



Measuring progress on climate adaptation in the Columbia Basin

Indicators and pathways to chart the course

A summary report

Columbia
Basin **trust**

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Acknowledgements

Project Team

The project was implemented by Columbia Basin Trust's (the Trust's) Communities Adapting to Climate Change Initiative (CACCI) in cooperation with the Columbia Basin Rural Development Institute (RDI) at Selkirk College, which currently manages the State of the Basin indicator program.

Since 2008, the Trust has, via CACCI, worked directly with 14 local governments, as well as a variety of other agencies and organizations in the Columbia Basin to develop and implement climate adaptation plans and projects. The RDI is a regional research centre with a mandate to support informed decision-making by Columbia Basin-Boundary communities.

The State of the Basin was originally developed by Columbia Basin Trust and is now under the stewardship of the RDI.

Funding

Columbia Basin Trust and the Columbia Basin Rural Development Institute gratefully acknowledge the financial support of Natural Resources Canada in making this project possible.

Behind the Scenes

A Project Advisory and Steering Committee (PASC) supported the project team with advice and guidance. The PASC included representatives from:

BC Ministry of the Environment
BC Ministry of Communities, Sport and Cultural Development
City of Rossland
Columbia Basin Rural Development Institute
Columbia Basin Trust
Emergency Management BC
Engineers Canada
Pacific Climate Impacts Consortium
West Coast Environmental Law

Key indicator design concepts were also reviewed by local government representatives from:

City of Castlegar
City of Kimberley
Regional District of East Kootenay

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Canada

The Question

Can indicators of well-being
inform community progress
on climate adaptation



Introducing the State of Climate Adaptation
and Resilience in the Basin (SoCARB) Indicator Suite.

The Current Situation

Extreme weather events are happening with greater frequency and many communities are recognizing the need to prepare for a more variable and less predictable climate.

For communities in the Columbia Basin Trust region (the Basin), projected changes to weather and climate are expected to result in a wide range of impacts to the natural environment.

These include:

- retreating glaciers
- changes to stream flows
- more frequent flood events
- more frequent wildfires
- longer growing seasons
- changes in biodiversity

**Some of these changes could alter where and how people
live and earn a living in the Basin.**

Projected changes to Basin climate by the 2050s include:

- average temperature increases of 1.6 to 3.2 C.
- median decreases in summer precipitation of 6 per cent.
- median increases in winter precipitation of 7 per cent when compared to Basin climate conditions during 1961 to 1990.

The number of extremely hot days, frequency of warm spells and intensity of rainfall events are also projected to increase.





Introducing SoCARB

A new *State of Climate Adaptation and Resilience in the Basin* (SoCARB) indicator suite has been developed to provide communities in the Basin with data to support their climate adaptation efforts.

SoCARB builds on the Columbia Basin Rural Development Institute's (RDI) existing State of the Basin indicator initiative, demonstrating how common indicators of well-being can also be used to measure climate change, impacts, adaptation and resilience.

SoCARB measures progress on adaptation priorities that address critical community assets and climate risks for the Columbia Basin. It incorporates a community resilience index (CRI) to help track performance on socio-economic factors that support climate resilience.

This document summarizes the SoCARB indicator suite development process and the degree to which existing indicators of well-being can provide a snapshot of the state of climate adaptation and resilience in Basin communities. The complete SoCARB report — *Indicators of Climate Adaptation in the Columbia Basin* — can be downloaded at cbt.org/climatechange or cbrdi.ca.

