BEAVER ACTION PLAN

SITUATION ASSESSMENT

FOR BRIGHTON UTAH

By

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fulfillment of the requirements for the degree

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# Glossary of Terms and Acronyms

**Beaver Dam Analog (BDA)-** promoting and/or mimicking beaver dam activity

**Beaver Deceiver** – A fence around upstream and downstream entrances to culvert, deters beavers from building dams.

**Clemson Beaver Pond Leveler**- A style of pond leveler with a section of perforated drainpipe (usually PVC) protected by cylindrical wire cage to prevent beaver clogging

**Combination Systems**- Combination of approaches to prevent beavers from clogging culvert and ensuring pond never exceeds a certain level (i.e., pond leveler and beaver deceiver)

**Culvert Outlet Installations** – Protecting downstream outlets of culverts

**Diversion or starter dam**- encourages beavers to dam immediately upstream of the culvert instead of inside of it. Works well when ponding upstream of culvert is tolerable.

**Fence Posts**- Untreated wood rounded post with one sharpened end. Typically, 3-4' in diameter with various heights. (used in BDAs)

**Goat Panels**- Same as hog panel but with 4" x4" mesh.

**Hog Panel**-A rectangular sheet of robust fencing commonly used to contain pigs or other livestock 6 "x 6" mesh.

**Keystone Culvert Fence**- Type of upstream culvert fencing ('beaver deceiver') a triangle shape culvert protection that has the wide end up stream and the point end towards the culvert.

**Low-Tech Process-Based Restoration** **(LTPBR)**- A practice of using simple, low-unit cost, structural additions (e.g. wood and beaver dams) to riverscapes to mimic functions and promote specific processes. "Letting the system do the work", which defers critical decision making to riverscapes and beaver. (Wheaton et al., 2019)

**Pipe**- double or single wall flexible pipe used in pond leveler installations usually 10", 12", or 15" diameter. It is recommended to use sections no longer than 10' to sink easier.

**Pond Leveler**-Control pond stage heights in active beaver areas, *best in areas with at least 3' depth* so a whirlpool is not created. An 8" pipe may work for 2.5' of depth of water.

**T-Posts** – Metal stakes shaped like a T.

**Wildlife Passage**- Passage through beaver control devices so that wildlife does not get stuck inside them, usually a ramp made of wire mesh.

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# Abstract

This assessment examines the possibilities of a community policy promoting beaver-human coexistence for Brighton, Utah, known as a beaver action plan. Beavers in Utah are classified as protected wildlife by the Utah Division of Wildlife Resources, which has the sole discretion of their management. Here is a framework in which a community may positively influence beaver populations, stay in their management jurisdiction, and increase ecosystem health and biodiversity solely by focusing on managing the human dimensions of the beaver-human interaction. A beaver action plan aims to reduce negative beaver-human interactions by providing support, planning, education, and other tools to mitigate the nuisance effects that the beavers might have. This assessment is based on interviews with 16 stakeholders of the mountain town of Brighton, Utah, located in Salt Lake City’s protected culinary watershed. Participant stakeholders are property owners, local government, partnering agencies, and scientists. All were asked the same questions, while the scientist stakeholder group were asked three additional questions relevant to their expertise. The intent was to understand different perspectives and summarize key themes emerging from the possibility of a beaver action plan. This assessment will bring increased clarity about what a beaver action plan could look like for the Town of Brighton and act as the first step towards a community collaborative process on a natural resource issue of mutual concern.

# Background & Purpose

**Beaver History**

Recent history of the Uinta-Wasatch-Cache national forest, in which the Town of Brighton is located, has more to do with beavers than many realize. The estimated beaver population in North America before European settlers arrived, in the early 1800s, was around 60-400 million (Naiman et al.,1988.) Around this time the Town of Brighton likely had around 14 beaver dams every kilometer on its creeks and a total dam capacity of 533 based on modeling (fig.27). The first wave of Europeans that moved through the area were fur trappers fueled by a lucrative trade in beaver pelts. These were the mountain men of the American West, and according to ecological journalist Ben Goldfarb (2019), “between the early 1820s and the late 1840s, [the trappers] systematically ransacked just about every pond and stream between Colorado and California.” By the time Mormon Pioneers came to the Salt Lake Valley in 1847, most of the beavers had already been virtually extirpated. By 1907 when Theodore Roosevelt created the Salt Lake Forest Preserve, which eventually became part of the Uinta-Wasatch-Cache National Forest (Jacono, 1959), beaver had been removed from the landscape, and the watersheds had been degraded by unmanaged livestock grazing, timber harvest, and mining (History: A Legacy of Protection, 2021.) The very name “cache” in the national forest name is a relic the beaver fur trade which describes a pit in which fur was buried for storage (Uinta-Wasatch-Cache National Forest - History & Culture, n.d.)

Public concern over the loss of wildlife and excessive erosion in the west eventually led to a successful beaver reintroduction campaign in the 1940s, leading to a continent-wide recovery (Wright, 2021.) Regulations were created that controlled beaver harvest through seasons and methods of take. Beaver populations in North America are still only an echo of what they once were and are now estimated between 6-12 million by Naiman et al. (1988.) Since beavers were virtually eliminated in advance of most immigrant settlers, most of the infrastructure, and society as we know it was built without beavers in mind. Landscape amnesia of what a thriving river ecosystem looks like set in, and for most of the 20th century, common scientific theory was that a healthy stream was an efficient sinuous one with a line of trees and shrubs along its side (Schumm et al., 1984.) By the 21st century, where we now find ourselves, the missing reference stage of what a healthy, thriving riverine ecosystem looked like before beaver extirpation was added to the stream evolution model. This reference stage is referred to as “Stage 0” and is characterized by a dynamic network of multiple channels with vegetated islands and floodplain connectivity (Cluer and Thorne, 2014, Shahverdian et al., 2019.) This “stage 0” system is what most of the wadable rivers in North America looked like before beaver extirpation. It is now the ideal target for river restoration where possible as available floodplain allows (Pope et al., 2018.)

