Table 3-23. Special Status Species – Wildlife: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
SSW-1		No current objectives or decisions for special status wildlife species as they were not discussed as a group in the RMP. Several current special status species were discussed under general wildlife in current RMP. Threatened and Endangered wildlife is managed in accordance with the requirements of the Endangered Species Act. There was no discussion of the Wyoming Game and Fish Department's list of Species of Greatest Concern.		
SSW-2		The BLM will participate with the FWS in the evaluation and designation of critical habitat for T&E species on BLM-administered lands. If proposed surface-disturbing or disruptive activities could affect these species, the BLM will consult with the FWS as required by the Endangered Species Act.		Ongoing.
SSW-3		Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY8797 for the management of potential gray wolf habitat are incorporated by reference, per BLM Instruction Memorandum WY-2005-046.		Implemented.
SSW-4		Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY9669c for the management of potential Canada lynx habitat are incorporated by reference, per BLM Instruction Memorandum WY-2005-058.		Implemented.
SSW-5		Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY9741d for the management of potential Black-footed ferret habitat are incorporated by reference, per BLM Instruction Memorandum WY-2006-037.		Implemented.
SSW-6		Conservation Measures and BMPs as described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY07FA0408 for the management of white-tailed prairie dog habitat are incorporated by reference, per BLM Instruction Memorandum WY-2008-025.		Implemented.
SSW-7		Conservation Measures and BMPs described in attachment 2 of USFWS Conference Memorandum ES-61411/W.02/WY9751d for the management of grizzly bear are incorporated by reference, per BLM Instruction Memorandum WY-2006-049.		Implemented.
SSW-8		Conservation recommendations as described in the USFWS Biological Opinion for the Wyoming BLM RMPs and Their Effects to the Bald Eagle transmitted by USFWS Memorandum ES-61411/W.02/WY7682b are incorporated by reference, per BLM Instruction Memorandum WY-2004-051.		Implemented.

SSW-9		Habitat preservation measures as identified in the Wyoming BLM Statewide Programmatic Biological Assessment for Whooping Cranes *(Grus Americana)* and USFWS concurrence as transmitted by Memorandum ES-61411/W.02/(BIO-OPIN.WPD) are incorporated by reference, per BLM Instruction Memorandum WY-2004-032.		Implemented.
SSW-10		Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY07FA0290 for the management of mountain plover habitat are incorporated by reference, per BLM Instruction Memorandum WY-2007-018.		Implemented.
SSW-11		For the protection of prey bases essential to the peregrine falcon or other T&E birds, spraying of insecticides will not be allowed until after the completion of site-specific environmental analyses.		Implemented.

Table 3-24. Wild Horses: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
WH-1		Wild horse are managed under interim decisions until the Decision Record from the Evaluation of Wild Horse Herd Areas and Capture Environmental Assessments, which implemented the recommendations from the 1992 Evaluation of Wild Horse HMAs and the USDI-BLM 1992 Strategic Plan for Management of Wild Horses and Burros on Public Lands.		Ongoing.
WH-2		Wild horse gathers are implemented to control population size, diversity, and habitat values.		Ongoing.
WH-3		Public education about wild horses is implemented as part of management and used to generate support for the wild horse program.		Ongoing.

3.2.5 Heritage and Visual Resources

Table 3-25. Cultural Resources: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Cult-0.1		Site-specific inventories for cultural resources are required before the start of surface-disturbing activities. Adverse effects on significant resources will be mitigated, or the resources themselves will be avoided by surface-disturbing activities.		Status?
Cult-0.1		Sites listed on the NRHP are appropriately protected. Any violations of the Archaeological Resources Protection Act are investigated.		Status?
Cult-0.1		The BLM's consultation with the Advisory Council for Historic Preservation and the Wyoming State Historic Preservation office is consistent with the cultural resources programmatic agreement signed in 1995.		Status?
Cult-0.2		Rock art, as well as other prehistoric and historic archaeological sites and districts associated with specific time periods or cultures, are managed for scientific, public, and socio-cultural use. General areas will be managed for research, with emphasis on interpreting former ecosystems. Specific sites or areas will be preserved for future study and use. Near rock art, the use of heavy equipment to construct fire lines and the use of chemical and dye retardants will be restricted or prohibited.		Status?
Cult-0.3		As appropriate, specific sites on public lands will be managed for their traditional Native American cultural values.		Status?
Cult-0.4		Adverse effects are avoided on public lands and resource values listed in National Park Service inventories of possible NNL. These lands and resources include paleontological and scenic values at Beaver Rim and Red Canyon.		Status?
Cult-0.5		Protective measures will be implemented for all important cultural sites, either known or identified in the future.		Status?
Cult-1	Beaver Creek	All management actions in the Beaver Creek area are consistent with the Oregon/Mormon Pioneer NHT Management Plan. Pursue designation and enrollment of the Beaver Rim NNL.		The trails are managed in accordance with the Plan. Experience has shown that the ¼ mile protection zone does not comply with the National Historic Preservation Act and does not adequately protect the Trail. The Beaver Rim NNL was not implemented.

Table 3-25. Cultural Resources: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Cult-2	Red Canyon	The Red Canyon NNL's natural character and qualities are protected. Protect future appreciation of classic natural history resource.		The ACEC provisions have adequately protected the NNL values. An educational interpretive sign at the highway turn off has been provided.
Cult-3	South Pass	The South Pass area is managed to protect fragile and important historic sites. Prevent deterioration of 19th and 20th century historical resources.		A Cultural RMP was approved in the early 1990s and some measures have been implemented. Some stabilization work has been done at Miner's Delight Townsite and Cemetery, Lemley Mill, Carrie Shield Mine and a few unnamed cabins. The Carrissa Mine has been stabilized and developed as an interpretive site.
Cult-4	South Pass	The South Pass area is managed to deter destruction of historical sites.		Yearly site patrols have been done over the area.
Cult-5	South Pass	The South Pass area is managed to preserve all significant sites within the historic district.		As much preservation as staff time and money allows has been done.
Cult-6	South Pass	The South Pass area's historical setting is maintained around South Pass City.		The historic setting around South Pass City has been improved. Although some modern intrusions have been allowed, mostly for infrastructure, they have not significantly impacted the setting of the site.
Cult-7	South Pass	Miner's Delight is managed to improve understanding of its history. Test excavations will be made to facilitate interpretation.		A historical context was written and accepted for Miner's Delight in the late 1990s but it has not been implemented do to funding constraints. Excavations were conducted at Miner's Delight resulting in much new data about the occupation and use of the townsite.
Cult-8	Gas Hills	A management plan will be developed for Castle Gardens including walkways and other fencing to halt deterioration of the site.		A new management plan has not been implement, although one is being prepared at the time of the RMP revision.
Cult-9	Gas Hills	The NHT Management Plan is incorporated into the RMP and used for management decisions in the Gas Hills area.		Proposed development near the Trail was made consistent with the Management Plan. However, experience has showed that the ¼ mile protection zone does not comply with the National Historic Preservation Act and is not adequate to protect historic trail values.
Cult-10	Gas Hills	Pursue a protective withdrawal for the Martin's Cove site.		The withdrawal was not pursued.

Table 3-25. Cultural Resources: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Cult-11	Dubois	Conduct a study of stabilization needs of the Warm Spring Canyon Flume in the Dubois area.		A stabilization study was written in the early 2000s but not implemented due to funding.
Cult-12	Dubois	Develop a management plan for the Warm Springs Canyon Flume.		Due to funding constraints, this has not been pursued.
Cult-13		Manage regional trails on a case-by-case basis.		Partially implemented. Activity plans need to be implemented to protect visual resources.
Cult-14		Review the ACEC nominations and the cultural resource alternatives.		

Table 3-26. Paleontological Resources: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Paleo-1		No objectives or management decisions on paleontological resources are included in the RMP. The resources included under cultural resources.		Status?
Paleo-2		Important paleontological resources are managed for scientific and public use.		Implemented.
Paleo-3		Potential effects on paleontological resources are considered in site-specific environmental analyses before the authorization of surface-disturbing activities. As appropriate, site-specific inventories are required where significant fossil resources are known or anticipated to occur.		Implemented.
Paleo-4		Closing lands or restricting uses to protect paleontological resources will be evaluated on a case-by-case basis.		Implemented.
Paleo-5		Important paleontological sites are protected through the use of surface and subsurface protection stipulations and discretionary management authority.		Implemented.

Table 3-27. Visual Resources: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
VRM-1		No current objectives and decisions for Visual Resources are included in the RMP. Visual resources were considered primarily in ACEC designations.		Not adequate.
VRM-2		Visual resources are managed in accordance with objectives for VRM classes that have been assigned to the planning area (Map XX).		Sometimes implemented.
VRM-3		Visual resource values are considered before authorizing land uses that may affect visual resource quality.		Sometimes implemented.
VRM-4		Surface-disturbing activities will be prohibited in Class I or II VRM areas, unless adverse impacts can be mitigated or avoided.		Sometimes implemented.
VRM-5		See Appendix XX and other management decisions in this RMP for other restrictions on surface-disturbing activities that apply to protection of visual resources.		Sometimes implemented.
VRM-7		Visual resources are considered before authorizing land uses that may affect them. VRM requirements are applied on public lands or to BLM-approved mineral development on split-estate lands.		Sometimes implemented.
VRM-8		Facilities or structures, such as power lines, oil wells, and storage tanks are screened, painted, and otherwise designed to blend with the surrounding landscape. Facilities or structures proposed in or near WSAs will be designed so as not to impair wilderness suitability.		Sometimes implemented.
VRM-9		The construction or modification of ROW along Wyoming highways are evaluated individually to assure that adverse effects on scenic values are not increased.		Sometimes implemented.
VRM-10		VRM objectives are considered in the evaluation of all proposals for activities on the public lands in the planning area and are incorporated into design features. Impacts to visual resources will be mitigated by applying the guidance for mitigating surface-disturbing activities in the Wyoming BLM Standard Oil and Gas Lease Stipulations or by mitigations developed through the environmental analysis process.		Sometimes implemented.

3.2.6 Land Resources

Table 3-28. Lands and Realty: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Realty-1		The preferred method of disposal or acquisition of lands by BLM is through exchange.		Status?
Realty-2		Acquired lands and/or interests in acquired lands will be managed in a manner consistent with adjacent or nearby public lands if applicable. Acquired lands within an ACEC or other special management area will be managed in accordance with the special management area's activity plan.		Status?
Realty-3		Proposals for disposal of any BLM-administered lands in the planning area not identified for disposal in the RMP will be considered on a case-by-case basis. Before a disposal action could be implemented, the RMP would have to be amended.		Status?
Realty-4		Tracts 134 and 135 in the Green Mountain area (see map) are identified for disposal and will be considered on a case-by-case basis.		Implemented; sold.
Realty-5		Twenty-five isolated tracts in the Beaver Creek area are identified for disposal and will be considered on a case-by-case basis.		0 Disposed of – All still available.
Realty-6		Ten full tracts and four partial tracts in the Lander Slope area are identified for disposal and will be considered on a case-by-case basis.		3 Full tracts and 1 partial tract have been disposed of.
Realty-7		No public lands are identified for disposal in the Red Canyon area.		Status?
Realty-8		No public lands are identified for disposal in the South Pass area.		Status?
Realty-9		Forty tracts are identified for disposal in the Gas Hills area and will be considered on a case-by-case basis.		4 Tracts have been disposed of.
Realty-10		In the East Fork area, tracts 24, 25, 26, and 27 (totaling 961 acres) are identified for disposal but only to private or public agencies which will use the lands in consistency with management objectives for elk winter range. Future exchanges will be considered on a case-by-case basis.		Status?

Table 3-28. Lands and Realty: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Realty-11		In the Dubois Badlands area, parcels 33, 34, and 35 are identified for disposal with exchange as the preferred method, and will be considered on a case-by-case basis.		2 Tracts have been disposed of.
Realty-12		In the Whiskey Mountain area, landownership adjustments will be allowed only when the Bighorn Sheep Interagency Technical Committee has analyzed and recommended such adjustments.		
Realty-13		Tracts 1, 4, 5, 7, 8, 11, 14, 16, 17, 20, 21, 22, 23, 28, 30, 32, 37, and 168 in the Dubois area are identified for disposal and will be considered on a case-by-case basis.		8 Tracts have been disposed of.
Realty-14		Agricultural trespass on public land generally will be resolved by prohibiting the unauthorized use; however, land sales, exchanges, or leases could resolve agricultural trespass in some cases. Leases might be used to develop the lands as wildlife food and cover areas.		Trespass has not been one of the top priorities to be completed in the Lander Field Office.
Realty-15		R&PPs leases and patents are considered on a case-by-case basis.		Implemented.
Realty-16		The acquisition of non-BLM-administered lands to achieve management objectives will be considered on a case-by-case basis.		Implemented.
Realty-17		Existing stock driveway withdrawals will be retained, although the BLM reserves the right to modify historic trailing routes and use, to mitigate any impacts associated with trailing, or to deny trailing use if the impacts cannot be adequately mitigated.		Implemented.
Realty-18		The BLM access policy in Wyoming is to acquire permanent exclusive easements (BLM controls and includes rights for the public) over mainline roads in the BLM transportation plan. A BLM mainline road is considered the principal access into larger blocks of BLM-administered public lands or into tracts of BLM administered lands with high resource values.		Implemented.
Realty-19		The BLM will seek to acquire administrative access to areas identified as important for resource and resources uses.		Implemented.
Realty-20		The BLM will pursue public access on important roads and trails identified in the BLM transportation plan. The transportation plan will be updated as necessary and implemented to provide access to large blocks of public land or to smaller parcels of land having high public values.		Implemented.

Table 3-28. Lands and Realty: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Realty-21		Access to specific areas may be closed or restricted to protect public health and safety. Before access is upgraded in the vicinity of important cultural, paleontological, natural history, wildlife habitat, or other sensitive resources, the security and protection of these resources will be carefully considered.		Implemented.
Realty-22		As of 1985, easements in the Green Mountain area will be negotiated for Willow Creek Road (via Cooper Creek Road), Crooks Mountain Road, and Taggart Meadows Road.		Taggart Meadows Rod is partially completed (Ellen Fox portion).
Realty-23		In the Beaver Creek area, negotiate with landowners for easements or initiate appropriate route alternatives to secure public access on East Beaver Creek, Twin Creek, Government Draw, Signor Ridge, Hudson-Atlantic City, Beaver Rim, and Dilabaugh Butte roads.		Not implemented.
Realty-24		In the Green Mountain area, public access is provided for forest, wildlife, recreation, and livestock management. Existing necessary roads will be maintained. Additional easements or appropriate route alternatives will be negotiated to secure public access.		Implemented.
Realty-25		In the Lander Slope area, negotiate for easements or initiate appropriate route alternatives to secure public access on the Shoshone Lake Road to Mormon Basin.		Not implemented.
Realty-26		In the Gas Hills area, negotiate with landowners for administrative access and easements for Copper Mountain Road, Wolf Gap, Beef Gap, and Beaver Rim Road. Consider other alternatives for easements.		Not implemented.
Realty-27		Negotiations with landowners for easements across Tappan Creek Road will be pursued.		Not implemented.

Table 3-29. Renewable Energy: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Renew-1		No current objectives and decisions for renewable energy are included in the RMP. Any non-wind renewable energy proposal will require a plan amendment to implement.		Status?
Renew-2		The Wind Energy Programmatic ROD (2005) is incorporated into the RMP. Any wind energy proposals will require a plan amendment to implement except for those activities authorized by the ROD, such as meteorological towers. The provisions of IM-2009-043 are followed in processing applications for wind energy development.		Implemented.

Table 3-30. Rights-of-Way and Corridors: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
ROW-1		Most of the planning area is open for the location of utility and transportation systems. Proposals will be addressed on an individual basis with emphasis on avoiding identified potential conflict areas.		Implemented.
ROW-2		Utility, pipelines, and ROWs will be co-located whenever possible.		Implemented.
ROW-3		To protect scenic quality, placement of aboveground facilities, such as power lines, will be avoided along major transportation routes.		Implemented.
ROW-4		If restricted types of ROWs are required in avoidance areas or when such areas cannot reasonably be avoided, the adverse effects of construction will be intensively mitigated.		Implemented.
ROW-5		No utility and pipeline corridors or communication site windows are designated in the RMP. The Whiskey Peak area is identified as a location where a communication tower exists.		Implemented.

Table 3-30. Rights-of-Way and Corridors: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
ROW-6		Public lands in the Green Mountain area will be open for the location of utility and transportation systems and concentrated in existing corridors whenever possible.		Implemented.
ROW-7		Construction of major utility systems in the Beaver Creek will be allowed and concentrated in existing corridors whenever possible, except for the Oregon/Mormon Pioneer Trails corridor, Sweetwater Canyon, and Sweetwater Rocks. ROWs might be granted in the exception areas if no feasible alternative route or designated corridor is available.		Implemented.
ROW-8		The Lander Slope is avoided when locating major utility systems; locating these systems in the Lander Slope is only allowed when no feasible alternative route or designated ROW corridor is available. The BLM will consider lowlands near Hwy 28-287 for utility systems before allowing them on slopes of the mountain.		Implemented.
ROW-9		Red Canyon is avoided for placement of major utility systems. Major utility system ROWs may be granted only when no feasible alternative route or designated corridor is available.		Implemented.
ROW-10		South Pass, East Fork, Dubois Badlands, and Whiskey Mountain are avoided for placement of major utility systems. Major utility system ROWs may be granted only when no feasible alternative route or designated corridor is available.		Implemented.
ROW-11		Major utilities are allowed in the Gas Hills area. No utilities will be allowed along the Oregon/Mormon Pioneer Trails corridor and the Sweetwater Rocks. Utility systems will be concentrated in existing corridors whenever possible. ROW might be granted if no feasible alternative route or designated ROW corridor is available.		Implemented.
ROW-12		Major utility systems will be allowed in the Dubois area, but utility systems will be concentrated in existing corridors whenever possible.		Implemented.
ROW-13		Power line construction will be required to incorporate standard or special design features to reduce bird collisions and reduce impacts to habitat. Additional power line construction limitations will be applied on a case-by-case basis in special situations to reduce bird collisions.		Implemented
ROW-14		Existing transportation and utility routes for roads, pipelines, and power lines will be designated as preferred ROW corridors, which would be the preferred location for existing and future ROW grants (map 6).		Implemented.

Table 3-31. Trails and Travel Management: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Travel-1		Unless otherwise specified, vehicular use on BLM-administered public lands in the general planning area is designated as limited to existing roads and trails (Map XX). "Existing" roads and trails apply only to roads and trails in existence when these designations were identified for the Lander planning area in the Federal Register on August 29, 1990. Roads or trails created after this date are not "existing" within the intent of the RMP and will be closed as time and funding allow.		Ongoing.
Travel-2		Except for areas designated as closed to vehicular use, performance of necessary tasks requiring off-road use of a vehicle is authorized. Examples of necessary tasks include picking up big game kills and constructing or repairing authorized range improvements.		Ongoing.
Travel-3		See Appendix __ and other management decisions in this RMP for other restrictions on surface-disturbing activities that may apply to OHV or general vehicular use.		Ongoing.
Travel-4		Until activity planning specifically addresses the use of over-the-snow vehicles, they are subject to the same requirements and limitations as all other vehicles.		Ongoing.
Travel-5		No open area for OHV "play" or other cross-country vehicular use is designated.		Ongoing.
Travel-6		Motorized vehicle use is prohibited on wet soils and on slopes greater than 25 percent, when and where unnecessary damage to vegetation, soils, or water quality would result.		Ongoing.
Travel-7	Green Mountain	Unnecessary roads in the Green Mountain area, such as the Cooper Creek fire access road, will be removed and rehabilitated.		Ongoing.
Travel-8	Green Mountain	OHV use in the Green Mountain area is limited to designated roads and trails with seasonal (December 1-June 15) road closure above 7,000 feet to protect roadbed and surrounding watershed values.		Ongoing.
Travel-9	Beaver Creek	Existing BLM roads and easements in the Beaver Creek area are maintained to BLM standards. Roads in the area of the Sweetwater Rocks will not be upgraded.		Ongoing.
Travel-10	Beaver Creek	OHV use in the Beaver Creek and Gas Hills area are limited to existing roads and trails. The Castle Gardens withdrawal area is closed to OHV use, but the BLM road to Castle Garden's picnic area is open.		Ongoing.

Table 3-31. Trails and Travel: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Travel-11	Lander Slope	OHV use in the Lander Slope is limited to designated roads and trails with seasonal closures (December 1-June 15) except for snowmobiles.		Ongoing.
Travel-12	Red Canyon	The existing transportation system in Red Canyon is maintained. No new roads or easements are identified.		Ongoing.
Travel-13	Red Canyon	OHV use is limited to designated roads and trails with seasonal closures (December 1-June 15).		Ongoing.
Travel-13.1	Whiskey	Motorized use in the Whiskey Mountain Area is limited to designated roads and trails with seasonal travel limitations (Closed December 1-June 15).		Ongoing
Travel-14	South Pass	Existing transportation system is adequate for recreational use and will be maintained.		Ongoing.
Travel-15	South Pass	OHV use is limited to existing roads and vehicle routes, except for casual use, such as loading game animals during hunting season.		Ongoing.
Travel-16	Gas Hills	Existing roads are maintained, including Castle Gardens access road.		Ongoing.
Travel-17	East Fork, Dubois Badlands, Whiskey Mountain	In the East Fork, Dubois Badlands, and Whiskey Mountain areas, the existing transportation systems are maintained.		Ongoing.
Travel-18	East Fork.	OHV use in the East Fork area is limited to existing roads and trails.		Ongoing.
Travel-19	Dubois Badlands	The Dubois Badlands area is closed to OHV to protect outstanding scenery and natural values.		Ongoing.
Travel-20	Whiskey Mountain	OHV use is limited to designated roads and trails. Seasonal closures are imposed in some area. Some roads will be rehabilitated to put areas back into production for wildlife habitat; other roads will be kept open for wildlife viewing opportunities.		Ongoing.
Travel-21	Dubois	OHV use in the Dubois area is limited to existing roads and trails.		Ongoing.

Table 3-32. Recreation: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Rec-1	Green Mountain, Lander Slope, Red Canyon	The Green Mountain Area, Lander Slope, and Red Canyon are managed as ERMAs where dispersed recreation is encouraged and with freedom of recreational choice with minimal regulatory constraint. A 14-day limit on camping is imposed. Commercial use quotas will be established. Management emphasizes resolution of competing uses with resource protection and enhancement.		Implemented.
Rec-2	Lander Slope	No major recreational developments are planned in the Lander Slope ERMA.		Implemented.
Rec-3	Red Canyon	An interpretive marker will be developed for Red Canyon. The Red Canyon elk winter range is closed to all winter sport activities.		Implemented.
Rec-4		The NHTs are managed as a SRMA. Existing campgrounds and facilities are maintained and intensively managed, but no new facilities are developed except to protect visitor safety and visual resources. Recreation opportunities for rustic, open-space settings are maintained. An SRMA plan will be developed in conjunction with cultural resource plan for South Pass area. Miner's Delight Townsite and Peabody Ridge Overlook are intensively managed.		Implemented.
Rec-5		The Continental Divide National Scenic Trail is managed as an SRMA. Existing campgrounds and facilities are maintained and intensively managed, but no new facilities are developed except to protect visitor safety and visual resources. Recreation opportunities for rustic, open-space settings are maintained.		Implemented.
Rec-6		The South Pass Historic Mining Area is managed as an SRMA. Existing campgrounds and facilities are maintained and intensively managed, but no new facilities are developed except to protect visitor safety and visual resources. Recreation opportunities for rustic, open-space settings are maintained. An SRMA plan will be developed in conjunction with the cultural resource plan for South Pass area. Miner's Delight Townsite and Peabody Ridge Overlook are intensively managed.		Implemented.

Table 3-32. Recreation: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Rec-7	Dubois Badlands	The Dubois Badlands will be designated an ERMA and managed in its natural state. Resolving user conflicts and providing resource protection is emphasized.		Implemented.
Rec-8	Dubois	The Dubois area is managed as an ERMA where dispersed recreation is encouraged and with freedom of recreational choice with minimal regulatory constraint.		Implemented.

Table 3-32. Recreation: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Rec-9	Beaver Creek	Management in the Beaver Creek area emphasizes resolution of competing uses with resource protection and enhancement. Existing developments are maintained. Management and maintenance are minimal, but public safety hazards will be reduced.		Implemented.
Rec-10	Gas Hills	In the Gas Hills area, dispersed recreation is encouraged. Resolving user conflicts and providing resource protection is emphasized. Existing developments at Devil's Gate Interpretive Site and at Castle Gardens picnic site are maintained. More interpretation and resource protection at Castle Gardens will be added.		Implemented.
Rec-11	East Fork	Minimal recreation management is provided. Resolving user conflicts and providing resource protection is emphasized.		Implemented.
Rec-12	Whiskey Mountain	In cooperation with the WGFD, non-consumptive wildlife visitor use management is emphasized. No commercial hunting camps are permitted if they are not compatible with management of the bighorn sheep herd. There is a 14-day camping limit.		Implemented.
Rec-13		All remaining portions of the planning area are designated as ERMAs.		Implemented.
Rec-14		SRPs authorizing organized recreational use are issued as a tool to achieve recreation goals and objectives.		Implemented.

Table 3-33. Wilderness Characteristics: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Wilderness-1	N/A	No current objectives or decisions for wilderness characteristics are included in the RMP.		

1

Table 3-34. Livestock Grazing: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-1		Livestock grazing use in the planning area will be continued. Livestock grazing will also be managed to provide for protection or enhancement of other resource values. Actions will be consistent with the Guidelines for Livestock Grazing Management for public lands administered by the BLM in the State of Wyoming.		Ongoing.
Grazing-2		This plan incorporates the "Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for Public Lands Administered by the BLM in the State of Wyoming" approved August 12, 1997. Please see Appendix XX.		Ongoing.
Grazing-3		High-intensity monitoring will be conducted on top-priority Category I allotments, on allotments with AMPs. Low intensity monitoring will be conducted on the other Category I allotments and on Category M and C allotments.		Ongoing.
Grazing-4		The current amounts, kinds, and seasons of livestock grazing use will continue to be authorized until monitoring indicates a grazing use adjustment is necessary or that a class of livestock or season of use modification can be accommodated.		Ongoing.
Grazing-5		The decisions for the Gas Hills Study Area and the Green Mountain Rangeland Programs Summary were developed from the Lander RMP/EIS.		Ongoing.
Grazing-6		Decisions will be made when monitoring data are sufficient to support decisions. Decisions may include changing livestock numbers, changing periods of use, or both. Monitoring will be a continuous process to assure management objectives are being met. If further modification of periods of use, livestock numbers, classes of livestock or grazing systems, adjustments will be made only after consultation with livestock operators and other affected parties.		Ongoing.
Grazing-7		Grazing allotments are grouped into three categories. Category I allotments are managed to improve existing resource conditions and to reduce or eliminate resource use conflicts. Category M allotments are managed to maintain or improve present satisfactory resource condition and allotment management. Category C allotments are managed to prevent deterioration of current resource conditions by managing the lands in a custodial manner.		Implemented.
Grazing-9		Based on available monitoring data, management actions will be implemented, beginning with Category I allotments needing the most improvement. AMPs will be developed for allotments in the planning area on a priority basis. The intensity of the AMPs will depend on allotment condition and resource conflicts.		Ongoing.

1

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-10		The remaining grazing allotments in the planning area are the "M" and "C" category allotments. They will be monitored at a lower intensity level to ensure no significant adverse changes are taking place as a result of ongoing management.		Implemented.
Grazing-11		Stock driveway withdrawals will be retained, although the BLM reserves the right to modify historic trailing routes and use, to mitigate any impacts associated with trailing, or to deny trailing use if the impacts cannot be adequately mitigated. Portions of grazing allotments that are outside withdrawn stock driveways and that are affected by trailing will be monitored to determine whether the allotment can accommodate trailing without unacceptable effects on resources.	See Realty-17	Implemented.
Grazing-12		The level of livestock grazing on public lands, when combined with all other public land uses, will not be allowed to exceed the carrying capacity of the land. Meeting the SHR is the most important requirement of livestock grazing management.		Ongoing.
Grazing-13	Gas Hills Study Area	Management actions will address known resource problems. The following rangeland improvements will be made: • 45 to 55 miles of fence will be constructed. • Ten reservoirs will be constructed. • 57 other water improvement projects will be built. • Reduce livestock grazing 13-19 percent in Category I allotments (cumulative target: 114,298-144,101 AUMs; overall change between 4 percent decrease to 21 percent increase).		Ongoing.
Grazing-14	Gas Hills Study Area Category M Allotments	Present resource management will be retained and, if possible, improved. The following management will be utilized: • Authorize current livestock use under a 10-year permit. • Authorize increases in livestock use, when appropriate, that will be consistent with multiple-use objectives and will not be detrimental to other resources; increases range from 10-55 percent. • Consult with permittees to develop flexibility in livestock operations. • Authorize and construct range improvements to meet multiple-use management objectives. • Monitor trends in range condition and productivity to ensure conditions of the basic renewable resources will remain satisfactory.		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-15	Gas Hills Study Area Category I Allotments	Use all management actions as necessary to reverse downward trends in range conditions, increase productivity of vegetation resources, improve wildlife habitat and improve soil and watershed conditions. Funding is allocated to Category I allotments first.		Ongoing.
Grazing-16	Gas Hills Study Area Category I Allotments	Develop monitoring program to evaluate effectiveness of present management situation. Develop AMPs and incorporate any/all specific management actions if objective(s) are not being met. The following actions may be taken for Category I allotments not meeting Standard of Rangeland Health 1-3: • Adjust stocking levels of grazing animals; include increases/ decreases in livestock grazing and/or wildlife. • Implement grazing systems. • Conduct vegetation manipulation projects. • Adjust turn-out dates/seasons of use.		Ongoing.
Grazing-17	Gas Hills Study Area Category I Allotments	The following actions may be taken for Category I allotments. • Develop water projects where livestock distribution problems have been caused by lack of water. • Use grazing systems and/or range improvements to solve problems where large grazing animals are concentrating on riparian areas. • Adjust turn-out dates and/or season of use based on plant phenology and range readiness. • Implement grazing systems to provide for the physiological needs of the key forage plants. • Where land-use conflicts have been causing a loss of forage production because of surface disturbance, rehabilitation efforts will be conducted and monitored for effectiveness. • Where land-use conflicts have been damaging structural improvements or causing a livestock trespass situation, identify the agent causing the problem and correct it. • For land-use conflicts involving damage to public and private lands by off-road vehicle use during wet weather, BLM will develop sign program and/or seasonal site-specific road closures.		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-18	Gas Hills Study Area Category C Allotments	Deterioration of current resource conditions will be prevented by managing lands in a custodial manner. Livestock use will be permitted as authorized under a 10-year permit/lease. BLM will conduct low-intensity use supervision and monitoring. Adjustments will be made in numbers and season of use where necessary to prevent deterioration of present resource conditions.		Ongoing.
Grazing-19	Green Mountain Study Area	Livestock grazing is managed to provide enough forage on a sustained-yield basis to satisfy at least the present demands of livestock, wild horses, and wildlife and to maintain range condition at a level that would provide for sustained yield of forage production. Terrestrial, aquatic and riparian ecosystems are maintained or improved to provide wildlife with adequate amounts of forage and habitat for planned population levels.		Ongoing.
Grazing-20	Green Mountain Study Area Economic Analysis	Final Rangeland Improvement Policy requires an economic analysis for proposed range improvements. As improvement projects are proposed from allotment monitoring and consultation process, benefit/cost evaluations are done. For allotments that may have potential for economic return on public investment, BLM will conduct benefit/cost analyses on AMPs or grazing system plans and related range improvements before they are implemented.		Benefit cost analysis was done on a project by project basis. BLM Management removed the requirement to do cost/benefit analysis.
Grazing-21	Green Mountain Study Area Category M allotments	Maintain or improve the allotment condition. Consult with all affected interests to establish a mutual understanding of the management flexibility for livestock operations given to individual livestock operators; a change in category may be necessary if a significant change in management occurs.		Ongoing.
Grazing-22	Green Mountain Study Area Category M allotments	Current livestock active preferences are authorized under a 10-year permit/lease with the following management: • Conduct low-level monitoring of actual use, climate and trend. • Allow increases in grazing use by any or all types of grazing animals if monitoring indicates this will be consistent with multiple-use objectives. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operator(s); occasional counts of livestock numbers may be conducted. • Authorize any range improvements that meet multiple-use objectives for the allotment. • Encourage livestock operator(s) to fund installation of range improvements; some range betterment funds may be made available as budges permit.		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-23	Green Mountain Study Area Category M allotments Monitoring	The following are the monitoring priorities: • Conduct low-level monitoring of actual use, climate and trend with priority given to those allotments that have marginally met the categorization criteria. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operators and occasional counts of livestock numbers.		Ongoing.
Grazing-24	Green Mountain Study Area Category I Allotments	Manage livestock grazing to improve existing resource conditions and to reduce or eliminate resource conflicts. Take corrective measures in response to the existing problems. Help to better define the problems, provide for input from all interested parties to find solutions to the problems, and implement measures determined to be beneficial in achieving multiple use objectives.		Ongoing.
Grazing-25	Green Mountain Study Area Category I Allotments	Conduct monitoring of allotments which are not satisfactory for the range trend, utilization, actual use, and climate.		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-26	Green Mountain Study Area Category I Allotments	The following factors are considered in managing Category I allotments: • Actions may include development of grazing systems, changes in turnout dates and season of use, development of additional water to improve distribution and adjustments in stocking levels. • Implement adjustments in stocking levels of all grazing animals if range condition/vegetation production is deteriorating. • HMAs will be a priority for development of management plans. • Development of water sources will be priority in allotments where lack of water is the primary problem. • Implement grazing systems and/or fencing if cattle concentrate in riparian areas, even though there's sufficient water in allotment. • Use flexibility for turnout dates and season of use in allotments that may be unsatisfactory. • Rehabilitate areas where land-use conflict(s) has caused loss of forage production; this may include adjustments in stocking levels of grazing animals. • Where livestock grazing is causing adverse conditions for another land use, alternative management actions will be considered on a case-by-case basis. • Management actions will be dependent on manpower capability and improvement funding; concentrate limited resources in the allotments with most problems and the ones that offer the prospect for maximum return on public investment. • Monitoring on Category I allotments will be conducted in accordance with a list of procedures (p. 85 of ROD).		Ongoing.
Grazing-27	Green Mountain Study Area C Allotments	Prevent deterioration of current resource conditions by managing lands in a custodial manner. Category C allotments will be redesignated or eliminated by the following methods: • Changing fence locations. • Exchanging land to block up public land. • Selling public land.		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-28	Green Mountain Study Area C Allotments	Manage the allotments are follows: • Authorize current livestock active preference under a 10-year permit/lease. • Consult with all affected interests to establish a mutual understanding of the management flexibility given to the individual livestock operations. • Conduct low-level monitoring of actual use, climate and trend, with priority given to those allotments designated for fence location changes. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operators; occasional counts of livestock numbers may be conducted. • Authorize any range improvements that meet multiple-use objectives of the allotment. • Encourage livestock operator(s) to fund installation of range improvements (some range betterment funds may be made available). • Decisions on Category C allotments will be issued as land is sold or exchanged or fence locations are changed.		Ongoing.
Grazing- 29		Appendix XX identifies the various types of management actions including grazing systems, land treatments, range improvements, and development of AMPs that will be implemented throughout the planning area. These actions will be directed toward resolving or reducing such concerns as continuous spring grazing and conflicts between livestock grazing and wildlife uses, and toward improvement of wetland/riparian areas and overall vegetative ground cover and production. If these measures fail to accommodate the livestock grazing preference, while concurrently providing for protection of other resource values, reductions in livestock grazing use may become necessary.		Ongoing.
Grazing-30		Any adjustments in livestock grazing use, either short-term or long-term, will be made as a result of monitoring and consultation with grazing permittees or through negotiation with grazing permittees and other affected interests. Adjustments may also result from land use planning decisions to change the allocation of land uses or from transfers of BLM-administered public lands to other agency jurisdictions or into nonfederal ownerships.		Ongoing.
Grazing-31		The level of livestock grazing on public lands, when combined with all other public land uses, will not be allowed to exceed the carrying capacity of the land. (See Glossary.)		Ongoing.

Table 3-34. Livestock Grazing: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Grazing-32		The placement of salt and mineral supplements on public lands is allowed outside riparian areas and reclaimed or reforested areas, in locations designed to improve livestock distribution.		Ongoing.
Grazing-33		If grazing management techniques are not adequate to meet the objectives of resource management, livestock grazing will be reduced or eliminated on some allotments, especially around sources of springs, reservoirs, other riparian wetland, aspen stand regeneration areas, and crucial big game winter ranges.		Ongoing.

3.2.7 Special Designations and Other Management Areas

Table 3-35. ACECs and Other Management Areas: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
ACEC-1		The plan designates approximately 117,000 acres as ACECs. This represents about 4.7 percent of the planning area.		Implemented.
ACEC-2	Green Mountain	Designate 18,000 acres for the Green Mountain ACEC, which includes crucial elk winter range and the area within a 350-foot radius of Sparhawk Cabin.		Implemented. Sparhawk Cabin has been protected from development impacts and was partially stabilized in 2005 and 2006.
ACEC-3	Beaver Creek	Designate about 7,000 acres in the Beaver Creek area as an ACEC along Beaver Rim to protect natural values.		Implemented.
ACEC-4	Beaver Creek and Gas Hills MU	Designate about 22,600 acres in the Beaver Creek and Gas Hills areas as an ACEC along the Oregon/Mormon Pioneer Trail (expanded to include the California and Pony Express Trails).		Implemented. Proposed development near the Trail was made consistent with the Management Plan; ¼ mile zone dies not comply with the NHPAt and is not adequate to protect trail values.
ACEC-5	Beaver Rim	Beaver Rim ACEC: Designate about 7,000 acres in the Beaver Creek area along Beaver Rim as an ACEC.		Implemented

Table 3-35. ACECs and Other Management Areas: Current Management (Continued)

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
ACEC-6	Lander Slope	Designate about 25,000 acres as ACEC to protect the important wildlife habitat and scenic quality of the Lander Slope		Implemented.
ACEC-7	Red Canyon	Designate 15,000 acres within the Red Canyon area as an ACEC for protection of highly visible steep slopes and areas of important wildlife habitat.		Implemented.
ACEC-8	South Pass	Designate 12,000 acres in the South Pass area as ACEC to protect significant cultural values, which will include the Historic Mining District. Improve habitat for the Lander moose herd winter range and other species. Develop special management actions for aspen and beaver management, in-stream structure developments and fencing projects, and protecting willow regeneration. Emphasize improvement of conifer, aspen, willow-riparian, and other shrub stands.		Implemented.
ACEC-9	East Fork	Designate 1,000 acres in the East Fork area surface as an ACEC to protect crucial elk winter range.		Implemented. Also completed mineral entry withdrawal on 10,525 acres for 20 years. Withdrawal expires in 2013.
ACEC-10	Dubois Badlands	Designate approximately 5,000 acres in the Dubois Badlands as ACEC to protect bighorn sheep habitat, scenic quality and protect against the erosive nature of the badlands.		Implemented
ACEC-11	Whiskey Mountain	Designate approximately 4,000 acres as an ACEC to protect the Whiskey Mountain Bighorn Sheep Winter Range.		Implemented. Acquired 4,173 acres through land exchanges in 1990, 1991, 1993, 1997, and 1998 for inclusion into the Whiskey Mountain Bighorn Sheep Winter Range. These acres were added to the ACEC. Also completed mineral withdrawal on 11,041 acres for 20 years.
ACEC-12		See appendix B for other restrictions that may be applied to surface-disturbing activities, as appropriate.		Identify surface disturbance prescriptions.
ACEC-13		Identify wildfire prescriptions for each ACEC that advances the values for which the ACEC is designated.		Prescribed fire will be used as appropriate to accomplish multiple use objectives.

Table 3-36. Scenic or Backcountry Byways: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current management decisions for scenic or backcountry byways are included in the RMP.		

Table 3-37. National Historic Trails and National Scenic Trails: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Cong Des-1		Management activities for the NHTs were addressed in the ACEC designation and in other management actions, such as ROW avoidance zones.		Current management does not comply with the National Historic Preservation Act or BLM guidance for management of Congressionally designated trails. Current management is not adequate, including the ¼ mile prescription, visual resource surface disturbance, recreation, and other management prescriptions are not adequate.

Table 3-38. National Scenic Trails: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
Cong Des-2		The Continental Divide National Scenic Trail is managed as a Congressionally-designated trail.		Current management does not comply with the Trail planning or BLM guidance for management of Congressionally designated trails. Current management is not adequate, including the ¼ mile prescription, visual resource surface disturbance, recreation, and other management prescriptions are not adequate.

Table 3-39. Wild and Scenic Rivers: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for WSRs are included in the RMP.		

Table 3-40. Wilderness Study Areas: Current Management Decisions

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for WSAs are included in the RMP.		
	Dubois Badlands	A portions of the Dubois Badlands MU are presently designated a WSA and will remain under BLM's Wilderness Interim Management Policy until Congress makes the final decision on wilderness designation.		Status?
	Whiskey Mountain	A portions of the Whiskey Mountain MU are presently designated a WSA and will remain under BLM's Wilderness Interim Management Policy until Congress makes the final decision on wilderness designation.		Status?

3.2.8 Socioeconomic Resources

Table 3-41. Social Conditions: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for social conditions are included in the RMP.		

Table 3-42. Economic Conditions: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for economic conditions are included in the RMP.		

Table 3-43. Health and Safety: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for health and safety are included in the RMP. Other management actions for other resources, such as fire or recreation, addressed public safety as a part of those programs.		

Table 3-44. Environmental Justice: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for environmental justice are included in the RMP.		

Table 3-45. Tribal Treaty Rights: Current Management

Planning Decision Number	Decision Source	Current Management Decision	Duplication with Other Resource Areas	Status
N/A	N/A	No current objectives and decisions for tribal treaty rights are included in the RMP.		

4.0 MANAGEMENT OPPORTUNITIES

This chapter analyzes the ability of current management direction to achieve desired conditions and address resources and demands for use of the resources. It describes resource management activities that may or may not, under current management, be meeting the goals specified in the RMP. This chapter serves a starting point for alternative formulation by identifying management opportunities for consideration during the alternative development process.

4.1 Desired Conditions and Ability to Address Resource Demands

Management decisions from the 1987 Lander RMP are identified in the following table. Each management decision has been assigned a planning decision number.

4.1.1 Physical Resources

Table 4-1. Air Quality: Management Opportunities

Planning Decision Number	Current Management Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
A-1	No current objectives or decisions on air quality are included in the RMP. BLM complies on a project-by-project basis with Federal air quality laws and regulations.	No	Increased mineral development, population growth, and cumulative impacts from other activities along with policy have raised issues that the Lander Field Office must address.	Obtain better background data such as being done as part of the Gun Barrel, Madden Deep and Iron Horse, and Beaver Creek EISs. Work with partners to obtain a better perspective on air quality and potential impacts.
A-2	All BLM-initiated or authorized actions, such as the use of prescribed fire, avoids violation of Wyoming and national air quality standards. This is accomplished through the coordination of BLM-managed activities with the Wyoming DEQ and the EPA.	Unknown	Lander Field Office coordinates with the Wyoming DEQ and EPA as appropriate, but with little background data, it is difficult to determine the impacts to air quality.	Obtain better background data such as being done as part of the Gun Barrel, Madden Deep and Iron Horse and Beaver Creek EISs. Work with partners to obtain a better perspective on air quality and potential impacts.
A-3	Air quality standards are monitored by the Wyoming DEQ. Air quality permits will be obtained from Wyoming DEQ before prescribed fires are set on public land. Smoke and pollution will be minimized as described in the Smoke Management Guidebook (BLM 1985).	Yes		
A-4	The Lander Field Office will coordinate with the Wyoming DEQ and the EPA on developing air quality standards and guidelines as needed.	Yes	As mineral developments in the planning area increase, monitoring and guidelines will become more important.	Ensure that full field developments and large scale mining operations consider air resources impacts, especially cumulative impacts/

Table 4-2. Geologic Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Geo1	No current objectives or decisions for geologic resources are included in the RMP except to the extent that they are addressed in ACECs, such as Red Canyon and Beaver Creek.	Yes		

Table 4-3. Soil Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Soil 1	No current objectives or decisions for soils are included in the RMP except to the extent that these are addressed in ACECs or WSAs. The EIS considered soils as part of the existing environment.	No	Soil resources support other resources and uses and can be addressed in those sections. An analysis of oil suitability as part of permitting decisions is needed. Soils with low reclamation potential (LRP) need to be identified and managed. Soil suitability is not directly addressed.	Incorporate soil suitability into each permitted activity. Consider soil site potential. Address impacts to erosion.
Soil 2	BLM Guidance ("Standard Lease Surface Disturbance Stipulations") limits some types of soil disturbance. • Disturbance on slopes in excess of 25 percent. • Construction during periods when the soil material is saturated, frozen, or when watershed damage is likely to occur.	No	The 25% slope limitation is a rough guide and does not address all soil types, some of which are vulnerable at less than 25% slope. The soil type determines acceptable steepness.	Make soil type (along with other factors such as vegetation health) determine when and how soils may be disturbed.

Table 4-3. Soil Resources: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Soil 3	On a case-by-case basis, soil resources are addressed in other resources and uses, such as water quality, surface disturbance, and rangeland health.	Yes	This is adequate with the caveat that disturbed soil is protected through reclamation and stabilization. Existing soil surveys need to be completed (approximately 200,000 acres have not been surveyed). Surveys that are dated or too broad should be improve.	Vegetation and soil reclamation is addressed under vegetation resources. Current management has not been adequate to achieve adequate soil stabilization or to reestablish vegetation as habitat in some areas. Review adequacy of reclamation requirements. BLM reclamation policy is discussed in Vegetation. The Wyoming Storm Water Discharge Program has reduced erosion from surface disturbance. The anticipated increase in mineral development in areas vulnerable to erosion, such as Green Mountain, require strict compliance with the Wyoming Storm Water Discharge Program.
Soil-4	Improving soil health is a management objective; enhancement opportunities should not be overlooked. Soil erosion monitoring will be conducted as necessary to track the effectiveness of management.	No	If more fully implemented, this management action would improve soil. Very limited monitoring is done.	GIS technology could make implementation of this decision far more effective. Using GIS data (slopes, LRP, distance from water, etc.) as a planning tool for locating surface disturbing activities will improve soil management.

Table 4-4. Water Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Water-1	No objectives or decisions on water resource management are included in the RMP that are not already current Bureau policy. According to current policy: See Wyoming Water rights fact Sheet at: http://www.blm.gov/nstc/WaterLaws/wyoming.html . Also, see Bureau national water policy at: http://www.blm.gov/nstc/WaterLaws/blmwaterpolicy.html . Water quality is addressed in other programs, such as livestock grazing and mineral resources. The SHR, including the protection of water and riparian resources, are part of every management action.	No	Water resources are very scarce in the planning area and are under increasing competing uses and drought. The health of the public lands depends on appropriate water quality and quantity.	Ensure that water is part of every management action, both in terms of impacts of the action to water quality and also managing for drought conditions. Wyoming DEQ has primacy on compliance with the Clean Water Act. Opportunities to partner to improve water quality should be explored.
Water-2	PFC is considered in all management actions.	No	More progress towards PFC needs to be achieved.	Make achieving progress towards PFC more important in management decisions. PFC is a critical element in achieving Rangeland health.
Water-3	Surface-disturbing activities are prohibited within 500 feet of surface water and/or riparian areas, except when such activities are necessary and when their impacts can be mitigated or avoided.	No	Management needs to be extended to riparian/wetlands. Mining activities can be allowed in riparian areas.	Consider more focused site specific keep out zones where needed for resource protection. Locatable minerals: Because of rights granted to claimants under the mining laws, the BLM may impose only those surface use restrictions that are necessary to prevent undue and unnecessary degradation.
Water-4	Non-RMP decisions restrict ssurface-disturbing activities that apply to watershed protection.	No	Many areas are not meeting PFC or making progress. There is not adequate monitoring of riparian conditions. Reclamation is not being achieved in some areas which has increased erosion and degraded water quality.	See Riparian and Soil section.
Water-5	To protect watershed values, roads and trails will be closed and reclaimed if they are heavily eroded or washed out, or if roads in better condition are available. These management actions are addressed under other programs, such as travel management.	Yes	The management decisions are appropriate but implementation has not been fully realized due to funding limitations and lack of staff.	Partnerships with interested publics may provide the best tools to address issue.

Table 4-4. Water Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Water-6	To protect watershed values, vehicular travel is prohibited on wet soils and on slopes greater than 25 percent, when and where unnecessary damage to vegetation, soils, or water quality would result.	No	Looking through the NRCS soil interpretations, the general slope break where uses encounter Severe restrictions for slope is 15%. Generally, Bureau-engineered roads are restricted to using slopes under 8 percent.	The 25 % figure was more of a vehicle limitation than an erosion concern. A more appropriate slope figure for protecting soil resources from erosion would be 15% slope.

1

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Water-9	Riparian area condition will be noted as part of rangeland health assessments. Management of riparian areas that are not properly functioning will emphasize strategies identified in BLM technical references TR 1737-4 and TR 1737-6. Monitoring and evaluation will track progress toward meeting RHSs.	No	Funding, other workload priorities, and staffing constraints have limited the BLM's ability to monitor which, coupled with the impacts of the drought, has resulted in little progress towards PFC being made and insufficient on the ground data.	Partner with interested publics to better monitor and improve rangeland health. Make livestock grazing plans that have to flexibility to respond to changing riparian conditions, particularly in light of drought and climate change.
Water-10	To protect water quality, fire retardant drops by air tankers are prohibited within 200 feet of water.	Yes	See Fire and Fuels section.	
Water-11	Produced water will be disposed of in accordance with Onshore Oil and Gas Order No. 7.	Yes	See Oil and Gas.	
Water-12	The BLM may acquire mineral exploratory wells and drill holes that produce water. These acquired wells will be developed for multiple use purposes if they meet the criteria listed in Appendix I for water well conversion.	Yes	Minerals.	

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Water-13	BLM is a signatory to the Wyoming Governor's Drought Plan of 2003. This plan is directed at raising drought awareness, prediction, monitoring, and contingency planning.	Yes	BLM has never incorporated the monitoring procedures detailed in the Plan. Livestock grazing has not been modified to incorporate management systems that would better address the impacts of drought. Drought impacts reclamation of all surface disturbing activities.	See livestock grazing, riparian, and vegetation sections regarding the impacts of drought on adequacy of management actions and options for management change.

Table 4-5. Cave and Karst Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
C&K-1	No current objectives or decisions on cave and karst resources are included in the RMP. This resource is not addressed in the RMP and no inventory for cave and karst resources has been conducted.	No	No cave and karst inventory has been undertaken.	Work with partners to develop inventory.
C&K-2	Other important caves or cave passages identified in the future will be protected.	N/A		
C&K-3	AML projects will be wildlife (bat) friendly.	Yes		

4.1.2 Mineral and Energy Resources

Table 4-6. Locatable Minerals: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Loc-1	All federal lands within the resource area will be open to locatable mineral exploration and development unless specifically withdrawn or segregated from appropriation under the mining laws (see map 2). At the present time, approximately 1 percent of the federal mineral estate within the resource area is closed to locatable mineral exploration and development.	No	Important resource values are not protected such as visual, recreational, and cultural resources . Examples include Castle Gardens, areas near the NHTs and Continental Divide National Scenic Trail, near the Warm Springs Canyon Flume, regional historic trails and highways, and tribal sacred areas.	See OHV, Cultural Resources, Visual Resources, Wildlife and other areas.
Loc-2	The entire Green Mountain area will be open for locatable mineral exploration and development. Maintain opportunities for exploration and development of locatable mineral resources.	No	Riparian areas and water recharge areas are not adequately protected.	See water quality and riparian areas.
Loc-3	Locatable mineral exploration and development activities on Green Mountain which could cause unacceptably high adverse impacts to other significant resource values are restricted. 120 acres surrounding BLM and county campgrounds and picnic sites on Green Mountain are closed to locatable mineral exploration and development.	No	See above under water and soil quality.	Withdraw the conflict areas from locatable minerals or provide other restrictions.
Loc-4	A Plan of Operations is required for all locatable mineral exploration and development within 350 feet of Sparhawk Cabin.	No	Sparhawk should be withdrawn from mineral entry to fully protect it.	Withdraw the area from locatable mineral entry.
Loc-5	Crucial elk winter range is designated an ACEC.	Yes	See Wildlife and ACEC.	
Loc-6	The entire Beaver Creek area is open for locatable mineral exploration and development. Opportunities for exploration and development of locatable mineral resources are maintained.	No	Protections for greater sage-grouse may not be adequate. The area has potential for phosphate development could threaten visual resources.	See ACEC.

Table 4-6. Locatable Minerals: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Loc-7	Locatable mineral exploration and development in the Beaver Creek area where activities could cause unacceptably high adverse impacts to other significant resource values are restricted.	No	See Loc-6.	Identify areas of high resource values, utilizing tools such as the visual resources inventory, sage grouse locations and other current data to identify other significant resources. Jon needs to understand what is meant by restricted. We can have seasonal restrictions, or modify access, or whatever, but we cannot make areas off-limits unless we have a withdrawal.
Loc-8	The 1,710 acres surrounding Split Rock Landmark, Rocky Ridge, the Split Rock Interpretive Site, the Aspen Grove Site and an additional 280 acres proposed for withdrawal around Rocky Ridge are closed to locatable mineral exploration and development.	No	This action was only partially implemented.	See Cultural resources and the NHT sections.
Loc-9	A Plan of Operations is required for all locatable mineral exploration and development within 1/8 mile of the Gilespie Place Historic Site and Willies Handcart Site, Beaver Rim, and Ice Slough.	No	To totally protect these sites and trails, the areas should be protected by a minerals withdrawal.	See Cultural resources and the NHT sections.
Loc-10	The Lander Slope area is designated an ACEC. The entire management unit (MU) is open to locatable mineral exploration and development. A Plan of Operations is required for all locatable mineral exploration and development within areas of highly steep slopes and important wildlife habitat within the Lander Slope.	No	A minerals withdrawal would protect the visual resources, slopes vulnerable to erosion, and wildlife habitat.	See Lander Slope ACEC.
Loc-11	The Red Canyon ACEC is open to locatable mineral exploration and development. A Plan of Operations for all locatable mineral exploration and development operations within the highly visible steep slopes and areas with important wildlife habitat is required.	No	A minerals withdrawal would protect the visual resources, slopes vulnerable to erosion, and wildlife habitat.	See Red Canyon ACEC.
Loc-12	The South Pass area is open for locatable minerals exploration and development. There are 1,727 acres which will continue to be segregated from appropriation under the mining laws, as a designated ACEC.	No	Not enough area is withdrawn to protect the historic site.	See South Pass Historic Mining District ACEC.

