

CHAPTER NINE

FIRE AND WATER

Establishing a Roadmap for Adapting to Climate Change Effects on Water

The Okanagan Basin is a semi-arid valley in south-central British Columbia that has a growing population, significant agricultural development and areas of stressed water resources. Statistics Canada identifies the Okanagan as having the smallest per capita freshwater availability in Canada.

I have to admit I always arrive in the Okanagan with a mixture of delight and trepidation. It is a beautiful place and hospitality there is unfailingly warm and generous. I consider the Okanagan Basin Water Board to be one of the best organizations of its kind in the country and I am always excited to see what they are doing.

My trepidation resides in this region's utter vulnerability to the climate disruptions that are beginning to characterize a new normal in the rest of the country and continent. Every time I go there, the Okanagan reminds me of so many other places where I have observed first-hand what appears to me to be a lethal combination of factors that could very quickly add up to hydro-climatic disaster.

When I land here by plane, I think of the Middle East and in particular Israel with its dry hillsides, dusty mountaintop forests, and its precious valley lake kept, with enormous sacrifice, at a level that sustains its tourism appeal. I am reminded also of the American Southwest, and in particular Phoenix, Arizona, where in the midst of the severest aridity anywhere in the US we find the country's most profligate water use.

Despite the fact that the Okanagan is the driest inhabited region in Canada, per capita water use is around 675 litres per person per

day, more than twice the national average and six times the per capita use in water-conscious cities elsewhere in the world.

I think too of California: its exploding population, with climate warming now superimposed over a newly revealed history of century-long droughts and mega-floods, and how the state's powerful economy can suddenly, within a single year, seize up for want of water.

I also worry about the Okanagan in the context of what we are beginning to see happen in the rest of Canada. It appears that changes in hydro-climatic conditions are beginning to cascade through every ecosystem in the country. Recent research demonstrates that if this trend continues, the Canadian West is going to be a very different place. This same research also makes it clear we are not going to have to wait until the end of the century for a new and very different West to come into existence. It is happening now.

When I see what is happening in the interior of the continent, I cannot see how sooner or later these changes will not somehow affect the Okanagan in a profound way. I shudder to think of the region's vulnerability. I worry that it won't be long before the relative stability the people who live there have enjoyed may be disrupted. In saying this I do not wish to imply that this is the end of the world. They know what they need to do in the Okanagan. But what is happening elsewhere in Canada and the rest of the world should add urgency to their efforts. The people of the Okanagan have already experienced disaster. They know what can happen when the rain fails to fall.

OKANAGAN BURNING

It was August of 2003 and there had been no rain in the valley for 44 days. The weather had been hot, with daytime temperatures of over 30°C for weeks. Winter snowpacks, lower than average to begin with, had long since disappeared. This was the driest summer since 1899 and there were no signs the drought was about to end. Rapidly growing populations and the need to keep the level of Okanagan Lake at acceptable levels for the region's critical tourism economy had put huge pressure on already limited water supplies. Rationing had been imposed in the cities, but conservation was not

saving enough water to meet all needs. Deep and persistent drought was breaking down water governance structures. Various jurisdictions – from irrigators in rural districts right up to the provincial and federal governments – began arguing over which users were legally entitled to water first. Trout Creek was not the only dispute over water that summer, but what happened there put climate-related water governance challenges in this basin and elsewhere in Canada into stark relief.

Trout Creek enters Okanagan Lake near Summerland, BC. As the second-largest tributary to the lake, Trout Creek provides domestic and agricultural water supply as well as supporting important sport fish – notably rainbow trout and kokanee. In 2003, water storage and intake diversions for irrigation resulted in greatly reduced streamflow. As the drought progressed, less and less water remained in Trout Creek. When ordered by Fisheries and Oceans Canada to restore flows to levels that would protect aquatic ecosystem health, the municipality of Summerland refused to do so, arguing that human needs had to be met first. But it wasn't just the shortage of water that had everyone on edge. Water exists in close relation to its symbolic and diametric opposite, fire. Apprehension about the fire hazard in surrounding forests had been growing for good reason. Without rain, neighbouring timber had completely dried out.

On August 16 the worst fears of emergency services experts were realized. What some have called one of the greatest natural disasters in the history of British Columbia was sparked by a typical summer lightning storm in the middle of the night. The fire started in Okanagan Mountain Park, a 10,000-hectare wilderness that separates Kelowna from Penticton. It was so hot and dry that when lightning struck a single tree it instantly candled into a fireball. Before the resulting conflagration was brought under control, 25,000 hectares of forest had been reduced to ash. Canadian Forces were called in, and 30,000 people – a third of Kelowna – were forced to flee their homes in what became the second-largest evacuation in Canadian history. Though no lives were lost, 250 homes burned to the ground. Damage to built structures and public infrastructure was in the hundreds of millions of dollars.

After the smoke cleared, the residents of the Okanagan rebuilt, but with new respect for what the relationship between climate and water might mean to their future. What the Okanagan Basin Water Board learned for the future is that, under some climate models, the conditions that occurred in Europe and in parts of North America in 2003 could on average be presenting themselves every second year by 2030. Models suggested that similar conditions might arise in one of every four years in the Okanagan by 2018. The board discovered also that they could not adapt to such circumstances under current water governance structures and institutional arrangements.

New ways of managing water are necessary if communities in the Okanagan basin are to become sustainable in the face of a warming climate in what is already the driest inhabited region of Canada. With the help of a wide range of provincial and federal agencies and many local partners, the Okanagan Basin Water Board has started down the difficult road toward policy reform as a means of adapting to climate change. Ten years later, however, the members of the board are still worried that accelerating climate change effects may cause the road they are on to disappear from beneath them before they reach their goal. Evidence from around the world suggests this is not an unreasonable fear.

THE OKANAGAN IN THE ANTHROPOCENE: SOME POLICY RESPONSES

There are very knowledgeable people all around the globe who consider that the hydro-climatic change we are seeing is just one manifestation of much broader effects which human numbers and activities are having on the Earth system. As was noted in earlier chapters, it is being put forward in enlightened scientific and policy circles, not just abroad but also here in Canada, that our impacts are of such a scale that we have, in essence, entered a new geological era in which human activities rival the processes of nature itself. The proposal is to call this new geological era the Anthropocene.

The foundation of the Anthropocene rests on new understanding of how the Earth system actually works. Four components in tandem appear to regulate the stability that makes conditions for life on this planet possible. These include the atmosphere: the air we

breathe; the hydrosphere: the water we drink; the cryosphere: the refrigerating influence of the Earth's snow, glaciers and ice sheets; and the biosphere: the living elements of our planet.

Through our emissions we have changed the composition of the atmosphere, and our land use changes and water demands have altered the hydrosphere. Rising sea-surface temperatures are shrinking the cryosphere, and our agriculture and expanding global presence are reducing biodiversity. As a consequence of these compound impacts our climate has begun to change.

