

Challenges to Using Beaver Coexistence Tools in Alberta

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Introduction

Humans and beavers do not always get along. On a shared landscape, with increasing human population, land use, and development pressure, the needs of wildlife often clash with those of people. To reduce conflict and provide practical coexistence tools, the Miistakis Institute and Cows & Fish (Alberta Riparian Habitat Management Society) initiated the collaborative project; *Putting Beavers to Work for Watershed Resiliency and Restoration*. This project's primary goal was to foster human-beaver coexistence, promote the resilience of watersheds and restore the benefits that beavers provide.

Beavers have been recognized as important for climate resiliency as they facilitate groundwater storage, increase stream permanence, enhance water quality, mitigate floods, create terrestrial and aquatic habitat, among myriad benefits. Despite this, beavers can also cause unwanted flooding, damage infrastructure, incur maintenance costs, and remove trees. We believe that with a better understanding of beaver ecology and effective implementation of coexistence tools, the negative impacts of beaver behaviour can be addressed.

Since 2012, the collaborative has focused its human-beaver coexistence efforts in Alberta on five elements: educational workshops and webinars, coexistence demonstration sites and monitoring, hands-on skills development sessions and site tours, social science to evaluate knowledge and perceptions about beavers, and awareness materials. It is by providing sound science, cost-benefit analysis, and addressing challenges to new techniques that we inform and encourage coexistence and acceptance of beavers by landowners, land managers, and policy-makers.

Through the hands-on coexistence workshops and research on management tools, the collaborative has developed extensive expertise on human/beaver coexistence within and beyond Alberta. Although the use of coexistence tools is relatively new in Alberta, they have been proven effective in many jurisdictions across the United States and Canada, including among Alberta's neighbours in British Columbia, Montana, Idaho, Utah, and Washington. There is also a growing body of evidence of their efficacy within Alberta; for example, at the Cooking Lake-Blackfoot Provincial Recreation Area and Elk Island National Park, in addition to many individual sites across the transition zone between Parkland and Boreal Natural Regions.

This report provides an overview of the current challenges and successes in using coexistence tools in Alberta, including pond levellers, culvert protectors, relocation, and beaver dam analogues (BDAs). For each of the tools, we provide a description, present the regulatory context, highlight challenges using a case study, and recommend how they could be overcome. We identify common challenges among tools and suggest how these can be addressed.

Although we have identified many challenges to using beaver coexistence tools in Alberta, our hope is that with greater awareness and clearer regulatory guidance, we can replace challenges with methods that will foster the benefits that beavers provide while minimizing their negative impacts. Despite these challenges, the rapid uptake of these new tools in the past five years shows their relevance and a willingness to address challenges to their implementation.

Current Alberta Context

As human impacts increase across Alberta, innovation to restore and protect natural resources, particularly water, emerges. The Alberta government has prioritized watershed health with initiatives such as the Water for Life Strategy, Watershed Resiliency and Restoration Program, Respect our Lakes, and Stepping Back from the Water guidance document (Alberta Environment and Sustainable Resource Development, 2012). An important part of a functional watershed is a healthy riparian ecosystem—a relationship that was historically enabled by beavers due to the role they play to enhance floodplain connectivity, increase groundwater storage, maintain stream permanence, and improve water quality (among others). Many of these watershed benefits have been lessened because of the mass removal of beavers during the fur trade era; estimated to be by 90–97% across North America (Naiman, Melillo, & Hobbie, 1986). Hence, federal and provincial regulations regarding both water protection and beaver management interact.

In Alberta, beavers are managed as furbearers under the Alberta Wildlife Act, which provides guidance on lethal control of beavers and destruction of their dams. In brief: “Beavers may be hunted and trapped, without a licence and during all seasons, on privately owned land by the owner or occupant of the land, or by a resident with written permission from the owner or occupant of the land. Additionally, beavers may be trapped under a Fur Management Licence during an open season or by someone who holds a Damage Control Licence (this can be issued from any Fish and Wildlife Office). A Damage Control Licence authorizes the removal of beavers outside of normal trapping seasons.” (Government of Alberta, 2020).

Den/lodges can be removed with a Damage Control Licence but may need additional permits. Therefore, a consultation with local municipal, provincial and federal government policies and procedures is required (Government of Alberta, 2020).

Dams affecting private land can be removed with no provincial regulatory approval as it is an exempted activity in the Water Act. However, the Department of Fisheries and Oceans (DFO) (July 2020) requires adherence to beaver dam removal codes of practice to reduce impacts to fish and fish habitat (Fisheries and Oceans Canada, 2020). Nevertheless, dam removal is occurring without seeking approval on both public and

private lands. Partial dam removal for installation of pond levellers or full removal for installation of culvert protector fencing is treated inconsistently—in some cases they are considered an exempted activity under the Water Act, but not in others, based on our experience with nearly a dozen specific examples we are aware of, two of which are profiled in this document.

There is no clear policy regarding relocation of beavers but landowners can apply for a relocation permit under the Wildlife Act and related regulations but this must be authorized by a collection licence (Stepnisky, 2017) or research licence. These applications are approved on a case-by-case basis in Alberta and all wildlife relocations in Alberta are considered using IUCN guidelines. There are no regulations or guidance on humane handling of beavers specifically, disease or genetic considerations, nor requirements for recipient waters, habitat or neighbouring landowner concerns.