Table 4-6. Locatable Minerals: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Loc-13	The Gas Hills management area is open to locatable mineral exploration and development and management should maximize opportunities for the exploration and development of locatable mineral resources. Few restrictions on locatable mineral exploration and development are placed and only in those areas where these activities could cause significant adverse impacts on other resources.	No	Management is not adequately protective of other resources.	Identify areas of conflict and consider surface occupancy restrictions or other protections.
Loc-14	80 acres around Castle Gardens will be segregated from appropriation under mining laws.	No	Area is not large enough to protect other resources.	See ACECs and Cultural sections.
Loc-15	830 acres are withdrawn around Devil's Gate landmark, Devil's Gate Interpretive Site, and fragile lands along the Oregon/Mormon Pioneer Trail.	No	Area is not large enough to protect other resources.	See ACECs and Cultural sections.
Loc-16	680 acres around Martin's Cove NRHP site are proposed for withdrawal from appropriations.	No	..The original withdrawal proposal for Martin's Cove was never done, but subsequent action by Congress for the Martin's Cove lease included withdrawal of 1240 acres.	Because of Congressional actions, there is no need for further withdrawals
Loc-17	Require a Plan of Operations for all locatable mineral exploration and developments along Oregon/Mormon Pioneer Trails.	No	Does not protect the visual and cultural resources associated with the Trails and their setting.	See ACECs, Cultural and NHTs sections. There are NO options here with respect to locatable minerals other than withdrawing the trail corridor.
Loc-18	Designate ACECs for significant sites and segments along Oregon/Mormon Pioneer Trails.	No.	Narrow width of existing ACEC does not protect the visual and cultural resources associated with the Trails and their setting.	See ACECs, Cultural and NHTs sections.
Loc-19	Close approximately 13,855 acres to locatable mineral exploration and development for the East Fork ACEC. Withdraw approximately 10,423 acres of mineral estate from mining laws for implementation of USFWS/ WGFD/BLM plan for elk crucial winter range. 3,432 acres have been withdrawn under mining laws and made available for elk crucial winter range.	Yes	See ACEC.	

Table 4-6. Locatable Minerals: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Loc-20	The entire Dubois Badlands area is open for exploration and development. A Plan of Operations for all locatable mineral exploration and development for the area within Dubois Badlands WSA is required.	No.	See ACEC.	
Loc-21	Whiskey Mountain Bighorn Sheep Winter Range is closed to locatable mineral exploration and development. The entire 6,630 acres of federal mineral estate in the Whiskey Mountain ACEC will be withdrawn from appropriation.	Yes	See ACEC.	
Loc-22	The entire Dubois management area will be open for locatable mineral exploration and development except for 190 acres in Warm Springs Canyon, which will be withdrawn from appropriation.	No	Decision never implemented	The RMP revisions could have language about the area still needing a mineral withdrawal. See Cultural resources section.

Table 4-7. Leasable Coal: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Coal-1	The coal screening process (as identified by 43 CFR 3420.1-4) has not been conducted in the planning area, and coal leasing has not been analyzed. If an application for a coal lease should be received in the future, an appropriate land use and environmental analysis, including the coal screening process, will be conducted to determine whether or not the coal areas applied for are acceptable for development and for leasing (43 CFR 3425). The RMP will be amended as necessary.	Yes		

Table 4-8. Leasable Geothermal: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Thermal-1	Although Geothermal resources were not analyzed in the RMP, and the RMP does not contain any provisions for geothermal leasing, the Programmatic Geothermal ROD amended the RMP. It did not identify any high potential in the planning area, which was confirmed in the Geothermal RFD. Consequently, geothermal energy development will not be analyzed in detail. If an application for a geothermal lease is received, an appropriate land use analysis and RMP amendment would be required.	Yes		..

Table 4-9. Leasable Oil and Gas: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
	Public lands will be made available for oil and gas leasing and development to the maximum extent possible, while giving due consideration to the protection of other significant resource values. The potential for the occurrence of oil and gas and the significance and sensitivity of other resource values present in the resource area were used as management tools to aid in the determination of detailed management prescriptions for each MU.	No	The 1987 RMP did not analyze or consider the extensive development that would occur in the planning area and in surrounding areas. Therefore, impacts to other resources such as sage-grouse were not considered.	Re-analyze conflicts to other resources while supporting the production of oil and gas.

Table 4-9. Leasable Oil and Gas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
O&G-2	Less than 1 percent of the slightly more than 2.7 million acres of federal mineral estate within the planning area are closed to leasing. All but approximately 12,000 acres of the open acreage will be managed under a management prescription that will allow for enhanced management of the oil and gas resources by being less restrictive of oil and gas development related to other surface resource values in known geologic structures and areas rated as having a high potential for the occurrence of oil and gas. This would be accomplished over the life of this plan as analyses are done to determine where the restrictions can be modified and still avoid significant impacts to other resources. In addition, as new information on the potential occurrence of oil and gas in any given area is obtained or new discoveries of oil and gas reserves are made, the potential rating for the area will be revised to reflect the new data. New leases issued in these areas will be issued under the management prescription for that new rating.	No	Additional limits on surface occupation are imposed by other resource constraints.	See O&G-1
O&G-3	Oil and gas leases issued within the resource area will be conditioned with stipulations to protect other important resource values. These restrictions will provide needed protection to other resources and at the same time allow for as much opportunity as possible to explore for and develop the oil and gas reserves within the resource area.	Yes	Responsive in most cases. Sensitive areas for wildlife, etc. may cause resource conflicts.	Plan to extend controlled surface use stipulations, time limiting stipulations, or conditions of approval through the maintenance and operation activity in highly sensitive habitats for BLM special status species, T&E, wildlife, and wild horses.
O&G-4	Geophysical activities associated with oil and gas exploration will generally be restricted in the same manner as other oil and gas exploration and development activities. Geophysical activities don't necessarily have the same impacts on surface resources as do other oil and gas exploration activities, but because of the wide variety of methods and the even wider variety of impacts associated with them, it will be impossible to predict all possible combinations of methods and resources potentially impacted and to develop a management prescription that will be detailed enough to cover all possibilities. If a particular method of geophysical exploration could be conducted within the constraints necessary to protect other resources, it would be allowed.	No	Not sufficiently protective of other resources. Geophysical exploration, particularly when repeatedly done, has potential for damaging other resources.	Consider imposing limits on geophysical exploration as necessary to protect other resources.

Table 4-9. Leasable Oil and Gas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
O&G-5	The entire Green Mountain area is open for oil and gas leasing with maximum management flexibility; enhanced management of surface resources is allowed while providing opportunities for exploration and development of the oil and gas reserves. New leases in high-potential areas will be conditioned with NSO and seasonal restrictions only when necessary to avoid significant adverse impact(s) to other resources. Lease restrictions may be waived if the lessee demonstrates that adverse impacts to other resources could be acceptably mitigated. NSO restrictions in areas of low and moderate potential are applied with seasonal closures to protect wildlife and soils.	No	See O&G-1	See O&G-1
O&G-6	The entire Beaver Creek area is open for oil and gas leasing with maximum management flexibility; enhanced management of surface resources is allowed while providing opportunities for exploration and development of the oil and gas reserves. New leases in high-potential areas will be conditioned with NSO and seasonal restrictions only when necessary to avoid significant adverse impact(s) to other resources. Lease restrictions may be waived if the lessee demonstrates that adverse impacts to other resources could be acceptably mitigated. NSO restrictions in areas of low and moderate potential will be applied with seasonal closures to protect wildlife and soils.	No	See O&G-1	See O&G-1
O&G-7	The Lander Slope is open to oil and gas leasing, but the majority of the area will have restrictions, including NSO and seasonal restriction to protect crucial wildlife habitat areas, to protect other resources when necessary. The entire unit has been determined to have low oil and gas potential. Sensitive visual resources, crucial wildlife habitats, and fragile areas are protected while allowing exploration and development of oil and gas resources in area.	Yes	See ACEC.	

Table 4-9. Leasable Oil and Gas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
O&G-8	The Red Canyon is open to oil and gas leasing with restrictions; new oil and gas leases will include NSO where necessary and seasonal restrictions to protect sensitive visual resources, crucial wildlife habitats, fragile areas, and the Red Canyon National Natural Landmark (NNL), while providing for opportunities to explore and develop oil and gas resources. The Red Canyon has been determined to have low oil and gas potential.	Yes	See ACEC.	
O&G-9	The South Pass area is open to oil and gas leasing with restrictions. New leases will include NSO restriction and wildlife seasonal closures when necessary.	Yes	See ACEC.	
O&G-10	The South Pass NRHP Mining District boundary will be redefined to exclude all areas devoid of significant historical resources after completion of historical resource inventories. Historical resources in the proposed NRHP District are protected.	No	Additional inventory and study determined that the boundaries should not be reduced but expanded.	See South Pass Historic Mining ACEC.
O&G-11	The entire Gas Hills area is open for oil and gas leasing with maximum management flexibility; enhanced management of surface resources is allowed while providing opportunities for exploration and development of the oil and gas reserves. New leases in high-potential areas will be conditioned with NSO and seasonal restrictions only when necessary to avoid significant adverse impact(s) to other resources. Lease restrictions may be waived if lessee demonstrates that adverse impacts to other resources could be acceptably mitigated. NSO restrictions in areas of low and moderate potential are applied with seasonal closures to protect wildlife and soils.	No	See O&G-1	See O&G-1
O&G-12	The entire East Fork area is designated as a no-lease area.	Yes		See ACEC.
O&G-13	The Dubois Badlands management area is open to oil and gas leasing with restrictions to protect significant surface resource values including natural and visual characteristics of Dubois Badlands, crucial wildlife habitats, and fragile areas. All new oil and gas leases have NSO stipulations. Exploration activities are seasonally restricted in important wildlife habitat areas.	Yes		See ACEC

Table 4-9. Leasable Oil and Gas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
O&G-14	6,630 acres on Whiskey Mountain are closed to oil and gas leasing unless drainage of reserves occurs on adjacent private or state lands. If leasing occurs, then they will include NSO stipulations with no exceptions to NSO restriction. Leasing must be consistent with cooperative management efforts.	Yes		Whiskey Mountain Area will need analysis to see if area of no leasing could be expanded based on acquisitions of lands and expansion of Big Horn Sheep use areas.
O&G-15	The entire Dubois management area is open for oil and gas leasing with maximum management flexibility; enhanced management of surface resources is allowed while providing opportunities for exploration and development of the oil and gas reserves. New leases in high-potential areas will be conditioned with NSO and seasonal restrictions only when necessary to avoid significant adverse impact(s) on other resources. Lease restrictions may be waived if lessee demonstrates that adverse impacts to other resources could be acceptably mitigated. NSO restrictions in areas of low and moderate potential are applied with seasonal closures to protect wildlife and soils.	Yes		

Table 4-10. Leasable Other Solids: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Lease-other-1	Surface-disturbing activities associated with all types of minerals and geophysical exploration and development and are subject to application of the Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing Activities.	No	See Soils and Vegetation-reclamation.	See O&G-1
Lease-other-2	The Beaver Creek area is open for exploration and development of phosphate reserves subject to minor constraints. All exploration permits and leases issued within the unit will include NSO stipulations when necessary to protect water quality, fisheries, riparian area, sage grouse leks, steep slopes, T&E species, important scenic areas, and significant cultural sites. In addition, seasonal restrictions will be applied to prospecting and exploration as needed to protect crucial wildlife habitat areas.	No	Some potential for resource conflict with phosphate leasing may occur.	Review protections for visual resources and ACEC. See ACEC.
Lease-other-3	Phosphate prospecting, exploration, and leasing are allowed on the Lander Slope subject to major constraints.. Phosphate activities on the Lander Slope are restricted to prevent significant adverse impacts to scenic values and important wildlife habitat. In some cases, these restrictions may impede or prevent the economic recovery of the phosphate.	No	Some potential for resource conflict with phosphate leasing may occur.	Review protections for visual resources and ACEC. See ACEC.
Lease-other-4	The NNL is closed to phosphate leasing and the crucial elk winter range is open to phosphate prospecting and leasing with major constraints. The phosphate resources within the unit have low development potential.	No	Some potential for resource conflict with phosphate leasing may occur.	Review protections for visual resources and ACEC. See ACEC.

Table 4-11. Mineral Materials (Salables): Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Salable-1	Exploration and development of other minerals, such as sand and gravel, building stone, and other common-variety mineral materials will be provided on a demand basis and in consistency with the limitations and restrictions imposed on oil and gas, locatable minerals, and phosphate exploration and development within the resource area.	Yes	Areas suitable for mineral materials sales should be identified so as to make the process more efficient and improve resource protection.	Identify sale areas and make known to the public. Reduce process associated with mineral material sales for the convenience of the public and the efficiency of the BLM.
Salable-2	Sales and extraction of mineral materials from existing mineral sites will be allowed. Establishment of new mineral sites will be evaluated individually.	Yes	See record above.	See record above

4.1.3 Fire and Fuels Management

Table 4-12. Unplanned/Wildland Fire: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire-1	All wildland fire actions will comply with the 2001 Federal Wildland Fire Management Policy (Update of 1995 Federal Fire Policy) and the 2003 Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy as guiding principles and policy in the Northern Wyoming Fire Zone.	Yes		
Fire-2	A FMP (FMP 2004 update) is on record to identify fire suppression strategies within all FMU within the planning area. The FMP contains criteria for protecting high resource values, such as significant cultural resources, crucial winter range for big game, high priority watersheds, and WUI areas. The FMP also identifies resources that would benefit or be enhanced by wildfire. The FMP includes operational aspects of implementing suppression strategies. A wildland fire situation analysis will be conducted whenever the fire escapes initial attack to establish objectives and constraints for the management of the fire. A Wildland Fire Implementation Plan will be completed when a fire is determined to be a Wildland Fire Use candidate fire.	Yes		
CO-008	Firefighter and public safety is the highest priority in every fire management activity.	Yes		
Fire-3	Fire suppression efforts are concentrated in areas containing high resource and/or human values and in areas with intermingled landownership patterns.	Yes		

Table 4-12. Unplanned/Wildland Fire: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire-4	The Northern Wyoming Fire Zone provides for an AMR on all wildland fires occurring in the Lander planning area. Responses include full to limited suppression, monitoring, and/or wildland fire use. Responses to each wildland fire will be initiated in a timely manner and will be based upon established fire management direction as documented in the Northern Wyoming Zone FMP, which is tiered onto this RMP. The use of AMR will allow land managers to tailor preplanned wildland fire responses to meet objectives established in this RMP and associated implementation plans.	Yes		
Fire-5	Limited use of bulldozers and graders on wildfires, and use Minimum Impact Suppression Tactics when possible.	Yes		
Green Mountain FMU	Fire suppression personnel will avoid aerial or ground application of fire chemicals within 300 feet of waterways and will avoid dipping from rivers or lakes with a helicopter bucket containing residual fire chemicals. An adjacent reload site will be established, and fire chemicals will be managed with portable tanks. Deviation from these limits is allowed when life or property is threatened and the use of fire chemicals can be reasonably expected to alleviate the threat.	Yes		
Fire-7	Where aquatic T&E species or their habitats are potentially affected by aerial application of retardant or foam, the following additional procedures apply: • As soon as practical, determine whether the aerial application has caused any adverse effect on the T&E species or their habitat. • When aerial application of fire chemicals within 300 feet of a waterway have been applied, the unit administrator will determine whether there have been any adverse effects to the T&E species. If an adverse effect is determined, the agency must consult with the USFWS.	Yes		

Table 4-12. Unplanned/Wildland Fire: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire 7.5	The Lander planning area (which is part of the Southern Wyoming Fire Zone) will conduct all wildland fire actions in compliance with the 2001 Federal Wildland Fire Management Policy (2001 Federal Fire Policy).	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Fire-8	Full suppression of fires on Green Mountain will be employed as quickly as possible with as little surface disturbance as possible, with limited or restricted use of heavy equipment, and with an aggressive initial attack. Prescribed fire will be utilized to enhance range and wildlife habitat.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Fire-9	Within the Sweetwater Valley FMU, AMR would most likely result in full suppression of fires with limited use of bulldozers and graders on wildfires. Use Minimum Impact Suppression Tactics when possible.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Fire-10	Within the Lander Slope FMU, AMR would most likely result in full suppression of fires with limited use of bulldozers and graders on wildfires. Use Minimum Impact Suppression Tactics when possible.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Lander Slope FMU	Within the Dubois FMU, AMR would most likely result in full suppression of fires with limited use of bulldozers and graders on wildfires. Use Minimum Impact Suppression Tactics when possible.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Fire-12.5	Fire management in the Gas Hills area will protect private and state lands. Management is designed to reduce suppression costs and environmental damage due to heavy equipment in limited suppression areas.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	
Fire-13	Gas Hills: Zone 1: Full suppression with limited use of heavy equipment. Zone 2: Limited suppression. Zone 3: Full suppression with limited use of heavy equipment. No heavy equipment is used in Sweetwater Rocks Area.	Yes	Note: Fire management policy must follow the IM for management of WSAs.	

Table 4-12. Unplanned/Wildland Fire: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire-14	Wildland fire and fuels practices are managed to promote, maintain, and enhance resources. Wildland fire is allowed to function in its ecological role when appropriate for the site and situation, while providing for firefighter and public safety as well as local communities and economic interests.	Yes		
Fire-15	All wildland fire actions will comply with the 2001 Federal Wildland Fire Management Policy (Update of 1995 Federal Fire Policy) and the 2003 Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy as guiding principles and policy in the Northern Wyoming Fire Zone.	Yes		

Table 4-13. Planned/Prescribed Fire: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire-16	As appropriate, prescribed burns and non-fire tools, such as mechanical and chemical treatments, will be used achieve a number of fuels management goals, such as improvements to wildlife habitats, hazardous fuels reduction, and overall ecological health. All vegetation treatment methods will be used to achieve management objectives such as those for AMPs and HMPs. Due to potential erosion problems on steep slopes, fire management decisions state "Full suppression with limited or restricted use of heavy equipment" will be utilized during fires." Prescribed burns will also be utilized. There is nothing about "mechanical and chemical treatments" in the ROD.	Yes		Implemented and ongoing with coordinated rangeland mowing with treatments such as those within the Sweetwater Valley FMU, Copper Mountain FMU, Lander Slope FMU, Dubois FMU, and Green Mountian FMU to benefit wildlife habitat,increase herbaceous production, and achieve hazardous fuels loading.
Fire-18	All fire and non-fire vegetation management proposals will be considered on a case-by-case basis to ensure environmental integrity and consistency with the multiple resource objectives and activity plans.	Yes		
Fire-19	Prescribed burn planning will include obtaining proper smoke permits from the Wyoming DEQ in compliance with the Wyoming Ambient Air Quality Standards.	Yes		
Fire-20	Fuels management treatments within the WUI are the highest planned/prescribed fire priority for implementation with the planning area.	Yes		

Table 4-14. Stabilization and Rehabilitation: Management Opportunities

Planning Decision Number	Planning Decision	Duplication with Other Resource Areas	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fire-21	Reclamation and soil stabilization practices are applied to burned areas on a case-by-case basis. Additionally, livestock grazing will be controlled on burned areas on a case-by-case basis through the use of such methods as fencing or resting from livestock grazing.		No	Additional management needed as reclamation has not been uniformly successful.	Implement planning area wide reclamation policy and standards.

4.1.4 Biological Resources

Table 4-15. Vegetation – Forests, Woodlands, and Forest Products: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Forest-1	No current objectives or decisions on forest/woodland habitat are in the RMP. The resource was not addressed in the current RMP as an independent resource, but was included as part of the existing environment in the EIS.	No	The drought and pine beetle infestation need to be addressed. The absence of any demand for local timber requires that management outside of timber sales will be required.	Partner with other land managers in planning for opportunities to improve health of the forest. Determine if there are stewardship opportunities available to address tree mortality.
Forest-2	Hand cutting and mechanical methods are used to reduce the extent and density of juniper and limber pine woodlands. Where appropriate, use prescribed burning to reduce the density of juniper and limber pine in sagebrush steppe and mountain shrub habitat.	No	There are not enough resources to address the forest problems with small efforts. A programmatic approach is needed.	Continue work on limber pine woodlands within the Green Mountain, Copper Mountain, Lander Slope and Twin Creek areas to removed diseased and dying trees with goal of improving woodland health, maintaining sagebrush steppe habitat and reducing hazardous fuels.
Forest-3	Identify and preserve old-growth stands of juniper and limber pine.	No	Funding and staff limitations have prevented this from being implemented.	Identify opportunities to do a complete inventory including old-growth.
Forest-4	Small timber sales are offered in Dubois on a demand basis to improve the timber conditions on small areas by regenerating harvested areas.	No	Fails to address both the absence of demand in sufficient amount to make improvements in forest health and does not address the wide-spread death of the local forest.	Work with partners including the community of Dubois and the USFS Shoshone National Forest to develop forest wide approaches for addressing beetle and drought kill trees.
Forest 5	Small timber sales in South Pass are offered where appropriate to help maintain wildlife cover and to protect watersheds. Timber cuts are limited to harvesting dead and dying trees to improve stand regeneration.	No	Cutting in South Pass for firewood needs to be controlled so that resource objectives are protected.	Work with stakeholders to develop appropriate cutting areas to satisfy local demand for firewood and Christmas trees while improving resource conditions.

Table 4-15. Vegetation – Forest, Woodlands, and Forest Products: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Forest-5	In the South Pass area, harvest aspen stands in clear cuts or use prescribed fire to remove competing conifers; use woven wire fencing or brush to protect regenerating stands until aspen are 6 – 8 feet tall. Use artificial regeneration if natural regeneration is not successful.	Yes	The 1987 RMP appropriately addressed South Pass aspen. However, there has been little interest in aspen harvest and no funding to protect stands. New opportunities to protect aspen need to be addressed.	Not implemented due to lack of demand and BLM personnel to implement. Updated forest stand inventory needed. Partnership and funding opportunities need to be pursued to address aspen health.
Forest-6	Sales of up to 10 million board feet (MMBF) are available on the Lander Slope, followed by no activity for 10 years during which logging roads are closed. Irregularly shaped clear cuts of up to 25 acres are available, with only partial cutting allowed within 100 feet of perennial streams.	Yes	The 1987 RMP appropriately addressed South Pass aspen. However, there has been little interest in aspen harvest and no funding to protect stands. New opportunities to protect aspen need to be addressed.	Not implemented due to lack of demand and BLM personnel to implement. Updated forest stand inventory needed. Partnership and funding opportunities need to be pursued to address aspen health.
Forest-7	No harvesting with conventional logging equipment is allowed in the Lander Slope area on slopes greater than 45 percent. A ratio of 40-60 percent cover to forest ratio is maintained for optimum elk habitat. Piling and burning of unusable debris is required to prepare harvested sites for regeneration. Artificial regeneration is used if natural regeneration is unsuccessful.	Yes	This management is appropriate (with perhaps a reconsideration of allowable slope of less than 45% to bring more n line with other surface disturbing activities. There has been no interest in commercial logging and little funding for forest health treatments. There has been no staff time or funding for artificial regeneration.	Treatment is undertaken as funding allows.
Forest-8	200 MMBF of saw timber products is authorized on Green Mountain. 0.5 MMBF is authorized for minor forest products. Green Mountain is managed on a 17 compartment basis and rotated every 5-6 years.	No	The commodity approach to forest health (i.e., relying on commercial sales of forest products to improve forest health) has not been successful because of lack of demand.	Partnership and funding opportunities need to be pursued to address aspen health.

Table 4-15. Vegetation – Forest, Woodlands, and Forest Products: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Forest-9	Prescribed burning or other techniques are utilized on Green Mountain following sale. Each adjacent compartment is segregated in time to aid forest progression to move to an uneven-aged condition. A 40-60 percent cover to forage ratio is maintained within each compartment.	No	Lack of demand for sawtimber or wood products and funding. Because of steep slopes and the risk of accelerated erosion, harvesting on Green Mountain is expensive. Not fully implemented due to lack of local and regional demand for timber sales. Minor forest product sales are active on Green Mountain.	Minor forest treatments are undertaken but there has not been staff time or budget to do the full treatment needed.
Forest-10	Clearcut blocks up to 25 acres with irregular shapes to achieve an edge effect are used on Green Mountain. There are no clearcuts within 100 feet of perennial streams. Conventional logging equipment is not allowed on slopes greater than 45 percent.	No	See Record 9. Not fully implemented as intended in the management decision due to lack of local and regional demand for timber sales. Implemented on a forest health treatment basis, but not specifically according to compartment management.	
Forest-11	On Green Mountain, clear cut aspen stands or use prescribed fire to remove competing conifers. Use woven wire fencing or brush to protect regenerating stands until aspen are 6–8 feet tall. Use artificial regeneration if natural is not successful.	No	See Record 9 Not fully implemented as intended in the management decision due to lack of local and regional demand for timber sales. Implemented on a forest health treatment basis, but not specifically according to compartment management.	See Record 9.
Forest-12	Piling and burning of unusable debris is required on Green Mountain to prepare harvested sites for regeneration. Artificial regeneration is used if natural regeneration is unsuccessful. Pre-commercial or commercial thinning in younger stands are considered as required.	Yes	Currently being successfully implemented.	Continue with projects.
Forest-13	Utilize timber sales and prescribed burning in Red Canyon to improve wildlife habitat.	No	Currently being implemented on a forest health basis.	Continue with projects.

Table 4-15. Vegetation – Forest, Woodlands, and Forest Products: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Forest-14	Aspen woodlands in Red Canyon are managed to create healthy wildlife habitat and alter landscape-level wildfire behavior. Harvest aspens in partial or clearcuts up to 5 acres. Conifer stand harvesting is limited to partial cutting to remove dead and dying trees.	No	Not implemented due to lack of local and regional demand for timber sales and lack of BLM forestry personnel. Updated forest stand inventory needed.	Undertake inventory as funding allows.
Forest-15	Some artificial regeneration is employed in Red Canyon if natural regeneration is unsuccessful.	No	Not implemented due to lack of local and regional demand for timber sales and BLM forestry personnel. Updated forest stand inventory needed.	Undertake inventory as funding allows.
Forest-16	Timber sales are allowed in the South Pass area where appropriate to help maintain wildlife cover and to protect watersheds. Small timber sales are allowed to local cutters.	Yes		
Forest-17	Aspen woodlands are managed in the South Pass area to create healthy wildlife habitat and to alter landscape-level wildfire behavior. Harvest aspens in partial or clearcuts up to 5 acres. Conifer stand harvesting is limited to partial cutting to remove dead and dying trees.	Yes	But see record 9 above.	
Forest-18	Some artificial regeneration is employed in the South Pass area if natural regeneration is unsuccessful.	No	Not implemented due to lack of local and regional demand for timber sales and lack of BLM forestry personnel. Updated forest stand inventory needed.	Undertake inventory as funding allows.
Forest-19	Surface-disturbing and disruptive activities associated with all types of forest management will be subject to appropriate mitigation developed through use of the mitigation guidelines.	Yes		Wyoming Standard Surface Disturbing Guidelines need to be applied consistently to Forest Management Activities.
Forest-20	No current objectives or decisions on forest/woodland habitat are in the RMP. The resource was not addressed in the current RMP as an independent resource, but was included as part of the existing environment in the EIS.	Yes	implemented.	

Table 4-16. Vegetation – Grasslands and Shrublands: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grass-1	Vegetation is addressed in the RMP as a subpart of livestock grazing and by the SHR.	No	We have addressed vegetative objectives and goals in AMPs, Rangeland Management Agreements and other cooperative agreements. However, very few of the allotments have been identified as moving from I to C or M categories. Little progress towards PFC has been identified and even allotments with AMPs are not meeting SHR.	The RMP is re-analyzing vegetation in this RMP and needs to address how management moving forward will be more successful than in the period since the 1987 RMP was adopted..
Grass 2	Vegetative communities within the planning area were the Green Mountain.(1979) and Gas Hills (1983) inventories. They determined frequency, density and species composition as outlined in the NRCS range site guides.	Yes	Data is antiquated.	Current inventories are dated. A new Ecological Site Inventory or comparable inventory needs to be completed for the planning area.
Grass 3	Vegetative communities are managed in accordance with SHR under standard #3 & 4.	Yes	About 1/3 of our allotments have been analyzed under the SHR.	Complete large blocks of rangeland by managing and assessing on a watershed or landscape basis.
Grass 4	Crucial wildlife habitats have special vegetation management prescriptions to benefit individual species of wildlife.	No	Data is not current.	Complete desired plant community prescriptions and implement vegetative treatments on these crucial wildlife habitat areas to attain desired outcomes.
Grass 5	Manage vegetation with treatments to attain healthy rangeland ecosystems that meet SHR.	Yes	We have started implementing projects in areas under the "pilot program" approach.	Need to implement vegetative treatments throughout the planning area to restore diversity of perennial plant communities.

Table 4-17. Riparian/Wetland Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Rip-1	Riparian areas are managed as part of livestock grazing. Standard 2 of the Wyoming SHR addresses riparian condition and improvement.	No	Progress towards achieving Standard 2 is slow and, in some cases, riparian/wetland degradation is occurring.	Review S&Gs to determine success. Develop cooperative partnerships to address riparian health. In consideration of drought and climate change, approach livestock grazing management to improve riparian health.
Rip-2	The condition of uncommon and important wildlife habitats are maintained or improved through vegetative manipulations or other habitat improvement projects, and application of the Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing Activities.	In part.	Since surface disturbance guidelines have been established and with improvements as a result of Wyoming storm water discharge permitting, riparian/wetland degradation has been lessened. More work needs to be done, particularly in light of the drought and difficulty of reclamation.	Make surface disturbance and reclamation an important priority in all land use activities. Partner with stakeholders to improve education and public understanding.
Rip-3	Surface disturbing activities within 500 feet of surface water and/or riparian areas, aquatic habitats and 100 year floodplains are prohibited.	Mostly	Does not apply to mineral activities under the 1872 Mineral Act.	Consider withdrawing riparian/wetland areas from mineral activities.
Rip-4	Access (including 4-wheel drive, snowmobile, horseback, and pedestrian access) will be limited in areas of crucial habitats, sensitive species habitats and wetland/riparian habitat. The type of limitation will depend on the kind of resource value being protected.	No	Management has proven inadequate. Travel management has not been fully signed and enforcement has been low, spotty, or more recently, non-existent. Demand for "play areas" has been expressed, as well as "solitude" or non-motorized access.	See Travel Management section. The public needs to be educated as to the rules regarding protection of these important habitats and the rules need to be enforced. BLM lacks adequate staffing to fully implement this, so cooperative actions with other agencies are important.
Rip-5	No new permanent facilities are permitted in floodplains, riparian areas, or wetlands, except to benefit watershed health or vegetation. Linear watercourse crossings are considered on a case-by-case basis.	Yes		

Table 4-17. Riparian/Wetland Resources: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Rip-6	Wetlands are managed to maintain and improve habitat through the implementation of changes in livestock grazing systems.	No	Progress towards achieving Standard 2 is slow and, in some cases, riparian/wetland degradation is occurring.	Review S&Gs to determine success. Develop cooperative partnerships to address riparian health. In consideration of drought and climate change, approach livestock grazing management to improve riparian health.
Rip-7	OHV and recreational use is managed to maintain and improve riparian/wetland habitat.	No	See Record 4.	See Travel Management Section.

Table 4-18. Invasive Species: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Weed-1	Noxious weeds and other undesirable vegetation will be controlled in conjunction with local counties; the USDA - APHIS; and other agencies and affected interests, consistent with: 1985 Northwest Area Noxious Weed Control Program EIS and its 1987 Supplement and the ROD (BLM, 1985; BLM, 1986); the ROD for the Final EIS Addressing Vegetation Treatment on BLM Lands in Thirteen Western States (BLM 1991); and the Vegetation Treatments Using Herbicides ON BLM Lands in Seveteen western States Programmatic FEIS and it's ROD (BLM, 2008) .	Yes		
Weed-2	Control of noxious weeds may include manual, mechanical, biological, cultural, or chemical methods. If herbicides are proposed for use, those that are effective on the target weed species and that have minimum toxicity to wildlife and fish, will be selected. As per BLM policy, via BLM Manual direction, buffer zones will be provided along streams, rivers, lakes, and riparian areas, including riparian areas along ephemeral and intermittent streams.	Yes	The buffer strip provisions of the BLM manual are in addition to any other herbicide label precautions.	

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Weed-3	Also, as per current BLM Manual direction, treatments will avoid raptor and upland game bird nesting seasons and other times when loss of cover or disturbance by equipment could be detrimental.	Yes	The buffer strip povisions of the BLM manual are in addtion to any other herbicide label precautions.	
Weed-4	Projects that may affect threatened or endangered plants or animals will be modified to protect the presence of these species. In such cases, the BLM will consult with the USFWS as required by the ESA.	Yes		

1

Table 4-19. Fish: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fish-1	Routine fish habitat improvement projects are developed and maintained in the Green Mountain area after appropriate review and where consistent with capabilities and priorities. Selected tree and shrub sites are manipulated to improve beaver, fisheries and other species habitat.	No	Management decision is adequate but not well funded. Livestock grazing has negatively impacted fisheries and fish habitat. Old surface disturbance has degraded fisheries.	Incorporate riparian/wetlands considerations into livestock grazing management and all surface disturbing activities.
Fish-2	The Green Mountain area is a moderate priority area for development of aquatic (fisheries, beaver, riparian) HMPs. The vigor of, expanding the size of, and reestablishing aspen/willow stands to stabilize forage and material base for beavers and dam complexes is prioritized.	No	Historic mineral activities, livestock grazing, and OHV use have contributed to degradation of aquatic habitat. Funding and staff limits have reduced the habitat treatments undertaken.	Incorporate riparian/wetlands considerations into livestock grazing management and all surface disturbing activities.
Fish-3	Special management projects and actions are undertaken in the Beaver Creek area to improve fisheries and associated riparian habitat in Upper Sweetwater River and Beaver Creek drainages.	No	Some watershed improvement has been achieved, but there are many areas where fisheries and riparian/wetlands are not improved.	Incorporate riparian/wetlands considerations into livestock grazing management and all surface disturbing activities. Consider watershed wide implementation of improvement projects.
Fish-4	Routine fish habitat improvement projects are developed and maintained in the Beaver Creek area after appropriate review and where consistent with capabilities and priorities.	No	See Record 3 and 4.	See Record 3 and 4.
Fish-5	Routine fish and wildlife habitat improvement projects are developed and maintained on the Lander Slope after appropriate review and where consistent with capabilities and priorities.	No	See Record 3 and 4.	See Record 3 and 4.
Fish-6	BLM will initiate prescribed burns and other practices to rehabilitate fisheries and riparian habitat on the Lander Slope.	Yes	Management decision is responsive although funding and staff time have not been adequate to fully implement.	Cooperate with partners such as Trout Unlimited, the Popo Agie Conservation District, and angler groups for additional funding and volunteer programs.
Fish-7	Routine fish improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities in Red Canyon.	Yes	Management decision is responsive although funding and staff time have not been adequate to fully implement.	Cooperate with partners such as The Nature Conservancy, Trout Unlimited, the Popo Agie Conservation District, and angler groups for additional funding and volunteer programs.

Table 4-19. Fish: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Fish-8	Prescribed burns and other practices to rehabilitate elk, mule deer, moose, bighorn sheep, fisheries, and riparian habitat are used in Red Canyon in limited ways.	Yes	See record above.	
Fish-9	In-stream structures and fencing in Barret Creek drainage will be used to improve fisheries and riparian habitat.	Yes	The need for fencing has changed due to the implementation of intensive in grazing management in this area.	
Fish-10	Aquatic habitat management for fisheries, beaver, and riparian species use is improved in the South Pass area. Routine fish habitat improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities.	Partially	Habitat improvement has been hampered in areas due to permitted land uses. Project implementation has been limited due to funding and staffing limitations.	Cooperate with partners such as Trout Unlimited, the appropriate Conservation District, the WGFD, the Wyoming State Parks and Cultural Resources Department, and angler groups for additional funding and volunteer programs.
Fish-11	Routine fish and wildlife habitat improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities in the Gas Hills, Dubois, and Dubois Badlands areas.	Yes		

Table 4-20. Wildlife: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Wildlife-1	Routine wildlife habitat improvement projects are developed and maintained in the Green Mountain area after appropriate review and where consistent with capabilities and priorities.	Yes	Management decision is responsive to issues but staff funding and time have been limited.	Partner with other stakeholders to increase ability to improve habitat.
Wildlife-2	Major habitat improvement objectives for elk/mule deer are incorporated into comprehensive timber management plan and grazing AMPs in the Green Mountain area.	No	Wildlife is considered in permitted activity but habitat improvement is not the primary focus. Timber is not being managed on Green Mountain, except for small vegetation treatment projects, due to lack of demand. Livestock grazing does not incorporate major habitat improvement.	Partner with other entities to manage the timber on Green Mountain. More vigorously manage livestock grazing on Green Mountain for habitat benefit.
Wildlife-3	Promote aspen and willow regeneration to create diversity in size, age-class, and edge-effect in conifer stands while maintaining elk cover requirements in the Green Mountain area.	No	Wildlife is considered in permitted activity but habitat improvement is not the primary focus. Timber is not being managed on Green Mountain, except for small vegetation treatment projects, due to lack of demand. Livestock grazing does not incorporate major habitat improvement.	Partner with other entities to manage the timber on Green Mountain. More vigorously manage livestock grazing on Green Mountain for habitat benefit.
Wildlife-4	Green Mountain MU is a moderate priority area for development of aquatic (fisheries, beaver, riparian) HMP. The vigor of, expanding the size of, and reestablishing aspen/willow stands to stabilize forage and material base for beavers and dam complexes is prioritized.	No	Management decision does not address the loss of beaver and fisheries habitat. Treatment to improve aspen/willow stands is not undertaken on an adequate basis.	Partner with other stakeholders to increase ability to improve habitat.
Wildlife-5	Routine wildlife habitat improvement projects are developed and maintained in the Beaver Creek area after appropriate review and where consistent with capabilities and priorities.	Yes	Management decision is responsive to issues but staff funding and time have been limited.	Partner with other stakeholders to increase ability to improve habitat.
Wildlife-6	Routine wildlife habitat improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities on the Lander Slope.	Yes	Management decision is responsive to issues but staff funding and time have been limited.	Partner with other stakeholders to increase ability to improve habitat.

Table 4-20. Wildlife: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Wildlife-7	The Lander Slope area is a high-priority area for development of a terrestrial HMP, with elk as the primary species. BLM will initiate prescribed burns and other cultural practices to rehabilitate elk, mule deer, moose, bighorn sheep, and riparian habitat.	Yes	Management decision is responsive to issues but staff funding and time have been limited.	Partner with other stakeholders to increase ability to improve habitat.
Wildlife-8	Routine wildlife habitat improvement projects are developed and maintained in Red Canyon after appropriate review and where consistent with capabilities and priorities.	Yes	Management decision is responsive to issues but staff funding and time have been limited.	Partner with other stakeholders to increase ability to improve habitat.
Wildlife-9	Red Canyon is a high-priority area for development of a terrestrial HMP with elk as the primary species. The MU is managed to continue to make available 500 AUMs of forage for elk.	No	Red Canyon has more than 500 wintering elk.	Consider whether there is adequate forage and larger number of AUMs should be allocated for elk.
Wildlife-10	Prescribed burns and other practices to rehabilitate elk, mule deer, moose, bighorn sheep, and riparian habitat are used in limited ways in Red Canyon.	Yes		
Wildlife-11	Aquatic habitat management for beaver and riparian use is improved in the South Pass area. Routine wildlife habitat improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities.	No	Wildlife is considered in permitted activity but habitat improvement is not the primary focus. Only small vegetation treatments are undertaken due to lack of funding. Livestock grazing does not incorporate major habitat improvement.	Continue to expand opportunities for habitat management through vegetation treatment.
Wildlife-12	In conjunction with interested publics and partners, develop a workable bighorn sheep reintroduction program for Sweetwater Rocks.	No	Many private landowners objected to reintroduction.	Manage habitat so that reintroduction could be possible in the future with public support and funding.
Wildlife-13	Routine fish and wildlife habitat improvement projects are developed and maintained after appropriate review and where consistent with capabilities and priorities in the Gas Hills, Dubois, and Dubois Badlands areas.	No	Wildlife is considered in permitted activity but habitat improvement is not the primary focus. Only small vegetation treatments are undertaken due to lack of funding. Livestock grazing does not incorporate major habitat improvement.	Continue to expand opportunities for habitat management through vegetation treatment. Address increasing risk to habitat from drought or beetle killed trees.
Wildlife-14	Continue with cooperative habitat improvement projects to improve elk habitat in the East Fork area. Prescribed burning, seeding, pitting, herbicide treatment, and water development are utilized for the benefit of the elk.	Yes		

Table 4-20. Wildlife: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Wildlife-15	Projects initiated in the East Fork area will be designed to improve habitat for wintering elk.	Yes		
Wildlife-16	Use all habitat and animal management techniques and improvement projects for direct/indirect benefit of Whiskey Mountain bighorn sheep population and habitat.	Yes		
Wildlife-17	Any projects used to improve habitat for other species (besides bighorn sheep) in the Whiskey Mountain area will reduce the competition of these animals with bighorns or to not cuase significant negative effects on bighorn sheep.	Yes		
Wildlife-18	Activities and surface use will be prohibited within 0.25 mile of Greater sage-grouse strutting grounds (leks) or as appropriate unless an exception is authorized.	No	Science now shows that the .25 mile distance is inadequate and that entire lifecycle habitat must be protected.	Work cooperatively to protect sage-grouse and their habitat in intact and functioning condition to prevent listing as a T&E species. BLM is determining prescriptions that will be adopted to protect sage-grouse and their habitats..
Wildlife-19	A seasonal restriction will be applied to surface-disturbing and disruptive activities and land uses during nesting/brooding periods within a two-mile radius of active Greater sage-grouse leks or as appropriate on a case-by-case basis.	No	Science now shows that the 2 mile radius is inadequate. Seasonal restrictions may be inadequate and generally do not apply to production activities, just exploration and drilling activities.	Work cooperatively to protect sage-grouse and their habitat in intact and functioning condition to prevent listing as a T&E species. . BLM is determining prescriptions that will be adopted to protect sage-grouse and their habitats..
Wildlife-20	BLM will consult with the WGFD before waiving, allowing exceptions to, or modifying wildlife-related land use restrictions and mitigations.	Yes		
Wildlife-21	Seasonal restrictions will be applied as appropriate to surface-disturbing and disruptive activities and land uses on big game crucial winter range, elk winter range, big game parturition areas, sage-grouse breeding and nesting habitat, and raptor nesting areas.	No	Current restrictions protect habitat only during the seasonal period and do not ensure habitat is available the following year. Research has shown that current protection distances for sage-grouse habitats are inadequate and need to be increased	Develop habitat loss thresholds in important and limited habitats. Adopt recommendations for increasing sage-grouse protection distances.
Wildlife-22	Wildlife escape ramps would be installed in all water troughs to prevent birds and small mammals from drowning.	Yes		Existing projects needed to be checked more frequently and escape ramps repaired or replaced as needed.

Table 4-20. Wildlife: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Wildlife-23	No planning decisions address protecting wildlife migration routes.	No	Current plan did not address wildlife migration routes.	Work with WGFD to identify migration routes and develop protection measures. Include seasonal migration as well as "historic migration corridors."

Table 4-21. Special Status Species – Plants: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
SSP-1	A management plan is implemented to identify, protect, and maintain the habitat and population of rare plants, the Beaver Rim cushion plant (*Phlox pungens)* and limber pine/bluebunch wheatgrass (*Pinus flexilis/Agropyron spicatum*) communities in the Beaver Creek area.	Yes	Consider making more of the habitat protected from surface or mineral entry.	
SSP-2	A management plan is implemented to identify, protect, and maintain the habitat of Barneby's clover (*Trifolium barnebyi*) in Red Canyon.	Yes	A management plan was not required because the lands in Red Canyon on which Barneby's clover habitat has been identified are owned by The Nature Conservancy and managed to protect the sensitive species.	
SSP-3	A management plan is implemented to identify, protect, and maintain the habitat and population of Meadow pussytoes (*Antennaria arcuata*), Williams rock cress (*Arabis Williamsii*), and Small rock cress (*Arabis pusilla*) in the South Pass area.	No	Inventory determined that the species are not found in the South Pass area.	
SSP-4	Conservation Measures and BMPs as described in USFWS Amended Consultation Memorandum ES-61411/W.02/WY9485 for the management of the Desert Yellowhead *(Yermo xanthocephalus)* and its critical habitat are incorporated by reference, per BLM Instruction Memorandum WY-2005-052.	Yes		Close critical habitat to mineral leasing, ROWs, and vehicle traffic. Maintain current locatable mineral withdrawal.
SSP-5	Conservation Measures and BMPs described in USFWS Biological Opinion Memorandum ES-61411/W.02/WY06F0205b for the management of the Ute Ladies'-tresses orchid are incorporated by reference, per BLM Instruction Memorandum WY-2007-020.	Yes		

Table 4-22. Special Status Species – Fish: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives or decisions for special status fish species are included in the RMP; however, all management decisions relating to fish species, and many management actions relating to water quality, riparian and wetland resources, livestock grazing, fire and fuels management, locatable mineral resources, and management of invasive/non-native species, would also apply to or have an impact on special status fish species.	No	Special status fish species need to be addressed.	Develop protection measure for special staus fish species.
SSF-1	Consultation is required as described in the USFWS Memorandum concerning Federal Agency Actions Resulting in Minor Water Depletions to the Platte River System dated June 13, 1996.	Yes		

Table 4-23. Special Status Species – Wildlife: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
SSW-1	No current objectives or decisions for special status wildlife species as they were not discussed as a group in the RMP. Several current special status species were discussed under general wildlife in current RMP. Threatened and Endangered wildlife is managed in accordance with the requirements of the Endangered Species Act. **There was no discussion of the Wyoming Game and Fish Department's list of Species of Greatest Concern.**	No	Management focuses on the more high profile wildlife such as Canadian lynx and sage-grouse and little attention is paid to other special status species that are not covered by specific laws such as the Migratory Bird Treaty Act.	Identify indicator species for habitats, such as the sage-grouse, so that habitat management that protects the sage-grouse will likely protect the less well known or more difficult to track species. Partner with the educational institutions and organizations to increase the knowledge of and awareness for other special status species.
SSW-2	The BLM will participate with the FWS in the evaluation and designation of critical habitat for T&E species on BLM-administered lands. If proposed surface-disturbing or disruptive activities could affect these species, the BLM will consult with the FWS as required by the Endangered Species Act.	Yes		

1

Table 4-23. Special Status Species – Wildlife: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
SSW-3	Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY8797 for the management of potential gray wolf habitat are incorporated by reference, per BLM Instruction Memorandum WY-2005-046.	Ongoing	Gray wolf has been proposed for de-listing. The status in Wyoming is dependent on USFWS's acceptance of the Wyoming management plan.	
SSW-4	Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY9669c for the management of potential Canada lynx habitat are incorporated by reference, per BLM Instruction Memorandum WY-2005-058.	Yes		
SSW-5	Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY9741d for the management of potential Black-footed ferret habitat are incorporated by reference, per BLM Instruction Memorandum WY-2006-037.			
SSW-6	Conservation Measures and BMPs as described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY07FA0408 for the management of white-tailed prairie dog habitat are incorporated by reference, per BLM Instruction Memorandum WY-2008-025.	Yes		
SSW-7	Conservation Measures and BMPs described in attachment 2 of USFWS Conference Memorandum ES-61411/W.02/WY9751d for the management of grizzly bear are incorporated by reference, per BLM Instruction Memorandum WY-2006-049.	Yes		Identify priority habitat areas and potential conflicts with other land uses.
SSW-8	Conservation recommendations as described in the USFWS Biological Opinion for the Wyoming BLM RMPs and Their Effects to the Bald Eagle transmitted by USFWS Memorandum ES-61411/W.02/WY7682b are incorporated by reference, per BLM Instruction Memorandum WY-2004-051.	Yes		

Table 4-23. Special Status Species – Wildlife: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
SSW-9	Habitat preservation measures as identified in the Wyoming BLM Statewide Programmatic Biological Assessment for Whooping Cranes *(Grus Americana)* and USFWS concurrence as transmitted by Memorandum ES-61411/W.02/(BIO-OPIN.WPD) are incorporated by reference, per BLM Instruction Memorandum WY-2004-032.	Yes	Species is extirpated in planning area.	
SSW-10	Conservation Measures and BMPs described in attachment 2 of USFWS Informal Conference Memorandum ES-61411/W.02/WY07FA0290 for the management of mountain plover habitat are incorporated by reference, per BLM Instruction Memorandum WY-2007-018.	Yes	Seasonal protections are breeding and nesting mountain plovers are currently in required for surface-disturbing activities.	
SSW-11	For the protection of prey bases essential to the peregrine falcon or other T&E birds, spraying of insecticides will not be allowed until after the completion of site-specific environmental analyses.	Yes		

Table 4-24. Wild Horses: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
WH-1	Wild horse are managed under interim decisions until the Decision Record from the Evaluation of Wild Horse Herd Areas and Capture Environmental Assessments, which implemented the recommendations from the 1992 Evaluation of Wild Horse HMAs and the USDI-BLM 1992 Strategic Plan for Management of Wild Horses and Burros on Public Lands.	No	Population expansion has exceeded the numbers approved in the Consent Decree. Population control is provided as possible within funding constraints.	Continue adoption programs. Work with partners to find additional support for population control.
WH-2	Wild horse gathers are implemented to control population size, diversity, and habitat values.	No	See Record 1.	See Record 1.
WH-3	Public education about wild horses is implemented as part of management and used to generate support for the wild horse program.	No	Some progress on education is being made. Additional public outreach and viewing opportunities should be expanded.	Partner with wild horse enthusiasts and tourism promoters to improve wild horse viewing opportunities and adoption programs.

4.1.5 Heritage and Visual Resources

Table 4-25. Cultural Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
	Site-specific inventories for cultural resources are required before the start of surface-disturbing activities. Adverse effects on significant resources will be mitigated, or the resources themselves will be avoided by surface-disturbing activities.	Yes		
	Sites listed on the NRHP are appropriately protected. Any violations of the Archaeological Resources Protection Act are investigated.	Yes		
Cult-0.1	The BLM's consultation with the Advisory Council for Historic Preservation and the Wyoming State Historic Preservation office is consistent with the cultural resources programmatic agreement signed in 1995.	Yes		
Cult-0.2	Rock art, as well as other prehistoric and historic archaeological sites and districts associated with specific time periods or cultures, are managed for scientific, public, and socio-cultural use. General areas will be managed for research, with emphasis on interpreting former ecosystems. Specific sites or areas will be preserved for future study and use. Near rock art, the use of heavy equipment to construct fire lines and the use of chemical and dye retardants will be restricted or prohibited.	Yes		
Cult-0.3	As appropriate, specific sites on public lands will be managed for their traditional Native American cultural values.	Yes	Additional consultation may be required as more sites and TCP become known or recognized.	
Cult-0.4	Adverse effects are avoided on public lands and resource values listed in National Park Service inventories of possible NNL. These lands and resources include paleontological and scenic values at Beaver Rim and Red Canyon.	No	The potential status of Beaver Rim as a NNL is not considered in management decisions.	Incorporate into current management.

Table 4-25. Cultural Resources: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Cult-0.5	Protective measures will be implemented for all important cultural sites, either known or identified in the future.	Yes		
Cult-1	All management actions in the Beaver Creek area are consistent with the Oregon/Mormon Pioneer NHT Management Plan. Pursue designation and enrollment of the Beaver Rim NNL.	No	The Trails are managed in accordance with the Plan. Experience has shown that the ¼ mile protection zone does not comply with the National Historic Preservation Act and does not adequately protect the Trails. Designation of the Beaver Rim NNL was not implemented.	Look for partners to assist in designating the Beaver Rim NNL, including tourism and education groups. Expand protections for the NHTs to comply with National Historic Preservation Act and adequately protect the Trails.
Cult-2	The Red Canyon NNL's natural character and qualities are protected. Protect future appreciation of classic natural history resource.	Yes		
Cult-3	The South Pass area is managed to protect fragile and important historic sites. Prevent deterioration of 19th and 20th century historical resources.	Partially	Additional lands are needed to be included in the protected area.	Expand ACECs. Work with the Wyoming Parks Department to protect the historic resources. Work with other BLM field offices to fully protect the area.
Cult-4	The South Pass area is managed to deter destruction of historical sites.	Partially	The area has been patrolled annually.	Work to acquire additional protections for historic resources.
Cult-5	The South Pass area is managed to preserve all significant sites within the historic district.	Partially	There are additional sites, such as the original Miner's Delight, that are not part of the public lands being adequately managed.	Work cooperatively to protect additional historic resources.
Cult-6	The South Pass area's historical setting is maintained around South Pass City.	Partially	The area has been significantly stabilized. Some new intrusions have occurred but they have not significantly diminished from the historical setting.	Identify unnecessary modern intrusions that, if removed, would contribute to the historical setting. Other management decisions, above, would also contribute to maintaining the setting.
Cult-7	Miner's Delight is managed to improve understanding of its history. Test excavations will be made to facilitate interpretation.	Partially	Excavations have been conducted at Miner's Delight and useful information has been collected; however, good interpretation at the site is lacking	Secure funding to implement the recommendations of an interpretation plan that was written by the University of Wyoming for the BLM.

