Riparian Health Summary
Final Report

- Paddle River –
Upstream of Paddle River Dam Reservoir

Alberta Riparian Habitat Management Society
(Cows and Fish)

December 2010

Prepared for:

Paddle River Landowner Group

Project Area:

Paddle River upstream of Paddle River Dam Reservoir

Prepared by:

Cows and Fish
Alberta Riparian Habitat Management Society
c/o
306 J.G O'Donoghue Building
7000-113 Street
Edmonton, Alberta, Canada
T6H 5T6
(780) 427-7940

Writers:
Kerri O'Shaughnessy

Suggested report citation: *O'Shaughnessy, K.. Riparian Health Summary, Final Report, Paddle River upstream of Paddle River Dam Reservoir. 2010.0Alberta Riparian Habitat Management Society (Cows and Fish).*

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Acknowledgements

A key to the success of this project was the exceptional level of interest and co-operation demonstrated by landowners in the Paddle River upstream of Paddle River Dam Reservoir (hereafter referred to as the Paddle River) project area. Thank you to everyone who allowed access to their land and supported this riparian inventory initiative!

Disclaimer

- Any release of the information contained in this report, in whole or in part, to parties other than the members of the Paddle River Landowner Group will not be the responsibility of Cows and Fish. Liabilities with the release of this report or use of the information beyond the original intent of the work will be the responsibility of the Paddle River Landowner Group.

- All information in this report is a summary reflecting the overall state of riparian health of the Paddle River project area. It does not share any specific information on individual landholdings assessed, based on Cows and Fish's commitment of confidentiality with the landowners who participated. Only general findings, reflecting the overall state of riparian health of the Paddle River project area are presented in this report. Due to the broad-scale nature of this representative sampling methodology, there may be unique areas of riparian zone within each reach not represented by the overall health rating for that reach.

- This report outlines the findings from Year Two (2010) of the Paddle River Landowner Group's riparian health evaluation initiative. In the first year (2009), rapid health survey information was collected and reported by riparian pasture walks with Cows and Fish staff and landowners. Additional riparian inventories and/or assessments are required in subsequent year(s) to fairly represent the trend of riparian health within the Paddle River project area.

- The inventory and assessment of the functioning condition (health) of riparian habitat does not address any in-stream, hydrological (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts) or water quality parameters associated with the Paddle River project area.

Remember:

All information is confidential and is provided to each landowner through individual landowner reports. This is not a finger pointing exercise; it's an awareness process.

1 BACKGROUND

1.1 The Cows and Fish Program

In 1992, Cows and Fish was formed to foster a better understanding of how improvements in grazing management on riparian areas can enhance landscape health and productivity for the benefit of producers and others who use and value riparian areas. A key feature empowering Cows and Fish is the declaration of ownership of the riparian grazing issue by cattle producers, landowners and community groups. See our enclosed fact sheet called *Facing the Issues* for more on Cows and Fish and its members and supporters.

1.2 What Is A Riparian Area?

Riparian areas are the portions of the landscape strongly influenced by water and are recognised by water-loving vegetation along rivers, streams, lakes, springs, ponds and seeps (Figure 1). Riparian areas can be described as the "green zones" around lakes and wetlands and bordering rivers and streams.

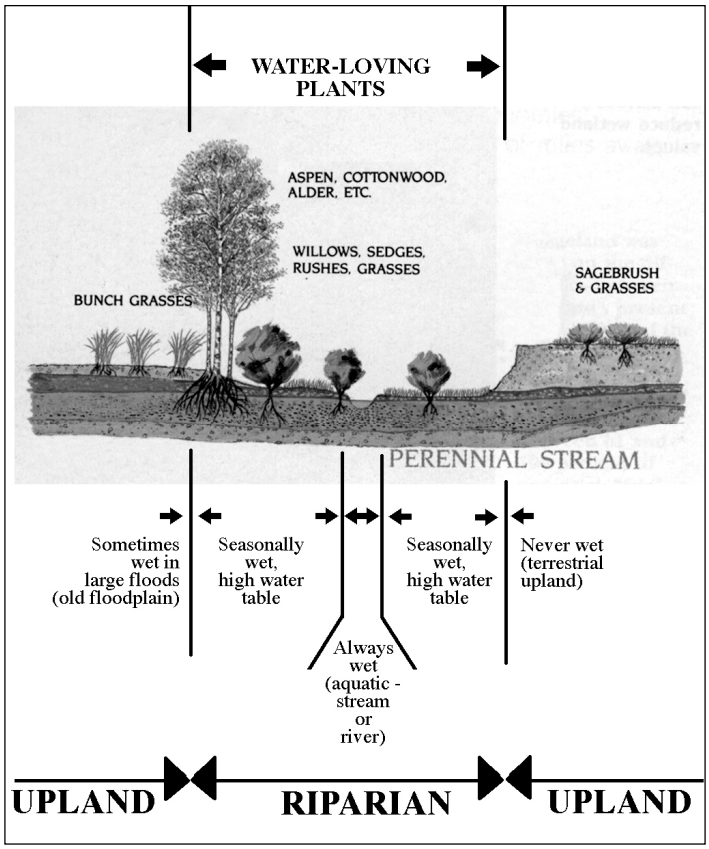


Figure 1 Diagrammatic Representation of a Riparian Area[1]

[1] Source: Fitch, L., B.W. Adams and G. Hale. 2001. Riparian Health Assessment for Streams and Small Rivers – Field Workbook. Lethbridge, Alberta: Cows and Fish Program. 90 pages.

1.3 Why Are Healthy Riparian Areas Important?

When in a properly functioning condition or *healthy* state, riparian areas are one of the most ecologically diverse ecosystems in the world. Healthy riparian areas sustain fish and wildlife populations, provide good water quality and stable water supplies, and support people on the landscape. In doing so they play a role that is disproportionately important to the amount of area that they encompass (approximately 2-5% of the landscape).

Important ecological functions performed by healthy riparian areas include trapping and storing sediment to maintain and build banks, recharging groundwater supplies, providing stable flows and flood protection, improving water quality by filtering runoff and reducing the amount of contaminants and nutrients reaching the water, and providing habitat for fish and wildlife, and shelter and forage for livestock. Thus, despite occupying only a small percentage of the total land area within a watershed, riparian areas are critical to the long-term sustainability of a healthy landscape.

1.4 Why Assess Riparian Health?

The intent of riparian health inventories is to provide a *state of the environment report* to the local community. Hopefully, this report will provide better information on riparian health or function to assist your community in making the best decisions on how to manage riparian range resources most effectively.

Combining this information with existing practical knowledge of rangeland resources will provide the best alternatives for the sustainability of healthy riparian areas within the Paddle River watershed. In general, this information assists producers and local communities to identify and effectively develop non-legislated or voluntary action plans to address specific riparian land use issues within local watersheds.

Assessing riparian health allows communities, landowners and professionals to:

- **Create awareness** amongst local producers and their communities and build common understanding on riparian management issues in their watersheds.
- **Take action** by assisting local decision-makers develop strategies to find local solutions to address riparian land use issues.
- **Monitor progress** in improving, maintaining and protecting riparian health for their operation or watershed.
- **Identify environmental risk** and integrate into farm and ranch planning
- **Develop and maintain** range management plans for long-term productivity and ecological health.
- **Establish** benchmarks of riparian health from which change over time can be measured.

Working together on riparian management issues, including riparian health inventories, displays a proactive message to the public that your community and the agricultural sector in general are taking steps to ensure the health of our landscapes and water supplies are being protected, maintained and improved.

2 PROJECT DESCRIPTION

2.1 Project Background

Funding for this project was provided by Alberta Conservation Association Grant Eligible Conservation Fund, RBC Blue Water Project grant, and Cows and Fish members and supporters (in-kind). Additional support was received from West Central Conservation Group (WCCG), West Central Forage Association (WCFA), individual landowners involved with the Paddle River Landowner Group, Lac Ste. Anne County and Woodlands County Agriculture Service Boards. Riparian health inventories for this project were conducted in the last week of August and September 1st of 2010.

2.2 Project Area

The project area is defined as a selection of riparian areas involving a number of landowners along the Paddle River from the headwaters of both the south and north branches downstream to the Paddle River Dam Reservoir and did not include any part of the reservoir (refer to project area map – Figure 2). All ten of the sites assessed were located on the main channels of the Paddle River. All landowners gave their permission for their individual site data to be used to create this project area overview.

The headwaters of the Paddle River originate in the Crown Land west of Secondary Highway 751 and flows east towards the Paddle River Dam through Woodlands County and Lac Ste. Anne County. There are two main "headwater" branches of the Paddle River in the west, one towards the north of the watershed (Township 57 Range 12 W5) and one to the south (Township 56 Range 11 W5), both of which were included in this project. The two branches meet near Range Road 102 and continue east. Another branch joins from the south near Range Road 90 but was not included as part of this project. The Paddle River flows through primarily agriculture lands (grazing and pasture with some crop and hayland) within the Dry Mixedwood natural subregion. Deeded and crown land (vacant and lease) are present within the project area.

Table 1 Project Area Description

Waterbody Name	# Landowners Contacted	# Landowners Participated	# Riparian Inventories	Stream Distance Inventoried (km)
Paddle River	9	9	10	9.81

2.3 Site Selection

Based on the objectives and resources of the community group, it was not possible for every kilometre of river to be assessed. Using current aerial photography and in consultation with the Paddle River Landowners Group, and West Central Conservation Association, the local watershed was delineated into sections with similar physical, vegetative and management influences along the river. Each section is referred to as a reach. Landholdings, generally those belonging to people who requested an inventory of their riparian areas to be completed were chosen to represent each reach. Riparian inventory sites, or polygons, were then identified

within those landholdings after one-on-one discussion with the landowners, who described the different management practices used in the pastures and fields along the stream.

3 RIPARIAN HEALTH INVENTORY METHODS

3.1 Riparian Health Inventory

Riparian health inventories provide comprehensive information about the diversity, structure and health of plant communities within the project area. The health inventory establishes an important baseline to compare to in the future, to keep track of whether riparian health is being maintained, improved or is declining.

A riparian health inventory differs from the 'shorter' riparian health assessment (survey) because it is a detailed inventory that thoroughly examines the vegetative, soil and hydrological parameters of the project area. During a riparian health inventory 79 health parameters are examined to provide comprehensive and detailed information on riparian function. A health score is derived from this data (Table 2) and breaks information down into 11 parameters that are used in this report to discuss the riparian health of the Paddle River. Six of the parameters relate to vegetation[2] and five relate to soil and hydrology. *A more detailed description of each of these 11 parameters and how they are evaluated is given in* ***Appendix D***. By objectively examining each of these health parameters we can determine which pieces are adequately performing the necessary functions of a healthy riparian area, and which are not. This examination provides us with a better understanding of where to concentrate efforts if improvements in riparian management are required, and what land use practices are currently maintaining riparian health.

Table 2 Description of Riparian Health Ratings

Health Category		*Score Ranges*	*Description*
Healthy		*80-100%*	little to no impairment to any riparian functions
Healthy, but with problems		*60-79%*	some impairment to riparian functions due to management or natural causes
Unhealthy		*<60%*	severe impairment to riparian functions due to management or natural causes

[2] Invasive plants is considered one parameter, however is broken into two parts separating canopy cover and density distribution. Utilisation of woody plants is also broken into two parts to take into account browse use by animals and cutting / mowing of woody plants by humans and beavers.