In Alberta, the only provincial policy for beaver management is related to trapping (furbearer harvest) and allowances for lethal removal. Therefore, there is no existing guidance on regulatory requirements needed for use of coexistence tools such as pond levellers, culvert protectors, BDAs, or relocation. This has led to wide variation among departments, regions, and staff within the Alberta Government in how approvals are interpreted, conditions applied and decisions made. This limits the effective use of beaver coexistence tools. For example, Alberta Environment and Parks (AEP) fund projects that increase watershed resiliency and restoration, such as *Putting Beavers to Work for Watershed Resiliency and Restoration*, yet the success of these projects are limited by lack of guidance for use of coexistence tools. The array of legislation that can apply to coexistence tools is shown in the following table:

Alberta and Canadian Legislation Related to Beaver Coexistence Tools (based on experience)

Legislation	Coexistence Tools	Relevance
Alberta Wildlife Act	Relocation	Movement of living wildlife from one site to another
Alberta Water Act	Relocation, pond leveller, culvert protector, beaver dam analogue	Partial damage to active beaver dam, adjustment to aquatic habitat
Alberta Water Act - Water Allocation/ Licensing	Beaver dam analogue	Concern with reduced flows resulting from installation
Alberta Public Lands Act - Department License of Occupation – Bed and Shore	Pond leveller, culvert protector, beaver dam analogue	Work within Bed and Shore when adding coexistence devices that last beyond 5 yrs
Alberta Public Lands Act - Temporary Field Authorization	Pond leveller, culvert protector, beaver dam analogue	Access to a site and disturbance of ground surface to conduct work

Legislation	Coexistence Tools	Relevance
Alberta Historic Resources Act	Beaver dam analogue	Potential to flood area of historic resource importance
Canadian Fisheries Act	Pond leveller, culvert protector, beaver dam analogue	Potential impact on fish habitat by release of materials or change in physical structure due to installations

Unofficially, and based on a recent survey, Albertans are interested in coexisting with beavers, with 49% of respondents indicating they would allow beavers to live on their property (Kinas, Duke, & Panesar, 2017). For landowners that had beavers living on their property, 36% considered them to be “not a problem” and 28% considered them to be a “slight problem”. Albertans generally feel beavers are beneficial (74% of respondents) with only 8% feeling they are harmful (Kinas et al., 2017). Despite the support for coexistence with beavers in Alberta, the current regulatory structure is outdated and limits the tools that can be used to facilitate human-beaver coexistence.

By outlining coexistence tools, challenges to their implementation, and recommendations to overcome these challenges, we hope to enhance human-beaver coexistence in Alberta and realize watershed resiliency and restoration benefits provided by beavers.

Tools

Pond Leveller

(Otherwise Known As: flow device, water level control device, flexible pond leveller, Castor Master, Clemson pond leveller, and beaver baffler)

Tool Description

A pond leveller is a water regulation tool that allows the user to control the depth of the pond upstream of a beaver dam, thereby reducing the risk of flooding caused by the dam. Typically, a pond leveller consists of a long flexible pipe that is installed through the dam, with a cage that is submerged in the pond at the upstream end (Figure 1). The height of the outflow pipe in the dam, sets the maximum water level for the pond.

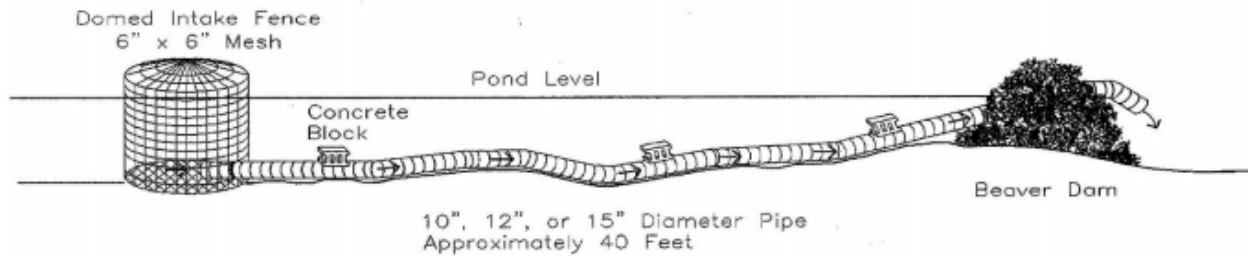


Figure 1: Pond Leveller (Callahan, n.d.-a)

Pond levellers are used where the pond upstream of a dam is a flooding concern (flooded road, trail, agricultural land, building, etc.). To allow beavers to remain at the site, it is ideal that the water level remain as high as can be tolerated; the lodge entrances must remain submerged and the pond needs to be deep enough that it will not freeze to the bottom in the winter (Miistakis Institute & Alberta Riparian Habitat Management Society, 2018).

Challenges for Use

The greatest challenge to installing a pond leveller is uncertainty of the need for approval and the required conditions to be met for its use. Pond levellers are installed in-stream (or within a constricted section of wetland, including at culverts) that may require a permit under the Alberta Water Act or Public Lands Act. Landowners are required to contact their local AEP office to determine if an approval is required and what conditions need to be met for the installation and use of this tool.

There is inconsistency in requirements among regions for sites with similar conditions (see case studies below). Some of this variation is due to specific site considerations, but most is due to the lack of formalized guidance provided by AEP on tool use and approval conditions. This stems from differences in interpretation and application of the Water Act and Public Lands Act.