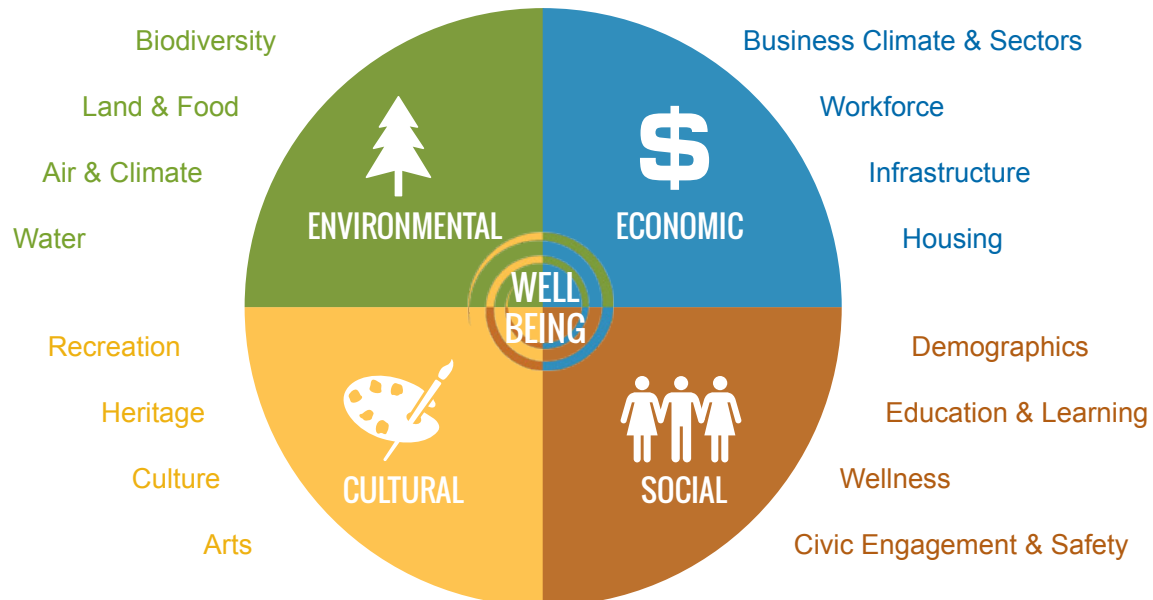
Development of SoCARB Indicator Suite

State of the Basin is a regional monitoring program managed by the RDI that collects, analyzes and reports on indicators relating to economic, social, cultural and environmental well-being in the Basin. State of the Basin is the foundation of the SoCARB indicator suite.

As of 2014, the RDI reports on over 40 indicators ranging from job creation to air quality. State of the Basin indicators have evolved since the initiative began in 2007 and it is expected that they will continue to evolve as new data become available, new types of analysis are possible, and new priorities emerge in the region.

Twenty-one of these indicators have been incorporated into SoCARB's adaptation pathways and community resilience index. They are identified in the figures and tables that follow.

State of the Basin Research Framework

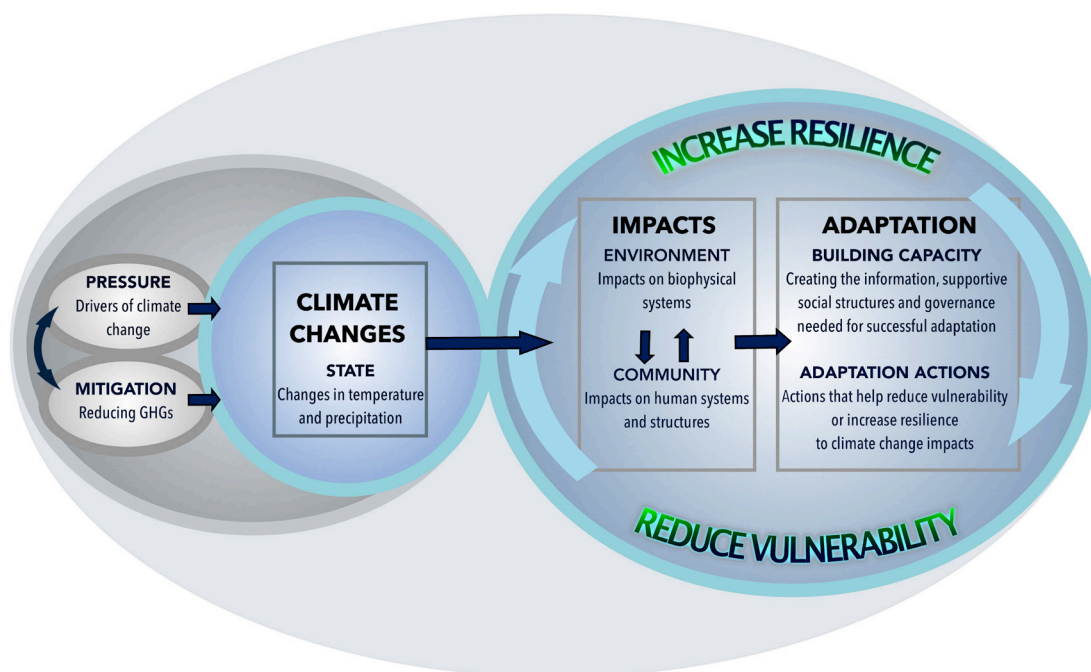


Building on the literature

SoCARB's design was informed by an extensive literature review that explored the various approaches and types of indicators used to measure adaptation and climate resilience. The literature review also guided development of indicator selection criteria. Key findings of the literature review are summarized in the final report. The *Climate Resilience Indicator Literature Review* is also available as a separate document.

