

User Guide

for the Climate Change
Adaptation Pathways Framework
Supporting Sustainable Local Food in B.C.

Dr. Liese Coulter

Prepared for the B.C. Ministry of Agriculture
through the 2018-19 Mitacs Science Policy Fellowship.



BRITISH
COLUMBIA

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Who is this for?

This User Guide was written to help communities and agricultural producers to develop shared adaptation goals and objectives with a focus on sustainable local food. If you are interested in planning long-term adaptation for communities but need some support, this User Guide was written to help you. Adaptation pathways work at many scales, focused on collective actions to manage climate change over time. Pathways can be developed by communities focused on a place such as a town or region, communities which share practices such as farming or fishing, and communities connected through shared beliefs, culture and traditions. Adaptation pathways use a participatory and inclusive approach that helps communities address future goals one step at a time.

About the author

As the 2018-19 Mitacs Science Policy Fellow with the Ministry of Agriculture, Dr. Liese Coulter developed a synthesis of literature supporting adaptation pathways, featuring resources that are relevant to support agricultural adaptation in British Columbia. Liese had extensive experience working with national adaptation research institutions in Australia prior to completing a PhD at Griffith University in Brisbane. She was an editor for the book [Communicating Climate Change Information for Decision-Making](#), which focused on how climate change knowledge is being developed, communicated and applied.

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Glossary of key terms

Adaptation pathway: a sequence of adaptation options and decision points, laid out over time, to address impacts from climate change in one or more key areas of decision-making.

Adaptation pathways map: the graphical representation of adaptation pathways.

Adaptation option: a response that reduces climate change impacts or increases adaptive capacity.

Agricultural Land Use Inventories (ALUI): consistent, credible, and comprehensive data about B.C.'s agricultural land use including details on crop type, irrigation, livestock, and land use and non-farm uses in the Agricultural Land Reserve (ALR).

Applied adaptation pathways: developing adaptation pathways that have been shown in practice to create an action-oriented outcome, and help decision makers develop and visualise actions needed immediately.

Climate Preparedness: The knowledge and capacities to effectively anticipate, respond to and recover from the impacts of likely, imminent or current climate change impacts.

Decision point: a point in time where progress needs to be reviewed and a choice made between alternate response options. Decision points often occur prior to a use-by-date or threshold.

Food security: exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO).

Local sustainable food systems: aim to achieve food and nutrition security and healthy diets while limiting negative environmental impacts and improving socio-economic welfare (CGIAR).

Key area of decision-making: an area of decision-making within which adaptation options may be needed to manage the impacts of climate change on an asset, value or service.

Maladaptation: responses to climate change that achieve short term adaptation in one key area of decision-making but that may have negative outcomes in other areas or in the same area in the longer term.

Preferred pathway: a preferred subset of adaptation options that have been identified by participants within their complete pathways map.

Resilience: the capacity of a system to absorb disturbance and reorganise so as to retain essentially the same function, structure, and feedbacks and keep operating in much the same kind of way.

Threshold: the point at which a system starts to operate in a significantly different way. Thresholds can be social, economic, environmental or physical.

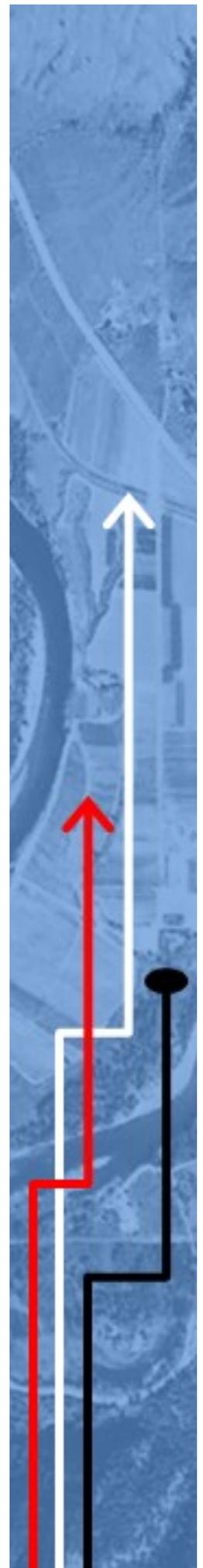
Traditional food system: wild food sources traditionally managed by First Nations people who actively monitor wildlife populations and their health to ensure sustainable use.

Transformational adaptation: adaptation that changes fundamental attributes of a socio-ecological system in anticipation of climate change impacts.

Trigger: when a system driver (such as sea level rise) changes so that existing response options should be reviewed and new options implemented (e.g. a decision point is activated).

Use-by-date: the point in time (usually, or a degree of change such as sea level rise) when an adaptation option is no longer effective. This might be a little later than the trigger and associated decision point to adapt to this failure.

Adapted from Siebentritt, 2016



Context for climate preparedness

As climate change impacts become more evident, our communities, businesses and the natural environment will be challenged to adapt. Food security risks can come from reduced agricultural production and from climate impacts to traditionally managed food sources within the local environment, especially for First Nations people, where traditional foods provide important nutritional and cultural value.

Although some high priority responses can be identified right away, there are likely many new ways to prepare for climate change that will become evident at different points. Changes over time in society and the environment will affect what options are preferred. Eventually, even resilient systems will change, so planning for significant transitions is a vital practice to prepare for climate change.

Many changes will involve complex interactions, so planning even the first steps for climate change preparation may be daunting. Considering a range of possible futures adds to a sense of uncertainty that can make people hesitate to act. When situations are both complex and uncertain, climate preparation requires imagination as well as trustworthy sources of information. Communities will need to work together to decide priorities, setting adaptation goals such as well-managed water resources, adequate emergency response capabilities and sustainable local food production.

Adaptation Pathways Framework: Supporting Sustainable Local Food in B.C.

This User Guide is a companion to the [Climate Change Adaptation Pathways Framework](#) which provides more in-depth and technical advice, an illustrative hypothetical example and more academic and international references.

How to use this guide

This guide was developed to offer communities in B.C. a non-technical, user-friendly overview to start developing adaptation pathways. It also highlights the role of agriculture in communities to support sustainable local food production into the future. The guide sets out the critical steps that any organisation, community or local government can take to develop long-term climate preparedness.

Detailed information on local situations is informed by both numbers and narratives. Information gained from engineering assessments and climate calculations links to local values and social insights gained through research and community participation. This way, adaptation pathways can be informed by common aspects of planning for long-term change and combine the implications of climate change.