From a practical point of view, the idea of the Anthropocene is not as frightening or illogical as it might at first appear. What the concept recognizes is that humanity has in itself become a major force in changing the nature of the Earth's surface. It is hard to deny this. We are veritable chimneys of emissions. At 40,000 parts per billion, our exhaled breath contains a hundred times the concentration of carbon dioxide found in the atmosphere. Seven billion people and their livestock generate seven billion tonnes of carbon dioxide in addition to the 30 billion tonnes we generate burning fossil fuels. Our collective and cumulative breath keeps the world warm. In addition we have become a force in our own right in terms of weathering and erosion. We have also altered global carbon, nitrogen, phosphorus and water cycles. We are causing changes in the chemistry, salinity and temperature of our oceans and the composition of our atmosphere. In tandem our effects are now significant enough to alter weather and climate patterns globally. The concept of the Anthropocene is interesting in that it calmly and dispassionately recognizes that we have changed the terms and conditions of life on Earth. No one intended that humanity should have such an impact on Earth. The Anthropocene concept simply suggests that we should recognize those impacts and manage them.

While many may not agree, some are suggesting that in a way it is a relief to enter the Anthropocene. The idea of naming this new era is that we should stop ignoring what we have done and are doing and start recognizing what we have become. We are now a force of nature, and as such we need to act accordingly in the interests of our long-term survival. We have no choice now, for example, but to work with a changing climate, not against it. We have to prepare

for deeper and more persistent droughts and more powerful storms and more frequent flooding, because that is what we are likely going to get. We can already guess what it is going to be like on the prairies. The Anthropocene there – as we saw in chapter seven – is likely to be a very turbulent era.

If there were to be an iconic image of the Okanagan in the Anthropocene, what might that look like? While the Okanagan has greatly benefited from climate disruption to the extent that warming winter temperatures have made the wine industry successful, attention must be paid to changes that are occurring all around us. Researcher Scott Smith has projected that rising temperatures are expected to double the rate of evaporation in the valley bottom. These faster evaporation rates are expected to increase the fire hazard in the Okanagan basin even if precipitation increases.

Like the rest of the country, the Okanagan should also expect more frequent and intense weather events. Flooding, landslides and debris torrents will become more common. Disasters may be triggered more by extreme weather events than by changes in overall weather patterns.

Preserving prosperity in the Okanagan in the Anthropocene will demand that those who live there decide collectively what hydrological and climatic steady state they want and then set self-regulation on the road to achieving those conditions. Some of the best people on this continent are working on these problems. What may be needed now, however, is a greater public sense of political urgency.

No one knows better than the Okanagan Basin Water Board that the watershed basin is the minimum unit at which water must managed. This fact in itself – that basin-scale water management is critical to social, economic and environmental resilience amid changing hydro-climatic conditions throughout the Okanagan – will hopefully inspire greater local action.

The Okanagan is responding to the need for effective water management and has made significant progress in preparing for the anticipated impacts of climate change and population growth with the development of adaptations for water management. Through continuous research since 2000, which that has included climate trend analysis, general circulation model application, and hydrologic

modelling and analysis, scientists have been able to identify a broad range of expected influences of climate change on water availability in the Okanagan basin. These include a decline in lake inflows; a change in streamflow timing, with earlier onset of seasonal peak streamflow and an extended low-flow period; increased frequency of drought and/or longer drought periods; and an increase in agricultural water demand due to a longer, drier, hotter growing season. Other projected effects include increases in residential water demand during the growing season, accompanied by additional increases due to population growth; more frequent late-summer water shortages; high variability, both seasonal and annual, in both water supply and water demand; and increases in health-related issues associated with water quality.

For water resource managers in the Okanagan basin, the evolution of climate change adaptation measures has been influenced by a regional policy framework. Within this framework, a decade of collaborative discussions and research, combined with the need for adaptations to the existing governance structure, has led to and legitimized the actions proposed in the Okanagan Sustainable Water Strategy (osws). The osws outlines forty-five actions dealing with water source protection, security of supplies, and delivering on the implementation strategy. The strategy represents a coordinated approach that will promote regional adaptation to climate change as the actions are collectively applied. Currently the actions are at the pre-implementation to implementation stage.

Key factors or concepts that have influenced the successful development of water management adaptations in the Okanagan include a highly inclusive, multi-level governance structure; a strong focus on multi-stakeholder involvement; reliance on local knowledge as well as scientific research; and a regional view of what successful adaptation means. The importance of effective action has also been stressed.

COULD WATER POLICY NATIONALLY EMULATE OKANAGAN PROGRESS?

The aim of this book is to explore the relationship between climate change adaptation and water governance in Canada. Progress in

places like the Okanagan notwithstanding, Canada is largely unprepared for climate change. A survey conducted in 2014 by the Federation of Canadian Municipalities revealed that 48 per cent of the jurisdictions that responded did not have formal climate change adaptation plans and were not considering developing any in the immediate future.

Preliminary analysis of the effectiveness of water governance structures in widely different geographic regions suggests that overwhelming obstacles stand in the way of urgently required action on climate change adaptation in Canada. These barriers include the fragmentation of water governance under the Canadian Constitution; reactive governance and lack of a nationally binding policy framework; and information gaps that limit wise management of water in a changing climate. Put simply, water management in Canada is barely coping with the effects of climate change so far, and focused attention is required now if we are to properly address adaptation needs as climate effects accelerate over the longer term. The research that resulted in this book also revealed nested opportunities for addressing the need to change the way we manage water in this country. What is called for is a new road map for making the necessary changes to water governance.

A new road map is imperative because water policy in many parts of Canada has not kept pace with changing political, economic and climatic conditions. While the established apportionment of responsibilities and jurisdiction with respect to the management of water has served our country adequately for more than a century, the policy vehicles that currently dictate how water is allocated and used, and how its quality is protected, were built for an earlier and very different time when the population was smaller and more dispersed and we had fewer competing uses for our water supplies. Our current policy frameworks were also developed during a period of relative climate stability that appears to be coming to an end.

Because water policy in Canada has not kept up with population and economic growth, we find ourselves confronted today with two converging challenges, both of which are being exacerbated by a changing climate. Much of our legislation was crafted to meet

19th century water allocation needs in the context of 20th century technology and hydrological understanding. Unfortunately, however, the way we currently manage water in Canada is not adequate to 21st century circumstances, in which the integration of nature's own need for water and the broader ecological protection of water sources have become recognized factors in sustaining economic and social development.

Because of the way jurisdiction over water is atomized in Canada, it is difficult to change our management practices quickly enough to address the growing array of surface and groundwater problems that are appearing across the country, or to take full advantage of new technologies and best practices that could greatly improve the efficiency of water use in both economic and environmental terms.

