ALBERTA LOTIC HEALTH ASSESSMENT FOR LARGE RIVER SYSTEMS (Survey) USER MANUAL

The user manual is intended to accompany the Alberta Lotic Health Assessment For Large River Systems (Survey) Form for the rapid evaluation of riparian areas along large river systems (those with channels wider than 50 ft [15 m]). Another form entitled the Alberta Lotic Wetland Health Assessment For Streams and Small Rivers (Survey) is available for use on smaller rivers and streams.

ACKNOWLEDGEMENT

Development of these assessment tools has been a collaborative and reiterative process. Many people from many agencies and organizations have contributed greatly their time, effort, funding, and moral support for the creation of these documents, as well as to the general idea of devising a way for people to look critically at wetlands and riparian areas in a systematic and consistent way. Some individuals and the agencies/organizations they represent who have been instrumental in enabling this work are Dan Hinckley, Tim Bozorth, and Jim Roscoe of the USDI Bureau of Land Management in Montana; Karen Rice and Karl Gebhardt of the USDI Bureau of Land Management in Idaho; Bill Haglan of the USDI Fish and Wildlife Service in Montana; Barry Adams and Gerry Ehlert of Alberta Public Lands Division; Lorne Fitch of Alberta Environmental Protection; and Greg Hale and Norine Ambrose of the Alberta Cows and Fish Program.

BACKGROUND INFORMATION

Introduction

Public and private land managers are being asked to improve or maintain lotic (riparian) habitat and stream water quality on lands throughout western North America. Three questions that are generally asked about a wetland site are: 1) What is the potential of the site (e.g., climax or potential natural community)? 2) What plant communities currently occupy the site? and 3) What is the overall health (condition) of the site? For a lotic (flowing water) site, the first two questions can be answered by using the Alberta Lotic Wetland Inventory Form along with *Classification and Management of Riparian and Wetland Sites of Alberta's Grassland Natural Region* (Thompson and Hansen 2002) or a similar publication written for the region in which you are working.

For riparian areas along rivers approximately 50 ft (15 m) or more in width, this is a method for rapidly addressing the third question above: what is the site's overall health (condition)? It provides a site rating useful for setting management priorities and stratifying riparian sites for remedial action or more rigorous analytical attention. It is intended to serve as a first approximation, or "coarse filter," by which to identify riparian areas along rivers in need of closer attention so that managers can more efficiently concentrate their efforts. We use the term "riparian health" to mean the ability of a riparian area (including the channel and its riparian zone) to perform certain functions. These functions include sediment trapping, bank building and maintenance, water storage, aquifer recharge, flow energy dissipation, maintenance of biotic diversity, and primary production. Excellent sources of practical ideas and tips on good management of these streamside wetland sites are found in *Caring for the Green Zone* (Adams and Fitch 1995), *Riparian Areas: A User's Guide to Health* (Fitch and Ambrose 2003). In Saskatchewan some excellent resources are *Streambank Stewardship, Your Guide to Caring For Riparian Areas in Saskatchewan* (Huel 1998) and *Managing Saskatchewan Wetlands—A Landowner's Guide* (Huel 2000).

Flowing Water (Lotic) Wetlands vs. Still Water (Lentic) Wetlands

Cowardin and others (1979) point out that no single, correct definition for wetlands exists, primarily due to the nearly unlimited variation in hydrology, soil, and vegetative types. Wetlands are lands transitional between aquatic (water) and terrestrial (upland) ecosystems. Windell and others (1986) state that "wetlands are part of a continuous landscape that grades from wet to dry. In many cases, it is not easy to determine precisely where they begin and where they end."

In the semi-arid and arid portions of western North America, a useful distinction has been made between wetland types based on association with different aquatic ecosystems. Several authors have used ***lotic*** and ***lentic*** to separate wetlands associated with running water from those associated with still water. The following definitions represent a synthesis and refinement of terminology from Shaw and Fredine (1956), Stewart and Kantrud (1972), Boldt and others (1978), Cowardin and others (1979), American Fisheries Society (1980), Johnson and Carothers (1980), Cooperrider and others (1986), Windell and others (1986), Kovalchik (1987), Federal Interagency Committee for Wetland Delineation (1989), Mitsch and Gosselink (1993), and Kent (1994).

Lotic wetlands are associated with rivers, streams, and drainageways. Such wetlands contain a defined channel and floodplain. The channel is an open conduit, which periodically or continuously carries flowing water, dissolved, and

suspended material. Beaver ponds, seeps, springs, and wet meadows on the floodplain of, or associated with, a river or stream are part of the lotic wetland.

Lentic wetlands are associated with still water systems. These wetlands occur in basins and lack a defined channel and floodplain. Included are permanent (i.e., perennial) or intermittent bodies of water such as lakes, reservoirs, potholes, marshes, ponds, and stockponds. Other examples include fens, bogs, wet meadows, and seeps not associated with a defined channel.

Functional vs. Jurisdictional Wetland Criteria

Defining wetlands has become more difficult as greater economic stakes have increased the potential for conflict between politics and science. A universally accepted wetland definition satisfactory to all users has not yet been developed because the definition depends on the objectives and the field of interest. However, scientists generally agree that wetlands are characterized by one or more of the following features: 1) ***wetland hydrology,*** the driving force creating all wetlands, 2) ***hydric soils,*** an indicator of the absence of oxygen, and 3) ***hydrophytic vegetation,*** an indicator of wetland site conditions. The problem is how to define and obtain consensus on thresholds for these three criteria and various combinations of them.

Wetlands are not easily identified and delineated for jurisdictional purposes. Functional definitions have generally been difficult to apply to the regulation of wetland dredging or filling. Although the intent of legislation is to protect wetland functions, the current delineation of jurisdictional wetland still relies upon structural features or attributes. The hydrogeomorphic (HGM) approach being developed by the US Corps of Engineers is intended to focus more specifically on wetland functions.

The prevailing view among many wetland scientists is that functional wetlands need to meet only one of the three criteria as outlined by Cowardin and others (1979) (e.g., hydric soils, hydrophytic plants, and wetland hydrology). On the other hand, jurisdictional wetlands need to meet all three criteria, except in limited situations. Even though functional wetlands may not meet jurisdictional wetland requirements, they certainly perform wetland functions resulting from the greater amount of water that accumulates on or near the soil surface relative to the adjacent uplands. Examples include some woody draws occupied by the *Fraxinus pennsylvanica/Prunus virginiana* (green ash/common chokecherry) habitat type and some floodplain sites occupied by the *Artemisia cana/Agropyron smithii* (silver sagebrush/western wheatgrass) habitat type or the *Populus tremuloides/Cornus stolonifera* (aspen/red-osier dogwood) habitat type. Currently, many of these sites fail to meet jurisdictional wetland criteria. Nevertheless, these functional wetlands provide important wetland functions vital to wetland dependent species and may warrant special managerial consideration. The current interpretation is that not all functional wetlands are jurisdictional wetlands, but that all jurisdictional wetlands are functional wetlands.