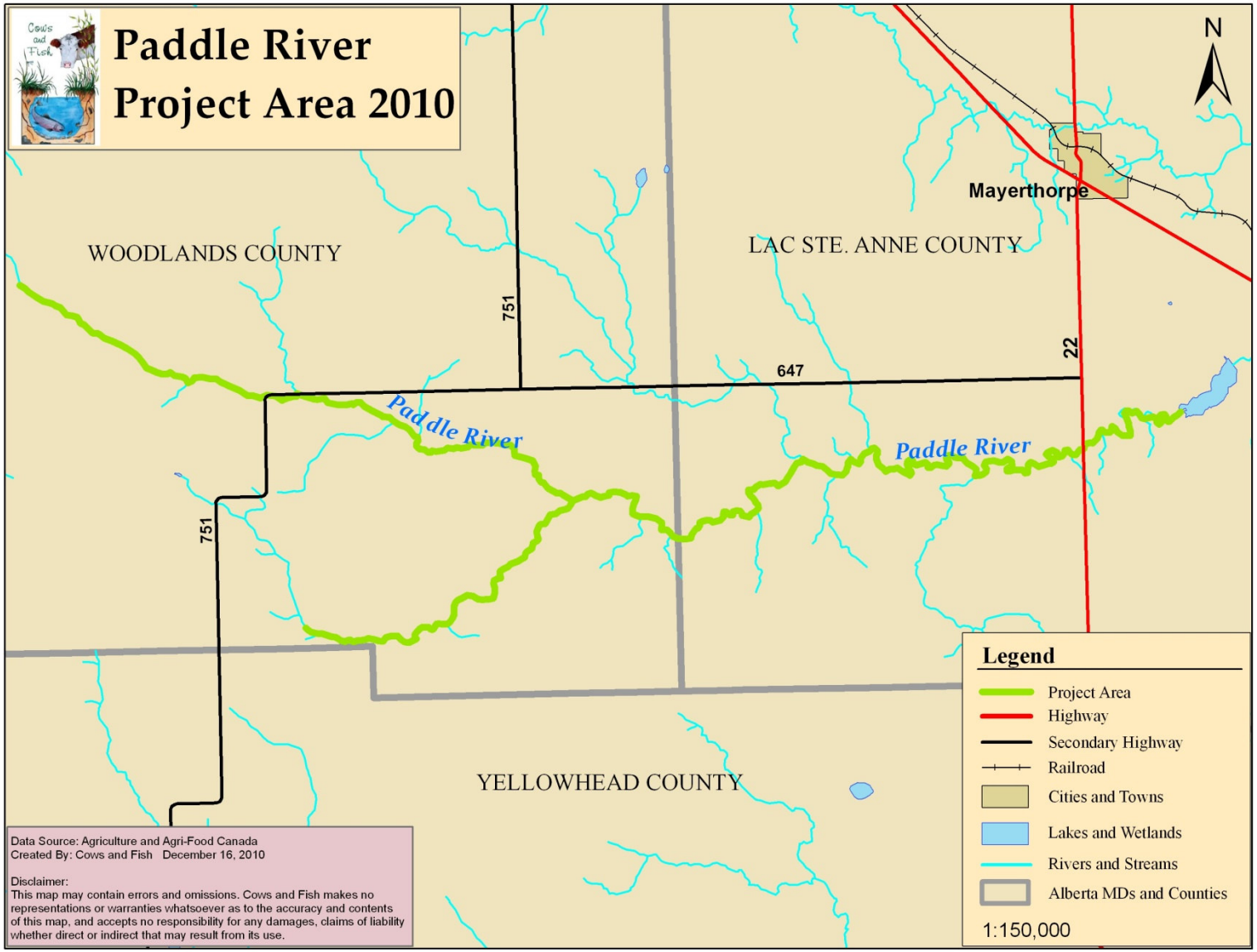


Figure 2 Paddle River Project Area (2010)

3.2 General Inventory Protocol

Riparian health parameters are visually assessed by trained observers in the field. A health rating is derived from this field data using a computer software program (FileMaker Pro).

A hand-held Garmin GPS60™ Global Positioning System (GPS) receiver is used to record the locations of the upstream and downstream ends of the site. For monitoring purposes, benchmark photographs looking upstream and downstream are taken at each end of the site. Additional photographs are taken where warranted to document features of interest or concern (e.g., weed infestations, bank erosion etc.). The lateral extent of the riparian area is subjectively determined in the field and mapped on an airphoto[3] (1: 5,000 to 1: 20,000 scale).

On creeks and small rivers both sides of the waterbody are inventoried as these generally have the same ownership and type of management. Within the Paddle River project area this is variable and some sites included both sides of the channel and others only one side depending on ownership, type of management, width and cross-ability of the channel. Landmarks such as fence lines, tributaries or other identifiable features are used, where possible, to delineate the ends of the site in order to facilitate monitoring the same section of river in the future. Inventory sites encompass a minimum of two meander cycles. A complete meander cycle has equal inside and outside curvature.

3.3 What Makes a Riparian Area "Healthy"

Riparian areas are like a jigsaw puzzle and each individual piece or component is important to the successful function of the entire system. How the individual pieces function together affects the health of the riparian ecosystem including the stream, its watershed, and overall landscape health and productivity.

Healthy riparian areas have the following *pieces* intact and functioning properly:

- successful reproduction and establishment of seedling, sapling and mature trees and shrubs (if site has potential to grow them),
- lightly browsed trees and shrubs (by livestock or wildlife),
- floodplains and banks with abundant plant growth,
- banks with deep-rooted plant species (trees and shrubs),
- very few, if any, invasive weeds (e.g. Canada thistle),
- not many disturbance-caused plant species (e.g. Kentucky bluegrass, dandelion),
- very little bare ground or altered banks, and
- ability to frequently (i.e. every few years) access a floodplain at least double the channel width.

When riparian health degrades it usually means that one or more of the pieces has been impacted by natural or human-caused disturbances such as development, recreation, grazing, flooding or fire. As the rate and intensity of disturbance increases, the severity of health degradation can reach a point when the riparian area fails to perform its functions properly and becomes

[3] Aerial photographs for the project were provided by Lac Ste. Anne County and Woodlands County. They were also sourced from Air Photo Services in Edmonton.

unhealthy. Riparian areas with moderate levels of impacts will typically fall within *the healthy, but with problems* category, while those with very few or no impacts will normally be rated as *healthy*. Generally, it is often difficult to see specific parameters decline in health, especially if the degradation occurs gradually over a long period of time.

Note: Refer to Appendix A for a glossary of terms used in this report

4 WHAT DID WE FIND?

4.1 Riparian Health Summary

In total, ten sites were assessed on nine landholdings within the project area. As mentioned previously, data from all ten sites is included in this summary. Overall, the average riparian health of these Paddle River sites is *healthy, but with problems* (66%). Weighted by area, the average is slightly higher (71%) but still within the *healthy but with problems* category. Due to the small number of sites inventoried these health ratings do not represent the health of the entire Paddle River watershed but do well represent the main stem of Paddle River upstream of the Paddle River Dam Reservoir.

Of the ten sites assessed, two (20%) rated *healthy*, four (40%) rated *healthy, but with problems*; and the remaining four (40%) rated *unhealthy* (Figure 3). Photos a - c (pages 8 & 9) show examples of riparian areas along the Paddle River in each of the three health categories.

Refer to **Appendix B** for average derived health scores for the entire project area.

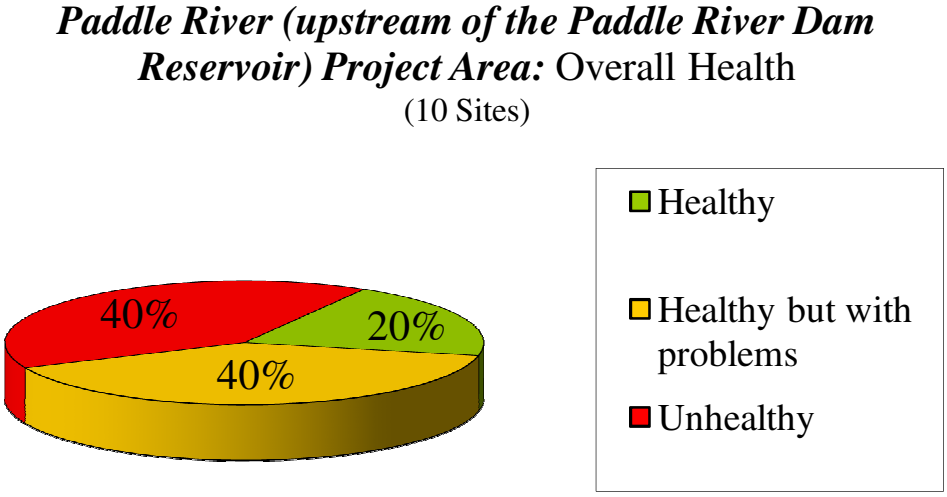


Figure 3 Paddle River Project Area Riparian Health Score Results

Please Keep in Mind:

The objective of completing these riparian health inventories is to provide a coarse filter review of the status of riparian health or function within the project area. The riparian health scores provide a general status of riparian health, not an absolute one. Riparian areas are dynamic and are constantly changing. Because of this natural variability, the range of possible scores in each category is broad and one assessment is only an approximation of health. Inventories over a period of years at the same locations will provide a better picture of whether current management is maintaining, improving or negatively impacting riparian health.

Example of a riparian area along Paddle River rated as "Healthy"

Photo a: Healthy plant community along banks and floodplain. A diversity of native trees, shrubs, grasses and forbs are present. Channel is narrow and banks are gently sloping (not incised). There are no visible physical alterations to the riparian area. (*Photographer: K. Adair, RHIP15PAD007*)

Example of a riparian area along Paddle River rated as "Healthy but with problems"

Photo b: Vegetation cover is excellent though the species composition has more introduced and invasive species (e.g. smooth brome and Canada thistle can be seen in the foreground). The banks are vegetated but steeper and the channel is lower in the floodplain indicating some incisement. New terraces of herbaceous perennial plants are well established within the high banks. (*Photographer: K. Adair, RHIP13PAD013*)

Example of a riparian area along Paddle River rated as "Unhealthy"

Photo c: Left bank has bare ground and physical alterations (hoof shear) adding to instability of the channel throughout the photo. There is a lack of preferred woody plants along the steep banks but there is some woody plant component present. (*Photographer: D. White, RHIP12PAD013)*

5 RIPARIAN HEALTH DISCUSSION

5.1 Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **Grazing animals (including livestock and wildlife)** have primarily dominated land use in Alberta's riparian zones for hundreds of years. Prior to the introduction of cattle, bison provided the greatest seasonal grazing pressures on riparian areas within the project area. Currently, livestock grazing continues to be the dominant land use influencing riparian health along Paddle River and adjacent lands[4].

- **Cropland cultivation** and tame pasture 'improvements' for grazing and hay, including some localised, prolonged continuous season-long grazing by livestock, have contributed to an increased presence of disturbance-caused undesirable plants within the riparian zones. Opinions vary on how these plant species, in particular Kentucky bluegrass (*Poa pratensis*) and smooth brome *(Bromus inermis*) should be viewed in terms of contributing to riparian health, but generally are thought to reduce long-term productivity of riparian systems.