Both of these challenges are affected by a changing climate. Climate effects on water have been clearly identified by researchers all over the world. Warming temperatures have already begun to alter the extent and timing of precipitation and runoff in some regions of the country. As was so amply demonstrated in the Okanagan in 2003, we are also beginning to understand the direct link that exists between water and wildfire. The effects of climate change are expected to accelerate and compound in not entirely predictable or uniform ways as global temperatures continue to warm, with potentially alarming effects on water security in some areas. This is not something we can ignore.

In places like the Okanagan, climate change has already demonstrated that our outmoded systems of water management are becoming increasingly vulnerable to disruption, with potentially disastrous future impacts on our economy and way of life. Even in relatively water-abundant areas such as Nova Scotia and the Northwest Territories, climate effects on the delicate balance of water supply to natural systems are of growing concern.

On the positive side, many municipalities, regional districts, some provinces and territories and a number of federal agencies have committed to formal processes of evaluation of adaptation potential at various scales in different regions of the country. Much of the focus on adaptation to climate change has been on ensuring reliable water supply, not just for domestic and industrial needs but

also for economic and environmental sustainability now and under possibly changed conditions in the future.

Municipal leaders and policy-makers across the country are discovering that improved water management for its own sake would achieve a number of important sustainability goals in a broad range of economic sectors, which in themselves will add up to greater adaptive capacity. Provided that climate change is contained within reasonable limits by fossil fuel emissions reductions, the harmonizing and streamlining of federal, provincial, regional and municipal water governance structures and functions will go a long way toward make adaptation to climate effects on water resources possible even in already water-stressed areas of the country. At the time of this writing, however, there is little evidence to suggest that fossil fuel emissions in Canada are being reduced in any meaningful way, and harmonization of federal, provincial, regional and municipal water governance structures is happening so slowly that it is difficult to know whether progress is in fact occurring. While some gains are clearly being made in the important area of water conservation, it appears that whatever governance advancements are occurring are still being mocked and overshadowed by population growth and further economic expansion. We can't keep up with the problems we are creating for ourselves. As this appears to be a problem everywhere in the world, there is much we can learn from others.

LEARNING FROM THE GLOBAL WATER PICTURE

Most studies cite population growth as the principal driver of increases in the global demand for water. Although there are always numerous uncertainties surrounding future projections, research shows that the world population is likely to grow by 30 per cent between 2000 and 2025, and by 50 per cent between 2000 and 2050. At a minimum, the fact that global population is expected to grow perhaps as high as 10 billion by 2050 invites questions as to whether there will be enough water to support increases of this magnitude. The concern becomes more urgent when it becomes clear that nearly all of this growth will occur in developing countries. Unfortunately, many of these countries had inadequate or barely adequate water

supplies to support the populations that existed even at the turn of the millennium, and they will face correspondingly greater difficulty as those populations continue to swell. It must also be recognized that further economic development is likely to fuel increased demand for water, both directly in the growth of water-consuming industries, and indirectly in the form of dietary and other lifestyle changes which tend to require more and more water.

In short, the global picture appears to be almost inescapably one of growing demand in the face of static or shrinking supplies. Water experts like Steven Solomon have argued that a new world order is about to emerge out of the collision between population and economic growth and our planet's rapidly changing hydrology. Solomon points out that the divide is expanding globally between freshwater haves and have-nots. Many analysts believe this explosive disparity is likely to widen across the entire 21st century political, social and economic landscape. We should expect global water and related food security to be among the most pressing political issues of our time. In this there is opportunity for Canada to prosper economically by helping others.

Provided Canadian agriculture can address its own sustainability problems, we should anticipate that this sector will play a significant role in addressing the issue of food security. But water availability will not just affect food production. The amount of water available to a given nation will determine its industrial capacity and the quality of life its citizens enjoy as a result of nature receiving the water it needs to make places be worth living in. Prosperous countries in the future will be those that have enough water for food, cities, industry and nature – and those that know how to ensure that each of these users gets the water it needs when it needs it.

Canada could be a leader in this emerging new world water order, but only if it can ensure that the serious problems and unfortunate paralyses that have emerged so widely elsewhere in the world with respect to the management of water do not gain a permanent foothold in this country. Although the same population growth and economic pressures that together have created a global water crisis elsewhere have already begun to appear here, Canada has started, albeit slowly, to move in the direction of governance changes which,

if they were more focused, could put us in a leadership position. But we will have to move faster if we want to be a player in this new world water order. Contrary to the myth built up over centuries of limitless clean and abundant Canadian water, the fact is that there is no longer any foundation for our national pride in the quality of the water in our lakes, streams and rivers.

While this book focuses largely on climate impacts on freshwater and how governance might adapt to them, climate change is only one of many threats to water security as identified by Environment Canada. Additional hazards include an expanding number of water-borne pathogens; the growing effects of persistent organic pollutants and mercury; the widespread contamination of streams, rivers and lakes throughout southern Canada by agricultural runoff; aquatic acidification; the ecosystem effects of genetically modified organisms; urban runoff and municipal wastewater effluents; industrial point-source discharges; the poisonous effects of mine water, landfills and waste disposal contamination; and growing concerns over the concentration of endocrine-altering and other troubling substances in our water supplies. Together these problems contribute to reduced ecosystem function and further loss of biodiversity. It could be said with considerable justification that we are diminishing our way of life in Canada through ineffective governance of our precious water resources. While that may not be apparent to most city-dwelling Canadians now, our failures and shortsightedness will be put into clear relief as our climate warms.

SO HOW BAD WILL IT BE?

Climate change is a risk multiplier. Canada's water supplies are already under increasing strain, and climate change will not only compound these problems but create new ones as well. Our current, fragmented approaches to water management stand in the way of addressing water management challenges in an integrated way. This in itself is a feedback, if you will, that will likely increase our vulnerability to the effects of climate change.

Changes in Canada's climate are already affecting water systems across the country, with many more impacts anticipated as these changes accelerate and intensify. Climate change influences

the hydrologic cycle, which in turn affects water in all of its forms and every one of its biogeophysical functions. Warm the world even slightly, and surface water and groundwater, ice and snow, ecology and habitat, weather patterns and ocean dynamics are all simultaneously altered in response. Experts predict that climate change will increase precipitation, evaporation, water temperatures and hydrological variability across Canada, all of which will negatively affect the quality of our water. While climate change and climate influences on water show general consistency across the country, regional differences are also apparent. In the Yukon and coastal British Columbia, for example, potential changes include increased spring flood risks and impacts on river flows caused by glacier retreat and disappearance that are likely to reduce hydroelectric potential. There will also be ecological impacts related especially to fisheries, as well as damage to infrastructure, and issues over apportionment of water for human uses.

