RIPARIAN AREA MANAGEMENT

Greenline
Riparian-Wetland
Monitoring

by

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Greenline Riparian-Wetland Monitoring

I. Introduction

Though riparian areas are not abundant in the landscape, they have great historical significance. The provide a variety of useful products, such as water, forage, and firewood. Additional values such as biological diversity, water storage, and sediment trapping have more recently been attributed to riparian areas. However the ability of a given site to provide this range of products may be dependent upon the quality of the vegetation present. For example, a stand of coyote willow will provide building materials for beaver, whereas a stand of Nebraska sedge will not. Yet the dense root mass of Nebraska sedge will provide overhanging streambanks, a key fishery habitat feature, whereas the root system of Kentucky bluegrass will not.

Modern land management plans must address these complex relationships to establish the best balance of multiple-use activities in riparian-wetland areas. Any activities in riparian-wetland areas will have an impact on the vegetation community—particularly grazing. Publications such as *Managing Grazing of Riparian Areas in the Intermountain Region* (Clary and Webster 1989); Technical Reference 1737-4, *Grazing Management in Riparian Areas* (Kinch 1989); *Managing Fisheries and Wildlife on Rangelands Grazed By Livestock* (Platts 1990); and *Effects of Cattle Grazing Systems on Willow-Dominated Plant Associations in Central Oregon* (Kovalchik and Elmore 1990) all contain a dominant theme: different grazing strategies will result in predictable changes in the vegetation community. Consequently, it is no longer valid to prescribe grazing management changes based on vague objectives such as a desire to “improve the range.”

Streamside riparian areas have different vegetation production capacities based on a range of factors such as soils, hydraulic controls, or slope gradient. Technical Reference 1737-3, *Inventory and Monitoring of Riparian Areas* (Meyers 1989), contains a comprehensive list of stream segment components affecting potential plant community. Technical Reference 1737-7, *Procedures for Ecological Site Inventory* (Leonard et al. 1992), provides the basis for determining the long-term potential vegetation community associated with a given site. The greenline monitoring method can play an important role in evaluating whether site-specific riparian vegetation objectives are being met.

II. Purpose

The Bureau of Land Management's (BLM's) riparian area management policy of January 22, 1987 (USDI, 1991) contains the following statement:

> "Achieve riparian area improvement and maintenance objectives through the management of existing uses wherever feasible."

If existing conditions are not established, it will be impossible to determine if conditions are improving or being maintained. Similarly, if objectives are not established, success cannot be measured and direction is lost. BLM establishes objectives through its activity planning process. A well crafted Activity Plan provides clear direction with five essential features:

1. A description of existing conditions.
2. Measurable objectives.
3. A description of management actions designed to meet the objectives.
4. A description of how progress toward meeting objectives would be monitored.
5. A determination of how and when the plan would be evaluated.

The purpose of the greenline monitoring method is to provide riparian vegetation information suitable for use in structuring an Activity Plan as described above. The following sequence can be achieved:

1. The greenline monitoring method generates baseline data that describe existing conditions.
2. From these established existing conditions, measurable riparian vegetation objectives may be formulated.
3. The site-specific objectives provide the means for selecting a management strategy.
4. Greenline studies provide the trend data portion of the monitoring plan.
5. Rereading the data in the timeframe specified in the objectives provides the data necessary for comparative analysis in evaluating the effectiveness of the plan.

The greenline monitoring method is intended as a tool for land managers to use in analyzing riparian vegetation. It is considered an addition to, and not a replacement for, all the existing techniques currently available.

It should be noted that the greenline approach does involve one important limitation. The central data collection procedure involves a single line intercept transect. With data from a single transect or plot, statistical analysis, such as confidence intervals, cannot be computed. However the data generated are not intended as a statistical sample of the population. Rather they are a description of the transect area population itself. The transect location is carefully, as opposed to randomly, selected. Regardless, if statistical analysis is to be performed, a different data gathering procedure may need to be considered.

III. The Greenline

A. The Greenline Concept

The greenline concept is designed for measuring vegetation trends on streambanks, but can be adapted to a variety of circumstances. The method relies on identification of riparian plant community types on a line intercept transect.

Typically, a soil moisture gradient is exhibited when moving away from the channel in a riparian area. In a trend transect placed in a typical western floodplain, a different soil moisture could conceivably be encountered at each plot. Attempting to average the vegetation found in these divergent plots into a single set of data can be problematic. The greenline is a point of reference that minimizes problems associated with changing moisture gradient.

Fixed plots placed in riparian areas are vulnerable to being washed out or silted over. A greenline transect is a variable plot method that is repeatable independent of peak flow events.

B. The Greenline Definition

The greenline is defined as *that specific area where a more or less continuous cover of vegetation is encountered when moving away from the center of an observable channel.* Figure 1 is a schematic stream channel cross section illustrating the location of the greenline. When monitoring a riparian area using the greenline as a point of reference, the objective is to identify which plant communities occupy the greenline. By the definition above, a greenline would be encountered at a single point and one plant community identified. In Figure 1, the greenline on the right side of the