The “real-world” relationships between climate changes, impacts and adaptation are reflected in the project indicator model that guided the design and development of SoCARB. The project indicator model created the basis for the four types of indicators as well as the adaptation pathways described in the next section.

Project Indicator Model



Understanding vulnerability and resilience

Vulnerability is the degree to which human and ecological systems are susceptible to and unable to cope with adverse climate impacts.

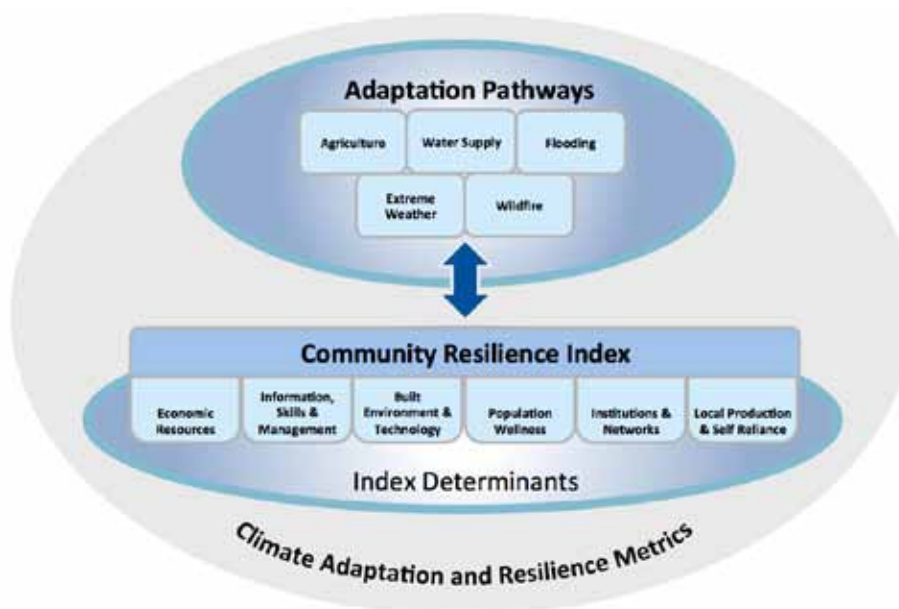
Resilience is the ability of human and ecological systems to absorb disturbances while retaining the same basic structure and ways of functioning, as well as the capacity of those systems to cope with, adapt to and recover fully or partially from stress and change.



Addressing adaptation and community resilience

A two-pronged approach was adopted after an initial review determined that State of the Basin indicators alone would be insufficient to measure climate adaptation and that new indicators would have to be developed. At the same time, many of State of the Basin's social and economic indicators were seen as relevant to measuring community resilience to climate change, which prompted the creation of a community resilience index. The two-pronged approach is illustrated in the model below, highlighting the two-way relationship between adaptation and community resilience.

Pathways and Resilience Model



Five Adaptation Priorities, Five Adaptation Pathways

The adaptation pathways address five priorities: agriculture, extreme weather and emergency preparedness, flooding, water supply, and wildfire. The pathways illustrate how the four types of SoCARB indicators are interconnected through cause and effect.

Four types of indicators:

1. **Climate change indicators** measure changes in climate over time through the use of data on key trends relating to temperature and precipitation.
2. **Environmental impact indicators** measure the impacts of changes in climate on biophysical systems.
3. **Community impact indicators** measure the impact of changes in climate on human systems and infrastructure.
4. **Climate adaptation indicators** measure how communities respond to climate impacts by building capacity and implementing adaptation actions, and the outcomes of those efforts.

Eleven criteria related to data quality, usefulness, understandability and acceptability were used to screen over 150 potential indicators for use in the pathways. The resulting pathways incorporate 12 State of the Basin indicators plus 48 additional indicators. In the figures that follow, current State of the Basin indicators are presented in light green font.

