PRAIRIE STREAMS

An Illustrated Guide

Thoughts from Rob Gardner

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October 2, 2019

THE ONCE AND FUTURE STREAM

Throughout Alberta's grassland region, water limits both economic and ecological growth. Without water, plants don't grow, and animals can't graze. Much of our precipitation arrives as snow. However, grassland managers watch with dismay as warm winds cause it to melt with a rush, carrying the valuable water away before it can benefit the land.

Perhaps we can understand this situation better if we look at our region's ecological history. Since colonization began, our grassland has suffered from a succession of environmental disruptions. First the decimation of aboriginal populations by disease, then the introduction of horses and rifles. Beaver were systematically removed from the region, followed soon by the bison. With little grazing, the grass grew lush, for a few years. Vast grassfires must have raged across the region from time to time, but species such as prairie chicken and perhaps greater sage-grouse expanded their ranges.

Late in the nineteenth century, large herds of cattle were moved north to take advantage of the valuable grazing. As the grazing leases became formalized, unsustainable stocking rates were required by the government. Soon after, massive immigration tied to cultivation fragmented the landscape, ploughing up almost half the grass in just a few years.

This ecological turmoil still stirs our landscape, a hundred years later. It should be no surprise that the earliest settlers had trouble understanding their new home.

Manyberries Archives (Heydlauff)

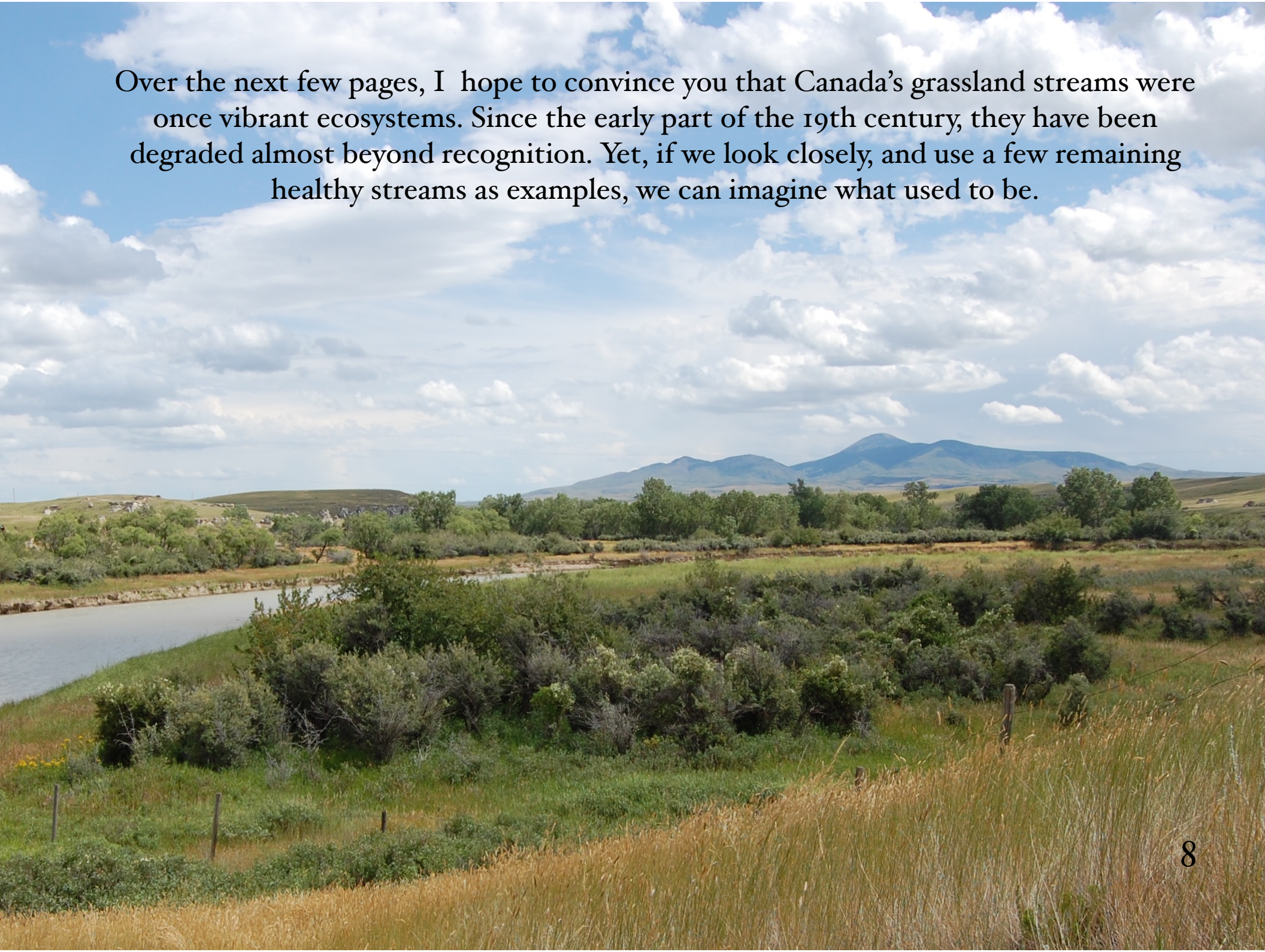
Since the 1930s, increasingly thoughtful management has been informed by better understanding of the ecosystem. Some species such as beaver have recovered, even as others continue to fade away. Ranchers still seek greater control of the land, in the face of challenges presented by climate change and invasive species.

At the same time, ranchers need expertise in many technical and varied fields, including reproductive technology, mechanics, computers and marketing. Overworked people may focus their efforts. In many places, a simplified landscape is considered easier to manage.

Other books and websites describe riparian health, but few provide illustrations. One picture is worth a thousand words, as the saying goes. Since grassland managers are often people of few words, I thought you might appreciate seeing the actual results of suggested actions, rather than reading about them. “Seeing is believing”, to quote another cliche.

The majority of the photos were taken in southern Alberta, with a few from north-central Montana. Unless otherwise indicated, they are by the author.

References are provided to help readers follow up for more detail, not to appear scientific. All internet sources have been accessed without payment of any fees, so are considered to be in the public domain.



Over the next few pages, I hope to convince you that Canada's grassland streams were once vibrant ecosystems. Since the early part of the 19th century, they have been degraded almost beyond recognition. Yet, if we look closely, and use a few remaining healthy streams as examples, we can imagine what used to be.

Riparian Health

Streams passing through the grassland region carry out a number of important ecological functions. Cows and Fish, a prominent conservation organization in Alberta, lists these roles as:

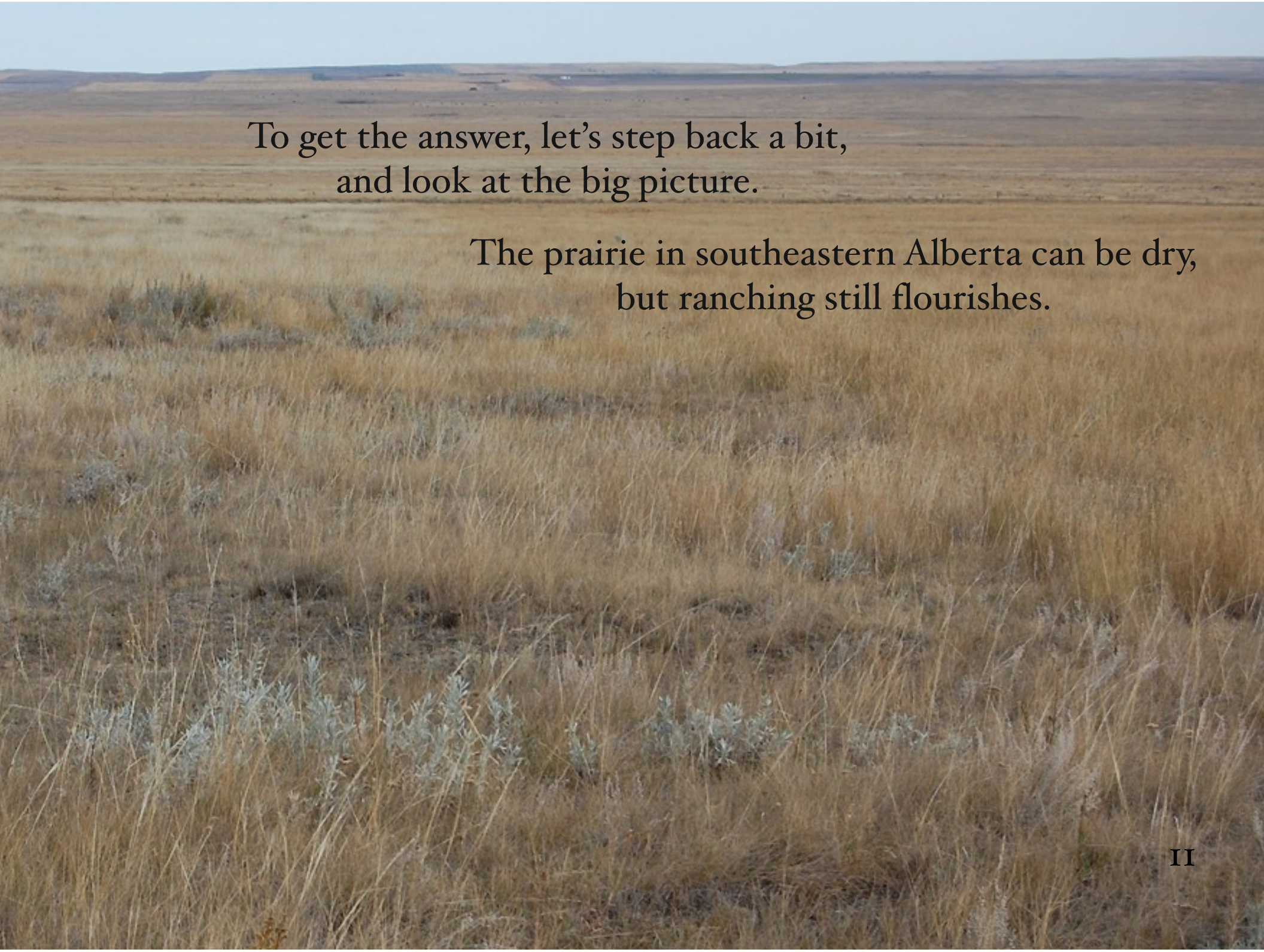
- Trap sediment
- Build and maintain stream banks
- Store flood water and energy
- Recharge the aquifer
- Filter and buffer water
- Reduce and dissipate stream energy
- Maintain biodiversity
- Create primary productivity

Fitch et al, 2009

These actions may seem a bit academic or distant. A different wording may make more sense:

- Keeping cattle's water free of disease
- Ensuring all livestock have safe, stable and healthy access to water
- Reducing damage due to flooding
- Increase the season that streams flow
- Ensure a stable flow of clean water
- Reduce erosion
- Provide shelter and food for both resident and migratory wildlife
- Grow the maximum amount of vegetation for feed and shelter


This stream demonstrates these functions being achieved.
It would be an asset on any ranch.
Why don't most prairie streams look like this?



To get the answer, let's step back a bit,
and look at the big picture.

The prairie in southeastern Alberta can be dry,
but ranching still flourishes.

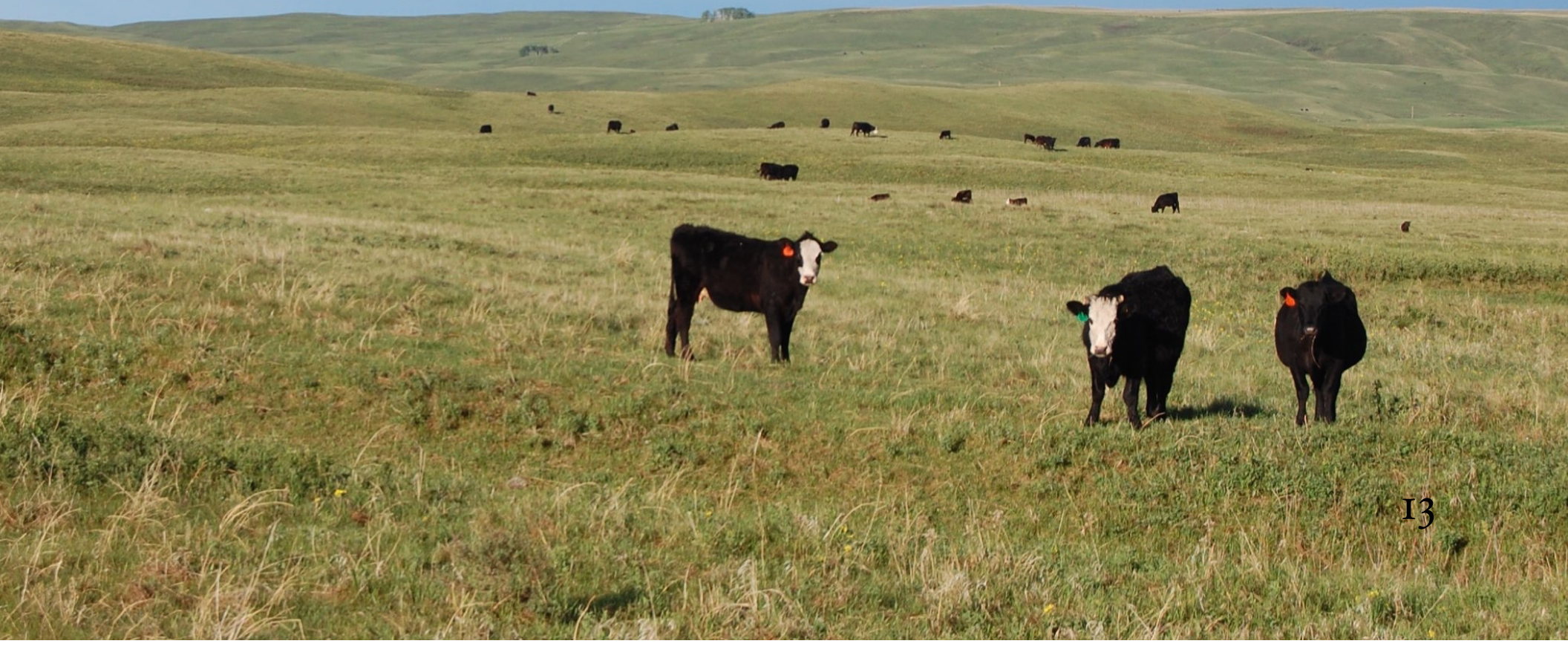
Ranchers generally manage grazing to ensure good carryover, helping the grass get through dry periods.

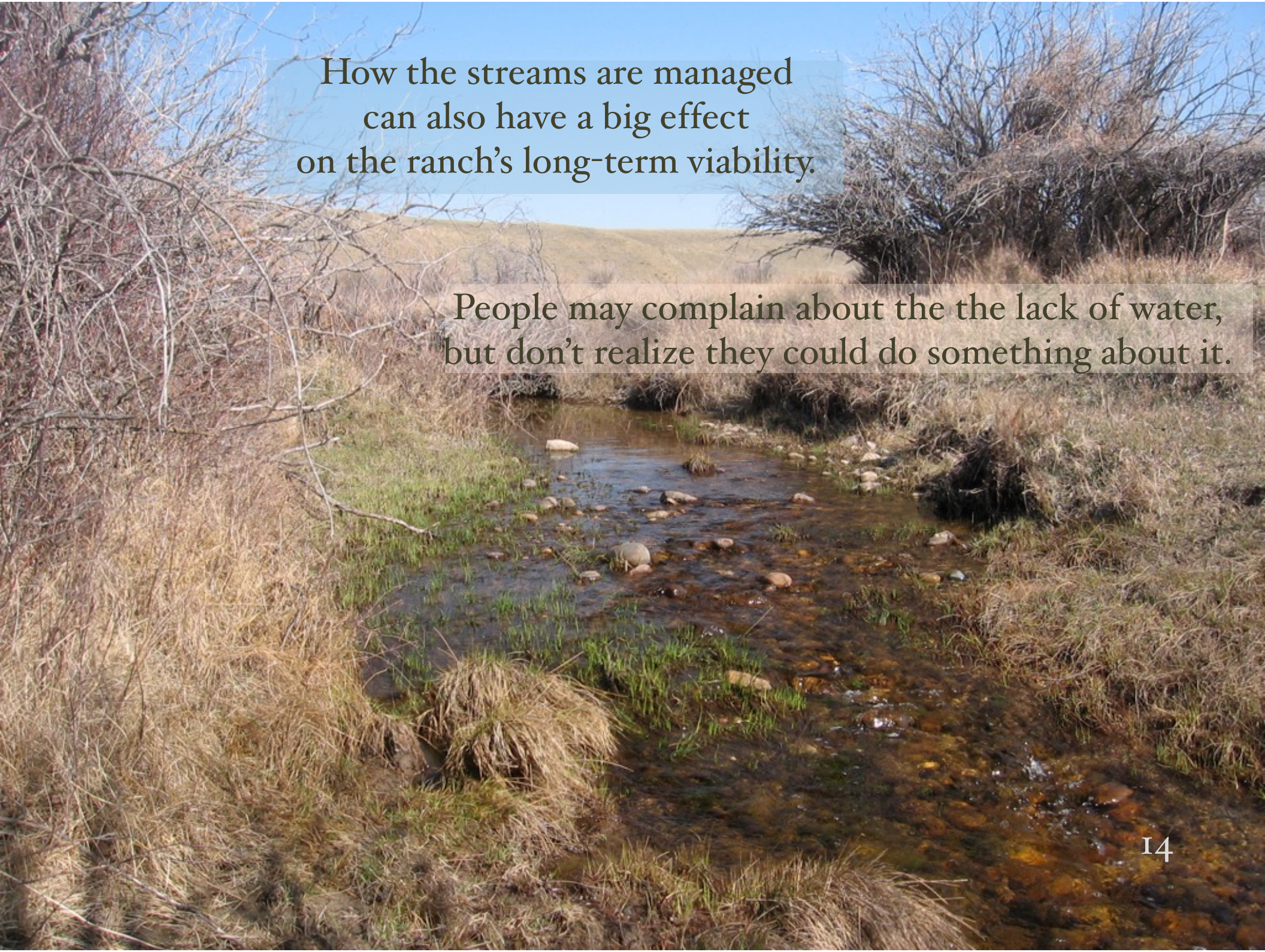
Range management has come a long way over the past century.
Now, ranchers often use Range Health Assessments

(Alberta Environment & Parks 2017) to help them plan their grazing.
This simple but formal process uses questions from a worksheet

to objectively "score" each pasture.

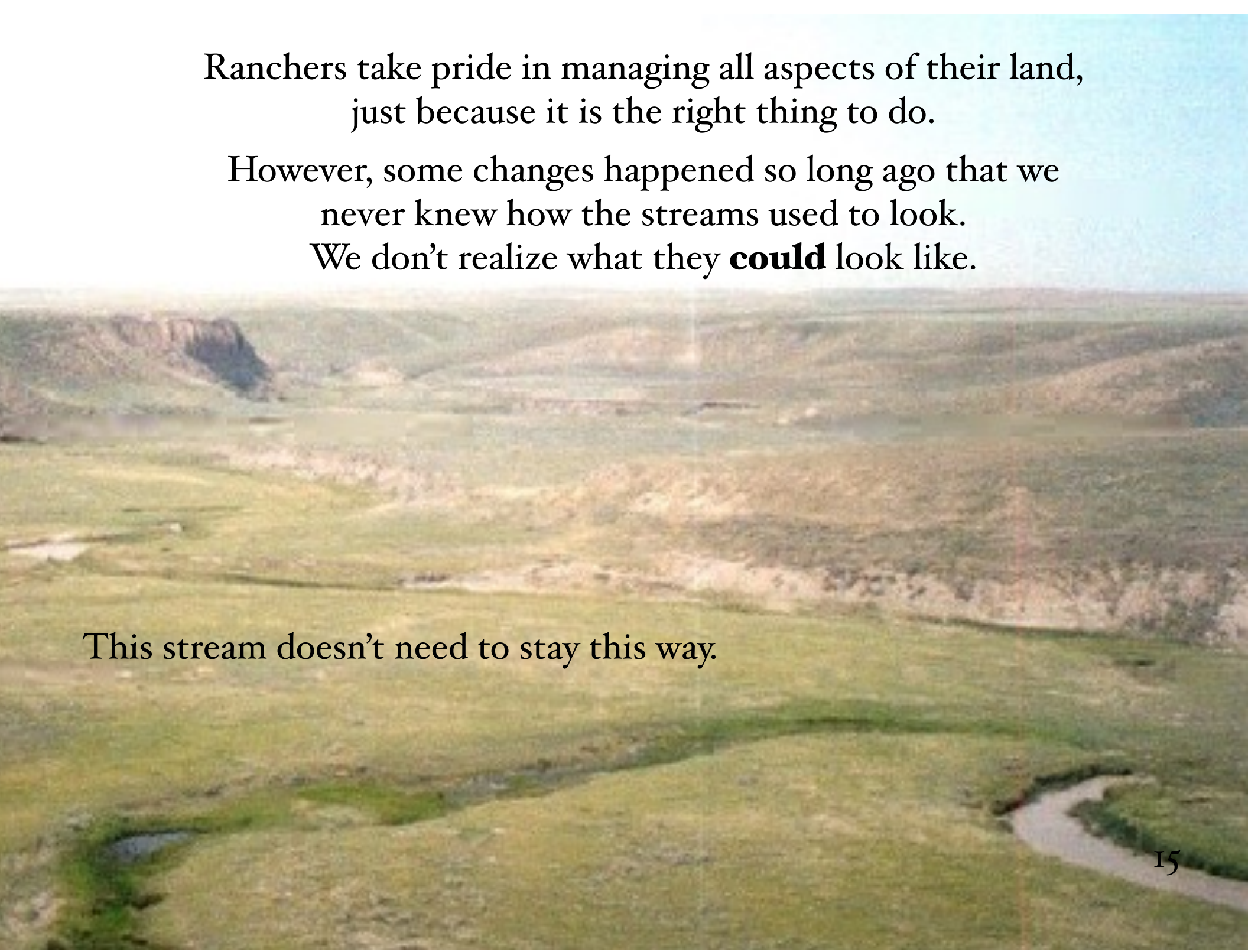
The answers point to aspects of management that can be improved.



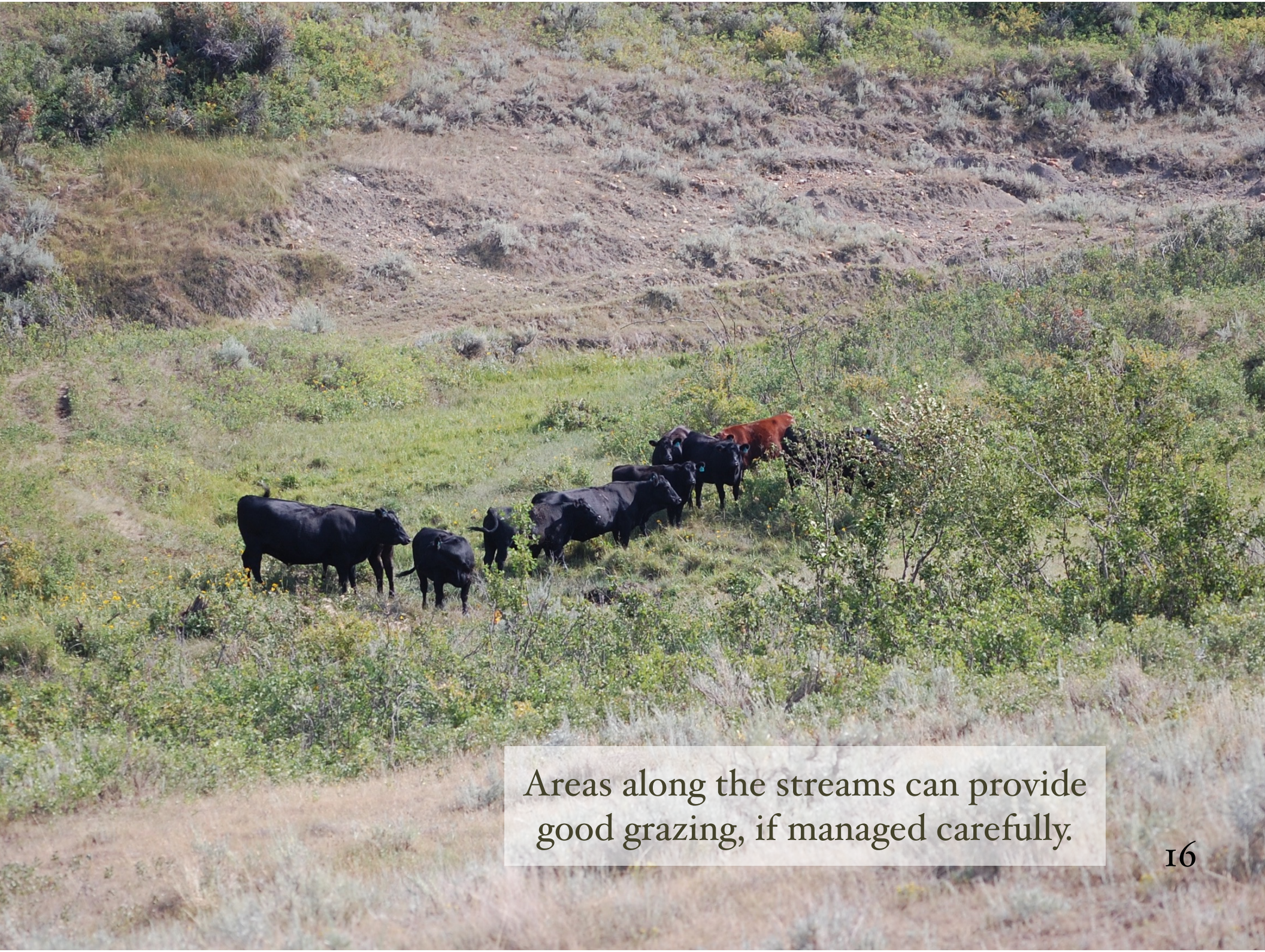

How the streams are managed
can also have a big effect
on the ranch's long-term viability.
People may complain about the the lack of water,
but don't realize they could do something about it.