Table 4-25. Cultural Resources: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Cult-8	A management plan will be developed for Castle Gardens including walkways and other fencing to halt deterioration of the site.	No	Resources have only recently been available to implement this program.	A plan is now being developed which will look at better protecting Castle Gardens and interpreting the site in the context of a larger geographic area. To protect Native American cultural values, surface disturbing and mining activities will need to be limited, prohibited or avoided.
Cult-9	The NHT Management Plan is incorporated into the RMP and used for management decisions in the Gas Hills area.	No	See Record Cult-1.	See Record Cult-1.
Cult-10	Pursue a protective withdrawal for the Martin's Cove site.	Yes	..The original withdrawal proposal for Martin's was never done, but subsequent action by Congress for the Martin's Cove lease included withdrawal of 1240 acres.	Because of Congressional actions, there is no need for further withdrawals
Cult-11	Conduct a study of stabilization needs of the Warm Spring Canyon Flume in the Dubois area.	Partially	A stabilization study has been made but not implemented, due to budget constraints.	Work with the Shoshone National Forest, the Dubois community and other stakeholders to implement the conservation plan.
Cult-12	Develop a management plan for the Warm Springs Canyon Flume.	No	Not implemented due to budget constraints.	See Record Cult-11.
Cult-13	Manage regional trails on a case-by-case basis.	Partially	Only a limited implementation has been possible because of lack of knowledge and little RMP protection.	Provide more intensive management of the regional trails including their historic setting, particularly those with intact segments. Work cooperatively with groups to raise educational awareness, contribute to tourism by developing interpretive sites, making use of scenic overlooks, signs, and walking trails. Coordinate regional trails management with adjoining public land managers.
	Review the ACEC nominations and the cultural resource alternatives.			

Table 4-25. Cultural Resources: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
????	Manage American Indian religious sites on a case-by-case basis	No	Subsequent Executive Orders and laws have increased our responsibilities for protecting and managing tribal sacred, religious, spiritual, and traditional sites	Add language to reflect our increased responsibilities.Since the approval of the Lander RMP in 1987, several laws, Executive Orders and regulations have been established to guide BLM in managing Native American religious sites. These include the Native American Graves Protection and Repatriation Act, Executive Order 13007, and Presidential Memorandum on Government to Government Relations with Native American Tribal Governments, BLM Manual 8120 now guides BLM offices on how to consult with tribal authorities.

1

Table 4-26. Paleontological Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Paleo-1	No objectives or management decisions on paleontological resources are included in the RMP. The resources included under cultural resources. BLM Guidance on paleontological resources has been issued.	No	New guidance has been approved to ensure better management of paleontological resources,	Implement protections of paleontological resources.
Paleo-2	Important paleontological resources are managed for scientific and public use.	Yes		
Paleo-3	Potential effects on paleontological resources are considered in site-specific environmental analyses before the authorization of surface-disturbing activities. As appropriate, site-specific inventories are required where significant fossil resources are known or anticipated to occur.	Yes		
Paleo-4	Closing lands or restricting uses to protect paleontological resources will be evaluated on a case-by-case basis.	Partially	Insufficient information is known about paleontological resources and additional information is needed to identify areas that might be appropriate for closure.	Work cooperatively with scientific investigators, mineral development companies and others to obtain better knowledge about the resources.
Paleo-5	Important paleontological sites are protected through the use of surface and subsurface protection stipulations and discretionary management authority.	Yes	New guidance has been approved to ensure better management of paleontological resources; it needs to be referred to in here.	
CO-005	Areas in the immediate vicinity of significant cultural and paleontological resource sites, and within 0.25 mile or the visual horizon (whichever is closer) of significant segments of historic trails and early highways are avoidance areas for surface-disturbing activities. Included under these provisions are the Bridger Trail, the Rawlin – Fort Washakie Trail, the Casper to Lander Road, the Green River to South Pass Trail, the Birdseye Pass Trail, the Point of Rock to South Pass Stage Road, the Yellowstone Highway, and the National Park to Park Highway. No objectives or management decisions on regional historic trails are included in the RMP.	No	..New RMP decisions are needed to ensure more consistent management of regional historic trails, and to reduce workloads on staff when conflicts arise.	Revise management prescriptions in accordance with those developed for the Bridger Trail through Memorandum of Agreements.

1

Table 4-27. Visual Resources: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
VRM-2	Visual resources are managed in accordance with objectives for VRM classes that have been assigned to the planning area (See Map 21)	No	See Record 1.This decision was done with limited inventory information, and does not recognize the increase in visual sensitivity .	A new inventory will be developed to support management decisions in this RMP. Through the land use allocation process, important visual resources will be supported with allowable use stipulations. Additionally Visual Resource Management classes will be complimentary to other planning decisions, so as to avoid conflicting planning decisions (e.g. a VRM class 2 overlaid across a high potential area targeted for intensive resource extraction).
VRM-3	Visual resource values are considered and impacts mitigated on a project by project bases. Wyoming Standard Surface Disturbing Guidelines prohibit surface disturbing activities in VRM Classes 1 and 2.	No	Often project proponents and lease holders are unaware of Visual Resource Management requirements . Standard Surface Disturbing Guidelines have not been applied consistently.	Allowable use stipulations need to be developed to support VRM classifications.

4.1.6 Land Resources

Table 4-28. Lands and Realty: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Realty-1	The preferred method of disposal or acquisition of lands by BLM is through exchange.	Yes		
Realty-2	Acquired lands and/or interests in acquired lands will be managed in a manner consistent with adjacent or nearby public lands if applicable. Acquired lands within an ACEC or other special management area will be managed in accordance with the special management area's activity plan.	Yes		
Realty-3	Proposals for disposal of any BLM-administered lands in the planning area not identified for disposal in the RMP will be considered on a case-by-case basis. Before a disposal action could be implemented, the RMP would have to be amended.	Yes		
Realty-4	Tracts 134 and 135 in the Green Mountain area (see map) are identified for disposal and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated. Both tracts have been disposed of.
Realty-5	Twenty-five isolated tracts in the Beaver Creek area are identified for disposal and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated. All still available.
Realty-6	Ten full tracts and four partial tracts in the Lander Slope area are identified for disposal and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated.3 full tracts and 1 partial tract have been disposed of.
Realty-7	No public lands are identified for disposal in the Red Canyon area.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated.

Table 4-28. Lands and Realty: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Realty-8	No public lands are identified for disposal in the South Pass area.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated.
Realty-9	Forty tracts are identified for disposal in the Gas Hills area and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated.4 tracts have been disposed of.
Realty-10	In the East Fork area, tracts 24, 25, 26, and 27 (totaling 961 acres) are identified for disposal but only to private or public agencies which will use the lands in consistency with management objectives for elk winter range. Future exchanges will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated. All 4 tracts are still available.
Realty-11	In the Dubois Badlands area, parcels 33, 34, and 35 are identified for disposal with exchange as the preferred method, and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated. 2 tracts have been disposed of.
Realty-12	In the Whiskey Mountain area, landownership adjustments will be allowed only when the Bighorn Sheep Interagency Technical Committee has analyzed and recommended such adjustments.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated.
Realty-13	Tracts 1, 4, 5, 7, 8, 11, 14, 16, 17, 20, 21, 22, 23, 28, 30, 32, 37, and 168 in the Dubois area are identified for disposal and will be considered on a case-by-case basis.	No	Needs to be re-evaluated in light of current management and community needs.	Analysis of existing land ownership, resource and resource use needs, and adequacy of management need to be evaluated. 8 tracts have been disposed of.
Realty-14	Agricultural trespass on public land generally will be resolved by prohibiting the unauthorized use; however, land sales, exchanges, or leases could resolve agricultural trespass in some cases. Leases might be used to develop the lands as wildlife food and cover areas.	No	Because of limited staff and budget, trespass can be rewarded by acquiring property interests that are not in the best interest of other resources and uses. Trespass is not limited to agricultural trespass.	Identify all trespass, including agricultural trespass, and begin process of resolving. Avoid creating a moral hazard encouraging trespass.
Realty-15	R&PP leases and patents are considered on a case-by-case basis.	Yes		

Table 4-28. Lands and Realty: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Realty-16	The acquisition of non-BLM-administered lands to achieve management objectives will be considered on a case-by-case basis.	Yes		
Realty-17	Existing stock driveway withdrawals will be retained, although the BLM reserves the right to modify historic trailing routes and use, to mitigate any impacts associated with trailing, or to deny trailing use if the impacts cannot be adequately mitigated.	Yes		
Realty-18	The BLM access policy in Wyoming is to acquire permanent exclusive easements (BLM controls and includes rights for the public) over mainline roads in the BLM transportation plan. A BLM mainline road is considered the principal access into larger blocks of BLM-administered public lands or into tracts of BLM administered lands with high resource values.	Yes		
Realty-19	The BLM will seek to acquire administrative access to areas identified as important for resource and resources uses.	Yes		See Travel Management section.
Realty-20	The BLM will pursue public access on important roads and trails identified in the BLM transportation plan. The transportation plan will be updated as necessary and implemented to provide access to large blocks of public land or to smaller parcels of land having high public values.	Yes		See Travel Management section.
Realty-21	Access to specific areas may be closed or restricted to protect public health and safety. Before access is upgraded in the vicinity of important cultural, paleontological, natural history, wildlife habitat, or other sensitive resources, the security and protection of these resources will be carefully considered.	Yes		See Travel Management section.
Realty-22	As of 1985, easements in the Green Mountain area will be negotiated for Willow Creek Road (via Cooper Creek Road), Crooks Mountain Road, and Taggart Meadows Road.	Partially	Funding and staff time have not been adequate to complete this work.	Improve access as funding permits.
Realty 23	In the Beaver Creek area, negotiate with landowners for easements or initiate appropriate route alternatives to secure public access on East Beaver Creek, Twin Creek, Government Draw, Signor Ridge, Hudson-Atlantic City, Beaver Rim, and Dilabaugh Butte roads.	Partially	Funding and staff time have not been adequate to complete this work.	Improve access as funding permits.

Table 4-28. Lands and Realty: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Realty-24	In the Green Mountain area, public access is provided for forest, wildlife, recreation, and livestock management. Existing necessary roads will be maintained. Additional easements or appropriate route alternatives will be negotiated to secure public access.	Partially	Funding and staff time have not been adequate to complete this work.	Improve access as funding permits.
Realty-25	In the Lander Slope area, negotiate for easements or initiate appropriate route alternatives to secure public access on the Shoshone Lake Road to Mormon Basin.	Partially	Funding and staff time have not been adequate to complete this work.	Improve access as funding permits.
Realty-26	In the Gas Hills area, negotiate with landowners for administrative access and easements for Copper Mountain Road, Wolf Gap, Beef Gap, and Beaver Rim Road. Consider other alternatives for easements.	Partially	Funding and staff time have not been adequate to complete this work.	Improve access as funding permits.
Realty-27	Negotiations with landowners for easements across Tappan Creek Road will be pursued.	No	Not pursued because of staff time limitations.	Re-evaluate.

Table 4-29. Renewable Energy: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Renew-1	No current objectives and decisions for renewable energy are included in the RMP. Any non-wind renewable energy proposal will require a plan amendment to implement.	Yes		
Renew-2	The Wind Energy Programmatic ROD (2005) is incorporated into the RMP. Any wind energy proposals will require a plan amendment to implement except for those activities authorized by the ROD, such as meteorological towers. The provisions of IM-2009-043 are followed in processing applications for wind energy development.	Yes	Some of the analysis issues in connection with wind energy development were not addressed by the Programmatic ROD.	Address analysis issues at the time of a “full blown” wind energy development proposal.

Table 4-30. Rights-of-Way and Corridors: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
ROW-1	Most of the planning area is open for the location of utility and transportation systems. Proposals will be addressed on an individual basis with emphasis on avoiding identified potential conflict areas.	No	Current guidance and sensible planning require designating appropriate ROW systems. This will save time and expense for the public and BLM.	Use the RMP revision process to designate ROW corridors that respond to modern needs for transportation, access, and transmissions while protecting other resources and uses.
ROW-2	Utility, pipelines, and ROWs will be co-located whenever possible.	Yes		
ROW-3	To protect scenic quality, placement of aboveground facilities, such as power lines, will be avoided along major transportation routes.	No	See Record 1.	See Record 1.
ROW-4	If restricted types of ROWs are required in avoidance areas or when such areas cannot reasonably be avoided, the adverse effects of construction will be intensively mitigated.	No	See Record 1 plus intensive mitigation is not in compliance with existing guidance (see Visual Resources.)	Develop VRM and other resource specific land use allocation. Avoidance and reduced impacts are part of the design of the project.
ROW-5	No utility and pipeline corridors or communication site windows are designated in the RMP. The Whiskey Peak area is identified as a location where a communication tower exists.	No	See Record 4.	See Record 4.
ROW-6	Public lands in the Green Mountain area will be open for the location of utility and transportation systems and concentrated in existing corridors whenever possible.	No	See Record 4.	See Record 4.
ROW-7	Construction of major utility systems in the Beaver Creek will be allowed and concentrated in existing corridors whenever possible, except for the Oregon/Mormon Pioneer Trails corridor, Sweetwater Canyon, and Sweetwater Rocks. ROWs might be granted in the exception areas if no feasible alternative route or designated corridor is available.	No	See Record 1; see also issues identified under NHTs and the Continental Divide National Scenic Trail.	See Record 1.

Table 4-30. Rights-of-Way and Corridors: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
ROW-8	The Lander Slope is avoided when locating major utility systems; locating these systems in the Lander Slope is only allowed when no feasible alternative route or designated ROW corridor is available. The BLM will consider lowlands near Hwy 28-287 for utility systems before allowing them on slopes of the mountain.	No	See Record 4.	See Record 4.
ROW-9	Red Canyon is avoided for placement of major utility systems. Major utility system ROWs may be granted only when no feasible alternative route or designated corridor is available.	No	See Record 4.	See Record 4.
ROW-10	South Pass, East Fork, Dubois Badlands, and Whiskey Mountain are avoided for placement of major utility systems. Major utility system ROWs may be granted only when no feasible alternative route or designated corridor is available.	No	See Record 4.	See Record 4.
ROW-11	Major utilities are allowed in the Gas Hills area. No utilities will be allowed along the Oregon/Mormon Pioneer Trails corridor and the Sweetwater Rocks. Utility systems will be concentrated in existing corridors whenever possible. ROW might be granted if no feasible alternative route or designated ROW corridor is available.	No	See Record 7.	See Record 7.
ROW-12	Major utility systems will be allowed in the Dubois area, but utility systems will be concentrated in existing corridors whenever possible.	No	See Record 4.	See Record 4.
ROW-13	Power line construction will be required to incorporate standard or special design features to reduce bird collisions and reduce impacts to habitat. Additional power line construction limitations will be applied on a case-by-case basis in special situations to reduce bird collisions.	Yes		..
ROW-14	Existing transportation and utility routes for roads, pipelines, and power lines will be designated as preferred ROW corridors, which would be the preferred location for existing and future ROW grants (map 6).	Yes		

Table 4-31. Trails and Travel Management: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Travel-1	Unless otherwise specified, vehicular use on BLM-administered public lands in the general planning area is designated as limited to existing roads and trails (Map will be supplied with Alternatives). "Existing" roads and trails apply only to roads and trails in existence when these designations were identified for the Lander planning area in the Federal Register on June 9, 1987 .	No	Proliferation of roads and trails continues increase.	All areas in the field office within the "limited to existing designation" need a published map detailing exactly what constitutes an existing road. In doing so, law enforcement officials can realistically enforce the limited to existing travel designation. The RMP should also provide a mechanism to adaptively respond (changing a limited to existing area to a limited to designated) if resource conditions or planning objectives are compromised.
Travel-2	Existing OHV designations completed in 1981 on about one-half of the resource area will be continued. Designations will be completed on the remaining areas of public lands. OHV management will focus more intensive management on those units having crucial wildlife values, significant visual resources, high watershed sensitivity, and outstanding natural character.	No	See travel 1	See travel 1
Travel-3	Except for areas where motorized travel is closed or limited to designated roads or, performance of necessary tasks requiring off-road use of a vehicle is authorized. Examples of necessary tasks include picking up big game kills and constructing or repairing authorized range improvements.	No	Current Travel Management guidance from the Wyoming State Office and the BLM Washington Office has further refined what actions can be exempted from travel management decisions in	All exceptions to travel management decisions will need further detail and definition.
Travel-4	The Red Canyon Management Unit is closed to over the snow vehicle travel and winter activities. Until activity planning specifically addresses the use of over-the-snow vehicles in the rest of the field office, they are subject to the same requirements and limitations as all other vehicles.	No	Critical Ungulate Winter and parturition areas are open to over the snow travel; even though they are closed to motorized vehicles. Groomed Non-motorized over the snow trails are also susceptible to damage by snow machine use.	This RMP needs to review all travel decisions associated with over the snow travel.
Travel-5	No open area for OHV "play" or other cross-country vehicular use is designated.	No	Customer demand has demonstrated a need for such an area.	This RMP needs to explore options for managing for a more intensive OHV use area.
Travel-7	Unnecessary roads in the Green Mountain area, such as the Cooper Creek fire access road, will be removed and rehabilitated.	No	Road closures and rehab needs to be conducted in a manner that is enforceable by BLM law enforcement.	Utilize this process to identify existing and new road closures in the Green Mountain Area. Develop partnerships to implement and enforce these closures, and armor /improve areas where

Table 4-31. Trails and Travel Management: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
				motorized use will be allowed. Limiting mechanized use may be necessary to protect identified resource values.
Travel-8	OHV use in the Green Mountain area is limited to designated roads and trails with seasonal (Closed December 1-June 15) travel limitations above 7,000 feet to protect roadbed and surrounding watershed values.	No	Area above 7,000 feet does not provide a strong boundary to anchor travel restrictions.	See travel 7

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Table 4-31. Trails and Travel Management: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Travel-10	The Castle Gardens withdrawal area is closed to OHV use, but the BLM road to Castle Gardens picnic area is open.	No	Easy public access to the petroglyph sites have resulted in vandalism.	The closure may need to be expanded to encompass a larger area to ensure resource protection.
Travel-11	Motorized use in the Lander Slope is limited to designated roads and trails with seasonal travel limitations (Closed December 1-June 15) except for snowmobiles.	No	Management of over the snow travel needs to be consistent with the management of overland vehicles.	Travel limitations on all forms of motorized and mechanized conveyances needs to be explored to consistently protect identified resource values.
Travel-13	Motorized use in Red Canyon is limited to designated roads and trails with seasonal travel limitations (Closed December 1-June 15).	No		Travel limitations on all forms of motorized and mechanized conveyances needs to be explored to consistently protect identified resource values.
Travel-13.1	Motorized use in the Whiskey Mountain Area is limited to designated roads and trails with seasonal travel limitations (Closed December 1-June 15).	No.	See Travel 1	See Travel 1

Table 4-31. Trails and Travel Management: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Travel-14	Existing transportation system is adequate for recreational use and will be maintained.	Yes	In the future the LFO transportation system will be revised through activity level planning. Revisions will be consistent with the revised Lander RMP.	
Travel-18	OHV use in the East Fork area is limited to existing roads and trails.	No	Management of travel needs to consider critical wildlife ranges contained in this area.	Travel limitations on all forms of motorized and mechanized conveyances needs to be explored to consistently protect identified resource values.
Travel-19	The Dubois Badlands area is closed to OHV to protect outstanding scenery and natural values.	Yes	Implementation needs to be stronger; offsite OHV use site may be necessary to provide users an alternative.	Explore methods to reduce illegal use in the Badlands.

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Table 4-32. Recreation: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Recreation-1	The Following areas are Special Recreation Areas: The 1987 RMP stated that SRMAs were areas that required explicit on-the0ground management. • Continental Divide National Scenic Trail • Oregon-Mormon Pioneer National Historic Trail • South Pass Historic Mining District	No	These SRMAs were established under old guidance. Existing SRMAs were established broadly and in some cases encompass more area then was necessary, and in others encompass less area then necessary. These SRMAs do not contain adequate management guidance and/or may encompass areas where SRMA	This RMP needs t review customer demand and available supply to determine the locations of all SRMAs. Adequate detail including setting prescriptions' and allowable use decisions need to be developed for all SRMAs to ensure the protection of important recreational outcomes and settings.

Table 4-32. Recreation: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Recreation-2	The following areas are Extensive Recreation Management Areas: The 1987 RMP stated that minimal management is frequently sufficient in extensive recreation management areas. • Beaver Rim • Castle Gardens • Copper Mountain • Dubois Badlands • Government Draw • Green Mountain • Lander Slope/Red Canyon • Lysite Badlands • Sweetwater Canyon • Sweetwater Rocks • Warm Springs Canyon • Whiskey Mountain/East Fork • The Rest of the Field Office not in a SRMA or individual ERMA	No	Management of ERMAs needs to be focused on the field office wide visitor service objectives of resource protection, ensuring human health/safety, and preventing resource use/user conflict. Separate ERMAs and supporting objectives may be established to address local planning issues. Actions in ERMAS need to be the minimum necessary to address and make progress towards the identified objective.	Ensure ERMAs are managed under the standard field office wide custodial objectives for resource protection, ensuring human health/safety, and preventing resource use/user conflict. Considerate separate ERMAs and supporting objectives to address local planning issues. Ensure actions in these areas are the minimum necessary to address and make progress towards the identified objective.
Recreation-3	Prohibit surface occupancy within the following developed recreation sites (Map XXX): • Cottonwood Campground (XXX acres) • Lands adjacent to the Fremont County Campground (XXX acres) • Wildhorse Point (XXX acres) • Atlantic City Campground (XXX acres) • Big Atlantic Gulch (XXX acres) • Miners Delight (XXX acres)	No	New developed sites have been added since the 1987 RMP.	Protections need to be established for all developed recreation sites. Additionally adaptive language needs to be added to protect future developed recreation sites.

Table 4-33. Wilderness Characteristics: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Wilderness-1	No current objectives or decisions for wilderness characteristics are included in the RMP.	No	Guidance and court cases make clear that BLM must inventory the lands it manages and identify areas with wilderness characteristics and determine appropriate management.	Review citizens' proposals for areas with wilderness characteristics and BLM inventories and identify those areas that should be managed as non-WSA lands containing wilderness character.

Table 4-34. Livestock Grazing: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-1	Livestock grazing use in the planning area will be continued. Livestock grazing will also be managed to provide for protection or enhancement of other resource values. Actions will be consistent with the Guidelines for Livestock Grazing Management for public lands administered by the BLM in the State of Wyoming.	No	Insufficient progress has been made to avoiding damage to other resources or towards achieving rangeland health in some areas.	Re-examine livestock grazing decisions and AMPs to refocus direction on achieving rangeland health.
Grazing-2	This plan incorporates the "Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for Public Lands Administered by the BLM in the State of Wyoming" approved August 12, 1997. Please see Appendix ____.	Yes	See Record 1	
Grazing-3	High-intensity monitoring will be conducted on top-priority Category I allotments, on allotments with AMPs. Low intensity monitoring will be conducted on the other Category I allotments and on Category M and C allotments.	No	Based on dated information and analyzed prior to the SHR being incorporated into the RMP.	The RMP is re-analyzing livestock grazing.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-4	The current amounts, kinds, and seasons of livestock grazing use will continue to be authorized until monitoring indicates a grazing use adjustment is necessary or that a class of livestock or season of use modification can be accommodated.	No	Stocking rates were addressed on only a portion of the high priority allotments and there has been little staff time or budget to monitor results.	S&Gs need to be completed on all category I allotments and monitoring success must be implemented in cooperation with interested stakeholder.
Grazing-5	The decisions for the Gas Hills Study Area and the Green Mountain Rangeland Programs Summary were developed from the Lander RMP/EIS.	Yes		
Grazing-6	Decisions will be made when monitoring data are sufficient to support decisions. Decisions may include changing livestock numbers, changing periods of use, or both. Monitoring will be a continuous process to assure management objectives are being met. If further modification of periods of use, livestock numbers, classes of livestock or grazing systems, adjustments will be made only after consultation with livestock operators and other affected parties.	No	See Record 4. Grazing systems have not been implemented on all of the high priority I allotments.	See Record 4. Hot season grazing and season long grazing needs to be eliminated on category I allotments.
Grazing-7	Grazing allotments are grouped into three categories. Category I allotments are managed to improve existing resource conditions and to reduce or eliminate resource use conflicts. Category M allotments are managed to maintain or improve present satisfactory resource condition and allotment management. Category C allotments are managed to prevent deterioration of current resource conditions by managing the lands in a custodial manner.	Yes		
Grazing-8	High intensity monitoring will be conducted on top priority "I" allotments, on allotments with AMPs. Low intensity monitoring will be conducted on the other "I" allotments and on "M" and "C" category allotments.	In part.	Condition and trend monitoring projects in a large number of priority allotments have been implemented. A total of 150+ transects have been installed. These were read every five years from 1982 until 1997. Staff and budget have not been available to monitor since that time.	Partner with interested publics to improve monitoring. Make more staff time available for field work through efficiencies in office work and other strategies. Employ conditions that will reduce the need for on-the-ground monitoring as an approach to ensuring improvements in rangeland health.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-9	Based on available monitoring data, management actions will be implemented, beginning with Category I allotments needing the most improvement. AMPs will be developed for allotments in the planning area on a priority basis. The intensity of the AMPs will depend on allotment condition and resource conflicts.	No	See Records 6 and 8.	See Records 6 and 8.
Grazing-10	The remaining grazing allotments in the planning area are the "M" and "C" category allotments. They will be monitored at a lower intensity level to ensure no significant adverse changes are taking place as a result of ongoing management.	No	There is insufficient staff and time to meet this requirement.	Adjust grazing systems, seasons of use, and stocking rates to improve rangeland health in the face of reduced staff time and budget.
Grazing-11	Stock driveway withdrawals will be retained, although the BLM reserves the right to modify historic trailing routes and use, to mitigate any impacts associated with trailing, or to deny trailing use if the impacts cannot be adequately mitigated. Portions of grazing allotments that are outside withdrawn stock driveways and that are affected by trailing will be monitored to determine whether the allotment can accommodate trailing without unacceptable effects on resources.	Yes		
Grazing-12	The level of livestock grazing on public lands, when combined with all other public land uses, will not be allowed to exceed the carrying capacity of the land. Meeting the SHR is the most important requirement of livestock grazing management.		See Record 4.	See Record 4.
Grazing-13	Management actions will address known resource problems. The following rangeland improvements will be made: • 45 to 55 miles of fence will be constructed. • Ten reservoirs will be constructed. • 57 other water improvement projects will be built. • Reduce livestock grazing 13-19 percent in Category I allotments (cumulative target: 114,298-144,101 AUMs; overall change between 4 percent decrease to 21 percent increase).	No	Some of the improvements have been made. Livestock grazing has, for the most part, not been implemented. The identification of improvements needs to be re-assessed in light of the SHR.	Re-assessment of all grazing decisions through S&Gs and AMPs needs to be accomplished. See Records 6 and 8.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-14	Present resource management will be retained and, if possible, improved. The following management will be utilized: • Authorize current livestock use under a 10-year permit. • Authorize increases in livestock use, when appropriate, that will be consistent with multiple-use objectives and will not be detrimental to other resources; increases range from 10-55 percent. • Consult with permittees to develop flexibility in livestock operations. • Authorize and construct range improvements to meet multiple-use management objectives. • Monitor trends in range condition and productivity to ensure conditions of the basic renewable resources will remain satisfactory.	No	These allotments may have higher resource values such as riparian/wetlands that were not considered. Livestock use has been authorized on a 10 year permit without determining progress on SHR.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.
Grazing-15	Use all management actions as necessary to reverse downward trends in range conditions, increase productivity of vegetation resources, improve wildlife habitat and improve soil and watershed conditions. Funding is allocated to Category I allotments first.		See Records 6 and 8.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.
Grazing-16	Develop monitoring program to evaluate effectiveness of present management situation. Develop AMPs and incorporate any/all specific management actions if objective(s) are not being met. The following actions may be taken for Category I allotments not meeting Standard of Rangeland Health 1-3: • Adjust stocking levels of grazing animals; include increases/ decreases in livestock grazing and/or wildlife. • Implement grazing systems. • Conduct vegetation manipulation projects. • Adjust turn-out dates/seasons of use.	No	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs. Stocking rates have not been re-assessed. Many grazing systems have not been implemented or evaluated.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-17	The following actions may be taken for Category I allotments. • Develop water projects where livestock distribution problems have been caused by lack of water. • Use grazing systems and/or range improvements to solve problems where large grazing animals are concentrating on riparian areas. • Adjust turn-out dates and/or season of use based on plant phenology and range readiness. • Implement grazing systems to provide for the physiological needs of the key forage plants. • Where land-use conflicts have been causing a loss of forage production because of surface disturbance, rehabilitation efforts will be conducted and monitored for effectiveness. • Where land-use conflicts have been damaging structural improvements or causing a livestock trespass situation, identify the agent causing the problem and correct it. • For land-use conflicts involving damage to public and private lands by off-road vehicle use during wet weather, BLM will develop sign program and/or seasonal site-specific road closures.		See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs. Stocking rates have not been re-assessed. Many grazing systems have not been implemented or evaluated.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.
Grazing-18	Deterioration of current resource conditions will be prevented by managing lands in a custodial manner. Livestock use will be permitted as authorized under a 10-year permit/lease. BLM will conduct low-intensity use supervision and monitoring. Adjustments will be made in numbers and season of use where necessary to prevent deterioration of present resource conditions.	No	See Records 6 and 8.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.
Grazing-19	Livestock grazing is managed to provide enough forage on a sustained-yield basis to satisfy at least the present demands of livestock, wild horses, and wildlife and to maintain range condition at a level that would provide for sustained yield of forage production. Terrestrial, aquatic and riparian ecosystems are maintained or improved to provide wildlife with adequate amounts of forage and habitat for planned population levels.	No	See Records 6 and 8.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-20	Final Rangeland Improvement Policy requires an economic analysis for proposed range improvements. As improvement projects are proposed from allotment monitoring and consultation process, benefit/cost evaluations are done. For allotments that may have potential for economic return on public investment, BLM will conduct benefit/cost analyses on AMPs or grazing system plans and related range improvements before they are implemented.	No	Benefit cost analysis was done on a project by project basis. BLM Management removed the requirement to do cost/benefit analysis.	Reconsider whether cost/benefit analysis of rangeland improvements would be a useful tool that is allowed under current guidance.
Grazing-21	Maintain or improve the allotment condition. Consult with all affected interests to establish a mutual understanding of the management flexibility for livestock operations given to individual livestock operators; a change in category may be necessary if a significant change in management occurs.	No	These allotments may have higher resource values such as riparian/wetlands that were not considered. Livestock use has been authorized on a 10 year permit without determining progress on SHR.	See Records 6 and 8. Re-assess all grazing decisions using S&Gs and AMPs.
Grazing-22	Current livestock active preferences are authorized under a 10-year permit/lease with the following management: • Conduct low-level monitoring of actual use, climate and trend. • Allow increases in grazing use by any or all types of grazing animals if monitoring indicates this will be consistent with multiple-use objectives. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operator(s); occasional counts of livestock numbers may be conducted. • Authorize any range improvements that meet multiple-use objectives for the allotment. Encourage livestock operator(s) to fund installation of range improvements; some range betterment funds may be made available as budges permit.	No	See Record 14.	See Record 14.
Grazing-23	The following are the monitoring priorities: • Conduct low-level monitoring of actual use, climate and trend with priority given to those allotments that have marginally met the categorization criteria. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operators and occasional counts of livestock numbers.	No	See Record 9.	See Record 9.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing-24	Manage livestock grazing to improve existing resource conditions and to reduce or eliminate resource conflicts. Take corrective measures in response to the existing problems. Help to better define the problems, provide for input from all interested parties to find solutions to the problems, and implement measures determined to be beneficial in achieving multiple use objectives.	No	See Record 9.	See Record 9.
Grazing-25	Conduct monitoring of allotments which are not satisfactory for the range trend, utilization, actual use, and climate.	No	See Record 9.	See Record 9.
Grazing-26	The following factors are considered in managing Category I allotments: • Actions may include development of grazing systems, changes in turnout dates and season of use, development of additional water to improve distribution and adjustments in stocking levels. • Implement adjustments in stocking levels of all grazing animals if range condition/vegetation production is deteriorating. • Horse HMAs will be a priority for development of management plans. • Development of water sources will be priority in allotments where lack of water is the primary problem. • Implement grazing systems and/or fencing if cattle concentrate in riparian areas, even though there's sufficient water in allotment. • Use flexibility for turnout dates and season of use in allotments that may be unsatisfactory. • Rehabilitate areas where land-use conflict(s) has caused loss of forage production; this may include adjustments in stocking levels of grazing animals. • Where livestock grazing is causing adverse conditions for another land use, alternative management actions will be considered on a case-by-case basis. • Management actions will be dependent on manpower capability and improvement funding; concentrate limited resources in the allotments with most problems and the ones that offer the prospect for maximum return on public	No	See Record 9.	See Record 9.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
	investment. • Monitoring on Category I allotments will be conducted in accordance with a list of procedures (p. 85 of ROD).			
Grazing-27	Prevent deterioration of current resource conditions by managing lands in a custodial manner. Category C allotments will be redesignated or eliminated by the following methods: • Changing fence locations. • Exchanging land to block up public land. • Selling public land.	No	See Record 6 and 8.	See Record 6 and 8.
Grazing-28	Manage the allotments are follows: • Authorize current livestock active preference under a 10-year permit/lease. • Consult with all affected interests to establish a mutual understanding of the management flexibility given to the individual livestock operations. • Conduct low-level monitoring of actual use, climate and trend, with priority given to those allotments designated for fence location changes. • Conduct low-intensity use supervision consisting of periodic consultation with livestock operators; occasional counts of livestock numbers may be conducted. • Authorize any range improvements that meet multiple-use objectives of the allotment. • Encourage livestock operator(s) to fund installation of range improvements (some range betterment funds may be made available). Decisions on Category C allotments will be issued as land is sold or exchanged or fence locations are changed.	No	See Record 6 and 8.	See Record 6 and 8.

Table 4-34. Livestock Grazing: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Grazing- 29	Appendix E identifies the various types of management actions including grazing systems, land treatments, range improvements, and development of AMPs that will be implemented throughout the planning area. These actions will be directed toward resolving or reducing such concerns as continuous spring grazing and conflicts between livestock grazing and wildlife uses, and toward improvement of wetland/riparian areas and overall vegetative ground cover and production. If these measures fail to accommodate the livestock grazing preference, while concurrently providing for protection of other resource values, reductions in livestock grazing use may become necessary.	Yes		
Grazing-30	Any adjustments in livestock grazing use, either short-term or long-term, will be made as a result of monitoring and consultation with grazing permittees or through negotiation with grazing permittees and other affected interests. Adjustments may also result from land use planning decisions to change the allocation of land uses or from transfers of BLM-administered public lands to other agency jurisdictions or into nonfederal ownerships.	Partially	See Record 6 and 8	See Record 6 and 8
Grazing-31	The level of livestock grazing on public lands, when combined with all other public land uses, will not be allowed to exceed the carrying capacity of the land. (See Glossary.)	Partially	See Record 6 and 8.	See Record 6 and 8.
Grazing-32	The placement of salt and mineral supplements on public lands is allowed outside riparian areas and reclaimed or reforested areas, in locations designed to improve livestock distribution.	Yes		
Grazing-33	If grazing management techniques described or referenced above are not adequate to meet the objectives of resource management, livestock grazing will be reduced or eliminated on some allotments or portions of allotments, especially around sources of springs, reservoirs, other riparian wetland, aspen stand regeneration areas, and crucial big game winter ranges.	No	Never implemented.	Implement.

4.1.7 Special Designations and Other Management Areas

Table 4-35. ACECs and Other Management Areas: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
ACEC-1	The plan designates approximately 117,000 acres as ACECs. This represents about 4.7 percent of the planning area.	No	There are other areas in the planning area that meet the requirements for ACEC designations and need special management.	Consider the input from internal and external scoping for other areas meeting the ACEC requirements including regional trails, Cedar Ridge, Castle Gardens, and others. Identify surface prescriptions, VRM and OHV allocations and other management needs.
ACEC-2	Designate 18,000 acres for the Green Mountain ACEC, which includes crucial elk winter range and the area within a 350-foot radius of Sparhawk Cabin.	Yes	Although Sparhawk Cabin may not be as historically important as originally thought, it is still a contributing part of the ACEC and BLM has invested in conserving it.	Continue the ACEC management. Determine if the parturition areas on Green Mountain need to be included in the ACEC to meet ACEC objectives. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-3	Designate about 20,000 acres in the Beaver Creek area as an ACEC along the Oregon/Mormon Pioneer Trail (expanded to include the California and Pony Express Trails).	No	Experience has shown that the ¼ mile protection zone does not comply with the National Historic Preservation Act and does not adequately protect the Trails.	Re-evaluate the protections along the Trails. Appropriately consider VRM of the Trails' setting. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-4	Designate about 3,900 acres in the Gas Hills area as an ACEC along the Oregon/Mormon Pioneer Trail (expanded to include the California and Pony Express Trails.)	No	Experience has shown that the ¼ mile protection zone does not comply with the National Historic Preservation Act and does not adequately protect the Trails.	Re-evaluate the protections along the Trails. Appropriately consider VRM of the Trails' setting. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-5	Beaver Rim ACEC: Designate about 7,000 acres in the Beaver Creek area along Beaver Rim as an ACEC.	Partially	Other parts of Beaver Rim have been nominated for ACEC nomination because of important natural values.	Study Beaver Rim area and consider adding to the existing ACEC.

Table 4-35. ACECs and Other Management Areas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
ACEC-6	Designate about 25,000 acres as ACEC to protect the important wildlife habitat and scenic quality of the Lander Slope	No	Does not adequately protect against phosphate or surface mining.	Consider a withdrawal and determine if other surface controls should be implemented. Work with WGFD regarding dates of seasonal closures. Consider land acquisition and blocking up parcels. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-7	Designate 15,000 acres within the Red Canyon area as an ACEC for protection of highly visible steep slopes and areas of important wildlife habitat.	No	Does not adequately protect against phosphate or surface mining.	Consider a withdrawal and determine if other surface controls should be implemented. Work with WGFD regarding dates of seasonal closures. Consider land acquisition and blocking up parcels. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-8	Designate 12,000 acres in the South Pass area as ACEC to protect significant cultural values, which will include the Historic Mining District. Improve habitat for the Lander moose herd winter range and other species. Develop special management actions for aspen and beaver management, in-stream structure developments and fencing projects, and protecting willow regeneration. Emphasize improvement of conifer, aspen, willow-riparian, and other shrub stands.	No	Does not include enough area to adequately protect historic resources. Redirect ACEC emphasis towards importance as a historic resource and less as a wildlife ACEC.	Determine appropriate boundaries to adequately protect historic resources in their historic setting. Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-9	Designate 1,000 acres in the East Fork area surface as an ACEC to protect crucial elk winter range.	Yes	Mineral withdrawal needs to be extended.	Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-10	Designate approximately 5,000 acres in the Dubois Badlands as ACEC to protect bighorn sheep habitat, scenic quality and protect against the erosive nature of the badlands.	Yes		Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-11	Designate approximately 4,000 acres as an ACEC to protect the Whiskey Mountain Bighorn Sheep Winter Range.	Yes	Mineral withdrawal needs to be extended.	Identify surface prescriptions, VRM and OHV allocations and other management needs and adequacy of current management.
ACEC-12	See appendix for other restrictions that may be applied to surface-disturbing activities, as appropriate.	No	Surface Disturbing Activities are not adequately described.	Identify surface disturbance prescriptions.

Table 4-35. ACECs and Other Management Areas: Management Opportunities (Continued)

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
ACEC-13	Identify wildfire prescriptions for each ACEC that advances the values for which the ACEC is designated. Prescribed fire will be used as appropriate to accomplish multiple use management objectives as they are identified.	Yes		

Table 4-36. Scenic or Backcountry Byways: Management Opportunities

Planning Decision Number	Planning Decision	Duplication with Other Resource Areas	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Byways	No current objectives and decisions for scenic or backcountry byways are included in the RMP.	N/A			

Table 4-37. National Historic Trails and National Scenic Trails: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
Cong Des-1	Management activities for the NHTs were addressed in the ACEC designation and in other management actions, such as ROW avoidance zones.	No.	Current management does not comply with the National Historic Preservation Act or BLM guidance for management of Congressionally designated trails. Current management is not adequate, including the corridor management , visual resource surface disturbance, recreation, and other managements prescriptions.	Completely revise the management prescriptions to bring it into compliance with current requirements and properly manage the Trails and their historic and recreational setting.
Cong Des-2	The Continental Divide National Scenic Trail is managed as a Congressionally-designated trail.	No	Current management does not comply with the Trail planning or BLM guidance for management of Congressionally designated trails. Current management is not adequate, including corridor management, visual resource management, recreation, and allowable use decisions.	Completely revise the management prescriptions to bring it into compliance with current requirements and properly manage the Trail .

Table 4-38. Wild and Scenic Rivers: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for WSRs are included in the RMP.	No	BLM must inventory to tentative classify all eligible and suitable waterways.	This RMP will develop plans for all waterways found to be eligible and suitable for inclusion in the Wild and Scenic Rivers system.

Table 4-39. Wilderness Study Areas: Management Opportunities

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	All WSAs are managed under the Interim Management Policy For Lands Under Wilderness Review.	Yes	Additional management actions and allowable uses will be complimentary of the IMP.	The RMP needs to address livestock grazing levels in the Sweetwater Canyon WSA. Additionally all travel management allocations need to be revised and updated within WSAs.
	Motorized travel in all WSAs except the Dubois Badlands (which is closed) is limited to designated roads and trails that existed at the time the area became a WSA.	No	Travel management in other WSAs needs to be fully implemented.	Develop travel management allocations for all WSAs; develop implementation level travel management decisions in all WSAs.

4.1.8 Socioeconomic Resources Table 40

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for social conditions are included in the RMP.	No	Management actions on public lands can have a profound impact on social conditions.	Consider impacts on social conditions.

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for economic conditions are included in the RMP.	No	Management actions on public lands can have a profound impact on economic conditions.	Consider impacts on economic conditions.

Planning Decision Number	Planning Decision	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for health and safety are included in the RMP. Other management actions for other resources, such as fire or recreation, addressed public safety as a part of those programs.	Yes		

Table 4-43. Environmental Justice: Management Opportunities

Planning Decision Number	Planning Decision	Duplication with Other Resource Areas	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for environmental justice are included in the RMP.	N/A			

Table 4-44. Tribal Treaty Rights: Management Opportunities

Planning Decision Number	Planning Decision	Duplication with Other Resource Areas	Is decision responsive to current issues?	Remarks (rationale)	Options for Change
N/A	No current objectives and decisions for tribal treaty rights are included in the RMP.	N/A			

4.2 Areas of Relative Ecological Importance

Areas of relative ecological importance are places recognized as important to managing the health, diversity, and productivity of the public lands in either the planning area or the broader, eco-region. Identifying areas of relative ecological importance is an important step in the RMP revision process. It enables planners to understand tradeoffs when establishing land use allocations and management requirements and is fundamental to developing a range of alternatives in the RMP and EIS. Focusing on these areas will help to guide the planning process through the identification of management opportunities for the maintenance or rehabilitation of areas important to the overall health of public lands.

Areas of relative ecological importance in the planning area have been identified for each resource area or land use by interdisciplinary team members with expertise in that resource (Map 66). The following section includes a description of why each area is important for a given resource, as well as the current management and condition of the area.

Dubois Area

The northwest corner of the planning area is a high priority management area because of its important wildlife values, scenic resources, WUI issues, pine beetle infestation problems, recreational use, and historic relics. The Dubois area has three ACECs, two WSAs, two wildlife management units, habitat for sensitive species and sometimes list T&E species, and adjoins the Fitzpatrick Wilderness and potential Wild and Scenic River segments.

Sweetwater Watershed and Sage-Grouse Concentration Area

The southern section of the planning area is a high priority management area because of its important wildlife values, scenic resources, recreational use, and extraordinary historic values. The area contains some of the most intact sage-grouse habitat in the nation, five WSAs, two ACECs, five Congressionally designated trails with the best trail segments in the nation, priority wildlife habitat, blue ribbon fishing, a proposed Wild and Scenic River, national landmarks, and high recreational use.

Lander Slope including Red Canyon

The Lander Slope flank of the Wind River Mountains is a high priority management area because of its important wildlife values, scenic resources, recreational usage and WUI issues. It has extraordinary geologic formations and is the iconic image for the Lander area. It contains two ACECs, a National Natural Landmark, a proposed Wild and Scenic River, and high recreational usage.

5.0 CONSISTENCY/COORDINATION WITH OTHER PLANS

5.1.1 Local, Tribal, State, and Federal Management Plans

According to guidance found in FLPMA (43 CFR 1610), BLM RMPs must be consistent, to the extent practical, with officially approved or adopted resource-related plans of other Tribal, Federal, State, and local governments so long as the plans are compatible. BLM RMPs must also be consistent with the purposes, policies, and programs of FLPMA and other Federal laws and regulations related to public lands. If these other entities do not have officially approved or adopted resource-related plans, them BLM RMPs must, to the extent practical, be consistent with those entities' officially approved and adopted resource-related policies and programs. This consistency will be accomplished so long as BLM RMPs incorporate the policies, programs, and provisions of public land laws and regulations. Table 5-1 outlines the applicable Tribal, local, state, and federal management plans that pertain to the Lander Planning Area and the resource areas that will require coordination with those plans.

Table 5-1. Local, State, and Federal Management Plans That Pertain to the Bighorn Basin Planning Area

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil Resources	Water Resources	Cave and Karst Resources	**Mineral and Energy Resources**	**Fires and Fuel Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Historic Trails	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights of Way and Corridors	Trails and Travel Management	Recreation	Wilderness Characteristics	Livestock Grazing	**Special Designations**	ACECs and Other Management Areas	Scenic or Backcountry Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
COUNTY PLANS																																		
Fremont County Land Use Plan			x	X	X		X		X	x	X	X		X		X		X		X	X	X	x			X				X	X	X		
Hot Springs County Land Use Plan		X			X		X		X		X	X	X	X						X		X		X			X	X				X		
Sweetwater County Land Use Plan			X	X	X		X		X	X	X			X		X				X		X	X	X		X	X	X		X	X	x		
Natrona County Land Use Plan		X			X		x																											
CONSERVATION DISTRICTS																																		
Popo Agie CD Plan				x	X				X											x		X									x			
Sweetwater CCD Plan																																		
Lower Wind River CD				X	X		X		X					x			X			X		X									X			
Dubois Crowheart CCD Plan			X	X	X						X			X								X									x			
Powell Clarks Fork Conservation District Plan			X	X					X											X		X												
WEED MANAGEMENT PLANS																																		
Fremont C W&P				x	X			X	X										X	X		X										X		
Natrona C W&P					X		X		X											X		X										X		
Dubois-Crowheart WMA				X	X				X										X	X		X								X	X	X		
Popo Agie WMA					X				X													X										X		

Table 5-1. Local, State, and Federal Management Plans That Pertain to the Bighorn Basin Planning Area

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil Resources	Water Resources	Cave and Karst Resources	**Mineral and Energy Resources**	**Fires and Fuel Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Historic Trails	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights of Way and Corridors	Trails and Travel Management	Recreation	Wilderness Characteristics	Livestock Grazing	**Special Designations**	ACECs and Other Management Areas	Scenic or Backcountry Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
Lower Wind River WMA				X	X		X	X	X										X	X		X									X	X		
STATE AGENCY PLANS																																		
Wyoming Dept of Agriculture Strategic Plan 2005																						X												
Wyoming Game and Fish Strategic Habitat Plan									X											X		X												
Wyoming Game and Fish Greater Sage-Grouse Conservation Plan				X	X		X		X											X		X												
Wyoming Game and Fish Final Wyoming Gray Wolf Management Plan 2007									X																									
Wyoming State Water Plan Wind/Bighorn River Basin 2003					X						X						X			X		X												X
Wyoming Statewide Comprehensive Outdoor Recreation Plan (2003)																			X	X														
Wyoming Statewide Trails Plan 2004												X							X	X						X		X						
Wyoming SHPO Comprehensive Statewide Historic Preservation Plan											X	X	X	X																				

Table 5-1. Local, State, and Federal Management Plans That Pertain to the Bighorn Basin Planning Area

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil Resources	Water Resources	Cave and Karst Resources	**Mineral and Energy Resources**	**Fires and Fuel Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Historic Trails	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights of Way and Corridors	Trails and Travel Management	Recreation	Wilderness Characteristics	Livestock Grazing	**Special Designations**	ACECs and Other Management Areas	Scenic or Backcountry Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
2007-2013																																		
FEDERAL AGENCY PLANS																																		
Shoshone National Forest Plan		X		X	X		X	X	X											X	X	X					X	X		X	X			
US Fish and Wildlife Service Wyoming Plan					X				X																									
US EPA Region 8 Wyoming State Implementation Plans		X												X																				
FIRE MANAGEMENT PLANS																																		
Fremont County Fire Plan		x			X			X	X					X								X								X	X			
US Forest Service National Fire Plan		X		X	X			X	X																									

5.1.2 Cooperating Agencies

The BLM plans to collaborate with other federal, state, and local agencies and governmental entities throughout the RMP process. Coordination was initiated at the inception of the project through the identification of cooperating agencies, including:

- Fremont County Board of Commissioners
- Hot Springs County Commissioners
- Popo Agie Conservation District
- Lower Wind River Conservation District
- Dubois Crowheart Conservation District
- Sweetwater Conservation District
- State of Wyoming: Governor's Office
- State of Wyoming: Department of Agriculture
- State of Wyoming: Game & Fish Department
- State of Wyoming: Department of Environmental Quality
- State of Wyoming: Business Council
- State of Wyoming: State Historic Preservation Officer
- State of Wyoming: Trail Program
- US National Parks Department
- US Bureau of Indian Affairs

Additional opportunities for cooperation with other agencies will be sought throughout the RMP and EIS development process. Project phases where state and local governments, other federal agencies, and tribal government are involved will assist in providing consistency.

Regular interaction between the BLM and the cooperators will provide expertise and consistency.