Lotic (Riparian) Health of River Systems

As noted above, the health of a lotic site (a wetland adjacent to flowing water) may be defined as the ability of that system to perform certain wetland functions. These functions include sediment trapping, bank building and maintenance, water storage, aquifer recharge, flow energy dissipation, maintenance of biotic diversity, and primary biotic production. A site's health rating may also reflect management considerations. For example, although *Cirsium arvense* (Canada thistle) or *Euphorbia esula* (leafy spurge) may help to trap sediment and provide soil-binding properties, other functions (i.e., productivity and wildlife habitat) will be impaired; and their presence should be a management concern.

No single factor or characteristic of a wetland site can provide a complete picture of either site health or the direction of trend. This evaluation is based on assessment of sixteen channel and riparian vegetation factors. It relies heavily on vegetative characteristics as integrators of factors operating on the landscape. Because they are more visible than soil or hydrological characteristics, plants may provide early indications of riparian health as well as successional trend. These are reflected not only in the types of plants present, but also by the effectiveness with which the vegetation carries out its riparian functions of stabilizing the soil, trapping sediments, and providing wildlife habitat. Furthermore, the utilization of certain types of vegetation by animals can indicate the current condition of the riparian area and may indicate trend toward or away from potential natural community (PNC).

In addition to vegetation factors, an analysis of site health and its susceptibility to degradation must consider physical factors (soils and hydrology) for both ecologic and management reasons. Changes in soil or hydrologic conditions obviously affect functioning of a wetland ecosystem. Moreover, changes in physical characteristics are often (but not always) more difficult to remedy than vegetative changes. For example, extensive incisement (down-cutting) of a stream channel may lower the water table and thus change site potential from a *Salix lutea*/*Cornus stolonifera* (yellow willow/red-osier dogwood) habitat type to an *Bromus inermis* (smooth brome) community type or even to an upland (non-riparian) type. Sites experiencing significant hydrologic, edaphic (soil), or climatic changes will likely also have a change in plant community potential.

This river health assessment attempts to balance the need for a simple, quick index of health against the reality of an infinite variety of wetland situations. Although this approach will not always work perfectly, we believe in most cases it will yield a usefully accurate index of riparian health. Some more rigorous methods to determine status of a river's channel morphology are Dunne and Leopold (1978), Pfankuch (1975), and Rosgen (1996). These relate their ratings to degree of channel degradation, but do not integrate other riparian functions into the rating. Other methods are available for determining condition from perspectives that also include vegetation, most notably the USDI Bureau of Land Management (BLM) proper functioning condition (PFC) methodology (1998).

This river health assessment method is not designed for an in-depth and comprehensive analysis of ecologic processes. Such analysis may be warranted on a site and can be done after this evaluation has identified areas of concern. Nor does this rating yield an absolute rating to be used to compare riparian systems along flowing waters in other areas or of other types. Comparisons using this rating with rivers of different types (Rosgen 1996), different orders (size class), or from outside the immediate locality should be avoided. Appropriate comparisons using this rating can be made between segments of one river, between neighbouring rivers of similar size and type, and between subsequent assessments of the same site.

A single evaluation provides a rating at only one point in time. Due to the range of variation possible on a riparian site, a single evaluation cannot define absolute status of site health or reliably indicate trend (whether the site is improving, degrading, or stable). To monitor trend, health assessments should be repeated in subsequent years during the same time of year. Evaluation should be conducted when most plants can be field identified and when hydrologic conditions are most nearly normal (e.g., not during peak spring runoff or immediately after a major storm). Management regime should influence assessment timing. For example, in assessing trend on rotational grazing systems, avoid comparing a rating after a season of use one year to a rating another year after a season of rest.

Pre-Assessment Preparation

The river health assessment process incorporates data on a wide range of biological and physical factors. The basic unit of delineation upon which an assessment is made is referred to as a ***polygon.*** Polygons are delineated on 7.5-minute topographic (topo) maps by marking the upper and lower ends before observers go to the field. (The widths of most riparian zones are unknown before the inventory and cannot be pre-marked.) On 7.5-minute topo maps, polygons are numbered sequentially proceeding downstream. It is important to clearly mark and number polygons on the topo map. Polygons must be clearly marked and numbered. Polygons are numbered pre-field (in the office) with consecutive integers (1, 2, 3 . . .). In cases where field inspection shows the need to change the delineation or to subdivide the pre-drawn polygons, additional polygons should be numbered using alpha-numerics (e.g., 1a, 1b, 2a, 2b, etc.). Combination of delineated polygons will be field identified as the hyphenated tags of both combined parts (e.g., 1-2, 2-3, etc.).

Upper and lower polygon boundaries are placed at distinct locations such as fences, stream confluences, or river meanders that can hopefully be recognized in the field. If aerial photos are available, pre-field polygon delineations may be based on vegetation differences, geologic features, or other observable characteristics.

Once in the field, observers are to verify (ground truth) the office-delineated polygon boundaries. If the pre-assigned numbers are used, be sure the inventoried polygons correspond exactly as drawn originally. Observers are allowed to move polygon boundaries, create new polygons, or consolidate polygons if the vegetation, geography, location of fences, or width of the riparian zone warrant. If polygon boundaries are changed, the changes must be clearly marked on the field copies of the 7.5-minute topographic maps. The original polygon numbers should be retained on the map for cross-reference.

The outer boundaries of riparian polygons are at the wetland vegetative type outer edges. These boundaries are sometimes clearly defined by abrupt changes in the geography and/or vegetation, but proper determination often depends on experienced interpretation of more subtle differences.

Identification of plant communities by vegetation type (Thompson and Hansen 2001, Hansen and others 1995) will be useful both in site selection and, later, in determining appropriate management. These may be in a mosaic difficult to map. An area may have a mix of herbaceous communities, shrubs, and forest. These communities have diverse resource values and may respond differently to a management action, but it is seldom practical to manage such communities separately. Community composition can be described as percentages of component types. Management actions can then be keyed to the higher priority types present.

Selection of a Reach to Evaluate

Two considerations in determining appropriate reach size and location for river health assessments are: 1) the need for the reach boundaries to be relocated for future repeatability, and 2) the need to include adequate area and channel length to ensure a representative sample of the variability within the system.

The above needs can be met by basing reach size and location on a map grid which is related to the average width of the floodplain being assessed. Future reassessment of the site requires the ability to relocate the same site. Due to the dynamic nature of most river systems, it is impractical to tie long-term reference points to many physical features found on a floodplain landscape. Instead, a reach can be bounded by the upstream and downstream sides (or east-west, depending on which direction is most nearly perpendicular to the valley) of a square in a map grid. The size of the grid squares can be based on the average width (to the closest quarter mile [0.4 km]) of the floodplain over a ten-mile (16.0 km) section which includes the site in question. For example: If the average floodplain width is 0.69 miles (1.1 km), then lay out a 3/4 mile (1.2 km) grid on the map system which aligns with the established Public Land Survey section and quarter-section lines. The assessed reach should extend laterally away from the river to the floodplain/upland boundary on each side. The map should show the river channel and lateral extent of the riparian zone. The evaluator should sketch the general position and extent of important riparian plant communities.

In most cases, polygons should be at least one half mile (0.8 km) in length. Because along most river systems the channel acts as a barrier to movement, polygons will usually be limited to the riparian zone on a single side. If the evaluator determines that cross-channel access is not restricted, both sides may be included in a single polygon.