Ranchers take pride in managing all aspects of their land,
just because it is the right thing to do.

However, some changes happened so long ago that we
never knew how the streams used to look.
We don't realize what they **could** look like.



This stream doesn't need to stay this way.



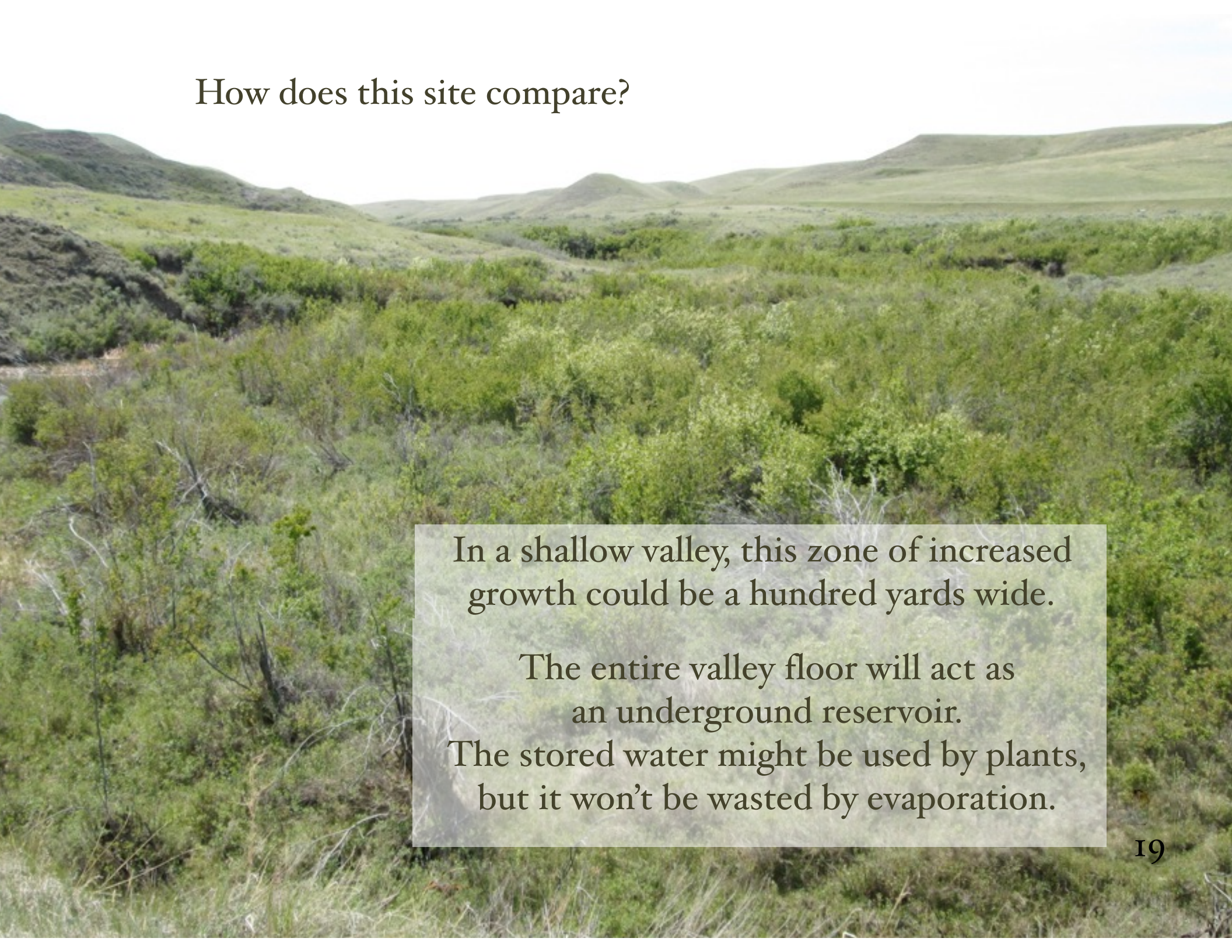
Areas along the streams can provide good grazing, if managed carefully.

Droughts appear to be getting more severe,
even as floods get more frequent.

The answer might seem to be more dams.

Sure, cattle have enough water to drink, but is it healthy? Muddy sites like this can bring foot problems and scours.

How does this site compare?



In a shallow valley, this zone of increased growth could be a hundred yards wide.

The entire valley floor will act as an underground reservoir. The stored water might be used by plants, but it won't be wasted by evaporation.

We have all seen healthy, wooded streams with broad riparian zones, and know they are possible.
By the way, “riparian” refers to the band of lush plant growth separating the grassland from the streams.

I think your streams are willing to do their part,
but they may need some help.

Just to be clear:

Are we managing for this type of stream, or . . .


. . . does this stream look better?
Both photos show the same stream,
less than one kilometre apart.
Management makes a difference!

SIDE BAR:

How does ground water work?

Groundwater supports an extensive band of shrubs.

Streams, ponds, springs and other water bodies are connected to the groundwater beneath your ranch. Understanding the basics of groundwater will help you manage your surface water. Let's start from the very simplest example, and build up, step by step.

I hope this will help people understand the somewhat mysterious, but logical, process happening under our feet.

A fact to keep in mind:

Ground water flows downhill, like surface water.
And the steeper the slope, the faster it moves.

It only flows uphill when it is pushed by a pump
or other water pressure.

And another thing:

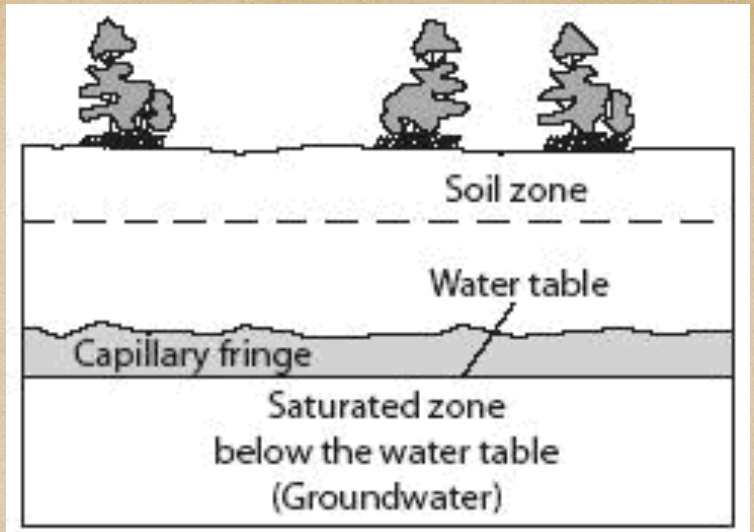
When uniform spheres are packed together, like a pile of clean sand, about one-third of the volume is open space. That is the maximum amount of water that soil or rock can hold. The actual amount may be much smaller, but is still a very large volume.

Some bedrock, like granite, has no spaces for water. Shale, such as in badlands, may hold some water, but the small open spaces prevent it from moving. Sandstone and loose surface deposits from glaciers have large connected spaces that can hold considerable water.

Groundwater moves very slowly due to the very small spaces. It may move at mm/year through sandstone, or m/day if the rock has large cracks.

Underground rivers and lakes do not exist, except in very rare cave systems. When wells are drilled into layers of gravel, the water moves faster and gives the impression of being an underground stream.

SIMPLEST CASE

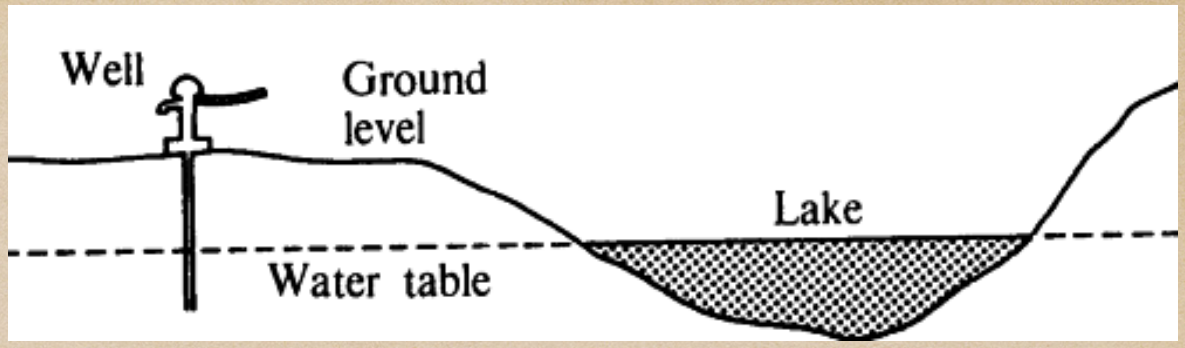


Source: EPA.

Precipitation that is not absorbed by vegetation will percolate very slowly down through permeable soil and rock. Over millennia, the water accumulates, saturating the rock and sub-soil. The top of this saturated volume is known as the water table.

In this simple case, the only way for water to get out is through plant roots. The water table will be close to the depth of the longest roots.

ONE COMPLEXITY ADDED



When a depression is deep enough to reach the water table, a pond or other water body will result.

When water evaporates from the pond, ground water will flow into the pond (seepage or a spring). This will gradually lower the water table close to the pond.

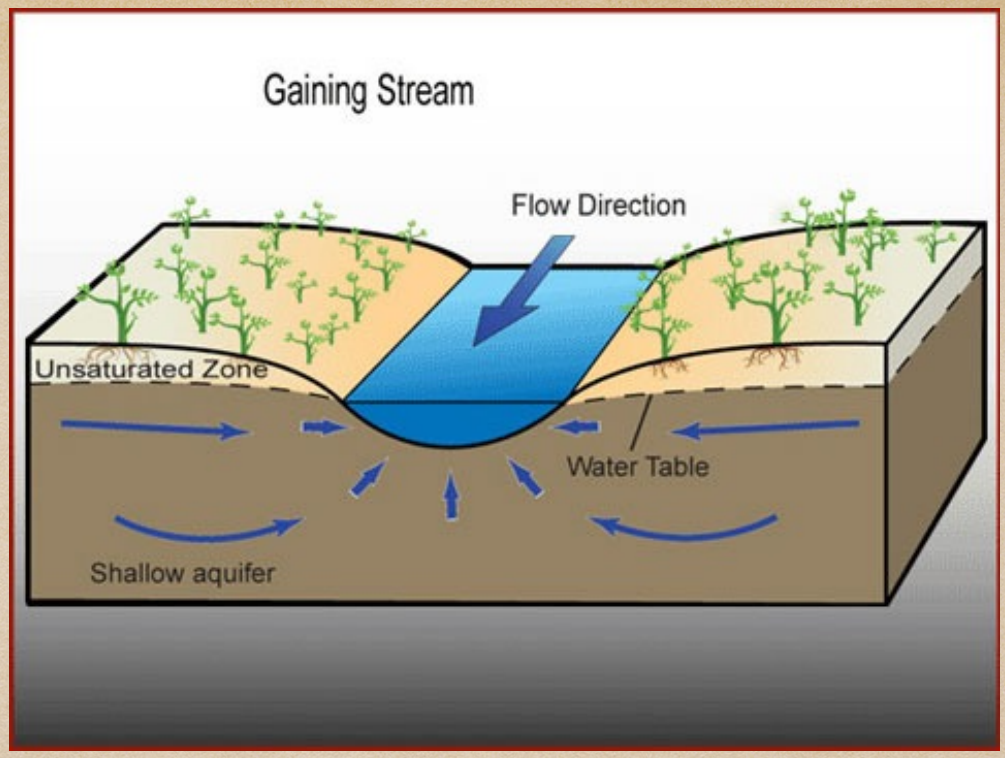
When high overland flow raises the pond level, water will flow from the pond into the soil until equilibrium is reached.

SPRINGS

Springs occur where the water table reaches the ground surface, and water can flow out.
Valleys in the grassland often have a line of springs above the valley floor. The downward motion of water through the sandy glacial deposits is stopped by the clay-rich bedrock. The water then moves sideways toward the valley.

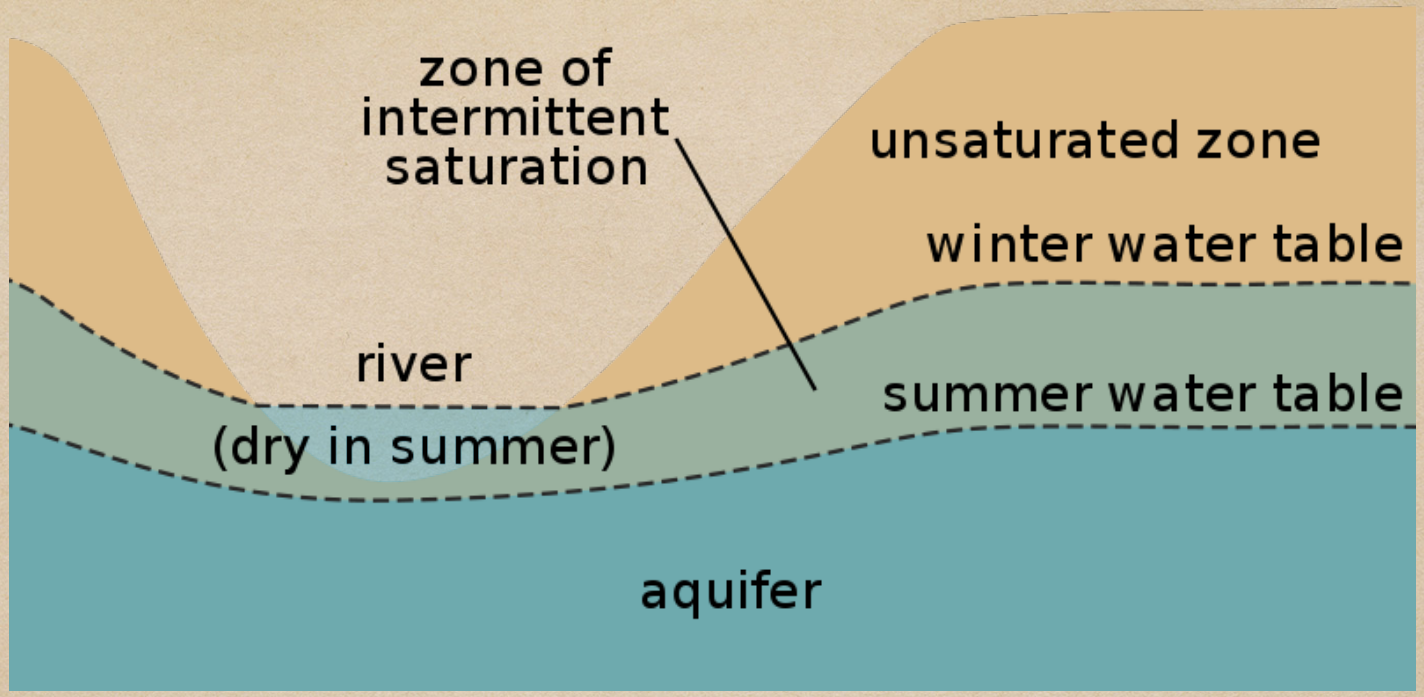
Springs can be identified at a distance by the groves of shrubs (Chokecherry or Saskatoon) or perhaps trees (Manitoba Maple, Plains Cottonwood, Aspen). These species flourish with the steady supply of water.

ANOTHER FACTOR



If the depression is a stream, the ground water will drain away. In hilly areas, the flow of ground water into the stream bed may be sufficient to produce the up-welling needed to keep gravel beds clear of silt.

Cross-section view of a river valley

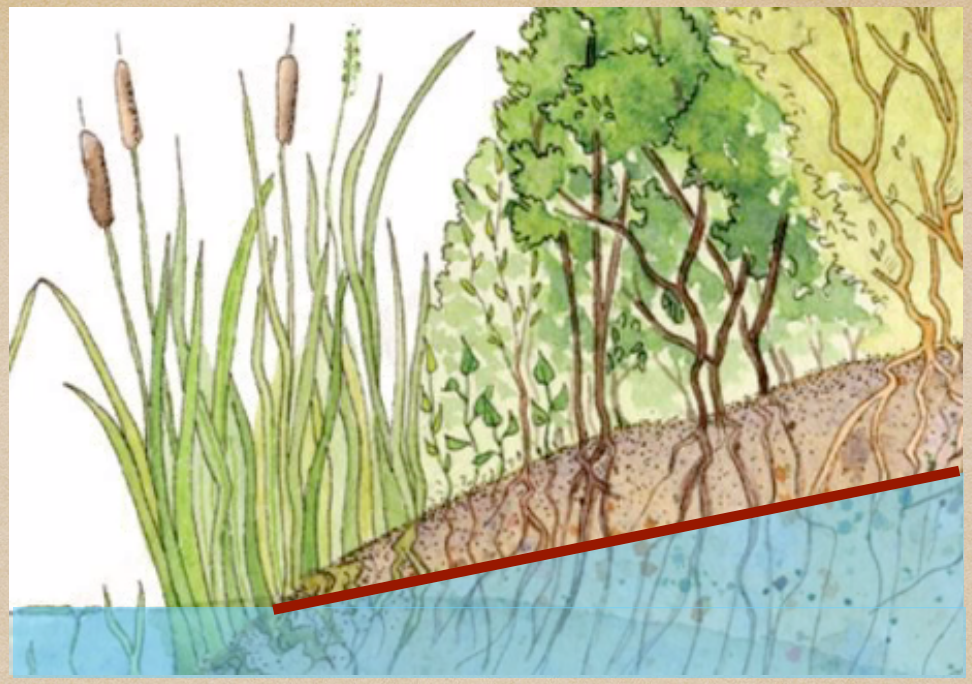


The water table's elevation follows that of the topography, but with more gentle slopes.

When the river goes down, the water table is partly drained.

When it goes up, the water table is recharged.

(These water tables should be shown coming together not too far from the river bank, beyond the influence of seasonal changes.)



The red line shows the water table in this situation.
When looking at a cross-section of a valley, the water table always goes up from the water body in the valley floor.

TAKE-HOME MESSAGE

Putting these ideas together,
is seems that if land managers slowed down the flow of water, it would soak into the ground. Water stored underground will be available for use in times of drought.

Making the Most of Your Rainfall

Water is clearly the limiting factor for ranching anywhere in the Northern Great Plains.

How can land managers use their rainfall more effectively?
Some managers try to get rid of water as quickly as possible,

as if it was a liability.

Instead, we should try to slow it down so we can use it better.

We should use vegetation to trap the most precipitation. What happens on your fields strongly impacts your streams.

To achieve maximum production, as much vegetation should be left as possible, while still harvesting enough to feed the cattle.
Before we see what this actually looks like in practice,
let's summarize where we are at so far.

Stream Action Plan

GOAL
More cattle grazing on the pasture

LIMITATIONS

- few sources of water, often seasonal
- uneven distribution of cattle leaves considerable forage unused

existing water has marginal quality

- overuse of small riparian area reduces water quality further

CHANGE IS POSSIBLE !


Your role as stream manager
is to assess your situation
and choose the best approach.

Most people strike a balance between two types of decision-making:

Tried and True Experience

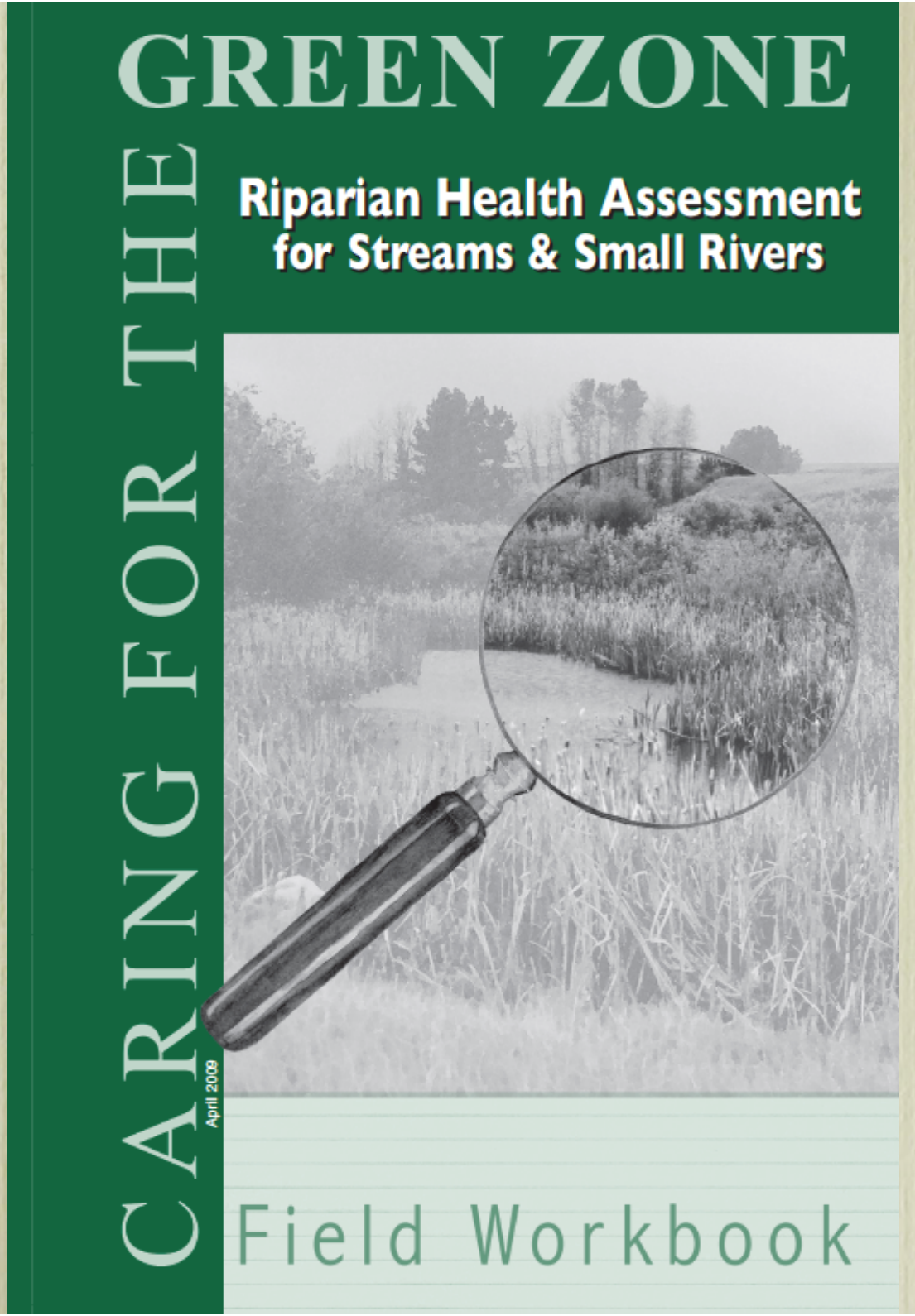
Create Our Own Solution

Tried and True Experience

For ranchers wanting the "sure thing", experience across North America has shown what works:

- Riparian Health Assessment
- Rest rotation grazing
- Off-stream watering
- Luring cattle away from the stream with minerals or supplements
- Herding to more distant parts of pasture

Each of these has a well-documented quick payback. In fact, many progressive ranchers are already using these techniques. Let's look at them in a little more detail.



Take an objective look at where your water is compared to the grazing capacity of the surrounding field.

Then use this simple process to find out how healthy your streams are.

This will provide a starting point, from which you can measure your progress.

