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Watershed Science Institute Technical Report

Assessing Conditions of Riparian-Wetland Corridors at the Areawide Level

Using Proper Functioning Condition (PFC) methodology -- an interdisciplinary assessment tool

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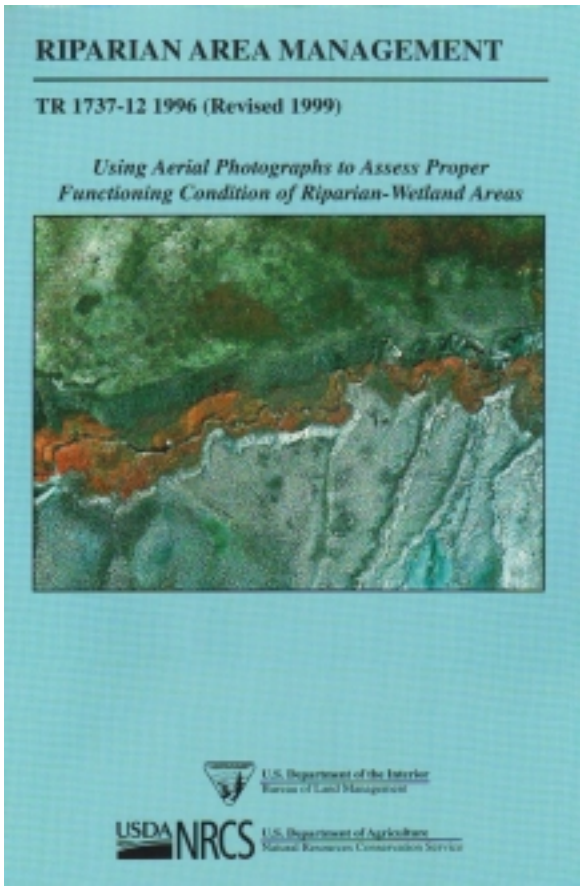
Figure 1. Color infrared photograph of Lodge Grass Creek which flows from the lower left of photo towards Lodge Grass, Montana in the upper right (Crow Indian Reservation). Various types of aerial photography and maps are available from local sources and through the U.S. Geological Survey. USGS may be contacted at *1-888-ASK-USGS* or at their web URL: *http://mapping.usgs.gov/www/products/status.html*



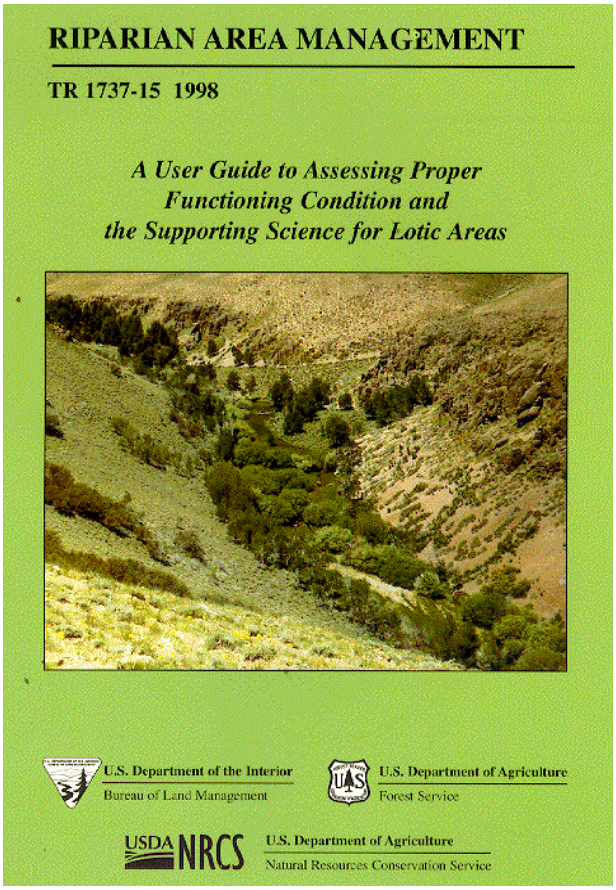


Figure 2. Proper Functioning Condition or PFC methodology is described in the USDI-Bureau of Land Management publications TR 1737-12 and TR 1737-15. A key element in utilizing the PFC approach is a partnership of organizations and interagency training in the classroom and on-the-ground.

Purpose

The purpose of this report is to share a rapid assessment approach with field, area and state staffs of the NRCS and partner organizations who are involved with large area stream corridor assessments. The approach represents one way of inventorying and assessing a critical landscape element, streams and their associated riparian-wetland areas, at the areawide or watershed level. Two accompanying case studies illustrate the use and results of the methodology as used by NRCS staff specialists.