**Examples of Beaver Improving Watersheds & Wildlife Habitat**

Beavers are well-known ecosystem engineers and build dams from sticks, rock, and mud in stream trenches that pond water, alter physical processes and change vegetation dynamics that ultimately improve habitat for themselves and other wildlife in a positive feedback loop (Pollock et al., 2018.) Beavers excavate mud and dig channels radiating from a pond area into the surrounding landscape, which saturates with water and increases their area of influence (Gurnell 1998.) Beaver's are known as keystone species because thier effect on the landscape benefits many other wildlife, such as amphibians, birds, insects, fish, waterfowl, and mammals who utilize the habitat they create. In the American West, wetlands cover only 2% of the land but support 80% of the biodiversity (Goldfarb 2020.) Active beaver populations translate to such tangible benefits to humans as increased water retention and higher base flows with decreased peak flows, groundwater recharge, sediment retention, temperature moderation, carbon sequestration, increased wildfire protection, cleaner water, and increased riparian vegetation (Pollock et al., 2018, Fairfax et al. 2020, Dewey et al., 2022.) All these beaver benefits sum up to have the effect of increasing watershed resiliency, which is defined as the ability of a watershed to withstand or maintain its characteristic system state from acute stressors such as fires and floods and chronic long-term stressors such as increasing urbanization and changing precipitation regimes (Lane et al., 2022.)

Channel incision is a widespread problem in which streambeds are gradually lowered and eroded and become disconnected from their floodplain. Incised channels are often referred to as degraded channels (Cluer and Thorne 2014.) If the incision goes low enough, riparian vegetation roots can be disconnected from the water table leading to vegetation regime change, increased erosion, and degradation in a negative feedback loop. In a now seminal restoration experiment in the arid region of Bridge Creek in Central Oregon, watershed scientists Pollock et al. (2012) set out to try a novel restoration technique that would be cost-effective and scalable to help restore geomorphic, hydrologic, and ecological functions of the stream by helping the small beaver population in the area build longer lived dams. Due to the high amount of sediment in that watershed and extreme channel incision, the beaver’s dams would be filled with sediment or blow out frequently, forcing them to move every few years. Research had already proven the beavers were helping this incised stream in aggrading the channel with sediments caught behind their dams (Pollock et al. 2007.) The scientists sought to ‘partner with beaver’ and help them to restore the watershed. The experiment involved reinforcing existing beaver dams, and installing round wooden fence posts across the floodplain and filling and weaving them with woody material and mud mimicking beaver dams.

These structures were named beaver dam support structures (BSAs), beaver dam analogs (BDAs), and post-assisted log structures (PALS) during this Bridge Creek study. They are still called that today. An ongoing monitoring campaign of the Bridge Creek Watershed and original BDA installations has proven invaluable to the broader community in understanding their effects and how to repeat this restoration process. To say this experiment became a sensation would be putting it mildly. It has sparked a movement in the west that has led to an effort to actively work with beavers so they can do stream restoration work cheaper and better than humans can.

# Methods

Between October 7th and November 20th, 2022, 16 confidential interviews with stakeholders who relate to Brighton or know of watershed science and beaver restoration were conducted. The process was limited to no more than 90 days to keep momentum and stay relevant. Interviewees were selected in consultation with a community sponsor, a full-time resident of Brighton who has been active in Beaver restoration projects. The stakeholders represent four different groups: local government, property owners, scientists/ practitioners, and partnering government agencies (Fig. 1.) There was an overlap between local government and property owners because local government members are also residents and property owners. Over half hour to an hour of telephone or video conference interview sessions, stakeholders were asked a standardized set of open-ended questions (Appendix A). All members of the scientist stakeholder group were asked three additional standardized questions relevant to their expertise. All interviewees were allowed to review and fact-check their responses for accuracy in interpretation before the analysis was performed. A spreadsheet was used to analyze the interviews by separating and establishing overarching themes in the answers to each question category. Common consistencies and differences were identified between agreement and disagreement, opportunities, and challenges with the intent to find patterns. An interviewee's response to a question can have more than one perspective or theme, so one response could have multiple themes.

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Figure . Brighton Stakeholders Categories

In addition to the situation assessment, the Beaver Restoration Assessment Tool (BRAT) from Utah State University Restoration Consortium (Macfarlane et al., 2015) was used to assess the potential of beaver expansion in the Town of Brighton. The BRAT data analysis tool was used in the mapping platform ArcGIS Pro 2.9.5 (ESRI 2022.) Shapefiles and raster files with various datasets such as watershed boundaries, elevation, vegetation, roads, and stream flow were imported into a map and clipped at the extent of Brighton town limits plus a 30-meter buffer. The clipped data was then used in the BRAT capacity model to objectively assess the approximate beaver dam capacity for Brighton, where prime beaver habitat exists and is least likely to conflict with humans and where human/beaver conflict areas exist, among other potential queries. In addition to the BRAT model estimating the current dam capacity, it also paints a vision of what the watershed once was in terms of historic dam capacity. BRAT analysis helps build realistic expectations in initiating beaver restoration goals and answers a few questions that many participants had.

# Analysis of Individual Question Responses

**Issue 1. Perceived Health of Brighton’s Stream and Wetland Areas and Future Trajectory.**

When asked if they were worried about the health of Brighton’s streams and wetlands, the single theme with the greatest agreement was no concerns about stream or wetland health (23%). The remainder of the interviewees had various concerns in different categories (77%). Climate change was the top concern for stream health in Brighton (19%). There were mentions of drought, intense precipitation events, insect infestation in the forest, wildfires, and earlier snowmelt. The second highest concern was the high number of people and cars in the canyon (15%). As one respondent stated, “1.7 million visitors come to Brighton annually.” There is concern that the high number of people recreating in the canyon will negatively impact stream health. Increasing residential and ski resort development (12%) was tied with concerns over the state of the conservation area, Willow Heights, where the water level in the lake there has been steadily decreasing since the loss of beavers (12%). Outlier concerns were flooding by beavers in Brighton Circle, sediment in streams from erosion, and a lack of fish.

* “The general overview is that some sections of the stream are healthy, and some are more impacted.” -participant stakeholder

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Figure . Shared Concerns for Local Stream and Wetland Health in Brighton

When asked what, if anything, needs to change if there were concerns, the area of greatest agreement on solutions to potentially declining stream and wetland health in Brighton was for people to recognize and be educated about the importance of beavers to stream health with strategies for coexistence (35%). This theme was followed by agreement on the need for increased recreation management and infrastructure improvements to handle the current level of visitation (24%). Mitigating erosion from dirt roads, increasing regulations on new development, and building more BDAs all tied for the third most agreed-upon solutions. Mapping all wetlands in Brighton was also mentioned as a first step for preserving them.