The main content of this User Guide describes the five basic stages for developing adaptation pathways (see page 7). When followed as a complete cycle to address a single adaptation goal, the stages can be grouped into the three phases of Preparation, Planning and Practice (see page 8). Actions can also be used separately to extend an adaptation process already underway. How the adaptation pathways approach is applied depends on the specific preparedness needs and the actors involved in planning. Resources for designing the process are included on page 17.

This approach can be used alongside other guidance on general adaptation planning available through local and provincial government sources (e.g. <https://www2.gov.bc.ca/gov/>) and from regional organisations (e.g. <https://www.retooling.ca/>). Making use of international experience, this guide is informed by adaptation pathways that have been applied in other countries, notably in Australia and the Netherlands.

What is an adaptation pathways approach?

There are many paths to reach a desired future. An adaptation pathways approach recognises that combining immediate and future actions may be the best way forward. Breaking adaptation actions into a sequence of stages can help to manage uncertainty and provide confidence to start putting plans into action.

Adaptation pathways make it easier to communicate how decisions can be structured and ordered because many actions can be visually mapped through diagrams. A pathways' map can show a range of climate preparedness options, sequenced through time. These visual pathways offer a general approach that can be applied to almost any adaptation objective or goal.

Adaptation pathways have been applied to manage coastal infrastructure in the United States, river flooding in the Netherlands, and local government planning and agricultural production in Australia.

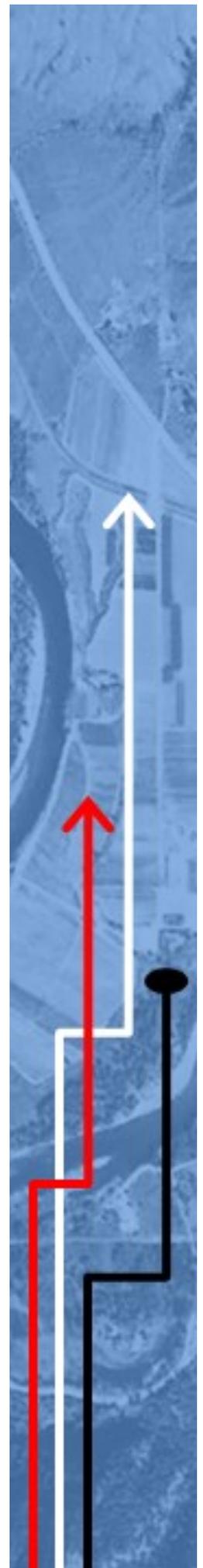
Addressing key challenges

The adaptation pathways approach addresses four key challenges in applying climate adaptation. It supports community planning and operations to:

- 1) Make decisions for multiple possible futures
- 2) Explicitly identify and prepare for likely future decisions
- 3) Employ flexible and adaptive planning processes
- 4) Strengthen the adaptive capacity of people and organisations

Why choose an adaptation pathways approach?

Adaptation pathways can illustrate how a range of climate preparedness options can be realised through time, to help take the first steps.



Why adopt a pathways approach?

Even without climate change, planners justify, prioritise and implement actions to adapt to changes in the environment, values and knowledge, and socio-political and financial systems. A pathways approach helps to plan for climate change and manage uncertainty by helping to:

- Adopt proactive and strategic planning. In addition to examining current policies and conditions, a pathways approach encourages creative thinking about potential and desirable futures.
- Develop adaptive and robust strategies that facilitate short-term actions, keep options open, and guide monitoring indicators along a sequence to identify when, why and how to change course.
- Use vulnerability assessments to plan actions and address the underlying drivers of those vulnerabilities.
- Adopt a social learning approach that involves decision-makers, researchers and other stakeholders to reframe issues, potential options, actions and roles. A learning approach can align insights into current situations and highlight innovative transitions and transformational pathways.
- Facilitate relevant and credible stakeholder dialogue about desirable and unacceptable conditions, changes and preparedness options, and pathways preferences.
- Identify where planned actions can lead to other problems. Such maladaptive actions can come from a narrow focus on cause-effect relationships or assumptions that favoured approaches from the past are 'right'. This approach can help identify when an option or pathway may create lock-in or shut-down future options.
- Build on existing good practice, helping to reduce vulnerabilities and increase resilience to climate change impacts. Pathways planning allows organisations to commit to short-term actions and guide future actions.

How are adaptation pathways applied?

Adaptation pathways need community ownership and support to prepare agreed climate preparedness plans and inform decision-making. While much information about current and future climate change will come from technical, expert and institutional sources, the voices of many other stakeholders within communities must be heard to tell the complete story.

Pathways development starts with a participatory process where the community is involved in setting adaptation goals and clarifying preferred actions. Participants can use a number of processes to identify, appraise and sequence options which can be shown on an adaptation pathways map. Experience has shown that involved participants are more likely to support proposed actions and work to realise the goals.

Transformational adaptation

Adaptation that transforms systems will require ongoing community participation and long-term inclusion and support for across all community members when setting objectives and goals. A stepwise approach is needed to identify adaptation triggers and sequence decisions over time. All levels of government will play a role, including local and First Nations, provincial and federal government, as well as stakeholders such as community groups and industry.

Developing adaptation pathways

Pathway development follows a simple cyclic 5 stage process:

1. Define objectives

The process starts by defining the objectives and goals, including key indicators of success. Goals are likely to be revised and changed, or even abandoned over time.

2. Analyse current situation

With the goals in mind, the current situation is assessed to set environmental, social and economic baselines. This starting point helps to judge what results would be without change and to envision possible futures. This analysis includes exploring historic drivers and actions that shape the issues.

3. Assess possible futures

The third stage is to develop possible future scenarios considering the expected state of key factors in the future. Based on Stage 2 data and informed by climate projections, these scenarios can then be tested to understand if they are desirable options.

4. Develop pathways

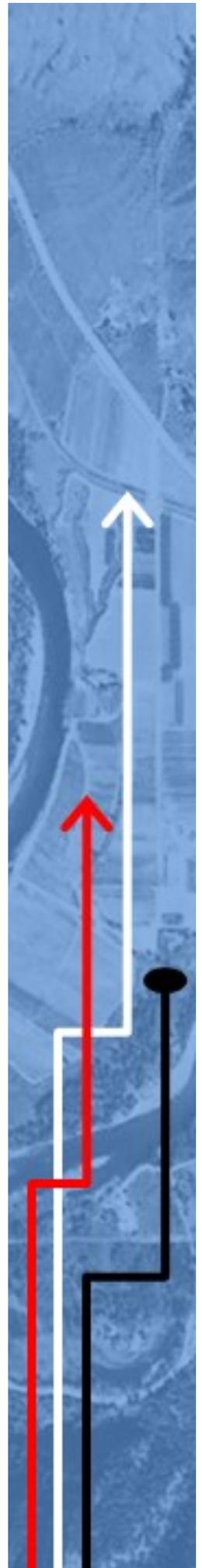
The future scenarios inform what adaptation pathways can be taken. Climate preparedness options are identified and tested against each scenario for their resilience and ability to adapt to those conditions. Tipping points, turning points and triggers are recognised to determine at what points a pathway may become unviable and reach its use-by-date.