In addition to reach length, riparian zone width must be considered. The riparian zone is that generally green and relatively flat area influenced by water from a stream and its floodplain. The contrast between a riparian zone and adjacent upland is most notable in late summer when many of the upland herbaceous plants have gone dormant. The area to be assessed includes any terraces dominated by facultative wetland and wetter plant species (Reed 1988), the active floodplain, streambanks, and areas in the channel with emergent vegetation (Figure 1). Reference to Reed's list of plants found in wetlands should not be necessary to determine the area for evaluation. The evaluator should simply focus on that area which is obviously more lush, dense, or greener by virtue of proximity to the stream.

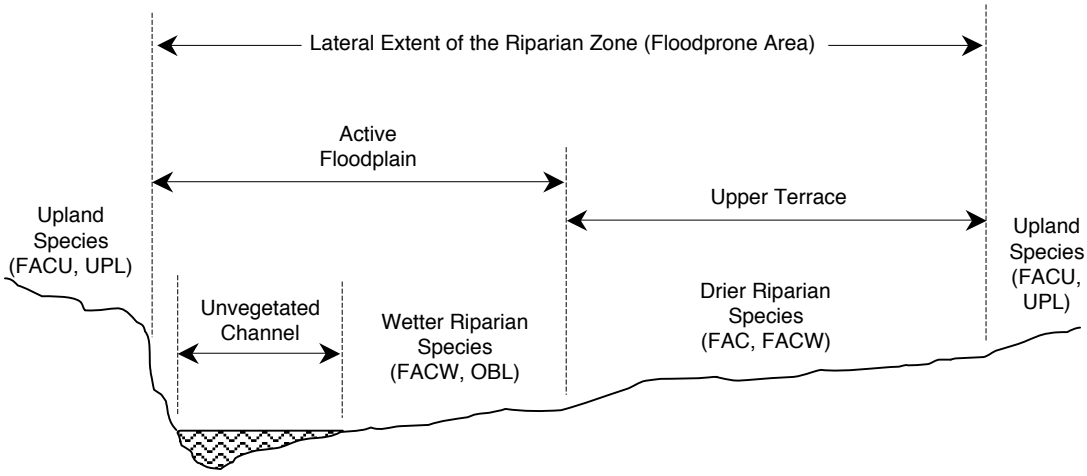


Figure 1. A schematic example of a typical riparian zone cross section showing near-channel landform features. *Note:* FAC (facultative), OBL (obligate), UPL (upland), etc. refer to categories of frequency a species is found on wetland (Reed 1988).

DATA FORM ITEMS

Record ID No. This is the unique identifier allocated to each polygon. This number will be assigned in the office when the form is entered into the database.

Administrative Data
A1. Identify what organisation is doing the evaluation field work.

A2. Identify what organisation is paying for the work.

A3a. Identify any Indian or Métis Reserve on which work is being done.

A3b. Identify any National or Provincial Park, Preserve, or Sanctuary on which work is being done.

A3c. Identify any local Ecological or Municipal Reserve (Exclude national or provincial reserves) on which work is being done.

A3d. Was the work done on Private or Deeded Land? Simply answer "Yes" or "No."

A4. Observers: Name the evaluators recording the data in the field.

A5a. Date that the field data was collected**:** Use the format: month/day/year

A5b. Record the year that the field data was collected**.**

A6a. Identify any grazing lease or grazing reserve on which work is being done.

A6b. Give any grazing disposition identifying number.

A6c. Give any other grazing name (e.g. Community Pasture) to identify where the work is being done.

Note: Items A7a-h are completed in the office; field evaluators need not complete these items.

A7. The several parts of this item identify various ways in which a data record may represent a resampling of a polygon that may have been inventoried again at some other time. The data in this record may have been collected on an area that coincides precisely with an area inventoried at another time and recorded as another record in the database. It may also represent the resampling of only a part of an area previously sampled. This would include the case where this polygon overlaps, but does not precisely and entirely coincide with one inventoried at another time. One other case is where more than one polygon inventoried one year coincides with a single polygon inventoried another year. All of these cases are represented in the database, and all have some value for monitoring purposes, in that they give some information on how the status on a site changes over time.

A7a. Does this record represent the latest data recorded for this polygon?

A7b. Has any part of the area within this polygon been inventoried previously, or subsequently, as represented by another data record in the Lotic Wetland database? Such other records would logically carry different dates.

A7c. Does the areal extent of this polygon exactly coincide with that of any other inventory represented in the Lotic Wetland database? In many cases, subsequent inventories only partially overlap spatially. The purpose of this question is to identify those records that can be compared as representing exactly the same ground area.

A7d. If A7c is answered "Yes," then enter the years of any inventories of this exact polygon.

A7e. If A7c is answered "Yes," also enter the record ID number(s) of any other previous or subsequent reinventories (resamplings) of this exact polygon for purposes of cross-reference in the database.

A7f. Even though this polygon is not a re-inventory of the exact same area as any other polygon, does it share at least some common area with one or more polygons inventoried at another time?

A7g. If A7f is answered "Yes," enter the years of any other inventories of polygons sharing common area with this one.

A7h. If A7f is answered "Yes," also enter the record ID number(s) of any other polygon(s) sharing common area with this one.

A8a. Has a management change been implemented on this polygon?

A8b. If A8a is answered "Yes," in what year was the management change implemented?

A8c. If A8a is answered "Yes," describe the management change implemented.

Location Data
B1. Province in which the field work is being done.

B2a, b. Identify the Natural Region and Sub-Region in which the field work is being done. Use the Natural Regions and Subregions of Alberta (Alberta Natural Heritage Information Centre (1999).

B3. County or municipal district in which the field work is being done.

B4a. The city, town, or village in which the field work is being done.

B4b. The subdivision in which the field work is being done.

B4c. The subdivision block in which the field work is being done.

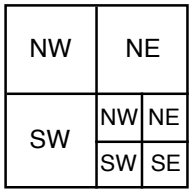
B4d. The subdivision lot on which the field work is being done.

B5. Identify the allotment, range unit, or landowner where the field work is being done.

B6. Name the waterbody or area on which the field work is being done.

B7. Polygon number is a sequential identifier of the actual piece of land being surveyed. This is referenced to the map delineations.

B8. The location of the polygon is presented as a legal land description: 1/4,1/4 section, 1/4 section, Township, Range, and Meridian are read from smallest to largest unit.



B9. Elevation (feet or meters) of the polygon ***centroid.*** Elevation is usually interpolated from a topographic map

B10a. Name the major watershed (e.g. North Saskatchewan River) of which the site being surveyed is a part.

B10b. Name the minor watershed (e.g. Battle River) of which the site being surveyed is a part. This is normally subordinate to the major watershed named above in #B10a.

B10c, d. The minor watershed area (km^2) and perimeter (km) are obtained from the map in the office.

B10e. Name the sub-basin (e.g. Iron Creek). This is the local watershed of which the site being surveyed is a part. This is normally subordinate to the minor watershed named above in #B10b.

B11a-c. Universal Transverse Mercator (UTM) coordinates are recorded for the upper and lower ends of the polygon using GPS units in the field. Other locations of special interest may be recorded using the GPS unit. These coordinates are considered accurate to within approximately 50 m. Field observers are to use GPS units to obtain these coordinates following standard protocol. Record UTM coordinates at each end of the long axis of the polygon.

