Wascana Riparian Health Assessment 2012-14. Part 3- Downstream of Regina

Wascana Upper Qu'Appelle Watersheds Association Taking Responsibility (WUQWATR)

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Wascana Riparian Health Assessment Project: 2014 Interim Report

Introduction

The study area for the third phase of the Wascana Riparian Health Assessment (WRHA) project extended from the western city limits of the City of Regina to where the Wascana Creek flows into the Qu'Appelle River. This stretch of Wascana Creek is approximately 71 km long, and runs mostly through privately-owned property.

Land uses along this part of the creek include agriculture, recreation and conservation, and residential. Wascana Trails Recreation Site, Deer Valley Golf and Estates, and Sherwood Forest Golf and Country Club are located along this stretch of the creek and were chosen as representative sites. The City of Regina's municipal Waste Water Treatment Plant is also located in the study area, shown in Figure 1.

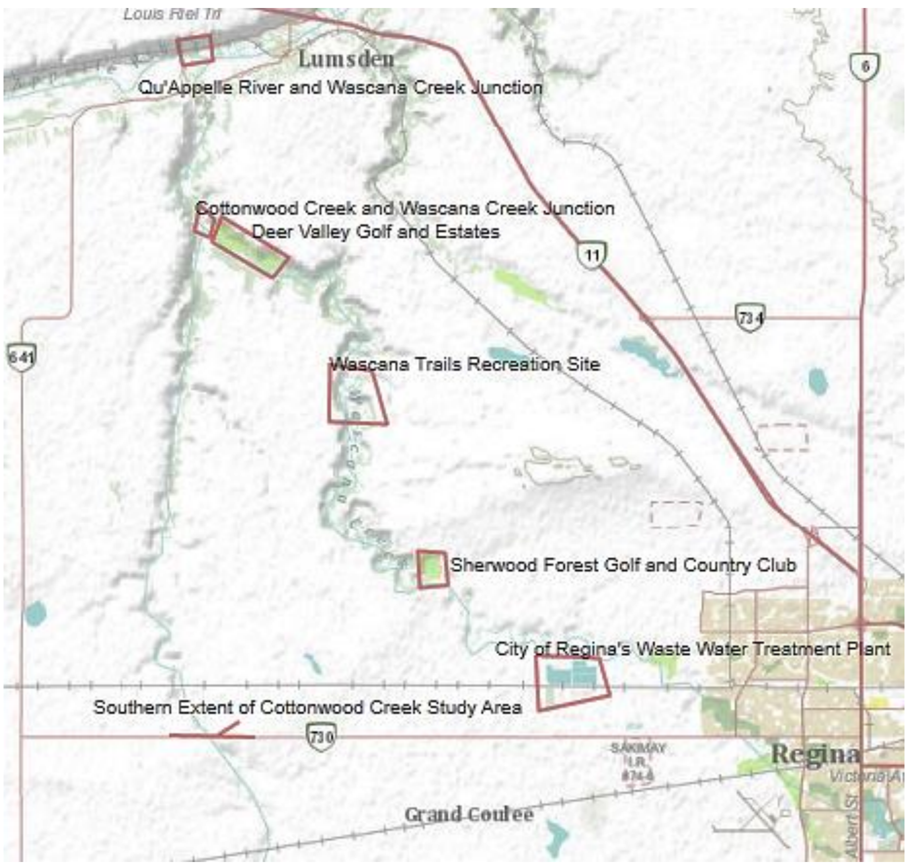


Figure 1: This map shows phase 3 study area, including the planned representative areas.

Methods

The 2013 and 2014 sites had not been determined in the 2010 Wascana Riparian Health Assessment Design.

The site selection for the 2014 study sites was similar to the 2013 study, where sites were chosen using GPS, Rural Municipality (RM) maps, and the satellite imagery from the Saskatchewan Ministry of Environment Interactive Mapping software. This interactive mapping tool and the RM maps were used to randomly choose sites along the creeks.

The 35 sites on Wascana Creek, as well as 15 sites on Cottonwood Creek, were randomly selected with the addition of four representative areas. Wascana Trails Recreational Site, Sherwood Forest Golf and Country Club, Deer Valley Golf and Estates, and the City of Regina's Waste Water Treatment Plant are under different management practices from the other sites, and at least one site in each of these locations was assessed.

Due to the conditions observed during the course of field assessments, additional representative sites were added on Seven Bridges Road, and at the junctions where Cottonwood Creek joins Wascana Creek and where Wascana Creek joins the Qu'Appelle River. These conditions include rock armoring by the local RM and the impact of stream junctions on creek health.

Both water bodies were assessed using the lotic assessment method developed and published by the Prairie Conservation Action Plan (PCAP) and the Alberta Riparian Habitat Management Society (Cows and Fish). The PCAP Field Book for Streams and Small Rivers (PCAP 2008) was used as the assessment tool.

