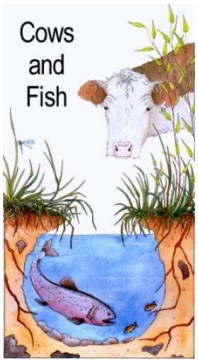
Battle River Watershed Riparian Areas and Health Summary

Prepared for:

Battle River Watershed Alliance State of the Watershed Report



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1 WHAT ARE RIPARIAN AREAS

Riparian areas are the portions of the landscape that are strongly influenced by water, the green zones around lakes, wetlands, ponds and seeps, the emerald threads of vegetation that border rivers and streams and the lush fringe in valleys. Riparian areas are transitional, providing the buffer between aquatic and upland habitats. Three clues help to define or characterize what is riparian:

- The presence of surface or 'near-to-the-surface' water, either seasonally or regularly
- The presence of water-loving vegetation such as willows, cattails or sedges
- Soils that are influenced and modified by the presence of abundant water, water movement and lush, productive vegetation

When in good condition, these green zones are one of the most ecologically diverse ecosystems in the world. Healthy riparian areas sustain fish and wildlife populations, provide good water quality and supply, offer forage and shelter for livestock, buffer the impacts of floods and droughts and support people, communities, our lifestyles and often our businesses on the landscape. Although riparian areas make up a small portion of the landscape, approximately 2 to 5 % of Alberta's settled portion, they play a role that is disproportionately important to the amount of area they encompass. Vital to a healthy, functioning landscape, riparian areas also form part of an extensive watershed, and are critical to overall watershed condition and ecological function.

2 WHAT IS RIPARIAN HEALTH?

Riparian health or condition is the ability of a reach of a stream, river, lakeshore or wetland to perform a number of key ecological functions, such as filtering and buffering water, trapping and storing water, minimizing erosion and providing habitat for fish and wildlife.

A healthy riparian area generally has the following characteristics:

- An abundance and diversity of plant cover
- Successful reproduction and establishment of seedling, sapling and mature trees and shrubs
- Stream banks and shorelines with deep-rooted plant species (e.g. willows, sedges)
- Very few, if any, invasive plants (e.g. Canada thistle) and disturbance-caused plants (e.g. dandelion, foxtail barley)
- Minimal structurally altered or eroded stream banks and shorelines
- The ability of regular flood events (i.e. approximately every 1-3 years) to access a floodplain appropriate to stream or river size
- Little or no artificial addition or removal of water

These ecological functions form the foundation of a healthy riparian area and when present, link together to produce multiple benefits and a healthy functioning landscape.

When riparian health is compromised, it usually means one or more of the functions listed above have been impacted by natural or human-caused disturbances, such as development, recreation, grazing, flooding or fire. In general, healthier riparian areas should perform a higher number of ecological functions better than less healthy riparian areas.

3 RIPARIAN HEALTH EVALUATION

A riparian health inventory is a detailed field examination of the vegetative, soil and hydrological parameters of a particular riparian area. Subsequent to data collection, a derived riparian health assessment score is assigned to each site. This rating is expressed as a percentage, as well as a health category, namely *healthy*, *healthy but with problems* or *unhealthy*, as described in Table 1.

Table 1. Description of Riparian Health Categories

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

Lentic (non-flowing waterbodies) or lotic (flowing waterbodies) *riparian health inventory* and *riparian health assessment* (or survey) are two formats of data collection commonly used by Cows and Fish staff in Alberta to measure the ecological function or condition of riparian ecosystems. For larger flowing waterbodies (e.g. rivers), Cows and Fish primarily uses a large river health assessment (survey) form. The inventory method is highly detailed encompassing approximately 80 questions and is typically used to gather benchmark data or monitor health over time of a particular riparian system. A computer database designed to utilize the inventory data derives the health score and category post field data collection. In contrast, the assessment or survey method is less detailed, encompassing between 9, 11 or 15questions and is less valuable for use in monitoring riparian health over time. A riparian health score and category are immediately generated by observation using this method in the field. Riparian health inventory and assessment (survey) methodology utilized by Cows and Fish can be found in Appendices F-I.

4 RIPARIAN HEALTH IN THE BATTLE RIVER WATERSHED

A combination of surveys and inventories are included and summarized in this section for lakes, wetlands, streams and rivers. Where possible for the Battle River mainstem, the large river survey health results were used. For all other lotic tributaries the streams and small rivers derived inventory or survey result is reported. For Driedmeat Lake and remaining lentic tributaries the lakes and wetlands derived inventory or survey ratings are used. Plant species and community/habitat type information is obtained from lotic or lentic inventories on all sites with that data.

All data has been collected, analyzed and reported on by Cows and Fish between 2001 and 2009 and is based on the most recent assessment of each site. This summary includes all sites completed between 2001 and 2009, with the exception of one, for which the landowner expressed that their data not be included. Funding and/or support for these riparian health inventory projects was provided in many areas by the local community, municipality, watershed group, various grant allocation programs and the Cows and Fish members and supporters. For a list of Cows and Fish members and supporters, see Appendix J

4.1 OVERALL RIPARIAN HEALTH IN THE BATTLE RIVER WATERSHED

Overall, the average riparian health in the Battle River watershed, for 195 lentic and lotic sites assessed between 2001 and 2009, is 66.6% or *healthy but with problems*. Of the 195 sites, 26% are rated as *healthy*, 61% as *healthy but with problems* and 13% as *unhealthy* (Figure 1). Provincially, the average riparian health for 1939 sites assessed in Alberta between 1997 and 2009 is 68.9%, with 25% rated as *healthy*, 50% as *healthy but with problems* and 25% as *unhealthy*.

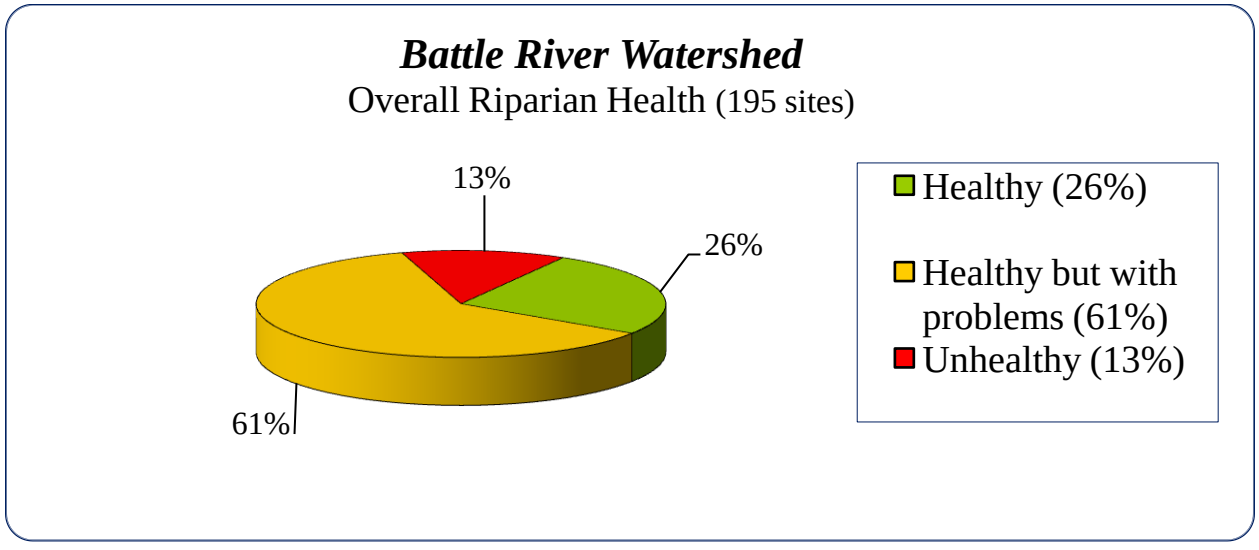

Figure 1. Battle River Watershed – Overall Riparian Health (195 sites)

A total of 169 kilometers of shore and stream/river distance has been assessed by Cows and Fish, on approsxmately 119 different landholdings. Five lentic systems and nine lotic systems, for a total of 14 different waterbodies are included in this summary. See Table 2.

Table 2: Battle River Watershed Riparian Sites

Riparian System Type	# Riparian Inventories or Assessments	# Landowners / Landholdings	# Waterbodies	Stream and/or Shoreline Distance Inventoried (km)
Total	**195**	**119**	**14**	**169 km**
Lentic	18	14*	5	12 km
Lotic	177	105**	9	157 km

*There are 14 unique landowners/landholdings with lentic sites. There are an additional two that also have lotic sites

*There are 103 unique landowners/landholdings with lotic sites plus an additional two that also have lentic sites

There are five lentic or non-flowing waterbodies (eg. lakes and wetlands), in the Battle River Watershed with riparian health data involving approximately 15 landowners and covering a shore distance of 12 km (Table 3).

Table 3: Battle River Watershed Lentic Waterbodies with Riparian Health Data

Waterbody Name	# Riparian Inventories or Assessments	# Landowners / Landholdings	Stream and/or Shoreline Distance Inventoried (km)
Driedmeat Lake	7	6*/7	5.4
Gooseberry Lake	1	1	0.05
Grattan Creek (Coulee)	3	2	2
Little Beaver Lake	5	5	2
Mirror Lake	2	1**	2.5
Lentic Total	**18**	**15**	**12 km**

*There are six unique landowners/landholdings on Driedmeat Lake. In addition, there is one landowner that is common between Driedmeat Lake and Battle River.

**The landowner/landholding for Mirror Lake is common with that of Camrose Creek and Camrose Creek Tributary

Lakes and wetland riparian health averages 63% (*healthy but with problems*) for 18 sites. Of these, 28% rated as *healthy*, 33% as *healthy but with problems* and 39% as *unhealthy* (Figure 2).

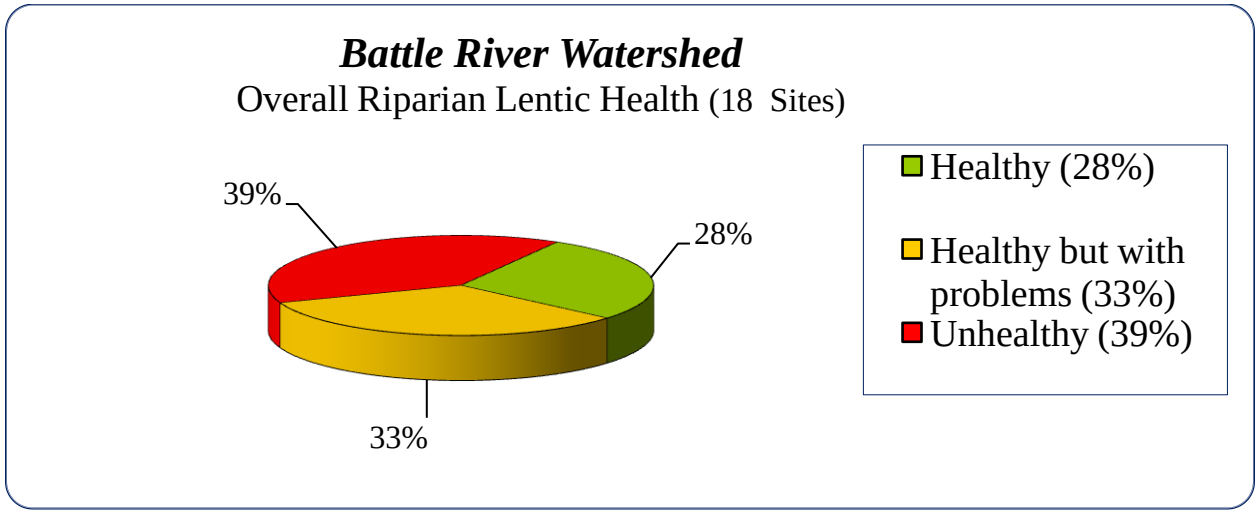

Figure 2. Battle River Watershed – Overall Riparian Lentic Health (18 sites)

There are nine flowing waterbodies, or lotic systems in the Battle River Watershed with riparian health data involving approximately 114 landowners and covering a stream or river distance of 157 km (Table 4).

Table 4: Battle River Watershed Lotic Waterbodies with Riparian Health Data

Waterbody Name	# Riparian Inventories or Assessments	# Landowners / Landholdings	Stream and/or Shoreline Distance Inventoried (km)
Battle River	74	37*/38	67.4
Black Creek	10	9	9.5
Camrose Creek	8	1	8.5
Camrose Creek Tributary	1	1**	0.8
Grattan Creek	22	18	12
Iron Creek	34	29	30
Iron Creek Tribuary (a&b)	2	2	2.4
Ribstone Creek	26	8	26.5
Lotic Total	**177**	**114**	**157 km**

*There are 37 unique landowners/landholdings on Battle River. In addition, there is one landowner that is common between Driedmeat Lake and Battle River.
**Camrose Creek and Camrose Creek Tributary (as well as Mirror Lake) share the same landowner).

Stream and river riparian health averages 67% for 177 sites assessed. Of these sites, 12% rated as *healthy*, 64% as *healthy but with problems* and 24% as *unhealthy* (Figure 3).

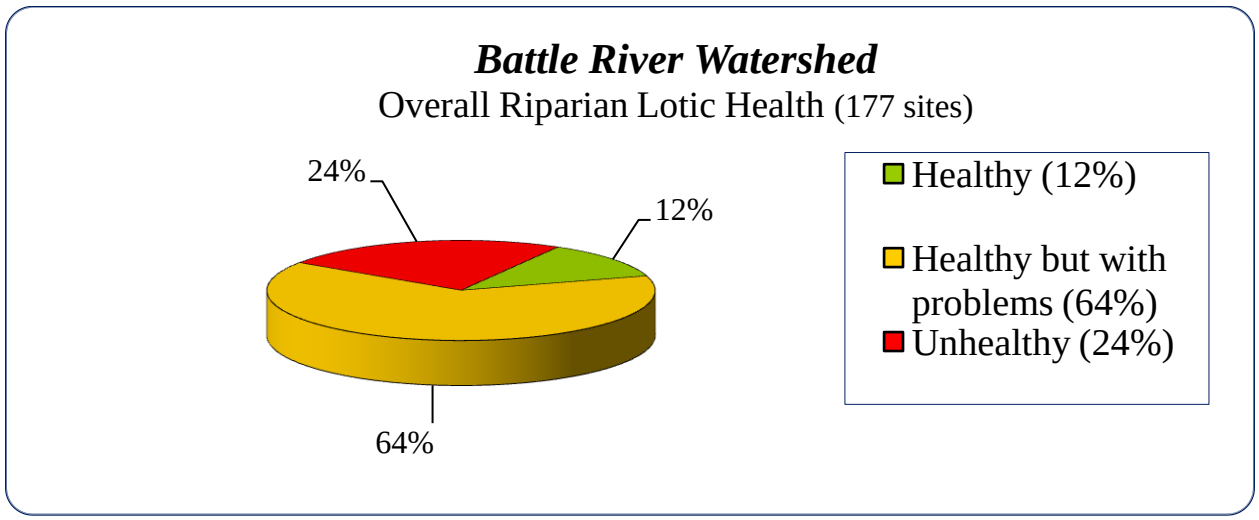

Figure 3. Battle River Watershed – Overall Riparian Lotic Health (177 sites)

4.2 Battle River Mainstem (and Driedmeat Lake) Riparian Health

The Battle River Mainstem and Driedmeat Lake riparian health summary includes data collected on 81 sites within four jurisdictions, involing 44 landowners and a total length of 73 km assessed (Tables 5 and 6).

Table 5: Overall Riparian Sites for the Battle River Mainstem (and Driedmeat Lake)

# Riparian Inventories or Assessments	# Landowners / Landholdings	# Waterbodies	Stream and Shoreline Distance Inventoried
81	44	2	72.8 km

Table 6: Riparian Sites for the Battle River Mainstem (and Driedmeat Lake) by Jurisdiction

Waterbody Name	Jurisdiction Sites Completed Within	# Riparian Inventories or Assessments	Stream and/or Shoreline Distance Inventoried	Year of Riparian Health Data Collection
Battle River & Driedmeat Lake	Camrose County	52	45.8 km	2001 (29), 2002 (1), 2004 (22)
Battle River	Flagstaff County	12	11.8 km	2004
Battle River	Paintearth County	7	6.1 km	2004
Battle River	MD of Wainwright*	10	9.1 km	2005
Total	**4**	**81**	**72.8 km**	

*Includes Canadian Forces Base (CFB) Wainwright

For the Battle River and Driedmeat Lake (together), riparian health averages 64% (*healthy but with problems*). Of the 81 sites assessed, 1% rated as *healthy*, 69% as *healthy but with problems* and 30% as *unhealthy* (Figure 4).

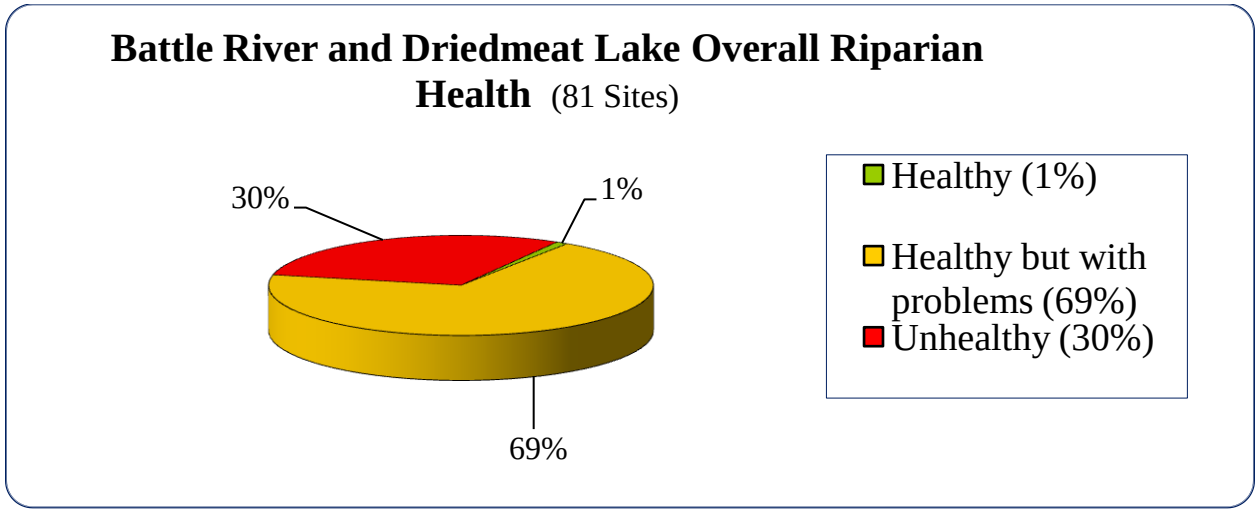

Figure 4. Battle River Watershed – Battle River & Driedmeat Lake Overall Health (81 sites)

4.3 Battle River Tributaries Riparian Health

The Battle River Tributaries riparian health summary includes data collected on 114 lotic and lentic sites within four jurisdictions, involving 61 landowners and a total length of 96 km assessed (Tables 7 and 8).

Table 7: Overall Riparian Sites Assessed for the Battle River Tributaries

# Riparian Inventories or Assessments	# Landowners / Landholdings	# Waterbodies	Stream and Shoreline Distance Inventoried
114	61	11	96.3 km

Table 8: Riparian Sites for Lentic and Lotic Tributaries in the Battle River Watershed by Jurisdiction

Waterbody Name	Jurisdiction Sites Completed Within	# Riparian Inventories or Assessments	Stream and/or Shoreline Distance Inventoried	Year of Riparian Health Data Collection
Black Creek	MD of Wainwright	10	9.5 km	2001
Camrose Creek	County of Camrose	8	8.5 km	2004
Camrose Creek (trib)	County of Camrose	1	0.8 km	2004
Gooseberry Lake	County of Paintearth	1	0.05 km	2006
Grattan Creek	MD of Wainwright	25	14.0 km	2001
Iron Creek	Flagstaff County	34	30.0 km	2006
Iron Creek (Tributary)	Flagstaff County	1	1.7 km	2006
Iron Creek (Tribuary)	Flagstaff County	1	0.7 km	2006
Little Beaver Lake	Camrose County	5	2.0 km	2009
Mirror Lake	Camrose County	2	2.5 km	2004
Ribstone Creek	MD of Wainwright*	7	5.0 km	2008
Ribstone Creek	Paintearth County	19	21.5 km	2001 (16), 2006 (3)
Total	**4**	**114**	**96.3 km**	

*Includes Canadian Forces Base (CFB) Wainwright

For the Battle River Tributaries (lentic and lotic together), riparian health averages 69% (*healthy but with problems*). Of the 114 sites assessed, 22% rated as *healthy*, 55% as *healthy but with problems* and 23% as *unhealthy* (Figure 5).

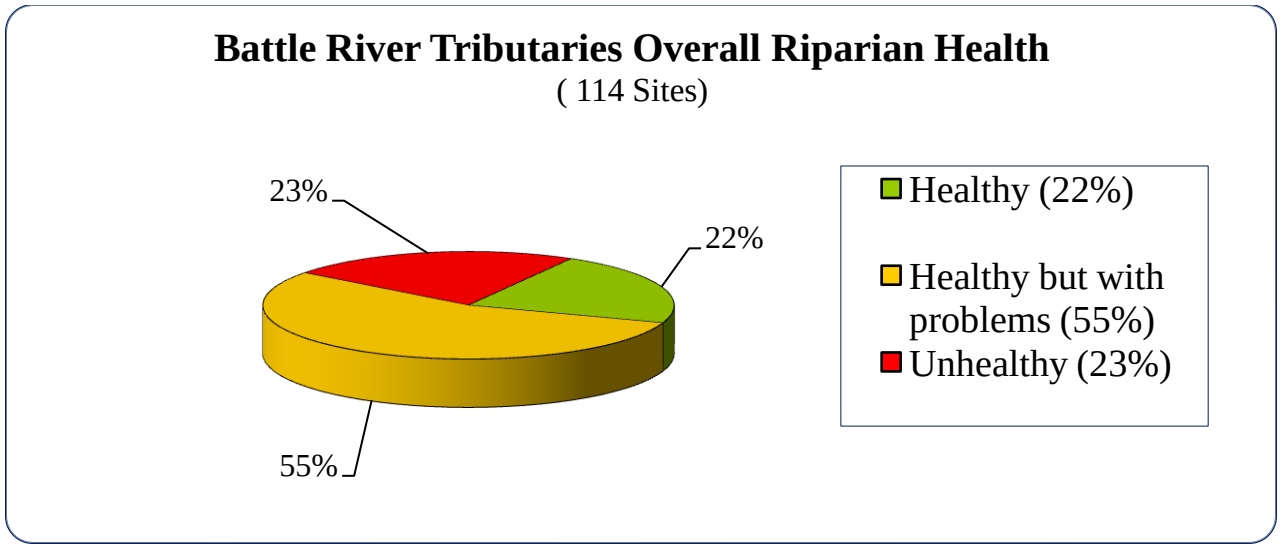

Figure 5. Battle River Watershed – Battle River Tributaries Overall Health (114 sites)

5 Riparian Health – *A Closer Look at the Pieces*

5.1 Battle River Mainstem (and Driedmeat Lake) Riparian Health Parameters (81 sites)

The riparian areas within the Battle River mainstem and Driedmeat Lake support an abundance of different plant species. Plant inventories conducted along the river and lake document no less than 267different plant species and 40 different plant community and habitat types. A description of vegetation habitat and community types is included in Appendix A and a list of plant community and habitat types for the Battle River and Driedmeat Lake riparian health sites is in Appendix B. Refer to Appendix C for a list of all plants found within the Battle River and Driedmeat Lake riparian health sites.

The Woody Plants

Of the known plant species, five are trees and balsam poplar (*Populus balsamifera*) and Mantioba maple (*Acer negundo)* are the most abundant and commonly occurring. Shrub diversity is excellent with 41 different shrub species, including 8 willows, present within Battle River and Driedmeat Lake riparian areas. Red osier dogwood (*Cornus stolonifera*), a highly palatable shrub for both livestock and wildlife is one of the most common shrubs. Snowberry/buckbrush (*Symphoricarpos occidentalis*), a grazing resistant shrub is also very common.

Grasses and Broad-Leaved Flowering Plants

Approximately 54 grass or 'grass-like' species are found along the Battle River and Driedmeat Lake riparian areas, including up to 40 native species. Two introduced 'disturbance-caused' grasses are found in the most abundance of all graminoid plants. These are smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Several native grasses such as reed canary grass (*Phalaris arundinacea),* Sprengel's sedge (*Carex sprengelii*) and fowl bluegrass (*Poa palustris*) also make up the grass component of riparian vegetation along with other introduced species. At least 167 different broad-leaved flowering plants (forbs) are also found. Two invasive plants, Canada thistle (*Cirsium arvense*) and perennial sow thistle (*Sonchus arvensis*), and common dandelion (*Taraxacum officinale*), a disturbance-caused forb are commonly occurring broad-leaved flowering plants. Native broad-leaved plants are also present and there is diversity of them, including wild sarsaparilla (*Aralia nudicaulis*), Canada goldenrod (*Solidago canadensis*) and common horsetail (*Equisetum arvense*).

Collectively, the vegetation parameters for the Battle River mainstem and Driedmeat Lake rated *unhealthy.* Soil/hydrology parameters for the combined Battle River mainstem and Driedmeat Lake rated *healthy but with problems* overall. Figure 6 shows the health rating for each parameter relevant to lentic and lotic tributaries in the Battle River Watershed. Additional detail regarding specific parameters is discussed below. Where appropriate, discussion of parameters may be combined.

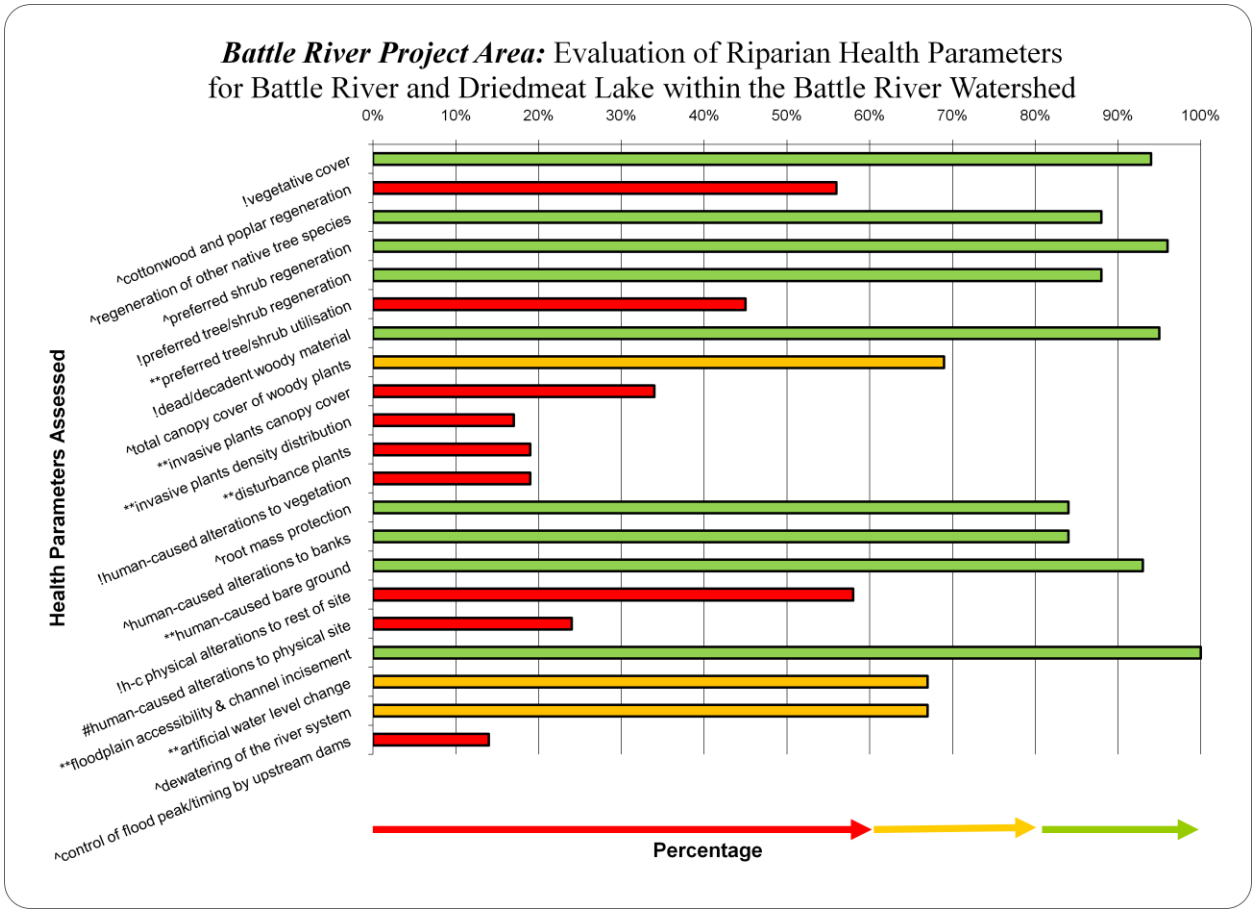

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Figure 6. Evaluation of Riparian Health Parameters for Battle River and Driedmeat Lake (81 sites)

Vegetative Cover of Streambank, Floodplain and Shore

Health Status: **Healthy**

Almost all of the riparian areas assessed along the Battle River and Driedmeat Lake have excellent amounts of plant cover along the banks, floodplain and shores. To be considered excellent, over 85% of the bank, floodplain and shore should be covered by vegetation.

