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River of No Return *Water & Climate Security in the* *Anthropocene*



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River of No Return

Water & Climate Security in the Bow River Basin

Slide 1: Title Slide

Thank you very much for the invitation to speak today before this specialized and very expert audience. Thank you also for your kind introduction. The focus of conference is proven and advanced technologies for waste-water recovery and re-use. My presentation is on what is happening globally that may have a bearing on the value of the kinds of innovative new technologies you are here to introduce and discuss. I hope to provide the view of the future that Mayor Achison called for in his opening remarks. For those who do not know me, please allow me to explain that the goal of my work with the UN is to build a better bridge between science and public understanding and policy action on water and climate issues in Canada and abroad. One of the principal roles of our initiative is to make the best international example on water and water-related climate concerns available at national and sub-national levels in all of the UN's member states.

Slide 2: Follow the Water

My principal focus is on water security. As everyone at this gathering knows, water security means having and being able to reliably provide adequate water of the right quality where and when you need it for all purposes especially agriculture but also for purposes related to sustainable natural bio-diversity-based Earth system function.

It also means ensuring that your use and management of water in the region in which you live does not in any way negatively affect the water security of regions up or downstream from you now or in the future.

Over the last decade water security has also come to mean being able to achieve these goals not just in the face of growing populations but also in the face of a growing number of cumulative and compounding human effects that at present make sustainability a moving target. We need to stabilize these effects if we don't want adaptation and resilience to constantly be beyond reach.

Slide 3: National Academies Report and Quote

These effects include the massive impacts of changes in land use and cover on the global hydrologic cycle; changes in the rate and manner in which water moves through the hydrologic cycle brought about by rising atmospheric temperatures; the effects of the loss of Arctic sea ice on the behaviour of the northern hemisphere jet stream; the capacity of a warmer atmosphere to transport more water vapour; and the appearance of phenomena such as atmospheric rivers that produce flooding events on a scale humans have not experienced before.

We of course know that hydrological conditions on this planet have always been changing. We also know that have been fortunate here in the West to have had a century or so of relative hydro-climatic stability. We also know that that era is over. The long-term hydrologic stability of the climate we experienced in the past will not return during the lifetime of anyone alive today.

As a consequence we no longer have any choice but to manage our river basins holistically. To do so successfully now means we have to manage not just surface and groundwater flows but understand and manage the entire water cycle to whatever extent we can if we want to assure water security in the future. In a very real sense we find ourselves on a river of no return. Some of you will remember the movie of that name.

Slide 4: Movie Poster

River of No Return is a 1954 American Western film directed by Otto Preminger and starring Robert Mitchum and Marilyn Monroe. Set in the Northwestern United States in 1875, the film focuses on a widower named Matt Calder (played Robert Mitchum), who recently has been released from prison after serving time for killing a man while defending another one.

Slide 5: Mark, Kay and Matt camping

Calder arrives in a boomtown tent city in search of his ten-year-old son Mark, who was left in the care of dance hall singer named Kay who is played by Marilyn Monroe. Kay's fiancé, gambler Harry Weston, is played by Rory Calhoun. Weston tells Kay they must go to Council City to file the deed on a gold mine he won in a poker game. They head downriver on their flimsy log raft, and when they encounter trouble in a series of rapids, Matt and Mark rescue them. Weston offers to buy Matt's rifle and horse so as to reach Council City by land, and when Matt refuses, Harry knocks Matt unconscious and steals both. Kay faithfully chooses to stay behind to take care of Matt and Mark, and the three are stranded in the wilderness.

Slide 6: In the rapids

When hostile local natives threaten, the three are forced to escape down the river on Harry's rickety raft. Their lives are changed utterly by the rapids they encounter.

All of the river scenes in River of No Return were shot at the headwaters of the South Saskatchewan River system in Banff National Park. At a place called Bow Falls which many of you have visited. It is in a wilderness that in many ways is easy to compare to the one in which the world uncertainly entered in Paris with respect to climate change.

What we have embarked upon in at last waking up to the threat of hydro-meteorological disruption is nothing less than a ride on a flimsy log raft down a River of No Return. The whole world is on that raft, and we are heading fast for the rapids.

Like the wilderness situation that Matt, Mark and Kay find themselves in, the rapids are only part of a large circumstance in which humanity finds itself dangerously situated. Similarly, climate disruption is just one of many hazards we face.