Fitch et al 2009

RIPARIAN HEALTH ASSESSMENT - FIELD SHEET

Landowner/Lessee:_____ Date: _____ Reach No.: _____

Stream/River: _____

Site Description: _____ Scores or N/A

_____ *Actual / Possible*

1. Vegetative Cover of Floodplain and Streambanks

6 4 2 0 ___/___

2. Invasive Plant Species

Canopy Cover

3 2 1 0 ___/___

Density/Distribution

3 2 1 0 ___/___

3. Disturbance-increaser Undesirable Herbaceous Species

3 2 1 0 ___/___

4. Preferred Tree and Shrub Establishment and Regeneration

6 4 2 0 ___/___

5. Use of Trees and Shrubs

Preferred Trees and Shrubs - Browse

3 2 1 0 ___/___

All Trees and Shrubs – Use other than browse

3 2 1 0 ___/___

6. Standing Decadent and Dead Woody Material

3 2 1 0 ___/___

7. Streambank Root Mass Protection

6 4 2 0 ___/___

8. Human-Caused Bare Ground

6 4 2 0 ___/___

9. Streambank Structurally Altered by Human Activity

6 4 2 0 ___/___

10. Reach Structurally Altered by Human Activity (excl. banks)

3 2 1 0 ___/___

11. Stream Channel Incisement (vertical stability)

9 6 3 0 ___/___

TOTAL SCORE = ____/____

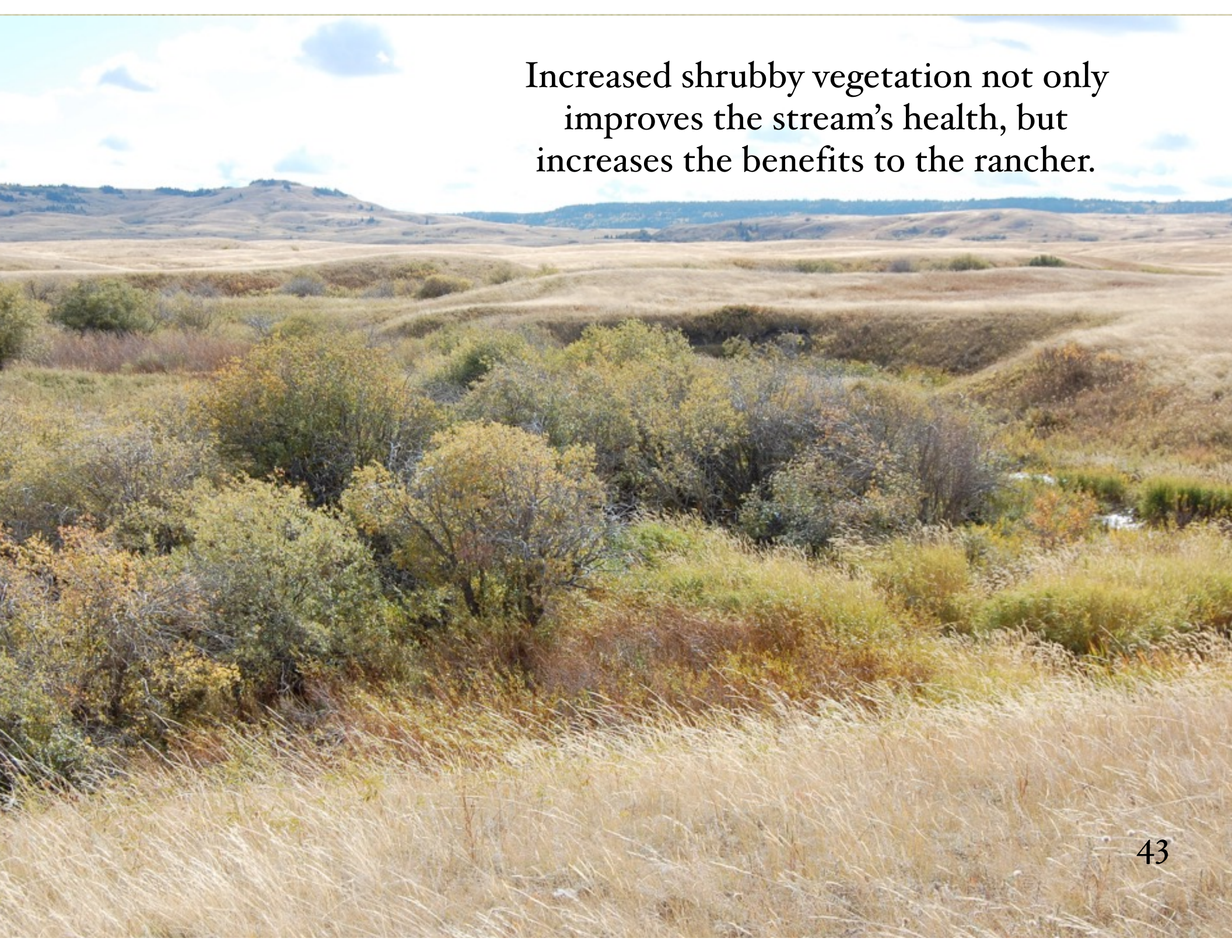
PTS	18/60	26/60	30/60	33/60	36/60	39/60	42/60	48/60	54/60
%	30	40	50	55	60	65	70	80	90

Non-Functional (Unhealthy) — *Functional At Risk (Healthy with problems)* — *Functioning (Healthy)*

On this worksheet, five questions totalling more than one-third of the points, relate to the positive impact of woody vegetation.

21/60

Some managers take the easy way out, claiming their stream doesn't have the capacity to sustain shrubs.
I think an honest look will show the streams could be doing more.



Increased shrubby vegetation not only improves the stream's health, but increases the benefits to the rancher.

RIPARIAN HEALTH ASSESSMENT - FIELD SHEET

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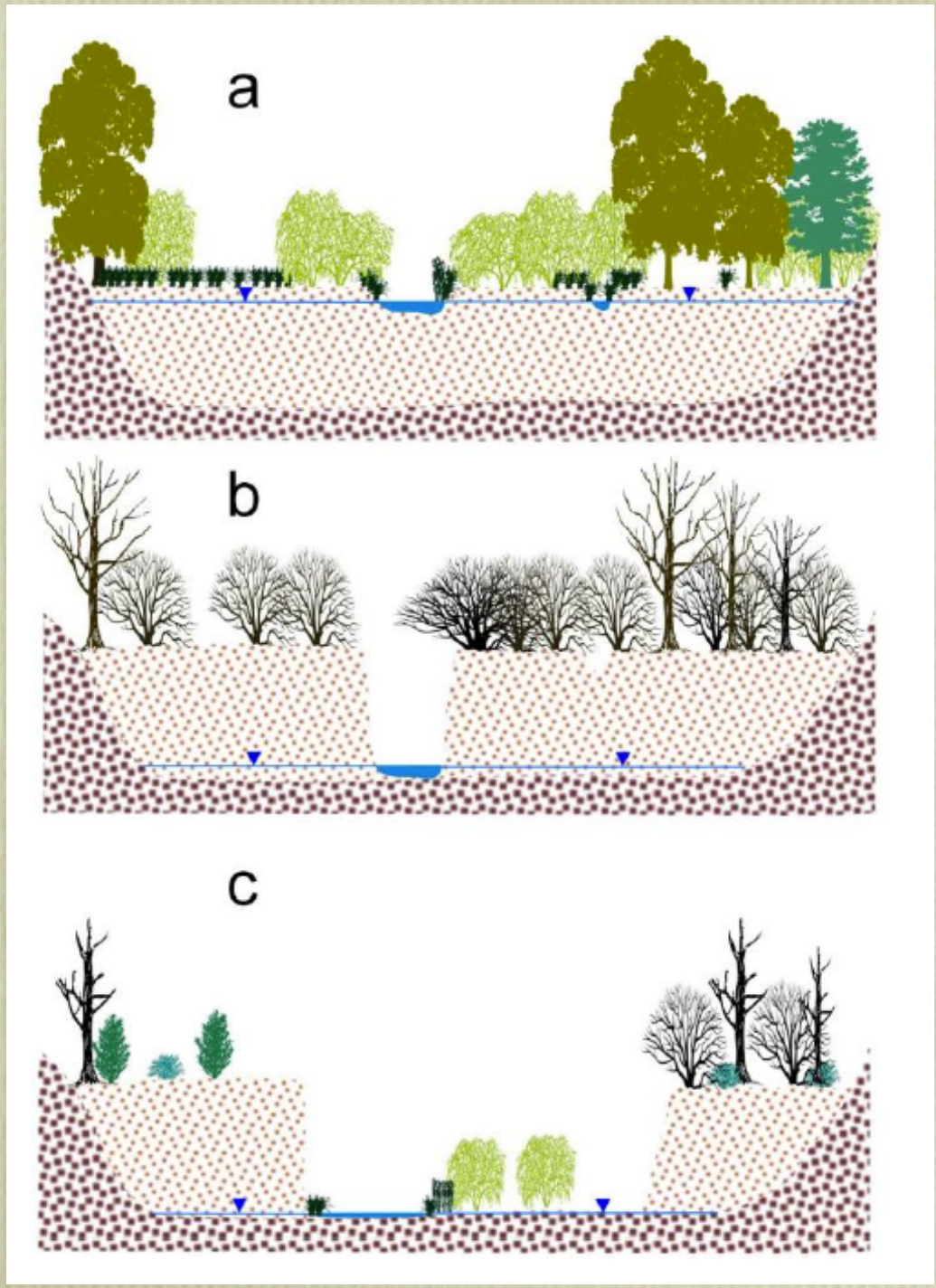
Non-Functional (Unhealthy) — *Functional At Risk (Healthy with problems)* — *Functioning (Healthy)*

Let's take a closer look at the last question: incisement.

Has your stream cut downward to create a mini-canyon?

Steep-sided stream banks are not normal or healthy, although they are very common. Incised streams drain water away before it can spread across the floodplain.



Pollock et al 2011

How do streams get this way?

a. Healthy streams in a flattish landscape have shallow valleys and a wide area of riparian vegetation.

b. At some point, this stream's equilibrium was disturbed, and it began to erode down. The lowered water table caused die-back.

c. When a new equilibrium is established, the stream resumes sideways erosion. A new floodplain is created within the the old valley, leaving a dry terrace with dying vegetation. Wildfire can remove all signs of shrubs.

Why are so many prairie streams incised?

In much of North America, beaver dams provided the base level for streams. Moving water cannot erode deeper than that point.

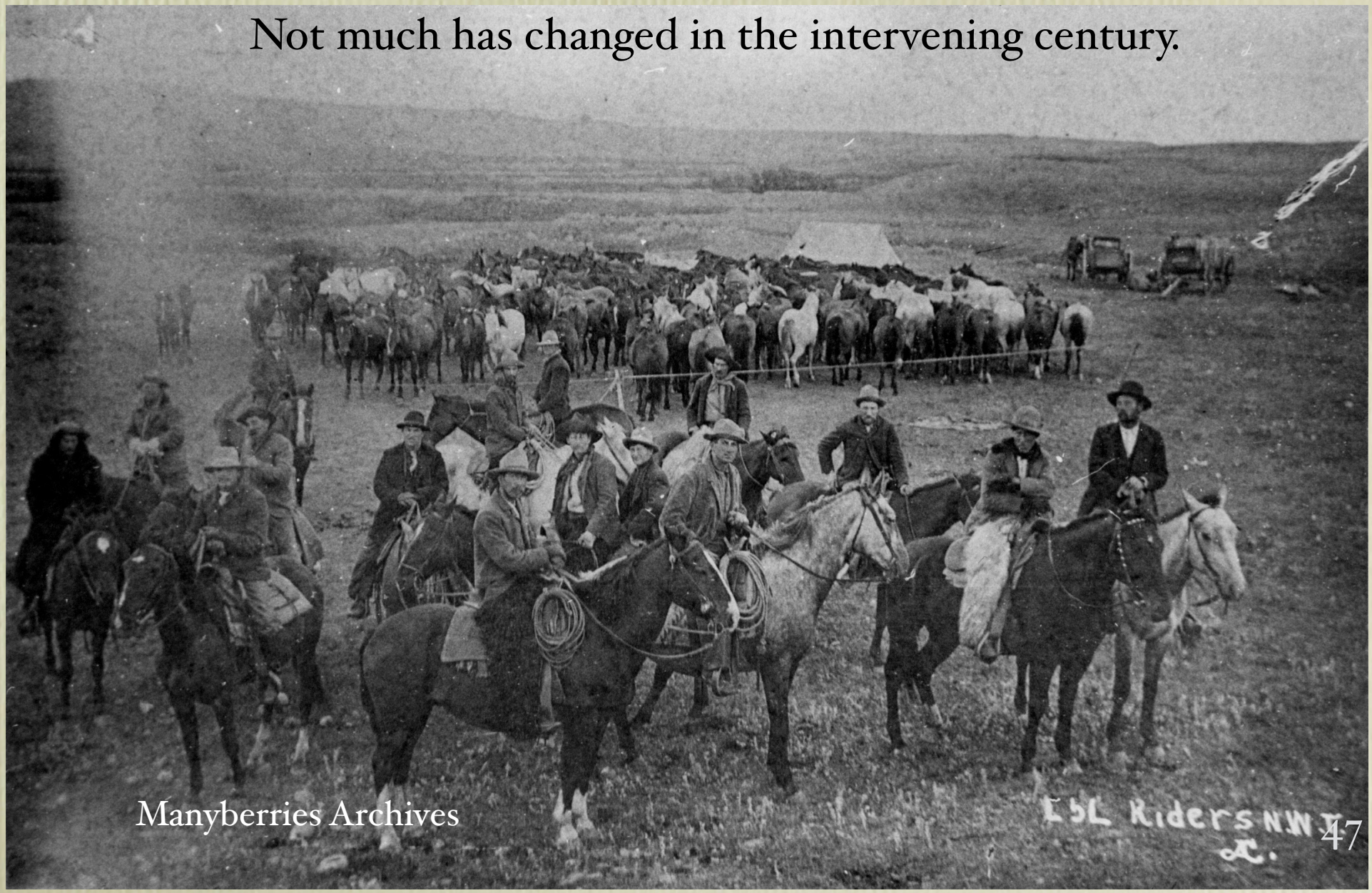
When beaver make a dam, they scoop mud from beside it, making a deep pool. They also dig channels upstream where the pond gets shallow.

Dams usually leak where one end meets the valley wall. Eventually, without repair, this expands into a full washout. When this happens, the water flowing through the drained pond is immediately focussed in the channels dug by the beaver.

Fairly quickly, the stream erodes downward until a new equilibrium slope is reached.

This process occurred in the nineteenth century, after the beaver had been trapped out and before the early ranchers arrived. European settlers did not realize that their streams once flowed all summer, and hosted a lush riparian zone.

This very early photo, taken south of Manyberries, shows a meandering but incised stream with small shrubs and one substantial bluff of trees in the centre.
Not much has changed in the intervening century.



A recent photo, taken in the same region, shows that the incised stream has stolen the ground water.

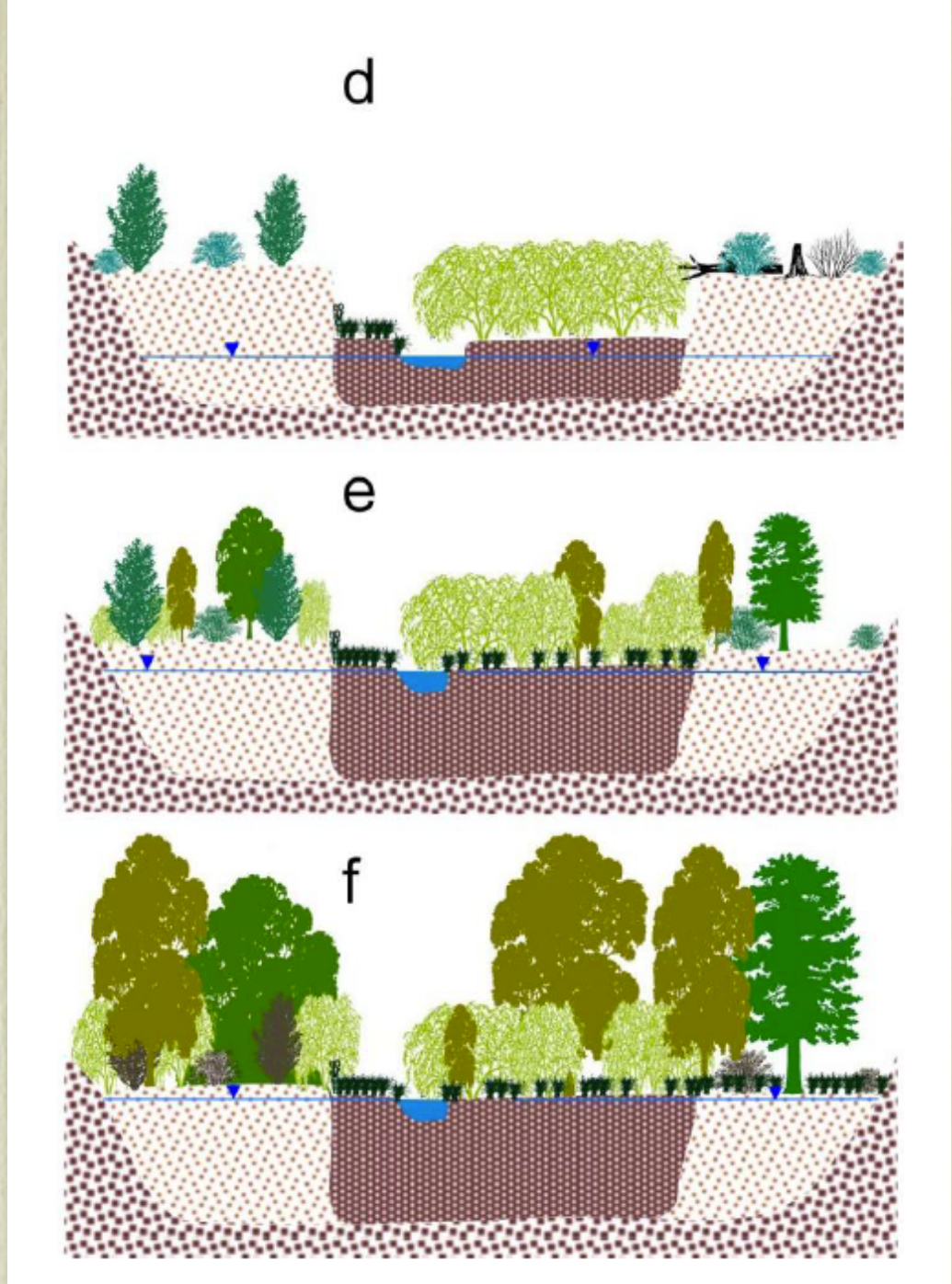
This broad valley has a lot of grazing potential hidden, waiting to be released by raising the water table again.

How does restoration happen?

d. Riparian vegetation, including shrubs and deadfall, slows the water, and traps sediment.

e. As the stream bed accumulates soil, the water table rises and the riparian area widens. Soil deposition is accelerated.

f. Eventually, the stream's new floodplain is rejoined with the old terrace.



Pollock et al 2011

To start this process, help the stream vegetation by reducing the time cattle spend along the stream. Get your cattle using the whole pasture with salt and herding. Once you introduce them to the under-grazed corners, they will return on their own.

Herding can be fun and restful. It allows the rancher to properly observe the health and behaviour of all stock.

Manyberries Archives (Heydlauff)

This spring and its lush vegetation have been fenced.
Water is piped to a trough where cattle have easier access.

Off-stream water also draws the cattle away from the riparian area, giving shrubs a chance to grow.

Cattle taste-tests (really!) have shown they prefer the clean water, and will drink more. The dry footing and convenient height are attractive bonuses.


Portable systems can move with the cattle from field to field.
The float keeps the water intake out of the mud.

Some practical tips

When the grass can support more than a dozen cattle, the simple rectangular trough will not be large enough. Get a large, preferably round, trough that can accommodate most of the herd at once.
Ensure calves can reach the water.

Photos and advice from Hyland Armstrong,
retired rancher, Cypress Hills

In many cases, cattle can drain the trough faster than the pump can fill it. Having a large tank nearby will allow quick automatic refilling, with enough water for even the slowest cow.

Photo and advice from Hyland Armstrong, retired rancher, Cypress Hills

CREATE YOUR OWN SOLUTION

You may be surprised to hear that some ranchers are independent-minded and don't always follow the herd. If you fit in this group, you can probably think of other ways to improve your stream's health. Great! Give 'em a try!
Other ranchers have suggested these changes, that may need more inputs and effort:

- Planting willows along streams
- Fencing riparian areas so they can be managed better
- Using various structures to influence the stream
- Removing facilities from the floodplain

Like many investments, these require a longer time to show results. Let's take a closer look at these approaches.

Give the shrubs a head start!

Planting shrubs, especially willows, seems like an obvious way to increase their number. It can take a lot of time, though. Invite a few friends and relatives for a "picnic"!

- Willow stems from a nearby stream can be planted along the shoreline.
- Use stems about the thickness of your thumb, and about half a metre long. Put at least 2/3 of the stem in the ground; a steel bar can be used to make a hole first.
- Keep them right-end up, or root-end down!
- Protect them from cattle with a temporary (electric) fence. Consider planting in the field that will be rested that year.

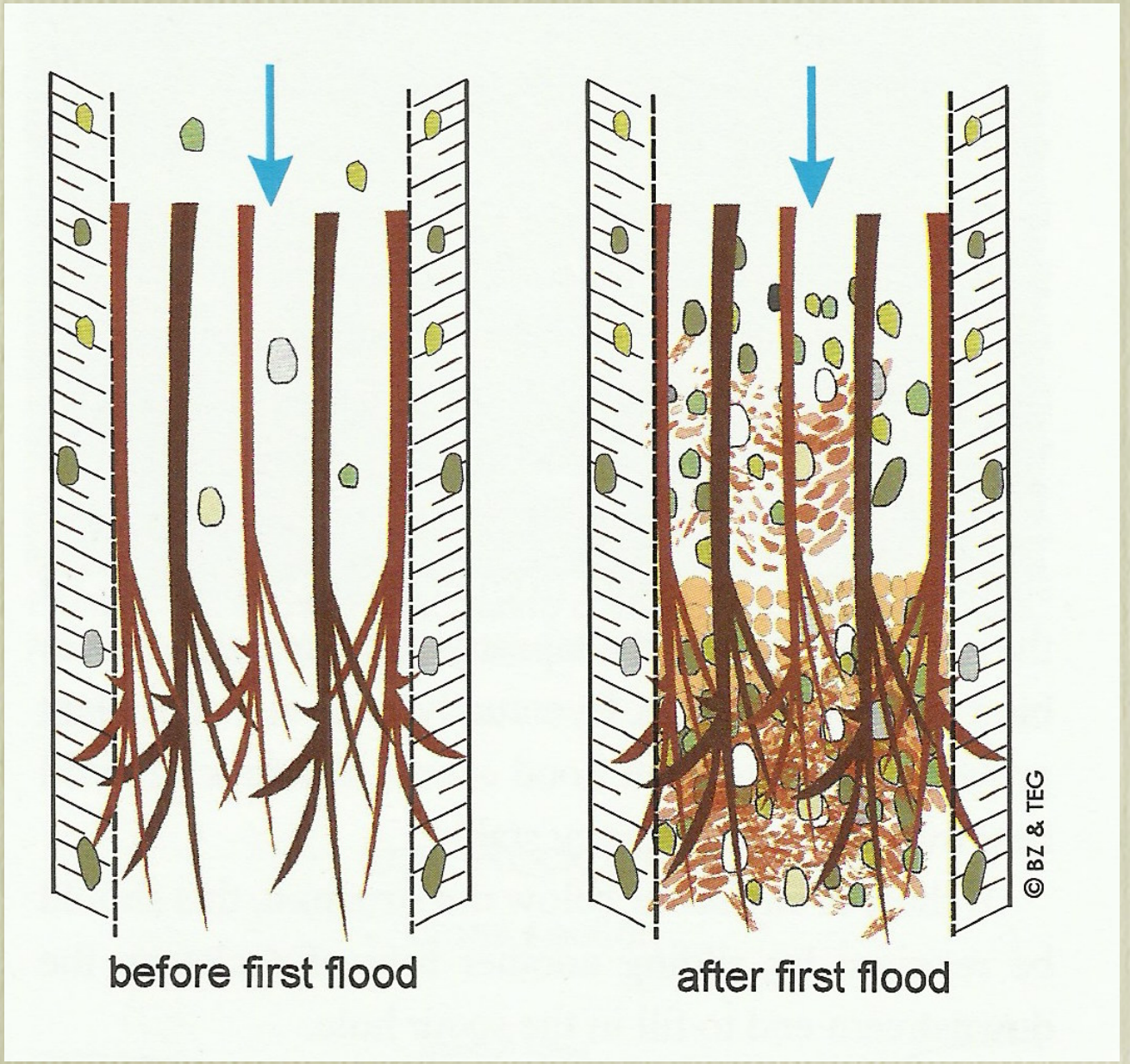
Plant willows where soil is accumulating, not eroding, and where it will remain moist all summer.


Ideally, select places that have standing water,
even when the stream stops flowing.

Grazing intensity can be managed more easily if fences are placed along vegetation boundaries, rather than survey lines. Where practical, try to fence the riparian area separately from the large upland fields. Limited access points can be developed for watering.

The fences are not intended to prevent grazing near the stream, just allow you to manage how much time cattle spend there.

With no fence, it will take serious incentives of salt and off-stream water to keep them away. Otherwise, they will over-graze next to the stream, and neglect the farther corners of the field.