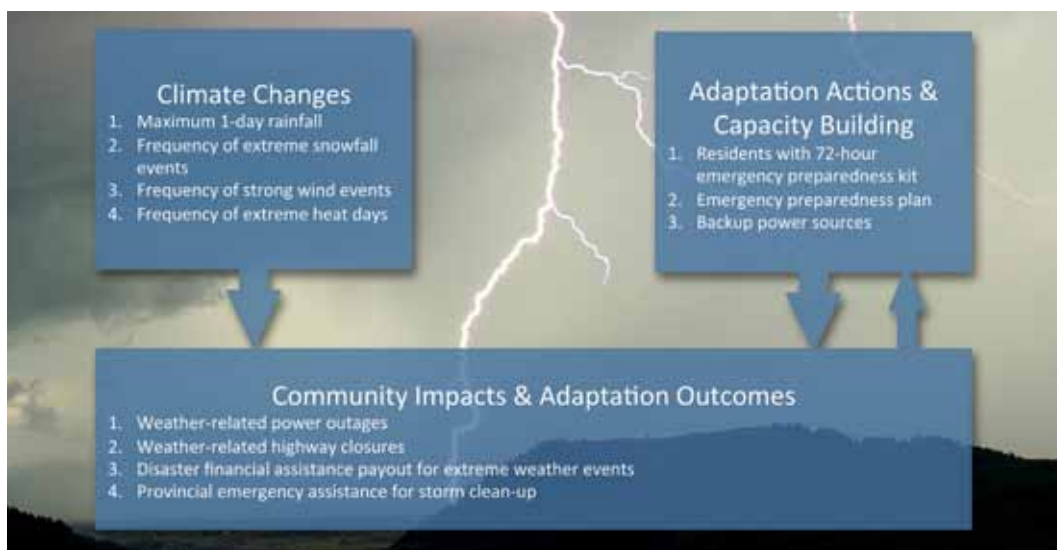
1. Agriculture Pathway

Agriculture is an important economic driver for some Basin communities and a factor in Basin food security. The agriculture pathway tracks climate changes, environmental impacts and community-level impacts likely to affect farmers, agricultural producers and farming practices, and identifies actions that support climate adaptation in the agriculture sector.



2. Extreme Weather and Emergency Preparedness Pathway

Events such as extreme rain and snowfall, windstorms, and extreme heat—which many Basin communities are already experiencing—are projected to increase in frequency and magnitude in the future. This pathway tracks short duration and intense weather events, their impact on communities and how prepared communities are to deal with them. The environmental impact component has been left out of this pathway because it is intended to track the direct impact of extreme weather events on communities.



3. Flooding Pathway

Flooding, including debris flows and debris floods, has already affected many Basin communities, with the frequency of some flood events projected to increase in the future. The flooding pathway focuses on the main causes of flooding, including climate and environmental changes, potential impacts on communities, as well as community adaptation actions and their outcomes.



4. Water Supply Pathway

Although most Basin communities have developed reliable access to clean and plentiful water, climate changes may influence supply of, demand for, and the quality of fresh water in the future. The water supply pathway monitors changes in the climate, environment, adaptation actions and outcomes relating to the quality and quantity of water available for consumption by Basin communities and residents.



5. Wildfire Pathway

Climate projections suggest that there will be larger and more frequent wildfires as a result of warmer, drier summers and reduced summer precipitation. The wildfire pathway tracks wildfire risk, the impact fires have on the environment and communities, and how communities are preparing to deal with them. While fire is a natural process in forested ecosystems in the Basin, wildfires can cause serious damage to infrastructure, community water supplies and human health.





Community Resilience Index

The SoCARB community resilience index (CRI) is designed to report on the status of six socio-economic determinants, providing a valuable snapshot of a community's underlying capacity to adapt and be resilient.

Six socio-economic determinants of community resilience

Economic resources: access to financial resources increases adaptive capacity and lack of financial resources can limit adaptation options.

Information, skills and management: while greater access to information increases the likelihood of appropriate adaptation, a lack of informed or trained personnel reduces that capacity.

Institutions and networks: well-developed social institutions can help reduce the impacts of climate-related events and increase adaptive capacity. Existing policies and regulations can either constrain or enhance adaptive capacity.

Population wellness: factors such as population structure and social determinants of health will help indicate a population's capacity to adapt to external pressures.