Although provincial regulatory frameworks are part of the challenge, federal regulations, with respect to the Fisheries Act, pose similar challenges of clarity and consistency. In 2020, interim guidance on beaver dam removal was issued by DFO, however pond leveller installations are not explicitly mentioned (Fisheries and Oceans Canada, 2020).

Another challenge to the use of pond levellers is a lack of awareness about the tool and how it works, combined with limited installation experience. We have tried to address this challenge by creating awareness tools and hosting skills development workshops. During these hands-on coexistence tools workshops we teach landowners, and other natural resource management professionals, how to install coexistence tools, so they can apply these skills at other sites.

It is the responsibility of the landowner to obtain installation approval from AEP. In most of our workshops, the landowner has been a rural municipality (i.e., county or municipal district) where AEP instructions indicated that no permit was required for pond leveller installation. Had a permit been necessary, there would have been greater comfort and local expertise (to varying degrees) for submitting an application for approval as this is something municipalities do for other work. But since most beaver conflict has resulted in dam removal through regulatory exemptions, not requiring permits, some municipalities have difficulty understanding why coexistence methods are treated with permits. As a result, they lack the expertise to fully implement a diverse, regulatory approach. For private landowners, submission of permit applications is a challenge due to unfamiliarity with, and ambiguity of, the approval process.

Because dam removal has not required approval and / or permitting in the past, coexistence tools have been treated similarly by those installing them, but not necessarily by the regulatory bodies. This accounts for some of the confusion around whether or not approvals and/or permits are required.

In our discussions of approvals with landowners and land managers, we have discovered that there is a broad range of approval conditions, ranging from:

- No permit application needed,
- Rigorous and expensive requirements for Water Act approval related to “constructing works,” including a full Fish and Fish Habitat Assessment and relevant mitigation,
- Conditions under the Public Lands Act requiring the applicant either complete a Temporary Field Authorization that would be active for five years or complete an application for a Department License of Occupation for a longer-term installation (>5 years).

Case Studies

ROCKY VIEW COUNTY

In 2018 Rocky View County had an issue on municipal reserve land where a beaver pond was causing flooding on adjacent private agricultural property. Traditional management (e.g., repeated dam removal, lethal trapping, etc.) was not a reasonable approach at this site with a high likelihood of recolonization due to its favourable habitat. As a result, the County proposed using a pond leveller. The County submitted an application for Water Act Approval for Construction Works for the installation. They specified that no water would be diverted from the stream, and that the pond leveller would simply let some water flow through the dam and mitigate flooding. They also provided a description of how the pond leveller works and would be installed.

In reply to the application, AEP outlined the following additional conditions needed for the approval:

- Fish and Fish Habitat Assessment including recommendations and appropriate mitigation, conducted by a Qualified Aquatic Environmental Specialist (QAES),
- Temporary Field Authorization, as the work would be within bed and shore,
- Detailed drawing/plan for the site and pond leveller

Rocky View County decided to not pursue their application due to the substantial cost of a Fish and Fish Habitat assessment conducted by a QAES.

This case highlights the apparent incongruity of a regulatory response. Installing a pond leveller would preserve the aquatic habitat, consistent with the goals of the legislation. Nevertheless, an onerous process was required. Dam removal was potentially much more destructive to fish habitat yet required no approvals (see 'Current Alberta Context' section for regulatory details).

LAMONT COUNTY

In 2019, Lamont County, and a private landowner, with the support of two other non-government organization partners, began the permitting process for installing a pond leveller at a chronically flooded site on private land. Flooding also affected roads, bridges and municipal drainage systems upstream of the dam in times of seasonal high flows. The process investigated the need for permits under both provincial and federal regulations.

The waterbody where the pond leveller was planned is fish bearing and was therefore subject to federal Fisheries Act Legislation. A request for review was recommended in a response from the DFO inquiry line because the concept of a pond leveller did not fit within the codes and practices for beaver dam removal under the Fisheries Act. A Request for Review to DFO was submitted and the pond leveller project was granted approval with minimal restrictions.

Under the Alberta Water Act, through a direct inquiry with AEP staff, the proponents were advised that no approval or authorization was required, as beaver dams are exempt under the Water Act. Therefore, an application did not need to be submitted. Included in that communication was the recommendation to check requirements under the Public Lands Act.

The proponents were further advised by AEP staff, that, under the Alberta Public Lands Act, a Temporary Field Authorization (TFA) would be required by the private landowner. This was because the pond leveller would occupy crown Bed and Shore. If approved, TFA's are only valid for five years, requiring perpetual reapplication. To obtain a longer-term authorization, the proponents would need to submit an application for a Department License of Occupation (DLO) permit for Bed and Shore; an extensive process.

Currently, the private landowner, with the support and assistance of the county and the partner organizations have begun the process to apply for TFA Authorization under the Public Lands Act. The effort to apply and the outcomes are yet to be determined but will help inform the process and cost effectiveness of the pond leveller, especially for private land owners.

This case study required a TFA, and possibly a DLO, yet neither of these was a requirement in the prior case study, despite the coexistence tool being the same, pointing to a clear incongruity of a regulatory response.

Culvert Protector

Culvert protectors have a variety of names based on trademarks, locale, or slight design variations. Other commonly used terms include beaver exclusion fencing, Beaver Deceiver™, and Keystone Fence™.

