ALBERTA LOTIC WETLAND HEALTH ASSESSMENT FOR STREAMS AND SMALL RIVERS (Survey) USER MANUAL

The user manual is intended to accompany the Alberta Lotic Wetland Health Assessment For Streams and Small Rivers (survey) Form for the rapid evaluation of lotic (riparian) wetlands. Another form entitled the Alberta Lentic Wetland Health Assessment (survey) Form, with a different set of codes and instructions, is available for lentic (still water) wetlands.

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.

The health assessment survey 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 lotic wetlands in need of closer attention so that managers can more efficiently concentrate effort. We use the term "riparian health" to mean the ability of a riparian reach (including the riparian area and its channel) 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), and *Riparian Health Assessment for Streams and Small Rivers* (Fitch and others 2001). 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 flowing 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, also referred to as riparian wetlands, contain a defined channel and floodplain. The channel is an open conduit which periodically or continuously carries flowing water and 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 *Acer negundo/Prunus virginiana* (Manitoba maple/choke cherry) habitat type (Thompson and Hansen 2002) 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

As noted above, the health of a lotic site (a wetland, or riparian area, 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. The lotic health assessment is based on consideration of physical, hydrologic, and vegetation factors. It relies heavily on vegetative characteristics as integrators of factors operating on the landscape. Because they are more visible than soil or hydrologic 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 wetland functions of stabilizing the soil, trapping sediments, and providing wildlife habitat. Furthermore, the utilization of certain types of vegetation by animals may indicate the current condition of the wetland 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 assessment method 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 rating of riparian health. Some more rigorous methods to determine status of a stream'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 rapid assessment procedure has been tested in Montana, surrounding states, and western Canada since 1992. Some potential uses for this rating are: 1) for stratifying streams or stream reaches by degree of ecologic dysfunction, 2) for identifying ecologic problems, and 3) when repeated over time, for monitoring to detect functional change. A less direct, but also important, value of an environmental assessment of this kind is its educational potential. By getting land managers to focus on individual riparian functions and ecologic processes, they may come to better understand how the parts work together and are affected by human activities.

This 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 approach yield an absolute rating to be used in comparison with streams in other areas or of other types. Comparisons using this rating with streams 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 stream, between neighbouring streams 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 identified in the field 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, one should avoid comparing a rating after a season of use one year to a rating another year after a season of rest.

There are some visible changes to riparian area health which we have no simple way to measure. An obvious and commonly encountered example is excess entrained sediment. This may indicate serious degradation, but we leave it out of the assessment due to difficulty in knowing how much is normal. Instead, we address on-site causes of sediment production: bare ground, banks with poor root mass protection, and human-caused structural damage to the banks. Another potentially serious degrading factor for which we have no simple measurement yet is dewatering of the system by irrigation diversion/pumping and by upper drainage retention dams.

Pre-Assessment Preparation

The lotic wetland health assessment process incorporates data on a wide range of biological and physical categories. 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, most polygons are usually drawn as a single line following the stream or river and are numbered sequentially proceeding downstream. It is important to clearly mark and number the polygons on the topo map. 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.). Combinations of delineated polygons will be field identified as the hyphenated tags of both combined parts (e.g., 1-2, 2-3, etc.).

If aerial photos are available, pre-field polygon delineations may be based on vegetation differences, geologic features, or other observable characteristics. On larger systems with wide riparian areas, aerial photos may allow the pre-field drawing of multiple polygons away from the river. In these cases, where polygons can be drawn as enclosed units (instead of just as a line), a minimum mapping unit of 5 to 10 acres (2 to 4 ha) should be used. The size of the minimum mapping unit should be based on factors such as management capabilities and the costs and capabilities of data collection.

Upper and lower polygon boundaries are placed at distinct locations such as fences, stream confluences, or stream meanders that can be recognized in the field. Polygons should not cross fences between areas with different management. In most cases, polygons are delineated one quarter to three quarters of a mile (0.4 km to 1.2 km) long. On smaller streams, polygons include the land on both sides of the stream. On large rivers, or if property ownership or access differs, polygons may include only one side of a stream.

Once in the field, observers will 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 wetland 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.

Selection of a Reach to Evaluate
If time is available, or the length of stream in question is short, the entire stream can be assessed. If not, then one or more reaches may represent the whole. The evaluator may choose either a ***critical*** reach (an especially sensitive spot) or one ***representing*** (typical of) the larger area. It may be wise to assess both critical and representative reaches. To determine what is actually representative, observers must become familiar with the entire length of the designated stream and adjacent riparian area. This will require walking the entire length.

Identification of plant communities by vegetation type (such as Thompson and Hansen 2002) will be useful both in site selection and, later, in determining appropriate management. These communities 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.

We recommend the length of reach be at least one channel meander cycle, although two is preferable. Streambank problems will be overestimated if the reach is located mostly on an outside curve and underestimated if it is mostly on an inside curve. A complete meander cycle has equal inside and outside curvature (Figure 1)