Slide 7: Earth system boundaries

No matter where we live in the world, we, all of us, are confronted with a number of larger cumulative and compounding human effects that at present make sustainability a moving target. We need to stabilize these effects if we don't want adaptation and resilience to constantly be beyond reach.

The problem is that our numbers, needs and mentalities globally are such that we have begun to undermine the planetary conditions upon which we depend for the stability of environment and economy that are the foundation of our prosperity.

Nine Earth system boundaries have been identified as critical in that the extent they are not crossed mark the safe zone for human presence on this planet. Of these nine boundaries, we have already crossed two and are on our way to crossing two others. The first boundary we have crossed relates to biochemical flows – in particular the cycling of nitrogen and phosphorous through the Earth system. The second is biodiversity loss. The loss of biodiversity is particularly troubling in that Earth system function is biodiversity based. The two boundary conditions we are close to crossing are land system impacts and climate change. It is important to note, however, that we know so little about the other five Earth system boundaries that it is not out of the question that we could pass over invisible and irreversible thresholds in these domains without knowing we have done so until we feel the effects. In other words, we are on the river in the dark, with little but the rapids to light our way.

Slide 8: UN Sustainable Development Summit

The growing realization of the implicate nature of Earth system function means we have to re-think sustainability. Despite inherent tensions among them the next iteration of global sustainable development goals and targets must create a safe operating space within Earth system and social boundaries.

The United Nations responded to the urgency and the opportunity of finally getting sustainable development right in September of 2015, just before the Paris climate talks. Their response was the announcement of a new framework for action in support of global sustainability.

The 2030 *Transforming Our World* agenda promises to be the most comprehensive and inclusive effort to positively change the world in all of human history. This may well be the most important thing we have ever done for ourselves and for our planet. It is nothing less than a charter for people and the planet for the 21st century. The 2030 *Transforming Our World* agenda raises the ceiling on sustainability. As such this agenda is held to be as important as climate negotiations in Paris in that it deals with damage we are doing to other elements of the Earth system that are exacerbating and being exacerbated by climate change.

It is at the country level that these goals must be met. The degree of our success will depend on governance, by which I mean the way in which authority is organized and executed at national and subnational levels in a society. Translating the global sustainable development agenda to action at the national and sub-national level is therefore the greatest challenge we now face in dealing with the degree of hydro-climatic change we are now witnessing on a planetary scale.

Slide 9: UN Sustainable Development Periodic Table

The scale of the *Transforming Our World* challenge should not be underestimated.

The UN's global sustainable development agenda is about getting ourselves out of a very dangerous place in which we as a civilization have placed ourselves. There are 17 goals in the 2030 *Transforming Our World* sustainable development agenda. As serious as it is, climate action is only one of them – but all are connected.

Slide 10: The Anthropocene

Because of the inter-linked nature of the Earth system, damage to one part can lead to damage to others. We have not only altered our planet's global carbon, nitrogen and phosphorous cycles. We are also causing changes in the chemistry, salinity and temperature of our oceans and the composition of our atmosphere. Changes in the composition of the atmosphere in tandem with land use changes and our growing water demands have also altered the global water cycle. *On top of all this* we have altered our climate.

What this means is that we have entered an new era in which we can no longer count on self-willed, self-regulated natural landscapes to absorb human impacts on Earth system function. Whether we like it or not we have to assume responsibility for staying within Earth system boundaries. Climate stability is only one of those boundaries, but it is a critical one. What elevates the issue of climate action to its current and growing importance is that we cannot achieve success in addressing the 16 other global sustainable development challenges, unless we stabilize the composition of the Earth's atmosphere. We now know that the composition of the atmosphere is the lynch-pin holding the ice-water-weather-climate system of the planet together.

If we cannot stabilize the composition of the Earth's atmosphere we cannot know to what end our sustainability efforts must aim because we will not know the conditions to which we will need to adapt.

Because of warming effect on the global hydrologic cycle, we have to stabilize the composition of the atmosphere or we will not be able to fully protect our cities from ever more powerful storms, bigger floods and longer heat waves.

We will not know how much sea level rise we will need to defend our coastal cities against.

Without stabilizing the composition of the Earth's atmosphere we will no longer be able to reliably predict where our food will be grown. Without stabilizing the composition of the Earth's atmosphere we cannot reverse the acidification that is reducing the amount of food we can take from our oceans. What we learn from this is that we cannot have water and food security without climate security. And without water, food and climate security there cannot be sustainability.