The Rocky Mountains may see higher-altitude snowlines in winter and spring, possible increases in snowfall in some areas and more frequent rain-on-snow events, which will increase the risk of both avalanches and floods. There may also be a decrease in summer and late-season streamflow, which could have ecological effects as well as impacts on tourism and recreation.

On the prairies the possible changes are expected to be manifold. These include changes in annual and summer streamflow which will have implications for agriculture, hydroelectric generation, water allocation and ecosystem health. The increased probability of severe drought has the potential to increase aridity in semi-arid zones, further adding to losses in agricultural production and resulting in land use changes. The combination of these factors is likely to affect surface and groundwater quality and quantity in ways that may have adverse impacts on farm incomes. As noted earlier, a trend toward more intense and frequent storms and floods has already been confirmed.

In the densely populated Great Lakes basin, climate change and climate influences on water are likely to result in precipitation increases coupled with greater evaporation leading to reduced runoff and declines in lake levels. This will have potential consequences

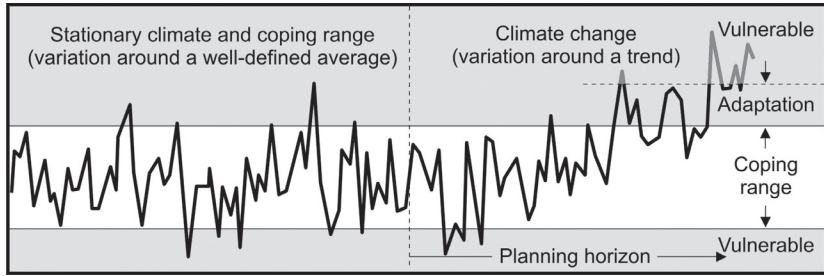
for hydroelectric generation, shoreline infrastructure, shipping and recreation. Decreased lake-ice extent, including some years without ice cover, will result in ecological changes and increased water loss through evaporation, which will affect navigation.

In Atlantic Canada, less snowfall and a shortened duration of snowcover are likely to result in smaller spring floods and lower summer streamflow. Changes in the magnitude and timing of freeze-up and breakup will have implications for spring flooding and coastal erosion. Further saline intrusion into precious coastal aquifers is also expected to occur, which will result in loss of potable water and increased conflict over water allocation.

In Arctic and sub-Arctic regions, climate change and climate influences on water are likely to result in thinner sea ice, a one- to three-month lengthening of the ice-free season and an increased extent of open water, which, while improving navigation, will have ecological effects with consequences for traditional ways of life. Terrestrial impacts will be pronounced as well, including loss of permafrost, which will affect ecosystems, wildlife migration, road transportation and human life in many northern communities. As we saw in chapter three, the thawing of permafrost and warming of the Arctic Ocean could also result in a rapid and significant increase in methane release into the atmosphere that could further accelerate climate change, not just in the circumpolar North but around the world.

HOW WELL ARE WE ADAPTING?

The sheer extent of the projected impacts of climate change on water resources across Canada should serve as a strong impetus to ensure that we adapt appropriately to minimize negative effects. Yet our current approach to water management is proving largely ineffective at enhancing our resilience. A June 2010 report from the National Round Table on the Environment and the Economy confirmed that Canada's water management approach is outdated, and highlighted climate change as one of the four most important water sustainability issues affecting the nation, predicting that it will transform the way we manage water. Nothing has changed since 2010.



The white strip indicates the fixed envelope of relative certainty within which we have come to expect our weather and climate to fluctuate over a typical period of time. This bounded range of possibility is something engineers, for example, would take into consideration in designing major infrastructure such as bridges or highways. Also shown are the increasing number of extremes we will have to adapt to over time. This loss of what is called “stationarity” is making our society increasingly vulnerable to accelerating climate change effects. One of Canada’s leading experts on climate change adaptation, Dr. Ian Burton, coined the term “adaptation deficit” to characterize this failure to recognize or fully acknowledge the evidence that our climate system and its related services are moving in a direction that is beyond the range of our current capacity to adapt.

La Niña years, in which cooler temperatures and greater precipitation occur, will allow some people in some places to keep believing that nothing is changing, but such years will become less frequent over time. Researchers at NASA concluded in January 2010 that despite large year-to-year fluctuations associated with the El Niño–La Niña cycle of tropical ocean temperature, the global temperature continued to rise rapidly in the past decade. In the wake of the worst fire season in history in Russia in 2010, the world reached a record high global temperature as measured by instrument data. Pakistan experienced the fourth-highest temperature ever recorded, 53.7°C, or about 128.6°F, in the spring of 2010. In 2015 drought conditions persisted in Pakistan despite extraordinary flooding in the intervening years.

Ever more frequent extreme weather events continue to drive home the realization that the enormous cost of repairing the damage caused, particularly by flooding, could make it very difficult to sustain our prosperity while at the same time protecting and improving our environment. We should expect increased costs resulting from droughts such as in the Okanagan and floods like Manitoba’s.

As those costs rise we should also expect the potential for general tensions and conflict to rise with them.

WE ARE COPING, NOT ADAPTING

The primary response to climate change thus far has focused principally on mitigating it by reducing greenhouse gas emissions. While such action is crucial, it is inadequate by itself. Current and projected atmospheric concentrations of greenhouse gases are substantial enough to mean that further climate change will occur, and indeed is already occurring, regardless of our success in reducing emissions. Therefore it is important to couple our efforts to *mitigate* the cause of the problem – greenhouse gas emissions – with efforts to *adapt* to the current and anticipated effects of climate change. Despite groundbreaking work being done in places like BC's Okanagan basin and by a number of municipal governments, even the most progressive jurisdictions are only in the pre-implementation or early implementation stages of effective adaptation.

Adaptation is intended to reduce vulnerability and enhance resilience. The latter term is defined by the Intergovernmental Panel on Climate Change as “the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to stress and change.”

In 2009 the Adaptation to Climate Change Team at Simon Fraser University investigated and confirmed the effects of climate change on biodiversity. In his summary report on climate change adaptation and biodiversity, lead policy author Jon O'Riordan recommended that governments transition to a regime in which all land- and water-based decisions are either made by a single agency or coordinated across several agencies as overseen by a single agency, and legislation and regulations be aligned to ensure resource decisions are based on ecological principles that support ecosystem resiliency in a changing climate. British Columbia adopted this approach with the creation in 2010 of the Ministry for Natural Resource Operations, which consolidated all resource decision-making into a single, integrated model. The government is currently analyzing how water

decisions will be made under a proposed Water Sustainability Act, which will balance efficiency of decision-making with sustaining the ecological health of watersheds.