Overview

The USDA Natural Resources Conservation Service (NRCS) has joined with the USDI Bureau of Land Management (BLM) and the USDA Forest Service (USFS) to encourage landowners and land managers to assess and restore stream corridor systems in the West. A key element of this partnership has been the training of users in the riparian-wetland area assessment entitled "Proper Functioning Condition" or PFC. PFC is an interdisciplinary assessment tool for analyzing the condition of stream riparian-wetland areas and prioritizing the need for further detailed inventories and treatment. The method looks at conditions and issues related to stream channel and floodplain stability but does not assess individual plant or animal species or water quality contaminants.

NRCS's Intermountain Riparian/Wetland Resource Technical Team headquartered in Bozeman, Montana, has used the aerial photographic PFC assessment method on several large projects including the:

- Crow Indian Reservation, south-central Montana -- 1,006 stream miles.
- Cut Bank Creek Watershed, north-central Montana -- 210 stream miles.
- Wind River Indian Reservation, central Wyoming -- 1,330 stream miles.

The areawide PFC assessment method utilizing aerial photographic remote sensing has proven to be a rapid tool that can be used when dealing with large areas with limited staff resources. Limitations such as the availability of current aerial photographs for the area of interest, difficulty in interpreting stream channel characteristics, and the need for an interdisciplinary team need to be considered before selecting the areawide PFC method.

The case studies in this technical report provide an introduction to the aerial photographic, or areawide PFC, methodology and operational information on the results of its use on two large projects: 1) the Crow Indian Reservation, and 2) the Cut Bank Creek Watershed. The methodology used for the projects is contained in the publications listed below (covers of the documents are shown in figure 2 on the opposite page). They can be obtained by contacting the Bureau of Land Management, National Business Center, BC-650B, P.O. Box 25047, Denver, Colorado 80225-0047.

- **Riparian area management: a user guide to assessing proper functioning condition and the supporting science for lotic areas.** Prichard, D., J.Anderson, C.Correll, J.Fogg, K.Gebhardt, R.Krapf, S.Leonard, B.Mitchell, J.Staats, 1998. TR 1737-15. Bureau of Land Management, BLM/RS/ST-98/001+1737, National Business Center, CO. 126 p.

- **Riparian area management: using aerial photographs to assess proper functioning condition of riparian-wetland areas.** Prichard, D., et al, 1999. TR 1737-12. Bureau of Land Management, BLM/RS/ST-96/007+1737, National Applied Resources Sciences Center, CO. 52 pp.

BLM's publications TR 1737-15 and TR 1737-12 are the reference bases for all parts of this technical report.

A description of Proper Functioning Condition methodology (PFC)

Proper Functioning Condition or PFC is a qualitative method based on quantitative scientific methods used to determine the health of riparian-wetland area conditions. The term PFC is used to describe both the assessment process and a classification or rating of the condition of a specific riparian-wetland area or reach.

A PFC assessment requires an interdisciplinary team (ID) comprised of hydrology, vegetation, biology and soil specialists. The intent is to have assessments performed by an ID team possessing local quantitative sampling experience with riparian-wetland areas. Such experience improves the calibration and consistency of making qualitative PFC assessments.

The PFC assessment provides a uniform approach for considering *hydrology*, *vegetation*, and *erosion/deposition (soils)* attributes and processes to determine stream channel and floodplain stability. A checklist including 17 items that relate to stream channel stability is used (shown in Appendix A, page 63, of BLM's publication TR 1737-15). Items are answered "yes," "no" and, in some cases, "not applicable." The checklist and its summarization, which can be done quickly, are used to classify the health or state of physical processes of the riparian-wetland area or reach being studied into one of four categories:

- Proper Functioning Condition (PFC)
- Functional--At Risk (FAR)
- Nonfunctional (NF)
- Unknown

The preponderance of "yes" and "no" responses help the ID team determine the proper classification. However, there are no set criteria in BLM publications TR 1737-12 and TR 1737-15 that equate the number of "yes" or "no" responses to a PFC, FAR or NF classification.

The significance or meaning of the classification categories are:

PFC: The stream channel and floodplain have the physical characteristics that provide stability through various frequency flow events. This resiliency allows an area to produce desired values, such as fish habitat, bird habitat, or forage, over time. (Note: A PFC rating should not be equated with the term "Desired Future Condition" though it may be a prerequisite or starting point.)