It is clear we need to define a safe place in terms of adaptation to which all of humanity must aim. In this quest knowledge is not enough. We need the will and the permission of every nation in the world to solve global change problems.

Slide 11: Plus Tard, Ce Sera Trop Tard

That is why the Paris climate conference was so important. We need the will and the permission now because, as the motivating theme of COP 21 made clear, "Later, it will be too late." So how did we do in Paris?

Slide 12: Separating the Hype from the Hope In Paris: The Hype

Perhaps it was George Monbiot who said it best. By comparison to what it could have been, what happened in Paris was a miracle. Compared to what it should have been, however, it was a disaster.

As Bill McKibben pointed out we are no longer sitting around the table negotiating with other countries. We are negotiating with fundamental atmospheric physics and the physics holds all the best cards. If we can't keep global temperature rise under 2°C and earthly temperatures rise 4°C to 5°C as they are presently projected to do, significant areas of the planet are likely to become uninhabitable for at least parts of the year. Parts of the North American plains could be among those places.

Because it has taken us 20 years just to agree upon goals, accelerating the pace of response has now been identified as critical. That said, the Paris agreement grants the world five more years not to set the pace as might be expected but just to set national targets. Prior to 2020 nothing is obligatory.

Even participation in mechanisms for establishing targets for greenhouse gas emissions reductions beyond 2023 into mid-century and longer is voluntary. The fear is that these conditions in themselves undermine the agreement from its very inception.

Slide 13: Climate Action Tracker

In the five years Parties to the Convention have granted themselves to establish how much they will contribute to global emissions reductions we will very likely blast past any real opportunity to limit mean warming to 1.5°C.

The delay in action could even put the 2°C target out of reach. All self-congratulations aside it appears that one more time all we have done is kick the can down the road. Cut the numbers any way you want but at the end of the Paris conference we still have less than a 50% chance of avoiding runaway climate impacts.

The agreement also has other shortcomings. There is no mention of direct human health risks. Aviation and shipping are not mentioned or included in this Paris agreement. Water security is not mentioned in the agreement even though effective management of water is the foundation of climate security.

While the agreement recognizes the critical need for technological solutions and to reduce emissions generated by deforestation and forest degradation, there is no reference beyond forestry management to ecosystem-based mitigation and adaptation strategies such as the enhancing of soil health as a means of increasing carbon sequestration. In this agreement agriculture, in fact, is barely mentioned.

Nor is it clear where the money is going to come from to finance even what has been proposed in terms of climate action. It is also an agreement that is easy to get out of. There is also some question as to whether this agreement can withstand outside disruptions such as large-scale terrorism events or cyclic economic collapses neither economists nor politicians appear to be able to predict or control.

Because it is non-binding the agreement is also highly vulnerable to political manipulation. The question then becomes whether it can survive political turmoil. How, for example, will the agreement fare if Donald Trump became President of the United States?

In order to have even a reasonable chance to achieving the 1.5°C target, at least 80% of known fossil fuel reserves have to stay in the ground. If we really mean that it means that exploration and extraction of new sources has to stop now. Let's be realistic. Is that even remotely likely? Here? Now, in this economy? With the current oil price shock and its effects we have just got a glimpse into the kinds of complications we are likely to face in the future as we work to restructure our economy.

Slide 14: Separating the Hype from the Hope In Paris: The Hope (Marchers)

OK, so what was positive about Paris? The real miracle in Paris is that for a moment at least we got 193 nations – rich and poor – to agree something however limited at the same time. That is an achievement in itself. Whether everyone will continue to agree once the delegations return home and are worked over by their divided political constituencies remains to be seen. No, it's not perfect – in fact it is far from perfect – but now at least we have something to build on – something concrete we can work together toward that didn't exist until COP 21. This is a beginning not an end.

Slide 15: Climate within the larger SDG periodic table

The first thing that is really important about the Paris agreement is that it nests climate action within the larger context of the UN's 2030 *Transforming Our World* global sustainable development agenda as well as other important UN conventions.

The agreement importantly recognizes the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available scientific knowledge.

The agreement makes it very clear that the global effort must be to hold the increase of global average to well below 2°C and to limit the increase to 1.5°C if possible.