- **Beaver** have been building and modifying riparian areas for thousands of years. Beaver "manage" riparian areas with their extensive dams and through their harvest of trees and shrubs. Over long periods of time stream valleys evolve under beaver management, however, in the short term this activity can conflict with our uses of riparian systems. There are a variety of techniques available[5] that deal with the management of beaver problems such as population control and water level control. Most importantly, we must recognise that Paddle River is a beaver-modified valley that is fragile and needs deep-rooted plants to resist down-cutting through accumulated sediment.

- **Availability and flow of water.** Paddle River is a variable system in terms of the amount of water that flows through it at different times of the year and between years. Many landowners commented that in the past several years the Paddle has stopped flowing. Others mentioned that they remember times when the water was so deep the animals couldn't cross. There are those major flood events when the entire valley was under water and some commented that the water came up fast but it didn't last long. It is possible that there has been a reduction in current water available to the Paddle River today due to land management changes over the past century (agricultural and industrial, including roads) within the Paddle River drainage. These impacts may have altered the natural dynamics of water flow and storage. Further studies or investigation of existing information on roads, water control structures, and agricultural impacts within the Paddle River drainage may provide insight into the future of water availability to the floodplains and riparian areas of the Paddle River project area.

[4] Based on aerial photo interpretation and observations from Cows and Fish field crews.
[5] The Beaver Handbook: A Guide to Understanding and Coping with Beaver Activity.

5.2 A Closer Look at the "Pieces"

To better understand the overall health ratings for the project area, it is helpful to take a closer at which pieces of the riparian area are intact and functioning and which area not. Figure 4 provides an overview of the health ratings (averaged by all sites) for each of the riparian health parameters that were assessed. Table 3 summarizes the vegetative, soil and hydrology and overall health ratings for the project area.

Table 3 Vegetative, Soil and Hydrology and Overall Heath Scores Average for All Sites in the Paddle River Project Area

# of Sites	Total Channel Length / Size of Riparian Area	Vegetative Health Rating (Average)	Soil & Hydrology Health Rating (Average)	Overall Health Rating (Average)	Overall Health Description (Average)
10	9.8 km / 25 ha	69%	63%	66%	Healthy but with problems

Collectively the vegetation parameters in the project area were rated as *healthy but with problems* (69%). Riparian areas are well vegetated with a diversity of plant species. Refer to **Appendix C** for a list of all plants found in the Paddle River project area.

Tree cover occupies approximately 26% of the project area, shrubs 62%, grass and grass-like plants 83% and forbs (broad leaf plants) 22%. Detracting from the vegetative health of riparian areas is a high amount of disturbance-caused grasses and forbs. The prevalence of invasive weeds also reduced the vegetative score. For example, Canada thistle covered 2.7% of the project area, and was found in all sites.

Soil/hydrology parameters in the project area were rated as *healthy but with problems* (63%). Human-caused bare ground is present in most areas and root mass protection along the banks is moderate. There are some concerns with human-caused alterations to the riverbanks and floodplain. Channel incisement scored the lowest for soil/hydrology parameters suggesting water in the channel does not get out on the floodplain on a regular basis which can over time affect riparian integrity and health.

Most of the impacts to vegetation and soil/ hydrology health are related to alterations caused by long-term agricultural use, although other land uses (e.g., construction) are also having a minor impact on riparian health.

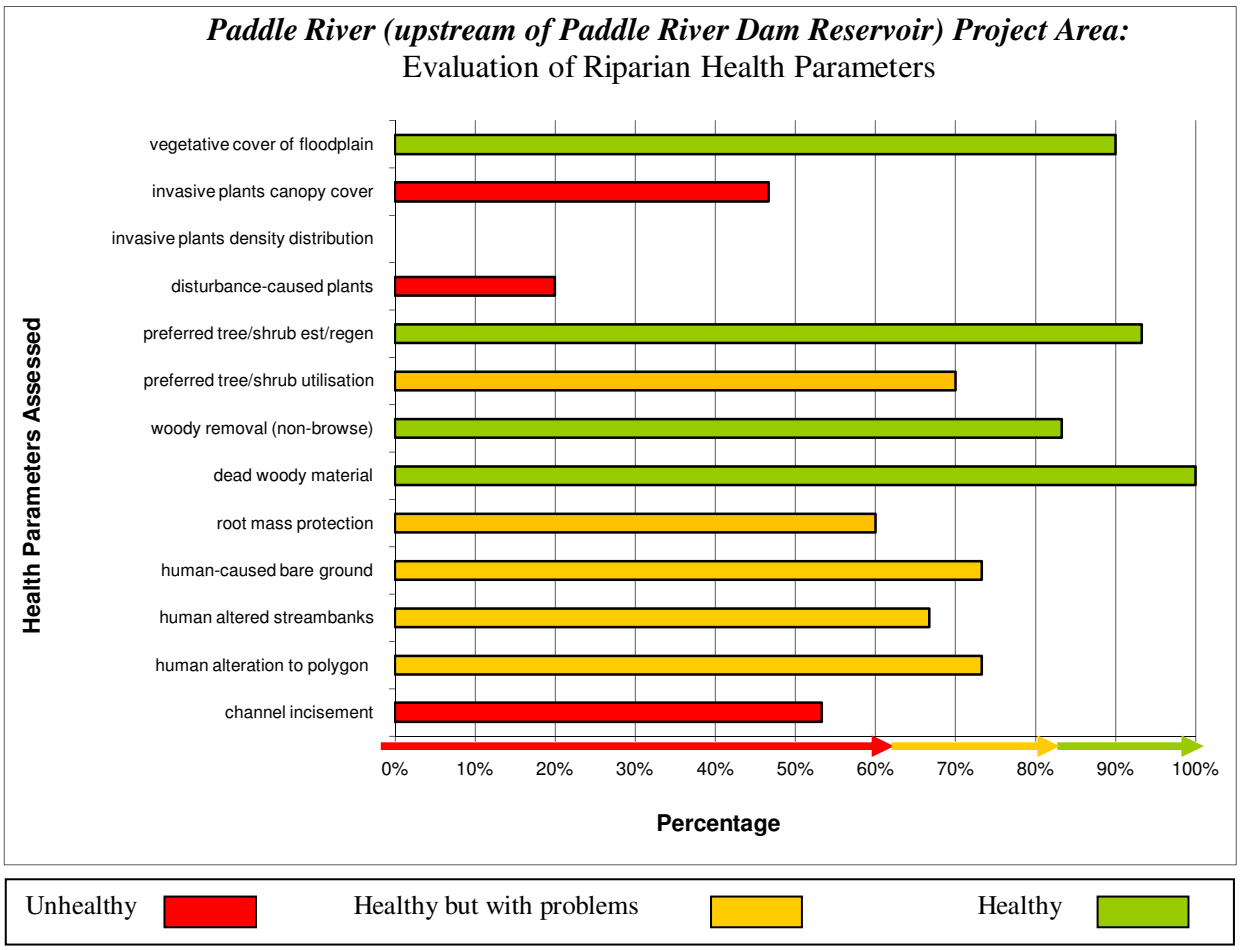


Figure 4 Breakdown of Riparian Health Parameter Ratings for Paddle River

5.3 Riparian Plant Communities

The vegetation health rating for a riparian area is determined by the types of riparian plant communities present, and the health of both the woody and non-woody (herbaceous) plant components (refer to Sections 5.4 and 5.5).

Background Information on Riparian Plant Communities

Typically, a particular species of willow or other shrub will form the understory of a poplar, cottonwood or spruce species, within a riparian area. On smaller systems willows might be the dominant plant in the upper canopy with sedges and smaller shrubs forming the understory. These different combinations of plants occupying the same ecological niche are referred to as the potential natural community. The potential natural community is comprised of **habitat types** and **community types**. Habitat types have the potential to support 'climax' or, final state, plant communities that are self-perpetuating and in dynamic equilibrium with their environment. Community types have the potential to support 'seral' or, interim, plant communities that are replaced by another community or species as succession progresses. Using this classification

system all the plant communities within the project area, whether habitat types or community types, were identified and stratified

Understanding the type of riparian plant communities a stream, lake, or wetland system has the potential to grow is important for a number of reasons. Firstly it allows land managers to know if the desired plant communities are growing there already and if not, why not? How extensive should the plant communities be? Secondly it provides insight into the feasibility of improving existing site conditions and recovering desired and healthier plant communities, if the desired plant community does not exist or is limited. Knowing how far existing plant communities are from the potential natural community of the riparian area allows managers to:

i. set realistic goals to either improve or maintain existing riparian health,
ii. understand how long recovery may take if improvement is needed, and
iii. obtain insight into what management strategies need to be implemented for improvement to occur or to maintain existing riparian health.

A well-known stockman, A.E. Cross, once stated, "Look after the grass, and the grass will look after you." If there is one thing a land manager, landowner or community can do to improve riparian health, it is to keep riparian plant communities healthy by using sustainable grazing management strategies and land use practices.

Paddle River Project Area Riparian Plant Communities

Tree and shrub plant communities form the majority of riparian communities found in the Paddle River project area (Table 4). An indicator of a healthy shrub understory is the presence of willows (*Salix spp.*) and red-osier dogwood (*Cornus stolonifera*) which are both highly palatable shrub species with deep binding root systems. Approximately 26% of the project area is occupied by final or 'climax' habitat types while 57% of the project area is occupied by those that are considered 'seral" or interim communities. The remainder of the project area is occupied by community types that could not be classified based on current information[6].

Table 4 Paddle River Riparian Plant Communities

Plant Community[6]	*Classification**	*Area Occupied (Hectares)*	*Area Occupied (%)*
Tree Communities			
balsam poplar/red-osier dogwood	Community Type	10.9	43
white spruce/low-bush cranberry	Habitat Type	1.6	6
balsam poplar	Community Type	0.6	2
	Tree Total	**13.1**	**51**

[6] The Riparian Classification for the Parkland and Dry Mixedwood Natural Region (Thompson and Hansen, July 2003) and Riparian Classification for the Grassland Natural Region (Thompson and Hansen, July 2000) were used to classify the riparian plant communities along Paddle River. The Grassland classification includes an adjacent fringe of various widths for the Foothills Parkland natural sub-region to the west.

Plant Community[6]	*Classification**	*Area Occupied (Hectares)*	*Area Occupied (%)*
Shrub Communities			
Bebb's (beaked) willow/awned sedge	Habitat Type	5.1	20
sandbar willow	Community Type	1.1	4
basket willow/awned sedge	Habitat Type	0.3	1
Bebb's (beaked) willow/red-osier dogwood	Habitat Type	0.2	0.8
	Shrub Total	**6.7**	**25.8**
Grass/Grass-like Communities			
bluejoint	Habitat Type	0.4	2
reed canary grass	Habitat Type	0.4	1.5
awned sedge	Habitat Type	0.2	0.8
	Grass/Grass-like Total	**1.0**	**4.3**
Unclassified Plant Communities			
Variety of woody & herbaceous species	Dominance Type	3.8	15

5.4 Woody Plants - Trees and Shrubs: Presence, Reproduction and Health

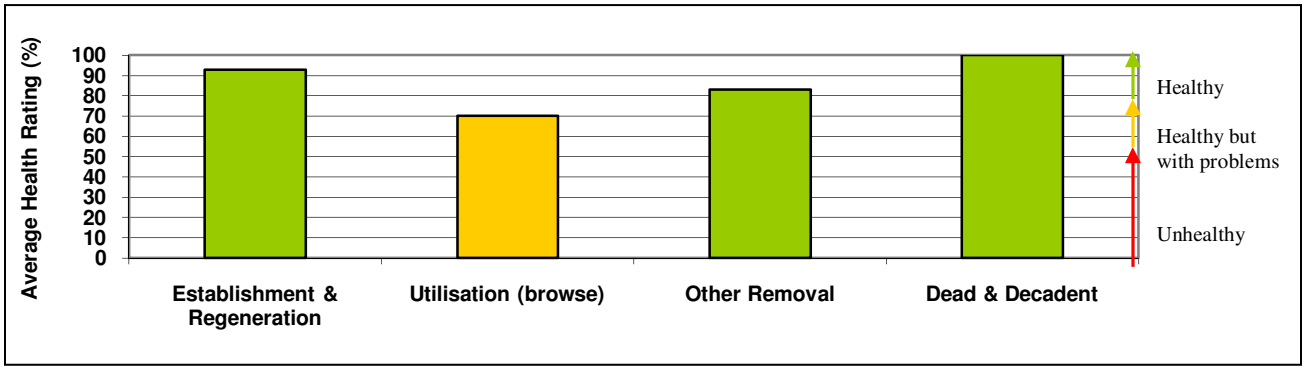


Figure 5 Paddle River Woody Plant Parameter Health Ratings

Presence

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides "habitat layers" – low, medium, and high, benefiting wildlife and livestock.