Landowner permission was obtained to access 27 of the 35 sites on Wascana Creek, and 9 of the 15 potential sites on Cottonwood Creek. Following the guidelines set by the PCAP Field Book, the length of assessment sites was determined as either two natural meanders or 500 meters in the absence of meanders. Reach width was determined on foot, using the guidelines set by the field book. In most cases the edge of the riparian area was where transitional vegetation stopped or changed, usually on the slope between the upland and the flood plain.

Assessment Questions

Lotic assessments for streams and small rivers assign scores based on 12 questions:

1) Total vegetative cover (6 points)
2) a) Invasive species cover (3 points)
   b) Invasive species distribution (3 points)
3) Disturbance caused vegetation cover (3 points)
4) Preferred tree/shrub regeneration (6 points)
5) Preferred tree/shrub utilization (3 points)
6) Dead and decadent woody vegetation (3 points)
7) Binding root mass stream bank protection (6 points)
8) Human-caused bare ground (6 points)
9) Human alteration of the stream bank (6 points)
10) Lateral active cutting of stream bank (6 points)
11) Human alteration throughout the reach (3 points)
12) Stream bank incisement/ ability of stream to reach its floodplain (9 points)

This type of assessment uses visual observations to give a score to the area based on the condition of the stream bank stability and vegetation as well as the amount of human alteration. The sum of the scored questions is then divided by the potential score or "perfect score" and given a percent value. This percent value is then used to divide the sites into three categories:

(1) "Healthy" is between 80% and 100%;
(2) "Healthy with problems" is between 60% and 79%; and
(3) "Unhealthy" is between 0% and 59%.

A "healthy" score means that all the necessary riparian functions are being performed and maintained. These sites have riparian areas that are in good condition and naturally resilient against disturbances. Current management practices are sustaining riparian health.

A "healthy with problems" site still has many riparian functions that are being performed, but stress is evident in the area. These sites are vulnerable to disturbances and health may degrade with further stress.

"Unhealthy" sites are areas where the riparian functions are compromised or non-existent. These areas are not performing normal environmental functions and are the most vulnerable to further stress.

All site assessments were performed between June 3rd and August 13th. Almost all sites along the creeks had riparian areas bordered by pastures or fields with permanent forage crops.

Results

Wascana Creek

There were no “healthy” sites along Wascana Creek downstream of the City of Regina. Only 4 sites were scored as “healthy with problems” (15%) and 22 sites were rated as “unhealthy” (85%). The average health score of the downstream portion of Wascana Creek was 48.1% which rated as “unhealthy”.

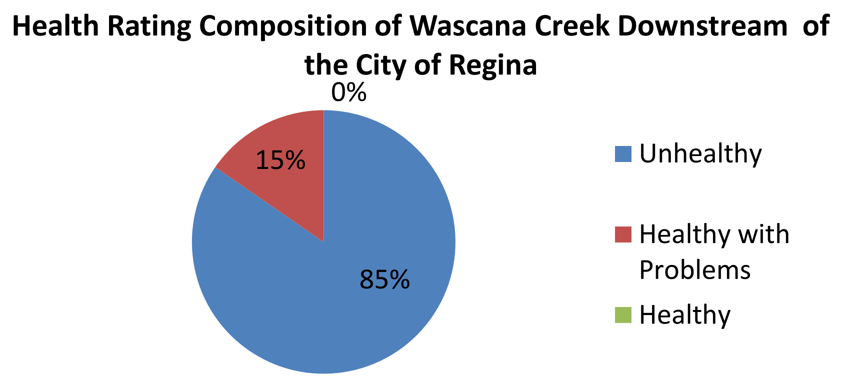


Figure 2: This pie chart shows the health rating composition (healthy, unhealthy, and healthy with problems) of Wascana Creek flowing from the western city limits of the City of Regina to where Wascana Creek flows into the Qu'Appelle River.

Question 1 scores the total vegetative cover of the site. Canopy cover is important because it protects the soil from the “erosive impact of raindrops” (PCAP 2008). At many of the sites, the outside curves of the meanders were bare from erosion and/ or there were stretches of sediment deposition where no vegetation was growing on the inside of the curve (see figure 8 on page 17). There were also many sites where flooding had washed out the vegetation and it had re-established due to the continuous high flows.

Question 2 (a) assesses the coverage of invasive plants in the reach, and **Question 2 (b)** is used to analyze the distribution patterns of the invasive species. Smooth brome (*Bromus inermus*) was present in abundance and evenly distributed at every site on

Wascana Creek downstream of the City of Regina, so almost every site was given a low score on these questions. Other common invasive species seen during the assessments include: absinth (*Artemisia absinthium*), nodding thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), and scentless chamomile (*Matricaria perforata*).