Built environment and technology: lack of infrastructure and technology limits the range of potential adaptation options, and regions with less technological capacity are less likely to develop and implement technological adaptations. A greater variety of and investment in infrastructure can enhance adaptive capacity, although the location and characteristics of infrastructure can significantly influence the options available.

Local production and self-reliance: local production and self-sufficiency generally contribute to increased adaptive capacity and are enhanced by access to and control of important resources such as water and energy.

The CRI uses 11 State of the Basin indicators plus seven new indicators. It is intended to measure the socio-economic resilience of communities or regions on a relative scale and tracks changes in resilience over time rather than comparing communities. Nonetheless, CRI indicators could be used individually to inform decision-making.

Indicators of community resilience

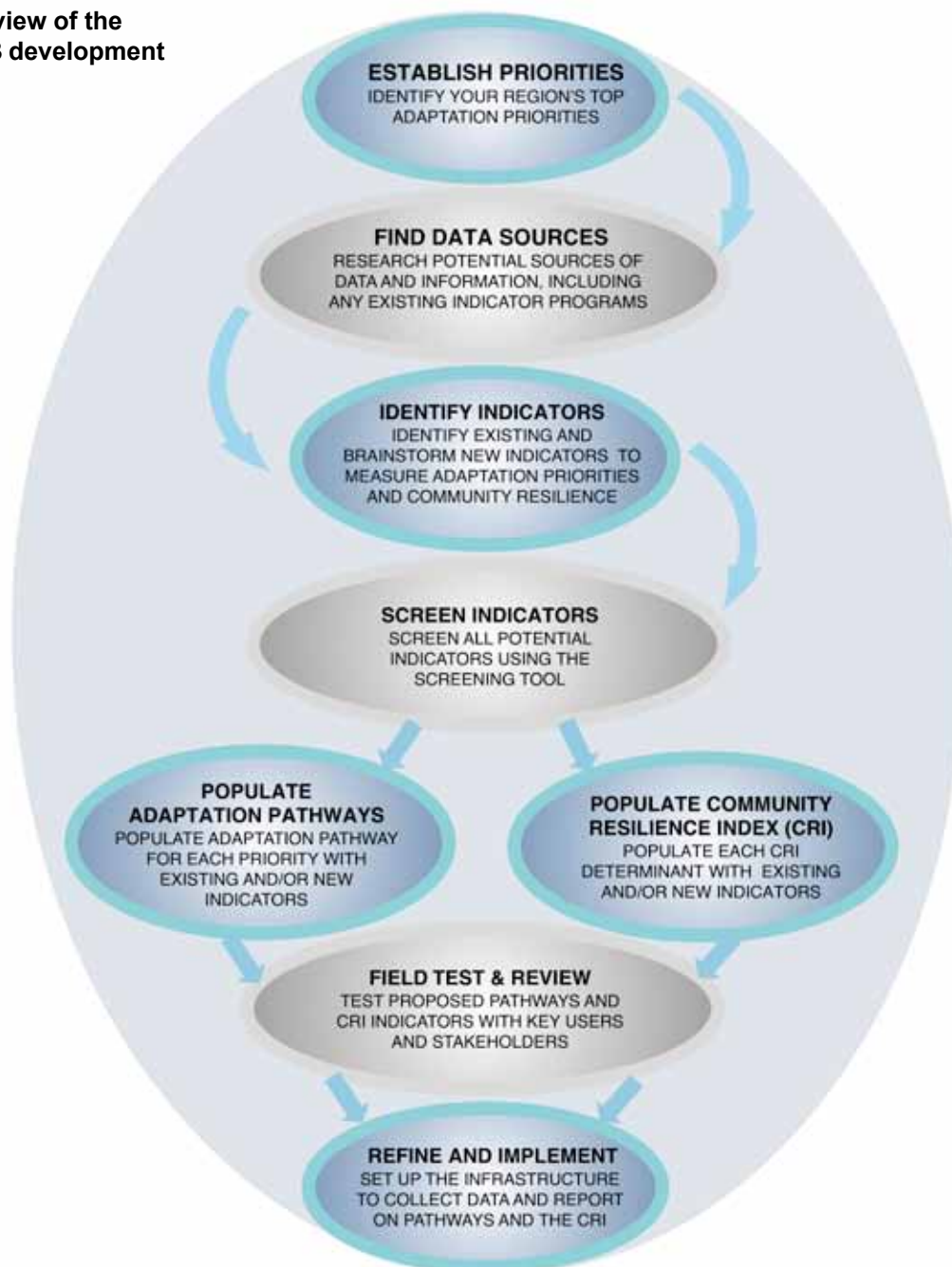
Determinant	Aspect	Indicator	Direction	Existing SoTB
Economic resources	Income generation	Income	Higher is better	Yes
	Business climate	Employment by sector	Higher is better	Yes
	Employment opportunities	EI and income assistance dependency	Lower is better	Yes
Information, skills and management	Education	Workforce education	Higher is better	Yes
	Access to information	Access to broadband	Higher is better	No
	Knowledge	Knowledge of important environmental issues, including climate change	Higher is better	Yes
	Practices	Completion of climate change adaptation actions	Higher is better	No
Institutions and networks	Civic engagement	Voter turnout	Higher is better	Yes
		Volunteerism	Higher is better	No
	Sense of community	Belonging and attachment to community	Higher is better	Yes (as of 2014)
Population wellness	Dependency	Age/gender	No direction	Yes
	Equity	Income disparity	Lower is better	Under development
	Health care	Life expectancy	Higher is better	Yes
Built environment and technology	Municipal infrastructure	Asset management planning	Higher is better	No
	Communication infrastructure	Basin cell phone coverage	Higher is better	No
	Housing and neighbourhoods	Housing stock in need of repair	Lower is better	No
		Walkability	Higher is better	No
Local production and self-reliance	Food production	Amount of area farmed	Higher is better	Yes
	Energy	Residents with a backup energy source	Higher is better	No
	Water availability	Late summer streamflow volume	Higher is better	Yes