FAR: The stream is functioning but is lacking enough vegetation, soils or landform characteristics to withstand a various frequency events without significantly damaging the riparian corridor. FAR is the only category that is further stratified by trend (up, down, not apparent). An upward trend rating indicates a recovery towards increasing stability. A downward trend indicates deteriorating conditions that could become NF. Deteriorating conditions can be transmitted both up and downstream. A trend that is not apparent requires further study of the area.

NF: The stream is not stable because it lacks most of the stabilizing physical characteristics and may continue to deteriorate. The degraded area or reach cannot sustain long-term desired values and return to proper functioning condition without intervention (change in management).

Unknown: Sufficient information to make a rating is lacking. Additional study or data collection is needed.

Classification of reaches using the PFC method help local planning groups establish a common vocabulary for discussing desired conditions of their key riparian-wetland landscape elements. The need, type, and location of more detailed inventories (upland methods as well as riparian-wetland corridor methods) can be prioritized once the PFC assessment classifications are known in preparation for developing restoration and management alternatives.

Fundamentals of using aerial photography to assess Proper Functioning Condition (PFC)

Interpretation of aerial photography provides valuable information for land and water conservation planning. Aerial photography typically allows large areas to be viewed and interpreted quickly, requiring less time, staff, and cost than ground-based methods covering the same terrain. It is particularly suited for large farm, ranch, areawide and watershed plans and assessments.

Figure 3. A color-infrared film positive of a watershed on the Crow Indian Reservation, Montana. Aerial photography allows large areas to be viewed and interpreted quickly.

BLM's publication TR 1737-12 provides procedures for PFC ID teams who desire to assess large areas with aerial photography. Instructions focus on how to answer PFC checklist items using magnification and stereoscopic viewing of available photographs.

The aerial photographic PFC assessment procedure involves:

- ***Gathering existing source material***

  U.S. Geological Survey (USGS) topographic maps are needed for delineating reaches and establishing photo-to-ground reference points.

  Recent, color infrared (CIR) aerial photograph film positive transparencies, 1:40,000 scale, are the preferred materials. (Photos from different years are helpful when making trend determinations.) CIR photos allow interpreters to detect subtle differences in vegetation due to the spectral reflectance of the film (see the image on the front cover).

  Natural color photography can be used, but spectral reflectance is less than that of CIR. Film transparencies are easier to interpret than paper prints and worth the extra cost for added sharpness and clarity. Transparencies cause less eye strain.

- ***Analyzing equipment needs***

  Equipment needs will vary depending upon type of photo (CIR transparency or paper) and photo scale. A mirror type stereoscope with at least 4X magnification capability is recommended. Magnifications of 10X-20X offer more magnification but reduce the field of view. A monocular hand lens or magnifier also works well for viewing a specific area on an aerial photo. A light table is mandatory when using film transparencies and, when paper prints are used, sharpens images by backlighting. Mylar overlays on topographic maps or photos may be used for recording reach data as it is assessed.

Figure 4. A mirror type stereoscope with at least 4X magnification capability is recommended. A 10-20X monocular hand lens or magnifier also works well for viewing a specific area on an aerial photo.

- ***Defining reaches/areas***

  Stream reaches should be identified relative to confinement, gradient, sinuosity, land use, structures, bridges, and adjacent land management changes. Reaches can be determined before or as interpretations are being done. As a general rule, reaches should be at least 1/4-mile in length.

- ***Interpreting the aerial photos***

  Representative sample reaches within the project area must be interpreted and ground-truthed before actual classifications are made. This is especially critical if older photos are used to perform the interpretation. A general interpretation key should be locally developed to provide uniformity of ratings during the assessment. An example of this key is provided in Appendix A of BLM TR 1737-12.

  During the interpretation phase, ID team members determine classifications of individual reaches, cross-check one another and note reaches difficult to classify. Ground-truthing is an integral part of interpretation and validates the accuracy of interpretations. Final changes to reach segments need to be rectified on maps of record at the time that they are interpreted.

- ***Filling out the PFC checklist***

  A PFC checklist is completed for each identified reach. Each checklist form is labeled with the applicable aerial photo number, USGS quadrangle map, and other identifying references. Notes should be recorded on the checklist to document observations from aerial photos and field verifications. Checklist forms should be organized to facilitate ground-truthing and later use for more detailed inventories.

Figure 5. Reach breaks were identified on USGS quadrangle maps for Pryor Creek, Crow Indian Reservation, Montana. During the interpretation phase, the breaks were modified if needed and ratings marked in green (PFC) and yellow (FAR).

