# 2009 Riparian Health Community Report

# - Nose Creek and West Nose Creek -

Alberta Riparian Habitat Management Society
(Cows and Fish)

April 2010

***Prepared for:***

Nose Creek Watershed Partnership

***Project Area:***

Nose Creek and West Nose Creek,
Rocky View County, Alberta
(between Airdrie and Crossfield)

***Prepared by*:**

Alberta Riparian Habitat Management Society
(Cows and Fish)
c/o Alberta Beef Producers Office
#320, 6715 8th Street NE
Calgary, Alberta, Canada
T2E 7H7
(403) 451-1182

***Writers***

Kathryn Hull and Amanda Halawell

***Contributors:***

Cameron Wood, Nicole Bach and Kathryn Romanchuk

***Suggested report citation:*** *Hull, K. and A. Halawell. 2009. 2009 Riparian Health Community Report for Nose Creek and West Nose Creek. Alberta Riparian Habitat Management Society (Cows and Fish). Calgary, Alberta.*

# TABLE OF CONTENTS

## *TABLES*



## *FIGURES*

## *APPENDICES*

## ***Acknowledgements***

A key to the success of this project was the interest, co-operation and hospitality demonstrated by landowners and municipalities in the Nose Creek and West Nose Creek project area, including the City of Airdrie and Rocky View County. Thank you to everyone who allowed access to their land and supported this riparian inventory initiative!

Funding support for this project was provided by the Nose Creek Watershed Partnership (NCWP) and members and supporters of the Alberta Riparian Habitat Management Society (Cows and Fish). Digital aerial photography and geographic information system (GIS) base mapping layers were provided by Rocky View County.

Special thank you to Erin McMahon (NCWP Coordinator), Tim Dietzler (Rocky View County, Agricultural Fieldman) and Chad Willms (Rocky View County, Municipal Ecologist) for assisting with the logistics, planning and coordination of this project.

## ***Disclaimer***

- *Any release of the information contained in this report, in whole or in part, to parties other than the members of the Nose Creek Watershed Partnership will not be the responsibility of Cows and Fish.* Liabilities with the release of this report or use of the information beyond the original intent of the work will be the responsibility of the Nose Creek Watershed Partnership.

- Due to Cows and Fish's commitment of confidentiality with the landowners who participated, detailed site specific information is not given for privately owned acreage properties. Only general findings, reflecting the overall state of riparian health are discussed for sites conducted within private acreage lot landholdings.

- This riparian health inventory did not evaluate any in-stream, hydrological (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts) or water quality parameters associated with Nose Creek and West Nose Creek.

- Only a limited number of sites were assessed (or re-assessed) along Nose Creek and West Nose Creek due to constraints of the project scope. Sites were strategically chosen based on priority monitoring objectives and landowner interest. Representative sampling was not conducted, and the results from this project can therefore <u>not</u> be extrapolated to reflect average riparian health conditions in the entire watershed.

## EXECUTIVE SUMMARY

Protection of riparian areas, riparian health monitoring, restoration of riparian vegetation, and promotion of local riparian stewardship are identified among the priority recommendations in the Nose Creek Watershed Water Management Plan. A baseline riparian health inventory of Nose Creek and West Nose Creek was first conducted by the Alberta Riparian Habitat Management Society (Cows and Fish) in 2000. This baseline inventory encompassed 17 km of Nose Creek and 11 km of West Nose Creek, representing a total of 36 riparian health inventory sites. Baseline assessments were done from the headwaters of these creeks to their downstream confluence in the City of Calgary.

In 2009, Cows and Fish again partnered with the Nose Creek Watershed Partnership (NCWP) and Rocky View County to monitor riparian health trends at four of the original baseline sites (including three Nose Creek sites in the City of Airdrie and the Town of Crossfield and one West Nose Creek site in Rocky View County). Three new sites in the headwaters region of West Nose Creek and a newly established Environmental Reserve along Nose Creek in the Williamstown subdivision of Airdrie were also assessed as part of this project. This riparian health monitoring project is aimed at continuing to build public awareness and promoting community-based riparian stewardship. In total 3.8 km was assessed along Nose Creek and 1.4 km was assessed along West Nose Creek.

Two of the three sites reassessed on Nose Creek have improved slightly in health, but remain in the same overall riparian health category. Tree and shrub plantings, streambank bioengineering, and natural recovery of vegetation cover have contributed to improved health ratings in these sites. Floodplain and streambank alterations from conversion of unused riparian habitat to a golf course have led to riparian health declines in the third site in Crossfield. The overall health of the three sites remains *healthy, but with problems* (<70%). Disturbance-adapted, non native species (primarily Kentucky bluegrass [*Poa pratensis*] and smooth brome [*Bromus inermis*]) have permanently altered the floodplain plant community of all three sites. Invasive species, in particular Canada thistle (*Cirsium arvense*) and smooth perennial sow-thistle (*Sonchus uliginosus*) remain prevalent in two of the sites and have increased in abundance in the golf course site. Low levels of scentless chamomile (*Matricaria perforata*) and a previously unrecorded species, yellow toadflax (*Linaria vulgaris*), occur in low amounts in two of the four sites. Despite the abundance of non-native species, native sedge communities remain intact along a large portion of streambank habitat along Nose Creek. Native woody plant communities, by comparison, remain scarce in all three sites and there is little sign of natural regeneration of native trees or shrubs. Landscaping and soil compaction due to frequent lawn mowing are the main alterations affecting the streambank and floodplain in most sites. Channelization and residential development have contributed to some loss of riparian habitat and function in the Willow Brook Park Site in Airdrie.

Of the 2009 inventory sites on Nose Creek, Nose Creek Park and the newly established Williamstown Environmental Reserve in Airdrie have the highest health ratings. These sites have a larger proportion of protected riparian habitat and higher integrity riparian plant communities. The wide, largely undisturbed floodplain in the Williamstown Reserve has a unique assemblage of saline tolerant native plant communities, indicating saline soil conditions. Riparian habitat in the Reserve provides excellent potential nesting habitat for a wide variety of waterfowl, shorebirds and migratory grassland nesting songbirds.

The 2009 West Nose Creek project area included three privately owned acreage lots in addition to the monitoring site on the Rocky View County Environmental Reserve. All four sites have higher average riparian health ratings than the Nose Creek sites, with most sites bordering on healthy conditions (i.e. >70%), and one site in the *healthy* category (>80%). These sites all have an excellent diversity and integrity of native riparian plant communities including well established sedge meadow and willow communities and naturally regenerating populations of aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*). Horse grazing and historic livestock use have contributed to soil compaction from trampling impacts and also to some encroachment of disturbance and invasive plants along the outer riparian fringe. Canada thistle and smooth perennial sow-thistle occur in all sites but only in drier edge habitats. No other invasive species were observed along West Nose Creek in 2009. None of the West Nose Creek sites have been channelized or otherwise developed for recreational, agricultural or other purposes. Beavers are active in the West Nose Creek valley and their damming activities have strongly influenced riparian ecology in all sites. The lush, fertile riparian soils in the broad valley bottom are a product of long-term historic beaver use in the valley. Two of the four sites have large ponds created by beaver dams along the main channel of the creek. Beaver ponds provide tremendous wildlife habitat value particularly for amphibians, shorebirds and waterfowl. These ponds also help to trap sediment, raise the water table, contribute to groundwater recharge and slow stream flows, lessening downstream erosion.

Other than roadway improvement impacts to a minor portion of the Rocky View County Environmental Reserve along West Nose Creek, the site has not changed notably since 2000. High integrity sedge and willow communities remain intact in the floodplain, although there has been some further encroachment of Canada thistle and smooth perennial sow-thistle. Increased invasive species cover has led to a slight decline in the vegetation health rating for this site. Soil / hydrology health trends cannot be assessed for this site due to changes in assessment methods since 2000 and lack of a defined stream channel in the site.

Riparian health reports were provided to all of the municipalities and landowners that participated in this project. These reports summarize riparian health scores and offer management suggestions for improving / maintaining riparian functions. Management suggestions are summarized in Section 6 of this report to help guide the NCWP in its efforts to support riparian stewardship initiatives in the watershed. A key recommendation is for the NCWP to continue to promote riparian area protection and to assist with efforts to restore native riparian plant communities, particularly weed monitoring and control and improved native tree and shrub cover in the Nose Creek Basin. A more comprehensive riparian health inventory of a larger proportion of the watershed is also suggested to better assess basin wide trends for both Nose and West Nose Creeks.

# 1 BACKGROUND

## *1.1 Introduction*

2000 Nose Creek Watershed, Riparian Health Evaluation

A comprehensive, baseline riparian health inventory of Nose Creek and West Nose Creek was conducted in 2000 by the Alberta Riparian Habitat Management Society (Cows and Fish) (Gerrand *et al.* 2001). As part of this project, approximately 17 km of stream distance was assessed along Nose Creek from its headwaters to the confluence with the Bow River. An additional approximately 11 km of stream distance was assessed along West Nose Creek from its headwaters to the confluence with Nose Creek. In all, 22 landowners participated in the project and a total of 36 sites (17 Nose Creek sites and 19 West Nose Creek sites) were evaluated. This baseline riparian health evaluation was funded by Alberta's Environmentally Sustainable Agriculture (A.E.S.A.) program, the Nose Creek Watershed Partnership (NCWP), Rocky View County (formerly known as the Municipal District of Rocky View), Alberta Environment and Cows and Fish partners. The intent of this project was to help create awareness among landowners and local communities about the value of riparian areas and riparian management issues and to promote improved, voluntary stewardship of riparian habitats in the Nose Creek watershed. Several awareness activities were held in conjunction with the project and all of the landowners that participated received riparian health summary reports for their property. These reports outlined the current status of riparian health and offered management suggestions and information resources to help improve or maintain riparian health.

2009 Riparian Health Monitoring

To assess progress toward improving riparian health in the watershed, the NCWP recently partnered again with Cows and Fish and Rocky View County to monitor changes in riparian health at select locations. In 2009, Cows and Fish re-evaluated riparian health of three of the original sites along Nose Creek and one site along West Nose Creek. Four new sites were also inventoried as part of this project near the headwaters of West Nose Creek and in a recently established Environmental Reserve along Nose Creek in the City of Airdrie. A comparison of the 2000 vs. 2009 riparian health data is discussed in Section 5 of this report.

With the exception of sites in the City of Calgary, this is the first attempt to re-evaluate riparian health along Nose and West Nose creeks since 2000. Two sites along West Nose Creek and four sites on Nose Creek were monitored in 2007 and 2008 as part of a three year riparian health inventory project in the City of Calgary, funded by Calgary Parks and Water Resources (Halawell and Hull 2008; Hull 2009). Benchmark photographic monitoring was also done at a selection of the original baseline sites in 2007 by Palliser Environmental Services Ltd. (Palliser Environmental Services Ltd. 2007a).

The intent of the 2009 riparian health inventory project is to continue to build public awareness about the current state of riparian health in the Nose Creek watershed. The project is also aimed at encouraging riparian stewardship efforts, particularly in the headwaters of West Nose Creek. The headwater region of West Nose Creek contains some of the healthiest portions of riparian habitat in the watershed.

### *1.2 What Is A Riparian Area?*

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

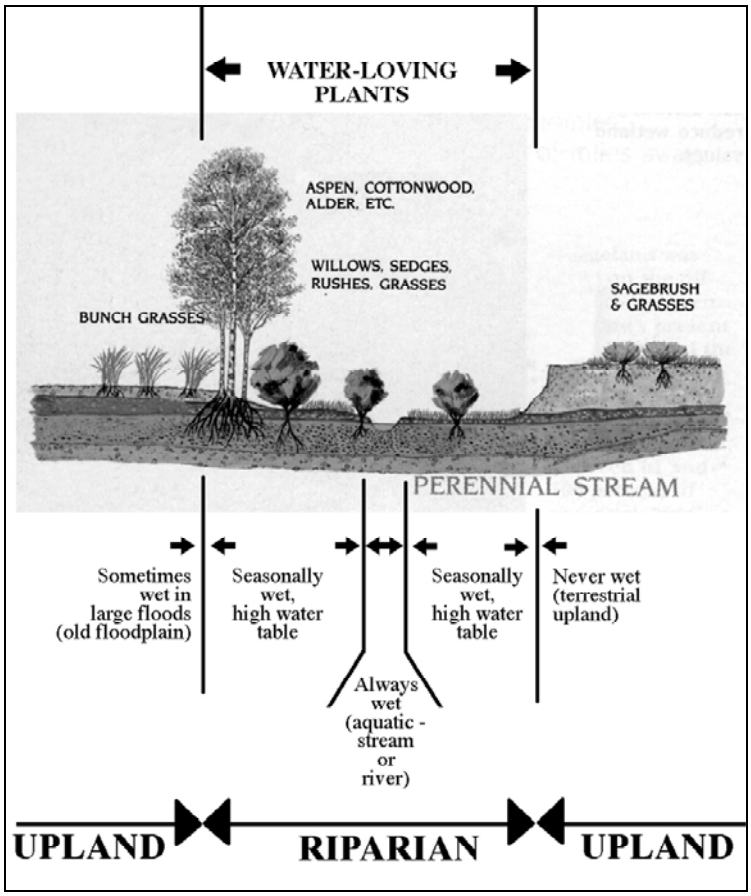



**Figure 1 Diagrammatic Representation of a Riparian Area**[1]

### *1.3 Why Are Healthy Riparian Areas Important?*

When in a properly functioning condition or *healthy* state, riparian areas are one of the most ecologically diverse ecosystems in the world. Healthy riparian areas recharge groundwater supplies; improve water quality through stormwater filtration and sediment capture; sustain vital habitat for fish and wildlife populations; and provide sustainable forage and shelter for livestock. Healthy riparian habitats provide good water quality and stable water supplies, and support people on the landscape. In doing so they play a role that is disproportionately important to the amount of area they encompass (approximately two to five percent of the landscape).

[1] Source: Fitch *et al.* 2001

### *1.4 Why Assess Riparian Health?*

Riparian protection is identified as an important priority in the Nose Creek Watershed Water Management Plan (Palliser Environmental Services Ltd. 2007b). This priority is based on the understanding that *"healthy riparian areas contribute to better water quality, stable streambanks, flood reduction and wildlife habitat in the Nose Creek Watershed"* (Palliser Environmental Services Ltd. 2007b, p. 25). Riparian setbacks and appropriate riparian management practices are recommended in the Plan in addition to ongoing awareness, education and riparian health monitoring.

The intent of riparian health inventories is to assist the NCWP, landowners and municipalities make the best decisions on how to manage riparian resources most effectively. In general, this information assists landowners and local communities to identify and develop non-legislated or voluntary action plans to address specific riparian land use issues within local watersheds.

Assessing riparian health allows communities, landowners and professionals to:

- **create awareness** amongst local producers and their communities and build common understanding on riparian management issues in their watersheds;
- **take action** by assisting local decision-makers develop strategies to find local solutions to address riparian land use issues;
- **monitor progress** in improving, maintaining and protecting riparian health for their landholding or watershed;
- **identify environmental risk** and integrate into land use planning;
- **develop and maintain** riparian management plans for long-term productivity and ecological health; and
- **establish** benchmarks of riparian health from which change over time can be measured.

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

Landowner engagement, West Nose Creek riparian awareness event, 2008

# 2 PROJECT AREA DESCRIPTION

## *2.1 Project Area*

The 2009 project area encompassed four sites along Nose Creek (three in the City of Airdrie and one in the Town of Crossfield) and four sites in the headwaters region of West Nose Creek in Rocky View County (Table 1, Figure 2). A total of 3.8 km was assessed along Nose Creek. Due to smaller landholdings, a shorter distance of 1.4 km was assessed along West Nose Creek (Table 1).

Nose Creek flows south from its origin northwest of the Town of Crossfield (near the northern edge of Rocky View County), through the City of Airdrie, joining the Bow River in the City of Calgary near the Calgary Zoo. Nose Creek is fed mainly by intermittent streams and groundwater sources near its headwaters. Urban and industrial development in the watershed has dramatically increased stormwater discharge volumes in Nose Creek compared to pre-development conditions. West Nose Creek is the main permanent tributary of Nose Creek. West Nose Creek originates northwest of Calgary, joining Nose Creek in Confluence Park near Deerfoot Trail (Queen Elizabeth II Highway) directly west of the Calgary International Airport. West Nose Creek is about 65 km in length and encompasses approximately 33% of the Nose Creek Watershed area (Palliser Environmental Services Ltd. 2007b).

**Table 1 Project Area Description**

| Year | Stream/ Waterbody | # Landowners Contacted | # Landowners Participated | # Riparian Inventories | Stream Distance Inventoried (km) |
|---|---|---|---|---|---|
| 2009 | Nose Creek | 3 | 3 | 4 | 3.8 |
| | West Nose Creek | 4 | 4 | 4 | 1.4 |

## *2.2 Site Selection*

Based on the objectives and resources of the NCWP, it was not possible to re-assess all 36 riparian health inventory sites originally evaluated in 2000 along Nose and West Nose Creeks. Since an extensive riparian health inventory project is ongoing in the City of Calgary, sites within Calgary were not evaluated as part of the NCWP 2009 project.

Except for a privately operated golf course site along Nose Creek, the remainder of sites selected for re-assessment were City-owned lands in the City of Airdrie and an Environmental Reserve in Rocky View County. New sites (not previously assessed in 2000) included a newly designated Environmental Reserve in Airdrie and three private acreage lots in the headwaters region of West Nose Creek. Privately owned sites were selected from a group of landowners that attended a riparian awareness event in 2008 and who expressed an interest in wanting to monitor and improve riparian health. The riparian awareness event was hosted by the NCWP, Rocky View County and Cows and Fish on a private acreage along West Nose Creek.

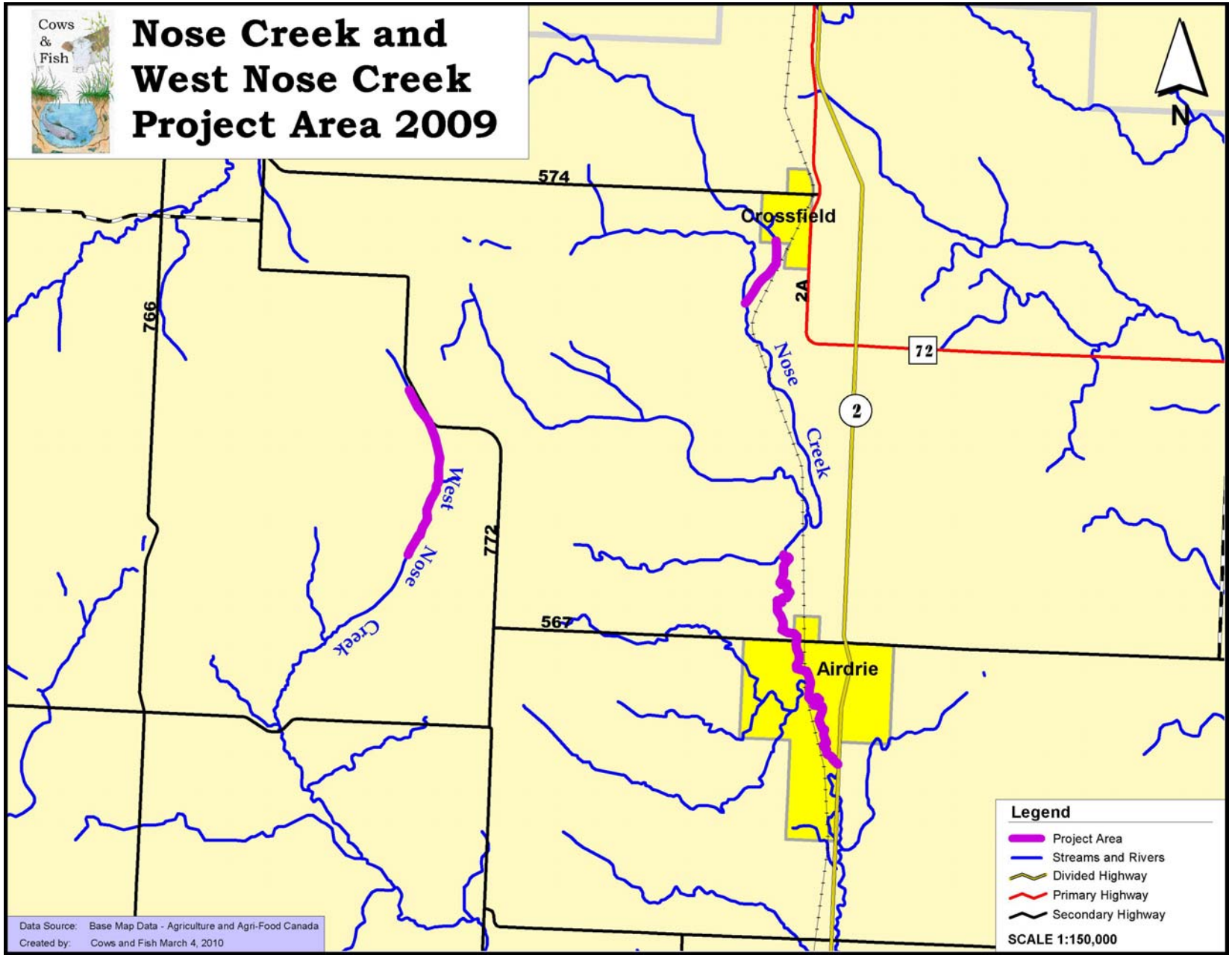



**Figure 2 Nose Creek and West Nose Creek Project Areas (2009)**

# 3 RIPARIAN HEALTH INVENTORY METHODS

## *3.1 Riparian Health Inventory*

A riparian health inventory measures key indicators that determine how well a riparian site is performing ecological functions (e.g. sediment trapping, water filtration, biological diversity and primary production). The riparian health evaluation methods used in this project were developed by Cows and Fish in collaboration with Dr. Paul Hansen and William Thompson (formerly of University of Montana's Riparian and Wetland Research Program), currently of Ecological Solutions Group LLC. These methods have become the provincial standard in Alberta and are endorsed by Alberta Sustainable Resource Development.

During a riparian health inventory, detailed information is collected about riparian vegetation and the physical characteristics of the site (i.e. soil and hydrology). Vegetation features examined include plant community types, plant species composition and canopy coverage, and the age class breakdown of woody species. Physical features assessed include a description of bank substrate, non-vegetated ground cover types, and a detailed breakdown of the causes of human-caused physical alterations. Riparian health inventories examine more than 70 parameters in total.

Riparian health parameters are visually assessed by trained observers in the field. A health rating is derived from this field data using a computer software program (FileMaker Pro). A hand-held Garmin GPS60$^{TM}$ Global Positioning System (GPS) receiver is used to record the locations of the upstream and downstream ends of the site. For monitoring purposes, benchmark photographs looking upstream and downstream are taken (or repeated) at each end of the site. Additional photographs are taken where warranted to document features of interest or concern (e.g., weed infestations, bank erosion etc.).

On streams and small rivers both sides of the waterbody are inventoried, provided there is the same ownership and type of management on both sides. Landmarks such as fence lines, tributaries or other identifiable features are used, where possible, to delineate the ends of the site in order to facilitate monitoring the same section of stream in the future. Inventory sites encompass a minimum of two meander cycles wherever possible. A complete meander cycle has equal inside and outside curvature.

## *3.2 Riparian Health Ratings*

Health ratings for streams and small rivers are determined by evaluating six vegetation health parameters and five soil/hydrology parameters (Table 2). Each of these parameters and how they are evaluated is described in Appendix I.