6.0 SPECIFIC MANDATES AND AUTHORITY

6.1 Mandates and Authorities Pertaining to All Resources

6.1.1 Federal Laws and Statutes

Federal Law or Statute	Year
Act of October 30, 1978 (92 Stat. 2073-2075)	1978
Act of September 1, 1949, Section 3 (30 U.S.C. 192c)	1949
Act of June 30, 1950 (16 U.S.C. 508(C) and (e))	1950
Act of August 13, 1954 (68 Stat. 708, 30 U.S.C. 521 subpart)	1954
Act of July 23, 1955 (P.L. 16743 CFR 3710)	1955
Act of September 28, 1962 (P.L. 87-713, 76 Stat. 652)	1962
Air Pollution Control Act (P.L. 84-159) as amended	1955
American Indian Religious Freedom Act (42 U.S.C. 1996)	1978
Antiquities Act (16 U.S.C. 431-433, P.L. 59-209, 34 Stat. 225)	1906
Acquired Lands Act - Act of August 7, 1947 (61 Stat. 913)	1947
Archaeological Resources Protection Act (16 U.S.C. 47Oaa et seq., P.L. 96-95, 93 Stat. 721) as amended (P.L. 100-555, P.L. 100-588)	1979
Archeological and Historic Preservation Act (16 U.S.C. 469-469c-1, P.L. 86-523, 74 Stat. 220, 88 Stat. 174)	1974
Archeological and Paleontological Salvage for Federal Highway Projects (23 U.S.C. 305, 72 Stat. 913 (1958), 74 Stat. 525 (1960))	1960
Bald Eagle Protection Act (16 U.S.C. 668-668d, 54 Stat. 250)	1940
Carey Act of August 18, 1894 as amended (43 U.S.C. 641 et seq.)	1894
Carlson-Foley Act of 1968 (42 U.S.C. 1241-1243)	1968
Classification and Multiple Use Act of September 19, 1964 (43 U.S.C. 1411–18, 78 Stat. 986)	1964
Clean Air Act of 1970 (42 U.S.C. 7401-7671q) as amended	1970
Coastal Zone Management Act (16 U.S.C. 1451-1456, P.L. 92-583)	1972
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601)	1980
Department of Energy Organization Act (42 U.S.C. 7101 et seq.)	1977
Department of the Interior Secretarial Order 3226	2001
Desert Land Act (43 U.S.C. 321-323, 19 Stat. 377), as amended	1877
Economy Act 1932, as amended (31 U.S.C. 686, P.L. 72-211, 47 Stat. 417)	1932
Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11001-11050)	1986
Emergency Wetland Resources Act of 1986 (16 U.S.C. 3901-3932)	1986
Endanger Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended	1973
Energy Policy Act (P. L. 109–58)	2005
Engle Act (43 U.S.C. 155 et seq.)	1958
Executive Order 11514 – Protection and Enhancement of Environmental Quality	1970
Executive Order 11593 – Protection and Enhancement of the Cultural Environment	1971
Executive Order 11644–Use of Off-Road Vehicles on the Public Lands	1972
Executive Order 11738 – Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act With Respect to Federal Contracts, Grants, or Loans	1973

Federal Law or Statute	Year
Executive Order 11987 – Exotic organisms	1977
Executive Order 11988 – Floodplain Management	1977
Executive Order 11989 – Off-road Vehicles on Public Lands	1977
Executive Order 11990 – Protection of Wetlands	1977
Executive Order 11991 – Relating to protection and Enhancement of Environmental Quality	1977
Executive Order 12088 – Federal Compliance with Applicable Pollution Control	1978
Executive Order 12580 –Superfund Implementation and 13016 – Amendment to Executive Orders 12580	1987 and 1996
Executive Order 13007 – Indian Sacred Sites	1996
Executive Order 13084 – Consultation and Coordination with Indian Tribal Governments	1998
Executive Order 13112 – Invasive Species	1999
Executive Order 13148 – Greening of the Government through Leadership in Environmental Management	2000
Executive Order 13195 – Trails for America in the 21st Century	2001
Executive Order 13212 – Actions to Expedite Energy-Related Projects	2003
Executive Order 13287 – Preserve America	2003
Executive Order Public Water Reserve 107	1926
Executive Order 10355 – Delegating to the Secretary of the Interior the authority of the President to withdraw or reserve lands of the United States for public purposes	1952
Executive Order 13175 – Consultation and Coordination with Indian Tribal Governments	2000
Executive Order 6910 and Executive Order 6964, and amendments	1934
Executive Order 13443 – Facilitation of Hunting Heritage and Wildlife Conservation	
Federal Aid Highway Act (23 U.S.C. 107(d) and 317)	1958
Federal Cave Resources Preservation Act (16 U.S.C. 4301 – 4309)	1988
Federal Coal Leasing Amendments Act (90 Stat. 1083-1092), as amended	1976
Federal Coal Management Program Coal Screening Process (43 CFR 3420.1-4)	1997
Federal Facilities Compliance Act of 1992 (42 U.S.C 6901-6992, P.L. 102-368)	1992
Federal Land Policy and Management Act (43 U.S.C. 1701, P.L. 94-579)	1976
Federal Land Recreation Enhancement Act (P.L. 108-477)	2004
Federal Land Transaction Facilitation Act (43 U.S.C. 2301, et seq.)	2000
Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et seq.)	1974
Federal Oil and Gas Royalty Management Act	1982
Federal Plant Pest Act (7 U.S.C. 150aa et seq.)	1957
Federal Property and Administrative Services Act of 1949	1949
Federal Water Pollution Control Act (33 U.S.C. 1251 - 1376), as amended	1948
Federal Water Projects Recreation Act [16 U.S.C 460(L)(12)- 460(L)(21)], as amended	1965
Federal Wildland Fire Management Policy	2001
Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661-667e), as amended	1934
Fish and Wildlife Conservation Act (16 U.S.C. 2901-2911)	1980
Food Security Act of 1985 (16 U.S.C. 3801-3862)	1985
General Allotment Act, Section 4 (25 U.S.C 334), as amended	1887
General Mining Law of 1872, as amended	1872
Geothermal Steam Act of 1970 (30 U.S.C. 1001 et seq.), as amended	1970
Guidance for Implementation of Federal Wildland Fire Management Policy	2009

Federal Law or Statute	Year
Healthy Forests Restoration Act (P.L. 108-148)	2003
Historic Sites Act of 1935 (16 U.S.C. 461 et seq.)	1935
Independent Offices Appropriation Act of 1952 (31 U.S.C. 9701)	1952
Lacey Act (18 U.S.C. 42), as amended	1988
Land & Water Conservation Act, as amended (16 U.S.C. 4601-4)	1965
Lode Law Act of 1866 (14 Stat. 251)	1866
Materials Act of July 31, 1947 (30 U.S.C. 601-604), as amended	1947
Migratory Bird Conservation Act of 1929 (16 U.S.C. 715-715r)	1929
Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 et seq.)	1918
Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.)	1920
Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351 et seq.)	1947
Mining and Mineral Policy Act of 1970 (30 USC 181 et seq.)	1970
Mining Claim Rights Restoration Act (30 U.S.C. 621-625)	1955
Multiple Mineral Development Act (30 U.S.C. 521-531 et seq.)	1954
Naval Petroleum Reserves Production Act (43 CFR 2361.1(f))	1976
National Environmental Policy Act (42 U.S.C. 4321 et seq.)	1969
National Fire Plan	2000
National Historic Trails System Act (16 U.S.C. 1241-1249), as amended	1968
National Historic Preservation Act of 1966 (16 U.S.C. 470)	1966
National Materials and Minerals Policy, Research and Development Act of 1980 (P.L. 96-479, 94 Stat. 2305)	1980
National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300).	1998
National Parks and Recreation Act of 1978 (16 U.S.C. 1242 and 1243)	1978
National Trails System Act of 1968 (16 U.S.C. 1241 et seq.), as amended	1968
National Wild & Scenic Rivers Act (16 U.S.C. 1271 et seq.)	1968
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.)	1990
Neotropical Migratory Bird Conservation Act (P.L. 106-247)	2000
Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 et seq.)	1990
Noxious Weed Control Act of 2004 (P.L. 108-412)	2004
O&C Lands Act of 1937 (62 Stat. 162)	1948
Occupational Safety and Health Act (29 U.S.C. 651 et seq.)	1970
Oil Pollution Act (33 U.S.C. 2701 et seq.)	1990
Placer Law - Act of July 9, 1870 (16 Stat. 217)	1870
Plant Protection Act (7 U.S.C. 7701-7772)	2000
Pollution Prevention Act (42 U.S.C. 13101)	1990
Public Range Improvement Act (43 U.S.C. 1901 et seq.)	1978
Public Rangelands Improvement Act of 1978 (43 U.S.C. 1901 et seq.)	1978
Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States	2008
Record of Decision for Designation of Energy Corridors on BLM-Administered Lands in the 11 Western States	2009
Recreation and Public Purposes Act (43 U.S.C. 869), as amended in 1988	1926
Reorganization Plan No. 3 of 1946 (5 U.S.C. Section 402)	1946

Federal Law or Statute	Year
Reservoir Salvage Act of 1960 (16 U.S.C. 469), as amended by Archeological and Historic Preservation Act of 1974	1960
Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.) and the Bevill Amendment (Section 3001(b) (3) (A) (ii) and 40 CFR 261.4(b)(7))	1976
Riparian-Wetlands Initiative for the 1990's, The U.S. Department of the Interior, Bureau of Land Management, January 22, 1992	1992
Rivers and Harbors Act of 1899 (10 U.S.C. 1899, Section 10)	1899
Safe Drinking Water Act, as amended 1977 (42 U.S.C. 201, 300 et. seq., P.L. 95-190)	1977
San Juan Basin Wilderness Protection Act of 1984 (16 U.S.C. 1132)	1984
Sikes Act of 1974, as amended (16 U.S.C. 670 et seq.)	1974
Soil and Water Resources Conservation Act of 1977 (16 U.S.C. 2001 et seq.)	1977
Soil Conservation and Domestic Allotment Act of 1935, as amended (16 U.S.C. 590)	1935
Soil Information Assistance for Community Planning and Resource Development Act of 1966 (42 U.S.C. 3271)	1966
Stock Raising Homestead Act of 1916 as amended (43 U.S.C. 299)	1916
Surface Mining Control and Reclamation Act (30 U.S.C. 1201 et seq.)	1977
Surface Resources Act of 1955 (30 U.S.C. 611-614)	1955
Taylor Grazing Act of 1934 (43 U.S.C 315)	1934
Toxic Substance and Control Act of 1976 (P.L. 104-66), as amended in 1995	1976
Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management	2000
US Onshore Orders Onshore Order No. 1 – Approval of operations on onshore Federal and Indian oil & gas leases Onshore Order No. 2 – Onshore oil and gas drilling operations on Federal and Indian oil and gas leases Onshore Order No. 3 – Site security on Federal oil and gas leases Onshore Order No. 4 – Measurement of oil on Federal oil and gas leases Onshore Order No. 5 – Measurement of gas on Federal oil and gas leases Onshore Order No. 6 – Hydrogen sulfide operations on Federal oil and gas leases Onshore Order No. 7 – Disposal of produced water from Federal oil and gas leases	 1983 1988 1989 1989 1989 1991 1993
U.S. V. Peck, No. 97-8122, 1999 WL 33022	1999
Water Quality Act of 1987, as amended from the Federal Water Pollution Control Act of 1977 (Clean Water Act) as amended (33 U.S.C. 1251 et seq.)	1987
Water Resources Development Act	1974
Water Resources Planning Act (42 U.S.C. 1962a - 1962(a)(4)(e)), as amended	1965
Watershed Protection and Flood Protection Act, as amended (16 U.S.C. 1001 et seq.)	1954
Watershed Restoration and Enhancement Agreements ("Wyden Amendment") (P.L.104-208, Sec. 124, P.L. 10-5-277, Sec. 136 of the 1999 Interior Appropriations Act of 1998)	1998
Wild and Free Roaming Horse and Burro Act (P.L. 92-195)	1971
Wild and Scenic Rivers Act (16 U.S.C. 1271 et seq.)	1968
Wilderness Act of 1964 (16 U.S.C. 1131), as amended	1964

6.1.2 Regulations and Policies

BLM Directive	Year
Abandoned Mine Lands National Strategic Plan	2006
Applications for Permits to Drill Fees	2007
Applications for Permits to Drill (APDs)	2007
Best Management Practices – "The Gold Book"	2007
BLM 3809 Manual (1985, revised 2001)	2001
BLM Handbook (Draft) H-2101-5 – Environmental Site Assessments for Disposal of Real Property	2004
BLM Handbook 2200-1, Land Exchange Handbook	2005
BLM Handbook 3809 (Draft 2006)	2006
BLM Handbook H-1112-2, Safety and Health for Field Operations Manual	1998
BLM Handbook H-1703-1, Response Actions NCP/CERCLA	2001
BLM Handbook H-1742-1, Burned Area Emergency Stabilization and Rehabilitation Handbook	2007
BLM Handbook H-1790-1, National Environmental Policy Act	2008
BLM Handbook H-2101-4, Pre-Acquisition Environmental Site Assessments	2000
BLM Handbook H-3042-1, Solid Minerals Reclamation Handbook	1992
BLM Handbook H-3720-1, Abandoned Mine Land Program Policy	2007
BLM Handbook H-3809-1, for Mineral Examiners, v. 3-332, Sept., 11, 2007	2007
BLM Handbook H-3809-3, Validity Mineral Reports, June 1969	1969
BLM Handbook H-4180-1 Rangeland Health Standards	2001
BLM Handbook H-8160-1, General Procedural Guidance for Native American Consultation	1994
BLM Handbook H-9214-1, Prescribed Fire Management Handbook	1998
BLM Information Bulletin No. WO-2002-101, Cultural Resource Considerations in Resource Management Plans	2002
BLM Instruction Memorandum No. 2008-009, Potential Fossil Yield Classification System for Paleontological Resources on Public Lands	2007
BLM Instruction Memorandum No. WO-2003-147, Application for Permit to Drill - Process Improvement #3 - Cultural Resources	2003
BLM Instruction Memorandum No. WO-2005-003, Cultural Resources and Tribal Consultation for Fluid Minerals Leasing	2005
BLM Instruction Memorandum No. WO-2005-227, NHPA Section 106 and Oil and Gas Permitting	2005
BLM Instruction Memorandum No. WO-99-039, Issuance of Grazing Permits in Compliance with Applicable Laws, Regulations and Policy	1999
BLM Instruction Memorandum No. WY-97-111, Report of Conformance of BLM Land Use Plans with the S&Gs on the Public Lands; Follow-up Maintenance of Land Use Plans	1997
BLM Instruction Memorandum No. WY-99-20, Complying with Section 106 in Conformance with WO IM No. 99-039	1999
BLM Instructional Memorandum No. WO-2003-147, Application for Permit to Drill - Process Improvement #3 - Cultural Resources	2003

BLM Directive	Year
BLM Instructional Memorandum No. WO-2005-003, Cultural Resources and Tribal Consultation for Fluid Minerals Leasing	2005
BLM Instructional Memorandum No. WO-2005-227, NHPA Section 106 and Oil and Gas Permitting	2005
BLM Instructional Memorandum No. WO-99-039, Issuance of Grazing Permits in Compliance with Applicable Laws, Regulations and Policy	1999
BLM Instructional Memorandum No. WY-97-111, Report of Conformance of BLM Land Use Plans with the S&Gs on the Public Lands; Follow-up Maintenance of Land Use Plans	1997
BLM Instructional Memorandum No. WY-99-20, Complying with Section 106 in Conformance with WO IM No. 99-039	1999
BLM Instructional Memorandum WY-2005-046, Conservation measures and best management practices for the management of potential gray wolf habitat	2005
BLM Instructional Memorandum WY-2005-058, Conservation measures and best management practices for the management of potential Canada lynx habitat	2005
BLM Instructional Memorandum WY-2006-037, Conservation measures and best management practices for the management of potential Black-footed ferret habitat	2006
BLM Instructional Memorandum WY-2006-049, Conservation measures and best management practices for the management of grizzly bear habitat	2006
BLM Instructional Memorandum WY-2007-018, Conservation measures and best management practices for the management of mountain plover habitat	2007
BLM Land Use Planning Handbook H-1601-1	2005
BLM Manual 1737, Riparian Habitat	1992
BLM Manual 2800, Cadastral Surveys-General	1985
BLM Manual 3060, Mineral Reports - Preparation and Review, April 7, 1994	1994
BLM Manual 4180 , Land Health	2001
BLM Manual 6500, Manual of Wildlife, Fish and Plant Resources	2002
BLM Manual 6840, Special Status Species Management	1988
BLM Manual 6840, Special Status Species Policy	2008
BLM Manual 8100, Cultural Resource Management	2004
BLM Manual 8160, Native American Consultation and Coordination	1990
BLM Manual 8340, Off-Road Vehicles	1982
BLM Manual 8341, Conditions of Use (Off- Road Vehicles)	1979
BLM Manual 8342, Designation of Roads and Trails	1988
BLM Manual 8343, Vehicle Operations	1979
BLM Manual 8344, Permits	1979
BLM Manual 8400, Visual Resource Management	1980
BLM Manual Section 1703, Hazardous Materials Management	2007
BLM Manual Section 7240, Water Quality	1978
BLM Manual Section 7250, Water Rights	1984
BLM Manual Section 8270-1, General Procedural Guidance for Paleontological Resource Management	1998
BLM Policy Statement on Riparian Area Management	1987

BLM Directive	Year
BLM TR 1734-6 Version 4: Interpreting Indicators of Rangeland Health	2005
BLM TR 1737 series: Riparian Area Management Assessing Proper Functioning Condition (PFC) for Lotic and Lentic areas	various
BLM Wyoming Riparian Management Activity Guide	1991
BLM Wyoming Sensitive Species Policy and List	2002
Board of Regents of the University of Oklahoma, 165 IBLA 231	2005
BLM grazing administration range improvements and water rights (43 CFR 4100 et seq.)	2002 (revised)
Cave Management (43 CFR 37.4(c) and 37.11(c)(3)(iii))	1988
Competitive Leasing (43 CFR 3120)	2002
Delegation of Authority, Cooperative Agreements, & Contracts for Oil & Gas Inspection (43 CFR 3190)	1987
Federal Coal Management Program Regulations (43 CFR Group 3400)	1979
Federal Manual for Identifying and Delineating Jurisdictional Wetlands	1991
Fish and Wildlife 2000 BLM National, State and District policies	2000
Geothermal Resource Leasing (43 CFR 3200)	1998
Geothermal Resources Unit Agreements (43 CFR 3280)	1973
Instructional Memorandum 2002-196	2002
Instructional Memorandum 2003-020, Interim Wind Energy Development Policy	2003
Instructional Memorandum 2005-069, Offsite Compensatory Mitigation Guidelines	2005
Instructional Memorandum 2005-176, Filing of Protests on lands Included in Oil and Gas Lease Sales	2005
Instructional Memorandum 2005-210, Energy Policy and Conservation Act (EPCA) Inventory – Data Compilation for Phases III and IV	2005
Instructional Memorandum 2005-247, National Environmental Policy Act (NEPA) Compliance for Oil, Gas, and Geothermal Development	2005
Instructional Memorandum 2006-071, Process Improvement for Oil, Gas, Geothermal, Geophysical, and Related Rights-of-Way Approvals	2006
Instructional Memorandum 2006-206, Oil and Gas Bond Adequacy Reviews	2006
Instructional Memorandum No. 2006-145, Cooperative Conservation Based Strategic Plan for the Abandoned Mine Lands Program	2006
Instructional Memorandum No. 2007-096, Refinement of the Methodology to Identify Abandoned Mine Land Sites Near Populated Places and High Use Areas	2007
Instructional Memorandum No. WY-2003-011	2002
Instructional Memorandum No. WY-2006-009	2006
Mineral Leasing Act of 1920 (43 CFR From 3100-11 (July 2006), 43 CFR Part 3160)	1920
Mineral Leasing Act of 1920 (43 CFR 2006 3425.1–7(a)(2)(iv, v))	1920
Mineral Leasing Act of 1920 (43 CFR 2006 3461.5(h)(2)(i))	1920
Mineral Leasing Act of 1920 and others (43 CFR 2006 3591.1(b)(10))	1920
Mineral Leasing Act of 1920 and others (43 CFR 2006 3430.4-4(a)(10); 43 CFR 2006 3430.4-4(b)(8))	1920

BLM Directive	Year
Minerals Management, Generally (43 CFR 3000)	1983
National Contingency Plan Regulations (40 CFR 300)	1994
National Management Strategy for Motorized Off-highway Vehicle Use on BLM Public Lands	2001
National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties	1990
Natural Resource Damage Assessment Regulations (43 CFR Part 11)	1986
Noncompetitive Leasing (43 CFR 3110)	1988
Off-Road Vehicle Implementation Strategy Washakie Resource Area	1994
Oil and Gas Leasing (43 CFR 3100)	1983
Onshore Oil and Gas Geophysical Exploration (43 CFR 3150)	1988
Onshore Oil and Gas Operations (43 CFR 3160)	1982
Onshore Oil and Gas Unit Agreements; Unproven Areas (43 CFR 3180)	1983
Permits for Recreation on Public Lands (43 CFR 2930)	2004
Riparian-Wetlands Initiative for the 1990's, The U.S. Department of the Interior, BLM	1992
Solicitor's Opinion of Jan. 17, 1986	1986
Solicitor's Opinion of July 10, 1963	1963
Solicitor's Opinion of Oct. 12, 1956	1956
Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming	2004
Standards for Healthy Rangelands, Standard #2	1997
The Standards for Healthy Rangelands and Guidance for Livestock Grazing Management (43 CFR 4180)	1997
WO- Instructional Memorandum -2002-034, Recent Changes in Management Direction: Federal Wildland Fire Management Policy, National Fire Plan	2002
WY Instructional Memorandum No. 2005-034, Travel Management Guidelines for the Public Lands in Wyoming	2005
WY Instructional Memorandum No. 89-402, April 3, 1989, Inspection and Enforcement Program for Locatable Minerals Activities	1989
WY-2001-040, Issuance of BLM (Wyoming) Sensitive Species Policy and List (Expires 9/30/02)	2001
Wyoming BLM Coal/Coal Bed Methane Policy	2000
Wyoming BLM Soil Program Ten Year Strategy	2003
Wyoming Instructional Memorandum 87-672, August 26, 1987	1987

6.1.3 Applicable Wyoming State Laws and Regulations

Wyoming State Laws and Regulations
Wyoming State Engineer's Office Statutes, Rules & Regulations
State of Wyoming Occupational Health and Safety Rules & Regulations
State of Wyoming Oil & Gas Conservation Commission Rules & Regulations
Wyoming Department of Environmental Quality Rules & Regulations
State of Wyoming Occupational Health and Safety Rules & Regulations
State of Wyoming Oil & Gas Conservation Commission Rules & Regulations
Wyoming Department of Environmental Quality Rules & Regulations

6.1.4 Memoranda and Agreements

Memoranda and Agreements	Year	Description
Memorandum of Understanding No. WY 19	2003	Between the United States DOI BLM and the Wyoming DEQ-Land Quality Division (LQD) and addresses Management Of Surface Mining and Exploration for Locatable Minerals On Public Lands. It was signed November 11, 2003. This is a Supplemental Memorandum to the General Statewide MOU dated October, 1975, between the Governor of Wyoming and the United States, by and through the State Director, Bureau Of Land Management, United States, Department of the Interior.
Wyoming DEQ	N/A	There are currently no agreements between BLM and the State of Wyoming DEQ-LQD regarding exploration for or development of non-energy leasable minerals. Wyoming DEQ-LQD processes applications for these minerals under their "Non-Coal" rules and regulations. It is possible that the same Memorandum of Understanding between BLM and Wyoming DEQ-LQD for locatable minerals would have some valuable application should these two agencies need to work together to process applications related to non-energy leasable minerals.
Clean and Diversified Energy Initiative	2005	Recommends initiatives to facilitate the timely leasing and permitting of geothermal resources.
BLM Memorandum of Understanding WO300-2006-08, April 2006	2006	Facilitate interagency coordination and establish policies and procedures to implement Section 225 of the Energy Policy Act of 2005.
National Memorandum of Understanding between the BLM and the Department of Defense		This Memorandum of Understanding outlines procedures for processing Notices of Intent (NOIs) to conduct geophysical operations when Air Force, Army, and Navy lands are involved. The Department of Defense will be the lead agency when their lands are involved in an NOI.
Interagency between BLM and Bureau of Reclamation cy Agreement		The BLM has jurisdiction over NOIs to conduct geophysical exploration which involve Bureau of Reclamation (BOR) lands. The BOR will be contacted for their conditions of approval.

Memoranda and Agreements	Year	Description
Memorandum of Understanding between BLM and State of Wyoming Oil and Gas Conservation Commission		Outlines the handling of NOIs to conduct geophysical exploration and sharing of information and compliance inspections. The State of Wyoming Oil and Gas Conservation Commission (WOGCC) has jurisdiction over injection wells and spacing.
Memorandum of Agreement, between the Wyoming Department of Environmental Quality and the State of Wyoming Oil and Gas Conservation Commission	1999	Wyoming DEQ delegated permitting of road applications for oilfield wastes when the wastes are to be applied on the lease, unit, or communitized area. Wyoming DEQ still has the jurisdiction for permitting road application of oil field wastes outside of the lease, unit, or communitized area.
Interagency Agreement between the U. S. Forest Service and the BLM	2006	Establishes procedures for the administration of oil and gas operations on federal leases within the National Forest System.
Memorandum of Understanding BLM/APHIS-Wildlife Services (ADC)	2003	Detailing cooperative efforts between the two groups on suppression of grasshoppers and Mormon crickets on BLM lands (Document #03-8100-0870-MU, February 27, 2003), and local National Resource Conservation Service (NRCS).
Western Association of Fish and Wildlife Agencies WAFWA/USFS/BLM/USFWS Memorandum of Understanding (08-31-2000)	2000	Involving the management of sage grouse and their habitat.
Memorandum of Understanding between the BLM and the Department of Agriculture (60F26045-48)	1995	Predator control protocols were formalized in this Interagency Memorandum of Understanding.
Cooperative Agreements with Weed and Pest Districts	2003-2009	Popo Agie Conservation District, Lower Wind River Conservation District, Dubois Crowheart Conservation District, weed and pest management
Programmatic Agreement Among BLM, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Offices (SHPOs)	1997	Regarding the Manner in which BLM will meet its responsibilities under the NHPA.
State Protocol Agreement Between the Wyoming BLM State Director and the Wyoming SHPO	2006	Regarding the Manner in which BLM will meet its responsibilities under the NHPA.
Memorandum of Agreement WY-7		Memorandum of Agreement between the BLM and the Wyoming Recreation Commission; addresses land classifications and withdrawals to protect public lands generally, and specifically to protect historic trails.
Memorandum of Agreement WY-19		Memorandum of Agreement between the BLM and the Wyoming Governor, addresses overall cooperation in public and state land management efforts.

Memoranda and Agreements	Year	Description
Memorandum of Agreement WY-20		Memorandum of Agreement between the BLM and the Wyoming Game and Fish Commission, addresses a myriad of land and resource management issues, including classifications, land acquisition and disposal, and access.
Memorandum of Agreement WY-21		Memorandum of Agreement between the BLM and Region II and Region IV of the U.S. Forest Service, addresses overall coordination on a myriad of land and resource management issues.
Memorandum of Agreement WY-63		Memorandum of Agreement among the BLM, the U.S. Forest Service, Wyoming Department of Public Lands and the Wyoming Game and Fish Commission, addresses public land access and management of access problems.
Memorandum of Agreement WY-65		Memorandum of Agreement between the BLM and the ASCS, addresses overall coordination on a myriad of land and resource management issues.
Memorandum of Agreement WY-77		Memorandum of Agreement among the BLM, the ASCS, U.S. Forest Service, AES, and Wyoming State Conservation Commission, addresses overall coordination on conservation planning projects.
Memorandum of Agreement WY-117		Memorandum of Agreement among the BLM and the Wyoming Board of Land Commissioners, the Wyoming State Historic Preservation Office and the Advisory Council on Historic Preservation, addresses cultural resource protection in state exchanges.
Memorandum of Agreement WY-118		Memorandum of Agreement between the BLM and the Wyoming Board of Land Commissioners, addresses processing state exchanges.
Memorandum of Agreement WY-119		Memorandum of Agreement between the BLM and the ASCS, addresses management of agricultural trespass.
Memorandum of Agreement WY-121		Memorandum of Agreement between the BLM and the National Park Service, addresses management of the Oregon National Historic Trails.
Memorandum of Agreement WY-122		Memorandum of Agreement among the BLM and the U.S. Forest Service, Wyoming Department of Public Lands, Wyoming Game and Fish Commission, Wyoming Recreation Commission, Wyoming Department of Agriculture, and the Wyoming State Planning Coordinator's Office, addresses access to public land.
Memorandum of Agreement WY-131		Memorandum of Agreement between the BLM and the WGFD, addresses overall coordination on land and resource management.
Memorandum of Agreement WY930-91-06-38		Memorandum of Agreement between the BLM and the Wyoming Board of Land Commissioners, addresses exchange pooling.
Memorandum of Agreement WY930-91-06-39		Memorandum of Agreement between the BLM and the Wyoming Board of Land Commissioners, addresses exchange of state land in holdings in wilderness areas.

Memoranda and Agreements	Year	Description
Memorandum of Understanding WY920-08-07-192	2007	Memorandum of Understanding (Memorandum of Understanding) WY920-08-07-192 between BLM, the Federal Aid Highway Administration, and the Wyoming Department of Transportation, addresses each agency's responsibilities in regard to processing Federal-aid highway appropriations. To implement Sections 107(d) and 317 of the Federal Aid Highway Act (23 U.S.C. 107(d) and 317), as amended, the agencies operate under this Memorandum of Understanding (updated in August 2007). All appropriations under the Federal Aid Highway Act are required to be consistent with the referenced Memorandum of Understanding.
Memorandum of Understanding WY920-02-09-108	2002	Between the BLM, the FHWA, and the Wyoming Department of Transportation that defines each agency's responsibilities in regard to processing federal-aid highway appropriations.
Programmatic Agreement Among BLM, the Advisory Council on Historic Preservation, and the National Conference of SHPOs	1997	Regarding the Manner in which BLM will meet its Responsibilities Under the NHPA.
State Protocol Agreement between the Wyoming BLM State Director and the Wyoming SHPO	2006	Regarding the Manner in which BLM will meet its Responsibilities Under the NHPA.
Assistance agreement KAA990028-Abandoned Mine Land Reclamation Agreement		The AML program in Wyoming currently operates pursuant to this assistance agreement between the Wyoming State Office of the BLM and the Wyoming DEQ. It provides for the cooperative effort between the two agencies for a long term relationship to efficiently and economically plans for, and share responsibilities to ensure, effective abandoned mine land reclamation on public lands in Wyoming.

7.0 SUMMARY OF SCOPING REPORT

7.1 Purpose of the Scoping Process

Public involvement, which includes the scoping process, is a vital component of the FLPMA and NEPA. Through the public involvement process, the public is able to participate in the planning process. NEPA requirements for public involvement are set forth in the Council on Environmental Quality regulations 40 CFR 1500–1508.

The purpose of the public scoping process is to identify issues and planning criteria that should be considered in the Lander RMP revision and associated EIS and to initiate public participation in the planning process. Issues identified during the scoping process are then used to formulate management alternatives later on in the revision process. As part of the scoping process, the BLM solicited comments and issues from the public, organizations, tribal governments, and federal, state, and local agencies, as well as from BLM specialists.

7.2 Scoping Period

The scoping period for the Lander RMP revision project began with the publication of the Notice of Intent in the Federal Register on February 13, 2007. The Notice of Intent served to notify the public of the BLM's intent to revise the RMP for the Lander planning area, provide the location of the public scoping meetings, and identify the preliminary issues and preliminary planning criteria to be utilized in the RMP revision process. The scoping period lasted 60 days ending on April 16, 2007.

During the scoping process, the BLM hosted 5 public scoping meetings in locations across the planning area to provide the public with an opportunity to learn and ask questions about the project and the planning process and to submit their issues and concerns to the BLM. Approximately 70 individuals attended the public meetings which were held in Riverton, Shoshoni, Jeffrey City, Dubois, and Lander in March 2007. The times and locations of public scoping meetings were advertised to the public using a variety of outreach methods. The number of comments obtained during those meetings and the resource areas addressed during scoping are summarized in the Table 7-1.

The BLM received approximately 30 comment documents during the scoping process. Comment documents were submitted to the BLM in person, mailed to the Lander Field Office, or submitted via e-mail. Commenters included individuals, private organizations, businesses, county governments, conservation districts, and state and federal agencies. Most comment documents received contained multiple comments. The BLM identified approximately 725 unique comments from the comment documents that related to RMP planning issues. In addition, the BLM received a number of comments that fall outside the scope and will not be addressed in the RMP including comments related to policy, regulatory, or administrative actions.

Table 7-1. Number of Public Comments for Each Resource Area Received During the Public Scoping Period for the Lander Resource Management Plan Revision

Resource and Resource Uses	Number of Comments	Resource and Resource Uses	Number of Comments
Air Quality	8	Recreation	31
Coal	7	Scenic Byways	2
Cultural Resources	15	Scenic Trails	2
Cumulative Impacts	2	Soils	3
Drought	9	Special Recreation Management	18
Fire Management	9	Threatened and Endangered Species	11
Forest Management	16	Vegetation	0
Grazing	84	Water	25
Historical and Cultural Resources	1	Wild and Scenic Rivers	11
Historic Trails	7	Wild Horses	3
Mineral Leasing	156	Wilderness	24
Noise	1	Wildlife	75
Oil and Gas	40	Wind Energy	3

Planning Issues

As part of the scoping process the BLM identified key issues that are considered in the RMP revision process. Planning issues are controversies or concerns about existing and potential land and resource allocations, levels of resource use, production, and related management practices. Issue identification is a key component of the scoping process, and the BLM used a multi-step process to categorize and distill the issues presented in the scoping comments. All issues identified during scoping will be considered in alternative formulation and the effects analysis.

The issues identified by the BLM during the scoping process are presented below in the form of questions. These issue statements summarize the key questions and concerns identified in the scoping comments. Adjustments to the planning issues will continue to be made as needed during the planning process as the BLM receives additional input from the public and cooperators.

Climate Change:

- How can the BLM incorporate climate change into its land management practices?

Watershed and Air Management:

- How can the BLM manage use of public lands while protecting watershed and air quality?

Energy and Minerals Management:

- Which areas should be open to mineral and energy development, and how should BLM manage such development while protecting human health as well as natural and cultural resources?

Fire and Fuels Management:

- How can the BLM manage fire and fuels to protect public safety as well as natural and cultural resources?

Invasive and/or Noxious Species:

- How can the BLM manage the spread of and mitigate impacts associated with invasive species and/or noxious weeds?

Fish, Wildlife, and Special Status Species:

- How can the BLM manage public land use while maintaining and improving terrestrial and aquatic habitats?

Wild Horses:

- How can the BLM manage wild horses on public lands while also protecting natural and cultural resources?

Cultural and Paleontological Resources:

- How can the BLM manage paleontological, cultural, and traditional resources to provide both resource protection and opportunities for public education and study?

Visual Resources:

- How can the BLM manage public lands for visual qualities?

Lands and Realty:

- What land tenure and management adjustments are needed to meet access and development needs, while also protecting natural and cultural resources?

Comprehensive Trails and Travel Management, and OHV:

- How can the BLM manage travel on public lands?

Recreation and Visitor Use:

- How can the BLM provide recreational opportunities on public lands while protecting public safety, and natural and cultural resources?

Livestock Grazing:

- How can the BLM manage livestock use on public lands while also protecting natural and cultural resources?

Special Designation Management:

- How can the BLM manage areas that contain unique or sensitive resources?

Socioeconomic Resources:

- How can the BLM manage public land use with the preservation of local tradition and local economies that rely upon BLM-administered land?

For a detailed description of all issues identified during scoping, please refer to the Lander Field Office Final Scoping Report (BLM 2007). The scoping report is available on the Lander RMP website, http://www.blm.gov/wy/st/en/info/NEPA/lfodocs/lander_rmp.html.

8.0 LIST OF PREPARERS

Name	Education	Title	Role	Years of Experience
BLM Team				
Kristin Yannone	B.A. History J.D. Law	Environmental Planner and Coordinator	Project Manager/Inspector and Team Leader	21
Jim Cagney	B.S. Range/Forest Management	Field Office Manager (acting)	Lander Field Office Manager	32
Connie Breckenridge	B.S., Fish and Wildlife Biology, Iowa State University	GIS Specialist	GIS Data Management	27
Sydney Schoepke	B.S. Land Resource Management, MS Applied Geographic Information Sciences	GIS Specialist	GIS Data Management	1
Beth Ransel	M.S. Environmental Policy and Management, B.S. Environmental Studies	Assistant Field Manager for Minerals and Lands (Acting)	Realty Specialist	6
Greg Bautz	B.S. Resource Management	Soil Scientist	Soil, Surface Water, Invasive	29
Jared Oakleaf	B.A. Geography and Recreation, B.A. Environmental and Natural Resources	Outdoor Recreation Planner	Cave and Karst, Recreation, Travel Management, Wild and Scenic Rivers, Wilderness Study Areas, Areas with Wilderness Characteristics, Visual Resources, ACECs, National Scenic Trails	9
Scott Fluer	B.S. Range Science	Rangeland Management Specialist	Vegetation, Riparian/Wetland Areas, Livestock Grazing, ACECs	23
Tim Kramer	B.S. Rangeland Resources and History, M.S. Rangeland Resources, Crops and Soil Sciences	Natural Resource Specialist,Fire and Fuels	Forestry, Fire and Fuels	13
Sue Oberlie	B.S. Wildlife Management; B.S. Secondary Education	Wildlife Biologist	Fish & Wildlife, Special Status Species, ACECs	25
Craig Bromley	B.A. Anthropology	Archeologist	Cultural, Paleontology, National Historic Trails, ACECs	31
Jon Kaminsky	B.A. Geology, M. Sci. Hydrogeology	Geologist	Geology, Solid Minerals, Mineral Occurrence Report	22
Roy Packer	B.S. Forestry and Range and Watershed Management	Rangeland Management Specialist	Wild Horses	35

Name	Education	Title	Role	Years of Experience
Leta Rinker	B.S. Business Administration, B.A. Business Managemenet	Realty Sepcialist	Lands & Realty, including Transportation/Access and ROWs, Renewable Energy Utility/Communication Corridors, Land Tenure	24
Stuart Cerovski	B.S. Petroleum Engineering	Petroleum Engineer	Fluid Minerals	26
Roy Allen	B.S. Chemistry M.S. and PhD Economics	Social Conditions/ Economic Conditions/ Environmental Justice	Socioeconomics	32
Dean Stillwell	B.S. Geology and M.S. Geology	Geologist	Oil and Gas, RFD	31
Stan William Davis-Lawrence	B.S. Math/Physics/ Geophysical Engineering, M.S. Geophysical Engineering	Petroleum Engineer	Oil and Gas, RFD	36
Alfred M. Elser	B.S. Geology, M.S. Geology, and Ph.D. Chemistry with a concentration in geochemistry	Petroleum Geologist	Oil and Gas, RFD	5
John Zachariassen	B.S. Biology, 1981, Carleton University M.S. Soils, 1985, University of Nebraska-Lincoln Ph.D., Biogeochemistry/ Atmosphere-Bios Interactions, 1992 Colorado State University	Air Quality Specialist	Air Quality	11
Contractor				
SAIC and ICF International				

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9.0 GLOSSARY

The definitions provided below are the broadest meaning and context of a particular term or phrase. For any specific application the statutes, executive orders, regulations, or other State Director policies relative to the subject activity should be consulted first for a more specific meaning of a particular term or phrase. Additional glossary terms are contained in the Land Use Planning Handbook and other guidance, laws, regulations and directives.

Areas Administratively Unavailable to Leasing: BLM H-1601-1 - Land Use Planning, Appendix C.4 uses the term areas closed to oil and gas leasing. Areas administratively unavailable or closed to oil and gas leasing are areas where it has been determined that other land uses or resource values cannot be adequately protected with even the most restrictive oil and gas leasing stipulations; appropriate protection can be ensured only by making the areas administratively unavailable to oil and gas leasing for the life of the plan. Lands currently under lease would remain leased for the life of the leases. After expiration of these leases, no lands would be available for lease.

Allotment: An area of land where one or more livestock operators graze their livestock. Allotments are Bureau of Land Management (BLM) lands, but may also include other federally managed, state-owned, and private lands. An allotment may include one or more separate pastures. Livestock numbers and periods of use are specified for each allotment. Allotments are classified by the following:

Category I – Improve Existing Resource Conditions

Category M – Maintain Existing Resource Conditions

Category C – Custodial Management.

Analysis Area: Any lands, regardless of jurisdiction, for which the BLM synthesizes, analyzes, and interprets data for information that relates to planning for BLM-administered lands.

Animal Unit Month (AUM): A standardized measurement of the amount of forage necessary for the sustenance of one cow unit or its equivalent for 1 month (approximately 800 pounds of forage).

Appropriate Management Response (AMR): Term formerly used for Fire Management Response planning. Current term is Response to Wildland Fire (RWF).

Authorized /Authorized Use – This is an activity (i.e., resource use) occurring on the Public Lands that is either explicitly or implicitly recognized and legalized by law or regulation. This term may refer to those activities occurring on the Public Lands for which the BLM, or other appropriate authority (e.g., Congress for RS 2477 rights-of-way [ROWs], FERC for major, interstate ROWs, etc.), has issued a formal authorization document (e.g., livestock grazing lease/permit; right-of-way grant; coal lease; oil and gas permit to drill; etc.). Formally authorized uses typically involve some type of commercial activity, facility placement, or event. These formally authorized uses are often spatially or temporally limited. Unless constrained or bounded by statute, regulation, or an approved land use plan decision, legal activities involving public enjoyment and use of the Public Lands (e.g., hiking, camping, hunting, etc.) require no formal BLM authorization.

Authorized Surface-Disturbing Activities: See Surface-Disturbing Activities

Big Game Crucial Winter Range: Winter habitat on which a wildlife species depends for survival. Because of severe weather conditions or other limiting factors, no alternative habitat would be available.

Borrow Material: A term used in conjunction with construction. The term refers to unprocessed material excavated from a borrow pit for use as fill at another location.

Carbon Dioxide Flood: A carbon dioxide flood is an enhanced oil recovery technique that injects fluid into the reservoir. When carbon dioxide is injected, it mixes with the oil and the two compounds dissolve into one another. The injected CO_2 acts as a solvent to overcome forces that trap oil in tiny rock pores and helps sweep the immobile oil left behind after the effectiveness of water injection decreases, resulting in increased oil production (EnCana 2005).

Casual Use: The term varies in meaning depending upon the use or resource involved. Reference to the guidance for the particular application must be made.

Cheatgrass: Cheatgrass is an annual grass that forms tufts up to 2 feet tall. The leaves and sheaths are covered in short, soft hairs. The flowers occur as drooping, open, terminal clusters that can have a greenish, red, or purple hue. Flowering occurs in the early summer. These annual plants will germinate in fall or spring (fall is more common), and senescence usually occurs in summer. Cheatgrass invades rangelands, pastures, prairies, and other open areas. Cheatgrass has the potential to completely alter the ecosystems it invades. It can completely replace native vegetation and change fire regimes and is most problematic in areas of the western United States with lower precipitation levels.

Class I Wells: Injection wells that are

(1) Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities to inject hazardous waste beneath the lowermost formation containing, within ¼ mile of the well bore, an underground source of drinking water.

(2) Other industrial and municipal disposal wells that inject fluid beneath the lowermost formation containing, within ¼ mile of the well bore, an underground source of drinking water.

(3) Radioactive waste disposal wells that inject fluid below the lowermost formation containing an underground source of drinking water within ¼ mile of the well bore.

Class II Wells: Injection wells

(1) That are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production, and may be commingled with wastewaters from gas plants, which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.

(2) For enhanced recovery of oil or natural gas.

(3) For storage of hydrocarbons that are liquid at standard temperature and pressure.

Closed: Generally denotes that an area is not available for a particular use or uses; refer to specific definitions found in law, regulations, or policy guidance for application to individual programs.

Commodity: An economic good, such as a product of agriculture or mining.

Commodity Production: Production aim at maximizing commercial benefit of resource use.

Communication Site Management Plan: A plan that provides for effective administration of a communications site. The site plan defines the principles and technical standards adopted in the site designation. The site plan provides direction for the day-to-day operations of the site in connection with the lease. The site plan shall delineate the types of uses that are appropriate at this site and the technical and administrative requirements for management of the site. The site plan should reflect the complexity of the current situation and the anticipated demand for the site.

Comprehensive Weed Management Plan: A plan for controlling invasive plant species that incorporates integrated weed management techniques and accounts for pertinent considerations, such as management actions and allocations affecting weeds.

Condition of Approval: A site-specific and enforceable requirement included in an approved Application for Permit to Drill or sundry Notice that may limit or amend the specific actions proposed by the operator. Conditions of Approval minimize, mitigate, or prevent impacts to resource values or other uses of public lands.

Controlled Surface Use (CSU): Surface occupancy or use will be restricted or prohibited unless the operator and surface managing agency arrive at an acceptable plan for mitigation of anticipated impacts. Identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for the no surface occupancy or timing limitation stipulations.

Cooperative Monitoring: Joint Cooperative Monitoring – Process where partners voluntarily help us collect monitoring information. This involves data collected by outside parties in a cooperative manner and assumes some level of agreement in advance as to the data to be collected as well as the specific methods, timing and locations for data collection. Although data may be provided by permittees or other groups or individuals outside of the agency without prior discussion or agreement, that would not be considered joint cooperative monitoring regardless of whether or not the agency considers the data provided to be useful or accurate.

Data collected by state or federal agencies that are responsible for resources or monitoring on public land, or contractors that we have hired to collect monitoring information is not necessarily considered to be joint cooperative monitoring.

Cultural Resource Inventory Levels: A three-tiered process for discovering, recording, and evaluating cultural resources.

(a) Class I - A review of existing literature and oral informant data combined with an analysis of a specific geographic region (e.g., an area of potential effect, drainage basin, resource area, etc.).

(b) Class II - A sampling survey usually aimed at developing and testing a predictive model of cultural resource distribution.

(c) Class III - An on-the-ground survey to discover, record, and evaluate cultural resources within a specific geographic area (e.g., usually an area of potential effect for a proposed undertaking).

(d) dB (decibel): A unit of measurement of the loudness or strength of a signal. One decibel is considered the smallest difference in sound level that the human ear can discern. Decibels are a relative measurement derived from two signal levels: a reference input level and an observed output level. A decibel is the logarithm of the ratio of the two levels. One Bel is when the output signal is 10x that of the input and one decibel is $1/10^{th}$ of a Bel.

Desired Plant Community (DPC): Of the several plant communities that may occupy a site, the DPC is the community that has been identified through a management plan to best meet the plan's objectives for the site. At a minimum, it must protect the site.

Disruptive Activities: Those Public Land resource uses/activities that are likely to alter the behavior, displace, or cause excessive stress to existing animal or human populations occurring at a specific location and/or time. In this context, disruptive activity(ies) refers to those actions that alter behavior or cause the displacement of individuals such that reproductive success is negatively affected, or an individual's physiological ability to cope with environmental stress is compromised. This term does not apply to the physical disturbance of the land surface, vegetation, or features. Examples of disruptive activities may include noise, human foot or vehicle traffic, domestic livestock roundups, or other human presence regardless of the activity. When administered as a land use restriction (e.g., *No Disruptive Activities*), this term may prohibit or limit the physical presence of sound above ambient levels, light beyond background levels, and/or the nearness of people and their activities. The term is commonly used in conjunction with protecting wildlife during crucial life stages (e.g., breeding, nesting, birthing, etc.), although it could apply to any resource value on the Public Lands. The use of this land use restriction is not intended to prohibit all activity or authorized uses.

Distance Zones: Landscapes are divided into three distance zones based on relative visibility from travel routes or observation points. The Foreground Middle Ground Zone is an area between 0 and 5 miles, the Background Zone is an area between 6-15 miles, and the Seldom Seen zone is the area beyond the Background and areas within the Foreground/Middle ground that cannot be seen.

Ecological Site: A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in that the site has the ability to produce distinctive kinds and amounts of vegetation and to respond to management. Ecological sites are defined and described with information about soil, species composition, and annual production.

Ecological Integrity: An approach used to evaluate the health of an ecological site, in terms of functioning as a system to meet site potential.

Ephemeral Stream: A stream that flows only in direct response to precipitation, and whose channel is at all times above the water table. Confusion over the distinction between intermittent and ephemeral streams may be minimized by applying Meinzer's suggestion that the term "ephemeral" be arbitrarily restricted to streams that do not flow continuously for at least 30 days (Prichard et al. 1998). Ephemeral streams support riparian areas when streamside vegetation reflects the presence of permanent subsurface water.

Exceedance: An event in which measurements of ambient air quality are above the national ambient air quality standard (NAAQS) or Wyoming Department of Environmental Quality (DEQ) standard set for a particular pollutant. For example, an annual average nitrogen dioxide value of 110 µg/m3 is an exceedance of both the NAAQS and Wyoming DEQ annual average standard for nitrogen dioxide of 100 µg/m3.

Exception: A one-time exemption for a particular site within the leasehold; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold. An exception is a limited type of waiver.

Exclusion Areas: Areas with sensitive resource values where rights-of-way and 302 permits, leases, and easements would not be authorized.

Please use definition from land use planning handbook.**Fire Management Plan:** Identifies appropriate strategies to achieve resource objectives. Identifies fire policy, objectives, and prescribed actions; may include maps, charts, tables, and statistical data.

Fire Regime Condition Class: A classification of the amount of departure from the natural fire regime. The departure results in changes to one or more of the following ecological components: vegetation characteristics (e.g., species composition, structural stages, stand age, canopy closure, and mosaic pattern), fuel composition, fire frequency, severity, and pattern, and other associated disturbance (e.g., insect and disease mortality, grazing, and drought). The three condition classes are listed below:

(e) **Condition Class 1**

- The historic disturbance regime is largely intact and functioning (e.g., has not missed a fire return interval)
- Potential intensity and severity of fire within historic range
- Effects of disease and insects within historic range
- Hydrologic functions within normal historic range
- Vegetation composition and structure resilient to disturbances
- Nonnative species currently not present or to a limited extent
- Low risk of loss for key ecosystem components.

(f) **Condition Class 2**

- Moderate alterations to historic disturbance regime evident (e.g., missed one or more fire return intervals)
- Effects of disease and insects pose an increased risk of loss of key community components

- Riparian areas and associated hydrologic function show measurable signs of adverse departure from historic conditions
- Vegetation composition and structure shifted toward conditions less resilient to disturbances
- Populations of nonnative species may have increased, increasing the risk of further increases following disturbance.

(g) **Condition Class 3**

- Historic disturbance regime significantly altered; historic disturbance processes and impacts may be precluded (e.g., missed several fire return intervals)
- Effects of disturbance (fire, insects, and disease) may cause significant or complete loss of key community components
- Hydrologic functions may be adversely altered; high potential for increased sedimentation and reduced streamflows
- Invasive, nonnative species may be common and in some cases the dominant species on the landscape; disturbance will likely increase both the dominance and geographic extent of these invasive species
- Highly altered vegetation composition and structure predisposes community to disturbance events outside the range of historic availability; disturbance may have effects not observed or measured before.

Fire Return Interval: The number of years between two successive fire events at a specific site or area.

Flaring/Venting: The controlled burning (flare) or release (vent) of natural gas that cannot be processed for sale or use because of technical or economic reasons.

Floodplain Connectivity: Maintenance of lateral, longitudinal, and vertical pathways for biological and hydrological processes in the floodplain. Examples of failures to maintain connectivity could include culverts or levees that restrict flow in the floodplain and that focus overbank flow into the channel.

Flushing Livestock: Flushing livestock is the holding of livestock in an invasive, nonnative plant species (INPS) seed-free area where they are fed an INPS seed-free ration for 72 hours, thus flushing INPS seed from the animals' digestive systems.

Fossil: The remains or traces of an organism preserved by natural processes in the earth's crust. This would include plants and animals, their tracks, burrows, and other imprints, and are considered a non-renewable resource. It does not include minerals such as coal, oil and gas, and tar sands.

Geologic Resources: Resources associated with the scientific study of the Earth, including its composition, structure, physical properties, and history. Geologic resources commonly include the study of minerals (**mineralogy**) and rocks (**petrology**); the structure of the Earth (**structural geology**) and volcanic phenomena (**volcanology**); and landforms and the processes that produce them (**geomorphology** and **glaciology**).

Goal: A broad statement of a desired outcome. Goals are usually not quantifiable and may not have established timeframes for achievement.

Guzzler: A water development for wildlife.

HABS/HAER: The Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) is an integral component of the federal government's commitment to historic preservation. The program documents important architectural, engineering and industrial sites throughout the United States and its territories. A complete set of HABS/HAER documentation, consisting of measured drawings, large-format photographs, and written history plays a key role in accomplishing the mission of creating an archive of American architecture and engineering and in better understanding what historic resources tell us about America's diverse ethnic and cultural heritage. To insure that such evidence is not lost to future generations, the HABS/HAER Collections are archived at the Library of Congress, where they are made available to the public.

Heavy Equipment Use: This phrase is used in fire management and is relative to limiting fire suppression tactics. In this context it refers to not using dozers, skidders, or graders in areas where important resource values are in need of protection. Fire engines and water tenders used during suppression activities would be allowed.

Held by Production: Leases that become productive and do not terminate until all wells on the lease have ceased production.

Hot Season Grazing: Hot-season grazing is the use of pastures during nthe critical growing season for riparian plants. In the planning area, this is **g**enerally, mid-June to mid-September (TR 1737-20 2006).

Integrated Pest Management: The use of all appropriate weed control measures, including fire, as well as mechanical, chemical, biological, and cultural techniques, in an organized and coordinated manner on a site-specific basis.

Intermittent Stream: A stream that flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas. Confusion over the distinction between intermittent and ephemeral streams may be minimized by applying Meinzer's suggestion that the term "intermittent" be arbitrarily restricted to streams that flow continuously for periods of at least 30 days (Prichard et al. 1998).

Impact Analysis for Planning (IMPLAN 2000) Model: IMPLAN is a regional economic model that provides a mathematical accounting of the flow of money, goods, and services through a region's economy. The model provides estimates of how a specific economic activity translates into jobs and income for the region. It includes the "ripple effect" (also called the "multiplier effect") of changes in economic sectors that may not be directly impacted by management actions, but are linked to industries that are directly impacted. In IMPLAN, these ripple effects are termed indirect impacts (for changes in industries that sell inputs to the industries that are directly affected) and induced impacts (for changes in household spending as household income increases or decreases due to the changes in production).

Land Tenure: To improve the manageability of the Bureau of Land Management (BLM) lands and improve their usefulness to the public, the BLM has numerous authorities for "repositioning" lands into a more consolidated pattern, disposing of lands, and entering into cooperative management agreements. These land-pattern improvements are completed primarily through the use of land exchanges, but also through land sales, jurisdictional transfers to other agencies, and through the use of cooperative management agreements and leases. These ownership or jurisdictional changes are referred as "Land Tenure Adjustments."

Laramide orogeny: The Laramide orogeny (orogeny is the Greek word for mountain building) was a period of mountain building in western North America which began during the Late Cretaceous period, 70 to 80 million years ago, and ended 35 to 55 million years ago. The major feature that was created by this orogeny was the Rocky Mountains, but evidence of this period is found from Alaska to Mexico and as far east as the Black Hills. The phenomenon is named for the Laramie Mountains of eastern Wyoming.

Leasable Minerals: Those minerals or materials subject to lease by the federal government under the Mineral Leasing Act of 1920. They include coal, phosphate, asphalt, sulphur, potassium, and sodium minerals; oil and gas, as well as geothermal resources.

Locatable Minerals: Minerals subject to exploration, development, and disposal by staking mining claims as authorized by the Mining Law of 1872, as amended. This includes deposits of metallic minerals such as gold, silver, and other uncommon materials not subject to lease or sale.

Maintenance Action: A minor adjustment to the land use plan that does not require an amendment.

Major Utility System: A major right-of-way is a Category 6 processing project. It includes large power lines (115kV or above), large diameter pipelines, ROW with significant surface disturbance either linear or site, Long distance ROWs, ROWs involving multiple federal jurisdictions, ROW that would require a LUP amendment, proposals with a high lever of public controversy, ROW that may impact critical or sensitive resources, ROW that require extensive coordination or consultation, cross border projects (US to Mexico or Canada), any ROW requiring an EIS.

Mineral Materials (Salables): Materials such as common varieties of sand, stone, gravel, pumice, pumicite, and clay that are not obtainable under the mining or leasing laws, but can be acquired under the Mineral Materials Act of 1947, as amended.

Mineral Withdrawal: A formal order that withholds federal lands and minerals from entry under the Mining Law of 1872, as amended, and closes the area to mineral location (i.e., staking mining claims) and development.

Mitigation:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

Modern Intrusions: includes not only the intrusion but also related impacts, such as a water well; related impacts could include livestock trails to the well and un-reclaimed roads leading to it (update and add to this definition)

Modification: A change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all site within the leasehold to which the restrictive criteria are applied.

Multiple Use Reservoir: A human-created lake or pond with a combination of balanced uses, including, but not limited to, recreation, livestock watering, watershed health, and wildlife and fish.