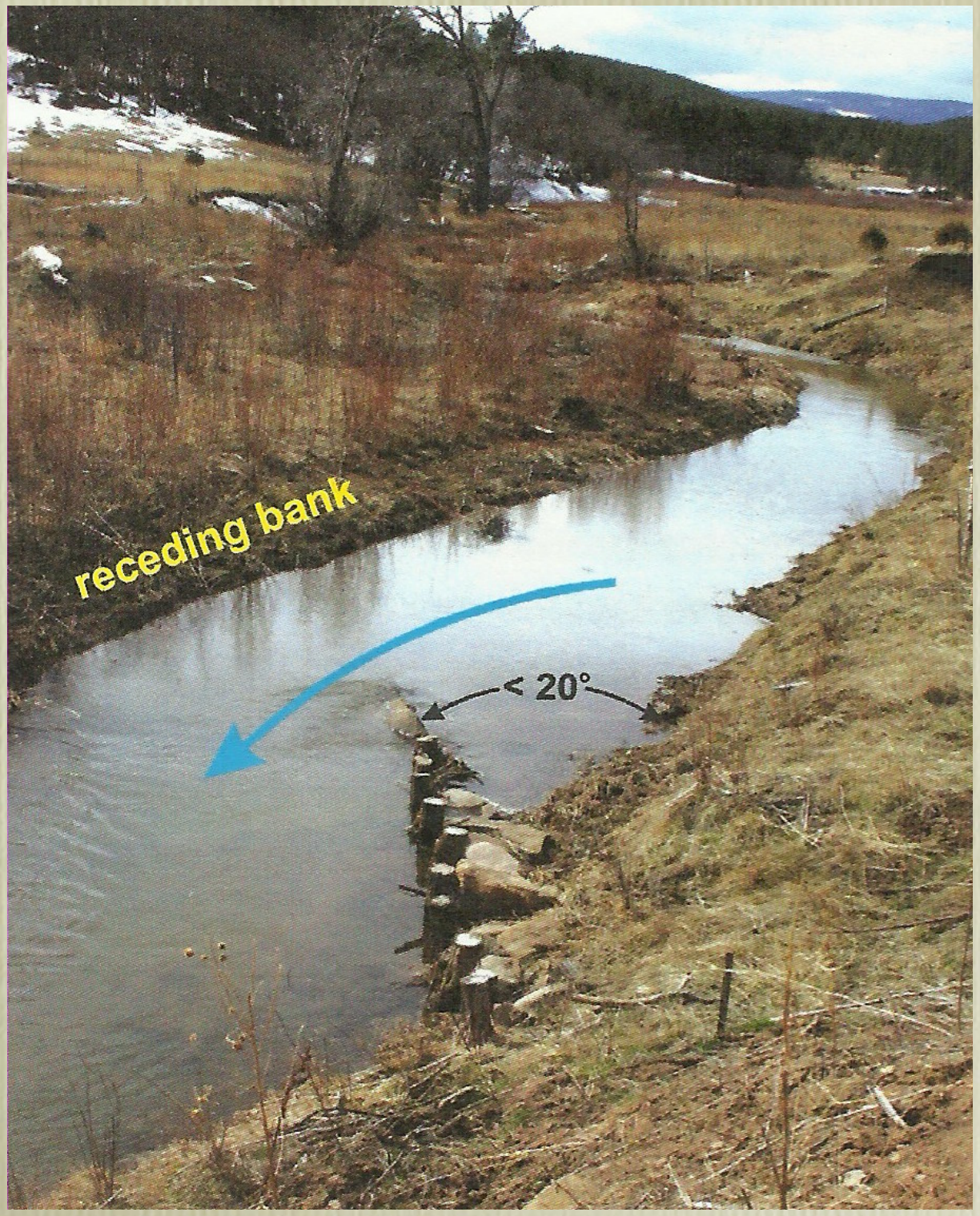
Zeedyk & Clothier 2012

Give your creek some bling!

Zeedyk and Clothier (2012) suggest some simple changes to your stream that can help the health improve. Zeedyk (2006) presents a concise summary for those wanting to explore this approach.

Tree Mat

With very narrow gullies, small trees can be laid in the bed to trap sediment.



Vane

This structure catches sediment while pushing the stream against the opposite bank.

Usually, three or four of these will be installed close together on alternate banks.

The combination of erosion and deposition creates meanders, slowing the water's speed.

Zeedyk & Clothier 2012

Stream Catcher

This leaky dam catches debris and some silt,
while slowing the high water.

We know that buildings in the floodplain will be washed away sometime.
Why not be pro-active and move them now?

Paul von Huene

A century ago, ranchers had little choice but to winter cattle in coulees.

Now, movable shelters, located out of the riparian area,
can keep cattle comfortable through the winter,
and can be taken to different sites each season.

Stream Action Plan

GOAL
More cattle grazing on the pasture

LIMITATIONS

- few sources of water, often seasonal
- uneven distribution of cattle leaves considerable forage unused

existing water has marginal quality

- overuse of small riparian area reduces water quality further

CHANGE IS POSSIBLE !

OPTIONS

- Train cattle to graze underused parts of pasture, using herding
- Lure cattle with salt and/or protein supplements
- Provide off-stream water in troughs
- Install devices in streams to induce meandering and trap sediment
- Rest pastures with overused riparian areas
- Plant willows if not present

SEEING THE RESULTS

Together, these actions provide long-term benefits:

- More even forage use
- Better drought resistance
- Less erosion during floods
- Less disease in cattle
- Better weight gain

Overall, a higher stocking rate is likely.

SIDEBAR: Put Dugouts To Work

Thousands of check-dams and dugouts have been built along the streams in Alberta's grassland region. Each stores valuable runoff, but at a cost. The riparian area downstream is deprived of water, and the shrubs have often faded away.

However, considerable water often remains in these ponds at the end of the grazing season. This water has been lazing away the summer at the bottom of the pond, being unproductive.

Here is how you can get more value from the water:

What if, whenever the pond seemed to have more than enough water, a small quantity was pumped uphill from the pond, irrigating willows that had been planted there? Any water not used by the shrubs will drain back into the pond. If pumps are not available, a very small amount of water can be released over the dam to support the water table in the lower valley. I picture a garden hose, set up as a siphon over the dam. A post can hold the intake at a predetermined level, so the entire pond is not drained.

This stream is improving,
as shown by the many patches of new willows.

Stream Action Plan

GOAL
More cattle grazing on the pasture

LIMITATIONS
- few sources of water, often seasonal
- uneven distribution of cattle leaves considerable forage unused

existing water has marginal quality

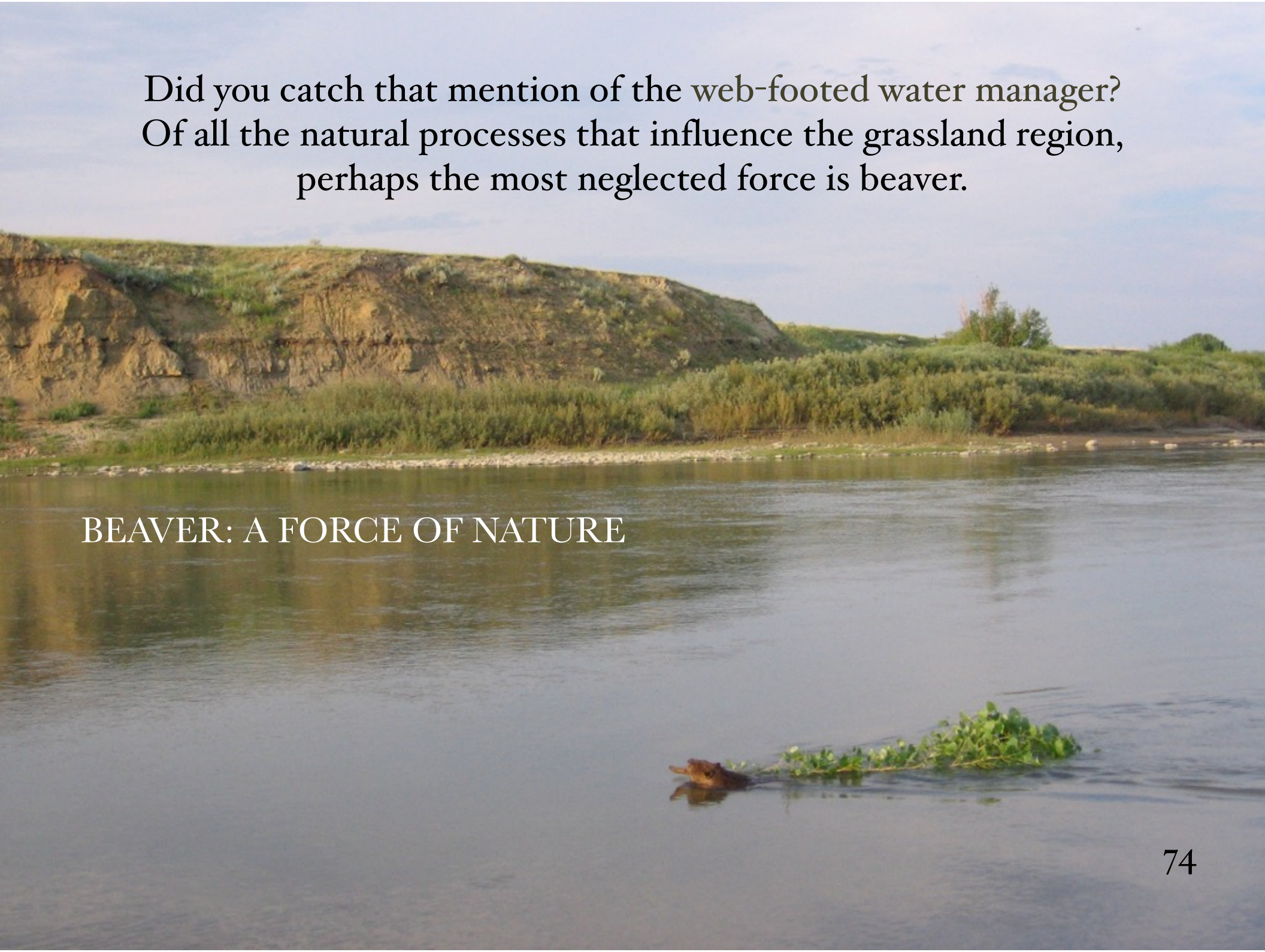
- overuse of small riparian area reduces water quality further

CHANGE IS POSSIBLE !

OPTIONS
- Train cattle to graze underused parts of pasture, using herding
- Lure cattle with salt and/or protein supplements
- Provide off-stream water in troughs
- Install devices in streams to induce meandering and trap sediment
- Rest pastures with overused riparian areas
- Plant willows if not present

RESULT
- Stream health improves
- Water has higher quality, and flows for longer time
- Both upland and riparian carrying capacity increase
- Beaver colonize the stream, conserving even more water

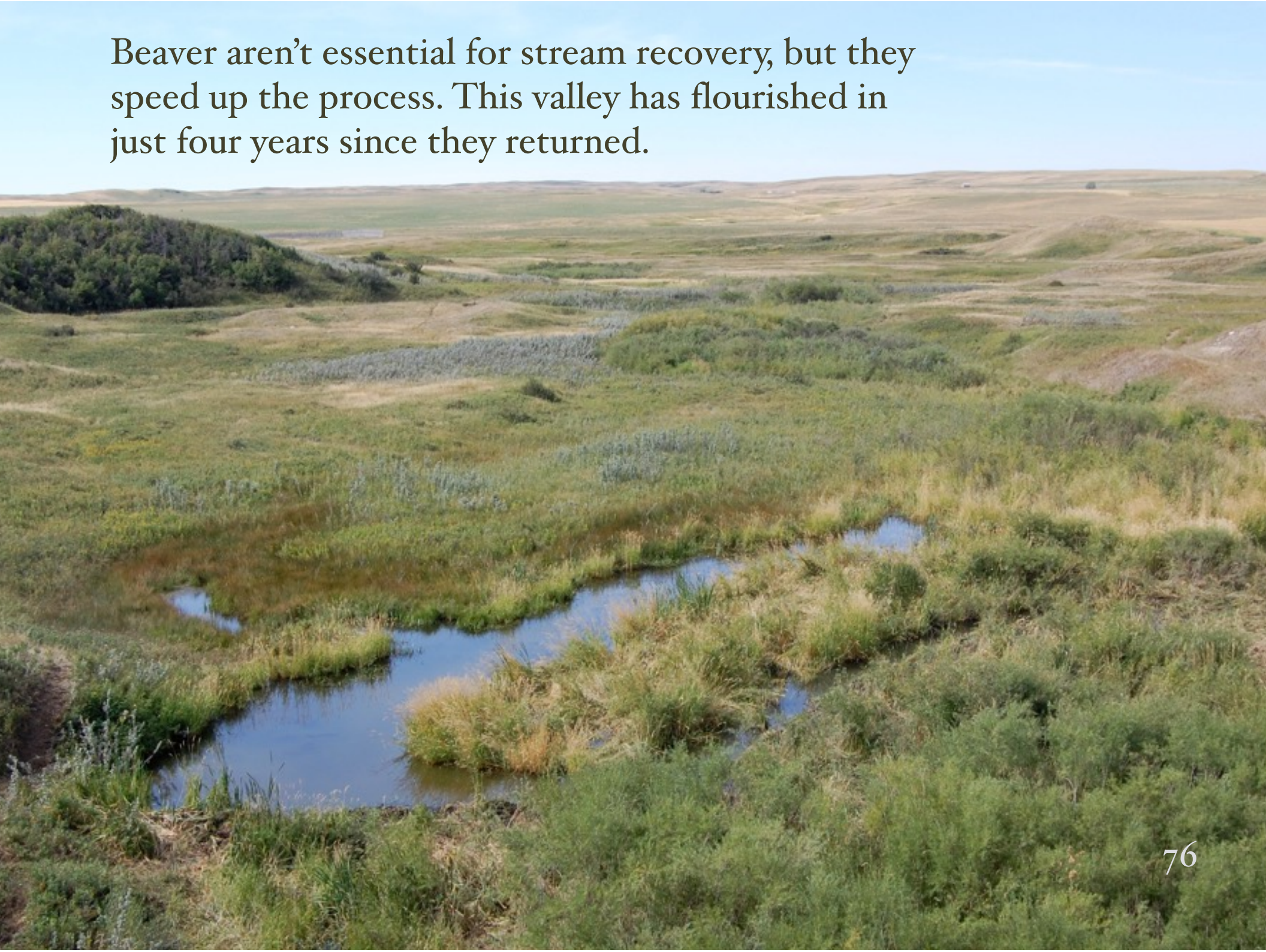
Did you catch that mention of the web-footed water manager? Of all the natural processes that influence the grassland region, perhaps the most neglected force is beaver.

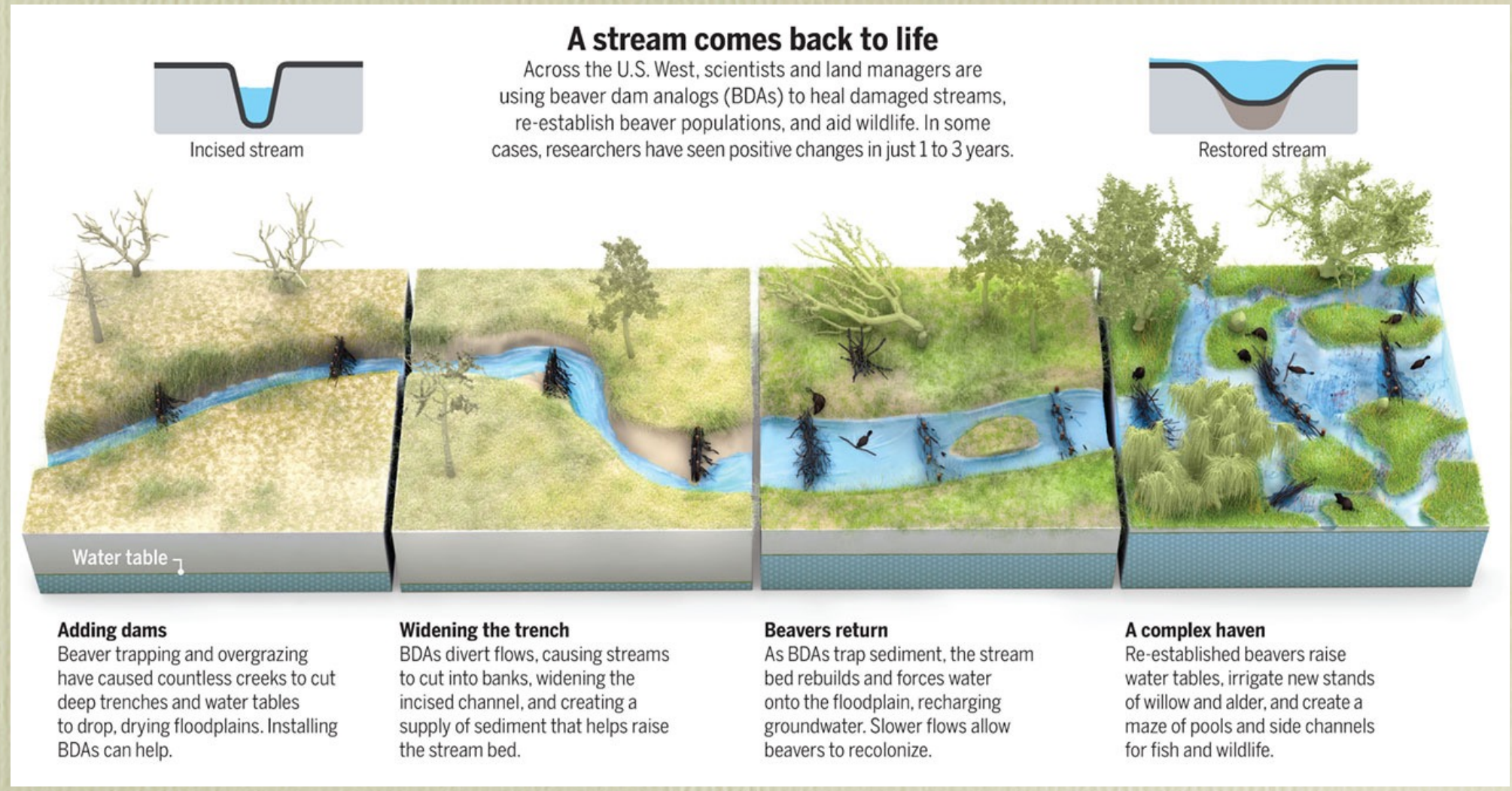


BEAVER: A FORCE OF NATURE

Much of what is commonly believed about beaver ecology comes from the boreal region. There, the impacts, both positive and negative, differ greatly from those found when beaver return to the grassland. Yes, beaver were once widespread across the driest areas of southern Canada. In later pages, we will learn to recognize the subtle but distinct signs of their habitation.

Beaver aren't essential for stream recovery, but they speed up the process. This valley has flourished in just four years since they returned.

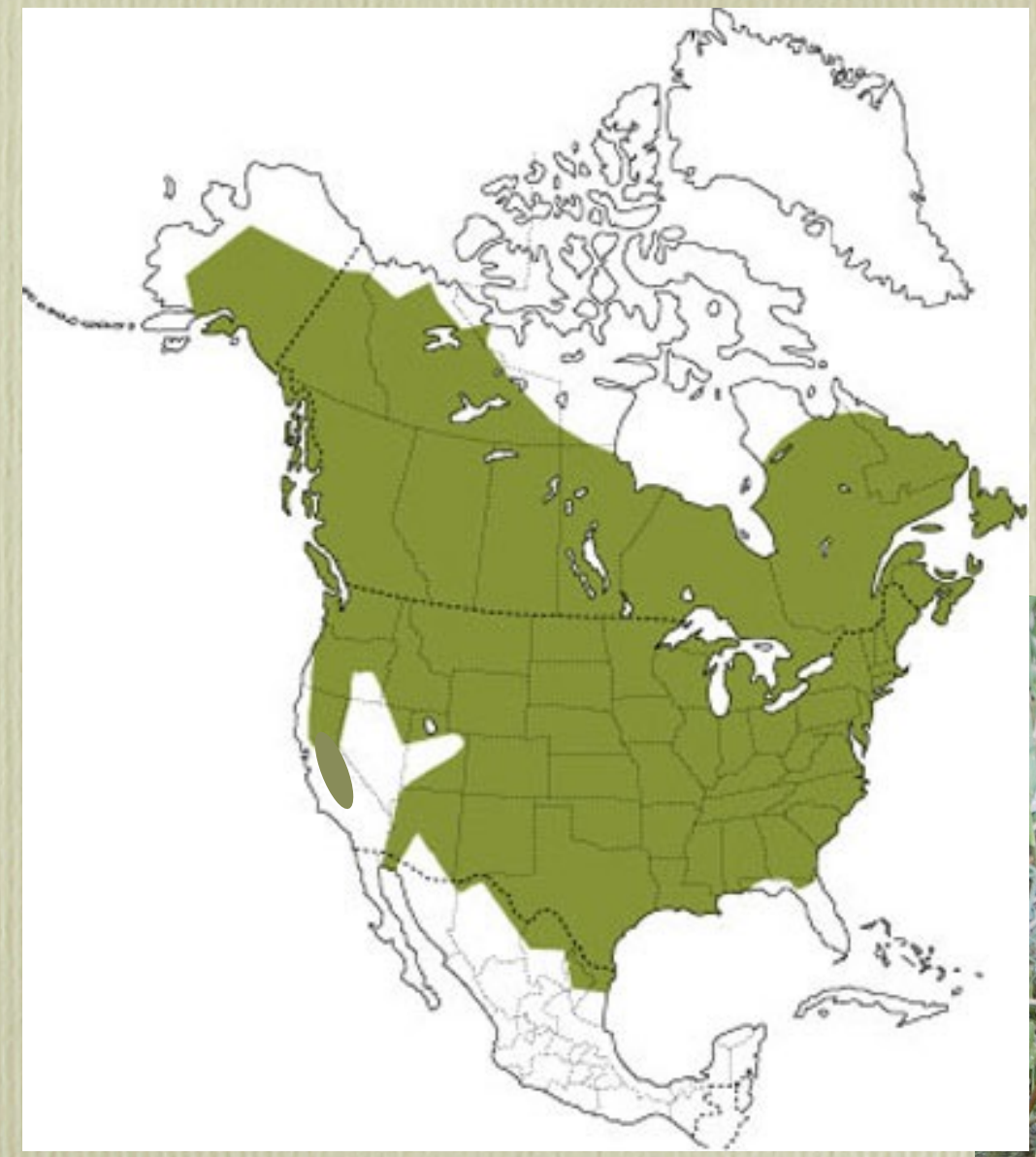




This graphic shows how artificial leaky dams (mentioned earlier) can help re-establish natural stream behaviour. They act like beaver dams, so may be called "Beaver Dam Analogues".

(Google it! BDAs are a real thing!)

Goldfarb 2018b



Historic Distribution of Beaver

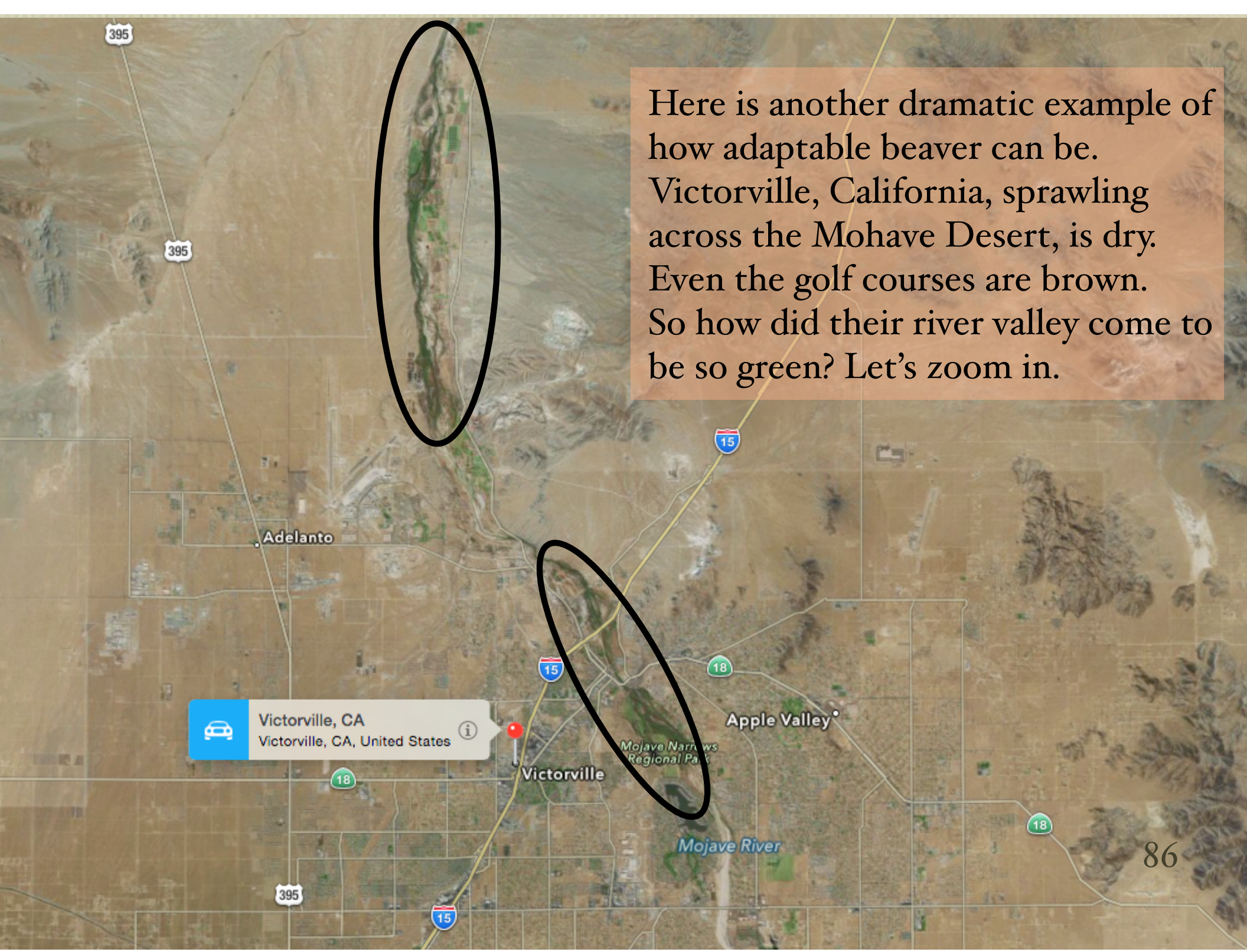
Beaver really did live in virtually every depression within this enormous area. Although aspen and willow are the mainstays of their diet, beaver easily manage eating a wide variety of aquatic plants. In particular, cattail roots provide substantial nutrition while the long leaves can be matted, with mud, to form dams and lodges. This adaptability enables them to survive in marginal sites as they disperse to more suitable places.