By objectively examining each of the health parameters listed in Table 2 we can gain a better understanding of where to concentrate management efforts to improve overall riparian health.

**Table 2 Vegetation and Soil/Hydrology Riparian Health Parameters for Streams**

| Riparian Health Parameter Description | |
|---|---|
| **Vegetation Parameters** | 1. Vegetation cover of the riparian area |
| | 2. Invasive plant species :<br>- Canopy cover<br>- Density distribution |
| | 3. Disturbance-caused undesirable herbaceous species |
| | 4. Preferred tree and shrub establishment and regeneration |
| | 5. Use of trees and shrubs:<br>- Wildlife browse<br>- Use other than browse (i.e. beaver cutting and / or human mowing or logging) |
| | 6. Amount of dead and decadent woody vegetation |
| **Soil / Hydrology Parameters** | 7. Streambank root mass protection |
| | 8. Human-caused bare ground |
| | 9. Streambank structural alterations |
| | 10. Structural alteration of the floodplain |
| | 11. Stream channel incisement |

*Note: Refer to Appendix I for a detailed description of each of these parameters and how they are assessed.*

Riparian health scores (ratings) are expressed as a percentage and a health category (healthy, healthy, but with problems, or unhealthy) (Table 3).

**Table 3 Description of Riparian Health Ratings**

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

### *3.3 What Makes a Riparian Area "Healthy"*

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

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

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

When riparian health degrades it usually means that one or more of the pieces has been impacted by natural or human-caused disturbances such as development, recreation, grazing, flooding or fire. As the rate and intensity of disturbance increases, the severity of health degradation can reach a point when the riparian area fails to perform its functions properly and becomes *unhealthy*. Riparian areas with moderate levels of impacts will typically fall within *the healthy, but with problems* category, while those with very few or no impacts will normally be rated as *healthy*.

### *3.4 Classification of Riparian Plant Communities*

The main stem of Nose Creek is located within the Foothills Fescue Sub-Region of the Grassland Natural Region. West Nose Creek is situated within the Central Parkland Sub-Region of the Parkland Natural Region (Natural Regions Committee 2006). Riparian plant community classifications developed by Thompson and Hansen (2002 and 2003) were used to classify riparian plant communities in the project area.

Riparian plant communities were classified according to "habitat types" and "community types" described by Thompson and Hansen (2002 and 2003). 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. Habitat types can otherwise be described as the "Potential Natural Community" (PNC) for a site. 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. Primary succession is the development of plant communities on newly created soil surfaces such as a newly deposited alluvial bar along a river. Secondary succession occurs on a site after a disturbance (such as a fire) alters or destroys established vegetation cover, but does not destroy the soil. Secondary succession can either occur toward or away from the climax PNC. For example, if livestock grazing disturbance

prevents tall shrubs from establishing, the understory of a forest can become dominated by disturbance-adapted non-native grasses like Kentucky bluegrass. This prevents a PNC from forming that would otherwise be dominated by tall and medium shrubs and have greater biodiversity and wildlife habitat value.

Understanding the type of riparian plant communities a riparian area has the potential to grow is important for a number of reasons. Firstly, it allows land managers to know if desired, productive and stable plant communities are present or if current land uses have altered the PNC. 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 much existing plant communities deviate from the PNC 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 may need to be implemented for improvement to occur or to maintain existing riparian health.

# 4 2009 RIPARIAN HEALTH RESULTS AND DISCUSSION

## *4.1 Nose Creek Overall Health Results*

In comparison to the West Nose Creek basin, the Nose Creek basin is much more heavily industrialized and developed. Nose Creek flows through the Town of Crossfield, the City of Airdrie and the City of Calgary and runs parallel to a major transportation corridor, Queen Elizabeth II Highway, as well as the Canadian Pacific railway line. Urban, commercial, industrial and more intensive agricultural development (cropland and ranching) in the Nose Creek valley has altered riparian areas, leading to degradation of riparian health and function. Cumulative land use alterations have also contributed to degraded water quality from direct and indirect inputs of fertilizers, pesticides, herbicides, fecal coliforms and sediment into the watercourse through stormwater outfalls and overland runoff. Long-term improvements to riparian health will help absorb and filter some of these pollutants and contribute to both improved aquatic and terrestrial wildlife habitat.

Health scores for the four sites assessed along Nose Creek in 2009, range from 53% (*unhealthy*) to 76% (*healthy, but with problems*); with an equal number of sites in each of these categories. Health scores are highest for the Nose Creek Park and Williamstown Environmental Reserve sites in Airdrie. These sites have greater integrity of riparian plant communities and a larger proportion of intact riparian habitat. Golf course and residential development (including channelization of Nose Creek through Willow Brook Park in Airdrie) has contributed to loss and alteration of riparian habitat in the remainder of the 2009 project area.

In 2000, of the 17 sites evaluated along Nose Creek, 65% were rated as *unhealthy*, 23% rated *healthy, but with problems*, and 12% rated *healthy* (Gerrand *et al.* 2001). Only three of these sites were revisited in 2009 (see Section 5 for a discussion of monitoring results). More comprehensive long-term monitoring is needed to assess trends on a larger scale.

### *4.2 Nose Creek Vegetation Health*

The average vegetation health rating of the four Nose Creek (2009) sites is *healthy, but with problems* (68%). Figure 3, below, shows the health score breakdown for each of the six vegetation parameters assessed. Key vegetation health concerns relate to invasive species cover, prevalence of disturbance-caused species, and a general scarcity of native riparian trees and shrubs and woody plant communities.

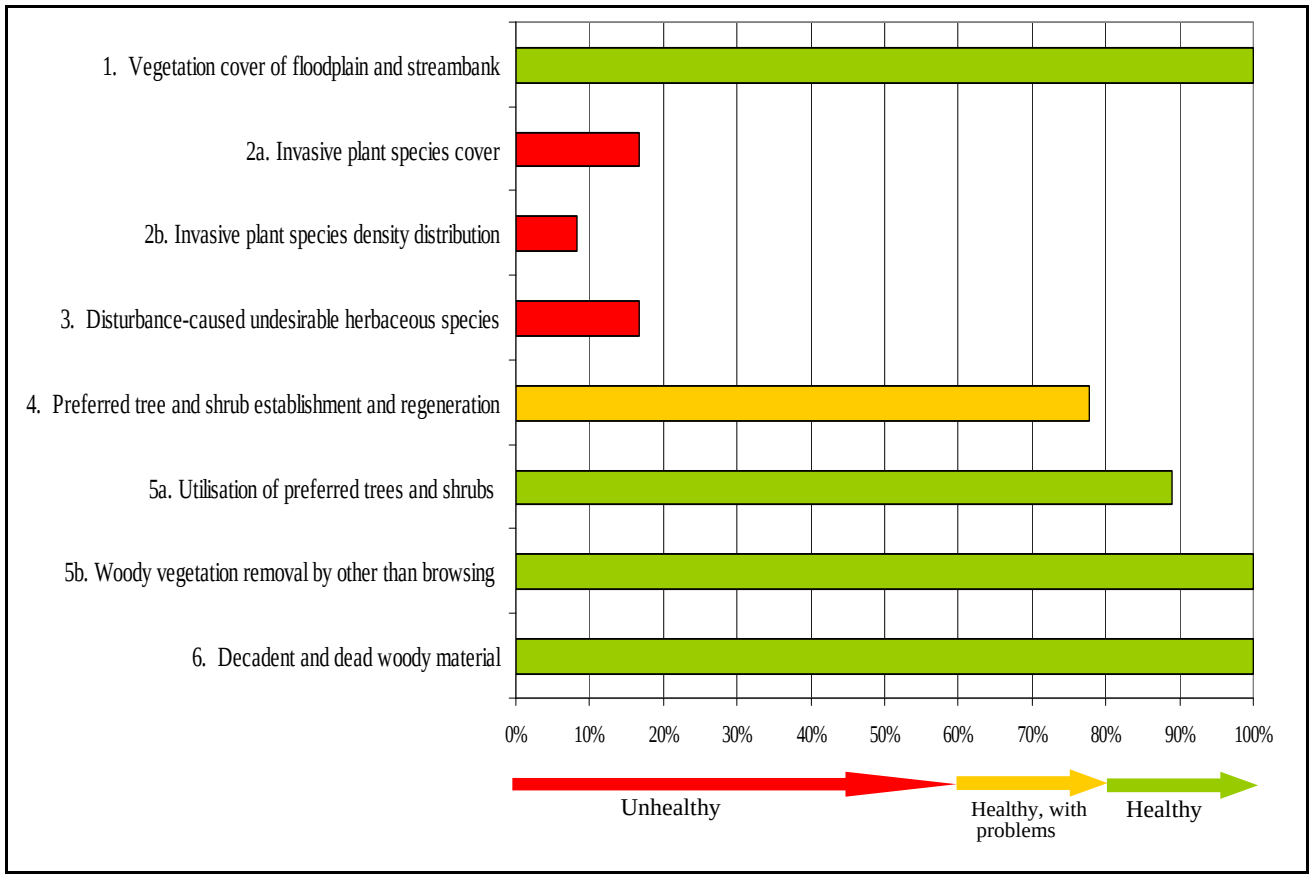



**Figure 3 Nose Creek: Vegetation Parameter Health Ratings**

#### *4.2.1 Riparian Plant Communities*

Vegetation health is largely determined by the extent to which existing plant communities on a site differ from the potential natural communities expected for that site. Historical agricultural activities (i.e. livestock grazing) and more recent urban and commercial land uses have contributed to either directly or indirectly altering riparian plant communities in the Nose Creek project area. In comparison to less impacted headwater reaches of Nose Creek, the sites we assessed had substantially reduced occurrence of riparian tree and shrub communities. In most instances (except where salinity is a factor) this is likely due to human land use pressures. None of the sites evaluated in 2009 have native riparian tree communities. Although some native tree species have been planted in urban parks, tree cover is largely sparse overall. Native shrub communities occupy only a very small proportion of the project area (4.4%) (Table 4).

**Table 4 Nose Creek Riparian Plant Communities**

| Plant Community* | Classification | Number of Sites Where Found | Area Occupied | Percentage of the Project Area (%) |
|---|---|---|---|---|
| ***Shrub Communities*** | | | | |
| beaked willow / awned sedge | Habitat Type | 1 | 0.1 ha (0.2 ac) | 0.2 |
| beaked willow | Community Type | 1 | 0.04 ha (0.09 ac) | 0.1 |
| buckbrush (snowberry) | Community Type | 2 | 1.7 ha (4.1 ac) | 4.1 |
| ***Total Area Occupied By Shrub Communities*** | | | | ***4.4*** |
| ***Grass / Grass-Like Communities*** | | | | |
| awned sedge | Habitat Type | 2 | 0.9 ha (2.2 ac) | 2.3 |
| Kentucky bluegrass | Community Type | 2 | 5.9 ha (14.4 ac) | 14.5 |
| Nuttall's salt-meadow grass | Habitat Type | 1 | 8.9 ha (21.9 ac) | 22.0 |
| reed canary grass | Habitat Type | 1 | 0.7 ha (1.8 ac) | 1.8 |
| smooth brome | Community Type | 2 | 2.6 ha (6.2 ac) | 6.3 |
| three-square rush | Habitat Type | 1 | 0.9 ha (2.2 ac) | 2.2 |
| tufted hair grass | Habitat Type | 1 | 0.9 ha (2.2 ac) | 2.2 |
| water sedge | Habitat Type | 2 | 3.8 ha (9.2 ac) | 9.3 |
| wire rush | Community Type | 2 | 9.2 ha (22.4 ac) | 22.6 |
| ***Total Area Occupied By Grass / Grass-Like Communities*** | | | | ***83.2*** |
| ***Forb Communities*** | | | | |
| common cattail | Habitat Type | 3 | 0.5 ha (1.2 ac) | 1.2 |
| ***Unclassified Communities*** | | | | |
| unclassified wetland types | Community Type | 4 | 4.9 ha (11.9 ac) | 12.0 |

**Based on Thompson and Hansen 2002 and 2003; refer to Appendices C and D for plant species scientific names.*

Buckbrush (*Symphoricarpos occidentalis*) is the main shrub community type. Buckbrush has poor forage value and palatability and spreads by seed and vegetative reproduction (i.e. suckers). These traits make it resistant to heavy grazing pressure and allow it to increase in cover even in disturbed areas. Beaked willow (*Salix bebbiana*) communities are fairly scarce in the project area. Historically, heavy cattle, sheep or horse use may have contributed to reduced willow abundance. Willows have higher nutritional value and are much more palatable to all classes of livestock, making them susceptible to over-utilisation. Land clearing in urban centres and in golf courses has also contributed to reduced abundance of willows and other preferred native shrubs. Long-term browse pressure and direct removal of native tree and shrub cover reduces streambank and floodplain stability and detracts from fish and wildlife habitat availability.

The majority of the 2009 Nose Creek project area is comprised of grass / grass-like plant communities (Table 4). With the exception of the site in the Williamstown Environmental Reserve in Airdrie, the floodplain of most sites is dominated by non-native grasses (i.e. Kentucky bluegrass and smooth brome) (***Photo a***, page 13). These introduced grass species

were historically seeded as hay crops in and adjacent to riparian areas or they have encroached into riparian areas from adjacent urban and agricultural lands. These grasses are also commonly used in lawn seed mixes and for road ditch reclamation. They spread rapidly by rhizomes and aggressively out-compete native grasses in moist, non-saline habitats. In saline habitats, such as the lower floodplain of the Williamstown Environmental Reserve, native grasses have retained their dominance. The Williamstown Reserve lower floodplain has a unique mix of saline tolerant plant communities (primarily Nuttall's salt-meadow grass [*Puccinellia nuttalliana*] and wire rush [*Juncus balticus*]) (***Photo b***, page 13). Kentucky bluegrass communities are limited to higher terraces along the outer periphery of this Reserve.

Despite having altered floodplain communities, most sites in the project area have a good diversity of native sedge and wire rush communities directly along the streambank or in natural seepage areas (***Photos c and d***, page 13). Deeply rooted sedges such as water sedge (*Carex aquatilis*) and awned sedge (*Carex atherodes*) provide especially good erosion protection and improve bank stability (***Photo c***, page 13). Reed canary grass (*Phalaris arundinacea*) is also good at providing streambank protection and overhanging vegetation cover; however, this perennial rhizomatous grass typically outcompetes and shades out other grasses, reducing the biodiversity value of streambank habitat (Stannard and Crowder 2001). Although reed canary grass is considered native to parts of Alberta, aggressive introduced varieties are common in the Calgary region. Reed canary grass is a dominant community type in only one of the sites we assessed (the golf course site). Fertilizer runoff from adjacent golf course fairways may explain the abundance of reed canary grass in this site since this grass species thrives in nutrient rich soils and requires high amounts of nutrients to sustain growth (Stannard and Crowder 2001). Reed canary grass is a good runoff filter, reducing nutrient loading into Nose Creek. Cutting and removal of biomass is needed for good nutrient uptake performance. A six to eight inch cut height is recommended for rapid re-growth to maximize nutrient uptake by this species (Stannard and Crowder 2001).

Stormwater outfalls and unnaturally high runoff volumes contribute to widening and deepening portions of the Nose Creek channel. While this diminishes ecological function, it creates ideal micro-habitats for common cattail (*Typha latifolia*) to establish. Localized patches of cattail habitat occur in three of the sites, mostly in proximity to stormwater outfalls. Cattail is otherwise uncommon along upper reaches of Nose Creek except in proximity to beaver ponds.

Approximately 12% of the Nose Creek project area is comprised of unclassified plant communities (Table 4). These mainly represent disturbance type communities that have not yet been described for natural systems by Thompson and Hansen (2002 and 2003) in either the Parkland or Grassland Natural Regions. Unclassified communities in the project area are dominated by invasive weeds such as Canada thistle and smooth perennial sow-thistle and a mix of non-native grasses (e.g. quack grass [*Agropyron repens*], Kentucky bluegrass and smooth brome). These plant species assemblages are typical of disturbed sites in an urban setting. One exception is a narrow-leaved bur-reed (*Sparganium angustifolium*) community along receding portions of the channel bottom in the Williamstown Environmental Reserve. This community type seems to be quite unique to that reach of Nose Creek, possibly due again to higher salinity.

**Photo a:** Kentucky bluegrass and smooth brome communities dominate the floodplain along much of Nose Creek, particularly in former agricultural fields, golf courses and urban parks. (*Photographer: K. Romanchuk, Catalogue Number: RHIP15NOS021*).

**Photo b:** The lower floodplain of the Williamstown Environmental Reserve in Airdrie is characterized by saline tolerant plant communities dominated by Nuttall's salt-meadow grass, salt grass, wire rush and foxtail barley (*Photographer: K. Hull, Catalogue Number: RHIP22NOS002*).

**Photo c:** Deeply rooted native sedges provide excellent streambank stability and erosion protection. Sedge communities are well established along banks in the majority of the Nose Creek project area. (*Photographer: K. Hull, Catalogue Number: RHIP22NOS006*).

**Photo d:** Seepage areas along this portion of Nose Creek in Airdrie contain remnant native sedge and rush communities. (*Photographer: K. Hull, Catalogue Number: RHIP17NOS027*).

### *4.2.2 Woody Plants - Trees and Shrubs: Presence, Reproduction and Health*

- *Presence*

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides low, medium, and tall habitat layers for wildlife. Studies have found that breeding bird diversity and abundance are influenced by the presence of denser and more diverse vegetation (Palliser Environmental Services Ltd. 2008, Saunders and Hurly 2000a, Saunders and Hurly 2000b). Overhanging tree and shrub cover also offers shade, a source of food and sheltering habitat for fish. Another benefit of having a diversity of native trees and shrubs is improved bank stability associated with having a wider range of rooting depths.

- Eight tree species (six of which are native[2]) and 12 shrub species (10 of which are native) were recorded in the Nose Creek 2009 project area (Appendix C).
- Trees only account for a trace amount of cover in the project area (less than 0.5%).
- Shrubs cover almost 6% of the project area.

Nearly all of the tree species observed were intentionally planted in Airdrie parks. Although many of these planted species are native to Alberta, species such as white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), tamarack (*Larix laricina*) and Manitoba maple (*Acer negundo*) do not naturally occur in the Nose Creek basin. As mentioned, tree cover is presently quite scarce in the basin, but historically it may have been much higher. Naturally occurring tree communities, primarily aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*), can be found along the upper most reaches of Nose Creek.

Shrub cover in the project area is dominated primarily by buckbrush and native rose species (including common wild rose [*Rosa woodsii*] and prickly rose [*Rosa acicularis*]). As discussed, these shrubs are resilient to livestock and wildlife browse pressure and spread fairly rapidly by suckering. These characteristics enable these shrubs to thrive even in less healthy, more intensively used or disturbed riparian areas. Rose and buckbrush tend to be more shallowly rooted than species such as willows and red-osier dogwood (*Cornus stolonifera*), making them of less value for streambank stabilisation. Beaked willow and intentionally planted populations of shining willow (*Salix lucida*) represent better indicators of riparian health. These species, although more abundant than other preferred native shrubs, are relatively scarce in the project area (less than 5% canopy cover). Soil and moisture conditions in the basin could potentially support much more substantive willow communities. Intentionally planting and / or promoting natural recovery of willows and other preferred native shrubs (e.g. Saskatoon [*Amelanchier alnifolia*] and choke cherry [*Prunus virginiana*]) would benefit riparian health.

[2] This total includes Manitoba maple that is native to parts of eastern Alberta but that has been intentionally planted in the Nose Creek project area.

➢ *Reproduction*

A good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young age classes. To maintain age class structure, at least 15% of the total cover of **preferred**[3] trees and shrubs should be comprised of seedlings and saplings[4].

- All sites have potential to support preferred trees and shrubs with the exception of the Williamstown Environmental Reserve. Saline soil conditions in the Williamstown Reserve limits woody plant establishment.
- There is a scarcity of naturally occurring preferred tree and shrub seedlings / saplings in the project area as a whole.
- Although the Nose Creek Park and Willow Brook Park sites in Airdrie received 'healthy' scores for this parameter, neither of these sites have naturally occurring regeneration, and both sites have low total cover of preferred woody plants. Native conifer seedlings planted in these parks are not ideally suited to the soil or moisture conditions in the Nose Creek basin. Intentional plantings are beneficial for improving riparian health, but better suited locally adapted trees and shrubs should be used where possible.

➢ *Health*

Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy. All sites rated healthy for this parameter (i.e. less than 5% of the total canopy cover of woody species is decadent and / or dead). This indicates there is sufficient moisture within the system, and that disease is not a problem in maintaining these communities. Livestock and wildlife browse (utilisation) is presently minimal or absent in all sites we assessed. Historical livestock use may have been a factor in reducing woody plant cover in the Williamstown Environmental Reserve, but the other urban sites have not been grazed by livestock for at least the past 10 years. Wild deer populations make occasional use of Nose Creek through Airdrie and Crossfield, although they tend to avoid busier urban parks. Deer reportedly travel through the golf course on the outskirts of Crossfield fairly frequently.

It is difficult to assess the degree to which native tree and shrub vegetation has been mechanically removed by logging or mowing in the project area. There may have been some historical clearing of woody vegetation, but reduced woody cover may also be due to historic livestock use (more than 10 years ago). Lawns are being actively maintained in three of the sites we assessed which may contribute to reduced potential for natural establishment of woody plant seedlings. Except for some recent clearing of willows in the Willow Brook Park site, there is no other recent evidence of human clearing of woody vegetation.

[3] Not all trees and shrubs are equally important, useful or desirable for maintaining ecological function. Only those that contribute most beneficially to riparian condition and stability (e.g. native willows, red-osier dogwood and saskatoon) are considered in evaluating establishment and regeneration. Aggressive, grazing resistant species such as buckbrush and rose are not evaluated for regeneration since they tend to thrive even in heavily disturbed sites.

[4] When assessing this parameter for the Calgary area only poplar regeneration from seed (as opposed to asexual regeneration from root sprouts) is counted. Plants installed by human plantings are counted but only if they are successfully established (i.e. if they have survived at least one complete growing season on the site).

Possibly due to the scarcity of woody plants, none of the sites have recent sign of beaver use. Sign of inactive beaver use (i.e. old chewed stems and washed out dams) was apparent in both of the Airdrie park sites. Beavers are a long-standing natural component of the Nose Creek ecosystem. Beaver populations occur in upper reaches of Nose Creek and in the City of Calgary. Beavers will likely re-colonise the 2009 project area if woody plant availability increases. Wiring mature tree stems and caging new plantings are simple mitigations to prevent against unwanted beaver damage until woody plant cover increases to sustainable levels. Healthy woody plant communities are adapted to withstand low to moderate amounts of beaver use.

### *4.2.3 Non-Woody Plants: Diversity and Health*

- *Diversity*

Herbaceous plants, particularly native species, provide nectar and food sources for wildlife. The diversity of native species serves as a biodiversity indicator and signals greater ecosystem integrity. Native grasses and deeply rooted sedges and rushes also contribute to site and bank stability.

- 36 species of grasses and grass-like plants and 77 species of broad-leaved plants (forbs) were recorded in the project area (Appendix C).
- 67% (i.e. 76 species) of these non-woody plants are native species.

- *Health*

Disturbance-caused undesirable herbaceous species and invasive herbaceous species are prevalent in the project area. Disturbance-caused plants are shallow-rooted, fast spreading plants like common dandelion and Kentucky bluegrass (the main grass used for lawns). Invasive herbaceous plants are those listed by the *Weed Control Act of Alberta* as **restricted** or **noxious** weeds. They are non-native species that spread rapidly and are difficult to control. Both disturbance and invasive species tend to have limited value for bank binding, erosion prevention and wildlife habitat.