5. Implement, monitor and learn

The final stage in this iteration involves staged implementation of the agreed action plan, while continuing to monitor, evaluate and report. In some cases, improvements and learning while developing the adaptation pathways will be more important for adaptability than implementation and monitoring.



Figure 1. Five stage approach to adaptation pathways planning, adapted from Serrao-Neumann, 2015.



Phases: Preparation, Planning and Practice

Preparation phase

Stages 1 and 2 focus on preparing to develop an adaptation pathway by defining objectives and goals, then analysing the current situation. Preparation can be informed by reviewing existing strategies, plans and data to identify the relevant preparedness capacities and needs. The assessment is regularly updated by the most current information on climate change and its impacts and preparedness options, so adaptation objectives can be refined.

Planning phase

Stages 3 and 4 analyse potential futures where scenarios for future change are imagined, and used to develop pathways. These sequences of potential paths aim to support resilience and manage transitions,

using expected decision points based on physical and environmental factors, which are considered in terms of social values, rules and knowledge. Planning the pathways process involves consultation and negotiation at the start to generate meaningful support within affected communities.

Practice phase

In practice, communities implement pathways and monitor agreed indicators of climate change and preparedness so that choices can be informed by new knowledge. Adaptation pathways are designed to be actively used over decades while decisions are implemented, changes are monitored, and lessons inform adaptation decisions.

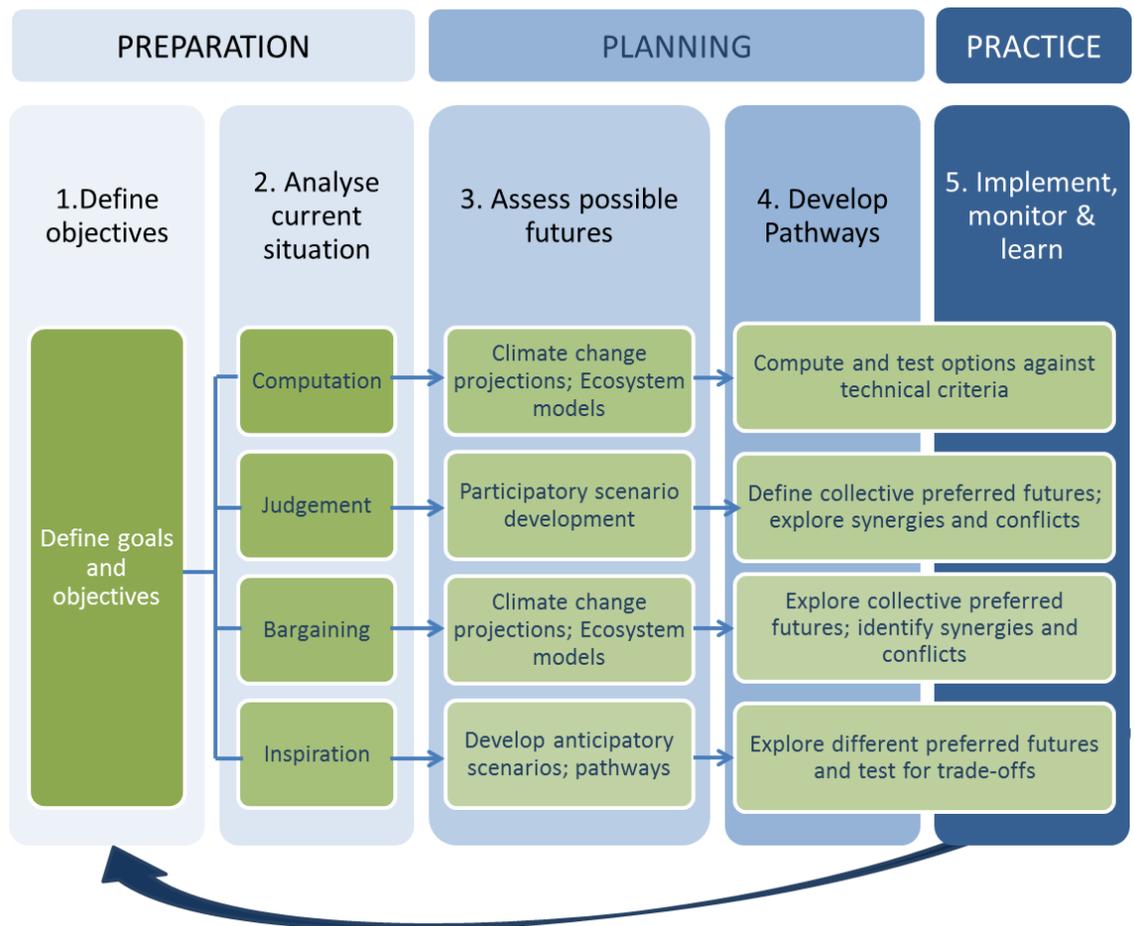


Figure 2. Schematic adaptation pathways process through four decision-making frames; Computation, Judgement, Bargaining, and Inspiration - adapted from Bosomworth, 2015.

Stage 1

Define objectives

Output: Statement on the key areas for decision-making and agreement on vision, goals and objectives

The pathway will be shaped by understanding the *why*, *what* and *how* of your community's response to climate change impacts. Set a vision for the future by making it clear *why* time, attention and resources will be dedicated to an adaptation pathway over many years. Define goals of *what* will be accomplished by agreeing on future-focused intentions and purposes. Set objectives that drive *how* goals will be reached and are measurable and realistic, considering expected climate change .

Clarify the scope of the issues and preparedness projects from the start. Depending on capacity to manage assets and resources, pathways can apply to multiple issues across a region or sector, or focus on a single issue and specific projects. On larger scales, pathways tend to be more generic and involve strategic, rather than specific planning. As the scope narrows, pathways are more specific and address individual decisions and operational planning.