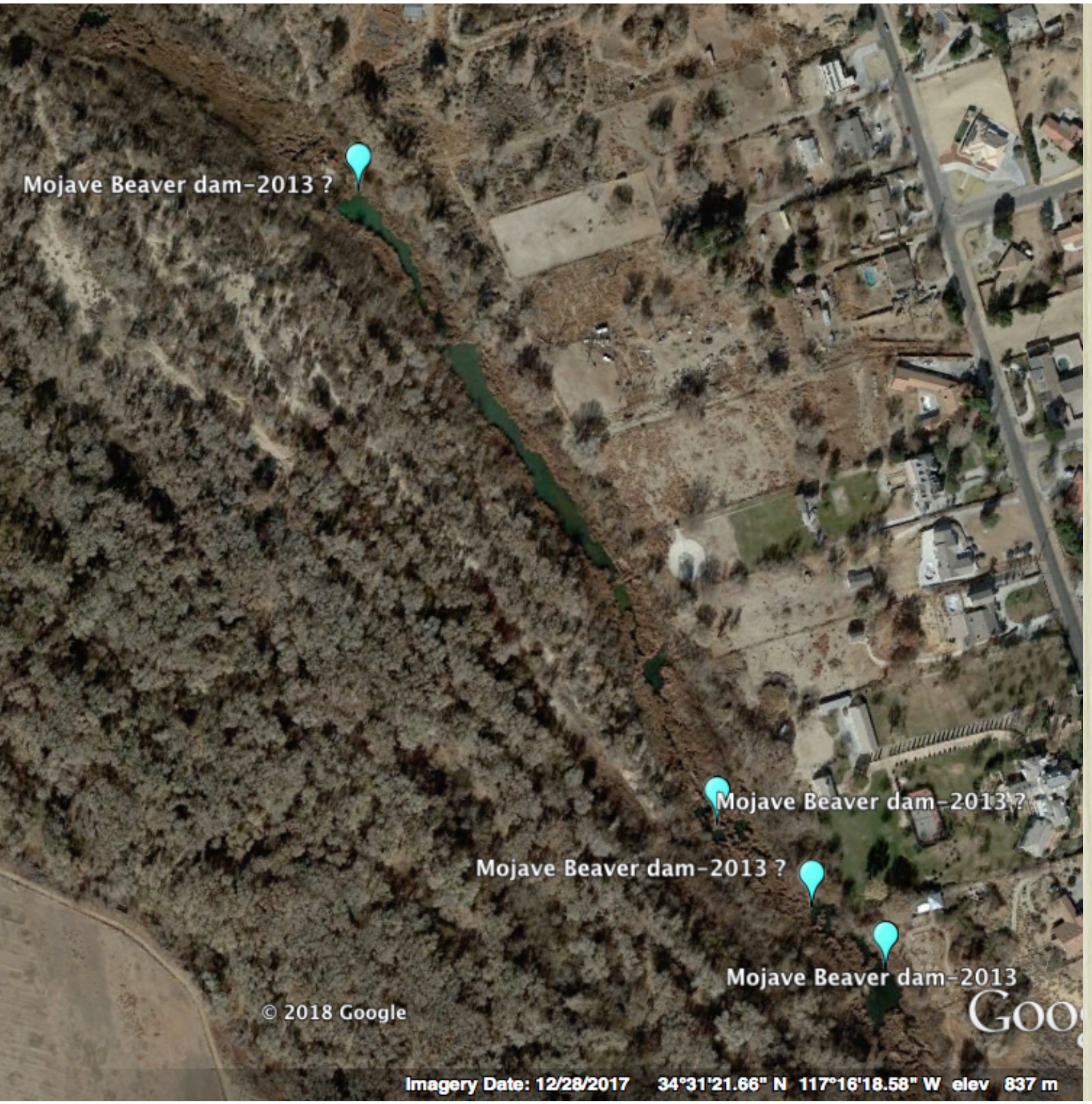
For example, this prairie is not most people's idea of beaver habitat.


But look at what the little guys have created!

At another site, the dams consist entirely of cattails.

Dams can be built from most available materials, including rocks, as in this example.


Here is another dramatic example of how adaptable beaver can be. Victorville, California, sprawling across the Mohave Desert, is dry. Even the golf courses are brown. So how did their river valley come to be so green? Let's zoom in.
395
395
15
Adelanto
15
18
Victorville, CA
Victorville, CA, United States
Apple Valley
Victorville
18
Mojave River
18
395
15



Their river hosts an extensive chain of beaver dams, with a broad, lush riparian forest.

The dates show how the dams come and go over the years. Several unmarked ponds can be seen in the centre of the photo.

Thanks to Jean Thie for finding these surprising locations.

SIDE BAR: USING AIR PHOTOS

Google Earth and other sources of air photos can be very useful for identifying existing beaver dams and suitable habitat. Watch for black water bodies with a sharp line across the downstream end. The other (upstream) end gradually fades into vegetation.

A caution: the steep banks of down-cut streams can cast dark shadows that look very much like narrow ponds.

Alberta Agriculture and Forestry Canada Alberta Soil Information Viewer

Alberta Soil Information Viewer provides aerial photos of the entire prairie region of Canada. In Alberta, the legal survey boundaries (Section, Township and Range) are also shown, which makes locating your land quite easy.

The photo database is not exactly the same as Google Earth, so check it for different info.

https://soil.agric.gov.ab.ca/agrasidviewer/

Evans 2015

Susie Creek, a 250 sq km watershed in north-east Nevada, illustrates what is considered extreme beaver habitat. With encouragement, over some twenty years, beaver dams increased from 0 to 139, as plant growth increased 32%.

SIDE BAR:

SIGNS OF ANCIENT BEAVER

The Place: Ellesmere Island, Lat. 78 N
The Time: Mid-Pliocene, 4-5 million years ago
The Event: A small ancient beaver called Diploides chewed down small trees and piled the sticks, creating the earliest documented beaver dam.

Mitchell et al 2016

At this time, Ellesmere Island had a forest of larch, birch and willow, as well as typical smaller boreal plants. Overall, the plants indicate a minimum temperature of about -15 C. However, the day length would be the same as now: no sunshine at all for three winter months. (timeanddate.com)

One cluster of sticks lies mainly horizontal, a possible dam, while another group poked vertically into the mud has been interpreted as a food cache.
The storing of winter food indicates an alternative to hibernation for surviving the long dark winter. Squirrels and some mice also do this.

Close-up of a 4 MILLION-year-old stick in the previous photo, clearly showing bite marks of a beaver.

Role of Beaver In Improving Stream Health

Although beaver can colonize degraded sites, they more commonly live in streams that have a basic level of health. By health, we mean a good density of shrubs growing along the banks. (Snowberry, wolf willow, and rose don't count! They taste lousy, so I hear, and they don't have soil-binding root systems.) When willows begin to return, beaver won't be far behind.

Beaver and ranchers both have the same goal: to save more water to grow more vegetation. Beaver are willing to do all the work, and give the cattle all the grass. The beaver just wants a little space, and some of the shrubs.

Beaver are already in your neighbourhood. All major rivers and most streams throughout their historic range now have resident populations. They will find your stream, and if they are left alone, it will soon begin to blossom.

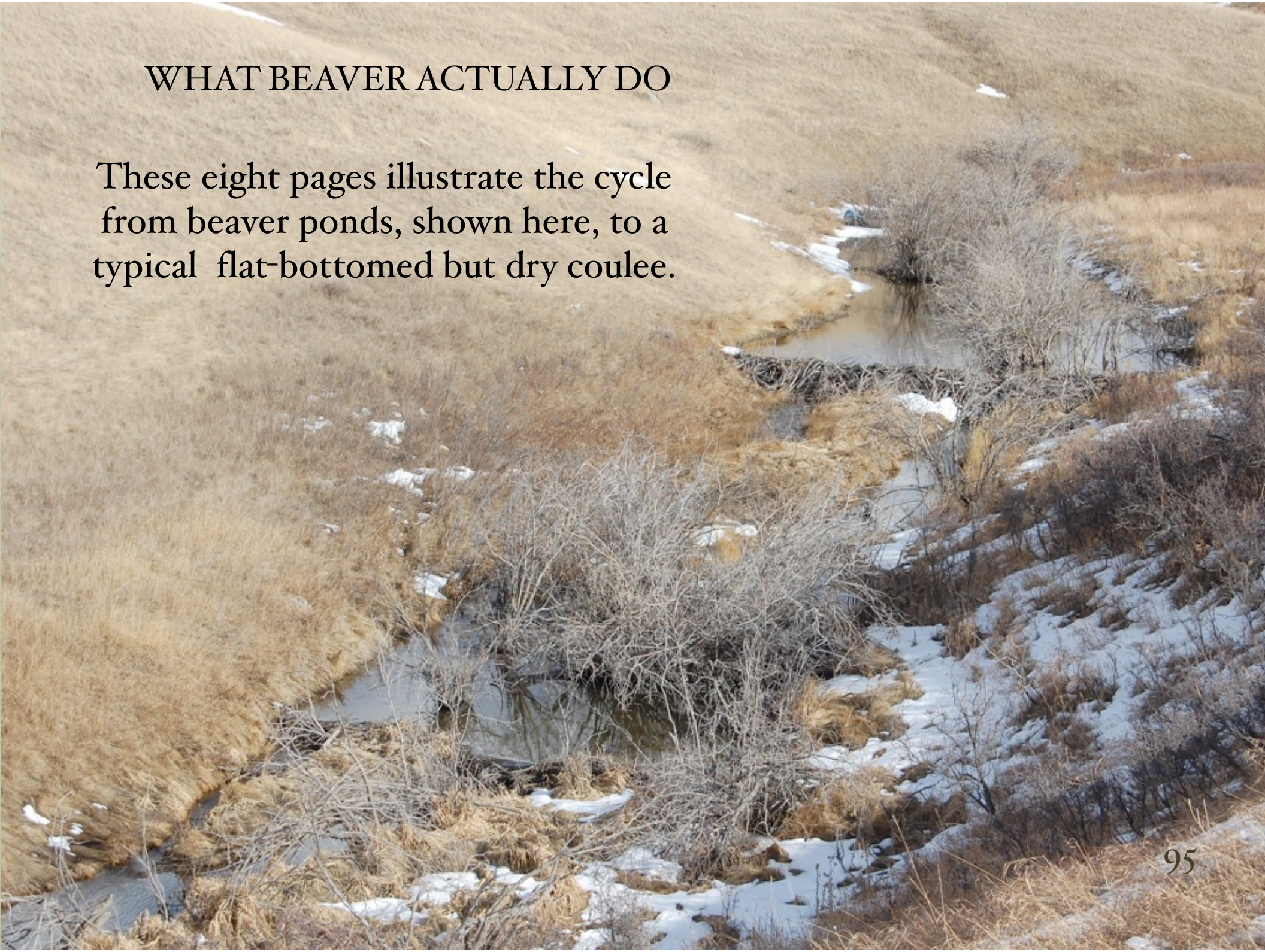
Changing Times

Change can be scary, especially if it is sudden and appears unpredictable. Fires, floods, and droughts all impact the prairie landscape. Land managers have done their best to reduce these changes, to make their operation, and their profits, more dependable. Consider, though, that without disturbance, our landscape will slide into a rut. A few species flourish, while many less prominent types decline.

No doubt about it: beaver are a strong disturbance on the landscape. Sometimes, change is a good thing. Typically, each site goes through a cycle of predictable steps. Sites with a broader floodplain and a moister climate will accommodate beaver more easily, and take longer for each stage. On a watershed scale, beaver create a patchy landscape with a variety of habitats.

WHAT BEAVER ACTUALLY DO

These eight pages illustrate the cycle from beaver ponds, shown here, to a typical flat-bottomed but dry coulee.



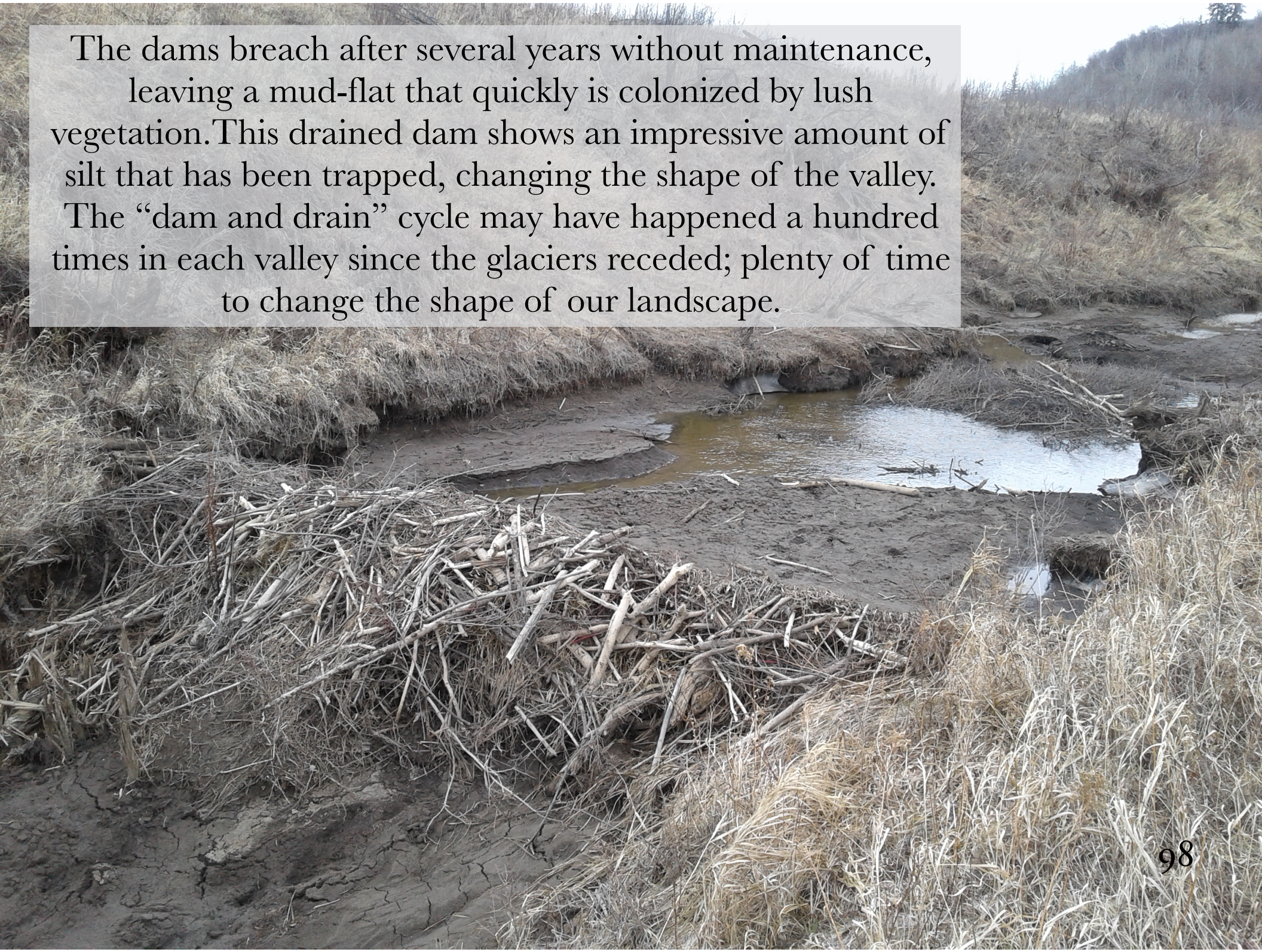
- Beaver settle at a site, chewing off shrubs and some trees to make a dam and lodge. In this case, an ancient willow is renewed yet again with fresh cutting.

- The stable water level encourages growth of shrubs and grass.

- As the dam gets taller, water is pushed onto the flood plain, greatly increasing the area of riparian vegetation.

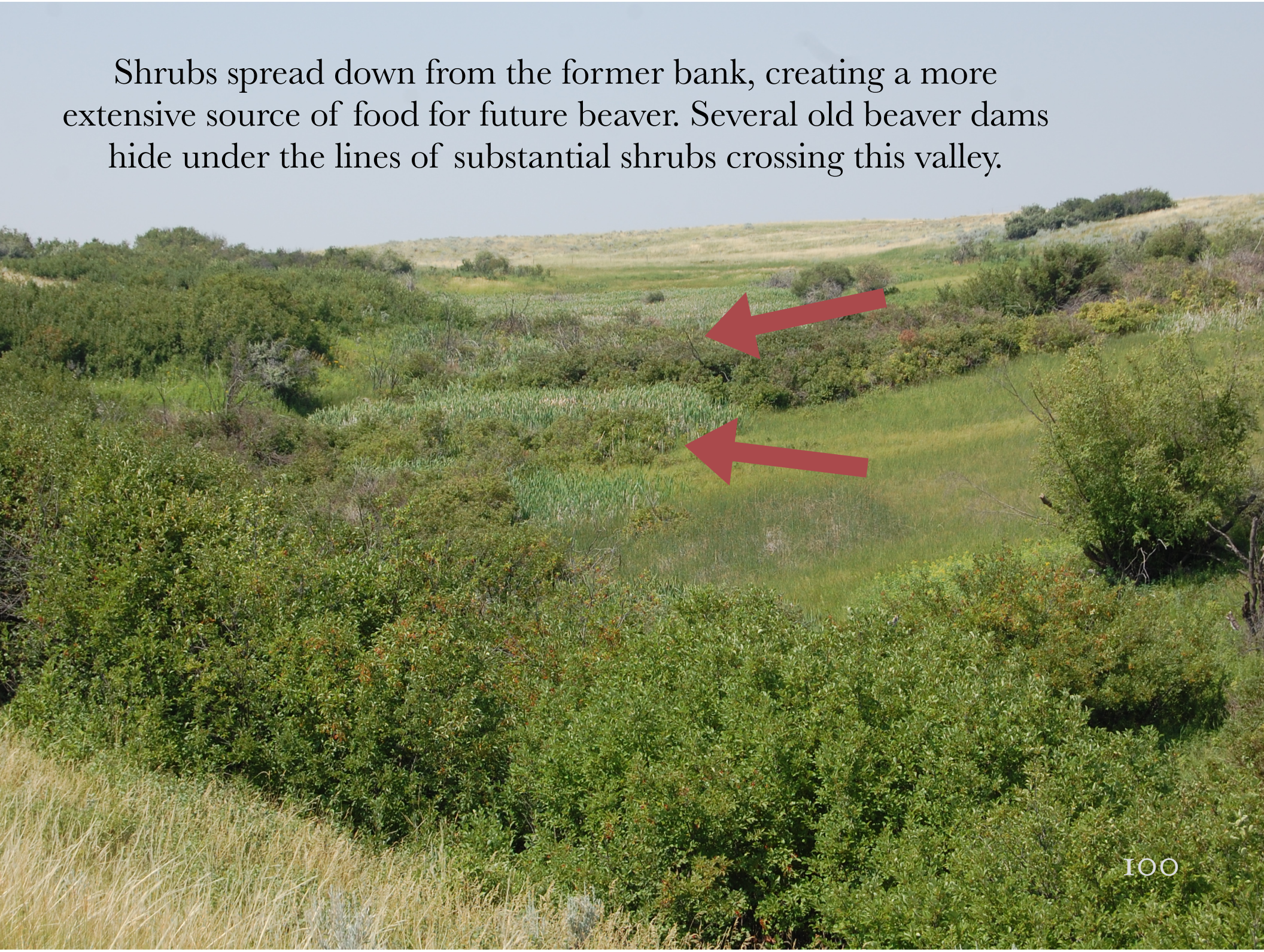
- Dams leak at the ends, eroding the valley wall which leads to localized slumping that further widens the valley.

- Ponds gradually silt up, and with little predation, beaver numbers outstrip the food supply. Together, these can force the beaver to move away.

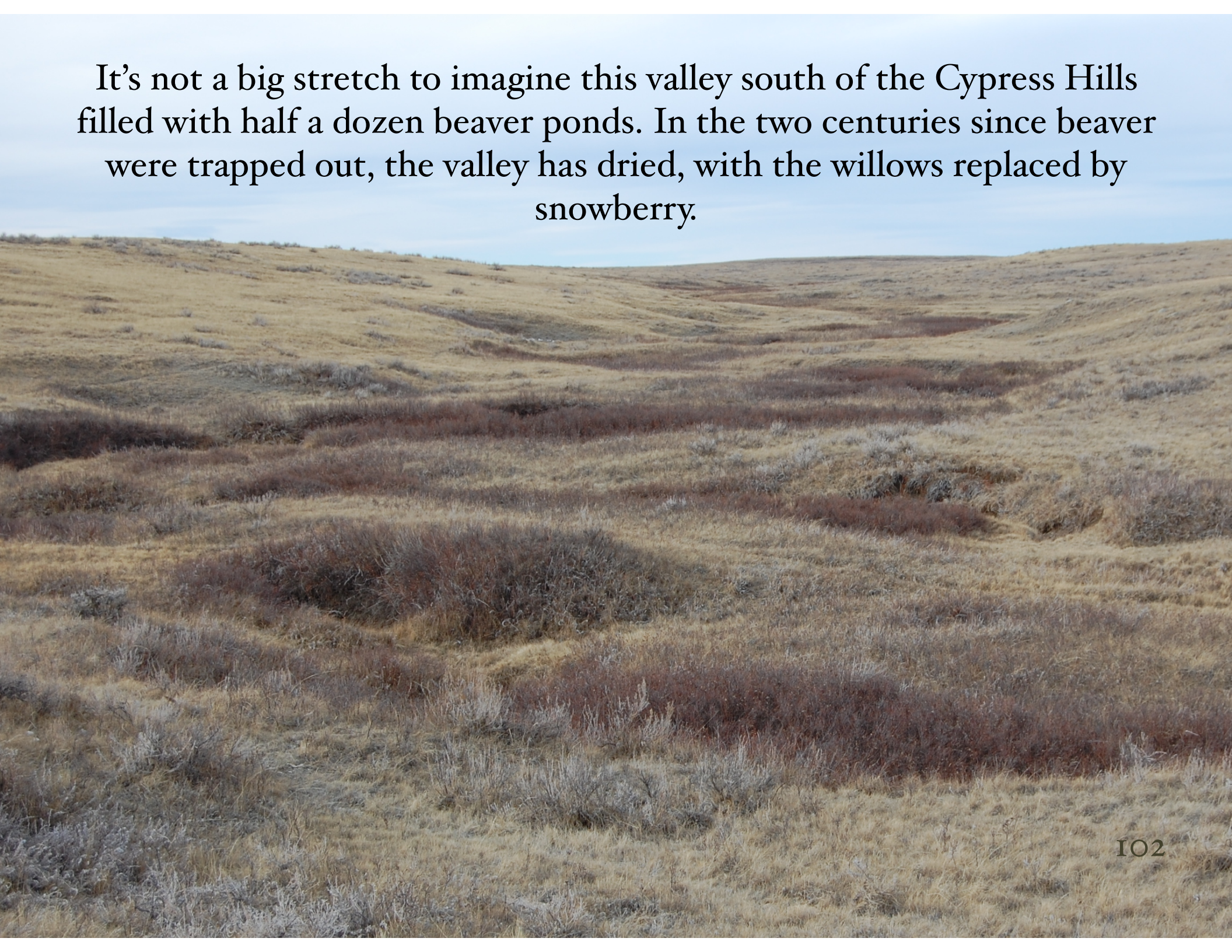


The dams breach after several years without maintenance, leaving a mud-flat that quickly is colonized by lush vegetation.This drained dam shows an impressive amount of silt that has been trapped, changing the shape of the valley. The “dam and drain” cycle may have happened a hundred times in each valley since the glaciers receded; plenty of time to change the shape of our landscape.

This beaver dam was drained 5 - 10 years ago,
and the stream now shows early stages of downcutting.


Shrubs spread down from the former bank, creating a more extensive source of food for future beaver. Several old beaver dams hide under the lines of substantial shrubs crossing this valley.
100

- In a few years, beaver return to the site. The cycle begins again, but from a more fertile and productive starting point.
- This upward spiral leads to flat valley bottoms covered with willows and ponds. Streams often run year-round.



It's not a big stretch to imagine this valley south of the Cypress Hills filled with half a dozen beaver ponds. In the two centuries since beaver were trapped out, the valley has dried, with the willows replaced by snowberry.

In summary, beaver save water and disrupt the ground surface with dams and canals. They start a process which leads to a richer, more diverse, landscape. Plants and animals become more abundant, both in species and overall numbers. The ecosystem demonstrates much greater resilience to both drought and flood.