- **Disturbance-caused undesirable herbaceous plants (primarily Kentucky bluegrass) are prevalent** in the floodplain of the golf course site and the two urban parks in Airdrie. The Williamstown Environmental Reserve in Airdrie is the only site with less than 25% cover from disturbance plants. Agricultural land use, transportation corridors and urban development has increased the spread of introduced disturbance species in the Nose Creek watershed. Saline conditions have helped limit their spread in the Williamstown Environmental Reserve. Native plant communities are intact and disturbance plants are presently not a significant concern in the Reserve except in higher floodplain terraces along its outer edge.

- A total of 17 disturbance-caused plant species were identified, including six grass and 11 forb species (Appendix C). Most of these species are introduced with the exception of two native early successional or disturbance adapted species, foxtail barley (*Hordeum jubatum*) and silverweed (*Potentilla anserina*). The most prevalent non-native disturbance species are Kentucky bluegrass, smooth brome, quack grass,

common dandelion, lamb's quarters (*Chenopodium album*) and white clover (*Trifolium repens*).

- **The prevalence of invasive plants is a concern.** Cumulatively, the canopy coverage of invasive species is about 7% of the project area. Four invasive forbs were recorded in the project area (Appendix C). These species are listed here in order of relative abundance: Canada thistle (occurs in all sites), smooth perennial sow-thistle (occurs in all sites), scentless chamomile (*Matricaria perforata*) (occurs in both of the Airdrie sites), and yellow toadflax (otherwise called 'butter-and-eggs') (*Linaria vulgaris*) (occurs in two sites, in Airdrie and Crossfield).

- Invasive plants were recorded in all of the sites. Canada thistle (*Photo e*) and secondarily smooth perennial sow-thistle are most abundant and widespread in the project area. Ongoing weed monitoring and control will help reduce and prevent further spread of these species. Invasive weeds encroach quickly into areas of natural or human caused bare ground such as disturbed berms resulting from construction activities (*Photo f* ).

*Photographer: K. Hull, Catalogue Number:RHIP04NOS021*

**Photo e:** A large Canada thistle infestation near a stormwater outfall at the downstream end of the Nose Creek Park site in Airdrie.

*Photographer: K. Hull, Catalogue Number: RHIP17NOS019*

**Photo f:** This disturbed berm adjacent to a recently channelized stretch of Nose Creek in Willow Brook Park in Airdrie is infested with Canada thistle and a large population of scentless chamomile.

### *4.3 Nose Creek Soil and Hydrology Health*

The 2009 Nose Creek sites received an overall soil / hydrology health rating of 63% (*healthy, but with problems*). With the exception of human-caused bare ground, the remainder of soil / hydrology parameters rated as either *unhealthy* or *healthy, but with problems* (Figure 4). Landscaping (including berms) and soil compaction associated with lawn mowing are the main alterations affecting the streambank and floodplain in most sites.

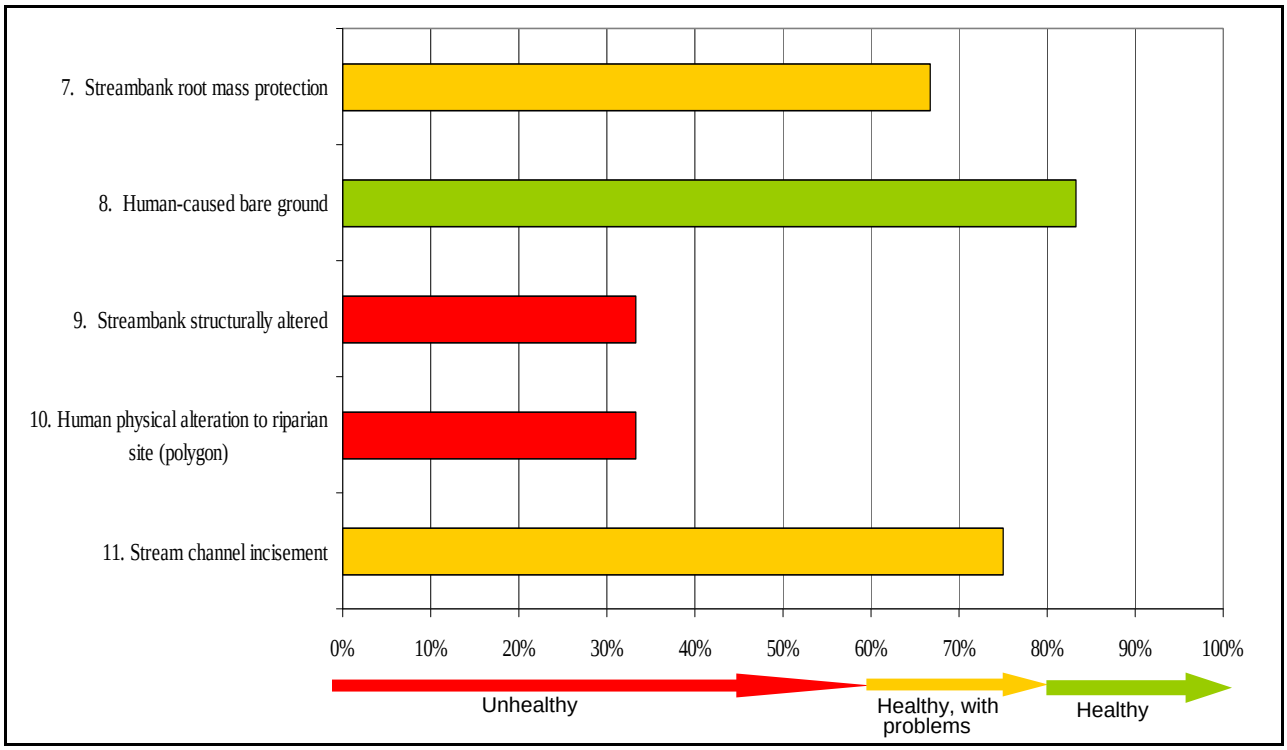



**Figure 4 Nose Creek: Soil / Hydrology Parameter Health Ratings**

#### *4.3.1 Streambank Stability and Root Mass Protection*

The role of streambank vegetation is to maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. Erosion rates are considered normal if unstable banks are occasional, limited to a few outside meander bends, and the banks revegetate within a year.

When assessing root mass protection along a small stream such as Nose Creek, the bank and a band extending back at least 2 m from the bank top is evaluated. Ideally, more than 85% of the streambank should be covered by vegetation with deep binding roots to adequately protect streambanks from excessive erosion and to protect fish habitat. Sedges and rushes generally provide good rootmass protection to small stream systems such as Nose Creek. Additional reinforcement from deep rooted native shrubs (e.g. willows and red-osier dogwood) may be needed along urbanized parts of Nose Creek with higher than normal erosive forces from elevated stormwater runoff rates. Urban land development practices can generate five to 100 times more runoff compared to predevelopment conditions (Palliser Environmental Services

Ltd. 2007b). Some of the contributing factors leading to higher stormwater flows include increased impervious surface coverage, soil grading and compaction, draining and / or infilling of wetlands, and removal of native vegetation (Palliser Environmental Services Ltd. 2007b). Increased channel erosion, higher pollutant loads and adverse impacts on aquatic species are some of the consequences of accelerated and elevated stormwater inputs.

- Two of the four sites in the project area have healthy levels of streambank root mass protection, mainly from deeply rooted native sedges and rushes. This includes the Nose Creek Park site and the Williamstown Environmental Reserve site in Airdrie. Despite healthy ratings at present, additional root mass protection from native shrubs may be needed to reinforce portions of these reaches downstream from stormwater outlets. Bioengineering using live willow stakes and wattle fences has helped reinforce a portion of the Nose Creek Park site damaged by stormwater erosion in 2005 (***Photo g***, page 20). This bioengineering project near the Main Street bridge crossing was coordinated by the NCWP.

- The golf course site and Willow Brook Park in Airdrie have 35% to 65% deep binding root mass protection along their banks (i.e. unhealthy levels). Shallow-rooted disturbance grasses such as Kentucky bluegrass are fairly prevalent along these reaches. This compromises bank stability and decreases fish and wildlife habitat value along the bank.

### *4.3.2 Human-Caused Bare Ground*

Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Bare ground in riparian areas is often attributed to natural processes (e.g. sediment deposition from recent flood events). Bare ground can also result from activities like vehicle traffic, recreational trails, timber harvest, and landscaping. In healthy systems, natural areas of bare ground typically do not remain unvegetated for long and there is a greater potential for native species to successfully re-colonize these exposed areas. Areas of human-caused bare ground, by contrast, tend to be more prone to weedy species encroachment and often remain unvegetated for longer periods unless the area is managed differently. This increases erosion potential and sediment inputs into the stream.

- Most sites have minimal (i.e. less than 5%) or only trace amounts (i.e. less than 1%) of human-caused bare ground.

- Human-caused bare ground in the project area is mainly attributable to recent construction activities associated with berms, stormwater outfall structures, or pedestrian pathways and / or foot bridges (***Photo h***, page 20). Only a trace amount of bare ground is from recreational impacts such as undesignated trails (from bikes, people or dogs). A small amount of human-caused bare ground has also resulted form erosion of culvert crossings (***Photo i,*** page 20) and from sandpit developments in the golfcourse fairways. Most areas of human-caused bare ground have the potential to recover fairly rapidly with appropriate restoration strategies. Bare ground in Airdrie parks may need to be restored using native shrub and graminoid plantings. There is greater potential for localized areas of bare ground in the Williamstown Environmental Reserve site to naturally recover since native plant communities are well established in this site (***Photo h***, page 20).

**Photo g:** Live willow cuttings and wattle fences were installed along this eroded bank in 2006 as part of a soil bioengineering workshop. This portion of bank is located adjacent to a stormwater outfall at the downstream end of Nose Creek Park in Airdrie. (*Photographer: K. Hull, Catalogue Number: RHIP04NOS020*).

**Photo h:** Bare ground adjacent to recently constructed paved trails in the Williamstown Reserve has been seeded with a native seed mix, but it also has good potential for natural recovery. (*Photographer: K. Hull, Catalogue Number: RHIP22NOS012*).

**Photo i:** Bare ground has resulted from erosion of this culvert crossing in the golf course site. Soil compaction and landscaping due to fairway developments have caused streambank and floodplain alterations. (*Photographer: K. Romanchuk, Catalogue Number: RHIP15NOS023*).

**Photo j:** Deeply rooted native sedges are providing good root mass protection along this stretch of Nose Creek in Nose Creek Park; however landscaping and mowing have caused soil compaction in the floodplain. (*Photographer: K. Hull, Catalogue Number: RHIP04NOS028*).

**Photo k:** Residual trampling impacts from historic livestock use are still apparent along the streambank in the Williamstown Environmental Reserve. (*Photographer: K. Hull*).

**Photo l:** Channelization of Nose Creek in Willow Brook Park in Airdrie has caused loss of riparian habitat and may lead to higher downstream erosion. (*Photographer: K. Hull, Catalogue Number: RHIP17NOS018*).

### *4.3.3 Alterations to the Streambank and Floodplain*

When streambanks are physically altered, the system may become unstable. Erosion can increase and mobilize channel and bank materials and water quality can deteriorate. Moist, fine-textured riparian soil is especially susceptible to erosion and compaction from human related activities. Soil compaction reduces the water-holding abilities of riparian soil and consequently impacts water storage and aquifer recharge. This can in turn affect filtration, nutrient uptake, floodplain maintenance and primary productivity.

- Approximately 22% of the length of the streambank inventoried has alterations. These alterations are mainly due to channelization / berming (***Photo l***, page 20); landscaping and mowing within 2 m of the water's edge (***Photo i***, page 20**)**; historic livestock trampling impacts (***Photo k***, page 20); bridge and culvert crossings; and stormwater outfall structures and rip-rap. Only a minor portion of the streambank (0.1%) has been directly impacted by undesignated recreational trails. Streambank alterations contribute to soil compaction, increased erosion potential and loss of riparian fish habitat.
- Streambank alterations range from severe (i.e. >35% of bank length altered) for the Willow Brook Park site to slight (i.e. 5 to 15% of bank length altered) for the Nose Creek Park site. Alterations for the other two sites are moderate (i.e. 15% to 35% of bank length altered). Berms adjacent to the storm pond and channelization of the upstream half of Nose Creek have resulted in permanent physical alterations to the Willow Brook Park site. These alterations have removed riparian habitat, constricted the width of accessible floodplain, and permanently altered the topography of the site. By comparison, mowing and remnant livestock trampling alterations have greater potential for natural recovery if these sites are managed appropriately to maintain an undisturbed buffer along the bank.
- Approximately 17% of the project area has human-caused alterations in the floodplain. Floodplain alterations have resulted mainly from landscaping and mowing (***Photo j***, page 20), paved trails, and removal of natural vegetation in the urban park and golf course sites. Berming and channelization of Nose Creek through Airdrie also impacts a portion of the floodplain. A pre-existing dugout and newly constructed paved trails and stormwater infrastructure has structurally altered a small portion of the Williamstown Environmental Reserve site.
- Reduced amounts of maintained lawn in the floodplain and restoration of native vegetation in landscaped areas will help alleviate soil compaction and improve water filtration and water infiltration capacity.

### *4.3.4 Stream Channel Incisement*

Channel incisement (or downcutting) refers to the downward erosion of the channel bottom. This can result from increased stormwater flow directed to the creek, removal of deep-rooted plants along the streambank, mechanical channelization (straightening and deepening of the stream channel), or from improperly sized culverts which constrict and increase the erosive force of floodwater. Downward erosion deepens the channel, reducing the ability of floodwater to spill over the banks. Periodic flood events are needed to disperse moisture throughout the riparian area for the maintenance of riparian vegetation. Flooding also reduces erosion downstream by spreading the energy of moving water over the floodplain, allowing sediment to be deposited and creating new areas for seedling establishment.

- Nose Creek is not incised through the golf course site or the Williamstown Environmental Reserve. Floodwaters can easily access a wide floodplain in both of these sites, helping to recharge shallow groundwater and maintain productive riparian habitat. Channel incisement may result in the future from upstream development if adequate riparian setbacks and are not implemented in upstream reaches of Nose Creek. Watershed management of stormwater inputs using low impact development techniques is another consideration to minimize potential for future channel incisement.

- Channelization of Nose Creek through the upstream end of Willow Brook Park has contributed to deepening the channel, creating a moderate degree of channel incisement. Berms constructed adjacent to the creek also effectively reduce the amount of floodplain habitat that is accessible to floodwaters.

- The Nose Creek Park site is slightly incised. Slight incisement here is mainly due to the influence of stormwater outfalls and the erosive potential of elevated bursts of stormwater inputs from an urbanized landscape.

### *4.4 West Nose Creek Overall Health Results*

Outside of the City of Calgary, agriculture (cropland and ranching) remains the dominant land use in the West Nose Creek basin. City of Calgary expansion and increased acreage lot developments may lead to reduced agricultural production in the basin in the future. These trends have been observed since 2000. Many existing acreage developments along West Nose Creek have single family homes and are used for pasturing horses.

Less intensive land uses in the West Nose Creek basin correlate with higher average riparian health ratings for this system. In 2000, of the 19 sites assessed, 16% were rated as *healthy*, 63% were rated as *healthy, but with problems*, and 21% were rated as *unhealthy*. Only one of these sites was reassessed in 2009 (refer to Section 5.3). As with the Nose Creek basin, more comprehensive long-term monitoring is needed to assess trends on a larger scale.

In 2009, three of the four sites assessed along West Nose Creek rated as *healthy, but with problems*. One site rated as *healthy*. The average health score for these four sites is 74% (*healthy, but with problems*). For the most part these sites all have well functioning riparian habitat and good integrity of native riparian plant communities. Horse grazing is the main land use in all of the sites we assessed. Horse use has contributed to soil compaction in the floodplain and also to weedy species encroachment, but native vegetation cover provides excellent streambank stability and erosion protection in all sites. None of the sites have been developed, channelized or otherwise modified for recreational or industrial purposes.

### *4.5 West Nose Creek Vegetation Health*

The average vegetation health of the four West Nose Creek (2009) sites is *healthy, but with problems* (73%). All of the parameters related to the health of the woody plant community rated as *healthy* except for browse pressure from wildlife and livestock (Figure 5). Similar to Nose Creek, there are concerns with invasive and disturbance-caused species. However, weedy species are less abundant in the West Nose Creek sites and there are fewer types of invasive species present.

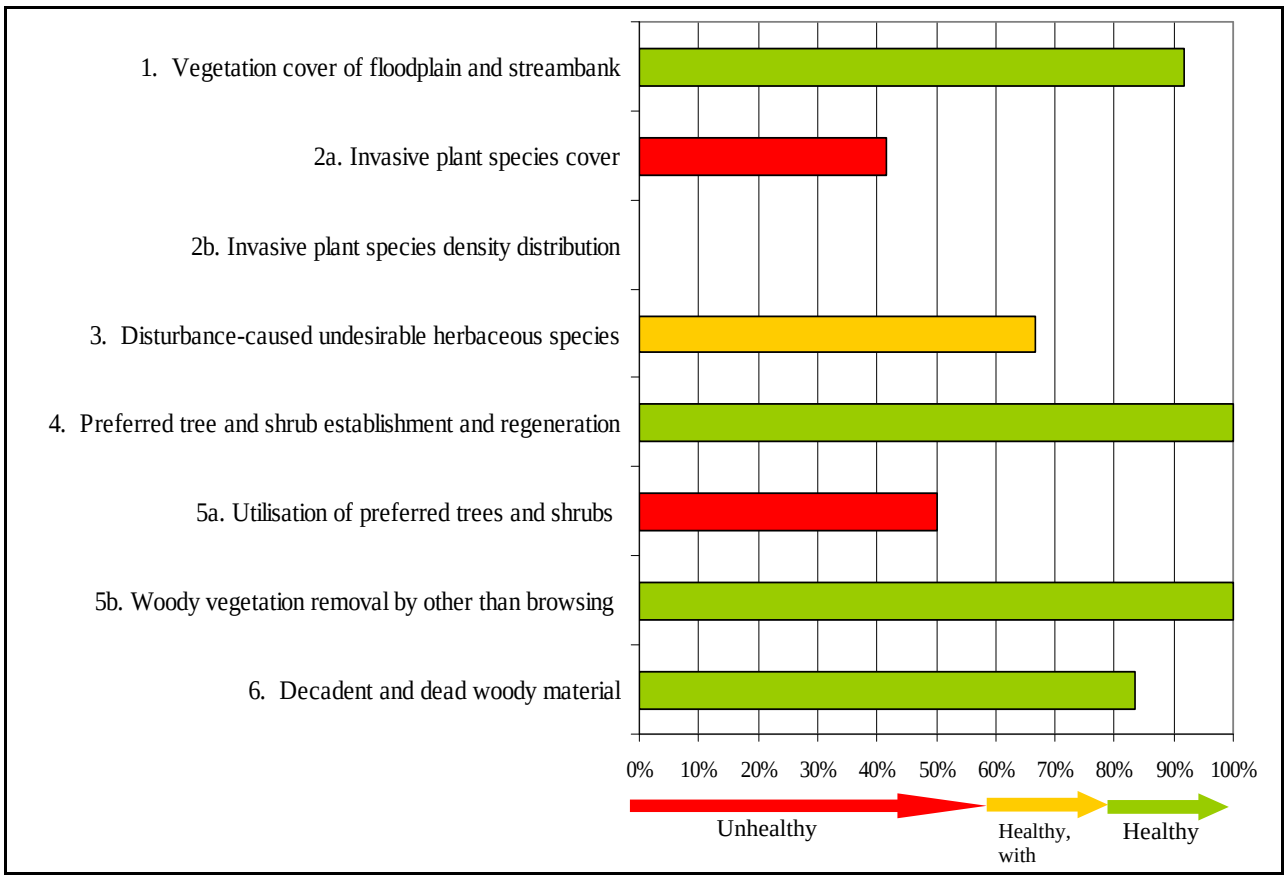



**Figure 5 West Nose Creek: Vegetation Parameter Health Ratings**

#### *4.5.1 Riparian Plant Communities*

One of the most obvious and distinctive differences between the West Nose and Nose Creek basins is the greater prevalence and abundance of natural woody plant communities along West Nose Creek. The diversity and integrity of native riparian plant communities is generally much higher for the West Nose Creek sites.

Native shrub communities comprise about 63% of the 2009 West Nose Creek project area (Table 5). Beaked willow is the dominant shrub in all sites. In undisturbed sites, beaked willow has an understory of sedges (mainly water sedge [*Carex aquatilis*] and to a lesser extent small bottle sedge [*Carex utriculata*]). Beaked willow communities along the outer fringe of the riparian area and in disturbed sites have an understory dominated by grasses due to the influence

of historic and current livestock grazing. As many as seven willow species were observed in the project area. Some of the more abundant of these willows include flat-leaved willow (*Salix planifolia*), false mountain willow (*Salix pseudomonticola*) and basket willow (*Salix petiolaris*). A variety of other native shrubs also occur intermixed in the willow communities (Appendix D).

Trees are less abundant in the project area than shrubs. An aspen / red-osier dogwood community occurs in two of the sites we assessed. This tree community comprises only 1.2% of the project area (Table 5). Although there is potential for red-osier dogwood shrubs to occur in this community type, willows (mainly beaked willows) are the dominant understory shrub in the project area. Balsam poplar trees are intermixed with aspen trees in three of the sites.

A good indication of the high integrity of native plant communities in the project area is the prominence of both native shrub and graminoid community types. Unlike the Nose Creek sites, none of the West Nose Creek sites have communities dominated exclusively by non-native grasses such as Kentucky blue grass. A water sedge habitat type, representing a climax, potentially natural community, occurs in a wide band along the stream channel and valley bottom in all sites. This lush and productive habitat type provides excellent ground stabilisation and provides winter forage for moose and sheltering habitat for many waterfowl and shorebird species. Water sedge is dominant in this habitat type but other commonly occurring sedges in the project area include awned sedge (*Carex atherodes*), small bottle sedge and woolly sedge (*Carex lanuginosa*).

Unclassified community types account for only a small proportion (about 3%) of the project area. These represent disturbed communities found along the drier outer fringes of the riparian area along the base of the valley slopes. Unclassified communities along West Nose Creek are characterised by disturbance grasses such as Kentucky bluegrass, red fescue (*Festuca rubra*) and smooth brome intermixed with native shrubs such as wild rose, shrubby cinquefoil (*Potentilla fruticosa*) and buckbrush.

**Table 5 West Nose Creek Riparian Plant Communities**

| Plant Community* | Classification | Number of Sites Where Found | Area Occupied | Percentage of the Project Area (%) |
|---|---|---|---|---|
| ***Tree Communities*** | | | | |
| aspen / red-osier dogwood | Community Type | 2 | 0.32 ha (0.78 ac) | 1.2 |
| ***Shrub Communities*** | | | | |
| beaked willow / awned sedge | Habitat Type | 3 | 3.1 ha (7.4 ac) | 11.4 |
| beaked willow | Community Type | 2 | 13.9 ha (33.9 ac) | 52.0 |
| | | | ***Total Area Occupied By Shrub Communities*** | ***63.4*** |
| ***Grass / Grass-Like Communities*** | | | | |
| water sedge | Habitat Type | 1 | 9.2 ha (22.4 ac) | 34.3 |
| ***Unclassified Communities*** | | | | |
| Unclassified wetland type | Community Type | 2 | 0.7 ha (1.7 ac) | 2.6 |

**Based on Thompson and Hansen 2002 and 2003*

### *4.5.2 Woody Plants - Trees and Shrubs: Presence, Reproduction and Health*

- *Presence*

  - Three native tree species and 13 native shrub species were recorded in the West Nose Creek project area (Appendix D).
  - Trees only occupy a small portion of the project area (less than 1%).
  - Shrubs are abundant in all of the sites. Shrubs cover about 60% of the project area.