Question 3 assesses how much of the total vegetative canopy cover is composed of undesirable disturbance-caused plants. This did not have as significant an impact on the scores as question 2. Although some sites had high coverage of disturbance-caused plants, only a few sites had more than 45% of the total canopy cover. The sites that got a score of 0 were at the end of the study area, close to where the Wascana joins the Qu'Appelle River. This is where the lateral cutting and sediment deposition was the worst, creating large bare patches of soil which is prime habitat for disturbance-caused vegetation.

Some disturbance species encountered during the project include: red-root pigweed (*Amaranthus retroflexus*), common burdock (*Arctium minus*), foxtail barley (*Hordeum jubatum*), Kentucky bluegrass (*Poa pratensis*), wild buckwheat (*Polygonum convolvulus*), and common dandelion (*Taraxacum officinale*)

Question 4 looks at the presence and regeneration of preferred tree and shrub species. Overall, this question scored quite high as there were lots of small trees growing in the reaches. If there were no trees, the site was given a low score and the following two questions regarding browsing (question 5) and standing dead and decadent wood (question 6) were given an N/A. The total possible score was then adjusted to exclude these questions. Of the preferred species, the seedlings and saplings were mostly chokecherry (*Prunus virginiana*), Manitoba maples (*Acer negundo*), saskatoon (*Amelanchier alnifolia*), red osier dogwood (*Cornus stolonifera*), wolf willow (*Eleagnus commutata*), and other willow species (*Salix* spp.)

Question 5 which deals with animal utilization of the preferred trees and shrubs, scored low mainly because of the beaver activity along the creek. The field book indicates that "if beaver cut stems are encountered, measure these as 'heavy' utilization" (PCAP 2008), which is given 0 points. About a third of the sites on the Wascana had beaver browsing. Except for beaver cut stems, there was very little utilization except for occasional browsing by deer. As discussed in question 4, some sites were given an N/A score because there were no preferred trees or shrubs.

Question 6 assesses the amount of standing dead and decadent wood on the preferred tree and shrubs present in the reach. Overall, this question scored fairly high because there was extensive tree coverage in most of the riparian areas. Those trees were healthy and maintaining themselves. There were many full grown trees observed in the creek, some having been washed down as late as this spring during the peak in flows.

Question 7 quantifies the amount of deep binding root mass protecting the banks. In most areas the stream bank was so severely damaged that the vegetation was either gone or is shallow-rooted. Overall, this question scored very low.

Question 8 looks at the amount of bare ground that is caused by human activity. The human-caused bare ground encountered in the riparian area of Wascana Creek includes cattle and people trails, roads, urban developments, and cultivation in some areas. Overall, this question scored reasonably high because the area adjacent to the Creek is mainly treed, or covered with pasture or permanent forage crops.

Question 9 asks if the stream bank itself has been altered by human activity. Some examples of this encountered downstream of the city include bridges, culverts, pugging and hummocking from livestock, fences along the bank, cattle crossings, rock and riprap, and some excavation. This question scored fairly high because there was little alteration of the stream bank. Cattle were the most common factor in the study area, but the amount of livestock impact was small in relation to the size of the study area.

Question 10 scored very low, as there were no sites that did not have at least 15% of the reach showing active lateral cutting. Most of the sites were given a score of 0 on this question because more than 75% of the reach displayed active lateral cutting.

Question 11 asks if the reach is compacted or rutty from use. Most of the sites were given full points for this question because the reach was relatively uncompact or rutted compared to the stream bank.

Question 12 scored very low in terms of incisement. Incisement of the bank was up to 3 meters in height. In most places the stream could be three times bank full and still not be able to access its natural floodplain.

Cottonwood Creek

There were 8 sites assessed on Cottonwood Creek, ranging from SK-730 grid in the south to where Cottonwood Creek joins Wascana Creek. Of these 8 sites, 4 were "healthy" (50%), 3 were "unhealthy" (37%) and only one fell in the category of "healthy with problems" (13%).

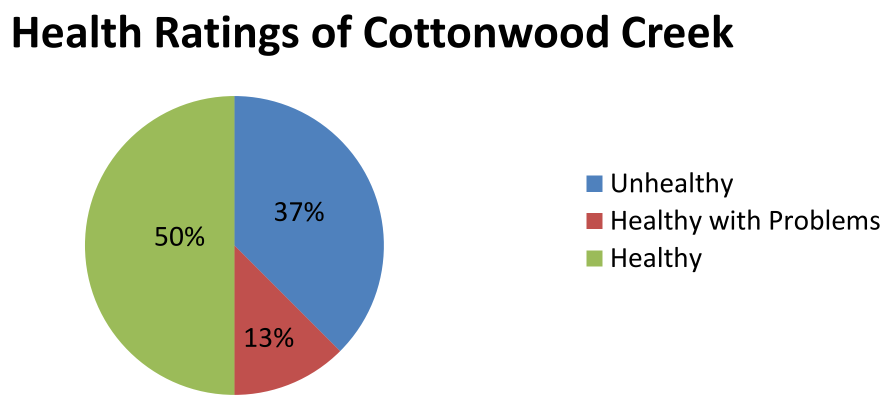


Figure 3: This pie chart shows the health rating composition (healthy, healthy with problems, and unhealthy) of Cottonwod Creek from grid SK-730 to where it joins Wascana Creek.