Native plants are best for providing riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife. Along the Battle River and Driedmeat Lake there are no less than 192 known native species.

Tree & Shrub Regeneration

Health Status: **Healthy**

The root systems of woody species are excellent bank stabilizers, while their spreading canopies provide protection to soil, water, wildlife and livestock. The Battle River and Driedmeat Lake have excellent ability and potential to support robust tree and shrub communities and existing communities are providing adequate cover and function. However, current inventories show that mature stands of balsam poplar persist but lack an abundant understory of new seedlings and saplings that will replace mature trees in the future. There are other tree species present and though in less abundance than balsam poplar, do show good signs of regeneration by the presence of younger age classes.

In addition to trees, a great diversity of shrubs are present within riparian areas of the Battle River and Driedmeat Lake. In some areas these shrubs form a dense layer of vegetation shading the grasses and forbs underneath. The presence of many different shrub species is an indicator of healthy diversity. This diversity is important because it can be linked to providing both structure and habitat layers (i.e. understory, mid-storey, canopy layers) benefiting songbirds, wildlife, livestock and riverbank stability.

Tree & Shrub Utilisation

Health Status: **Unhealthy**

Overall, trees and shrubs are receiving moderate to heavy browse pressure from livestock and wildlife. In some areas, this pressure can be the cause of removing new growth and preventing seedlings and saplings from reaching a mature age class. Moderate to heavy browse levels are not sustainable in woody plant communities, and will eventually reduce

or eliminate preferred trees and shrub species, leave the less palatable, less deeply rooted, less diverse, and more browse resistant plants to dominate in the riparian area.

Invasive and Disturbance-caused Plants

Health Status: **Unhealthy**

Like many other watersheds and riparian areas in Alberta, the prevalence of invasive and disturbance-caused plants is a concern. Most riparian areas assessed along the Battle River and Driedmeat Lake have occurrences of invasive and disturbance-caused plants. Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*) are the most abundant and commonly occurring invasive plants. A total of 10 invasive plants and 36 disturbance-caused plants have been recorded.

Disturbance-caused plants are those plants which are well adapted to an environment of continual stress, where the competitive advantage of preferred riparian species has been diminished. A high cover of disturbance plants indicates an alteration to the normal plant community that would be expected to occur on the reach. In general, disturbance-caused plants tend to be less productive and more shallow-rooted than native riparian plants. Of the 36 disturbance-caused species recorded, the two most abundant graminoids by area covered include smooth brome (*Bromis inermis*) and Kentucky bluegrass (*Poa pratensis.*) Quack grass (*Agropyron repens*), foxtail barley (*Hordeum jubatum*), common dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*) and silverweed (*Potentilla anserine*) were also common.

Complete elimination of invasive and disturbance-caused plants is not realistic; however, with a combination of sound land management practices and weed control measures, the prevalence of these plants could be reduced. Weed control is primarily the responsibility of the landowner or lease holder with the majority of control coordination originating with the local Municipal District or County.

Riverbank Root Mass Protection and Alterations (Lotic Only)

Health Status: **Healthy**

The deep roots of trees and shrubs provide the 'glue' to hold riverbanks together, preventing erosion and lateral cutting. To rate in the healthy category, riverbanks should be about 85 % covered by vegetation with deep, binding roots. The majority of riverbanks inventoried along the Battle River have adequate amounts of deep, binding roots. For river systems, a variety of trees, shrubs and less importantly, graminoid species are required to maintain the integrity and structure of the riverbanks. Along the Battle River banks, deep-binding root mass is provided, for the most part, by the 40 native shrub species and 5 native tree species recorded. Graminoid species contribute to this function of bank stabilization to a lesser extent.

Stable riverbanks maintain channel configuration, integrity and bank shape. Structural alterations to riverbanks (e.g., mechanically broken down by livestock activity, cultivation or other human impacts) is another factor that may contribute to instability. These altered sections of riverbank increase the potential for erosion while inhibiting the establishment of riparian plant species. Of the sites assessed along the Battle River, there are no concerns with riverbank alterations. Vegetative cover and establishment are sufficient to maintain stability and human and livestock impacts are minimal overall. A healthy riverbank has less than 5% of its length altered.

HUMAN-CAUSED BARE GROUND

Health Status: **Healthy**

Soil not covered by plants, litter, downed wood or large rocks is considered bare ground and is considered erodible by water or wind. Human impacts to riparian areas, including livestock grazing, recreation, cultivation, development and industrial activities may result in an increased presence of bare soil indicating a deterioration to riparian health. Human-caused bare soil in the Battle River and Driedmeat Lake riparian areas is limited, and is not impacting overall health. To be rated healthy, less than 1% of the total riparian area is comprised of bare soil due to human impacts.

Bare ground resulting from natural events or processes, such as deposition, wildlife use, and drought are not included in the human-caused bare soil evaluation.

VEGETATIVE AND PHYSICAL ALTERATIONS TO RIPARIAN AREAS

Health Status: **Unhealthy**

Changes in the riparian plant community can be indicated by a shift from native to introduced, or a loss of structural layers caused by human activities. The evidence of such changes to the plant community are present along Driedmeat Lake in moderate amounts. It should be noted that vegetative alterations are only evaluated on lentic systems in this context.

Compared to the narrow riverbank area, the Battle River has a wide floodplain and the impacts from livestock, cropping, recreation and other human activities are moderate to light, on average, over these large areas. There are however, several sites that on their own, have heavy impacts meaning at least 25% or greater of the riparian area is physically altered by some human cause.

STREAM CHANNEL INCISEMENT & FLOODPLAIN ACCESSIBILITY (LOTIC ONLY)

Health Status: **Healthy**

Incisement (or down-cutting) can increase water energy within the channel be reducing sinuosity, water retention and storage. The result is increased erosion of the banks and lack of sediment deposition in the system. The Battle River has experienced very little downward channel incisement to date and periodic high water events can still access broad floodplains along most of the river length. High flood waters that periodically access the

highest terraces of the floodplain are important to disperse moisture throughout the riparian area for maintenance of riparian vegetation. Flooding also spreads the energy of moving water over the riparian area allowing sediment to be deposited where it can be utilized by vegetation. The floodplain is fully accessible with very little to no human interference.

Artificial Water Level Change (Lentic Only) and Dewatering of the River System (Lotic Only)

Health Status:  **Healthy but with problems**

Driedmeat Lake is the water source for the City of Camrose. It is subject to water withdrawals at times of the year as well as additions. The weir holds the water level at a height that might not naturally occur and the addition of water from Clear Lake can alter the natural timing of fluctuations expected for this constructed lake. Lake, wetland and even stream and river surface waters fluctuate in their levels throughout a year and over multiple years. These changes are part of the evolving process of shorelines and floodplains and the vegetation within them. Along Driedmeat Lake, it is acknowledged that there is artificial removal and/ or addition of water but it is at a rate slow enough or amount appropriate enough to maintain and allow riparian vegetation to establish.

Comparing historic flow records of the Battle River with the fraction of the average river flow volume that is changed today during the critical growing season can give us an idea of how the water supply has been manipulated and the impacts it may have on riparian health. The healthy but with problems rating means that one quarter or less of the average river flow volume during the critical growing season is changed along the Battle River. This can affect wetland plant communities, bank and shore stability, wildlife habitat and primary production throughout the system.

Control of Flood Peak and Timing by Upstream Dams (Lotic Only)

Health Status:  **Unhealthy**

Manipulating the volume and timing of annual peak flows, which are determined by the watershed water yield and variability of the local climate, can negatively affect the ecological function of the natural riverine system. In this context the health of the river system relates directly to the fraction of the watershed which remains undammed and therefore includes all tributaries which flow into the river upstream of the reach being assessed. The unhealthy rating for this parameter means that, on average, more than 50% of the Battle River watershed inventoried (i.e. upstream of the east boundary of CFB Wainwright) is controlled by dams or other water control structures.

5.2 BATTLE RIVER WATERSHED TRIBUTARIES (114 SITES) RIPARIAN HEALTH PARAMETERS

Riparian areas along the tributaries to the Battle River support an abundance and diversity of plant species. Plant inventories conducted along the tributary streams, lakes and wetlands document no less than 314 different plant species and 49 of different plant community and habitat types. Refer to Appendix E for a list of all plants found within riparian health sites for combined tributaries to the Battle River and Appendix D for a list of plant community and habitat types.

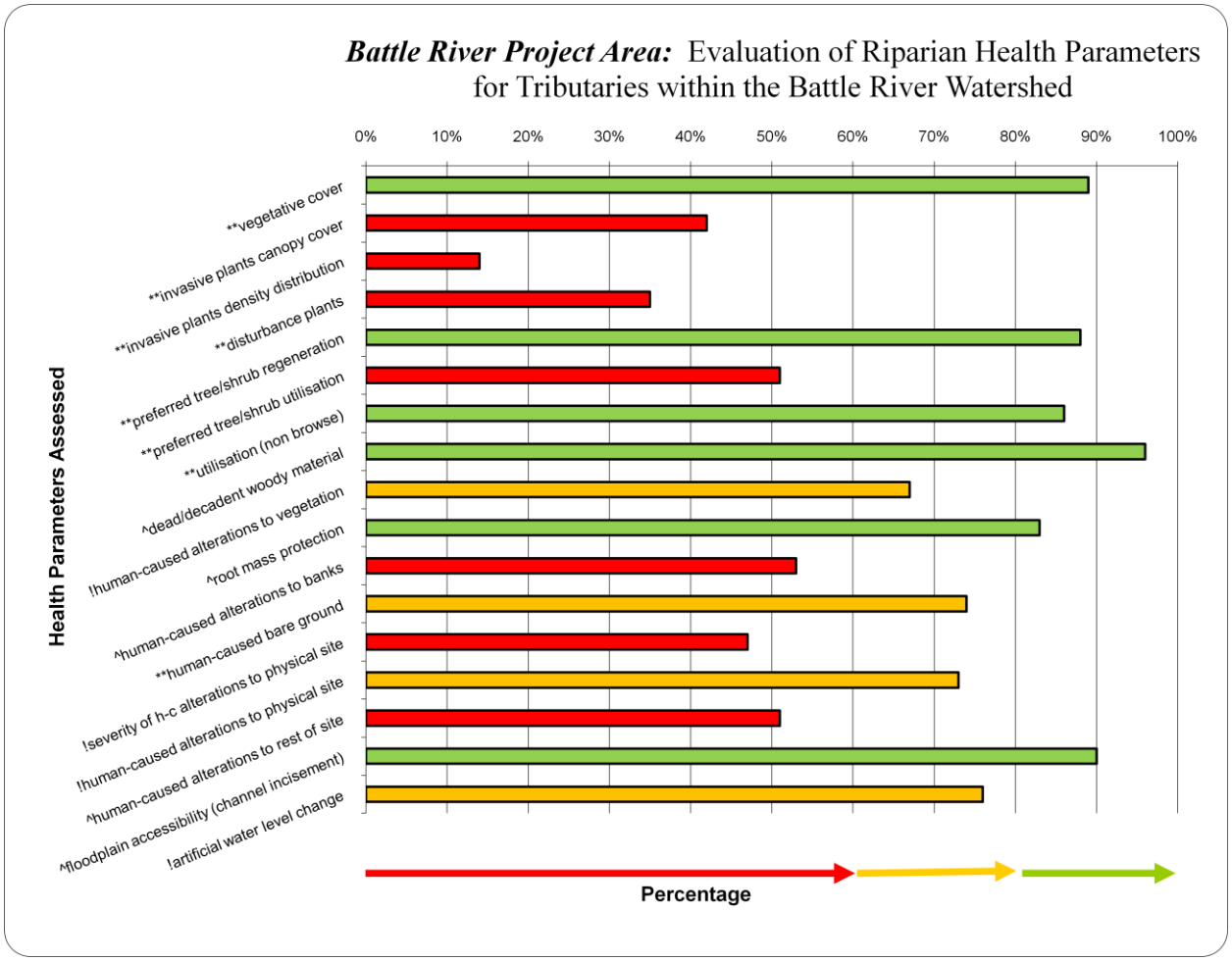
THE WOODY PLANTS

Of the known plant species, seven are native trees with balsam poplar (*Populus balsamifera*) and aspen (*Populus tremuloides*) being the most abundant and commonly occurring. Shrub diversity is excellent with 53 known different shrub species, including 12 willows, present within riparian areas along tributaries to the Battle River. Beaked willow (*Salix bebbiana*), basket willow (*Salix petiolaris*), red osier dogwood (*Cornus stolonifera*) and northern gooseberry (*Ribes oxyacanthoides*) are most commonly occurring, with the two willows providing being most abundant. Snowberry/buckbrush (*Symphoricarpos occidentalis*) and silverberry (*Elaeagnus commutata*), both grazing resistant shrubs are also very common, with snowberry being most abundant of all shrub types.

GRASSES AND BROAD-LEAVED FLOWERING PLANTS

Approximately 68 known grass or 'grass-like' species are found along the Battle River tributaries riparian areas, including up to 55 native species. Three introduced 'disturbance-caused' grasses, smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*) and foxtail barley (*Hordeum jubatum*), are found in the most abundance of all graminoid plants. Several native grasses or grass-like plants such as small bottle sedge (Carex utriculata), wire rush (Juncus balticus) and awned sedge (Carex aquatilis) are also common and abundant. At least 181 different broad-leaved flowering plants (forbs) are also found. Two invasive plants, perennial sow thistle (*Sonchus arvensis*) and Canada thistle (*Cirsium arvense*) and silverweed (*Potentilla anserina*), a disturbance-caused forb, are commonly occurring. Native broad-leaved plants are also present and there are a diversity of them, including common cattail (*Typha latifolia*), wild mint (*Mentha arvensis*) and Canada goldenrod (*Solidago canadensis*).

Collectively, the vegetation parameters for the Battle River Tributaries rated *unhealthy.* Soil/hydrology parameters for the Battle River Tributaries rated *healthy but with problems* overall. Figure 7 shows the health rating for each parameter relevant to lentic and lotic tributaries in the Battle River Watershed. Additional detail regarding specific parameters is discussed below. Where appropriate, discussion of parameters may be combined.



! lakes and wetlands, ^ streams ** streams, lakes and wetlands

Figure 7. Evaluation of Riparian Health Parameters for All Tributaries (Lotic and Lentic) within the Battle River Watershed (114 sites)

Vegetative Cover of Streambanks, Floodplains and Shores

Health Status: **Healthy**

Both the amount and type of plant cover within riparian areas dictates their ability to provide key ecological functions such as reducing erosion, trapping sediment, stabilizing banks and shores, absorbing and recycling nutrients and providing shelter and forage values for wildlife and livestock. Vegetation cover of riparian areas along tributaries of the Battle River is excellent overall. Many inventoried sites have greater than 85% of the reach covered by vegetation, and in many cases, over 95% of the reach is vegetated.

Native plants are best for providing riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife. Along the Battle River tributaries there are no less than 192 known native species.

INVASIVE AND DISTURBANCE-CAUSED PLANTS

Health Status: **Unhealthy**

Like many other watersheds and riparian areas in Alberta, the prevalence of invasive and disturbance-caused plants is a concern. Most riparian areas assessed along the Battle River tributaries have occurrences of invasive and disturbance-caused plants. Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*) are the most abundant and commonly occurring invasive plants. A total of 9 invasive plants and 34 disturbance-caused plants have been recorded.

Disturbance-caused plants are those plants which are well adapted to an environment of continual stress, where the competitive advantage of preferred riparian species has been diminished. A high cover of disturbance plants indicates an alteration to the normal plant community that would be expected to occur on the reach. In general, disturbance-caused plants tend to be less productive and more shallow-rooted than native riparian plants. Of the 34 disturbance caused species recorded, the three most abundant by area covered include smooth brome (*Bromis inermis*), Kentucky bluegrass (*Poa pratensis*) and foxtail barley (*Hordeum jubatum*).

Complete elimination of invasive and disturbance-caused plants is not realistic; however, with a combination of sound land management practices and weed control measures, the prevalence of these plants could be reduced. Weed control is primarily the responsibility of the landowner or lease holder with the majority of control coordination originating with the local Municipal District or County.

TREE & SHRUB REGENERATION

Health Status: **Healthy**

Trees and shrubs have an important role in riparian condition. Their root systems contribute to bank and shore stabilization and they play a key role in the uptake of nutrients that could otherwise degrade water quality. A good indicator of the ecological stability of riparian areas is the presence of trees and shrubs in all age classes, including mature, seedling and sapling.

Of the preferred trees and shrubs present within riparian areas along tributaries, more than 15% of the total woody plant canopy cover is comprised of seedling and/or sapling plants. Examples of preferred trees and shrubs include balsam poplar (*Populus balsamifera*), aspen (*Populus tremuloides*), Manitoba maple (*Acer negundo*), beaked willow (*Salix bebbiana*) and basket willow (*Salix petiolaris*). Examples of non-preferred shrubs include snowberry (*Symphoricarpos occidentalis)* and prickly rose (Rosa acicularis). Shrub species are providing higher vegetative cover, up to nearly 7 times more, than trees, along tributaries to the Battle River.

TREE & SHRUB UTILISATION

Health Status: **Unhealthy**

Trees and shrubs are receiving moderate to heavy browse pressure from livestock and wildlife, and in areas, this browse pressure is removing new growth and preventing seedlings and saplings from reaching a mature age class. Moderate to heavy browse levels are not sustainable in woody plant communities, and will eventually reduce or eliminate preferred trees and shrubs, leaving the less palatable and more browse resistant plants (eg. snowberry) to dominate in the riparian area.

HUMAN-CAUSED BARE GROUND

Health Status: **Healthy, but with Problems**

Bare ground is the ground surface not protected from erosional forces by plants, litter or duff, woody material or large rocks. In the majority of inventoried riparian areas, exposed soil surface, or bare ground due to human impacts was moderate. Human impacts causing bare ground include, livestock grazing, cultivation, recreation, development and industrial activities. Bare ground resulting from natural events or processes, such as deposition, wildlife use, and drought are not included in the human-caused bare soil evaluation. Naturally occurring bare soil, is most often attributed to depositional material (i.e., sediment) from recent floods and drawdown due to drought conditions. Floods form the channel point bars that many plant species, including willows seedlings, rely on for establishment.

VEGETATIVE AND PHYSICAL ALTERATIONS TO RIPARIAN AREAS

Health Status: **Unhealthy**

Physical alterations vary significantly both between sites and between lotic and lentic systems inventoried. Physical alterations on lotic systems rate *unhealthy*, and on lentic systems rate *healthy but with problems*. Combined, physical alterations to riparian areas for all tributaries assessed rates *unhealthy*, with an average of greater than 25% of the riparian area altered due to human impacts. Physical changes to the shores and floodplains of the lakes, wetlands and streams assessed alter water infiltration and may increase sedimentation of surface waters. Ultimately, physical impacts due to livestock, cultivation, recreation and other human causes, may impact the water holding capacity of riparian soils and thus the recharge of aquifers.

Vegetative alterations apply to lentic sites only, and refer to changes to the plant community composition which may include loss or change of plant community structural layers and replacing native plants with non-native plants. A moderate amount of vegetative alterations are present with this parameter rating healthy, but with problems overall.

STREAMBANK ROOT MASS PROTECTION AND ALTERATIONS (LOTIC ONLY)

Health Status: **Healthy, but with Problems**

Although streambank root mass protection rated *healthy*, streambank alterations are high, and scored *unhealthy* overall providing the average rating of *healthy, but with problems*.

The deep roots of trees and shrubs provide the 'glue' to hold streambanks together, preventing erosion and lateral cutting. To rate in the healthy category, streambanks should be approximately 85% covered by vegetation with deep, binding roots. The majority of streambanks inventoried along the tributaries to the Battle River have adequate amounts of deep, binding roots. For stream systems, a variety of trees, shrubs and native graminoids provide excellent deep-binding root mass. Along the streambanks, deep-binding root mass is provided, for the most part, by the 51 native shrub species recorded including beaked willow (Salix bebbiana), basket willow (*Salix petiolaris*), saskatoon (*Amelanchier alnifolia*) and choke cherry (*Prunus virginiana*). In addition, graminoid species, such as small bottle sedge (*Carex utriculata*) and water sedge (*Carex aquatilis*) contribute to this function of bank stabilization.

Stable streambanks maintain channel configuration, integrity and bank shape. When streambanks are physically altered from their natural topography and shape, erosion can increase, water quality can deteriorate and instability can increase within a particular reach and downstream. The most common structural alterations to streambanks include livestock trailing and trampling, recreational trails, is another factor that may contribute to instability. These altered sections of streambank increase the potential for erosion while inhibiting the establishment of riparian plant species. Of the sites assessed along the tributaries to the Battle River, there are no concerns with riverbank alterations. Vegetative cover and establishment is sufficient to maintain stability and human and livestock impacts are minimal overall. A healthy riverbank has less than 5% of its length altered.

STREAM CHANNEL INCISEMENT & FLOODPLAIN ACCESSIBILITY (LOTIC ONLY)

Health Status: **Healthy**

The Battle River tributaries have experienced very little downward stream channel incisement to date and periodic high water events can still access broad floodplains along most of the stream lengths. Flood waters that periodically access the highest terraces of floodplains are important to disperse moisture throughout the riparian area to maintain riparian plant communities. Flooding also spreads the energy of moving water over the riparian area, allowing sediment to be deposited and the creation of new areas for seedling establishment. Incisement can increase stream energy by reducing sinuosity, water retention and storage while increasing erosion.

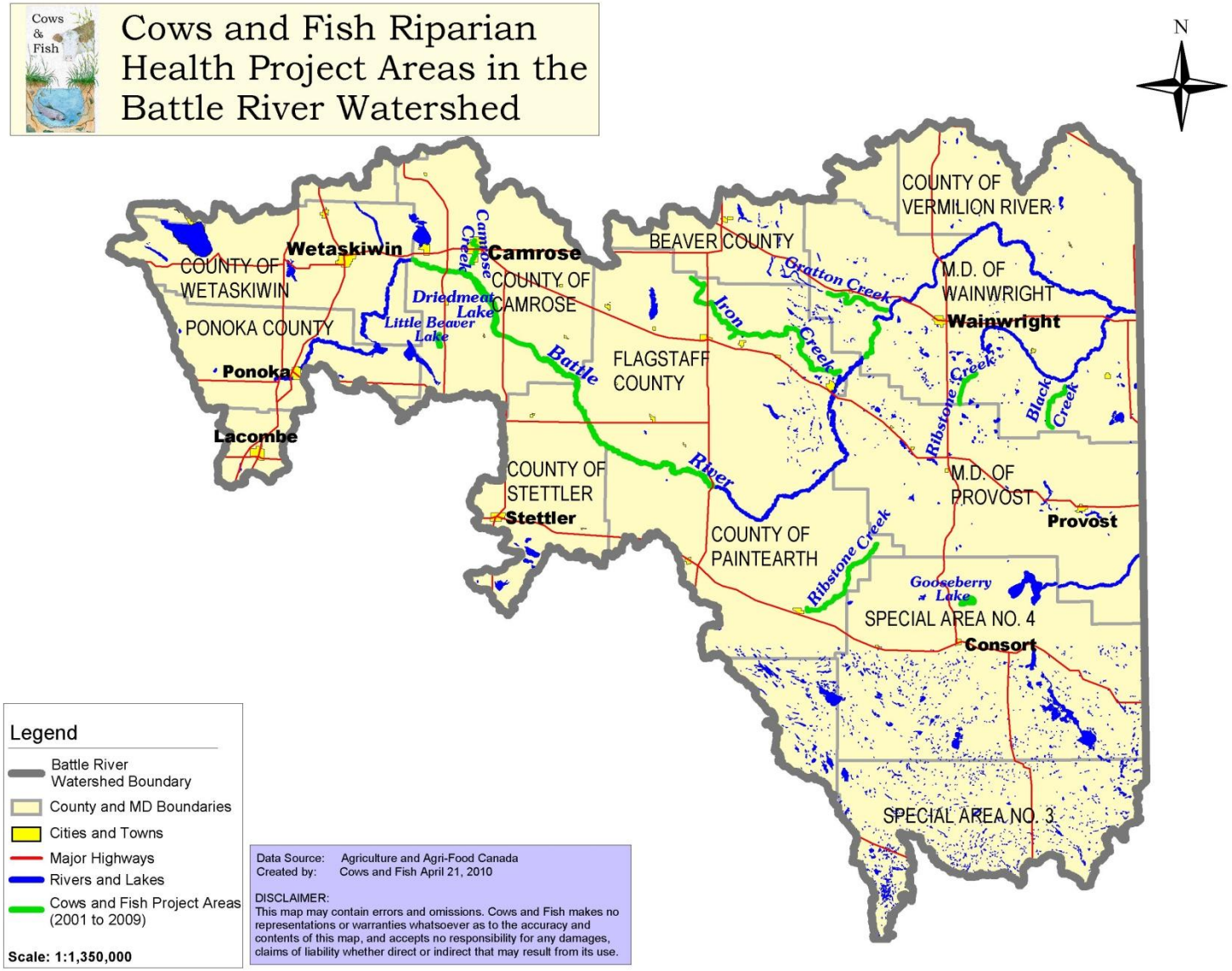
ARTIFICIAL WATER LEVEL CHANGE (LENTIC ONLY)

Health Status: **Healthy, but with Problems**

Three of four lentic systems inventoried are subject to minor artificial water level changes (i.e. removal or addition of water). In most cases, the shore area remains well vegetated and water level changes are minimal enough to prevent exposed soil. The remaining one lentic system is not subjected to artificial water removal or addition.

Although lakes and wetlands have naturally fluctuating water levels, artificial water level changes impact the natural timing and fluctuation of water which is critical to the maintenance of healthy riparian plant communities. The most common cause of artificial water level changes is the presence weirs or other water control structures.

6 Cows and Fish Riparian Health Project Areas in the Battle River Watershed



7 DATA GAPS AND RECOMMENDATIONS

Significant gaps in data collection exist for the mainstem Battle River west of Camrose County, from Highway 36 east to the MD of Wainwright and east of CFB Wainwright to the Alberta border with Saskatchewan. Data collected and represented in this summary may only be representative for portions of the Battle River in Camrose County, Flagstaff County, County of Paintearth and CFB Wainwright within the MD of Wainwright. To date, nearly 73 kilometers of the Battle River and Driedmeat Lake have been inventoried, of the total 570 kilometers[1] length within Alberta and Saskatchewan.

Similarly, for the tributaries inventoried, the data does well represent particular reaches and project areas, but may not well represent the overall riparian health for all tributaries and other lentic and lotic systems within the watershed.