- Five tree species and 31 shrub species were recorded within the Paddle River project area. All of these woody plants, except two are native to Alberta (Appendix C).
- Total area covered by all trees and shrubs within the project area is 73%.

- White spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*) are the dominant trees occurring in the project area. Shrubs with a significant presence are buckbrush/snowberry (*Symphoricarpos occidentalis*), Drummond's willow (*Salix drummondiana*) and beaked/Bebb's willow (*Salix bebbiana*).
- 11 of the shrubs recorded are willow species and many others are indicative of moisture-rich habitats.

Reproduction

A good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young age classes. To maintain age class structure, at least 15% of the total cover of **preferred**[7] trees and shrubs should be comprised of seedlings and saplings. There are no concerns with the reproduction of preferred trees and shrubs in the project area. Successful preferred tree and/or shrub reproduction is occurring in almost every site inventoried (Photos d & f, page 21).

Health

Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy. This indicates there is sufficient moisture within the system, and that disease, insect infestation or spray drift is not a problem in maintaining these communities. In 50% of sites, preferred trees and shrubs species are receiving light browse pressure from livestock and wildlife. Woody plants can sustain low levels of use, but increased browsing can deplete root reserves and inhibit establishment and regeneration. Two sites display signs of heavy browse pressure. The indicators of heavy browse pressure are umbrella-shaped mature shrubs (photo e, page 21) and flat-topped or hedged seedling and saplings.

Removal of woody plants by means other than browse refers to loss of trees or shrubs due to beaver or human cutting. This type of removal can have similar negative impacts on riparian health as heavy browsing though they are direct and more immediate. On the Paddle River, beaver would have the largest influence on this parameter but despite the presence of beaver dams in many reaches of the Paddle River 60% of the sites (6 out of 10) show no evidence of their impact on the tree and shrub community.

How the Health of Trees and Shrubs Could Be Improved

Monitor browse pressure on trees and shrubs and reduce where heavier. Trees and shrubs that are considered preferred in terms of riparian health also tend to be those that are most palatable to livestock (e.g. red-osier dogwood). Browsing tends to occur most in the fall and winter after grasses have matured or in spring before grass begins growth. Early in the growing season, trees and shrubs are also very palatable along with the younger age class seedlings and saplings. Where there have been plantings of trees or shrubs along the riparian area it is highly recommended that livestock are excluded from those areas for the first years until the plantings can get established.

[7] Not all trees and shrubs are equally important, useful or desirable for maintaining ecological function. Only those that contribute most beneficially to riparian condition and stability are considered in evaluating establishment and regeneration.

5.5 Non-Woody Plants: Diversity and Health

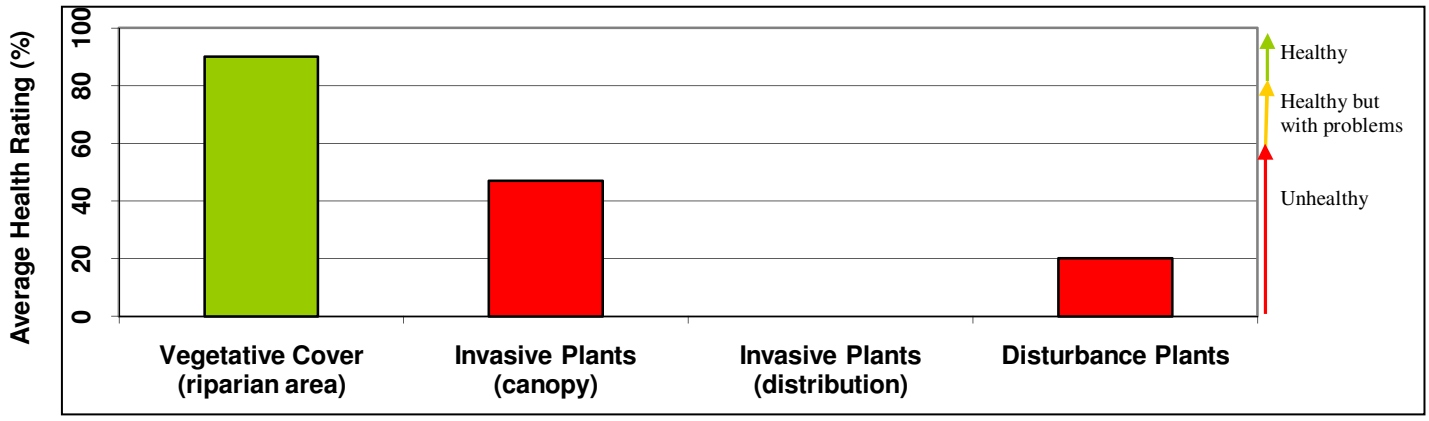


Figure 6 Paddle River Vegetation Cover and Composition Health Ratings

Diversity

Greater diversity lends to more robust and steady productivity over the long term and enhanced resilience to changes in the environment. An abundance of diversity in plant species occurs in the Paddle River project area:

- 27 species of grasses and grass-like plants and 81 species of broad-leaved plants (forbs) were recorded.
- 75% (108 species) of the non-woody plants recorded are native plants. Native plants provide riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife.
- Five plants with known poisonous and one with potentially poisonous characteristics were recorded within the project area: common horsetail (*Equisetum arvense*), red and white baneberry (*Actaea rubra*), water hemlock (*Cicuta maculata*), common tansy (*Tanacetum vulgare*), tall larkspur (*Delphinium glaucum)*, and milk vetch (*Astragalus spp.)* [may be poisonous]. None of these species are present in extremely large amounts but because of their potentially toxic nature to livestock in particular they are species to be aware of. If poisonous plants were found on any landowner's property, they are identified in the plant list within their individual report.

Health

All sites have adequate amounts (greater than 85%) of plant cover in the riparian area and most have greater than 95% cover. Disturbance-caused undesirable herbaceous species as well as invasive species are prevalent in the project area. Disturbance plants are typically non-native grasses and forbs (broad-leaved flowering plants) that aggressively displace native plants once the soil surface has been disturbed. Invasive plants are those that are listed by the *Weed Control Act of Alberta* as **restricted** or **noxious** weeds. They are non-native species that spread rapidly and are difficult to control.

- Seven of the ten sites have more than 50% of the riparian area covered in disturbance-caused undesirable herbaceous species. Overall, these species cover approximately 42% of the project area. Of the 21 disturbance-caused plants present, the most prevalent is

smooth brome[8]. Disturbance plants typically do not have a deep, binding root mass and therefore do not provide river bank protection as well as non-disturbance native species.

- Despite the abundance of disturbance-caused plants, native grasses and forbs continue to be maintained within the project area.
- **The prevalence of invasive plants is a concern.** Canada thistle (*Cirsium arvense*) was found in every site. Its distribution in the riparian area ranges from a few scattered individuals to a few patches plus several individual plants. Most sites fall into the latter category. Smooth perennial sow-thistle (*Sonchus uliginosus)* also occurs on all sites. Although it is present in much less abundance than Canada thistle, it too is distributed in a few patches with several individual plants throughout most sites. Tall buttercup (*Ranunculus acris*) occurs on four sites, common tansy on three sites; common caragana *(Caragana arborescens),* cleavers *(Galium aparine),* and yellow toadflax (*Linaria vulgaris*) occur on one site each. The cover and distribution of all of these additional invasive species is low though their presence could lead to future increased infestations. (Photo g, page 22) .

How the Health of Non-Woody Plants Could Be Improved

- **Prevent an increase in the presence of disturbance-caused plants.** Complete elimination of disturbance-caused plants is not realistic. However, with sound grazing strategies the prevalence of disturbance-caused plants could be reduced. From a grazing perspective, disturbance-caused plants do provide some forage for livestock at specific times of the year but require specific management, as they "green up" and mature earlier than most native grasses. Providing maximum rest during the growing season, skim grazing and time-controlled grazing management practices can be applied, to reduce the potential for an increase in these species while maintaining an abundance of native species.

- **Be aware of plants with poisonous properties.** Generally livestock will avoid grazing plants that can be potentially toxic to them if there is enough other forage or supplemental feed in the pasture to sustain them. Avoiding early season use and late season use may be beneficial in helping to prevent livestock losses from plant poisoning. Learning about each plant with poisonous characteristics to better understand when they may be most dangerous is also recommended.

- **Reduce the presence of invasive plants.** The abundance of invasive plants can fluctuate greatly from year to year and should therefore be monitored closely. The first step is to reduce the amount of exposed soil where invasive plants become established. Each landowner has been notified of these plants along with contact information for the municipal agricultural fieldman or local weed representative. In Woodlands County the Agricultural Fieldman is Dawn Fortin (780-584-3866, dawn.fortin@woodlands.ab.ca). In Lac Ste. Anne County the Agricultural Fieldman is Geoff Thompson (780-785-3411, gthompson@gov.lacsteanne.ab.ca).

[8] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded many rangelands over the past decades. Opinions vary on how these grasses should be viewed in terms of contributing to riparian or pasture health but generally are thought to reduce long-term productivity. For the purpose of this assessment, points were subtracted for the presence of these non-native species.

Where Efforts Could Be Focused

- Achieving the above goals requires ensuring plant communities have enough rest from grazing during the growing season to reduce the amount of bare ground and to allow native plants to out-compete disturbance-caused and invasive plants for nutrients and water. A combination of weed control measures and grazing strategies that consider distribution, timing of use and stocking rates will be required.