Enter the UTM coordinate data, including the UTM zone and the identifying waypoint number, on the form for each point collected. Save the data in the GPS unit for downloading to the computer later. When starting work in a new location, always check the GPS receiving unit against a known point by using the UTM grid and map.

B11d, e. Identify the GPS unit used, and the name or number designator of the waypoints saved for the upper and lower ends of the polygon and for other locations. Describe any comments worth noting about the waypoints (i.e., monument referenced or general location descriptions).

B12a-c. Record the name(s), scale, and publication year of the quadrangle map(s) or any other map(s) locating the polygon. Use precisely the name listed on the map sheet. Provision is made for listing two maps in case the polygon crosses between two maps.

B13. Record identifying data for any aerial photos used on this polygon.

Selected Summary Data

C1. Wetland type is a categorical description of predominant polygon character. Select from the following list of categories that may occur within a lotic system the one that best characterizes the majority of the polygon. Observers will ***select only one category*** as representative of the entire polygon. If significant amounts of other categories are present, indicate this in the last item, "Comments and Observations," or consider dividing the original polygon into two or more polygons.

Category Description
River. Rivers are generally larger than streams. They flow year around, in years of normal precipitation and when significant amounts of water are not being diverted out of them. Those watercourses called rivers on USGS 7.5 minute topo quads and/or those having bankfull channel widths greater than 50 ft (15 m) will be classified as rivers for the purpose of this inventory.
Nonriparian (Upland). This designation is for those areas which are included in the inventoried polygon, but which do not support functional wetland vegetation communities. Such areas may be undisturbed inclusions of naturally occurring high ground, or such disturbed high ground as roadways and other elevated sites of human activity.
Other. Describe the water source.

C2. The size (acres/hectares) of polygons large enough to be drawn as enclosed units on 1:20,000 or 1:50,000 scale maps is determined in the office using a planimeter, dot grid, or GIS. For polygons too small to be accurately drawn as enclosed units on the map, and that are represented by line segments on the map along the drainage bottom, polygon size is calculated using polygon length and average polygon width (items C5 and D7).

C3a-d. Evaluators may be asked to survey some areas that have not been determined to be wetlands for the purpose of making such a determination. Other polygons include areas supporting non-wetland vegetation types. A "Yes" answer here indicates that no part of the polygon keys to a riparian habitat type or community type (HT/CT). Areas classified in item C8 as any vegetation type described in a riparian and/or wetland classification document for the region in which you are working are counted as functional wetlands. Areas listed as UNCLASSIFIED WETLAND TYPE are also counted as functional wetlands. Other areas are counted as non-wetlands, or uplands. The functional wetland fraction of the polygon area is listed in item C3c in acres and as a percentage of the entire polygon area in item C3d.

C4. Some riparian areas do not contain an unvegetated, defined stream channel. In some cases, these polygons are in ephemeral systems which may flow infrequently, but which do support riparian plant communities. In other cases, these polygons may be associated with larger river systems that have wide floodplains where polygons may be delineated in areas not adjacent to the channel.

C5. Channel length— the length of channel contained within or adjacent to the polygon—is measured by scaling from the map. This data is considered accurate to the nearest 0.1 mile (0.16 km).

C6. In some cases, the polygon record is used to characterize, or represent, a larger portion of a stream system. The length represented by the polygon is given here. For example, a 0.5 mile (0.8 km) polygon may be used to represent 4 miles (6.4 km) of a stream. In this case, 0.5 mile (0.8 km) is the channel length of the polygon (item C5), and 4 miles (6.4 km) is entered in item C6.

C7. List the riparian habitat type(s) and/or community type(s) found in the polygon (Hansen and others 1995 or another appropriate publication). If the habitat type cannot be determined for a portion of the polygon, list the appropriate community type(s) of that portion. If neither the habitat type nor community type can be determined for any portion of the polygon (or in areas [outside of Montana] where the habitat and community types have not been named and described), list the area in question as "unclassified wetland type" and give the dominant species present. Indicate with the appropriate abbreviation if these are habitat types (HT), community types (CT), or dominance types (DT), for example, PSEMEN/CORSTO HT. For each type listed, estimate the percent of the polygon represented. If known, record the successional stage (i.e., early seral, mid-seral, late seral, and climax) or give other comments about the type. As a minimum, list all types which cover 5% or more of the polygon. The total must approximate 100%. Slight deviations due to use of class codes or to omission of types covering less than 5% of the polygon are allowed. ***Note:*** For any area classified as an "unclassified wetland type," it is important to list any species present which can indicate the wetness or dryness of the site.

Optional Physical Site Characteristics
Items D1-D14 may be answered at the discretion of the user.

D1. Answer "Yes" if the site has habitat types or community types characterized by tree or tall shrub species. Tall shrubs do not include the snowberries (*Symphoricarpos* spp.), wild rose (*Rosa woodsii*), silver sagebrush (*Artemisia cana*), and greasewood (*Sarcobatus vermiculatus*).

D2. Record the rating category which best describes the vegetation use by animals (Platts and others 1987). Do not record a specific percent within a category.

Code	Category Description
0 to 25%	Vegetation use is light or none. Almost all plant biomass at the current development stage remains. Vegetative cover is close to that which would occur without use. Unvegetated areas (such as bedrock) are not a result of land uses.
26 to 50%	Vegetation use is moderate. At least half the potential plant biomass remains. Average stubble height is more than half its potential at the present stage of development.
51 to 75%	Vegetation use is high. Less than half the potential plant biomass remains. Plant stubble height is usually more than 2 inches (on many ranges).
76 to 100%	Vegetation use is very high. Only short stubble remains (usually less than 2 inches on many ranges). Almost all potential plant biomass has been removed. Only the root systems and parts of the stems remain.

D3. Record ***average*** width of the polygon, which on smaller streams corresponds to the width of the riparian zone. To determine this width, subtract the width of the non-vegetated stream channel (item D3) from the distance between the two opposite riparian/upland boundaries. In the case of very wide systems where the polygon inventoried does not extend across the full width of the riparian zone (e.g., area with riparian vegetation communities lies outside the polygon), record the average width of the polygon inventoried and make note of the situation in the comments.

Water Quality Data
Note: This category (items E1-E7) currently applies only to inventories conducted in the United States. Data will be entered in the office.

E1-E2. For Montana, this information can be obtained from the current state 303(d) list of impaired waters maintained by Montana Department of Environmental Quality. In other states, contact the appropriate agency.

E3. Enter High, Medium, or Low for TMDL development priority. Obtain from current federal/state 303(d) list of impaired waters.

E4. Enter TMDL development status: EPA approved, de-listed due to reassessment, incomplete at present. Obtain from state environmental health agency.

E5-E7. Enter probable causes, probable impaired uses, and probable sources. Information can be obtained from current state 303(d) list of impaired waters.

Photograph Data
Note: Take at least one photo upstream and one downstream at each end of every polygon. This applies even to situations where the polygon is at one end of an inventoried reach and one of the photos is taken into a non-inventoried area, as well as situations in which another polygon is adjacent to the one being inventoried.