In establishing the 1.5°C target, the agreement recognizes the specific needs and special circumstances of developing countries and countries particularly vulnerable to harmful climate effects.

The agreement also recognizes that many nations may be affected not only climate change but also by the impacts of measures taken in response to it. Think of Canada and particularly Alberta within that context.

Parties to the agreement have to formally submit their targets for greenhouse gas emissions reductions by 2020 and resubmit revised targets every five years thereafter.

Signatories to the agreement are bound in such submissions to clearly and transparently include common baseline references such as the year to which emissions reductions must be compared; methods utilized in estimating and accounting for anthropogenic emissions; assumptions and methodological approaches in arriving at targets; timelines for implementation; and explanation of how their reductions of emissions contribute to the objective of strengthening the overall global response to the climate change threat.

Slide 16: World Climate Summit Paris

The agreement also makes it clear that adaptation is urgently required. The agreement also acknowledges that governments can't do all of this alone. The achievement of any meaningful level of climate security will require the coordinated action of all of civil society, both the public and private sector including cities and other subnational jurisdictions, local communities and indigenous peoples.

This agreement is all about opportunity linked to hastening the transition to renewable energy. But that is not all. Article 5 of the agreement recognizes the importance of preserving and enhancing carbon sinks and provides clear marching orders in this regard for forestry management. The agreement encourages signatories to take action to implement and support policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, enhancing the role of conservation and enhancement of forest carbon storage in support of sustainable forest management.

Slide 17: Paris Green Leaf

“The climate conference in Paris,” the French Ambassador to Canada Nicolas Chapuis said in Ottawa three weeks before the conference began “is an opportunity to put out the fire that is burning our house down.” Flames were no longer seen to be shooting out of the roof at the close of the conference, but clearly the fire is still smoldering inside our house.

The first test of the durability of the Paris agreement will be to see if Parties to the agreement actually ramp up their carbon reduction programs between now and 2020.

The second test will be to see if the 100 billion dollar climate fund is topped up by 2020. The final test is whether we will be able to keep our Paris promises and build on them beyond 2020.

Slide 18: North Saskatchewan River Basin Map overlapped with Paris image

So what does all this mean to us, here in Saskatchewan, at this conference? The Paris agreement is infinitely better than what we were left with after Copenhagen but the outlines of how difficult these goals will be to achieve are beginning to become clear. As this conference demonstrates, however, we are not starting over here. What we are saying in other countries is that the first priority nationally must be to integrate adaptation with development.

The second priority is to manage water better with the goal of protecting, restoring and increasing terrestrial carbon sinks while still honouring the broadest range of human and environmental values.

The third is to develop full-cost energy accounting that takes into account the entire life cycle of producing and consuming any given unit of energy.

The fourth is to raise the price of emitting greenhouse gases to a level that roughly reflects their costs.

The fifth priority is to force the adoption and diffusion of existing and emerging technologies. This what this conference is about.

The sixth priority is to substantially increase research in renewable energy and carbon sequestration especially as it relates to improving agricultural soil health and prudent forest management.

The seventh priority is to plan for the Anthropocene, the new epoch we appear to be entering in which we are going to have to take responsibility for managing and restoring vital elements of the Earth system.

What happened in Paris underscores the absolutely critical nature of the innovative technologies which you are here to advance. But having technology is just the start. The discussions we had this morning about getting past utilizing sewage lagoons in First Nations is exactly the one we had when I spoke at the organizational conference of the Saskatchewan Water Action Network three years ago. It appears that little or no progress has been made despite the clear presence of technology that could address these problems in First Nations and other small communities. Without the timely application of the critically important technologies you are developing specifically for use at the farm level, in small communities, developments and remote locations we at the UN are of the view it will be impossible to manage water in a way that will assure any meaningful level of combined water, food, and climate security in a warmer world. Here or anywhere.

The evidence that allows me to confidently say that your technologies have to be future comes from hydro-climate trends we are already seeing and projections of where those trends will take us over time.

Many of these trends – I regret to say – are symbolized in Canada and in many other places around the world by what is currently happening with respect to the health of Lake Winnipeg.

Slide 19: [Lake Winnipeg](#)

Lake Winnipeg has become a bellwether of the tensions we can anticipate at the nexus of water, food and climate security in the interior of North America in a warmer world.

The urgency of meaningful action to address the deteriorating ecological condition of the lake and the threat it poses to the economic health of surrounding communities appears now to be increasing by the month not by the year as it has in the past.