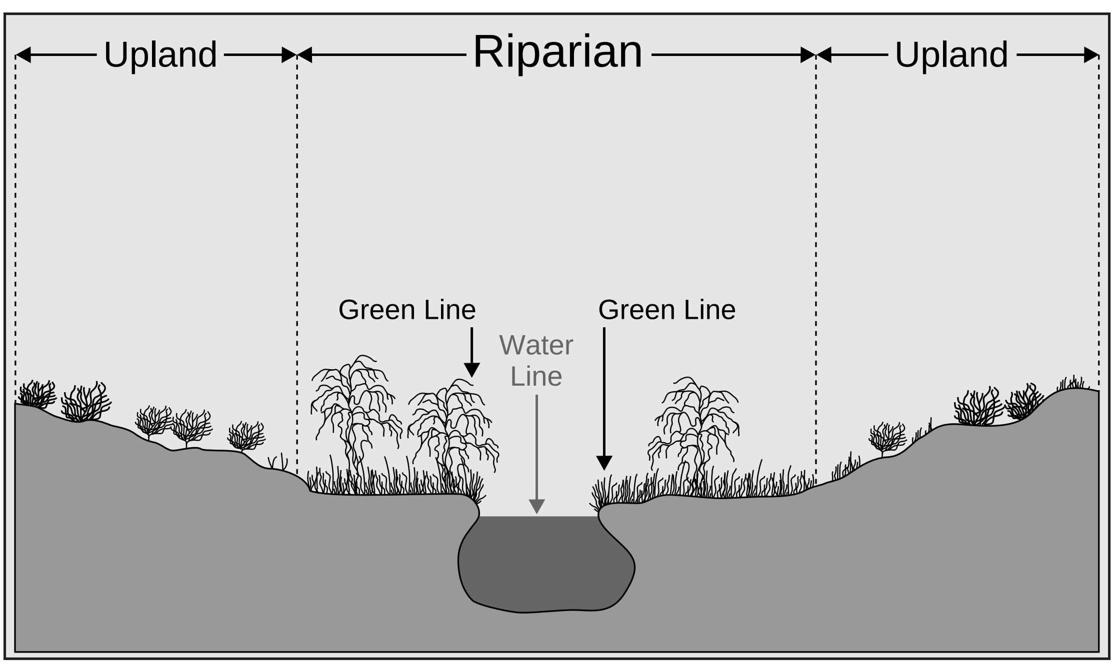


Figure 1. *Stream channel cross section shows the location of the greenline.*

streambank is a herbaceous vegetation community. On the left, the greenline is a shrub-dominated community with a sub-dominant herbaceous understory. When vegetation data are collected, the observer follows the greenline in a line intercept transect recording an accumulation of these points to compile a data set.

The greenline is often, but not necessarily, located at the water's edge. Areas such as unvegetated point bars are handled by following the line of vegetation behind the point bar. Vegetation growing in the channel, and islands of vegetation that do not form continuous cover, are not part of the greenline. Figures 2 and 3 are two examples of locations of the greenline along stream reaches.

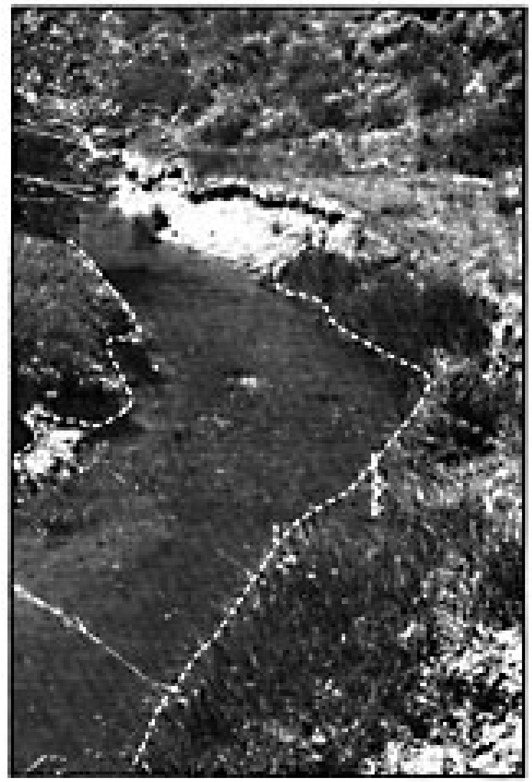


Figure 2. *Dotted line shows the location of the greenline, which follows the continuous line of vegetation along Trout Creek in southwest Wyoming.*

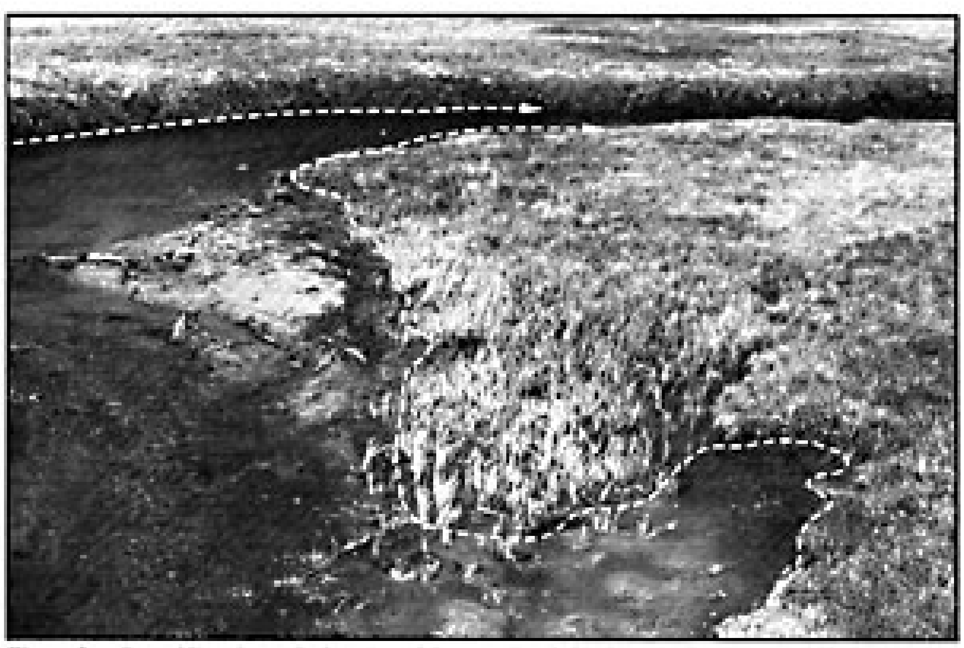


Figure 3. *Dotted line shows the location of the greenline behind a point bar in central Utah.*

IV. Riparian Community Types

One of the most dramatic differences between upland and riparian vegetation is the capacity for change with regard to both magnitude and timeframe. Barring major disturbance, such as fire, a sagebrush/bunchgrass upland plant community is relatively stable. A realistic objective would involve changes in *plant community composition* over a 30-year period. The sagebrush/bunchgrass *community type* could be expected to remain constant. In a riparian area, however, a Nebraska sedge community type could change to a Kentucky bluegrass community type in a fraction of that period. Furthermore, identification of herbaceous riparian species, one plant at a time, can be prohibitively difficult, particularly if the area has been grazed. Consequently, the greenline riparian monitoring method is designed to detect changes in plant community succession along the greenline rather than change in species composition.

