Comprehensive community planning (vision, values)
TEK Studies

The First Nations Watershed Planning Guidebooks offer an approach to watershed planning that is led by and grounded in the voices, values and priorities of First Nations.

This guidebook discusses:

State of the Watershed

Indigenous Knowledge,
Western Science

Natural Features

Human Context

Watershed Management