- Populations are declining or restricted in numbers and (or) distribution, extirpation is not imminent; habitat is not restricted, vulnerable, but no loss; species is not sensitive to human disturbance
  OR
- Species is widely distributed, population status or trends are unknown, but are suspected to be stable; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance
  OR
- Populations that are stable or increasing and not restricted in numbers and (or) distribution; ongoing significant loss of habitat.

Natural Fire Regime: The general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). The ultimate regulating factor for any natual fire regime is climate, with aspects such as the historic intensity of fire, time between fires (frequency), season of burning , the extent (or patchiness) of a fire, and the type of fire (i.e. solely above ground versus also consuming the organic layer of soil) collectively combining to define the natural fire regime for a given landscape (Whelan, 1995).

No Surface Occupancy (NSO): The term "no surface occupancy" (NSO) is used in two ways. It is used in one way to define a NSO area where no surface-disturbing activities of any nature or for any purpose would be allowed. For example, construction or the permanent or long-term placement of structures or other facilities for any purpose would be prohibited in an NSO area.

The other way the "no surface occupancy" term is used is as a stipulation or mitigation requirement for controlling or prohibiting selected land uses or activities that would conflict with other activities, uses, or values in a given area. When used in this way, the NSO stipulation or mitigation requirement is applied to prohibit one or more specific types of land and resource development activities or surface uses in an area, while other—perhaps even similar—types of activities or uses (for other purposes) would be allowed. For example, protecting important rock art relics from destruction may require closing the area to the staking of mining claims and surface mining, off-road vehicle travel, construction or long-term placement of structures or pipelines, powerlines, general purpose roads, and livestock grazing.

Conversely, the construction of fences to protect the rock art from vandalism or from trampling or breakage by livestock, an access road or trail, and other visitor facilities to provide interpretation and opportunity for public enjoyment of the rock art would be allowed. Further, if there were interest in development of leasable minerals in the area, leases for oil and gas, coal, and so forth, could be issued with a "no surface occupancy" stipulation or mitigation

requirement for the rock art site, which would still allow access to the leasable minerals from adjacent lands and underground. The term “no surface occupancy” has no relationship or relevance to the presence of people in an area.

Occupied Lek: A lek that has been active during at least one strutting season within the last 10 years.

Objective: A description of a desired condition for a resource. Objectives can be quantified and measured and, where possible, have established timeframes for achievement.

Open: Generally denotes that an area is available for a particular use or uses. Refer to specific program definitions found in law, regulations, or policy guidance for application to individual programs.

Off-Highway Vehicle (OHV): Any motorized vehicle capable of, or designed for, travel on or immediately over land, water, or other natural terrain, excluding (1) any non-amphibious registered motorboat; (2) any military, fire, emergency, or law enforcement vehicle being used for emergency purposes; (3) any vehicle whose use is expressly authorized by the authorized officer, or otherwise officially approved; (4) vehicles in official use; and (5) any combat or combat support vehicle when used in times of national defense emergencies.

Off-Highway Vehicle (OHV) Management Designations: The authorized officer shall designate all public lands as either open, limited, or closed to off-road vehicles. All designations shall be based on the protection of the resources of the public lands, the promotion of safety of all users of the public lands, and the minimization of conflicts among the various uses of the public lands; and in accordance with the following criteria:

(a) Areas and trails shall be located to minimize damage to soil, watershed, vegetation, air, or other resources of the public lands, and to prevent impairment of wilderness suitability.

(b) Areas and trails shall be located to minimize harassment of wildlife or significant disruption of wildlife habitats. Special attention will be given to protect endangered or threatened species and their habitats.

(c) Areas and trails shall be located to minimize conflicts between off-road vehicle use and other existing or proposed recreational uses of the same or neighboring public lands, and to ensure the compatibility of such uses with existing conditions in populated areas, taking into account noise and other factors.

(d) Areas and trails shall not be located in officially designated wilderness areas or primitive areas. Areas and trails shall be located in natural areas only if the authorized officer determines that off-road vehicle use in such locations will not adversely affect their natural, esthetic, scenic, or other values for which such areas are established.

Closed Area: an area where off-road vehicle use is prohibited. Use of off-road vehicles in closed areas may be allowed for certain reasons; how-ever, such use shall be made only with the approval of the authorized officer.

Open Area: An area where all types of vehicle use is permitted at all times, anywhere in the area subject to the operating regulations and vehicle standards set forth in the code of federal regulations.

Limited Area: An area restricted at certain times, in certain areas, and/or to certain vehicular use. These restrictions may be of any type, but can generally be accommodated within the following type of categories: Numbers of vehicles, types of vehicles, time or season of vehicle use; permitted or licensed use only; use on existing roads and trails; use on designated road and trails; and other restrictions.

Off-site Mitigation: Mitigation that is performed away from the immediate project area.

Over-Snow Vehicle: An over-snow vehicle is a motor vehicle that is designed for use over snow that runs on a track or tracks and/or a ski or skis. An over-snow vehicle does not include machinery used strictly for the grooming of non-motorized trails.

Overgrazing: Continued heavy grazing that exceeds the recovery capacity of the forage plants and creates deterioration of the grazing lands (Valentine 1990).

Paleontological Locality: A geographic point or area where a fossil or associated fossils are found in a related geological context. A paleontological locality is confined to a discrete stratigraphic layer, structural feature, or physiographic area.

Perennial Stream: A stream that flows continuously. Perennial streams generally are associated with a water table in the localities through which they flow (Prichard et al. 1998).

Pest: With the exception of vascular plants classified as invasive nonnative plant species, a pest can be any biological life form that poses a threat to human or ecological health and welfare. For the purposes of this planning effort, an “animal pest” is any vertebrate or invertebrate animal subject to control by Animal and Plant Health Inspection Service (APHIS). APHIS is currently BLM’s authorized agent for controlling “animal pests.” For this reason, “animal pests” will be considered a subset of Pest.

Planning Area: A geographic area for which land use and resource management plans are developed and maintained. For the Lander Land Use Plan revision, planning area is the Lander Field Office.

Potential Natural Community (PNC): The biotic community that would become established if all successional sequences were completed without interference by humans under the present environmental conditions. Natural disturbances are inherent in development. PNCs can include naturalized nonnative species.

Prairie Dog "Complex": Defined as a cluster of two or more prairie dog towns within 3 kilometers of each other (Clark and Stromberg 1987; Luce 2003), and bounded by either natural or artificial barriers (Whicker and Detling 1998) which effectively isolate one cluster of colonies from interacting/interchanging with another. Prairie dogs may commonly move among colonies of a cluster, and thereby foster reproductive/genetic viability, but exhibit little emigration/immigration between clusters. A cluster may include some currently unoccupied, through physically suitable (i.e., vegetation, soils, topography, etc), land immediately adjacent to occupied colonies that support other prairie dog-associated (ecosystem function), obligate or facultative species (e.g., swift fox, mountain plover, burrowing owl, etc.).

Prescribed Burning: Controlled application of fire to wildland fuels in either their natural or modified state under specified environmental conditions that allow the fire to be confined to a predetermined area and at the same time to produce the fire intensity and rate of spread required to attain planned resource management objectives.

Prescribed Fire: The introduction of fire to an area under regulated conditions for specific management purposes.

Priority Fish Species: Priority fish species are species considered to be sport fish and native species.

Probable Fossil Yield Classification: Geologic units in the planning area are classified according to the Probable Fossil Yield Classification, usually at the formation or member level, according to the probability of yielding resources of concern to land managers, primarily vertebrate fossils. The classification uses a ranking of 1 through 5, with Class 5 assigned to units with a high potential for fossils. Within the planning area, Class 4 and Class 5 geologic formations account for approximately 50 percent of the total acreage, including all ownerships. About 35 percent of public land in the planning area is underlain by Class 4 and Class 5 formations. The classifications are described as below.

> **Class 1.** Igneous and metamorphic geologic units, or units with highly disturbed preservational environments that are not likely to contain recognizable fossil remains. Management concern is negligible for Class 1 resources and mitigation requirements are rare.

> **Class 2.** Sedimentary geologic units that are not likely to contain vertebrate fossils or significant nonvertebrate fossils. Management concern is low for Class 2 resources and mitigation requirements are not likely.

Class 3. Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence, or units of unknown fossil potential. Management concern may extend across the entire range of management. Ground-disturbing activities require sufficient assessment to determine whether significant resources occur in the area of the proposed action.

Class 4. Class 4 units are Class 5 units with a lowered risk of human-caused adverse impacts or lowered risk of natural degradation. Ground-disturbing activities require assessment to determine whether significant resources occur in the area of the proposed action and whether those actions will impact the resource. Mitigation may include full monitoring of significant localities.

Class 5. Highly fossiliferous geologic units that regularly produce vertebrate fossils or significant nonvertebrate fossils and that are at risk of natural degradation or human-caused adverse impacts. Class 5 areas receive the highest level of management focus. Mitigation of ground-disturbing actions is required and may be intense. Areas of special interest may be designated and intensely managed.

Produced Water: Groundwater removed to facilitate the extraction of minerals, such as coal, oil, or gas.

Proper Functioning Condition: Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize steambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The functioning condition of riparian-wetland areas is a result of interaction among geology, soil, water, and vegetation. (BLM, 1993).

Proper Grazing: Proper grazing is the practice of managing forage use by grazing animals at a sustainable level that maintains rangeland health. Proper grazing will maintain or increase plant cover, including residue, which acts to slow down or reduce runoff, increase water infiltration, and keep erosion and sedimentation at or above acceptable levels within the potential of ecological sites within a given geographic area (e.g., watershed, grazing allotment, etc.).

Rangeland: Land on which the native vegetation is predominantly grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing. This includes lands revegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of grazing. Rangelands include natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows.

Rangeland Health: The degree to which the integrity of the soil and ecological processes of rangeland ecosystems are sustained.

Range Improvement Project: A structural improvement requiring placement or construction to facilitate management or control distribution and movement of grazing or browsing animals. Such improvements may include, but are not limited to, fences, wells, troughs, reservoirs, water catchments, pipelines, and cattleguards. The project also may include a practice or treatment which improves rangeland condition and or resource production for multiple use. Nonstructural types of projects may include, but are not limited to, seeding and plant control through chemical, mechanical, and biological means or prescribed burning.

Raptor: Bird of prey with sharp talons and a strongly curved beak, such as hawks, falcons, owls, vultures, and eagles.

Recreation experiences : Sychological outcomes realized either by recreation-tourism participants as a direct result of their onsite leisure engagements and recreation-tourism activityparticipation or by non-participating community residents as a result of their interaction withvisitors and guests within their community and/or interaction with the BLM and other public andprivate recreation-tourism providers and their actions.

Recreation management zones (RMZ): Subunits within a SRMA managed for distinctly different recreation products. Recreation products are comprised of recreation opportunities, the natural resource and community settings within which they occur, and the administrative and service environment created by all affecting recreation-tourism providers, within which recreation participation occurs.

Recreation niche : The place or position within the strategically targeted recreation-tourism market for each SRMA that is most suitable (i.e., capable of producing certain specific kinds of recreation opportunities) and appropriate (i.e., most responsive to identified visitor or resident customers), given available supply and current demand, for the production of specific recreation opportunities and the sustainable maintenance of accompanying natural resource and/orcommunity setting character.

Recreation opportunities : Favorable circumstances enabling visitors' engagement in a leisure activity to realize immediate psychological experiences and attain more lasting, value-added beneficial outcomes.

Recreation opportunity spectrum (ROS): One of the existing tools for classifying recreation environments (existing and desired) along a continuum ranging from primitive, low-use, and inconspicuous administration to urban, high-use, and a highly visible administrative presence. This continuum recognizes variation among various components of any landscape's physical, social and administrative attributes; and resulting descriptions (of existing conditions) and prescriptions (of desired future conditions) define recreation setting character.

Recreation setting character conditions ~ the distinguishing recreational qualities of any landscape, objectively defined along a continuum ranging from primitive to urban landscapes, expressed in terms of the nature of the component parts of its physical, social and administrativeattributes. These recreational qualities can be both classified and mapped. This classification and mapping process should be based on variation that either exists (i.e., setting descriptions) or is desired (i.e., setting prescriptions) among component parts of the various physical, social, and administrative attributes of any landscape. The recreation opportunity spectrum is one of the existing tools for doing this.

Recreation settings ~ the collective, distinguishing attributes of landscapes that influence, and sometimes actually determine, what kinds of recreation opportunities are produced.

Recreation-tourism market ~ recreation-tourism visitors, affected community residents, affecting local governments and private sector businesses, or other constituents and the communities or other places where these customers originate (local, regional, national, or international). Based on analysis of supply and demand, land use plans strategically identify primary recreation-tourism markets for each SRMA-destination, community, or undeveloped.

Response to Wildland Fire (RWF): The policy area defining the actions for managing a wildland fire.

Restricted Disposal: Parcels identified for restricted disposal may be disposed of under the Recreation and Public Purposes Act, by exchange, may limit the disposal to a particular type of entity capable of preserving the resource values, or may include the use of covenants in the deed or land sale patent to ensure the resource values are protected.

Riparian Areas: Riparian areas are a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

Riparian/Wetland Functionality Classification:

Functional-At-Risk (FAR): Riparian/wetland areas that are in functional condition, but an existing soil, water, or vegetation attribute makes them susceptible to degradation.

Proper Functioning Condition (PFC): A riparian or wetland area is considered to be in proper functioning condition when adequate vegetation, landform, or large woody debris is present to do the following:

- Dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality
- Filter sediment, capture bedload, and aid floodplain development
- Improve floodwater retention and groundwater recharge
- Develop root masses that stabilize streambanks against cutting action
- Develop diverse ponding and channel characteristics to provide the habitats and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses
- Support greater biodiversity.

Nonfunctional: Riparian or wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, and so on, as listed above. The absence of certain physical attributes, such as a floodplain where one should be, are indicators of nonfunctioning conditions.

Unknown: Riparian or wetland areas that the Bureau of Land Management lacks sufficient information on to make any form of determination.

Rights-of-Way (ROW): A ROW grant is an authorization to use a specific piece of public land for a specific project, such as roads, pipelines, transmission lines, and communication sites. The grant authorizes rights and privileges for a specific use of the land for a specific period of time.

ROW Avoidance Areas: Areas where negative routing factors exist. ROWs either will not be granted in these areas, or—if granted—will be subject to stringent terms and conditions. In other words, ROWs would be *restricted* (but not necessarily prohibited) in these avoidance areas.

Saleable Minerals: Common variety of minerals on public lands, such as sand and gravel, used mainly for construction. Saleable minerals are disposed of by sales to the public or free-use permits to government agencies or nonprofit organizations.

Seasonal Ranges: The Wyoming Game and Fish Department has identified various ranges for big game species. These ranges are defined as follows:

> **Summer or Spring-Summer-Fall:** A population or portion of a population of animals uses the documented habitats within this range annually from the end of previous winter to the onset of persistent winter conditions.
>
> **Severe Winter Relief:** A documented survival range, which may or may not be considered a crucial range area as defined above. It is used to a great extent, but only in extremely severe winters. It may lack habitat characteristics that would make it attractive or capable of supporting major portions of the population during normal years, but is used by and allows at least a significant portion of the population to survive the occasional extremely severe winter.
>
> **Winter:** A population or portion of a population of animals annually uses the documented suitable habitat sites within this range in substantial numbers during the winter period only.
>
> **Winter/Year-long:** A population or a portion of a population of animals makes general use of the documented suitable habitat sites within this range on a year-round basis. During the winter months there is a significant influx of additional animals into the area from other seasonal ranges.
>
> **Year-long:** A population or substantial portion of a population of animals makes general use of the suitable documented habitat sites within the range on a year-round basis. On occasion, animals may leave the area under severe conditions.
>
> **Parturition Areas:** Documented birthing areas commonly used by females. They include calving areas, fawning areas, and lambing grounds. These areas may be used as nurseries by some big game species.

Section 106 of National Historic Preservation Act: "The head of any Federal agency having direct or indirect jurisdiction over a proposed federal or federally assisted undertaking in any state and the head of any federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any federal funds on

the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking" (16 U.S.C. 47 df).

Sensitive Sites or Resources: Sensitive sites or resources refer to significant cultural resources that are or may be eligible for nomination to the National Register of Historic Places.

Sensitive Species: Species designated as sensitive by the Bureau of Land Management (BLM) State Director include species that are under status review, have small or declining populations, live in unique habitats, or require special management. BLM Manual 6840 provides policy and guidance for special status species management. The BLM Wyoming Sensitive Species Policy and List are provided in a memorandum updated annually. Primary goals of the BLM Wyoming policy include maintaining vulnerable species and habitat components in functional BLM ecosystems and preventing a need for species listing under the Endangered Species Act.

Seral Stage: One of a series of plant communities that follows another in time on a specific ecological site.

Setting (Recreational): The condition of any recreation system, objectively defined along a continuum ranging from primitive to urban in terms of variation of its component physical, social, and administrative attributes.

Setting (Cultural): Setting is the physical environment of a historic property and how the property evokes a sense of feeling and association with past events. Accordingly, setting referees to the **character** of the place in which the property played its historic role. It involves **how**, not just where, the property is situated and its relationship to surrounding features and open space. These features and their relationships should be considered not only within the exact boundaries of the property, but also between the property and its surroundings.

Significant Paleontological Resource (also Significant Fossil Resource): Any paleontological resource that is considered to be of scientific interest, including most vertebrate fossil remains and traces, and certain rare or unusual invertebrate and plant fossils. A significant paleontological resource is considered to be scientifically important because it is a rare or previously unknown species, it is of high quality and well-preserved, it preserves a previously unknown anatomical or other characteristic, provides new information about the history of life on earth, or has identified educational or recreational value.

Special Status Species: Includes proposed species, listed species, and candidate species under the Endangered Species Act; state-listed species; and BLM State Director-designated sensitive species (see BLM Manual 6840, Special Status Species Policy).

Split-Estate: Surface land and mineral estate of a given area under different ownerships. Frequently, the surface will be privately owned and the minerals federally owned.

Standards for Healthy Rangelands (SHR): Range health standards adopted by Wyoming BLM August 12, 1997 which apply to all activities on the BLM-administered lands.

State-Listed Species: Species proposed for listing or listed by a state in a category implying, but not limited to, potential endangerment or extinction. Listing is either by legislation or regulation.

Surface-disturbing Activities (or Surface Disturbance): The physical disturbance and movement or removal of land surface and vegetation. These activities range from the very minimal to the maximum types of surface disturbance associated with such things as off-road vehicle travel or use of mechanized, rubber-tired, or tracked equipment and vehicles; some timber cutting and forest silvicultural practices; excavation and development activities associated with use of heavy equipment for road, pipeline, power line and other types of construction; blasting; strip, pit, and underground mining and related activities, including ancillary facility construction; oil and gas well drilling and field construction or development and related activities; range improvement project construction; and recreation site construction.

Surface Water Classes and Uses: The following water classes are a hierarchical categorization of waters according to existing and designated uses. Except for Class 1 waters, each classification is protected for its specified uses plus all the uses contained in each lower classification. Class 1 designations are based on value determinations rather than use support and are protected for all uses in existence at the time of or after designation. There are four major classes of surface water in Wyoming with various subcategories within each class (see "Wyoming Surface Water Classification List" for current listing).

(a) Class 1, Outstanding Waters. Class 1 waters are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Pursuant to Section 7 of these regulations, the water quality and physical and biological integrity that existed on the water at the time of designation will be maintained and protected. In designating Class 1 waters, the Environmental Quality Council shall consider water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archeological, fish and wildlife, the presence of substantial quantities of developable water, and other values of present and future benefit to the people.

(b) Class 2, Fisheries and Drinking Water. Class 2 waters are waters, other than those designated as Class 1 that are known to support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent, or ephemeral and are protected for the uses indicated in each subcategory listed below. Five subcategories of Class 2 waters exist.

(c) Class 3, Aquatic Life Other than Fish. Class 3 waters are waters other than those designated as Class 1 that are intermittent, ephemeral, or isolated waters, and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning or certain perennial waters that lack the natural water quality to support fish (e.g., geothermal areas). Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna that inhabit waters of the state at some stage of their life-cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value. Generally, waters suitable for this classification have wetland characteristics; and such characteristics will be a primary indicator used in identifying Class 3 waters. There are four subcategories of Class 3 waters.

(d) Class 4, Agriculture, Industry, Recreation, and Wildlife. Class 4 waters are waters other than those designated as Class 1 where it has been determined that aquatic life uses are not attainable pursuant to the provisions of Section 33 of these regulations. Uses designated on Class 4 waters include recreation, wildlife, industry, agriculture and scenic value. (Source: WDEQ, Wyoming Surface Water Quality Standards)

Vegetative Diversity: The variety of vegetative types in an area, including species, the genetic differences among species and populations, the communities and ecosystems in which vegetation types occur, and the structure and seral stage of these communities. Vegetative diversity includes rare as well as common vegetative types, and typically supports a diverse array of animal species and communities.

Visual Resource Management (VRM) Classes: Categories assigned to public lands based on scenic quality, sensitivity level, and distance zones. There are four classes. Each class has an objective which prescribes to amount of change allowed in the characteristic landscape.

- **Class 1:** The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
- **Class 2:** The objective to this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any

changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

- **Class 3:** The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- **Class 4:** The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Waiver: A permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

Wetlands: Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and which, under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, Riparian-Wetland Area Management, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands.

Wildfire: Any natural fire ignition occurring on wildland that neither meets management objectives nor occurs within a prescribed fire area, thus requiring a suppression response.

Wildland Industrial Interface: The area where industrial development meets or intermingles with undeveloped wildland.

Wildland Urban Interface (WUI): Healthy Forest Recreation Act 2003: defines wildland urban interface (WUI) (section 101) as an area within or adjacent to an at risk community that has been identified by a community in it's wildfire protection plan or, for areas that do not have such a plan, an area extending; 1) ½ mile from the boundary of an at risk community, or 2) 1 ½ miles when other criteria are met. (e.g., a sustained steep slope or a geographic feature aiding in creating an effective fire break or is condition class III land, or 3) is adjacent to an evacuation route.

Wildland Fire Use: Using non-prescribed fire (accidental, naturally occurring, human caused, etc.) to achieve predetermined fire objectives.

Wildlife-Disturbing Activity: BLM-authorized activities other than routine maintenance that may cause displacement of or excessive stress to wildlife during critical life stages. Wildlife-disturbing activities include human presence, noise, and activities using motorized vehicles or equipment.

Wind River Indian Reservation (WRIR): The Tribal Reservation of the Eastern Shoshone and Northern Arapahoe Tribes located in central Fremont County.

Winter Activities: Activities occurring in the winter season within dates set by individual resources such as wildlife stipulations.

Withdrawal: Removal or withholding of public lands, by statute or Secretarial order, from operation of some or all of the public land laws. A mineral withdrawal includes public lands potentially valuable for leasable minerals, precluding the disposal of the lands except with a mineral reservation clause, unless the lands are found not to contain a valuable deposit of minerals. A mineral withdrawal is the closing of an area to mineral location and development activities.

Yellowcake: Yellowcake is the product of the uranium extraction (milling) process. Early production methods resulted in a bright yellow compound, hence the name yellowcake. The material is a mixture of uranium oxides that can vary in proportion and color from yellow to orange to dark green (blackish), depending at which temperature the material was dried (level of hydration and impurities). Higher drying temperatures produce a darker, less soluble material. Yellowcake is commonly referred to as U3O8 and is assayed as pounds U3O8 equivalent. This fine powder is packaged in drums and sent to a conversion plant that produces uranium hexafluoride as the next step in the manufacture of nuclear fuel.

References:

Agee, J.K. 1993. Fire ecology of Pacific Northwest Forests. Island Press, Wash. DC.

Brown, J.K. 1995. Fire regimes and their relevance to ecosystem management. Pages 171-178 In Proceedings of Society of American Foresters National Convention, Sept. 18-22, 1994, Anchorage, AK. Society of American Foresters, Wash. DC.

BLM (Bureau of Land Management). 1984. Visual Resource Management. BLM Manual 8400.

BLM. 2001. Special Status Species Management. BLM Manual 6840.

Clark, T.W., and M.R. Stromberg. 1987. Mammals in Wyoming. University of Kansas – Museum of Natural History. Lawrence, Kansas. Pgs. 108-111.

EnCana. 2005. Carbon Dioxide Miscible Flood. Accessed at: http://www.encana.com/operations/technology/ot_co2_miscible_flood.html.

Luce, R. 2003. Personal communication with Dave Roberts (USDI-BLM, Wyoming) regarding prairie dog "complexes." Sierra Vista, AZ.

Prichard, D., J. Anderson, C. Correll, J. Fogg, K. Gebhardt, R. Krapf, S. Leonard, B. Mitchell, and J. Staats. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and Supporting Science for Lotic Areas. U.S. Department of the Interior, Bureau of Land Management, U.S. Department of Agriculture, Forest Service, and Natural Resources Conservation Service Technical Reference 1737-15.

Valentine, J.F. 1990. *Grazing Management*. San Diego, CA: Academic Press, Inc.

Whicker, A., and J.K. Detling. 1988. Ecological Consequences of Prairie Dog Disturbances. Bioscience 38 (11): 778-785.

WDEQ (Wyoming Department of Environmental Quality). Wyoming Surface Water Quality Standards – Implementation Policies for Anti-degradation, Mixing Zones, Turbidity, Use Attainability Analysis. Wyoming Department of Environmental Quality.

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10.0 REFERENCES

Reference	Resource Area
Abandoned Mine Lands, http://www.blm.gov/wy/st/en/programs/aml/projects.html, accessed March, 2009	Health and Safety
Abandoned Mine Lands, Current Projects. http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/abandoned_mine_site.html, accessed March, 2009	Health and Safety
Abandoned Mine Lands, Current Projects. http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/abandoned_mine_site.html, accessed March, 2009	Health and Safety
Agee, J.K.1993. Fire Ecology of Pacific Northwest Forests. Island Press, Wash.DC	Fire and Fuels
Amundson, Michael, "Home on the Range No More: The Boom and Bust of a Wyoming Uranium Mining Town, 1957-1988", The Western Historical Quarrerly, Utah State University, Logan, winter 1995	Locatable Minerals, Socio-economics
Antelope Site, Converse County 2004	Air Resources
Antelope Site, Converse County 2006	Air Resources
Antelope Site, Converse County 2007	Air Resources
Arneson, C. S., Case, J. C., Frederick, K. D., Gloss, S. P., Hamerlink, J. D., Huntoon, P. W., Munn, L. C., Needham, S., and Wireman, M., 1998, Wyoming Groundwater Vulnerability Assessment Handbook, Volume I: Background, Model Development, and Aquifer Sensitivity Analysis, University of Wyoming SDVC Report 98-01, 201 p.	Water
Bailey, Robert G. 1995. Description of the Ecoregions of the United States (2nd ed.). Misc. Pub.No. 1391, USDA Forest Service, 108pp. Plus map: Map scale 1:;7,500,000.	Air Resources
Bartos, D.L. and Campbell, R.B. 1998. Decline of quaking aspen in the Interior West-Examples from Utah. Rangelands 20(1): 17-24	Vegetation – Forest, Woodlands, and Forest Products
BLM Manual 3031	Mineral Resources
BLM Manual 8100	Cultural Resources
BLM Manual Section 8410	Visual Resources
BLM 1987. Resource Management Plan for the Lander Field Office	All

Reference	Resource Area
BLM 1991. *Wyoming Statewide Wilderness Study Report Wilderness Study Area Specific Recommendations.* Cheyenne	WY: USDI.
BLM 1993. Riparian Area Management, Process for Assessing Proper Functioning Condition, TR 1737-9.	Glossary
USDOI BLM, USDA, 1994a, Process for Assessing Proper Functioning Condition for Lentic Riparian-Wetland Areas, TR 1737-11	Riparian and Wetlands
BLM 1994b. Standards for Healthy Rangelands (SHR)	Livestock Grazing
BLM. 1998a. Interpreting Indicators of Rangeland Health. TR 1737-15.	Livestock Grazing, Soil
BLM 1999. Grazing Management for Riparian-Wetland Areas, TR 1737-14	Riparian and Wetlands
BLM 2002. Lander Field Office Review of Potential Wild and Scenic Rivers in the Lander Resource Management Plan Planning Area	Wild and Scenic Rivers
BLM 2003. Travel Management Guidelines for the Public Lands in Wyoming.	Trails & Travel Management
BLM Planning Handbook (BLM), 2005) H-1601-1	All
BLM 2005 Update to the Wyoming BLM Forest and Woodland Management Action Plan, (BLM, May 2005)	Fire
BLM 2006. Riparian Area Management, Grazing Management Processes and Strategies for Riparian-Wetland Areas.	Riparian
BLM 2007a. Vegetation Treatments Using Herbicides Final Programmatic EIS, BLM/WO/GI-07/009+6711.	Invasive Species and Pest Management
BLM 2007b, Programmatic ROD, Designation of Energy Corridors on Federal Land in the 11 Western States.	Rights-of-Way and Corridors
BLM and USDA Forest Service 2007. BLM and Forest Service Announce 2007 Federal Grazing Fee. BLM-CA-N-07-31. February 2.	Socioeconomics
BLM and USFS 2008. Geothermal Resources Programmatic ROD	Geothermal
BLM, 2009a, 3-44 Draft Mineral Occurrence and Development Potential Report	Mineral Resources
BLM. 200b, Lander Field Office Reasonable Foreseeable Development.	Leasable Oil and Gas
BLM and USDA Forest Service (BLM and USFS). 2007. BLM and Forest Service Announce 2007 Federal Grazing Fee. BLM-CA-N-07-31. February 2.	Socioeconomics

Reference	Resource Area
Bailey, R.G. 1995. Description of the Ecoregions of the United States. U.S. Department of Agriculture. Miscellaneous Publication No. 1391. 2nd Edition. USDA, Washington, D.C.	Air Resources
Brown 1995. Aspen decline in the inland northwest: a review of some relevant literature,	Vegetation – Forest, Forest Products
Bureau of Economic Analysis (BEA). 2007. Regional Economic Information System, 1969-2006. Online at http://www.bea.gov/bea/regional/reis/, accessed February 2008.	Socioeconomics
Bureau of Labor Statistics (BLS). 2008a. Employment Status of the Civilian Noninstitutional Population, 1940 to Date. Online at http://www.bls.gov/cps/home.htm, http://www.bls.gov/cps/cpsaat1.pdf, accessed February 2008.	Socioeconomics
Bureau of Labor Statistics (BLS). 2008b. Local Area Unemployment Statistics. Online at http://www.bls.gov/lau/home.htm, accessed February 2008.	Socioeconomics
Bureau of Reclamation, (http://www.usbr.gov/dataweb/dams/wyo1299.htm)	Water
Casper Star Tribune 5-13-2008	Health and Safety
Clancey, K.L. 1990. Agriculture and Human Health in C.A. Edwards and R. Lan (ed.) Sustainable agricultural systems. Soil Water Conserv. Soc., Ankeny, IA. P 655-665	Livestock Grazing
Clark, R. a. (1971). The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Reasearch. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northewest Forest and Range Experiment Station	Recreation
Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver, 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming.	Wildlife
Consensus Revenue Estimating Group (CREG). 2008. Wyoming State Government Revenue Forecast: Fiscal Year 2008 – Fiscal Year 2012. January.	Socioeconomics
Cordell, H. B. (2004). Outdoor recreation for 21st century America. State College, PA: Venture Publishing, Inc.	Recreation
Cordell, H. M. (1999). History of outdoor recreation and nature-based tourism in the United States. Champaign, IL: Sagamore Publishing.	Recreation
Curtis, J., and K. Grimes, 2004: *Wyoming Climate Atlas*. 328 pp.	Air Resources

Reference	Resource Area
Davies, K.W., R.L. Sheley, and J.D. Bates. 2008. Does prescribed fall burning *Artemisia tridentata* steppe promote invasion or resistance to invasion after a recovery period? Journal of Arid Environment 72:1076-1085	Fire and Fuels Management
Davies, K.W., J.D. Bates, and J.J. James. 2009. Microsite and herbaceous vegetation hetergeneity after burning *Artemisia tridentata* steppe. Oecologia 159:597-606.	Fire and Fuels Management
Dean Runyan Associates. 2007. State Office of Travel and Tourism Wyoming Business Council. Online at http://www.deanrunyan.com/impactsWY.html, accessed February 2008.	Socioeconomics
DeBruin, R.H., 2007, Oil and gas field map of Wyoming, Wyoming State Geologic Survey MS-55, cd-rom disc.	Mineral Resources
Driver, B. a. (1978). The Opportunity spectrum concept and behavoir information in outdoor recreation resource supply inventories: A rationale. In Integrated inventories of renewable natural resources: Precedings of the workshop. *General Tech Reoport RM-55* (pp. 24-31). Fort Collins, CO: USDA Forest Service Rocky Mountaint Forest and Range Experiement Station.	Recreation
Driver, B. L. (2008). Why Outcomes-Focused Management is Needed. In Driver, Managing to Optimize the Benefical Outcomes of Recreation (pp. 1-18). State College, PA: Venture Publishing, Inc.	Recreation
Dubois Crowheart Conservation District (DCCD) 2004. Upper Wind River Watershed Assessment (2001-2003)	Water
Elmore and Kauffman 1994	Water
Executive Order 13007, AIRFA	Cultural
Federal Cave Resources Protection Act [FCRPA], Sec. 3(1)	Cave and Karst
Federal Land Policy and Management Act FLPMA of 1976.	All
Federal Onshore Oil and Glass Reform Act of 1987	Leasable Oil and Gas
Fetter, C. W., Jr., 1980, Applied Hydrogeology: Charles E. Merrill Publishing Co., Columbus Ohio, 488 p.	Water
Fire Regime Condition Class www.frcc.gov	Fire
Flores and Keighin 1999 A Summary of Tertiary Coal Resources of the Wind River Basin, Wyoming	Leasable Coal
Fremont County 2004. Land Use Plan for Fremont County	Livestock Grazing
Garbutt , D., 2004, Unconventional gas: Shlumberger White Paper OF_03_056, 11 pages, downloaded from: http://www.slb.com/media/services/solutions/reservoir/shale_gas.pdf	Mineral Resources

Reference	Resource Area
General Mining Law of 1872 (as amended) 30 USC 22-54, 611-615	Mineral and Energy Resources
Geothermal Leasing in the Western United States, October 2008.	Geologic Resources
Geothermal Steam Act of 1970 (as amended)	Mineral and Energy Resources
Geothermal Resources Council [GRC] 2003	Geothermal
Grenvik, C. 2005. Personal communication between Craig Grenvik, Wyoming Department of Revenue, Mineral Tax Division and Rob Fetter, Science Applications International Corporation. February 1, 2005.	Socioeconomics
Gucker, C. L. 2007. Bromus tectorum in Fire Effects Information System (database). U.S. Dept. Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. (www.fs.fed.us/database/feis; viewed Oct. 7, 2007) (and references cited).	Livestock Grazing
Hamerkinck, J.D., and Arneson, C.S., 1998, editors, Wyoming Ground Water Vulnerability Assessment Handbook; Volume 1. Background, Model Development, and Aquifer Sensitivity Analysis: Spacial Data and Visualization Center, Publication SDVC 09-0101, University of Wyoming, Laramie, Wyoming, 75 p. with appendices.	Water
Hammack, Stephen P. and Ronald J. Gill. 1997. Frame Score and Weight of Cattle. Texas Agriculture Experiment Station, Texas A & M University System.	Livestock Grazing
Hann, W.J., and Bunnell,D.L. 2001. Fire and land management planning and implementation across multiple scales, nternational Journal of Wildland Fire, 10:389–403.	Fire and Fuels Management
Hardy, C. 2006. Press Release: Congress Passes Soda Ash Royalty Relief. Office of Senator Craig Thomas. September 29. Online at http://thomas.senate.gov/index.cfm?FuseAction=PressReleases.Detail&PressRelease_id=635&Month=9&Year=2006, accessed January 2007.	Socioeconomics
Hausel , W.D., 1989, The Geology of Wuyoming's Precious Metal Load and Placer Deposits: The Geological Survey of Wyoming Bulletin No.68, 248 p.	Locatable Minerals
Hausel, W.D., 1991, Economic Geology of the South Pass Granite-Greenstone Belt, southern Wind River Range, Wyoming: Wyoming Geological Survey Report of Investigations No. 44, 129 p.	Locatable Minerals

Reference	Resource Area
Headwaters Economics. 2008. Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-focusing Counties Benefiting? Bozeman, MT. Online at www.headwaterseconomics.org/energy. September.	Socioeconomics
Headwaters Economics. 2009. A SocioEconomic Profile: Wind River Reservation, WY. Report generated by the Economic Profile System; data and generation macros online at www.headwaterseconomics.org. Generated February 11, 2009.	Socioeconomics
Heasler, H. P., E. R. Decker, and K. L. Buelow, Heat Flow Studies in Wyoming : 1979 to 1981, pp. 292-312, in Geothermal Direct Heat Program Roundup Technical Conference Proceedings, ed. C. A. Ruscetta, Earth Sci. Lab., Univ. of Utah, DOE/ID/12079-71, 1982.	Geothermal
Hirsch, S.A. and J.A. Leitch, 1996, The Impact of Knapweed on Montana's Economy, Agricultural Economics Report No. 355, North Dakota Agricultural Experiment Station, Fargo, North Dakota.	Soil
Hopkins, B. (2008). Outcomes-Focused Management of the BLM's Red Hill Special Recreation Management Area. In B. Driver, *Managing to Optimize the Beneficial Outcomes of Recreation* (pp. 279-285). State College, PA: Venture Publishing, Inc.	Recreation
HIS Energy Group, 2008, Rocky Mountain US Well Data: Network License for PI/Dwights PLUS Version 1.7	Mineral Resources
IMPROVE 2006, Interagency Monitoring of Protected Visual Environments, IMPROVE, Bridger Station	Air Resources
International Atomic Energy Association (IAEA), 2001	Mineral Resources
International Panel on Climate Change, 2001	Air Resources
Jacquet, J. 2006. Sublette County Wage and Employment Study. Prepared for The Sublette County Commissioners and The Sublette County Socioeconomic Analysis Advisory Committee. July. Online at http://www.sublette-se.org/files/Sublette_County_Wage_Study.pdf, accessed December 2006.	Socioeconomics
Johnson, L., Wallace, G., & Mitchell, J. (1997). Visitor perceptions of livestock grazing in five wilderness areas: a preliminary assessment. . *International Journal of Wilderness. 3(2):* 14, 20	Recreation

Reference	Resource Area
Johnson, R.C., and Rice, D.D., 1993, Coalbed Methane potential of Upper Cretaceous Mesaverde and Meeteetse Formations, Wind River Indian Reservation, Wyoming, *in* Keefer, W.R., Metzger, W.J., and Godwin, L.H., eds., Oil and Gas and Other Resources of the Wind River Basin: Wyoming Geological Association Special Symposium 1993 Guidebook, pp. 215-242.	Leasable Oil and Gas
Johnson, R.C., Finn, T.M., Keefer, W.R., and Szmajter, R.J., 1996, Geology of Upper Cretaceous and Paleocene Gas-bearing Rocks, Wind River Basin, Wyoming: U.S. Geological Survey Open File Report 96090, 120 p. Johnson et al. 1993	Leasable Oil and Gas
Jost, L. 2007. Personal communication (interview) between Loren Jost, Director, Riverton Museum, Riverton, WY, and R. Fetter, SAIC. August 15.	Socioeconomics
Kauffman, J. Boone and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications… a review. Journal of Range management, Vol. 37(5): September. 1984. 430-438 pp.	Riparian/Wetland Resources
Keefer, W.R., 1970, Structural Geology of the Wind River Basin, Basin: Geology of the Wind River Basin, Central Wyoming, U.S. Geological Survey Professional Paper 495-D, 35 p.	Geologic Resources
King, R.H., 1947, Phosphate Deposits near Lander, Wyoming: Wyoming Geological Survey Bulletin 39, 84 p.	Other Solid Leasable Minerals
Kominsky , Jon, Personal Conversation, 2009	Soil
Lacey, J.R., C.B. Marlow, and J.R. Lane, 1989, Influence of spotted knapweed (Cenaurea maculosa) on surface water runoff and sediment yield, Weed Technology 3:627-631.	Soil
Lander, Fremont County 2007	Air Resources
Love, J. D, Christiansen, Ann Coe, and Ver Ploeg, Alan J., 1993, Stratigraphic Chart showing Phanerozoic Nomenclature for the State of Wyoming, Map Series 41, U.S. Geological Survey.	Paleontological Resources
Love, J. D. and Christiansen, Ann Coe, 1985, Explanation for Geologic Map of Wyoming Sheet 2 of 3, U.S. Geological Survey.	Paleontological Resources
Love, J. D. and Christiansen, Ann Coe, 1985, Geologic Map of 1 Wyoming Sheet 1 of 3, U.S. Geological Survey.	Paleontological Resources
Martner 1986	Air Resources
Massey, G.M. 2004. Making Sense of Work on the Wind River Indian Reservation. American Indian Quarterly, Summer/Fall. Volume 28: No. 3 & 4, p. 786-816.	Socioeconomics
Masters, J.A., 1979, Deep basin gas trap in western Canada: American Association of Petroleum Geologists Bulletin, vol. 63, no. 2, pp. 151-181.	Leasable Oil and Gas

Reference	Resource Area
Materials Act of 1947	Mineral and Energy Resources
McClaran, M. P. (2000). Improving Livestock Management in Wilderness. *Wilderness Science in a time of change conference. 5*, pp. 49-63. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.	Recreation
McGuinness, C. L., 1963, The Role of Groundwater in the National Water Situation: U. S. Geological Survey Water Supply Paper 1800, 1121 p.	Water
McIntosh et al. 1994	Water
Meinzer, O. E., 1923, The Occurrence of Groundwater in the United States, with Discussion of Principles: U. S. Geological Survey Water Supply Paper 489, 321 p.	Water
Meissner, F.F., 1984, Cretaceous and lower Tertiary coals as sources for gas accumulations in the Rocky Mountain area, in Woodward, J., Meissner, F.F., and Clayton, J.L., eds., Hydrocarbon source rocks of the greater Rocky Mountain region: Rocky Mountain Association of Geologists, pp. 401	Mineral Resources
Miner 1992	Livestock Grazing
Mineral Leasing Act of 1920 (as amended)	Mineral Resources
Mineral Leasing Ac for Acquired Lands of 1947 (as amended)	Mineral Resources
Mining and Minerals Policy Act of 1970	Mineral Resources
Mitchell, J. E., Wallace, G. N., & Wells, M. D. (1996). Visitor perception about cattle grazing on National Forest land. *Journal of Range Management 49(1)* , 81-86.	Recreation
Moline B.R., R.R. Fletcher, and D.T. Taylor. 1991. Impact of Agriculture on Wyoming's Economy. Laramie, WY: University of Wyoming, Cooperative Extension Service, Department of Economics, College of Agriculture. B-954. April.	Socioeconomics
Moore, R. L. (2005). *Introduction to Outdoor Recreation: Providing and Managing Natural Resource Based Opportunities.* State College, PA: Venture Publishing, Inc.	Recreation
National Academy of Sciences, 2006	Air Resources
National Atmospheric Deposition Program, Source: http://nadp.sws.uiuc.edu/trends	Air Resources
National Environmental Policy Act Handbook, BLM (H-1790-1, 2008)	All
National Fire Plan (2002)	Fire and Fuels Management
National Invasive Species Management Plan (NISMP), 2008	Invasive Species and Pest Management

Reference	Resource Area
National Outdoor Leadership School, website: http://www.nols.edu/about/history/ accessed April, 2009	Socioeconomics
Northern Wyoming Fire Zone Fire Management Plan	Fire and Fuels Management
Ohmart, R. D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. Pp. 245-79 in P. R. Krausman, ed. Rangeland wildlife. Denver, Co: Society for Range Management.	Water
Popo Agie Conservation District 2001. Water Quality Monitoring	Water
Popo Agie Conservation District 2005. Water Quality Monitoring	Water
Palmer Hydrologic Drought Index, National Climatic Center, NESDIS, NOAA	
Pannell, F. 2008 . Personal contact between Fred Pannell, Wyoming Office of State Lands and Investments, and J. Sidon, SAIC. March.	Socioeconomics
Partners Against Weeds Action Plan, 1996. BLM/MT/ST-96/003+1020.	Invasive Species and Pest Management
Pergams and Zaradic 2006	Recreation
Pew 2008. Confined Animal Feeding Operations	Livestock Grazing
Pierskalla et al. 2004 Pierskalla, C. M. (2004). Understanding Relationships Among Recreation Opportunities: A Meta-Analysis of Nine Studies. . *Leisure Sciences 26* , 163-180.	Recreation
Plafcan, M., Eddy-Miller, C. A., Fritz, G. F., and Holland J. P.R, II, 1995, Water Resources of Fremont County, Wyoming: U. S. Geological Survey Water-Resources Investigations Report 95-4095, 3 sheets, 133 p.	Water
Platts, William S. 1991. Chapter 11, Livestock grazing. Pp. 389-423. In W.R. Meehan (ed). Influences of forest and rangeland management on salmonid fishes and their habitats. Amer. Fish. Soc. Special Pub. 19, Bethesda, Maryland. 751 pp	Water
Popo Agie Watershed Plan, Popo Agie Conservation District, 2005)	Water
President's Healthy Forest Initiative August 22, 2002	Vegetation – Forest, Forest Products
Programmatic Environmental Impact Statement for a Wind Energy Development Program in 2005.	Renewable Energy
PRSEIS 2007	Air Resources
Public Law 90-543	Special Designations

Reference	Resource Area
Reservoir Management Group, (BLM) Draft Reasonable Foreseeable Development for Oil and Gas, Second Draft Report, February 9, 2009	Oil and Gas
Richter, J. R., 1981, Occurrence and characteristics of groundwater in the Wind River Basin, Wyoming, Volume IV-A: Wyoming Water Resources Research Institute, 149 p.	Water
Reike, H.H., and Kirr, J.N., 1984, Geologic Overview, Coal, and Coalbed Methane Resources of the Wind River Basin, Wyoming, *in* Rightmire, C., Eddy. G.E., and Kirr, J.N., eds., Coalbed Methane Resources of the United States: American Association of Petroleum Geologists Studies in Geology, Series 17, pp. 295-334.	Leasable Coal
Riparian-Wetland Initiative for the 1990s.	Riparian
Riverton Museum. 2007. Riverton History Page. Online at http://www.wyoming.com/~rivmus/rivhist.htm, accessed February 28, 2008.	Socioeconomics
Resource Management Group (RMG) 2009. Mineral Occurrence and Development Report, http://www.blm.gov/style/medialib/blm/wy/information/NEPA/lfodocs/lander_rmp.Par.90593.File.dat/MineralOccurence_DevelopmentPotential.pdf	Leasable Oil and Gas
Rogers 2001, Using Forest health Monitoring to Assess Aspen Forest Cover Change in the Southern Rockies Ecoregion. Ogden, Utah: USDA FS, Rocky Mountain Research Station, p.5	Vegetation – Forest, Woodlands, and Forest Products
Roggenbuck and Watson 1988	Recreation
Roper Starch Worldwide, I. (2000). *Outdoor recreation in America 2000: Addressing key societal concerns.* . Washington, DC: The Recreation Round Table.	Recreation
Sanderson, H. R., Meganck, R. A., & Gibbs, K. C. (1986). Range Management and Scenic Beauty as Perceived by Dispersed Recreationists. *Journal of Range Management 39(5)* , 464, 469	Recreation
Schuster, P.F., White, D.E., Naftz, D.L., and Cecil, L.D. (2000) Chronological Refinement of an Ice Core Record at Upper Fremont Glacier in South Central North America. *Journal of Geophysical Research,* 105, D4: 4657-4666.	Air Resources
Secord, Ross, 1996, Report of First Phase of Forest Service Paleontological Resource Assessment and Classification, Agreement No. 1102-0002-96-032. Cooperative Agreement with BLM, US Forest Service, University of Wyoming.	Paleontological Resources
Seinfeld 1986, *Atmospheric Chemistry and Physics of Air Pollution,* John Wiley and Sons.	Air Resources

Reference	Resource Area
Sestak, M.L.; Riebau, A.R. 1988. SASEM, Simple approach smoke estimation model. U.S. Bureau of Land Management, Technical Note 382. 31 p p.Sestak and Riebau 1988	Air Resources
Shepler, G. 2008 . Personal contact between Glenda Shepler, Wyoming Field Office, National Agricultural Statistics Service, and J. Sidon, SAIC. March.	Socioeconomics
Smithson, S.B., Brewer, J.A., Kaufman, S., Oliver, J.E., and Hurich, C.A., 1979, Structure of the Laramide Wind River Uplift, Wyoming, from COCORP Deep Reflection Data and from Gravity Data,: Journal of Geophysical Research, V. 84., n. B11, pp. 5955-5972.	Geologic Resources
Sonoran Institute. (2007). *Population, Employment, Earnings, and Personal Income Trends: Fremont County, WY.* Bozeman, MT: Sonoran Institute.	Recreation
Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management, State of Wyoming, August 12, 1997.	Livestock Grazing
State of Wyoming Designated Noxious Weed List	Invasive Species and Pest Management
State of Wyoming. 2004. Wyoming Statute 9-4-601. Distribution and Use; Funds, Accounts, Cities and Towns Benefited; Exception for Bonus Payments. Available on Internet: http://legisweb.state.wy.us/statutes/titles/title09/ c04a06.htm.	Socioeconomics
Stewart, B. 2008 . Personal contact between Bud Stewart, Wyoming Game and Fish Department, and J. Sidon, SAIC. February.	Socioeconomics
Sutherland, W.M., 1990, Location Map of Wyoming Gemstones, Lapidary Material, and Geologic Collectibles: Geological Survey of Wyoming Open File Report 90-9, 1:1,000,000 scale, 1 sheet.	Locatable Minerals
Sweetwater Joint Travel & Tourism Board. 2005. "Area History: The Trona Patch." http://www.tourwyoming.com/areahistory.htm, accessed December 12, 2005.	Socioeconomics
Taylor, D.T. and R.H. Coupal. 2000. The Cost of Rural Community Services in Wyoming. University of Wyoming, Department of Agricultural and Applied Economics. Laramie, Wyoming. June.	Socioeconomics
Trewartha & Horn, 1980. An Introduction to climate (fifth edition)	Air Resources
U.S. Census Bureau (Census). 2007a. Census 2000 Summary File 3 (SF 3) - Table H6. Occupancy Status [3] - Universe: Housing Units.	Socioeconomics

Reference	Resource Area
U.S. Census Bureau (Census). 2007b. 2005 County Business Patterns (NAICS). Online from http://censtats.census.gov/cbpnaic/cbpnaic.shtml, accessed February 2008.	Socioeconomics
United States Department of Agriculture USDA – National Agricultural Statistics Service (USDA - NASS). 2008. Wyoming County Data - Livestock. Online at http://www.nass.usda.gov/Statistics_by_State/Wyoming/index.asp#.html, accessed February 2008.	Socioeconomics
United States Department of Agriculture – National Agricultural Statistics Service (USDA - NASS). 2004a. 2002 Census of Agriculture - Volume 1 - Wyoming State Level Data. Online at http://www.nass.usda.gov/census/census02/volume1/wy/index1.htm.	Socioeconomics
United States Department of Agriculture USDA – National Agricultural Statistics Service (USDA - NASS). 2004b. 2002 Census of Agriculture County Profile. Online at http://www.nass.usda.gov/census/census02/profiles/wy/index.htm, accessed February 2008.	Socioeconomics
USDA-NRCS National Range and Pasture Handbook, 190-VI, NRPH, rev. 1, December 2003) Ecological Sites and Forage Suitability Groups (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).	Vegetation
University of Colorado and Colorado Endowment for the Humanities. No date. The Arapaho Project. Online at http://www.colorado.edu/csilw/arapahoproject/contemporary/faq.htm, accessed February 16, 2009.	Socioeconomics
http://www.wrds.uwyo.edu/sco/drought/drought.html	Water
USBM 1982	Other Solid Leasable Minerals
USDA ARS 9-3-2002	Air Quality
USDA date unkown	Recreation
US EPA, Wyoming air quality monitoring, http://www.epa.gov/air/data/repsst.html?st~WY~Wyoming	Air Quality
USDA Forest Service. (2004a). Population pressures on public lands (Local, 2020). Athens, GA: USDA Fores Service, Recreation, Wilderness, Urban Forest, and Demographic Trends Research Group.	Recreation

Reference	Resource Area
USDA Forest Service. (2004b). Recreation demand pressures on public lands (Local, 2020). Athens, GA: USDA Fores Service, Recreation, Wilderness, Urban Forest, and Demographic Trends Research Group.	Recreation
USDA Forest Service. (2004c). Percentage of county area in public land cover, 2000. Athens, GA: USDA Forest Service, Recreation, Wilderness, Urban Forest, and Demographic Trends Research Group.	Recreation
USDA. (UNK.). *ROS Users Guide: Appendix A.* UNK: USDA Forest Service.	
USDA. 1993: USDA NRCS Soil Survey Manual, USDA Ag. Handbook No. 18, Issued October, 1993. U.S. Gov't printing Office. Washington, D.C. pp. 40-44.	Soil
USDA-NRCS, National Range and Pasture Handbook, Chapter 3 (190-VI, NRPH, rev. 1, December 2003) Ecological Sites and Forage Suitability Groups, (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).	Grasslands
USDA-NRCS Hydric Soils Technical Note 1: Proper use of Hydric Soil Terminology.	Soil
US Department of Energy, http://tonto.eia.doe.gov/dnav/pet/pet_cons_refmg_d_nus_VTR_mgalpd_m.htm.	Oil and Gas
USFS 2000	Air Resources
USFS 2006	Air Resources
US Fish and Wildlife Waterfowl Population Status, 2008	Wildlife
USFS and BLM. 1992. Grazing Fee Review and Evaluation: Update of the 1986 Final Report. Washington, D.C.	Socioeconomics
USFS, 2007	Air Resources
US-GAO 1988	Livestock Grazing
USGS 1956, Sedimentation and Chemical Quality of Surface Waters in the Wind River Basin, Wyoming, US Geological Survey Water-Supply Paper 1373	Water
USGS 1999, Environmental Setting of the Yellowstone River Basin, Montana, North Dakotak, and Wyoming, US Geological Survey Water Resources Investigation Report 98-4269	Water
USGS 2001, Water Resource Data, Wyoming Water Year 2001, http://pubs.usgs.gov/wdr/WDR_WY_01/pdf/WDR_WY_01_1.pdf	Water
USGS 2008. US Phosphate Rock and Materials, http://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock/	Other Leasable Minerals