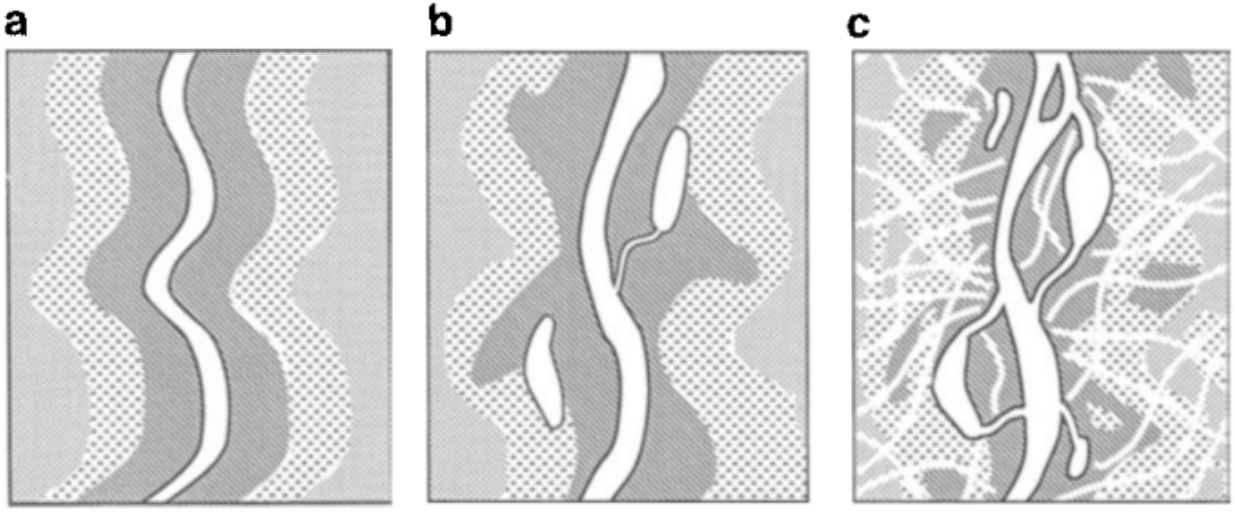


Figure 2. Human modifications have fundamental impacts on the vegetative patch structure of river corridors. When channel processes are constrained by management, the vegetation mosaic becomes a simple linear zone (a). Under the influence of natural hydrology and channel processes, the heterogeneity is improved (b), but only with the feeding and movements of large animals is the patch heterogeneity optimized for riparian vegetation. Vegetative patches are smaller, more numerous, and more spatially dispersed under the influence of animals (c).

Naiman & Rogers 1997

This stream in Saskatchewan's Cypress Hills illustrates the process described by Naiman and Rogers. A narrow stream has been converted into a broad band of willows and wetlands. Several dozen beaver ponds can be seen.

The beaver's important ecological role leads to it being called a keystone species, playing a major role in holding the aquatic ecosystem together.

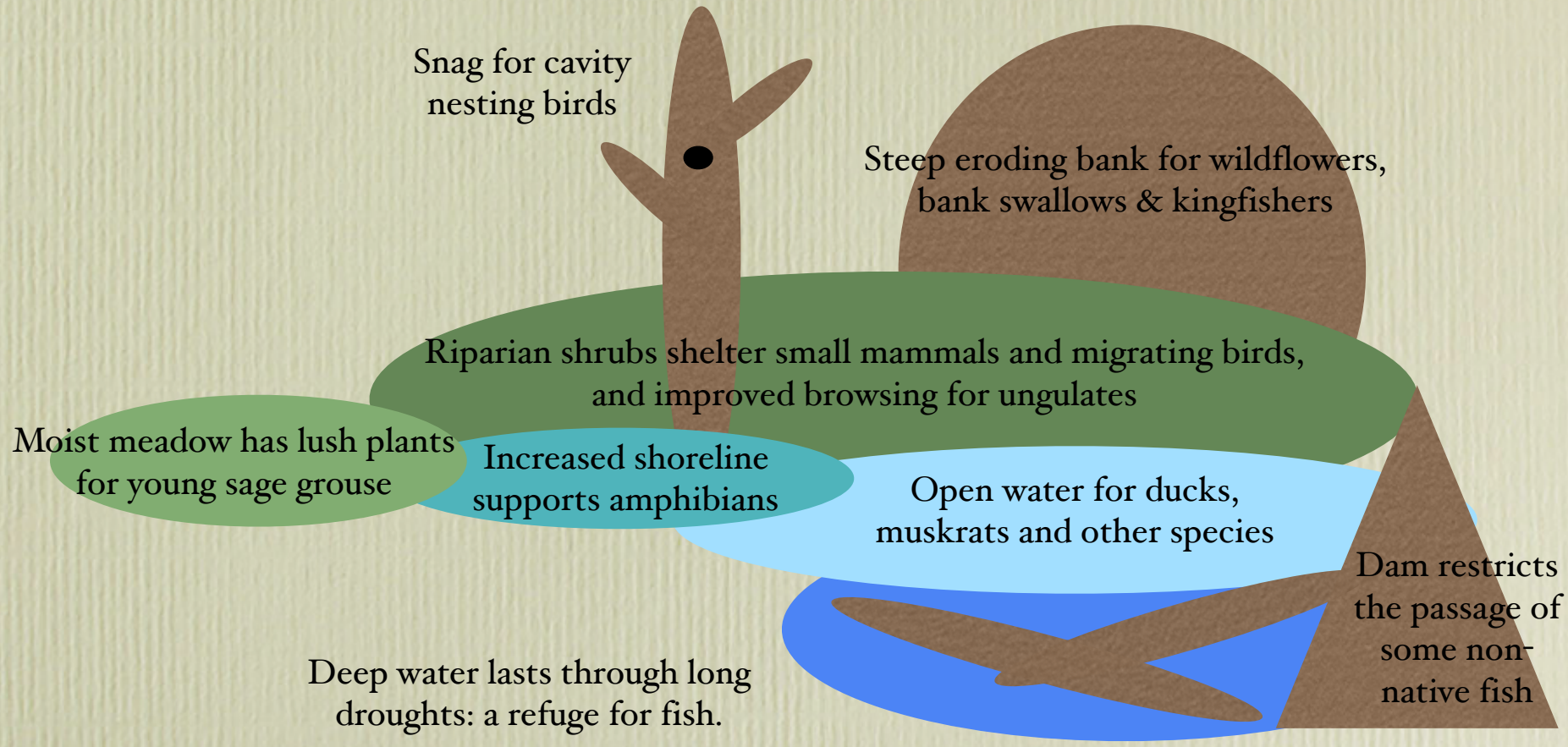
Because the beaver creates its own habitat,
it is also known as an ecosystem engineer.

"Ecosystem engineer" might be an unfamiliar term. Here are a couple of examples of how beaver change habitat to the benefit of other species:

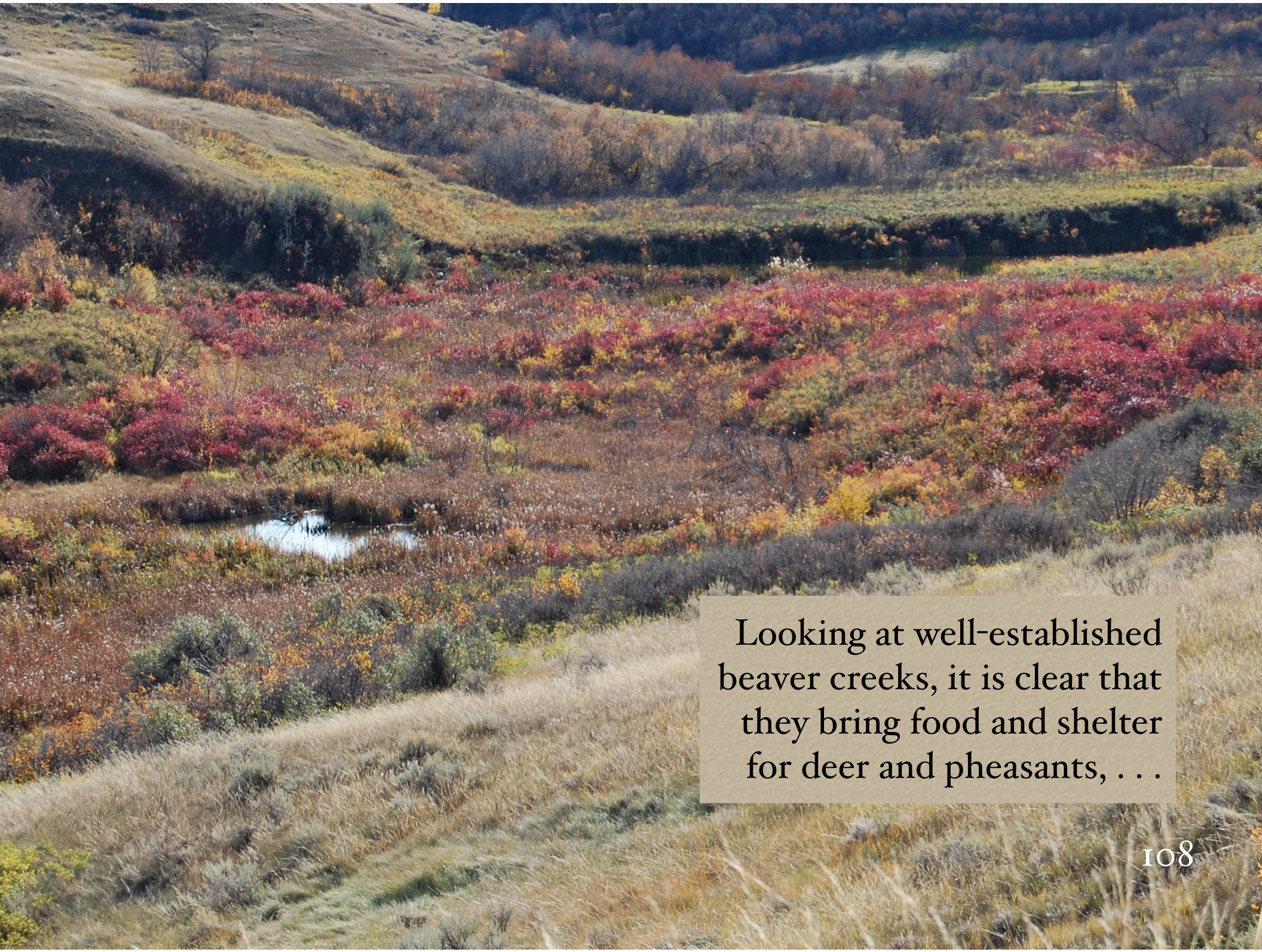
When the typical pond is created, trees may be drowned, leading to nesting sites for tree swallows and cavity nesting ducks.
The canals leading from the pond are prime sites for several types of frogs.
The high eroding banks host rough-winged swallow and kingfisher nests.

Mark Schiebelbein

BEAVER AS ECOSYSTEM ENGINEER



This graphic summarizes the valuable specialized habitats that beavers create through their daily activities.



Looking at well-established beaver creeks, it is clear that they bring food and shelter for deer and pheasants, . . .

migrating warblers and sparrows,
and several kinds of amphibians.


The smallish Long-eared Owl prefers shrubby areas along streams for nesting.
©Mark Schiebelbein

Perhaps surprisingly, the lush meadows of abandoned beaver ponds are valuable habitat for greater sage-grouse chicks. Silver sagebrush, their primary winter food, is a riparian species that benefits from the high water table induced by beaver dams.

Utah Public Radio 2017

In some jurisdictions, beaver are restored specifically to support greater sage-grouse.

Sage Grouse Initiative

This American government-led program encourages pro-active measures by ranchers to prevent the decline of Greater Sage-Grouse.

Natural Resources Conservation Service 2019

This website provides great tips, photos and videos of low-tech but innovative projects that bring streams back to a healthy state. Totally voluntary, it keeps the ranchers in the decision-making role.

EXTENDED "FAMILY" OF THE BEAVER

Birds
Greater Sage-Grouse
Long-eared Owl
Rough-winged Swallow
Bank Swallow
Tree Swallow
Belted Kingfisher
Eastern Kingbird
Yellowthroat
Migrating songbirds

Mammals
Muskrat
Mink
Bobcat
Long-tailed Weasel
Porcupine

Fish
Western Silvery-sided Minnow

Herptiles
Leopard Frog
Tiger Salamander
Garter Snake
Bull Snake

Plants
Sandbar Willow
Manitoba Maple
Burr-Reed
Speedwell
Evening-Star

Dan Schiebelbein

SIDEBAR: ABORIGINAL AGRICULTURE

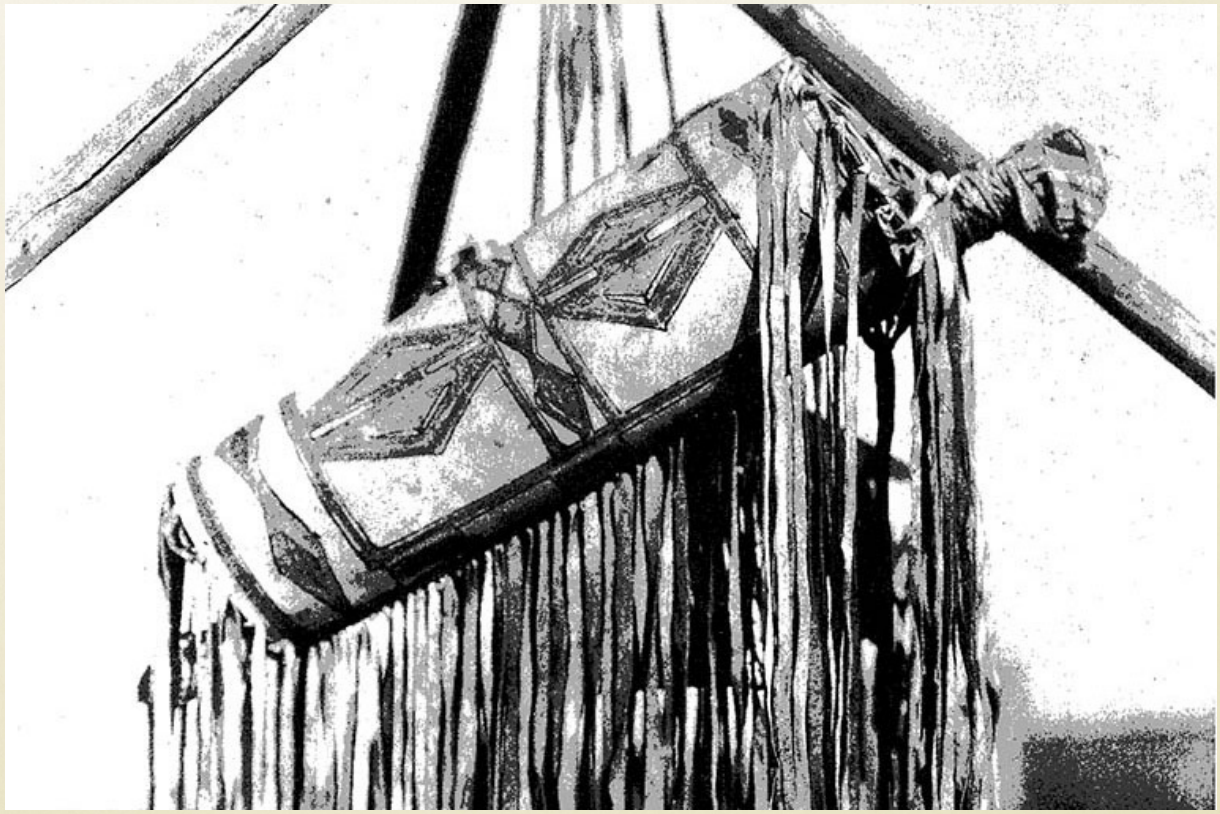
Tobacco Ceremony (Glenbow Archives)

The Blackfoot people recognized beaver flats as excellent places to grow crops. They planted tobacco in the spring, confident that the high water table and sheltered valley would nurture the sacred plants without further assistance from people.

In Chandler (2016), Eldon Yellowhorn of the Piikani people states that "the ecology of the beaver was a perfect match for the ecology of the tobacco".

"Each spring, the Beaver medicine bundle was opened. Everything that was needed for growing tobacco was kept in a bundle that was opened in the spring, including not only seeds and tools for planting and sticks to help keep count of the growing season but also plants for smudging, paints and rattles for the ceremonies, and animal and bird skins as memory aids for some 400 accompanying songs."
(Eldon Yellowhorn, quoted in Reder 2012)

The First Nations of the Great Plains valued beaver for their important role of conserving water, and were reluctant to trap them.

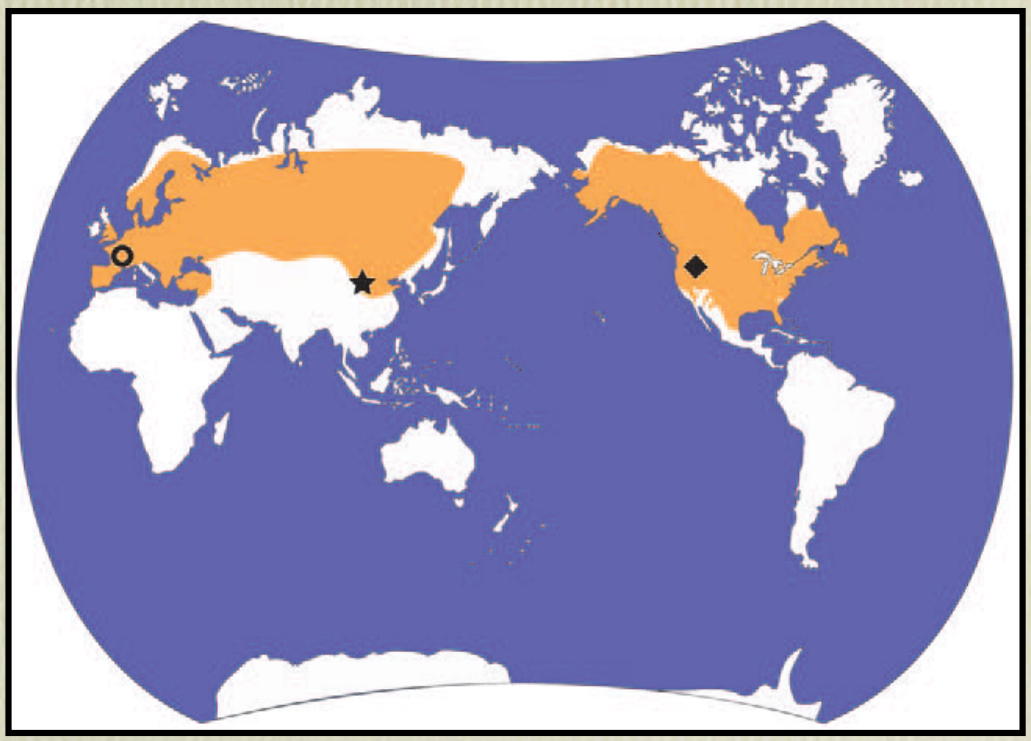


Early Tobacco Bundle
(Glenbow Archives)

HOW CAN BEAVER CREATE HABITAT BY CHEWING IT DOWN?

Early beaver fossils, dating back to 24 million years ago, have been found in Canada's high arctic by Dr. Natalia Rybczynski, of the Canadian Museum of Nature (Rybczynski, 2007).

Over this enormous length of time, beaver and their "prey", stream-side vegetation, seem to have developed a symbiotic relationship. Beaver provide a dependable source of water that allows shrubs to grow many fresh shoots each year to feed beaver and other animals.



Maximum distribution of Eurasian Beaver (*Castor fiber*) and American Beaver (*Castor canadensis*), Rybczynski et al. 2010

This relationship became clearer when American Beaver were introduced to Tierra del Fuego, which has a similar climate to typical beaver habitat in Canada.

"Many tree species in the northern hemisphere regenerate well when cut. We humans have utilised this feat by repeatedly coppicing trees to obtain timber. It is possible that the regenerative properties of northern temperate trees are adaptations to foraging by beavers and other large herbivores and this is why beavers are considered ecologically beneficial (or at least benign) in their native range where trees recover from felling. However, outside their native range, introducing the North American beaver to Tierra del Fuego on the southern tip of South America had disastrous consequences for the local ecosystem partly because many tree species there are unable to regenerate when felled."
(University of Oxford, 2013)

Beaver damage on Navarino Island, Chile. (Cadwell, 2005)

A further example of how beaver and willow are closely linked involves castoreum, the excretion used to mark a beaver's territory. Willow bark contains salisylic acid, a form of aspirin (Wikipedia, Castoreum). Beaver concentrate this chemical, which becomes the main constituent in castoreum. I wonder, "Does this process remove the chemical before it intoxicates the beaver?"


So, once beaver get established, they will create their own habitat, as well as better grazing.

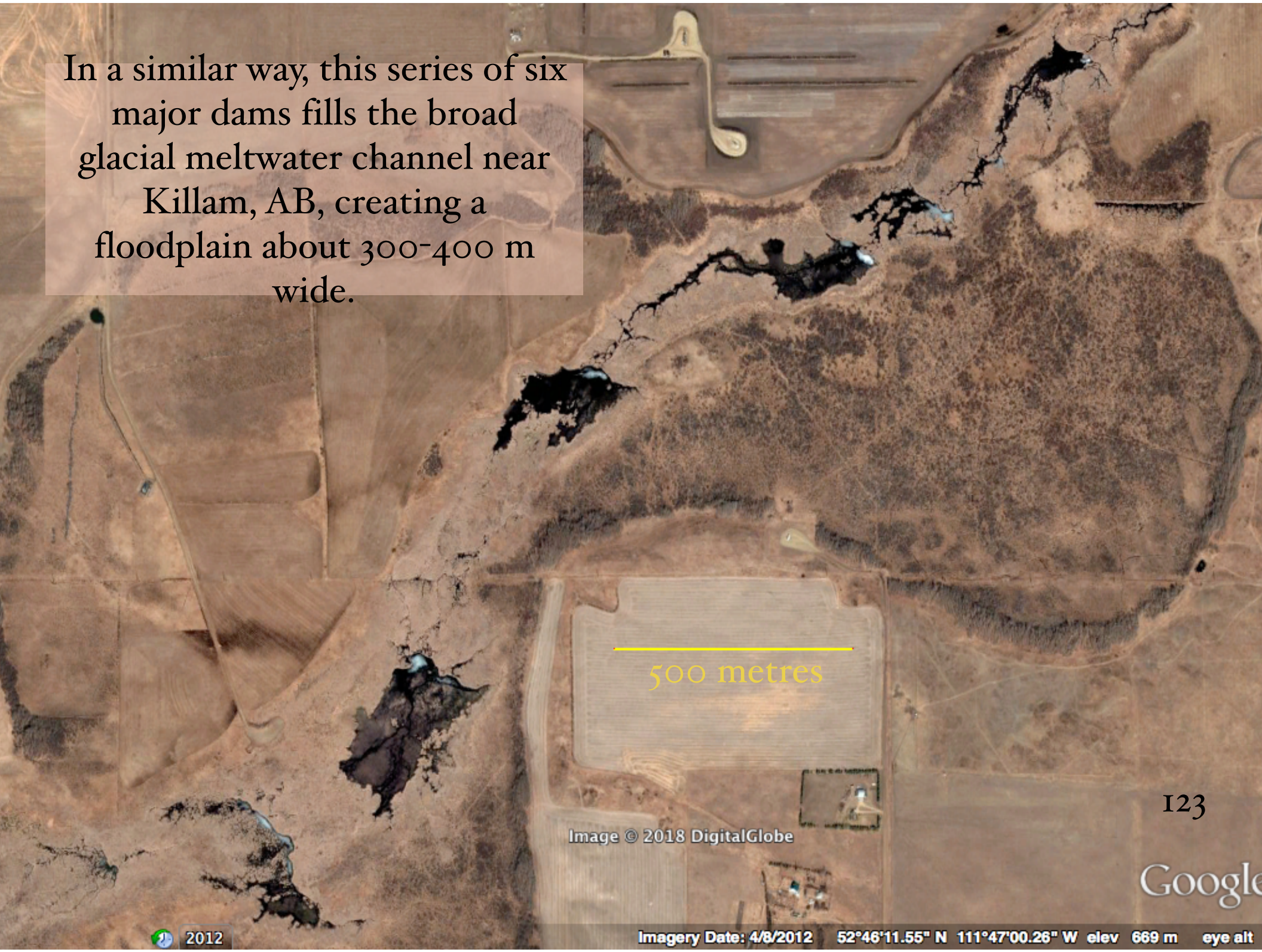
This mature beaver dam complex fills a valley in southern British Columbia.