The publication *Riparian Community Type Classification of Eastern Idaho-Western Wyoming* (Youngblood, Padgett, and Winward 1985) is the prototype for classifying and developing a knowledge of riparian plant communities. This document contains an established list of community types that can be determined in the field using a dichotomous key. Technical Reference 1737-5, *Riparian and Wetland Classification and Review* (Gebhardt et al. 1990), provides an overview of comprehensive riparian classifications available.

If no comprehensive community type classification is available for your area, start developing one. Riparian community types can be identified by observing dominance as a function of vegetation cover. Whatever species exhibits the most cover is what is called the community type. Community types may be defined as a single dominant or dominant/subdominant combination.

Dominant/subdominants are identified in a size class hierarchy: tree/shrub or shrub/grass (or grasslike). Community types such as Nebraska sedge with a subdominant of coyote willow, for example, are not identified. If Nebraska sedge has more canopy than willow, then the site is recorded as a Nebraska sedge community type. Herbaceous community types normally do not have subdominants, although exceptions occur. It is normal for community types to occur with several associated species as minor components.

It is important to work from a compiled list of community types prior to running a transect. Attempting to identify community types concurrent with running a transect will result in inconsistent decision making in community type identification and reduce repeatability of the data. If no local list of community types is available, the stream reach where the transect is to be run is inspected, and a field list of community types likely to be encountered along the transect is constructed. Field notes that describe associated species occurring within the community types identified should be kept, and a local list of community types observed in the planning area should be built continuously.

V. Field Procedures

The greenline monitoring method actually entails three data collection procedures designed to generate a compatible data set. Greenline composition, riparian cross-section composition, and woody species density are the data products. Based on the site-specific circumstances, it is not always necessary to collect all the data options described. For this reason the text is structured to provide a general overview of the concepts and procedure, followed by two case studies in which the concept was applied in two distinctly different ways. The example applications provide guidelines regarding installation of transects and data analysis.

A. Materials

1. Three forms entitled *Greenline Transect Data*, *Greenline Supplemental Data*, and *Cross-Section Composition* (see Appendix A).
2. Camera with film.
3. Six fence posts with post pounder or sledgehammer.
4. Compass.
5. Six readily visible markers; engineering pin flags work well.
6. Calculator.
7. One 6-foot rod.

Note: See the Perennial Creek Study section for a detailed description of how each of these materials are used.

B. Transect Location

The data will be most useful if a transect is located entirely within a reach of comparable potential. Within a reach, a key area location without obvious changes in factors such as slope or soils should be selected.

The greenline monitoring method is particularly useful for observing succession and trends on sites that are relatively stable. This method has the least utility in stream reaches that are rapidly changing through factors such as channel headcutting or beaver activity.

C. Recording Plant Community Data Along the Greenline

The greenline is traversed over the length of an established transect and the number of feet of each community type observed recorded on the *Greenline Transect Data* form found in Appendix A. A running tally of each community type observed is recorded, making no effort to keep track of the sequence in which the community types were observed. For example, along the greenline there may be 5 feet of a Nebraska sedge community type followed by 6 feet of coyote willow/Nebraska sedge, which in turn are followed by 8 feet of Nebraska sedge. This would be recorded as:

Nebraska sedge	~~5~~	13	ft.
Coyote willow/Nebraska sedge	6		ft.

Recording Nebraska sedge as “5, 8” with the intention to sum the total at the end is risky practice because “5, 8” can too easily become “58” when the data are analyzed.

1. Greenline Ground Rules

The following ground rules aid in collecting valid, repeatable data:

- Transects should be a minimum of 726 feet along the greenline; this distance provides an easy conversion to acreage. This length, 6 feet wide, computes to 1/10th of an acre.

- The width of the community type is not a factor when traversing a line intercept along the greenline. The objective is to identify the first community type that can be observed moving away from the center of the channel. Many factors, such as slope gradient, will determine how far this community type extends away from the channel. If the width of a community type is considered important, a line intercept cross section is run through the riparian area as a separate database as described in the Cross-Section Transects section.

- One foot is the minimum length along the transect a community type may occupy to be recorded in the database. Community types shorter than this should be combined with an adjacent community type. A 726-foot transect could be considered as 726 1-foot plots where vegetation dominance is observed.

- The vertical downward projection from the canopy determines the vegetation identified along the greenline. For example, a large cottonwood tree may dominate a site even though it is not actually rooted immediately in the greenline area.

- Community types identified do not have to be riparian vegetation; upland community types can in many cases be the vegetation occupying the greenline under the definition.

- Site-specific ground rules such as “only perennial vegetation was considered in identifying the location of the greenline” may be incorporated if documented.

- Since this method relies on the ability to step off distance accurately, it is recommended that a reliable stride be calibrated along a tape.

- Repeatability is significantly enhanced when data are reread at the same phenological stage as when the original data were collected.