Cautions, recommendations, advantages, and limitations of using PFC at the areawide level

The aerial photographic PFC assessment method has a high potential for use by NRCS and partners throughout the United States. The method may be more difficult to use in heavily forested areas because of the masking of channel characteristics.

PFC methodology is relatively easy to use and is based on quantitative scientific documentation. The approach provides consistency, flexibility and a common terminology between agencies, notably BLM, USFS and NRCS in the western states. However, a number of items or concerns need to be considered in using the aerial photographic PFC approach:

Cautions

- It is not a sole methodology for assessing the "health" of the aquatic or terrestrial components of a riparian-wetland system.
- It does not yield detailed information on plants or animals species, their habitat or use of riparian-wetland areas.
- PFC should not be equated with desired condition or desired future condition.
- It does not substitute for a watershed analysis or provide data to make water quality standard ratings.
- It was not designed to be used as a long term monitoring tool but may provide guidance of where to monitor.

Recommendations

- CIR film transparencies are preferred over natural color or black-and-white film. CIR allows more accurate interpretations at a smaller scale. Also, positive transparencies provide a clearer picture of many features than paper prints.
- Mylar overlays protect photos or USGS maps and allow recording of reach data.
- Photo scale is a key determinant of project time and cost. Larger scales (e.g., 1:3,000) are easier to interpret but many more photos are required to cover the same area as one small-scale photo (e.g., 1:40,000).
- Photos taken in mid to late summer are preferred to assure accurate signatures of vegetation, width/depth ratios, and erosion/deposition attributes. Care should be taken in answering checklist questions that can be affected by low water levels in summer.
- Additional stratification of PFC, FAR (including trend), NF and Unknown ratings may be necessary to increase the usefulness of the PFC methodology (see the Crow Reservation case study).
- Ground-truthing or field verification should be completed on about 25 percent of the reaches.
- Global Positioning System or GPS units can facilitate identification of reach breaks, areas of concern and other features during ground-truthing.
- Geographic Information Systems (GIS) can facilitate and automate the production of interpretive maps for identifying areas needing detailed inventories and for planning activities.

Figure 6. Ground-truthing or field verification should be completed on about 25 percent of the reaches. Changes need to made on applicable base maps or mylars and in data summaries.

Advantages

- The approach can be used to cover a large area in a short period of time.
- Assessments can be done year-round.
- Upland impacts are easier to detect on the aerial photos compared to ground-based methodology.
- General trends can be detected if accompanied by in-field investigations.
- Plant vigor and geomorphological status can be assessed more easily with "big picture" aerial photographic PFC methodology.

Limitations

- Usable aerial photos based on age and scale may not be available.
- Transparencies are more costly than paper prints.
- Reaches tend to be longer and subtle differences can be missed due to the lower level of resolution compared to on-the-ground assessments.
- Channel characteristics are difficult to interpret as photo scale becomes smaller.
- Ground-truthing may cover a limited area of each reach.
- An experienced, interdisciplinary team is required, i.e., entry level staff cannot be used.
- The aerial photographic PFC methodology is not suited to short term monitoring.

Figure 7. In some cases, channel characteristics are difficult to interpret depending greatly on the scale and quality of aerial photography. On-the-ground reconnaissance of an area before the photo interpretation phase can greatly improve an interpreter's skill level.

CASE STUDY - Crow Indian Reservation Assessment

Introduction

In 1997, the Crow Indian Tribe and Crow Conservation District in south-central Montana requested a natural resource assessment of their reservation. An assessment of riparian areas was to be one component of the overall assessment. The reservation encompasses 2.2 million acres and 6 major watersheds containing over 1,000 miles of perennial streams. The task of the riparian assessment was assigned to the NRCS Intermountain Riparian/Wetland Resource Technical Team headquartered in Bozeman, Montana.

This request for assistance was given a high priority by the NRCS in Montana. The goal for completion of the assessment was September 30, 1997. Due to the magnitude of the job, the time constraints (less than one year) and the lack of existing data on the riparian-wetland areas, remote sensing was considered the only viable option for completing the assessment on time. Since team members had experience using ground-based PFC assessment methodology, the aerial photographic method for applying PFC was selected. The assessment would be the first large scale application of this methodology by NRCS. The assessment would provide information to aid in prioritizing sub-watersheds needing improvement or further inventory.

Figure 8. Headwaters of East Buckeye Creek. Dryland agriculture and grazing land with woody draws were common on the Crow Indian Reservation, Montana.