Riparian areas are dynamic and are constantly changing. Because of this natural and human influenced variability, one inventory during a particular time period is only an approximation of health. Monitoring over time is required to determine trend in riparian health. To date, riparian health monitoring has occurred only in the Iron Creek watershed (2001 and again in 2006). Monitoring is planned for a portion of the Battle River and Driedmeat Lake sites within Camrose County in 2010. A recommended timeframe to monitor for changes in riparian health is approximately every five years.

[1]Source: http://en.wikipedia.org/wiki/Battle_River

8 MANAGEMENT IMPLICATIONS AND BEST MANAGEMENT PRACTICES

Riparian Health Component	Beneficial Management Practices
Vegetative Cover of Streambanks, Shorelines and Riparian Area	• Native plant communities require rest from grazing or other disturbances during the growing season to regrow, reduce the amount of bare ground and to out-compete disturbance-caused and invasive plants for nutrients and water • Other human activities such as recreation, transportation and industrial development should be managed to preserve native plant communities
Invasive and Disturbance-caused Plants	• Grazing strategies should consider distribution, timing, and stocking rates that fall within the carrying capacity of pasture units. Proving rest during the growing season, skim grazing and time-controlled grazing management practices can be applied as a means to reduce the potential for invasive and disturbance-caused plants. • Other land-use management plans (eg. industrial, transportation, extraction) should have reclamation plans and sites should be monitored closely until reclamation is complete • Recreational use……
Tree & Shrub Establishment and Regeneration	• Water management strategies should include maintenance of natural flows necessary for healthy riparian ecosystems • Maintain existing preferred tree and shrub communities (eg. poplars, willows, dogwood) and prevent the increase of browsing-resistant shrub communities (eg. snowberry, rose) • Provide adequate rest from continuous browse pressure to promote regeneration of existing preferred tree and shrub communities and sustain future reproduction and establishment • Attention to grazing management options such as distribution, timing, rotation and stocking rate should maintain and increase preferred trees and shrubs • Other land uses should also strive to maintain native woody plant communities and consider appropriate timing and intensity of use in riparian forests
Streambanks & Shorelines: Root Mass Protection & Physical Alterations	• Livestock management should consider avoiding streambank and floodplain areas when they are saturated • Maintain and/or re-establish natural flow patterns and meander cycles to allow more periodic flooding and sediment deposition on the floodplain where it can begin to restore alterations to the soil • Leaving a buffer between crops and riparian area will help maintain streambank vegetation.
Bare Ground & Physical Alterations to Entire Riparian Area	• Good distribution of livestock throughout riparian areas, effective rest during the growing season and avoiding grazing during vulnerable periods (eg. early spring) to maintain well vegetated and stable riparian areas. Use of off-stream watering systems to improve livestock distribution and limit direct access to stream channel. • Maintain environmental reserves, where present, and refrain from human development and activity within these zones • Cropping practices limit disturbance within ecological riparian boundary and if possible, leave a buffer between crop and riparian area.

Stream Channel Incisement, Stability & Artificial Removal or Addition of Water	• Maintain and increase the amount of vegetation with deep-binding root mass along river and streambanks through the successful regeneration of preferred trees and shrubs, and maintenance of native graminoid communities • Maintain and/or re-establish natural flow patterns and meander cycles • Maintain and restore wetlands within the watershed to trap and store water and reduce impacts from flooding

9 PHOTOS

Vegetation Health Parameter Photos

Photo a: Diverse and abundant tree and shrub communities along the Battle River contribute to riverbank stability. (*Photographer: K. Spicer-Rawe, Photo Number KSRBAT001*)

Photo b: Healthy tree and shrub communities along a lentic system within the Battle River watershed. (*Photographer: K. Spicer-Rawe, Catalogue Number: MONTLBL0001*)

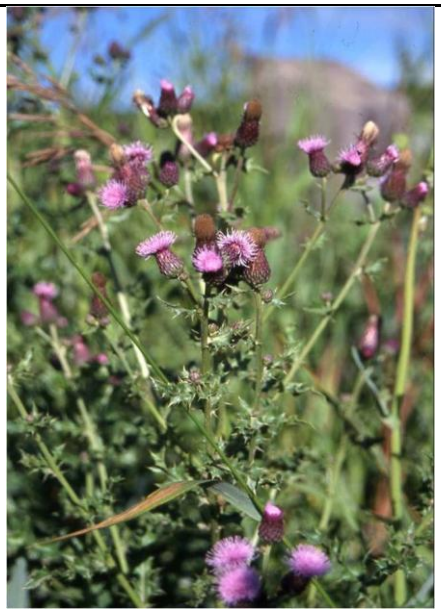


Photo c: Invasive weeds, such as Canada thistle, are present within riparian areas inventoried in the Battle River watershed. (*Photographer: M. Gerrand*, *Catalogue Number: PRESPR0041*)

Photo d: Disturbance-caused plants such as common dandelion, are present within riparian areas inventoried in the Battle River watershed. *(Photographer: N. Ambrose, Catelogue Number:*

RHASDHS0009)

Photo e: Tributaries, such as Ribstone Creek, vary significantly in the amount of woody vegetation present (as compared to photo f). (Photographer: L.Fitch , Catalogue Number AERLRIB0038).

Photo f: Tributaries, such as Ribstone Creek, vary significantly in the amount of woody vegetation present (as compared to photo e). (Photographer: L.Fitch ,Catalogue Number AERLRIB0016)

Photo m: Battle River at Duhamel (*Date Unknown)*. A well wooded valley, with an abundance of trees and shrubs across the floodplain. (*Source: Provincial Archives, Photographer: Unknown, Catalogue Number HISTBAT008)*

Photo n: Battle River at HWY 21 near Duhamel (2003). Human impacts have influenced the abundance of trees and shrubs within the wide floodplain. *(Photographer: L. Fitch, Catalogue Number: AERLBAT0017)*

Soil / Hydrology Health Parameter Photos

Photo g: The Battle River meanders across a wide floodplain for much of its length, and in many areas flood waters regularly access the floodplain to disperse energy and moisture. (*Photographer: L. Fitch, Catalogue Number AERLBAT0119*)

Photo h: A section of the Battle River exhibiting excellent streambank stability and no lateral cutting. (*Photographer: K. Spicer-Rawe, Photo Number: KSRBAT002*)

Photo i: Cultivation is one land-use occurring in the Battle River watershed that may result in physical alterations as well as changes to the native plant community and thus impact riparian health. *(Photographer: L. Fitch, Catalogue Number AERLBAT005)*

Photo j: Bare soil and structural alterations due to livestock use along a reach of the Battle River. *(Photographer: Michael Uchikura, Catalogue Number: RHIP10BAT005)*

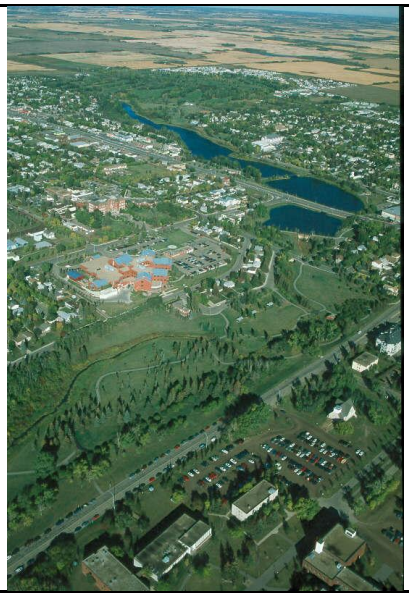


Photo k: Urban development, such as the City of Camrose, also impact riparian health. Mirror Lake is an example of a constructed lentic system. *(Photographer: L. Fitch, Catalogue Number AERLCAS0021)*

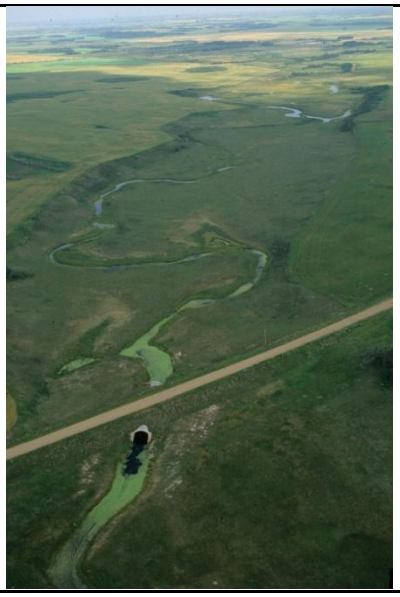


Photo l: Transportation systems and culverts, as seen here on Iron Creek, influence riparian health somewhat in the Battle River watershed. *(Photographer: L. Fitch, Catalogue Number: AERLIRO0047)*

APPENDIX A: RIPARIAN PLANT COMMUNITY AND HABITAT TYPES

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 (HT)** and **community types (CT)**. Habitat types have the potential to support 'climax plant communities' or, final state plant communities that are self-perpetuating and in dynamic equilibrium with their environment. Community types have the potential to support 'seral plant communities', or interim plant communities that are replaced by another community or species as succession progresses. All the plant communities within the project area, whether habitat types or community types, were identified and stratified using this classification system[2].

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.

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[2]Riparian Plant Community References for Alberta

Thompson, William H. and Paul L. Hansen. 2002. Classification and management of riparian and wetland sites of the Alberta Grassland Natural Region and adjacent subregions. Bitterroot Restoration, Inc. Prepared for the Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta, Canada. 416 p.

Thompson, William H. and Paul L. Hansen. 2003. Classification and management of riparian and wetland sites of Alberta's Parkland Natural Region and Dry Mixedwood Natural Subregion. Bitterroot Restoration, Inc. Prepared for the AlbertaRiparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta, Canada. 340 p.

APPENDIX B: BATTLE RIVER & DRIEDMEAT LAKE PLANT COMMUNITY AND HABITAT TYPES

Plant Community					
Scientific Name	**Common Name**	**Type**	**Area of Type (acres)**	**% of Project Area**	**Constancy***
Acer negundo/Prunus virginiana	Manitoba maple/Choke cherry	Habitat Type	107.27	3.88%	7.59%
Betula papyrifera	White birch	Community Type	2.08	0.08%	2.53%
Bromus inermus	Smooth brome	Community Type	267.63	9.67%	20.25%
Carex aquatilis	Water sedge	Habitat Type	0.25	0.01%	1.27%
Carex atherodes	Awned sedge	Habitat Type	25.91	0.94%	7.59%
Carex utriculata	Small bottle sedge	Habitat Type	56.05	2.03%	8.86%
Cornus stolonifera	Red-osier dogwood	Community Type	105.07	3.80%	10.13%
Deschampsia cespitosa	tufted hair grass	Habitat Type	11.40	0.41%	5.06%
Elaeagnus commutata	silverberry	Community Type	21.72	0.78%	2.53%
Glyceria grandis	common tall manna grass	Community Type	10.36	0.37%	3.80%
Hordeum jubatum	foxtail barley	Community Type	10.49	0.38%	5.06%
Phalaris arundinacea	reed canary grass	Habitat Type	76.49	2.76%	8.86%
Picea glauca/Cornus stolonifera	White spruce/Red-osier dogwood	Habitat Type	5.02	0.18%	2.53%
Picea glauca/Equisetum arvense	White spruce/Common horsetail	Habitat Type	11.73	0.42%	2.53%
Picea glauca/Viburnum edule	White spruce/Low-bush cranberry	Habitat Type	6.02	0.22%	2.53%
Poa pratensis	Kentucky bluegrass	Community Type	147.31	5.32%	16.46%
Populus balsamifera/Cornus stolonifera	Balsam poplar/Red-osier dogwood	Community Type	438.91	15.86%	30.38%
Populus balsamifera/Herbaceous	Balsam poplar/herbaceous	Community Type	2.56	0.09%	2.53%
Populus balsamifera/Symphoricarpos occidentalis	Balsam poplar/Buckbrush/snowberry	Community Type	12.16	0.44%	3.80%
Populus tremuloides	Aspen	Community Type	2.72	0.10%	3.80%
Populus tremuloides/Cornus stolonifera	Aspen/Red-osier dogwood	Habitat Type	0.32	0.01%	2.53%
Populus tremuloides/Symphoricarpos occidentalis	Aspen/Buckbrush/snoberry	Community Type	3.49	0.13%	2.53%
Populus tremuloides/Viburnum edule	Aspen/Low-bush cranberry	Community Type	245.09	8.86%	24.05%
Prunus virginiana	choke cherry	Community Type	26.93	0.97%	2.53%
Rosa woodsii	common wild rose	Community Type	1.91	0.07%	1.27%
Salix bebbiana	beaked willow	Community Type	19.98	0.72%	3.80%
Salix bebbiana/Carex atherodes	Beaked willow/Awned sedge	Habitat Type	18.85	0.68%	5.06%

Plant Community					
Scientific Name	**Common Name**	**Type**	**Area of Type (acres)**	**% of Project Area**	**Constancy***
Salix bebiana/Cornus stolonifera	Beaked willow/Red-osier dogwood	Habitat Type	151.89	5.49%	17.72%
Salix exigua	sandbar willow	Community Type	172.73	6.24%	46.84%
Salix lutea	yellow willow	Community Type	0.57	0.02%	1.27%
Salix lutea/Cornus stolonifera	Yellow willow/Red-osier dogwood	Habitat Type	202.84	7.33%	35.44%
Salix petiolaris	basket willow	Community Type	18.17	0.66%	7.59%
Salix petiolaris/Cornus stolonifera	basket willow/red-osier dogwood	Habitat Type	0.09	0.00%	1.27%
Salix planifolia	flat-leaved willow	Community Type	2.09	0.08%	3.80%
Salix planifolia/Carex utriculata	Flat-leaved willow/Small bottle sedge	Habitat Type	15.83	0.57%	3.80%
Scirpus acutus	great bulrush	Habitat Type	26.54	0.96%	8.86%
Symphoricarpos occidentalis	buckbrush/snowberry	Community Type	36.46	1.32%	6.33%
Typha latifolia	common cattail	Habitat Type	18.39	0.66%	8.86%
Unclassified Wetland Type			468.80	16.94%	24.05%
Upland Type			37.65	1.36%	6.33%

*Constancy is the number of times the plant community occurs divided by the total number of sites.