Reference	Resource Area
USGS Stream Gauge, (http://pubs.usgs.gov/wdr/WDR_WY_01/pdf/WDR_WY_01_1.pdf)	Water
Western Regional Climate Center, online database,http://wrcc.edu,	Air Quality
Whelan, Robert J., (1995). *The Ecology of Fire. Cambridge,UK: Cambridge University Press.*	
Whitcomb, H. A., and Lowry, M. E., 1968, Ground-Water Resources and Geology of the Wind River Basin Area, Central Wyoming: Hydrologic Investigations Atlas HA-270, scale 1:250 000, 3 sheets, 13 p.	Water
Wyoming Oil and Gas Conservation Commission, Wyoming well data and statistics, online database: http://wogcc.state.wy.us	Mineral Resources
WDEQ 2006/ 305(b) Report	Water
WDEQ, 2008 Water Quality Rules and Regulations, Chapter 1, Section 4(a), 2008	Water
Wyoming Water Quality Rules and Regulations, Chapter 1, Section 4(b), 2008)	Water
WDEQ. Wyoming Ambient Air Monitoring Annual Network Plan 2008, http://deq.state.wy.us/aqd/downloads/AirMonitor/Network%20Plan_2008.pdf	Air Quality
WDEQ, Wyoming's 2006 305(b) Integrated State Water Quality Assessment Report	Water
WGFD. 2003. Determining the Value of Wildlife Associated Recreation per U.S. Bureau of Land Management Field Office Region in Wyoming. Wyoming Game and Fish Department.	Socioeconomics
Whitcomb and Lowry (1968) Wind River Basin Aquifers, http://pubs.usgs.gov/wri/wri984269/gwater.html	Water
WLSO. (Wyoming Legislative Service Office). 2003. Short Report: Background and Framework for Business Taxation. Written by D.C. Richards and B.P. Farmer. Wyoming Legislative Service Office. Cheyenne, Wyoming.	Socioeconomics
Woodruff, E.G., and Winchester, D.E., 1910, Coal Fields of the Wind River Region, Fremont and Natrona Counties, Wyoming: Contributions to Economic Geology Part II, U.S. Geological Survey Bulletin 471, pp. 516-564.	Leasable Coal
WSGS, 2002, State Geological Survey completes Rattlesnake Hills geologic map: Office of the Wyoming State Geologist Press Release, September 13, 2002, 1 p.	Locatable Minerals
Wyoming BLM Forest and Woodland Management Action Plan, 2005 Update.	Fire and Fuels Management

Reference	Resource Area
Wyoming Department of Education. 2007a. Education Report Series #2, Historical Enrollment by Grade and District for Years 1996 Through 2006. Online at http://www.k12.wy.us/statistics/stat2.aspx, accessed February 2008.	Socioeconomics
Wyoming Department of Education. 2007b. Historical District Assessed Valuations for 1997 through 2006. Online at http://www.k12.wy.us/statistics/stat1/2006_historical_assessed_valuations_for_1997_through_2006.pdf, accessed February 2008.	Socioeconomics
Wyoming Department of Environmental Quality, Violation #4314-08, July 17, 2008 and	Mineral Resources
Wyoming Department of Health www.badskeeter.com	Health and Safety
Wyoming Department of Revenue (Wyoming DOR). 1999. 1999 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2000. 2000 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2001a. 2001 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2001b. Property Tax System in Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/uploads/propertytaxsystem.pdf. Accessed July 9, 2004.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2002. 2002 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2003. 2003 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2004. 2004 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics

Reference	Resource Area
Wyoming Department of Revenue (Wyoming DOR). 2005. 2005 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2006. 2006 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Revenue (Wyoming DOR). 2007. 2007 Annual Report. Online at: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10, accessed February 2008.	Socioeconomics
Wyoming Department of Transportation. 2008a. Unpublished data on vehicle crashes. Obtained from Thomas Carpenter, Highway Safety Program, 307-777-4274, in February 2008.	Socioeconomics
Wyoming Department of Transportation. 2008b. Unpublished data on vehicle miles traveled. Obtained from Sherman Wisemen, Transportation Surveys, 307-777-4190, in February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2001. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2002. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2003. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2004. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2005. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Division of Criminal Investigation. 2006. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics

Reference	Resource Area
Wyoming Division of Criminal Investigation. 2007. Crime in Wyoming - Annual Report. Online at: http://attorneygeneral.state.wy.us/dci/CrimeInWyomingReports.html, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2000. Wyoming Cost of Living for the Second Quarter 2000. Cheyenne, WY. October 3.	Socioeconomics
Wyoming Economic Analysis Division. 2002a. Population for Wyoming, Counties, Cities, and Towns: 1990 to 2000. Online at http://eadiv.state.wy.us/pop/c&sc90_00.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2002b. Annual Population for Wyoming, Counties, and Municipalities: 1980 to 1990. Online at http://eadiv.state.wy.us/pop/c&sc8090.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2002c. Wyoming and County Population: 1970 to 1980. Online at http://eadiv.state.wy.us/pop/cnty7080.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2003a. Wyoming and County Population by Age by Sex by Race: July 1, 1990 to April 1, 2000. Online at http://eadiv.state.wy.us/pop/CO-ASR9000.xls, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2007a. Wyoming Incorporated Place Population Estimates: April 1, 2000 to July 1, 2006. Online at http://eadiv.state.wy.us/pop/SUB-06EST.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2007b. Wyoming and County Population Estimates: July, 2001 to July, 2006. Online at http://eadiv.state.wy.us/pop/CO_AS06.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2007c. Estimates of the Resident Population by Age and Sex for Wyoming: 2000 to 2006. Online at http://eadiv.state.wy.us/pop/ST_AS06.htm, accessed February 2008.	Socioeconomics
Wyoming Economic Analysis Division. 2007d. Annual Estimates of Housing Units for Counties in Wyoming: April 1, 2000 to July 1, 2006. Online at http://eadiv.state.wy.us/pop/cty06hu-est.htm, accessed February 2008.	Socioeconomics

Reference	Resource Area
Wyoming Economic Analysis Division. 2007e. Wyoming Cost of Living Index - Table V: Average Rental Rates - 2Q07 & 2Q06. Online at http://eadiv.state.wy.us/housing/Rental_rates2Q07.pdf, accessed February 2008.	Socioeconomics
Wyoming Forest Health Report, Wyoming State Division of Forestry, 2001.	Vegetation – Forest,
Wyoming Environmental Quality Council, Wyoming Water Quality Rules and Regulations, Chapter 1, Section 4(b), 2008	Water
Wyoming Housing Database Partnership. 2007. A Profile of Wyoming Demographics, Economics and Housing, Semiannual Report, Ending June 30, 2007. Online at http://www.wyomingcda.com/PDFfiles/Profile1/Profile07a_Vol_I_Final.pdf, accessed February 2008.	Socioeconomics
Wyoming Oil and Gas Conservation Commission 2008	Leasable Oil and Gas
Wyoming State Auditor. 2007. Comprehensive Annual Financial Report - Basic Financial Statements for the Fiscal Year Ended June 30, 2007. Online at http://sao.state.wy.us/CAFR/cafr_report.htm#newestcafr, accessed March 2008.	Socioeconomics
Wyoming State Forestry Division, Wyoming Forest Health Report 1995-1998, 2001	Vegetation, Forestry
Wyoming Travel and Tourism (WTT). 2007. Discover the Impact of Tourism in Wyoming – 2006 Impact Report. Online at: http://www.wyomingbusiness.org/tourism/traveltourismresearch.aspx.	Socioeconomics
Wyoming Travel and Tourism Industry, 2006	Recreation
University of Wyoming, State Climate Homepage, online at: http://www.wrds.uwyo.edu/sco/drought/drought.html, access march 31, 2009	Soil
Zouhar et al. 2008. WIldland Fire in ecosystems: fire and nonnative invasive plants. RMRS-GTR-42-Vol 6	Fire and Fuels

1

Lander Summary of the
Analysis of the Management Situation

Appendix A

Maps

MAPS

Maps are included in electronic format. CD versions are available from the Lander Field Office.

Map #	Map Title
Map 1	Federal Surface Lands in the Planning Area
Map 2	Federal Mineral Estate in the Planning Area
Map 3	Oil and Gas Basins in the Planning Area
Map 4	Uranium Mining Projects in the Planning Area NEEDS WORK
Map 5	Wind Erosion Susceptibility of Soils in the Planning Area
Map 6	Water Erosion Susceptibility of Soils in the Planning Area
Map 7	Annual Precipitation in the Planning Area
Map 7-A	Major River Basins
Map 8	Hydrologic Sub-basins
Map 9	Oil and Gas Leases in the Planning Area
Map 10	Oil and Gas Fields in the Planning Area
Map 11	Conventional Oil and Gas Potential
Map 12	Coalbed Natural Gas Potential
Map 13	Phosphate Potential
Map 14	Sand and Gravel Potential
Map 15	Limestone Potential
Map 16	Historic Fire Regimes
Map 17	Fire Regime Condition Class
Map 18	Distribution and Extent of Historic Fire Regimes in the Planning Area
Map 19	Fire Management Units in the Planning Area
Map 20	Vegetation Communities in the Planning Area
Map 21	Precipitation for Ecological Sites
Map 22	Wyoming Major Land Resource Areas
Map 23	Proper Functioning Condition Rating in the Planning Area
Map 24	Invasive Weeds
Map 25	Fish Streams
Map 26	Big Game Parturition Areas
Map 27	Big Game Crucial Winter Range
Map 28	Areas of Critical Environmental Concern in the Planning Area
Map 29	Wyoming Governor’s Greater Sage-Grouse Core Area
Map 30	Sage Grouse in Planning Area
Map 31	Lynx Management Units
Map 32	Wild Horse Management Areas

Map 33	Nine Archeological Sub-regions in the Planning Area
Map 34	Significant Cultural Sites in the Planning Area
Map 35	Paleontological Resources
Map 36	Existing Visual Resource management Classifications
Map 37	Visual Resource Inventory-Inventory Classes
Map 38	Visual Resource Inventory Distance Mapping Zones
Map 39	Visual Resource Inventory Sensitivity
Map 40	Visual Resource Inventory Scenic Quality
Map 41	Wind Energy Potential in the Planning Area
Map 42	Energy Rights-of-Way in the Planning Area
Map 43	Right-of-Way Utility Corridors from Other Field Offices
Map 44	Jeffrey City Area Roads
Map 45	Lander Area Maps
Map 46	Lysite Area Roads
Map 47	Dubois Area Roads
Map 48	Lander Field Office Roads
Map 49	Existing Recreational Sites in the Planning Area
Map 50	Recreation Opportunity Spectrum 1987 Settings
Map 51	Recreation Setting 2009 Physical Setting
Map 52	Recreation Setting 2009 Social Setting
Map 53	Recreation Setting 2009 Operational Setting
Map 54	Areas identified in the Citizens' Wilderness Characteristics Proposal
Map 55	Grazing Allotments in the Planning Area
Map 56	Cancelled Allotments
Map 57	Major Emigrant Trails in the Western United States
Map 58	National Historic Trail Routes in the Planning Area
Map 59	National Historic Trail Routes in Wyoming
Map 60	National Historic Trail Condition Classes in Wyoming
Map 61	Major Historic Sites along the National Historic Trails
Map 62	Continental Divide National Scenic Trail in the Planning Area
Map 63	Wilderness Study Areas in the Planning Area
Map 64	Formerly Used Defense Sites (FUDS)
Map 65	Known Landslides
Map 66	Areas of Relative Ecological Importance

Lander Summary of the
Analysis of the Management Situation

Appendix B

Lander Field Office Species List

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation

Common Name	*Scientific Name*
Plants	
Aspen	*Populus spp.*
Barneby's clover	*Trifolium barnebyi*
Beaver rim phlox	*Phlox pungens*
Black henbane	*Hyoscyamus niger*
Blowout penstemon	*Penstemon haydenii*
Buffalobur	*Solanum rostratum*
Canada thistle	*Cirsium arvense*
Cedar rim thistle	*Cirsium aridum*
Cheatgrass/downy brome	*Bromus tectorum*
Chokecherry	*Prunus virginiana*
Common burdock	*Arctium minus (Hill) Bernh.*
Common cocklebur	*Xanthium sp.*
Common St. Johnswort	*Hypericum perforatum*
Common tansy	*Tanacetum vulgare*
Cottonwood	*Populus spp.*
Dalmation toadflax	*Linaria genistifolia ssp. dalmatica*
Desert yellowhead	*Yermo xanthocephalus*
Diffuse knapweed	*Centaurea diffusa*
Douglas -fir	*Pseudotsuga menziesii*
Dubois milkvetch	*Astragalus gilviflorus var. purpureus*
Dwarf Mistletoe	
Dyer's woad	*Isatis tinctoria*
Field bindweed	*Convolvulus arvensis*
Fremont bladderpod	*Lesquerella fremontii*
Greasewood	*Sarcobatus vermiculatus*
Halogeton	*Halogeton glomeratus*
Hoary cress (whitetop)	*(Cardaria draba and Cardaria pubescens Desv.)*
Houndstongue	*Cynoglossum offinale*
Indian paintbrush	*Castilleja spp.*
Larkspur	*Delphinium occidentale*
Leafy spurge	*Euphorbia esula*
Limber pine	*Pinus flexilis*
Locoweed	*Astragalus spp.*
Locoweed	*Oxytropis sp.*
Lodgepole pine	*Pinus contorta*
Lupine	*Lupinis spp.*
Meadow pussytoes	*Antennaria arcuata*
Mistletoe	*Arceuthobium spp.*
Musk thistle	*Carduus nutans*
Nelson's milkvetch	*Astragalus nelsonianus*

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation (Continued)

Common Name	*Scientific Name*
Owl creek miner's candle	*Cryptantha subcapitata*
Ox-eye daisy	*Leucanthemum vulgare or Chrysanthemum leucanthemum*
Perennial pepperweed (giant whitetop)	*Lepidium latifolium*
Perennial sowthistle	*Sonchus arvensis*
Persistent sepal yellowcress	*Rorippa calycina*
Phlox	*Phlox spp.*
Plains prickley pear	*Opuntia polyacantha*
Plumeless thistle	*Carduus acanthoides*
Ponderosa pine	*Pinus ponderosa*
Porter's sagebrush	*Artemisia porteri*
Puncturevine	*Tribulus terrestris*
Purple loosestrife	*Lythrum salicaria*
Quackgrass	*Agropyron repens*
Rocky Mountain juniper	*Juniperus scopulorum*
Rocky Mountain twinpod	*Physaria saximontana var. saximontana*
Russian knapweed	*Acroptilon repens (synonym = Centaurea repens)]*
Russian olive	*Elaeagnus angustifolia*
Sagebrush	*Artemisia spp.*
Saltcedar	*Tamarix spp.*
Scotch thistle	*Onopordum acanthium*
Shoshonea	*Shoshonea pulvinata*
Showy milkweed	*Asclepias speciosa*
Skeletonleaf bursage	*Franseria discolor*
Spotted knapweed	*Centaurea maculosa*
Utah juniper	*Juniperus osteosperma*
Ute ladies'-tresses	*Spiranthes diluvialis*
Water birch	*Betula occidentalis*
Wild licorice	*Glycyrrhiaz lepidota*
Willow	*Salix spp.*
Yellow toadflax	*Linaria vulgaris*
Big sagebrush	
Sedge	*Carex spp.*
Rush	*Juncus spp.*
Russian thistle	*Salsola tragus*
Mustard	*Brassicaceae spp.*
Plains larkspur / Geyer larkspur	*Delphinium geyeri*
Wyeth lupine	*Lupinus wyethii*
Swainsonpea	*Sphaerophysa salsula*
Curlycup gumweed	*Grindelia squarrosa*
Foxtail barley	*Hordeum jubatum*
Lady's bedstraw	*Galium verum*

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation (Continued)

Common Name	*Scientific Name*
Mountain thermopsis	*Thermopis montana*
Poplar Bud-Gall Mite	*Eriophes parapopuli*
Bull Thistle	*Cirsium vulgare*
Sulfur Cinquefoil	*Potentilla recta*
Tumble Mustard	*Thelypodiopsis spp.*
Fungi	
Blister rust or white pine blister rust	*Cronartium ribicola*
Fish	
Bear River cutthroat	*Oncorhynchus clarki utah)*
Black bullhead	*Ameirus melas*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Common carp [Carp in text]	*Cyprinus carpio*
Creek chub	*Semotilus atromaculatus*
Cutthroat trout	*Oncorhynchus clarki*
Emerald shiner	*Notropis atherinoides*
Fathead minnow	*Pimephales promelas*
Flathead chub	*Platygobio gracilis*
Golden shiner	*Notemigonus crysoleucas*
Grass Carp	*Ctenopharyngodon idella*
Green sunfish- [Green Sunfish - Bluegill Hybrid]	*Lepomus cyanellus*
Iowa Darter	*Etheostoma exile*
Johnny Darter	*Etheostoma nigrum*
Lake chub	*Couesius plumbeus*
Lake trout	*Salvelinus namaycush*
Largemouth bass	*Micropterus salmoides*
Longnose dace	*Rhinichthys cataractae*
Longnose sucker	*Catostomus catostomus*
Mottled Sculpin	*Cottus bairdi*
Mountain sucker	*Catostomus platyrhynchus*
Mountain whitefish	*Prosopium williamsoni*
Plains killifish	*Fundulus zebrinus*
Rainbow trout	*Oncorhynchus mykiss*
River carpsucker	*Carpiodes carpio*
Sand shiner	*Notropis stramineus*
Sauger	*Sander canadensis*
Shorthead redhorse	*Moxostoma macrolepidotum*

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation (Continued)

Common Name	*Scientific Name*
Snake River cutthroat	*Oncorhynchus clarki spp.*
Splake (brook and lake trout hybrid)	*Salvelinus namaycush X Salvelinus fontinalis*
Spottail Shiner	*Notropis hudsonius*
Stonecat	*Noturus flavus*
Tiger Muskie (Muskellunge and Northern Pike hybrid)	*Esox lucius X Esox masquinongy*
Walleye	*Sander vitreus*
White Crappie	*Pomoxis annularis*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*
Wildlife	
Badger	*Taxidea taxus*
Baird's sparrow	*Ammodramus bairdii*
Bald eagle	*Haliaeetus leucocephalus*
Beaver	*Castor canadensisis*
Beet leafhopper	*Circulifer tenellus*
Bighorn sheep	*Ovis canadensis)*
Bison	*Bison bison*
Black bear	*Ursus americanus*
Black-footed ferret	*Mustela nigripes*
Blue grouse	*Dendragapus obscurus*
Bobcat	*Lynx rufus*
Boreal chorus frog	*Pseudacris triseriata*
Boreal toad (Rocky Mtn. population)	*Bufo boreas boreas*
Brewer's sparrow	*Spizella breweri*
Bull snake	*Pituophis catenifer*
Burro	*Equus asinus*
Burrowing owl	*Speotyto cunicularia*
Canada lynx	*Lynx canadensis*
Chukar partridge	*Alectoris chukar*
Cooper's Hawk	*Accipiter cooperii*
Coot	*Fulica spp.*
Cottontail rabbit	*Sylvilagus spp.*
Coyote	*Canis latrans*
Dwarf shrew	*Sorex nanus*
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*
Elk	*Cervus elaphus*
Ferruginous hawk	*Buteo regalis*
Golden eagle	*Aquila chrysaetos*
Goshawk	*Accipiter gentilis*
Gray wolf	*Canis lupus*

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation (Continued)

Common Name	*Scientific Name*
Great Basin Spadefoot Toad	*Spea intermontana*
Great gray owl	*Strix nebulosa)*
Great horned owl	*Bubo virginianus,*
Greater sage-grouse [Sage-grouse in Ch. 2]	*Centrocercus urophasianus*
Greater short-horned lizard	*Phrynosoma hernandesi*
Grizzly bear	*Ursus arctos horribilis*
Ground squirrel	*Spermophilus sp.*
Horse	*Equus ferus caballus*
Hungarian partridge	*Perdix perdix*
Intermountain wandering gartersnake	*Thamnophis elegans vagrans*
Kestrel	*Falco spp.*
Loggerheaded shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Long-eared myotis	*Myotis evotis*
Long-eared owl	*Asio otus*
Marten	*Martes sp.*
Merlin	*Falco columbarius*
Mink	*Mustela vison*
Moose	*Alces alces*
Mormon cricket	*Anabrus simplex*
Mountain lion	*Puma concolor*
Mountain plover	*Charadrius montanus*
Mourning dove	*Zenaida macroura*
Mouse	*Peromyscus spp.*
Mule deer	*Odocoileus hermionus*
Muskrat	*Ondata zibethicus*
Northern goshawk	*Accipiter gentilis*
Northern harrier	*Circus cyaneus*
Northern leopard frog	*Rana pipiens*
Northern sagebrush lizard	*Sceloporus graciosus*
Peregrine falcon	*Falco peregrinus*
Pheasant	*Phasianus colchicus*
Plains rattlesnake	*Crotalus viridis*
Plains spadefoot toad	*Scaphiopus bombifrons*
Prairie falcon	*Falco mexicanus*
Pronghorn [antelope in text]	*Antilocapra americana*
Pygmy rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
Rail	*family Rallidae*
Rat	*Rattus spp.*
Red fox	*Vulpes vulpes*
Red squirrel	*Tamiasciurus hudsonicus*

Table B-1. Common and Scientific Names of Plant and Wildlife Species Identified in the Analysis of the Management Situation (Continued)

Common Name	*Scientific Name*
Red-tailed hawk	*Buteo jamaicensis*
Ruffed grouse	*Bonasa umbellus*
Sage sparrow	*Amphispiza belli*
Sage thrasher	*Oreoscoptes montanus*
Sandhill crane	*Grus canadensis*
Sharp-shinned hawk	*Accipiter striatus)*
Shrew	*family Soricidae*
Short-eared owl	*Asio flammeus)*
Skunk	*family Mephitidae*
Snipe	*Gallinago sp.*
Snowshoe hare	*Lepus americanus*
Spotted bat	*Euderma maculatum*
Spotted frog	*Rana luteiventris*
Swainson's hawk	*Buteo swainsoni*
Swift fox	*Vulpes velox*
Tiger salamander	*Ambystoma tigrinum mavortium*
Townsend's big-eared bat	*Corynorhinus townsendii*
Trumpeter swan	*Cygnus buccinator*
Vole	*Microtus sp.*
Weasel	*Mustela spp.*
White-faced ibis	*Plegadis chihi*
White-tailed deer	*Odocoileus virginianus*
White-tailed jackrabbit	*Lepus townsendii*
White-tailed prairie dog	*Cynomys leucurus*
Yellow-billed cuckoo	*Coccyzum americanus*
Prairie dogs	*Cynomys spp.*
Ducks and Geese	*family Anatidae*
Invertebrates	
Grasshopper	*suborder Caelifera; order Orthoptera*
Mountain pine beetle	*Dendroctonus ponderosae*
Mosquito	*Culicidae spp.*
Mosquito	*Culex tarsalis*
Army cutworm	*Euxos auxilliarius*
Fecal coliform bacteria	*Escherichia coli*

Lander Summary of the
Analysis of the Management Situation

Appendix C

Lands Currently Identified for Disposal in the Lander RMP

LANDS IDENTIFIED FOR DISPOSAL IN RMP

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
1	T. 43 N., R. 108 W., Sec. 27: SW¼NW¼, NW¼SW¼ 80 ac.	None (December 10, 2008)	None	WL-MG-3 CR-C-0-0 R-HV		
5	T. 42 N., R. 108 W., Sec. 21: S½NE¼ 80 ac.	None (December 10, 2008)	None	WL-E-3 WL-D-3 WL-MG-3 CR-A-0-0 F-C		
7	T. 43 N., R. 108 W., Sec. 35: NE¼SW¼ 40 ac.	None (December 10, 2008)	Coal withdrawal (No effect)	WL-M-3 WL-R-4 WL-MG-3 CR-B-0-0		
8	T. 42 N., R. 108 W., Sec. 2: E2SE¼ 80 ac.	None (December 10, 2008)	None	WL-D-3 WL-M-3 WL-RP-4 CR-B/C-0-0		
11	T. 42 N., R. 107 W., Sec. 18: S½NW¼, SW¼ 240 ac.	None (December 10, 2008)	None	WL-D-3 WL-SG-3 CR-B-0-0		
12	T. 42 N., R. 108 W., Sec. 25: N½NE¼ 80 ac.	None (December 10, 2008)	Yes, power site withdrawal Res. 6 EO 07-02-1910	WL-D-3 WL-M-3 WL-WF-3 WL-F-3 WL-T&E-3&4 WL-RP-3 CR-B-12.5-O R-HV		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
14	T. 42 N., R. 107 W., Sec. 17: S½SW¼ 20: NW¼, NE¼SW¼ 280 ac.	None (December 10, 2008)	None	WL-D-3 WL-SG-3 A-A/B-0-0		
24	T. 43 N., R. 105 W., Sec. 32: W½NW¼ 80 ac.	None (May 8, 1984)	None	WL-E-1 WL-D-3 WL-MG-3 CR-A/B-0-0 R-HV East Fork Elk Winter Range		
25	T. 43 N., R. 105 W., Sec. 33: E½E½, W½NE¼ 34: W½W½ 400 ac.	None (December 10, 2008)	None	WL-E-3 WL-D-3 WL-MG-3 CR-A/B-0-0 R-HV East Fork Elk Winter Range		
26	T. 42 N., R. 105 W., Sec. 4: Lots 3, 4 (N½NW¼) S½NW¼ Sec. 5: SE¼NE¼ 200.7 ac.	None (December 10, 2008)	None	WL-E-1 WL-D-3 CR-A/B-0-0 R-HV East Fork Elk Winter Range		
27	T. 42 N., R. 105 W., Sec. 3: S½SE¼ 10: NE¼, SE¼NW¼ 280 ac.	None (December 10, 2008)	None	WL-D-1 WL-E1 CR-B-0-0 R-HV East Fork Elk Winter Range		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
28	T. 42 N., R. 105 W., Sec. 9: SW¼SE¼ 40 ac.	None (December 15, 2008)	None	WL-D-1 WL-E-1 WL-M-3 CR-B-0-0 R-HV		GREEN ON MAP
34	T. 41 N., R. 105 W., Sec. 8: NW¼NW¼, NW¼SE¼ 80 ac.	None (December 10, 2008)	None	WL-D-1 WL-A-3 WL-BS-1 CR-BC-0-0		GREEN ON MAP
38	T. 40 N., R. 106 W., Sec. 22: SE¼NE¼, S½ 360 ac.	None (December 10, 2008)	None	WL-E-3 WL-D-3 WL-BS-1 WL-M-3 CR-B/C-0-0 R-HV		GREEN ON MAP
48	T. 33 N., R. 100 W., Sec. 28: E½SE¼ 80 ac.	None (December 10, 2008)	None	WL-D-1 WL-M-3 WL-UP-3 CR-C-0-0 (MLs-P-M)		
56	T. 32 N., R. 99 W., Sec. 17: SE¼NW¼ 40 ac.	None (December 15, 2008)	None	WL-D-3 CR-C-0-0		
62	T. 32 N., R. 99 W., Sec. 30: SE¼NE¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 WL-M-3 CR-C-0-0		
66	T. 31 N., R. 98 W., Sec. 5: Lot 4, SE¼NW¼ 80.86 ac.	None (December 10, 2008)	None	WL-SG-2 WL-D-1 CR-C-0-0 (MLs-P-M)		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
67	T. 31 N., R. 98 W., Sec. 21: SE¼NE¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 CR-C-0-0		
68	T. 30 N., R. 98 W., Sec. 7: NE¼SE¼ 18: SE¼NE¼, NE¼NW¼ 120 ac.	None (December 10, 2008)	EO 9/4/1912 Wdl Pho Res 15	WL-M-1 WL-F-3 CR-B/C-0-0 (MLs-P-M)		
69	T. 30 N., R. 98 W., Sec. 12: S½NE¼, SE¼NW¼ N½N½ 280 ac.	None (December 15, 2008)	None	WL-SG02 WL-D-3 WL-M-1 WL-UG-3 CR-B/C-0-0		
70	T. 30 N., R. 97 W., Sec. 18: SE¼SE¼ 19: NE¼NE¼ 20: NW¼NW¼ 120 ac.	None (December 15, 2008)	None	WL-SG-2 CR-B/C-0-0		
71	T. 29 N., R. 100 W., Sec. 25: NE¼ 160 ac.	None (December 15, 2008)	None	WL-M-1 CR-B/C-0-0		
72	T. 29 N., R. 98 W., Sec. 7: Lot 5 37.57 ac.	None (December 10, 2008)	None	WL-M-1 CR-B/C-0-0 MLc-Au-H		
73	T. 29 N., R. 98 W., Sec. 10: SE¼SW¼, SW¼SE¼ 15: NE¼NE¼ 120 ac.	None (December 10, 2008)	None	WL-M-3 CR-B/C-0-0		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
74	T. 29 N., R. 98 W., Sec. 11: SW¼NE¼, S½NW¼ 120 ac.	None (December 10, 2008)	None	WL-M-3 CR-C-0-0 (MLs-P-M)		
75	T. 29 N., R. 98 W., Sec. 1: SW¼SW¼ 12: W½NW¼, NW¼SW¼ 160 Ac.	None (December 10, 2008)	None	WL-M-3 CR-B/C-0-0 (MLs-P-M)		
78	T. 31 N., R. 97 W., Sec. 10: SW¼SE¼ 11: N½SW¼ 120 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 CR-B/C-0-0		
79	T. 31 N., R. 97 W., Sec. 12: SE¼SE¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 WL-A-1 CR-B/C-0-0		
80	T. 31 N., R. 96 W., Sec. 18: SW¼SE¼ 19: N½NE¼, SW¼NE¼ 160 ac.	None (December 10, 2008)	None	WL-D-1 WL-A-1 CR-B/C-0-0 MS-SG-H		
81	T. 31 N., R. 96 W., Sec. 20: SE¼SW¼, S½SE¼ 29: NE¼NW¼, N½NE¼ 28: W½NW¼ 320 ac.	None (December 10, 2008)	None	WL-R-2 WL-D-1 WL-A-1* CR-B/C-0-0 *Also restricted area no. 2		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
82	T. 31 N., R. 96 W., Sec. 21: SE¼SE¼ 22: SW¼SW¼ 80 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 CR-C-0-0		
83	T. 31 N., R. 96 W., Sec. 27: SW¼SW¼ 34: NW¼NE¼, NE¼NW¼ 120 ac.	None (December 15, 2008)	None	WL-D-1 WL-A-1 CR-C-0-0		
84	T. 31 N., R. 96 W., Sec. 33: E½SE¼ 80 ac.	None (December 15, 2008)	None	WL-D-1 WL-A-3 CR-C-0-0		
85	T. 31 N., R. 96 W., Sec. 35: N½SW¼ 80 ac.	None (December 10, 2008)	None	WL-D-1 WL-E-3 WL-RP-3 CR-B-C-0-0		
86	T. 40 N., R. 94 W., Sec. 11: NE¼NW¼ 40 ac.	None (December 15, 2008)	None	WL-D-1 WL-UG-3		
87	T. 40 N., R. 94 W., Sec. 12: SE¼NE¼, NE¼SE¼ T. 39 N., R. 93 W., Sec. 7: SW¼NW¼ 120 ac.	None (December 16, 2008)	None	WL-D-1 WL-UG-3 CR-C-0-0 MLs-Au-H		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
88	T. 40 N., R. 93 W., Sec. 5: SE¼NE¼ 40 ac.	None (December 10, 2008)	None	WL-UG-3 CR-B/C-0-0		
89	T. 40 N., R. 93 W., Sec. 3: SW¼SW¼ 40 ac.	None (December 10, 2008)	None	WL-UG-3 CR-C-0-0		
90	T. 40 N., R. 92 W., Sec. 6: Lot 5 T. 40 N., R. 93 W., Sec. 1: NW¼SE¼, NE¼SW¼ 128.15 ac.	None (December 10, 2008)	None	WL-E-2 CR-C-0-0		
91	T. 40 N., R. 93 W., Sec. 14: SW¼NW¼ 15: NE¼SE¼ 80 ac.	None (December 10, 2008)	None	WL-D-3 CR-C-0-0		
92	T. 40 N., R. 91 W., Sec. 19: NW¼SE¼ 20: NW¼SW¼ 80 ac.	None (December 10, 2008)	None	WL-D-1 WL-UG-3 CR-B/C-0-0		
93	T. 40 N., R. 92 W., Sec. 11: S½SE¼ 80 ac.	None (December 16, 2008)	None	WL-D-1 WL-E-3 WL-UG-3 CR-B-0-0 MLc-U-H		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
96	T. 40 N., R. 91 W., Sec. 5: NE¼NW¼ (Lot 3) 45.83 ac.	None (December 10, 2008)	None	WL-RP-4 CR-A/B-0-0		
97	T. 40 N., R. 91 W., Sec. 8: N½NE¼, SW¼NE¼ 120 ac.	None (December 10, 2008)	None	CR-B-0-0		
98	T. 40 N., R. 91 W., Sec. 9: NE¼NW¼ 40 ac.	None (December 10, 2008)	None	CR-B-0-0		
99	T. 40 N., R. 91 W., Sec. 10: SW¼NW¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 WL-RP-3 CR-A/B-0-0		
101	T. 40 N., R. 91 W., Sec. 3: Lots 1, 2 91.88 ac.	None (December 10, 2008)	None	WL-D-1 WL-UG-3 WL-RP-4 CR-B/C-0-0		
105	T. 40 N., R. 89 W., Sec. 9; N½NE¼ 80 ac.	None (December 10, 2008)	None	WL-SG-2 WL-E03 CR-C-0-0		
106	T. 39 N., R. 91 W., Sec. 24: NW¼SE¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 WL-A-1 CR-B/C-0-0 MLs-OG-H		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
108	T. 39 N., R. 89 W., Sec. 8: E½NW¼ 80 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 CR-B/C-0-0 MLs-OG-H		
109	T. 39 N., R. 89 W., Sec. 8: NE¼SE¼ 40 ac.	None (December 10, 2008)	None	WL-D-1 WL-A-1 WL-RP-4 CR-B/C-100-4 MLs-OG-H MS-SG-H (FUP)		
110	T. 39 N., R. 89 W., Sec. 8: SW¼SW¼ 17: NW¼NW¼ 18: NE¼NE¼ 120 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 WL-RP-4 CR-B/C-0-0 MLs-OG-H MS-SG-H (FUP)		
112	T. 38 N., R. 94 W., Sec. 11: SW¼SW¼ 14: W½NW¼ 120 ac.	None (December 10, 2008)	Yes, Cl. SO 08/25/1945 CL Pwr S 375 NW¼NW¼ of Sec. 14 only	WL-R-2 WL-D-3 WL-A-1 CR-B/C-0-0		
118	T. 37 N., R. 89 W., Sec. 28: NW¼NW¼ 29: N½N½, SW¼NE¼, S½NW¼ 320 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 WL-RP-3 CR-B-0-0		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
119	T. 35 N., R. 92 W., Sec. 4: Lot 1 41.31 ac.	None (March 13, 1984	None	WL-D-3 WL-A-1 WL-RP-3 CR-B-0-0		
121	T. 35 N., R. 90 W., Sec. 10: SE¼SW¼ 40 ac.	None (December 10, 2008)	None	WL-SG-2 WL-D-3 CR-C-100-0		
122	T. 34 N., R. 94 W., Sec. 31: NE¼NE¼ 32: NW¼NW¼ 80 ac.	None (December 10, 2008)	None	CR-C-0-0		
124	T. 31 N., R. 92 W., Sec. 33: S½NW¼ 80 ac.	None (December 10, 2008)	None	CR-B-0-0		
127	T. 30 N., R. 93 W., Sec. 26: SW¼SW¼ 34: NE¼NE¼ 35: NW¼NW¼ 120 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-1 CR-A/B-0-3		
133	T. 29 N., R. 92 W., Sec. 23: NE¼SE¼ 24: NW¼SW¼ 80 ac.	None (December 10, 2008)	None	WL-SG-2 WL-A-1 CR-B-0-0		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
136	T. 30 N., R. 89 W., Sec. 29: SW¼SW¼ 32: NW¼NW¼ 80 ac.	None (December 10, 2008)	None	WL-D-3 WL-RS03 WL-R04 CR-B/C-0-0		
137	T. 30 N., R. 89 W., Sec. 15: S½NW¼, SW¼ 240 ac.	None (December 10, 2008)	None	WL-D-1 WL-D03 WL-R-4 CR-B/C-0-0		
138	T. 30 N., R. 89 W., Sec. 9: SE¼ 10: NW¼SW¼ 200 ac.	None (December 10, 2008)	None	WL-D-1 WL-D-3 WL-R-4 WL-A+4-4 CR-B-0-4		
139	T. 32 N., R. 88 W., Sec. 3: NW¼SW¼ 40 ac.	None (December 10,2008)	None	CR-B/C-0-0		
140	T. 32 N., R. 88 W., Sec. 15: W½SE¼ 22: NW¼NE¼ 120 Ac.	None (December 10, 2008)	None	CR-B/C-0-0		
141	T. 32 N., R. 87 W., Sec. 3: Lot 4 41.58 ac.	None (December 10, 2008)	None	WL-D-3 WL-E CR-B/C-0-0		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
143	T. 32 N., R. 87 W., Sec. 15: NW¼NE¼ 40 ac.	None (December 10, 2008)	None	WL-E CR-C-0-0		
144	T. 32 N., R. 87 W., Sec. 31: NW¼SE¼ 40 ac.	None (December 10, 2008)	None	CR-B/C-0-0		
145	T. 31 N., R. 87 W., Sec. 5: SE¼NE¼, NE¼SE¼ 80 ac.	None (December 10, 2008)	None	CR-B/O-0-0		
146	T. 31 N., R. 87 W., Sec. 28: W½NE¼ 80 ac.	None (December 10, 2008)	None	CR-B/C-0-0		
147	T. 32 N., R. 85 W., Sec. 13: NE¼NE¼ 40 ac.	None (December 10, 2008)	None	WL-D-3 WL-A-3 CR-B/C-0-0		
149	T. 30 N., R. 85 W., Sec. 7: SE¼SW¼ 18: E½NW¼ 120 ac.	None (December 10, 2008)	None	CR-B/C-0-0		
150	T. 30 N., R. 85 W., Sec. 29: NW¼NE¼, NE¼NW¼ 80 ac.	None (December 10, 2008)	None	WL-A-1 WL-WF-3 CR-B-0-0		

LANDS IDENTIFIED FOR DISPOSAL IN RMP (Continued)

Parcel No.	Legal Description	Mining Claims	Withdrawals	Resource Values	Management Category	Priority
158	T. 29 N., R. 88 W., Sec. 20: NE¼NW¼, E2NW¼NW¼, NW¼NW¼NW¼ 19: N½NE¼NE¼, SW¼SE¼NE¼ 100 ac.	None (December 10, 2008)	None	WL-A-1 WL-WF-4 CR-A-0-3,4		
160	T. 28 N., R. 89 W., Sec. 24: SW¼NW¼ 40 ac.	None (December 10, 2008)	None	WL-A-1 CR-B/C-0-0 MS-SG-H		
167	T. 33 N., R. 93 W., Sec. 33: E½E½ 34: W½NW¼ 240 ac.	None (December 10, 2008)	None	CR-C/B-0-0		

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Lander Summary of the
Analysis of the Management Situation

Appendix D

Fire Regime Groups, Descriptions, and Condition Classifications

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Table 1. Fire Regime Groups and Descriptions

Group	Frequency	Severity	Severity description
I	0–35 years	Low / mixed	Generally low-severity fires replacing less than 75% of the dominant over story vegetation; can include mixed-severity fires that replace up to 75% of the over story
II	0–35 years	Replacement	High-severity fires replacing greater than 75% of the dominant over story vegetation
III	35–200 years	Mixed/low	Generally mixed-severity; can also include low-severity fires
IV	35–200 years	Replacement	High severity fires
V	200+ years	Replacement/any severity	Generally replacement-severity; can include any severity type in this frequency range.

Table 2. Fire Regime Condition Classifications

Condition Class	Severity description
I	For the most part, fire regimes in this fire condition class are within historical ranges. Vegetation composition and structure are intact. Therefore, the risk of losing key ecosystem components from the occurrence of fire remains relatively low.
2	Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.
3	Fire regimes on these lands have been substantially altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure, and diversity have been substantially altered.

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Lander Summary of the
Analysis of the Management Situation

Appendix E

Livestock Grazing Allotments and Range Improvements

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This appendix provides an overview of livestock grazing allotments including acreage and season of use; allotment categorization; and allotments assessed for standards and guidelines. In addition it provides details of range improvement projects. The data are presented in five tables:

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use E-2

Table 2. Allotment Categorization – Current and Proposed E-27

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards E-40

Table 4. Allotment Management Plans and Rangeland Management Agreements Developed E-45