2. Greenline Troubleshooting

- In some instances, a choice may have to be made between two lines of vegetation that appear to meet the greenline definition. When a site is recovering

Figure 4. *Arrows depict upper and lower continuous lines of vegetation along Little Spearfish Creek in western South Dakota. Since both lines are equally continuous, the lower line forms the greenline.*

Figure 5. *Arrows depict upper and lower continuous lines of vegetation along Canyon Creek in southwest Wyoming. Since the upper line is more continuous, the observer has correctly chosen the upper line as the correct greenline.*

from a recent channel incision or period of heavy trampling, a new line of vegetation often begins to form at the water's edge below an old, established greenline. This can occur on a very short-term basis, such as prior to the turnout of livestock in a pasture. This common situation is illustrated in Figures 4 and 5. Consequently, a determination of which line to observe will have a pronounced effect on the database. In Figure 4, a pure stand of sedges comprises the lower line, and the upper line is a mixture of sedges, shallow-rooted grasses, and forbs. When this situation occurs, data are collected on the line that appears to be most continuous; if they appear to be about the same, the lower line is used. Figures 6 and 7 illustrate rapid movement of the greenline over a 7-year period. The data collection procedure is designed to accommodate the rapid change in stream channel morphology evident in the photographs.

- A community type titled "trample" or "barren" can be used to skip over gaps in the greenline caused by trails, etc. However, vegetation that appears trampled should be recorded whenever possible because the site will likely appear as a vegetation community type if observed during even a brief rest or deferment from grazing.

Figure 6. *Dotted line shows the location of the greenline along Cottonwood Creek in northwest Wyoming, August 1982.*

Figure 7. *Dotted line shows the new location of the greenline along the same stream segment seen in Figure 6, August 1989, after vegetation growth has narrowed the channel width.*

- Cut banks opposite point bars (Figure 8) and areas with slumping soils (Figure 9) present problems in identification of the greenline when unvegetated soil goes to the edge of the channel. The arrows in Figures 8 and 9 illustrate natural breaks that are commonly encountered in the greenline. When this occurs, the first option is to reconsider the site as a suitable key area. In many cases this problem can be avoided by good transect location. The second option is to follow the continuous line of vegetation behind the slump or cut, in which case the community type will normally be upland

Figure 8. *Arrow indicates where the greenline ends abruptly at a cutbank opposite a point bar along Red Canyon Creek in northwest Wyoming.*

Figure 9. *Arrows show where slumping soils create breaks in the greenline along Vermillion Creek in southwest Wyoming.*

vegetation. However, this could result in too much irrelevant upland data. The third option is to follow the water's edge, where a greenline may be anticipated to form, until a normal greenline situation is reencountered.

- A "rock" or "log jam" may also be cited to skip over an unvegetated area if traversing the greenline vegetation in strict accordance with the definition would result in lower quality data.

- When special situations such as those noted above are encountered, a narrative of how the site was handled should be provided.

D. Woody Species Counts

Density of woody species is an ideal complement to greenline data. The transect is retraced while holding a 6-foot rod centered over the inside edge of the greenline. Woody species of specific concern, which are rooted in the plot formed by the 6-foot rod are counted. These data are being collected in Figure 5. Appendix A contains a *Greenline Supplemental Data* form, which is used to quantify woody species in the transect area. The form allows for the vegetation to be tallied by either age or height classes.

1. Multistemmed Species

Multistemmed species such as coyote willow or water birch are best tabulated in the following age categories:

a. Seedling - This year’s growth only. Multistemmed plants such as willows exhibit only a single stem at this growth stage.

b. Young - Immature plants that appear to show more than a single season’s growth. Multistemmed plants exhibit 2 to 10 stems at this stage.

c. Mature <50% Dead - Vigorous healthy plants. Multistemmed plants exhibit more than 10 stems.

d. Mature >50% Dead/Clubbed - Old declining plants; includes “mushroom” shaped willows and any plants that exhibit a clubbed appearance from long-term heavy browsing.

2. Single-Stemmed Species

Single-stemmed species such as cottonwood are best tabulated in height classes: 0 to 3 feet, >3 to 6 feet, >6 to 10 feet, and over 10 feet. It is common to encounter trees in atypical form as a result of flood events, etc. These trees are tallied at the height they occur on the day observed. For example, if a 30-foot tree has been knocked down but remains alive, the tallest part on the day observed may be the 5-foot height of a lower branch.

3. Woody Species Ground Rules

The following ground rules and tips aid in collecting valid, repeatable data:

- The rod is centered on the greenline in order to detect reproduction on point bars between the greenline and the water’s edge. Generally, where no point bars are encountered, half of the rod hangs out over the stream channel. When observing narrow streams, only those plants associated with the bank being traversed are recorded in order to avoid counting plants twice.

- On some transects, seedlings or young plants may be too numerous to readily count. It is sufficient to note this in lieu of a tally count.

- Identification of individual plants can be difficult, as some judgement is required to differentiate between an individual plant and a sprout or stem. If it cannot be reasonably assumed that two stems share a common root without excavating soil, the two should be tallied as individuals.

- Dead plants are ignored on woody counts.

E. Cross-Section Transects

Appendix A contains a *Cross-Section Composition* form used to record the plant community composition of a riparian area in general. To collect these data, a line intercept transect is run perpendicular to the riparian area, and data are recorded in the same manner as described in the Recording Data Along the Greenline section. The data form is designed to record three cross-section transects. In some areas, up to five cross-section transects may be desirable. In such cases, a second form can be used. See the Perennial Creek Study section for more information regarding cross-section transects.

F. Photopoints

Photopoints provide an excellent record in both interpreting the data and aiding in repeatability. Pictures are taken to show both the transect location and the data collected. The *Greenline Supplemental Data* form (Appendix A) contains a place to record the content of photos taken.

VI. Greenline Monitoring Method Applications

The greenline monitoring method can be adapted to observe riparian vegetation in a variety of circumstances. Following are examples of two diverse applications.