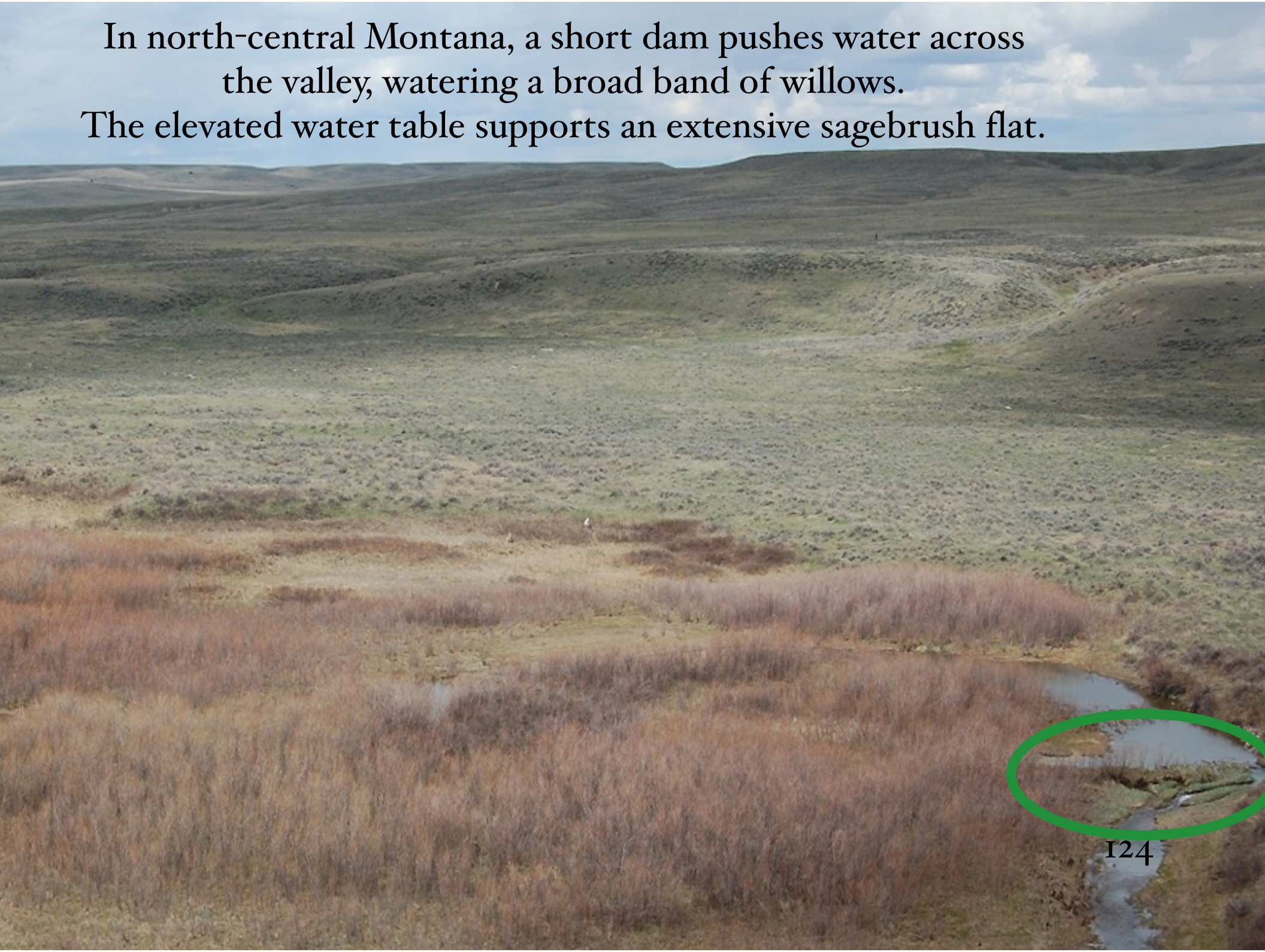
Dividing a watercourse into several small streams can enable each to be dammed.

Water is dispersed across the floodplain, letting the water soak into the ground.

Floods are reduced, while droughts are mitigated.

The same valley, showing the extensive water storage and profusion of willows.


In a similar way, this series of six major dams fills the broad glacial meltwater channel near Killam, AB, creating a floodplain about 300-400 m wide.
500 metres
Image © 2018 DigitalGlobe
Google
2012
Imagery Date: 4/8/2012 52°46'11.55" N 111°47'00.26" W elev 669 m eye alt

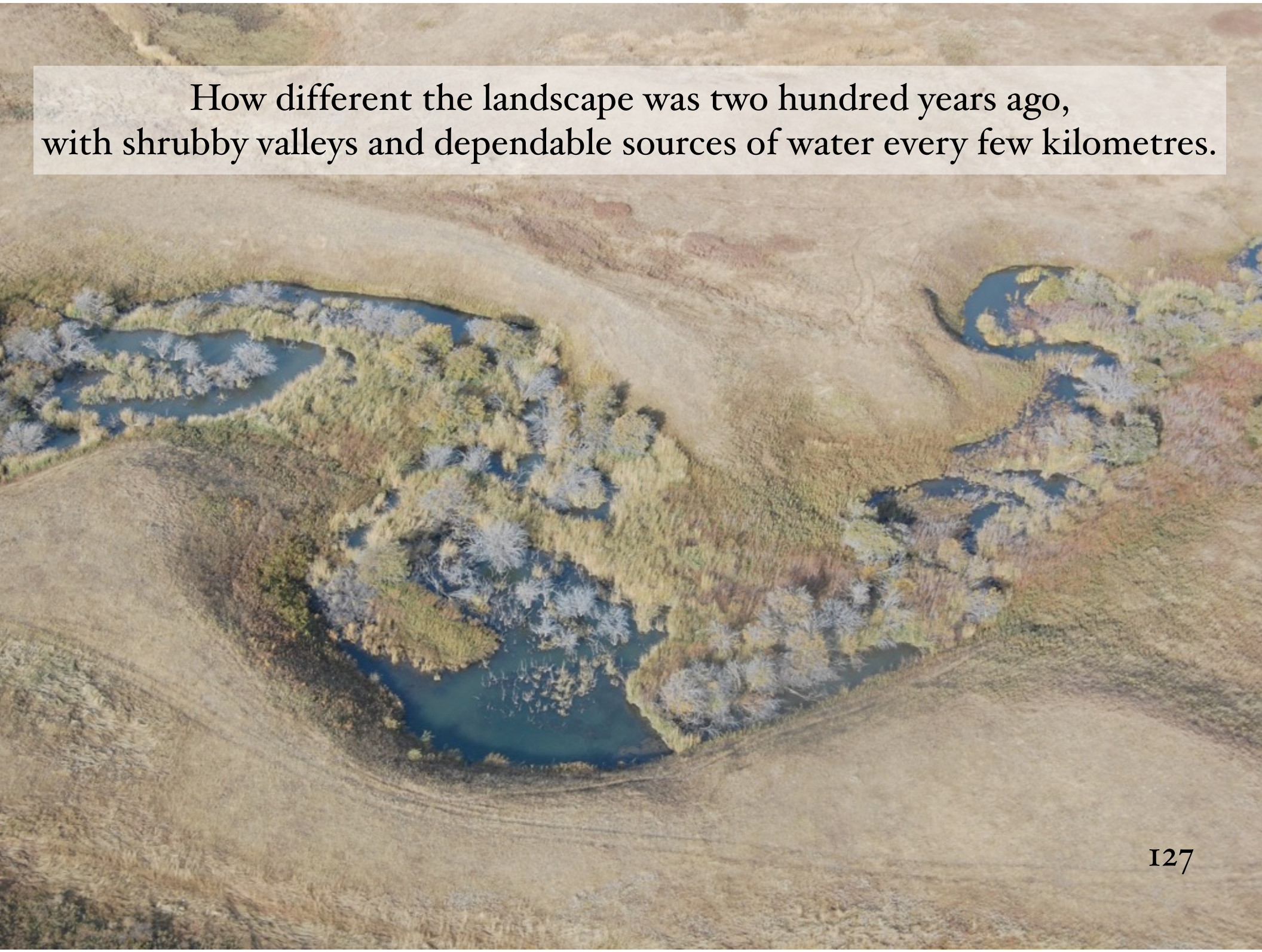


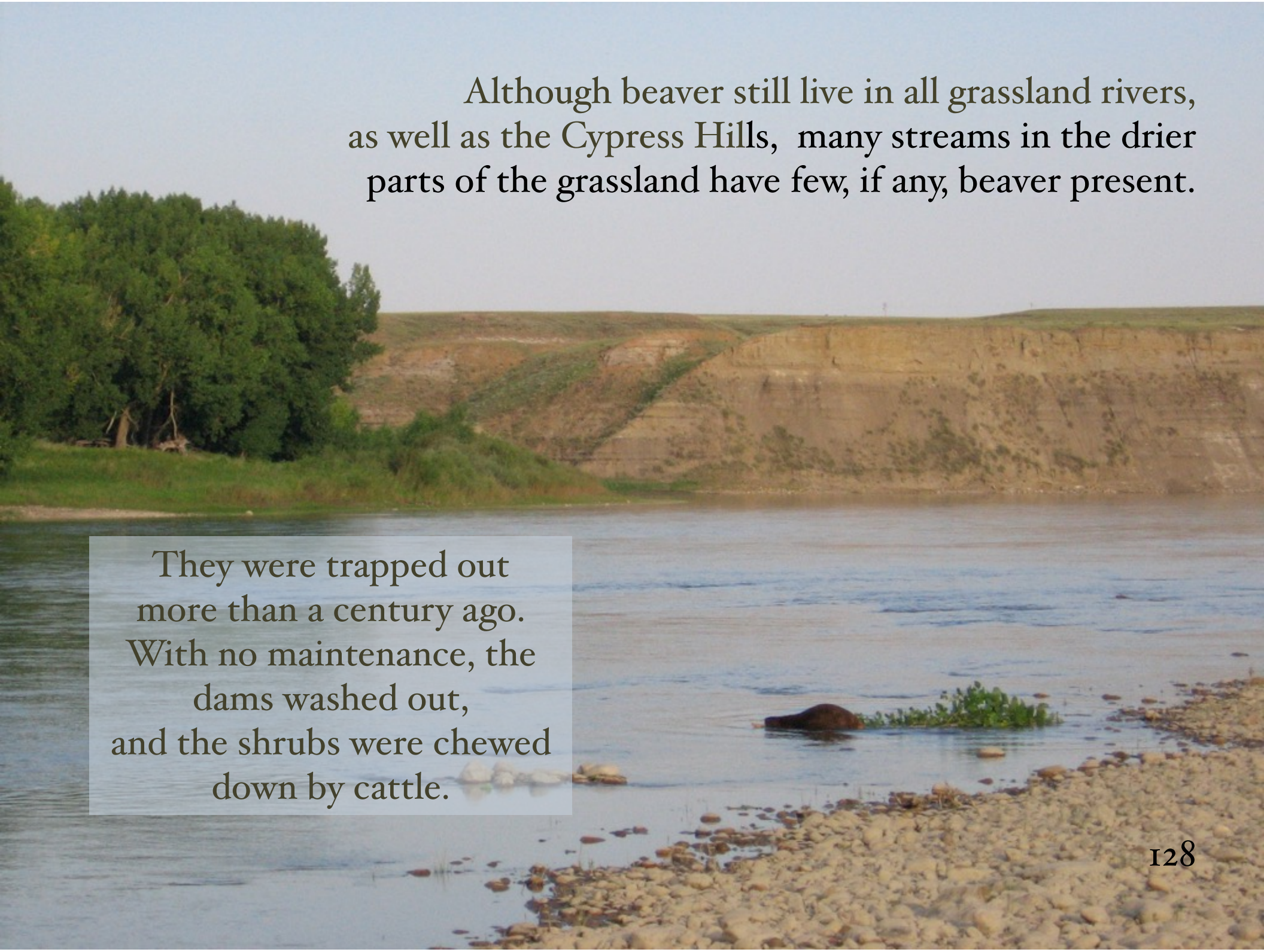
In north-central Montana, a short dam pushes water across the valley, watering a broad band of willows. The elevated water table supports an extensive sagebrush flat.

Looking downstream from the same point, the only trees for miles appreciate the steady flow of water from the chain of beaver dams. However, being below the last dam, this area's water table is lower and the sagebrush is suffering.

Beaver were once found in virtually every gully and pond across the prairies.

How different the landscape was two hundred years ago,
with shrubby valleys and dependable sources of water every few kilometres.





Although beaver still live in all grassland rivers, as well as the Cypress Hills, many streams in the drier parts of the grassland have few, if any, beaver present.

They were trapped out more than a century ago. With no maintenance, the dams washed out, and the shrubs were chewed down by cattle.

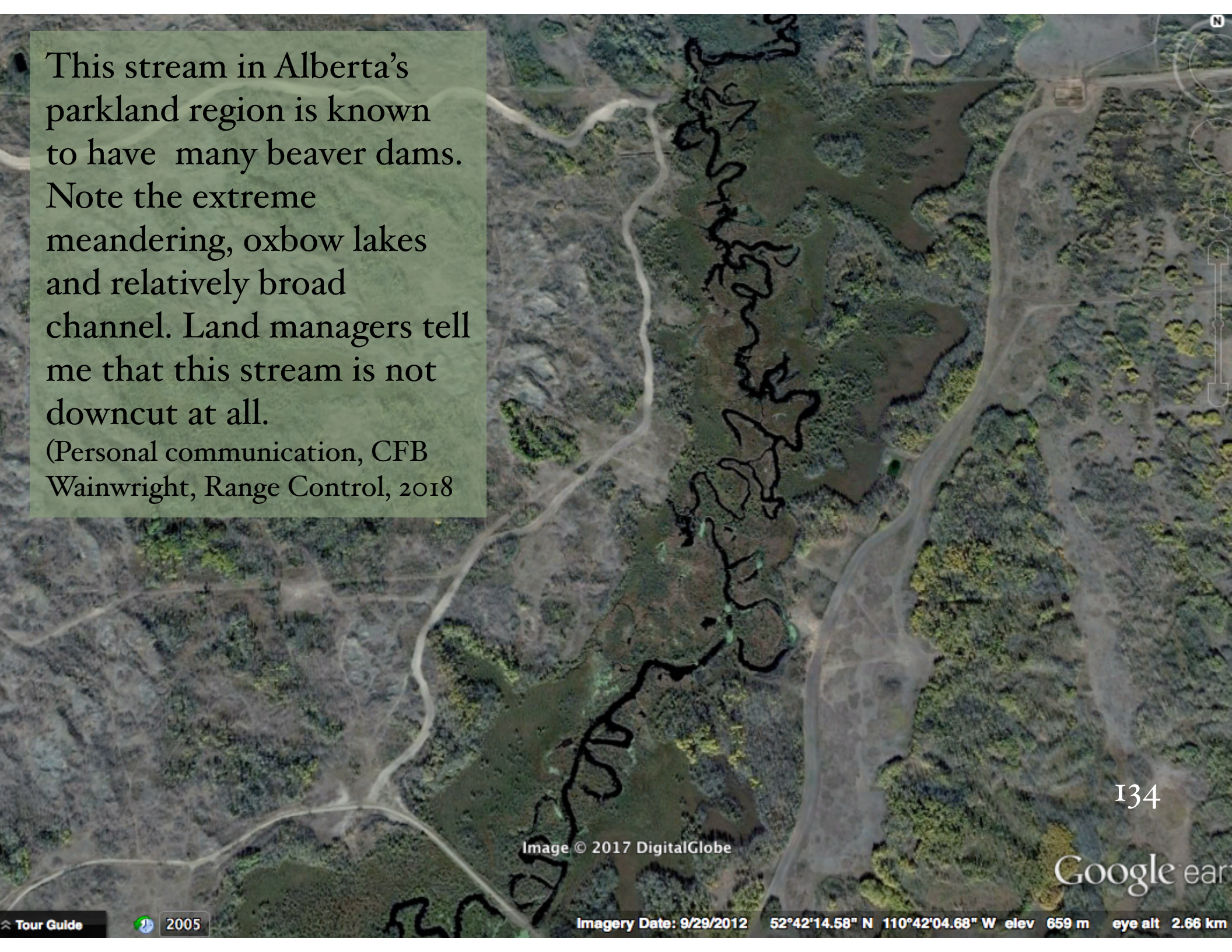

Evidence of their work still persists
if we look carefully.
Old willows and remnants of dams
show where beaver once lived.

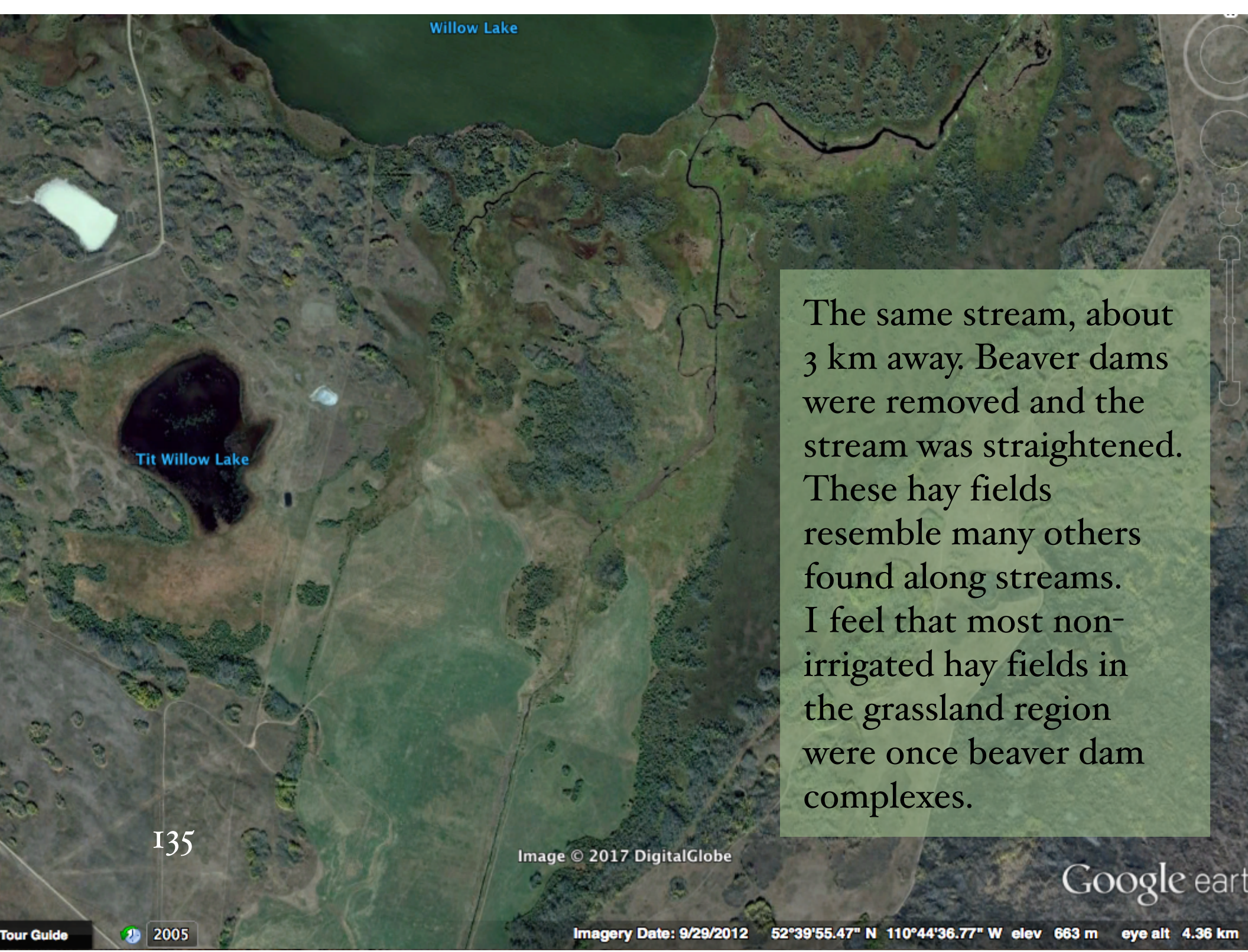

Let's use present observations to learn about the past. I think we all agree that this photo shows a fairly typical beaver dam.

Here is the same site, showing the impact of several months of high water.

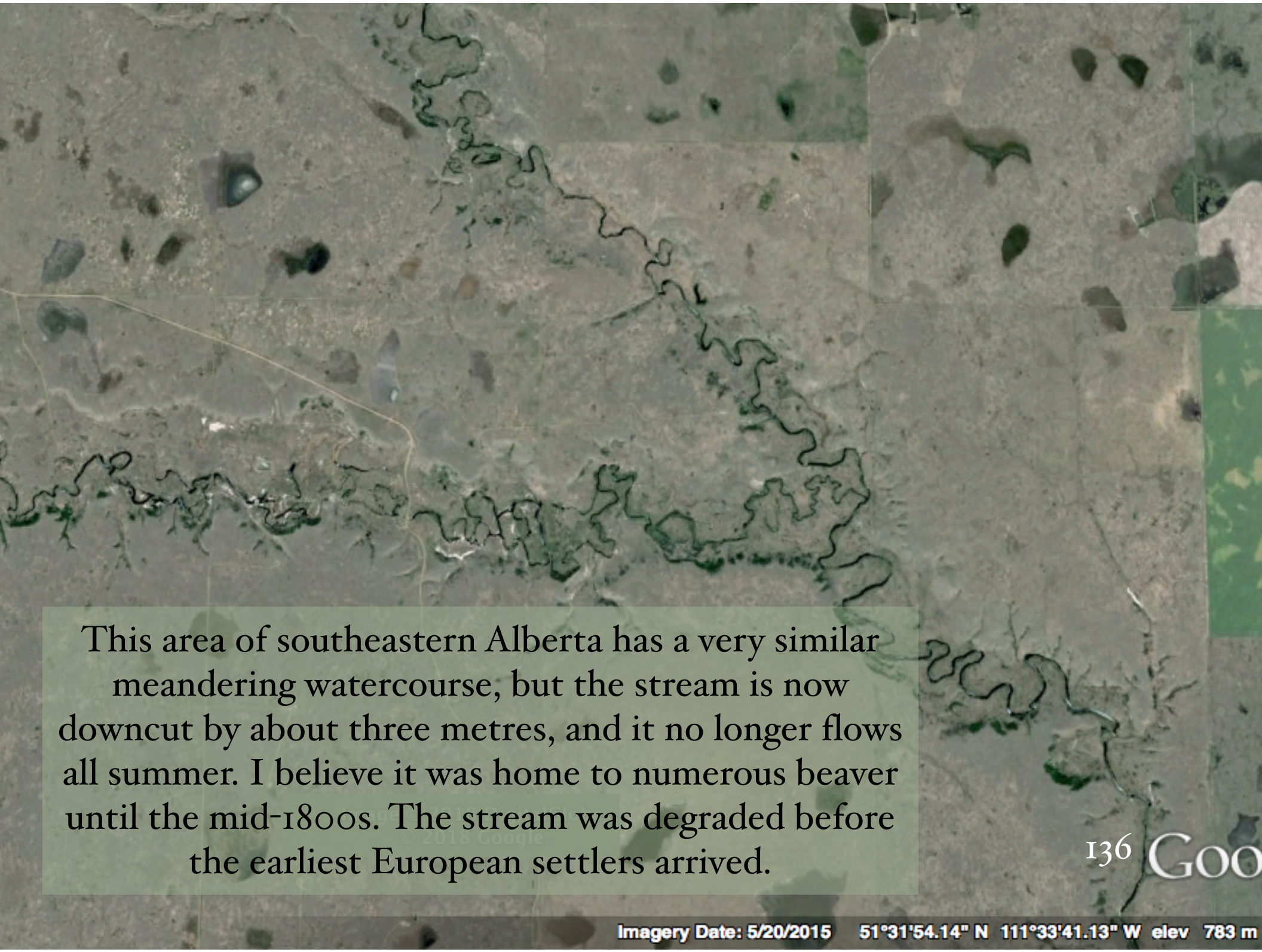

Here is a different site which resembles the degraded dam.


Another site interpreted as
an abandoned beaver dam


This stream in Alberta's parkland region is known to have many beaver dams. Note the extreme meandering, oxbow lakes and relatively broad channel. Land managers tell me that this stream is not downcut at all.
(Personal communication, CFB Wainwright, Range Control, 2018
134
Image © 2017 DigitalGlobe
Google ear
Tour Guide
2005
Imagery Date: 9/29/2012 52°42'14.58" N 110°42'04.68" W elev 659 m eye alt 2.66 km



The same stream, about 3 km away. Beaver dams were removed and the stream was straightened. These hay fields resemble many others found along streams. I feel that most non-irrigated hay fields in the grassland region were once beaver dam complexes.



This area of southeastern Alberta has a very similar meandering watercourse, but the stream is now downcut by about three metres, and it no longer flows all summer. I believe it was home to numerous beaver until the mid-1800s. The stream was degraded before the earliest European settlers arrived.


Relict beaver ponds?

MAKE BEAVER YOUR SILENT PARTNERS

- The first step in harvesting your rainfall is to stop removing the dams. If you think the beaver is a problem, remove the animal, but leave the dam.
- The dam will store water for years without upkeep.
- Beaver are naturally expanding their range back into the grassland. A positive attitude toward them will show rapid benefits.