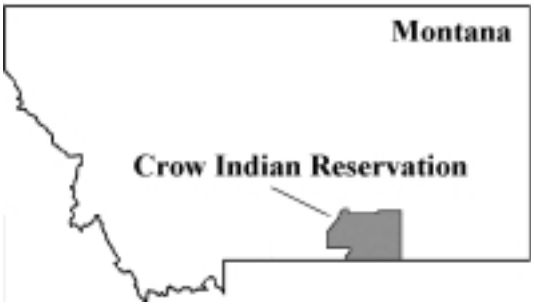


Figure 9. Location map showing the Crow Indian Reservation in southern Montana.

Photography used for this assessment was 1980 and 1981 color infrared transparencies with a scale of 1:63,000.

Results

Riparian assessments were conducted on six watersheds of the Crow Reservation. Over 200 perennial stream reaches with a total length of 1,000 miles were evaluated (see Figure 10). Of 208 reaches assessed:

- 95 reaches, 375 miles, were rated PFC
- 109 reaches, 614 miles, were rated FAR
- 4 reaches, 11 miles, were rated NF

Reaches rated FAR were assigned a trend rating: *up*, *down*, or *not apparent*. Trend is only determined on FAR reaches because all NF reaches need improvement and PFC is considered a stable situation. An upward trend rating indicates that physical recovery is progressing toward a PFC condition.

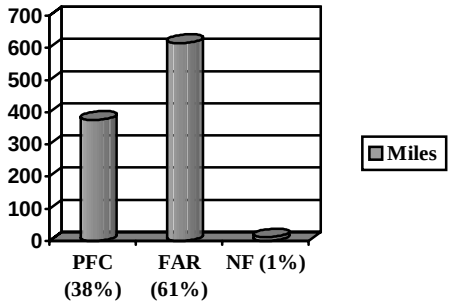


Figure 10. Crow Reservation functional condition summary with a FAR classification predominating.

Downward trend indicates conditions in the rated reach are continuing to deteriorate and, if left unchecked, could result in a reach that is NF. These deteriorating conditions can be transmitted both up and downstream. When trend is not apparent, further study is indicated.

Of the 109 FAR reaches assessed (see Figure 11), trend for:

- 43 reaches, 215 miles, was upward
- 8 reaches, 61 miles, was downward
- 58 reaches, 338 mi., was not apparent

Because of the large number of miles in the FAR condition (and the likely priority FAR reaches would be given later during planning), the aerial photographic PFC methodology was expanded to identify adjacent, predominant sub-watershed land uses and impacts. This modification allowed the ID team to recognize probable cause-effect relationships between watershed condition and reach condition. Non-functional reaches were not analyzed in this manner because of their relatively low mileage. For the Crow Reservation, the observed land uses/impacts (see Figure 12) were denoted by four FAR sub-classes:

- FAR1 - reaches affected by grazing use
- FAR2 - reaches affected by cropland use
- FAR3 - reaches affected by both grazing and cropland use.
- FAR4 - reaches affected by channel straightening, structures, road encroachment, and reaches where the cause of impairment was not apparent

Results of the remote riparian assessment were ground-truthed or field verified on 40 percent of the reaches. Field verification was limited to locations with adequate access for vehicles. Further investigations were conducted if observations conflicted with the findings of the remote assessment. Field verification indicated a 95 percent accuracy for the remote assessment. Results were displayed on a Geographic Information System after field verification.

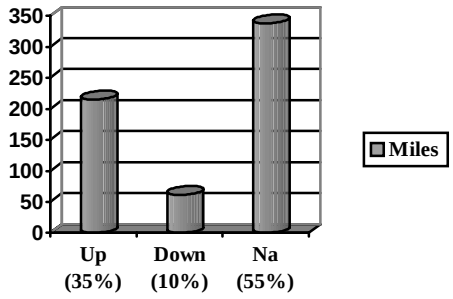


Figure 11. FAR rated reaches subdivided by trend.

Discussion

This was the first large scale application of aerial photographic PFC methodology and the first experience of the ID team with remote sensing of riparian conditions. Several issues arose during the remote assessment of the riparian areas of the Crow Indian Reservation.

After early delays in obtaining needed materials, the team began remote assessments on stream corridors in the Rosebud and Upper Tongue Watersheds in the eastern part of the Crow Indian Reservation. In May 1997, the team initiated their first field verification which revealed some serious inaccuracies in the remotely rated reaches. The team took steps to improve accuracy by conducting on-the-ground assessments and improving the photo interpretation key. Rating problems could have been eliminated or at least minimized by doing more reconnaissance and customizing the photo interpretation key (Appendix A of BLM publication TR 1737-12) prior to starting the remote assessment.