A. Perennial Creek Study

A goal was established to improve trout habitat by increasing vegetation that shades the creek and is capable of supporting overhanging streambanks. Data are required to develop measurable objectives associated with this goal. Because Perennial Creek contains important resource values and is of high public interest, all the types of data associated with the greenline riparian monitoring method were collected.

Figure 10 is a drawing of how the greenline and three cross-section transects were established on Perennial Creek. This was accomplished through the following steps:

Step 1 - A witness post was located in upland vegetation at the edge of the riparian vegetation zone adjacent to where the greenline transect will be initiated.

Step 2 - A second post was located in upland vegetation across the riparian zone in a location where a line between the two posts would be perpendicular to the riparian zone, not the creek. A pin flag was left on the greenline where it intersects this line between these two witness posts as seen on Figure 10. These two posts and the pin flag formed the first cross-section transect and the starting point of the greenline transect. The compass bearing or azimuth of the cross-section transect was recorded.

Note: Witness posts were located in upland vegetation to prevent them from being washed out, and to allow for a potential increase in the width of the riparian zone itself.

Step 3 - The greenline was traversed upstream from the initial pin flag, placing pin flags at 100, 200, 300, and 363 feet. The stream was crossed and the greenline traversed back down the opposite bank 363 feet. A final pin flag was placed there to mark the end of the greenline transect. These markers help the observer keep track of location within the transect and provide valuable reference points for photographs.

Note: The final pin flag is not expected to be directly opposite the starting pin flag.

Step 4 - The second cross-section transect was installed by locating witness posts in the same manner as in step 2, with the flag at 200 feet at the point of intersection along the greenline. In order to be perpendicular to the riparian zone, this cross-section transect crosses the stream three times (see Figure 10).

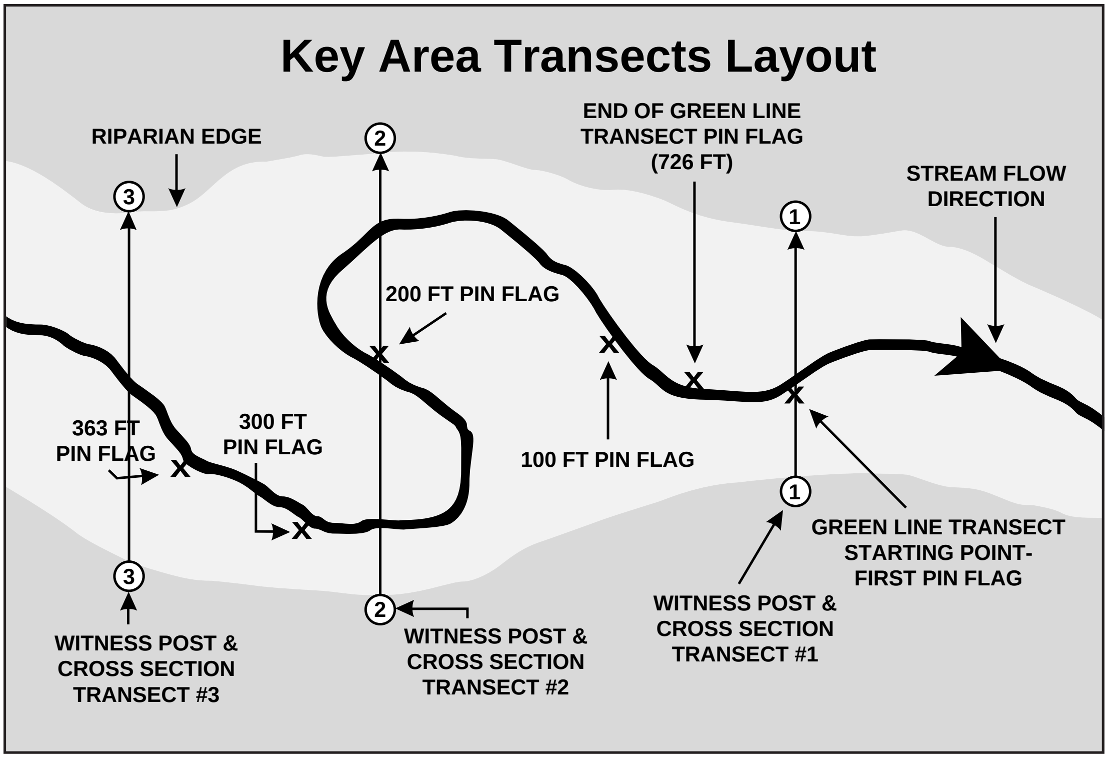


Figure 10. *Key area transects layout for the Perennial Creek Study.*

Step 5 - The third cross-section transect was installed with the pin flag at 363 feet as the point of intersection along the greenline.

Note: If the stream channel moves between the time the transects are installed and reread at a later date, the cross sections will no longer intersect the greenline at the points 200 and 363 feet along the greenline. However the greenline transect is always initiated at the point of intersection between the first cross-section witness posts.

Following installation of the witness posts and marker flags, the greenline and cross-section transects were traversed according to the general instructions. Figures 11 and 12 illustrate data collection on the field forms. Appendix B contains a cross-reference of all plant names and symbols used in this document.

Note: While traversing the transect, a calculator is helpful because the data do not provide a running total of the distance along the transect traveled without adding the sum of all the plant community types observed. It is valuable to stop and sum the total communities observed at each marker, in order to keep tabs on the consistency of your stride. At the end of the transect, the sum of all community types observed came out to 730 feet, which is close enough to the 726 feet traversed when the markers were left. A difference greater that 5 percent is considered excessive.

Woody species were counted in age classes because the vegetation on the key area is comprised of multistemmed willows and birches. Figure 13 is an example of data form tabulation.