5.6 Streambanks and Floodplain

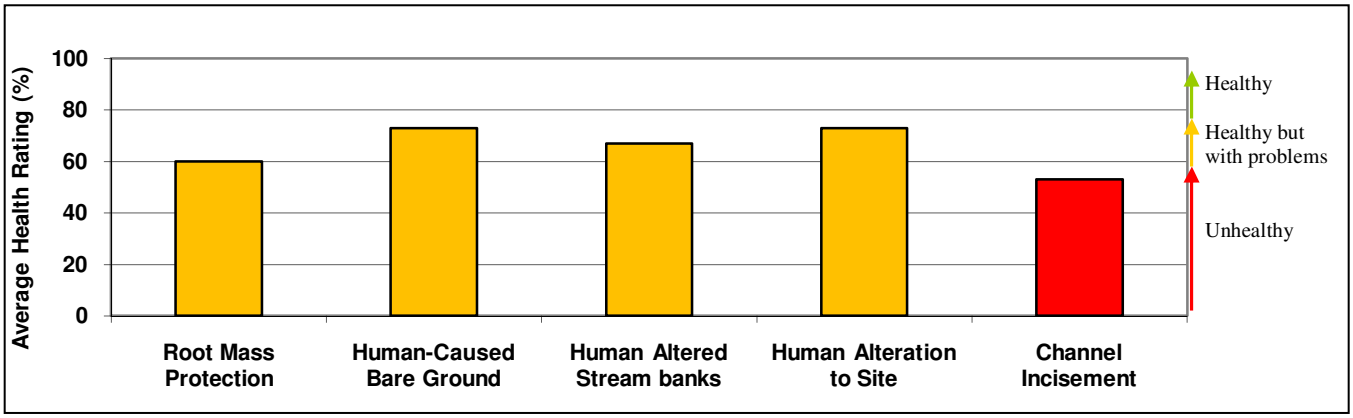


Figure 7 Paddle River Soil and Hydrology Health Rating

Stability

The role of riverbank vegetation is to maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. Healthy, well vegetated riparian areas slow the rate of erosion and balance erosion in one spot with bank increases through deposition elsewhere. If unstable banks are occasional, limited to a few outside meander bends, and the banks re-vegetate within a year, erosion rates are normal. Much of Paddle River bank inventoried has adequate amounts of deep, binding root mass however there are concerns with some portions of the bank being at risk of increased erosion (Photo h, page 22).

- Five of the ten sites within the project area have less than adequate amounts (<65%) of deep, binding root mass along the banks. This indicates there are portions of Paddle River that are vulnerable to erosion and lack the plant communities that are needed to help hold the bank and channel together. More than 85% of the streambank covered by vegetation with deep, binding roots is considered sufficient to protect riparian areas from excessive erosion and only three of the other five sites have this rating. The remaining two sites are in the middle with 65-85% deep binding root mass.

Bare Ground

Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Bare ground in riparian areas is often attributed to natural processes (sediment deposition from recent flood events). Bare ground can also result from activities like vehicle traffic, livestock hoof shear and trailing (photo j, page 22), recreational trails, timber harvest, and landscaping. Areas of natural or human-caused bare ground are susceptible to weedy species encroachment and erosion.

- The amount of bare ground overall in the project area is minimal at only 3% of the total area. The majority of this is caused by human activity or that of our agents (i.e. livestock). Depending on the site the amount of human-caused bare ground is highly variable ranging from less than 1% up to 15%.

Alterations to the Banks and Floodplain

Human-caused changes to the physical integrity of the riparian area affect the performance of many important functions. The human activities that can cause these alterations are similar to those that cause bare ground. When a riverbank is physically altered erosion can increase, mobilizing channel and bank materials, water quality can deteriorate and instability can increase within the reach and downstream. A key function of rest of the riparian area (beyond the bank and the floodplain) is to have abundant plants that filter and trap sediments. This builds a soil layer of moist, fine-textured material. Associated with this, roots and underground fauna create soil structure and macropores that allow water infiltration and storage. These types of soils are very susceptible to vehicle traffic, hoof action and compaction. Compaction reduces infiltration into the soil which increases runoff, limits groundwater storage and hinders plant growth.

- Overall, the banks of Paddle River are in fair condition with 14% of the bank length within the project area having structural alterations caused by human activities. Almost all (98%) of the alterations are due to grazing activities. Only one site had more than 35% of bank length structurally altered by human activity. Half of the sites had 5% to and 35% altered bank with the remaining three sites having less than 5% altered bank.
- The riparian area beyond the banks is slightly better. Overall, about 8% of the project area (excluding the banks) has human caused alterations. Five of the ten sites have less than 5% of this area physically altered by human causes. The remainder have 5% to 25% alterations. Soil compaction as a result of primarily grazing accounts for the alterations. A small amount could be attributed to construction or use of machinery.

Channel Incisement

Incisement is vertical (lowering) erosion of the channel including the bed and banks and either dynamic can impact the ability of a stream or river to flood. This impact can be evident by downcutting or lateral (widening) cutting of the channel. Periodic flood events are important to disperse moisture throughout the riparian area for the maintenance of riparian vegetation. Flooding also spreads the energy of moving water over the riparian area, allowing sediment to be deposited and creating new areas for seedling establishment.

- Regular, high water events rarely access the highest terraces of the floodplain according to many of the landowners we spoke to.
- By averaging the incisement on all sites, overall the Paddle River would be considered moderately incised. However, within the Paddle River project area, the degree of incisement changes throughout the length of project area.
- The upper sections are not incised and waters can access a wide floodplain at least every few years. There has been little to no lowering of the channel bed or downcutting. Perennial riparian vegetation is well established along the banks and throughout the floodplain.
- The middle sections are characterised by steeper banks and a channel bed that is much lower than the top of the bank making access to the floodplain difficult unless there is a very large rain event or snow melt. If there is a lower floodplain developing within the channel, it is starting to become vegetated but there are areas where the banks are lacking vegetation strong vegetation (photo i, page 22).
- The lower sections, closer to the reservoir, are slightly incised and in some cases the channel bed is wider than it is deep. There is an adequate floodplain accessible every few years, though it's narrower than it may have been, and riparian vegetation is well established along it.

How Health of Stream banks and Floodplains Could Be Improved

- ***Reduce livestock access and other human activities along the banks and within the active floodplain*** to allow structurally altered and damaged areas time to heal and the potential exists for this recovery. Limiting livestock access with distribution tools (photo k, page 23), rotation and timing will provide opportunity for areas of bare ground to become vegetated, for deep-rooted woody plants to become established or continue to grow. These plants will help trap sediment to rebuild stream banks, and protect against lateral cutting and erosion. Once again, rest is needed during the sensitive portions of the growing season such as early spring to promote recovery.

- ***Channel incisement*** is a difficult aspect of riparian health to understand and manage. Sometimes it is a part of the natural process of a stream as it makes its way from a higher gradient to a lower gradient. However, incisement can also be a result of changes in the watershed that might create more water volume and energy in the stream at times that are not "normal". When water has more energy it has more power to erode laterally and vertically and thus a stream can become incised. For example, culverts and road crossings that are improperly placed or sized can have this effect. Loss of critical tree and shrub communities along the length of the Paddle River (and within the watershed) can also increase channel incisement because the buffer, which can slow down water and thus reduce water energy, is removed. Restoring tree and shrub communities and maintaining existing vegetation in riparian areas will reduce the rate at which incisement may continue. It can also assist by trapping sediment to begin the process of recovery even thought it may never be restored to the stage it once was. It may also be necessary to look at the rest of the watershed to manage and reduce increased runoff and to address other potential issues that may be influencing this parameter of riparian health.

Vegetation health parameter photos

Photo d: Sign of balsam poplar regeneration within the riparian area. These seedlings and saplings represent the future of the woody plant community along the Paddle River. Although poplar is a seral stage of the mixed wood forest, they are necessary for promoting succession. (*Photographer: D. White, RHIP16PAD012*).

Photo e: Long term browse utilisation on woody plants is apparent here in the umbrella or mushroom shape of the mature willows. Snowberry/buckbrush in the understory indicates heavier pressure in the past as well. We can learn a lot from plant communities. (*Photographer: D. White, RHIP12PAD006*).

Vegetation health parameter photos

Photo f: Young willows growing along the bank and lower floodplain represents the potential for the slightly wetter portion of the riparian area. These deep rooted woody plants will trap sediment, bind the existing soil and promote both physical and vegetation recovery in the riparian area. (*Photographer: K. Adair, RHIP17PAD012*).

Photo g: A patch of Canada thistle in the riparian area can quickly spread, even among the most well-vegetated of sites, if it is not managed. (*Photographer: K. Adair, RHIP15PAD012*).

Soil / hydrology health parameter photos

Photo h: Slumping occurring along a stretch of bank (left side) lacking deep rooted woody plants. The right side is well protected. (*Photographer: D. White, RHIP09PAD002*).

Photo j: Steep banks on both sides of the channel indicate downcutting in the past. This can be a deterrent to livestock access. Maintaining vegetation cover on these sensitive banks is key for overall riparian health. (*Photographer: K. Adair, RHIP05PAD002*).

Soil / hydrology health parameter photos

Photo j: Trailing close to the water edge creates compaction and bare soil, adding to alteration of the physical structure and making this bank vulnerable to erosion and weed infestations. (*Photographer: D. White, RHIP11PAD012*)

Photo k: Alternative water systems such as this one are an excellent tool for limiting or removing livestock access to surface water. If equipment and lift allowed, this system could be placed further back to avoid the sensitive steep slope behind it. (*Photographer: D. White, RHIP12PAD017*)

6 THE NEXT STEPS

6.1 Community and Individual Action

- ***Take stock of current and past conditions.*** The first step in addressing riparian management issues has been made; the collection of baseline information on riparian health and a review of historical land use practices have answered the question ***"Where are we now?"***

- ***Highlight and profile what's working on the landscape right now.*** The next step is to use this knowledge, along with the application of sound range and riparian management techniques, towards the restoration of riparian health. By working with landowners wanting to improve riparian health, practical examples of proper riparian management can be demonstrated to other landowners and communities. Landowners already managing healthy riparian areas in the area can be profiled, meaning their "good news" stories can be shared with others to speed up our knowledge of what works. As these sites yield results, the landowners of Ranchers of the Jumping Pound will be closer to answering the question ***"Where do we want to go?"***

- ***Take control of the reins.*** Every participating landowner has received a report on the riparian health for their landholding indicating what pieces of riparian health are there and what might be missing. Within these landowner reports are some basic range management principles specific to their riparian pastures, providing insight into the question ***"How do we get there?"***

- ***Continue riparian inventory work over the long-term.*** Monitor progress of community and individual effort to address riparian land use issues. With the application of sound range management principles on an individual and watershed basis, it is inevitable that the trend in riparian health will be positive over time. Long-term riparian monitoring and refinement in management will answer the question ***"Did we make it?"***

  - A single evaluation cannot define the absolute status of site health. To measure trend (improving, declining or staying the same) monitoring should be pursued in subsequent years. Establishing demonstration and profile sites, or another overall riparian inventory can achieve this – every 3 to 5 years.

  - The field workbook Riparian Health Assessment for Streams & Small Rivers is available from Cows and Fish. This workbook explains how to conduct a riparian health assessment, or rapid survey, to quickly check the health status of your riparian area. This tool will allow landowners and managers to monitor and track their own progress regarding riparian health.

  - Management objectives should include maintaining the existing tree and shrub communities as well as the diversity of herbaceous plants.

  - Restoration of healthy woody plant communities will be slow. However, some improvement should be recognised within a few years, depending on the commitment

of the individual, riparian site potential and the riparian management strategy implemented.

6.2 Management Objectives

- ***Management objectives should include:***

  - Establishing new and maintaining the existing healthy tree and shrub communities.
  -
  - Increasing and maintaining successful regeneration and subsequent canopy cover of trees and shrubs in the understory.

  - Reducing browse utilisation of trees and shrubs by livestock in reaches identified.

  - Monitoring removal of woody plant communities by means other than browse (human or beaver).