This approach, however, is at odds with the linear system of engineering which was the main paradigm governing water management in the 20th century and continues to predominate. In linear system engineering, physical projects are designed to supply water, control floods, improve drainage and support transportation. Although subject to environmental assessments, these projects have tended to degrade ecological system function and require large fiscal and engineering resources. In an adaptive paradigm, the emphasis would switch to “engineered ecology,” in which maintaining or restoring ecological function is paramount to retaining ecosystem resiliency. Examples include “low impact design” in the management of rain-water to increase the use of natural drainage systems rather than engineered solutions; demand management and water conservation to reduce the need for new water supply projects; and protecting wetlands and flows in rivers and streams to sustain ecological function.

Such strategies underscore the value of adaptive rather than reactive approaches to managing water. A key strategy is to embed the concept of “public trust” in water governance. This means that all levels of government have a fiduciary duty to protect public rights to clean and secure water supplies and to maintain healthy ecosystems, and that these interests override private rights through licensing and water allocation.

Ralph Pentland is one of the most respected water policy analysts in Canada and a senior member of the Forum for Leadership on Water. As he has pointed out,

Public trust law or its equivalent goes back to the time of the Romans or even earlier. It is founded on the reality that certain natural resources – especially air, fresh water and oceans – are central to our very existence. For that reason, governments must exercise a continuing fiduciary duty to sustain those resources for the use and enjoyment of the entire population, not just the privileged.

Pentland notes that since the 1970s, a rich body of public trust law has developed in the United States. He cites Joseph Sax, who, in an important 1969 journal article, put forth three key ideas in support of the doctrine of public trust:

- that certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than of serfs;
- that certain interests are so particularly the gifts of nature's bounty that they ought to be reserved for the whole of the populace; and
- that certain uses have a peculiarly public nature that makes their adaptation to private use inappropriate.

The principle of public trust began to be undermined in Canada as provincial governments, led by Alberta, made a subtle but ultimately very significant shift in their thinking about environmental protection. The change is best understood by examining how the mandate of many provincial environment ministries changed from "environmental protection" to "environmental assurance." Whereas "environmental protection" meant that landscapes and public resources such as air and freshwater needed clearly defined protection, the notion of "environmental assurance" meant that governments could reserve the right to compromise the level of such protection in the service of economic interests, provided that certain impacts were mitigated and established pollution standards were not exceeded. Environment ministries no longer protect the environment so much as they employ mitigation measures in an attempt to limit the amount of impact economic development may have on it. Their job is to make development acceptable.

After this change gradually occurred, however, most provincial environment ministries found themselves with reduced budgets and diminished capacity, especially with respect to monitoring and enforcement. As industry self-regulation became more common, governments moved further and further away from effective administration of public trust with respect to air and water. The public trust is now seen to have been so violated by resource activity in some provinces that governments as represented by environment

ministries are being publicly accused of outright failure of duty and care. Can this be so?

In a 2009 conference presentation called “Fixing Canada’s Failing Water Contract,” Pentland observed that modern public trust doctrine in the US is primarily a creature of state courts, and that there are in fact as many variants of it as there are states. The real power of the doctrine, he said, lies not in the laws themselves, which are often weak or unclear, but in the creativity of the courts and those arguing cases before them, adding:

Differences in the nature and scope of public property rights in Canada and the US make an exact duplication impossible in this country. But there is definitely a “trusting relationship between governments and citizens which could facilitate the development of something akin to public trust law in this country.

Pentland has noted elsewhere that:

there is a lot we could learn from other federated states. The most important thing we could learn from our closest neighbour, the United States, which is also a federation, is the importance of governance systems which are much more open and transparent than ours, which better prioritize the public interest and environmental protection, which guarantee citizen participation in all water management decisions, and which give citizens the legal right to insist that their governments meet their fiduciary duties.

Public trust is the heart of an adaptive approach to water management that builds natural ecological resilience by increasing the capacity of a given water system to absorb disturbances, making it more responsive to change. It requires a focus on maintaining ecological integrity of watersheds; using the same water more than once; an experimental approach that promotes learning; management at the basin scale; multi-level governance; stakeholder participation; open, coordinated sharing of learning; strong and persistent leadership; and the creation of financial and insurance

mechanisms that promote appropriate attitudes toward water use and protection.

The most commonly recommended adaptation options for the water resources sector all represent “no-regrets” policy choices, meaning that implementation of them would lead to benefits irrespective of the effects of climate change. These include water conservation measures; providing ecological flows in watersheds; retaining properly functioning ecosystems; improved planning and preparedness for droughts and severe floods; improved water quality protection from cultural, industrial and human wastes; enhanced monitoring efforts; and improved procedures for equitable allocation of water.

Well-planned, practical policy options are essential if we want to effect lasting, sustainable change in our water governance in Canada. But even the most progressive water management cannot succeed in creating the level of adaptation required without breaking down jurisdictional and other barriers to improved watershed governance.

BARRIERS TO EFFECTIVE ADAPTATION

In a 2011 report on the need to adapt to climate change effects on water in Canada, the Simon Fraser Adaptation to Climate Change Team identified several key obstacles to achieving this goal. These include the high cost of infrastructure replacement, jurisdictional fragmentation, reactive governance, policy gaps and gaps in information. Foremost of these is the high cost of infrastructure replacement.

Adaptation to the water-related effects of climate change will require expensive infrastructure upgrades. The cost of such works – and the fact that the Canadian public has swallowed the neoliberal fable that the fiscal capacity of governments to replace infrastructure is limited – are enormous obstacles to increasing resilience and therefore pose significant barriers to effective adaptation.

The second issue, jurisdictional fragmentation, arises because responsibility for water resource management in Canada is diffuse. The Canadian Constitution apportions legislative power over freshwater between the federal government and the provinces, producing a complex regulatory web that spans municipal, regional, provincial

and federal levels of government. Although no powers are explicitly delegated for “water” or the “environment,” the Constitution identifies many responsibilities that necessarily include these topics. The federal government has constitutional power over fisheries, transboundary waters and First Nations lands; provincial governments have jurisdiction over water quality regulation, allocation rights and land use; and municipalities are most often responsible for land-use zoning, water services and infrastructure.

Furthermore, different ministries and departments have their own internal requirements, standards and regulations, which are often not well coordinated. The intersections of these responsibilities, both vertically and horizontally, create competing pressures that allow key issues to slip through cracks, and throw up confusing barriers for policy practitioners and politicians alike. Many of the same kinds of problems presently exist within and among Aboriginal governments.

The complexity, fragmentation and lack of coordination in water governance in Canada results in policies that are often inconsistent with one another as to drinking water quality, ecosystem protection, allocation rights and climate change adaptation. According to Dr. Karen Bakker, editor of *Eau Canada: The Future of Canada's Water*, the trend of “passing the buck” between levels of government creates “an ill-coordinated downshifting of responsibilities, leaving key areas in a policy vacuum.” As Canada's water resources come under increasing pressure from climate change in the coming decades, exacerbating existing challenges and creating new ones, it is crucial that all orders of government address this source of vulnerability by working toward interjurisdictional harmonization of water regulation and movement toward the integration of land and water management at the watershed scale. This is a lot more easily said than done.