Putting it all Together

Taken together, the adaptation pathways and CRI are intended to provide a multi-dimensional snapshot of the state of climate adaptation in Basin communities, with the CRI providing a measure of the foundation necessary for community progress on climate adaptation and resilience.

The major steps of the SoCARB development process are outlined in the figure below, providing a high level roadmap for agencies and jurisdictions seeking to develop a similar tool.

An overview of the SoCARB development process



What Was Learned

Valuable lessons were learned in the development process of SoCARB. Recognizing the complexities of measuring climate change, impacts and adaptation, SoCARB embodies a balance between methodological rigour and practicality of implementation.

It was learned that:

Existing well-being indicator suites are not sufficient. While intended for the measurement of general well-being and a valuable place to start, these suites will not be sufficient to measure all aspects of climate adaptation.

New indicators are required. Indicators specific to climate adaptation will need to be developed to supplement existing well-being indicator suites.

Local knowledge and expertise are useful. Engaging local knowledge and expertise helps ensure that the pathways and CRI reflect local risks, priorities and realities.

Selecting indicators to measure climate adaptation is an iterative process. It requires balancing methodological rigour with practicality and a need for flexibility. Many prospective indicators were rejected or adjusted due to data constraints or limitations.

Adaptation pathways can facilitate understanding. Pathways show how different indicators are connected around common adaptation priorities, yet are only as complete and robust as the indicators available to populate them.

Developing a manageable suite of indicators requires clear priorities. Decisions to keep, modify or reject potential indicators are much easier when clear priorities have been established.

Gaps in data and measurability are inevitable. Some potential indicators could not be incorporated into the pathways or CRI due to unresolvable data collection or measurement challenges.

Consider end users when choosing language and terminology. Simple and appropriate terminology can facilitate understanding and acceptability by end users.





The Future

Climate change is a serious global issue. Adapting to climate change is an important undertaking for individuals, communities and all levels of government. Measuring progress on climate adaptation and resilience will help inform residents, organizations, and governments of important trends, and facilitate understanding of complex issues and the effectiveness of adaptation measures.

The next major step for SoCARB is to collect the data and report on the full suite of indicators proposed in this project. Feedback from communities and local governments will play a key role in determining how SoCARB can best support community efforts on climate adaptation and resilience in the Columbia Basin.

The tools and approach used by SoCARB can also be adapted by other jurisdictions to develop a comparable suite of indicators based on local priorities.

For more information about SoCARB and Columbia Basin Trust's efforts on climate adaptation and climate-resilient communities, please visit: www.cbt.org/climatechange

For more information about the Columbia Basin Rural Development Institute and State of the Basin, please visit: www.cbrdi.ca



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