  - Reducing expansion of disturbance-caused plants. It is unrealistic to set a goal of completely removing these plants once established in riparian areas, however, sound grazing practices can be effective in reducing the prevalence of disturbance-caused plants.

  - Monitoring existing invasive plant infestations. Weed control may be necessary to reduce and prevent the expansion of invasive plants now that they are established. The Counties are often your best source for identification and control options. The Alberta Invasive Plant Council also has excellent resources for better understanding invasive plants and their management.

  - Increasing and maintaining the amount of vegetation with deep binding root mass along the riverbanks. This will be achieved by the continued successful regeneration of trees and shrubs.

  - Reducing livestock access to riverbanks and active floodplain to allow structurally altered and damaged areas time to heal. There is excellent potential for recovery of the areas with human-caused alterations..

  - Limiting the amount of human-caused bare ground being created by livestock.

Many of these livestock related management objectives can be achieved through consideration of timing of use, animal numbers, length of grazing versus rest periods and use of distribution tools such as salt and mineral placement, appropriately sized alternative watering systems, and/or fencing.

Range management ideas for accomplishing the objectives listed above are highlighted in ***Caring for the Green Zone: Riparian areas and Grazing Management*** *(included with this report). Additional copies are available from Cows and Fish.*

6.3 How to Contact Us

The Cows and Fish emphasis is to help individuals, municipalities and local communities address riparian management issues on a watershed basis by increasing awareness and obtaining baseline riparian health information. This riparian health inventory enables local communities and managers to identify and effectively develop plans to address specific land use issues. Working locally to develop common goals and objectives for entire watersheds is rewarding – it helps keep people invested in natural landscapes. Riparian management tools developed with the community allow people to improve landscape health, for their benefit and for others who use and enjoy these green zones.

To inquire about additional references for riparian health monitoring and management, and for further information on any aspect of this report, please contact:

Kerri O'Shaughnessy
Riparian Specialist
Alberta Riparian Habitat Management Society – Cows and Fish
Tel: (780) 427-7940
Fax: (780) 422-9745
Email: koshaugh@cowsandfish.org

APPENDIX A: GLOSSARY OF TERMS

Alluvial – deposited by running water. Recent alluvial bars are an accumulation of sediments deposited by floodwater in the current season.

Bankfull channel width – width of a stream channel at the point where high water will begin to escape the channel during floods. This point may be determined by: the elevation at the top of depositional features like sand, silt or gravel bars; changes in bank material from coarse substrate within an active channel to deposited material of a smaller size; or exposed roots below an intact, vegetated soil layer indicating erosion.

Canopy cover – the ground area covered by vegetative growth. Different plant species can provide varying degrees of cover depending on their overall size and abundance. Total canopy cover can be greater than the area being studied due to overlap in plant structural layers.

Climax (plant) community – Refers to the final or steady state plant community which is self-perpetuating and in dynamic equilibrium with its environment. Also known as *Potential Natural Community.*

Community type – An aggregation of all plant communities distinguished by floristic and structural similarities in both overstory and undergrowth layers. ***For the purposes of this document, a community type represents seral vegetation, and is never considered to be climax.***

Disturbance-caused undesirable herbaceous species – native or introduced non-woody plant species that are well adapted to disturbance or an environment of continual stress. This term *does not* include invasive plant species.

Floodplain – the land base alongside a stream that has the potential to be flooded during high water events.

Habitat type – the land area that supports, or has the potential to support, the same primary climax vegetation. It is based on the potential of the site to produce a specific plant community (plant association).

Hoof shear – pieces of bank broken off as a result of hoofed animals walking along the stream edge.

Human-caused bare ground – areas devoid of vegetation as a result of human activity. This can include vehicle roads, recreational trails and livestock trampling.

Invasive plant species – these are typically weed species classified as *noxious* or *restricted* by your municipal district or county and have the potential to infest riparian areas.

Lotic – this term means *flowing water* (i.e., streams and rivers).

Pointbar – areas along the stream edge where sediment has been naturally deposited by moving water. These typically occur on the inside portion of a channel bend. Also known as a *sandbar or alluvial bar.*

Polygon – term used to describe a riparian inventory site. On lotic systems, a polygon has an upstream and downstream end along a reach of a stream and an associated riparian width. The lateral extent (width) of the riparian area is subjectively determined in the field based on vegetation and terrain clues indicating the flood prone area.

Pugging and Hummocking – the depressions (pugging) and raised mounds of soil (hummocking) resulting from large animals walking through soft or moist soil.

Reach – section of a stream or river with similar physical and vegetative features and similar management influences.

Stream channel incisement – the degree of downward erosion within the channel bed.

Structural alteration – physical changes to the shape or contour of the streambank caused by human influences. Some examples are livestock crossings, culverts and 'riprap'

Tree and shrub regeneration – the presence of seedlings and saplings, or the 'new growth'.

Woody plant species – simply refers to trees and shrubs. These plants serve different riparian functions than grasses and broad-leaf plants.

APPENDIX B: RIPARIAN HEALTH SCORE SHEET - PADDLE RIVER PROJECT AREA

	Average		
Riparian Parameter	**Actual Score**	**Possible Score**	
Vegetation			
1. Vegetative Cover of Floodplain and Streambanks	5.4	6	
2a. Invasive Plant Species Canopy Cover	1.4	3	
2b. Invasive Plant Species Density Distribution	0	3	
3. Disturbance-Caused Undesirable Herbaceous Species	0.6	3	
4. Preferred Tree and Shrub Establishment and Regeneration	5.6	6	
5a. Utilisation of Preferred Trees and Shrubs	2.1	3	
5b. Woody Vegetation Removal by Other than Browsing	2.5	3	
6. Decadent and Dead Woody Material	3	3	
Vegetation Subtotal:	***20.6***	***30***	***69 %***
Soil/Hydrology			
7. Streambank Root Mass Protection	3.6	6	
8. Human-Caused Bare Ground	4.4	6	
9. Streambank Structurally Altered	4	6	
10. Human Alteration to Site	2.2	3	
11. Stream Channel Incisement	4.8	9	
Soil/Hydrology Subtotal:	***19***	***30***	***63 %***
Project Area Total:	***39.6***	***60***	***66 %****

	Healthy (80-100%)		**Healthy but with Problems (60-79%)**		**Unhealthy (<60%)**

*When weighted by area, the overall average health rating is 71% (*healthy but with problems*).

APPENDIX C: RIPARIAN PLANT INVENTORY - PADDLE RIVER PROJECT AREA

			Percent Canopy Cover[2]		
LIFEFORM common name (Scientific name)	Plant Status[1]	Area by Species (acres)	Average	MAX Cover Range	Constancy[3]
TREES					
balsam poplar (Populus balsamifera)	native	9.507	15.19%	30.00%	100%
white spruce (Picea glauca)	native	5.245	10.68%	20.00%	90%
white birch (Betula papyrifera)	native	1.841	4.72%	10.00%	50%
aspen (Populus tremuloides)	native	0.137	0.50%	0.50%	40%
Alaska birch (Betula neoalaskana)	native	0.087	0.50%	0.50%	20%
SHRUBS					
buckbrush/snowberry (Symphoricarpos occidentalis)	native	10.384	19.92%	60.00%	90%
Drummond's willow (Salix drummondiana)	native	7.004	14.26%	30.00%	90%
beaked willow (Salix bebbiana)	native	5.653	9.03%	20.00%	100%
sandbar willow (Salix exigua)	native	2.707	7.74%	10.00%	40%
common wild rose (Rosa woodsii)	native	2.407	4.06%	10.00%	90%
red-osier dogwood (Cornus stolonifera)	native	2.166	3.46%	10.00%	100%
Saskatoon (Amelanchier alnifolia)	native	1.797	3.03%	20.00%	90%
river alder (Alnus tenuifolia)	native	1.479	3.12%	10.00%	50%
wild red raspberry (Rubus idaeus)	native	1.226	1.96%	10.00%	100%
balsam willow (Salix pyrifolia)	native	1.113	2.50%	3.00%	70%
flat-leaved willow (Salix planifolia)	native	1.067	7.33%	10.00%	20%
basket willow (Salix petiolaris)	native	0.882	2.68%	10.00%	40%
shining willow (Salix lucida)	native	0.852	2.29%	3.00%	30%
common caragana (Caragana arborescens)	invasive, introduced	0.395	3.00%	3.00%	10%
dusky willow (Salix melanopsis)	native	0.395	3.00%	3.00%	10%
bracted honeysuckle (Lonicera involucrata)	native	0.391	1.51%	3.00%	40%
firm leaf willow (Salix pseudomyrsinites)	native	0.380	1.61%	3.00%	20%
northern gooseberry (Ribes oxyacanthoides)	native	0.289	0.50%	0.50%	80%
choke cherry (Prunus virginiana)	native	0.205	1.34%	3.00%	50%
yellow willow (Salix lutea)	native	0.186	0.50%	0.50%	30%
Canada buffaloberry (Shepherdia canadensis)	native	0.169	0.50%	0.50%	40%
bunchberry (Cornus canadensis)	native	0.152	0.50%	0.50%	30%
low-bush cranberry (Viburnum edule)	native	0.118	0.50%	0.50%	20%

SHRUBS continued					
prickly rose (Rosa acicularis)	native	0.108	0.50%	0.50%	30%
silverberry (Elaeagnus commutata)	native	0.066	0.50%	0.50%	10%
common bearberry (Arctostaphylos uva-ursi)	native	0.052	0.50%	0.50%	10%
dwarf birch (Betula pumila)	native	0.052	0.50%	0.50%	10%
dewberry (Rubus pubescens)	native	0.052	0.50%	0.50%	10%
false mountain willow (Salix pseudomonticola)	native	0.034	0.50%	0.50%	10%
willow (Salix spp.)	unknown, not unique	0.026	0.50%	0.50%	10%
tatarian honeysuckle (Lonicera tatarica)	introduced	0.020	0.50%	0.50%	10%

GRASSES AND GRASS-LIKES					
smooth brome (Bromus inermis)	disturbance, introduced	17.388	27.78%	60.00%	100%
awned sedge (Carex atherodes)	native	9.955	20.27%	50.00%	90%
bluejoint (Calamagrostis canadensis)	native	5.086	14.15%	30.00%	80%
small-fruited bulrush (Scirpus microcarpus)	native	4.552	7.27%	10.00%	100%
Kentucky bluegrass (Poa pratensis)	disturbance, introduced	3.727	6.10%	10.00%	90%
redtop (Agrostis stolonifera)	introduced	2.665	10.00%	10.00%	20%
quack grass (Agropyron repens)	disturbance, introduced	2.330	4.18%	10.00%	90%
timothy (Phleum pratense)	disturbance, introduced	2.199	4.26%	10.00%	80%
reed canary grass (Phalaris arundinacea)	native	1.278	2.04%	10.00%	100%
common tall manna grass (Glyceria grandis)	native	0.999	1.60%	10.00%	100%
slender wheat grass (Agropyron trachycaulum var. unilaterale)	NOT IN MOSS	0.736	4.10%	10.00%	30%
small bottle sedge (Carex utriculata)	native	0.568	3.61%	10.00%	40%
fowl bluegrass (Poa palustris)	native	0.468	0.79%	3.00%	90%
fringed brome (Bromus ciliatus)	native	0.314	3.00%	3.00%	10%
foxtail barley (Hordeum jubatum)	disturbance, native	0.227	0.79%	3.00%	60%
alpine rush (Juncus alpinoarticulatus)	native	0.212	0.50%	0.50%	50%
slough grass (Beckmannia syzigachne)	native	0.209	0.50%	0.50%	70%
water sedge (Carex aquatilis)	native	0.208	0.84%	3.00%	40%
hairy wild rye (Elymus innovatus)	native	0.186	0.50%	0.50%	30%
creeping spike-rush (Eleocharis palustris)	native	0.133	0.50%	0.50%	20%
creeping meadow foxtail (Alopecurus arundinaceus)	introduced	0.067	0.50%	0.50%	10%
toad rush (Juncus bufonius)	native	0.067	0.50%	0.50%	10%
slender wheat grass (Agropyron trachycaulum)	native	0.058	0.50%	0.50%	20%
sedge (Carex spp.)	unknown, not unique	0.052	0.50%	0.50%	10%
short-awn meadow-foxtail (Alopecurus aequalis)	native	0.030	0.50%	0.50%	30%