Tool Description

Culverts are installed to allow water to flow under a road or trail. This is an “easy” dam for Beavers, as they only need to plug the culvert to back up the water and create a pond. The growing pond can potentially flood the road, trail, and nearby areas, making it impassable and sometimes damaging the infrastructure. A solution to this problem is a culvert protector that prevents beavers from plugging the culvert.

While some culvert protectors allow beaver and other wildlife passage through the culvert, beavers are not able to bring sticks and building materials into the culvert to plug it. Typically, a culvert protector consists of metal t-posts, and panels of hog wire that form a trapezoidal shape around the culvert opening (Figure 2). The trapezoidal shape forces any debris or building materials placed by the beavers to flow to the sides of the culvert protector so they are unable to obstruct flow.

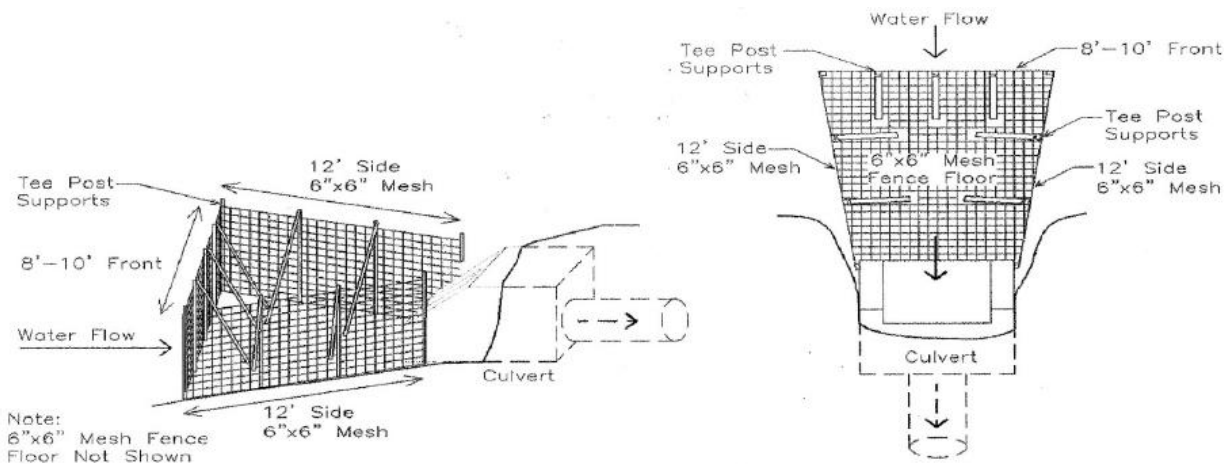


Figure 2: Culvert Protector (Callahan, n.d.-b)

Challenges for Use

The greatest challenge to use of a culvert protector is uncertainty in the need for, and required conditions of an approval or permit for installation. Culvert protectors are installed in-stream (or within a constricted section of wetland, including at culverts) which may require a permit under the Alberta Water Act, or Public Lands Act, given that the installation may occur on a waterbody bed or shore.

Landowners are encouraged contact their local AEP approvals office to determine if approval or permit is required and, if so, the conditions required to be met. Indeed, there is great variation in requirements among regions, and personnel within the AEP approvals department. Some of this variation is due to specific site considerations, but most is due to the underlying issue of no general, formalized guidance provided by AEP on the use of this tool and approval conditions.

That said, we are not aware of any approvals being required to install a culvert protector on private or public land. However, with recent changes in federal regulations to the Fisheries Act related to habitat protection (Fisheries and Oceans Canada, 2020), caution is recommended. The release of interim codes of practices for beaver dam removal and culvert maintenance from DFO may clarify regulations and alleviate the need for formal approval if the installation meets the codes of practice. In the past, the removal of beavers and their dams required no approval/permitting. Thus, the use of coexistence tools, like culvert protectors, was considered in this same spirit by those installing them. However, the regulatory bodies may not always agree, accounting for some of the confusion regarding whether or not approvals/permits are required.

Culvert protectors are frequently used in combination with pond levellers. This occurs where a culvert has insufficient water to prevent beavers from accumulating debris around the fencing. In such cases, the challenges to culvert protectors become the same as for pond levellers (see above).

As with levellers, another challenge to the use of culvert protectors is the lack of awareness of what it is and how it works, combined with limited installation experience. We have addressed this challenge using awareness tools and hosting skills development workshops. During our hands-on coexistence tools workshops, teach landowners and other natural resource management professionals, to install this tool so they can apply these skills at other sites.

Beaver Dam Analogue (BDA)

(Also known as beaver mimicry, beaver mimicry restoration, artificial beaver dams, and simulated beaver dams)

Tool Description

A beaver dam analogue is a habitat management tool that mimics a naturally occurring beaver dam. It is simple, small and is often installed in series. This structure is built instream using upright posts (natural or manufactured fence posts), a natural weave material (typically willow, spruce, or other on-site vegetation), and at the base, gravel and mud (Figure 3). Posts can also be installed to support an existing beaver dam.