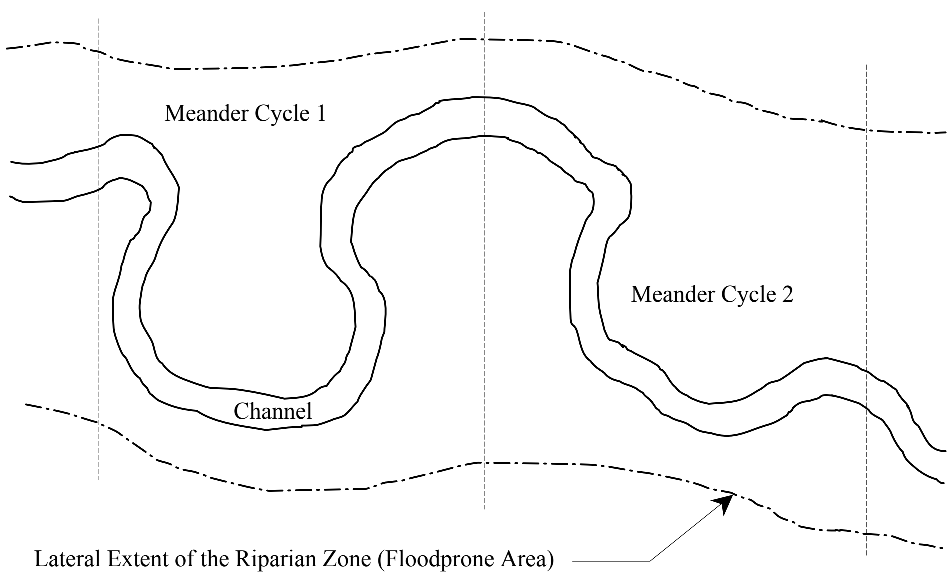


Figure 1. A schematic example of meander cycle delineation showing two cycles

Scale should be considered in determining reach length. Whereas a 600 ft (180 m) reach length may include two meander cycles on smaller streams, such a length would be inadequate on a river 100 ft (30 m) wide. If the reach to be assessed must be shorter than a full meander cycle, the evaluator should look beyond the delineated reach to include a full meander cycle when rating channel morphology and streambank factors. If it is impractical to assess a full meander cycle, we recommend a 600 ft (180 m) minimum length.

In addition to reach length, riparian zone width must be considered. 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. 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 2). 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.

The location of the inner (or streamside) polygon boundary is also required, even on polygons that span the stream. This allows data to be collected on the riparian area while excluding the aquatic zone of the stream. The aquatic zone is the area covered by surface water and lacking persistent emergent vegetation. Persistent emergent vegetation consists of wetland species that normally remain standing at least until the beginning of the next growing season, e.g., *Typha* spp. (cattails) or *Scirpus* spp. (bulrushes) (Cowardin and others 1979).

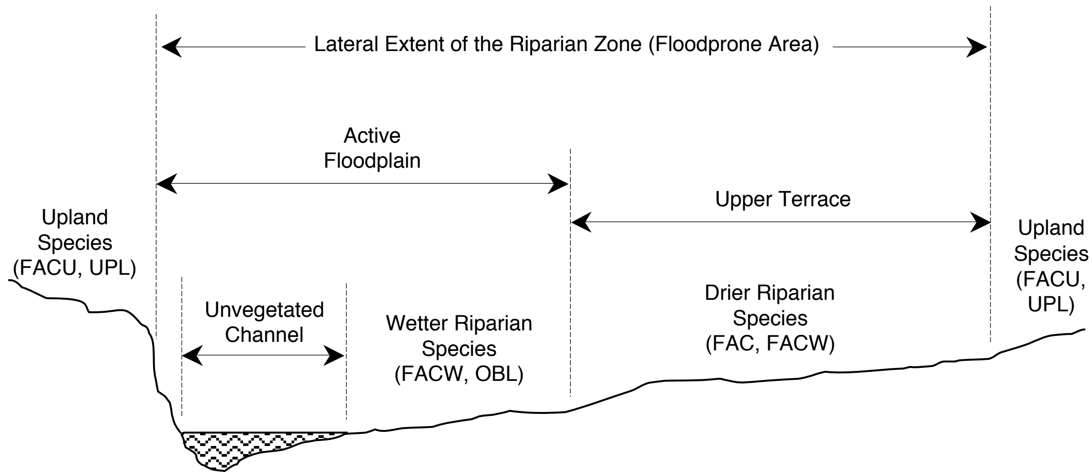


Figure 2. A schematic example of a typical riparian zone cross section showing near-channel landform features. *Note:* FAC (facultative), OBL (obligate), UPL (upland), etc. refer to categories of frequency a species is found in wetlands (Reed 1988).

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. The average width of the non-vegetated stream channel is recorded, and its area 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.

Assessments should not cross fences between areas with different management. If the stream to be rated crosses more than one management unit, at least one reach should be assessed in each unit. Fences exert a strong influence on livestock movement and grazing patterns; therefore, assessed reaches should be located at least 250 ft (75 m) from any fence. The evaluation should include the riparian zone on both sides of the stream if both are under the same management. Along a large stream, the same operator may not manage both sides. The channel may be so large that livestock (or evaluators) cannot easily cross. In such cases it may not be feasible to evaluate both sides at once.

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.

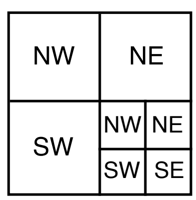
B4d. The subdivision lot on which the field work is being done.