APPENDIX C: BATTLE RIVER & DRIEDMEAT LAKE PLANT INVENTORY

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
TREES						
aspen (Populus tremuloides)	native	106.75	8.35%	0.00%	30.00%	60.76%
balsam poplar (Populus balsamifera)	native	212.78	10.10%	0.00%	70.00%	77.22%
Manitoba maple (Acer negundo)	native	230.58	11.21%	0.00%	50.00%	64.56%
white birch (Betula papyrifera)	native	5.41	1.28%	0.00%	3.00%	20.25%
white spruce (Picea glauca)	native	8.13	1.55%	0.00%	20.00%	24.05%
SHRUBS						
basket willow (Salix petiolaris)	native	23.01	3.94%	0.00%	40.00%	21.52%
beaked hazelnut (Corylus cornuta)	native	1.28	0.50%	0.00%	0.50%	12.66%
beaked willow (Salix bebbiana)	native	97.27	4.26%	0.00%	30.00%	83.54%
birch (Betula spp.)	unknown	0.06	0.50%	0.00%	0.50%	1.27%
bog birch (Betula glandulosa)	native	0.41	0.50%	0.00%	0.50%	1.27%
bracted honeysuckle (Lonicera involucrata)	native	0.10	0.50%	0.00%	0.50%	1.27%
buckbrush/snowberry (Symphoricarpos occidentalis)	native	280.05	10.59%	0.00%	40.00%	97.47%
bunchberry (Cornus canadensis)	native	0.04	0.50%	0.00%	0.50%	1.27%
Canada buffaloberry (Shepherdia canadensis)	native	3.28	0.56%	0.00%	3.00%	34.18%
choke cherry (Prunus virginiana)	native	201.23	10.87%	0.00%	30.00%	60.76%
common caragana (Caragana arborescens)	***invasive***	0.08	0.50%	0.00%	0.50%	1.27%
common wild rose (Rosa woodsii)	native	35.93	5.42%	0.00%	20.00%	24.05%
creeping juniper (Juniperus horizontalis)	native	0.09	0.50%	0.00%	0.50%	1.27%
currant (Ribes spp.)	unknown	0.28	0.50%	0.00%	0.50%	1.27%
dewberry (Rubus pubescens)	native	3.77	1.00%	0.00%	3.00%	13.92%
false mountain willow (Salix pseudomonticola)	native	19.87	2.45%	0.00%	10.00%	31.65%
flat-leaved willow (Salix planifolia)	native	21.71	3.40%	0.00%	20.00%	26.58%
golden currant (Ribes aureum)	native	5.86	0.84%	0.00%	3.00%	25.32%
green alder (Alnus crispa)	native	1.08	1.19%	0.00%	3.00%	3.80%
ground juniper (Juniperus communis)	native	0.14	0.50%	0.00%	0.50%	3.80%
high-bush cranberry (Viburnum opulus)	native	15.38	2.08%	0.00%	10.00%	34.18%
hoary willow (Salix candida)	native	0.49	0.50%	0.00%	0.50%	1.27%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
low-bush cranberry (Viburnum edule)	native	10.47	2.25%	0.00%	10.00%	15.19%
narrow-leaved meadowsweet (Spiraea alba)	native	12.10	0.95%	0.00%	3.00%	46.84%
northern gooseberry (Ribes oxyacanthoides)	native	7.81	0.52%	0.00%	3.00%	54.43%
Nuttall's atriplex (Atriplex nuttallii)	native	0.30	0.50%	0.00%	0.50%	2.53%
pin cherry (Prunus pensylvanica)	native	4.93	1.66%	0.00%	3.00%	15.19%
prickly rose (Rosa acicularis)	native	136.97	6.35%	0.00%	30.00%	79.75%
pussy willow (Salix discolor)	native	0.30	0.50%	0.00%	0.50%	5.06%
red-osier dogwood (Cornus stolonifera)	native	294.06	11.60%	0.00%	30.00%	94.94%
river alder (Alnus tenuifolia)	native	8.12	1.47%	0.00%	10.00%	22.78%
round-leaved hawthorn (Crataegus rotundifolia)	native	5.25	0.83%	0.00%	3.00%	26.58%
sandbar willow (Salix exigua)	native	228.07	8.71%	0.00%	20.00%	96.20%
Saskatoon (Amelanchier alnifolia)	native	116.85	5.43%	0.00%	20.00%	78.48%
shrub (Shrub)	unknown	0.41	0.50%	0.00%	0.50%	2.53%
silverberry (Elaeagnus commutata)	native	101.80	8.12%	0.00%	30.00%	45.57%
thorny buffaloberry (Shepherdia argentea)	native	0.06	0.50%	0.00%	0.50%	1.27%
twinflower (Linnaea borealis)	native	0.04	0.50%	0.00%	0.50%	1.27%
twining honeysuckle (Lonicera dioica)	native	1.78	0.50%	0.00%	0.50%	11.39%
water birch (Betula occidentalis)	native	22.78	2.66%	0.00%	20.00%	32.91%
wild black currant (Ribes americanum)	native	0.01	0.50%	0.00%	0.50%	1.27%
wild red currant (Ribes triste)	native	13.42	1.61%	0.00%	10.00%	29.11%
wild red raspberry (Rubus idaeus)	native	68.61	3.34%	0.00%	30.00%	72.15%
yellow willow (Salix lutea)	native	168.97	6.98%	0.00%	40.00%	81.01%
GRASSES AND GRASS-LIKES						
alkali cord grass (Spartina gracilis)	native	0.20	0.50%	0.00%	0.50%	1.27%
awned sedge (Carex atherodes)	native	45.81	6.91%	0.00%	20.00%	25.32%
Barley crop (Hordeum species)	unknown	234.70	73.59%	0.00%	90.00%	7.59%
blue grama (Bouteloua gracilis)	native	6.55	2.89%	0.00%	10.00%	8.86%
bluejoint (Calamagrostis canadensis)	native	36.69	1.99%	0.00%	20.00%	65.82%
Canada wild rye (Elymus canadensis)	native	7.15	0.78%	0.00%	3.00%	36.71%
common great bulrush (Scirpus validus)	native	28.36	1.49%	0.00%	20.00%	62.03%
common tall manna grass (Glyceria grandis)	native	62.62	2.40%	0.00%	30.00%	93.67%
creeping spike-rush (Eleocharis palustris)	native	12.50	0.80%	0.00%	3.00%	53.16%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
crested wheat grass (Agropyron pectiniforme)	*disturbance*	2.07	2.70%	0.00%	10.00%	5.06%
cultivated barley (Hordeum vulgare)	*disturbance*	0.25	0.50%	0.00%	0.50%	2.53%
cultivated oat (Avena sativa)	disturbance	0.76	0.50%	0.00%	0.50%	3.80%
fowl bluegrass (Poa palustris)	native	74.78	3.29%	0.00%	30.00%	81.01%
fowl manna grass (Glyceria striata)	native	2.49	0.92%	0.00%	3.00%	7.59%
foxtail barley (Hordeum jubatum)	*disturbance*	68.30	3.41%	0.00%	20.00%	82.28%
fringed brome (Bromus ciliatus)	native	11.50	1.45%	0.00%	10.00%	34.18%
graminoid (Graminoid)	unknown	0.77	0.50%	0.00%	0.50%	6.33%
great bulrush (Scirpus acutus)	native	0.21	0.50%	0.00%	0.50%	1.27%
green foxtail (Setaria viridis)	*disturbance*	1.31	0.50%	0.00%	0.50%	7.59%
green needle grass (Stipa viridula)	native	2.84	0.50%	0.00%	0.50%	15.19%
June grass (Koeleria macrantha)	native	1.90	0.50%	0.00%	0.50%	8.86%
Kentucky bluegrass (Poa pratensis)	*disturbance*	378.29	14.05%	0.00%	60.00%	94.94%
knotted rush (Juncus nodosus)	native	1.31	0.50%	0.00%	0.50%	13.92%
meadow brome (Bromus biebersteinii)	*introduced*	12.23	30.00%	0.00%	30.00%	1.27%
needle grass (Stipa spp.)	unknown	0.76	0.50%	0.00%	0.50%	6.33%
needle-and-thread (Stipa comata)	native	6.54	2.48%	0.00%	3.00%	6.33%
northern awnless brome (Bromus inermis ssp pumpellianus)	native	1.81	2.23%	0.00%	3.00%	2.53%
northern reed grass (Calamagrostis inexpansa)	native	2.97	0.50%	0.00%	0.50%	13.92%
northern wheat grass (Agropyron dasystachyum)	native	10.39	1.20%	0.00%	10.00%	35.44%
Nuttall's salt-meadow grass (Puccinellia nuttalliana)	native	2.57	0.55%	0.00%	3.00%	21.52%
orchard grass (Dactylis glomerata)	*introduced*	0.50	0.50%	0.00%	0.50%	2.53%
pale bulrush (Scirpus pallidus)	native (rare)	0.31	0.50%	0.00%	0.50%	2.53%
quack grass (Agropyron repens)	*disturbance*	131.27	6.11%	0.00%	30.00%	75.95%
redtop (Agrostis stolonifera)	*introduced*	15.86	5.08%	0.00%	10.00%	11.39%
reed canary grass (Phalaris arundinacea)	native	144.51	5.50%	0.00%	50.00%	88.61%
reed grass (Calamagrostis spp.)	unknown	0.45	0.50%	0.00%	0.50%	3.80%
rough hair grass (Agrostis scabra)	native	0.09	3.00%	0.00%	3.00%	1.27%
rush (Juncus spp.)	unknown	0.83	0.66%	0.00%	3.00%	6.33%
salt grass (Distichlis stricta)	native	1.64	2.49%	0.00%	3.00%	3.80%
sand grass (Calamovilfa longifolia)	native	0.06	0.50%	0.00%	0.50%	1.27%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
Sartwell's sedge (Carex sartwellii)	native	1.60	1.80%	0.00%	3.00%	5.06%
sedge (Carex spp.)	unknown	16.22	2.36%	0.00%	20.00%	13.92%
short-awn meadow-foxtail (Alopecurus aequalis)	native	3.04	0.50%	0.00%	0.50%	25.32%
slender rush (Juncus tenuis)	native	0.63	0.50%	0.00%	0.50%	6.33%
slender wheat grass (Agropyron trachycaulum var. unilaterale)	native	17.65	1.69%	0.00%	10.00%	32.91%
slender wheat grass (Agropyron trachycaulum)	native	24.15	1.47%	0.00%	10.00%	54.43%
slough grass (Beckmannia syzigachne)	native	33.80	1.84%	0.00%	97.50%	70.89%
small bottle sedge (Carex utriculata)	native	65.33	5.31%	0.00%	50.00%	49.37%
small-fruited bulrush (Scirpus microcarpus)	native	38.28	1.71%	0.00%	10.00%	72.15%
smooth brome (Bromus inermis)	*disturbance*	784.43	29.65%	0.00%	80.00%	94.94%
Sprengel's sedge (Carex sprengelii)	native	108.30	13.35%	0.00%	70.00%	32.91%
three-square rush (Scirpus pungens)	native	1.41	0.50%	0.00%	0.50%	2.53%
timothy (Phleum pratense)	*disturbance*	39.14	4.82%	0.00%	30.00%	32.91%
tufted hair grass (Deschampsia cespitosa)	native	41.03	4.39%	0.00%	20.00%	34.18%
water sedge (Carex aquatilis)	native	5.57	0.95%	0.00%	10.00%	13.92%
western wheat grass (Agropyron smithii)	native	13.83	1.91%	0.00%	10.00%	29.11%
wheat grass (Agropyron spp.)	unknown	0.12	0.50%	0.00%	0.50%	2.53%
wild oat (Avena fatua)	*disturbance*	4.97	2.26%	0.00%	10.00%	5.06%
wild rye (Elymus spp.)	unknown	4.01	0.77%	0.00%	20.00%	8.86%
wire rush (Juncus balticus)	native	5.83	0.75%	0.00%	3.00%	26.58%
witch grass (Panicum capillare)	*introduced*	0.13	0.50%	0.00%	0.50%	1.27%
woolly sedge (Carex lanuginosa)	native	1.18	0.50%	0.00%	0.50%	10.13%
FORBS						
absinthe wormwood (Artemisia absinthium)	*introduced*	1.96	0.50%	0.00%	0.50%	18.99%
agrimony (Agrimonia striata)	native	9.47	0.82%	0.00%	3.00%	37.97%
alfalfa (Medicago sativa)	*introduced*	15.99	2.18%	0.00%	50.00%	24.05%
alpine hedysarum (Hedysarum alpinum)	native	0.05	0.50%	0.00%	0.50%	2.53%
alpine locoweed (Oxytropis cusickii)	*poisonous*	0.34	0.50%	0.00%	0.50%	1.27%
alsike clover (Trifolium hybridum)	*disturbance*	14.77	1.67%	0.00%	10.00%	34.18%
American dragonhead (Dracocephalum parviflorum)	native	0.30	0.50%	0.00%	0.50%	1.27%
annual hawk's-beard (Crepis tectorum)	*disturbance*	4.04	0.50%	0.00%	0.50%	30.38%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
annual sow-thistle (Sonchus oleraceus)	*disturbance*	0.19	0.50%	0.00%	0.50%	1.27%
Arctic butterweed (Senecio conterminus)	native	1.28	0.50%	0.00%	0.50%	10.13%
arrow-leaved coltsfoot (Petasites sagittatus)	native	0.45	0.50%	0.00%	0.50%	3.80%
artemisia (Artemisia spp.)	unknown	0.68	0.50%	0.00%	0.50%	3.80%
arum-leaved arrowhead (Sagittaria cuneata)	native	4.95	0.62%	0.00%	3.00%	16.46%
aster (Aster spp.)	unknown	1.70	0.50%	0.00%	0.50%	8.86%
biennial sagewort (Artemisia biennis)	native	0.63	0.50%	0.00%	0.50%	3.80%
bindweed (Convolvulus spp.)	unknown	0.37	0.50%	0.00%	0.50%	6.33%
bishop's-cap (Mitella nuda)	native	0.30	0.50%	0.00%	0.50%	2.53%
black medick (Medicago lupulina)	*introduced*	0.91	0.50%	0.00%	0.50%	6.33%
bluebur (Lappula squarrosa)	*disturbance*	5.13	0.50%	0.00%	0.50%	29.11%
bog violet (Viola nephrophylla)	native	0.36	0.50%	0.00%	0.50%	2.53%
brittle prickly-pear (Opuntia fragilis)	native	0.24	0.50%	0.00%	0.50%	2.53%
broad-leaved arrowhead (Sagittaria latifolia)	native (rare)	0.38	0.50%	0.00%	0.50%	3.80%
broad-leaved fireweed (Epilobium latifolium)	native	0.04	0.50%	0.00%	0.50%	1.27%
broomweed (Gutierrezia sarothrae)	*poisonous*	0.54	0.50%	0.00%	0.50%	1.27%
bull thistle (Cirsium vulgare)	*introduced*	0.15	0.50%	0.00%	0.50%	1.27%
butter-and-eggs (Linaria vulgaris)	***invasive***	13.66	1.10%	0.00%	3.00%	29.11%
Canada anemone (Anemone canadensis)	native	9.35	0.50%	0.00%	0.50%	75.95%
Canada goldenrod (Solidago canadensis)	native	36.12	1.65%	0.00%	10.00%	68.35%
Canada thistle (Cirsium arvense)	***invasive***	48.01	1.91%	0.00%	10.00%	96.20%
cattail (Typha spp.)	unknown	0.04	0.50%	0.00%	0.50%	1.27%
celery-leaved buttercup (Ranunculus sceleratus)	native	2.43	0.50%	0.00%	0.50%	13.92%
chicory (Cichorium intybus)	*introduced*	0.04	0.50%	0.00%	0.50%	1.27%
cinquefoil (Potentilla spp.)	unknown	0.29	0.50%	0.00%	0.50%	1.27%
cleavers (Galium aparine)	***invasive***	0.21	0.50%	0.00%	0.50%	1.27%
cocklebur (Xanthium strumarium)	native	5.52	0.50%	0.00%	0.50%	30.38%
common annual sunflower (Helianthus annuus)	native	0.18	0.50%	0.00%	0.50%	2.53%
common blue lettuce (Lactuca pulchella)	native	1.56	0.50%	0.00%	0.50%	8.86%
common blue-eyed grass (Sisyrinchium montanum)	native	0.01	0.50%	0.00%	0.50%	1.27%
common burdock (Arctium minus)	*disturbance*	0.12	0.50%	0.00%	0.50%	1.27%
common cattail (Typha latifolia)	native	25.18	2.89%	0.00%	20.00%	41.77%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
common dandelion (Taraxacum officinale)	*disturbance*	28.20	1.40%	0.00%	10.00%	82.28%
common fireweed (Epilobium angustifolium)	native	1.45	0.50%	0.00%	0.50%	11.39%
common horsetail (Equisetum arvense)	*poisonous*	30.20	1.32%	0.00%	20.00%	82.28%
common knotweed (Polygonum arenastrum)	*introduced*	2.02	0.50%	0.00%	0.50%	15.19%
common mare's-tail (Hippuris vulgaris)	native	3.09	0.50%	0.00%	0.50%	17.72%
common nettle (Urtica dioica)	native	10.98	0.56%	0.00%	10.00%	69.62%
common pepper-grass (Lepidium densiflorum)	native	4.01	0.50%	0.00%	0.50%	21.52%
common pink wintergreen (Pyrola asarifolia)	native	0.16	0.50%	0.00%	0.50%	5.06%
common plantain (Plantago major)	*disturbance*	14.62	0.62%	0.00%	3.00%	86.08%
common scouring-rush (Equisetum hyemale)	native	1.61	0.50%	0.00%	0.50%	12.66%
common tall sunflower (Helianthus nuttallii)	native	1.00	0.50%	0.00%	0.50%	3.80%
common tansy (Tanacetum vulgare)	***invasive***	13.43	1.20%	0.00%	3.00%	39.24%
common yarrow (Achillea millefolium)	native	10.36	0.50%	0.00%	0.50%	72.15%
cow parsnip (Heracleum lanatum)	native	1.33	0.50%	0.00%	0.50%	7.59%
cream-colored vetchling (Lathyrus ochroleucus)	native	0.97	0.50%	0.00%	0.50%	11.39%
curled dock (Rumex crispus)	*introduced*	13.28	0.87%	0.00%	3.00%	55.70%
cut-leaved anemone (Anemone multifida)	native	0.41	0.50%	0.00%	0.50%	1.27%
cut-leaved ragwort (Senecio eremophilus)	native	1.27	0.50%	0.00%	0.50%	8.86%
early blue violet (Viola adunca)	native	0.05	0.50%	0.00%	0.50%	1.27%
erigeron (Erigeron spp.)	unknown	1.69	0.50%	0.00%	0.50%	3.80%
fairybells (Disporum trachycarpum)	native	0.83	0.50%	0.00%	0.50%	2.53%
false dragonhead (Physostegia parviflora)	native	0.49	0.50%	0.00%	0.50%	1.27%
felwort (Gentianella amarella)	native	3.09	0.50%	0.00%	0.50%	22.78%
field mouse-ear chickweed (Cerastium arvense)	*disturbance*	0.04	0.50%	0.00%	0.50%	1.27%
flixweed; tansy mustard (Descurainia sophia)	*disturbance*	7.06	0.50%	0.00%	0.50%	46.84%
forb (Forb)	unknown	1.27	0.99%	0.00%	3.00%	5.06%
fringed loosestrife (Lysimachia ciliata)	native	7.08	0.50%	0.00%	0.50%	37.97%
gaillardia (Gaillardia aristata)	native	2.38	0.50%	0.00%	0.50%	12.66%
giant bur-reed (Sparganium eurycarpum)	native	4.75	2.05%	0.00%	10.00%	12.66%
golden aster (Heterotheca villosa)	native	2.30	0.50%	0.00%	0.50%	11.39%
golden dock (Rumex maritimus)	native	9.34	0.91%	0.00%	20.00%	31.65%
goosefoot (Chenopodium spp.)	unknown	1.00	0.50%	0.00%	0.50%	3.80%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
graceful cinquefoil (Potentilla gracilis)	native	0.48	0.50%	0.00%	0.50%	3.80%
gumweed (Grindelia squarrosa)	native	2.49	0.50%	0.00%	0.50%	24.05%
harebell (Campanula rotundifolia)	native	3.64	0.50%	0.00%	0.50%	27.85%
heart-leaved Alexanders (Zizia aptera)	native	0.36	0.50%	0.00%	0.50%	3.80%
hemp-nettle (Galeopsis tetrahit)	*disturbance*	2.23	0.50%	0.00%	0.50%	18.99%
horseweed (Erigeron canadensis)	native	0.53	0.50%	0.00%	0.50%	5.06%
hound's-tongue (Cynoglossum officinale)	**invasive**	0.09	0.50%	0.00%	0.50%	1.27%
Indian hemp (Apocynum cannabinum)	*poisonous*	0.48	0.50%	0.00%	0.50%	5.06%
lamb's-quarters (Chenopodium album)	*disturbance*	7.14	0.50%	0.00%	0.50%	43.04%
large-leaved yellow avens (Geum macrophyllum)	native	1.52	0.50%	0.00%	0.50%	10.13%
late yellow locoweed (Oxytropis monticola)	*poisonous*	0.10	0.50%	0.00%	0.50%	1.27%
leafy spurge (Euphorbia esula)	***invasive***	17.09	2.51%	0.00%	10.00%	10.13%
Lindley's aster (Aster ciliolatus)	native	0.14	0.50%	0.00%	0.50%	2.53%
locoweed (Oxytropis spp.)	unknown	0.54	0.50%	0.00%	0.50%	1.27%
long-fruited anemone (Anemone cylindrica)	native	1.40	0.50%	0.00%	0.50%	5.06%
long-leaved sagewort (Artemisia longifolia)	native	0.16	0.50%	0.00%	0.50%	2.53%
low goldenrod (Solidago missouriensis)	native	1.23	0.50%	0.00%	0.50%	3.80%
Macoun's buttercup (Ranunculus macounii)	native	0.57	0.50%	0.00%	0.50%	6.33%
many-flowered yarrow (Achillea sibirica)	native	8.67	0.50%	0.00%	0.50%	59.49%
maple-leaved goosefoot (Chenopodium gigantospermum)	native	0.04	0.50%	0.00%	0.50%	1.27%
marsh hedge-nettle (Stachys palustris)	native	8.23	0.50%	0.00%	0.50%	51.90%
marsh skullcap (Scutellaria galericulata)	native	0.66	0.50%	0.00%	0.50%	7.59%
marsh yellow cress (Rorippa palustris)	native	0.29	1.38%	0.00%	3.00%	2.53%
mealy primrose (Primula incana)	native	0.13	0.50%	0.00%	0.50%	1.27%
mountain goldenrod (Solidago spathulata)	native	0.15	0.50%	0.00%	0.50%	2.53%
mustard (Brassica spp.)	unknown	1.38	0.50%	0.00%	0.50%	8.86%
narrow-leaved collomia (Collomia linearis)	native	1.60	0.50%	0.00%	0.50%	3.80%
narrow-leaved dock (Rumex triangulivalvis)	native	0.25	0.50%	0.00%	0.50%	1.27%
narrow-leaved hawkweed (Hieracium umbellatum)	native	0.59	0.50%	0.00%	0.50%	2.53%
nodding beggarticks (Bidens cernua)	native	0.34	0.50%	0.00%	0.50%	3.80%
northern bedstraw (Galium boreale)	native	11.39	0.61%	0.00%	3.00%	69.62%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
northern grass-of-parnassus (Parnassia palustris)	native	0.05	0.50%	0.00%	0.50%	1.27%
northern water-horehound (Lycopus uniflorus)	native	1.20	0.73%	0.00%	3.00%	3.80%
northern willowherb (Epilobium ciliatum)	native	1.60	0.50%	0.00%	0.50%	3.80%
oak-leaved goosefoot (Chenopodium salinum)	native	0.10	0.50%	0.00%	0.50%	2.53%
owl-clover (Orthocarpus luteus)	native	1.04	0.50%	0.00%	0.50%	2.53%
pale persicaria (Polygonum lapathifolium)	native	0.36	0.50%	0.00%	0.50%	2.53%
palmate-leaved coltsfoot (Petasites palmatus)	native	0.79	0.50%	0.00%	0.50%	5.06%
pasture sagewort (Artemisia frigida)	*introduced*	26.00	1.81%	0.00%	20.00%	49.37%
perennial sow-thistle (Sonchus arvensis)	***invasive***	29.90	1.09%	0.00%	3.00%	97.47%
Philadelphia fleabane (Erigeron philadelphicus)	native	4.78	0.50%	0.00%	0.50%	37.97%
pineappleweed (Matricaria matricarioides)	*introduced*	0.28	0.50%	0.00%	0.50%	1.27%
plains wormwood (Artemisia campestris)	native	6.32	0.50%	0.00%	0.50%	41.77%
polygonum (Polygonum spp.)	unknown	0.04	0.50%	0.00%	0.50%	1.27%
prairie cinquefoil (Potentilla pensylvanica)	native	0.71	0.50%	0.00%	0.50%	1.27%
prairie coneflower (Ratibida columnifera)	native	0.19	0.50%	0.00%	0.50%	1.27%
prairie groundsel (Senecio canus)	native	0.04	0.50%	0.00%	0.50%	1.27%
prairie sagewort (Artemisia ludoviciana)	*introduced*	7.17	0.50%	0.00%	0.50%	44.30%
prickly annual sow-thistle (Sonchus asper)	*introduced*	0.52	0.50%	0.00%	0.50%	2.53%
prickly lettuce (Lactuca serriola)	*introduced*	0.79	0.50%	0.00%	0.50%	6.33%
prostrate amaranth (Amaranthus graecizans)	native	0.27	0.50%	0.00%	0.50%	2.53%
rape (Argentine canola- unknown) (Brassica napus var. napus)	*introduced*	57.449	70.00%	0.00%	70.00%	1.27%
red and white baneberry (Actaea rubra)	*poisonous*	2.98	0.50%	0.00%	0.50%	15.19%
red clover (Trifolium pratense)	*disturbance*	5.39	0.90%	0.00%	3.00%	21.52%
red-root pigweed (Amaranthus retroflexus)	*disturbance*	0.10	0.50%	0.00%	0.50%	1.27%
rough cinquefoil (Potentilla norvegica)	*disturbance*	2.96	0.50%	0.00%	0.50%	26.58%
scentless chamomile (Matricaria perforata)	***invasive***	5.41	0.62%	0.00%	3.00%	26.58%
seaside arrow-grass (Triglochin maritima)	*poisonous*	0.54	0.50%	0.00%	0.50%	5.06%
seaside buttercup (Ranunculus cymbalaria)	native	3.15	0.62%	0.00%	3.00%	30.38%
shepherd's-purse (Capsella bursa-pastoris)	*disturbance*	1.14	0.50%	0.00%	0.50%	6.33%
silverweed (Potentilla anserina)	*disturbance*	18.98	0.82%	0.00%	10.00%	83.54%
small-leaved everlasting (Antennaria parvifolia)	*disturbance*	1.63	0.50%	0.00%	0.50%	12.66%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
smooth aster (Aster laevis)	native	4.29	0.50%	0.00%	0.50%	39.24%
smooth fleabane (Erigeron glabellus)	native	1.75	0.50%	0.00%	0.50%	15.19%
snakeroot (Sanicula marilandica)	native	0.54	0.50%	0.00%	0.50%	1.27%
sneezeweed (Helenium autumnale)	*poisonous*	9.27	0.68%	0.00%	10.00%	45.57%
spear-leaved goosefoot (Monolepis nuttalliana)	native	0.04	0.50%	0.00%	0.50%	1.27%
spreading dogbane (Apocynum androsaemifolium)	*disturbance*	0.10	0.50%	0.00%	0.50%	1.27%
star-flowered Solomon's-seal (Smilacina stellata)	native	4.18	0.50%	0.00%	0.50%	29.11%
sticky purple geranium (Geranium viscosissimum)	native	0.06	0.50%	0.00%	0.50%	1.27%
stinkweed (Thlaspi arvense)	*disturbance*	6.58	0.73%	0.00%	3.00%	29.11%
sweet-scented bedstraw (Galium triflorum)	native	0.66	0.50%	0.00%	0.50%	5.06%
tall larkspur (Delphinium glaucum)	*poisonous*	0.13	0.50%	0.00%	0.50%	1.27%
three-flowered avens (Geum triflorum)	native	1.17	0.50%	0.00%	0.50%	5.06%
tufted white prairie aster (Aster ericoides)	native	2.17	0.50%	0.00%	0.50%	16.46%
two-grooved milk vetch (Astragalus bisulcatus)	*poisonous*	0.04	0.50%	0.00%	0.50%	1.27%
veiny meadow rue (Thalictrum venulosum)	native	8.95	0.56%	0.00%	3.00%	51.90%
violet (Viola spp.)	unknown	0.54	0.50%	0.00%	0.50%	1.27%
water parsnip (Sium suave)	native	6.81	0.50%	0.00%	0.50%	53.16%
water smartweed (Polygonum amphibium)	native	8.68	0.65%	0.00%	3.00%	37.97%
water smartweed (Polygonum coccineum)	native	0.86	0.50%	0.00%	0.50%	3.80%
water-hemlock (Cicuta maculata)	*poisonous*	5.59	0.50%	0.00%	0.50%	31.65%
wavy-leaved thistle (Cirsium undulatum)	native	1.60	0.50%	0.00%	0.50%	7.59%
western bluebur (Lappula occidentalis)	*introduced*	0.69	0.50%	0.00%	0.50%	5.06%
western Canada violet (Viola canadensis)	native	0.76	0.50%	0.00%	0.50%	3.80%
western dock (Rumex occidentalis)	native	2.53	0.50%	0.00%	0.50%	16.46%
western water-horehound (Lycopus asper)	native	0.25	0.50%	0.00%	0.50%	3.80%
western willow aster (Aster hesperius)	native	0.16	0.50%	0.00%	0.50%	1.27%
white clover (Trifolium repens)	*disturbance*	24.58	1.60%	0.00%	10.00%	60.76%
white cockle (Silene pratensis)	***invasive***	0.88	0.50%	0.00%	0.50%	6.33%
white sweet-clover (Melilotus alba)	*disturbance*	4.91	0.73%	0.00%	3.00%	27.85%
wild bergamot (Monarda fistulosa)	native	9.77	0.78%	0.00%	3.00%	36.71%
wild blue flax (Linum lewisii)	native	1.15	0.50%	0.00%	0.50%	5.06%
wild buckwheat (Polygonum convolvulus)	*disturbance*	0.13	0.50%	0.00%	0.50%	1.27%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
wild daisy fleabane (Erigeron hyssopifolius)	native (rare)	0.04	0.50%	0.00%	0.50%	1.27%
wild licorice (Glycyrrhiza lepidota)	native	3.98	0.71%	0.00%	3.00%	17.72%
wild lily-of-the-valley (Maianthemum canadense)	native	0.10	0.50%	0.00%	0.50%	3.80%
wild mint (Mentha arvensis)	native	14.56	0.74%	0.00%	3.00%	67.09%
wild morning-glory; hedge bindweed (Convolvulus sepium)	*disturbance*	0.13	0.50%	0.00%	0.50%	1.27%
wild sarsaparilla (Aralia nudicaulis)	native	38.94	6.22%	0.00%	20.00%	26.58%
wild strawberry (Fragaria virginiana)	*disturbance*	7.56	0.56%	0.00%	3.00%	53.16%
wild tomato (Solanum triflorum)	native	0.34	0.50%	0.00%	0.50%	1.27%
wild vetch (Vicia americana)	native	10.95	0.50%	0.00%	0.50%	79.75%
wormseed mustard (Erysimum cheiranthoides)	*disturbance*	1.73	0.50%	0.00%	0.50%	12.66%
yellow avens (Geum aleppicum)	native	4.11	0.50%	0.00%	0.50%	36.71%
yellow evening-primrose (Oenothera biennis)	native	6.59	0.50%	0.00%	0.50%	34.18%
yellow sweet-clover (Melilotus officinalis)	*disturbance*	7.55	0.74%	0.00%	3.00%	44.30%

Summary	
Total # of species =	290
Total # of TREE species =	5
Total # of SHRUB species =	44
Total # of GRASSWS/GRASS-LIKES species =	62
Total # of FORB species =	179

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=45%-55%; 60.0=55%-65%; 70.0=65%-75%; 80.0=75%-85%; 90.0=85%-95%; 97.5=greater than 95%; — = not observed.

[3] Constancy is the number of times the species occurrs divided by the total number of polygons.

APPENDIX D: BATTLE RIVER LENTIC & LOTIC TRIBUTARIES PLANT COMMUNITY AND HABITAT TYPES

Plant Community					
Scientific Name	**Common Name**	**Type**	**Area of Type (acres)**	**% of Project Area**	**Constancy***
Acer negundo/Prunus virginiana	Manitoba maple/choke cherry	Habitat Type	34.02	2.47%	66.67%
Artemisia cana/Agropyron smithii	silver sagebrush/western wheat grass	Habitat Type	0.12	0.01%	8.33%
Betula occidentalis	water birch	Community Type	0.26	0.02%	8.33%
Betula papyrifera	white birch	Community Type	3.14	0.23%	16.67%
Bromus inermus	smooth brome	Community Type	55.67	4.04%	75.00%
Calamagrostis stricta	narrow reed grass	Community Type	1.48	0.11%	8.33%
Carex aquatilis	water sedge	Habitat Type	96.95	7.04%	266.67%
Carex atherodes	awned sedge	Habitat Type	17.36	1.26%	25.00%
Carex lanuginosa	woolly sedge	Habitat Type	3.21	0.23%	25.00%
Carex utriculata	small bottle sedge	Habitat Type	59.94	4.35%	166.67%
Crataegus rotundifolia	round-leaved hawthorn	Community Type	18.19	1.32%	50.00%
Deschampsia cespitosa	tufted hair grass	Habitat Type	24.88	1.81%	83.33%
Distichlis stricta	salt grass	Habitat Type	6.79	0.49%	50.00%
Elaeagnus commutata	silverberry	Community Type	3.67	0.27%	66.67%
Eleocharis palustris	creeping spike-rush	Habitat Type	8.74	0.63%	25.00%
Glyceria grandis	common tall manna grass	Community Type	2.02	0.15%	8.33%
Glycyrrhiza lepidota	wild licorice	Community Type	0.41	0.03%	8.33%
Hordeum jubatum	foxtail barley	Community Type	117.81	8.55%	216.67%
Juncus balticus	wire rush	Community Type	24.49	1.78%	100.00%
Phalaris arundinacea	reed canary grass	Habitat Type	40.80	2.96%	50.00%
Poa pratensis	Kentucky bluegrass	Community Type	122.23	8.87%	100.00%
Populus balsamifera	balsam poplar	Community Type	3.59	0.26%	8.33%
Populus balsamifera/Cornus stolonifera	balsam poplar/red-osier dogwood	Community Type	14.61	1.06%	83.33%
Populus balsamifera/Herbaceous	balsam poplar/herbaceous	Community Type	0.76	0.06%	8.33%
Populus balsamifera/Symphoricarpos occidentalis	balsam poplar/buckbrush/snowberry	Community Type	4.65	0.34%	58.33%

Plant Community					
Scientific Name	**Common Name**	**Type**	**Area of Type (acres)**	**% of Project Area**	**Constancy***
Populus tremuloides	aspen	Community Type	1.23	0.09%	16.67%
Populus tremuloides/Cornus stolonifera	aspen/red-osier dogwood	Habitat Type	30.24	2.19%	91.67%
Populus tremuloides/Symphoricarpos occidentalis	aspen/buckbrush/snowberry	Community Type	4.23	0.31%	33.33%
Prunus virginiana	choke cherry	Community Type	25.68	1.86%	41.67%
Puccinellia nuttalliana	Nuttall's salt-meadow grass	Habitat Type	8.68	0.63%	41.67%
Rosa acicularis	prickly rose	Community Type	42.87	3.11%	66.67%
Rosa woodsii	common wild rose	Community Type	4.64	0.34%	8.33%
Salix bebbiana	beaked willow	Community Type	40.30	2.92%	116.67%
Salix bebbiana/Carex atherodes	beaked willow/awned sedge	Habitat Type	70.97	5.15%	133.33%
Salix bebiana/Cornus stolonifera	beaked willow/red-osier dogwood	Habitat Type	107.16	7.78%	191.67%
Salix exigua	sandbar willow	Community Type	6.69	0.49%	50.00%
Salix lutea	yellow willow	Community Type	1.60	0.12%	8.33%
Salix lutea/Cornus stolonifera	yellow willow/red-osier dogwood	Habitat Type	1.13	0.08%	8.33%
Salix petiolaris	basket willow	Community Type	8.16	0.59%	58.33%
Salix petiolaris/Carex atherodes	basket willow/awned sedge	Habitat Type	63.89	4.64%	91.67%
Salix petiolaris/Cornus stolonifera	basket willow/red-osier dogwood	Habitat Type	62.26	4.52%	41.67%
Salix planifolia/Carex aquatilis	flat-leaved willow/water sedge	Habitat Type	22.78	1.65%	16.67%
Salix planifolia/Carex utriculata	flat-leaved willow/small bottle sedge	Habitat Type	4.95	0.36%	33.33%
Scirpus acutus	great bulrush	Habitat Type	5.23	0.38%	41.67%
Scirpus pallidus	pale bulrush	Habitat Type	1.23	0.09%	16.67%
Scirpus pungens	three-square rush	Habitat Type	6.39	0.46%	41.67%
Symphoricarpos occidentalis	buckbrush/snowberry	Community Type	91.97	6.67%	158.33%
Typha latifolia	common cattail	Habitat Type	60.41	4.38%	175.00%
Unclassified Wetland Type			77.60	5.63%	158.33%
Upland Type			1.72	0.12%	25.00%

*Constancy is the number of times the plant community occurs divided by the total number of sites