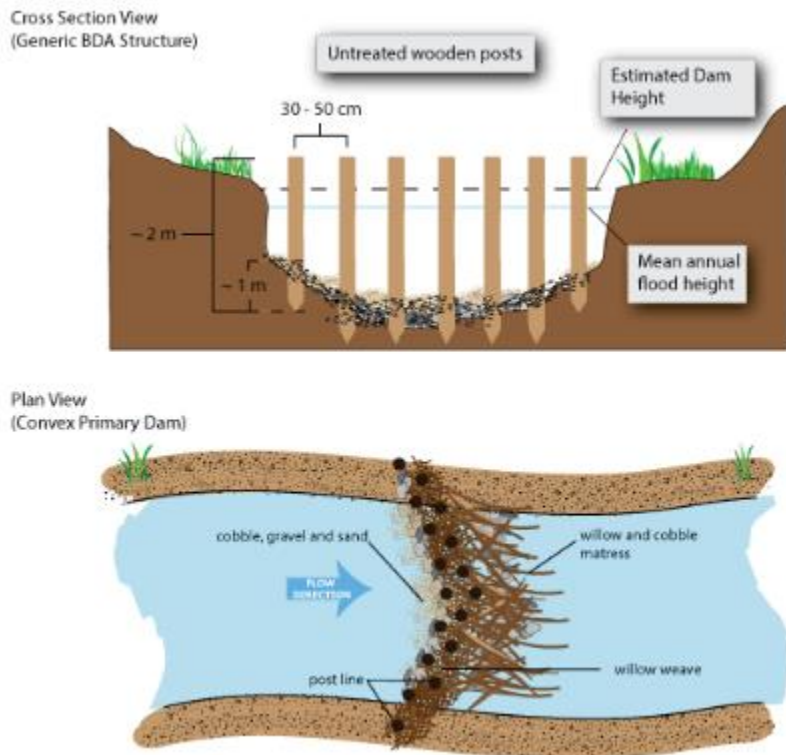


Figure 3: Beaver Dam Analogue (Anabran Solutions, n.d.)



Figure 4: "Early generation BDA. The structure is characterized by a tight willow weave and limited downstream mattress, leaving it more susceptible to scour that can undermine the posts. The downstream mattress shown here was built by beaver, and provided the original inspiration for incorporating mattresses into BDAs which diffuses flows coming over the dam." (J.M. Wheaton, Bennett, Bouwes, Maestas, & Shahverdian, 2019)

BDAs use depends on the project goal, but their main purpose is stream restoration in degraded riparian systems, and/or to encourage beavers to resume normal activities for the stream's benefit. BDAs can be used specifically for beaver and fish habitat restoration, for general habitat restoration to the benefit of multiple species including species-at-risk, to encourage natural beaver recolonization, and to guide beaver activity to places where culverts remain unobstructed, typically upstream of the culvert mouth.

Challenges for Use

The greatest challenge to use of BDAs is the uncertainty of the permits and approvals required. This leads to potentially unrealistic, complicated and expensive processes for what is a small, low impact mitigation. Because the tool is new to Alberta, approval officers are largely unaware of its purpose, function, or impacts, and may treat the BDA as a hard or grey infrastructure dam (earthen, concrete, etc.). This latter approach permanently holds back water, leading to many additional approvals and regulatory considerations that should not apply to BDAs. The lack of guidance on beaver management provided by the province leaves approvals officers unsure how BDAs should be permitted.

Landowners are required to contact their local AEP approvals office to determine if an approval or permit is required for the installation and use of this tool, and to determine

what conditions need to be met to obtain approval. BDAs are installed on stream beds and shores that are regulated by the Alberta Government. Therefore, approval should be sought on both private or public land under the Water Act and the Public Lands Act. Various other provincial Acts and approvals may apply depending on the site location, including consultations with First Nations/Métis settlements, the Historic Resources Act, federal and provincial species at risk legislation and regional-scale landuse plans.

If the stream is fish-bearing, DFO also has jurisdiction and their approval must also be sought.

A secondary challenge remains the lack of awareness about the tool and how it works, and limited installation experience. Once this tool is more readily utilized in Alberta, these secondary challenges will be more easily resolved.

Case Studies

SOUTHERN EASTERN SLOPES, CROWN LAND PILOT PROJECT

In 2018, the Miistakis Institute and Cows and Fish beaver collaborative pursued a BDA pilot project to determine the effectiveness of the tool at enhancing habitat so that beavers would naturally return to an abandoned site, as an alternative to relocation.

An extensive site search was undertaken leading to the selection of a small, unnamed stream that flowed into Stimson Creek, Alberta in the southeastern slopes of the Rocky Mountains. The site was located on public crown land, west of Highway 22, north of Highway 532. The stream is approximately 0.75m wide and has inconsistent flow throughout the year.

The Water Act office of AEP deemed this tool to be an impoundment and the Public Lands Act required a Department License of Occupation—Bed and Shore—Water Control Structure. The activities to satisfy both acts are detailed in the table below. In general, however, as with the other coexistence tools outlined (above), this was treated as a destructive activity as opposed to mitigative; there was no guidance for treating restorative or habitat improvement projects differently than destructive projects.