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
Perennial Stream. A stream or stretch of stream that flows continuously for most of most years. Perennial streams are generally fed in part by springs or discharge from groundwater.
Intermittent Stream. A stream or stretch of stream which flows only at certain periods of the year when it receives water from springs, discharge from groundwater, or melting snow in mountainous areas. These streams generally flow continuously at least one month most years.
Ephemeral Stream. A stream or stretch of stream that flows in normal water years only in direct response to precipitation. In normal years it receives no water from springs and no extended supply from melting snow or other surface source. Ephemeral streams are not in contact with groundwater and normally do not flow continuously for as long as one month. Not all ephemeral streams support riparian plant communities.
Subterranean Stream. A stream that flows underground for part of the stream reach. This occurs on systems composed of coarse textured, porous substrates. Surface flow may disappear and re-emerge farther downstream.
Pooled Channel Stream. An intermittent stream that has significant channel pools after surface flow ceases. Pools are generally at meander curves and are usually considerably deeper than the rest of the channel bottom. Water sources for the pools may be springs or contact with subsurface groundwater. This stream type is typical of fine textured sedimentary plains in semi-arid regions where headwater drainages lack the extended runoff of deep mountain snowpack. This stream type may not be apparent early in the season when flow in continuous.
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.
Beaver Dams. A systems that is predominantly characterized by beaver dams that change the character of the system from a regular flowing channel to a "stepped" system of ponds where water is spread wide and flow velocity is apparent only at each dam outlet before it enters the next pond. Water is still flowing through the riparian system.
Wet Meadow. This type of wetland may occur in either riparian (lotic) or in still water (lotic) systems. A lotic wet meadow has a defined channel or flowing surface water, but is typically much wider than the riparian zone associated with the classes described above. This is often the result of the influence of lateral groundwater not associated with the stream flow. Lotic and lotic wet meadows may occur in proximity (e.g., when enough groundwater emerges to begin to flow from a mountain meadow, the system goes from lotic to lotic). Such communities are typically dominated by herbaceous hydrophytic vegetation that require saturated soils near the surface, but tolerate no standing water for most of the year. This type of wetland typically occurs as the filled-in site of old beaver ponds, lakes, and potholes.
Spring/Seep. Groundwater discharge areas. In general, springs have more flow than seeps. This wetland type may occur in a riparian (lotic) or still water (lotic) system.
Irrigation Canal. Includes all types of canals and ditches associated with irrigation systems.
Other. Describe the water source (e.g., irrigation return flow, industrial discharge, etc.).
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.

C2. The size (acres/hectares) of polygons large enough to be drawn as enclosed units on available maps may be determined in the office using a planimeter, dot grid, or GIS. For polygons too narrow or small to be accurately drawn as enclosed units on available maps, size is calculated using polygon length and average polygon width (items C5 and C7).

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. Record ***average*** width of the polygon, which on smaller streams corresponds to the width of the riparian zone. This width is 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.

C8. List the riparian habitat type(s) and/or community type(s) found in the polygon (Thompson and Hansen 2002 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, POPUTRE/CORNSTO 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 Site Characteristics
D1a, b. Make a call on whether the polygon has potential for tall woody type(s), and if the answer is "Yes," then tell whether such types are present on the polygon. Tall woody types are any tree HTs or CTs and such taller shrubs as willows, Saskatoon, Alder, birch, etc. Not included are shorter shrub species, such as buckbrush/snowberry, rose, etc.

D2. Give the waterbody number (FMIS/Hydro code).

D3. If water quality data is available on this waterbody, list the reference where the data can be found.

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.

E1. Identify the film roll number, photo (frame) number, and description of each photograph taken at the upper end of the polygon. List them in the order of upper views, then lower views, and then each other shot taken to show features of interest. Also, identify the photographer and camera used.

E2. Indicate if there is adjacent polygon upstream of this one.

E3. Same as E1 above for shots taken at the most southerly/easterly end or side of the polygon.

E4. Indicate if there is adjacent polygon downstream of this one.

E5. Identify all additional photos taken outside of polygon (i.e., non-polygon photos) by giving roll number, frame number, and description of view.

E6. Record the brand of film, film speed, camera lens size, and lens focal length or magnification.

THE LOTIC HEALTH ASSESSMENT SCORE SHEET (SURVEY)

Some factors on the evaluation will not apply on all sites. Sites without potential for woody species are not rated on factors concerning trees and shrubs. Vegetative site potential can be determined by using a key to site type (e.g., Hansen and others 1995, Kovalchik 1987, or another appropriate publication). On severely disturbed sites, vegetation potential can be difficult to determine. On such sites, clues to potential may be sought on nearby sites with similar landscape position.

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

Each factor below will be rated according to conditions observed on the site. The evaluator will estimate the scoring category and enter that value on the score sheet.

1. Vegetative Cover of Floodplain and Streambanks. Vegetation cover helps to stabilize banks, control nutrient cycling, reduce water velocity, provide fish cover and food, trap sediments, reduce erosion, and reduce the rate of evaporation (Platts and others 1987). 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 live 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% live vegetative cover are included as part of the riparian vegetation.

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

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

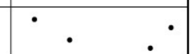
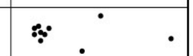
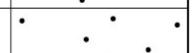
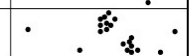
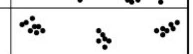
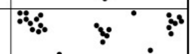
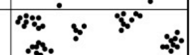
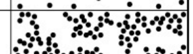
2. Invasive Plant Species (Weeds).
Invasive plants (weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of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

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

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

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

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

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

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

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

Antennaria spp. (pussy-toes)
Brassicaceae (mustards)
Bromus inermis (smooth brome)
Fragaria spp. (strawberries)
____

Hordeum jubatum (foxtail barley)
Plantago spp. (plantains)
Poa pratensis (Kentucky bluegrass)
____
____

Potentilla anserina (silverweed)
Taraxacum spp. (dandelion)
Trifolium spp. (clovers)
____
____

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

4. Preferred Tree and Shrub Establishment and/or Regeneration. (Skip this item if the site lacks potential for trees or shrubs; for example, the site is a herbaceous wet meadow or marsh.) Not all riparian areas can support trees and/or shrubs.