Question 1 scored high overall, as the canopy cover in most cases was more than 85% covered by vegetation. Out of the 8 sites, only two questions got a score of 4 out of 6, and only one site was scored as a 0. The rest were given full points.

Questions 2 (a) and **(b)** were scored low for Cottonwood Creek, much like Wascana Creek. In a few of the sites the reed grass had either out-competed the smooth brome or prevented an invasion of brome. Although there was no smooth brome on these sites, there were other invasive species such as Canada thistle and absinth that brought the score down because they were both abundant and evenly distributed.

Question 3 scored very high for most of the sites, as there was little bare ground for disturbance plants to establish. Closer to where Cottonwood Creek joins the Wascana Creek, there is potential for disturbance vegetation to establish in the areas that slumped this year or on the bars of sediment deposited this summer.

Question 4 was given full scores for each site except for one site. In the most sites there were preferred trees with more than 15% of the tree canopy cover composed of seedlings and saplings.

Question 5 got a very low score. Utilization of preferred tree and shrub species was mostly due to beaver activity and cattle and deer browsing

Question 6 was scored mostly as 2 out of 3. Where there were trees and shrubs on these sites, there was some standing dead or decadent wood, but it was not enough to alter the riparian function.

Question 7 scored fairly high overall. The flow in Cottonwood Creek is lower than the Wascana, and so even though there are not as many preferred trees and shrubs, there is sufficient deep-root vegetation to stabilize the bank.

Question 8 was scored high because most of the land along Cottonwood Creek in the study area is pasture, both grazed and ungrazed. The only bare ground that is human caused is cattle trails and roads. Compared to Wascana Creek this is relatively low.

Question 9 scored high because Cottonwood Creek had very little human alteration to the stream bank. Examples of stream bank human alteration include bridges and cattle activity on the stream bank.

Question 10 was scored low because almost half of the study area showed active lateral cutting. However, the lateral cutting only began to appear halfway between grid SK-730 and the junction where Cottonwood Creek joins the Wascana. The closer to Wascana Creek the sites were, the more active lateral cutting was present.

Question 11 was scored fairly high. Except for the sites that were being actively grazed, none of the reaches were compacted or rutted from use.

Question 12 was given a high score, as most of the creek had access to its floodplain, which helps to slow water down in high flood events. The closer to Wascana the Cottonwood got, the worse incisement was.

Results for Key Questions

Wascana

Vegetative cover (Question 1) averaged at 3 points out of the total 6. This means there is a large amount of bare ground. Bare ground appears to be in areas where flooding has washed out the banks, especially on the outside curve of meanders. Bare ground became more common as the creek neared the junction with the Qu'Appelle River.

Questions 2(a) and (b) received 0.04 out of 6, indicating widespread problems with the presence and distribution invasive species. The main invasive species encountered were smooth brome, absinth, thistle, and some patches of leafy spurge (*Euphorbia esula*).

Questions regarding preferred trees and shrubs (Questions 4, 5, and 6) averaged 8.8 out of a total of 12 points, indicating both the presence and regeneration of preferred tree and shrubs at most sites. Although there were quite a few sites that showed evidence of beaver browsing, there were no beaver dams observed on any of the sites on Wascana Creek.

Deep rooted vegetation scored an average of 2 out of 6 total points, which indicates that on average, the creek banks only have 35% to 65% of their bank protected by deep-rooted vegetation.

Human caused bare ground averaged 4.5 out of 6, and human alteration scored 4.8 out of 6. Both of these average scores indicated good local management practices.

Active lateral cutting had an average score of 0.7 out of 6, indicating that at least 30% of each site along Wascana Creek showed significant lateral cutting.

Incisement averaged at 2.1 points out of a total of 9 points, showing that almost none of the sites had slopes gradual enough that the creek could access its floodplain.

Cottonwood

Because the scores for the key questions score are significantly lower as Cottonwood Creek gets closer to its junction with the Wascana, averages for the questions do not properly represent the overall condition of the creek. The health degrades the closer the Cottonwood gets to joining the Wascana, creating a health and condition gradient. This pattern is best shown by the health scores instead of the averages.