There is a healthy diversity and abundance of shrub species in all sites and native tree species also naturally occur in the project area. Woody cover is far more abundant in comparison to the Nose Creek project area. Native willows are the dominant cover, but aspen and balsam poplars may increase in cover as young trees mature. Willows and poplar species are fast growing and provide excellent forage and shelter for wildlife.

- *Reproduction*

  - All sites have excellent, healthy amounts of tree and shrub seedlings and saplings (i.e. more than 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings).

  - The presence of a healthy proportion of younger aged plants is essential to the longevity of woody plant communities, ensuring that new growth is available to replace ageing plants.

- *Health*

The majority of woody plant communities are vigorous and healthy. Exceptions are where beaver dams have created flooding which has flooded out a portion of woody cover in two of the sites (***Photo m***, page 26). This is reflected by the dead and decadent rating for those sites where 5% to 25% of the canopy was affected. Beaver flooding is a natural process in the West Nose Creek valley. Poplar and willow species rebound quickly after flooding due to their fast spreading growth habits.

There are no signs of human removal of woody plants in any of the sites. Recent beaver activity is apparent in all sites, but loss of woody plants due to beaver cutting has been more than offset by vigorous new woody growth (***Photo n***, page 26). Most beaver chewed poplar and willow stems are re-sprouting or have sent out new suckers. Willows, balsam poplars and aspen are especially well adapted to beaver utilisation, having evolved with beavers as a keystone ecosystem species. These plants all have quick growth rates and reproduce vegetatively and by seed, enabling them to better withstand frequent cutting.

Utilisation of preferred woody species (e.g. willows and poplars) is light to moderate for all sites. Beaked willow, being the dominant shrub, is also the main browse source for wildlife (deer and moose) and also for horses. Moderate browse use is indicated by young plants with a flat-topped appearance and mature plants with an umbrella-shaped growth form. Other woody species

appear to be either lightly browsed or not browsed at all. Beaked willow is one of the most palatable willow species and has high protein and phosphorus content (Tannas 2003).

Horses have winter, summer or year-round access to the riparian area in most sites except for the Rocky View County Environmental Reserve that is excluded from livestock use. There is also a resident moose herd in the West Nose Creek valley as well as a sizeable population of mule deer and some white-tailed deer. Most tree and shrub species can recover from periodic episodes of heavy browse pressure, but long term heavy browse pressure is not sustainable. Most wildlife browse pressure occurs in the winter when there is limited availability of alternative forages. Willows also retain their nutritional value better than most herbaceous species over the winter. Browse levels are highest in those sites with combined horse and wildlife use, particularly winter horse use.

*Photographer: K. Romanchuk*
*Catalogue Number: RHIP23WNO012*

**Photo m:** Beaver dams have caused flooding of this site leading to die out of a portion of the willow community. This is a natural part of the successional process of riparian communities in beaver modified habitats.

*Photographer: K. Romanchuk,*
*Catalogue Number: RHIP25WNO006*

**Photo n:** Beaver removal of willows, aspen and balsam poplar has been offset by an abundance of new growth. These types of native woody plants are well adapted to beaver disturbance by their ability to regenerate vegetatively. Cut willow stems quickly send out new shoots using stored root reserves.

### *4.5.3 Non-Woody Plants: Diversity and Health*

- *Diversity*

There is a tremendous diversity of herbaceous native plants in the West Nose Creek project area.

- 28 species of grasses and grass-like plants and 65 species of broad-leaved plants (forbs) were recorded in the project area (Appendix D).
- About 82% (i.e. 76 species) of these non-woody plants are native species.

- *Health*

- Disturbance-caused plants are much less abundant than in the Nose Creek project area. Only one site has more than 25% cover from disturbance plants. Most of the sites have just over 5% disturbance plant cover, primarily Kentucky bluegrass, quack grass and white clover.

- Native plant communities have excellent integrity in most sites, particularly in wetter portions of the valley (***Photo o***, page 28). Disturbance plants are mainly only a concern along the outer periphery of the sites, at the base of the valley slopes (***Photo q***, page 28). Sites adjoining cropland or seeded pasture have higher levels of disturbance plants.

- In total, 14 disturbance-caused plant species were identified, including five grass and nine forb species (Appendix D). Most of these species are introduced except for four native early successional or disturbance adapted species, foxtail barley, wild strawberry (*Fragaria virginiana*), silverweed and showy everlasting (*Antennaria pulcherrima*).

- **Invasive plants are a concern, but only two invasive species were recorded in the project area.** Canada thistle and, to a lesser extent, smooth perennial sow-thistle occur in all sites (Appendix D).

- Canada thistle is particularly abundant in two of the sites where it is mainly invading from the adjacent valley slope (***Photo r***, page 28). Adjacent croplands, hayfields, roadways and historical horse and cattle grazing along the valley has contributed to the establishment and spread of Canada thistle.

**Photo o:** The West Nose Creek valley bottom is characterized by wide, vigorous and productive native sedge communities. (*Photographer: K. Hull, Catalogue Number: RHIP07WNO008*).

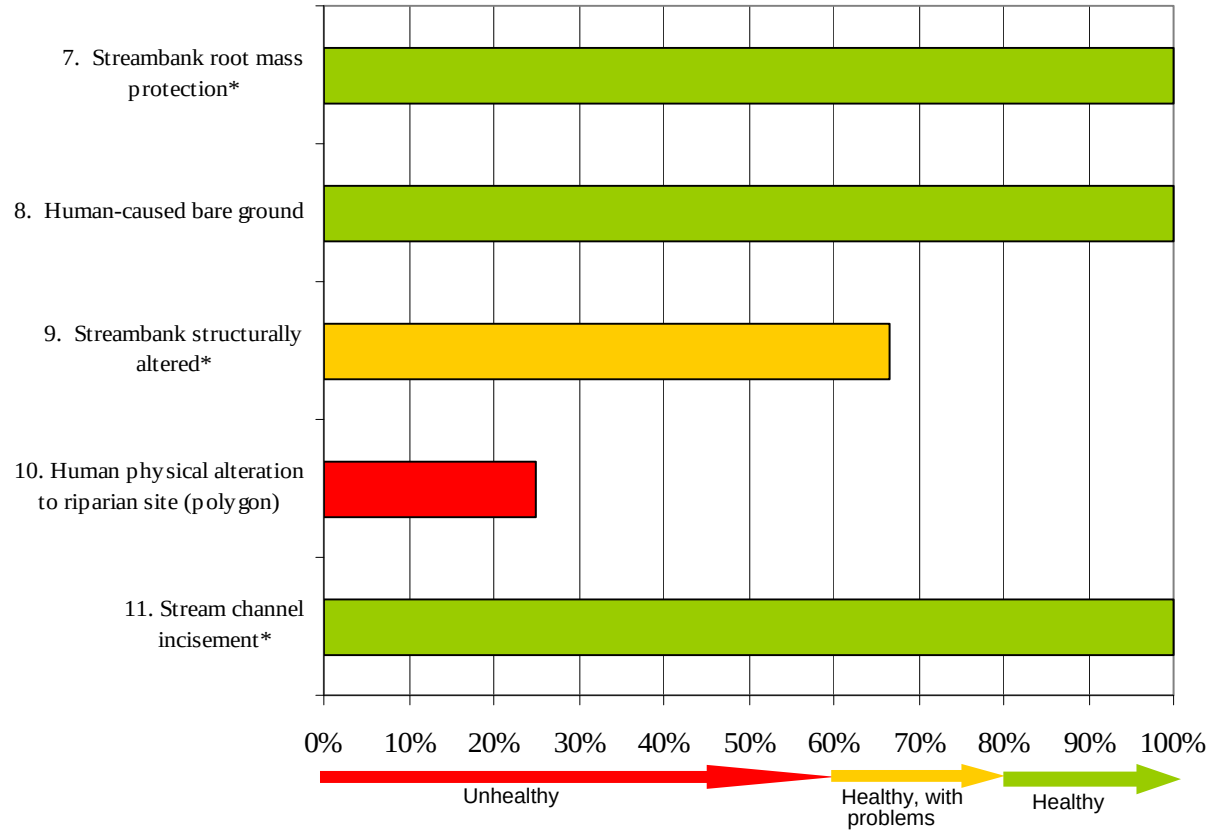
**Photo p:** All of the West Nose Creek sites we assessed have healthy, diverse native tree and shrub communities. Beaked willow is the dominant shrub in all sites. (*Photographer: K. Hull, Catalogue Number: RHIP24WNO011*).

**Photo q:** Disturbance caused plants, mainly Kentucky bluegrass and white clover, are encroaching along the periphery of a few sites. These plants encroach from adjacent cropland or heavily grazed pastures. (*Photographer: K. Hull, Catalogue Number: RHIP07WNO018*).

**Photo r:** Canada thistle is fairly abundant along side slopes of the West Nose Creek valley. Thistle infestations along the valley slopes are beginning to invade into the outer edges of the riparian area. (*Photographer: K. Hull, RHIP23WNO13*).

### *4.6 West Nose Creek Soil and Hydrology Health*

The average soil and hydrology health rating for the West Nose Creek sites is 81% (*healthy*). All parameters rated *healthy* except for human-caused structural alteration to the streambanks and floodplain (Figure 6). Of note though, ***parameters related to the streambank (i.e. #7, #9, and #11) could only be assessed for one of the four sites, since only one site had a defined stream channel***. The streambank was not visible or accessible in two of the sites where beaver dams have caused flooding (***Photo u***, page 31). The Rocky View Environmental Reserve site also lacks a defined stream channel due to upstream damming of the creek combined with subsurface flows, creating a wet sedge meadow throughout the valley bottom.




* *These parameters were only assessed for one of the sites; three sites lacked a defined streambank (either beaver ponds / wet sedge meadow).*

**Figure 6 West Nose Creek: Soil / Hydrology Parameter Health Ratings**

#### *4.6.1 Streambank Stability and Root Mass Protection*

All sites have stable, well vegetated streambanks or valley bottoms due to wide expanses of deeply rooted native sedge habitat. Willows mainly occur along the mid to outer edges of the valley bottom. Sedges and willows provide excellent root mass protection to small stream systems.

### *4.6.2 Human-Caused Bare Ground*

- All sites have only trace amounts (i.e. less than 1%) of human-caused bare ground, mainly attributable to horse trails and hoof shear.

- Most of the bare ground in the project area is due to naturally receding water levels along the edge of beaver ponds. Natural bare ground, although not as much of a management concern, should still be monitored for weed establishment.

### *4.6.3 Alterations to the Streambank and Floodplain*

- Bank alterations could only be assessed for one site, making it difficult to report on averages for the project area. The one site with a defined stream channel has minor amounts of alterations (i.e. 5% to 15% of the bank is structurally altered by human activity). Alterations in this case were due mainly to horse trampling, although wildlife trampling may also have been a contributing factor.

- Horse use and past cattle use have created trailing and pugging and hummocking (***Photo v***, page 31) impacts to more than 25% of the floodplain in most sites. Pugging and hummocking refers to the raised mounds ('hummocks') and depressions ('pugs') created by livestock hoof imprints. Moist, fine textured soil in the West Nose Creek valley bottom is especially susceptible to these types of impacts. Trampling impacts are extensive but not severe in all but one site. Severe impacts where pugs and hummocks are deep and frequent can take a fairly long time to recover naturally by infilling of sediment. Trampling can contribute to soil compaction if impacts are severe. Compacted soil has less moisture holding and absorption potential. This can increase runoff rates and lead to reduced recharge rates of shallow groundwater reserves. The two beaver flooded sites may have exaggerated levels of trampling impacts because only the narrow, un-flooded portion of the sites could be assessed for structural alterations.

- None of the sites have any permanent structural alterations from human buildings or other infrastructure or impervious surfaces. There are no bridges, pathways, berms or channel realignment evidence in any of the sites. Road construction immediately to the south of the Rocky View Environmental Reserve site has removed a small portion of the riparian area. Rip-rap has been installed at the new culvert crossing as part of this roadway development (***Photo s***, page 31).

### *4.6.4 Stream Channel Incisement*

West Nose Creek has a natural meandering channel morphology in the 2009 project area, with no evidence of channel incisement. Beaver ponds along West Nose Creek help to slow and stabilize streamflows, reducing the potential for downstream erosion. However, if beaver dams burst rapidly due to human or natural causes (e.g. a large flood event), this can create downward channel erosion (incisement) due to the rapid and forceful release of water stored in beaver ponds. The newly constructed culvert at the south end of the Rocky View Environmental Reserve also has potential to alter stream flow hydrology. Improperly sized or placed culverts have potential to constrict water flows and create increased erosive force downstream, leading to incisement.

**Photo s:** New road construction along the south end of the Rocky View Environmental Reserve. Rip-rap has been installed at the culvert. Roads and culverts have potential to alter natural subsurface and surface hydrology. Long-term monitoring is suggested to examine these effects. (*Photographer: K. Hull, Catalogue Number: RHIP07WNO013*).

**Photo t:** Beaver activity is common in the West Nose Creek valley. There are several active beaver lodges and recently built dams in the project area. (*Photographer: K. Hull*).

**Photo u:** Two of the sites in the project area have been recently flooded by beaver dams. Beaver ponds like this one help to trap sediment, slow stream flows and reduce erosion, recharge aquifers, and provide habitat for wetland wildlife species. (*Photographer: K. Romanchuk, Catalogue Number: RHIP23WNO007*).

**Photo v:** Fine textured soil in the valley bottom is easily susceptible to trampling impacts from wildlife and livestock use. This creates raised mounds of soil and depressions from hoof impacts, contributing to soil compaction. (*Photographer: K. Hull, Catalogue Number: RHIP24WNO002*).

# 5 RIPARIAN HEALTH TREND

Cows and Fish has been evaluating riparian health since 1997. As we continue to gain knowledge of riparian areas, we have made some changes to the inventory and assessment methodology. These small changes have improved our ability to evaluate riparian health, but as a result some of the health parameters from the 2000 inventory are different from those evaluated in 2009. New health parameters assessed in 2009 that were not assessed in 2000 include invasive plant density distribution; woody vegetation removal other than browse; and physical alterations to the floodplain. A few of the health parameters assessed in 2000 (e.g. total canopy of woody species and degree of active lateral cutting) no longer contribute to the final riparian health rating.

Monitoring results for the three sites re-assessed along Nose Creek and the one site re-visited on West Nose Creek are given in Appendices E to H. Also included in Appendices E to H are benchmark photographs and aerial photograph comparisons. Benchmark photographs were retaken at each of the monitoring sites, showing changes at the upstream and downstream ends of the site. Aerial photographs from 2000 and 2007 for each site show land use or land cover changes over that time period. In general, sites that have experienced noticeable land use changes associated with residential or recreational developments have downward trends in riparian health scores. Sites with few or no obvious land use changes have only slight changes in their riparian health rating since 2000.

## *5.1 Overall Health Trend*

Once we have inventoried a site two or more times, we can start to assess trend and recognise where changes are occurring. Trend analysis is only possible for the three sites re-visited along Nose Creek. The overall riparian health rating of these sites has declined slightly from 68% in 2000 to 62% in 2009, remaining in the *healthy, but with problems* category (Table 6). Only one of the sites declined in health notably since 2000 due to loss of riparian habitat and structural alteration of the banks and floodplain associated with golf course development. The other two sights showed slight overall improvement in health, but not sufficient improvements to shift to a higher health category.

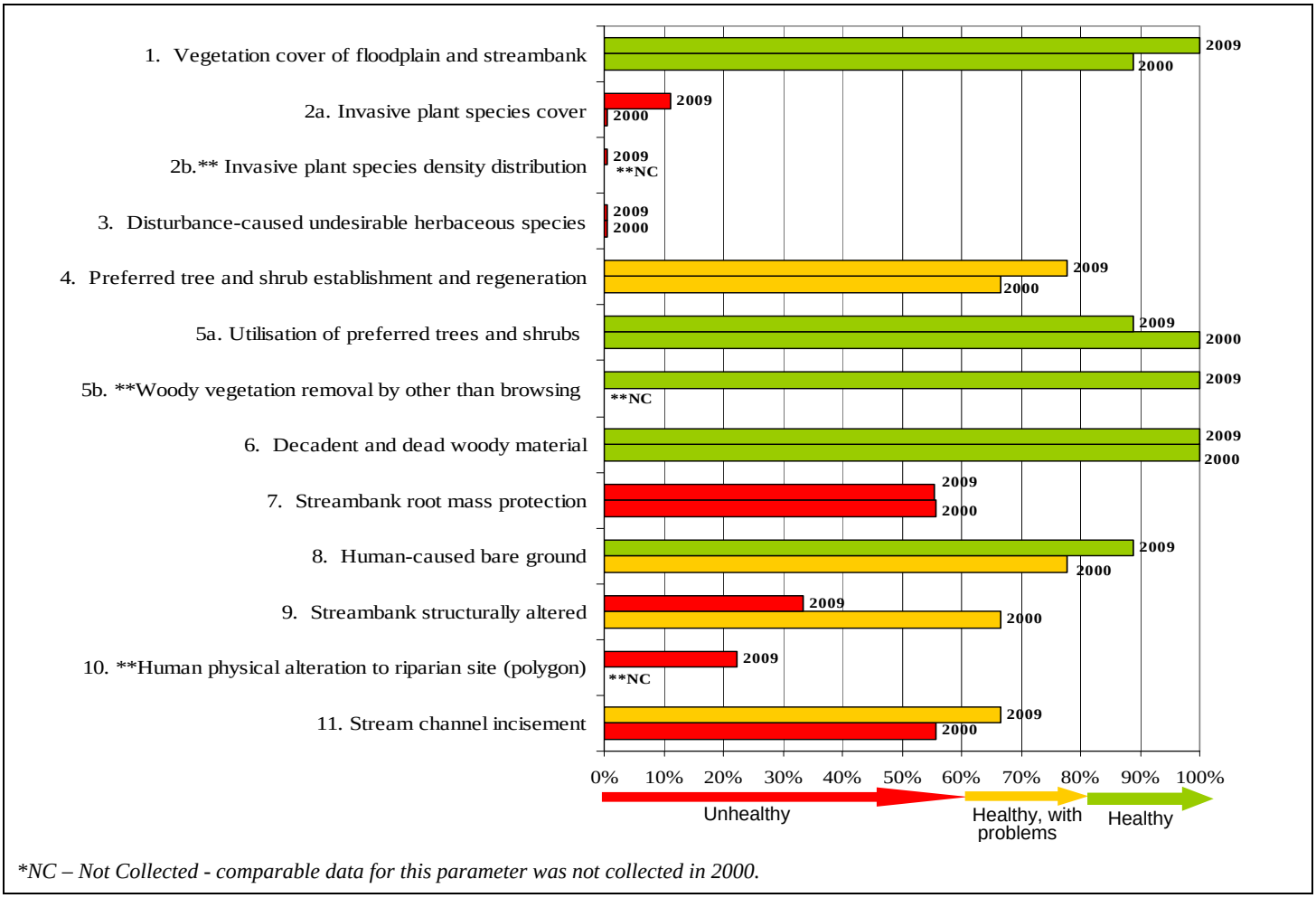
For the Nose Creek Project Area, average health scores improved for four of the eleven parameters: total vegetation cover; preferred tree and shrub establishment and regeneration; human caused bare ground; and stream channel incisement (Figure 7). Average health scores for the remaining parameters either stayed the same or declined since 2000 (Figure 7).

The West Nose Creek Environmental Reserve site showed a slight decline in riparian health since 2000. However, it is only possible to examine the trend in the vegetation health rating of this site (see Section 5.3 for more details). This site represents an ecologically significant reach near the headwaters of West Nose Creek that continues to perform many important riparian functions. In particular it provides excellent habitat for wild ungulates and songbirds and it provides water recharge and runoff filtration services. The Environmental Reserve also provides a valuable opportunity for environmental education and awareness, wildlife viewing, and community environmental stewardship activities.

**Table 6 Riparian Health Monitoring Trends for Nose and West Nose Creeks (2000 to 2009)**

| Site # | Vegetative Health Rating | | Soil & Hydrology Health Rating | | Overall Health Rating | | Overall Health Description | |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2009 | 2000 | 2009 | 2000 | 2009 | 2000 | 2009 |
| ***Nose Creek*** | | | | | | | | |
| City of Airdrie, Nose Creek Park (NOS4) | 54% | 70% | 78% | 80% | 68% | 75% | Healthy, but with problems | Healthy, but with problems |
| City of Airdrie, Willow Brook Park (NOS17) | 50% | 70% | 50% | 37% | 50% | 53% | Unhealthy | Unhealthy |
| Golf Course (Town of Crossfield vicinity) (NOS15) | 63% | 57% | 100% | 57% | 85% | 57% | Healthy | Unhealthy |
| ***Average Score*** | ***56%*** | ***66%*** | ***76%*** | ***58%*** | ***68%*** | ***62%*** | ***Healthy, but with problems*** | ***Healthy, but with problems*** |
| ***West Nose Creek*** | | | | | | | | |
| Rocky View County Environmental Reserve (WNO7) | 88% | 77% | 100% | **67% | 90% | **74% | Healthy | Healthy, but with problems |

**** Direct comparison of these scores is not possible due to changes in assessment methodology and lack of a defined streambank in this site.**




**NC – Not Collected - comparable data for this parameter was not collected in 2000.*

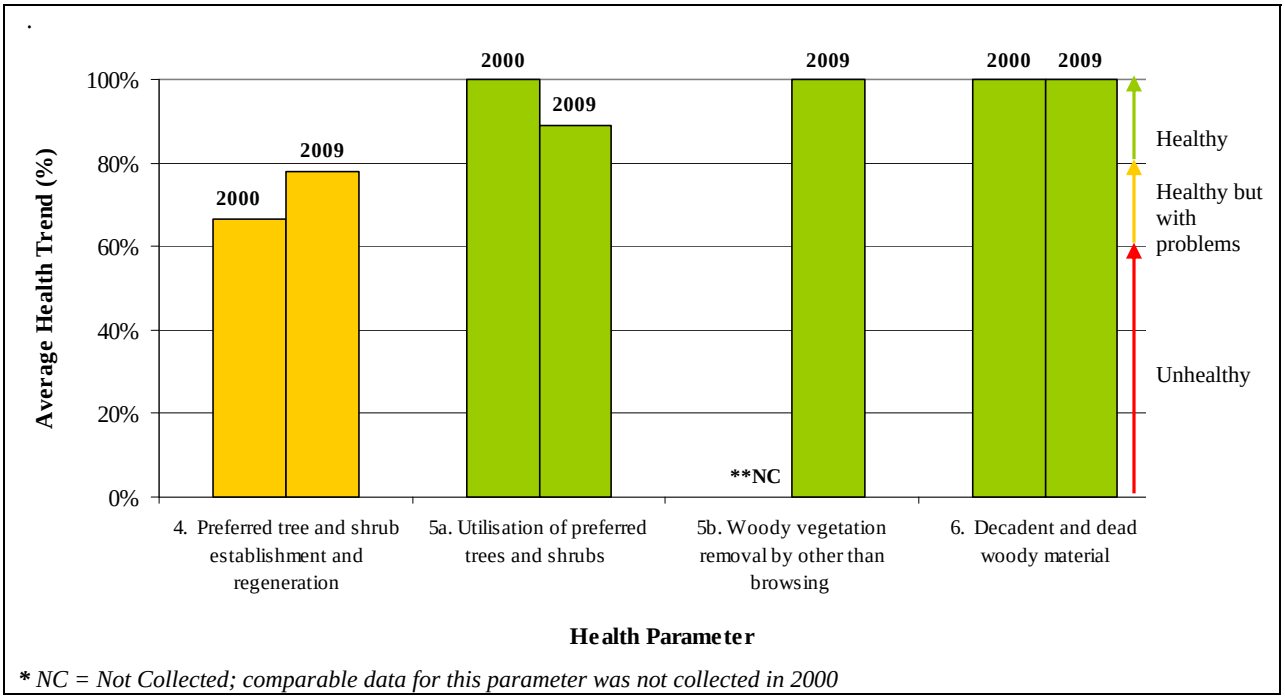
**Figure 7 2000 and 2009 Riparian Health Parameter Comparisons for Nose Creek**

## *5.2 Nose Creek Health Trends*

The following results and discussion pertain to the three sites re-assessed along Nose Creek in 2000 and 2009.