* “Willow Lake is an example of a declining wetland ecosystem due to lack of beavers. We need them at Willow Heights.” -participant stakeholder

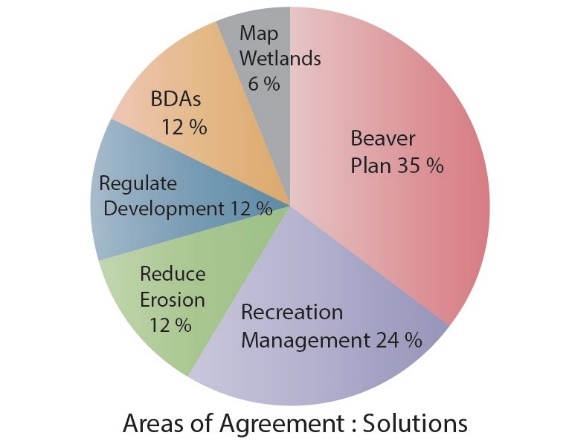


Figure . Agreement on What Needs to Change to Protect Stream & Wetland Health in Brighton

**Issue 2. Perceptions of an Increased Need for Stream Restoration or Protection in Brighton**

A majority (69%) think that there is an increased need for stream restoration or protection in the Town of Brighton and Big Cottonwood Canyon (Fig.4). The most popular actions for increasing stream restoration and protection in Brighton are tied between recreation management through various means such as increased patrols, patrols in off-peak hours, and funding for staff and infrastructure (5), and the creation of a plan to coexist with beaver by using flood control devices for beaver-human conflict zones (5). Another idea was to increase regulation on new development, such as square foot limits on new homes and remodels. Reducing vehicular traffic and a long-term stream monitoring program that would measure the physical characteristics of the riparian zone, not just water quality, were also mentioned (Fig.5).

* “Restoration is needed in areas where we have a lot of people such as Cardiff Fork, where there is compacted dirt and loss of vegetation right along the creek.” -participant stakeholder

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| Chart, diagram, pie chart  Description automatically generated  Figure . Stakeholder's Agreement on an Increased Need for Restoration and Protection of Brighton's Streams | Chart, bar chart  Description automatically generated  Figure . Agreement on Actions to Take to Protect and Restore Streams in Brighton |

**Issue 3. Willow Heights**

A lake surrounded by trees

Description automatically generated with low confidenceAll people in this assessment were familiar with the Willow Heights area (100%). Most think that beavers are appropriate to the site, with only one being unsure (Fig. 7). Fourteen of the interviewees support beavers being reintroduced to Willow Lake, with five prioritizing both relocation and supporting migration and two preferring natural migration only (Fig. 6).

* “This time of year (fall) there is not much water running out of there [Willow], and in the past, when the dam was built strong, the stream was more consistent throughout the year. It used to quit Dec-Jan time due to freezing. Now it quits in late August or early September. It runs out of water.” -participant stakeholder

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| Diagram  Description automatically generated  Figure . Agreements on how to get Beavers Back to Willow Heights | Diagram  Description automatically generated  Figure . Perception of Willow Heights as a Good Place for Beavers |

An overarching theme of concern regarding Willow heights is that Willow Lake is disappearing, and there is a strong opinion that the area needs beavers to sustain its water level (27%). Other themes included various ideas about why there are still no beavers at Willow Heights despite having a healthy population at Silver Lake (23%). Many doubt that natural migration is possible after it hasn’t happened in 16 years (23%). An area of divergence occurred where there was an even split between people wanting nuisance beaver from Silver Lake relocated to Willow Lake (14%) and others mentioning that the DWR is hesitant to relocate any Beaver in Brighton, where there has been a history of nuisance beaver (14%). (Fig 8)

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Figure . Themes Regarding Beavers at Willow Heights

Issue 4. Watershed Resiliency

Chart, bar chart

Description automatically generated When asked if beaver could be an important part of watershed resiliency for Brighton, the majority said yes (14), and the remainder were unsure (2). Areas of agreement on the most significant benefits to beaver in the watershed are increased water storage (28%), consistent and higher baseflow (21%), wildfire protection (17%), vegetation growth and health (14%), drought resiliency (3%), carbon sequestration (3%), and wildlife habitat (3%).

Figure . Agreements on How Beavers Help Watershed Resiliency in Brighton

* “Beavers slow the water down and allow for groundwater recharge and sustainability of water resources.”

-participant stakeholder

**Issue 5. Human Beaver Coexistence:**

When asked what is needed for beavers and humans to coexist in Brighton, the area of greatest agreement was education (26 %), followed by beaver mitigation devices (16%) to prevent flooding. Many found it critical to have clearly defined “no flooding” zones (14%) and address homeowners' worries by supporting them in property protection (14%). Updated building codes and ordinances to build culverts that are not easy to block by beavers and electrical boxes out of the floodplain were seen as potential amendments (12%). Also mentioned and emphasized was that mitigation devices should be installed *correctly* to not discourage the community from depending on them (9%). Maintenance and monitoring of the devices (5%) and funding for installation help and materials came up twice (5%). (Fig.10)

* “The devices must be installed correctly. Poorly installed mitigation measures leave a bad impression, and people give up on mitigation measures.” -participant stakeholder

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Figure . Themes on What is Needed for Beaver-Human Coexistence in Brighton

**Issue 6. Beaver Dam Analogs BDAs:**

Everyone in the stakeholder group had heard of Beaver Dam Analogs and was supportive of their use for restoration (100%). Four people said they would like to learn more about them and be involved in future installation projects (25%). A couple of people had healthy skepticism that they could be effective because they did not think the water that backed up behind them would be deep enough to attract beavers (13%), but that did not hinder their support. (Fig. 11)

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Figure . Stakeholder's Knowledge and Perspectives on BDAs

**Issue 7. Hopes:**

When asked about the best-case scenario for beaver populations increasing in Brighton, the most agreed upon positive vision was beaver populations sustained, and flooding controlled (24%). Tied for second was community pride in being a demonstration for other communities (15%), with many mentioning the joy of watching wildlife and beavers at work. Positive ecological benefits, including improved wildlife habitat (15%) and an educated populace that knows the value of beavers, were following (13%). Tied next were pro-beaver policies such as a beaver action plan (9%) and adequately installed flood control devices (9%). Another tie was between adequate funding for staff and materials (7%) with homeowners not feeling threatened despite having a healthy beaver population (7%). Finally, there was a vision of installing more BDAs with yearly maintenance (2%) (Fig. 12).