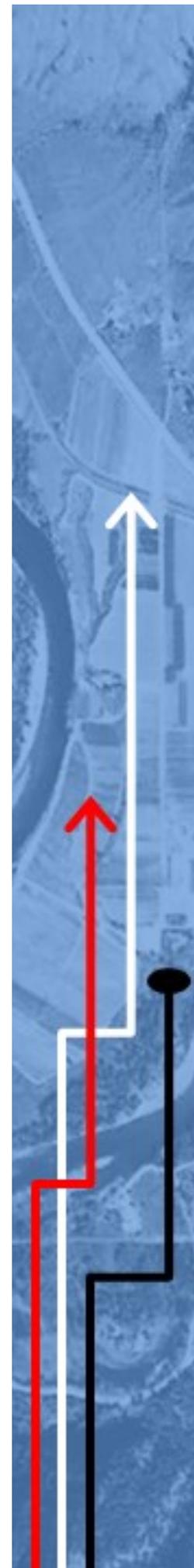
With a clear scope, local climate projections can be explored to develop a summary of potential climate change impacts. In B.C. the Pacific Climate Impacts Consortium (PCIC) makes climate services available for adaptation planning and has developed statistical projections that have been regionally downscaled for some local governments. For climate preparedness planning, it is important to take into account the upper range of projected future climate change, especially when planning critical infrastructure investments. Over-reliance on averages can mask the seasonal impacts of extremes in rainfall and temperatures. Ensure projections are being interpreted consistently and in accordance with climate services advice.

Setting goals in key areas of decision-making

- Focus pathway goals on what is important to the people involved in planning, their capacity to respond, and what key concerns will be impacted.
- Link goals to important infrastructure and services (e.g. those supporting drinking water and health).
- Consider what level of response is needed to meet realistic goals, which will be different if they aim to manage and protect, or to enhance and enable transitions.
- Connect related climate impacts to goals and concerns. If reducing wildfire risk is a goal for example, how are combinations of temperatures and rainfall extremes expected to develop over time and affect that risk?

Valuable resources are available if you stay up-to-date with climate preparedness planning. Seek out and use adaptation tools such as PCIC's *Plan2Adapt* and other resources compiled on websites such as *Retooling for Climate Change* by the Fraser Basin Council (FBC) and project outputs from the BC Agriculture & Food Climate Action Initiative. These tools can guide different types of analysis and discussion. For example, decision lifetime analysis helps to understand what long-term decisions will likely be impacted by climate change, discussing community values helps set local priorities, and conducting risk and vulnerability assessments offers insight into those assets and services most important to a community. Reviewing adaptation plans for other communities offers insight into their approaches to climate preparedness.

A final step in setting goals is to check that the participants developing the pathway see that goals are achievable. This is more straightforward with high level plans for broad regions. However, with very specific or narrow pathways, some goals might not be realistic to achieve and will need to be adjusted.



Stage 2

Analyse the current situation

Output: Documented current practices and their limitations with respect to future climate change

Shared and up-to-date knowledge is the foundation for climate preparedness planning. A transparent and accessible knowledge platform will need to be resourced, managed and updated as credible new information becomes available. Data can come from scientific and technical sources, and from cultural and local knowledge. Incorporating local and traditional knowledge and values in plans will reflect the local character and address key areas of decision-making.

How issues are managed will depend on a combination of information certainty and community values. Different approaches can be selected to manage issues depending on how much confidence and certainty there is around the information, compared to how much community agreement there is around goals. Table 1 offers some guidance to choose approaches that are most useful, singly or in combination.

Ways to approach issues

Computation is useful when there is little uncertainty about the knowledge and there is a lot of community agreement on the way forward. For example, planning to ensure adequate water supplies for residential use can be informed by analysis that combines projected seasonal changes in rainfall and current reservoir capacity.

Bargaining is effective where knowledge is fairly certain but the community is not in agreement on goals. For example, trade-offs will need to be negotiated to ensure water supply for some businesses and industries when climate projections indicate there will not be enough water for all existing users.

Judgement has to be applied when a community agrees on goals but knowledge is uncertain. For example, decisions to protect a riverside downtown core reflecting climate projections of increased risk of both drought and flood, depending on the season.

Inspiration is needed when communities face complex system changes that will affect issues involving contested values. For example, when lands will become unsuitable for traditional forestry or agricultural practices, transformative and innovative options will need to be trialled to see how they might work.

Table 1. Approaches to issues by certainty and level of agreement on values and goals.

	Far from certain about system or asset	Issues requiring 'Judgement' Experimental intervention Adaptive management Social learning Collaboration	Issues requiring 'Inspiration' Leadership Reframing Social Learning Adaptive Governance Collaboration
	Close to certain about system or asset	Issues requiring 'Computation' Analysis Computation of options Implementation	Issues requiring 'Bargaining' Trade-offs Co-operation Define common ground
		Close to agreement on goals	Far from agreement on goals



Stage 3

Assess possible futures

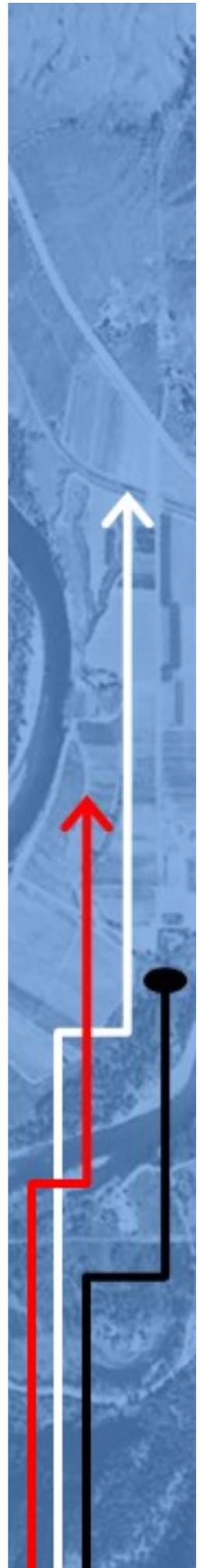
There is a range of possible futures depending on technological innovations, social change and ongoing climate change impacts. Considering a range of futures is a useful way to account for uncertainties and include new knowledge as it becomes available. Navigating multiple futures is a fundamental strength of the pathways approach to sequence decision points and recognise when climate preparedness options will reach their use-by-date and no longer be effective.