However, on those sites where such species do belong, they play important roles. The root systems of woody species are excellent bank stabilizers, while their spreading canopies provide protection to soil, water, wildlife, and livestock. Young age classes of woody species are important indicators of the continued presence of woody communities not only at a given point in time but into the future. Woody species potential can be determined by using a key to site type (Thompson and Hansen 2001, Hansen and others 1995). On severely disturbed sites, the evaluator should seek clues to potential by observing nearby sites with similar landscape position. *(**Note:*** Vegetation potential is commonly underestimated on sites with a long history of disturbance.)

One species (*Elaeagnus angustifolia* [Russian olive]) and three other shrub genera (*Symphoricarpos* spp. [buckbrush/snowberry], *Rosa* spp. [rose], and *Crataegus* spp. [hawthorn] 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. *Elaeagnus angustifolia* (Russian olive) 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* (buckbrush/snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals. We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of buckbrush/snowberry).

For shrubs in general, seedlings and saplings can be distinguished from mature plants as follows. For those species having a mature height generally over 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 trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the observer is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below.)*

6 = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and 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 tree/shrubs is seedlings and saplings.
0 = Preferred tree/shrub seedlings or saplings absent.

5. Utilisation of Preferred Trees and Shrubs. (Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh.) Many riparian woody species are browsed by livestock and/or wildlife. Heavy browsing can prevent establishment or regeneration of these important species. Excessive browsing can eliminate them from the community and result in their replacement by undesirable invaders.

One tree species (*Elaeagnus angustifolia* [Russian olive]) and three shrub genera (*Symphoricarpos* spp. [snowberry], *Rosa* spp. [rose], and *Crataegus* spp. [hawthorn] are excluded from the evaluation of utilization 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. *Elaeagnus angustifolia* (Russian olive) is considered an especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (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 utilized 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 utilization. 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 utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use since this may not accurately reflect actual use because significant browsing can occur late in the season. 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 use of dead plants unless it is clear this condition was the result of over-grazing.

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. Standing Decadent and Dead Woody Material. (Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh.) The amount of decadent and dead woody material on a site can be an indicator of the overall health of a riparian area. Large amounts of decadent and dead woody material may indicate a reduced flow of water through the stream (dewatering) 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 from over browsing. Finally, large amounts of decadent and dead woody material may indicate climatic impacts, disease and insect damage. For instance, severe winters may cause extreme die back of trees and shrubs, and cyclic insect infestations may kill individuals in a stand. In all these cases, a high percentage of dead and decadent woody material reflects degraded vegetative health, which can lead to reduced streambank integrity, channel incisement, and excessive lateral cutting, besides reducing production and other wildlife values.

The most common usage of the term ***decadent*** may be for over mature trees past their prime and which may be dying, but we use the term in a broader sense. We count decadent plants, both trees and shrubs, as those with 30% or more dead wood in the upper canopy. In this item, scores are based on the percentage of total woody canopy cover which is decadent or dead, not on how much of the total polygon canopy cover consists of dead and decadent woody material. Only decadent and dead standing material is included, not that which is lying on the ground.

Scoring: (If site lacks potential for woody species, replace both Actual and Potential Scores with NA.)

3 = Less than 5% of the total canopy cover of woody species is decadent or dead.
2 = 5% to 25% of the total canopy cover 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. Streamside vegetation stabilizes the soil to the extent that it provides deep, binding roots. All tree and shrub species provide such roots. Herbaceous annuals lack this quality. Perennial herbs provide it in varying degree. Some rhizomatous species, such as sedges (*Carex* spp.), are excellent streambank stabilizers. Other rhizomatous species, such as Kentucky bluegrass (*Poa pratensis*), have shallow roots and are poor streambank stabilizers. The evaluator should seek to determine if the types of root systems present in the polygon are in fact contributing to the stability of the streambanks. For this item consider the streambank to extend from the toe of the bank to approximately 18 inches 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. Remember to include both banks (e.g., both sides of the stream).

Scoring:

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

8. Human-Caused Bare Ground. Bare ground is soil not covered by plants, litter or duff, downed wood, or rocks larger than 2.5 inches (6 cm). Bare ground caused by human activity indicates a deterioration of riparian health. Sediment deposits and other natural bare ground are excluded as normal or probably beyond immediate management control. Human land uses causing bare ground include livestock grazing, recreation, roads, and industrial activities. The evaluator should consider the causes of all bare ground observed and estimate the fraction that is human-caused.

Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. 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 1% of the polygon is human-caused bare ground.
4 = 1% to 5% of the polygon is human-caused bare ground.
2 = 5% to 15% of the polygon is human-caused bare ground.
0 = More than 15% of the polygon is human-caused bare ground.

9. Streambank Structurally Altered by Human Activity. Streambank structural integrity is vital to good channel configuration and bank shape. Impaired structure can mobilize channel and bank materials, cause loss of fishery and wildlife habitat, lower the water table, etc. Bank alteration can result from such causes as livestock hoof shear, recreation, and resource extraction. Do not include pugging and hummocking as they are taken care of later. In rating this item, consider the bank area from the water's edge up to 18 inches (45 cm) 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. Remember to include both banks (e.g., both sides of the stream).

Scoring:
6 = Less than 5% of the bank is structurally altered by human activity.
4 = 5% to 15% of the bank is structurally altered by human activity.
2 = 15% to 35% of the bank is structurally altered by human activity.
0 = More than 35% of the bank is structurally altered by human activity.