* “The entire community buys into living with beaver and doing what is needed to keep the [beaver] population healthy for everyone to benefit with mitigation techniques in place.” -participant stakeholder

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Figure . Best-Case Outcome for Beavers in Brighton

**Issue 8. Fears:**

Chart, bar chart

Description automatically generatedWhen asked what the worst-case scenario would look like for increased beaver populations in Brighton, the greatest agreement was on beavers getting killed (32%), with a close second to flooding and property damage (29%). Many people agreed on ecological degradation with the loss of beavers (8%), understaffing to meet needs (8%), and anxiety over flooding (8%). If an attempt to coexist with beaver failed, a few worried about Brighton being a cautionary tale to other communities (5%). Others thought the current situation with no plan and nuisance beaver kill permits being issued is already the worst case (5%). Tied in last place was the sabotage of BDAs or beaver dams by people who may be opposed (3%), and the beaver population increased with no implementation of a plan (3%) (Fig. 13).

* “The way it is now, multiple calls to the DWR for removal, no plans, beavers being a nuisance by doing what they do best. The beavers will outwork people any day.” -participant stakeholder

Figure . Worst-Case Outcome for Beavers in Brighton

**Issue 9. Thoughts on a Beaver Action Plan**

Everybody answered yes when asked if they thought the Brighton Community could benefit from a beaver action plan (100%). The most considerable agreement on issues to address in a beaver action plan was a clear plan of action for nuisance beavers (28%), a map delineating areas of management concern and ideal beaver habitat (18%), with input on the plan from a wildlife biologist with knowledge of beavers (18%). A monitoring plan on beaver activity and devices (15%), education about beavers to the community (7%), interagency collaboration with education and planning (7%), funding (5%), staff (4%), a long term policy scope that would outlast staff turnover (4%) was also seen as necessary. Lastly, a plan for building more BDAs was seen as a helpful intermediary step (2%) (Fig. 14).

* “People would know where to go for nonlethal help with nuisance beavers and a succinct plan.”

-participant stakeholder

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Figure . Areas of Agreement on Beaver Action Plan Contents

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Description automatically generated A further breakdown of what was mentioned as most important in a plan to deal specifically with nuisance beaver was dependability and accessibility (28%), prioritizing non-lethal first (28%), including a monitoring component (17%), and a flow chart with steps of action to follow (17%). Additional targeted prevention was recommended in priority areas identified as high beaver-human conflict zones (11%). (Fig. 15).

* “Every time there is a beaver flooding issue, there needs to be a person who can be called and depended upon to arrive and assess the situation and provide a path to remediation that is non-lethal.” – participant stakeholder

Figure . Further Breakdown on a Plan of Action for Nuisance Beavers

A picture containing chart

Description automatically generated**Issue 10. Beaver Education**

A breakdown of agreements on what beaver education content should emphasize, general beaver information and their ecological benefits were seen as the most important (48%), followed by beaver/human coexistence techniques (33%) and how to get help with nuisance beaver if you need it (19%). (Fig 16)

Figure . Areas of Agreement on What Topics of Beaver Education Should be Emphasized in Brighton

How the education should be disseminated was agreed upon in the following ways: events including training, films, and educational talks where the most popular (25%), interpretive signs teaching human/beaver coexistence in areas such as Cardiff Fork and Silver Lake came in second (21%), tied with door to door, in-person communication for high conflict zones, particularly HOAs (21%). There was a four-way tie between demonstrations (7%), information flyers (7%), newsletters (7%), and social media (7%) as means to get information to the public. A brochure was also brought up as an idea (4%). (Fig.17)

Who would be the best to provide beaver education in Brighton was agreed upon, with the Town of Brighton coming in number one (45%), Forest Service (27 %), Cottonwood Canyons Foundation (18 %), Ski Resorts (5 %) and Salt Lake City Public Utilities (5 %). (Fig. 18)

* “It’s good to know what the beaver does for us and how beneficial they can be.” -participant stakeholder

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| Chart, bar chart  Description automatically generated  Figure . Agreements on Best Ways for Beaver Education to be Disseminated in Brighton | Diagram, venn diagram  Description automatically generated  Figure . Agreements on Who Would be Best to Provide Beaver Education in Brighton |

**Issue 11. Grant Funding**

All stakeholders would support grant-funded assistance for nuisance beaver mitigation (100%). Funds could go towards mitigation device materials, skilled labor, and training, among other things. The estimation of a rough budget was recommended.

* “There is no beaver sugar daddy.” -participant stakeholder

**Issue 12. Biggest Challenge**

Areas of agreement on the challenges presented for a beaver action plan in Brighton were communication and education as number one (40%), funding and finding skilled personnel (20%), and the unfortunate fact that in the short term, it is easier to kill beavers than install devices for coexistence (15%). A few people raised concerns that an increasing beaver population will eventually run out of room in Big Cottonwood Canyon, which might lead to too-many beavers (10%). The human population in the area is increasing, which will bring more development and wildlife habitat fragmentation (10%), and finally, a leader in managing the project (5%). (Fig. 19)

* “Convincing the people of Brighton that beavers are good and it’s good for there to be a significant population present. Currently, they only know them as a nuisance.” -participant stakeholder

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Figure . Themes on the Greatest Challenges to Human-Beaver Coexistence for Brighton

**Issue 13. Biggest Benefits**

Diagram

Description automatically generatedThe benefits of creating a beaver action plan for the town of Brighton would be watershed reliance and ecosystem health (36%), community pride in coexistence and joy people find in watching wildlife (28%), improved wildlife habitats (28%), and wildfire prevention (8%). (Fig. 20)

* “The symbiotic relationship between beavers and all living things, including the human race.” -participant stakeholder

Figure . Themes on the Greatest Benefits to Human-Beaver Coexistence in Brighton

**Issue 14. Community Collaborative Process**

Most participants would be willing to engage in a community collaborative process about this issue (85%), and only a few were unsure (15%). (Fig.21)