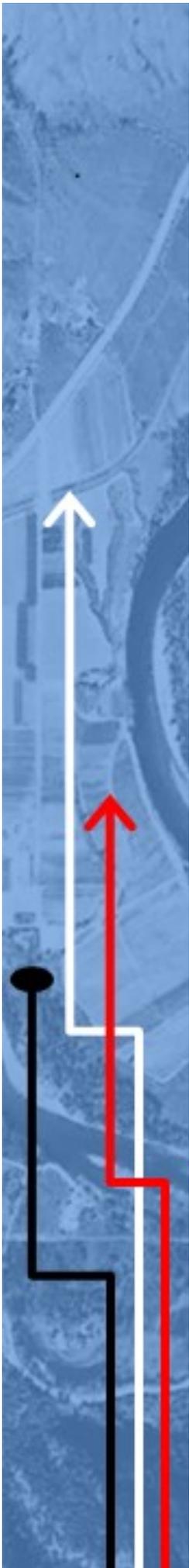
Expected climate change over the next three decades is incorporated into this stage of planning so immediate and medium-term (e.g. 5-10 year) strategies can be developed in the context of much longer-term environmental and social change. Access tools such as the *Pacific Climate Impacts Consortium's Climate Explorer (PCEX)* to locate, visualise and download data describing regional projected future climate conditions.

Choose tools and methods to describe potential futures based on what goals and issues are the top priorities for the adaptation pathway. Learn more about and apply some recognised techniques for future thinking that can be used singly or in combination. These include foresighting, backcasting, the Delphi process and Bayesian belief networks. The resulting scenarios can guide what possible futures are explored and how their implications are analysed.

Participation and inclusion

Use participatory techniques to support open discussions about the value judgements that are implicit in planning issues and to explicitly address differing perspectives. By having stakeholders participate in the process of deciding what futures are considered, plans begin to gain agreement from the outset through experimentation, learning and building shared meaning.





Stage 4 Develop Pathways

Community planning will inform an adaptation pathway that can be put into practice over multiple years. Some of these steps will be repeated as adaptation options shift and climate change impacts affect community values, as shown in Figure 3.

Steps that make a pathway

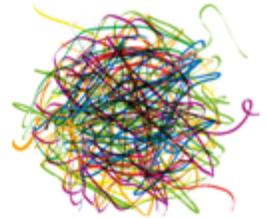
- A) Address existing drivers of vulnerabilities
- B) Bookmark decision points
- C) Consider alternative actions
- D) Develop plausible timelines
- E) Evaluate and refine pathways
- F) Finalise and visualise pathways

A. Identify options to address existing drivers of vulnerabilities under current conditions.

Ongoing community issues that are subject to weather events and climate patterns have existing management strategies, with their own strengths and vulnerabilities. Understanding how practices are suited to the past climate offers insight into the ways climate change can increase existing vulnerabilities or present new ones.

A focus on increasing resilience can help reduce vulnerability to the current climate with co-benefits for future adaptation. For example, the BC Agriculture & Food Climate Action Initiative has developed a wealth of resources for agricultural producers and their communities to address identified priorities. Such reports and analysis offer a strong starting point for adaptation pathways across a range of issues.

Address Vulnerabilities



Bookmark Decisions



Consider Alternatives



Develop Timelines



Evaluate Pathways



Finalise Pathways



Figure 3. Illustration of steps to develop an adaptation pathway.

B. Identify tipping points, turning points and trigger points

Pathways start with current management options that will be affected by the potential implications of climate change. Practices have to be reconsidered when these thresholds or tipping points and turning points are approached (see box) Combining information on current and future scenarios helps start to identify potential tipping points where 1) some actions may no longer be effective, 2) system or asset thresholds might be reached and 3) an asset or system might change (e.g. directly driven by climate change or by changes in surrounding land use). In addition to increased risks, there will also be opportunities from positive triggers such as availability of additional funds, increased community champions or political will.

C. Identify alternate options under a range of possible futures

By taking into account identified decision points, options can be recognised that help to avoid, limit or remove the impacts of climate change and other socio-political, economic and environmental factors. Review possible actions in terms of what triggers could make them necessary and judge if they are robust across plausible futures.

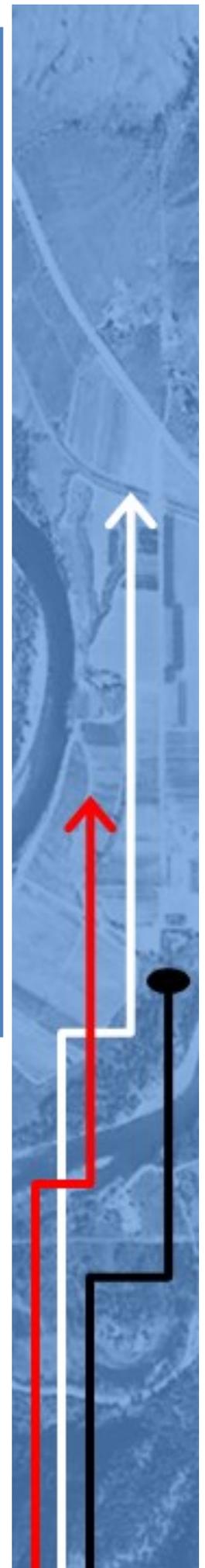
For each potential option, document an initial evaluation of their tipping points, turning points and trigger points. Because adaptation and mitigation are both needed into the future, consider co-benefits for mitigation and sequestration in climate preparedness options. It can be challenging to identify new options so support diverse and creative participation and constructive collaboration to raise, discuss and consider things that are unusual. Pay attention to what an option contributes to achieving goals and what are the stakeholders' roles, including those of agricultural organisations.

Tipping, turning and trigger points

Tipping points identify thresholds where current management strategies can no longer meet objectives due to climate change consequences, such as new patterns of drought and flood. Tipping points mark when a new management strategy is needed, and show the limits of current practices to cope with climate change.

Turning points indicate thresholds found in socio-political systems that may be passed due to changes in climate, policy objectives or social values. For example, policy changes to manage water may influence farming practices that have implications for livelihoods and rural communities. A social threshold relevant to B.C. may be a turning point where there is not sufficient irrigation supply for local sustainable food production.

Trigger points mark the start of lead time needed for action, before a turning point is reached. How far in advance triggers appear depends on the time needed to choose, plan and implement change. Exploring multiple futures prepares communities for difficult decisions by identifying triggers in advance. They are a crucial part of a pathways approach, enabling strategic plans to be made before tipping points are reached.



D. Sequence potential actions into draft pathways

This step draws all the earlier work together to develop a sequence of potential options to create pathways. The previously defined tipping, turning and trigger points help to identify under what conditions a specific option stops working and earlier points when action must be taken. Existing activities are documented first, placing on a time-line no-regret options and those robust across most futures. This alignment is checked against the identified tipping, turning and trigger points. The sequencing process can show up gaps between current management practices and the resources, political and community support needed to enable the adaptation pathway. The Resources section provides links to guidance on how to map or sequence pathways.