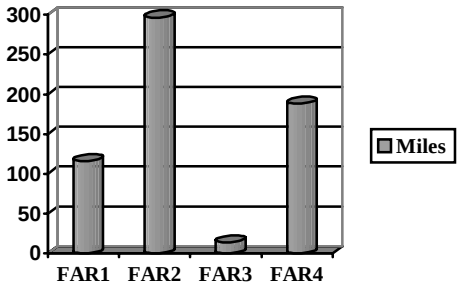


Figure 12. FAR rated reaches subdivided by land use/impacts.

After establishing the local interpretation key, the assessment moved along more smoothly. Field verification in the Little Big Horn Watershed indicated that the remote assessment was 98 percent accurate.

Another concern that influenced the accuracy ratings was the age of the aerial photographs. The photos used were 16 - 17 years old at the time of the assessment but were the only color-infrared photos available. Interestingly, accuracy ratings have remained high for the project despite the use of older photos.

Owl Creek and other streams in the southeast portion of the Little Big Horn River Watershed were somewhat puzzling and difficult to rate (see figure 13). These streams had become incised in the past yet appeared to have stabilized without the development of significant flood plains. The team could not assign ratings on these reaches based on the standard PFC checklist alone. Data on channel geometry and hydrology were collected to determine if these reaches had experienced a 25-year frequency flow. Further analysis indicated that since the down-cutting had occurred, these stream reaches had not experienced any 25-year flow events. These reaches were assigned a rating of FAR since the flood plain characteristics appeared inadequate to provide stability through a 25-year flow event. The site-based version of PFC methodology would have also required the collection and analysis of channel geometry and hydrology. In most cases, whether the PFC assessment is remote or site-based, ratings are assigned by using the checklist without the collection of additional data.

Figure 13. An incised Owl Creek reach rated FAR that appeared to be stabilized on the Crow Indian Reservation, Montana.

The assessment produced large amounts of data. Over 60 percent of the reaches were falling into the FAR category. This category normally receives priority for planning and application because restoration activities may only require changes to existing management. The subdivision of FAR by trend and by land use/impact (see the Results section) made the assessment more useful for the Crow Indian Tribe and the Crow Conservation District.

Priorities for inventorying, planning and application became evident after completion and analysis of the PFC assessment in context with other components of the reservation's natural resource assessment:

1. FAR reaches - downward trend
2. FAR reaches - upward trend
3. NF reaches
4. PFC reaches where the landowner has identified a desired future condition

NF reaches usually require greater restoration costs and structural measures, and respond more slowly to treatment. Generally, it is more cost effective to treat FAR reaches. However, non-functioning reaches can threaten the stability of upstream and downstream reaches and, in some project areas, warrant a higher priority than the scheme above.

For this project, the priority for further study is most notable for reaches rated FAR/trend *not apparent* and FAR4. In these reaches, neither trend or the impacts resulting in the FAR rating are known.

The assessment of 1,000 miles of streams on the Crow Indian Reservation was accomplished with a total of 180 staff days. The interdisciplinary team of a hydrologist, soil scientist, and vegetative specialist, completed the aerial photo interpretation in 41 days (123 staff days). Field verification of the interpretations were completed in 17 days (51 staff days) which was followed by 6 staff days of report preparation.

It is estimated that a site-based PFC assessment of the same 1,000 miles of stream would have required over 200 days or 600 staff days (see Figure 14). Considering Montana's latitude, the project would have spanned at least 2 field seasons.

The Crow Indian Reservation and Conservation District have used the PFC assessment information to set priorities for watershed treatment on the 2.2 million acre land holding. The Pryor Creek Watershed with its mix of functional condition ratings and opportunities for treatment was identified as a high priority watershed and starting point for planning. A more detailed inventory and structured planning effort have been implemented.

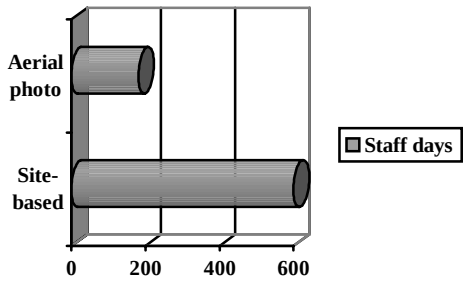


Figure 14. Comparison of aerial photographic PFC methodology with site-based PFC methodology in terms of ID team staff days.