First, the scale of the problem appears to be growing rapidly both in extent and complexity. Algal blooms as large as 17,000 square kilometers in area are now appearing in Lake Winnipeg. Members of Manitoba's Lake Friendly Alliance are clearly aware of the troubling new developments that have taken place in the barely two years since the Alliance was formed to address eutrophication and other threats to Lake Winnipeg and to like lakes, streams and rivers in Manitoba.

Researchers of the reputation of the University of Saskatchewan's Dr. John Pomeroy have demonstrated that the basin has in fact crossed an invisible hydro-climatic threshold into a new hydro-meteorological regime in which we can expect more frequent large-scale flooding that will mobilize more nutrients not just into Lake Winnipeg but into all of Manitoba's

like water bodies. It was then discovered that Manitoba was not alone in facing this problem. Independent research findings identified the presence of cyanotoxins such as those that have appeared in Lake Winnipeg in 246 lakes across Canada. Eutrophication is clearly becoming an issue nationally.

Zebra mussels were then discovered in both the Red River and Lake Winnipeg, a development that will complicate every effort to assure the health and maintain the biodiversity of the lake and similar water bodies throughout southern Manitoba.

It did not help the reputation of the province that an international fisheries watchdog then claimed to the world that because of what it perceived as poor fisheries management consumers should not buy fish from Manitoba's largest lakes.

Slide 20: Lake of the Woods

The urgency of dealing more quickly with the Lake Winnipeg situation was further brought home in early December of 2015 when in their fall newsletter The Lake of the Woods Water Sustainability Foundation published satellite images of the unprecedented extent and long duration of algal blooms in that nearby lake system.

The presence of such large algal blooms in Lake of the Woods, in addition to further reports of accelerating eutrophication in Lake Erie and in other Great Lakes, make it clear that the problem may be more widespread than we thought.

What happened next confirms this. Hard on the heels of the Lake of the Woods report, a global survey of hundreds of the Earth's lakes published in *Science* revealed that climate change is causing lakes to warm faster than the oceans or the air around them. One reason is that warmer wintertime temperatures are producing less ice atop lakes that normally freeze over. Reduced lake ice coverage, in turn, increases the amount of sunlight lakes absorb. These rising temperatures will not only exacerbate problems associated with eutrophication, they may also speed the conversion of carbon-rich organic matter in lake sediments into methane and carbon dioxide, gases that once released into the atmosphere exacerbate global warming.

Further research outcomes have demonstrated that lake temperatures in Canada appear to be warming at double the global average. We can all see the direction in which this problem is heading. We appear to live in an event-driven world in which beliefs are not changed and policies reformed by the force of argument but by force of circumstance. We change when events in the outside world become experientially and psychologically overwhelming – when what is happening around us becomes too poignant to be denied and too potent to be ignored. The events and disasters we have experienced to date have been bad; but not bad enough – but they will be.

Slide 21: Lake Friendly Action Plan

We – none of us – can ignore any longer the growing urgency of the hydro-climatic problem we must now face. But as this conference makes clear, it is hardly the end of the world.

There is opportunity here also and one opportunity is to turn waste into wealth. This conference is all about that opportunity.

Climate impacts will not be all bad. It is going to be very interesting to see what kind of *net* impacts climate warming will or could have on western Canadian agriculture.

Slide 22: Canadian Climate Forum

Some know David Sauchyn. Some of you in this room may have been involved in his recent research projects. At the Canadian Climate Forum held in Ottawa last November, Dr. Sauchyn showed images of the Canadian prairies pointing out that this is a landscape of adaption – very successful adaptation in fact – at least to date. He then went on to show evidence that indicates an increase in the number of growing and heat days as well as greater water availability in winter and less in summer when it is needed most.

He then pointed to research outcomes that suggested a possible increase in crop yield of up to 228% could be possible in some parts of the Canadian prairies based on these trends. But, he noted, annual averages were not the whole story. The range between dry and wetter conditions is growing which means when dry periods occur they are likely to be of greater extremes.

Sauchyn then showed the mean average water flows on the Canadian prairies over the past 1100 years which made it clear that droughts of a century or longer have occurred and will occur again but in a warmer world.