GRASSES AND GRASS-LIKES continued					
meadow foxtail (Alopecurus pratensis)	introduced	0.017	0.50%	0.50%	10%
short-awned sedge (Carex microglochin)	native	0.017	0.50%	0.50%	10%

FORBS					
common dandelion (Taraxacum officinale)	disturbance, introduced	1.801	3.23%	10.00%	90%
Canada thistle (Cirsium arvense)	invasive, introduced	1.697	2.71%	10.00%	100%
common horsetail (Equisetum arvense)	native, poisonous	1.564	2.50%	10.00%	100%
white sweet-clover (Melilotus alba)	disturbance, introduced	1.361	3.25%	10.00%	70%
alsike clover (Trifolium hybridum)	disturbance, introduced	1.240	2.02%	3.00%	90%
Canada goldenrod (Solidago canadensis)	native	1.019	2.06%	10.00%	90%
Canada anemone (Anemone canadensis)	native	0.746	1.19%	3.00%	100%
yellow sweet-clover (Melilotus officinalis)	disturbance, introduced	0.567	1.19%	3.00%	70%
agrimony (Agrimonia striata)	native	0.539	1.28%	3.00%	70%
red clover (Trifolium pratense)	disturbance, introduced	0.451	1.85%	3.00%	50%
cow parsnip (Heracleum lanatum)	native	0.446	1.03%	3.00%	60%
nodding beggarticks (Bidens cernua)	native	0.395	0.94%	3.00%	70%
yellow lucerne (Medicago falcata)	introduced	0.395	3.00%	3.00%	10%
purple-stemmed aster (Aster puniceus)	native	0.372	1.68%	3.00%	40%
veiny meadow rue (Thalictrum venulosum)	native	0.330	0.67%	3.00%	90%
common plantain (Plantago major)	disturbance, introduced	0.314	0.68%	3.00%	60%
many-flowered yarrow (Achillea sibirica)	native	0.313	0.50%	0.50%	100%
wild strawberry (Fragaria virginiana)	disturbance, native	0.313	0.50%	0.50%	100%
smooth perennial sow-thistle (Sonchus uliginosus)	invasive, introduced	0.313	0.50%	0.50%	100%
common yarrow (Achillea millefolium)	native	0.307	0.50%	0.50%	90%
northern bedstraw (Galium boreale)	native	0.296	0.50%	0.50%	90%
wild vetch (Vicia americana)	native	0.296	0.50%	0.50%	90%
curled dock (Rumex crispus)	introduced	0.271	0.50%	0.50%	80%
yellow avens (Geum aleppicum)	native	0.254	0.50%	0.50%	60%
western willow aster (Aster hesperius)	native	0.253	0.50%	0.50%	80%
wild mint (Mentha arvensis)	native	0.222	0.50%	0.50%	60%
hemp-nettle (Galeopsis tetrahit)	disturbance, introduced	0.211	0.50%	0.50%	80%
plains wormwood (Artemisia campestris)	native	0.193	0.50%	0.50%	60%
northern willowherb (Epilobium ciliatum)	native	0.184	0.50%	0.50%	40%
common fireweed (Epilobium angustifolium)	native	0.178	0.50%	0.50%	40%
star-flowered Solomon's-seal (Smilacina stellata)	native	0.178	0.50%	0.50%	70%

FORBS continued					
red and white baneberry (Actaea rubra)	native, poisonous	0.175	0.50%	0.50%	50%
stinkweed (Thlaspi arvense)	disturbance, introduced	0.170	0.50%	0.50%	40%
knotweed (Polygonum monspeliense)	introduced	0.167	0.50%	0.50%	50%
water-hemlock (Cicuta maculata)	native, poisonous	0.157	0.50%	0.50%	40%
common mare's-tail (Hippuris vulgaris)	native	0.157	0.50%	0.50%	40%
silverweed (Potentilla anserina)	disturbance, native	0.154	0.50%	0.50%	30%
common nettle (Urtica dioica)	native	0.145	0.50%	0.50%	70%
tall buttercup (Ranunculus acris)	invasive, introduced	0.145	0.50%	0.50%	40%
smooth aster (Aster laevis)	native	0.135	0.50%	0.50%	50%
rough cinquefoil (Potentilla norvegica)	disturbance, native	0.135	0.50%	0.50%	30%
marsh hedge-nettle (Stachys palustris)	native	0.129	0.50%	0.50%	60%
common scouring-rush (Equisetum hyemale)	native	0.117	0.50%	0.50%	30%
white clover (Trifolium repens)	disturbance, introduced	0.100	3.00%	3.00%	10%
common tansy (Tanacetum vulgare)	invasive, introduced, poisonous	0.094	0.50%	0.50%	30%
giant hyssop (Agastache foeniculum)	native	0.087	0.50%	0.50%	20%
common red paintbrush (Castilleja miniata)	native	0.087	0.50%	0.50%	20%
cream-colored vetchling (Lathyrus ochroleucus)	native	0.087	0.50%	0.50%	20%
tall lungwort (Mertensia paniculata)	native	0.087	0.50%	0.50%	20%
palmate-leaved coltsfoot (Petasites palmatus)	native	0.087	0.50%	0.50%	20%
arrow-leaved coltsfoot (Petasites sagittatus)	native	0.087	0.50%	0.50%	20%
black medick (Medicago lupulina)	introduced	0.073	0.50%	0.50%	20%
milk vetch (Astragalus spp.)	unknown, not unique, may be poisonous	0.069	0.50%	0.50%	20%
flixweed; tansy mustard (Descurainia sophia)	disturbance, introduced	0.069	0.50%	0.50%	40%
water smartweed (Polygonum coccineum)	native	0.069	0.50%	0.50%	40%
tall larkspur (Delphinium glaucum)	native, poisonous	0.068	0.50%	0.50%	30%
goosefoot (Chenopodium pratericola)	native	0.067	0.50%	0.50%	10%
narrow-leaved hawkweed (Hieracium umbellatum)	native	0.067	0.50%	0.50%	10%
common pepper-grass (Lepidium densiflorum)	introduced	0.067	0.50%	0.50%	10%
wild sarsaparilla (Aralia nudicaulis)	native	0.066	0.50%	0.50%	10%
showy aster (Aster conspicuus)	native	0.066	0.50%	0.50%	10%
common cattail (Typha latifolia)	native	0.066	0.50%	0.50%	10%
large-leaved yellow avens (Geum macrophyllum)	native	0.060	0.50%	0.50%	20%
bull thistle (Cirsium vulgare)	introduced	0.055	0.50%	0.50%	20%

FORBS continued					
Philadelphia fleabane (Erigeron philadelphicus)	native	0.052	0.50%	0.50%	10%
woodland strawberry (Fragaria vesca)	disturbance, native	0.052	0.50%	0.50%	10%
cleavers (Galium aparine)	invasive, introduced	0.052	0.50%	0.50%	10%
spreading sweet cicely (Osmorhiza depauperata)	native	0.052	0.50%	0.50%	10%
kidney-leaved violet (Viola renifolia)	native	0.052	0.50%	0.50%	10%
alfalfa (Medicago sativa)	introduced	0.046	0.50%	0.50%	20%
lamb's-quarters (Chenopodium album)	disturbance, introduced	0.034	0.50%	0.50%	30%
absinthe wormwood (Artemisia absinthium)	introduced	0.026	0.50%	0.50%	10%
purple avens (Geum rivale)	native	0.026	0.50%	0.50%	10%
northern hedysarum (Hedysarum boreale)	native	0.026	0.50%	0.50%	10%
water parsnip (Sium suave)	native	0.026	0.50%	0.50%	10%
creeping white prairie aster (Aster falcatus)	native	0.024	0.50%	0.50%	20%
common tall sunflower (Helianthus nuttallii)	native	0.020	0.50%	0.50%	10%
biennial sagewort (Artemisia biennis)	native	0.017	0.50%	0.50%	10%
butter-and-eggs (Linaria vulgaris)	invasive, introduced	0.017	0.50%	0.50%	10%
shepherd's-purse (Capsella bursa-pastoris)	disturbance, introduced	0.006	0.50%	0.50%	10%
water smartweed (Polygonum amphibium)	native	0.006	0.50%	0.50%	10%

[1] Plant status is designated by Cows and Fish in association with Alberta Agriculture, Food and Rural Development and the Alberta Weed Control Act. *'unknown'* = plant not identified to species (plant status unknown).

[2] Based on visual estimates of the amount of ground the canopy of the plant covers. The percent cover values presented are the mid-values for the following ranges: 0.5=less than 1%; 3.0=1%-5%; 10.0=5%-15%; 20.0=15%-25%; 30.0=25%-35%; 40.0=35%-45%; 50.0=4

[3] Constancy is the number of times the species occurs divided by the total number of sites.

Paddle River Riparian Plant Composition Summary

Species Tally Summary		% Native Species
Total # of species =	144	73%
Total # of TREE species =	5	100%
Total # of SHRUB species =	31	90%
Total # of GRASS / GRASS LIKE species =	27	67%
Total # of FORB species =	81	79%

Total # of ***native plants*** =	105
Total # of ***restricted*** weeds =	0
Total # of ***invasive*** weeds =	7
Total # of *disturbance* plants =	21
Total # of plants with *poisonous* properties =	6

APPENDIX D: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS FOR STREAMS AND SMALL RIVERS

Some factors on the evaluation will not apply on all sites. For example, sites without potential for woody species are not rated on factors concerning trees and shrubs. Vegetative site potential can be determined by using a key to site type. On severely disturbed sites, vegetation potential can be difficult to determine. On other sites, clues to potential may be sought on nearby sites with similar landscape position.

Most of the factors in this evaluation are based on ocular estimations. Such estimation may be difficult on large, brushy sites where visibility is limited, but extreme precision is not necessary. While the rating categories are broad, evaluators do need to calibrate their eye with practice. It is important to remember that a health rating is not an absolute value. The factor breakout groupings and point weighting in the evaluation are somewhat subjective and are not grounded in quantitative science so much as in the collective experience of an array of riparian scientists, range professionals and land managers.

Each factor below will be rated according to conditions observed on the sites. The evaluator will estimate the scoring category and enter the value on the score sheet. It is important to remember that a health rating is not an absolute value. Each factor is rated according to conditions observed on the site at the time of evaluation.

1. Vegetative Cover of Floodplain and Streambanks

6 = More than 95% of the polygon area is covered by plant growth.
4 = 85% to 95% of the polygon area is covered by plant growth.
2 = 75% to 85% of the polygon area is covered by plants growth.
0 = Less than 75% if the polygon area is covered by plant growth.