One step at a time

Influencing how decisions are sequenced is particularly important for organisations that are not the 'lead agency' within a community planning initiative. For example, agricultural producers may have to declare their interests and advocate for a specific action or change. When developing the sequence of actions, compare current organisational conditions and adaptation goals for each scenario to identify key issues and prioritise risks and success factors that need to be addressed.

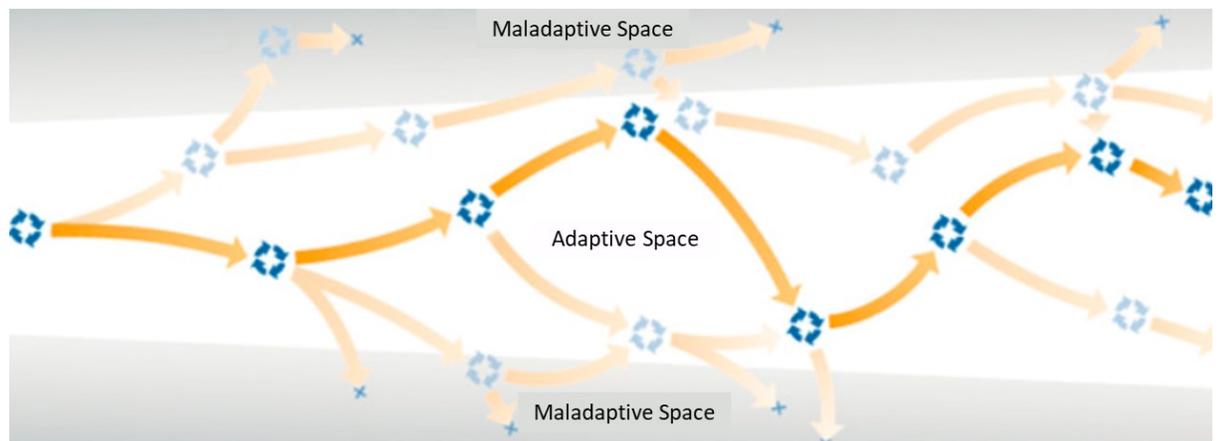


Figure 4. Schematic adaptation pathway map to avoid maladaptation (adapted from Wise, 2014).

E. Analyse and evaluate the pathways

As with any planning process, potential options are evaluated for cost, benefits, feasibility, acceptability and side-effects. Choosing preferred pathways will be a negotiated process with priority given to options and actions that can be implemented or supported immediately. In many cases, these will be the no-regret and low-regret actions, and those robust across many futures. Criteria to evaluate adaptation pathways include:

- **Co-benefits:** also supports biodiversity, mitigation, traditional foods or other agreed values
- **Maladaptation:** does not create a 'dead-end' by impacts on other assets, species, or values
- **Limits:** no new constraints in physical, socio-political, financial, or social systems
- **Flexible:** avoids lock-in and provides options if a strategy must be adapted or replaced
- **Sustainable:** supports physically and socially sustainable adaptation under different futures
- **Responsive:** enables switch between strategies or ability to postpone a turning point

F. Finalise and visualise pathways

This stage maps out or visually documents the sequence of potential pathways. As part of a participatory process, the adaptation pathways can be represented visually to communicate options and share decision-making. Computer-based tools and methods are available to help agricultural communities depict potential adaptation pathways. Pathways can be mapped in a fluid style that may be in keeping with cultural sensitivities, such as shown in Figure 4.

A more linear and technical style shown in the simplified schematic example in Figure 5, demonstrates another visualisation technique, using the free software *Generator*, listed in the Resources section.

The common feature of all adaptation pathway maps is a reflection of the steps already taken to increase climate preparedness, identify decision points, consider alternatives and present plausible timelines. Pathway maps are meant to be shared, revised and updated as new information becomes available.

Interpreting a pathways map

In the map style shown in Figure 5, each future scenario is represented by a coloured line, with current policies shown in grey. In this example, futures are mapped across a number-line segmented by decades. Actions could also be mapped to number-lines divided according to climate factors such as ‘number of consecutive days without rain’ or ‘number of days over 25°C’. The black circles mark tipping, turning or trigger points where decisions have to be reconsidered.

Following the grey line of the current policy below, targets begin to be missed after four years. Four options were identified that can begin to be implemented after this point. Actions A and D look to be effective for the next 100 years in all climate scenarios, so are likely preferred pathways. If Action B is chosen after the first four years, a tipping point is reached within five years where the option will no longer be useful and require a shift to one of the other actions to achieve goals (follow the gold lines). If Action C is chosen after the first four years, a shift to Action A, B, or D will be needed under one possible scenario (follow the solid green lines). In all other scenarios, the targets will be achieved for the next 100 years (the dashed green line).