### *5.2.1 Woody Plants: Health Trends*

➢ ***Overall Trend: Woody plants continue to be scarce in the Nose Creek project area, but human plantings have led to slightly improved cover of younger aged trees and shrubs.***




***** *NC = Not Collected; comparable data for this parameter was not collected in 2000*

**Figure 8 Woody Plant Health Trends for Nose Creek (n=3)**

***Preferred Tree and Shrub Establishment and/or Regeneration***

- Intentional plantings of tree and shrub seedlings and saplings in the two Airdrie park sites helped to increase health ratings for this parameter.
- Establishment and regeneration rates declined in only one site. Mowing and landscaping associated with golf course maintenance contributed to reduced woody plant recruitment in this site.

***Utilisation of Preferred Trees and Shrubs***

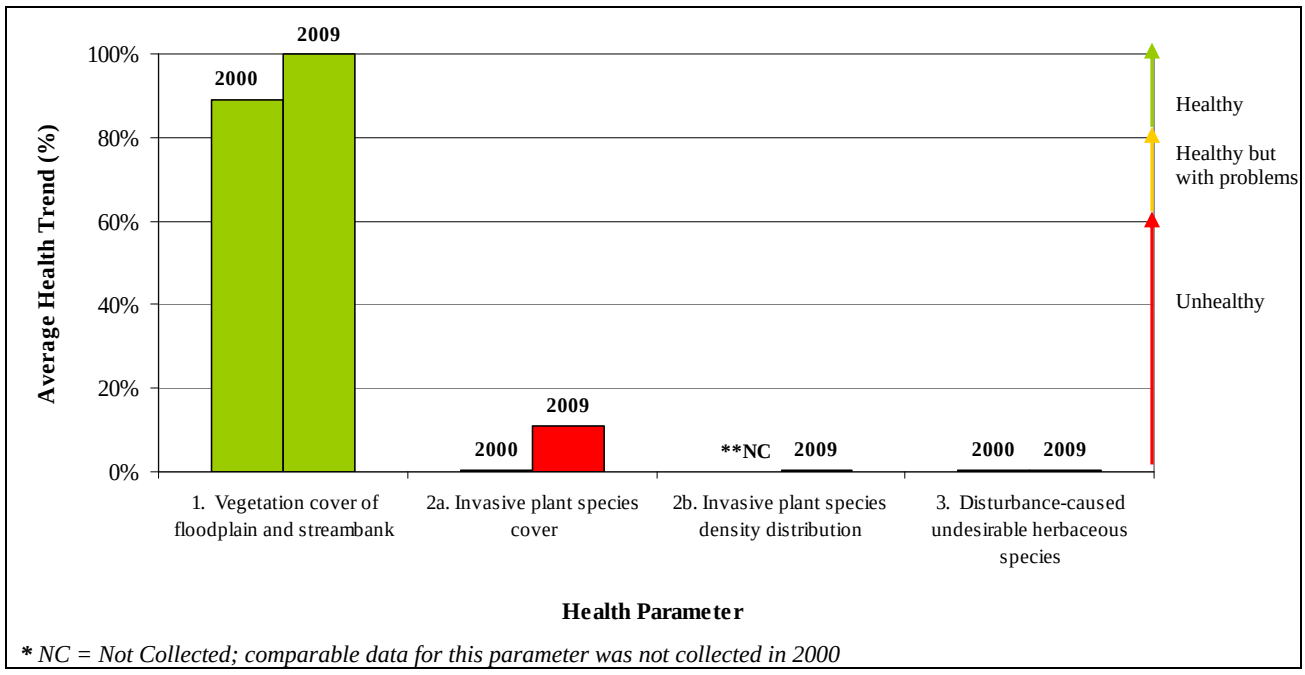
- Browse use of woody plants remains negligible due to the urban setting of the sites.
- Like in 2000, none of the sites are being used for domestic cattle grazing.

***Standing Decadent and Dead Woody Material***

- As we observed in 2000, woody plants in the project area do not show signs of stress or higher than normal amounts of dead or dying branches.

### 5.2.2 *Non-Woody Plants: Diversity and Cover Health Trends*

➢ ***Overall Trend: Vegetative cover of the floodplain has improved, but invasive and disturbance-caused plants remain prevalent in the project area.***




***** *NC = Not Collected; comparable data for this parameter was not collected in 2000*

**Figure 9 Herbaceous (Non-Woody) Plant Health Trends for Nose Creek (n=3)**

***Vegetative Cover of Floodplain and Streambanks***

- Overall vegetation cover of the riparian area has increased slightly since 2000. This increase is mainly due to re-vegetation of areas of human-caused bare ground in the Willow Brook Park site in Airdrie. This site had elevated levels of human-caused bare ground associated with residential development activities and creek realignment in 2000.
- Vegetation cover remains stable in the two other sites.

***Invasive plant species***

- Canada thistle and smooth perennial sow-thistle remain prevalent in the project area. These weeds have similar or slightly less abundance in the Airdrie sites compared to 2000 levels, but Canada thistle abundance has increased substantially in the golf course site.

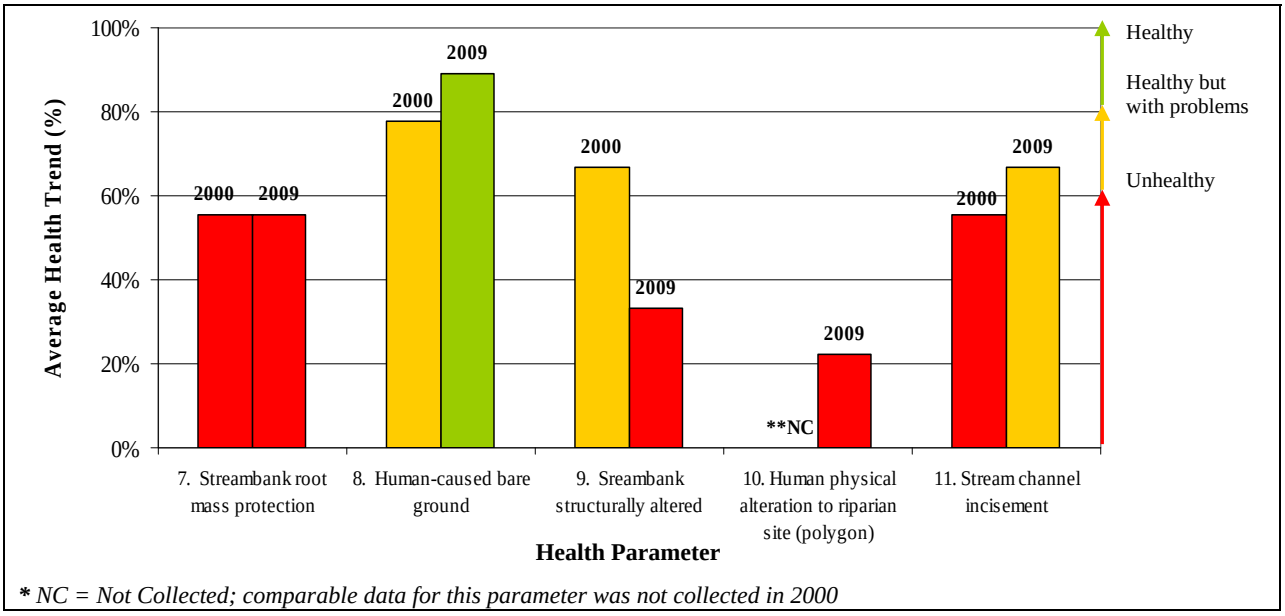
- Scentless chamomile has persisted in two of the sites in low amounts. This weed may increase substantially in the near future if it spreads into the riparian area from infestations in adjacent disturbed construction sites.
- A third noxious weed, butter-and-eggs (*Linaria vulgaris*), also known as 'yellow toadflax', is now present in trace amounts in Nose Creek Park in Airdrie and in the golf course site. This weed was not observed in 2000.

***Disturbance-Caused Undesirable Plant Species***

- Disturbance-caused plants, mainly Kentucky bluegrass and smooth brome, remain prevalent in the project area.
- Disturbance plants comprise between 50% to 70% of the riparian area in each site.
- It is likely not realistic for the plant community to revert completely back to native species. Instead, a priority should be to limit further soil disturbance and to protect remaining intact native plant communities such as sedge and rush communities along the streambank. Minimising human-caused alterations within 10 m of the streambank will help prevent spread of less desirable disturbance plants into erosion sensitive streambank habitat.

### *5.2.3 Streambanks and Floodplain Health Trends: Alterations and Stability*

➢ ***Overall Trend: Streambank and floodplain alterations have increased in two of the three sites leading to an overall decline in health for soil / hydrology parameters.***




***** *NC = Not Collected; comparable data for this parameter was not collected in 2000*

**Figure 10 Riparian Soil and Hydrology Health Trends for Nose Creek (n=3)**

***Streambank Root Mass Protection***

- Only one of the sites, Nose Creek Park, shows an improving trend in levels of root mass protection. In 2000, the bank was rated as *healthy with problems* for this parameter (i.e. 65% to 85% of the bank had deep, binding root mass). In 2009, the site rated *healthy* for this parameter (i.e. more than 85% of the bank has deep, binding root mass). Natural recovery of sedges, cattails and native shrubs contributed to improved bank stability and root mass protection in this site. Some bank stability improvements can also be partially attributed to the small bioengineering project near the Main Street bridge underpass (***Photos w*** and ***x***, page 38).

- Streambank root mass protection has improved slightly, but remains at *unhealthy* levels in the Willow Brook Park site. Less than 65% of the streambank length has sufficient deeply rooted plants in this site. Stream channelization, historical berms and prevalence of shallow-rooted disturbance grasses have reduced root mass protection along this reach of Nose Creek.
- Golf course development and maintenance has led to alteration and removal of deeply rooted native grasses and sedges along the banks of the third site. Between 35% to 65% of the bank length of this site now has sufficient rootmass protection compared to 2000 when more than 85% of the bank had adequate protection (Appendix G). This site was formerly used for livestock grazing and then crop production in the uplands. In 2000 a wide, unused buffer was in place along this reach.

***Human-Caused Bare Ground***

- Overall, the amount of exposed, human-caused bare ground has decreased in the project area since 2000.
- Both the Nose Creek Park and Willow Brook Park sites show improvements in bare ground levels. Bare ground has decreased to trace amounts (less than 1% cover) in both sites. In 2000 both sites had 1% to 5% human-caused bare ground cover (i.e. *healthy, with problems*). For the Nose Creek Park site this improvement is mainly due to revegetation of undesignated trails and other recreational impacts. Reduced human-caused bare ground in the Willow Brook Park site is mainly due to vegetation stabilisation of berms and disturbed construction sites.
- Only the golf course site has slightly increased human-caused bare ground (less than 5% cover), although the majority of the riparian area continues to be well vegetated. Minor bare ground has resulted here from golf cart trails, culvert erosion, and sand traps in the riparian area.

***Streambank Structurally Altered by Human Activity***

- Streambank alterations remain similar in two of the sites, but have increased notably in one site since 2000.
- The Nose Creek Park site in Airdrie has the least amount of alterations (approximately 5% to 15% of the bank length has been altered by human activity). Localized streambank structural alterations have resulted from stormwater outfalls, four pedestrian footbridges, the Main Street bridge crossing, a bike path, and soil compaction due to mowing and / or landscaping. Historical berms along Main Street may also have impacted portions of the bank. Despite these localized impacts, the streambank has retained natural meander curves through this site and it is well stabilized by native sedges. Structural alterations to the streambank were slightly underestimated in 2000 since bank alterations apparent in 2009 were also described in 2000. There do not appear to be any new bank alterations in this site since 2000.
- The Willow Brook Park site continues to have severe bank alterations that impact more than 35% of the bank length. Since 2000 the upstream portion of this reach has been further channelized.

**Photo w:** Pre-restoration photograph (2006), showing eroded bank downstream of a stormwater outfall at the downstream end of the Nose Creek Park riparian inventory site.

*Photographer: K. Hull, Catalogue Number: RHIP17NOS022*

**Photo x:** Bioengineering techniques (i.e. live willow fences) employed in 2006 remain intact. This photograph taken in 2009 shows that live willow cuttings have helped to stabilise and reshape the bank. There is now reduced erosion along the bank and the willow stems are helping to build out the bank by trapping sediment. Some additional willow fencing may be needed to reinforce this bank as there has been some willow mortality since 2006.

- Golf course development and maintenance (including culvert crossings and soil compaction from fairway mowing within 2 m of the channel) has caused alteration to 15% to 35% of the bank length in the third site. In 2000, less than 5% of the bank length had human-caused alterations.

***Human Physical Alteration to the Floodplain***

- Floodplain alterations were not measured in 2000, and so this parameter cannot be directly compared to 2009 ratings.
- Aerial photograph comparisons shown in Appendices E, F and G provide some indication of the extent of new floodplain alterations due to land use changes. From this analysis, alterations appear to have increased notably in two of the three sites. There are no obvious changes to floodplain alterations in the Nose Creek Park site (Appendix E).
- Residential development, channelization and berming of the upstream half of the reach has increased floodplain alterations in Willow Brook Park (Appendix F).
- Golf course development has increased the extent of soil compaction in the floodplain and caused some loss of natural riparian plant communities (Appendix G). This has resulted from landscaping, mowing and fairway construction and maintenance.

***Stream Channel Incisement***

- The degree of stream channel incisement has improved slightly since 2000.
- The site at the most upstream end of the project area is not incised. Like in 2000, this reach through the golf course is not eroded downward and floodwaters have access to a wide floodplain.
- Channel incisement has improved from moderate to slight in the Nose Creek Park site.
- The Willow Brook Park reach continues to be moderately incised from berms, channelization and removal of deep-rooted native plants along the streambank.

### *5.3 West Nose Creek Health Trends*

The only 2000 inventory site re-visited in 2009 along West Nose Creek, an Environmental Reserve in Rocky View County, has not changed notably since 2000 (Appendix H).

***For this site, a trend analysis is only possible for vegetation health parameters***. Soil / hydrology parameters pertaining to the streambank could not be assessed because this portion of West Nose Creek is a wide, wet sedge meadow that does not have a defined channel with discernible bed and banks. Structural alterations to the polygon (excluding the banks) were not assessed in 2000, making it not possible to compare soil / hydrology health trends.

The site is presently rated as *healthy, but with problems*; most of the riparian functions are intact although invasive plants (Canada thistle and smooth perennial sow-thistle) have increased slightly in abundance. Overall the site has excellent representation of native riparian plant communities and provides tremendous fish and wildlife habitat value and water filtration services. Slightly increased invasive plant species cover has led to a minor decline in vegetation health. Despite this, the majority of the riparian area continues to be dominated by healthy and vigorous beaked willow and water sedge communities (***Photo y***, below).

A large portion of the site has evidence of uneven soils from pugs and hummocks (deep depressions and raised mounds of soil resulting from hoof action in moist soils). Pugs and hummocks are currently minor in severity and are having minor impact on riparian functions. There is no bare soil or apparent impact on native vegetation or water infiltration capacity associated with hoof print impact. Similar pugging and hummocking impacts were documented in 2000 but these impacts were not factored into the health score at that time. The site has been managed as a protected Environmental Reserve since 2000. The only obvious, new alterations to the site are as a result of road construction and installation of a new culvert at the downstream end (***Photo s***, page 31).

*Photographer: K. Hull*
*Catalogue Number: RHIP07WNO015*

**Photo y:** The West Nose Creek Environmental Reserve has excellent representation of native sedge and willow communities in the riparian area. Native grassland is intact along the east valley slope.

# 6 THE NEXT STEPS

Monitoring riparian health is part of an ongoing process to generate awareness and encourage community-based action to improve and maintain health in the Nose Creek Watershed. Every landowner that participated in this monitoring project has received a report on the riparian health for their landholding. This report is intended to help landowners better understand and direct their efforts toward improving riparian functions that may be missing or impaired. General management suggestions are provided in the report to assist landowners in becoming more effective riparian stewards. The Nose Creek Watershed Partnership (NCWP) has an important role to play in coordinating and supporting riparian stewardship initiatives throughout the basin.

## *6.1 Riparian Management Recommendations*

In general, management goals should aim to limit further human impacts to the streambank and floodplain and restore degraded portions of riparian habitat where possible. A focal part of this is to maintain and enhance the integrity of native riparian plant communities, particularly native sedge and willow communities.

Listed below are a few key management suggestions to help maintain and improve riparian health and also to promote better awareness and community based riparian stewardship. The NCWP can provide leadership, technical assistance and coordination support to help implement these suggestions.

**Awareness Building and Community Based Stewardship:**

- Develop public interpretative signs to promote the social and ecological values of the West Nose Creek and Williamstown Environmental Reserves. Interpretive signs for these Reserves should be designed to instil a sense of community pride and appreciation of these natural areas. Signs should promote awareness of the role of riparian areas and the watershed and wildlife habitat functions they provide.
- Encourage community involvement in long-term weed control, litter clean-up and riparian restoration activities through the NCWP.
- Continue to promote the Nose Creek Watershed Water Management Plan as a planning tool for new and existing developments and activities for all jurisdictions in the Nose Creek Watershed.

**Weed Control and Monitoring:**

- Monitor and control invasive weeds.
- Ongoing monitoring and control is needed to keep existing Canada thistle, smooth perennial sow-thistle, scentless chamomile, and yellow toadflax in check and to prevent the establishment of other noxious / restricted weeds. Incorporating an annual weed monitoring and control program into the Nose Creek Water Management Plan is recommended.
- Mechanical weed control methods and hand-pulling (where appropriate) are generally preferred in riparian areas due to water contamination concerns associated with herbicides.

**Riparian Protection and Restoration:**

- Protect and restore riparian habitat along Nose Creek. At a minimum the width of protected riparian habitat should correspond to the flood prone area adjacent to the creek (Figure 11). Where possible, riparian protection should follow the recommendations outlined in the Nose Creek Water Management Plan. These recommendations take into account variable riparian setbacks that incorporate the 1:100 year floodplain, escarpments and meander belt widths.
- Riparian habitat should be managed to promote natural recovery of native riparian plants such as sedges, rushes and willows. This will help reduce streambank erosion and loss of land from slumping in addition to improving fish and wildlife habitat and water filtration capacity.
- To allow natural recovery of native plants, routine mowing should not be done in the protected riparian buffer, except for weed control purposes. Some mowing may be periodically needed to help tree and shrub seedlings outcompete disturbance grasses and reed canary grass.

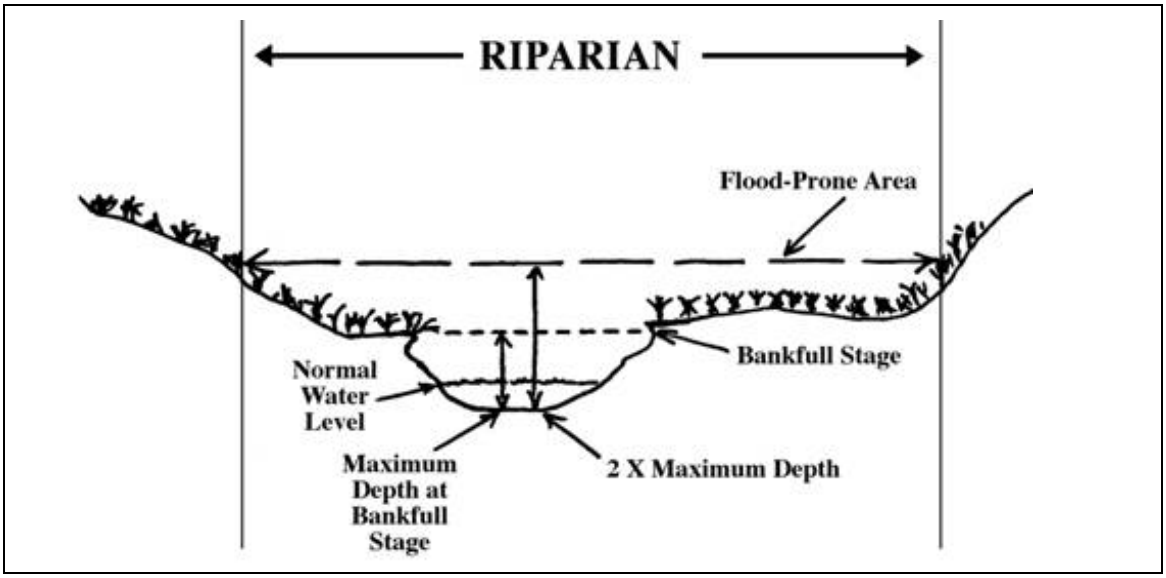



**Figure 11 Riparian Area Diagram Showing Flood-Prone Extent**

- Where natural recovery potential is limited, restoration using native plantings should be done. Priority sites for restoration include actively eroding or slumping banks that have been impacted by human alterations. Deeply rooted willow species and red-osier dogwood shrubs are particularly valuable for streambank restoration projects. ***The illustration on the following page provides native planting suggestions that can be implemented along Nose Creek to restore native riparian habitat, strengthen bank stability, and improve water quality***.
- Refer to Appendix B for local suppliers of native plants. The enclosed "Growing Restoration" Fact Sheet is also a useful resource.