F1a-c. Record items E1a-c for photos at the ***upstream*** end or within the upper half of the polygon. Record the film roll number (use initials and number, e.g., "RE-02") and photographer's initials. Record the photo frame number(s) behind the word indicating the direction the photos were facing (upstream, downstream, or other). Describe the location at which other photos were shot. Describe the view of each photo with reference to direction and polygon features such as streams, vegetation, boundaries, etc. For polygons without definite upstream and downstream ends, record the locations of photos taken.

F2a, b. Indicate whether there are adjacent polygons upstream and/or downstream of this polygon.

F3a-c. Record similar information (as in items E1a-c) for photos taken at the ***downstream*** end or in the lower half of the polygon.

F4. Record the brand of film, film speed, camera lens size, and lens focal length.

FACTORS FOR ASSESSING RIVER FLOODPLAIN HEALTH

1. Cottonwood Regeneration from Seed. Because cottonwoods are so important to many of the functions of rivers of western North America, there is reason to look at the ***sexual reproduction*** (from seed, as opposed to asexual reproduction, or "root suckering") of these species as a fraction of the total canopy cover of all the cottonwood trees in the polygon. This reproduction success can be determined by estimating the established seedling and sapling cover expressed as percentage of the overall cover of the species on the site. ***(Note:*** For this item, include plants taller than 1 ft (29 cm) in height, but less than 5 inches (12.5 cm) in dbh [diameter at breast height: 4.5 ft (1.35 m)]). If the polygon is on the outside of a long meander curve where depositional material is not expected, replace both Actual Score and Possible Score with NA.

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

2. Regeneration of other Tree Species. As succession progresses on a riparian site, the pioneer cottonwood and shrub communities are replaced by later seral communities (if river dynamics allow enough time). If the site is not de-watered or otherwise disturbed, this progression is often to communities dominated by other native tree species. Depending upon dynamics of the system (how fast the channel migrates laterally), the potential may exist for equilibrium at different locations along the river between younger (those dominated by young cottonwoods and willows) communities and older communities (with aging cottonwoods and later seral species such as *Acer negundo* [box elder], *Fraxinus pennsylvanica* [green ash], *Populus tremuloides* [quaking aspen], *Pseudotsuga menziesii* [Douglas fir], and *Juniperus scopulorum* [Rocky Mountain juniper]). ***Note:*** Seedlings and saplings of these species include individuals which are less than 3 inches (7.5 cm) in dbh, with the exception of *Pseudotsuga menziesii* [Douglas fir], for which saplings go up to 5 inch (12.5 cm) dbh. If the polygon is a newly formed island where all plant communities are in an early successional stage and where no later successional species are expected to be present at this time, replace both Actual Score and Possible Score with NA.

The health of a population can be based on current regeneration success without having to determine the exact potential distribution between cottonwoods and the other tree species on a site. This regeneration success can be determined from the seedling and sapling canopy cover expressed as a percentage of the overall cover of the group of tree species on the site other than cottonwoods. ***Note:*** Do not count *Elaeagnus angustifolia* [Russian olive] in this determination because it is considered an undesirable exotic species.

Scoring:
3 = More than 5% of the other (non-cottonwood) tree cover is seedlings and saplings.

2 = 1% to 5% of the other (non-cottonwood) tree cover is seedlings and saplings.
1 = Less than 1% of the other (non-cottonwood) tree cover is seedlings and saplings.
0 = Seedlings and saplings of trees species other than cottonwoods are absent.

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

Four shrub genera (*Symphoricarpos* spp. [snowberry], *Rosa* spp. [rose], *Crataegus* spp. [hawthorn], and *Tamarix* spp. [salt cedar] are excluded from the evaluation of establishment and regeneration. These are species that may reflect long term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long term moderate-to-heavy grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Tamarix* spp. [salt cedar] is considered an especially aggressive, undesirable exotic plant.

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

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

Scoring: *(If the site has no potential for shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the observer is not fairly certain potential exists for preferred shrubs, then enter NC and explain in the comment field below.)*

3 = More than 5% of the preferred shrub species cover is seedlings and saplings.
2 = 1% to 5% of the preferred shrub species cover is seedlings and saplings.
1 = Less than 1% of the preferred shrub species cover is seedlings and saplings.
0 = None of the preferred shrub species cover is seedlings and saplings.

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

Scores are based on the percentage of ***total woody canopy cover*** which is decadent or dead, ***not*** on the percentage of total polygon canopy cover represented by dead and decadent woody material. For example, woody vegetation may occupy 50% of the polygon. You would then only look at what percent of the woody vegetation is decadent or dead. Count only material which is standing, not that which is lying on the ground. Do not include the decadent and dead material of cottonwood trees which are decadent due to old age (rough and furrowed bark extends substantially up into the crowns of the trees).

Scoring:

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

5. Preferred Tree and Shrub Species Utilisation. Many riparian woody species are browsed by livestock and/or wildlife. Heavy browsing of key palatable species (*Cornus stolonifera* [red-osier dogwood], *Salix* spp. [willows], *Populus* spp. [cottonwoods and aspen], *Acer negundo* [box elder], *Fraxinus pennsylvanica* [green ash], *Prunus virginiana* [chokecherry], and *Amelanchier alnifolia* [serviceberry] can shift the community to less palatable and less desirable species or entirely remove woody species from the site. Therefore, this item reflects both current site condition and successional direction of changes in the vegetation community.

One tree species (*Elaeagnus angustifolia* [Russian olive]) and four shrub genera (*Symphoricarpos* spp. [snowberry], *Rosa* spp. [rose], *Crataegus* spp. [hawthorn], and *Tamarix* spp. [salt cedar] are excluded from the evaluation of utilisation of woody species. These are plants that may reflect long term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long term moderate-to-heavy grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Tamarix* spp. [salt cedar] is an especially noxious and aggressive exotic invader.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (i.e., *Salix* spp. [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a heavily utilised species of greater concern. ***FOR EXAMPLE***: A polygon may have *Symphoricarpos occidentalis* (common snowberry) with 30% canopy cover showing only light utilization, while also having a trace of *Salix exigua* (sandbar willow) present showing heavy utilisation. We feel that, although there is only a small amount of willow present, the fact that it is being heavily utilized is very important to the health evaluation. By including the snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of snowberry).

When estimating degree of utilisation, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use since this may not accurately reflect actual use because significant browsing can occur late in the season (after the evaluation). Only record a score for that portion of the woody material that is currently available for browse. If the woody material is too high for browsing by wildlife or livestock, then do not include it in the scoring. Determine percentage by comparing the number of leaders browsed with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree and shrub species present. Do not include utilisation of dead plants unless it is clear this condition was the result of over grazing. Do not include stems cut by beaver activity.

Scoring: *(If the site has no potential for trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the observer is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below.)*

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

6. Total Canopy Cover of Woody Species. Woody species play a critical role in riverbank integrity. Natural riverbanks are protected by large bank rock (e.g., boulders and cobbles) and by woody vegetation. On floodplains comprised primarily of fine textured materials—which are typical of many western rivers—riverbanks are protected only by the woody vegetation. In these cases, it is critically important to manage for healthy woody vegetation. Woody vegetation also traps sediment, helps to reduce velocity of flood waters, protects the soil from extreme temperatures, and provides wildlife habitat. ***Note:*** Unlike other items dealing with woody plants, this item focuses on how much of the total polygon is covered by woody plants.