As part of our permit process, we were instructed that the following was needed for the BDA pilot project site (included are notes on applicability related to each requirement):

Information Requirement	Information Required	Notes on Applicability
Water Act		
General Information	<ul style="list-style-type: none"> Detailed site maps and a sketch GIS Data polygons Detailed workplan proposal Completion of other details on online form 	

Impacts to downstream users	<ul style="list-style-type: none"> • Mitigation plan should the BDAs or subsequent beaver reoccupation impact downstream users. • A complete application shall identify and address: <ul style="list-style-type: none"> ○ Existing, potential and cumulative hydraulic, hydrological and hydrogeological effects that may result from the proposed impoundments. It is expected that the information provided will not only address the impacts on the subject watercourse but those downstream (Stimson Creek and the Highwood River); ○ Existing, potential or cumulative effects on the aquatic environment; ○ Existing, potential and cumulative effects on household users, traditional agricultural users and other higher priority licensees; ○ General and detailed plans tied to quarter section lines; and ○ Any other information required by the Director 	
Public Lands Act, Department License of Occupation permit – Bed and Shore – Water Control Structure		
General Information	<ul style="list-style-type: none"> • Detailed site maps and a sketch • Longitudinal profile of the stream • Cross-sectional profile for each of the three BDAs at the site • GIS Data polygons • Detailed workplan proposal Completion of other details on online form 	
Application Prerequisites	First Nations/Métis Settlements Consultation Submissions	
	Application Supplement	
	Landscape Analysis Tool (LAT) report <ul style="list-style-type: none"> • Identifies base features, Provincial Sanctuaries, applicable higher level plans, additional application requirements, Historical Resource application requirement, sensitive 	Report listed 71 conditions, although many were not applicable or were in direct contradiction to the landscape features

	features (wildlife and other sensitive species, Federal orders, and Grassland and Natural Regions) and conditions to be adhered to.	we were trying to change. Yet all 71 had to be explained.
	Wildlife surveys including raptor nest survey and species at risk surveys	
	Plan Confirmation Service <ul style="list-style-type: none"> Detailed and specific GIS polygons 	Process and formatting for polygons was incredibly detailed and time consuming. Needed to call AEP for technical assistance
Application Submissions	Public Land Disposition Applications	
	Plan Submission Package	
Land standing report	For each activity/title, there are notes whether or not the proponent needs to contact the landowner/manager depending on land designation (e.g., if there is a Protective Notation or other designation).	
Temporary Field Authorization		
Land Surveyor survey of site*		*Not confirmed as the pilot was terminated before this point in the permitting process
Aboriginal Consultation Office (resulting from the Department License of Occupation application)		
General Information	<ul style="list-style-type: none"> Detailed site maps and a sketch Detailed proposal plan for work Completion of other details on online form 	
Level 1: streamlined Consultation	<ul style="list-style-type: none"> Sent information package to all seven First Nations listed from the First Nations Consultation pre-consultation assessment 	Some of the responses from First Nations groups appeared to view the project the same as an industrial Oil and Gas project.
Historic Resources Act		
General Information	<ul style="list-style-type: none"> Detailed site maps and a sketch GIS Data polygons 	

	<ul style="list-style-type: none"> • Detailed workplan proposal • Completion of other details on online form [Approval granted with standard requirements (i.e., reporting of any historic resources discovered)]	
Federal Government: Department of Fisheries and Oceans		
General Information	<ul style="list-style-type: none"> • Self-assessment to determine need for review from DFO staff 	

As a result of the complex regulatory requirements, we concluded that BDAs are not a feasible coexistence tool for Alberta landowners. Unfortunately, this was the primary objective for piloting this method. The regulatory requirements for a BDA on private land do not require a permit under the Public Lands Act but the other permits may be required. The ability to blow up or otherwise remove a beaver dam is considered an exemption and requires no approval, yet trying to bring back missing beaver features for restoration purposes using something analogous to a dam is considered harmful or destructive, which is inconsistent with how the dam removal is treated.

ADDITIONAL CASE STUDIES

With BDAs being a relatively new tool in Alberta, we are aware of only two other projects where BDAs have been installed, and in both cases they were told they did not need the approvals outlined in the above case study for the aspects that were the same, such as Water Act, Public Lands Act, etc., demonstrating this tool is not being treated consistently in the regulatory process. However, this approach has been used extensively in the United States. Noted examples include:

- Cottonwood Creek, Montana: the National Wildlife Federation, in partnership with the U.S. Bureau of Land Management, is taking steps to improve riparian conditions on prairie streams in north-central Montana. They focus on using low-technology methods, that include BDAs, to imitate beaver activity and expand the diversity of flora and fauna (Bates, 2020).
- Bridge Creek, Oregon: significant increases in the density, survival, and production of juvenile steelhead without impacting upstream and downstream migrations (Bouwes et al., 2016).
- Benewah Creek, Idaho: adopted cost-effective and rapid stream and floodplain restoration allowing beavers to build more persistent dams in area, and increasing hydraulic connectivity with the floodplain (De vries, Fetherston, Vitale, & Madsen, 2012).
- Multiple projects, Upper Clark Fork River Basin, Montana: enhanced groundwater storage resulting in extended stream flow and a large (>2x) increase in fish numbers (Chadwick, 2018).
- Long Creek, Centennial Valley, Montana: BDA installation increased soil moisture, extended anaerobic soil conditions, and extended the green period of adjacent vegetation (Whitehead, Hartshorn, Kleindl, Payn, & Stoy, 2019).

- Triple Creek, Okanogan County, Washington: an ongoing project aims to restore floodplain function, stream and groundwater storage, support riparian and wetland vegetation (Vanderwal & Parrish, 2018).
- Currently in use or plans to be implemented by agencies in Utah, Nevada, Idaho: implemented for fire mitigation, fire restoration (planned research) (Randall, 2018; Shahverdian & Wheaton, 2018).
- Conceptual model based on various projects' research findings: BDAs or similar structures can substantially accelerate the recovery of incised streams and associated ecosystem (Pollock et al., 2014).