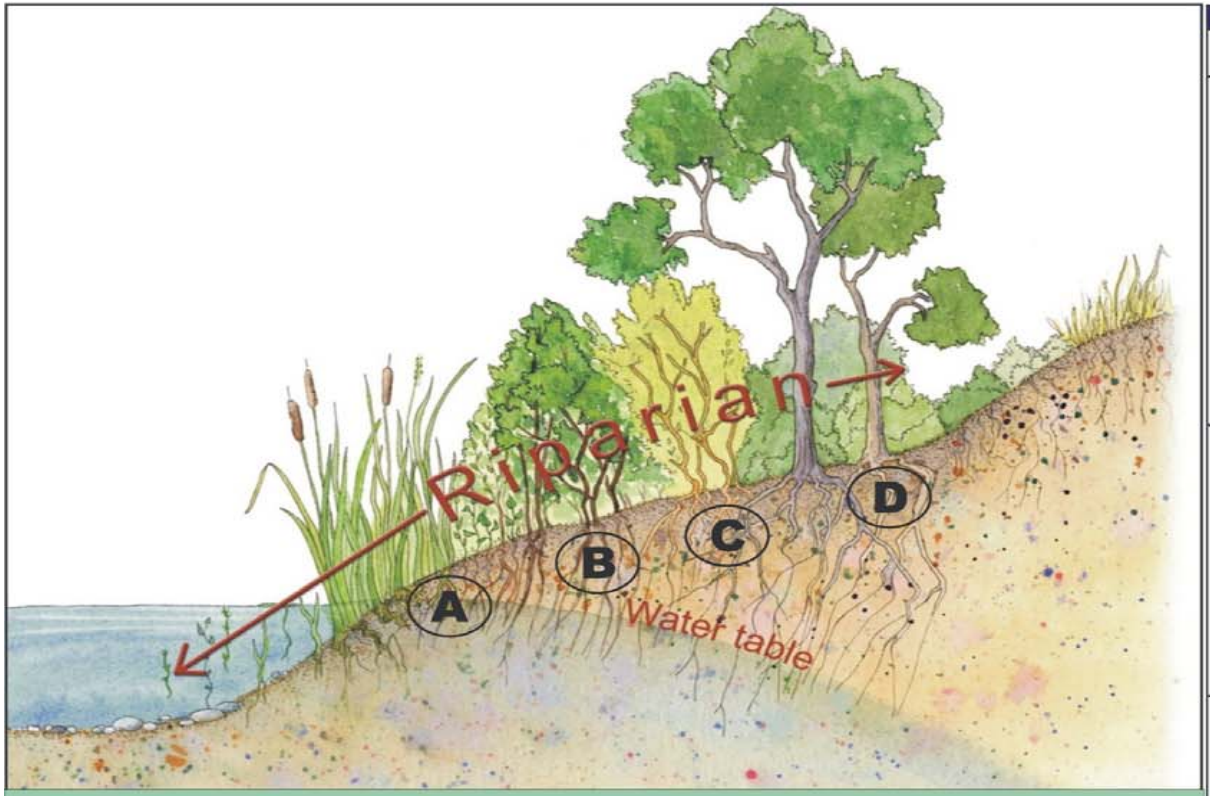
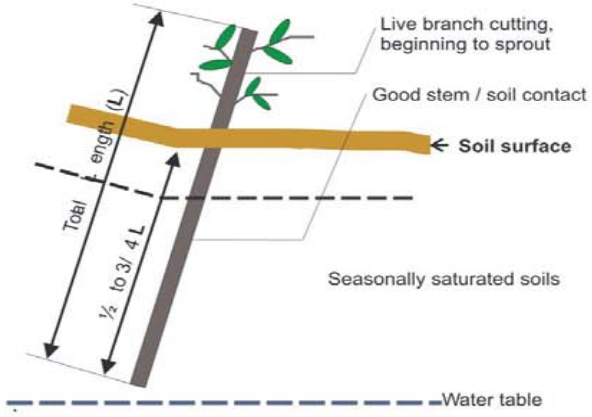



**Diagram for how to install willow, red-osier dogwood or balsam poplar live cuttings**




***General Notes:***

1) Harvest live branches in the spring and fall while they are still dormant (i.e. not leafed out).

2) Cuttings should be at least 2 cm in diameter (about the size of your thumb) and at least 50 cm to 3 m long. Ensure they are healthy and growing - they should be green and soft if the bark is scraped away. Keep cuttings moist and store in a dark, cold storage facility.

3) Soak cuttings in water for 10 days before planting in the early spring.

4) See the "Growing Restoration" Fact Sheet (enclosed) for more information.

**Adapted from:** Saldi-Caromile, K., K. Bates, P. Skidmore, J. Barenti, D. Pineo. 2004. Steam Habitat Restoration Guidelines: Final Draft. Co-published bythe Washington Departm ents of Fish and Wildlife and Ecology and the U.S. Fish and Wildlife Service. Olympia, Washington.

**TABLE 1**

| Moisture Gradient | Best Adapted, Locally Occurring Native Plant Species | |
|---|---|---|
| **A** **Wettest (permanently saturated)** Water levels are at or near the surface for most of the year. | ***Native grasses, sedges and rushes*** - common tall manna grass *(Glyceria grandis)* - small bottle sedge *(Carex utriculata)* - water sedge *(Carex aquatilis)* - woolly sedge *(Carex lanuginosa)* - creeping spike-rush *(Eleocharis palustris)* - small-fruited bulrush *(Scirpus microcarpus)* - wire rush *(Juncus balticus)* ***Native willows*** - sandbar willow *(Salix exigua)* - yellow willow *(Salix lutea)* - beaked willow *(Salix bebbiana)* - false mountain willow *(Salix pseudomonticola)* | |
| **B** **Moderately Wet (seasonally saturated)** Water levels are usually within 1 m of the soil surface throughout the summer. | ***Native grasses*** - fowl bluegrass *(Poa palustris)* - bluejoint *(Calamagrostis canadensis)* ***Native shrubs*** - sandbar willow *(Salix exigua)* - yellow willow *(Salix lutea)* - beaked willow *(Salix bebbiana)* - false mountain willow *(Salix pseudomonticola)* - red-osier dogwood *(Cornus stolonifera)* - water birch *(Betula occidentalis)* | |
| **C** **Moist (infrequently saturated)** Water table levels usually drop below 1 m of the soil surface in summer, but can remain moist. | ***Native shrubs*** - red-osier dogwood *(Cornus stolonifera)* - water birch *(Betula occidentalis)* - choke cherry *(Prunus virginiana)* ***Native trees*** - balsam poplar *(Populus balsamifera)* | |
| **D** **Moderately Dry (rarely saturated)** Soils are well drained and water table is below 1 m of soil surface | ***Native trees*** - white spruce (*Picea glauca*) - aspen (*Populus tremuloides*) | |
| | *Tall* | ***Native shrubs*** - choke cherry *(Prunus virginiana)* - round-leaved hawthorn (*Crataegus rotundifolia*) |
| | *Medium* | - saskatoon *(Amelanchier alnifolia)* - northern gooseberry *(Ribes oxyacanthoides)* - common wild rose *(Rosa woodsii)* - prickly rose (*Rosa acicularis*) - silverberry (*Elaeagnus commutata*) |
| | *Short* | - shrubby cinquefoil *(Potentilla fruticosa)* - buffaloberry (*Shepherdia canadensis*) - buckbrush/snowberry (*Symphoricarpos occidentalis*) - bracted or twining honeysuckle (*Lonicera involucrata; L. dioica*) - yellow mountain avens (*Dryas drummondii*) (ground cover) |

**Riparian Management of Urban Parks and Golf Course Sites:**

- Use native plants, where possible, for park landscaping and minimise the use of chemical herbicides, fungicides, pesticides and fertilizers, especially near the riparian area. The use of native plants for landscaping (especially those that are adapted to local conditions) helps to reduce watering and fertilizing requirements. Minimal use of chemical herbicides and fertilizers will reduce the amount of contaminants and nutrients entering into Nose Creek.
- Pay careful attention to the mix of plant species used for landscaping to prevent unintentional introduction of invasive ornamental species such as creeping bellflower / garden bluebell (*Campanula rapunculoides*), Dame's rocket (*Hesperis matronalis*), yellow clematis (*Clematis tangutica*), common caragana (*Caragana arborescens*) or Russian olive (*Elaeagnus angustifolia*). Refer to the enclosed Alberta Invasive Plant Council ***Weed Wise Gardening in Alberta*** brochure for more information.
- ***Avoid further structural impacts to the riparian area.*** For example, minimise creation of additional paved and hardened surfaces in the floodplain. Paved asphalt surfaces in the riparian area limit the moisture holding capacity of the floodplain and increase overland run-off of snowmelt and rainfall.

**Recreational Use:**

- Monitor recreational use in Environmental Reserves and urban parks.
- Restrict recreational use to designated pathways in Environmental Reserves and to pathways or existing altered portions of the floodplain in parks (away from native streambank habitats). Ensure dogs are kept on-leash near high integrity riparian habitats. Unrestricted public recreational use, including uncontrolled dog use, can damage sensitive riparian plant communities, cause bank erosion and ground disturbance and lead to proliferation of weeds and disturbance plants. Unrestricted recreational use can also damage or disturb bird nesting habitat. Well designed signs should be posted at all park / Reserve entry points to highlight the sensitivity of the area and clearly outline user responsibilities.

**Livestock Management in Rural Sites:**

- Pay attention to the timing, intensity and duration of use by livestock (including horses) in riparian areas. Riparian areas require rest and recovery during the growing season to maintain healthy woody plant communities.
- Fence 'like with like'. Pastures that have similar types of vegetation are easier to manage and maintain both good pasture and riparian health. Tame grass, native range and riparian areas can be fenced separately to manage these areas most effectively.
- Monitor fall grazing and any winter use. Even if livestock are provided feed during the winter they will still impact the riparian area if they have access to it. Livestock target woody plants in the fall/winter, which can result in trees/shrubs being lost from the riparian area. Feed and bedding can lead to nutrient build up in riparian areas and contamination of waterbodies.

- Distribute grazing pressure throughout the pasture. To accomplish this:
    - place salt/mineral/oilers away from water sources and from each other,
    - provide offsite water sources rather than using just surface water, and
    - cross-fence pastures where possible to provide rest during the growing season.
- Practice careful spring grazing management. Riparian areas are vulnerable to compaction in the spring when banks and shorelines are saturated. Grazing regrowth too soon severely impacts the amount of forage that is produced by that pasture throughout the rest of the growing season.
- Manage hay and tame forages. Ensure sufficient carry-over of perennial forage crops is left for fall, winter and spring to trap and hold moisture, prevent erosion and maintain soil health and plant vigour.

### *6.2 Riparian Monitoring Suggestions*

A single riparian health inventory cannot define the absolute status of site health. To measure trend, monitoring should be pursued in subsequent years. Riparian health monitoring is suggested at least every three to five years. Re-assessing riparian health is an important way of measuring progress of community and individual effort to address riparian land use issues. A larger scale riparian health inventory should be done in the future to better represent riparian health trends for the entire watershed.

Another useful monitoring tool is to establish demonstration and profile sites. Demonstration sites can be established in sites where restoration work or beneficial management changes will or have been implemented to improve riparian health. The purpose of these sites is to monitor the effectiveness of the restoration technique or management change by way of frequent photography monitoring and riparian health assessments. Public signage, interpretative tours, and reporting in newsletters or other forums are ways of showcasing lessons learned from demonstration sites. Profile sites can be established in Environmental Reserves or other undisturbed sites with high integrity native plant communities. These sites should be in *healthy* condition, or near *healthy* condition. The purpose of profile sites is to serve as reference sites in the watershed to showcase the ecological potential of natural, unmodified riparian areas.

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

Another cost effective monitoring tool is photography monitoring. Benchmark photographs taken at the upstream and downstream end points of each riparian health inventory site should be repeated yearly if possible. Other monitoring photographs can also be taken at management hot spots or areas of concern. Benchmark photograph monitoring should be done at a consistent time of year. As a standard rule, monitoring photographs should also be taken at consistent locations from the same vantage point. Where possible, monitoring photographs should be set-up to include permanent landscape features such as buildings, hills or bridges on the horizon to more easily locate and repeat photographs.

### *6.3 How to Contact Us*

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

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

**Kathryn Hull or Amanda Bogen Halawell**
Alberta Riparian Habitat Management Society (Cows and Fish)
#320, 6715 - 8th Street NE, Calgary, Alberta T2E 7H7
Telephone: (403) 451-1182
Fax: (403) 274-0007
Email: khull@cowsandfish.org or abogen@cowsandfish.org
www.cowsandfish.org

# 7 References Cited


Fitch, L., B. Adams and G. Hale. 2001. *Riparian Health Assessment for Streams and Small Rivers – Field Workbook*. Lethbridge, Alberta.

Gerrand, M., N. Bach, and G. Hale. 2001. *Nose Creek Watershed: Riparian Health Assessment Community Report.* Prepared for the Nose Creek Watershed Partnership and the Municipal District of Rocky View. Lethbridge, Alberta.

Halawell, A. and K. Hull. 2008. *Riparian Health Inventory 2007 Interim Report – Phase 1: Elbow River, West Nose, Nose and Beddington Creeks*. Prepared for the City of Calgary Parks and Water Resources. Calgary, Alberta.

Hull, K. 2009. *City of Calgary 2008 Riparian Health Inventory Interim Report*. Prepared for the City of Calgary Parks and Water Resources. Calgary, Alberta.

Palliser Environmental Services Ltd. 2008. *Linking Riparian Health Parameters to Forage and Biodiversity: Data Analysis and Compilation*. Cows and Fish Report No. 034. Lethbridge, Alberta.

Palliser Environmental Services Ltd. 2007a. *Nose Creek Watershed Riparian Photo Log Project*. Prepared for the Nose Creek Watershed Partnership. Calgary, Alberta.

Palliser Environmental Services Ltd. 2007b. *Nose Creek Watershed Water Management Plan*. Prepared for the Nose Creek Watershed Partnership. Calgary, Alberta.

Saunders, E. and T. Hurly. 2000a. *Birds, Creeks, and Cows: The Influence of Cattle Grazing on Birds and Vegetation in Cottonwood Forests along the Oldman River*. In: Proceedings of the Western Range Science Seminar – The Range: Progress and Potential. January 23-25, 2000, Lethbridge, Alberta. Agriculture, Food and Rural Development and Agri- Food Canada.

Saunders, E. and T. Hurly. 2000b. *The Influence of Grazing on Bird Populations Along a Prairie Creek in Southern Alberta*. Alberta Environment, Lethbridge, Alberta.

Stannard, M. and W. Crowder. 2001. *Biology, History, and Suppression of Reed Canarygrass (Phalaris arundinacea L.).* United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Plant Materials Technical Note 43, Pullman Plant Materials Center, Pullman, Washington.

Tannas, K. 2003. *Common Plants of the Western Rangelands, Volume 2: Trees and Shrubs*. Alberta Agriculture and Olds College. Olds, Alberta.

Thompson, W. and P. 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 Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta.

Thompson, W. and P. Hansen. 2002. *Classification and Management of Riparian and Wetland Sites of Alberta's Grasslands Natural Region and adjacent subregions*. Bitterroot Restoration, Inc., Prepared for the Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta.

# APPENDIX A: GLOSSARY OF TERMS

**Alluvial** –recent alluvial bars are an accumulation of sediments deposited by floodwater in the current season.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# APPENDIX B: LOCAL NURSERIES THAT SUPPLY NATIVE PLANTS

1) **ALCLA Native Plant Restoration Inc.**
3208 Bearspaw Dr. NW,
Calgary, AB T2L 1T2
Phone: (403) 282-6516
Fax: (403) 282-7090
Email: fedkenhp@cadvision.com
www.alclanativeplants.com

2) **Bearberry Creek Water Gardens**
RR2,
Sundre, AB T0M 1X0
Phone: (403) 638-4231
Fax: (403) 638-4793
Email: bbcreek@telus.net

3) **Boreal Horticultural Services Ltd.**
Bonnyville, AB
Phone / Fax: (780) 826-1709
Email: jbutt@incentre.net

4) **Bow Point Nursery Ltd.**
244034 Range Rd. 32
Calgary, AB T3Z 2E3
Phone: (403) 686-4434
Fax: (403) 242-8018
Email: info@bowpointnursery.com

5) **Eagle Lake Nurseries Ltd.**
Box 2340
Strathmore, AB T1P 1K3
Phone: (403) 934-3622
Fax: (403) 934-3626
Email:
gardencenter@eaglelakenurseries.com
www.eaglelakenurseries.com

6) **Eastern Slopes Rangeland Seed Ltd.**
Box 273
Cremona, AB T0M 0R0
Kathy & Clare Tannas
Phone: (403) 637-2473
Fax: (403) 637-2724
Email: ctannas@telusplanet.net

7) **Foothills Nurseries (wholesale)**
2626-48 St. SE
Calgary, AB T2B 1M4
Phone: (403) 203-3338
Fax: (403) 236-4433
Email: fhnurser@telusplanet.net

8) **Greenview Nurseries**
Box 12, Site 16, RR 7
Calgary, AB T2P 2G7
Phone: (403) 936-5431
Fax: (403) 936-5981
Email: info@greenviewnurseries
www.greenviewnurseries.ca

9) **(The) Professional Gardener Company Ltd. (wholesale, seeds only)**
915-23 Ave. SE
Calgary, AB T2G 1P1
Phone: (403) 263-4200
Fax: (403) 273-0029
Email: progar@telusplanet.net

# APPENDIX C: NOSE CREEK 2009 PROJECT AREA - RIPARIAN PLANT INVENTORY

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **TREES** | | | | | |
| aspen *(Populus tremuloides)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| balsam poplar *(Populus balsamifera)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| cottonwood *(Populus* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| lodgepole pine *(Pinus contorta)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| Manitoba maple *(Acer negundo)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| tamarack *(Larix laricina)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| white Elm *(Ulmus americana)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| white spruce *(Picea glauca)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| | | | | | |
| **SHRUBS** | | | | | |
| beaked willow *(Salix bebbiana)* | native | 2.8% | 0.0% | 10.0% | 75.0% |
| buckbrush/snowberry *(Symphoricarpos occidentalis)* | native | 3.7% | 0.0% | 20.0% | 75.0% |
| common wild rose *(Rosa woodsii)* | native | 5.6% | 0.0% | 20.0% | 50.0% |
| false mountain willow *(Salix pseudomonticola)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| mugo pine *(Pinus mugo)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| prickly rose *(Rosa acicularis)* | native | 3.0% | 0.0% | 3.0% | 25.0% |
| saskatoon *(Amelanchier alnifolia)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| shining willow *(Salix lucida)* | native | 2.3% | 0.0% | 3.0% | 50.0% |
| shrubby cinquefoil *(Potentilla fruticosa)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| silverberry *(Elaeagnus commutata)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| tatarian honeysuckle *(Lonicera tatarica)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| yellow willow *(Salix lutea)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| | | | | | |
| **GRASSES AND GRASS-LIKES** | | | | | |
| awned sedge *(Carex atherodes)* | native | 8.3% | 0.0% | 10.0% | 75.0% |
| bluejoint *(Calamagrostis canadensis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| common great bulrush *(Scirpus validus)* | native | 0.5% | 0.5% | 0.5% | 100.0% |
| common tall manna grass *(Glyceria grandis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| creeping spike-rush *(Eleocharis palustris)* | native | 1.0% | 0.0% | 3.0% | 75.0% |
| crested wheat grass *(Agropyron pectiniforme)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| fowl bluegrass *(Poa palustris)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| foxtail barley *(Hordeum jubatum)* | disturbance, native | 7.5% | 0.5% | 10.0% | 100.0% |
| graceful sedge *(Carex praegracilis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| green needle grass *(Stipa viridula)* | native | 0.5% | 0.0% | 0.5% | 50.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **GRASSES and GRASS-LIKES Cont'd**. | | | | | |
| Kentucky bluegrass *(Poa pratensis)* | disturbance, introduced | 24.2% | 20.0% | 40.0% | 100.0% |
| mat muhly *(Muhlenbergia richardsonis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| meadow foxtail *(Alopecurus pratensis)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| narrow reed grass *(Calamagrostis stricta)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| northern reed grass *(Calamagrostis inexpansa)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| northern wheat grass *(Agropyron dasystachyum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| Nuttall's salt-meadow grass *(Puccinellia nuttalliana)* | native | 19.4% | 0.0% | 20.0% | 50.0% |
| quack grass *(Agropyron repens)* | disturbance, introduced | 3.3% | 0.5% | 20.0% | 100.0% |
| red fescue *(Festuca rubra)* | native | 10.0% | 0.0% | 10.0% | 25.0% |
| redtop *(Agrostis stolonifera)* | introduced | 2.2% | 0.0% | 3.0% | 75.0% |
| reed canary grass *(Phalaris arundinacea)* | native | 6.9% | 0.0% | 10.0% | 75.0% |
| Russian wild rye *(Elymus junceus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| salt grass *(Distichlis stricta)* | native | 3.0% | 0.0% | 3.0% | 25.0% |
| sedge *(Carex* spp.*)* | unknown | 9.2% | 0.0% | 10.0% | 50.0% |
| slender wheat grass *(Agropyron trachycaulum var. unilaterale)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| slender wheat grass *(Agropyron trachycaulum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| slough grass *(Beckmannia syzigachne)* | native | 2.5% | 0.0% | 3.0% | 75.0% |
| small bottle sedge *(Carex utriculata)* | native | 3.0% | 0.0% | 3.0% | 50.0% |
| smooth brome *(Bromus inermis)* | disturbance, introduced | 8.9% | 3.0% | 30.0% | 100.0% |
| three-square rush *(Scirpus pungens)* | native | 2.7% | 0.0% | 3.0% | 75.0% |
| timothy *(Phleum pratense)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| tufted hair grass *(Deschampsia cespitosa)* | native | 2.8% | 0.5% | 3.0% | 100.0% |
| water sedge *(Carex aquatilis)* | native | 4.1% | 3.0% | 20.0% | 100.0% |
| western wheat grass *(Agropyron smithii)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| wire rush *(Juncus balticus)* | native | 31.4% | 3.0% | 40.0% | 100.0% |
| woolly sedge *(Carex lanuginosa)* | native | 1.3% | 0.5% | 10.0% | 100.0% |
| | | | | | |
| **FORBS** | | | | | |
| absinthe wormwood *(Artemisia absinthium)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| aster *(Aster* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| biennial sagewort *(Artemisia biennis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| bluebur *(Lappula squarrosa)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| butter-and-eggs (yellow toadflax) *(Linaria vulgaris)* | **invasive, introduced** | 0.5% | 0.0% | 0.5% | 50.0% |
| Canada anemone *(Anemone canadensis)* | native | 1.2% | 0.0% | 3.0% | 50.0% |
| Canada goldenrod *(Solidago canadensis)* | native | 0.5% | 0.5% | 0.5% | 100.0% |
| Canada thistle *(Cirsium arvense)* | **invasive, introduced** | 6.9% | 3.0% | 20.0% | 100.0% |
| common cattail *(Typha latifolia)* | native | 4.7% | 0.0% | 10.0% | 75.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **FORBS Cont'd.** | | | | | |
| common dandelion *(Taraxacum officinale)* | disturbance, introduced | 7.5% | 0.5% | 10.0% | 100.0% |
| common fireweed *(Epilobium angustifolium)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| common goat's-beard *(Tragopogon dubius)* | introduced | 0.5% | 0.0% | 0.5% | 75.0% |
| common horsetail *(Equisetum arvense)* | poisonous, native | 0.5% | 0.0% | 0.5% | 50.0% |
| common knotweed *(Polygonum arenastrum)* | introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| common mare's-tail *(Hippuris vulgaris)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| common nettle *(Urtica dioica)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| common pepper-grass *(Lepidium densiflorum)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| common plantain *(Plantago major)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| common yarrow *(Achillea millefolium)* | native | 1.0% | 0.0% | 3.0% | 75.0% |
| cow parsnip *(Heracleum lanatum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| creeping white prairie aster *(Aster falcatus)* | native | 3.0% | 0.0% | 3.0% | 25.0% |
| curled dock *(Rumex crispus)* | introduced | 3.0% | 0.0% | 3.0% | 25.0% |
| felwort *(Gentianella amarella)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| flixweed; tansy mustard *(Descurainia sophia)* | disturbance, introduced | 0.7% | 0.5% | 3.0% | 100.0% |
| Fremont's goosefoot *(Chenopodium fremontii)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| gaillardia *(Gaillardia aristata)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| golden bean *(Thermopsis rhombifolia)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| golden dock *(Rumex maritimus)* | native | 2.9% | 0.0% | 3.0% | 50.0% |
| goosefoot *(Chenopodium* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| gumweed *(Grindelia squarrosa)* | native | 2.9% | 0.0% | 3.0% | 50.0% |
| harebell *(Campanula rotundifolia)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| hemp-nettle *(Galeopsis tetrahit)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| lamb's-quarters *(Chenopodium album)* | disturbance, introduced | 2.3% | 0.5% | 3.0% | 100.0% |
| lance-leaved ironplant *(Haplopappus lanceolatus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| late goldenrod *(Solidago gigantea)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| Lindley's aster *(Aster ciliolatus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| marsh hedge-nettle *(Stachys palustris)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| marsh yellow cress *(Rorippa palustris)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| monkshood *(Aconitum delphinifolium)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| mustard *(Brassica* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| narrow-leaved bur-reed *(Sparganium angustifolium)* | native | 10.0% | 0.0% | 10.0% | 25.0% |
| narrow-leaved dock *(Rumex triangulivalvis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| northern bedstraw *(Galium boreale)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| northern green bog orchid *(Habenaria hyperborea)* | native | 0.5% | 0.0% | 0.5% | 25.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **FORBS Cont'd.** | | | | | |
| northern willowherb *(Epilobium ciliatum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| pasture sagewort *(Artemisia frigida)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| pineappleweed *(Matricaria matricarioides)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| plains cinquefoil *(Potentilla bipinnatifida)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| polygonum *(Polygonum* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| prairie cinquefoil *(Potentilla pensylvanica)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| prairie sagewort *(Artemisia ludoviciana)* | introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| prickly annual sow-thistle *(Sonchus asper)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| prickly lettuce *(Lactuca serriola)* | introduced | 0.5% | 0.0% | 0.5% | 75.0% |
| scentless chamomile *(Matricaria perforata)* | **invasive, introduced** | 1.2% | 0.0% | 3.0% | 50.0% |
| seaside arrow-grass *(Triglochin maritima)* | poisonous, native | 0.5% | 0.0% | 0.5% | 75.0% |
| seaside buttercup *(Ranunculus cymbalaria)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| silverweed *(Potentilla anserina)* | disturbance, native | 2.6% | 0.5% | 10.0% | 100.0% |
| smooth aster *(Aster laevis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| smooth perennial sow-thistle *(Sonchus uliginosus)* | **invasive, introduced** | 3.0% | 0.5% | 10.0% | 100.0% |
| star-flowered Solomon's-seal *(Smilacina stellata)* | native | 1.1% | 0.0% | 3.0% | 75.0% |
| sticky purple geranium *(Geranium viscosissimum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| stinkweed *(Thlaspi arvense)* | disturbance, introduced | 0.5% | 0.5% | 0.5% | 100.0% |
| strawberry blite *(Chenopodium capitatum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| summer-cypress *(Kochia scoparia)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| tufted white prairie aster *(Aster ericoides)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| veiny meadow rue *(Thalictrum venulosum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| water parsnip *(Sium suave)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| water smartweed *(Polygonum amphibium)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| water-hemlock *(Cicuta maculata)* | poisonous, native | 0.5% | 0.0% | 0.5% | 50.0% |
| western dock *(Rumex occidentalis)* | native | 2.4% | 0.0% | 3.0% | 75.0% |
| western willow aster *(Aster hesperius)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| white clover *(Trifolium repens)* | disturbance, introduced | 2.4% | 0.0% | 3.0% | 75.0% |
| white sweet-clover *(Melilotus alba)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| wild blue flax *(Linum lewisii)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| wild licorice *(Glycyrrhiza lepidota)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| wild mint *(Mentha arvensis)* | native | 1.1% | 0.0% | 3.0% | 75.0% |
| yellow sweet-clover *(Melilotus officinalis)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 75.0% |