CASE STUDY - Cut Bank Creek Watershed

Introduction

The Blackfeet Indian Tribe and Glacier County Conservation District requested an assessment of the riparian areas of the Cut Bank Creek Watershed in north-central Montana in September 1997. The tribe and conservation district were involved in the development of a local watershed group who needed background information on riparian conditions and causes of degradation. An assessment would supply information needed to stimulate the local watershed group and assist them in developing a framework for riparian improvement. Information from an assessment could also be used to develop grant applications.

The study area encompassed the perennial streams of the Cut Bank Creek Watershed within the Blackfeet Indian Reservation, Montana. The study area began at the Glacier National Park boundary at an elevation of 5,080 feet and continued eastward to the confluence of Cut Bank Creek and Two Medicine River at an elevation of 3,300 feet.

The assessment request was received by the NRCS Intermountain Riparian/Wetland Resource Technical Team headquartered in Bozeman, Montana, late in the annual work plan development process. Because of the late date, two options to provide a riparian assessment were considered:

1) have the local NRCS field office and tribal personnel use the site-based PFC approach (requiring about 120-140 days to complete including a two-day training course and 6 staff days of assistance in the field by a regional ID);

2) employ the aerial photographic PFC methodology and use an ID team (requiring about 45-60 staff days to complete the entire assessment including field verification).

Figure 15. Location map showing the Cut Bank Creek Watershed within the Blackfeet Indian Reservation in northwest Montana.

Option 1 was estimated to result in a completion of about 15 percent of the assessment during the first field season and add more workload to an already fully-employed field office staff. Option 2 was estimated to result in completion of the entire assessment but required a rearrangement of project priorities for the ID team. Option 2 was chosen because the assessment could be completed in the current field season without adding work-load to the local field staff. Also, experience gained during the assessment of the Crow Indian Reservation allayed any concern that the quality of data obtained using the aerial photographic method would differ significantly from the site-based approach.

The photography used for this assessment was color infrared transparencies from a September 1989 flight with a scale of 1:33,000. The resolution of these photographs was outstanding with signatures of riparian vegetation and stream channel characteristics readily discernible. The film-positive transparencies were 2.25 by 2.25 inches which allowed ample magnification to facilitate interpretations.

Results

Fifty-five reaches in the Cut Bank Creek Watershed, covering 209 miles of perennial stream, were evaluated (see Figure 16). Of 55 reaches assessed:

- 12 reaches, 31 miles were rated PFC
- 31 reaches, 124 miles were rated FAR
- 12 reaches, 54 miles were rated as NF

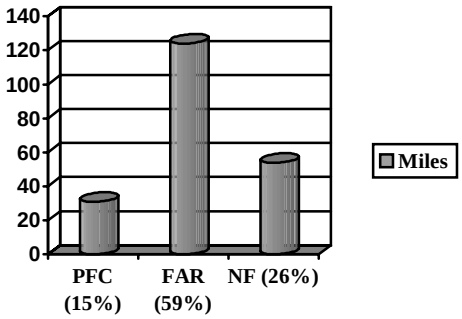


Figure 16. Crow Reservation functional condition summary with a FAR classification predominating.

The results of the assessment showed that nearly 60 percent of the reaches evaluated received ratings of FAR. Of the 31 FAR reaches assessed (see figure 17), trend for:

- 5 reaches, 10 miles, was upward
- 11 reaches, 48 miles, was downward
- 15 reaches, 66 miles, was not apparent

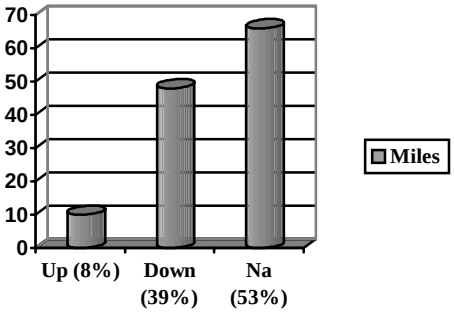


Figure 17. FAR rated reaches subdivided by trend.

Discussion

About 25 percent of the stream reaches assessed were field verified, indicating a 98 percent accuracy. This ground-truthing was generally limited to points along a stream reach with adequate access for vehicles. Further investigations were conducted if field observations conflicted with the results of the remote assessment.