Table 5. Summary of Range Improvements Lander Field Office 1986-2009……E-48

Table 6. Animal Unit Months (AUMs) Authorized from 1989-2008…….E-52

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
180	LOST CREEK	238.00	PERMIT- SEC 3	CATTLE	6/15-9/25	21	
655	COPPER MTN.*	248.00	PERMIT - SEC 3	CATTLE	6/1-11/15	121	
1301	CANTRIL JACK ALLOT.	6,875.00	PERMIT- SEC 3	CATTLE	8/16-11/30	573	
1302	NORTH OF CB&Q R.R.	961.00	PERMIT- SEC 3	CATTLE	3/5-5/4	160	
1303	SOUTH OF CB&Q R.R.	7,256.00	PERMIT- SEC 3	CATTLE	3/5-5/4	660	
				CATTLE	10/20-12/16		
				CATTLE	11/15-12/16		
1304	CRAWFORD CREEK	1,209.00	PERMIT- SEC 3	CATTLE	6/15-10/14	460	
1305	LYBYER NORTH	3,175.00	PERMIT- SEC 3	CATTLE	4/26-5/31	262	
1306	CANNING ALLOTMENT	347.00	PERMIT- SEC 3	CATTLE	8/10-2/28	28	
				CATTLE	3/1-5/1		
				HORSE	3/1-2/28		
1307	MALLET-SMITH PASTURE	137.00	PERMIT- SEC 3	CATTLE	7/1-9/30	24	
1308	167A SCOTT-ROBSON	283.00	PERMIT- SEC 3	CATTLE	5/1-6/15	33	
				CATTLE	10/15-12/17		
				SHEEP	5/1-6/15		
				SHEEP	10/15-12/17		
1309	LOGAN PASTURE	3,427.00	PERMIT- SEC 3	CATTLE	6/1-9/15	610	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1310	COTTONWOOD PASS	2,321.00	PERMIT- SEC 3	CATTLE	10/18-11/1	249	
				CATTLE	6/1-6/15		
1311	KEENAN	191.00	PERMIT- SEC 3	CATTLE	4/30-5/30	16	
1312	NORTH OF TRACKS	15,556.00	PERMIT- SEC 3	CATTLE	2/14-6/15	2820	
				CATTLE	10/1-12/31		
				HORSE	3/1-2/28		
1313	SOUTH OF TRACKS	8,923.00	PERMIT- SEC 3	CATTLE	4/1-12/31	1110	
1314	MONETA HILLS PASTURE	7,752.00	PERMIT- SEC 3	CATTLE	4/1-12/31	587	
1315	DITCH PASTURE	782.00	PERMIT- SEC 3	CATTLE	4/20-5/5	108	
1316	MADDEN RANCH PASTURE	1,442.00	PERMIT- SEC 3	CATTLE	5/5-12/30	170	
1317	BRANDAU RANCH ALLOT	309.00	PERMIT- SEC 3	CATTLE	8/15-12/31	167	
1318	BELOW THE HILL PAST.	2,793.00	PERMIT- SEC 3	CATTLE	6/1-9/29	78	
1319	TWIDALE	200.00	PERMIT- SEC 3	CATTLE	5/1-5/31	39	
				CATTLE	10/1-10/31		
				HORSE	11/1-2/28		
1320	ST CLAIR WEST	350.00	PERMIT- SEC 3	CATTLE	4/10-5/10	65	
1321	ST CLAIR RANCH	141.00	PERMIT- SEC 3	CATTLE	11/15-2/28	89	
				CATTLE	3/1-3/31		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1322	ST.CLAIR SOUTH PAST.	4,435.00	PERMIT- SEC 3	HORSE	5/1-1/15	726	
				CATTLE	10/15-12/31		
1323	FULLER ALLOTMENT	3,050.00	PERMIT- SEC 3	CATTLE	8/7-10/28	413	
				CATTLE	5/24-6/25		
1324	HOODOO CREEK ALLOT	23,168.00	PERMIT- SEC 3	CATTLE	9/1-10/10	1491	
				CATTLE	1/6-6/26		
1325	EAST OF RANCH	3,033.00	PERMIT- SEC 3	CATTLE	12/1-5/31	236	
				SHEEP	12/1-6/15		
1326	LICHTENSTEIN	5,998.00	PERMIT- SEC 3	CATTLE	1/1-2/28	501	
				SHEEP	12/1-4/15		
1327	MYRTLE REED ALLOT	1,213.00	PERMIT- SEC 3	CATTLE	5/1-10/31	72	
1328	BATTLE AXE SOUTH	6,994.00	PERMIT- SEC 3	CATTLE	5/1-9/12	552	
1329	LYSITE MOUNTAIN	8,192.00	PERMIT- SEC 3	CATTLE	5/10-11/1	2569	X
				HORSE	6/1-5/31		
1330	BATTLE AXE LYSITE	3,717.00	PERMIT- SEC 3	SHEEP	3/19-4/20	420	X
				CATTLE	8/15-10/1		
				CATTLE	4/15-6/1		
1331	BATTLE AXE BERGER	8,537.00	PERMIT- SEC 3	CATTLE	5/16-4/30	911	X
				HORSE	3/1-2/28		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1332	BOW & ARROW	1,094.00	PERMIT- SEC 3	CATTLE	4/10-6/15	159	
				CATTLE	10/1-12/1		
				HORSE	6/1-9/30		
1333	GATES DRAW ALLOTMENT	12,793.00	PERMIT- SEC 3	CATTLE	11/1-5/31	1490	
1334	COTTONWOOD PASS	3,890.00	PERMIT- SEC 3	CATTLE	6/11-10/20	825	
1335	OCLA SOUTH OF R.R.	6,848.00	PERMIT- SEC 3	CATTLE	12/1-3/31	912	
1336	OCLA NORTH OF R.R.	5,600.00	PERMIT- SEC 3	CATTLE	4/20-5/30	425	
1337	DE PASS RANCH	528.00	PERMIT- SEC 3	CATTLE	3/1-2/28	125	
1338	FULLER RANCH PASTURE	1,450.00	PERMIT- SEC 3	CATTLE	3/1-4/30	165	
1339	PICARD PRIVATE ALLOT	3,146.00	PERMIT- SEC 3	CATTLE	12/1-5/15	490	
1340	168A NORTH OF SEEPS	796.00	PERMIT- SEC 3	CATTLE	9/20-12/1	200	
				CATTLE	5/1-6/1		
				HORSE	6/1-9/30		
1341	168A STOCK DRIVEWAY	2,016.00	PERMIT- SEC 3	CATTLE	12/1-12/31	40	X
				HORSE	12/1-12/31		
1342	KNAPP INDIVIDUAL	997.00	PERMIT- SEC 3	CATTLE	10/10-11/15	40	
1343	TUFF CREEK PASTURE	15,728.00	PERMIT- SEC 3	CATTLE	11/16-2/28	860	
				CATTLE	4/1-7/31		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1344	WESTFALL	3,620.00	PERMIT- SEC 3	HORSE	3/1-12/20	698	
				CATTLE	6/1-2/28		
1345	MOUNTAIN PASTURE	1,135.00	PERMIT- SEC 3	CATTLE	5/20-1/15	277	
1346	BONNEVILLE RESERVOIR	10,968.00	PERMIT- SEC 3	CATTLE	4/15-6/10	984	
				HORSE	4/15-6/10		
				CATTLE	10/1-12/31		
1347	JONES CREEK BASIN	1,292.00	PERMIT- SEC 3	CATTLE	7/1-10/10	488	
1348	J.HERBST SUMMER	2,198.00	PERMIT- SEC 3	CATTLE	6/1-9/30	308	
				HORSE	10/1-4/30		
1349	J.HERBST TUFF CREEK	1,226.00	PERMIT- SEC 3	CATTLE	10/1-11/15	228	
				CATTLE	5/1-5/30		
1350	WM.HERBST SUMMER	885.00	PERMIT- SEC 3	CATTLE	10/15-12/15	60	
1351	SCOTT DRAW	3,386.00	PERMIT- SEC 3	CATTLE	10/1-11/7	303	
1352	JOE JOHNS PASTURE	1,109.00	PERMIT- SEC 3	CATTLE	8/15-11/30	298	
				SHEEP	6/1-10/1		
1353	CAMPBELL	2,843.00	PERMIT- SEC 3	CATTLE	5/13-11/30	299	
				HORSE	4/15-1/1		
				SHEEP	5/15-7/15		
				SHEEP	9/1-12/10		
1354	STINKING WELL	10,009.00	PERMIT- SEC 3	SHEEP	3/1-4/15	789	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
				SHEEP	5/15-6/15		
				CATTLE	3/1-5/31		
				CATTLE	12/1-2/28		
				SHEEP	12/1-2/28		
1355	LOOKOUT HILL	7,942.00	PERMIT- SEC 3	SHEEP	4/1-6/28	682	
				SHEEP	10/20-12/10		
				CATTLE	4/1-5/15		
1356	HOWARD PASTURE	2,717.00	PERMIT- SEC 3	CATTLE	1/1-2/28	224	
				SHEEP	4/1-7/31		
				SHEEP	12/15-2/28		
1357	SUMMER ALLOTMENT	182.00	PERMIT- SEC 3	CATTLE	6/15-7/14	32	
1358	TOP OF MOUNTAIN PAST	910.00	PERMIT- SEC 3	CATTLE	6/15-10/15	23	
1359	RAMAGE RANCH	11,990.00	PERMIT- SEC 3	HORSE	3/1-2/28	1549	
				CATTLE	11/1-6/20		
1360	RUTH FULLER PRIVATE	86.00	PERMIT- SEC 3	CATTLE	5/15-5/23	9	
				CATTLE	6/26-8/6		
1361	COPPER MT. (LANDER)	288.00	PERMIT- SEC 3	CATTLE	7/1-9/30	40	
1362	LYBYER SOUTH	2,500.00	PERMIT- SEC 3	CATTLE	3/1-4/30	319	
				CATTLE	10/15-11/30		
1363	HOODOO HQ PASTURES	86.00	PERMIT- SEC 3	CATTLE	3/1-2/28	4	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
				HORSE	3/1-2/28		
1364	RED RANCH PASTURE	24.00	PERMIT- SEC 3	CATTLE	3/1-2/28	1	
1365	QUIEN SABE RANCH PASTURE	5,973.00	PERMIT- SEC 3	CATTLE	4/1-6/30	944	
				CATTLE	10/1-11/15		
1366	CABIN PASTURE	265.00	PERMIT- SEC 3	CATTLE	3/1-2/28	65	
				HORSE	5/1-11/30		
				SHEEP	3/1-2/28		
1367	HENRICH PASTURE	81.00	PERMIT- SEC 3	CATTLE	5/15-11/1	11	
1368	BRIDGER CREEK	114.00	PERMIT- SEC 3	CATTLE	3/1-2/28	18	
				HORSE	3/1-2/28		
1369	PICARD RANCH HQ	191.00	PERMIT- SEC 3	CATTLE	3/1-2/28	17	
1373	COPPER MOUNTAIN	277.00	PERMIT- SEC 3	CATTLE	6/1-10/15	16	
1401	RIM PASTURE	19,100.00	PERMIT- SEC 3	CATTLE	6/1-10/31	3982	X
				SHEEP	6/1-10/8		
1402	DELFELDER ALLOTMENT	8,938.00	PERMIT- SEC 3	CATTLE	3/1-1/17	1203	
1403	CONANT CREEK COMMON	49,541.00	PERMIT- SEC 3	SHEEP	12/16-4/15	7987	X
				CATTLE	5/1-11/30		
				SHEEP	5/1-6/15		
				SHEEP	10/14-11/30		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1404	WM HERBST WINTER	2,932.00	PERMIT- SEC 3	CATTLE	4/6-6/20	398	
				CATTLE	11/1-12/31		
1405	POSEY NORTH ALLOTMNT	4,410.00	PERMIT- SEC 3	CATTLE	4/15-6/20	429	
				CATTLE	11/1-12/15		
1406	POISON CREEK	16,759.00	PERMIT- SEC 3	CATTLE	3/15-6/15	817	
				CATTLE	10/15-12/30		
1407	MUSKRAT AMP	39,494.00	PERMIT- SEC 3	CATTLE	10/15-4/30	3962	
1408	TOWNSHIP PASTURE	18,904.00	PERMIT- SEC 3	CATTLE	10/1-1/15	2478	
				HORSE	11/1-2/28		
				HORSE	3/1-4/30		
				CATTLE	4/1-4/30		
1409	MUSKRAT OPEN	99,243.00	PERMIT- SEC 3	CATTLE	5/1-11/30	10519	X
1410	POSEY PASTURE	1,061.00	PERMIT- SEC 3	CATTLE	4/22-5/20	165	
1411	SHOSHONI ROAD	21,158.00	PERMIT- SEC 3	CATTLE	3/1-1/17	2706	
				HORSE	3/1-2/28		
1412	POSTON WINTER	3,552.00	PERMIT- SEC 3	CATTLE	3/1-2/28	437	
1413	PIPELINE PASTURE	4,228.00	PERMIT- SEC 3	HORSE	12/1-4/30	452	
				CATTLE	12/1-5/4		
1414	ANDERSON WINTER	5,864.00	PERMIT- SEC 3	CATTLE	11/1-1/2	770	
				CATTLE	5/15-5/31		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1415	MYERS PASTURE	903.00	PERMIT- SEC 3	CATTLE	5/1-9/15	116	
1416	LAME JACK DRAW	6,373.00	PERMIT- SEC 3	CATTLE	5/1-9/30	720	
1417	HAYBARN HILL	9,947.00	PERMIT- SEC 3	CATTLE	11/1-4/30	1195	
1512	SOUTH DOBIE FLAT	6,847.00	PERMIT- SEC 3	CATTLE	5/23-6/9	1207	
				CATTLE	10/25-12/6		
1518	LITTLE BUG PASTURE	3,837.00	PERMIT- SEC 3	CATTLE	1/1-4/1	564	
1601	DODDS ALLOTMENT	1,744.00	PERMIT- SEC 3	SHEEP	5/1-10/30	446	
1604	#17 HORSE HEAVEN PST	16,329.00	PERMIT- SEC 3	HORSE	6/1-9/30	3077	
				CATTLE	6/15-10/19		
				SHEEP	7/1-10/18		
1605	#18 HORSE CREEK PAST	3,685.00	PERMIT- SEC 3	SHEEP	5/1-6/15	459	
				SHEEP	10/19-11/30		
				CATTLE	10/20-11/16		
1606	#19 VINEGAR HILL PST	6,662.00	PERMIT- SEC 3	SHEEP	10/19-12/12	981	
				HORSE	1/1-3/31		
				CATTLE	11/18-12/24		
				SHEEP	12/30-1/15		
1607	#16 PHILLIPS PAST.	1,872.00	PERMIT- SEC 3	SHEEP	1/16-4/15	259	
				CATTLE	12/25-2/8		
1608	#20 CALF	828.00	PERMIT- SEC 3	CATTLE	5/1-6/15	130	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
	PASTURE						
				SHEEP	5/1-6/15		
1609	#21 HORSE PASTURE	1,143.00	PERMIT- SEC 3	HORSE	4/1-5/31	168	
				CATTLE	6/1-6/6		
			PERMIT- SEC 3	SHEEP	6/16-6/30		
1610	#22 BULL PASTURE	908.00	PERMIT- SEC 3	CATTLE	4/1-6/30	156	
				SHEEP	5/1-6/15		
1612	HAMILTON ROCK PAST.	3,998.00	PERMIT- SEC 3	CATTLE	12/25-1/27	454	
				SHEEP	1/16-4/15		
1614	CIRCLE BAR ALLOTMENT	38,299.00	PERMIT- SEC 3	HORSE	5/1-2/28	5897	
				CATTLE	5/1-2/28		
1615	NORTH OF DRIFT FENCE	20,318.00	PERMIT- SEC 3	CATTLE	6/10-9/26	4391	
1616	KEESTER	29,779.00		HORSE	11/15-12/5	4582	
			PERMIT- SEC 3	CATTLE	5/16-11/28		
1619	WINTER PASTURES (incl.Clayto 1618)	17,569.00	PERMIT- SEC 3	CATTLE	9/26-5/15	2635	
				HORSE	12/6-6/30		
1620	CABIN CREEK PASTURE	1,153.00	PERMIT- SEC 3	CATTLE	7/10-10/26	241	
1622	HAT RANCH	5,022.00	PERMIT- SEC 3	CATTLE	3/1-5/15	855	
				HORSE	3/1-5/15		
				CATTLE	12/1-2/28		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
				HORSE	11/1-2/28		
1623	MURPHREE PASTURES	9,219.00	PERMIT- SEC 3	HORSE	6/25-11/16	1061	
				CATTLE	3/1-11/30		
1625	JAMERMAN PASTURES	6,603.00	PERMIT- SEC 3	CATTLE	3/1-5/19	478	
				CATTLE	11/1-2/28		
1626	MUD LAKE	1,324.00	PERMIT- SEC 3	CATTLE	12/1-12/31	113	
1628	SAGE HEN	1,312.00	PERMIT- SEC 3	CATTLE	12/1-2/28	189	
1629	JJ WINTER PASTURES	721.00	PERMIT- SEC 3	CATTLE	3/1-4/30	276	
				HORSE	3/1-2/28		
				CATTLE	11/1-2/28		
1630	TRAM ROAD PASTURE	1,136.00	PERMIT- SEC 3	CATTLE	4/1-5/15	135	
1631	CLAYTOR HOMESTEAD	59.00	PERMIT- SEC 3	CATTLE	3/1-3/31	6	
1632	NORTH HAT PASTURE	1,144.00	PERMIT- SEC 3	CATTLE	3/15-4/30	180	
				HORSE	6/1-8/31		
1633	STAMPEDE BOG	552.00	PERMIT- SEC 3	CATTLE	3/1-4/30	89	
				CATTLE	10/15-11/30		
1635	BIG ROCK PASTURE	13,386.00	PERMIT- SEC 3	CATTLE	4/1-5/31	1995	
				CATTLE	10/15-11/26		
1636	GRAINTE MT OPEN	77,746.00	PERMIT- SEC 3	CATTLE	5/10-10/31	12584	X
1638	WINTER	160.00	PERMIT- SEC 3	CATTLE	3/1-3/31	16	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
	ALLOTMENT						
1640	GARSON RANCH	2,531.00	LEASE- SEC 15	CATTLE	6/1-10/31	403	
1642	DEVILS GATE*	24,227.00	PERMIT- SEC 3	CATTLE	3/1 - 2/28	3700	
				HORSE			
1644	TURKEY TRACK RANCH*	9,057.00	PERMIT- SEC 3	CATTLE	3/1-2/28	1832	
				HORSE			
1660	HOME,NORTH OF HIGHWY	1,231.00	PERMIT- SEC 3	CATTLE	12/1-5/25	205	
				HORSE	3/1-5/25		
1701	FLAGG AMP	11,463.00	PERMIT- SEC 3	CATTLE	5/1-11/30	2086	X
1702	FLAGG INDIVIDUAL	298.00	PERMIT- SEC 3	CATTLE	12/1-2/28	51	
1703	BIG PASTURE	76,090.00	PERMIT- SEC 3	CATTLE	5/1-11/7	11909	X
1704	BREEDING PASTURE	16,916.00	PERMIT- SEC 3	CATTLE	4/3-6/8	1956	X
				CATTLE	9/1-11/16		
				HORSE	4/1-12/15		
1705	MYERS FENCED PASTURE	1,640.00	PERMIT- SEC 3	CATTLE	4/6-4/30	175	
1706	TRENT&HOME PLACE	427.00	PERMIT- SEC 3	CATTLE	11/16-2/28	40	
1707	ICE SLOUGH	953.00	PERMIT- SEC 3	CATTLE	5/1-7/31	183	
1709	LONG CREEK PASTURE	2,567.00	PERMIT- SEC 3	CATTLE	4/1-9/30	227	
				CATTLE	11/16-12/15		
1710	GRAHAM RANCH	1,129.00	PERMIT- SEC 3	CATTLE	11/15-2/28	175	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
	PASTURE						
				CATTLE	3/1-4/30		
1711	HAY MEADOW PASTURE	316.00	PERMIT- SEC 3	CATTLE	3/1-5/14	50	
				CATTLE	9/1-2/28		
1712	LONG CRK SWEETWATER	426.00	PERMIT- SEC 3	CATTLE	11/1-4/30	66	
1713	WHITLOCK FENCED	1,057.00	PERMIT- SEC 3	CATTLE	4/1-4/30	126	
1714	SCARLETT PASTURE	41.00	PERMIT- SEC 3	CATTLE	10/1-2/28	79	
1715	HORSE PASTURE	130.00	PERMIT- SEC 3	HORSE	3/1-3/31	14	
				HORSE	12/16-2/28		
1716	DISHPAN BUTTE	16,069.00	PERMIT- SEC 3	CATTLE	5/15-11/1	1983	X
1717	FENCED INDIVIDUAL	1,310.00	PERMIT- SEC 3	CATTLE	5/1-6/14	171	
1801	EAST BEAVER COMMON	61,911.00	PERMIT- SEC 3	CATTLE	5/1-11/15	7331	X
1802	SAND DRAW AMP	13,635.00	PERMIT- SEC 3	CATTLE	6/1-10/15	1418	
1803	GOVERNMENT DRAW	75,775.00	PERMIT- SEC 3	CATTLE	5/7-10/31	8940	X
1804	GOVT DRW-LWR BEAVER	20,468.00	PERMIT- SEC 3	CATTLE	3/1-6/10	4040	X
				CATTLE	11/1-2/28		
1805	KIRBY-RESERVATN BDRY	5,265.00	PERMIT- SEC 3	CATTLE	5/16-6/14	734	
				CATTLE	11/1-11/30		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1806	GRIFFIN BVR CRK	6,087.00	PERMIT- SEC 3	CATTLE	5/1-10/15	714	
1807	BALDWIN PASTURE	465.00	PERMIT- SEC 3	CATTLE	4/20-5/15	105	
1808	HUDSON DRAW PVT ALLT	481.00	PERMIT- SEC 3	CATTLE	5/7-6/14	38	
1809	BRINGOLF RANCH	668.00	PERMIT- SEC 3	CATTLE	4/15-5/14	141	
				CATTLE	10/1-10/31		
1810	YELLOWSTONE RANCH	338.00	PERMIT- SEC 3	CATTLE	11/1-12/31	92	
1813	BLUE RIDGE	260.00	PERMIT- SEC 3	CATTLE	11/1-12/16	8	
1814	HIGHWAY PASTURE	152.00	PERMIT- SEC 3	CATTLE	5/1-5/29	21	
1901	ATLANTIC CITY COMMON	38,698.00	PERMIT- SEC 3	CATTLE	5/20-9/30	4765	X
				CATTLE	5/8-10/4		
				GOAT	5/20-9/30		
1902	COTTONWOOD BASIN	7,625.00	PERMIT- SEC 3	HORSE	5/1-9/30	705	
				CATTLE	4/20-10/31		
1903	SILVER CREEK COMMON	32,941.00	PERMIT- SEC 3	CATTLE	5/15-10/31	3524	X
1904	DEVILS CANYON AMP	3,585.00	PERMIT- SEC 3	CATTLE	5/16-9/30	652	X
1905	ELLIS UPPER BEAVER	2,105.00	PERMIT- SEC 3	CATTLE	5/16-9/30	530	X
1906	TWIN CK. INDIVIDUAL	7,516.00	PERMIT- SEC 3	CATTLE	5/1-12/1	1644	
				HORSE	5/2-7/1		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1907	COMMISSARY HILL	953.00	PERMIT- SEC 3	CATTLE	6/1-6/15	74	
				CATTLE	10/1-10/15		
1908	LITTLE POPO AGIE AMP	8,541.00	PERMIT- SEC 3	CATTLE	5/10-10/1	1814	
1909	ONION FLAT	1,193.00	PERMIT- SEC 3	CATTLE	5/1-5/31	188	
				CATTLE	10/16-11/15		
1910	SAWMILL BASIN	2,401.00	PERMIT- SEC 3	CATTLE	6/1-10/15	197	
1911	RED CANYON AMP	3,605.00	PERMIT- SEC 3	CATTLE	5/15-8/28	580	X
1912	TWIN CREEK PRIVATE	385.00	PERMIT- SEC 3	CATTLE	5/16-10/15	44	
1913	MCGRAW FLAT INDIVIDUAL	1,034.00	PERMIT- SEC 3	CATTLE	6/1 - 9/30	206	
1914	MCGRAW FLAT COMMON	10,401.00	PERMIT- SEC 3	CATTLE	5/1-10/31	1824	X
1915	BEAVER AMP	8,958.00	PERMIT- SEC 3	CATTLE	5/1-10/31	1964	
1916	HALL CK. INDIVIDUAL	12,464.00	PERMIT- SEC 3	CATTLE	5/1-1/31	2328	
				HORSE	5/15-2/28		
1917	COTTONWOOD DIVIDE	5,685.00	PERMIT- SEC 3	CATTLE	6/1-7/10	1570	
				CATTLE	10/1-11/14		
1918	MC GRAW FLT-U.BEAVER	8,388.00	PERMIT- SEC 3	CATTLE	7/1-10/10	1146	
1919	GRAVEL SPRINGS	2,840.00	PERMIT- SEC 3	CATTLE	5/16-10/10	488	X
1920	SALISBURY AMP	5,389.00	PERMIT- SEC 3	CATTLE	5/16-9/30	996	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
				HORSE	5/16-9/30		
1921	LEVEL MEADOWS	3,249.00	PERMIT- SEC 3	CATTLE	6/1-10/30	701	
1922	FRENCH GEORGE CROSSING	626.00	PERMIT- SEC 3	CATTLE	5/16-9/30	146	
1923	ATL.CTY.UPPER FENCED	248.00	PERMIT- SEC 3	CATTLE	5/1-11/30	81	
1924	ATL. CTY. LOWER FENCED	127.00	PERMIT- SEC 3	CATTLE	5/1-11/30	58	
1925	HALL CRK WINTER PAST	1,299.00	PERMIT- SEC 3	CATTLE	11/23-2/28	98	X
1926	MCKINNEY INDIVIDUAL	818.00	PERMIT- SEC 3	CATTLE	5/1-9/30	235	
1927	UPPER ELLIS RANCH	236.00	PERMIT- SEC 3	CATTLE	9/15-12/31	157	
1928	LOWER ELLIS RANCH	321.00	PERMIT- SEC 3	CATTLE	9/15-12/31	48	
1929	BARRAS SPRING	51.00	NOT LICENSED				
1930	LONG WILLOW	709.00	NOT LICENSED				
1931	WOOLERY INDIVIDUAL	1,231.00	NOT LICENSED				
1932	SHEEP MOUNTAIN	558.00	PERMIT- SEC 3	CATTLE	6/1-9/30	99	
1933	LAZY Y	173.00	NOT LICENSED				
1934	RED CANYON RIM	846.00	PERMIT- SEC 3	CATTLE	6/5-10/31	29	
1935	BOWMAN RANCH		NOT LICENSED				
1936	DERBY		NOT LICENSED				

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
1937	LITTLE KNOLL		NOT LICENSED				
1938	BERGSTEDT RANCH	52.00	NOT LICENSED				
1939	AUER RANCH	649.00	PERMIT- SEC 3	CATTLE	11/1-2/28	93	
1940	HENTON RANCH	24.00	NOT LICENSED				
1941	FLAT ONION		NOT LICENSED				
1943	RED BLUFF CREEK	89.00	PERMIT- SEC 3	CATTLE	3/1-2/28	1	
				CATTLE	6/1-9/30		
2009	ALKALI PASTURE	444.00	PERMIT- SEC 3	CATTLE	5/1-6/30	28	
				CATTLE	8/1-10/31		
2011	HIGHWAY ALLOTMENT	509.00	PERMIT- SEC 3	CATTLE	4/1-5/15	90	
2021	WILLOW CREEK ALLOTME	85.00	PERMIT- SEC 3	CATTLE	5/1-6/30	15	
2023	CROOKS GAP	952.00	PERMIT- SEC 3	CATTLE	10/1-11/30	83	
2025	LECKINBY PASTURE	3,436.00	PERMIT- SEC 3	CATTLE	5/1-11/30	607	
2026	LITTLE CAMP CREEK*	2,281.00	PERMIT- SEC 3	CATTLE	5/1-10/31	294	
2028	MITCHELL PASTURE	544.00	PERMIT- SEC 3	CATTLE	6/15-9/15	106	
2029	DIAMOND HOOK	141.00	PERMIT- SEC 3	CATTLE	3/1-2/28	27	
2103	LIME KILN GULCH	1,159.00	LEASE-SEC 15	CATTLE	5/15-6/30	154	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
2104	LITTLE WARM SP. CNYN	315.00	NOT LICENSED	CATTLE	9/25-9/28	27	
2106	FIRE RIDGE	148.00	LEASE-SEC 15	HORSE	6/15-9/30	8	
2107	WELLS 11	305.00	LEASE-SEC 15	HORSE	5/1-6/30	31	
				HORSE	8/1-10/31		
2108	GEYSER CREEK	829.00	LEASE-SEC 15	HORSE	6/1-9/30	50	
2109	CROSS 14	643.00	LEASE-SEC 15	CATTLE	6/1-9/30	134	
2110	LITTLE HORSE CREEK	720.00	LEASE-SEC 15	HORSE	5/15-10/31	51	
2111	E A MOUNTAIN 16	1,761.00	LEASE-SEC 15	CATTLE	6/1-6/30	264	
				CATTLE	8/1-10/30		
2112	BEAR CREEK NO.2112	3,499.00	LEASE-SEC 15	CATTLE	5/1-6/30	542	
				CATTLE	10/15-11/30		
2113	CROOKED CREEK	1,247.00	LEASE-SEC 15	CATTLE	6/25-9/30	133	
				HORSE	6/25-10/28		
2114	SPENCE 23	1,470.00	LEASE-SEC 15	CATTLE	5/1-12/1	290	
2115	HAT BUTTE	893.00	LEASE-SEC 15	CATTLE	6/1-6/30	154	
				CATTLE	9/1-10/30		
2116	ELK RIDGE SOUTHEAST	316.00	LEASE-SEC 15	HORSE	6/1-8/31	21	
2117	BLUE HOLES	682.00	LEASE-SEC 15	HORSE	3/1-4/30	90	
				HORSE	11/1-2/28		
2119	WHITE PASS 31	650.00	LEASE-SEC 15	CATTLE	5/1-6/30	116	
				CATTLE	10/1-11/30		
2120	WINDY RIDGE	332.00	LEASE-SEC 15	CATTLE	4/1-6/30	54	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
				CATTLE	10/1-10/31		
2121	MASON DRAW	6,813.00	LEASE-SEC 15	CATTLE	5/1-6/30	845	
				CATTLE	10/1-10/30		
2122	TAPPAN CREEK 34	1,065.00	LEASE-SEC 15	CATTLE	6/1-11/15	180	
2123	BATTRUM MOUNTAIN	5,936.00	LEASE-SEC 15	CATTLE	6/1-10/15	531	
2125	ALBRIGHT 47	286.00	LEASE-SEC 15	HORSE	4/1-6/30	28	
				HORSE	10/1-10/31		
2126	CM 49	940.00	LEASE-SEC 15	HORSE	11/10-12/9	67	
				HORSE	6/1-6/30		
2127	WAGON GULCH	80.00	LEASE-SEC 15	CATTLE	6/15-12/15	95	
				HORSE	6/15-12/15		
2128	BITTERROOT 60	691.00	LEASE-SEC 15	HORSE	5/20-6/17	68	
2130	CROSS 67		LEASE-SEC 15	CATTLE	5/1-9/30	91	
2132	STONEY POINT 73	591.00	LEASE-SEC 15	HORSE	3/1-6/1	12	
		121.00		HORSE	10/15-2/28		
2201	NORTH FORK RIM		LEASE-SEC 15	CATTLE	6/1-10/31	60	
2202	BALDWIN CREEK SCHOOL	1,959.00	LEASE-SEC 15	HORSE	5/1-7/1	16	
2203	MADISON CREEK	1,656.00	LEASE-SEC 15	HORSE	5/1-11/30	20	
		282.00		CATTLE	5/1-11/30		
2204	TABLE MOUNTAIN 9	1,216.00	LEASE-SEC 15	CATTLE	6/1-10/1	128	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
2205	HOPKINS 13	200.00	LEASE-SEC 15	CATTLE	6/1-9/30	40	
				HORSE	6/1-9/30		
2206	WICKSTROM 17	179.00	LEASE-SEC 15	CATTLE	6/16-/7/16	11	
2207	STEERS 19	2,522.00	LEASE-SEC 15	CATTLE	6/15-9/30	146	
2208	PINE BAR 21	418.00	LEASE-SEC 15	CATTLE	6/1-8/31	6	
2210	WILLOW CREEK 24	1,108.00	LEASE-SEC 15	CATTLE	5/15-10/15	274	
2211	SQUAW CREEK	1,174.00	LEASE-SEC 15	CATTLE	6/1-8/31	209	
2212	FRANK RANCH 28	582.00	LEASE-SEC 15	CATTLE	5/1-11/1	110	
2213	SPRIGGS 36	2,196.00	LEASE-SEC 15	CATTLE	6/15-9/29	70	
2214	MEYER BASIN	1,273.00	LEASE-SEC 15	CATTLE	6/1-9/30	233	
2215	WUNDER 38	1,284.00	LEASE-SEC 15	CATTLE	7/1-9/15	63	
2216	DAY 39	106.00	LEASE-SEC 15	HORSE	6/1-7/13	4	
2217	NICHOLAS 40	428.00	LEASE-SEC 15	CATTLE	6/1-9/29	48	
2218	DOUBLE A 41	280.00	LEASE-SEC 15	CATTLE	6/1-6/30	38	
2219	ORCHARD DRAW	964.00	LEASE-SEC 15	CATTLE	5/10-10/1	124	
2220	RED BUTTE	40.00	LEASE-SEC 15	CATTLE	6/1-10/31	5	
2221	JUNIPER HILL	200.00	LEASE-SEC 15	CATTLE	10/1-11/15	15	
2222	SCHOOL ALLOTMENT	160.00	LEASE-SEC 15	CATTLE	5/1-7/2	25	
2223	BALDWIN CREEK 51	200.00	LEASE-SEC 15	CATTLE	6/1-8/31	18	
2224	NATURAL LAKE	235.00	LEASE-SEC 15	CATTLE	6/1-7/27	22	
2225	CRUMP 53	163.00	LEASE-SEC 15	HORSE	6/1-11/14	27	
2226	HUNTER	79.00	LEASE-SEC 15	CATTLE	6/1-8/31	6	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
2227	SMITH CREEK	78.00	LEASE-SEC 15	CATTLE	10/1-10/7	6	
2228	SPRIGGS 57	120.00	LEASE-SEC 15	HORSE	8/1-9/30	6	
2229	KAPER 59	277.00	LEASE-SEC 15	CATTLE	6/1-9/30	56	
2230	TABLE MTN 61	40.00	LEASE-SEC 15	CATTLE	6/1-9/22	7	
2231	BOOTH 62	121.00	LEASE-SEC 15	CATTLE	6/1-6/21	8	
2232	BEASON CREEK 63	476.00	LEASE-SEC 15	CATTLE	6/1-9/30	20	
2233	BATRUM GAP	474.00	LEASE-SEC 15	CATTLE	6/1-10/30	96	
				HORSE	12/1-12/15		
2234	SJOSTROM 66	168.00	LEASE-SEC 15	HORSE	6/1-8/31	18	
2235	HORNY TOAD ASSOCIATE	522.00	LEASE-SEC 15	CATTLE	6/1-10/30	35	
2236	FREEMAN 70	121.00	LEASE-SEC 15	HORSE	5/1-9/25	24	
2237	NORTH FORK	473.00	LEASE-SEC 15	CATTLE	5/10-10/31	38	
2238	HILLTOP	40.00	LEASE-SEC 15	CATTLE	3/1-6/1	7	
				CATTLE	11/15-2/28		
2239	CYCLONE PASS		NOT LICENSED				
2240	HARVEY BASIN	1,475.00	LEASE-SEC 15	CATTLE	5/15-10/30	183	
2520	WOODS BASIN	173.00	LEASE-SEC 15	CATTLE	6/20-9/30	25	
10160	CEDAR RIDGE LRA*	520.00	PERMIT- SEC 3	CATTLE	3/1-2/28	67	
10203	CHERRY CREEK*	28,793.00	PERMIT- SEC 3	CATTLE/HORSE	3/1-2/28	4841	
10205	BAR ELEVEN*	51,065.00	PERMIT- SEC 3	CATTLE	3/1-2/28	11419	
				HORSE			
				SHEEP			
10224	STEWART	61,284.00	PERMIT- SEC 3	CATTLE	5/28-8/30	149	X

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
	CREEK*						
10533	STEAMBOAT LAKE*	1,633.00	PERMIT- SEC 3	CATTLE	3/1-2/28	261	
				HORSE			
11501	MUSKRAT-LINN	54,118.00	PERMIT- SEC 3	CATTLE	1/1-12/31	6799	
11502	FRASER DRAW	73,110.00	PERMIT- SEC 3	CATTLE	5/16-12/16	5941	X
11504	CANYON CREEK	11,109.00	PERMIT- SEC 3	CATTLE	5/20-10/31	1400	
11505	SOUTH DEER CREEK	11,319.00	PERMIT- SEC 3	CATTLE	5/10-10/31	1292	
11506	DEER CREEK AMP	7,052.00	PERMIT- SEC 3	CATTLE	5/15-11/15	1297	
11507	SOUTH CROSS L	2,360.00	PERMIT- SEC 3	CATTLE	3/1-5/21	386	
				HORSE	6/1-10/12		
11508	GAS HILLS	48,496.00	PERMIT- SEC 3	CATTLE	5/16-12/10	3547	
				SHEEP	5/16-12/10		
11509	DIAMOND SPRINGS	40,573.00	PERMIT- SEC 3	CATTLE	6/10-11/20	4956	
				HORSE	10/23-11/20		
11510	NORTH WILLOW CREEK*	3,475.00	PERMIT- SEC 3	CATTLE	4/20-6/10	616	
11511	NORTH DOBIE FLAT	11,469.00	PERMIT- SEC 3	CATTLE	5/5-6/5	1516	
				CATTLE	10/15-11/30		
11513	BLACKJACK RANCH	31,197.00	PERMIT- SEC 3	CATTLE	6/6-9/6	1721	
11514	GAP PASTURE	3,433.00	PERMIT- SEC 3	CATTLE	5/1-6/2	581	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
11515	CROSS L PASTURES	1,327.00	PERMIT- SEC 3	CATTLE	12/16-4/30	316	
				HORSE	5/26-6/24		
11516	BASIN PASTURE	18,286.00	PERMIT- SEC 3	CATTLE	7/1-11/30	2471	
11517	BUG MEADOWS PASTURES	568.00	PERMIT- SEC 3	CATTLE	3/1-5/31	91	
12002	HARRIS SLOUGH PAST	110.00	PERMIT- SEC 3	CATTLE	4/20-5/19	5	
12003	WHISKEY PEAK INCOMM*	63,446.00	PERMIT- SEC 3	CATTLE	6/1-12/30	5254	X
				SHEEP			
12004	GREEN MT.FENCED	4,310.00	PERMIT- SEC 3	CATTLE	4/10-5/10	652	
				CATTLE	10/1-11/1		
				HORSE	8/1-9/30		
12005	HOME,SOUTH OF HIGHWY	2,715.00	PERMIT- SEC 3	CATTLE	12/16-3/5	383	
12006	46 PASTURE	2,683.00	PERMIT- SEC 3	CATTLE	3/1-6/15	488	
				CATTLE	10/1-2/28		
12007	RIGBY PASTURE	1,091.00	PERMIT- SEC 3	CATTLE	6/1-10/31	176	
12012	EAST ALLOTMENT	2,002.00	PERMIT- SEC 3	CATTLE	10/16-11/7	377	
				CATTLE	4/16-5/15		
12013	FENCED ALLOTMENT	10,329.00	PERMIT- SEC 3	CATTLE	5/16-10/31	1703	
12014	SOUTH HAT PASTURE	1,789.00	PERMIT- SEC 3	CATTLE	4/15-6/13	287	

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
12015	HADSELL PASTURE	3,806.00	PERMIT- SEC 3	CATTLE	5/10-10/16	547	
12016	STATE-71 MEADOWS	274.00	PERMIT- SEC 3	CATTLE	5/1-5/31	51	
12018	ALMA GRIEVE PASTURE	3,271.00	PERMIT- SEC 3	CATTLE	10/1-2/28	453	
12019	COOPER CREEK*	1,247.00	PERMIT- SEC 3	CATTLE	6/1-7/15	200	
				CATTLE	10/1-12/30		
12020	COTTONWOOD PASTURE*	2,019.00	PERMIT- SEC 3	CATTLE	11/1-2/28	265	
12242	SQUAW CREEK	80.00	LEASE-SEC 15	CATTLE	10/1-11/14	13	
14289	UPPER POISON SPIDER CREEK*	9,065.00	PERMIT- SEC 3	CATTLE		1693	
				SHEEP			
14808	THREE CROSSINGS ALLOTMENT	1,514.00	PERMIT- SEC 3	CATTLE	5/1-10/11	602	
				CATTLE	11/10-11/30		
20213	ELKHORN LRA (incl.oil city allot 1602)*	305.00	PERMIT- SEC 3	CATTLE	5/20-6/8	791	
				HORSES	5/15-6/14		
				CATTLE	7/15-10/15		
21519	MILLER SPRINGS PAST.	1,884.00	PERMIT- SEC 3	CATTLE	6/1-9/30	313	
21520	SCHOOL PASTURE	874.00	PERMIT- SEC 3	CATTLE	9/1-11/30	251	
21521	RIDDLE PASTURE	1,350.00	PERMIT- SEC 3	CATTLE	4/1-5/31	306	
				CATTLE	11/1-12/31		

Table 1. Grazing Allotments, Acres, AUMs, and Season of Use (Continued)

Allotment Number	Allotment Name	Public Acres GIS	Permit/Lease	Livestock Kind	Season of Use	Public AUMs	Common Allotment
21522	DECKER PASTURE	331.00	PERMIT- SEC 3	CATTLE	4/1-5/31	49	
				CATTLE	11/1-12/31		
21523	HAY MEADOW PASTURES	69.00	PERMIT- SEC 3	CATTLE	12/1-4/30	168	
31519	BEEF GAP PASTURE	352.00	PERMIT- SEC 3	CATTLE	5/1-6/2	72	
32001	GREEN MOUNTAIN CMN	466,474.00	PERMIT- SEC 3	SHEEP	3/1-2/28	47361	X
				CATTLE	5/1-12/31		
	TOTAL ACRES:	2,481,517			TOTAL AUMS:	308,376	

Table 2. Allotment Categorization – *Current and Proposed*

Allotment	Allotment Name	Existing RMP	Proposed New Category
180	LOST CREEK	M	M
00655	COPPER MTN	I	I
01301	CANTRIL JACK ALLOT.	M	M
01302	NORTH OF CB&Q R.R.	C	I
01303	SOUTH OF CB&Q R.R.	M	I
01304	CRAWFORD CREEK	I	I
01305	LYBYER NORTH	I	I
01306	CANNING ALLOTMENT	M	M
01307	MALLET-SMITH PASTURE	C	C
01308	167A SCOTT-ROBSON	M	M
01309	LOGAN PASTURE	M	M
01310	COTTONWOOD PASS	C	I
01311	KEENAN	C	C
01312	NORTH OF TRACKS	M	I
01313	SOUTH OF TRACKS	I	I
01314	MONETA HILLS PASTURE	M	M
01315	DITCH PASTURE	C	C
01316	MADDEN RANCH PASTURE	C	C
01317	BRANDAU RANCH ALLOT	C	I
01318	BELOW THE HILL PAST.	M	M
01319	TWIDALE	C	C
01320	ST CLAIR WEST	C	I
01321	ST CLAIR RANCH	C	C
01322	ST.CLAIR SOUTH PAST.	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01323	FULLER ALLOTMENT	I	I
01324	HOODOO CREEK ALLOT	I	I
01325	EAST OF RANCH	I	I
01326	LICHTENSTEIN	I	I
01327	MYRTLE REED ALLOT	I	I
01328	BATTLE AXE SOUTH	M	M
01329	LYSITE MOUNTAIN	I	I
01330	BATTLE AXE LYSITE	M	M
01331	BATTLE AXE BERGER	M	I
01332	BOW & ARROW	M	M
01333	GATES DRAW ALLOTMENT	I	I
01334	COTTONWOOD PASS	I	I
01335	OCLA SOUTH OF R.R.	I	I
01336	OCLA NORTH OF R.R.	I	I
01337	DE PASS RANCH	C	C
01338	FULLER RANCH PASTURE	I	I
01339	PICARD PRIVATE ALLOT	I	I
01340	168A NORTH OF SEEPS	C	I
01341	168A STOCK DRIVEWAY	M	M
01342	KNAPP INDIVIDUAL	C	C
01343	TUFF CREEK PASTURE	C	I
01344	WESTFALL	I	I
01345	MOUNTAIN PASTURE	C	I
01346	BONNEVILLE RESERVOIR	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01347	JONES CREEK BASIN	I	M
01348	J.HERBST SUMMER	M	I
01349	J.HERBST TUFF CREEK	C	I
01350	WM.HERBST SUMMER	C	C
01351	SCOTT DRAW	I	M
01352	JOE JOHNS PASTURE	C	C
01353	CAMPBELL	M	M
01354	STINKING WELL	I	I
01355	LOOKOUT HILL	M	M
01356	HOWARD PASTURE	I	I
01357	SUMMER ALLOTMENT	M	M
01358	TOP OF MOUNTAIN PAST	C	C
01359	RAMAGE RANCH	I	I
01360	RUTH FULLER PRIVATE	C	C
01361	COPPER MT. (LANDER)	C	C
01362	LYBYER SOUTH	I	M
01363	HOODOO HQ PASTURES	C	C
01364	RED RANCH PASTURE	C	C
01365	QUIEN SABE RANCH PASTURE	I	M
01366	CABIN PASTURE	C	C
01367	HENRICH PASTURE	I	I
01368	BRIDGER CREEK	C	C
01369	PICARD RANCH HQ	C	C
01373	COPPER MOUNTAIN	C	C
01401	RIM PASTURE	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01402	DELFELDER ALLOTMENT	I	I
01403	CONANT CREEK COMMON	I	I
01404	WM HERBST WINTER	I	I
01405	POSEY NORTH ALLOTMNT	I	I
01406	POISON CREEK	M	M
01407	MUSKRAT AMP	I	I
01408	TOWNSHIP PASTURE	I	I
01409	MUSKRAT OPEN	I	I
01410	POSEY PASTURE	I	I
01411	SHOSHONI ROAD	I	I
01412	POSTON WINTER	I	M
01413	PIPELINE PASTURE	I	M
01414	ANDERSON WINTER	M	M
01415	MYERS PASTURE	I	M
01416	LAME JACK DRAW	I	I
01417	HAYBARN HILL	C	I
01512	SOUTH DOBIE FLAT	M	I
01518	LITTLE BUG PASTURE	M	M
01519	MILLER SPRINGS PAST.	M	I
01520	SCHOOL PASTURE	M	M
01521	RIDDLE PASTURE	M	M
01523	BUG LAKE	M	M
01601	DODDS ALLOTMENT	M	M
01604	#17 HORSE HEAVEN PST	M	I
01605	#18 HORSE CREEK PAST	M	M

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01606	#19 VINEGAR HILL PST	M	M
01607	#16 PHILLIPS PAST.	M	M
01608	#20 CALF PASTURE	M	M
01609	#21 HORSE PASTURE	M	M
01610	#22 BULL PASTURE	C	C
01612	HAMILTON ROCK PAST.	M	M
01614	CIRCLE BAR ALLOTMENT	M	I
01615	NORTH OF DRIFT FENCE	M	I
01616	KEESTER	M	M
01619	WINTER PASTURES	M	M
01620	CABIN CREEK PASTURE	C	C
01622	HAT RANCH	I	M
01623	MURPHREE PASTURES	I	I
01625	JAMERMAN PASTURES	M	M
01626	MUD LAKE	C	C
01628	SAGE HEN	M	M
01629	JJ WINTER PASTURES	C	C
01630	TRAM ROAD PASTURE	M	I
01631	CLAYTOR HOMESTEAD	C	C
01632	NORTH HAT PASTURE	M	M
01633	STAMPEDE BOG	C	M
01635	BIG ROCK PASTURE	I	I
01636	GRANITE MT OPEN	I	I
01638	WINTER ALLOTMENT	M	M
01640	GARSON RANCH	C	C

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01642	DEVILS GATE	M	M
01644	TURKEY TRACK	I	I
01660	HOME,NORTH OF HIGHWY	M	M
01701	FLAGG AMP	I	I
01702	FLAGG INDIVIDUAL	C	C
01703	BIG PASTURE	I	I
01704	BREEDING PASTURE	M	M
01705	MYERS FENCED PASTURE	I	I
01706	TRENT&HOME PLACE	M	M
01707	ICE SLOUGH	I	I
01709	LONG CREEK PASTURE	I	M
01710	GRAHAM RANCH PASTURE	M	M
01711	HAY MEADOW PASTURE	C	C
01712	LONG CRK SWEETWATER	C	C
01713	WHITLOCK FENCED	I	I
01714	SCARLETT PASTURE	C	C
01715	HORSE PASTURE	M	M
01716	DISHPAN BUTTE	I	I
01717	FENCED INDIVIDUAL	I	M
01801	EAST BEAVER COMMON	I	I
01802	SAND DRAW AMP	I	I
01803	GOVERNMENT DRAW	I	I
01804	GOVT DRW-LWR BEAVER	I	I
01805	KIRBY-RESERVATN BDRY	I	I
01806	GRIFFIN BVR CRK	M	M

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01807	BALDWIN PASTURE	I	I
01808	HUDSON DRAW PVT ALLT	M	M
01809	BRINGOLF RANCH	C	C
01810	YELLOWSTONE RANCH	C	C
01813	BLUE RIDGE	C	C
01814	HIGHWAY PASTURE	C	C
01901	ATLANTIC CITY COMMON	I	I
01902	COTTONWOOD BASIN	I	I
01903	SILVER CREEK COMMON	I	I
01904	DEVILS CANYON AMP	I	I
01905	ELLIS UPPER BEAVER	I	I
01906	TWIN CK. INDIVIDUAL	I	I
01907	COMMISSARY HILL	I	M
01908	LITTLE POPO AGIE AMP	I	M
01909	ONION FLAT	I	I
01910	SAWMILL BASIN	I	I
01911	RED CANYON AMP	I	I
01912	TWIN CREEK PRIVATE	C	C
01913	MC GRAW FLAT INDIVID	I	I
01914	MCGRAW FLAT COMMON	I	I
01915	BEAVER AMP	I	I
01916	HALL CK. INDIVIDUAL	I	I
01917	COTTONWOOD DIVIDE	I	I
01918	MC GRAW FLT-U.BEAVER	I	I
01919	GRAVEL SPRINGS ALLT	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
01920	SALISBURY AMP	I	I
01921	LEVEL MEADOWS	I	I
01922	P HEART INDIVIDUAL	I	I
01923	ATL.CTY.UPPER FENCED	C	C
01924	ATL.CTY.LOWER FENCED	C	C
01925	HALL CRK WINTER PAST	M	M
01926	MCKINNEY INDIVIDUAL	I	I
01927	UPPER ELLIS RANCH	C	C
01928	LOWER ELLIS RANCH	C	C
01929	BARRAS SPRING	C	C
01930	LONG WILLOW	C	C
1931	WOOLERY INDIVIDUAL	M	M
01932	SHEEP MOUNTAIN	M	M
01933	LAZY Y	C	C
01934	RED CANYON RIM	I	M
01935	BOWMAN RANCH	C	C
01936	DERBY ALLOTMENT	M	M
01937	LITTLE KNOLL	C	C
01938	BERGSTEDT RANCH	C	C
01939	AUER RANCH	C	C
01940	HENTON RANCH	C	C
01941	FLAT ONION	I	I
01943	RED BLUFF CREEK	M	M
02009	ALKALI PASTURE	M	M
02011	HIGHWAY ALLOTMENT	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
02019	COOPER CREEK	M	M
02021	WILLOW CREEK ALLOTME	C	C
02023	CROOKS GAP	M	M
02025	LECKINBY PASTURE	M	M
02026	LITTLE CAMP CREEK	I	I
02028	MITCHELL PASTURE	C	C
02029	DIAMOND HOOK	C	C
02103	LIME KILN GULCH	C	C
02104	LITTLE WARM SP. CNYN	M	M
02106	FIRE RIDGE	M	M
02107	WELLS 11	M	M
02108	GEYSER CREEK	M	M
02109	CROSS 14	C	C
02110	LITTLE HORSE CREEK	I	I
02111	E A MOUNTAIN 16	M	M
02112	BEAR CREEK NO.2112	C	C
02113	CROOKED CREEK	C	C
02114	SPENCE 23	C	C
02115	HAT BUTTE RANCH	C	C
02116	ELK RIDGE SOUTHEAST	C	C
02117	BLUE HOLES	C	C
02119	WHITE PASS 31	C	C
02120	WINDY RIDGE	C	C
02121	MASON DRAW	I	I
02122	TAPPAN CREEK 34	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
02123	BATTRUM MOUNTAIN	C	I
02125	ALBRIGHT 47	C	C
02126	CM 49	M	M
02127	WAGON GULCH	C	C
02128	BITTERROOT 60	C	C
02130	CROSS 67	C	C
02132	STONEY POINT 73	C	C
02201	NORTH FORK RIM	M	M
02202	BALDWIN CREEK SCHOOL	C	C
02203	MADISON CREEK	C	C
02204	TABLE MOUNTAIN 9	C	C
02205	HOPKINS 13	I	I
02206	WICKSTROM 17	I	C
02207	STEERS 19	I	I
02208	PINE BAR 21	M	M
02210	WILLOW CREEK 24	I	I
02211	SQUAW CREEK	I	I
02212	FRANK RANCH 28	C	C
02213	SPRIGGS 36	I	C
02214	MEYER BASIN	I	I
02215	WUNDER 38	I	C
02216	DAY 39	C	C
02217	NICHOLAS 40	I	I
02218	DOUBLE A 41	I	I
02219	ORCHARD DRAW	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
02220	RED BUTTE	I	I
02221	JUNIPER HILL	C	C
02222	SCHOOL ALLOTMENT	I	I
02223	BALDWIN CREEK 51	I	I
02224	NATURAL LAKE	C	C
02225	CRUMP 53	I	I
02226	HUNTER	C	C
02227	SMITH CREEK	C	C
02228	SPRIGGS 57	I	I
02229	KAPER 59	C	C
02230	TABLE MTN 61	C	C
02231	BOOTH 62	C	C
02232	BEASON CREEK 63	I	I
02233	BATRUM GAP	C	C
02234	SJOSTROM 66	C	C
02235	HORNY TOAD ASSOCIATE	I	I
02236	FREEMAN 70	I	I
02237	NORTH FORK	C	C
02238	HILLTOP	C	C
02239	CYCLONE PASS	I	I
02240	HARVEY BASIN	I	I
02520	WOODS BASIN	C	C
10160	CEDAR RIDGE LRA	C	C
10203	CHERRY CREEK	I	I
10205	BAR ELEVEN	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
10224	STEWART CREEK	I	I
10533	STEAMBOAT LAKE	C	C
11501	MUSKRAT-LINN	I	I
11502	FRASER DRAW	M	M
11504	CANYON CREEK	I	M
11505	SOUTH DEER CREEK	I	M
11506	DEER CREEK AMP	I	I
11507	SOUTH CROSS L	M	M
11508	GAS HILLS	M	I
11509	DIAMOND SPRINGS	I	I
11510	NORTH WILLOW CREEK	M	M
11511	NORTH DOBIE FLAT	M	I
11513	BLACKJACK RANCH	I	I
11514	GAP PASTURE	M	M
11515	CROSS L PASTURES	M	M
11516	BASIN PASTURE	M	I
11517	BUG MEADOWS PASTURES	M	M
12002	HARRIS SLOUGH PAST	C	C
12003	WHISKEY PEAK INCOMM	I	I
12004	GREEN MT.FENCED	I	I
12005	HOME,SOUTH OF HIGHWY	I	I
12006	46 PASTURE	I	I
12007	RIGBY PASTURE	I	I
12012	EAST ALLOTMENT	M	M
12013	FENCED ALLOTMENT	I	I

Table 2. Allotment Categorization – *Current and Proposed (Continued)*

Allotment	Allotment Name	Existing RMP	Proposed New Category
12014	SOUTH HAT PASTURE	M	M
12015	HADSELL PASTURE	I	I
12016	STATE-71 MEADOWS	C	C
12018	ALMA GRIEVE PASTURE	M	M
12020	COTTONWOOD PASTURE	M	M
12242	SQUAW CREEK	C	C
14289	UPPER POISON SPIDER CREEK	I	I
14808	THREE CROSSINGS ALLOTMENT	M	M
20213	ELKHORN - LRA	I	I
21522	DECKER PASTURE	M	C
31519	BEEF GAP PASTURE	M	I
32001	GREEN MOUNTAIN CMN	I	I

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards

Allotment Number	Allotment Name	Year Assessed	Acres Assessed	Meeting Standards	Not Meeting Standards - Management Implemented	Not Meeting Standards - Causal Factors Not Determined	Not Meeting Standards - Other Than Livestock Grazing
1307	Mallet-Smith Pasture	2003	181	X			
1324	Hoodoo Creek	2001	23,209		X		
1327	Myrtle Reed	2003	1,209	X			
1329	Lysite Mountain	1998	8,192	X			
1330	Battle Axe Lysite	2000	4,298	X			
1334	Cottonwood Pass	1998	3,900	X			
1335	Ocla South of RR	2000	6,413	X			
1336	Ocla North of RR	2000	4,861		X		
1337	De Pass Ranch	2000	472	X			
1338	Fuller Ranch Pasture	2000	1,477		X		
1341	Stock Driveway	2000	2,185		X		
1358	Top Of Mountain Pasture	2001	1,449	X			
1359	Ramage Ranch	1998	12,060				X
1363	Hoodoo HQ Pasture	2001	149			X	

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards (Continued)

Allotment Number	Allotment Name	Year Assessed	Acres Assessed	Meeting Standards	Not Meeting Standards - Management Implemented	Not Meeting Standards - Causal Factors Not Determined	Not Meeting Standards - Other Than Livestock Grazing
1369	Picard Ranch HQ	2000	169		X		
1373	Copper Mountain	2001	128	X			
1401	Rim Pasture	2000	19,095	X			
1403	Conant Creek	2000	50,376	X			
1404	WM Herbst Winter	2000	2,989		X		
1405	Posey North	2000	4,431		X		
1412	Poston Winter	2000	3,239	X			
1414	Anderson Winter	2000	5,924	X			
1416	Lame Jack Draw	2000	6,060	X			
1417	Haybarn Hill	2000	10,288	X			
1506	Deer Creek AMP	1998	7,000				X
1508	Gas Hills	1998	42,201	X			
1509	Diamond Springs	2008	40,890			X	
1511	North Dobie Flat	2008	11,435			X	
1512	South Dobie Flat	2008	6,752			X	
1513	BlackJack Ranch	2008	31,708			X	

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards (Continued)

Allotment Number	Allotment Name	Year Assessed	Acres Assessed	Meeting Standards	Not Meeting Standards - Management Implemented	Not Meeting Standards - Causal Factors Not Determined	Not Meeting Standards - Other Than Livestock Grazing
1633	Stampede Bog	2000	301	X			
1704	Breeding Pasture	2001	17,107	X			
1705	Myers Fenced Pasture	2001	1,288	X			
1706	Trent & Home Place	2001	500	X			
1707	Ice Slough	2002	947	X			
1709	Long Creek Pasture	2001	2,406	X			
1710	Graham Ranch Pasture	2001	1,118	X			
1712	Long Creek Sweetwater	2001	388	X			
1713	Whitlock Fenced	2001	1,086	X			
1714	Scarlett Pasture	2001	173	X			
1715	Horse Pasture	2004	133	X			
1802	Sand Draw AMP	1999	11,092	X			
1805	Kirby Reservation Boundary	2000	5,333	X			
1806	Griffin Beaver Creek	2000	6,068	X			

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards (Continued)

Allotment Number	Allotment Name	Year Assessed	Acres Assessed	Meeting Standards	Not Meeting Standards - Management Implemented	Not Meeting Standards - Causal Factors Not Determined	Not Meeting Standards - Other Than Livestock Grazing
1901	Atlantic City Common	2001	39,094		X		
1903	Silver Creek Common	2000	33,702		X		
1904	Devils Canyon AMP	2004	3,717			X	
1905	Ellis Upper Beaver	2000	3,326	X			
1906	Twin Creek Individual	1998	7,602	X			
1908	Little Popo Agie AMP	1998	8,651	X			
1911	Red Canyon AMP	1999	3,699		X		
1914	McGraw Flat Common	2000	10,149	X			
1915	Beaver AMP	2004	10,640			X	
1916	Hall Creek Individuial	1998	12,711				X
1921	Level Meadows	2000	3,271	X			
1923	Atlantic City Upper Fenced	2000	60	X			
1924	Atlantic City Lower Fenced	2000	78	X			
1925	Hall Creek Winter Pasture	1998	1,305	X			

Table 3. Lander Field Office Grazing Allotments Assessed for Meeting Standards (Continued)

Allotment Number	Allotment Name	Year Assessed	Acres Assessed	Meeting Standards	Not Meeting Standards - Management Implemented	Not Meeting Standards - Causal Factors Not Determined	Not Meeting Standards - Other Than Livestock Grazing
1927	Upper Ellis Ranch	2002	598	X			
1928	Lower Ellis Ranch	2002	339	X			
1934	Red Canyon Rim	1998	853	X			
1939	Auer Ranch	2004	427	X			
2001	Green Mt. Common	1999	468,379		X		
2002	Harris Slough Pasture	2001	94	X			
2210	Willow Creek	2009	982				
2219	Orchard Draw	1998	1361	X			
			971,718				

Table 4. Allotment Management Plans and Rangeland Management Agreements Developed

Allotment Number	Allotment Name	AMP Implement Date	Public Acres
01330	Battle Axe Lysite	08/23/89	4,298
01361	Copper Mt. (Lander)	03/29/96	270
01401	Rim Pasture	05/01/92	19,037
01403	Conant Creek Common	07/15/92	47,078
01406	Poison Creek*	08/06/97	16,815
01407	Muskrat Amp	11/01/68	39,876
01408	Township Pasture *	05/16/94	19,162
01414	Anderson Winter	05/01/92	5,914
01415	Myers Pasture*	06/10/95	923
01512	South Dobie Flat	06/11/92	6752
01636	Granite Mt Open *	03/24/93	77,896
01643	Rawlins Draw	05/21/08	6,367
01660	Home,North Of Highwy	06/11/92	1,353
01701	Flagg Amp	06/01/69	11,361
01703	Big Pasture	07/05/91	74,351
01802	Sand Draw Amp	05/01/66	11,905
01803	Government Draw	11/26/90	77,299
01901	Atlantic City Common	07/31/97	38,765
01903	Silver Creek Common	05/08/97	31,953
01904	Devils Canyon Amp	05/01/69	3,717

Allotment Number	Allotment Name	AMP Implement Date	Public Acres
01905	Ellis Upper Beaver	05/01/70	2,370
01906	Twin Ck. Individual	03/28/93	7,532
01907	Commissary Hill	06/14/94	994
01908	Little Popo Agie Amp	06/01/70	10,760
01911	Red Canyon Amp	06/01/69	4009
01914	Mcgraw Flat Common	05/08/97	11,295
01915	Beaver Amp	06/01/69	10,640
01916	Hall Ck. Individual	12/20/89	14,386
01920	Salisbury Amp	11/01/69	5,384
01925	Hall Crk Winter Past	12/20/89	492
01926	Mckinney INDIVIDUAL*	04/03/97	800
01934	Red Canyon Rim	06/14/94	853
01939	Auer Ranch	06/01/69	427
102019	Cooper Creek	10/01/87	1,402
02021	Willow Creek Allotment	10/01/87	71
02029	Diamond Hook	10/01/87	207
02219	Orchard Draw	06/09/69	804
11504	Canyon Creek	02/25/99	11,065
11505	South Deer Creek	09/23/88	11,225
11506	Deer Creek Amp	05/01/69	6,447
11507	South Cross L	06/11/92	2,347
11509	Diamond Springs	06/11/92	40,890

Allotment Number	Allotment Name	AMP Implement Date	Public Acres
11510	North Willow Creek*	05/21/08	3469
11511	North Dobie Flat	06/11/92	11,435
11513	Blackjack Ranch	06/11/92	31,708
11514	Gap Pasture	06/11/92	3,604
11515	Cross L Pastures	06/11/92	1,535
11516	Basin Pasture	02/16/01	16,830
12003	Whiskey Peak	10/01/87	76,083
12005	Home, South Of Highway	06/11/92	2,560
12018	Alma Grieve Pasture	10/01/87	3,249
31519	Beef Gap Pasture	06/11/92	381
TOTAL ALLOTMENTS: 52		TOTAL ACRES:	779,108

*Denotes Rangeland Management Agreement

Table 5. Summary of Range Improvements Lander Field Office 1986-2009

Fiscal Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
Improvement Fences																									
Antelope drop panels								18.5												0.1					18.6
Electric								5	3		3	9		5	9	34	10	4.75		20.9	9.7				113.38
Exclosures, enclosures			1	2	1	5.5	3.3		1.4	1.4	1	0.5					5.7	2.7	1	1					27.5
Four strand plus	23.1	9.7	2.7		1			1	1	1	0.52	3.13		0.35	2.7	6.8	6.2	2.05		1.4	1	1.25			64.9
Three strand		4	1		17	4.2	9.05	11.2	5.84	6.3		29.2	11.2		4.8	3	5	2.6		9.4	2.5				126.19
Wood Rail													0.1	0.25					0.25	0.1		0.5			1.2
Other			0.1			1.3	0.2	1							1										3.6
Fence Total (Miles)	23.1	13.7	4.8	2	19	11	12.6	36.7	11.2	8.7	4.52	41.8	11.3	5.6	17.5	43.8	26.9	12.1	1.25	32.9	13.2	1.75	0	0	355.4
Land Treatments																									
Lake and Wetland Improvement					1															3			1		5
Lake and Wetland Improvement Total																				3			1		4
Land Treatment						5		6.5	50	9	35						100		100						305.5
Land Treatment Total					1	5		6.5	50	9	35						100		100	6			2		314.5
Management Facility																									
Cattleguard for vehicle use	2	2	1			1	2		1	7			1		11				1						29
Corrals and loading chutes						1																			1
Line Cabins																	1								1
Other																				1					1
Management Facility Total (Each)	2	2	1			2	2		1	7			1		11		1		1	1					32

Table 5. Summary of Range Improvements Lander Field Office 1986-2009 (Continued)

Fiscal Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
Vegetation Manipulation																									
Stream Improvement											1														1
Chemical																				313			2300		2613
Cutting or Beating																					4000	1220			5220
Prescribed Fire	910	160	250	100			1228		12			56													2716
Vegetation Manipulation Total (Acres)	910	160	250	100			1228		12		1	56								313	4000	1220	2300		10550
Water Control/ Development																									
Pipelines (miles)	1	5		4	9		9.2	3	5		1	7.26	10	5	38	1		2		7.5		0	1	1	109.96
Check Dams, earthen (each)				2																					2
Reservoirs (each)	6	5	2	2	6	1	4	2	6	5	3		3	1		2	5								53
Retention Dams: retains water/silt; primary object (each)							1		1		1														3
Sheet piling drop structure (each)													1				1								2
Springs (each)		2	3		1		1	1	4	7	5	2	1	1	3	2	2	2					1		38
Supplemental Water Storage (each)												1	1												2
Wells (each)	6		4	4	8	3	3		1	3	2	7	2	5	12	2	5	3	3	1	1		1		76
Water Control/ Development Total	12	7	9	8	15	4	9	3	12	15	11	10	8	7	15	6	13	5	3	1	1		2	0	176
Weed Control (acres)	0	246	240	297	60	207	183	156	69	18	56	216	408	561	882	735	620	800	770	948	700	996	0	1,650	10818

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Table E-6. Animal Unit Months (AUMs) Authorized from 1989-2008

Year	AUMs Billed	Percent Actual Use
1989	230351	82
1990	217122	78
1991	211366	76
1992	217322	78
1993	227202	81
1994	218276	78
1995	223874	80
1996	247568	89
1997	221688	79
1998	228616	82
1999	245140	88
2000	246760	88

2001	**220107**	**77**
2002	**152198**	**54**
2003	**143590**	**51**
2004	**177260**	**63**
2005	**191272**	**68**
2006	**160237**	**57**
2007	**143026**	**51**
2008	**167170**	**60**
Average Total:	**204,507**	**73**

Lander Summary of the
Analysis of the Management Situation

Appendix F

Designated Invasive Noxious Weeds and Pests and Secondary Weeds by County

Wyoming Invasive and Noxious Weeds		
Field bindweed	Perennial pepperweed	Scotch thistle
Canada thistle	Ox-eye daisy	Musk thistle
Leafy spurge	Skeletonleaf bursage	Common burdock
Perennial sowthistle	Russian knapweed	Plumeless thistle
Quackgrass	Yellow toadflax	Dyers woad
Hoary cress (whitetop)	Dalmatian toadflax	Houndstongue
Diffuse knapweed	Purple loosestrife	Common St. Johnswort
Common Tansy	Russian olive	Spotted knapweed
Designated Pests		
Grasshoppers	Mormon crickets	Prairie dogs
Ground squirrels	Mountain pine beetle	Beet Leafhopper

1 **Secondary Weeds by County**

	Fremont County	**Carbon County**	**Natrona County**	**Sweetwater County**
Mosquito	Yes	Yes	Yes	Yes
Russian olive	Yes	No	No	No
Swainsonpea	Yes	No	No	No
Plains prickly pear	No	Yes	No	No
Plains larkspur, Geyer larkspur	No	Yes	No	No
Wyeth lupine	No	Yes	No	No
Halogeton	No	No	Yes	No
Cheatgrass, downy brome	No	No	Yes	No
Wild licorice	No	No	Yes	No
Black henbane	No	No	Yes	Yes
Buffalobur	No	No	Yes	No
Curlycup gumweed	No	No	Yes	No
Puncturevine	No	No	Yes	No
Showy milkweed	No	No	Yes	No
Army cutworm	No	No	No	Yes

Foxtail barley	No	No	No	Yes
Lady's bedstraw	No	No	No	Yes
Poplar bud-gall mite	No	No	No	Yes

Source: County Pest Departments.