GREENLINE TRANSECT DATA

RESOURCE AREA Green River OBSERVER Jim Cagney DATE 7-31-91

KEY AREA NAME Perennial Creek ALLOTMENT # 4007 LOCATION T. 12 N., R. 106 W., Sec. 7 NWNW

PLANT COMMUNITY	# FEET OBSERVED	PERCENT
CANE	5 13 20 27 32 60 78 83 101 132 147 154	21
SAEX/CANE	6 31 47	06
SAEX	10 16 37 51	07
AGST	3 19 24 31 37 40	05
ELPA	3 12 16 25 31 44	06
Trample	9 16 22 31 34	05
DECA	4 7	01
Mesic Forbs	2 6 11	02
EQAR	6 8 13 18 21 27	04
BEOC	18 23	03
ARCA	3 8 12 14 21	03
ARTR/AGDA	18 22 30 35 44 51 62 71	10
JUBA	6 15 19 37 45 52 70 78 90	12
BEOC/CANE	12 18 30 31	04
POPR	08 15 27 29 34 41 46	06
ARCA/JUBA	6 8 10 20 25 28 33	05
	TOTALS 730	100

Figure 11. *Example of greenline data collection.*

CROSS-SECTION COMPOSITION

RESOURCE AREA *Green River* OBSERVER *Jim Cagney* DATE *7-31-91*

KEY AREA NAME *Perennial Creek* ALLOTMENT # *4007* LOCATION *T. 12 N., R. 106 W., Sec. 7 NWNW*

PLANT COMMUNITY and # FEET OBSERVED

TRANSECT #1 BEARING *85° W* TOTAL RIPARIAN WIDTH *105'*

ARTR/JUBA 8 12
POPR 12 23 28 38
SAEX 6 8 9 12
Creek 2
JUBA 14 22 27
CANE 7 12 14

TRANSECT #2 BEARING *10° N* TOTAL RIPARIAN WIDTH *180'*

ARTR/JUBA 7 18 21 22
POPR 12 31 40
JUBA 7 12 18 28
SAEX/CANE 6 9 12
ANRO 6 15
Creek 2 5 7

DECA 5 7
SAEX 6 16 24
AGST 25

TRANSECT #3 BEARING *5° N* TOTAL RIPARIAN WIDTH *85'*

ARTR 4
CANE 3
Creek 4
SAEX/CANE 7 9 14
POPR 9 16 24

DECA 12 15 20
SAEX 8 16

Figure 12. *Example of cross-section data collection.*

GREENLINE SUPPLEMENTAL DATA

RESOURCE AREA Green River OBSERVER Jim Cagney DATE 7-31-91

KEY AREA NAME Perennial Creek ALLOTMENT # 4007 LOCATION T. 12 N., R. 106 W., Sec. 7 NWNW

WOODY SPECIES COUNTS

AGE CLASS OPTION

SPECIES	SEEDLING	YOUNG	MATURE <50% DEAD	MATURE >50% DEAD
SAEX	numerous	22	2	3
BEOC	14	6		2

HEIGHT CLASS OPTION

SPECIES	0-3'	>3-6'	>6-10'	>10'

PHOTOS TAKEN/REMARKS:

Transect located on Perennial Creek, 1.7 miles east of Uncle Billy's Cabin on county road #17.
- Utilization of CANE is about 35%; cattle currently using the area.

Photos:
1) First cross section witness post. 2) Start marker in foreground, 100' marker in background. 3) 300' marker foreground, 363' marker background. 4) 363' marker in foreground looking upstream beyond the transect area. 5) 2nd cross section.
6) 3rd cross section.

Figure 13. *Example of multistemmed woody species data collection.*

Greenline data may be analyzed as shown in Table 1. In this example, plant communities were identified as "preferred," "undesirable," or "other" according to their value for watershed stability, ability to shade the creek, ability to form overhanging banks, and forage.

Table 1. *Data Analysis—Perennial Application*

Description of the Perennial Creek Key Area					
Preferred Community Types (Percent)		Undesirable Community Types (Percent)		Other Community Types (Percent)*	
Plant communities observed in the greenline transect:					
SAEX	07	ARCA	03	ARCA/JUBA	05
CANE	21	ARTR/AGDA	10	ELPA	06
BEOC	03	TRAMPLE	05	EQAR	04
JUBA	12	POPR	06	AGST	05
DECA	01	MESIC FORBS	02		
BEOC/CANE	04				
SAEX/CANE	06				
TOTAL	54		26		20
Plant communities observed (in aggregate) in the cross-section transects:					
DECA	07	POPR	28	ARTR/JUBA	09
CANE	11	ANRO	04	AGST	07
SAEX	07	ARTR	01		
SAEX/CANE	07			CREEK	02
JUBA	15				
TOTAL	47		33		18

* Other community types include features that are neither preferred nor undesirable, such as some creek crossings, rock outcrops, and some vegetation communities.

Communities having similar values were grouped together to establish the desired plant community objectives shown on Table 2. Desired plant community objectives were based on the specific site capability and formulated by an interdisciplinary team. Additional objectives were developed from the other data collected, involving the amount and age structure of key woody riparian species, and the width and composition of the riparian area itself.

Note: The occurrence of additional willow and sedge species would be considered advantageous; however, only species currently present were cited in the 5-year term desired plant community objectives. Use of short-term objectives is recommended when the long-term potential cannot be determined with an acceptable degree of confidence. However, it should be clearly stated that the short-term objectives are considered an incremental step to be updated at the scheduled evaluation.

Table 2. *Riparian Community Type Objectives*

Greenline Plant Community Types (CTs)	1992	Desired Plant Community	1997
SAEX-BEOC DOMINANT CTs	20%	INCREASE TO	30%
CANE	21%	INCREASE TO	30%
JUBA	12%	MAINTAIN AT	15%
POPR, FORB, ARTR, & ARCA CTs	26%	DECREASE TO	10%
OTHER	21%	DECREASE TO	15%

By 1997:

- Increase the dominance of preferred community types in the cross-section transects by 10 percent, with a corresponding decrease in undesirable community types.