10. Pugging and/or Hummocking. ***Pugging*** is typically considered the tracks of large animals left in fine textured soil. It is usually caused by hooved animals, livestock or wildlife, but on some sites the tracks of humans and/or their machines are left in fine textured soils. Clayey or silt mud is commonly of a consistency to hold tracks. Upon drying, pugged areas will have a hard, irregular surface, difficult to walk across. Bare soil may or may not be present. ***Hummocking*** is a micro-topographic relief characterized by raised pedicels of vegetated soil as much as 2 ft higher than the surrounding ground which results from long term large animal trampling and tracking in soft soil. Vegetation on the pedicels usually differs from that on the surrounding lower area due to moisture difference between the two levels.

Scoring:
3 = Less than 5% of the polygon is affected by pugging and/or hummocking.
2 = 5% to 15% of the polygon is affected by pugging and/or hummocking.
1 = 15% to 25% of the polygon is affected by pugging and/or hummocking.
0 = More than 25% of the polygon is affected by pugging and/or hummocking.

11. Stream Channel Incisement (vertical stability). Incisement can lower the water table enough to change current vegetation and site potential. It can also increase stream energy, reduce water retention/storage, and increase erosion. A stream is incised when downcutting has lowered the channel bed so that two-year flood events cannot overflow the banks. Four typical downcutting indicators are: a) headcuts; b) exposed cultural features (pipelines, bridge footings, culverts, etc.); c) lack of sediment and exposed bedrock; and d) a low, vertical scarp at the bank toe on the inside of a channel bend. Channel incisement can occur in any of several stages (Figure 4). A severe disturbance can initiate downcutting, transforming the system from a steady state of high water table, appropriate floodplain, and high productivity to one of degraded water table, narrow [or no] active floodplain, and low productivity. (These stages of incisement can be categorized in terms of Rosgen Level I channel types [Rosgen 1996].)

A top rating goes to those unincised channels from which the 1-2 year high flow can access its floodplain. These can be meandering meadow streams (Rosgen E-type) and wide valley bottom streams (Rosgen C-type) which access floodplains much wider than the stream channel, or they may be mountain and foothill streams in V-shaped valleys which have limited floodplains because of topography. These latter types are usually armoured (well-rocked) systems with highly stable beds and streambanks that are not susceptible to downcutting. The lowest rating goes to entrenched channels (Rosgen F- or G-type) where even medium high flows which occur at 5-10 year intervals cannot overtop the high banks. Intermediate stages can be improving or degrading and may reflect slightly incised channels not yet so downcut that intermediate floods cannot access the floodplain, or they may be old incisements that are healing and rebuilding floodplain at a new, lower elevation.

Scoring:
9 = Channel vertically stable and not incised; 1-2 year high flows 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 condition is illustrated in Figure 4 by the following three stages.

Stage A-1. A stable, unincised meandering meadow channel (Rosgen E-type). Flows greater than bankfull (1-2 year event) spread over a floodplain more than twice the bankfull channel width.

Stage A-2. A fairly stable, unincised wide valley bottom stream with broad curves and point bars (Rosgen C-type). Although these streams typically cut laterally on the outside of curves and deposit sediment on inside point bars, bankfull flows (1-2 year events) have access to a floodplain more than twice bankfull channel width.

Stage A-3. A stable, unincised mountain (Rosgen A-type) or foothill (Rosgen B-type) channel with limited sinuosity and slopes greater than 2%. Although bankfull flow stage is reached every 1-2 years, the adjacent floodplain is often narrower than twice the bankfull channel width. Consequently, overflow conditions are not so obvious as in Stages A-1 and A-2 systems.

6 = Either of two incisement phases: (a) an improving phase with a sinuous curve/point bar system (Rosgen C-type) or a narrow, meandering stream (E-type) establishing in an old incisement which now represents the new floodplain, although this may be much narrower than it will become;(b) an early degrading phase in which a narrow, meandering meadow stream (E-type) is degrading into a curve/point bar type (C-type) or a wide, shallow channel (Rosgen F-type). In either case, the 1-2 year high flow event can access only a narrow floodplain less than or only slightly wider than twice the bankfull channel width. Perennial riparian vegetation is well established along much of the reach. These conditions are represented in **Stage B** of Figure 4.

3 = Two phases of incisement fit this rating. (a) A deep incisement that is starting to heal. In this phase new floodplain development, though very limited, is key. This phase is characterized by a wide, shallow channel unable to access a floodplain (Rosgen F-type) evolving into a curve/point bar system (C-type) through sediment deposition and lateral cutting. Pioneer perennial plants are beginning to establish on the new depositional surfaces. (b) An intermediate phase with downcutting and headcuts probable. Flows less than a 5-10 year event can access a narrow floodplain less than twice bankfull channel width. These conditions are represented in **Stage C** of Figure 4.

0 = The channel is deeply incised to resemble a ditch or a gully. Downcutting is likely ongoing. Only extreme floods overtop the banks, and no floodplain development has begun. Both **Stages D-1** and **D-2** of Figure 4 fall into this rating.

Stage D-1. An incised stream with a wide, shallow (F-type) channel. Commonly found in fine substrates (sands, silts, and clays), channel banks are very erodable. Only limited vegetation, primarily pioneer species, is present along the side of the stream.

Stage D-2. A narrow, deep "gully" system (Rosgen G-type) downcut to the point that only extreme floods can overtop the banks. Distinguished from narrow mountain streams (A-type) by the presence of a flat floodplain through which the stream has downcut and by banks consisting of fine materials rather than larger rocks, cobbles, or boulders.