Summary of results

The relative health scores of both Wascana and Cottonwood Creeks decline as one moves downstream. When compared to a perfect score, Cottonwood Creek has a much higher average score than Wascana Creek (Figure 4).

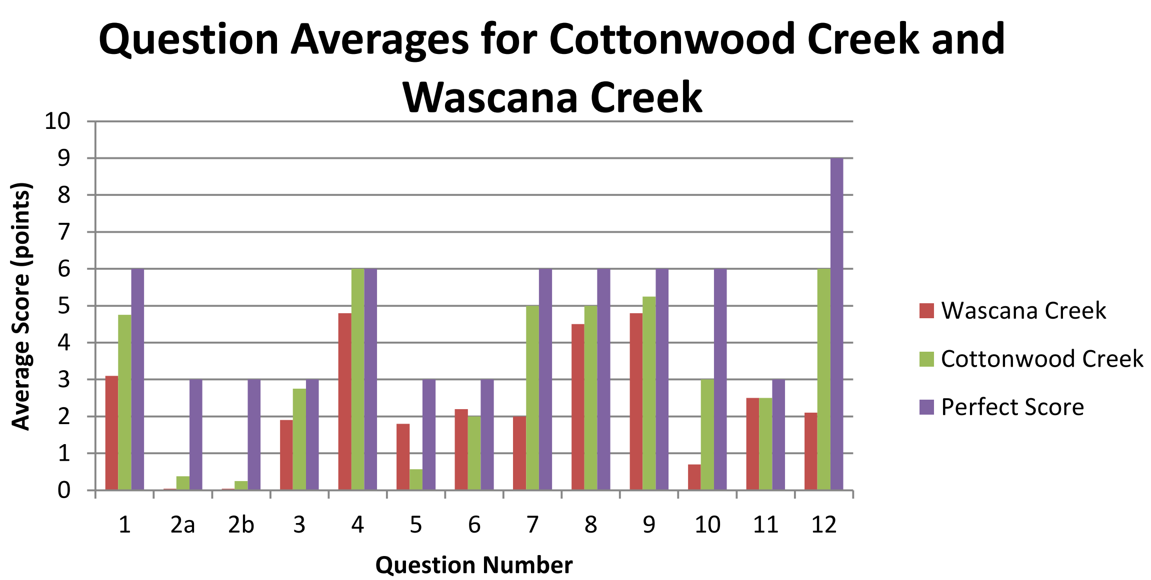


Figure 4: This bar graph compares the averages of the 12 assessment questions for both Cottonwood Creek and Wascana Creek against the perfect score possible for each question.

The average health for Wascana Creek sites scored an average health rating of 48.0% or "unhealthy". These scores were not chiefly attributable to local management or environmental factors, but were consistent with problems arising from increased water flows and management activities in the larger watershed.

Cottonwood Creek has an overall average score of 69.5% or "healthy with problems". This indicates that although there are some factors impairing overall health, the Cottonwood Creek system has considerably higher levels of resilience and function than its receiving water body.

Discussion of results

Riparian Health Assessments evaluate two major factors: structure and vegetative condition.

Structure

Downstream of the city, outside of the natural flow, there are two main factors that influence the stream bank integrity of Wascana Creek. These are flooding and storm surges, and constant additional flow from the Regina Waste Water Treatment Plant.

There have been several flood and intense storm events in the Wascana Creek watershed area in recent years. This includes high snowmelt runoff in spring, and high peak flows from major intense storms later in the season. The 2011 spring runoff peak came close to matching the historical record of 1974, and this was followed by major storm runoff later in the summer. Historical (1945-2013) mean spring peak flows at the confluence with the Qu'Appelle average around 14 cubic meters per second. The average hydrograph usually shows flows below 3 cubic meters per second throughout the growing season.

In recent years, intense and prolonged precipitation events have led to summer flows exceeding 20 cubic meters per second or higher. Higher precipitation has led to ground saturation and a fully recharged groundwater system which leads to higher runoff and continuously running springs feeding the watershed.

The natural or historical hydrograph has also been altered by the release of treated waste water from Regina throughout the year.

The structural condition of the streambanks downstream of Regina is consistent with flooding and storm surge events. Few sites on Wascana Creek did not show evidence of advanced lateral cutting, slumping and erosion. Deposition of silt from washed out banks was also apparent throughout. Most of Cottonwood Creek still has access to its flood plain, and cutting and siltation were much less evident.

Two geographical factors magnify the impact of high flows downstream of Regina. The elevation drops 60 meters between the City and the Qu'Appelle, which speeds up water flow. Soil texture in the Wascana Valley also becomes considerably lighter and more erodible as elevation drops.

These factors accelerate the speed of peak flows, and increase the potential impacts, creating deeply incised stream banks, with low stability.