Chart, pie chart

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Figure . Percentage of Stakeholders Willing to Engage in a Community Collaborative Process on a Beaver Action Plan

**Issue 15. Additional questions for the scientist stakeholder group:**

When asked about the current challenges with the process of beaver restoration, a theme of misinformation about water rights being negatively impacted by beaver dams was present in all responses (100%). Closely related was the idea that water resources should be moved as quickly and efficiently as possible downstream (75%), representing an old paradigm of thinking regarding what constitutes a healthy stream. Other topics included the idea that beavers will reduce water quality (they can improve it in many situations (Dewey 2022)), challenges with a community consensus, and different interpretations of regulatory BDA installation requirements depending on the watershed you are in. (Fig. 22)

Chart, bar chart

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Figure . Scientist Areas of Agreement on Current Challenges with Beaver Restoration

When asked if BDAs are still effective even if real beavers are never involved, all respondents said yes (100%). BDAs without beavers have some proven benefits but need yearly maintenance (some said more) to continue functioning as dams (75%). Without maintenance, they break down and serve as log jams that still provide some ecosystem services but to a lesser extent than dams. BDAs also help prepare degraded habitats for potential beaver return and help people be more supportive of beavers (75%). BDAs are no replacement for real beavers and are more expensive when humans maintain them, but they are the next best thing when real beavers aren’t an option (50%).

When asked if they thought the Utah DWR would be more likely to relocate beavers to a community with a beaver action plan, the response was yes (100%).

# Beaver Assessment and Restoration Tool (BRAT) Outputs for the Town of Brighton.

The BRAT tool is an open-sourced algorithm that anyone can use for free and participate in its development (Riverscapes Consortium GitHub Pages n.d., Utah State University Restoration Consortium 2020). BRAT analysis has been a technological breakthrough in beaver management planning and was used in the current version of the Utah Beaver Management Plan to estimate dam capacity in Utah streams (Utah Division of Wildlife Resources 2017). An interactive version of this data is available to explore for free on Databasin.org (Macfarlane 2015). As with all models, they are not 100% accurate but valuable approximations. In some cases, they may be surprisingly accurate. In others, they can be somewhat misleading, particularly with infrastructure humans can alter and may not show up in satellite imagery or databases. The BRAT maps should be used for further investigation and in conjunction with ground-truthing to assess accuracy. Attribute categories for different beaver zones are described in Table 1.

Table . Beaver Restoration Assessment Tool Glossary of Terms (J. Wheaton 2015)

Table

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The current capacity density (dams/km) for beaver dams in Brighton based on vegetation sources and typical streamflow is 10 dams/km and has the potential for up to 14 dams/km based on historical conditions. The total capacity for dams in Brighton is 376 and historically was 533. Brighton is currently at 1% of its dam capacity (rounded up), with only three active beaver dams. Stream reaches categorized as ‘low hanging fruit’ zones have the highest restoration potential due to naturally high dam capacity combined with low human conflict based on distance from infrastructure. These low-hanging fruit zones represent 38% of the dam capacity in Brighton. If all dams were restored in this zone, it would be an increase of 141 dams. A modest goal of a 20% capacity increase in this zone would be 28 additional dams. These are excellent areas to install BDAs and further improve the habitat for potential beaver migration if it should occur.

Living with beaver (high source) are areas with a naturally high dam capacity and are close to infrastructure. These ‘living with beaver’ stream reaches are categorized as needing beaver mitigation measures on infrastructure such as culverts and other strategies for human-beaver coexistence. This category makes up 47% or roughly half of all beaver dam capacity in Brighton. Unsurprisingly as humans and beavers tend to prefer similar valley bottom environments, these are the zones where all current beaver dams are located. One beaver dam, the Cardiff fork location, was listed as in an ‘anthropogenically limited’ zone; however, the dam's location was an approximation, and it could also be considered to be in a ‘living with beaver’ zone. If the living with beaver zones were brought to total capacity, it would be an additional 173 dams. Twenty percent of this would be a 33-dam increase. Any dam increases in this zone would require planning and culvert protection devices.

Table . BRAT Statistics Summary for Brighton with Dam Capacity Goals in Restoration Zones

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Map

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Figure . Vicinity map of waterways in Brighton, Utah. Beaver dam locations are approximate, and Town of Brighton limits include a 30-meter buffer.

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Figure . Stream reaches in Brighton the BRAT model deemed in need of "Living with Beaver" mitigation strategies such as culvert protection and pond levelers. Note two of the three existing beaver dams in Brighton are currently in high-need zones. Zoomed in area is Brighton Circle.

The above map (Fig. 24) lays out zones of potential human-beaver conflict based on habitat favorability for high dam capacity combined with urban development and infrastructure. Because infrastructure is tough to keep updated in databases, this map should be a general guide with the need for further investigation and refinement. Most stream reaches in Brighton, particularly in Brighton Circle and along the valley bottom, would need living with beaver strategies to support even a tiny portion of the total dam capacity.

Map

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Figure . Beaver restoration possibilities for Brighton, Utah, by stream reach. Blue stream color indicates areas with a naturally high capacity to support beavers based on environmental factors *and* proximity to human infrastructure; these are areas of potential most heightened conflict and need for “Living with Beaver” strategies. Green reaches have the largest natural capacity for dams based on environmental factors *and* the lowest possibility for conflict based on the distance to human infrastructure.

The above map (Fig. 25) is a further refinement of the prior map in focusing on priority living with beaver and low-hanging fruit zones. The blue areas should be considered a focus area for living with beaver strategies, and the orange unsuitable anthropogenically limited zones as potential beaver exclusion zones. One of the few existing active beaver areas in Brighton is in Cardiff Fork which is partially listed as an unsuitable anthropogenically limited zone. Again, it must be said that further refinement of these zones are needed, but this is an excellent first step. Note the low-hanging fruit categories in many of the side canyons which would be excellent places for beaver restoration zones.

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Figure . The existing natural capacity of Brighton streams to support beaver dams. This model considers current vegetation and streamflow but does not include anthropogenic factors.

Table . Breakdown of total km and percent of drainage network for existing capacity in each dam density category

|  |  |  |
| --- | --- | --- |
| Dam density/km | Total km | Percent of drainage network |
| None 0 | 5 | 13% |
| Occasional 1-5 | 7 | 19% |
| Frequent 6-15 | 18 | 47% |
| Pervasive 16-40 | 8 | 21% |

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Figure . The historical capacity of beaver dam density in Brighton, Utah prior to the 1800’s.