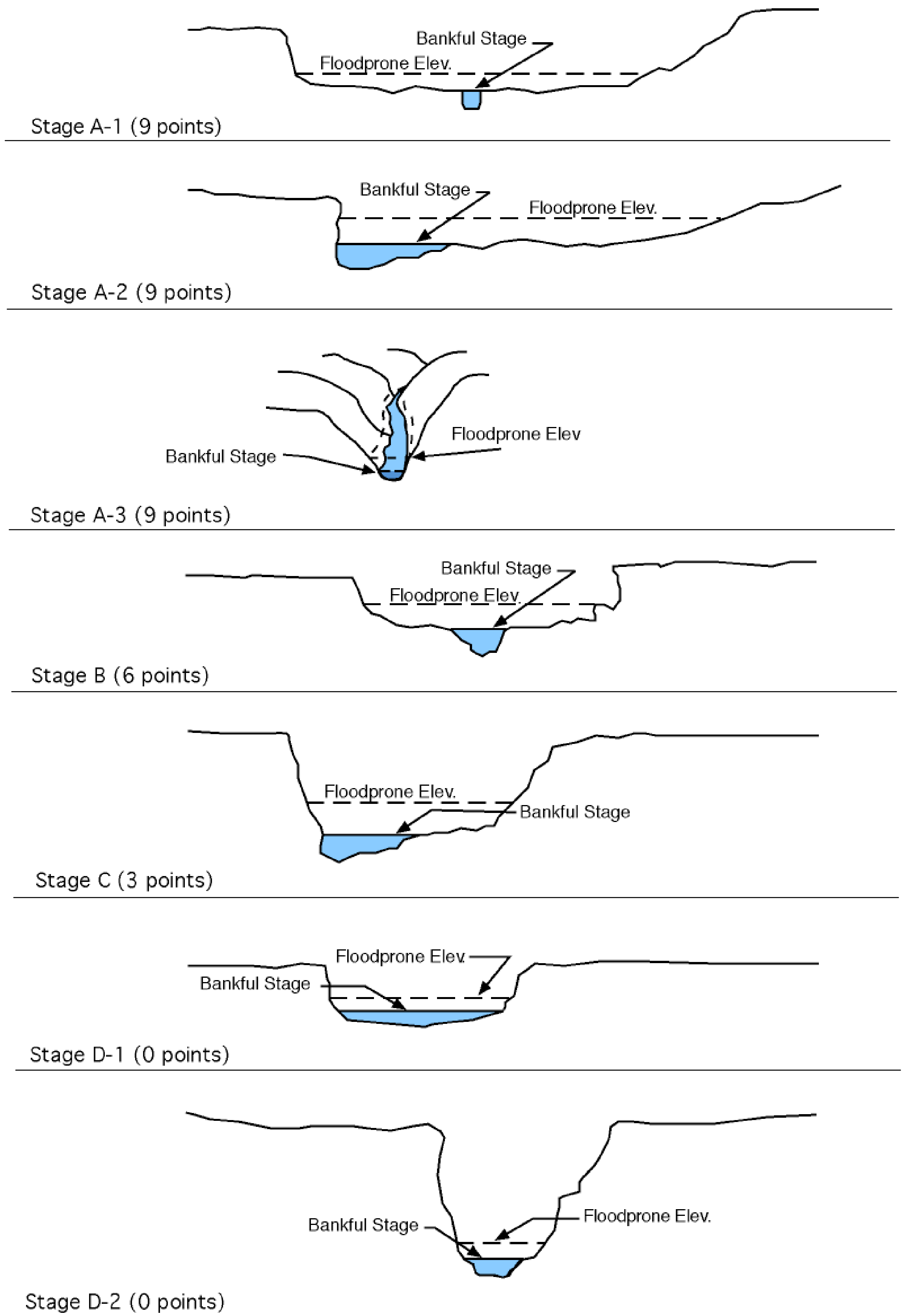


Figure 4. Guides for estimating stage of channel incisement.

10. 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 or to the physical conditions of the site. Each item in the health rating has a small space provided for specific information to enlighten the score given. This larger space is the place for more general commentary to help the reader understand the larger context of the data. Such things as landscape setting and local land use history are appropriate here.

Calculating the Lotic Health Score

To arrive at the overall site health rating, the scores are totalled for all the factors, and that total is divided by the possible perfect score total. A sample score sheet is shown below.

A sample score sheet of a site with no apparent potential for trees or shrubs

Vegetation Factors	**Actual Pts**	**Possible Pts**
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Total Canopy Cover of Invasive Plant Species	0	3
2b. Density/Distribution Pattern of Invasive Plant Species	1	3
3. Disturbance-Caused Undesirable Herbaceous Species	2	3
4. Preferred Tree and Shrub Establishment and Regeneration	NA	NA
5. Utilization of Preferred Trees and Shrubs	NA	NA
6. Standing Decadent and Dead Woody Material	NA	NA
Vegetative Score:	9	15
Soil/Hydrology Factors		
7. Streambank Root Mass Protection	4	6
8. Human-Caused Bare Ground	2	6
9. Streambank Structurally Altered by Human Activity	6	6
10. Pugging and/or Hummocking	2	3
11. Stream Channel Incisement (Vertical Stability)	9	9
Soil/Hydrology Score:	23	30
TOTAL SCORE:	**32**	**45**

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

Rating = (32) / (45) X 100% = 71%

Rating Category:

80-100%	= Proper Functioning Condition (Healthy)
60-79%	= Functional At Risk (Healthy, but with Problems)
Less than 60%	= Nonfunctional (Unhealthy)

The manager should realize that a less than perfect score is not necessarily cause for concern. An area rated at 80% is still considered to be functioning properly. At the same time, ratings of individual factors can be useful in detecting strengths or weaknesses of a site. A low score on any factor may warrant management focus. In the example reach above, low scores for invasive plants and bare ground (items 2 and 8) indicate factors that management might improve in a subsequent assessment.