The third area of concern relates to reactive government and policy gaps. Due to jurisdictional fragmentation, Canada lacks a clear national vision for managing our water resources, as evidenced in part by the fact that the last federal water policy was tabled in Parliament over two decades ago and has never been fully implemented.

Water in Canada tends to be governed in a less than proactive way, as we have seen in the oil sands of Alberta, for example, and in the case of the large-scale toxic algal blooms in Lake Winnipeg. This failure to act proactively with respect to water governance has left Canada with wide-open gaps in policy, particularly in terms of water quality regulations, where there are major disparities in public safety across the country. As a result of inadequate governance and funding cutbacks in water management, Canada is one of the very few developed countries that does not have legally enforceable water quality standards.

Finally, there are information gaps that exist as a result of incomplete or inconsistent hydrometric monitoring, which makes it very difficult to establish baselines against which we can compare what has happened in the past with what we are experiencing today. Throughout southern Canada it seems we have simply given up on this need for representative long-term monitoring. What we are doing is rather like declaring gauges irrelevant and just taking the dashboard out of your car so you don't know how fast you are going or how much gas you have, and then justifying those actions by claiming you can simply adapt to the consequences. It appears we had a better sense of what we had to know to manage water effectively 40 years ago than we do now. At least then we understood that we couldn't manage what we couldn't measure.

The failure to adequately monitor what is happening to our water resources is held in many circles to be one of the most problematic of all barriers to adapting to climate effects on our water supplies. The fact that both federal and provincial governments have cut monitoring and research related to their own hydrological circumstances could thus be viewed as a failure of public trust, if not a complete failure of government in matters of duty and care.

WHAT WE NEED IS A POLICY ROADMAP

Though there is growing public concern over water security, there has been no change in prevailing rates of water use. In the minds of most Canadians water remains an abundant resource, a free good, an inexhaustible commodity that does not need to be conserved. There is a need in Canada to shift to a conservation society. If such a

change does not occur quickly, water security in many parts of the country will be compromised. Climate change will result in more frequent extreme weather events that will cause flooding, more property damage, higher insurance costs and a greater infrastructure maintenance and replacement deficit nationally. Water quality will continue to deteriorate widely. Conditions on First Nations reserves will be even more difficult to address than they are today. Wetland loss and other climate-related impacts will combine with human activities to result in reduced ecosystem services, which will in turn cause lower flows for fisheries, more erosion, reduced groundwater recharge, worsened problems with nutrient and pesticide loading and still more trouble with toxic algae, adding further to water treatment costs. These impacts will be compounded in direct relationship with climate effects and will cost more and more over time, reducing our quality of life and diminishing Canada's economic competitiveness globally.

Neither have governments properly responded to what to some appears a contradiction between the fundamental human right to water, and appropriate pricing of water supply and sanitation services. Governments at different levels are responsible for promoting the fundamental right to basic water supply and sanitation while at the same time introducing appropriate pricing for water services. It cannot be one or the other. Sustainable water management demands both.

Changes in governance to date at the provincial level tend in the right direction for the most part, at least in terms of intention. In practice, however, they fail. In order to meet the growing challenge posed to water security by current and projected climate effects in many parts of Canada, governance has to become more focused and more actively coordinated across the provinces. This can be achieved through the Council of the Federation, which recently approved a new Water Charter and has already committed to working with all provinces and territories and with related organizations such as the Canadian Council of Ministers of the Environment to build watershed stewardship capacity throughout the country. The Council of the Federation has also established a role for expert advisers from outside the public sector to contribute views on new water

governance approaches. This development respects one of the advantages of Canadian federalism in that it demonstrates that experimentation at a variety of levels can produce effective, coordinated regional responses to national issues. This approach could be the bridge upon which to build a truly nationwide approach to water policy reform that could in turn become the foundation for successful climate change adaptation, at least as it relates to the management of vital water supplies and the ecosystems that both provide and rely upon those supplies for their integrity and sustainability.

Our changing climate and hydrology require that we shift out of the coping zone of what hydrologists call stationarity and adapt to the new normal. The extent of this adaptation will require that a new set of values underlie water governance in Canada in the future. Fundamental among these values will be the need to balance the water needs of nature with those of people. The creation of such a water ethic in Canada can be achieved in 12 steps. These could form the roadmap we need to finally achieve the water reforms we set out to put in place in 1987.

Step One

Value water appropriately and promote wise use and conservation of it through the establishment of national water conservation guidelines. This step would require provinces, territories, First Nations, municipalities, business and real estate associations, the wider Canadian agricultural community and the energy sector to work with the federal government to set national and regional water conservation guidelines that recognize the value of water. Such guidelines would include building-code standards for smart metering of water-using devices in new homes, with similar standards to radiate outward into all economic sectors. This step would require that conservation be identified as fundamental to a new Canadian ethic, and that cities and regions would compete to be “water smart.” Provinces would emulate Ontario in expediting development of clean technologies by encouraging water conservation and water-smart engineering through the creation of tax and other incentives and through the support of independent research clusters that incubate innovation.

Also in this first step, the federal government would encourage home audits of water conservation similar to energy audits, and explore implementation of variable water pricing schedules that do not discriminate against the poor, such as increasing block pricing and seasonal pricing. Also provided would be education so that the public becomes aware of water conservation opportunities in their own homes and businesses and appreciates how water savings are an important practical measure in our national effort to adapt to climate-related impacts on water security.

These actions would also include nationwide regimes to strategically link agricultural policy to water governance so as to reduce farm impacts on water quantity and quality. Such measures would also connect water policy with food security in Canada and abroad as well as with energy policy in order to reduce the impacts of energy production on water quantity and quality.

Step Two

Urge governments to value water to meet nature's needs and ensure that its use is consistent with sustaining resilient and functioning ecological systems. In this step all provinces, territories and First Nations governments would be required to adopt legislation in accordance with agreed standards for establishing, codifying and protecting ecological flows for nature now and in a climate-altered future. Each jurisdiction would create programs aimed at increasing the resilience of aquatic ecosystems to adapt to a changing climate through the establishment of legally defined ecological sustainability guidelines and through investment in ecosystem restoration within established watershed management frameworks. In this step, legislative mechanisms would come into existence to ensure that the value of ecosystem goods and services and environmental externalities such as pollution are accurately, uniformly and transparently accounted for in all development decisions.