Slide 23: The Smoking Gun Proving Climate Change

At the moment the most obvious effect of changing hydro-climatic regimes on the central prairies is the pole-ward advance of sub-tropical storm tracks. But as David Sauchyn has so clearly demonstrated there is another problem: the spectre of deep and persistent drought. We don't know if there are other invisible thresholds that will be crossed as mean temperatures continue to rise. Without action on global emissions temperatures on the prairies are projected to rise between 5°C and 8°C. We don't know what threshold of temperature increase will cause the hydrological coin to land on its dry side. All we know is that sooner or later it will.

Slide 24: Extreme Heat Days Table

Even small mean temperature increases result in far more extreme heat days. With warming today of only 0.85°C the prospect of extreme heat days is four to five times higher than in pre-industrial conditions. But look what happens when the temperature rises by 2°C. At three degrees of additional warming the prospect is that the number of extreme heat days – days with extreme temperatures beyond what we have experienced in our time – grows by an order of magnitude. Even if water is carefully managed we can expect water apportionment agreements between the Prairie Provinces to be severely tested in the future. Wastewater treatment and water re-use technologies will no longer be options. Depending upon how much warming materializes and the net effect of that warming on precipitation patterns these technologies will make the difference between places being productive and habitable and not.

It is perhaps here that it might be worthwhile to digress briefly into what we might be learning from the circumstances that recently unfolded in California.

Slide 25: Drought In California

California and the American Southwest recently faced a hydro-climatic double-whammy: a cyclic return of drier conditions combined with the effects of warming brought about by changes we have caused in the composition of the atmosphere in the past century. As a consequence of higher global temperatures the region may have already passed over an invisible threshold into a new hydro-climatic regime in which drier conditions could prevail over time. If this is so, the drought in California and the US Southwest could become persistent if not permanent.

Slide 26: Snowcover projections

There is also, as we have seen in California, a direct link between drought and mountain snowpack. For each 1°C rise in temperature snowline in the American West rises 500 feet, more than 150 metres. At 3°C the snowline rises 500 metres. The Sierra Nevada will lose half of its snowpack with 3°C of warming. Average snowpack in the American far west is expected to decline by 40% to 80% by the end of this century. This problem is not going away.

Slide 27: Pomeroy and Research Site

Careful monitoring conducted by the University of Saskatchewan's John Pomeroy has revealed that the winter snowpack and snowcover on the valley floor in the Rockies has declined by as much as half since the 1960s.

So the same thing that is happening in California has begun to happen at the headwaters of the Saskatchewan system.

Slide 28: California Wildfire

And, of course, there also is a direct link between drought and fire. When surface streamflow declines groundwater depletion accelerates and trees suffer. At the end of June of this past year we faced drought from Mexico to the Arctic and from Vancouver Island to the Manitoba border.

Weakened by drought and insect pests, forests catch fire. That is what we saw this past summer in British Columbia, Alberta, Saskatchewan and the Northwest Territories. Stay tuned.

The technologies you are developing here will have wide applicability elsewhere. We know because problems associated with water scarcity and hydro-meteorological change are not going away. On a global basis they are in fact getting worse.

Slide 29: WEF Global Risks 2016

It is important to be very clear on this point. Climate impacts will affect the development trajectory of all nations, rich and poor. In fact there is a proven link between climate disruption and de-development. While the link between recurring extreme weather events and challenges of maintaining critical physical and social infrastructure in developing countries has been noted by organizations like the United Nations and the World Bank, the extent to which climate disruption has begun not to just slow but reverse economic development was not recognized as a global economic threat until last month.

In January of this year the World Economic Forum held in Davos, Switzerland released its annual Global Risks Report. As part of that survey nearly 750 experts assess 29 separate global risks for both impact and likelihood over a 10 year time horizon. The risk with the greatest potential impact in 2016 was found to be the failure of climate change mitigation and adaptation. It is important to note that this was the first time since the report has been published that an environmental risk had the top ranking.

The failure to mitigate and adapt to climate change was now considered to have created greater potential risk of damage than weapons of mass destruction; a global water crisis; large scale involuntary migration and the economic consequences of energy price shock. When the risks were ordered in terms of likelihood alone, the number one risk in 2016 was thought to be large-scale involuntary migration, followed by extreme weather events; failure of climate change mitigation and adaptation; interstate conflict with regional consequences and major natural catastrophes.