ADDITIONAL MANAGEMENT CONCERNS (OPTIONAL)

The following items do not contribute to a site's health assessment rating. Rather, they may help to quantify inherent physical site characteristics that reveal structural weaknesses or sensitivities or to assess the direction of change on a site. These data can be useful for planning future site management.

13. Streambank Rock Volume and Size. The composition of streambank materials influences the susceptibility of the streambanks to erosion caused by trampling, water flow or other disturbance. In general, larger rocks provide better protection against disturbance than smaller materials. Thus, streambanks composed primarily of silts and clays—characteristic of the majority of streams in the Great Plains—require more vegetative protection to compensate for the smaller particle sizes.

13a. Streambank Rock Volume. Rate the streambank rock volume as the highest appropriate of the following categories:

Scoring:

3 = More than 40% of volume is rocks at least 2.5 inches.
2 = 20% to 40% of volume is rocks at least 2.5 inches.
1 = 10% to 20% of volume is rocks at least 2.5 inches.
0 = Less than 10% of volume is rocks at least 2.5 inches.

13b. Streambank Rock Size. Rate the streambank rock size for the polygon as the highest appropriate of the following categories:

Scoring:

3 = At least 50% of rocks present are boulders and large cobbles (>5 inch).
2 = 50% of rocks present are small cobbles and larger (>2.5 inches).
1 = At least 50% of rocks present are coarse gravels and larger (>0.6 inches).
0 = Less than 50% of rocks present are coarse gravels and larger (>0.6 inches).

14. Vegetation Use by Animals. Record the rating category which best describes the vegetation use by animals (Platts and others, 1987).

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.

15. Susceptibility of Parent Material to Erosion. The soils derived from shale or having a large clay content are highly susceptible to compaction and trampling when wet. There is evidence that trampling by hooves and subsequent loss of herbaceous vegetation when soils are wet are major contributions to site degradation. In contrast, those sites having soils derived from sandstone or any of the hard metamorphosed rock found in the northern Rocky Mountains commonly have a fine sandy loam to loam texture and are more resistant to damage when wet. Intermediate of these soils are those having textures of clay loam to loam. Texturing the soil by the ribboning technique or by feel will be required for this determination. Rate the polygon soil according to one of these categories based on indicators as described above.

Scoring:

3 = Not susceptible to erosion (well armoured).
2 = Slightly susceptible to erosion (moderately armoured).
1 = Moderately susceptible to erosion.
0 = Extremely susceptible to erosion.

16. Percent of Streambank Accessible to Livestock. Record the percent of streambank length accessible to livestock. In general, only consider topography (steep banks, deep water, etc.) and dense vegetation as restricting access. Fences, unless part of an exclosure, do not necessarily restrict livestock access even though they may appear to be doing so at the time.

17. Polygon Trend. Select the ***one category*** (Improving, Degrading, Static, or Status Unknown) which best indicates the current trend of the vegetative community on the polygon to the extent possible. 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 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 shoreline and recent establishment of woody seedlings and saplings. This would indicate changing conditions that suggest an improving trend. If such indicators are not apparent, enter the category “status unknown.”

18. Break Down the Polygon Area into the Land Uses Listed. Name any “Others” Observed.

19. Break Down the Area Adjacent to the Polygon into the Land Uses Listed. Name any “Others” Observed.

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ALBERTA LOTIC WETLAND SURVEY FIELD SCORE SHEET

1. Vegetative Cover of Floodplain and Streambanks. **Score:_________**

6 = More than 95% of the reach soil surface is covered by live plant growth.
4 = 85% to 95% of the reach soil surface is covered by live plant growth.
2 = 75% to 85% of the reach soil surface is covered by live plant growth.
0 = Less than 75% of the reach soil surface is covered by live plant growth.

2a. Total Canopy Cover of Invasive Plant Species (Weeds). **Score:_________**

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

2b. Density/Distribution Pattern of Invasive Plant Species. **Score:_________**

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

3. Disturbance-Caused Undesirable Herbaceous Species. **Score:_________**

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 45% of the site covered by disturbance-caused undesirable herbaceous species.
0 = More than 45% of the site covered by disturbance-caused undesirable herbaceous species.

4. Preferred Tree and Shrub Establishment and Regeneration. **Score:_________**

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 tree/shrubs is seedlings and saplings.
0 = Preferred tree/shrub seedlings or saplings absent.

5. Utilization of Preferred Trees and Shrubs. **Score:_________**

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. 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 the total canopy cover 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. **Score:_________**

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

8. Human-Caused Bare Ground. **Score:_________**

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

9. Streambank Structurally Altered by Human Activity. **Score:_________**

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. Pugging and/or hummocking. **Score:_________**

3 = Less than 5% of the polygon is affected by pugging and/or hummocking.
2 = 5% to 15% of the polygon is affected by pugging and/or hummocking.
1 = 15% to 25% of the polygon is affected by pugging and/or hummocking.
0 = More than 25% of the polygon is affected by pugging and/or hummocking.

11. Stream Channel Incisement (vertical stability). **Score:_________**

9 = Channel vertically stable and not incised; 1-2 year high flows 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 condition is illustrated in Figure 3 by the following three stages.

Stage A-1. A stable, unincised meandering meadow channel (Rosgen E-type). Flows greater than bankfull (1-2 year event) spread over a floodplain more than twice the bankfull channel width.