Table . Breakdown of total km and percent of drainage network for historic capacity in each dam density category

|  |  |  |
| --- | --- | --- |
| Dam density/km | Total km | Percent of drainage network |
| None 0 | 5 | 13% |
| Occasional 1-5 | 7 | 18% |
| Frequent 6-15 | 8 | 22% |
| Pervasive 16-40 | 18 | 48% |

# Discussion

The question I sought to answer in this assessment is: How can a plan of action help a community coexist with beavers? To answer this question, I completed 16 interviews from a sample drawn from four different stakeholder groups and conducted a Beaver Restoration Assessment Tool (BRAT) analysis of the stream network within town limits.

### Summary of themes on beavers in Brighton

The areas of agreement with 100% of the participants in consensus were that the Town of Brighton could benefit from a beaver action plan, people support building additional BDAs for stream restoration, and there is a need for funding, grant or otherwise, in assistance for nuisance beaver mitigation. The largest grouping of respondents was neutral (23%) when asked if they had concerns about stream health in Brighton. Meanwhile, the majority (77%) had various concerns. The top concerns were climate change and increased visitation from a growing population.

1. Increasing recreation management to meet the growing population and implementing a beaver action plan were seen as the most popular ways to support stream health in Brighton.
2. All were familiar with Willow Lake and concerned about its steadily declining water levels where beavers have been missing for 16 years. Willow was also identified as a low-hanging fruit zone on the BRAT maps indicating that it is an ideal target for beaver restoration. There was consensus that humans should relocate beavers back to the area if possible. In divergence with this is that the DWR may be hesitant to move beavers within a community with a history of human-beaver conflict. Many were hopeful that the DWR would be more likely to relocate beavers within a community with a beaver action plan.
3. Water storage, consistent and higher baseflows of creeks, and wildfire protection were seen as the top environmental benefits of increasing beavers in Brighton. Community education about beavers was seen as the first step to improve coexistence, followed by correctly installed beaver mitigation and flood control devices.
4. The best-case outcome for an increasing beaver population in Brighton was the ability to mitigate nuisance behaviors such as culvert blocking and flooding in conflict zones. The worst fear of an expanding beaver population in Brighton was being unable to mitigate flooding damage and beavers getting killed. A central common theme in both fear and hope responses is that flooding mitigation devices are vital to a coexistence plan. People would prefer alternative solutions to lethal options if their property were threatened.

### Summary of themes regarding a beaver action plan

The interviewees identified a central theme for the beaver action plan: a clear plan of what a resident can do when confronted with a nuisance beaver situation. Park City Municipal Corporation’s recommendation for an adaptive beaver management plan (Wheaton, J. 2013) has a flow chart which is an excellent reference for this and has been included in this assessment (Appendix C & D.)

1. The plan must be dependable to be used; somebody would need to respond whenever there is a threat. The need for availability indicates a call-down list or rotation of on-call volunteers or staff. The need for a human response also points to the need for funding, which was one of the most agreed-upon themes.
2. Non-lethal measures should be prioritized first. Prevention measures such as the correct installation of various beaver mitigation techniques should be employed, and hopefully, emergencies can be prevented or made less urgent. See the glossary of terms in this assessment for a list of beaver mitigation devices (Beaver Institute, Inc. 2021) and Appendix B for tree wrapping guidance from Swaner Ecocenter (Cone n.d.). Prioritizing non-lethal actions first implies there must dependable assistance that is better than or equal to lethal action.
3. Monitoring was identified as a critical element of the plan; there were some ideas of a community science aspect to the monitoring. A few community science monitoring possibilities were mentioned, including a beaver monitoring app (Utah Water Watch n.d.), “chronologs,” which are stationary brackets people place their phone on and take photos (Chronolog 2022), iNaturalist in which observations are recorded, and fellow members can see the update (California Academy of Sciences & National Geographic 2022). Monitoring could also be part of a trained volunteer or paid service or an automatic detection device that would alert staff of a rising water level or new dams.
4. Prevention in priority areas; BRAT maps of Brighton were made to identify priority stream reaches in need of mitigation techniques, although many are already known even without the maps. All current beaver dams in Brighton are in ‘living with beaver’ zones with the potential for beaver-human conflict. Prioritizing mitigation in ‘living with beaver’ areas is critical for coexistence in Brighton. These areas should also be the most frequently monitored.

### The number one challenge: education

The number one challenge to beaver coexistence in Brighton was recognized as community education. Education was identified as the critical component needed to build awareness and bring everyone on board to the rewards and challenges of wildlife coexistence strategies. A broad public relations campaign with social media, letters, emails, flyers in community spots, and anything the public will see was considered important to bring general awareness to the plan. Answering questions and opening dialog with the community on beaver basic facts and benefits they provide to the ecosystem, techniques for beaver-human coexistence, and how residents can get help were the top topics identified. Listening to points of view from people who may be opposed to understand different concerns was viewed as constructive for community adoption of a beaver plan. All town departments and partnering agencies such as UDOT should be aware of the project to avoid siloing.

Event-style training was seen as the most popular method of education. Outdoor film screenings, Brighton Days community gatherings, guest lectures, and volunteer days building BDA structures or maintaining existing ones with informal presentations were ideas for events. Multiple times in the assessment, the correct installation of beaver mitigation techniques became important. The Beaver Institute, located in Southampton, Massachusetts (Beaver Institute, Inc. 2021) is widely respected as one of the nation’s best sources of beaver mitigation techniques and education on coexistence. They offer “BeaverCorps” training which is a professional non-lethal beaver management training program. They have a directory of people in every state who are graduates of that program and can consult for problem areas and offer training. One option for the action plan is that a training could be with a BeaverCorps graduate who would teach the correct installation of devices and make recommendations for types. Partnering agencies might be interested in attending such device installation training as partnering with beavers is relatively new, and some of these techniques are best demonstrated and tailored to specific spots.