Slide 30: Munich Re 2016

In addition to measuring their likelihood and potential impact, the World Economic Forum Global Risks Report 2016 also explored interconnections among risks. This is a map of interconnections between various economic, environmental, geopolitical, societal and technologic risks associated with the failure to effectively and meaningfully adapt to climate change. It was presented by the global insurance giant Munich Re earlier last week at the World Economic Forum in Davos.

What this map illustrates is the cascading effect of the failure to adapt to hydro-climatic change. On a global scale failure leads first to greater vulnerability to extreme weather events; food crises; water crises; large-scale involuntary migration; further man-made environmental catastrophes which in turn lead to biodiversity loss and Earth system collapse.

Slide 31: Syria

This isn't speculation. It is happening now. What is happening now in Syria and the spill-over effects in Europe did not start as a war. It started as a five year drought that led to war.

What we haven't understood until now is the extent to which the fundamental stability of our political structures and global economy are in part predicated on relative hydrologic predictability. As a result of the loss of relative hydrologic stability, political stability and the stability of our global economy in a number of regions in the world are now at risk. We are only now beginning to understand how complex this issue has become.

Slide 32: International Year of Soils

What we are seeing here and globally is that if we want water, food and climate security here – or anywhere else – we are going to need technological help. If water, food and climate security are to remain in our grasp in a warming world agriculture must become restorative as well as productive; and we need to make it profitable for agriculture to achieve that goal.

What we may need is another agricultural revolution – one in which society agrees to pay farmers not just for crops but for perpetuating critical Earth system functions over the ever-expanding lands now under agriculture globally. What we need is another green revolution – but one this time focused on the integration of water, food and climate security at the basin scale.

Canada should be a leader in that revolution; but to have that revolution we need innovative technology. Given the work you are doing together, there is no reason that revolution can't start here.

Slide 33: River of No Return 2

Much was made during the Paris negotiations of the agreement being a way of saving the planet. We should be clear on this. Our goal should not be to save the planet. The planet will survive on its own terms, with or without us. The negotiations in Paris were not about saving the Earth; but about saving ourselves. And we and our flimsy raft of a global climate deal are not out of the rapids yet.

But in this country we have a decided advantage. Declining Earth system function gives the concept of true sustainability new force; and true sustainability begins with how we value and manage water. The rapids we are approaching are ones we can largely predict because we know and care about our rivers.

I believe that, if only out of sheer necessity, we will adapt and become more resilient as a society. While we may never be able to return to what once was, we should never lose sight of the fact that the potential always exists to create a better world.

And within this small community of people who care so much about water; creating a better world has always been our common goal.

Thank you.

Slide 34: Storm Warning Cover

Robert Sandford

“The Winston Churchill of Water”



Bob Sandford is the EPCOR Chair for Water and Climate Security at the United Nations University Institute for Water, Environment and Health. In this capacity Bob was the co-author of the UN *Water in the World We Want* report on post-2015 global sustainable development goals relating to water.

In his work Bob is committed to translating scientific research outcomes into language decision-makers can use to craft timely and meaningful public policy and to bringing international example to bear on local water issues. To this end, Bob is also senior advisor on water issues for the Interaction Council, a global public policy forum composed of more than thirty former Heads of State including Canadian Prime Minister Jean Chretien, U.S. President Bill Clinton and the former Prime Minister of Norway, Gro Brundtland.

Bob is also a Fellow of the Centre for Hydrology at the University of Saskatchewan and a Fellow of the Biogeoscience Institute at the University of Calgary. He is a senior policy advisor for the Adaptation to Climate Change team at Simon Fraser University and is also a member of the Forum for Leadership on Water (FLOW), a national water policy research group centred in Toronto. In 2013, *Alberta Ventures* magazine recognized Bob as one of the year’s 50 most influential Albertans.

In addition to many other books, Bob is also the author or co-author of a number of high-profile works on water including *Cold Matters: The State & Fate of Canada’s Snow and Ice*; *Saving Lake Winnipeg*; *Flood Forecast: Climate Risk & Resilience in Canada*; and *The Columbia River Treaty: A Primer*, all published by Rocky Mountain Books. His two latest books are *The Climate Nexus: Water, Food, Energy and Biodiversity*, which he co-authored with former Deputy Minister of Environment Jon O’Riordan and *Storm Warning: Water & Climate Security in a Changing Canada* which Bob authored solely. Both books were published in the late fall of 2015 by Rocky Mountain Books.