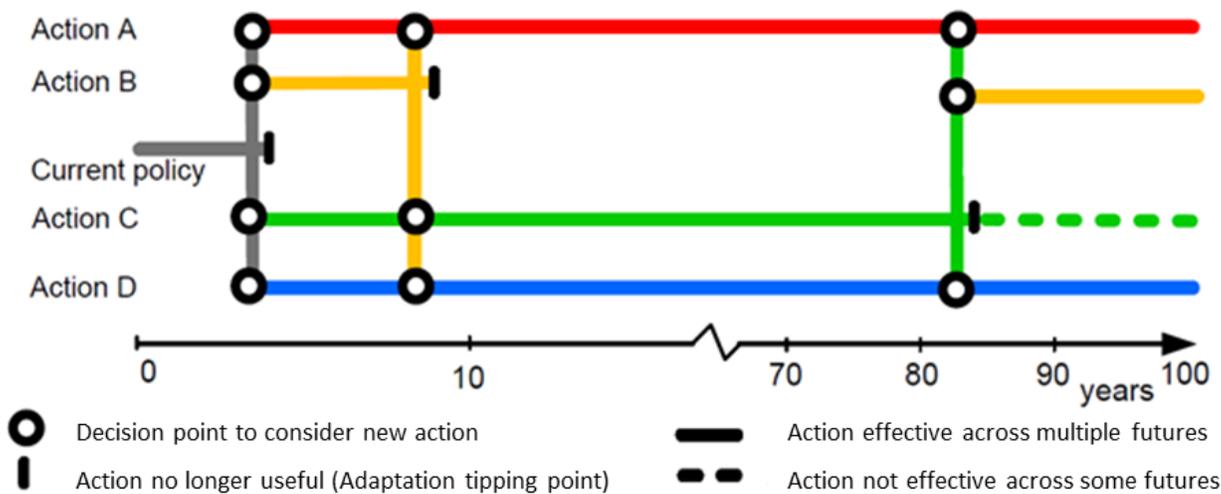
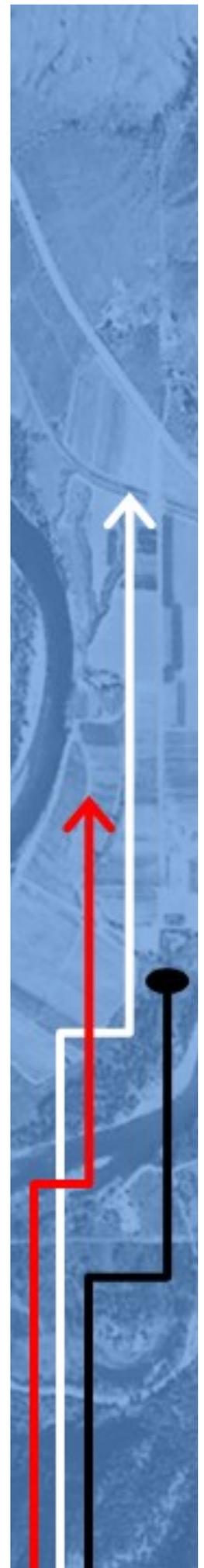
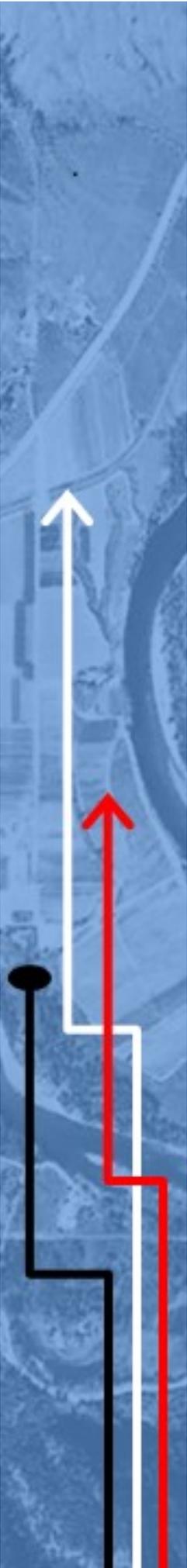


Figure 5. Schematic map of an adaptation pathway based on the style of the London Underground transportation map (adapted from Walker, 2015).





Stage 5

Implement, monitor & learn

When to start

The trigger to start implementing an adaptation pathway may be set before developing the pathway itself, possibly through an existing policy or funding opportunity. However, the signal to start will likely be a trigger or turning point identified as part of developing the pathway. Some assumptions and options informing pathways will be challenged by ongoing changes in natural or policy environments. Systematic monitoring is needed to identify when to re-evaluate the course of action. Choose signals that will be objectively trusted as measurable, timely and reliable, and able to be combined to give a full picture of change. Options such as building new infrastructure need a long lead time to plan, resource and build, so effective monitoring can signal when critical responses must be started.

When to reconsider

Developing an adaptation pathway allows decisions to be considered in sequence based on the information currently available. When applied over time however, a pathway will meet barriers, from climate impacts, social change, economic and financial challenges and crises in community support. Considering the goal of sustainable local food, triggers to monitor will include severe weather events, unseasonable temperature and rainfall patterns, and changes in pollinator health. Agricultural producers are keen observers of seasonal changes and vital contributors to local monitoring systems. Producers work with local, regional, and provincial agencies, as well as with community members, researchers, consultants and industry, to share information and implement climate preparedness actions.

Using new knowledge

The knowledge platform, developed as part of Stage 2, provides a base for the monitoring system that fits with each set of goals and objectives. Deciding what to monitor will be specific to the issues of concern. For example, low water levels in a significant river that trigger policy responses, such as mandatory water restrictions, can be anticipated by monitoring seasonal changes in rainfall, snowpack and freshet. Early warning of expected deficits can trigger early action such as requests for voluntary reductions in water consumption.

Roles and responsibilities

Because implementation of climate preparedness strategies affects all levels of government and communities, adaptation pathway planning will need to clearly identify, allocate and coordinate roles and responsibilities for effective action. While it takes significant time and resources to implement adaptation pathways that are participatory and inclusive, the benefits in resources and social cohesion are long lasting. Learning from experience will build the skills and capacities for climate preparedness planning and implementation across organisations and groups, including agricultural producers, to manage in a changing climate.

Resources

Websites

Provincial government sources

URL: <https://www2.gov.bc.ca/gov/>

BC Agriculture & Food Climate Action Initiative to access reports on adapting agriculture URL: <https://www.bcagclimateaction.ca/>

PCIC Climate Explorer (PCEX) to locate, visualise and download projected Pacific and Yukon climate condition data. URL: <https://www.pacificclimate.org/analysis-tools/pcic-climate-explorer>

ReTooling for Climate Change adaptation tools and resources supporting local governments, First Nations and natural resources URL: <https://www.retooling.ca/>

The Pathways Generator visualises pathways to explore policy options with stakeholders. URL: <https://publicwiki.deltares.nl/display/AP/Pathways+Generator>

Pathway Guides

Bosomworth K, Harwood A, Leith P, Wallis P. *Adaptation Pathways: a playbook for developing robust options for climate change adaptation in NRM*. 2015. URL: <https://terranova.org.au/repository/southern-slopes-nrm-collection/adaptation-pathways-a-playbook-for-developing-options-for-climate-change-adaptation-in-natural-resource-management/scarp-adaptation-pathways-a-playbook-final.pdf>

Haasnoot M, Kwakkel JH, Walker WE, ter Maat J. *Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world*. *Glob Environ Chang*. 2013;23(2):485–98. URL: <https://www.sciencedirect.com/science/article/pii/S095937801200146X>

Rissik D, Boulter S, Doerr V, Marshall N, Hobday A, Lim-camacho L. *The NRM Adaptation Checklist: Supporting climate adaptation planning and decision-making for regional NRM*. CSIRO and NCCARF; 2014. URL: <http://adaptnrm.csiro.au/wp-content/uploads/2014/06/AdaptNRM-Adapt-Planning-Tech-Guide1.pdf>

Serrao-Neumann S, Cox M, Schuch G, Low Choy D. *Adaptation Pathways*. 2015. URL: <https://www.terranova.org.au/repository/east-coast-nrm-collection/planning-packages>

Sieberttritt MA, Stafford Smith M. *A User's Guide to Applied Adaptation Pathways*. 2016. URL: www.adaptationpathways.net