In most of our study sites, the Creek is unable to access its flood plain, which would naturally absorb much of the energy contained in a peak flow.

The Wascana watershed has a higher urban density than any other Saskatchewan watershed.

Combined with changes in extreme precipitation patterns, urbanization may also be exacerbating peak flows downstream. Urban development and industrial expansion has led to decreased infiltration and increased runoff potential from hard surfaces like paving.

The drop in elevation as the creek gets farther from the city speeds up the water (Figure 5). The increase in the speed as well as the increase in volume of water increases active lateral cutting and riparian areas are washed away.

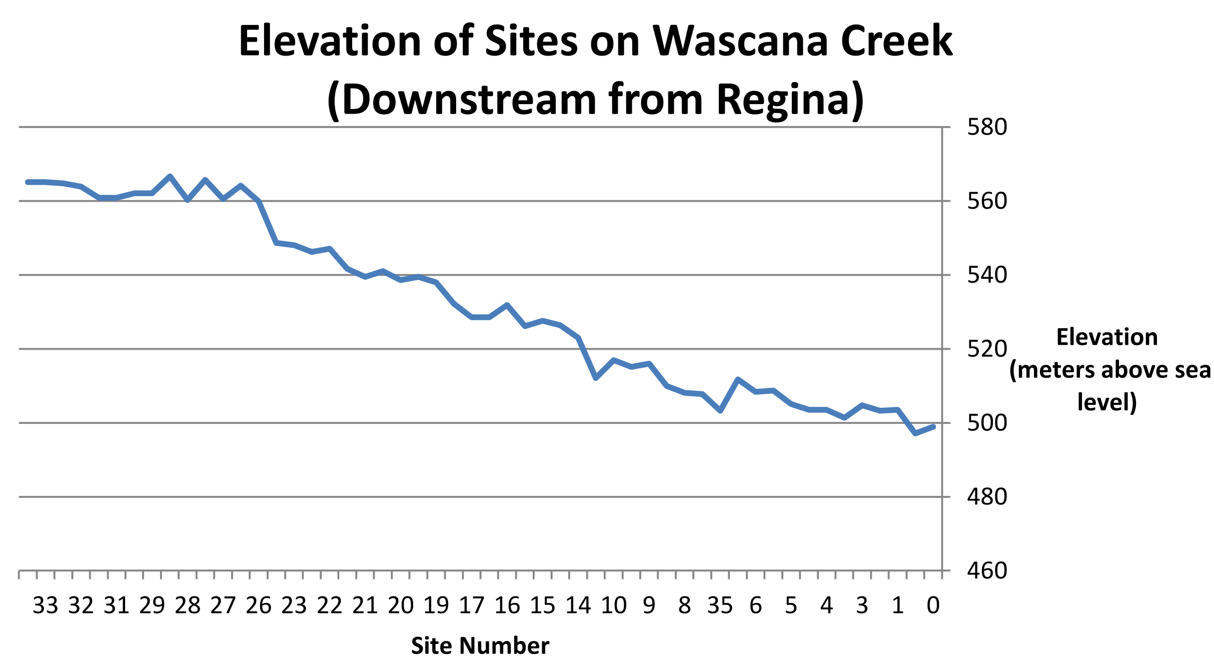


Figure 5: This line graph shows the drop in elevation (in meters above sea level) between the site closest to the Regina and the junction where Wascana Creek joins the Qu'Appelle River.

A similar pattern appears on the Cottonwood. As seen in Figure 6, the elevation falls as the Cottonwood flows toward Wascana Creek. Health scores decline along with the declining elevation, as reflected by the health score of the 8 sites selected along the creek (Figure 7). However, Cottonwood Creek has the advantage of having a less erodible soil along the banks.