[1] Our primary resource for plant species naming is Flora of Alberta by E.H. Moss (1994); for species not listed in Moss (1994), taxonomy follows the Integrated Taxonomic Information System (http://www.itis.gov/).

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

[3] 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%.

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

***Nose Creek 2009 Riparian Plant Composition Summary***

| Species Tally Summary | | Native Species Count | Percent Native Species |
|---|---|---|---|
| Total number of species = | 133 | 92 | 69% |
| Total number of TREE species = | 8 | 6 | 75% |
| Total number of SHRUB species = | 12 | 10 | 83% |
| Total number of GRASS / GRASS LIKE species = | 36 | 28 | 78% |
| Total number of FORB species = | 77 | 48 | 62% |

| Plant Status Summary | |
|---|---|
| Total number of **native** plants = | 92 |
| Total number of **restricted** plants = | 0 |
| Total number of **invasive woody** plants = | 0 |
| Total number of **invasive herbaceous** plants = | 4 |
| Total number of **disturbance** plants = | 17 |
| disturbance grasses / grass likes = | 6 (includes 1 native grass) |
| disturbance forbs = | 11 (includes 1 native forb) |

# APPENDIX D: WEST NOSE CREEK 2009 PROJECT AREA - RIPARIAN PLANT INVENTORY

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| | | | | | |
| **TREES** | | | | | |
| aspen *(Populus tremuloides)* | native | 2.9% | 0.0% | 10.0% | 75.0% |
| balsam poplar *(Populus balsamifera)* | native | 1.0% | 0.0% | 3.0% | 75.0% |
| white spruce *(Picea glauca)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| | | | | | |
| **SHRUBS** | | | | | |
| autumn willow *(Salix serissima)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| basket willow *(Salix petiolaris)* | native | 3.0% | 0.0% | 3.0% | 75.0% |
| beaked willow *(Salix bebbiana)* | native | 39.3% | 0.0% | 60.0% | 75.0% |
| bracted honeysuckle *(Lonicera involucrata)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| buckbrush/snowberry *(Symphoricarpos occidentalis)* | native | 0.9% | 0.0% | 3.0% | 75.0% |
| Canada buffaloberry *(Shepherdia canadensis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| common wild rose *(Rosa woodsii)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| false mountain willow *(Salix pseudomonticola)* | native | 3.3% | 0.0% | 10.0% | 75.0% |
| flat-leaved willow *(Salix planifolia)* | native | 18.1% | 0.0% | 20.0% | 75.0% |
| northern gooseberry *(Ribes oxyacanthoides)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| shrubby cinquefoil *(Potentilla fruticosa)* | native | 3.0% | 0.0% | 3.0% | 75.0% |
| velvet-fruited willow *(Salix maccalliana)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| yellow willow *(Salix lutea)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| | | | | | |
| **GRASSES AND GRASS-LIKES** | | | | | |
| awned sedge *(Carex atherodes)* | native | 10.0% | 0.0% | 10.0% | 25.0% |
| bluejoint *(Calamagrostis canadensis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| common tall manna grass *(Glyceria grandis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| foothills rough fescue *(Festuca campestris)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| fowl bluegrass *(Poa palustris)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| fowl manna grass *(Glyceria striata)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| foxtail barley *(Hordeum jubatum)* | disturbance, native | 0.5% | 0.0% | 0.5% | 50.0% |
| graceful sedge *(Carex praegracilis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| green needle grass *(Stipa viridula)* | native | 0.9% | 0.0% | 3.0% | 50.0% |
| Kentucky bluegrass *(Poa pratensis)* | disturbance, introduced | 4.6% | 0.0% | 40.0% | 75.0% |
| knotted rush *(Juncus nodosus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **GRASSES AND GRASS-LIKES Cont'd.** | | | | | |
| long-styled rush *(Juncus longistylis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| mat muhly *(Muhlenbergia richardsonis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| narrow reed grass *(Calamagrostis stricta)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| northern reed grass *(Calamagrostis inexpansa)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| quack grass *(Agropyron repens)* | disturbance, introduced | 3.0% | 0.0% | 3.0% | 25.0% |
| sedge *(Carex* spp.*)* | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| slender wheat grass *(Agropyron trachycaulum var. unilaterale)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| small bottle sedge *(Carex utriculata)* | native | 3.0% | 0.0% | 3.0% | 75.0% |
| small-fruited bulrush *(Scirpus microcarpus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| smooth brome *(Bromus inermis)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| tall cotton grass *(Eriophorum polystachion)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| timothy *(Phleum pratense)* | disturbance, introduced | 1.0% | 0.0% | 3.0% | 50.0% |
| tufted hair grass *(Deschampsia cespitosa)* | native | 0.9% | 0.0% | 10.0% | 75.0% |
| water sedge (*Carex aquatilis)* | native | 51.8% | 0.0% | 60.0% | 75.0% |
| western porcupine grass *(Stipa curtiseta)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| wire rush *(Juncus balticus)* | native | 9.7% | 0.0% | 10.0% | 75.0% |
| woolly sedge *(Carex lanuginosa)* | native | 10.0% | 0.0% | 10.0% | 25.0% |
| | | | | | |
| **FORBS** | | | | | |
| alpine hedysarum *(Hedysarum alpinum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| Canada anemone *(Anemone canadensis)* | native | 3.3% | 0.0% | 10.0% | 75.0% |
| Canada goldenrod *(Solidago canadensis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| Canada thistle *(Cirsium arvense)* | ***invasive, introduced*** | 1.3% | 0.0% | 10.0% | 75.0% |
| celery-leaved buttercup *(Ranunculus sceleratus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| common cattail *(Typha latifolia)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| common dandelion *(Taraxacum officinale)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 75.0% |
| common horsetail *(Equisetum arvense)* | native, poisonous | 0.5% | 0.0% | 0.5% | 25.0% |
| common knotweed *(Polygonum arenastrum)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| common plantain *(Plantago major)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **FORBS Cont'd.** | | | | | |
| common yarrow *(Achillea millefolium)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| creeping white prairie aster *(Aster falcatus)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| cut-leaved anemone *(Anemone multifida)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| felwort *(Gentianella amarella)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| few-flowered ragwort *(Senecio pauciflorus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| flixweed; tansy mustard *(Descurainia sophia)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| Flodman's thistle *(Cirsium flodmanii)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| gaillardia *(Gaillardia aristata)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| golden bean *(Thermopsis rhombifolia)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| golden dock *(Rumex maritimus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| graceful cinquefoil *(Potentilla gracilis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| harebell *(Campanula rotundifolia)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| heart-leaved Alexanders *(Zizia aptera)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| lamb's-quarters *(Chenopodium album)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| large-leaved yellow avens *(Geum macrophyllum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| long-stalked chickweed *(Stellaria longipes)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| low goldenrod *(Solidago missouriensis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| marsh hedge-nettle *(Stachys palustris)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| marsh ragwort *(Senecio congestus)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| marsh yellow cress *(Rorippa palustris)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| northern bedstraw *(Galium boreale)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| northern grass-of-parnassus *(Parnassia palustris)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| northern green bog orchid *(Habenaria hyperborea)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| northern willowherb *(Epilobium ciliatum)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| plains cinquefoil *(Potentilla bipinnatifida)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| prairie sagewort *(Artemisia ludoviciana)* | introduced | 0.5% | 0.0% | 0.5% | 50.0% |
| puccoon; woolly gromwell *(Lithospermum ruderale)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| purple milk vetch *(Astragalus dasyglottis)* | native | 0.5% | 0.0% | 0.5% | 25.0% |

| Life Form[1] | Plant Status[2] | Percent Canopy Cover[3] | | | |
|---|---|---|---|---|---|
| | | Average | Range | | Constancy[4] |
| **FORBS Cont'd.** | | | | | |
| seaside arrow-grass *(Triglochin maritima)* | native, poisonous | 0.5% | 0.0% | 0.5% | 25.0% |
| seaside buttercup *(Ranunculus cymbalaria)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| showy everlasting *(Antennaria pulcherrima)* | disturbance, native | 0.5% | 0.0% | 0.5% | 25.0% |
| silverweed *(Potentilla anserina)* | disturbance, native | 0.5% | 0.0% | 0.5% | 75.0% |
| silvery cinquefoil *(Potentilla argentea)* | introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| slender arrow-grass *(Triglochin palustris)* | native, poisonous | 0.5% | 0.0% | 0.5% | 50.0% |
| smooth aster *(Aster laevis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| smooth perennial sow-thistle *(Sonchus uliginosus)* | ***invasive, introduced*** | 3.3% | 0.0% | 10.0% | 75.0% |
| smooth scouring-rush *(Equisetum laevigatum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| star-flowered Solomon's-seal *(Smilacina stellata)* | native | 0.6% | 0.0% | 3.0% | 75.0% |
| sticky purple geranium *(Geranium viscosissimum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| stinkweed *(Thlaspi arvense)* | disturbance, introduced | 0.5% | 0.0% | 0.5% | 25.0% |
| unknown forb | unknown | 0.5% | 0.0% | 0.5% | 25.0% |
| veiny meadow rue *(Thalictrum venulosum)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| water parsnip *(Sium suave)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| water smartweed *(Polygonum amphibium)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| water-hemlock *(Cicuta maculata)* | native, poisonous | 0.5% | 0.0% | 0.5% | 25.0% |
| western Canada violet *(Viola canadensis)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| western dock *(Rumex occidentalis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| western willow aster *(Aster hesperius)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| white clover *(Trifolium repens)* | disturbance, introduced | 3.0% | 0.0% | 3.0% | 25.0% |
| wild bergamot *(Monarda fistulosa)* | native | 3.0% | 0.0% | 3.0% | 25.0% |
| wild mint *(Mentha arvensis)* | native | 0.5% | 0.0% | 0.5% | 75.0% |
| wild strawberry *(Fragaria virginiana)* | disturbance, native | 0.9% | 0.0% | 3.0% | 75.0% |
| wild vetch *(Vicia americana)* | native | 0.5% | 0.0% | 0.5% | 25.0% |
| yellow avens *(Geum aleppicum)* | native | 0.5% | 0.0% | 0.5% | 50.0% |
| yellow false dandelion *(Agoseris glauca)* | native | 0.5% | 0.0% | 0.5% | 25.0% |

[1] Our primary resource for plant species naming is Flora of Alberta by E.H. Moss (1994); for species not listed in Moss (1994), taxonomy follows the Integrated Taxonomic Information System (http://www.itis.gov/).

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

[3] 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%.

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

***West Nose Creek 2009 Riparian Plant Composition Summary***

| Species Tally Summary | | Native Species Count | Percent Native Species |
|---|---|---|---|
| Total number of species = | 109 | 92 | 84% |
| Total number of TREE species = | 3 | 3 | 100% |
| Total number of SHRUB species = | 13 | 13 | 100% |
| Total number of GRASS / GRASS LIKE species = | 28 | 23 | 82% |
| Total number of FORB species = | 65 | 53 | 82% |

| Plant Status Summary | |
|---|---|
| Total number of **native** plants = | 92 |
| Total number of **restricted** plants = | 0 |
| Total number of **invasive woody** plants = | 0 |
| Total number of **invasive herbaceous** plants = | 2 |
| Total number of **disturbance** plants = | 14 |
| disturbance grasses / grass likes = | 5 (includes 1 native grass) |
| disturbance forbs = | 9 (includes 3 native forbs) |

# APPENDIX E: NOS 4 (NOSE CREEK PARK, AIRDRIE) SCORE SHEET AND MONITORING PHOTOGRAPHS

**Waterbody:** Nose Creek **Location:** Nose Creek Park, Airdrie **Site Code:** NOS4

**First Inventory Date:** August 1, 2000 **Second Inventory Date:** August 17, 2009

| Question | 2000 | | | 2009 | | | |
|---|---|---|---|---|---|---|---|
| **Vegetation** | **Actual Score** | **Possible Score** | **%** | **Actual Score** | **Possible Score** | **%** | **Health Trend** |
| Vegetative Cover of Floodplain and Streambanks | 3 | 3 | | 6 | 6 | | No change |
| Invasive Plant Species (Cover) | 0 | 3 | | 1 | 3 | | Improved |
| Invasive Plant Species (Density Distribution) | NC | NC | | 0 | 3 | | NA |
| Disturbance-Caused Undesirable Herbaceous Species | 0 | 3 | | 0 | 3 | | No change |
| Preferred Tree and Shrub Establishment and Regeneration | 2 | 6 | | 6 | 6 | | Improved |
| Total Canopy Cover of Woody Species | 2 | 3 | | (*3) | 3 | | Improved |
| Utilisation of Preferred Trees and Shrubs | 3 | 3 | | 2 | 3 | | Declined |
| Woody Vegetation Removal by Other than Browsing | NC | NC | | 3 | 3 | | NA |
| Decadent and Dead Woody Material | 3 | 3 | | 3 | 3 | | No change |
| **Vegetation Rating** | **13** | **24** | **54** | **21** | **30** | **70** | **Improved** |
| **Soil/Hydrology** | | | | | | | |
| Streambank Root Mass Protection | 4 | 6 | | 6 | 6 | | Improved |
| Active Lateral Cutting of Streambanks | 6 | 6 | | (*6) | 6 | | No change |
| Human-Caused Bare Ground | 4 | 6 | | 6 | 6 | | Improved |
| Streambank Structurally Altered | 6 | 6 | | 4 | 6 | | Declined |
| Amount of Fine Material Present to Hold Water and Act as a Rooting Medium | 6 | 6 | | (*6) | 6 | | No change |
| Human Physical Alteration to Polygon | NC | NC | | 2 | 3 | | NA |
| Stream Channel Incisement | 2 | 6 | | 6 | 9 | | Improved |
| **Soil/Hydrology Rating** | **28** | **36** | **78** | **24** | **30** | **80** | **Improved** |
| **Overall Rating** | **41** | **60** | **68** | **45** | **60** | **75** | **Improved** |

**NC** – **Not Collected** – Data that was not collected and could not be extrapolated due to changes in the assessment methods.

**NA** – **Not Applicable** – Parameters for which a trend analysis could not be completed because of changes in assessment methods.

**(*)** Indicates numbers that were extrapolated from data to observe trends for parameters that no longer contribute to the final health rating.

| | |
|---|---|
| | **Healthy (80-100%)** – Little or no impairment to riparian functions. |
| | **Healthy but with Problems (60-79%)** – Some impairment to riparian functions due to human or natural causes. |
| | **Unhealthy (<60%)** – Impairment to many riparian functions due to human or natural causes. |

## NOS4 Benchmark Monitoring Photographs

2000

S. Witham, RHIP04NOS002

**NOS4U** Upstream end looking downstream. The floodplain is well vegetated although disturbance-caused grasses are prevalent.

2009

K. Hull, RHIP04NOS012

**NOS4U** Upstream end looking downstream. The floodplain and banks remain well vegetated. Native plant cover along the banks has improved since 2000.

2000

S. Witham, RHIP04NOS004

**NOS4L** Downstream end looking upstream. Bank slumping is apparent due to a lack of deeply rooted native plants at this location.

2009

K. Hull, RHIP04NOS016

**NOS4L** Downstream end looking upstream. Willows planted here in 2006 (as part of a soil bioengineering project) may have been impacted in 2008 during the repair of a ruptured water pipe.

### *2009 New Monitoring Photos*

2009

K. Hull, RHIP04NOS018

**NOS4A** Close-up view of the bioengineering site at the downstream end. Wattle fencing is intact, but additional reinforcement may be needed.

2009

K. Hull, RHIP04NOS028

**NOS4G** There is an excellent band of deeply rooted native plants along most of the streambank. Where possible, a wider band of natural riparian vegetation should be protected from mowing to improve infiltration capacity in the floodplain and to reduce runoff rates.

**NOS4 Aerial Photographs (circa 2000 and 2007)**


**Airphoto Date: circa 2000**


**Airphoto Date: 2007**

# APPENDIX F: NOS 17 (WILLOW BROOK PARK, AIRDRIE) SCORE SHEET AND MONITORING PHOTOGRAPHS

**Waterbody:** Nose Creek **Location:** Willow Brook Park, Airdrie **Site Code:** NOS17

**First Inventory Date:** August 17, 2000 **Second Inventory Date:** August 18, 2009

| Question | 2000 | | | 2009 | | | |
|---|---|---|---|---|---|---|---|
| **Vegetation** | **Actual Score** | **Possible Score** | **%** | **Actual Score** | **Possible Score** | **%** | **Health Trend** |
| Vegetative Cover of Floodplain and Streambanks | 2 | 3 | | 6 | 6 | | Improved |
| Invasive Plant Species (Cover) | 0 | 3 | | 0 | 3 | | No change |
| Invasive Plant Species (Density Distribution) | NC | NC | | 0 | 3 | | NA |
| Disturbance-Caused Undesirable Herbaceous Species | 0 | 3 | | 0 | 3 | | No change |
| Preferred Tree and Shrub Establishment and Regeneration | 4 | 6 | | 6 | 6 | | Improved |
| Total Canopy Cover of Woody Species | 0 | 3 | | (*0) | 3 | | No change |
| Utilisation of Preferred Trees and Shrubs | 3 | 3 | | 3 | 3 | | No change |
| Woody Vegetation Removal by Other than Browsing | NC | NC | | 3 | 3 | | NA |
| Decadent and Dead Woody Material | 3 | 3 | | 3 | 3 | | No change |
| **Vegetation Rating** | **12** | **24** | **50** | **21** | **30** | **70** | **Improved** |
| **Soil/Hydrology** | | | | | | | |
| Streambank Root Mass Protection | 0 | 6 | | 2 | 6 | | Improved |
| Active Lateral Cutting of Streambanks | 6 | 6 | | (*6) | 6 | | No change |
| Human-Caused Bare Ground | 4 | 6 | | 6 | 6 | | Improved |
| Streambank Structurally Altered | 0 | 6 | | 0 | 6 | | No change |
| Amount of Fine Material Present to Hold Water and Act as a Rooting Medium | 6 | 6 | | (*6) | 6 | | No change |
| Human Physical Alteration to Polygon | NC | NC | | 0 | 3 | | NA |
| Stream Channel Incisement | 2 | 6 | | 3 | 9 | | No change |
| **Soil/Hydrology Rating** | **18** | **36** | **50** | **11** | **30** | **37** | **Declined** |
| **Overall Rating** | **30** | **60** | **50** | **32** | **60** | **53** | **Improved** |

**NC** – **Not Collected** – Data that was not collected and could not be extrapolated due to changes in the assessment methods.

**NA** – **Not Applicable** – Parameters for which a trend analysis could not be completed because of changes in assessment methods.

**(*)** Indicates numbers that were extrapolated from data to observe trends for parameters that no longer contribute to the final health rating.

| | |
|---|---|
| | **Healthy (80-100%)** – Little or no impairment to riparian functions. |
| | **Healthy but with Problems (60-79%)** – Some impairment to riparian functions due to human or natural causes. |
| | **Unhealthy (<60%)** – Impairment to many riparian functions due to human or natural causes. |

## NOS17 Benchmark Monitoring Photographs

**2000**

K. O'Shaughnessy, RHIP17NOS002

**NOS17U** Upstream end looking downstream. The floodplain is well vegetated and the channel has natural meander bends.

**2009 (new upstream end)**

K. Hull, RHIP17NOS018

**NOS17U** Upstream end looking downstream. This portion of Nose Creek has been channelized since 2000. This has created channel incisement and loss of riparian habitat.

**2000**

K. O'Shaughnessy, RHIP17NOS004

**NOS17L** Downstream end looking upstream. Channelization and berms have contributed to lateral (outward erosion) of the stream channel.

**2009**

Hull, RHIP17NOS021

**NOS17L** Downstream end looking upstream. The downstream portion of the site has not changed appreciably since 2000. Introduced grasses seeded along the bermed west bank offer little root mass protection or fish habitat value.

## *2009 New Monitoring Photos*

**2009**

K. Hull,, RHIP17NOS019

**NOS17U** Weed monitoring and control is needed along the newly constructed berm at the upstream end (on the east side of the creek).