Interpretive signage about beaver-human coexistence techniques and the ecological benefits of beavers was a popular idea for Cardiff Fork, Willow Heights Trailhead, and Silver Lake Boardwalk/ Brighton Loop. Ideally, the best sign location would be where an active beaver mitigation device is visible to teach about coexistence. This idea was even split among people who were not opposed to signs but felt that people do not read them, and face-to-face interaction would be best. Door-to-door communication was recommended for targeted education in ‘living with beaver’ areas.

The Brighton Institute was recognized as the best equipped to provide local community beaver education, followed by Forest Service rangers who are frequently sought out as information sources by the visiting public. Cottonwood Canyons Foundation came in third as an option to provide beaver education.

### Removal, live trapping, & relocation options

The removal of beavers includes both live trapping and lethal trapping. The Utah Division of Wildlife Resources has sole authority to issue trapping permits; private residents and other government agencies do not have the authority to trap themselves or hire a professional trapper to kill or relocate a beaver without a permit and guidance from UDWR staff (DWR 2017). Until most nuisance problems are addressed and/or the successful adoption of a beaver action plan, beaver relocation within Brighton Town limits is unlikely to occur. The division will not move beaver in the same community where resources were just spent removing one. A recommended long-term goal of a Brighton beaver action plan would be to work with the DWR and have beavers introduced to a ‘low hanging fruit’ restoration zone such as Willow Heights, which has minimal infrastructure conflicts. However, reintroductions such as this can only be achieved by practicing coexistence in current conflict zones, developing a reliable program for dealing with nuisance beavers through non-lethal means, and contacting the DWR for trapping permits as a *last resort* only. Lethal trapping is seldom a successful long-term solution as other beavers eventually return to fill a prime habitat niche, and the cycle continues.

Beavers are believed to exhibit density-dependent population characteristics (UDWR 2017), which means that once the carrying capacity is reached, the population stabilizes. Participants' common concern in this assessment was that Brighton is a relatively small mountain valley. If the beaver population is allowed to increase, they might eventually grow to the point where they run out of room, and beavers will potentially be everywhere. The good news is that density-dependent population characteristics mean that beavers are unlikely to exceed the habitat's carrying capacity and a ‘beavers everywhere’ scenario is extremely unlikely. Dispersal or natural migration occurs at 24 months of age but varies depending on available habitat. If natural migration did occur, it could be the desired effect of a community action plan to promote natural beaver movement to the greatest extent possible without involving the DWR in costly and risky relocations. Prioritizing natural beaver migration over reintroduction is a recommended strategy.

Stakeholders identified a good relationship with UDWR biologists as an essential component of the beaver plan. This relationship will help with a smooth workflow when trapping is needed and can help with guidance in beaver-human coexistence.

The contact details for the UDWR Central Region are as follows:

Central Region 1115 N Main St., Springville, UT 84663 Phone 801-491-5678

# Conclusions

An impressive 85% of participants (13) indicated that they would be willing to engage in a community collaborative process on the creation of a Beaver Action Plan for Brighton. This level of interest demonstrates how much people care about the future of a healthy ecosystem for Brighton and human-wildlife coexistence. A preliminary draft of an action plan is recommended as the next step using this assessment as guidance in addition to Park City’s recommendations for an adaptive beaver plan (Wheaton, J. 2013 ) and review by a UDWR wildlife biologist. The draft of the plan would then be reviewed by the wider Brighton Community in a council meeting and be open to comments and furhter adaptation. The final draft would have suggestions incorporated and a final review at a public meeting followed by plan adoption by the Town of Brighton. (Fig. 28) Review of the plan is recommended every five years for updates.

![Timeline

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Figure . Suggested Process for a Brighton Beaver Action Plan

Cooperative decision-making by the community based on jointly found facts is increasingly seen as the best way to solve polarizing issues and achieve a lasting, socially legitimate policy (Herman A. Karl 2007). One challenge to a community collaborative process is that awareness of the benefits of beavers to ecosystems and humans are not broadly known. However, recent research has been slowly changing that. It is recommended that action be taken toward community beaver education sooner than later to get ahead of the draft review and broader public engagement in a beaver action plan. An overarching area of mutual concern is climate change and increased use impacting the streams and wetlands of Brighton. Partnering with beaver to achieve watershed resiliency may seem unconventional to some, but repeatable scientific research and consensus back up this plan. There is a need to protect and wisely manage this asset that not only is the drinking water source that roughly 65,000 people depend on daily but is a treasured place of natural beauty (Salt Lake City Public Utilities 2021).

This assessment is meant to serve as a useful bridge or snapshot in time for the Brighton community and interested parties. It seems possible now that the number of people who wish to find the best possible way to support beavers and the critical ecosystem services they provide may be rising in terms of number and intensity. My intention in this situation assessment was to summarize themes accurately, leaving room for future communication and problem solving. Like many natural resource issues, human-beaver coexistence continues to evolve and shift. Situation assessments are a serial process, so it is possible that another check on beaver action plan updates may be valuable in the future.

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# Appendices

Appendix A

Brighton Beaver Situation Assessment Interview Questions

Participant Background

* What is your relationship to the town of Brighton and Big Cottonwood Canyon?

Perspectives on Local Streams –

1. Where do you see the health of Brighton’s stream and wetland areas, leading in the future with the current status quo?
   1. What if anything needs to change?
2. Do you feel there is an increased need for stream restoration or protection in the Town of Brighton or Big Cottonwood Canyon?
3. Are you familiar with the Willow Heights area (Y/N)
   * 1. Do you think beaver reintroduction is appropriate to the Willow Heights area?
     2. Would you like to see beavers relocated here or continue to wait for natural migration?

Perspectives on Beavers-

1. Do you think that beavers could be an important part of watershed resilience for Brighton? Why or why not?
2. In mountain towns such as Brighton, where development is increasing, and private properties frequently border natural areas, what is needed for humans and beavers to coexist?
3. Have you heard of Beaver Dam Analogs (BDAS), and do you support them being built for stream restoration projects?
4. What would be the best-case outcome regarding beaver activity increasing in the Town of Brighton? [excited about]
5. What would be the worst-case outcome regarding beaver activity increasing in the Town of Brighton? [worried about]

Perspectives on Collaboration-

1. Do you think the Town of Brighton could benefit from a beaver action plan? (Y/N, Unsure)
   1. What are the key things you would like to see in a beaver action plan?
   2. Questions you would want it to address?
2. What, if any, community education regarding beaver coexistence would you consider appropriate?
   1. Which entity do you see as the best equipped to provide this education?
3. Would you be supportive of grant-funded assistance for nuisance beaver mitigation?
4. What do you see as the biggest management challenge to increasing beaver populations in the Town of Brighton? Biggest benefit?
5. Would you be willing to engage in a community collaborative process about this issue?