Literature

Abbott G, Chapman M. *Addressing the New Normal: 21st Century Disaster Management in British Columbia*. 2018. URL: <https://waterbucket.ca/wcp/2018/05/12/new-report-addressing-the-new-normal-21st-century-disaster-management-in-b-c/>

Columbia Basin Trust. *Indicators of Climate Adaptation in the Columbia Basin*. 2015. URL: <http://www.cbrdi.ca/Projects/Climate-Adaptation>

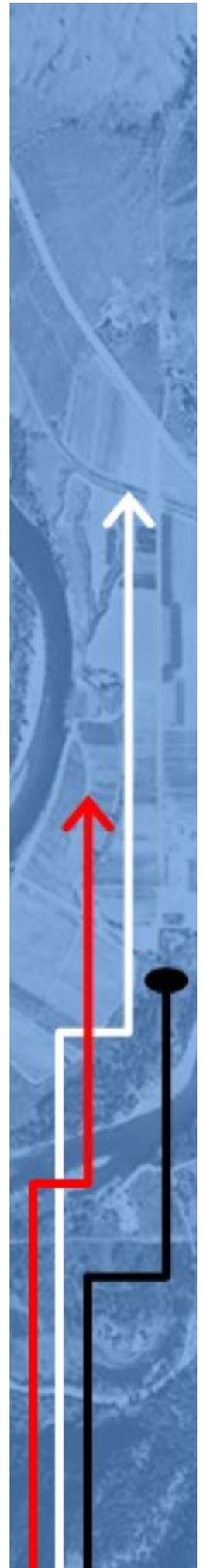
BC Agriculture & Food Climate Change Action Initiative. *Climate Change Adaptation Risk + Opportunity Assessment: Provincial Report*. 2012. URL: <https://www.bcagclimateaction.ca/wp/wp-content/media/AdaptROseries-Provincial.pdf>

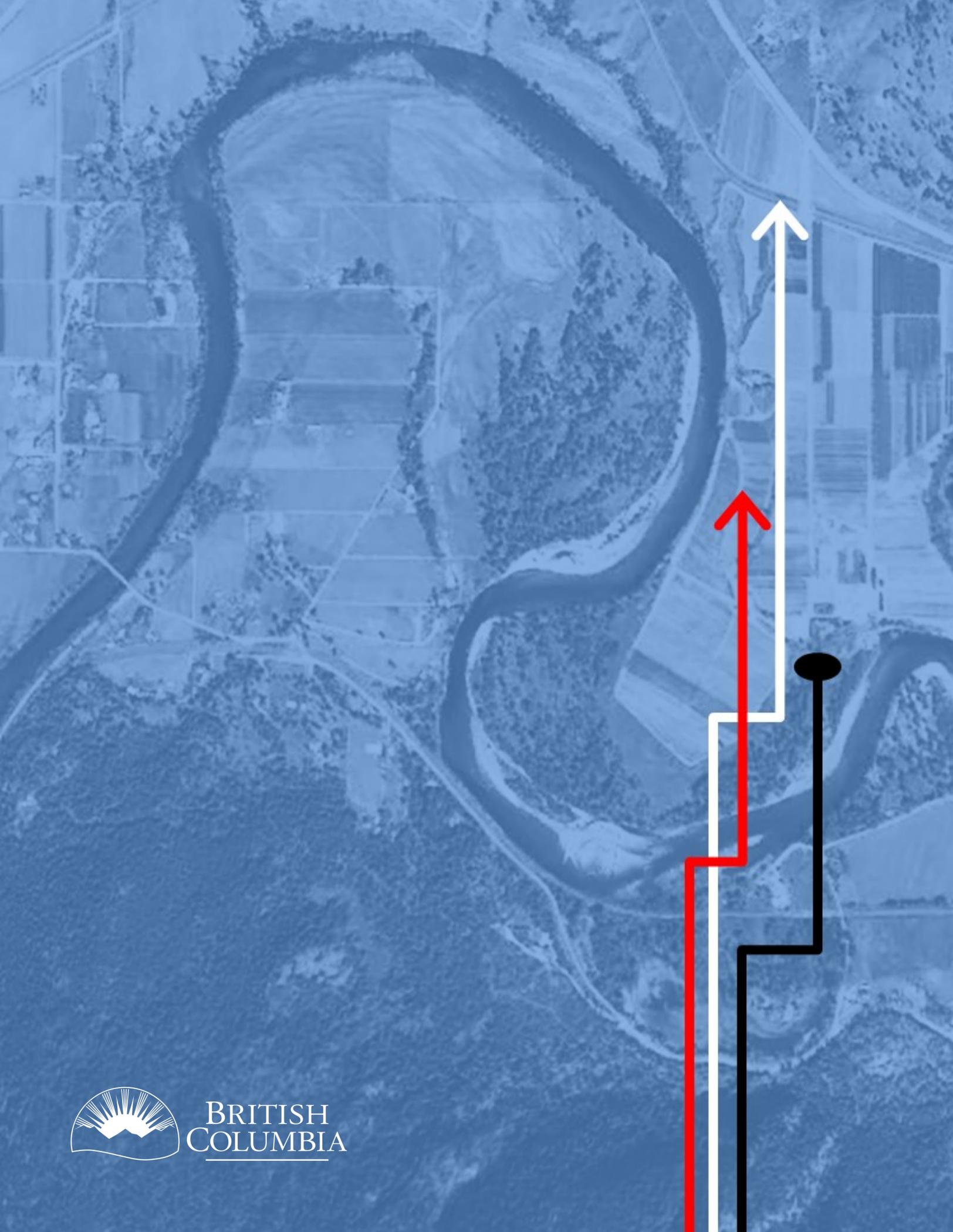
Crawford E, Beveridge R. *Strengthening BC's Agriculture Sector in the Face of Climate Change*. 2013. Available from: <https://pics.uvic.ca/sites/default/files/uploads/publications/Strengthening BC's Agriculture Sector 0.pdf>

Haasnoot M, van 't Klooster S, van Alphen J. *Designing a monitoring system to detect signals to adapt to uncertain climate change*. *Glob Environ Chang*. 2018;52 (September):273–85. URL: <https://doi.org/10.1016/j.gloenvcha.2018.08.003>

McLachlan I, Charlton S, Tyler S. *Pilot Application: Adaptive Design & Assessment Policy Tool (ADAPTtool)*. 2013; (December):82. URL: https://www.iisd.org/pdf/2014/adapttool_bc_ag.pdf

OAG-BC. *Managing climate change risks: An independent audit*. 2018. URL: https://www.bcauditor.com/sites/default/files/publications/reports/Climate_Change_FINAL.pdf





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