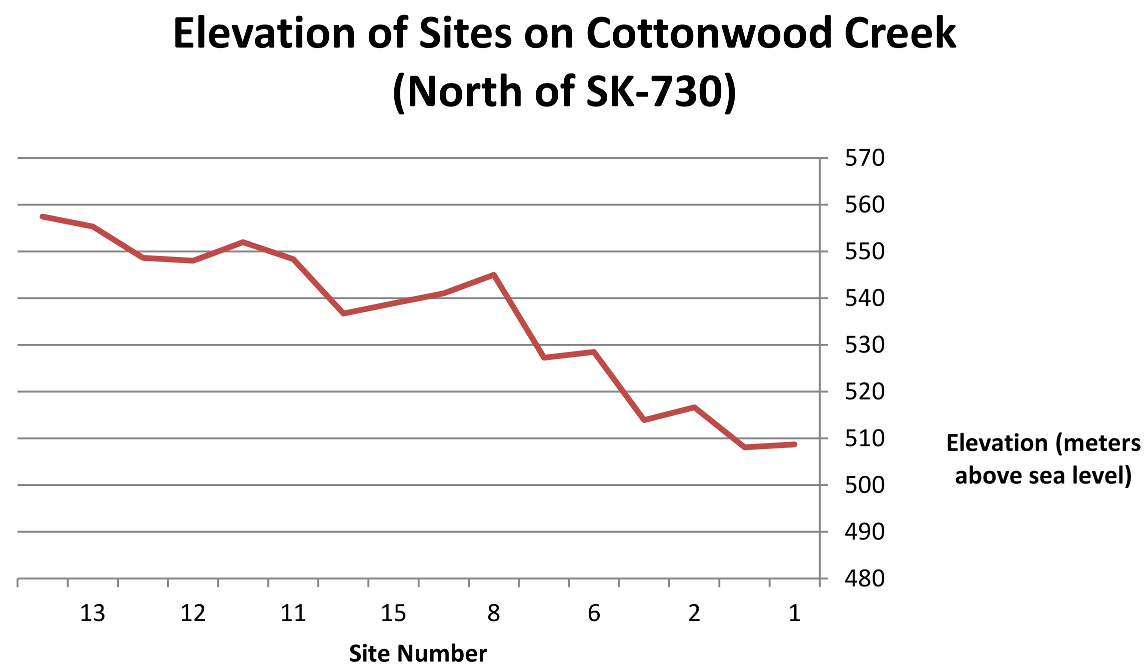


Figure 6: This line graph shows the drop in elevation (in meters above sea level) between the site on grid SK-730 to where Cottonwood Creek flows into Wascana Creek.

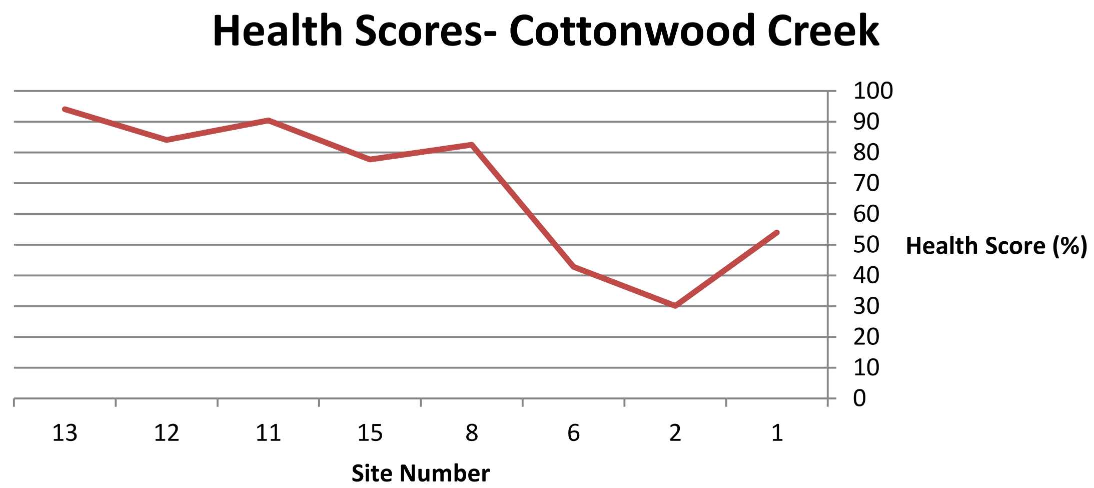


Figure 7: This line graph shows the decline in the health score from the beginning of the Cottonwood Creek study area (CC13) to where Cottonwood Creek joins the Wascana (CC1).

Overall, the health scores of Wascana Creek declines as it flows from the western city limits to the junction of Wascana Creek and the Qu'Appelle River. This decline in riparian health is a result of an increase in lateral active cutting and incisement, both of which are results of the increased flow, constant flow, and the fast-flowing water.