Stage A-2. A fairly stable, unincised wide valley bottom stream with broad curves and point bars (Rosgen C-type). Although these streams typically cut laterally on the outside of curves and deposit sediment on inside point bars, bankfull flows (1-2 year events) have access to a floodplain more than twice bankfull channel width.

Stage A-3. A stable, unincised mountain (Rosgen A-type) or foothill (Rosgen B-type) channel with limited sinuosity and slopes greater than 2%. Although bankfull flow stage is reached every 1-2 years, the adjacent floodplain is often narrower than twice the bankfull channel width. Consequently, overflow conditions are not so obvious as in Stages A-1 and A-2 systems.

6 = Either of two incisement phases: (a) an improving phase with a sinuous curve/point bar system (Rosgen C-type) or a narrow, meandering stream (E-type) establishing in an old incisement which now represents the new floodplain, although this may be much narrower than it will become;(b) an early degrading phase in which a narrow, meandering meadow stream (E-type) is degrading into a curve/point bar type (C-type) or a wide, shallow channel (Rosgen F-type). In either case, the 1-2 year high flow event can access only a narrow floodplain less than or only slightly wider than twice the bankfull channel width. Perennial riparian vegetation is well established along much of the reach. These conditions are represented in **Stage B** of Figure 3.

3 = Two phases of incisement fit this rating. (a) A deep incisement that is starting to heal. In this phase new floodplain development, though very limited, is key. This phase is characterized by a wide, shallow channel unable to access a floodplain (Rosgen F-type) evolving into a curve/point bar system (C-type) through sediment deposition and lateral cutting. Pioneer perennial plants are beginning to establish on the new depositional surfaces. (b) An intermediate phase with downcutting and headcuts probable. Flows less than a 5-10 year event can access a narrow floodplain less than twice bankfull channel width. These conditions are represented in **Stage C** of Figure 3.

0 = The channel is deeply incised to resemble a ditch or a gully. Downcutting is likely ongoing. Only extreme floods overtop the banks, and no floodplain development has begun. Both **Stages D-1** and **D-2** of Figure 3 fall into this rating.

Stage D-1. An incised stream with a wide, shallow (F-type) channel. Commonly found in fine substrates (sands, silts, and clays), channel banks are very erodable. Only limited vegetation, primarily pioneer species, is present along the side of the stream.

Stage D-2. A narrow, deep "gully" system (Rosgen G-type) downcut to the point that only extreme floods can overtop the banks. Distinguished from narrow mountain streams (A-type) by the presence of a flat floodplain through which the stream has downcut and by banks consisting of fine materials rather than larger rocks, cobbles, or boulders.

12. Comments and Observations:

ADDITIONAL MANAGEMENT CONCERNS (OPTIONAL)

13. Streambank Rock Volume and Size.

13a. Streambank Rock Volume. Rate the streambank rock volume as the highest appropriate category: **Score:**_________

- **3** = More than 40% of streambank volume is rocks at least 2.5 inches.
- **2** = 20% to 40% of streambank volume is rocks at least 2.5 inches.
- **1** = 10% to 20% of streambank volume is rocks at least 2.5 inches.
- **0** = Less than 10% of streambank volume is rocks at least 2.5 inches.

13b. Streambank Rock Size. Rate the streambank rock size for the polygon as the highest appropriate category: **Score:**_________

- **3** = At least 50% of rocks present are boulders and large cobbles (>5 inch).
- **2** = 50% of rocks present are small cobbles and larger (>2.5 inches).
- **1** = At least 50% of rocks present are coarse gravels and larger (>0.6 inches).
- **0** = Less than 50% of rocks present are coarse gravels and larger (>0.6 inches).

14. Vegetative Use by Animals. Use the categories below to score the amount of utilization. **Score:**_________

- **3** = 0 to 25% available forage taken.
- **2** = 26 to 50% available forage taken.
- **1** = 51 to 75% available forage taken.
- **0** = 76 to 100% available forage taken.

15. Susceptibility of Parent Material to Erosion. **Score:**_________

- **3** = Not susceptible to erosion (well armoured).
- **2** = Slightly susceptible to erosion (moderately armoured).
- **1** = Moderately susceptible to erosion.
- **0** = Extremely susceptible to erosion.

16. Percent of Streambank Accessible to Livestock. **Percent:**_________

17. Polygon Trend. Select one: Improving, Degrading, Static, or Status Unknown **Trend:**_____________________

18. Break Down the Polygon Area into the Land Uses Listed (must total to approx. 100%):

No land use apparent:__________
Turf grass (lawn): __________
Tame pasture (grazing): __________
Native pasture (grazing): __________
Recreation (ATV paths, campsites, etc.): __________
Development (buildings, corrals, paved lots, etc.): __________
Tilled cropping: __________
Perennial forage (e.g., alfalfa hayland): __________
Roads: __________
Logging: __________
Mining: __________
Railroads: __________
Other: __________

Description of Other Usage noted:____
____
____

19. Break Down the Area Adjacent to the Polygon Into the Land Uses Listed (must total to approx. 100%):

No land use apparent:__________
Turf grass (lawn): __________
Tame pasture (grazing): __________

Native pasture (grazing): __________
Recreation (ATV paths, campsites, etc.): __________
Development (buildings, corrals, paved lots, etc.): __________
Tilled cropping: __________
Perennial forage (e.g., alfalfa hayland): __________
Roads: __________
Logging: __________
Mining: __________
Railroads: __________
Other: __________

Description of Other Usage noted:____
____
____