Step Three

Recognize and value established knowledge and experience in prediction by strengthening and harmonizing flood protection strategies nationally. In this crucial step it will be necessary to develop

a joint provincial–federal–continental program for integrated flood prediction, prevention and management and to strengthen municipal emergency planning to deal with the new normal in natural variation of water cycles. It will be necessary at the same time to establish formal processes to reduce the projected economic costs of flooding, droughts and climate-related extreme events by protection of intact natural systems.

Step Four

Support the design and sustainability of water supply and waste disposal infrastructure based on ecological principles and adaptation to a changing climate, with special attention to First Nations. In order to adapt effectively to climate change effects on its water supplies, Canada needs to set new standards for the design and function of water-related infrastructure. This step recognizes that the effects of increased hydrological variability can be managed through the application of the principles of engineered ecology. In order to pay for these changes in infrastructure design it will be necessary to seek revenues through water metering, equitable water service pricing and technological innovations that include reuse of treated water, energy derived perhaps from fermentation of treated wastewater, and the integration of diverse untapped energy sources such as solid organic residues: food, wood and agricultural waste, lawn clippings, biomass. In this step the integration of rainwater management with wastewater handling would be encouraged as a means of reducing the costs of treatment and the energy required to transport water and treat sewage.

This step will demand the full engagement of the professional engineering and water management community in innovative infrastructure redesign that encourages the regeneration of the ecological health of watersheds through the principles of engineered ecology. This will provide the means and the technological solutions that will allow Canada to address critical challenges for access to clean and secure water supplies in numerous First Nations.

Step Five

Recognize the value of comprehensive monitoring and fulfill the need for accessible information required to manage water in a

changing climate. As has been reaffirmed again and again in this book, it is impossible to manage water effectively – especially in a changing climate – without careful monitoring. The importance of a rigorous national framework of consistent and regular hydrologic and water quality monitoring has already been established at Environment Canada through the National Water Survey and its provincial and territorial partners. This framework, however, needs to be incorporated into a permanent national database of hydrological information linked to similar systems in the United States so as to enhance the weather forecasting and climate prediction capacity of both countries.

In order to build on what we have, this fifth step will require the establishment of and permanent support for the monitoring of health effects of changing water cycles nationally, but especially on First Nations reserves, as well as the strengthening of public reporting of monitoring programs. It will also require consistent funding of ongoing science that will analyze the broadest possible range of water issues associated with a changing climate, with a special focus on continued support for centres of excellence in science, particularly as they relate to climate monitoring and water-related adaptations to climate change.

Step Six

Recognize, value and support the role of education in public understanding of the importance of water to our way of life. Lack of public understanding of the seriousness of the water governance issues across the country is one of the major obstacles to the rapid development of adaptive capacity in Canada. In order to change this, the provinces and territories may together decide that a nationwide public education and social media campaign is required to dispel the myth of limitless abundance of water in Canada and to establish and advance the principles of a new water ethic. Such a campaign could serve to reshape public understanding of the importance of water by countering this erroneous notion of inexhaustible supply and explaining the global water crisis and what it means in terms of both challenges and opportunities. In so doing, such a program would assist in the transition to adaptation by outlining changes in

habits and other measures Canadians need to undertake in order to assure water quality and security in the face of growing populations, increased economic activity and climate change. Such a program could also outline the extent of jurisdictional and legislative changes that will be required to achieve the ideals of the new Canadian water ethic, and perhaps even more importantly, lay the foundation for public support of political leadership that will reform and harmonize water policy at all levels of jurisdiction over the coming decades.

Step Seven

Recognize water as a human right integral to personal security and health. How we decide to manage water now will cast a long shadow forward. In order to assure a sustainable and prosperous future for those who follow us, it is crucial that we put into place today an ethical framework for appreciating the critical role of water in our lives and our world, a framework that will serve the next generation, who will inherit responsibility for their own children. Step seven encourages a nationwide commitment to honouring the principle of public trust, which recognizes the value of water as a public resource for the betterment and enjoyment of present and future generations.

On one level this means honouring the responsibility principles inherent in Canada's founding water ethic, which is to say the one established by Aboriginal peoples. This means honouring indigenous rights to clean water and sanitation as a matter of equity and justice and as a means to enhance adaptive capacity in the face of climate-related effects on water security. On a broader level it means developing and enforcing national drinking water standards and considering a public interest doctrine for water. It also means discouraging the creation of water markets until full analyses have been undertaken with respect to how current water quality concerns can be addressed and how these and other matters will be dealt with amid changing hydrological regimes in the future.

Step Eight

Provide support for holistic approaches to managing watersheds through collaborative governance. After 25 years with virtually no

movement at all, the logjam that has been water policy reform in Canada is beginning to shift. The first evidence of movement presented itself in the form of the new Water Charter put forward by the Council of the Federation, which is comprised of the premiers of all of Canada's provinces and territories. Step eight builds on their work.

This step recommends that the Water Charter be strengthened to include principles for water security as defined by the need to create a new Canadian water ethic. It proposes that the Council of the Federation advance water policy reform in Canada by aligning responsibilities set out for the federal, provincial, municipal and First Nations governments so that they work co-operatively to achieve the principles of climate-related adaptation and the Water Charter. This suggests the need to undertake watershed assessments of entire basins and not just portions of watersheds, as part of development proposals. It also means including water management as a central element in all land-use planning that projects climate-related effects forward to at least 2050.

Step Nine

Recognize the importance of groundwater and urge governments at all levels to understand and value its role in creating a sustainable future. Comprehensive and coordinated national groundwater protection and management strategies should be developed to address current inadequacies in groundwater mapping and monitoring.

Step Ten

Recognize the value of developing coordinated long-term national strategies for sustainably managing water in the face of climate change. The evidence obtained through the research efforts of networks funded by the Canadian Foundation for Climate and Atmospheric Science, as discussed above, will likely give readers a sense of why active adaptation to emerging climate effects on water should demand our full attention. What this tenth step recommends is that the provinces should work together with the Canadian Federation of Municipalities and the most senior levels of the federal government to establish a firmer climate adaptation approach to water management across the nation.

It will be important in this step to identify tangible changes in key management approaches to water conservation, flood protection and emergency measures and improved monitoring and science. It will also be important to develop new water allocation models based on priorities and having the flexibility to deal with droughts and attendant water shortages.

To ensure that real change occurs, it will be crucial at this step to further identify jurisdictional, institutional and legal obstacles to water policy reform and harmonization, and to undertake policy reform and harmonization at local, regional, provincial, territorial and federal levels in order to improve the way we manage water so as to ensure sustainability and security of supply and quality in the face of a changing climate.