Relocation

(Also known as: translocation, reintroduction)

Tool Description

Relocation is the intentional, human-assisted movement of wildlife from one location to another. This is a useful tool for beaver management in a variety of situations, including for non-lethal 'problem' beaver management, alleviating undesirable beaver activities, augmenting beavers in an area for habitat restoration, or assisting the natural recolonization or establishment of beaver colonies. This tool comes with many complexities related to animal welfare, disease transmission, and social tolerance at the recipient location.

In Alberta, beaver relocation could occur for all of these reasons, but is most often used to address 'problem' beavers (or their activities) that will otherwise result in lethal control. Some vacant beaver habitat is too far or isolated (barriers such as highways, developments preventing natural movement) from existing populations for natural dispersion to be possible. Although beaver relocation for stream restoration, wetland creation, water storage and other restorative reasons is not yet a common rationale for beaver relocation in Alberta, it is being used in other parts of North America (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2018; J.M. Wheaton et al., 2019; Wyoming Wetlands Society, 2013).

A thorough jurisdictional review for beaver relocation has already been completed - *Beaver Restoration Across Boundaries* (Haddock, 2015). A key recommendation of this report is to incorporate ecosystem goals as a part of beaver management:

- Consider the role beavers play in species at risk recovery.
- Monitor and report beaver population dynamics, occupied and potential beaver habitat.
- Link beaver coexistence to fish and wetland restoration as well as water quality in general (ecosystem services).

Challenges for Use

The greatest challenge to use of relocation is the lack of guidance and criteria for proper, regulated relocation. It is very difficult to find any information, regulations, or guidelines regarding live-trapping and relocation of beavers in Alberta. The general intent of current permitting indicates that beaver relocation is undesirable or only allowed under very narrow conditions. Combined with an onerous permitting process, relocation is confounded by a time lag between application and case-by-case approvals

Relocation can be complex and many factors both at the donor and recipient sites need to be considered. In Alberta, there is no clear policy for wildlife relocation but landowners can apply for a permit under the Wildlife Act and associated regulations but this must be authorized through a collection license (Stepnisky, 2017). According to Wildlife Act regulations, any relocations that occur should only be considered if the IUCN criteria for wildlife relocations are met (Stepnisky, 2017). However, there are no clear policies or regulations in Alberta that specify such criteria, and relocation applications are approved on a case-by-case basis.

Based on experience and communications with landowners, municipal employees, problem wildlife staff, trappers, and others, we have found that beaver relocations are occurring in Alberta without regulation or oversight. Although regulation and control over developments in waterbodies is tight, there is little or no relevant policy or guidelines to support either the public or AEP approvals staff regarding wildlife relocation. We also suspect that unregulated relocation is occurring in Alberta due to a lack of available education on or disregard for the current regulations, in part because the process is too onerous, unclear or generally intended to disallow this practice (despite a need). Unregulated relocation of beavers is dangerous for the well-being of the individual animal, local populations and for the watershed it is introduced to. As well, beavers can potentially become a 'problem', causing social and economic impacts and creating new unwanted impacts for recipient landowners and their neighbours.

Case Study

ANN AND SANDY CROSS CONSERVATION AREA (ASCCA)

In 2012, the collaborative (along with additional partners) worked with ASCCA to reintroduce two families of beavers to the 1942 hectare (4800 acre) conservation area to improve watershed stewardship and biodiversity. As studying the impact of beaver reintroduction was part of this project's intent, ASCCA received a research permit to reintroduce the beavers.

A research focus or intent is not realistic for most situations where the reason for relocation is a 'problem' beaver, since the goal is not to study them, but prevent or reduce the negative impacts they are believed to be causing. The beavers were released into suitable habitat with a long-term food supply close and adequate deep water. This site was chosen as it historically maintained a healthy beaver population

with old bank dens available for the new beavers. But because cougars and black bears are prevalent on the ASCCA, the reintroduced beavers faced numerous challenges and some were presumed to be lost to predation. It is likely that the natural movement of beavers into other areas of the ASCCA will take time as safe refuge for the beavers will only be available after they have established lodges in the deep water created by newly constructed dams.

To mitigate the challenges the beavers experienced and protect existing infrastructure (the first release site was in a constructed reservoir) the ASCCA installed a pond leveller and began a supplemental feeding regime to improve survival.

Challenges to Coexistence Tool Use

Guidelines and awareness of the value, applicability and utility of beaver coexistence tools can reduce costs, save time, improve and enhance tool use and benefit the environment. Alternatives to coexistence are conventional management methods where beavers are lethally removed and dams destroyed, which can be more expensive, time consuming and dangerous than coexistence tools with potential negative consequences for ecosystems, water quality and quantity. A recent cost-benefit analysis in Alberta showed that using coexistence tools instead of conventional management approaches resulted in a 90% cost savings (Hood, Manaloor, & Dzioba, 2018).

While conventional management will still be needed in some situations, current challenges to coexistence tools limit their relative efficiency and hence the benefits of beaver coexistence, costing public money and perpetuating ongoing conflict.

We have identified the common challenges to using beaver coexistence tools in Alberta, which include:

- Lack of clarity and regional variation on applicable legislation and permits.
- When permits are required, uncertainty on applicable conditions.
- Poor availability of information on permit requirements for landowners or land managers (including municipalities).
- Little emphasis on coexistence on the Government of Alberta webpage on beavers (Government of Alberta, 2020).
- Lack of awareness and training of beaver coexistence tools among government staff, including lack of awareness of the benefits of beaver coexistence.