APPENDIX E: BATTLE RIVER LENTIC & LOTIC TRIBUTARIES PLANT INVENTORY

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
TREES						
ash (Fraxinus spp.)	unknown	0.25	0.50%	0.00%	0.50%	5.36%
aspen (Populus tremuloides)	native	26.08	2.97%	0.00%	80.00%	57.14%
balsam poplar (Populus balsamifera)	native	27.90	4.16%	0.00%	40.00%	48.21%
blue spruce (Picea pungens)	*introduced*	0.24	0.50%	0.00%	0.50%	5.36%
bur oak (Quercus macrocarpa)	*introduced*	0.02	0.50%	0.00%	0.50%	0.89%
cottonwood (Populus spp.)	unknown	0.13	0.50%	0.00%	0.50%	0.89%
European mountain-ash (Sorbus aucuparia)	*introduced*	0.02	0.50%	0.00%	0.50%	0.89%
green ash (Fraxinus pennsylvanica)	*introduced*	0.05	0.50%	0.00%	0.50%	1.79%
jack pine (Pinus banksiana)	native	0.02	0.50%	0.00%	0.50%	0.89%
Manitoba maple (Acer negundo)	native	25.89	5.47%	0.00%	40.00%	25.89%
oak (Quercus spp.)	*introduced*	0.04	0.50%	0.00%	0.50%	1.79%
plains cottonwood (Populus deltoides)	native	0.13	0.50%	0.00%	0.50%	0.89%
unknown pine (Pinus spp.)	unknown	0.13	0.50%	0.00%	0.50%	0.89%
white birch (Betula papyrifera)	native	1.84	0.99%	0.00%	3.00%	13.39%
white spruce (Picea glauca)	native	0.66	0.79%	0.00%	3.00%	8.93%
SHRUBS						
alpine bearberry (Arctostaphylos rubra)	native	0.02	0.50%	0.00%	0.50%	0.89%
autumn willow (Salix serissima)	native	0.40	0.78%	0.00%	3.00%	3.57%
balsam willow (Salix pyrifolia)	native	1.08	1.36%	0.00%	3.00%	3.57%
basket willow (Salix petiolaris)	native	68.69	7.02%	0.00%	40.00%	59.82%
beaked hazelnut (Corylus cornuta)	native	4.88	8.69%	0.00%	40.00%	6.25%
beaked willow (Salix bebbiana)	native	96.98	7.50%	0.00%	30.00%	83.93%
birch (Betula spp.)	unknown	0.13	0.50%	0.00%	0.50%	0.89%
bog birch (Betula glandulosa)	native	1.19	3.06%	0.00%	10.00%	3.57%
bristly black currant (Ribes lacustre)	native	0.14	0.50%	0.00%	0.50%	0.89%
buckbrush/snowberry (Symphoricarpos occidentalis)	native	149.83	10.99%	0.00%	50.00%	96.43%
bunchberry (Cornus canadensis)	native	0.38	0.81%	0.00%	3.00%	3.57%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
Canada buffaloberry (Shepherdia canadensis)	native	1.82	0.74%	0.00%	3.00%	26.79%
choke cherry (Prunus virginiana)	native	41.54	6.27%	0.00%	30.00%	48.21%
common bearberry (Arctostaphylos uva-ursi)	native	0.13	0.50%	0.00%	0.50%	0.89%
common caragana (Caragana arborescens)	***invasive***	2.26	1.94%	0.00%	10.00%	11.61%
common wild rose (Rosa woodsii)	native	26.66	4.06%	0.00%	30.00%	45.54%
cotoneaster (Cotoneaster spp.)	*introduced*	0.01	0.50%	0.00%	0.50%	0.89%
creeping juniper (Juniperus horizontalis)	native	0.20	0.50%	0.00%	0.50%	1.79%
currant (Ribes spp.)	unknown	0.14	0.50%	0.00%	0.50%	0.89%
dewberry (Rubus pubescens)	native	0.93	0.50%	0.00%	0.50%	8.04%
false mountain willow (Salix pseudomonticola)	native	21.07	4.56%	0.00%	20.00%	40.18%
flat-leaved willow (Salix planifolia)	native	23.27	4.88%	0.00%	40.00%	24.11%
golden currant (Ribes aureum)	native	0.72	0.79%	0.00%	3.00%	12.50%
green alder (Alnus crispa)	native	0.03	0.50%	0.00%	0.50%	0.89%
ground juniper (Juniperus communis)	native	0.18	0.50%	0.00%	0.50%	1.79%
high-bush cranberry (Viburnum opulus)	native	0.96	3.16%	0.00%	10.00%	5.36%
hoary willow (Salix candida)	native	5.15	1.88%	0.00%	10.00%	16.96%
honeysuckle (Lonicera spp.)	native	0.08	0.50%	0.00%	0.50%	0.89%
low-bush cranberry (Viburnum edule)	native	0.28	0.50%	0.00%	0.50%	3.57%
narrow-leaved meadowsweet (Spiraea alba)	native	0.43	0.50%	0.00%	0.50%	8.04%
northern gooseberry (Ribes oxyacanthoides)	native	9.09	0.99%	0.00%	3.00%	71.43%
Nuttall's atriplex (Atriplex nuttallii)	native	0.07	0.50%	0.00%	0.50%	0.89%
pin cherry (Prunus pensylvanica)	native	0.28	0.69%	0.00%	3.00%	3.57%
prickly rose (Rosa acicularis)	native	47.56	5.81%	0.00%	30.00%	58.93%
pussy willow (Salix discolor)	native	0.44	1.02%	0.00%	3.00%	3.57%
red twinberry (Lonicera utahensis)	native	0.00	0.50%	0.00%	0.50%	0.89%
red-osier dogwood (Cornus stolonifera)	native	28.67	3.10%	0.00%	30.00%	73.21%
round-leaved hawthorn (Crataegus rotundifolia)	native	16.51	6.84%	0.00%	30.00%	18.75%
sandbar willow (Salix exigua)	native	12.95	1.87%	0.00%	10.00%	41.96%
Saskatoon (Amelanchier alnifolia)	native	43.88	5.90%	0.00%	30.00%	62.50%
scarlet mallow (Sphaeralcea coccinea)	native	0.01	0.50%	0.00%	0.50%	0.89%
Scouler's willow (Salix scouleriana)	native	0.50	2.97%	0.00%	3.00%	2.68%
shrub (Shrub)	native	4.34	5.25%	0.00%	97.50%	8.04%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
silver sagebrush (Artemisia cana)	native	0.04	0.50%	0.00%	0.50%	0.89%
silverberry (Elaeagnus commutata)	native	33.99	3.15%	0.00%	90.00%	75.00%
skunk currant (Ribes glandulosum)	native	0.08	0.50%	0.00%	0.50%	0.89%
thorny buffaloberry (Shepherdia argentea)	native	0.11	0.50%	0.00%	0.50%	1.79%
twining honeysuckle (Lonicera dioica)	native	1.13	0.92%	0.00%	3.00%	10.71%
velvet-fruited willow (Salix maccalliana)	native	5.97	7.70%	0.00%	20.00%	8.04%
water birch (Betula occidentalis)	native	30.56	7.62%	0.00%	60.00%	16.96%
western mountain-ash (Sorbus scopulina)	native	0.14	0.50%	0.00%	0.50%	2.68%
wild black currant (Ribes americanum)	native	0.51	2.53%	0.00%	3.00%	3.57%
wild red currant (Ribes triste)	native	0.87	0.56%	0.00%	3.00%	12.50%
wild red raspberry (Rubus idaeus)	native	9.82	1.81%	0.00%	10.00%	50.89%
willow (Salix spp.)	unknown	2.76	1.95%	0.00%	3.00%	7.14%
yellow willow (Salix lutea)	native	11.59	2.29%	0.00%	10.00%	34.82%
GRASSES AND GRASS-LIKES						
alkali cord grass (Spartina gracilis)	native	1.24	0.50%	0.00%	0.50%	8.04%
alpine rush (Juncus alpinoarticulatus)	native	0.16	0.50%	0.00%	0.50%	2.68%
annual bluegrass (Poa annua)	*introduced*	0.13	0.50%	0.00%	0.50%	0.89%
awned sedge (Carex atherodes)	native	73.36	11.68%	0.00%	40.00%	29.46%
bent grass (Agrostis spp.)	unknown	0.18	1.23%	0.00%	3.00%	1.79%
blue grama (Bouteloua gracilis)	native	0.39	1.57%	0.00%	10.00%	2.68%
bluegrass (Poa spp.)	unknown	0.04	0.50%	0.00%	0.50%	1.79%
bluejoint (Calamagrostis canadensis)	native	22.17	3.56%	0.00%	20.00%	43.75%
brome grass (Bromus spp.)	unknown	0.08	0.50%	0.00%	0.50%	0.89%
brownish sedge (Carex brunnescens)	native	0.92	10.00%	0.00%	10.00%	0.89%
bulrush (Scirpus spp.)	unknown	1.20	9.93%	0.00%	20.00%	2.68%
Canada wild rye (Elymus canadensis)	native	0.76	0.50%	0.00%	0.50%	4.46%
common great bulrush (Scirpus validus)	native	16.58	1.84%	0.00%	30.00%	63.39%
common tall manna grass (Glyceria grandis)	native	30.13	3.02%	0.00%	20.00%	56.25%
creeping spike-rush (Eleocharis palustris)	native	24.15	2.63%	0.00%	20.00%	52.68%
crested wheat grass (Agropyron pectiniforme)	*disturbance*	0.75	0.50%	0.00%	0.50%	8.93%
cultivated barley (Hordeum vulgare)	*disturbance*	0.06	0.50%	0.00%	0.50%	0.89%
fescue (Festuca spp.)	unknown	0.14	0.50%	0.00%	0.50%	2.68%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
fowl bluegrass (Poa palustris)	*disturbance*	21.62	3.60%	0.00%	10.00%	32.14%
fowl manna grass (Glyceria striata)	native	4.28	1.90%	0.00%	20.00%	17.86%
foxtail barley (Hordeum jubatum)	*disturbance*	145.61	11.03%	0.00%	50.00%	92.86%
fringed brome (Bromus ciliatus)	native	0.75	1.06%	0.00%	3.00%	10.71%
golden sedge (Carex aurea)	native	1.17	1.02%	0.00%	3.00%	6.25%
graminoid (Graminoid)	unknown	0.00	0.50%	0.00%	0.50%	0.89%
green foxtail (Setaria viridis)	*disturbance*	0.06	0.50%	0.00%	0.50%	0.89%
green needle grass (Stipa viridula)	native	0.29	0.50%	0.00%	0.50%	7.14%
hairy wild rye (Elymus innovatus)	native	0.14	3.00%	0.00%	3.00%	0.89%
hay sedge (Carex siccata)	native	0.62	2.73%	0.00%	10.00%	3.57%
Indian rice grass (Oryzopsis hymenoides)	native	0.10	0.50%	0.00%	0.50%	0.89%
inland sedge (Carex interior)	native	0.04	0.50%	0.00%	0.50%	1.79%
June grass (Koeleria macrantha)	native	1.06	0.62%	0.00%	10.00%	16.07%
Kentucky bluegrass (Poa pratensis)	*disturbance*	184.36	14.14%	0.00%	40.00%	94.64%
knotted rush (Juncus nodosus)	native	0.45	0.50%	0.00%	0.50%	2.68%
needle grass (Stipa spp.)	unknown	0.01	0.50%	0.00%	0.50%	0.89%
needle-and-thread (Stipa comata)	native	0.06	0.50%	0.00%	0.50%	1.79%
northern bog sedge (Carex gynocrates)	native	0.13	0.50%	0.00%	0.50%	0.89%
northern reed grass (Calamagrostis inexpansa)	native	16.44	3.21%	0.00%	30.00%	38.39%
northern wheat grass (Agropyron dasystachyum)	native	0.60	0.64%	0.00%	10.00%	5.36%
Norway sedge (Carex norvegica)	native	0.04	0.50%	0.00%	0.50%	0.89%
Nuttall's salt-meadow grass (Puccinellia nuttalliana)	native	18.08	3.07%	0.00%	20.00%	44.64%
orchard grass (Dactylis glomerata)	*introduced*	0.13	0.50%	0.00%	0.50%	1.79%
pale bulrush (Scirpus pallidus)	native	0.25	0.65%	0.00%	10.00%	4.46%
quack grass (Agropyron repens)	*disturbance*	55.71	6.59%	0.00%	40.00%	46.43%
redtop (Agrostis stolonifera)	*introduced*	10.33	6.88%	0.00%	30.00%	25.00%
reed canary grass (Phalaris arundinacea)	native	42.62	5.06%	0.00%	40.00%	40.18%
reed grass (Calamagrostis spp.)	unknown	0.05	0.50%	0.00%	0.50%	0.89%
Richardson needle grass (Stipa richardsonii)	native	0.10	0.50%	0.00%	0.50%	0.89%
rough hair grass (Agrostis scabra)	native	0.91	0.57%	0.00%	3.00%	10.71%
salt grass (Distichlis stricta)	native	10.39	3.69%	0.00%	30.00%	24.11%
sand grass (Calamovilfa longifolia)	native	0.62	3.00%	0.00%	3.00%	1.79%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
Sartwell's sedge (Carex sartwellii)	native	7.04	1.96%	0.00%	10.00%	24.11%
sedge (Carex spp.)	unknown	1.31	0.63%	0.00%	10.00%	8.93%
sheathed cotton grass (Eriophorum vaginatum)	native	0.06	0.50%	0.00%	0.50%	1.79%
short-awn meadow-foxtail (Alopecurus aequalis)	native	0.76	0.50%	0.00%	0.50%	7.14%
slender wheat grass (Agropyron trachycaulum var. unilaterale)	native	9.33	3.49%	0.00%	10.00%	25.00%
slender wheat grass (Agropyron trachycaulum)	native	12.63	1.89%	0.00%	10.00%	52.68%
slough grass (Beckmannia syzigachne)	native	5.19	0.65%	0.00%	10.00%	41.07%
small bottle sedge (Carex utriculata)	native	106.64	10.41%	0.00%	50.00%	55.36%
small-fruited bulrush (Scirpus microcarpus)	native	14.71	1.77%	0.00%	20.00%	44.64%
smooth brome (Bromus inermis)	*disturbance*	221.52	18.62%	0.00%	80.00%	78.57%
spangletop (Scolochloa festucacea)	native	2.82	3.60%	0.00%	10.00%	2.68%
spike-rush (Eleocharis spp.)	unknown	0.01	0.50%	0.00%	0.50%	0.89%
Sprengel's sedge (Carex sprengelii)	native	2.46	3.51%	0.00%	10.00%	8.04%
sweet grass (Hierochloe odorata)	native	0.10	0.50%	0.00%	0.50%	4.46%
tall cotton grass (Eriophorum polystachion)	native	0.27	0.50%	0.00%	0.50%	3.57%
three-square rush (Scirpus pungens)	native	15.62	3.08%	0.00%	70.00%	29.46%
timothy (Phleum pratense)	*disturbance*	0.65	0.50%	0.00%	0.50%	7.14%
toad rush (Juncus bufonius)	native	0.03	0.50%	0.00%	0.50%	0.89%
tufted bulrush (Scirpus cespitosus)	native	0.13	0.50%	0.00%	0.50%	0.89%
tufted hair grass (Deschampsia cespitosa)	native	36.05	4.61%	0.00%	30.00%	52.68%
tufted hair grass (Deschampsia cespitosa)	native	6.66	4.65%	0.00%	10.00%	7.14%
two-seeded sedge (Carex disperma)	native	0.13	0.50%	0.00%	0.50%	0.89%
water sedge (Carex aquatilis)	native	96.72	10.91%	0.00%	40.00%	72.32%
western porcupine grass (Stipa curtiseta)	native	4.16	4.52%	0.00%	10.00%	1.79%
western wheat grass (Agropyron smithii)	native	10.27	1.67%	0.00%	30.00%	26.79%
wheat grass (Agropyron spp.)	unknown	0.32	0.69%	0.00%	3.00%	5.36%
wild oat (Avena fatua)	*disturbance*	0.00	0.50%	0.00%	0.50%	0.89%
wire rush (Juncus balticus)	native	99.12	9.36%	0.00%	30.00%	77.68%
woolly sedge (Carex lanuginosa)	native	29.69	3.65%	0.00%	30.00%	50.89%
FORBS						
absinthe wormwood (Artemisia absinthium)	*introduced*	0.43	0.50%	0.00%	0.50%	6.25%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
agrimony (Agrimonia striata)	native	0.66	0.50%	0.00%	0.50%	11.61%
alfalfa (Medicago sativa)	*introduced*	2.08	0.50%	0.00%	0.50%	21.43%
alpine hedysarum (Hedysarum alpinum)	native	1.69	0.80%	0.00%	3.00%	6.25%
alsike clover (Trifolium hybridum)	*disturbance*	4.94	1.39%	0.00%	10.00%	32.14%
American brooklime (Veronica americana)	native	0.13	0.50%	0.00%	0.50%	0.89%
American milk vetch (Astragalus americanus)	native	0.08	0.50%	0.00%	0.50%	0.89%
arrow-leaved coltsfoot (Petasites sagittatus)	native	1.57	1.16%	0.00%	3.00%	10.71%
arum-leaved arrowhead (Sagittaria cuneata)	native	1.57	0.54%	0.00%	3.00%	23.21%
aster (Aster spp.)	unknown	0.25	0.50%	0.00%	0.50%	4.46%
bastard toadflax (Comandra umbellata)	native	0.17	0.50%	0.00%	0.50%	1.79%
beardtongue (Penstemon spp.)	unknown	0.48	0.50%	0.00%	0.50%	0.89%
black medick (Medicago lupulina)	introduced	0.41	1.14%	0.00%	3.00%	3.57%
bluebur (Lappula squarrosa)	*disturbance*	1.46	0.50%	0.00%	0.50%	9.82%
blunt-leaved bog orchid (Habenaria obtusata)	native	0.13	0.50%	0.00%	0.50%	0.89%
bog violet (Viola nephrophylla)	native	0.77	0.61%	0.00%	3.00%	16.07%
broad-leaved water-plantain (Alisma plantago-aquatica)	native	1.06	0.50%	0.00%	0.50%	5.36%
buck-bean (Menyanthes trifoliata)	native	0.78	3.00%	0.00%	3.00%	0.89%
bull thistle (Cirsium vulgare)	*introduced*	0.69	0.50%	0.00%	0.50%	13.39%
butter-and-eggs (Linaria vulgaris)	***invasive***	1.04	0.77%	0.00%	10.00%	13.39%
Canada anemone (Anemone canadensis)	native	4.30	0.59%	0.00%	3.00%	50.00%
Canada goldenrod (Solidago canadensis)	native	11.99	1.28%	0.00%	10.00%	69.64%
Canada thistle (Cirsium arvense)	***invasive***	31.26	2.39%	0.00%	30.00%	91.96%
Canadian milk vetch (Astragalus canadensis)	*poisonous*	0.13	0.50%	0.00%	0.50%	1.79%
caraway (Carum carvi)	*introduced*	0.17	0.50%	0.00%	0.50%	1.79%
celery-leaved buttercup (Ranunculus sceleratus)	native	2.01	0.53%	0.00%	3.00%	23.21%
cinquefoil (Potentilla macounii)	native	0.36	0.50%	0.00%	0.50%	0.89%
cinquefoil (Potentilla spp.)	unknown	0.10	0.50%	0.00%	0.50%	2.68%
cocklebur (Xanthium strumarium)	native	0.09	0.50%	0.00%	0.50%	0.89%
common blue lettuce (Lactuca pulchella)	native	0.24	0.50%	0.00%	0.50%	2.68%
common blue-eyed grass (Sisyrinchium montanum)	native	0.91	0.50%	0.00%	0.50%	6.25%
common burdock (Arctium minus)	*disturbance*	0.16	0.54%	0.00%	3.00%	2.68%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
common cattail (Typha latifolia)	native	68.29	8.27%	0.00%	50.00%	53.57%
common dandelion (Taraxacum officinale)	*disturbance*	12.34	1.24%	0.00%	10.00%	66.07%
common duckweed (Lemna minor)	native	0.06	0.50%	0.00%	0.50%	1.79%
common fireweed (Epilobium angustifolium)	native	1.56	0.61%	0.00%	3.00%	17.86%
common goat's-beard (Tragopogon dubius)	*introduced*	0.10	0.50%	0.00%	0.50%	1.79%
common horsetail (Equisetum arvense)	*poisonous*	4.22	0.69%	0.00%	3.00%	39.29%
common knotweed (Polygonum arenastrum)	*introduced*	0.43	0.50%	0.00%	0.50%	3.57%
common mare's-tail (Hippuris vulgaris)	native	1.96	0.50%	0.00%	0.50%	16.96%
common nettle (Urtica dioica)	native	4.29	0.64%	0.00%	3.00%	50.00%
common pepper-grass (Lepidium densiflorum)	*introduced*	0.84	0.50%	0.00%	0.50%	10.71%
common pink wintergreen (Pyrola asarifolia)	native	0.52	0.50%	0.00%	0.50%	9.82%
common plantain (Plantago major)	*disturbance*	7.55	0.72%	0.00%	3.00%	72.32%
common scouring-rush (Equisetum hyemale)	native	3.07	1.51%	0.00%	3.00%	11.61%
common tall sunflower (Helianthus nuttallii)	native	0.11	0.50%	0.00%	0.50%	4.46%
common tansy (Tanacetum vulgare)	***invasive***	0.17	0.50%	0.00%	0.50%	1.79%
common yarrow (Achillea millefolium)	native	6.29	0.52%	0.00%	3.00%	81.25%
cow parsnip (Heracleum lanatum)	native	0.77	0.51%	0.00%	3.00%	13.39%
cream-colored vetchling (Lathyrus ochroleucus)	native	0.91	0.94%	0.00%	10.00%	7.14%
curled dock (Rumex crispus)	*introduced*	7.69	1.03%	0.00%	10.00%	63.39%
cut-leaved anemone (Anemone multifida)	native	0.08	0.50%	0.00%	0.50%	3.57%
cut-leaved ragwort (Senecio eremophilus)	native	0.71	0.85%	0.00%	3.00%	6.25%
dame's rocket (Hesperis matronalis)	native	0.08	0.50%	0.00%	0.50%	0.89%
dock; sorrel (Rumex spp.)	unknown	0.10	0.50%	0.00%	0.50%	0.89%
elephant's-head (Pedicularis groenlandica)	native	0.29	0.50%	0.00%	0.50%	6.25%
erigeron (Erigeron spp.)	unknown	0.47	0.50%	0.00%	0.50%	8.93%
fairybells (Disporum trachycarpum)	native	0.13	0.52%	0.00%	3.00%	1.79%
false Solomon's-seal (Smilacina racemosa)	native	0.61	0.50%	0.00%	0.50%	2.68%
felwort (Gentianella amarella)	native	0.09	0.50%	0.00%	0.50%	0.89%
few-flowered ragwort (Senecio pauciflorus)	native	0.67	0.50%	0.00%	0.50%	3.57%
field mouse-ear chickweed (Cerastium arvense)	*disturbance*	0.68	0.50%	0.00%	0.50%	4.46%
flixweed; tansy mustard (Descurainia sophia)	*disturbance*	2.61	0.51%	0.00%	3.00%	25.89%
forb (Forb)	unknown	0.59	0.50%	0.00%	0.50%	4.46%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
fringed loosestrife (Lysimachia ciliata)	native	1.54	0.50%	0.00%	0.50%	14.29%
gaillardia (Gaillardia aristata)	native	0.18	0.50%	0.00%	0.50%	5.36%
giant bur-reed (Sparganium eurycarpum)	native	1.58	0.84%	0.00%	3.00%	7.14%
golden bean (Thermopsis rhombifolia)	native	1.02	0.57%	0.00%	3.00%	14.29%
golden dock (Rumex maritimus)	native	0.16	0.50%	0.00%	0.50%	4.46%
goosefoot (Chenopodium spp.)	unknown	0.19	0.50%	0.00%	0.50%	5.36%
graceful cinquefoil (Potentilla gracilis)	native	2.03	0.50%	0.00%	0.50%	14.29%
greenish-flowered wintergreen (Pyrola chlorantha)	native	0.26	0.50%	0.00%	0.50%	1.79%
gumweed (Grindelia squarrosa)	native	8.65	1.22%	0.00%	10.00%	46.43%
harebell (Campanula rotundifolia)	native	0.69	0.50%	0.00%	0.50%	16.96%
heal-all (Prunella vulgaris)	native	0.30	0.50%	0.00%	0.50%	2.68%
heart-leaved Alexanders (Zizia aptera)	native	1.87	0.50%	0.00%	0.50%	38.39%
hemp-nettle (Galeopsis tetrahit)	*disturbance*	3.38	1.77%	0.00%	10.00%	10.71%
horsetail (Equisetum spp.)	unknown	0.60	0.50%	0.00%	0.50%	0.89%
lamb's-quarters (Chenopodium album)	*disturbance*	7.68	1.65%	0.00%	30.00%	26.79%
large-flowered stickseed (Hackelia floribunda)	native	0.16	0.50%	0.00%	0.50%	1.79%
large-leaved yellow avens (Geum macrophyllum)	native	0.12	0.50%	0.00%	0.50%	2.68%
late yellow locoweed (Oxytropis monticola)	*poisonous*	0.07	0.50%	0.00%	0.50%	1.79%
leafy spurge (Euphorbia esula)	***invasive***	0.80	2.53%	0.00%	3.00%	2.68%
lilac-flowered beardtongue (Penstemon gracilis)	native	0.09	0.50%	0.00%	0.50%	1.79%
long-leaved chickweed (Stellaria longifolia)	native	1.84	0.50%	0.00%	0.50%	15.18%
low goldenrod (Solidago missouriensis)	native	0.65	0.50%	0.00%	0.50%	6.25%
Macoun's buttercup (Ranunculus macounii)	native	2.92	0.64%	0.00%	3.00%	21.43%
many-flowered yarrow (Achillea sibirica)	native	2.57	0.50%	0.00%	0.50%	21.43%
maple-leaved goosefoot (Chenopodium gigantospermum)	native	0.07	0.50%	0.00%	0.50%	2.68%
marsh aster (Aster borealis)	native	0.10	0.50%	0.00%	0.50%	0.89%
marsh hedge-nettle (Stachys palustris)	native	6.92	0.80%	0.00%	10.00%	44.64%
marsh skullcap (Scutellaria galericulata)	native	2.91	1.03%	0.00%	3.00%	15.18%
marsh yellow cress (Rorippa palustris)	native	0.60	0.50%	0.00%	0.50%	0.89%
meadow horsetail (Equisetum pratense)	native	0.31	0.50%	0.00%	0.50%	2.68%
medick (Medicago spp.)	unknown	0.08	0.50%	0.00%	0.50%	0.89%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
mountain goldenrod (Solidago spathulata)	native	0.22	0.50%	0.00%	0.50%	2.68%
mouse-ear chickweed (Cerastium spp.)	unknown	0.77	3.00%	0.00%	3.00%	0.89%
mustard (Brassica spp.)	unknown	0.17	0.50%	0.00%	0.50%	4.46%
narrow-leaved hawkweed (Hieracium umbellatum)	native	2.83	0.65%	0.00%	3.00%	28.57%
nodding beggarticks (Bidens cernua)	native	0.91	1.00%	0.00%	3.00%	9.82%
northern bedstraw (Galium boreale)	native	4.83	0.51%	0.00%	3.00%	68.75%
northern green bog orchid (Habenaria hyperborea)	native	0.42	0.50%	0.00%	0.50%	5.36%
northern hedysarum (Hedysarum boreale)	native	0.10	0.50%	0.00%	0.50%	1.79%
northern water-horehound (Lycopus uniflorus)	native	0.32	0.50%	0.00%	0.50%	7.14%
northern willowherb (Epilobium ciliatum)	native	0.18	0.50%	0.00%	0.50%	7.14%
one-sided wintergreen (Orthilia secunda)	native	0.13	0.50%	0.00%	0.50%	0.89%
palmate-leaved coltsfoot (Petasites palmatus)	native	0.22	0.50%	0.00%	0.50%	5.36%
pasture sagewort (Artemisia frigida)	*introduced*	15.09	2.69%	0.00%	30.00%	42.86%
perennial sow-thistle (Sonchus arvensis)	***invasive***	34.79	2.71%	0.00%	40.00%	89.29%
Philadelphia fleabane (Erigeron philadelphicus)	native	2.57	0.50%	0.00%	0.50%	36.61%
pineappleweed (Matricaria matricarioides)	*introduced*	0.48	0.50%	0.00%	0.50%	7.14%
plains wormwood (Artemisia campestris)	native	0.91	0.50%	0.00%	0.50%	13.39%
polygonum (Polygonum spp.)	unknown	0.15	0.50%	0.00%	0.50%	2.68%
prairie onion (Allium textile)	native	0.39	0.50%	0.00%	0.50%	2.68%
prairie sagewort (Artemisia ludoviciana)	*introduced*	4.86	0.53%	0.00%	3.00%	61.61%
prickly annual sow-thistle (Sonchus asper)	*introduced*	0.13	0.50%	0.00%	0.50%	0.89%
prostrate amaranth (Amaranthus graecizans)	native	0.12	0.50%	0.00%	0.50%	3.57%
purple peavine (Lathyrus venosus)	native	0.07	0.50%	0.00%	0.50%	1.79%
ranunculus (Ranunculus spp.)	unknown	0.25	0.50%	0.00%	0.50%	3.57%
red and white baneberry (Actaea rubra)	*poisonous*	1.47	1.45%	0.00%	10.00%	10.71%
red clover (Trifolium pratense)	*disturbance*	0.30	0.50%	0.00%	0.50%	5.36%
red-root pigweed (Amaranthus retroflexus)	*disturbance*	1.52	6.35%	0.00%	10.00%	5.36%
reflexed rock cress (Arabis holboellii)	native	0.08	0.50%	0.00%	0.50%	0.89%
rhombic-leaved sunflower (Helianthus subrhomboideus)	native	0.06	0.50%	0.00%	0.50%	1.79%
rough cinquefoil (Potentilla norvegica)	*disturbance*	0.11	0.50%	0.00%	0.50%	1.79%
round-leaved bog orchid (Habenaria orbiculata)	native	0.13	0.50%	0.00%	0.50%	0.89%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
Russian-thistle (Salsola kali)	*disturbance*	0.69	0.50%	0.00%	0.50%	2.68%
saline shooting star (Dodecatheon pulchellum)	native	0.37	0.50%	0.00%	0.50%	2.68%
scapose hawk's-beard (Crepis runcinata)	native	0.13	0.50%	0.00%	0.50%	0.89%
scentless chamomile (Matricaria perforata)	***invasive***	0.32	0.50%	0.00%	0.50%	6.25%
sea milkwort (Glaux maritima)	native	4.83	2.14%	0.00%	10.00%	24.11%
seaside arrow-grass (Triglochin maritima)	native	6.36	1.32%	0.00%	10.00%	40.18%
seaside buttercup (Ranunculus cymbalaria)	native	5.14	0.60%	0.00%	3.00%	54.46%
senecio (Senecio spp.)	unknown	0.51	0.63%	0.00%	3.00%	7.14%
shepherd's-purse (Capsella bursa-pastoris)	*disturbance*	0.23	0.50%	0.00%	0.50%	4.46%
showy locoweed (Oxytropis splendens)	*poisonous*	0.36	0.50%	0.00%	0.50%	0.89%
silverweed (Potentilla anserina)	*disturbance*	22.24	1.92%	0.00%	20.00%	80.36%
slender hawkweed (Hieracium triste)	native	0.09	0.50%	0.00%	0.50%	1.79%
small bedstraw (Galium trifidum)	native	0.13	0.50%	0.00%	0.50%	0.89%
small-leaved everlasting (Antennaria parvifolia)	*disturbance*	6.41	0.90%	0.00%	3.00%	44.64%
smooth aster (Aster laevis)	native	1.84	0.94%	0.00%	3.00%	20.54%
smooth fleabane (Erigeron glabellus)	native	0.35	0.50%	0.00%	0.50%	6.25%
smooth scouring-rush (Equisetum laevigatum)	native	0.26	0.50%	0.00%	0.50%	1.79%
sneezeweed (Helenium autumnale)	*poisonous*	0.26	3.00%	0.00%	3.00%	0.89%
spreading sweet cicely (Osmorhiza depauperata)	native	0.53	3.16%	0.00%	20.00%	2.68%
star-flowered Solomon's-seal (Smilacina stellata)	native	2.11	0.62%	0.00%	3.00%	31.25%
stellaria (Stellaria spp.)	unknown	0.13	0.50%	0.00%	0.50%	0.89%
sticky false asphodel (Tofieldia glutinosa)	native	0.17	0.50%	0.00%	0.50%	1.79%
stiff goldenrod (Solidago rigida)	native	0.09	0.50%	0.00%	0.50%	0.89%
stinkweed (Thlaspi arvense)	*disturbance*	2.43	0.52%	0.00%	3.00%	31.25%
stonecrop (Sedum spp.)	unknown	0.44	0.50%	0.00%	0.50%	2.68%
stork's-bill (Erodium cicutarium)	***invasive***	0.06	0.50%	0.00%	0.50%	0.89%
summer-cypress (Kochia scoparia)	*introduced*	0.55	1.93%	0.00%	3.00%	3.57%
sunflower (Helianthus spp.)	*unknown*	0.43	0.50%	0.00%	0.50%	1.79%
sweet clover (Melilotus spp.)	disturbance	0.10	0.50%	0.00%	0.50%	1.79%
sweet-scented bedstraw (Galium triflorum)	native	0.23	0.50%	0.00%	0.50%	9.82%
tall buttercup (Ranunculus acris)	***invasive***	0.54	0.88%	0.00%	3.00%	4.46%
tall lungwort (Mertensia paniculata)	native	0.50	2.60%	0.00%	3.00%	1.79%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
tall white bog orchid (Habenaria dilatata)	native	0.13	0.50%	0.00%	0.50%	0.89%
thistle (Cirsium spp.)	unknown	0.10	0.50%	0.00%	0.50%	4.46%
three-flowered avens (Geum triflorum)	native	1.05	0.50%	0.00%	0.50%	6.25%
tufted loosestrife (Lysimachia thyrsiflora)	native	3.32	2.49%	0.00%	10.00%	5.36%
tufted vetch (Vicia cracca)	*introduced*	0.50	0.50%	0.00%	0.50%	8.93%
tufted white prairie aster (Aster ericoides)	native	1.20	0.58%	0.00%	3.00%	25.89%
tumbleweed (Amaranthus albus)	native	0.06	0.50%	0.00%	0.50%	0.89%
veiny meadow rue (Thalictrum venulosum)	native	4.18	0.60%	0.00%	10.00%	42.86%
violet (Viola spp.)	unknown	0.26	0.50%	0.00%	0.50%	1.79%
water parsnip (Sium suave)	native	4.02	0.50%	0.00%	0.50%	39.29%
water smartweed (Polygonum amphibium)	native	2.34	0.71%	0.00%	3.00%	18.75%
water smartweed (Polygonum coccineum)	native	1.08	1.22%	0.00%	3.00%	4.46%
water-hemlock (Cicuta maculata)	*poisonous*	7.75	0.99%	0.00%	10.00%	58.93%
wavy-leaved thistle (Cirsium undulatum)	native	0.15	0.50%	0.00%	0.50%	3.57%
western bistort (Polygonum bistortoides)	native	0.96	0.50%	0.00%	0.50%	1.79%
western bluebur (Lappula occidentalis)	*introduced*	0.22	0.50%	0.00%	0.50%	8.04%
western Canada violet (Viola canadensis)	native	0.13	0.50%	0.00%	0.50%	6.25%
western dock (Rumex occidentalis)	native	1.61	0.50%	0.00%	0.50%	24.11%
western water-horehound (Lycopus asper)	native	1.01	1.53%	0.00%	3.00%	8.04%
western willow aster (Aster hesperius)	native	0.76	0.56%	0.00%	3.00%	14.29%
western wood lily (Lilium philadelphicum)	native	0.16	0.50%	0.00%	0.50%	2.68%
white adder's-mouth (Malaxis monophylla)	native (rare)	0.12	0.50%	0.00%	0.50%	1.79%
white camas (Zigadenus elegans)	*poisonous*	0.92	0.50%	0.00%	0.50%	18.75%
white clover (Trifolium repens)	*disturbance*	1.80	0.67%	0.00%	3.00%	16.96%
white sweet-clover (Melilotus alba)	*disturbance*	2.09	0.64%	0.00%	3.00%	28.57%
whitlow-grass (Draba incerta)	native	0.08	0.50%	0.00%	0.50%	0.89%
wild bergamot (Monarda fistulosa)	native	0.35	0.50%	0.00%	0.50%	7.14%
wild blue flax (Linum lewisii)	native	0.28	0.50%	0.00%	0.50%	4.46%
wild buckwheat (Polygonum convolvulus)	*disturbance*	0.19	0.50%	0.00%	0.50%	5.36%
wild licorice (Glycyrrhiza lepidota)	native	3.50	0.65%	0.00%	10.00%	34.82%
wild lily-of-the-valley (Maianthemum canadense)	native	0.12	0.52%	0.00%	3.00%	4.46%
wild mint (Mentha arvensis)	native	14.51	1.81%	0.00%	10.00%	57.14%