Scoring:

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

2. Invasive Plant Species. Invasive plants (noxious weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Without regard to whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is ***infested*** by noxious weeds. The term ***infestation*** is used to mean that area where the presence of invasive species is cause for managerial concern. It is a function of density/distribution, as well as abundance of the weeds. In determining the health score, all invasive species are considered collectively, not individually. A weed list should be used that is standard for the locality and that indicates which species are being considered.

For each weed species observed record two things: 1) its canopy cover as a percentage of the area of the site, and 2) its density/distribution class. Choose a class from the chart below (Figure 2) that best represents its density/distribution (i.e., pattern of presence).

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

For example:

leafy spurge may have canopy cover = 0.5%, and density/distribution class = 3 (a single patch)
Canada thistle may have canopy cover = 10.0%, and density/distribution class = 10 (continuous uniform occurrence of well spaced individuals).

Record the same two things for the total of all weed species considered collectively. Total weeds would have canopy cover = 10.0%, and density/distribution class = 10 (continuous uniform occurrence of well spaced individuals). This site would score 0 out of the 6 possible points for this item (using the scoring schedule below).

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

Figure 2. Weed density distribution class guidelines

Scoring: Consider all weeds collectively without regard to individual species.
6 = No invasive species (noxious weeds) on the site.
4 = Weed density/distribution is in a class from 1 to 3, ***AND*** weed canopy cover is less than 1%.
2 = Weed density/distribution is in a class from 4 to 7, ***AND*** weed canopy cover is less than 15%.
0 = Weed density/distribution is in class 8 or higher, ***OR*** weed canopy cover is 15% or more.

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

8. Disturbance-increaser Undesirable Herbaceous Species. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in riparian health. These species generally are less productive, have shallow roots, and poorly perform most riparian functions. They usually result from some disturbance which removes more desirable species. Invasive species considered in the previous item are not reconsidered here. As in the previous item, the evaluator should state the list of species considered. A partial list of undesirable herbaceous species appropriate for use in Alberta follows. The evaluator should list additional species included.

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

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

9. Presence of Native Graminoids. Certain riparian functions (i.e., primary forage production, wildlife habitat, and maintenance of natural biodiversity) are best served by native species, which evolved with the ecosystem. Native graminoids are very often reduced or eliminated from a site as the result of long term disturbance. Therefore, one measure of the health of a riparian site is the amount of cover by these species (as a group) remaining. Specific species will depend on location, and observers should indicate which species were included.

Scoring:
3 = More than 50% of the reach is covered by native graminoid species.
2 = 25% to 50% of the reach is covered by native graminoid species.
1 = 5% to 25% of the reach is covered by native graminoid species.
0 = Less than 5% or less of the reach is covered by native graminoid species.

10. Exotic Undesirable Woody Species. The degree to which the vegetative community consists of exotic undesirable woody species in most cases reflects a degradation of many riparian functions. Although these species may contribute to some riparian functions to varying degrees, their presence reflects s general reduction in riparian functions overall since they displace more vulnerable and valuable species. This item evaluates what percent of the total woody species canopy cover is composed of exotic undesirable woody species. The two species listed below should always be included in this item. If additional species are included, they should be noted. List those undesirable woody species present along with their infestation area in the comment section. For example, Russian olive = 10%.

Elaeagnus angustifolia (Russian olive) *Tamarix chinensis* (Tamarisk)

Scoring:
3 = Less than 5% of total woody coverage in the reach consists of exotic undesirable woody species.
2 = 5% to 25% of total woody coverage in the reach consists of exotic undesirable woody species.
1 = 25% to 50% of total woody coverage in the reach consists of exotic undesirable woody species.
0 = More than 50% of total woody coverage in the reach consists of exotic undesirable woody species.

11. Riverbank Root Mass Protection. The vegetation along rivers performs the primary physical functions of stabilizing the soil with a deep, binding root mass and filtering sediments from overland flow. All tree and shrub species are considered to have deep, binding root masses. Although certain herbaceous species may provide protection on smaller streams, their value along rivers is limited; thus, this item considers only woody species root mass protection. For this item consider the riverbank to be the area extending from the toe of the bank to approximately 9 ft (3 m) beyond the top of the bank. The bank top is that point where the upper bank levels off to the relatively flat surface of a floodplain or terrace. ***(Note:*** Omit from consideration those banks that are stabilized by rip-rap).

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

12. Human-Caused Bare Ground. Many human activities disrupt the proper functioning of riparian ecosystems by exposing the soil surface to erosive forces, reducing water-holding capacity, allowing the invasion of weeds and other undesirable plants, and reducing production and wildlife habitat. For this item, estimate the amount of area within the reach which is bare (i.e., not covered by plants, large rocks [> 2.5 in (6 cm)], woody debris, litter and duff, or moss and lichens) as the result of human activities which have disrupted the soil surface. Examples of such activities are farming, cattle trails, ATV trails, other recreation uses, logging, mining, etc. Do not include such natural examples of bare ground as recent alluvial bars.

Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. If the total vegetative cover of the channel is no more than 15%, it is considered a non-vegetated stream channel and is ***excluded*** from the polygon**.** Exceptions to this minimum of 15% canopy cover include channels with the vegetation removed by human-causes (such as grazing, logging, and construction). These are considered exposed soil surface (bare ground). Those channels that do contain more than 15% vegetative cover are included as part of the riparian vegetation.

Scoring:

6 = Less than 5% of the reach contains human-caused bare ground.
4 = 5% to 25% of the floodplain contains human-caused bare ground.
2 = 25% to 50% of the floodplain contains human-caused bare ground.
0 = More than 50% of the floodplain contains human-caused bare ground.

13. Dewatering of the River System. Proper functioning of any riparian ecosystem depends, by definition, upon the system supply of water. The degree to which this "lifeblood" is artificially removed from the system is directly reflected in a reduction of riparian functions (i.e., wetland plant community maintenance, channel bank stability, wildlife habitat, overall system primary production, etc.) Dewatering of the system can be estimated by determining the fraction of the average river discharge which is removed during the critical growing season each year. This determination can be based upon gauging station records as they relate to historic flow records established before construction of diversions. This question only deals with irrigation withdrawals from a river segment. The question of dams controlling the timing of peak runoff is taken care of in the next question.

Scoring:

9 = Less than 10% of average river discharge during the critical growing season is removed.
6 = 10% to 25% of average river discharge during the critical growing season is removed.
3 = 25% to 50% of average river discharge during the critical growing season is removed.
0 = More than 50% of average river discharge during the critical growing season is removed.

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

Scoring:

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

15. Human Alterations to the Riverbanks. Such human activities as residential development, road construction, farming, railroad construction, water diversion weirs, boat ramps, rip-rap, and levees along the immediate riverbanks negatively impact many functions of a riparian ecosystem. These alterations disrupt vegetative communities, alter bank integrity, constrict flows to the immediate channel, and otherwise change the natural system dynamics. Observers should consider both sides of all active channels when estimating the amount of total bank length altered by these activities.

Scoring:

9 = Less than 10% of the bank length has been restructured by human activity.
6 = 10% to 25% of the bank length has been restructured by human activity.
3 = 25% to 50% of the bank length has been restructured by human activity.
0 = More than 50% of the bank length has been restructured by human activity.