There is a history and culture among landowners, land managers, government agencies and the public for treating beavers as a pest species. We suspect that this has led to social resistance for considering coexistence. A lack of up-to-date beaver population data in Alberta prevents the public, landowners, land managers, and the government from knowing if and where problem with beaver populations exist. These factors, together with the challenges to using coexistence tools are driving beaver management in Alberta.

Recommendations to Address Challenges for Coexistence Tool Use in Alberta

We recommend that a comprehensive beaver management document with the following characteristics be prepared for Alberta.

1. **Management Tools:** A comprehensive overview of all management tools with emphasis on coexistence tools.
2. **Guidelines:** conditions for approval for use of each beaver management tool (if permits or approvals are required).
3. **Stakeholder Engagement:** Prepare the plan with a working group of relevant stakeholders (e.g., practitioners, AEP staff, environmental non-governmental organizations such as Miistakis and Cows and Fish, etc.).
4. **Ecosystem Goals:** Incorporate ecosystem goals as a part of beaver management, following the recommendations of Haddock (2015).
 - Consider the role beavers play in species at risk recovery.
 - Monitor and report beaver population dynamics, occupied and potential beaver habitat.
 - Link beaver coexistence to fish and wetland restoration as well as water quality in general (ecosystem services).
5. **Approvals Consistency:** Identify a strategy to make conditions of approval available to Government of Alberta officers, with training on the purpose, function, and criteria for each tool.
 - Such training content should be in a recorded or written format that can also be referred to for ongoing learning, a suitable version of which could also be available to the public.
6. **Prioritize Coexistence:** Include a strategy to make beaver coexistence an integral part of beaver management information provided by the Government of Alberta.
 - On the Government of Alberta website encourage human-beaver coexistence as a primary measure and provide detailed information on coexistence tools. Maintaining information on conventional management (lethal removal, dam breaching, etc.).

Additional Recommendations include:

1. Identify exemptions and codes of practice for common restoration techniques and beneficial management practices in Alberta under the Water Act, Public Lands Act, Historic Resources Act, and Aboriginal Consultation Office (as included under the Public Lands Act). Projects with restoration goals that adhere to a set of eligibility and implementation criteria should be exempted, and guidelines provided on how to design and implement the restoration.
 - An example of an exemption can be seen with the 'Interim Code of practice: beaver dam removal' from DFO with regard to fish and fish habitat (Fisheries and Oceans Canada, 2020). A similar approach could be

taken in Alberta to allow for ecological restoration projects to occur more readily.

2. Include continued support for education, social tolerance and skill development for both the public and Alberta government staff with opportunities led by environmental non-governmental organizations as well as government agencies.

Guideline Examples

Many of the challenges to coexistence tool use are not unique to Alberta. Jurisdictions and researchers within the United States have developed guidelines for successful beaver management incorporating coexistence tools. Below we provide guidelines developed in a variety of jurisdictions that could be used to tailor the development of an Alberta Beaver Management Plan. Additionally, our research shows that the creation of beaver management-specific legislation isn't necessary to improve how beaver are managed in Alberta (Haddock, 2015). It is clear from our work that education about beaver ecology, familiarity with coexistence tools, skill development through training, and understanding beaver management costs and benefits have already had considerable impact on day-to-day decisions of those managing beavers. If these were supported by guidelines, beneficial management practices, legislation, regulation and/or formalized provincial plans for beaver management, more ecosystem benefits could be realized.

Document Title	Jurisdiction	Description	Reference
Integrated Pest Management Plan City of St. Albert	Local (Municipal)	"The guidelines outline the City's approach to dealing with beavers, using both preventative and active management techniques. The beaver management guidelines are in line with the City's environmental policy that reflects a balanced approach to coexist with beavers while addressing flooding control, infrastructure integrity, native tree and shrub assets, and public safety on City owned lands."	City of St. Albert, 2017
Utah Beaver Management Plan	State	Plan goal is to maintain healthy, functional beaver populations in ecological balance with available habitat, human needs, and associated species. It provides direction for statewide beaver management including	Utah Division of Wildlife Resources & Beaver Advisory Committee, 2017

		expanding the beaver distribution to their historic range where appropriate.	
Recommendations for an Adaptive Beaver Management Plan: For Park City (Utah) Municipal Corporation	Local (Municipal)	Advises the municipality on how best to manage beaver populations while balancing municipal needs (habitat, aesthetic value, protection of property). Includes a monitoring framework to inform decision-making and management actions.	Joseph M. Wheaton, 2013
Beaver Management Solutions	Local (Municipal)	Provides a wide range of management solutions to beaver-related challenges.	King County Science and Technical Support Section, 2019
What do I do if I have a Beaver Issue?	Local (Municipal)	A beaver management decision flowchart to help decide on the best management action, from a landowner perspective.	King County, n.d.
Interim Code of practice: beaver dam removal	Canada Federal	Outlines exempted and best practices for beaver dam removal with regard to fish and fish habitat.	Fisheries and Oceans Canada, 2020
Stream Restoration Design National Engineering Handbook: Chapter 17: Permitting Overview	N/A	Outlines permit requirements for stream restoration projects.	United States Department of Agriculture: Natural Resources Conservation Service, 2007
The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains	N/A	"This guidebook provides a practical synthesis of the best available science for using beaver to improve ecosystem functions. If you are a restoration practitioner, land manager, landowner, restoration funder, project developer, regulator, or other interested cooperator, this guidebook is for you."	Pollock et al., 2018

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