Life Form	Plant Status[1]	Area by Species (acres)	Canopy Cover[2]			Constancy[3]
			Average	Range (Min & Max)		
wild sarsaparilla (Aralia nudicaulis)	native	3.60	4.28%	0.00%	20.00%	9.82%
wild strawberry (Fragaria virginiana)	*disturbance*	3.92	0.53%	0.00%	3.00%	50.89%
wild vetch (Vicia americana)	native	4.60	0.50%	0.00%	0.50%	63.39%
wormseed mustard (Erysimum cheiranthoides)	*disturbance*	0.73	0.50%	0.00%	0.50%	6.25%
yellow avens (Geum aleppicum)	native	3.01	0.52%	0.00%	3.00%	37.50%
yellow evening-primrose (Oenothera biennis)	native	0.29	0.50%	0.00%	0.50%	5.36%
yellow false dandelion (Agoseris glauca)	native	0.19	0.50%	0.00%	0.50%	4.46%
yellow lady's-slipper (Cypripedium calceolus)	native	0.13	0.50%	0.00%	0.50%	0.89%
yellow sweet-clover (Melilotus officinalis)	*disturbance*	2.96	0.90%	0.00%	3.00%	30.36%
tufted fleabane (Erigeron caespitosus)	native	0.05	0.50%	0.00%	0.50%	1.79%

Summary	
Total # of species =	350
Total # of TREE species =	15
Total # of SHRUB species =	56
Total # of GRSS/GRASS-LIKE species =	79
Total # of FORB species =	200

[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=45%-55%; 60.0=55%-65%; 70.0=65%-75%; 80.0=75%-85%; 90.0=85%-95%; 97.5=greater than 95%; — = not observed.

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

APPENDIX F: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS

Most of the parameters (factors) rated in these evaluations are based on ocular estimations. Such estimation may be difficult on large, heavily wooded 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 parameter breakout groupings and point weighting in the evaluation are somewhat subjective and are based on the collective experience of an array of riparian scientists, range professionals, and land managers.

Each parameter is rated according to conditions observed on the site. The evaluator estimates the scoring category for each parameter and enters that value on the score sheet. Not all of the same parameters are assessed for all waterbodies because lakes and wetlands, streams and small rivers and large rivers are somewhat different in their nature. Table C-1 portrays the parameters that can be assessed and which waterbodies and data collection methods they are applicable to. The function of the riparian area is the same but some of the factors that influence these waterbodies are unique to that system's health. Note that detailed descriptions of the methods are included in Appendices D-F and are the most up to date versions (2009) relevant to the data in this report. Riparian health methodology has been evolving over time so but where we are at today is believed to be most accurate and representative for evaluating riparian function and condition.

*Note: sites on large rivers may also be evaluated using the stream and small river method if all of the information is not available to complete a river health survey (e.g. dewatering of the river system and control of flood peak/timing by upstream dams).

Table E-1. Riparian health parameters relative to waterbody type.

Riparian Health Parameter Assessed		Waterbody Type		
		Lakes and Wetlands	**Streams and Small Rivers***	**Large River**
Vegetative	vegetative cover	✓	✓	
	cottonwood and poplar regeneration			✓
	regeneration of other tree species			✓
	preferred shrub regeneration			✓
	preferred tree/shrub regeneration	✓	✓	
	preferred tree/shrub utilisation	✓	✓	✓
	dead/decadent woody material		✓	✓
	total canopy cover of woody plants			✓
	invasive plants	✓	✓	✓
	disturbance plants	✓	✓	✓
	presence of native graminoids			✓
	exotic undesirable woody species			✓
	human-caused alterations to vegetation	✓		
Physical	root mass protection		✓	✓
	human-caused alterations to banks		✓	✓
	human-caused bare ground	✓	✓	✓
	human-caused alterations to rest of site		✓	
	human-caused alterations to the physical site	✓		
	floodplain accessibility			✓
	channel incisement		✓	
Hydrologic	artificial water level change	✓		
	dewatering of the river system			✓
	control of flood peak/timing by upstream dams			✓

APPENDIX G: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS: LARGE RIVER SURVEY

This description of riparian health parameters is based on the Alberta Lotic Wetland Health (Survey) Large Rivers User Manual as created by Ecological Solutions Group LLC (2009).

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 (e.g., Thompson and Hansen 2001, 2002, 2003, or another appropriate publication). On severely disturbed sites, vegetation potential can be difficult to determine. On such sites, clues to potential may be sought on nearby sites with similar landscape position.

The evaluator must keep in mind that this assessment form is designed to account for most sites and conditions in the applicable region. However, rarely will all the questions seem exactly to fit the circumstances on a given site. Therefore, the evaluator must try to answer each question with a literal reading. If necessary, explain anomalies in the comment section. Each factor below will be rated according to conditions observed on the site. The evaluator will estimate the scoring category and enter that value on the score sheet. The riparian health score for large rivers (survey) is based on 15 basic parameters pertaining to riparian health

1. Cottonwood and Balsam Poplar Regeneration. This item is assessed differently on either side of the Red Deer River valley. For areas south of and including the Red Deer River valley, do not count asexual regeneration from root sprouts. In this southern area of the province, count only reproduction from seed. This is because these trees are primarily riverine species that pioneer on recent alluvium from seed, and root sprouts do not serve well to maintain populations. In areas north of the Red Deer River valley (and some areas farther south in higher precipitation zones, such as the foothills west of Highway 2) count any mode of reproduction for this group of trees, because in these cooler/moister zones cottonwoods and balsam poplar populations are not dependent on seed deposited on riverine alluvium. (***NOTE:*** In this item do not include the species *Populus tremuloides* [aspen], which is included in the next item below.)

Reproduction success can be determined by estimating the established seedling and sapling cover expressed as percentage of the overall cover of the species on the site. (***Note:*** For this item, include plants taller than 30 cm (1 ft) in height, but less than 12.5 cm (5 in) in dbh [diameter at breast height: 1.35 m (4.5 ft)]). If no potential for cottonwood or balsam poplar exists on the site (such as when it is on the outside of a long meander curve where depositional material is not expected, or there are no such trees on similar site positions nearby) replace both Actual Score and Possible Score with NA. Count plants installed by human planting, if these are successfully established. To be successfully established the new plants need to have at least one complete growing season on the site. Most newly established plants do not survive the first growing season.

NOTE: *Use judgement and caution in counting occasional seedlings in precarious positions where they have little potential for survival due to natural physical jeopardy (e.g., at water's edge along outside curve).*

Scoring:
6 = More than 15% of the cottonwood and/or balsam poplar cover is established seedlings and/or saplings.
4 = 5% to 15% of the cottonwood and/or balsam poplar cover is established seedlings and/or saplings.
2 = Up to 5% of the cottonwood and/or balsam poplar cover is established seedlings and/or saplings.
0 = None of the cottonwood and/or balsam poplar cover is established seedlings or saplings.

2. Regeneration of Other Native Tree Species. As succession progresses on a riparian site, the pioneer trees and shrub communities are replaced by later seral communities (if river dynamics allow enough time). If the site is not de-watered or otherwise disturbed, this progression is often to communities dominated by other native tree species. Depending upon dynamics of the system (how fast the channel migrates laterally), the potential may exist for equilibrium at different locations along the river between younger (those

dominated by young trees and willows) communities and older communities with aging cottonwoods/poplars and later seral species such as *Populus tremuloides* (aspen), *Picea glauca* (white spruce), *Acer negundo* (Manitoba maple), and *Fraxinus pennsylvanica* (green ash). ***Note:*** Seedlings and saplings of these species include
individuals which are less than 7.5 cm (3 in) in dbh. In situations where all plant communities are in an early successional stage and where no later successional species are yet expected (such as a young point bar or a newly formed island), replace both Actual Score and Possible Score with NA.

The health of a population can be based on current regeneration success without having to determine the exact potential distribution between cottonwoods/poplars and the other tree species on a site. This regeneration success can be determined from the seedling and sapling canopy cover expressed as a percentage of the overall cover of the group of tree species on the site other than cottonwoods/poplars. Count plants installed by human planting, if these are successfully established. To be successfully established the new plants need to have at least one complete growing season on the site. Most newly established plants do not survive the first growing season.

Scoring:
3 = More than 5% of the other (non-cottonwood/balsam poplar) tree cover is seedlings and/or saplings.
2 = 1% to 5% of the other (non-cottonwood/balsam poplar) tree cover is seedlings and/or saplings.
1 = Less than 1% of the other (non-cottonwood/balsam poplar) tree cover is seedlings and/or saplings.
0 = Seedlings and saplings of trees species other than cottonwoods/balsam poplars or absent.

3. Regeneration of Preferred Shrub Species. Another indicator of a river system's ecological stability and, therefore, health is the presence of enough shrub regeneration to maintain the lifeform population along the river over the long term. Ecological stability is used in the broad sense that over the reach as a whole there is an equilibrium of community composition and structure.

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix*
species [salt cedar]) are excluded from the evaluation of establishment and regeneration. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (e.g., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A site may have *Symphoricarpos occidentalis* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this site, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

For shrubs in general, seedlings and saplings can be distinguished from mature plants as follows. For those species having a mature height generally over 1.8 m (6.0 ft), seedlings and saplings are those individuals less than 1.8 m (6.0 ft) tall. For species normally not exceeding 1.8 m (6.0 ft), seedlings and saplings are those individuals less than 0.45 m (1.5 ft) tall or which lack reproductive structures and the relative stature to suggest maturity. Count plants installed by human planting, if these are successfully established. Establishment success can be assumed for plants surviving at least one full year after planting. (***Note:*** Evaluators should take care also not to confuse short stature resulting from intense browsing with that due to young plants.)

Scoring: (*If the site has no potential for shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the evaluator is not fairly certain potential exists for preferred shrubs, then enter NC and explain in the comment field below.*)
6 = More than 5% of the preferred shrub species cover is seedlings and/or saplings.
4 = 1% to 5% of the preferred shrub species cover is seedlings and/or saplings.
2 = Less than 1% of the preferred shrub species cover is seedlings and/or saplings.
0 = None of the preferred shrub species cover is seedlings or saplings.

4. Standing Decadent and Dead Woody Material. The amount of decadent and dead woody material on a site can be an indicator of the overall health of a riparian area. Large amounts of decadent and dead woody material may indicate a reduced flow of water through the stream (de-watering) due to either human or natural causes. De-watering of a site, if severe enough, may change the site vegetation potential from riparian species to upland species. In addition, decadent and dead woody material may indicate severe stress from over browsing. Finally, large amounts of decadent and dead woody material may indicate climatic impacts, disease and insect damage. For instance, severe winters may cause extreme die back of trees and shrubs, and cyclic insect infestations may kill individuals in a stand. In all these cases, a high percentage of dead and decadent woody material reflects degraded vegetative health, which can lead to reduced streambank integrity, channel incisement, and excessive lateral cutting, besides reducing production and other wildlife values.

The most common usage of the term ***decadent*** may be for over mature trees past their prime and which may be dying, but we use the term in a broader sense. We count decadent plants, both trees and shrubs, as those with 30% or more dead wood in the upper canopy. In this item, scores are based on the percentage of total woody canopy cover which is decadent or dead, not on how much of the total site canopy cover consists of dead and decadent woody material. Only decadent and dead standing material is included, not that which is lying on the ground. The observer is to ignore (not count) decadence in poplars or cottonwoods which are decadent ***due to old age*** (rough and furrowed bark extends substantially up into the crowns of the trees) (species: *Populus deltoides* [plains cottonwood], *P. angustifolia* [narrow-leaf cottonwood], and *P. balsamifera* [balsam poplar]), because cottonwoods/poplars are early seral species and naturally die off in the absence of disturbance to yield the site to later seral species. The observer is to consider (count) decadence in these species if apparently caused by de-watering, browse stress, climatic influences, or parasitic infestation (insects/disease). The observer should comment on conflicting or confounding indicators, and/or if the cause of decadence is simply unknown (*but not due to old age*).

Scoring:
3 = Less than 5% of the total canopy cover of woody species is decadent and/or dead.
2 = 5% to 25% of the total canopy cover of woody species is decadent and/or dead.
1 = 25% to 50% of the total canopy cover of woody species is decadent and/or dead.
0 = More than 50% of the total canopy cover of woody species is decadent and/or dead.

5a. Browse Utilization of Available Preferred Trees and Shrubs. (*Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh, or all woody plants have already been removed.*) Livestock and/or wildlife browse many riparian woody species. Excessive browsing can eliminate these important plants from the community and result in their replacement by undesirable invaders. With excessive browsing, the plant loses vigour, is prevented from flowering, or is killed. Utilization in small amounts is normal and not a health concern, but concern increases with greater browse intensity.

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar]) are excluded from the evaluation of utilization. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian

olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (e.g., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A site may have *Symphoricarpos occidentalis* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this site, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

Consider as available all tree and shrub plants to which animals may gain access and that they can reach. For tree species, this means mostly just seedling and sapling age classes. When estimating degree of utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use, because this would not accurately reflect actual use when more browsing can occur later in the season. Browsing of second year or older material affects the overall health of the plant and continual high use will affect the ability of the plant to maintain itself on the site. Determine percentage by comparing the number of leaders browsed or utilized with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree and shrub species present. Do not count utilization on dead plants, unless it is clear that death resulted from over-grazing. ***Note:*** If a shrub is entirely mushroom/umbrella shaped by long term intense browse or rubbing, count utilization of it as heavy.

Scoring: (*Consider all shrubs within animal reach and seedlings and saplings of tree species. If the site has no woody vegetation [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
3 = None (0% to 5% of available second year and older leaders of preferred species are browsed).
2 = Light (5% to 25% of available second year and older leaders of preferred species are browsed).
1 = Moderate (25% to 50% of available second year and older leaders of preferred species are browsed).
0 = Heavy (More than 50% of available second year and older leaders of preferred species are browsed).

5b. Live Woody Vegetation Removal by Other Than Browsing. Excessive cutting or removing parts of plants or whole plants by agents other than browsing animals (e.g., human clearing, cutting, beaver activity, etc.) can result in many of the same negative effects to the community that are caused by excessive browsing. However, other effects from this kind of
removal are direct and immediate, including reduction of physical community structure and wildlife habitat values. ***Do not include natural phenomena such as natural fire, insect infestation, etc. in this evaluation.***

Removal of woody vegetation may occur at once (a logging operation), or it may be cumulative over time (annual firewood cutting or beaver activity). This question is not so much to assess long term incremental harvest, as it is to assess the extent that the stand is lacking vegetation that would otherwise be there today. Give credit for re-growth. Consider how much the removal of a tree many years ago may have now been mitigated with young replacements.

Three non-native species or genera are excluded from consideration here because these are aggressive, invasive exotic plants that should be removed. They are *Elaeagnus angustifolia* (Russian olive), *Rhamnus cathartica* (European/common buckthorn), and *Tamarix* species (salt cedar).

Determine the extent to which woody vegetation (trees and shrubs) is lacking due to being physically removed (i.e., cut, mowed, trimmed, logged, cut by beaver, or otherwise cut from their growing position). The actual timeframe is not as important as the actual ecological effect. Time to recover from this kind of damage can vary widely with site characteristics. What we really need to measure is the extent ***today*** of any damage remaining to the vegetation structure as a result of the woody removal. We expect that the woody community will recover over time (re-grow), just as an eroding bank will heal with re-growing root mass. This question

simply asks "How much woody material is still missing from what should be there?" --as judged by indications, such as stumps and other clues to what was removed. The amount of time since removal doesn't really matter, if re-growth has been allowed to progress. If 20 years after logging, the site has a stand of sapling spruce trees, then it should get partial re-growth credit, but not full credit, because the trees still lack most of their potential habitat and ecological value. (***NOTE:*** In general, the more recent the removal, the more entirely it should be fully counted; and conversely, the older the removal, the more likely it is to have been mitigated by re-growth.)

This question is really looking at volume (three dimensions) and not canopy cover (two dimensions). For example, if an old growth spruce tree is removed, a number of new seedlings/saplings may become established and could soon achieve the same canopy cover as the old tree had. However, the value of the old tree to wildlife and overall habitat values is far greater than that of the seedling/saplings. It wll take a very long time before the seedlings/saplings can grow to replace all the lost habitat values that were provided by the tall old tree. On the other hand, shrubs, such as willows, grow faster and may replace the volume of removed plants in a much shorter time. Answer this question by estimating the percent of woody material that is missing from the site due to having been removed by human action. Select a range category from the choices given that best represents the percent of missing woody material.

Scoring: (*If the site has no trees or shrubs **AND** no cut plants or stumps of any trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
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. Total Canopy Cover of Woody Species. Woody species play a critical role in riverbank integrity. Natural riverbanks are protected by large bank rock (e.g., boulders and cobbles) and by woody vegetation. On floodplains comprised primarily of fine textured materials—which are typical of many western rivers—riverbanks are protected only by the woody vegetation. In these cases, it is critically important to manage for healthy woody vegetation. Woody vegetation also traps sediment, helps to reduce velocity of flood waters, protects the soil from extreme temperatures, and provides wildlife habitat. ***Note:*** Unlike other items dealing with woody plants, this item focuses on how much of the total site is covered by woody plants.

Scoring:
3 = More than 50% of the total area is occupied by all woody species.
2 = 25% to 50% of the total area is occupied by all woody species.
1 = 5% to 25% of the total area is occupied by all woody species.
0 = Less than 5% of the total area is occupied by all woody species.

7. Invasive Plant Species (Weeds). Invasive plants (weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is infested by invasive plants. The severity of the problem is a function of the density/distribution (pattern of occurrence), as well as canopy cover (abundance) of the weeds. In determining the health score, all invasive species are considered collectively, not individually.

A weed list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). Space is provided on the form for recording weed species counted. Include both woody and herbaceous invasive species. ***Leave no listed species field blank, however;*** enter "0" to indicate absence of a value. (A blank field means the observer forgot to collect the data; a value means the observer looked.)

The site's health rating on this item combines two factors: weed density/distribution class and total canopy cover. A perfect score of 6 out of 6 points can only be achieved if the site is weed free. A score of 4 out of the 6 points means the weed problem is just beginning (i.e., very few weeds and small total canopy cover [less than 1%]). A moderate weed problem gets 2 out of 6 points. It has a moderately dense weed plant distribution (a

class between 4 and 7) and moderate total weed canopy cover (between 1% and 15%). A site scores 0 points if the density/distribution is in class 8 or higher, or if the total weed canopy cover is 15% or more.

7a. Total Canopy Cover of Invasive Plant Species (Weeds). The evaluator must evaluate the total percentage of the site area that is covered by the combined canopy of all plants of all species of invasive plants. Determine which rating applies in the scoring scale below.

Scoring:
6 = No invasive plant species (weeds) on the site.
4 = Invasive plants present with total canopy cover less than 1% of the site area.
2 = Invasive plants present with total canopy cover between 1% and 15% of the site area.
0 = Invasive plants present with total canopy cover more than 15% of the site area.

7b. Density Distribution of Invasive Plant Species (Weeds). The evaluator must pick a category of pattern and extent of invasive plant distribution from the chart below (Figure 2) that best fits what is observed on the site, while realizing that the real situation may be only roughly approximated at best by any of these diagrams. Choose the category that most closely matches the view of the site.

Scoring:
3 = No invasive plant species (weeds) on the 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.

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.	

Figure D-1. Weed density distribution class guidelines

NOTE: Prior to the 2001 season, the health score for weed infestation was assessed from a single numerical value that does not represent weed canopy cover, but instead represents the fraction of the site area on which weeds had a well established population of individuals (i.e., the area infested).

8. Disturbance-Increaser Undesirable Herbaceous Species. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in riparian health. These species generally are less productive, have shallow roots, and poorly perform most riparian functions. They usually result from some disturbance, which removes more desirable species. Invasive species considered in the previous item are not reconsidered here. As in the previous item, the evaluator should state the list of species considered. A partial list of undesirable herbaceous species appropriate for use in Alberta follows. A list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2001]). The evaluator should list any additional species included.

Antennaria spp. (pussy-toes)	*Hordeum jubatum* (foxtail barley)	*Potentilla anserina* (silverweed)
Brassicaceae (mustards)	*Plantago* spp. (plantains)	*Taraxacum* spp. (dandelion)
Bromus inermis (smooth brome)	*Poa pratensis* (Kentucky bluegrass)	*Trifolium* spp. (clovers)
Fragaria spp. (strawberries)	_____	_____

Scoring:
3 = Less than 5% of the reach covered by undesirable herbaceous species.
2 = 5% to 25% of the reach covered by undesirable herbaceous species.
1 = 25% to 50% of the reach covered by undesirable herbaceous species.
0 = More than 50% of the reach covered by undesirable herbaceous species.

9. Riverbank Root Mass Protection. Vegetation along river banks performs the primary physical functions of stabilizing the soil with a binding root mass and of filtering sediments from overland flow. Few studies have documented depth and extent of root systems of plant species found in wetlands, however flow energies commonly experienced by rivers are effectively
resisted only by the deep and extensive roots provided by tree and shrub species. Natural rivers typically move dynamically across their valley bottom. The vegetation roots serve to slow this lateral movement to a rate that allows normal floodplain ecosystem function, such as development of mid and later seral vegetation communities for habitat values. For this reason
there needs to be good root mass protection well back from the immediate toe of the current bank position.

In situations where you are assessing a high, cut bank (usually on an outside bend), the top may be upland, but the bottom is riparian. Do not assess the area that is non-riparian. In cases of tall, nearly vertical cut banks, assess the bottom portion that comes in contact with floodwaters. Omit from consideration those areas where the bank is comprised of bedrock, since these neither provide binding root mass, nor erode at a rate that is normally a concern. In assessing root mass protection along a river, consider a band that extends back approximately 15 m (50 ft) from the bank top. (This is a "rule of thumb" for guidance that requires only estimated measurements.) The bank top is that point where the upper bank levels off to the relatively flat surface of a floodplain or terrace. This question is most critically assessed along straight reaches and outside curves, therefore do not get too concerned with trying to find the exact location of the bank top along inside curve point bar positions. ***Note:****Rip-rap does not substitute for, act as, nor preclude the need for deep, binding root mass.*

Scoring:
6 = More than 85% of the riverbank has a deep, binding root mass.
4 = 65% to 85% of the riverbank has a deep, binding root mass.
2 = 35% to 65% of the riverbank has a deep, binding root mass.
0 = Less than 35% of the riverbank has a deep, binding root mass.

10. Human-Caused Bare Ground. Bare ground is soil not covered by plants, litter or duff, downed wood, or rocks larger than 6 cm (2.5 in). Hardened, impervious surfaces (e.g., asphalt, concrete, etc.) are not bare ground—these do not erode nor allow weeds sites to invade. Bare ground caused by human activity indicates a deterioration of riparian health. Sediment deposits and other natural bare ground are excluded as normal or probably beyond immediate management control. Human land uses causing bare ground include livestock grazing, recreation, roads, and industrial activities. The evaluator should consider the causes of all bare ground observed and estimate the fraction that is human-caused.