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

maps available) to the area within the FEMA (US Federal emergency Management Agency) 100 year floodplain map of the reach.

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

Calculating the Riparian Health Score
The scores are totalled for all the factors rated, and that total is divided by the possible perfect score. Below is a sample score sheet.

A sample score sheet of a riparian site along a major river

Vegetation Factors	**Actual Pts**	**Possible Pts**
1. Cottonwood Regeneration from Seed	2	6
2. Regeneration of other Tree Species	2	3
3. Shrub Regeneration	2	3
4. Standing Decadent and Dead Woody Material	2	3
5. Tree and Shrub Utilization	2	3
6. Total Canopy Cover of Woody Species	2	3
7. Invasive Herbaceous Species	4	6
8. Disturbance-increaser Undesirable Herbaceous Species	2	3
9. Presence of Native Graminoids	2	3
10. Exotic Undesirable Woody Species	3	3
Vegetative Score:	23	36

Soil/Hydrology Factors	**Actual Pts**	**Possible Pts**
11. Riverbank Root Mass Protections	4	6
12. Human-Caused Bare Ground	6	6
13. Dewatering of the River System	3	9
14. Control of Flood Peak/Timing by Upstream Dam(s)	3	9
15. Human Alterations to the Riverbanks	6	9
16. Floodplain Accessibility	6	6
Soil/Hydrology Score:	28	45
TOTAL SCORE:	**51**	**81**

Rating = (Total Actual) / (Total Possible) X 100%

Rating = (51) / (81) X 100% = 63%

Because of their size and the cumulative effects from upstream as well as downstream impacts, management of individual reaches along a river may be more difficult to implement than actions appropriate for smaller riparian areas. This characteristic of river systems argues for the larger watershed approach which is increasingly being taken to address riverine ecosystems.

The manager should realize that while certain factors affecting function of the river on his site may be outside his control, the system health is nevertheless degraded by such factors as “Dewatering of the River System” and “Control of Flood Peak/Timing by Upstream Dam(s),” even though these are occurring off his property upstream. His only recourse may be to lobby for a more cooperative, integrated approach to management of the whole system.

While a less than perfect score is not always cause for great concern, and an area rating at 80% is considered to be functioning properly, the scores of individual factors on the form can be useful in detecting strengths or weaknesses of a site. A low score on any factor may warrant management focus. For example, the sample shown above has low scores for “Cottonwood Regeneration from Seed”, “Dewatering of the River System” and “Control of Flood Peak/Timing by Upstream

Dam(s)" (items #1, #13, and #14). Of these factors the manager might bring improvement to #1 by changing timing of grazing.

17. Trend. Select a category (Improving, Degrading, Static, or Status Unknown) to indicate the trend of the vegetative community on the polygon. Trend refers, in the sense used here, not specifically to successional pathway change, but in a more general sense of apparent community health. By definition, trend implies change over time. Accordingly, a precise trend analysis would require comparison of repeated observations over time. However, some insights into trend can be observed in a single visit. For example, the observer may notice healing (revegetating) of a degraded streambank and recent establishment of woody seedlings and saplings. This would indicate changing conditions that suggest an improving trend. If such indicators are not apparent, select the category "status unknown."

18. Comments and Observations. Add any necessary commentary to explain or amplify the data recorded. Do not leave this space blank. Describe any unique characteristics of the site and other observations relating to the vegetation.

LITERATURE CITED

Adams, Barry and Lorne Fitch. 1995. Caring for the green zone, riparian areas and grazing management. Alberta Riparian Habitat Management Project. Lethbridge, Alberta, Canada. 37 p.

Alberta Natural Heritage Information Centre. 1999. Natural regions and subregions of Alberta. Internet website: http://www.gov.ab.ca/env/parks/anhic/abnatreg.html. Edmonton, Alberta, Canada. T5K 2J6.

American Fisheries Society, Western Division. 1980. Position paper on management and protection of western riparian stream ecosystems. American Fisheries Society, Bethesda, Maryland, USA. 24 p.

Boldt, Charles D., Daniel W. Uresk, and Keith E. Severson. 1978. Riparian woodlands in jeopardy on Northern High Plains. In: Strategies for protection and management of floodplain wetlands and other riparian ecosystems (R. R. Johnson and J. F. McCormick, Technical Coordinators). USDA Forest Service General Technical Report WO-12. Washington, DC, USA. pp. 184-189.

Cooperrider, Allen Y., Raymond J. Boyd, and Hanson R. Stuart. 1986. Inventory and monitoring of wildlife habitat. USDI Bureau of Land Management, Denver Service Center, Denver, Colorado, USA. 858 p.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deep water habitats of the United States. USDI Fish and Wildlife Service, Office of Biological Services, Washington, DC, USA. Publication Number FWS/OBS-79/31. 107 p.

Cows and Fish. 2001. Invasive Weed and Disturbance-caused Herbaceous Species List For Use in Riparian Health Assessment and Inventory in Alberta -- draft. Alberta Riparian Habitat Management Program. Lethbridge, Alberta, Canada.

Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1. US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, USA. 100 p.

Federal Interagency Committee for Wetland Delineation. 1989. Federal manual for identifying and delineating jurisdictional wetlands. US Army Corps of Engineers, US Environmental Protection Agency, USDI Fish and Wildlife Service, and USDA Soil Conservation Service Cooperative Technical Publication, Washington, DC, USA. 76 p.

Fitch, L. and N. Ambrose. 2003. Riparian areas: A user's guide to health. Lethbridge, Alberta: Cows and Fish Program. ISBN No. 0-7785-2305-5. 46 p.

Hansen, Paul L., Robert D. Pfister, Keith Boggs, Bradley J. Cook, John Joy, and Dan K, Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Miscellaneous Publication No 54. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, Montana, USA. 646 p.

Huel, Denis. 1998. Streambank stewardship, your guide to caring for riparian areas in Saskatchewan. ISBN No. 1-896793-20-7. Saskatchewan Wetland Conservation Corporation. Regina, Saskatchewan, Canada. 43 p.

Huel, Denis. 2000. Managing Saskatchewan Wetlands—a landowner's guide. ISBN No. 1-896793-26-6. Saskatchewan Wetland Conservation Corporation. Regina, Saskatchewan, Canada. 68 p.

Johnson, R. R., and S. W. Carothers. 1980. Riparian habitats and recreation: interrelationships and impacts in the Rocky Mountain region. Produced under agreement 53-82 FT-0-125 of the Eisenhower Consortium for Western Environmental Forestry Research, Fort Collins, Colorado, USA. 109 p.

Kent, Donald M. 1994. Applied wetlands science and technology. Donald M. Kent, editor. CRC Press, Inc., Lewis Publishers, Boca Raton, Florida, USA. 436 p.

Kovalchik, Bernard L. 1987. Riparian zone associations: Deschutes, Ochoco, Fremont, and Winema National Forests. USDA Forest Service Region 6 Ecology Technical Paper 279-87. Pacific Northwest Region, Portland, Oregon, USA. 171 p.

Mitsch, William J., and James G. Gosselink. 1993. Wetlands. Second Edition. Van Nostrand Reinhold, Publishers, New York, New York, USA. 722 p.