2a. Total Canopy Cover of Invasive Plant Species

3 = No invasive plants (weeds) on site.
2 = Invasive plants present with total canopy cover less than 1% of the polygon area.
1 = Invasive plants present with total canopy cover between 1 and 15% of the polygon area.
0 = Invasive plants present with total canopy cover more than 15% of the polygon area.

2b. Density/Distribution of Invasive Plant Species (Table 1)

3 = No invasive plants (weeds) on site.
2 = Invasive plants present with density/distribution in categories 1, 2 or 3.
1 = Invasive plants present with density/distribution in categories 4, 5, 6 or 7.
0 = Invasive plants present with density distribution in categories 8 or higher.

3. Disturbance-Caused Undesirable Herbaceous Species

3 = Less then 5% of the site covered by disturbance-caused undesirable herbaceous species.
2 = 5% to 25% of the site covered by disturbance-caused undesirable herbaceous species.
1 = 25% to 45% of the site covered by disturbance-caused undesirable herbaceous species.
0 = More than 45% of the site covered by disturbance-caused undesirable herbaceous species.

4. Preferred Tree and Shrub Establishment and Regeneration

(N/A will appear in the Riparian Health Score Table if the polygon lacks potential for preferred trees or shrubs)

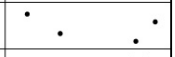
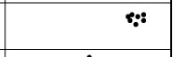
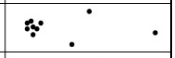
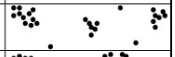
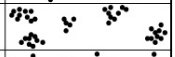
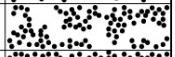
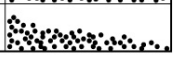
6 = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

4 = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

2 = Less than 5% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

0 = Preferred tree/shrub seedlings and saplings absent.

Table 1. Density/distribution of invasive plant species.

CLASS	DESCRIPTION OF ABUNDANCE	DISTRIBUTION PATTERN
0	No invasive plants on the polygon	
1	Rare occurrence	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several sporadically occurring plants	
7	A few patches	
8	A few patches plus several sporadically occurring plants	
9	Several well spaced patches	
10	Continuous uniform occurrence of well spaced plants	
11	Continuous occurrence of plants with a few gaps in the distribution	
12	Continuous dense occurrence of plants	
13	Continuous occurrence of plants associated with a wetter or drier zone within the polygon.	

5a. Utilisation of Preferred Trees and Shrubs

(N/A will appear in the Riparian Health Score Table if the polygon lacks potential for preferred trees or shrubs)

3 = None (0% to 5% of available 2nd year and older leaders of preferred species are browsed).

2 = Light (5% to 25% of available 2nd year and older leaders of preferred species are browsed).

1 = Moderate (25% to 50% of available 2nd year and older leaders of preferred species are browsed).

0 = Heavy (More than 50% of available 2nd year and older leaders of preferred species are browsed).

5b. Woody Vegetation Removal by Other than Browsing

(N/A will appear in the Riparian Health Score Table on page 1 if the site does not have live woody vegetation or visibly cut stumps)

3 = None (0% to 5% of live woody vegetation expected on the site is lacking due to cutting).

2 = Light (5% to 25% of live woody vegetation expected on the site is lacking due to cutting).

1 = Moderate (25% to 50% of live woody vegetation expected on the site is lacking due to cutting).

0 = Heavy (More than 50% of live woody vegetation expected on the site is lacking due to cutting).

6. **Standing Decadent and Dead Woody Material**
   3 = Less than 5% of the total canopy of woody species is decadent or dead.
   2 = 5% to 25% of the total canopy of woody species is decadent or dead.
   1 = 25% to 45% of the total canopy cover of woody species is decadent or dead.
   0 = More than 45% of the total canopy cover of woody species is decadent or dead.

7. **Streambank Root Mass Protection**
   6 = More than 85% of the streambank has deep, binding root mass.
   4 = 65% to 85% of the streambank has deep, binding root mass.
   2 = 35% to 65% of the streambank has deep, binding root mass.
   0 = Less than 35% of the streambank has deep, binding root mass.

8. **Human-Caused Bare Ground**
   6 = Less than 1% of the sites is human-caused bare ground.
   4 = 1% to 5% of the site is human-caused bare ground.
   2 = 5% to 15% of the site is human-caused bare ground.
   0 = More than 15% of the site is human-caused bare ground.

9. **Streambank Structurally Altered by Human Activity**
   6 = Less than 5% of the bank is structurally altered by human activity.
   4 = 5% to 15% of the bank is structurally altered by human activity.
   2 = 15% to 35% of the bank is structurally altered by human activity.
   0 = More than 35% of the bank is structurally altered by human activity.

10. **Human Physical Alteration to the Rest of the Site**
    3 = Less than 5% of the polygon is affected by human causes.
    2 = 5% to 15% of the polygon is affected by human causes.
    1 = 15% to 25% of the polygon is affected by human causes.
    0 = More than 25% of the polygon is affected by human causes.

11. **Stream Channel Incisement (Vertical Stability) (Table 2, Figure 1)**
    9 = Not incised
    6 = Slightly incised
    3 = Moderately incised
    0 = Severely incised

Table 2. Description of Incisement (Vertical Stability) Categories

Incisment Severity	Channel Development Stage	Rosgen Types Included	Description of Incisement Situation
Not Incised (9 points)	A	A, B, C, E	Channel is vertically stable and not incised; 1-2 year high flows can begin to access a floodplain appropriate to the stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain inside which perennial riparian plant communities are well established. This category includes a variety of stream types in all land forms and substrates. The floodplain may be narrow or wide, depending on the type of stream, but the key factor is vertical stability. The system may have once cut down, and later become healed and is now stable again, with a new floodplain appropriate to its stream type. In this case, the erosion of the old gully side walls will have ceased and stabilised. A mature, or nearly mature, vegetation community will occupy much of the new valley bottom.

Incisment Severity	Channel Development Stage	Rosgen Types Included	Description of Incisement Situation
Slightly (6 points)	B/D	C, F, G	This category contains both degrading and healing stages. In either case, the extent of incisement is minimal. In Stage B, the channel is just beginning to degrade, and a 2 year flood event may still access some floodplain, either partially or in spots. Downcutting is likely progressing. In Stage D, the system is healing. Downcutting should have ceased at this stage. A new floodplain should be well established with perennial vegetation, although it may not yet be as wide as the stream type needs. This is indicated by continuing lateral erosion of the high side walls of the original incisement, as the system continues to widen itself at its new grade level.
Moderately (3 points)	B/D	C, F, G	This category also contains both degrading and healing stages. In both cases, the extent of incisement is significant. In Stage B, the channel has downcut to a level that floods of the 1-5 year magnitude cannot reach a floodplain. Downcutting is likely still progressing, but the channel may already have the appearance of a gully. In Stage D, the system has only just begun to heal. A small floodplain along the new meanders within the gully is forming, and perennial vegetation is starting to colonize the new sediment features. The high side walls of the gully are being actively eroded as the system widens, and much of the fallen material is being incorporated along the bottom.
Severely (0 points)	C	F, G	This is the worst case category, where the system has no floodplain in the bottom of a deep entrenchment, and small-to-moderate floods cannot reach the original floodplain level. Downcutting may, or may not, still be in progress. High side wall banks may have begun to collapse and erode into the bottom, but high flows typically just wash this material directly through the system, with none of it being trapped to build a new floodplain. At this stage, the system has lost practically all of its riparian function and habitat value.

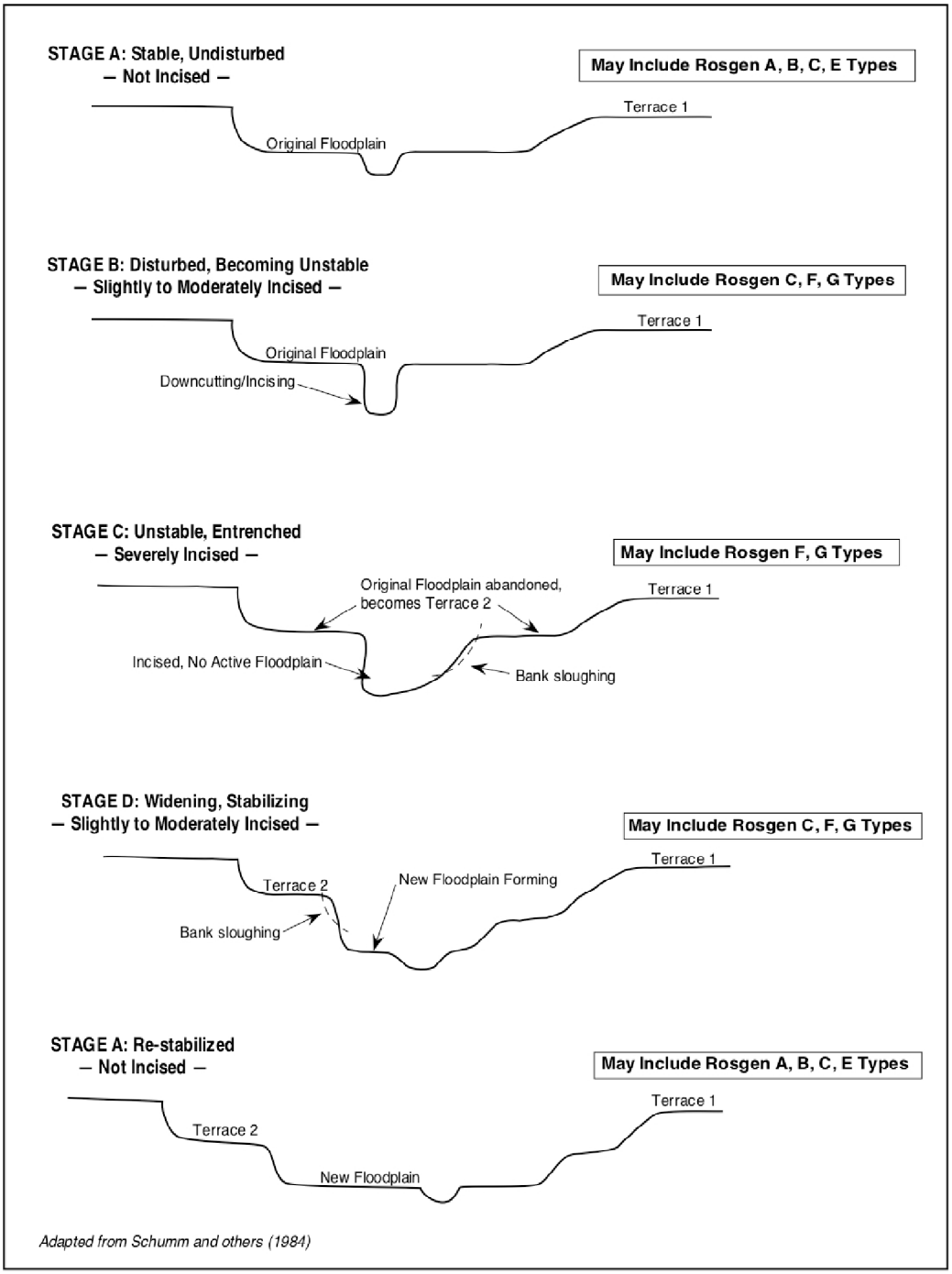


Figure 1. Guide for estimating channel incisement stage.