River channels that go dry during the growing season can create problems for site delineation. On most rivers, the area of the channel bottom is excluded from the site. (***Note:*** *The whole channel width extends from right bankfull stage to left bankfull stage; however we need to include the lower banks in all sites, therefore consider for exclusion ONLY the relatively flat and lowest area of the channel—the "bottom."*) This allows data to be collected on the riparian area while excluding the aquatic zone, or open water, of the river. The aquatic zone is the area covered by water and lacking persistent emergent vegetation. Persistent emergent vegetation consists of perennial wetland species that normally remain standing at least until the beginning of next

growing season, e.g., *Typha* species (cattails), *Scirpus* species (bulrushes), *Carex* species, and other perennial graminoids.

In many systems, large portions of the channel bottom may become exposed due to seasonal irrigation use, hydroelectric generation, and natural seasonal changes such as are found in many prairie ecosystems. In these cases, especially along prairie rivers, the channel bottom may have varying amounts of herbaceous vegetation, and the channel area is ***included*** in the site as area to be inventoried. Typically, these are the "pooled channel" river type that has scour pools scattered along the length, interspersed with reaches of grass, bulrush, or sedge-covered channel bottom. If over half (>50%) the channel bottom area has a canopy cover of persistent vegetation cover (perennial species), taken over the entire length of the site as a whole, then the entire channel qualifies for inclusion within the inventoried site area. If you are in doubt whether to include the channel bottom in the site, then leave it out, but be sure to indicate this in the comment section. This is important so that future assessments of the site will be looking at the same area of land.

Scoring:
6 = Less than 1% of the site 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.

NOTE: Questions 11 and 12 below generally must be answered in the office using maps and other data. Alberta Environment (2008) provided Cows and Fish the data for these questions in 2008 for the *Provincial Riparian Health Overview of Cows and Fish Data 1997-2006.* More details can be found in that report. The basis of analysis for these parameters is from methods used in a previous riparian health study of the South Saskatchewan River Basin completed by Cows and Fish in 2005.

11. Removal or Addition of Water from/to the River System. Proper functioning of any riparian ecosystem depends, by definition, upon the system supply of water. The degree to which this "lifeblood" is artificially manipulated by removal or addition from/to the system is directly reflected in a reduction of riparian functions (e.g., wetland plant community maintenance, channel bank stability, wildlife habitat, overall system primary production). The extent of this alteration of the system can be estimated by determining the fraction of the average river flow, which is removed or added during the critical growing season each year. This determination can be based upon gauging station records as they relate to historic flow records established before construction of diversions. This question only deals with water volume changes. The question of dams controlling the timing of peak runoff is taken care of in the next question.

Scoring:
9 = Less than 10% of average river flow volume during the critical growing season is changed.
6 = 10% to 25% of average river flow volume during the critical growing season is changed.
3 = 25% to 50% of average river flow volume during the critical growing season is changed.
0 = More than 50% of average river flow volume during the critical growing season is changed.

12. Control of Flood Peak and Timing by Upstream Dam(s). Natural riverine ecosystems adapt to, and depend upon, the volume and timing of annual peak flows, which are determined by the watershed water yield and variability of the local climate. Humans have installed dams on many rivers for agricultural and industrial purposes and to mitigate the damages caused by the natural flooding to human development on the floodplain. The dams affect the functional health of the natural system. In this context, the health of the river system relates directly to the fraction of the watershed which remains undammed. Thus, this item includes all tributaries which flow into the river upstream of the reach being assessed.

Scoring:
9 = Less than 10% of the watershed upstream of the reach is controlled by dams.
6 = 10% to 25% of the watershed upstream of the reach is controlled by dams.
3 = 25% to 50% of the watershed upstream of the reach is controlled by dams.
0 = More than 50% of the watershed upstream of the reach is controlled by dams.

13. Riverbanks Structurally Altered by Human Activity. Altered riverbanks are those having impaired structural integrity (strength or stability) due to human causes. These banks are more susceptible to cracking and/or slumping. Count as riverbank alteration such damage as livestock or wildlife hoof shear and concentrated trampling, vehicle or ATV tracks, and any other areas of human-caused disruption of bank integrity, including rip-rap or use of fill. The basic criterion is any disturbance to bank structure that increases erosion potential or bank profile shape change. One large exception is lateral bank cutting caused by stream flow, even if thought to result from upstream human manipulation of the flow. The intent of this item is to assess only direct, on-site mechanical or structural damage to the banks. Each bank is considered separately, so total bank length for this item is approximately twice the reach length of channel in the site (more if the river is braided).

NOTE: Constructed riverbanks (especially those with rip-rap) may be stabilized at the immediate location, but are likely to disrupt normal flow dynamics and cause erosion of banks downstream. In assessing structural alteration, consider a band along the river bank approximately 4 m (13 ft) wide back from the bank toe. As with deep, binding root mass, this question is most critically assessed along straight reaches and outside curves, therefore do not get hung up trying to find the exact location of the bank top along inside curve point bar positions.

Scoring:

6 = Less than 5% of the bank length has been structurally altered by human activity.
4 = 5% to 15% of the bank length has been structurally altered by human activity.
2 = 15% to 35% of the bank length has been structurally altered by human activity.
0 = More than 35% of the bank length has been structurally altered by human activity.

14. Human Physical Alteration to the Rest of the Site. Within the remainder of the site area, outside the stream bank area that was addressed in the previous question, estimate the amount of area that has been physically altered by human causes. The purpose of this question is to evaluate physical change to the soil, hydrology, etc. as it affects the ability of the natural system to function normally. Changes in soil structure will alter infiltration of water, increase soil compaction, and change the amount of sediment contributed to the water body. Every human activity in or around a natural site can alter that site. This question seeks to assess the accumulated effects of all human-caused change. Count such things as:

- **Soil Compaction.** This kind of alteration includes livestock-caused hummocking and pugging, recreational trails that obviously have compacted the soil, vehicle and machine tracks and ruts in soft soil, etc.
- **Plowing/Tilling.** This is disruption of the soil surface for cultivation purposes.
- **Results of Hydrologic Change.** Include in this category any area that is physically affected by removal or addition of water for human purpose, although cause may be occurring upstream off-site. The physical effects to look for are erosion due to reduced or increased water, bared soil surface that had water cover removed, or flooded area that normally supports a drier vegetation type.
- **Human Impervious Surface.** This includes roofs, hardened surfaces like walkways and roads, boat launches, etc.
- **Topographic Change.** This is the deliberate alteration of terrain and/or drainage pattern for human purposes. It may be for aesthetic (landscaping) or other reasons, including such structures as water diversions ditches and canals.

Scoring:

6 = Less than 5% of the site is altered by human causes.
4 = 5% to 15% of the site is altered by human causes.
2 = 15% to 25% of the site is altered by human causes.
0 = More than 25% of the site is altered by human causes.

15. Floodplain Accessibility within the Site. Many of the most important functions of a riparian ecosystem depend upon the ability of the channel to access its floodplain during high flows. This access is restricted by levees and other human constructed embankments, such as roadbeds. Evaluators should determine what fraction of the historic 100 year floodplain within the site remains unrestricted by such embankments. This can usually be determined by comparing the area within the embankments (as shown on the latest photos or maps available).

Scoring:

6 = More than 85% of the floodplain is accessible to flood flows.
4 = 65% to 85% of the floodplain is accessible to flood flows.
2 = 35% to 65% of the floodplain is accessible to flood flows.
0 = Less than 35% of the floodplain is accessible to flood flows.

APPENDIX H: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS: LOTIC SURVEY

This description of riparian health parameters is based on the Alberta Lotic Wetland Health (Survey) User Manual as created by Ecological Solutions Group LLC (2009).

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 (e.g., Thompson and Hansen 2001, 2002, 2003, or another appropriate publication). On severely disturbed sites, vegetation potential can be difficult to determine. On such sites, clues to potential may be sought on nearby sites with similar landscape position.

Most of the factors rated 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.

The evaluator must keep in mind that this assessment form is designed to account for most sites and conditions in the applicable region. However, rarely will all the questions seem exactly to fit the circumstances on a given site. Therefore, try to answer each question with a literal reading. If necessary, explain anomalies in the comment section. Each factor below will be rated according to conditions observed on the site. The evaluator will estimate the scoring category and enter that value on the score sheet. The riparian health score for streams and small rivers (survey) is based on 11 basic parameters pertaining to riparian health

1. Vegetative Cover of Floodplain and Streambanks. Vegetation cover helps to stabilize banks, control nutrient cycling, reduce water velocity, provide fish cover and food, trap sediments, reduce erosion, and reduce the rate of evaporation (Platts and others 1987). On most streams the area of the channel bottom is excluded from the polygon. (***Note:*** *The whole channel width extends from right bankfull stage to left bankfull stage; however we need to include the lower banks in all polygons, therefore consider for exclusion ONLY the relatively flat and lowest area of the channel—the "bottom."*) This allows data to be collected on the riparian area while excluding the aquatic zone, or open water, of the stream. The aquatic zone is the area covered by water and lacking persistent emergent vegetation. Persistent emergent vegetation consists of perennial wetland species that normally remain standing at least until the beginning of next growing season, e.g., *Typha* species (cattails), *Scirpus* species (bulrushes), *Carex* species, and other perennial graminoids.

In many systems, large portions of the channel bottom may become exposed due to seasonal irrigation use, hydroelectric generation, and natural seasonal changes such as are found in many prairie ecosystems. In these cases, especially the prairie streams, the channel bottom may have varying amounts of herbaceous vegetation, and the channel area is ***included*** in the polygon as area to be inventoried. Typically these are the "pooled channel" stream type that has scour pools scattered along the length, interspersed with reaches of grass, bulrush, or sedge-covered channel bottom. If over half (>50%) the channel bottom area has a canopy cover of persistent vegetation cover (perennial species), taken over the entire length of the polygon as a whole, then it qualifies for inclusion within the inventoried polygon area. If the you are in doubt whether to include the channel bottom in the polygon, then leave it out, but be sure to indicate this in the comment section. This is important so that future assessments of the polygon will be looking at the same area of land.

The evaluator is to estimate the fraction of the polygon covered by plant growth. Vegetation cover is ocularly estimated using the canopy cover method (Daubenmire 1959).

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

2. Invasive Plant Species (Weeds). Invasive plants (weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is infested by invasive plants. The severity of the problem is a function of the density/distribution (pattern of occurrence), as well as canopy cover (abundance) of the weeds. In determining the health score, all invasive species are considered collectively, not individually. A weed list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). Space is provided on the form for recording weed species counted. Include both woody and herbaceous invasive species. ***Leave no listed species field blank, however;*** enter "0" to indicate absence of a value. (A blank field means the observer forgot to collect the data; a value means the observer looked.)

The site's health rating on this item combines two factors: weed density/distribution class and total canopy cover. A perfect score of 6 out of 6 points can only be achieved if the site is weed free. A score of 4 out of the 6 points means the weed problem is just beginning (i.e., very few weeds and small total canopy cover [less than 1%]). A moderate weed problem gets 2 out of 6 points. It has a moderately dense weed plant distribution (a class between 4 and 7) and moderate total weed canopy cover (between 1% and 15%). A site scores 0 points if the density/distribution is in class 8 or higher, or if the total weed
canopy cover is 15% or more.

2a. Total Canopy Cover of Invasive Plant Species (Weeds). The evaluator must evaluate the total percentage of the polygon area that is covered by the combined canopy of all plants of all species of invasive plants. Determine which rating applies in the scoring scale below.

Scoring:
3 = No invasive plant species (weeds) on the 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 Pattern of Invasive Plant Species (Weeds). The observer must pick a category of pattern and extent of invasive plant distribution from the chart below (Figure 3) that best fits what is observed on the polygon, while realizing that the real situation may be only roughly approximated at best by any of these diagrams. Choose the category that most closely matches the view of the polygon.

Scoring:
3 = No invasive plant species (weeds) on the 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.

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.	

Figure 1. Weed density distribution class guidelines

NOTE: Prior to the 2001 season, the health score for weed infestation was assessed from a single numerical value that does not represent weed canopy cover, but instead represents the fraction of the polygon area on which weeds had a well established population of individuals (i.e., the area infested).

3. Disturbance-Increaser Undesirable Herbaceous Species. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in riparian health. These species generally are less productive, have shallow roots, and poorly perform most riparian functions. They usually result from some disturbance, which removes more desirable species. Invasive species considered in the previous item are not reconsidered here. As in the previous item, the evaluator should state the list of species considered. A partial list of undesirable herbaceous species appropriate for use in Alberta follows. A list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2001]). The evaluator should list any additional species included.

Antennaria spp. (pussy-toes)
Brassicaceae (mustards)
Bromus inermis (awnless brome)
Fragaria spp. (strawberries)
Hordeum jubatum (foxtail barley)
Plantago spp. (plantains)
Poa pratensis (Kentucky bluegrass)
_____
Potentilla anserina (silverweed)
Taraxacum spp. (dandelion)
Trifolium spp. (clovers)
_____

Scoring:
3 = Less than 5% of the site covered by disturbance-increaser undesirable herbaceous species.
2 = 5% to 25% of the site covered by disturbance-increaser undesirable herbaceous species.
1 = 25% to 50% of the site covered by disturbance-increaser undesirable herbaceous species.
0 = More than 50% of the site covered by disturbance-increaser undesirable herbaceous species.

4. Preferred Tree and Shrub Establishment and/or Regeneration. (*Skip this item if the site lacks potential for trees or shrubs; for example, the site is a herbaceous wet meadow or marsh.*) Not all riparian areas can support trees and/or shrubs. However, on those sites where such species do belong, they play important roles. The root systems of woody species are excellent bank stabilizers, while their spreading canopies provide protection to soil, water, wildlife, and livestock. Young age classes of woody species are important for the continued presence of woody communities not only at a given point in time but into the future. Woody species potential can be determined by using a key to site type (Thompson and Hansen 2001, 2002, 2003, etc.). On severely disturbed sites, the evaluator should seek clues to potential by observing nearby sites with similar landscape position. *(**Note:*** Vegetation potential is commonly underestimated on sites with a long history of disturbance.)

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar]) are excluded from the evaluation of establishment and regeneration. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (e.g., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A polygon may have *Symphoricarpos occidentalis* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

For shrubs in general, seedlings and saplings can be distinguished from mature plants as follows. For those species having a mature height generally over 1.8 m (6.0 ft), seedlings and saplings are those individuals less than 1.8 m (6.0 ft) tall. For species normally not exceeding 1.8 m (6.0 ft), seedlings and saplings are those individuals less than 0.45 m (1.5 ft) tall or which lack reproductive structures and the relative stature to suggest maturity. (***Note:*** Evaluators should take care not to confuse short stature resulting from intense browsing with that due to young plants.)

Scoring: *(If the site has no potential for trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the evaluator is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below.)*
6 = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings.
4 = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings.
2 = Less than 5% of the total canopy cover of preferred tree/shrubs is seedlings and/or saplings.
0 = Preferred tree/shrub seedlings and saplings absent.

5a. Browse Utilization of Available Preferred Trees and Shrubs. (*Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh, or all woody plants have already been removed.*) Livestock and/or wildlife browse many riparian woody species. Excessive browsing can eliminate these important plants from the community and result in their replacement by undesirable invaders. With excessive browsing, the plant loses vigour, is prevented from flowering, or is killed. Utilization in small amounts is normal and not a health concern, but concern increases with greater browse intensity.

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar]) are excluded from the evaluation of utilization. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (e.g., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia*

[Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A polygon may have *Symphoricarpos occidentalis* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

Consider as available all tree and shrub plants to which animals may gain access and that they can reach. For tree species, this means mostly just seedling and sapling age classes. When estimating degree of utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use, because this would not accurately reflect actual use when more browsing can occur later in the season. Browsing of second year or older material affects the overall health of the plant and continual high use will affect the ability of the plant to maintain itself on the site. Determine percentage by comparing the number of leaders browsed or utilized with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree and shrub species present. Do not count utilization on dead plants, unless it is clear that death resulted from over-grazing. ***Note:*** If a shrub is entirely mushroom/umbrella shaped by long term intense browse or rubbing, count utilization of it as heavy.

Scoring: (*Consider all shrubs within animal reach and seedlings and saplings of tree species. If the site has no woody vegetation [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
3 = None (0% to 5% of available second year and older leaders of preferred species are browsed).
2 = Light (5% to 25% of available second year and older leaders of preferred species are browsed).
1 = Moderate (25% to 50% of available second year and older leaders of preferred species are browsed).
0 = Heavy (More than 50% of available second year and older leaders of preferred species are browsed).

5b. Live Woody Vegetation Removal by Other Than Browsing. Excessive cutting or removing parts of plants or whole plants by agents other than browsing animals (e.g., human clearing, cutting, beaver activity, etc.) can result in many of the same negative effects to the community that are caused by excessive browsing. However, other effects from this kind of removal are direct and immediate, including reduction of physical community structure and wildlife habitat values. ***Do not include natural phenomena such as natural fire, insect infestation, etc. in this evaluation.***

Removal of woody vegetation may occur at once (a logging operation), or it may be cumulative over time (annual firewood cutting or beaver activity). This question is not so much to assess long term incremental harvest, as it is to assess the extent that the stand is lacking vegetation that would otherwise be there today. Give credit for re-growth. Consider how much the removal of a tree many years ago may have now been mitigated with young replacements.

Four non-native species or genera are excluded from consideration here because these are aggressive, invasive exotic plants that should be removed. They are *Elaeagnus angustifolia* (Russian olive), *Rhamnus cathartica* (common buckthorn), *Caragana arborescens* (common caragana), and *Tamarix* species (salt cedar).

Determine the extent to which woody vegetation (trees and shrubs) is lacking due to being physically removed (i.e., cut, mowed, trimmed, logged, cut by beaver, or otherwise removed from their growing position). The timeframe is less important than the ecological effect. Time to recover from this kind of damage can vary widely with site characteristics. The objective is to measure the extent of any damage remaining ***today*** to the vegetation structure resulting from woody removal. We expect that the woody community will recover over time (re-grow), just as an eroding bank will heal with re-growing plant roots.
This question simply asks "How much woody material is still missing from what should be here?" The amount of time since removal doesn't really matter, if re-growth has been allowed to progress. If 20 years after logging, the site has a stand of sapling spruce trees, then it should get partial re-growth credit, but not full credit, since the trees still lack much of their potential habitat and ecological value. (***NOTE:*** In general, the

more recent the removal, the more entirely it should be fully counted; and conversely, the older the removal, the more likely it will have been mitigated by re-growth.)

This question is really looking at volume (three dimensions) and not canopy cover (two dimensions). For example, if an old growth spruce tree is removed, a number of new seedlings/saplings may become established and could soon achieve the same canopy cover as the old tree had. However, the value of the old tree to wildlife and overall habitat values is far greater than that of the seedling/saplings. It will take a very long time before the seedlings/saplings can grow to replace all the lost habitat values that were provided by the tall old tree. On the other hand, shrubs, such as willows, grow faster and may replace the volume of removed plants in a much shorter time. Answer this question by estimating the percent of woody material that is missing from the site due to having been removed by human action. Select a range category from the choices given that best represents the percent of missing woody material.

Scoring: (*If the site has no trees or shrubs **AND** no cut plants or stumps of any trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
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. (*Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh.*) The amount of decadent and dead woody material on a site can be an indicator of the overall health of a riparian area. Large amounts of decadent and dead woody material may indicate a reduced flow of water through the stream (de-watering) due to either human or natural causes. De-watering of a site, if severe enough, may change the site vegetation potential from riparian species to upland species. In addition, decadent and dead woody material may indicate severe stress from over browsing. Finally, large amounts of decadent and dead woody material may indicate climatic impacts, disease and insect damage. For instance, severe winters may cause extreme die back of trees and shrubs, and cyclic insect infestations may kill individuals in a stand. In all these cases, a high percentage of dead and decadent woody material reflects degraded vegetative health, which can lead to reduced streambank integrity, channel incisement, and excessive lateral cutting, besides reducing production and other wildlife values.

The most common usage of the term ***decadent*** may be for over mature trees past their prime and which may be dying, but we use the term in a broader sense. We count decadent plants, both trees and shrubs, as those with 30% or more dead wood in the upper canopy. In this item, scores are based on the percentage of total woody canopy cover which is decadent or dead, not on how much of the total polygon canopy cover consists of dead and decadent woody material. Only decadent and dead standing material is included, not that which is lying on the ground. The observer is to ignore (not count) decadence in poplars or cottonwoods which are decadent ***due to old age*** (rough and furrowed bark extends substantially up into the crowns of the trees) (species: *Populus deltoides* [plains cottonwood], *P. angustifolia* [narrow-leaf cottonwood], and *P. balsamifera* [balsam poplar]), because cottonwoods/poplars are early seral species and naturally die off in the absence of disturbance to yield the site to later seral species. The observer is to consider (count) decadence in these species if apparently caused by de-watering, browse stress, climatic influences, or parasitic infestation (insects/disease). The observer should comment on conflicting or confounding indicators, and/or if the cause of decadence is simply unknown (*but not due to old age*).

Scoring: (*If site lacks potential for woody species, replace both Actual and Potential Scores with NA.*)
3 = Less than 5% of the total canopy cover of woody species is decadent and/or dead.
2 = 5% to 25% of the total canopy cover of woody species is decadent and/or dead.
1 = 25% to 50% of the total canopy cover of woody species is decadent and/or dead.
0 = More than 50% of the total canopy cover of woody species is decadent and/or dead.

7. Streambank Root Mass Protection. Vegetation along streambanks performs the primary physical functions of stabilizing the soil with a binding root mass and of filtering sediments from overland flow. Few studies have documented depth and extent of root systems of plant species found in wetlands. Despite this lack of documented evidence, some generalizations can be made. All tree and shrub species are considered to

have deep, binding root masses. Among wetland herbaceous species, the first rule is that annual plants lack deep, binding roots. Perennial species offer a wide range of root mass qualities.
Some rhizomatous species such as the deep rooted *Carex* species (sedges) are excellent bank stabilizers. Others, such as *Poa pratensis* (Kentucky bluegrass), have only shallow roots and are poor bank stabilizers. Still others, such as *Juncus balticus* (wire rush), are intermediate in their ability to stabilize banks. The size and nature of the stream will determine which herbaceous species can be effective. The evaluator should try to determine if the types of root systems present in the polygon are in fact contributing to the stability of the streambanks.

In situations where you are assessing a high, cut bank (usually on an outside bend), the top may be upland, but the bottom is riparian. Do not assess the area that is non-riparian. In cases of tall, nearly vertical cut banks, assess the bottom portion that comes in contact with floodwaters. Omit from consideration those areas where the bank is comprised of bedrock, since these neither provide binding root mass, nor erode at a perceptible rate.

Note: Rip-rap does not substitute for, act as, or preclude the need for deep, binding root mass.

Since the kind and amount of deep, binding roots needed to anchor a bank is dependent on size of the stream, use the following table as a general guide to determine width of a band along the banks to assess for deep, binding roots. This is a "rule of thumb" for guidance that requires only estimated measurements.

Stream Size (Bankfull Channel Width)	**Width of Band to Assess for Deep, Binding Roots**
Rivers (Larger Than 30 m [>100 ft])	15 m (50 ft)
Large Streams (Approx. 5-30 m [16-100 ft])	5 m (16 ft)
Small Streams (Up To Approx. 5 m [16 ft])	2 m (6 ft)

Scoring:
6 = More than 85% of the streambank has a deep, binding root mass.
4 = 65% to 85% of the streambank has a deep, binding root mass.
2 = 35% to 65% of the streambank has a deep, binding root mass.
0 = Less than 35% of the streambank has a deep, binding root mass.

8. Human-Caused Bare Ground. Bare ground is soil not covered by plants, litter or duff, downed wood, or rocks larger than 6 cm (2.5 in). Hardened, impervious surfaces (e.g., asphalt, concrete, etc.) are not bare ground—these do not erode nor allow weeds sites to invade. Bare ground caused by human activity indicates a deterioration of riparian health. Sediment deposits and other natural bare ground are excluded as normal or probably beyond immediate management control. Human land uses causing bare ground include livestock grazing, recreation, roads, and industrial activities. The evaluator should consider the causes of all bare ground observed and estimate the fraction that is human-caused.

Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. On most streams the area of the channel bottom is excluded from the polygon. (***Note:*** *The whole channel width extends from right bankfull stage to left bankfull stage; however we need to include the lower banks in all polygons, therefore consider for exclusion ONLY the relatively flat and lowest area of the channel—the "bottom."*) This allows data to be collected on the riparian area while excluding the aquatic zone, or open water, of the stream. The aquatic zone is the area covered by water and lacking persistent emergent vegetation. Persistent emergent vegetation consists of perennial wetland species that normally remain standing at least until the beginning of next growing season, e.g., *Typha* species (cattails), *Scirpus* species (bulrushes), *Carex* species, and other perennial graminoids.

In many systems, large portions of the channel bottom may become exposed due to seasonal irrigation use, hydroelectric generation, and natural seasonal changes such as are found in many prairie ecosystems. In these cases, especially the prairie streams, the channel bottom may have varying amounts of herbaceous vegetation, and the channel area is ***included*** in the polygon as area to be inventoried. Typically, these are the "pooled channel" stream type that has scour pools scattered along the length, interspersed with reaches of

grass, bulrush, or sedge-covered channel bottom. If over half (>50%) the channel bottom area has a canopy cover of persistent vegetation cover (perennial species), taken over the entire length of the polygon as a whole, then it qualifies for inclusion within the inventoried polygon area. If you are in doubt whether to include the channel bottom in the polygon, then leave it out, but be sure to indicate this in the comment section. This is important so that future assessments of the polygon will be looking at the same area of land.

Scoring:
6 = Less than 1% of the polygon is human-caused bare ground.
4 = 1% to 5% of the polygon is human-caused bare ground.
2 = 5% to 15% of the polygon is human-caused bare ground.
0 = More than 15% of the polygon is human-caused bare ground.

9. Streambank Structurally Altered by Human Activity. Altered streambanks are those having impaired structural integrity (strength or stability) usually due to human causes. These banks are more susceptible to cracking and/or slumping. Count as streambank alteration such damage as livestock or wildlife hoof shear and concentrated trampling, vehicle or ATV tracks, and any other areas of human-caused disruption of bank integrity, including rip-rap or use of fill. The basic criterion is any disturbance to bank structure that increases erosion potential or bank profile shape change. One large exception is lateral bank cutting caused by stream flow, even if thought to result from upstream human manipulation of the flow. The intent of this item is to assess only direct, on-site mechanical or structural damage to the banks. Each bank is considered separately, so total bank length for this item is approximately twice the reach length of stream channel in the polygon (more if the stream is braided). ***NOTE:*** Constructed streambanks (especially those with rip-rap) may be stabilized at the immediate location, but are likely to disrupt normal flow dynamics and cause erosion of banks downstream. The width of the bank to be considered is proportional to stream size. The table below gives a conceptual guideline for how wide a band along the bank to assess.

Stream Size (Bankfull Channel Width)	**Width of Band to Assess for Bank Alteration**
Rivers (Larger Than 30 m [>100 ft])	4 m (13 ft)
Large Streams (Approx. 5-30 m [16-100 ft])	2 m (6 ft)
Small Streams (Up To Approx. 5 m [16 ft])	1 m (3 ft)

Scoring:
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 Polygon. Within the remainder of the polygon area, outside the stream bank area that was addressed in the previous question, estimate the amount of area that has been physically altered by human causes. The purpose of this question is to evaluate physical change to the soil, hydrology, etc. as it affects the ability of the natural system to function normally. Changes in soil structure will alter infiltration of water, increase soil compaction, and change the amount of sediment contributed to the water body. Every human activity in or around a natural site can alter that site. This question seeks to assess the accumulated effects of all human-caused change. Count such things as:

- **Soil Compaction.** This kind of alteration includes livestock-caused hummocking and pugging, recreational trails that obviously have compacted the soil, vehicle and machine tracks and ruts in soft soil, etc.
- **Plowing/Tilling.** This is disruption of the soil surface for cultivation purposes. It does not include the alteration of drainage or topographic pattern, which are included in the **Topographic Change** category.
- **Hydrologic Change.** Include in this category any area that is physically affected by removal or addition of water for human purpose. The physical effects to look for are erosion due to reduced or increased water, bared soil surface that had water cover removed, or flooded area that normally supports a drier vegetation type.