Step Eleven

Consider the value of creating a non-statutory National Water Commission to champion the new Canadian water ethic. The Council of the Federation may see fit to become or create such a body, which would undertake a thorough, continuous examination of the kinds of legal, legislative and policy reforms that will be necessary to ensure that water everywhere in Canada can be managed in a manner consistent with integrated land and watershed management principles rather than through the fractured jurisdiction of artificial management units imposed by political boundaries. It will be crucial to undertake this examination in the context not just of the hydrological circumstances of today, but also of the realities that might come into play unexpectedly as a result of climate change. After identifying and prioritizing specific legal, legislative and policy barriers to holistic water management, a National Water Commission might then request that the Council of the Federation facilitate negotiations between all relevant levels of government and with affected economic sectors to gradually but persistently bring about necessary reform.

Step Twelve

This is the ongoing commitment to articulation and promotion of a new Canadian water ethic. As mentioned earlier, the jurisdictional schema of the Constitution would necessitate a multifaceted

governance model for water management. By definition, no single level of government can implement policies to improve water security. The Council of the Federation issued its Water Charter in August 2010 as an initial step in establishing a number of water stewardship principles that would bind all four levels of government. This is an important step toward water policy reform in Canada. But it is just a first step and it needs to be followed by many others that have not been taken in the five years since the Water Charter.

The Council of the Federation may wish also to consider the next phase of its Water Charter. In advancing the recommendations above, the Council would build on that Charter to articulate a new water ethic that would redefine the way Canadians value and relate to water. The values inherent in that ethic should include recognition of the crucial need for comprehensive and continuous monitoring of the state of our waters; recognition of water as a human right integral to human health; and recognition and respect for the water rights of indigenous peoples. Such an ethic should also include recognition of nature's own need for water; acknowledgement of the need to break down jurisdictional barriers to more holistic management of water; and recognition of the need for governments at all levels to further advance appropriate economic signals that effect positive change with respect to how water and water infrastructure are valued and managed.

Finally, the adoption of such an ethic must be founded on the wide recognition that successful adaptation to climate change will be only one of many benefits our society will derive from better management of our most precious natural resource.

FROM WATER POLICY REFORM TO BROADER ENVIRONMENTAL AND ECONOMIC CONCERNS

In the course of researching this book, the author visited dozens of Canadian communities. While each was at a different stage of adaptation, the various communities – as widely separated as Kelowna, BC; Sydney, NS; and Yellowknife, NWT – had each arrived at a common conclusion about how to most effectively begin adapting to climate effects that are already beginning to appear. Expert observers in each of these communities stated that the best way of quickly

defusing the climate threat is to manage water more effectively and in a more integrated way. They have seen that better water management in itself will make it possible to solve a number of other problems while at the same time assuring that climate-related water quality and quantity issues don't threaten their economic and social future.

This point was particularly well made by a former Nova Scotia deputy minister of environment and labour, Bill Lahey, at a forum held in Cape Breton as part of this book project. Mr. Lahey indicated that a new Canadian water ethic might be what is needed to bring about widespread change in the way we manage and protect water, not just in Nova Scotia but everywhere in the country. Effective policy change, he explained, needs an organizing principle or ethic around which the people and the politicians that represent them can rally. By way of demonstrating the power of such an ethic, Mr. Lahey cited the healthcare debate that took place in Canada during the 1960s, when the ethic of universal access emerged as the driving principle in the reform of our country's healthcare system. He noted that, though simple, the ethic at the heart of this principle was strong enough to survive repeated attacks, even by powerful interests advocating for private healthcare.

Mr. Lahey suggested that climate change adaptation in Canada could be rapidly advanced if Canadians got behind a new water ethic in the same way. He further argued that, if that were to happen, political leaders in many parts of Canada could – because there is less debate about water than many other resources – move quickly to address a good many related environment problems simultaneously en route to better water management. The affirmation of a new water ethic, he pointed out, could be a means of ultimately achieving greater adaptive capacity to climate change while generating numerous other lasting social, economic and environmental benefits along the way.

FAST FORWARD TO THE OKANAGAN IN 2035. WHAT HAS BEEN ACCOMPLISHED?

The drought and fires of 2003 were a crisis, to be sure, but they brought the Okanagan valley's vulnerability into sharp relief and

illuminated the need for change. A movement began in which community leaders worked across political boundaries to create a policy vehicle to collaborate on water management. Created in 1970, the Okanagan Basin Water Board had never been fully tested in its role of encouraging local governments to pool resources and make joint water management decisions. After 2003, however, it was given a new mandate to take the lead on regional science and policy for climate change adaptation, population growth and other shifts in society and the environment.

In the Okanagan the first steps taken were to build partnerships and strengthen communication with stakeholder groups, research institutions and various levels of government. The Okanagan Water Stewardship Council was established as a formal way to bring these groups together to advise the Water Board and create the Okanagan Sustainable Water Strategy. The council and other, more ad hoc partnerships have paved the way for basic water science studies and for rebuilding monitoring networks and calculating water needs for fish, food production and basic sanitation. Plans built on good science are more durable and they level the table for working on agreements with mutual benefits. Good planning has begun to shape the form of development and the design of infrastructure – the bones of communities.

This is a new era for the Okanagan. The people in this region have learned that adaptation or “sustainability” isn’t a state that a region just arrives at. It is a process of responding flexibly with timely action to situations as they arise – armed with good information. Collaboration, especially for water management, allows for that flexibility. There remains a great deal of work to be done, however. As noted at the beginning of this chapter, per capita water use in cities like Kelowna is around 675 litres per person per day, more than twice the national average and six times the per capita use in water-conscious cities elsewhere in the world. This despite the fact that at the time of this writing the hot breath of the California drought could be felt throughout the Okanagan.

The promise of the Okanagan example underscores the fact that we are perhaps one of the few countries in the world that could create a new water ethic. Unlike so many other places, Canada still has

slack it can take up in how it manages its water resources. On top of that we actually have a roadmap. By breaking down jurisdictional barriers to integrated water management we could become a sustainable society. And by becoming a sustainable society we have a far better chance of adapting to climate change. If this is what we desire, however, we should be working hard now to break down barriers to enhancement of adaptive capacity while the room to move is still there, for as the final chapter of this book will illustrate, there are many obstacles to the creation of as bright a future as we have just imagined. The most formidable of these include the widespread habits of dismissing or second-guessing science and refusing to act politically in matters related to the environment – except in support of special interests.

As the next chapter will show, a road map will be of no use if we don't choose to follow it. Unfortunately the map this book seeks to create will be no good to us if there is no acceptance at senior levels of government that climate change poses a significant threat to the country's water resources. Without support for the science that is necessary to create baselines for appropriate action, there can be no progress. All we can do is sit and wait to see what will happen.

At the moment, it doesn't appear we are on the road to anywhere nationally. Instead we are driving too fast in the dark without our headlights on, ignoring all the signposts and telling our terrified fellow passengers on this planet that we know where we are going and what we are doing, when clearly we don't. We look to places like the Okanagan and the Northwest Territories to find the road to sustainability again and to direct others to it.