Natural instability of streams in the Cut Bank Creek Watershed was common. It was not within the scope of this study to isolate and quantify natural instability from accelerated instability, such as bank erosion from human causes. However, evidence of accelerated instability such as excess sediment and bank erosion, began in the upper reaches of the study area and continued to accumulate downstream. In general, the excessive sediment load within the streams of the watershed had resulted in overly wide and shallow stream channels. Common manifestations of the sediment problem were lateral channel instability (bank erosion), deposition of central bars, and stream meander that are "cut off" from the main channel. The cumulative effects of bank erosion and sediment load were reflected in the ratings for the lower reaches of Cut Bank Creek. These ratings were all NF or FAR-downward trend except for one reach which flowed through a canyon where stability was provided by large rock.

In some areas, such as the North Fork of Cut Bank Creek, bank erosion appeared to be caused by the uncontrolled access of livestock to the stream during times when the banks were saturated. The vegetation in the general area was not overgrazed and would likely be adequate to provide bank stability if off-site livestock watering facilities were provided.

Grazing management and cropland encroachment in the riparian area appeared to be the most common practices causing accelerated erosion and sedimentation in the watershed. Grazing management currently involves winter-long grazing with uncontrolled access to streams and riparian areas. This type of management has severely reduced the quantity and quality of stabilizing vegetation. Woody species in particular have been severely diminished. Prescribed grazing management plans including the facilities to implement those plans would be advisable for all livestock producers bordering streams in the watershed.

Figure 18. Agricultural cultivation and cropping practices to the stream's edge are a concern on Cut Bank Creek in the Cut Bank Creek Watershed, Montana.

Agricultural cultivation and cropping practices to the edge of stream banks was another concern. Annual crops and hay do not have the rooting depth and strength to protect the stream banks from erosion. Riparian buffers of suitable woody and herbaceous species could alleviate this source of instability. Some form of bank stabilization would be needed for the more severe areas either before or during riparian buffer establishment.

The data from the assessment can be readily used to establish priorities for further study and treatment. Based strictly on the riparian assessment, priorities for planning and application could be:

1. FAR reaches - downward trend
2. FAR reaches - upward trend
3. NF reaches
4. PFC reaches where the landowner has identified a desired future condition

Reaches rated NF normally receive the lowest priority for planning because it often takes expensive structural measures combined with changes in land management to affect an improvement. In the case of the Cut Bank Creek Watershed, the main problem in the watershed was excess sediment. Any change in land management that reduces erosion or sediment delivery would benefit the stream system. Any producer who is ready, willing, and able to implement management changes that will reduce erosion or sediment delivery should receive assistance when resources are available.

Additionally, reaches that were NF can threaten system stability both upstream and downstream. Actions to stabilize a nonfunctioning reach may be justified when the conditions of that reach threaten the stability of other reaches.

Reaches rated FAR with a no apparent trend are top candidates for further study.

The assessment of 210 miles of perennial streams within the Cut Bank Creek Watershed was accomplished with a total of 45 staff days. Using an interdisciplinary team of a hydrologist, soil scientist, and biologist, the photo interpretations were completed in 9 days (27 staff days). Field verification of the interpretations was completed in 5 days (15 staff days) with 3 staff days required for preparing the summary report (see figure 19).

Assuming an assessment rate of five miles per day, a site-based PFC assessment of the same 210 miles of stream would have required the interdisciplinary team to spend 42 days (126 staff days) in the field. In addition, the local field office would have spent about 5 staff days obtaining permission of landowners to access reaches. Field verification would not have been required and report preparation time would have been the same (3 staff days) as the remote assessment. Thus, a site-based PFC assessment would have taken approximately 134 staff days (see figure 19).

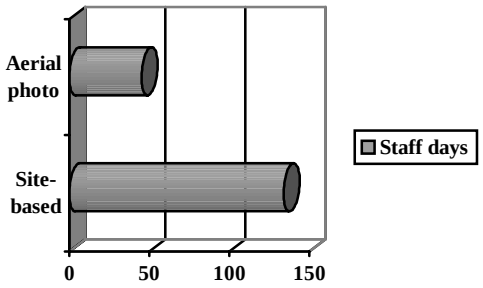


Figure 19. Comparison of aerial photographic PFC methodology with site-based PFC methodology in terms of ID team staff days. The aerial photographic PFC methodology takes about one-third the time of the site-based approach.

Assessment of the perennial streams within the Cut Bank Creek Watershed provides excellent background resource information. The likely sources of stream degradation and land management practices contributing to the degradation were identified. Also, the assessment and knowledge from similar watersheds in the region indicate the appropriate practices and management needed to improve stream system function.

The aerial photographic PFC methodology interpretations can be used to build consensus within local watershed groups, to establish needs in applications for financial grants, and to set priorities for the allocation of staff and financial resources. These benefits are all derived from a assessment approach that can be completed quickly with remote sensing products using a small ID team.