- **Human Impervious Surface.** This includes roofs, hardened surfaces like walkways and roads, boat launches, etc.
- **Topographic Change.** This is the deliberate alteration of terrain and/or drainage pattern for human purposes. It may be for aesthetic (landscaping) or other reasons, including such structures as water diversions ditches and canals.

Scoring:
3 = Less than 5% of the polygon is altered by human causes.
2 = 5% to 15% of the polygon is altered by human causes.
1 = 15% to 25% of the polygon is altered by human causes.
0 = More than 25% of the polygon is altered by human causes.

11. Stream Channel Incisement (Vertical Stability). An incised stream channel has experienced vertical downcutting of its bed. Incisement can lower the water table enough to change vegetation site potential. It can also increase stream energy by reducing sinuosity, reduce water retention/storage, and increase erosion. A stream becomes critically incised when downcutting lowers the channel bed so that the two-year flood event cannot overflow the banks. Some typical downcutting indicators are:
a) Headcuts;
b) Exposed cultural features (pipelines, bridge footings, culverts, etc.);
c) Lack of sediment deposits;
d) Exposed bedrock; and
e) A low, vertical scarp at the bank toe on the inside of a channel bend.

A severe disturbance can initiate downcutting, transforming the system from one having a high water table, appropriate floodplain, and high productivity to one of degraded water table, narrow (or no) active floodplain, and low productivity.

These stages of incisement can be categorized in terms of Schumm's stages of incised channel evolution (Schumm and others 1984). The following indicators, taken together, collectively will enable the observer to assess severity of channel incisement:

Channel bed downcutting—Look for headcuts, lack of bed load sediment and exposed bedrock, a low vertical scarp at tow of bank along straight reaches and inside curves, hanging culverts and exposed cultural features.

Limited access to floodplain by flood flows of 1 to 3 year frequency—Look for a lack of sediment deposits and debris deposits on lower floodplain elevations.

Widening of the incised channel—Look for lateral cutting and sloughing of the high banks. This is one of the early steps in the healing process on a severely incised channel. Initially, the downward bed erosion forms a narrow, deep channel that often resembles a gully. Flood waters in such a channel normally cannot deposit, but can only erode and transport, sediment; therefore the narrow incisement must be widened to provide lateral space for a new floodplain to form. This lateral cutting also supplies the sediment that may be deposited at the bottom to begin the formation of a new floodplain.

New floodplain formation within the incised channel—Look for small depositional bars and low, flat areas near the channel. These will increase in width and length, as the healing process proceeds. Look especially for perennial vegetation becoming established on these depositional features, as it is the vegetation that secures the newly gained floodplain increments. The relative width of the active floodplain (the lowest level, the one that is most frequently flooded) determines to what extent an incisement has healed. Remember that floodplain width is inversely proportional to stream gradient, so that higher gradient (B stream type) channels typically have narrow floodplains (typically less than one bankfull channel width), and C and E stream type have wide to very wide floodplains (typically greater than one bankfull channel width).

A top rating is given to un-incised channels from which the normal 1-2 year high flow can access a well formed floodplain. These can be meandering meadow streams (E stream type) and wide valley bottom streams (C stream type) which access floodplains much wider than the stream channel, or they may be mountain and foothill streams in V-shaped valleys which have narrow floodplains limited by topography or bedrock. These latter types are usually armoured (well-rocked) systems with highly stable beds and

streambanks that are not susceptible to downcutting (typically mountain and foothill streams of A and B stream types). The lowest rating goes to entrenched channels (F or G stream types) where even medium high flows which occur at 5-10 year intervals cannot over-top the high banks. Intermediate stages may be either improving or degrading, and may reflect slightly incised channels that are not yet downcut so badly that some flood stages still cannot access the floodplain, or they may be old incisements that are now healing and rebuilding a new floodplain in the bottom of the ravine.

Because a channel can be incised in any of several stages, the observer is to examine the channel in the polygon for indicators of the degree of channel bed grade stability and stage of incisement, as illustrated in Figure 4. Figure 4 adapts the Schumm channel evolution model to show a generalized schematic of stages through which a channel progresses from destabilization and downcutting to healing and reestablishment of a new floodplain. Actual sites will often have characteristics that are difficult to match with the generalized drawings in Figure 4. However, make a "best fit" call for category of incisement based on available evidence. If the indicators are confusing and inconclusive, choose the higher (less incised) indicated category. Explain your call in the comment field, and be sure to provide photo documentation of evidence on severely incised channels.

The following table defines incisement severity categories in terms of Schumm's model of channel evolution stages, as adapted by Rosgen (2006). Note that with destabilizing disturbance and subsequent change to remove disturbance, a channel may progress through predictable stages of incisement and healing, returning again ultimately to a functional, stable system.

Health Assessment Scoring	Incisement Class	Schumm's Channel Evolution Stages	Rosgen Types Included	Description of Incisment Situation
9	None	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 stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain in which perennial riparian vegetation 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 incised, 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 stabilized. A mature, or nearly mature, vegetation community will occupy much of the new valley bottom.
6	Slight	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, 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 be as wide as the stream type needs. This is indicated by ongoing lateral erosion of high side walls of the original incisement, as the system continues to widen itself at its new grade level.

3	Moderate	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 rogressing, but the channel may already look like a gully. In Stage D, the system has only just begun to heal. A small floodplain along the new curves in the gully is forming, and perennial vegetation is starting to colonize new sediment features. The high side walls of the gully are actively eroding as the system widens, and much of the fallen materials is being incorporated along the bottom.
0	Severe	C	F, G	The worst case category, where there is no floodplain in the bottom of a deep entrenchment, and small-to-moderate floods cannot reach the original floodplain level. Downcutting may 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 new floodplain. At this stage, the system has lost practically all of its riparian function and habitat value.

APPENDIX I: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS: LENTIC SURVEY

This description of riparian health parameters is based on the Alberta Lentic Wetland Health (Survey) User Manual as created by Ecological Solutions Group LLC. (2009).

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 (e.g., Thompson and Hansen 2001, 2002, 2003, or another appropriate publication). On severely disturbed sites, vegetation potential can be difficult to determine. On such sites, clues to potential may be sought on nearby sites with similar landscape position.

Most of the factors rated 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 site. The evaluator will estimate the scoring category and enter that value on the score sheet.

1. Vegetative Cover of the Polygon. Around lentic water bodies vegetation cover helps to stabilize shorelines, control nutrient cycling, reduce water velocity, provide fish cover and food, trap sediments, reduce erosion, reduce the rate of evaporation (Platts and others 1987), and contributes primary production to the ecosystem. This question focuses on how much of the entire polygon area is covered by standing plant growth. Item 8 below assesses the amount of human-caused bare ground. Although there is some overlap between these two items, the bare ground to be counted in item 8 is strictly limited in definition, whereas all unvegetated area not inundated by water is counted in this item. The only area within the polygon exempt from consideration here is area covered by water, including water between emergent plants such as cattails and bulrushes. Areas such as boat docks, hardened pathways, and artificial structures are counted as unvegetated along with any bare ground, downed wood, and other plant litter. The rationale is that all such unvegetated areas contribute nothing to several of the important lentic wetland functions.

The evaluator is to estimate the fraction of the polygon covered by plant growth. Vegetation cover is ocularly estimated using the canopy cover method (Daubenmire 1959).

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

2. Invasive Plant Species (Weeds). Invasive plants (weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is infested by invasive plants. The severity of the problem is a function of the density/distribution (pattern of occurrence), as well as canopy cover (abundance) of the weeds. In determining the health score, all invasive species are considered collectively, not individually.

A weed list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). Some common invasive species are listed on the form, and space is allowed for recording others. Include both woody and herbaceous invasive species. ***Leave no listed species field blank, however;*** enter "0" to indicate

absence of a value. (A blank field means the observer forgot to collect the data; a value means the observer looked.)

The site's health rating on this item combines two factors: weed density/distribution class and total canopy cover. A perfect score of 6 out of 6 points can only be achieved if the site is weed free. A score of 4 out of the 6 points means the weed problem is just beginning (i.e., very few weeds and small total canopy cover [less than 1%]). A moderate weed problem gets 2 out of 6 points. It has a moderately dense weed plant distribution (a class between 4 and 7) and moderate total weed canopy cover (between 1% and 15%). A site scores 0 points if the density/distribution is in class 8 or higher, or if the total weed canopy cover is 15% or more.

2a. Total Canopy Cover of Invasive Plant Species (Weeds). The observer must evaluate the total percentage of the polygon area that is covered by the combined canopy of all plants of all species of invasive plants. Determine which rating applies in the scoring scale below.

Scoring:
3 = No invasive plant species (weeds) on the 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 Pattern of Invasive Plant Species (Weeds). The observer must pick a category of pattern and extent of invasive plant distribution from the chart below (Figure 2) that best fits what is observed on the polygon, while realizing that the real situation may be only roughly approximated at best by any of these diagrams. Choose the category that most closely matches the view of the polygon.

Scoring:
3 = No invasive plant species (weeds) on the 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.

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.	

Figure 2. Weed density distribution class guidelines

NOTE: Prior to the 2001 season, the health score for weed infestation was assessed from a single numerical value that does not represent weed canopy cover, but instead represents the fraction of the polygon area on which weeds had a well established population of individuals (i.e., the area infested).

3. Disturbance-Increaser Undesirable Herbaceous Species. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in riparian health. These species generally are less productive, have shallow roots, and poorly perform most riparian functions. They usually result from some disturbance that removes more desirable species. Invasive species considered in the previous item are not reconsidered here. As in the previous item, the evaluator should state the list of species considered. A partial list of undesirable herbaceous species appropriate for use in Alberta follows. A list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). The evaluator should list any additional species included.

Antennaria spp. (pussy-toes)	*Hordeum jubatum* (foxtail barley)	*Potentilla anserina* (silverweed)
Brassicaceae (mustards)	*Plantago* spp. (plantains)	*Taraxacum* spp. (dandelion)
Bromus inermis (awnless brome)	*Poa pratensis* (Kentucky bluegrass)	*Trifolium* spp. (clovers)
Fragaria spp. (strawberries)	_____	_____

Scoring:
3 = Less than 5% of the site covered by disturbance-increaser undesirable herbaceous species.
2 = 5% to 25% of the site covered by disturbance-increaser undesirable herbaceous species.
1 = 25% to 50% of the site covered by disturbance-increaser undesirable herbaceous species.
0 = More than 50% of the site covered by disturbance-increaser undesirable herbaceous species.

4. Preferred Tree and Shrub Establishment and/or Regeneration. (Skip this item if the site lacks potential for trees or shrubs; for example, the site is a herbaceous wet meadow or marsh.) Not all riparian areas can support trees and/or shrubs. However, on those sites where such species do belong, they play important roles. The root systems of woody species are excellent bank stabilizers, while their spreading canopies provide protection to soil, water, wildlife, and livestock. Young age classes of woody species are important for the continued presence of woody communities not only at a given point in time but into the future. Woody species potential can be determined by using a key to site type (Thompson and Hansen 2001, 2002, 2003). On severely disturbed sites, the evaluator should seek clues to potential by observing nearby sites with similar landscape position. (***Note:*** Vegetation potential is commonly underestimated on sites with a long history of disturbance.)

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar]) are excluded from the evaluation of utilization. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is that they are far more abundant on many sites than are species of greater concern (i.e., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A polygon may have *Symphoricarpos occidentalis* (buckbrush/ snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

For shrubs in general, seedlings and saplings can be distinguished from mature plants as follows. For those species having a mature height generally over 1.8 m (6.0 ft), seedlings and saplings are those individuals less than 1.8 m (6.0 ft) tall. For species normally not exceeding 1.8 m (6.0 ft), seedlings and saplings are those

individuals less than 0.45 m (1.5 ft) tall or which lack reproductive structures and the relative stature to suggest maturity. (***Note:*** Evaluators should take care not to confuse short stature resulting from intense browsing with that due to young plants.)

Scoring: (*If the site has no potential for trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the observer is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below.*)
6 = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings.
4 = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings.
2 = Less than 5% of the total canopy cover of preferred tree/shrubs is seedlings and/or saplings.
0 = Preferred tree/shrub seedlings and saplings absent.

5a. Browse Utilization of Available Preferred Trees and Shrubs. (*Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh, or all woody plants have already been removed.*) Livestock and/or wildlife browse many riparian woody species. Excessive browsing can eliminate these important plants from the community and result in their replacement by undesirable invaders. With excessive browsing, the plant loses vigour, is prevented from flowering, or is killed. Utilization in small amounts is normal and not a health concern, but concern increases with greater browse intensity.

Nine shrub genera or species (e.g., *Elaeagnus angustifolia* [Russian olive], *Symphoricarpos* species [buckbrush/snowberry], *Rosa* species [rose], *Crataegus* species [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Potentilla fruticosa* [shrubby cinquefoil], *Caragana* species [caragana], *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar]) are excluded from the evaluation of utilization. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-intense grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* species (caragana), *Rhamnus catharticus* [European/common buckthorn], and *Tamarix* species [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (e.g., *Salix* species [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [Saskatoon serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE:*** A polygon may have *Symphoricarpos occidentalis* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the buckbrush/snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

Consider as available all tree and shrub plants to which animals may gain access and that they can reach. For tree species, this means mostly just seedling and sapling age classes. When estimating degree of utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use, because this would not accurately reflect actual use when more browsing can occur later in the season. Browsing of second
year or older material affects the overall health of the plant and continual high use will affect the ability of the plant to maintain itself on the site. Determine percentage by comparing the number of leaders browsed or utilized with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree and shrub species present. Do not count utilization on dead plants, unless it is clear that death resulted from over-grazing. ***Note:*** If a shrub is entirely mushroom/umbrella shaped by long term intense browse or rubbing, count utilization of it as heavy.

Scoring: (*Consider all shrubs within animal reach and seedlings and saplings of tree species. If the site has no woody vegetation [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
3 = None (0% to 5% of available second year and older leaders of preferred species are browsed).
2 = Light (5% to 25% of available second year and older leaders of preferred species are browsed).

1 = Moderate (25% to 50% of available second year and older leaders of preferred species are browsed).
0 = Heavy (More than 50% of available second year and older leaders of preferred species are browsed).

5b. Live Woody Vegetation Removal by Other Than Browsing. Excessive cutting or removing parts of plants or whole plants by agents other than browsing animals (e.g., human clearing, cutting, beaver activity, etc.) can result in many of the same negative effects to the community that are caused by excessive browsing. However, other effects from this kind of removal are direct and immediate, including reduction of physical community structure and wildlife habitat values. ***Do not include natural phenomena such as natural fire, insect infestation, etc. in this evaluation.***

Removal of woody vegetation may occur at once (a logging operation), or it may be cumulative over time (annual firewood cutting or beaver activity). This question is not so much to assess long term incremental harvest, as it is to assess the extent that the stand is lacking vegetation that would otherwise be there today. Give credit for re-growth. Consider how much the removal of a tree many years ago may have now been mitigated with young replacements.

Four non-native species or genera are excluded from consideration here because these are aggressive, invasive exotic plants that should be removed. They are *Elaeagnus angustifolia* (Russian olive), *Rhamnus cathartica* (common buckthorn), *Caragana arborescens* (common caragana), and *Tamarix* species (salt cedar).

Determine the extent to which woody vegetation (trees and shrubs) is lacking due to being physically removed (i.e., cut, mowed, trimmed, logged, cut by beaver, or otherwise removed from their growing position). The timeframe is less important than the ecological effect. Time to recover from this kind of damage can vary widely with site characteristics. The objective is to measure the extent of any damage remaining ***today*** to the vegetation structure resulting from woody removal. We expect that the woody community will recover over time (re-grow), just as an eroding bank will heal with re-growing plant roots.
This question simply asks "How much woody material is still missing from what should be here?" The amount of time since removal doesn't really matter, if re-growth has been allowed to progress. If 20 years after logging, the site has a stand of sapling spruce trees, then it should get partial re-growth credit, but not full credit, since the trees still lack much of their potential habitat and ecological value. (***NOTE:*** In general, the more recent the removal, the more entirely it should be fully counted; and conversely, the older the removal, the more likely it will have been mitigated by re-growth.)

This question is really looking at volume (three dimensions) and not canopy cover (two dimensions). For example, if an old growth spruce tree is removed, a number of new seedlings/saplings may become established and could soon achieve the same canopy cover as the old tree had. However, the value of the old tree to wildlife and overall habitat values is far greater than that of the seedling/saplings. It will take a very long time before the seedlings/saplings can grow to replace all the lost habitat values that were provided by the tall old tree. On the other hand, shrubs, such as willows, grow faster and may replace the
volume of removed plants in a much shorter time. Answer this question by estimating the percent of woody material that is missing from the site due to having been removed by human action. Select a range category from the choices given that best represents the percent of missing woody material.

Scoring: (*If the site has no trees or shrubs **AND** no cut plants or stumps of any trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA.*)
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. Human Alteration of Polygon Vegetation Community Composition. Human alteration of the vegetation is meant to include all changes to the plant community composition or structure on the polygon from human causes (e.g., logging, mining, roads, construction, or development) or by agents of human management (e.g., livestock). ***It is not meant to include transitory or short-term removal of plant material that does not alter long term plant community composition*** (i.e., grazing at carefully managed levels or wood cutting that does not change long term species composition of the community). Also include impacts caused by extreme concentrations of managed wildlife, rationale being that wildlife concentrations great enough to cause

significant site damage are usually the result of human management choices. Beaver activities that alter vegetative communities will not be included in this question, but are included in the utilization question.

Of concern are the kinds of change that diminish or disrupt the natural wetland function of the vegetation. These include, but are not limited to, conversion of natural communities to lawns or hayfields (but not the actual mowing), changing plant community composition (e.g., causing replacement of willows with rose and buckbrush, woody species with herbaceous species, etc.), replacing native plants with tame plants, replacing deep rooted plants with shallow rooted plants, and/or replacing tall species with short species. In a case where the vegetation community is altered, due to removal of woody cover that allows conversion to a long term cover of a different kind of vegetation (i.e., cottonwoods/poplars are cut, and the site changes to a *Poa pratensis* [Kentucky bluegrass] cover), then the polygon gets a low score for both woody vegetation removal and for alteration of the vegetation community.

On polygons adjacent to water, remember that the polygon extends out to where the water is two metres deep. (***NOTE:*** Do not count the same area twice by including it as both a vegetative and a physical alteration, unless there clearly are both kinds of alteration. Decide into which category a particular effect should go. For example: A timber harvest may clear vegetation, but not necessarily cause physical damage on one area; while on another area it may cause both clearing of vegetation and disruption of the soil by heavy equipment.)

Scoring:
6 = Less than 5% of polygon vegetation community composition is altered by human activity.
4 = 5% to 15% of polygon vegetation community composition is altered by human activity.
2 = 15% to 35% of polygon vegetation community composition is altered by human activity.
0 = 35% or more of polygon vegetation community composition is altered by human activity.

7. Human Alteration of Polygon Physical Site. The purpose of this question is to assess physical change to the soil, bank/ shore integrity, hydrology, etc. as it affects the ability of the natural system to function normally. Changes in shore and bank contour and any change in soil structure will alter infiltration of water, increase soil compaction, and cause increased sediment contribution to the water body. Every human activity in or around a natural site can alter that site. This question seeks to assess the accumulated effects of all human-caused change.

Include all changes to the physical attributes of the site caused by human actions (e.g., logging, mining, housing development) or by agents of human management (e.g., livestock) and also any effects from concentrated wildlife use (Rationale being that wildlife concentrations great enough to cause significant site damage are usually the result of human management activities.) The kinds of physical change that diminish or disrupt the natural wetland functions on the site include, but are not limited to, hummocking, pugging, animal trails (livestock or wildlife), human roads, trails, buildings, landscaping, boat launches/docks, beach clearing and building, or rip-rapping of shores and banks. (***NOTE:*** *Do not count the same area twice by including it as both a vegetative and a physical alteration, unless there clearly are both kinds of alteration. Decide into which category a particular effect should go.* For example: A cottage owner may clear vegetation to gain a view of the lake without causing physical damage to one area; whereas, if he/she hauls in sand to enhance the beach, there may also be physical alteration of the same site.) This item is scored in two parts:

7a. Estimate the percentage of the polygon that is altered by human activities.

Scoring:
12 = Less than 5% of the polygon is physically altered by human activity.
8 = 5% to 15% of the polygon is physically altered by human activity.
4 = 15% to 35% of the polygon is physically altered by human activity.
0 = More than 35% of the polygon is physically altered by human activity.

7b. Estimate the severity of the alteration, *without regard to the portion of the polygon it might occupy.*
Full score is given only to polygons with no physical alteration by human activity. Four categories of alteration severity are described here in terms of change to the site vegetation and hydrologic function. (***Note:*** *This call uses vegetation change to indicate degree of alteration, but the alteration must be physical in*

nature, not just vegetative change alone; e.g., disruption of soil, hydrology, topography, etc.) Document the severity of alteration with photos and commentary.
Categories of severity are described below using conceptual guidelines. These guidelines are not comprehensive, but are intended as a relative scale by which the observer can judge his/her site. Every case is different, and there is no absolute measuring stick to apply. Use the following comparative descriptions to choose a category of alteration on your site:

- ***None***—No human-caused physical alteration observed on the polygon.
- ***Slight***—Physical site integrity is near natural. Human-caused alteration (including recovery from any past severe alterations) is apparent, but reflects minimal impact to plant communities and hydrological function in the altered areas (e.g., the plant community is little changed from that on nearby sites lacking physical alteration; any pugging and hummocking or other disruption of the soil profile is relatively shallow and is well vegetated with appropriate species).
- ***Moderate***—As compared with nearby unaltered sites, human-caused physical alteration on the polygon (including recovery from any past severe alterations) has noticeably altered the physical site integrity to the point that plant communities and hydrological function on the altered areas show visible impact. The plant community differs noticeably (by having introduced or missing components) from nearby sites that are on similar landscape position and that lack physical alterations. Pugging and hummocking or other disruption of the soil profile is moderate in depth and height of hummocks. Such alteration is either becoming re-vegetated with appropriate species, or is well covered with a mix of less desirable and appropriate species.
- ***Severe***—Human-caused physical site alteration on the polygon has compromised the physical integrity of the altered areas (even if only a small area is altered). Old alterations have not recovered and are still affecting the vegetation or hydrological functions (e.g., the plant community differs radically from nearby sites in similar position that lack physical alterations, reflecting altered hydrologic and/or soil conditions). Pugging and hummocking or other disruption of the soil profile is severe in depth of disturbance and/or height of hummocking. Alterations remain mostly bare of plant cover, or are becoming vegetated with invasive or undesirable species.

Scoring:
3 = ***No physical alterations*** to the site by human activity.
2 = Human alterations to the physical site are ***slight*** in effect.
1 = Human alterations to the physical site are ***moderate*** in effect.
0 = Human alterations to the physical site are ***severe*** in effect.

8. Human-Caused Bare Ground. Bare ground is exposed soil surface (not covered by plants, litter or duff, down wood, or rocks larger than 6 cm [2.5 in]). Hardened, impervious surfaces (e.g., asphalt, concrete, etc.) are not bare ground—these do not erode nor allow weeds sites to invade. Bare ground may result naturally from several processes (i.e., sedimentation, flood erosion, fire, tree fall, and exposure of lakebed by low water level), but that caused by human activity always indicates an impairment of wetland health. Exposed soil is vulnerable to erosion and is where weeds become established. Bare soil is not producing, nor providing habitat. Sediment deposits and other natural bare ground are excluded as normal and probably beyond management control. Human land uses often causing bare ground include livestock grazing, recreation, off road vehicle use, and resource extraction activities. After considering the causes of all bare ground on the site, the evaluator must estimate what percent of the site (polygon) area is human-caused bare ground.

Scoring:
6 = Less than 1% of the polygon is human-caused bare ground.
4 = 1% to 5% of the polygon is human-caused bare ground.
2 = 5% to 15% of the polygon is human-caused bare ground.
0 = 15% or more of the polygon is human-caused bare ground.

9. Degree of Artificial Withdrawal or Raising of Water Level. Although water levels naturally fluctuate on a seasonal basis in most systems, many wetland systems are affected by human-caused (artificial) additions or withdrawals. This artificial changes of water level rarely follow a temporal regime that maintains healthy native wetland plant communities. The result is often a barren band of shore exposed or inundated for much of each growing season. This causes shore material to destabilize, and often provides sites for weeds to invade. Such conditions are extremely detrimental to healthy riparian function.

Not all lentic wetlands evaluated with this form will have surface water potential, but any wetland may have its water table degraded by draining, pumping, or diverting its surface or subsurface supply. On such lentic wetlands as marshes and wet meadows, look for evidence of drainage ditching, pumping, and the interruption of normal surface drainage inputs by livestock watering dugouts, cross slope ditches, or dams upslope.

In this item the evaluator is asked to categorize the degree to which the system is subjected to artificially rapid or unnaturally timed fluctuations in water level. Reservoirs intended for storage of water for power generation, irrigation, and/or livestock watering typically exhibit the most severe effects, but water may be diverted or pumped from natural systems for many other reasons (domestic use, industrial use, livestock watering, etc.). This item requires the evaluator to make a subjective call by choosing as a "best fit" one of the categories of drawdown severity described below. (***Note:*** Be careful to consider the scale of the water body as it relates to the scale of change. Pumping a small dugout full of water for livestock might severely impact a 0.8 ha (2 ac) slough, but be negligible to a lake covering a section of land.) Be sure to document the grounds for your estimate here. If there is no way to know with any reasonable degree of certainty how much water is being added or removed, it may be better to describe the situation and to "zero out" this item (not answer it). During periods of drought lakebeds become exposed, and often exhibit wide zones of almost barren shore. ***The evaluator must be careful not to attribute this natural phenomenon unfairly to a human activity.***

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Severity Categories of Lentic Water Level Manipulation

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Not Subjected The water body, or wetland, is not subjected to artificial water level change (e.g., drawdown, addition, stabilization, etc.).
This category may include very small amounts of change that cause no detectible fluctuation in water level.
Minor The water body or wetland is subject to no more than minor artificial water level change. The shore area remains vegetated, and withdrawal of water is limited or slow enough that vegetation is able to maintain growth and prevent soil exposure. A relatively narrow band affected by the water level fluctuation may support only annual plants.
Moderate The water body or wetland is subject to moderate quantities, speed and/or frequency of artificial water level change. Where water is removed, it is done in a way that allows pioneer plants to vegetate at least half of the exposed area resulting from drawdown. Where water is added, some flooding may occur at levels or times not typical to the area/season.
Extreme The water body or wetland is subjected to extreme changes in water level due to volume (extent), speed and/or frequency of artificial water addition or removal. Frequent or unnatural levels of flooding occur where water is added, including extensive flooding into riparian and/or upland areas; or no natural annual drawdown is allowed to occur. In extreme artificial drawdown situations, a wide band of exposed bottom remains unvegetated.

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Scoring:
9 = The water body, or wetland, is ***not subjected*** to artificial water level change.
6 = The degree of artificial water level change is ***minor.***
3 = The degree of artificial water level change is ***moderate.***
0 = The degree of artificial water level change is ***extreme.***

APPENDIX J: COWS AND FISH MEMBERS AND SUPPORTERS

Producers and Community Groups

Alberta Beef Producers

Trout Unlimited Canada

Canadian Cattlemen's Association

Alberta Agriculture and Rural Development

Alberta Environment

Alberta Sustainable Resource Development

Department of Fisheries and Oceans

Agriculture and Agri-Food Canada

Alberta Conservation Association

FUNDING ASSOCIATES:

Alberta Environmentally Sustainable Agriculture Program (AESA)