- Maintain or increase existing average riparian width of 123 feet.

- Allow at least 10 of the young or seedling willow and birch plants to reach the mature stage and maintain the existing age structure, given all size classes represented, with the younger classes most numerous.

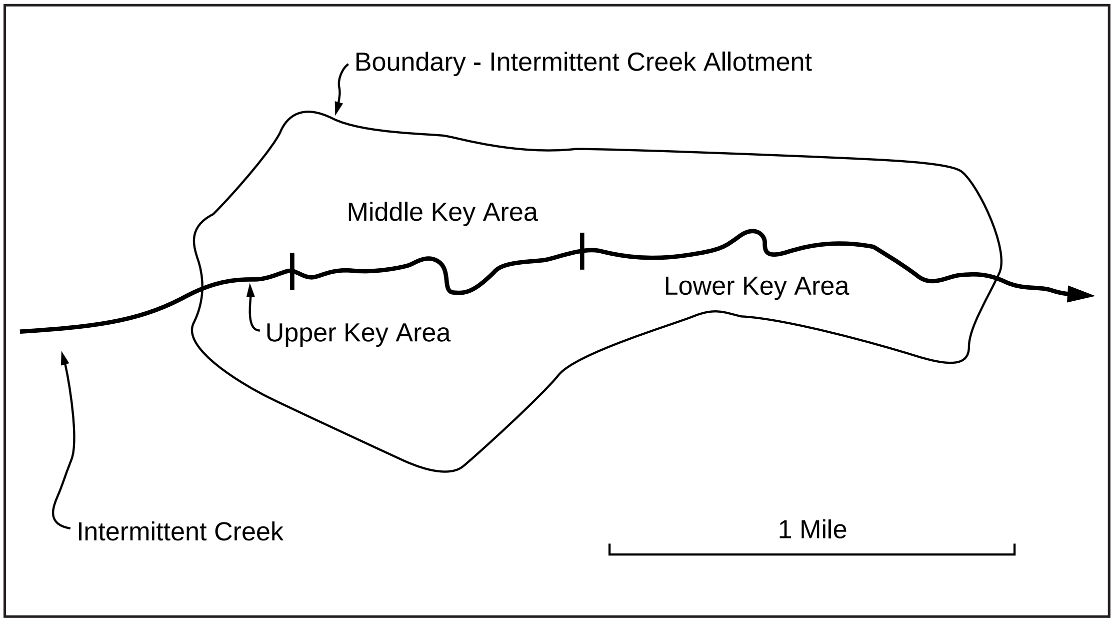
B. Intermittent Creek Study

The Intermittent Creek Drainage is an important source of sedimentation in a major river system. A goal was established to increase those plant communities that promote channel stability. Site-specific data were needed to evaluate grazing management in an allotment containing 2 miles of the creek.

In this 2-mile reach, flow volume and duration are greater in the upper reaches, declining steadily lower in the drainage. While a greenline is apparent in the upper reaches, intermittent, unreliable flow in the lower reaches produces areas of spotty riparian vegetation establishment, particularly on point bars, where no greenline can readily be observed. Because this stream produced riparian vegetation in sporadic patches, a determination was made that the cross-section transects would not provide meaningful information; consequently, they were omitted from the study.

The stream was divided into three key area reaches of similar site potential as a function of water availability. These reaches of similar potential are of unequal length as shown on Figure 14. Materials needed included the *Greenline Transect Data* and *Greenline Supplemental Data* forms and a camera with film.

Figure 14. *Transect layout—Intermittent Creek study.*



A preliminary evaluation revealed four preferred riparian community types, including Nebraska sedge, baltic rush, coyote willow, and narrowleaf cottonwood. A greenline transect was traversed along both banks of the creek. When preferred riparian communities were encountered, their lengths were recorded according to the general instructions. When other community types excluded from this list (such as rabbitbrush, Canada wildrye, and wheatgrasses) were encountered along the greenline, or no greenline was apparent, no data were recorded until another reach exhibiting a preferred community type was encountered. Collection of this information continued for the entire length of Intermittent Creek in the allotment. In essence, an inventory of the entire riparian resource was conducted, except to save time, only selected community types were observed. The field data sheets were generated in the same manner shown in the Perennial Creek application, and the organized results are shown in Table 3.

Table 3. *Intermittent Creek Riparian Community Type Data (1992)*

	Number Feet Observed			
Riparian Community Type	Upper Reach	II Reach	Lower Reach	Total
Coyote willow	295	670	379	1,344
Nebraska sedge	191	477	272	940
Narrowleaf cottonwood	36	168	102	306
Baltic rush	90	323	165	578
Aggregate Total	612	1,638	918	3,168

Cottonwood trees were counted in the four height classes shown in Table 4. The data display the number of individuals in each height class. The entire riparian area was observed, in all three key area reaches. Consequently Table 4 displays all the individual trees known to exist in the entire allotment.

Table 4. *Intermittent Creek Tree Species Data (1992)*

Key Area Reach	Cottonwood Height Class Distribution (Feet)				
	0-3	>3-6	>6-10	>10	Total
Upper	03	07	02	02	14
II	07	36	14	05	62
Lower	18	38	13	03	72
Total	28 (19%)	81 (55%)	29 (19%)	10 (7%)	148 (100%)

Fifteen mapped, readily identifiable photopoints were established in support of the vegetation data.

As noted, the key area reaches derived by streamflow duration were not equal in length. Table 5 shows the percentage of all four preferred riparian plant communities considered in aggregate, relative to the total length of the reach. Table 5 demonstrates that the four preferred community types decline in abundance in the lower reaches.