K. Hull, RHIP17NOS027

**NOS17F** Natural seeps / springs occur on the east side of the creek opposite the storm pond. This portion of the site has remnant, intact native riparian plant communities.

**NOS17 Aerial Photographs (circa 2000 and 2007)**


**Airphoto Date: circa 2000**


**Airphoto Date: 2007**

# APPENDIX G: NOS15 (CROSSFIELD, GOLF COURSE) SCORE SHEET AND MONITORING PHOTOGRAPHS

**Waterbody:** Nose Creek **Location:** Crossfield (vicinity), Alberta **Site Code:** NOS15

**First Inventory Date:** August 16, 2000 **Second Inventory Date:** August 19, 2009

| Question | 2000 | | | 2009 | | | |
|---|---|---|---|---|---|---|---|
| **Vegetation** | **Actual Score** | **Possible Score** | **%** | **Actual Score** | **Possible Score** | **%** | **Health Trend** |
| Vegetative Cover of Floodplain and Streambanks | 3 | 3 | | 6 | 6 | | No change |
| Invasive Plant Species (Cover) | 0 | 3 | | 0 | 3 | | No change |
| Invasive Plant Species (Density Distribution) | NC | NC | | 0 | 3 | | NA |
| Disturbance-Caused Undesirable Herbaceous Species | 0 | 3 | | 0 | 3 | | No change |
| Preferred Tree and Shrub Establishment and Regeneration | 6 | 6 | | 2 | 6 | | Declined |
| Total Canopy Cover of Woody Species | 0 | 3 | | (*0) | (3) | | No change |
| Utilisation of Preferred Trees and Shrubs | 3 | 3 | | 3 | 3 | | No change |
| Woody Vegetation Removal by Other than Browsing | NC | NC | | 3 | 3 | | NA |
| Decadent and Dead Woody Material | 3 | 3 | | 3 | 3 | | No change |
| **Vegetation Rating** | **15** | **24** | **63** | **17** | **30** | **57** | **Declined** |
| **Soil/Hydrology** | | | | | | | |
| Streambank Root Mass Protection | 6 | 6 | | 2 | 6 | | Declined |
| Active Lateral Cutting of Streambanks | 6 | 6 | | (*6) | (6) | | No change |
| Human-Caused Bare Ground | 6 | 6 | | 4 | 6 | | Declined |
| Streambank Structurally Altered | 6 | 6 | | 2 | 6 | | Declined |
| Amount of Fine Material Present to Hold Water and Act as a Rooting Medium | 6 | 6 | | (*6) | (6) | | No change |
| Human Physical Alteration to Polygon | NC | NC | | 0 | 3 | | NA |
| Stream Channel Incisement | 6 | 6 | | 9 | 9 | | No change |
| **Soil/Hydrology Rating** | **36** | **36** | **100** | **17** | **30** | **57** | **Declined** |
| **Overall Rating** | **51** | **60** | **85** | **34** | **60** | **57** | **Declined** |

NC – Not Collected – Data that was not collected and could not be extrapolated due to changes in the assessment methods.
NA – Not applicable – Parameters for which a trend analysis could not be completed because of changes in assessment methods.
(*) Indicates numbers that were extrapolated from data to observe trends for parameters that no longer contribute to the final health rating.

| | |
|---|---|
| | **Healthy (80-100%)** – Little or no impairment to riparian functions. |
| | **Healthy but with Problems (60-79%)** – Some impairment to riparian functions due to human or natural causes. |
| | **Unhealthy (<60%)** – Impairment to many riparian functions due to human or natural causes. |

## NOS15 Benchmark Monitoring Photographs

**2000**

K. O'Shaughnessy, RHIP15NOS002

**NOS15U** Upstream end looking downstream. Canada thistle patch in foreground. Good vegetation cover and wide riparian buffer. Narrow creek channel.

**2009**

K. Romanchuk, RHIP15NOS013

**NOS15U** Upstream end looking downstream. Golf course development has reduced the width of the riparian buffer on the east (right) side of creek. The creek channel is wider due to an ice jam at the culvert crossing. Canada thistle cover has increased.

**2000**

K. O'Shaughnessy, RHIP15NOS007

**NOS15A** Note the wide vegetated riparian buffer and excellent root mass protection along Nose Creek from deeply rooted grasses and sedges.

**2009**

K. Romanchuk, RHIP15NOS021

**NOS15A** Much of the riparian area has been converted to golf course fairways. This has created soil compaction, reduced root mass protection along the banks, reduced runoff filtration capacity, and less habitat for fish.

*2009 New Monitoring Photos*

**2009**

K. Romanchuk,, RHIP15NOS020

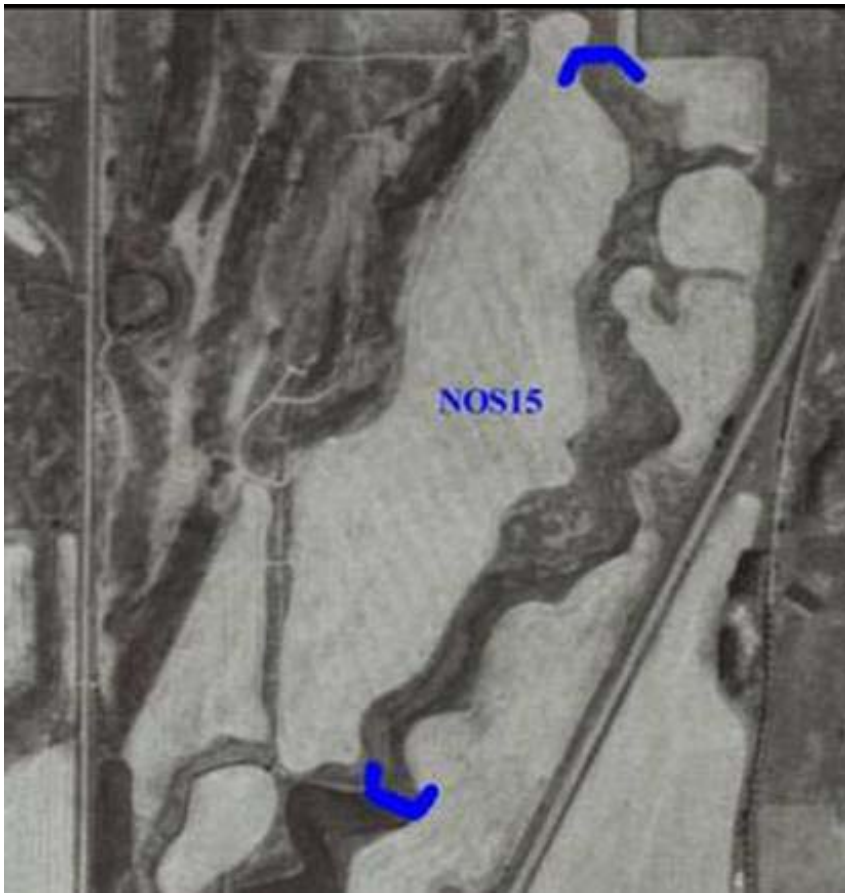
**NOS15A** Culvert crossings constrict water flows creating ice jams, erosion and bank slumping. This increases sediment inputs into the stream, decreasing water quality.

**2009**

K. Romanchuk, RHIP15NOS024

**NOS15D** Erosion along a small tributary that flows into Nose Creek near the upstream end on the east side of the creek. Lack of a riparian buffer is contributing to erosion.

## NOS15 Aerial Photographs (circa 2000 and 2007)




**Airphoto Date: circa 2000**


**Airphoto Date: circa 2007**

# APPENDIX H: WNO7 (ROCKY VIEW COUNTY, ENVIRONMENTAL RESERVE) SCORE SHEET AND MONITORING PHOTOGRAPHS

**Waterbody:** West Nose Creek **Location:** Environmental Reserve, Rocky View County **Site Code:** WNO7

**First Inventory Date:** June 21, 2000 **Second Inventory Date:** August 19, 2009

| Question | 2000 | | | 2009 | | | |
|---|---|---|---|---|---|---|---|
| **Vegetation** | **Actual Score** | **Possible Score** | **%** | **Actual Score** | **Possible Score** | **%** | **Health Trend** |
| Vegetative Cover of Floodplain and Streambanks | 3 | 3 | | 6 | 6 | | No change |
| Invasive Plant Species (Cover) | 2 | 3 | | 1 | 3 | | Declined |
| Invasive Plant Species (Density Distribution) | **NC** | **NC** | | 0 | 3 | | **NC** |
| Disturbance-Caused Undesirable Herbaceous Species | 2 | 3 | | 2 | 3 | | No change |
| Preferred Tree and Shrub Establishment and Regeneration | 6 | 6 | | 6 | 6 | | No change |
| Total Canopy Cover of Woody Species | 3 | 3 | | *(*3)* | *(3)* | | No change |
| Utilisation of Preferred Trees and Shrubs | 2 | 3 | | 2 | 3 | | No change |
| Woody Vegetation Removal by Other than Browsing | **NC** | **NC** | | 3 | 3 | | **NC** |
| Decadent and Dead Woody Material | 3 | 3 | | 3 | 3 | | No change |
| **Vegetation Rating** | **21** | **24** | **88** | **23** | **30** | **77** | **Declined** |
| **Soil/Hydrology** | | | | | | | |
| Streambank Root Mass Protection | NA | NA | | NA | NA | | NA |
| Active Lateral Cutting of Streambanks | NA | NA | | *(*NA)* | *(NA)* | | NA |
| Human-Caused Bare Ground | 6 | 6 | | 6 | 6 | | No change |
| Streambank Structurally Altered | NA | NA | | NA | NA | | NA |
| Human Physical Alteration to Polygon | **NC** | **NC** | | 0 | 3 | | **NC** |
| Stream Channel Incisement | NA | NA | | NA | NA | | NA |
| **Soil/Hydrology Rating** | **6** | **6** | **100** | **6** | **9** | **67** | |
| **Overall Rating** | **27** | **30** | **90** | **29** | **39** | **74** | **Not comparable** |

**NC** – **Not Collected** – Data that was not collected and could not be extrapolated due to changes in the assessment methods.

**NA** – **Not Applicable** – Parameters for which a trend analysis could not be completed because of changes in assessment methods.

**(*)** Indicates numbers that were extrapolated from data to observe trends for parameters that no longer contribute to the final health rating.

| | |
|---|---|
| | **Healthy (80-100%)** – Little or no impairment to riparian functions. |
| | **Healthy but with Problems (60-79%)** – Some impairment to riparian functions due to human or natural causes. |
| | **Unhealthy (<60%)** – Impairment to many riparian functions due to human or natural causes. |

## WNO7 Benchmark Monitoring Photographs

**2000**

A. Markiewicz, RHIP07WNO001

**WNO7U** Upstream end looking downstream. Excellent vegetative cover of the floodplain.

**2009**

K. Hull, RHIP07WNO008

**WNO7U** Upstream end looking downstream. The riparian area remains fully vegetated with water sedge and beaked willow communities. Vegetative cover is important for reducing erosion, trapping sediment and stabilising banks, and for providing forage and shelter for wildlife.

**2000**

A. Markiewicz, RHIP07WNO005

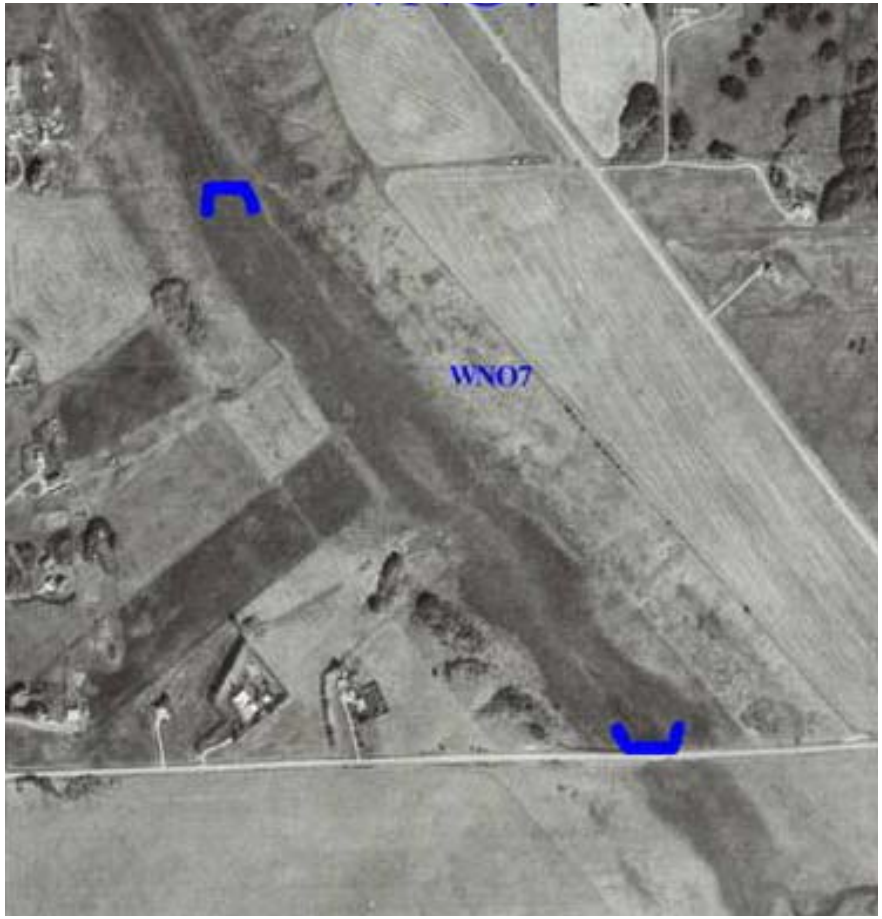
**WNO7L** Downstream end looking upstream. A large sedge meadow bordered by willows runs through the middle of the valley.

**2009**

K. Hull RHIP07WNOS012

**WNO7L** Downstream end looking upstream. The wide, robust sedge channel in the middle of the valley persists. Road construction activities have occurred since 2000. A new culvert crossing and associated rip-rap has been installed at this end of the site.

**WNO7 Aerial Photographs (circa 2000 and 2007)**




**Airphoto Date: circa 2000**


**Airphoto Date: 2007**

# APPENDIX I – 2009 RIPARIAN HEALTH SCORE SHEET CATEGORIES FOR STREAMS AND SMALL RIVERS

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

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

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

**1. Vegetative Cover of Floodplain and Streambanks**

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

**2a. Total Canopy Cover of Invasive Plant Species**

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

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

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

**3. Disturbance-Caused Undesirable Herbaceous Species**

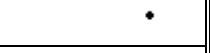
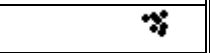
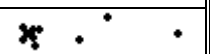
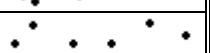
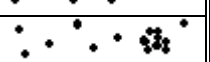
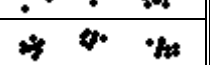
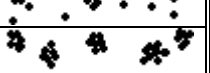
**3** = Less than 5% of the site covered by disturbance-caused undesirable herbaceous species.
**2** = 5% to 25% of the site covered by disturbance-caused undesirable herbaceous species.
**1** = 25% to 50% of the site covered by disturbance-caused undesirable herbaceous species.
**0** = More than 50%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

**4. Preferred Tree and Shrub Establishment and Regeneration**

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

**6** = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.
**4** = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.
**2** = Less than 5% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.
**0** = Preferred tree/shrub seedlings and saplings absent.

**Table 1.** Density/distribution of invasive plant species.

| Class | Description of Abundance | Distribution Pattern |
|---|---|---|
| 0 | No invasive plants on the polygon | |
| 1 | Rare occurrence |  |
| 2 | A few sporadically occurring individual plants |  |
| 3 | A single patch |  |
| 4 | A single patch plus a few sporadically occurring plants |  |
| 5 | Several sporadically occurring plants |  |
| 6 | A single patch plus several sporadically occurring plants |  |
| 7 | A few patches |  |
| 8 | A few patches plus several sporadically occurring plants |  |
| 9 | Several well spaced patches |  |
| 10 | Continuous uniform occurrence of well spaced plants |  |
| 11 | Continuous occurrence of plants with a few gaps in the distribution |  |
| 12 | Continuous dense occurrence of plants |  |
| 13 | Continuous occurrence of plants associated with a wetter or drier zone within the polygon |  |

**5a. Utilisation of Preferred Trees and Shrubs**

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

**3** = None (0% to 5% of available 2nd year and older leaders of preferred species are browsed).
**2** = Light (5% to 25% of available 2nd year and older leaders of preferred species are browsed).
**1** = Moderate (25% to 50% of available 2nd year and older leaders of preferred species are browsed).
**0** = Heavy (More than 50% of available 2nd year and older leaders of preferred species are browsed).

**5b. Live Woody Vegetation Removal by Other than Browsing**

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

**3** = None (0% to 5% of live woody vegetation expected on the site is lacking due to cutting and/or removal by beaver).
**2** = Light (5% to 25% of live woody vegetation expected on the site is lacking due to cutting and/or removal by beaver).
**1** = Moderate (25% to 50% of live woody vegetation expected on the site is lacking due to cutting and/or removal by beaver).
**0** = Heavy (More than 50% of live woody vegetation expected on the site is lacking due to cutting and/or removal by beaver).

**6. Standing Decadent and Dead Woody Material**

**3** = Less than 5% of the total canopy of woody species is decadent or dead.
**2** = 5% to 25% of the total canopy of woody species is decadent or dead.
**1** = 25% to 45% of the total canopy cover of woody species is decadent or dead.
**0** = More than 45% of the total canopy cover of woody species is decadent or dead.

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

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

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

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

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

| Incisement Severity | Channel Development Stage | Rosgen Types Included | Description of Incisement Situation |
|---|---|---|---|
| Not Incised flows (9 points) | A | A, B, C, E | Channel is vertically stable and not incised; 1-2 year high flows can begin to access a floodplain appropriate to the stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain inside which perennial riparian plant communities are well established. This category includes a variety of stream types in all land forms and substrates. The floodplain may be narrow or wide, depending on the type of stream, but the key factor is vertical stability. The system may have once cut down, and later become healed and is now stable again, with a new floodplain appropriate to its stream type. In this case, the erosion of the old gully side walls will have ceased and stabilized. A mature, or nearly mature, vegetation community will occupy much of the new valley bottom. |
| Slightly (6 points) | B/D | C, F, G | This category contains both degrading and healing stages. In either case, the extent of incisement is minimal. In Stage B, the channel is just beginning to degrade, and a 2 year flood event may still access some floodplain, either partially or in spots. Downcutting is likely progressing. In Stage D, the system is healing. Downcutting should have ceased at this stage. A new floodplain should be well established with perennial vegetation, although it may not yet be as wide as the stream type needs. This is indicated by continuing lateral erosion of the high side walls of the original incisement, as the system continues to widen itself at its new grade level. |
| Moderately (3 points) | B/D | C, F, G | This category also contains both degrading and healing stages. In both cases, the extent of incisement is significant. In Stage B, the channel has downcut to a level that floods of the 1-5 year magnitude cannot reach a floodplain. Downcutting is likely still progressing, but the channel may already have the appearance of a gully. In Stage D, the system has only just begun to heal.<br>A small floodplain along the new meanders within the gully is forming, and perennial vegetation is starting to colonize the new sediment features. The high side walls of the gully are being actively eroded as the system widens, and much of the fallen material is being incorporated along the bottom. |
| Severely (0 points) | C | F, G | This is the worst case category, where the system has no floodplain in the bottom of a deep entrenchment, and small-to-moderate floods cannot reach the original floodplain level. Downcutting may, or may not, still be in progress. High side wall banks may have begun to collapse and erode into the bottom, but high flows typically just wash this material directly through the system, with none of it being trapped to build a new floodplain. At this stage, the system has lost practically all of its riparian function and habitat value. |

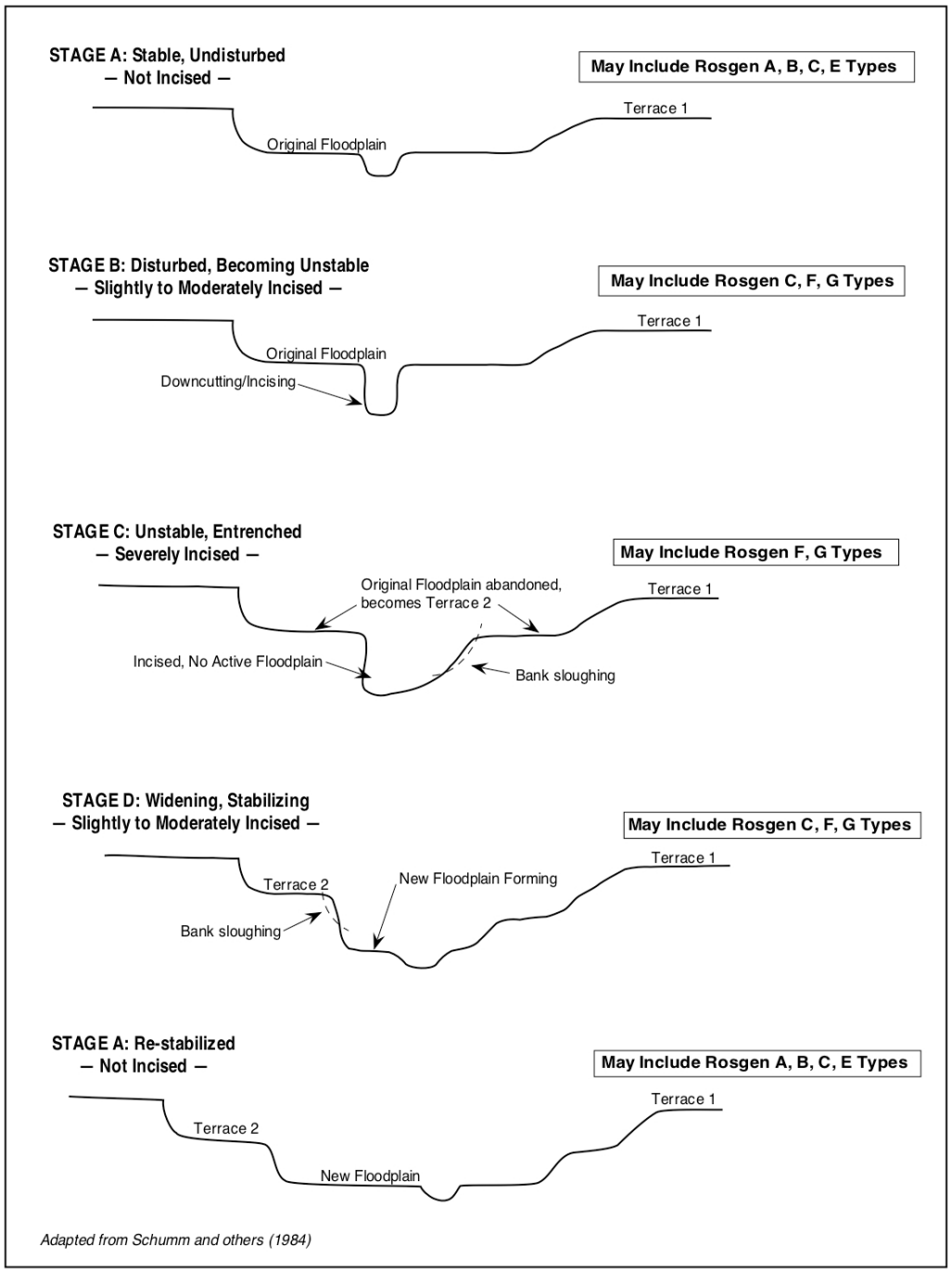



**Figure 1.** Guide for estimating channel incisement stage.