Wrap-up

1. Is there anything else you would like to share with me about this topic?
2. Is there anyone else you think I should talk to about this topi

**Scientists/ Practitioner Questions:**

1. What are the successes and challenges you currently see with the process of beavers, BDAS, and stream restoration?
2. Do you think BDAs are an effective tool for improving stream health without beavers and with them?
3. Do you think the Division of Wildlife resources would be more likely to relocate beavers to communities with a beaver action pl

Appendix B.

Tree Wrapping Guidelines (Cone n.d.)

Text

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Beavers create diverse habitats that act as firebreaks, keep water in a riparian system, restore wetlands, sequester carbon, and more. When possible, coexisting with beavers in the wildland urban interface is the easiest solution.

* Lethal removal of beavers from a habitat is not a permanent solution. If the habitat remains, the recolonization rates are extremely high within a short time.
* Relocation of beaver is difficult and costly, with few facilities and experts available.

**Tree damage by beavers can be prevented with physical barriers.**

Aspens, willows, and cottonwoods are preferred by beavers. They have co-evolved with beavers, and are quick to sprout after chewing. Brush-sized willows without a large main stem are left unfenced at the Swaner Preserve as chewing stimulates new growth and they grow back quickly. Other trees species can be targeted, but conifers tend to be left alone if other options are more readily available.

**Painting**

* Exterior latex paint mixed with sand, painted onto the tree bark can be an effective short-term solution, but may not deter beavers forever.
  + Paint can be color-matched so it is not as visible.
  + The tree should be painted 3 feet above the ground. Additional height should be added to reflect the winter snowpack in the area.

**Fencing**

If the area where trees are located is not fenced, then each tree that you’d like to protect should be fenced

individually or in clumps.

* If there are many trees, prioritize wrapping: fall path- onto homes, fencing, or infrastructure, size, sentimental connection, services provided- shade, erosion control.

Other tools needed:

* Wire cutters
* Measuring tape or string for estimating tree circumference.
* Needle nose pliers
* Gloves and eye protection
* Clippers or loppers for removing low branches
* Landscaping staples, 4 inches or longer
* Hog ring pliers with wire rings to secure ends, or zip ties can be helpful and quicker than bending cut ends around each other.

Fence specs:

* Height: a 4 foot fence height is ideal. If the trees are in a location with a high snowpack, then a taller fence might be needed.
* Grid: 2 in. x 2 in. grid has proven the most effective. Small grids with a thick gauge resist force and prevent reaching through grid.
  + 4 in. x 4 in. fencing is too large, and beavers are able to reach through if close to tree.
  + Chicken wire is not strong enough, and can be pulled down or squashed by beavers or environmental factors.

Cut a piece of fencing that is longer than the tree’s circumference. The wrap should leave room for tree growth over time. Wrap the tree’s main stem or stems in the fencing, and attach the ends by bending the cut ends around the fencing, or attaching with zip ties or chain link rings. Low limbs may need to be trimmed or cut to make room for the fencing. Fencing should sit flush on the ground without cutting into the tree bark, and can be secured with 2-3 landscaping staples. Sloped hillsides may require a larger diameter of fencing per tree.

Product suggestions:

* Fencer Wire 10 Gauge Galvanized Welded Wire Mesh Size 2 inch by 2 inch (4 ft. x 50 ft.) has proven to be the most effective and long-lasting fencing. It is durable and can be moved and re-used if needed.
  + Available [on Amazon.](https://www.amazon.com/gp/product/B01LY8WSMD/ref%3Dox_sc_act_title_1?smid=A1L5ROT033YGY7&psc=1)

**Other Notes:**

* Plastic sheaths around trunks or newly planted trees are not effective in preventing beaver herbivory.
* Other fairly inexpensive fixes exist to protect culverts from damming and to maintain and control pond levels. More information is available.
* Other resources are available and helpful.
  + [The Beaver Institute](https://www.beaverinstitute.org/)
  + [Facebook Group: Beaver Management Forum](https://www.facebook.com/groups/339105817425/)

Figure . 1 and 2. Small grid, welded wire fencing is most effective. Rebar or t-posts can also be used to reinforce. This tree is both painted and fenced.

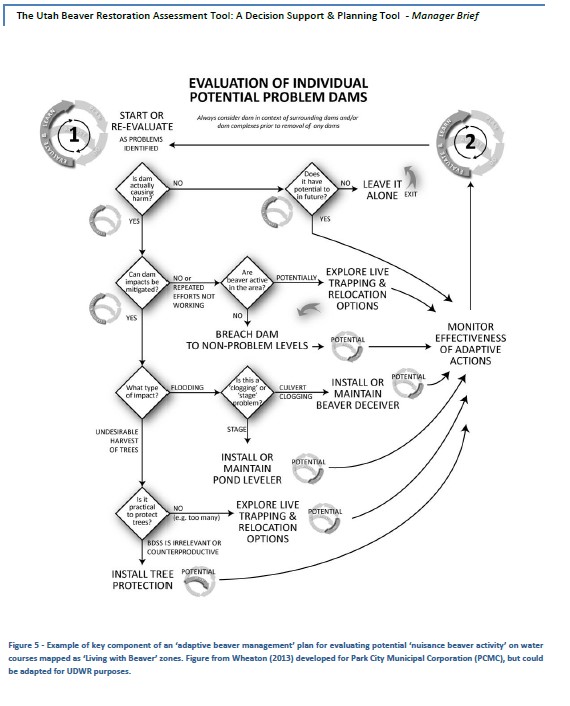


Contact Rhea Cone, Conservation Coordinator at the Swaner Preserve and EcoCenter, at [rhea.cone@usu.edu](mailto:rhea.cone@usu.edu) or 435- 797-8956 for more information.

Appendix C

Evaluation of Individual Potential Problem Dams Flow Chart

(Wheaton, J. 2013 )



Appendix D.

Evaluation of Water Courses with beaver Activity Flow Chart

(Wheaton, J. 2013 )

Diagram

Description automatically generated