Note: The linear length shown on Table 5 was computed by measuring the length of each reach on the 1:24,000 topography map scale. The vegetation data were collected by traversing the greenline along the creek incorporating each meander at its actual length. The percentages shown on Table 5 are an index of abundance because they compare actual field-scale vegetation data to map-scale linear length of reach data.

Table 5. *Percentage of Preferred Riparian Community Types (CTs) for Each Key Area Reach*

Key Area Reach	Aggregate Length, All Preferred CTs	Linear Length of Reach	Preferred CT Percentage
Upper	612	1,200	51
Middle	1,638	4,200	39
Lower	918	5,100	18
Totals	3,168	10,500	

Table 6 depicts the number of cottonwoods in each key area reach adjusted to address divergent reach length. The length of each reach was divided by the total number of trees observed to yield the number of feet per tree (feet/tree), a relative measure of tree species density. The lower the feet/tree observed, the greater the abundance of cottonwoods. Table 6 shows that the cottonwood numbers did not appear to decline in the lower reaches in conjunction with reliability of surface water, as do the community types shown in Table 5. This is considered an important determination in assessing site potential.

Table 6. *Abundance of Cottonwoods by Reach*

Key Area Reach	Linear Length of Reach	Total Number of Trees Observed	Number of Feet/Tree Observed
Upper	1,200	14	86
Middle	4,200	62	68
Lower	5,100	72	71

Tables 4 and 6 indicate that while ample tree species regeneration exists, the trees were concentrated in the lower height classes and were not “releasing” into height classes above 6 feet. Table 7 shows an analysis of the height class distribution for each of the three key area reaches, when the trees are classified as either greater than or less than 6 feet tall.

Table 7. *Riparian Tree Species Height Class Distribution*

Key Area Reach	Total Number Riparian Trees	Number up to 6 Feet	Number Greater Than 6 Feet
Upper	14	10	4
Middle	62	43	19
Lower	72	56	16
Totals	148	109	39

Given these data and subsequent analysis, the following objectives were established for Intermittent Creek over a 5-year period (1997):

1. Increase the preferred community type percentages depicted on Table 5 for each reach by a minimum of 5 percent. This objective will have to be considered in conjunction with streamflow volume data, as noted in the discussion associated with Table 5.

2. Maintain or increase cottonwood numbers. It is expected that these cottonwood objectives can be achieved independently of streamflow volume.

3. Allow sufficient release of tree species such that a minimum of 10 percent (approximately 10 trees) of those individuals currently less than 6 feet tall release into the height classes over 6 feet. About half that total should occur in the lower key area reach.

VII. Relationship and Use with BLM Planning and Implementation Processes

BLM will "prescribe management for riparian values that is based upon site-specific characteristics and settings" (USDI, 1991). While Resource Management Plans may contain general objectives or goal statements of broad intent, Activity Plans require site-specific measurable objectives designed to be achieved within established timeframes. The greenline monitoring method provides the means for establishing baseline data from which site-specific objectives can be determined. Desired plant community objectives can be developed in accordance with BLM Manual H-1734-1, *Vegetation Management Handbook.*

VIII. Conclusion

Riparian objectives must be developed through an interdisciplinary approach. Prior to establishing transects, the overall goals must be established by an interdisciplinary team in order to determine where and what type of studies will be required. Once this information has been derived, the greenline monitoring method is a viable alternative for developing the vegetation portion of an Activity Plan. Greenline vegetation data are an ideal complement to data collected by wildlife and fishery biologists, soil scientists, and hydrologists, in order to evaluate the complex relationships found in riparian areas.

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Appendix A
Data Forms

GREENLINE TRANSECT DATA

RESOURCE AREA ______________ OBSERVER ____________________ DATE ______________

KEY AREA NAME ______________ ALLOTMENT # ______________________________

LOCATION ______________________________

PLANT COMMUNITY	# FEET OBSERVED	PERCENT

CROSS-SECTION COMPOSITION

RESOURCE AREA ____________ OBSERVER ________________ DATE ________

KEY AREA NAME ____________ ALLOTMENT # ______________________

LOCATION ______________________________

PLANT COMMUNITY and # FEET OBSERVED

TRANSECT #1 BEARING: __________ TOTAL RIPARIAN WIDTH ________

TRANSECT #2 BEARING __________ TOTAL RIPARIAN WIDTH ________

TRANSECT #3 BEARING __________ TOTAL RIPARIAN WIDTH ________

GREENLINE SUPPLEMENTAL DATA

RESOURCE AREA ______________ OBSERVER ________________ DATE _______

KEY AREA NAME______________ ALLOTMENT # ___________________________

LOCATION ______________________________

WOODY SPECIES COUNTS

AGE CLASS OPTION

SPECIES	SEEDLING	YOUNG	MATURE <50% DEAD	MATURE >50% DEAD

HEIGHT CLASS OPTION

SPECIES	0-3'	>3-6'	>6-10'	>10'

PHOTOS TAKEN/REMARKS:

Appendix B
Common/Scientific Plant Names and Symbols

Symbol	Common Name	Scientific Name
AGDA	thickspike wheatgrass	*Agropyron dasystachyum*
ANRO	rose pussytoes	*Antennaria rosa*
AGST	red top	*Agrostis stolonifera*
ARCA	silver sage	*Artemisia cana*
ARTR	big sagebrush	*Artemisia tridentata*
BEOC	water birch	*Betula occidentalis*
CANE	Nebraska sedge	*Carex nebraskensis*
CHVI	green rabbitbrush	*Chrysothamnus viscidiflorus*
DECA	tufted hairgrass	*Deschampsia caespitosa*
ELPA	creeping spikesedge	*Eleocharis palustris*
EQAR	horsetail	*Equisetum arvense*
JUBA	baltic rush	*Juncus balticus*
POPR	Kentucky bluegrass	*Poa pratensis*
POAN	narrowleaf cottonwood	*Populus angustifolia*
SAEX	coyote willow	*Salix exigua*