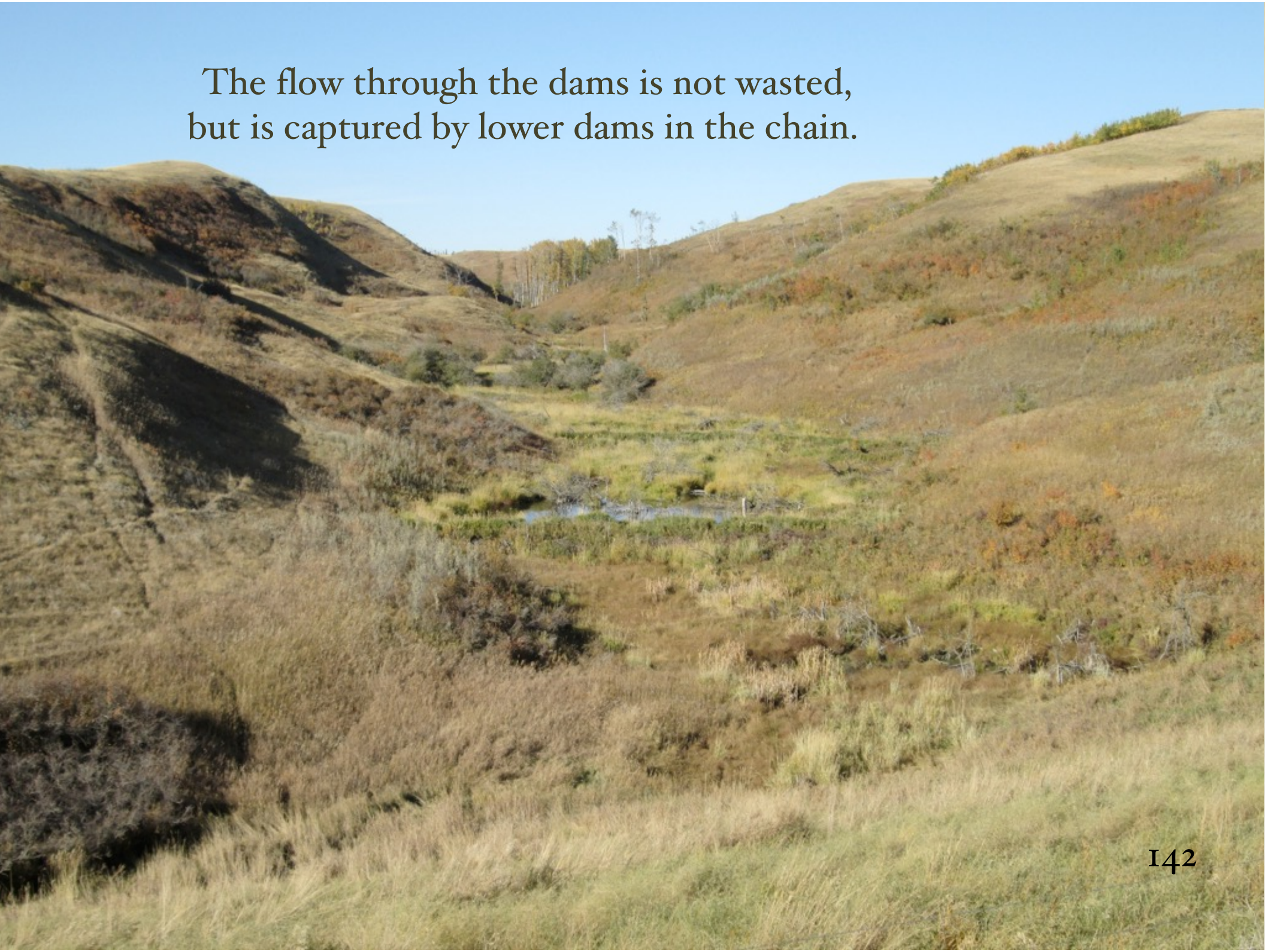
Make sure you have all the possible benefits.
Beaver can make many dams along a stream,
each one holding valuable water.

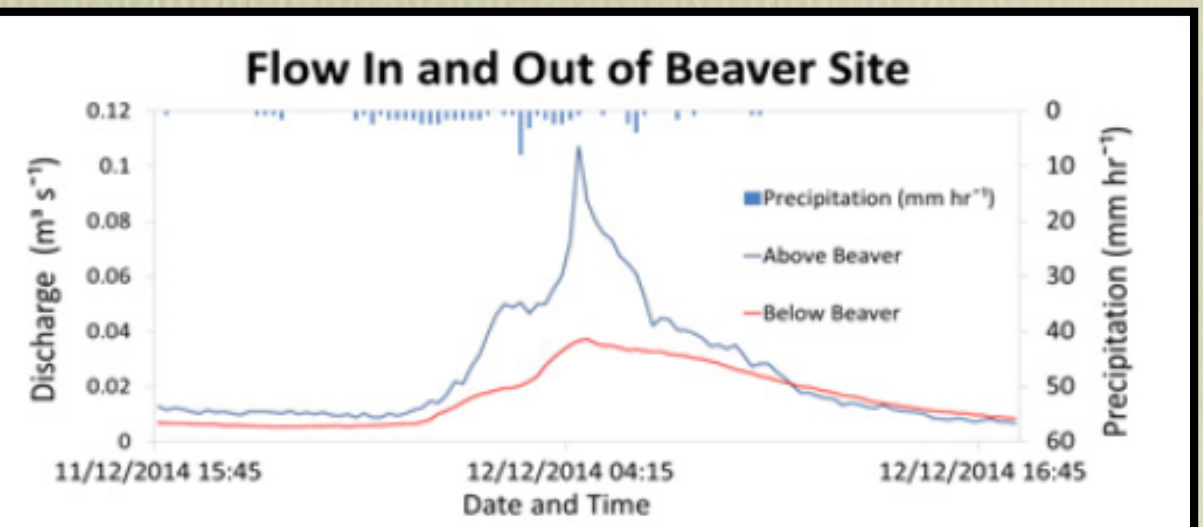
BENEFITS OF BEAVER

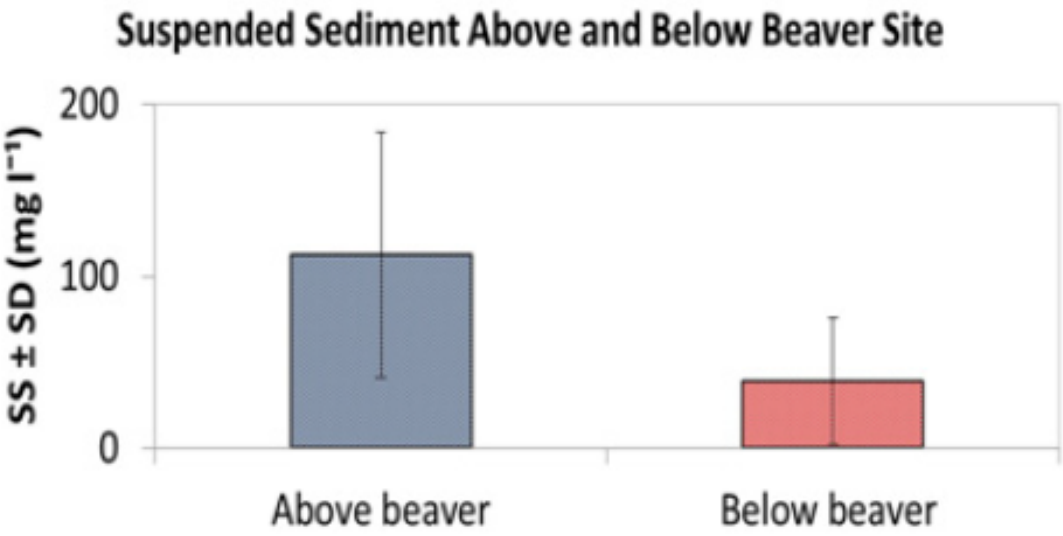
- Beaver dams can store substantial amounts of water.
- Beaver work cheap with no maintenance costs.
- They don't need water licences to store water.
- They create more habitat than they eat.
- The dams aren't big enough to cause damage if they wash out.
- Beaver are rodents, not a long-term commitment.

The leaky dams are key to the habitat improvement brought about by beaver.


Unlike man-made dams, beaver ponds
always have space to hold more water.


The flow through the dams is not wasted,
but is captured by lower dams in the chain.





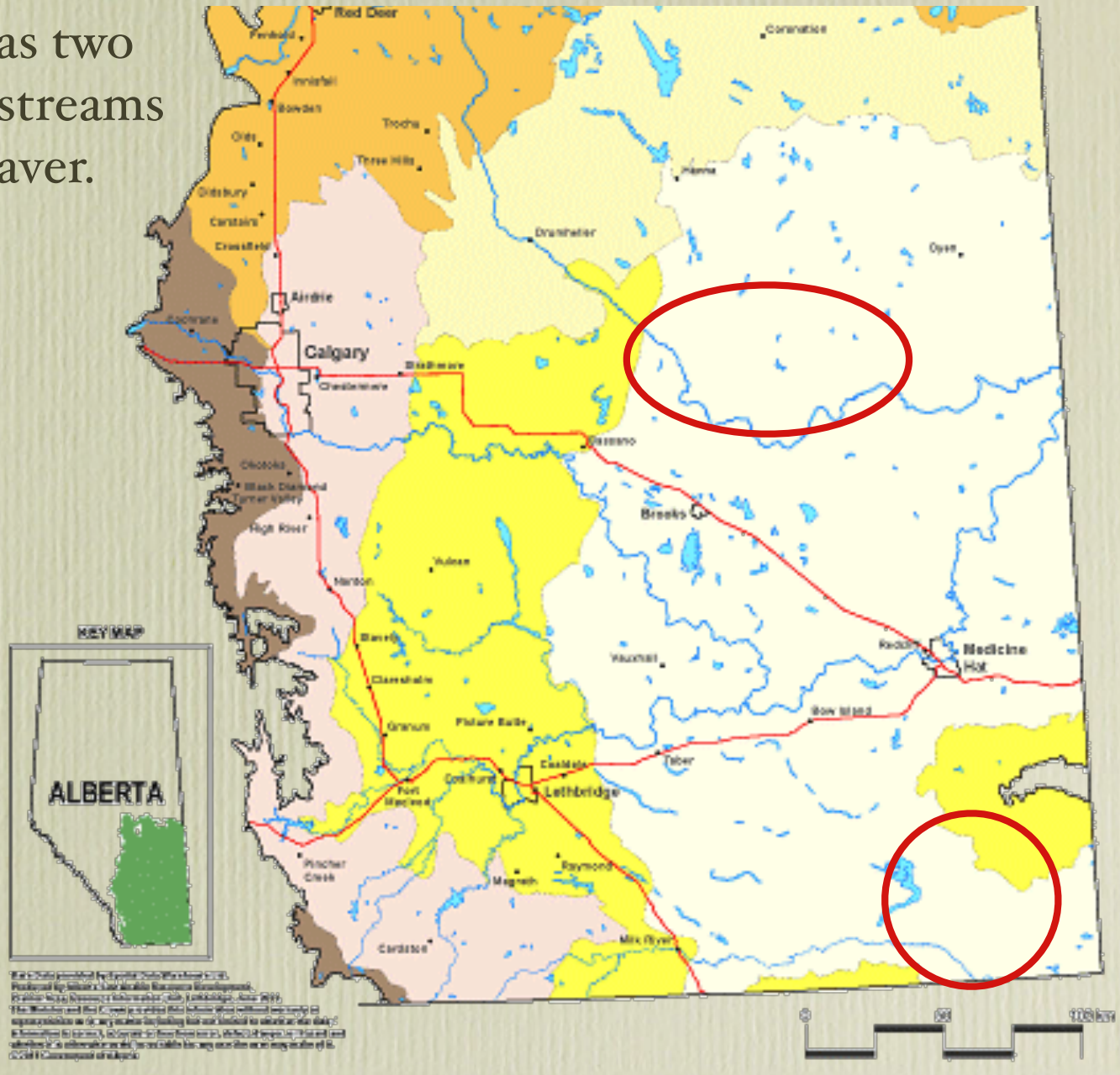
Britain has only recently restored beaver to their ecosystem, so careful documentation is important. This study clearly showed the reduction in both flooding and turbidity due to the dam.

Puttock et al, 2017

In the driest part of the year, the creek's flow is supplemented by water trickling out of the banks.

A prairie stream flourishing with beaver

Southeast Alberta has two regions with suitable streams that could host beaver.



Typical Grassland Streams

- no willows
- eroding banks
- muddy water
- no flow in late summer
- moderate downcutting

Even here, beaver can be restored.

NO DAM WAY!

Although dams are the most notable and unique aspect of the beaver lifestyle, they are not essential. Throughout North America, beaver live in rivers too large to dam. In such sites, the beaver may pile sticks and mud on the bank, then chew a tunnel up into the bank where the den is created.

Without any dams, beaver have a limited ecological impact: just a slight change in vegetation along the bank. However, the river habitat does connect the many streams, allowing easier re-colonization.

A bank lodge with the start of a winter feed pile on the bank of the South Saskatchewan River.

When beaver migrate out of moving water into ponds and sloughs, they can bring substantial changes.

Peter Fidler commented on prairie beaver while travelling south of the Battle River.
"*Passed several small lakes yesterday and this Day, the generality of which have 1, two and some 3 Beaver houses in each.*"
(Fidler & Haig 1991)

Peter Fidler (left) being instructed in surveying by Philip Turnor in 1790. (https://www.peterfidler.com/index.php)

Glynnis Hood studied the impact of beaver on small ponds in Elk Island National Park (Hood & Bayley 2008), as pictured below. Beaver were extirpated in the nineteenth century, before returning in 1954. Comparing aerial photos from before and after the presence of beaver, she documented a nine-fold increase in the area of open water brought about by beaver.

It seems the presence of beaver in ponds across the grassland likely led to these water sources being much more stable than they currently are. However, being isolated from water courses, they would be much less likely to be re-colonized after being trapped out.

POSSIBLE RE-INTRODUCTION

- Beaver have been reintroduced to streams where woody vegetation has disappeared.
- Willow and aspen branches must be provided for food and building materials.

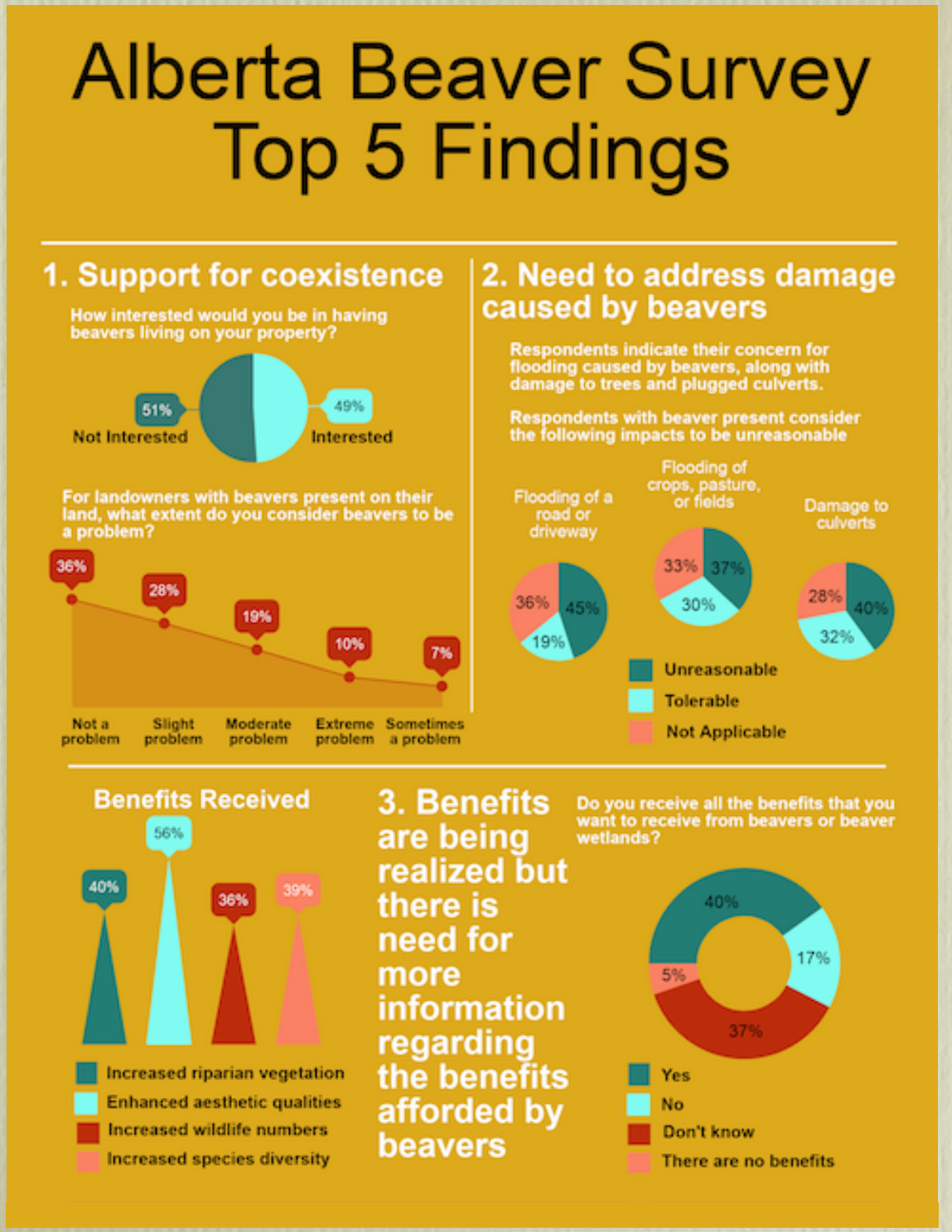
REMEMBER!

Always check with your agency responsible for fish & wildlife before you do anything rash! These helpful people can keep you out of trouble.

This could soon be a significant asset to the ranch,
as well as a wildlife oasis.

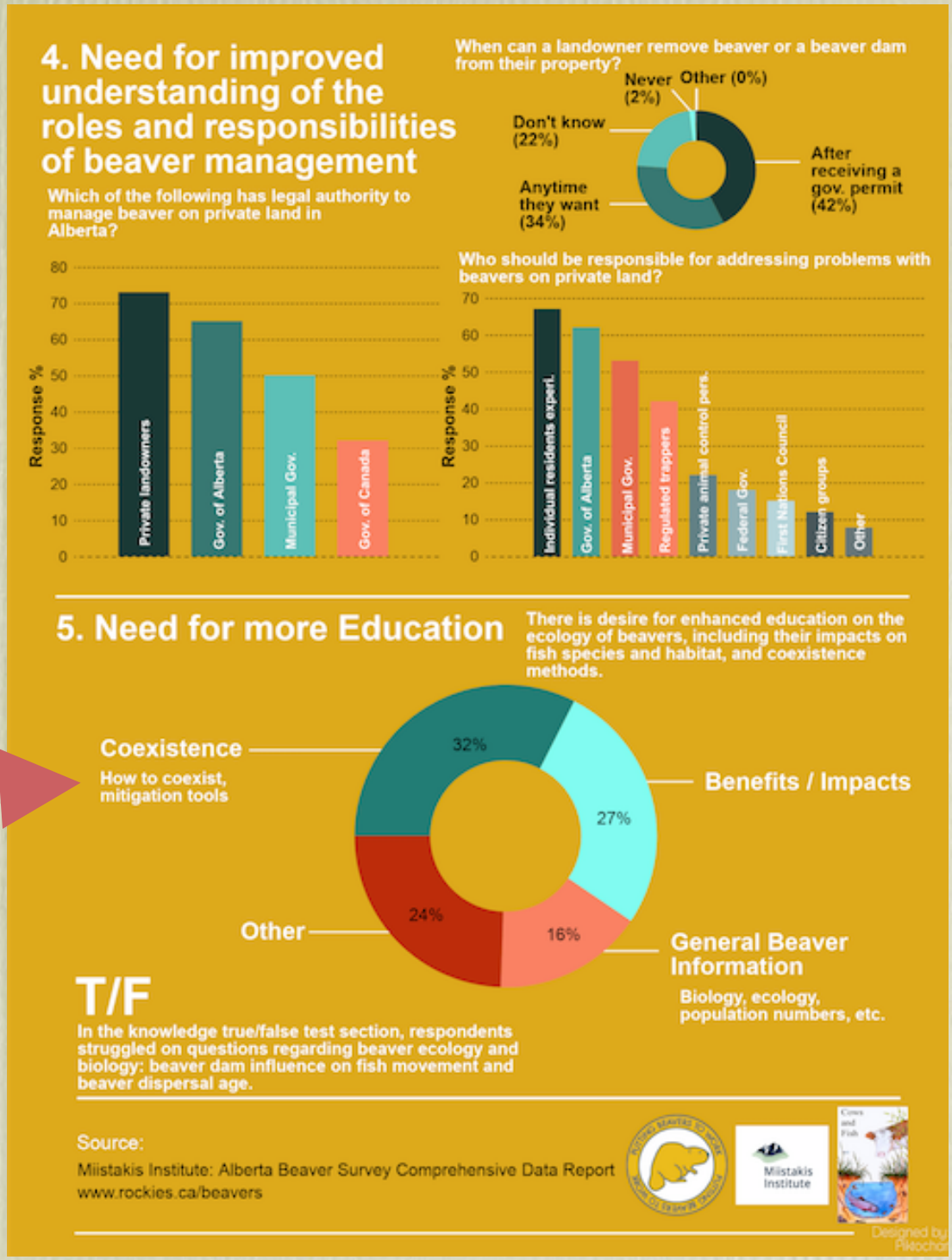
Disadvantages of Beaver

- They don't take direction very well, although they can be influenced.
- They can be over-ambitious.
- They don't have the patience to wait for willows to grow.



In 2017, Miistakis Institute questioned Alberta landowners about their attitudes toward beaver.

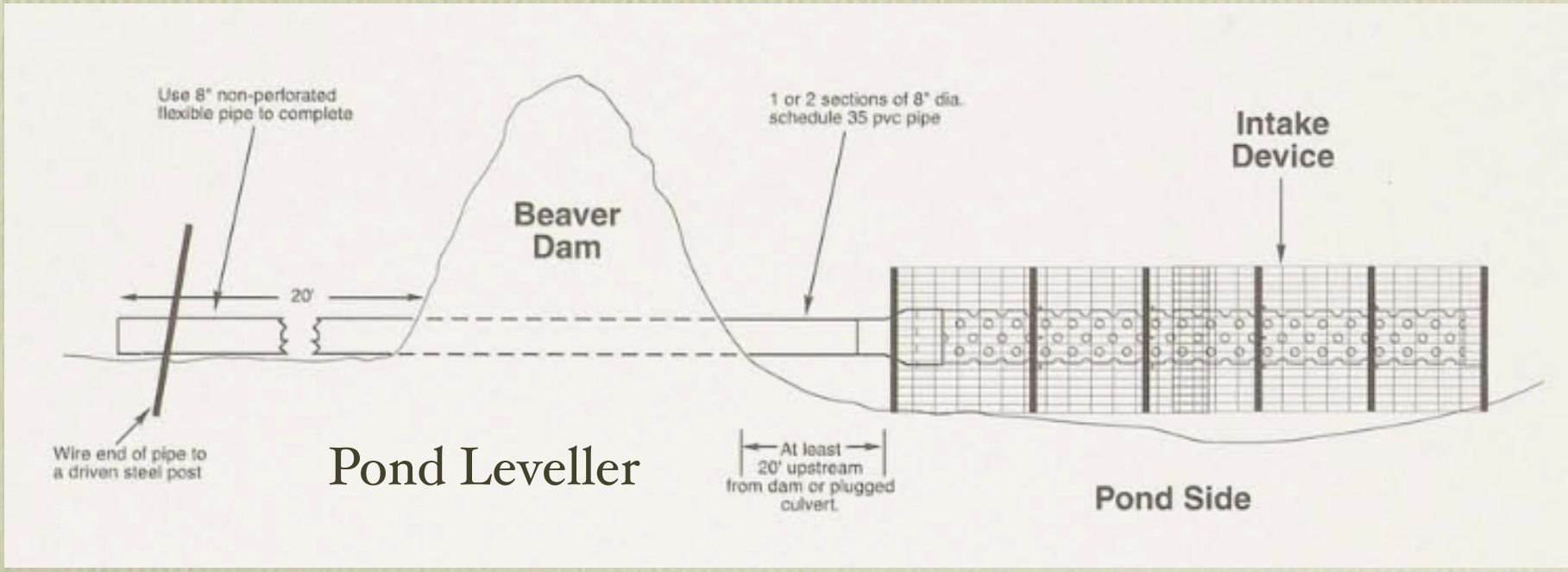
The results were considered quite positive. Overall, the study concluded that beaver are accepted by many landowners as part of the natural world that they value.
However, more extensive education could bring additional support.



LIVING WITH BEAVER

I am surprised that ranchers are intimidated by these rodents. Beaver can be out-witted, while still keeping their valuable dams. You can put them to work!

Thoughtful rural residents have devised several ways to keep the beaver happy while preventing damage. Numerous websites provide detailed instructions. Here are a couple of options to consider.



Pond Leveller

Option 1: The Pond Leveller allows the beavers to make a dam, but limits how high the water can rise behind it.

Option 2: Beaver Exclusion Fencing takes an alternate approach. A simple mesh barrier keeps the beaver away from the culvert and gives a much longer distance to be dammed.

Miistakis Institute (2018) provides a video that shows this being built, while the host discusses how they work. This device is cheaper, faster and doesn't require any heavy equipment, compared to the pond leveller.

Miistakis Institute 2018

Here is the finished barrier

Miistakis Institute 2018

Option 3: A stream catcher (remember the BDAs?) placed just upstream of a culvert will soon be adopted by beaver. The beaver will be happy, and the location you selected will keep the pond from flooding the road.

This well-managed stream, resistant to both flood and drought,
also provides more water and forage for your cattle.

MOVING AHEAD

Droughts are a fact of life.

Can your land benefit from harvesting more rain?

If so, put your stream to work. A stronger partnership will bring valuable rewards!

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