Vegetation

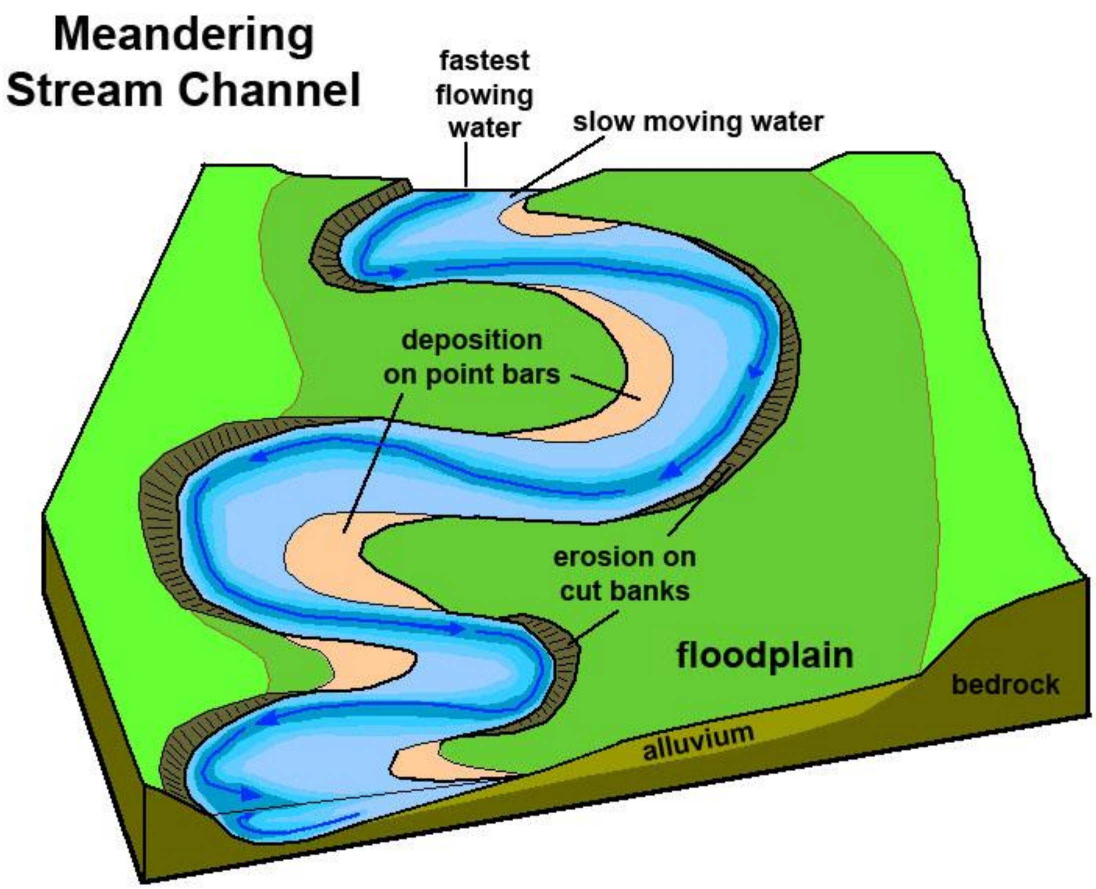
Riparian vegetation serves several functions. One of the key functions is ensuring bank stability. Without deep rooted vegetation to stabilize the bank, it is vulnerable to disturbances such as floods and erosion.

We observed throughout our sites, that high peak flows and storm surges have been washing away much of the riparian vegetation, including large trees.

The vegetation that would normally re-establish from any disruption caused by peak flows has not had the opportunity. This has caused the banks to be more vulnerable to high flows over time.

Another factor impeding the re-establishment of these preferred species is the high incidence of invasive vegetation.

When the fast water rounds a meander at a much faster speed than the banks are equipped to handle, two main problems result: severe lateral cutting on the outside curve of the meander, and sediment deposition along the inside of the curve (Figure 8).



http://www.geologycafe.com/class/chapter9.html

Figure 8: This figure shows the typical pattern of erosion and sediment deposition in meanders of a stream, creek, or river.

The severe lateral cutting destroys nearly the entire riparian area, in some cases, and leaves a sharp cliff of exposed soil. This cut area is extremely vulnerable to disturbance events and erosion.

The deposits of sediment from upstream along the inside curve of the meander result in large bars of bare soil that is ideal habitat for undesirable disturbance-caused and invasive species.

Invasive species are a large problem in the riparian areas of both Cottonwood Creek and Wascana Creek.

Smooth brome is present on almost all the sites assessed along Cottonwood Creek, and was found on every site on Wascana Creek. But there is no practical way to eliminate the species.

Invasive species such as absinth, scentless chamomile, and Canada thistle were the other most common invasive species found along the banks of both the Cottonwood Creek and Wascana Creek. These species can be controlled and/or eliminated in order to allow preferred species to re-vegetate areas where these invasive species have moved in.

Other invasive species spotted along the banks but were not in an abundance include nodding thistle, red currant (*Ribes rubrum*), Siberian elm (*Ulmus pumila*), leafy spurge, sea buckthorn (*Hippophae rhaminoides*), caragana (*Caragana arborescens*), common burdock, and crested wheatgrass (*Agropyron cristatum*).

Conclusion

The low overall riparian health rating of Wascana Creek is evidently attributable to alterations to the natural and long term hydrograph, and the presence of invasive plant species. The current poor structural condition has not been caused by local management or local environmental conditions, but by larger climatic and watershed influences.

Further discussions are required on what management and remediation tools are available to improve the riparian health of the Creek.