Padgett, Wayne G., Andrew P. Youngblood, and Alma H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service Region 4 Ecology 89-01. Intermountain Research Station, Ogden, Utah, USA. 191 p.

Pfankuch, D. J. 1975. Stream reach inventory and channel stability evaluation. USDA Forest Service, RI-75-002. Government Printing Office #696-260/200, Washington, DC, USA. 26 pp.

Platts, W. S., C. Armour, G. D. Booth, M. Bryant, J. L. Bufford, P. Cuplin, S. Jensen, G. W. Lienkaemper, G. W. Minshall, S. B. Monsen, R. L. Nelson, J. R. Sedell, and J. S. Tuhy. 1987. Methods for evaluating riparian habitats with applications to management. USDA Forest Service General Technical Report INT-221. Intermountain Research Station, Ogden, Utah, USA. 187 p.

Reed, Porter B., Jr. 1988. National list of plant species that occur in wetlands: Northwest (Region 9). US Fish and Wildlife Service Biological Report 88 (26.9). USDI Fish and Wildlife Service, Research and Development, Washington, DC, USA. 89 pp.

Rosgen, D. L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, Colorado, USA. 246 pp.

Shaw, S. P., and C. G. Fredine. 1956. Wetlands of the United States: Their extent and their value for waterfowl and other wildlife. USDI Fish and Wildlife Service, Circular 39. Washington, DC, USA. 67 p.

Stewart, R. E., and H. A. Kantrud. 1972. Classification of natural ponds and lakes in the glaciated prairie region. USDI Fish and Wildlife Service, Research Publication 92. 57 p.

Thompson, William H. and Paul L. Hansen. 2001. Classification and management of riparian and wetland sites of the Saskatchewan Prairie Ecozone and parts of adjacent subregions. Riparian and Wetland Research Program, the University of Montana, Prepared for the Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan, Canada. 298 pp.

Thompson, William H. and Paul L. 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. 416 pp.

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

USDA Forest Service. 1989. Ecosystem classification handbook: ECODATA. USDA Forest Service, Northern Region, Missoula, Montana, USA.

Windell, John T., Beatrice E. Willard, David J. Cooper, Susan Q. Foster, Christopher F. Knud-Hansen, Lauranne P. Rink, and George N. Kiladis. 1986. An ecological characterization of Rocky Mountain montane and subalpine wetlands. USDI Fish and Wildlife Service Biological Report 86(11). National Ecology Center, Division of Wildlife and Contaminant Research, Fish and Wildlife Service, US Department of the Interior, Washington, DC, USA. 298 p.

LARGE RIVER HEALTH ASSESSMENT
FIELD SCORE SHEET

1. Cottonwood Regeneration from Seed. **Score:_____**

6 = 15% of the cottonwood cover is established seedlings and saplings.
4 = 5% to 15%% of the cottonwood cover is established seedlings and saplings.
2 = Up to 5% of the cottonwood cover is established seedlings and saplings.
0 = None of the cottonwood cover is established seedlings and saplings.

2. Regeneration of other Tree Species. **Score:_____**

3 = More than 5% of the other tree cover is seedlings and saplings.
2 = 1% to 5% of the other tree cover is seedlings and saplings.
1 = Less than 1% of the other tree cover is seedlings and saplings.
0 = None of the other tree cover is seedlings and saplings.

3. Preferred Shrub Regeneration. **Score:_____**

3 = More than 5% of the preferred shrub cover is seedlings and saplings.
2 = 1% to 5% of the preferred shrub cover is seedlings and saplings.
1 = Less than 1% of the preferred shrub cover is seedlings and saplings.
0 = None of the preferred shrub cover is seedlings and saplings.

4. Standing Decadent and Dead Woody Material. **Score:_____**

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

5. Preferred Tree and Shrub Utilization. **Score:_____**

3 = Less than 5% of 2nd year and older available leaders of preferred species browsed.
2 = 5% to 25% of 2nd year and older available leaders of preferred species browsed.
1 = 25% to 50% of 2nd year and older available leaders of preferred species browsed.
0 = More than 50% of 2nd year and older available leaders of preferred species browsed.

6. Total Canopy Cover of Woody Species. **Score:_____**

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

7. Invasive Herbaceous Species. **Score:_____**

Scoring: Consider all weeds collectively without regard to individual species.
6 = No invasive species (noxious weeds) on the site.
4 = Weed density/distribution in a class from 1 to 3, ***AND*** less than 1% of site area is infested
2 = Weed density/distribution in a class from 4 to 7, ***AND*** less than 15% of site area is infested
0 = Weed density/distribution in class 8 or higher, ***OR*** 15% or more of the site area is infested

8. Disturbance-increaser Undesirable Herbaceous Species. **Score:_____**

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

9. Presence of Native Graminoids. **Score:_____**

3 = More than 50% of the reach is covered by native graminoid species.
2 = 25% to 50% of the reach is covered by native graminoid species.
1 = 5% to 25% of the reach is covered by native graminoid species.
0 = Less than 5% or less of the reach is covered by native graminoid species.

10. Exotic Undesirable Woody Species. **Score:_____**

3 =Less than 5% of total woody coverage in reach consists of exotic undesirable woody species.
2 = 5% to 25% of total woody coverage in reach consists of exotic undesirable woody species.
1 = 25% to 50% of total woody coverage in reach consists of exotic undesirable woody species.
0 = More than 50% of total woody coverage consists of exotic undesirable woody species.

11. Riverbank Root Mass Protection. **Score:_____**

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

12. Human-Caused Bare Ground. **Score:_____**

6 = Less than 5% of the reach contains human-caused bare ground.
4 = 5% to 25% of the floodplain contains human-caused bare ground.
2 = 25% to 50% of the floodplain contains human-caused bare ground.
0 = More than 50% of the floodplain contains human-caused bare ground.

13. Dewatering of the River System. **Score:_____**

9 = Less than 10% of average river discharge during the critical growing season is removed.
6 = 10% to 25% of average river discharge during the critical growing season is removed.
3 = 25% to 50% of average river discharge during the critical growing season is removed.
0 = More than 50% of average river discharge during the critical growing season is removed.

14. Control of Flood Peak and Timing by Upstream Dam(s). **Score:_____**

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

15. Human Alterations to the Riverbanks. **Score:_____**

9 = Less than 10% of the bank length has been restructured by human activity.
6 = 10% to 25% of the bank length has been restructured by human activity.
3 = 25% to 50% of the bank length has been restructured by human activity.
0 = More than 50% of the bank length has been restructured by human activity.

16. Floodplain Accessibility. **Score:_____**

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

Overall Polygon Health Rating Calculation. The sum of scores assessed for all items is calculated as the "Total Actual Score", and the sum of all possible item scores is calculated as the "Total Possible Score". These "Totals" are entered into the Health Rating Formula shown to derive a percentage "Health Rating" for the polygon. The percentage "Rating" is then categorized into a "Health Category" as defined below.

Health Rating Formula: Health Rating = (Total Actual Score) / (Total Possible Score) X 100%

Health Category:		
	80 to 100%	= Proper Functioning Condition (Healthy)
	60 to less than 80%	= Functional At Risk (Healthy, but with Problems)
	Less than 60%	= Nonfunctional (Unhealthy)

Comments and Observations.