WWP Exhibit 10

Bureau of Land Management

National Sage-Grouse Habitat Conservation Strategy

1.3.1 Guidance for Addressing Sagebrush Habitat Conservation in BLM Land Use Plans

U.S. Department of the Interior

November 2004

Guidance for Addressing Sagebrush Habitat Conservation in BLM Land Use Plans

This guidance is intended to help BLM planning teams include sagebrush habitat and sagebrush-dependent wildlife species (including sage-grouse) considerations in BLM land use planning efforts. Planning teams should use this guidance in planning areas with sagebrush habitat for land use plans in progress (to the extent practicable for plans well underway), new planning starts and plan amendments. This guidance may be supplemented, as appropriate, with additional information from completed State- or local-level sage-grouse strategies or plans.

Pursuant to the BLM Sage-grouse Habitat Conservation Strategy (Action 1.3.4), each State Director must, by April 2005, develop a process and schedule to update deficient land use plans to adequately address sage-grouse and sagebrush conservation needs. BLM state-level conservation strategies and/or plans should continue to be developed in concert with state agency-led efforts consistent with mutually agreed-upon schedules.

This guidance focuses on sagebrush habitat as a whole rather than on sage-grouse or other individual species because it is important to plan for the conservation of habitat for all wildlife species. It is also BLM policy to consider all special status species in planning (§6840.02B). This should assist in the conservation of species and reduce the need for listings under the Endangered Species Act.

This guidance describes how planning teams can incorporate sagebrush considerations into each of the basic steps involved in preparing a land use plan and associated NEPA analyses as listed below:

1. Prepare to Plan
2. Conduct Scoping
   a. Issue Statement
   b. Planning Criteria
3. Analyze the Management Situation
4. Develop Alternatives
   a. Goals and Objectives
   b. Allowable Uses and Management Actions
5. Estimate Effects of Alternatives

1. Prepare to Plan

IM 2001-038 (Development/Approval of Preparation Plans for New Planning Starts) lists the items that a preparation plan should include. Listed below are select components of the preparation plan where planning teams should address sagebrush habitat and associated wildlife species (including sage-grouse):

- Anticipated planning issues and management concerns (see step 2.a below);
- Preliminary planning criteria and outstanding questions that must be addressed to support management decisions (see step 2.b below);
- Available data and data collection/format standards employed;
- Known or anticipated data gaps; and

- Data standards, work-month costs, staffing and skill requirements, and estimated time-frames needed to establish an integrated, automated geospatial database for filling in data gaps.

2. Conduct Scoping

a. Issue Statement

Land use plans should include an issue statement that (1) describes the status of sagebrush-obligate species such as sage-grouse and (2) identifies the need to allocate land uses and identify management activities to help conserve sagebrush habitat and sagebrush-obligate species on BLM-administered lands.

b. Planning Criteria

Planning criteria should be based on federal laws, regulations and policies that guide land management decisions that affect the conservation of sagebrush habitat and sagebrush-obligate species on BLM-administered land (43 CFR 1610.4-2).

Listed below are the most significant federal laws, regulations and policies upon which such criteria may be based (see Attachment 1 for a summary of these items).

- Endangered Species Act of 1973 (ESA)
- Federal Land Policy and Management Act (FLPMA) of 1976 (43 U.S.C. 1701 *et seq.*)
- Sikes Act of 1974, Title II (16 U.S.C. 670g *et seq.*), as amended
- 43 CFR 1610 (Planning regulations)
- 43 CFR 4180 (Rangeland Health Standards)
- BLM Rangeland Health Standards Handbook (H-4180-1)
- BLM Land Use Planning Handbook (H-1601-1)
- BLM Manual 6840 - Special Status Species Management

It is recommended that planning teams also consider the information below in developing planning criteria, as they deal specifically with sage-grouse considerations.

- Western Association of Fish and Wildlife Agencies (WAFWA) Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats (Connelly et al., 2004)
- State and local sage-grouse conservation plans
- Relevant local and regional data relative to sage-grouse and other sagebrush-dependent wildlife species
- Relevant scientific literature, such as the WAFWA Guidelines for Management of Sage-grouse Populations and Habitats (Connelly et al, 2000)
- Other appropriate information

Planning teams may also want to consider 50 CFR Chapter IV – the Fish and Wildlife Service Policy for the Evaluation of Conservation Efforts when Making Listing Decisions (PECE). This policy provides a framework and criteria for evaluating conservation efforts that have not yet been implemented or have not yet demonstrated effectiveness.

3. Analyze the Management Situation

The Analysis of the Management Situation (AMS) should describe the following information about sagebrush habitat and sagebrush-obligate species (including sage-grouse) in the planning area:

- Decisions from all applicable planning documents (Resource Management Plans, plan amendments, etc) that are affecting or could affect sagebrush habitat.
- The importance of the planning area to habitat for sagebrush-obligate species from a regional perspective. For example, state whether any portion of the habitat is part of a sage-grouse stronghold within the state.
- Current condition and extent of habitat for sagebrush-obligate species.
- Areas of highest priority for protecting, maintaining and restoring sagebrush habitat. Consider the size, condition, and connectivity of habitat areas when identifying priority areas. Emphasize habitat for sagebrush-obligate species when identifying priority areas for sagebrush as a whole.
- Trends of habitat condition and extent for sagebrush-obligate species.
- Indicators or criteria that will be used to evaluate the effects of the alternatives.
- Management opportunities to respond to identified issues or conflicts (that could be arrayed in a range of alternatives).

Use maps and other materials from State wildlife agencies, BLM, and/or other sources to gather information about the importance of the planning area to sagebrush-obligate species (including sage-grouse) from a regional perspective and the current condition and extent of sagebrush habitat. Most BLM States have completed or are in process of completing “broad resolution” maps of sage-grouse habitat. IM 2004-136 also addresses this task. These maps display vegetative cover and its current or potential utility to sage-grouse, and are therefore useful information sources regarding sage-grouse habitat.

The broad resolution maps may not provide information about the specific locations and conditions of seasonal sage-grouse habitats (breeding, nesting/early brood rearing, late brood-rearing and wintering). Use available local maps to describe the seasonal habitats within the planning area. If seasonal habitat information is not available at present, prepare maps at the planning area scale according to guidelines in state strategies (if completed) or BLM’s Guidance for the Management of Sagebrush Plant Communities for Sage-grouse Conservation (if state strategies are not completed), in partnership with State wildlife agencies.

4. Develop Alternatives

The alternatives should identify and evaluate reasonable, feasible and effective options for conserving sagebrush habitats and associated species in accordance with BLM's multiple-use mandate in FLPMA.

Ensure that each alternative contains considerations for sagebrush habitat conservation by (1) developing one or more goals related to sagebrush habitat with emphasis on sage-grouse habitat that will apply to all alternatives, (2) including objectives in each alternative that pertain to the goals, and (3) identifying allowable uses or management actions to achieve the objectives. This method will ensure that all alternatives, including the preferred alternative, will include sagebrush and sage-grouse habitat considerations.

Evaluate different levels of sagebrush (and associated sage-grouse) habitat conservation in the range of alternatives. The amount of sagebrush and sage-grouse conservation will vary as the alternatives respond to other resource concerns or demands. The evaluation of different levels of habitat conservation will help determine which combination represents the best balance of sagebrush and sage-grouse habitat conservation and resource use over the long term.

Describe and analyze at least one alternative that maximizes conservation of sagebrush habitat (emphasizing special status species habitat) through objectives, land use plan decisions and management direction. This alternative may or may not be designated as the Preferred Alternative.

a. Goals and Objectives

Develop planning goals for protection/maintenance and restoration/rehabilitation of sagebrush habitat. Write objectives for each alternative that will achieve the goals to different degrees. Some objectives can be the same across some or all of the alternatives. For example, two alternatives may have the objective of initiating restoration/rehabilitating X percent of potential habitat by 2015, and another alternative may have the objective of initiating restoration/rehabilitating Y percent of potential habitat by 2015.

Listed below are recommended goals for the protection/maintenance and restoration/rehabilitation of sagebrush habitat. These goals may need to be modified for a given planning area based on the information that is available about the location and extent of sagebrush habitat and sagebrush-obligate species (especially sage-grouse) populations.

Protection/maintenance goal (focus on currently occupied high-priority habitat)

- Sustain the integrity of the sagebrush biome to provide the amount, continuity, and quality of habitat that is necessary to maintain sustainable populations of sage-grouse and other species by achieving the following results:

1. Maintain large patches of high quality sagebrush habitats, with emphasis on patches occupied by sage-grouse.
2. Maintain connections between sagebrush habitats, with emphasis on connections between habitats occupied by sage-grouse.

Restoration/rehabilitation goal

- Identify the amount of habitat that should undergo restoration and/or rehabilitation during the life of the plan and initiate restoration and/or rehabilitation by achieving the following results:
    1. Reconnect large patches of sagebrush habitat with emphasis on reconnecting patches occupied by stronghold and isolated populations of sage-grouse.
    2. Enlarge the size of patches of sagebrush habitats with emphasis on patches occupied by sage-grouse.

b. Allowable Uses and Management Actions

Set forth allowable uses and management actions in the plan to accomplish the objectives. Identify actions for protection/maintenance and restoration/rehabilitation to conserve sagebrush habitat with an emphasis on habitat for sage-grouse and other sagebrush-obligate species.

Include prescriptions, standards, and other mitigation measures to help protect/maintain and restore/rehabilitate sagebrush habitat according to the Suggested Management Practices section of BLM's Guidelines for the Management of Sagebrush Plant Communities for Sage-Grouse Conservation. Suggested Management Practices are provided for the maintenance and restoration of sagebrush vegetative communities that have been lost, fragmented, or are intact but of diminished quality. The Suggested Management Practices are cross-referenced to a variety of land management activities which could affect sagebrush communities.

See Attachment 2 for sample stipulations that could be included in land use plans.

5. Estimate Effects of Alternatives

Describe the direct, indirect, and cumulative impacts to sagebrush habitat and associated sage-grouse habitat (current occupied habitat and potential restoration/rehabilitation areas). Describe also impacts to populations of sage-grouse and other significant sagebrush-obligate species (if applicable). Quantify the impacts to the extent possible (e.g., Alternative A would allow for X miles of new roads or cause X acres of surface disturbance or X acres of sagebrush habitat loss in current sage-grouse habitat).

Attachment 1

Reference Materials for Planning Criteria for Sagebrush Habitat

Listed below are summaries of federal laws, regulations and policies that guide land management decisions affecting sagebrush habitat. The excerpts provided support and/or influence consideration of sagebrush and sage-grouse habitat in land use planning efforts. These should be considered in developing planning criteria in BLM land use plans, as appropriate.

Federal Land Policy & Management Act (FLPMA) of 1976, (43 U.S.C. 1701 *et seq.*)

Sec.102. [43 U.S.C. 1701], Declaration of Policy. (a) The Congress declares that it is the policy of the United States that: (8) the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use.

Sikes Act of 1974, Title II (16 U.S.C. 670g *et seq.*), as amended

This Act directs the Secretaries of Interior and Agriculture to, in cooperation with the State agencies, develop plans to "develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish and game. Such conservation and rehabilitation programs shall include, but not limited to, specific habitat improvement projects, and related activities and adequate protection for species considered threatened or endangered."

43 CFR 1610 - Planning regulations

Sec. 1610.4-3 Inventory data and information collection. (a) The District or [Field] manager shall arrange for resource, environmental, social, economic and institutional data and information to be collected, or assembled if already available. New information and inventory data collection will emphasize significant issues and decisions with the greatest potential impact. Inventory data and information shall be collected in a manner that aids application in the planning process, including subsequent monitoring requirements.

Sec. 1610.4-4 Analysis of the management situation. The District or [Field] Manager shall analyze the inventory data and other information available to determine the ability of the resource area to respond to identified issues and opportunities…

Sec. 1610.7-2 Designation of areas of critical environmental concern. Areas having potential for Areas of Critical Environmental Concern (ACEC) designation and protection management shall be identified and considered throughout the resource management planning process…(a) The inventory data shall be analyzed to determine whether there are areas containing resources, values, systems or processes or hazards eligible for further consideration for designation as an ACEC. In order to be a potential ACEC, both of the following criteria shall be met:
(1) Relevance. There shall be present a significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard.
(2) Importance. The above described value…shall have substantial significance and values…

43 CFR 4180 – Rangeland Health Standards

The regulations at 43 CFR 4180.1(d) require the management of rangelands so that "habitats are, or are making significant progress toward being, restored or maintained for Federal threatened and endangered species, Federal Proposed,…and other special status species."

BLM Rangeland Health Standards Handbook (H-4180-1)

BLM's 4180 Handbook expands upon the 4180 regulations to state that standards apply to all ecosystems falling under BLM management (not just rangelands) and all activities managed by BLM (not just livestock grazing). BLM developed Land Health Standards in each state to define minimum resource conditions that must be achieved and maintained to meet the four fundamentals of rangeland health described in 43 CFR 4180.1.

BLM's Land Use Planning Handbook (H-1601-1) – *Note: this handbook is currently under revision. Asterisks indicate places where wording may change according to the draft revised version of the handbook from April 2004.*

Appendix C of this handbook states that RMP decisions…

- Should identify strategies* and* decisions to conserve and recover special status species.
- Should identify actions and area-wide use restrictions needed to achieve desired population and habitat conditions.
- Should be sufficiently detailed to protect*/enhance habitat pending development of implementation-level plans.
- May include stipulations or criteria that would apply to implementation actions.
- Should be consistent with approved conservation agreements (CAs), biological opinions (BOs), etc.

Appendix C also states that implementation decisions should…

- Identify programmatic and site-specific actions to implement Land Use Plan (LUP)* decisions.
- Include an implementation schedule.*

BLM Manual 6840 - Special Status Species Management

The 6840 Manual provides for BLM to implement management plans that conserve candidate and Bureau-sensitive species and their habitats, and to ensure that actions authorized, funded, or carried out by the BLM do not contribute to the need for the species to become listed under the provisions of the Endangered Species Act.

Attachment 2

Oil and Gas Leasing Stipulations (RMP Format - Example)

The table below includes sample stipulations for No Surface Occupancy (NSO) and Timing Limitation (TL) that could benefit sage-grouse habitat conservation. Consider including stipulations such as these in land use plan revisions or amendments.

Type of Stipula-tion	Protected Resource	RMP Acres Affected (Approx.)	Stipulation Description
NSO	Greater Sage-grouse Leks [CODE XXX]	[insert total RMP NSO acres for Sage-grouse]	STIPULATON: Greater Sage-grouse Leks. This area encompasses sage-grouse leks. Surface Occupancy is not allowed within [insert distance] of identified lek sites. Purpose: To protect lek and nesting habitat within [insert distance] of active leks. (XXXXX RMP, Page XX) EXCEPTION: The Field Manager may grant an exception if an environmental analysis determines that the action, as proposed or conditioned, would not impair the function or utility of the site for current or subsequent reproductive display, including daytime loafing/staging activities. MODIFICATION: The Field Manager may modify in extent, or substitute with a timing limitation, if an environmental analysis finds that a portion of the NSO area is nonessential to site utility or function, or that the proposed action could be conditioned so as not to impair the function or utility of the site for current or subsequent reproductive display, including daytime loafing/staging activities. The stipulation may also be modified if the proponent, BLM, State wildlife agency, and where necessary, other affected interests, negotiate compensation or mitigation that satisfactorily offsets anticipated impacts to sage-grouse breeding activities and/or habitats. WAIVER: This stipulation may be waived, if after consulting with the State wildlife agency, it is determined that the site has been permanently abandoned or unoccupied for a minimum of __ years; site conditions have changed such that there is no reasonable likelihood of site occupation for a subsequent minimum period of __ years.
TL	Greater Sage-grouse Nesting Habitat Associated with Leks [CODE XXX]	[insert total RMP TL acres for Sage-grouse]	STIPULATON: Sage-grouse Nesting Habitat. This area encompasses suitable sage-grouse nesting habitat associated with individual leks. No new surface use is allowed (exploration, construction, and drilling), within [insert distance] of identified leks from [insert date] through [insert date]. This stipulation does not apply to operation and maintenance of existing production facilities and roads. PURPOSE: To protect sage-grouse nesting activities associated with individual leks on sagebrush vegetation types. (XXXXX RMP, Page XX) EXCEPTION: The Field Manager may grant an exception if an environmental analysis determines that the action, as proposed or conditioned so as not to affect nest attendance, egg, chick survival, or nesting success. An exception could also be granted if the proponent, BLM, and State wildlife agency and where necessary, other affected interests, negotiate compensation or mitigation that would satisfactorily offset the anticipated losses of nesting habitat or nesting activities. Actions designed to enhance the long-term utility or availability of suitable sage-grouse habitat may be exempted from this timing limitation. MODIFICATION: The Field Manager may modify the size and shape of the Timing Limitation area if an environmental analysis indicates the actual habitat suitability for nesting is greater or less than the [insert distance] radius. Timeframes may be modified based on studies documenting local periods of actual use. WAIVER: This stipulation may be waived, if after consulting with the State wildlife agency, it is determined that the described lands are incapable of serving the long-term requirements of sage-grouse nesting habitat and that these ranges no longer warrant consideration as components of sage-grouse nesting habitat.

WWP Exhibit 11

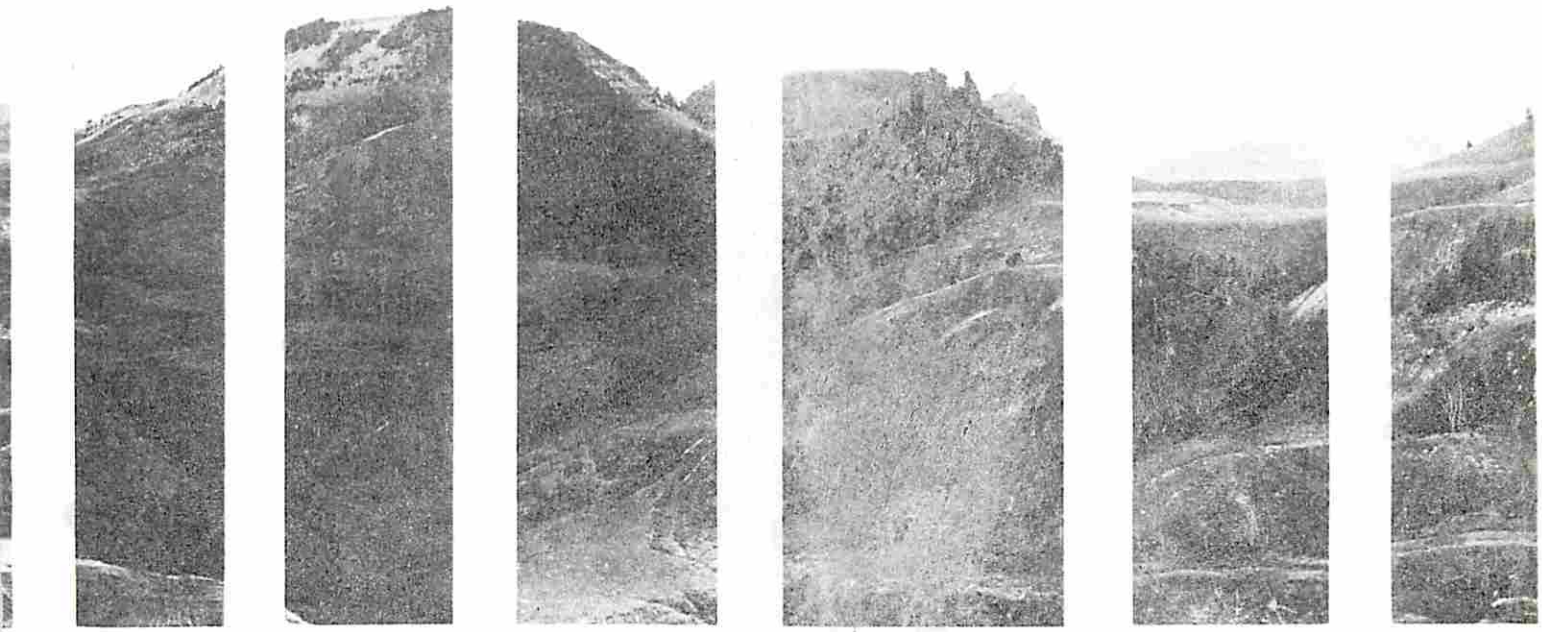
LFO_RMP_10174

No grazing
Alts

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

U. S. Department of the Interior
Bureau of Land Management
Rock Springs District, Wyoming

GEOLOGICAL SURVEY
OCT 1 3 1978
ROCK SPRINGS, WY
MINING BRANCH



Sandy Grazing Environmental Statement

FINAL

DEPARTMENT OF THE INTERIOR

FINAL

ENVIRONMENTAL STATEMENT

PROPOSED DOMESTIC LIVESTOCK GRAZING MANAGEMENT PROGRAM FOR THE SANDY AREA

Prepared by

BUREAU OF LAND MANAGEMENT

DEPARTMENT OF THE INTERIOR

State Director, Wyoming State Office

browse would usually be faster in a higher precipitation zone such as the Diamond Fork (14 inches per year) than for the Sandy area (8 inches per year). In the Diamond Fork, however, grazing intensity was initially reduced by 70% because this was believed to be necessary to accommodate the existing carrying capacity and proper use in the riparian areas. Dorn (1977) writes, "Forage competition caused by trampling and rubbing could become significant with heavier cattle stocking"

Although the Sandy area is not presently overstocked, especially in view of the amount of permitted nonuse, this amount of nonuse would not be continued under the proposal. Use of riparian areas by cattle would increase due to full or partial conversion from sheep to cattle. Moose which depend on the riparian areas would further increase pressure on the vegetation in these areas, particularly willows. In contrast there were very few, if any, moose using the Diamond Fork study area. Moose in the Sandy area probably mostly depend on willows according to diet studies. Crucial habitat (riparian browse) of the pastures shown in TABLE 3-35 having steep slopes would be adversely impacted by the proposal. Deterioration of the riparian browse and diversity in the above pastures would affect 50% of the moose crucial winter habitat. Approximately 95% (125,335 acres) of moose crucial winter habitat would be managed with a sequence of treatments which are probably uncomplementary to the growth style of willows and likely to be most detrimental to the portions of crucial winter habitat occurring in the pastures outlined in TABLE 3-35.

All grazing systems would probably increase the cover of grasses and forbs. Occupation and intensive use of meadows by livestock during Treatments A and B (graze season long and rest until seedripe, then graze) would be detrimental to the riparian browse. Cattle would damage willows by horning, scraping, and scratching as well as browsing (Dorn 1970). The systems with the least amount of early use per cycle, least duration of use per cycle, and the most rest over a cycle would complement plants likely to compose the bulk of moose diet.

Moose crucial winter habitat in Pastures 1 and 2 of the Fish Creek Allotment and Pasture 5 of the White Acorn Allotment would receive the most damage from livestock grazing because no season-long rest would be provided. Use would be alternated between the two pastures each year. These pastures contain approximately 5% (6,551 acres) of the moose crucial winter habitat. Willows and other riparian browse in these areas are presently in good condition. The Fish Creek two-pasture deferred system would be the least beneficial to moose crucial habitat. TABLE 3-36 shows the percent of crucial winter habitat that would be adversely impacted by the grazing systems. Existing damage to willows would occur in an estimated 10% (13,932 acres) of the crucial winter habitat.

Cover. Cover in moose habitat primarily includes aspen stands on the slopes and meadows with willow bottoms.

Water. The proposed water developments should successfully distribute cattle within a pasture, thereby relieving pressure on the riparian areas. The vegetation along riparian areas would, however, become more desirable to livestock during late summer as upland vegetation dries up. Shade is also provided cattle in riparian areas, which encourages grazing use. Better distribution combined with rest in the systems should cause increased vegetation production in the meadow types (vegetation section). The development of one spring each in the Prospect Mountain, Poston, and Pine Creek Allotments would be located within moose crucial habitat. Cattle grazing around these locations would be expected to reduce the carrying capacity of the moose habitat. The season-long rest (Treatment C) provided in the grazing systems, particularly the four-pasture alternately grazed system (Gold Creek), should complement the riparian areas by at least increasing vegetal cover but not willow browse.

Migration and Space. Moose seasonally change locations in the Sandy area, and MAP 2-25 illustrates the relationship between summer and winter habitat for moose in the Sandy area. Moose at times must move out of the riparian areas along streams, although they apparently prefer to stay within a few miles of these areas. This characteristic limits their summer habitat.

Custodial Pastures. Generally, the management of custodial pastures is liable to be detrimental to the welfare of moose. Moose are now probably utilizing those areas along streams at or near carrying capacity. Pastures C-5, 7, 11, 17, 18, 20, 24, 25, 31, 32, and 33 are within the crucial habitat. The larger pastures, particularly C-24 and 25, are more valuable to moose than smaller ones. It is assumed that most of these pastures would receive season-long grazing. Therefore, the riparian areas of these pastures are probably of less value than those utilized by the proposed management systems.

No Grazing. It is anticipated that moose would benefit from available forage in this area and that the population would continue to increase because there would be no livestock to compete for available forage. Riparian browse would be expected to be maintained (TABLE 3-15).

Water Development. Additional waters may distribute cattle away from riparian areas. However, it is believed that the effectiveness of these additional waters may not be very significant because of the following: (1) the close distance between existing waters and the riparian areas; (2) the attractiveness of the green riparian areas during the summer; (3) conversions or partial conversions to cattle which prefer the wet meadow vegetation; (4) the steep terrain located adjacent to riparian areas and the cattle's tendency to remain in the bottoms; (5) concentration of all the livestock into one-half to one-third of an allotment; and (6) limited reduction of grazing intensity.

Fence Construction. As snow depth increases, negotiation of fences would become more difficult for moose. Crusted snow would increase this problem. Existing and proposed fences in crucial winter habitat would pose the greater problem (TABLE 3-37).

Once the proposed fences are constructed, there would be nearly 143 miles of fencing in moose habitat. Approximately 47 miles (about 33%) of these fences would be located in crucial winter areas and some mor-

twelve years of operation, but physical trampling, sedimentation, and lack of willow reestablishment are still limiting factors for the aquatic environment (FIGURE 3-9).

As another comparison, U. S. Forest Service's Diamond Fork grazing programs near Provo, Utah, have found it necessary to completely rest pastures for four years prior to implementation of grazing systems incorporating additional rest in sequential years in order to obtain recovery and improvement of stream habitat and fish populations (Kimble and Savage 1974). FIGURES 3-10 and 3-11 show the effects of the grazing system.

It would therefore appear that the three-pasture rest-rotation systems as proposed combined with major increases in cattle use proposed in the allotments (except for Little Sandy-Little Prospect) would, at best, maintain existing stream habitat conditions over the short term. While they could improve or maintain present habitat conditions in some areas over the long term, the anticipated result would be a slight decline of habitat conditions in those areas where cattle use is presently low to nonexistent and streambanks are less than 50% stable to livestock pressures (TABLES 3-44 and 3-45). A detailed analysis by stream is available for review upon request from the Rock Springs District Office.

Threatened and Endangered Species

No threatened or endangered aquatic organisms have been identified to date in the Sandy area. Seasonal use of the lower Big Sandy River (Farson to the Green River) by roundtail chubs, bluehead, and flannelmouth suckers, which Baxter and Simon (1970) feel warrant rare considerations due to their limited habitat within the State of Wyoming, is not anticipated to be affected by the proposal. While little definitive information is available on the critical habitat elements required by suckers, an inverse relationship with habitat quality for game fish is often assumed, and on the basis of predicted habitat trends for seasonal game fish use of the lower Big Sandy, the proposal could possibly improve the stream habitat of the Big Sandy Use Area for nongame fish.

Formal consultation under Section 7 of the Endangered Species Act of 1973 has been initiated with the U.S. Fish and Wildlife Service.

Custodial Pastures

The anticipated system of use within custodial pastures for the purposes of analysis is considered to be that of Treatment A, graze season long. Estimated habitat condition and trend for pastures C-6, C-21, and C-26, which contain the most significant mileage of inventoried NRL streams (approximately 45% (7.25 mile) of all NRL stream miles within custodial pastures), has been projected on this basis and is shown in TABLES 3-44 and 3-45. Where less intensive use than season-long grazing occurs in custodial pastures, existing conditions would probably be maintained over the short term and attain projected short-term conditions under Treatment A over the long term. Nonuse in these areas would probably lead to a gradual habitat improvement over the long term. It is anticipated that the quality of the good and fair spawning and resident habitat would decrease by about 40% and 50%, respectively, and game fish populations by approximately 50 to 70% in these areas.

No Grazing Areas

The proposed discontinuation of grazing in Palmer Draw is anticipated to result in the maintenance of 3.0 miles of existing good quality resident habitat and the long-term improvement of 0.75 miles of spawning habitat from poor to fair condition on the Sweetwater River. Long-term improvement of streambank vegetal cover in areas presently experiencing bank cutting and mass wasting should improve the stream habitat channel stability 9%, or from the present high fair to a good stability rating.

Range Improvements

The development of supportive projects (water developments and fences) would be anticipated to have minimal effects on aquatic habitat in general. Of the 63 earthfill and 33 pit type reservoirs proposed for development, only six are proposed that would be fenced for the control of livestock and management of aquatic habitat. Manmade stock ponds have been found in numerous studies to provide more aquatic habitat, based on use percentages for waterfowl, than natural areas if aquatic habitat productivity is maintained (Lokemoen 1973). While construction of upland water sites would hold some livestock use within the given area, use on stream bottoms or shorelines is not anticipated to be reduced significantly for the reduction of impacts to aquatic habitat.

According to Hormay (per. comm., 1976), "Vegetation in certain areas, such as meadows and drainage ways, are invariably closely utilized under any stocking rate or system of grazing. Such use may be detrimental to wildlife, aesthetic, recreational, or other values. Where this is the case, about the only way to preserve values is to fence the area off from grazing. Reducing livestock or adjusting the grazing season usually will not solve such a problem" New aquatic habitat would be created at reservoir sites, but its value for fisheries would be limited due to the small size of reservoirs proposed. The primary benefits of these reservoirs or pits would be in the creation of potential sites for aquatic habitat and food production for waterfowl and birds.

Summary of Impacts

The general aquatic habitat trend within the Sandy area would continue to be downward as a result of the proposed action. The fact that streams function as a dynamic continuum throughout their watershed complicates improvement efforts or recovery during the rest periods as proposed. Considering the activation of addi-

WWP Exhibit 12

RIPARIAN AREA MANAGEMENT

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BLM

TR 1737-20

Grazing Management Processes and Strategies for Riparian-Wetland Areas

2006

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RIPARIAN AREA MANAGEMENT
Grazing Management Processes and Strategies for Riparian-Wetland Areas

By:

Sandra Wyman
Rangeland Management Specialist
National Riparian Service Team
Prineville, Oregon

Dr. Derek W. Bailey
Associate Professor
New Mexico State University
Las Cruces, New Mexico

Dr. Mike Borman
Extension Rangeland Resources Specialist
Rangeland Ecology and Management
Oregon State University
Corvallis, Oregon

Steve Cote
District Conservationist
Natural Resources Conservation Service
Arco, Idaho

Jimmy Eisner
Fisheries Biologist
Bureau of Land Management
Prineville, Oregon

Wayne Elmore
Riparian Ecologist
Bureau of Land Management (retired)
Prineville, Oregon

Bob Leinard
Riparian Ecologist/Rangeland Management Specialist
Natural Resources Conservation Service (retired)
Whitehall, Montana

Steve Leonard
Riparian Ecologist/Grazing Management Specialist
Bureau of Land Management (retired)
Midvale, Idaho

Floyd Reed
Rangeland Management Specialist
Forest Service (retired)
Delta, Colorado

Dr. Sherman Swanson
Range Extension State Specialist
University of Nevada, Reno
Reno, Nevada

Dr. Laura Van Riper
Social Scientist
National Riparian Service Team
Prineville, Oregon

Tim Westfall
Rangeland Management Specialist
Consultant
Lemhi, Idaho

Ron Wiley
Team Leader
National Riparian Service Team
Prineville, Oregon

Dr. Alma Winward
Ecologist
Forest Service (retired)
Ogden, Utah

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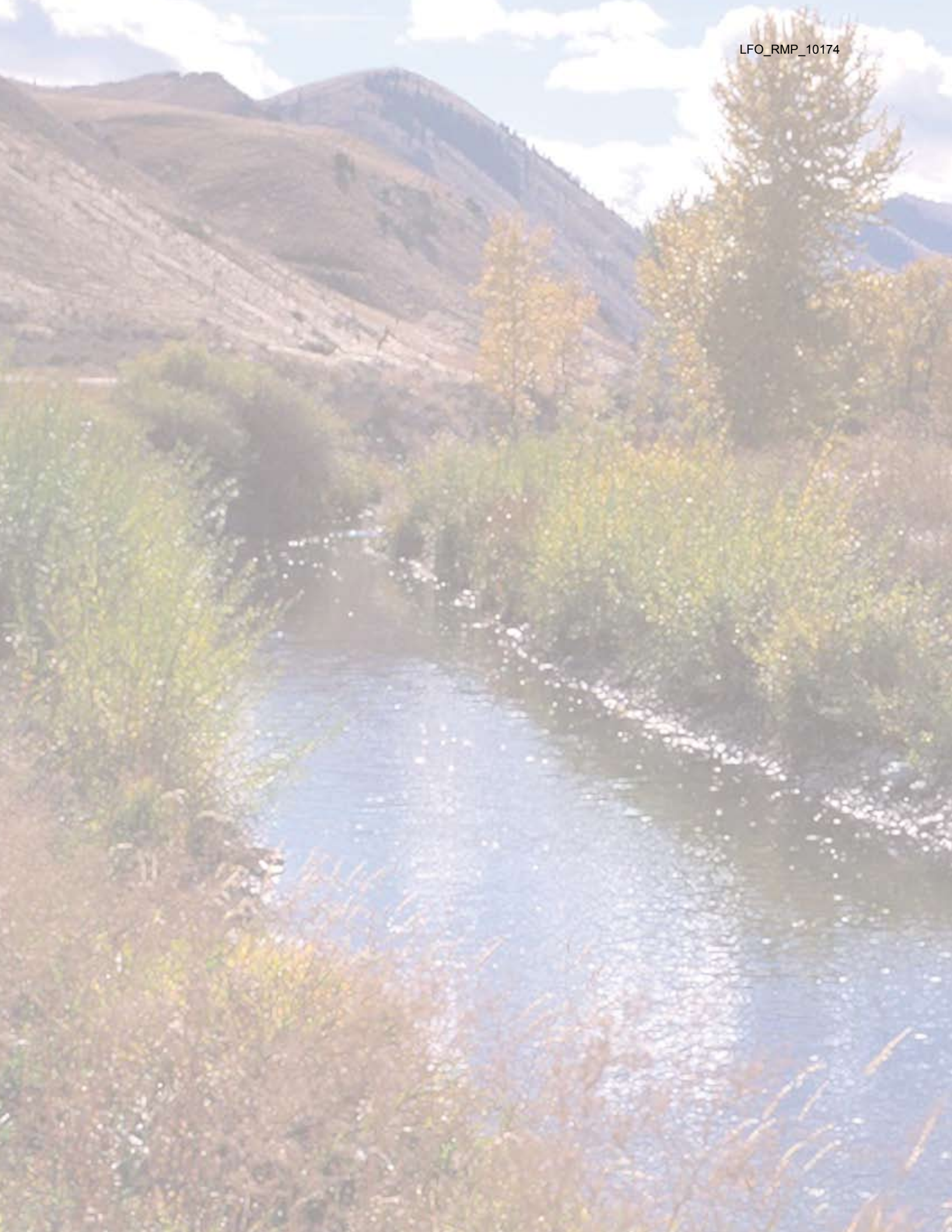
DEDICATION

This publication is dedicated to the livestock operators and land managers who work to solve private and public land resource issues both now and in the future. Their commitment to sustainable resource management will help maintain rural lifestyles, open space, and properly functioning watersheds.



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PREFACE

Grazing management in riparian-wetland areas has been a major issue facing rangeland managers for more than three decades. In the late 1960s, growing concern about the environment prompted landowners, land managers, land users, and a highly interested public to take a critical look at land management practices, with an eye toward reducing adverse environmental consequences resulting from use of the land. That critical look identified management of livestock grazing in riparian-wetland areas as a significant issue that has assumed permanence on both private and public grazing lands.

To help address this issue, Kinch (1989) developed Technical Reference (TR) 1737-4, *Grazing Management in Riparian Areas*. Throughout the 1990s, management actions were implemented and monitored in riparian-wetland areas. The resilience and quick response of riparian-wetland areas to these actions provided new information that was subsequently incorporated into TR 1737-14, *Grazing Management for Riparian-Wetland Areas* (Leonard et al. 1997). The implementation of grazing management strategies for riparian-wetland areas and the evaluation of their successes and failures continue to provide valuable information, emphasizing the need to periodically update this grazing management reference.

Accordingly, this technical reference provides the most current information to further assist livestock operators and land managers in developing successful riparian-wetland grazing management strategies across a wide array of land types. It is also the core document for the Grazing Management for Riparian-Wetlands training course. The training course is periodically conducted by an interagency, interdisciplinary team for a broad audience that includes ranchers; local, county, State, and Federal agencies; and the interested public.

Because of the complexity of riparian-wetland areas and issues, this technical reference does not set forth a specific formula for identifying the type of grazing strategy best suited for an area. Rather, it provides information to help design appropriate grazing strategies so that soil and vegetation aspects, water issues, and wildlife and livestock needs are addressed in a collaborative manner.

Basic topics covered in this technical reference include riparian-wetland area attributes and processes, resource assessments and inventories of riparian-wetland areas, development of good resource management objectives, management strategy factors, grazing treatments, and collaborative monitoring. Examples of tools, techniques, and treatments are provided, but they do not represent all of the "tools in the toolbox" that are available to resource managers. Although the term riparian is used alone throughout this document, riparian-wetland area is implied. While examples in this document feature running water (lotic) riparian-wetland areas for the most part, these principles are applicable to standing water (lentic) areas as well. This document is intended to provide the background and information necessary to allow managers to develop practices that will help protect riparian area resources while maintaining the viability and economic soundness of the grazing enterprise.

Management of the associated uplands can directly affect conditions in the riparian area. Consequently, it is important to consider the entire watershed and its resources when developing a grazing management strategy. A successful grazing management strategy meets the needs of the operator, livestock, wildlife, and upland and riparian resources. Continued success is achieved by monitoring how well the strategy meets these needs and making timely adjustments as necessary.

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Ray Banister, Banister Ranch, Wibaux, MT

Carol Evans, Fisheries Biologist, BLM, Elko, NV

Ceci Dale-Cesmat, Rangeland Management Specialist, NRCS, Susanville, CA

Pat Shaver, Rangeland Management Specialist, West Natl. Tech. Support Center, NRCS, Portland, OR

Leonard Jolley, Rangeland and Pastureland Ecologist, Resource Inventory and Assessment Division, NRCS, Beltsville, MD

Bryce Bohn, Hydrologist, USFS, Dillon, MT

Mark Hilliard, Wildlife Biologist, BLM, Boise, ID

Rick Danvir, Wildlife Biologist, Deseret Land and Livestock, Woodruff, UT

Dr. Tamzen Stringham, Assistant Professor, Rangeland Ecology and Management, Oregon State University, Corvallis, OR

Chance Gowan, Forest Aquatic Biologist, Malheur National Forest, John Day, OR

Dr. Dave Merritt, Streamside Vegetation Spec., Natl. Stream Systems Tech. Center, USFS, Fort Collins, CO

Dick Mayberry, Rangeland Management Specialist, BLM, Washington, DC

Dick Lindenmuth, Natural Resource Specialist, USFS, Washington, DC

Robert Bolton, Senior Rangeland Management Specialist, BLM, Washington, DC

Kenneth Visser, Rangeland Management Specialist, BLM, Reno, NV

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Eric Peterson, Extension Specialist, Pinedale, WY

Robert E. Lee, Lee Ranch, Judith Gap, MT

Dr. Bob Ehrhart, Assoc. Prof. of Rangeland Resources, Central Oregon Community College, Bend, OR

Dr. John Buckhouse, Professor, Rangeland Ecology and Management, Oregon State University, Corvallis, OR

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Dr. Paul Meiman, Rangeland Extension Specialist, University of Wyoming, Lander, WY

Marcus Miller, Wildlife Biologist, NRCS, Albuquerque, NM

Dr. L. Roy Roath, Associate Professor and Extension Range Specialist, Department of Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins, CO

Dick Loper, Consultant, Wyoming Stock Growers Board, Lander, WY

George Peacock, Rangeland Management Specialist, NRCS, Fort Worth, TX

Dr. Kelly Crane, Frontier Natural Resource Consulting, Prineville, OR

Van Elsbernd, Rangeland Management Specialist, USFS, Fort Collins, CO

Bob Welling, Research Support Manager, Ridley Block Operations, Vaughn, MT

John Christensen, Riparian Program Lead, BLM, Washington, DC

Janice Staats, Hydrologist, National Riparian Service Team, Prineville, OR

Susan Holtzman, Team Coordinator, National Riparian Service Team, Portland, OR

Carol Connolly, Public Affairs Specialist, National Riparian Service Team, Prineville, OR

Brian Pillsbury, Grazing Management Specialist, NRCS, Baraboo, WI

Stephanie Gripne, Research Fellow, Boone and Crockett Cons. Prog., University of Montana, Lander, WY

Pete Husby, State Biologist, NRCS, Bozeman, MT

Ervin Cowley, Rangeland Management Specialist, BLM, Boise, ID

Holly George, County Director and Livestock/Natural Resources Advisor, University of California Cooperative Extension, Quincy, CA

Dennis Thompson, National Grazinglands Ecologist, NRCS, Washington, DC

Wendell Gilgert, Wildlife Biologist, West National Technology Support Center, NRCS, Portland, OR

Gary McCuin, Program Coordinator, Nevada Department of Agriculture, Carson City, NV

Mike Lunn, Conflict Management Facilitator, Solutions for Sustainability, Prineville, OR

Dr. Jeff Mosley, Montana Range Extension Specialist, Montana State University, Bozeman, MT

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LFO_RMP_10174

CONTENTS

Dedication . . . iii

Preface . . . v

Acknowledgments . . . vii

I. Introduction . . . 1

II. Grazing and Riparian-Wetland Area Attributes and Processes . . . 3
- A. Vegetation . . . 5
- B. Channel Stability . . . 6
- C. Upland Connection . . . 6

III. Grazing Management Planning . . . 7
- A. Assess Resource Conditions . . . 8
  - 1. Classification . . . 8
  - 2. Ecological Site Descriptions . . . 8
  - 3. Proper Functioning Condition Assessment . . . 9
- B. Identify Issues . . . 11
- C. Develop Management Objectives . . . 11
  - 1. Objectives Based on Riparian Attributes . . . 12
  - 2. Elements of an Objective . . . 13
- D. Develop and Implement Management Strategies . . . 14
  - 1. Management Strategy Factors . . . 14
  - 2. Management Tools and Techniques Common to All Grazing Strategies . . . 24
  - 3. Grazing Treatments . . . 36
- E. Monitor Vegetation . . . 63
  - 1. General . . . 63
  - 2. Implementation Monitoring . . . 65
  - 3. Mid- and Long-Term Monitoring . . . 68
  - 4. Photo Monitoring . . . 69
  - 5. Cooperative Monitoring . . . 70
- F. Evaluate Progress . . . 72

IV. Cardinal Rules for Planning and Managing Grazing in Riparian Areas . . . 73

Appendix A: Reference Web Sites . . . 75
Appendix B: Collaborative Planning . . . 77
Appendix C: Ecological State and Transition Model Examples . . . 81
Appendix D: Proper Functioning Condition of Riparian-Wetland Areas Assessment Checklist (Lotic) . . . 85
Appendix E: Examples of Good Objectives . . . 87
Appendix F: Grazing Response Index (GRI) . . . 89
Appendix G: Low-Stress Stockmanship . . . 93

Glossary of Terms . . . 95

Literature Cited . . . 97

LFO_RMP_10174

I. INTRODUCTION

Marshes, wet meadows, shallow swamps, estuaries, and land adjacent to rivers, streams, and lakes are typical riparian areas. These areas can range in extent from a few square feet, such as around small springs, to tens of thousands of acres or more, such as in large wetland complexes. Riparian areas make up a relatively small, but productive and resilient portion of the landscape, exhibiting vegetative or physical attributes reflective of the influence of water. They are important for the ecosystem services they provide, such as floodplain and ground-water storage, water transport, improved water quality, and fish and wildlife habitat. Riparian areas are also economically important, particularly to the livestock industry, because of the water, forage, and cover they provide for livestock. No other landscape feature connects ecosystems and people as effectively as streams and riparian areas. For this reason, all land managers, both public and private, must work together to develop management strategies that reflect this connectivity.

Most livestock grazing pastures or allotments include some riparian areas, and managing livestock in those areas is one of the most contentious issues facing rangeland managers. This issue is complex because livestock operators and land managers must resolve conflicting economic and environmental issues, as well as other issues. For example:

- Most riparian acreage is privately controlled or intermingled with other ownerships.
- Riparian areas are often the primary, and sometimes the only, watering places for livestock grazing on pastures and rangeland.
- Public use and fragmentation of riparian areas are increasing.
- Other resources and uses, such as wildlife, fisheries, and recreation, are concentrated in and dependent on these areas.
- Grazing by livestock and wildlife can affect a number of resources and uses, both onsite and offsite.
- The value of properly functioning riparian systems is not widely understood.
- Traditional management strategies, practices, and thinking are often inadequate and difficult to change (Leonard et al. 1997).

These complexities often make the participation and cooperation of landowners, recreationists, other watershed users, agencies, and resource specialists from various disciplines critical to the success of riparian area management.

*"Land managers currently face over a century of riparian manipulation and often incompatible management actions. We must remember that successful riparian management and restoration require **patience** and persistence."*

Wayne Elmore,

Retired BLM Riparian Ecologist

Successful livestock riparian grazing strategies are developed by considering site-specific resource conditions, soil and vegetation capabilities, water quality requirements, livestock and wildlife needs, and human perspectives. While no single grazing system will maintain improved riparian areas or consistently help recover degraded areas, combinations of strategies can be used to customize an approach for each site (Leonard et al. 1997, Lucas et al. 2004). In fact, Clary and Webster (1989) thought that the grazing system selected may not be that important as long as there is direct control of livestock distribution and grazing intensity. Ehrhart and Hansen (1998) reported that in studies in Montana, riparian area conditions improved if the operator or manager was seriously committed and constantly involved. With this in mind, managers must work together to find grazing strategies and practices that make control of livestock distribution and grazing intensity easier and more effective or at least achievable (Leonard et al. 1997).

Any attempt to improve grazing management **generally** follows these basic principles:

- Avoid grazing the same place at the same time year after year.
- Provide for plant development prior to or plant recovery following the grazing period.
- Defoliate the primary forage plants only moderately.
- Provide for livestock needs throughout the year.
- Manage for maintenance or improvement of riparian area physical functionality.

LFO_RMP_10174

- Assess riparian area condition at a frequency adequate to enable, if necessary, prompt corrective management action to protect the health of the riparian area.

The case studies throughout this technical reference illustrate successful livestock grazing strategies and the consequent maintenance or recovery of riparian area function. These are just a few examples of riparian area improvement through livestock grazing that have occurred in the past 20-30 years on private and public land throughout the West. The compatibility of grazing in riparian areas depends on the extent to which the selected grazing management strategy considers and adapts to certain basic ecological and economic relationships. Prior to developing grazing management strategies for riparian areas, managers should have some understanding of grazing effects on the following:

- Functions of riparian ecosystems
- Growth and reproduction of woody and herbaceous plants on the site
- Dependency of other animals (mammals, fish, birds, and amphibians) on riparian areas
- Hydrologic and geomorphic conditions and processes
- Soils
- Water quality and quantity
- Recovery rates
- Upland conditions
- Other uses and demands for the site (e.g., recreation, domestic water)

An ecosystem perspective is critical to successful riparian area management. Leonard et al. (1997) stated that the structure and processes of riparian areas, more than those of any other ecosystem, are influenced by their connectivity to adjacent upland ecosystems. An ecosystem or watershed perspective provides a comprehensive basis for evaluating current grazing practices and other land uses, identifying riparian management objectives, and developing future management alternatives. Analyzing trends from an adaptive management perspective will help determine if goals and objectives are being met and what changes may be needed to move toward the desired outcome.

The information presented in this document will further enhance the ability of livestock managers to develop and implement successful riparian area grazing strategies. More information is available from other sources such as the Web sites listed in Appendix A.

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II. GRAZING AND RIPARIAN-WETLAND AREA ATTRIBUTES AND PROCESSES

"There is good agreement that riparian plants influence the stability of riverbanks, and root reinforcement of banks is arguably the most important way vegetation enhances stability."

Abernethy and Rutherford (2001)

Livestock can indirectly and directly affect stream condition through soil compaction, bank shearing, or severing of roots of riparian vegetation, which are needed for plant survival and bank stability (Behnke and Raleigh 1978). Depending on site, soil, and substrate characteristics, channel degradation generally takes one of two forms:

- If a restrictive soil (claypan, organic, or bedrock) layer is in the channel bed, bank erosion causes channel widening and stream depth decreases (Figures 1 and 2). Stream temperature may also rise and affect aquatic habitat when floodflows can no longer access the floodplain. Little water is retained in the streambanks for later use by vegetation or delayed release back into the stream.
- Conversely, if the restrictive soil layer is lower, the channel can downcut, and the stream gradient and energy can increase and move excessive sediment downstream (Figure 3). Water cannot access the floodplain as well or at all, the water table is lowered, and associated meadows dry up and become much less productive. Water is not stored for later use by vegetation or delayed release back into the stream.

Figure 2. Bank erosion caused by a bedrock channel bottom. (Photo by J. Staats, NRST.)

Figure 1. Bank erosion caused by channel widening and stream depth decreases due to an organic restrictive soil layer in the channel bed (arrow). (Photo by J. Staats, NRST.)

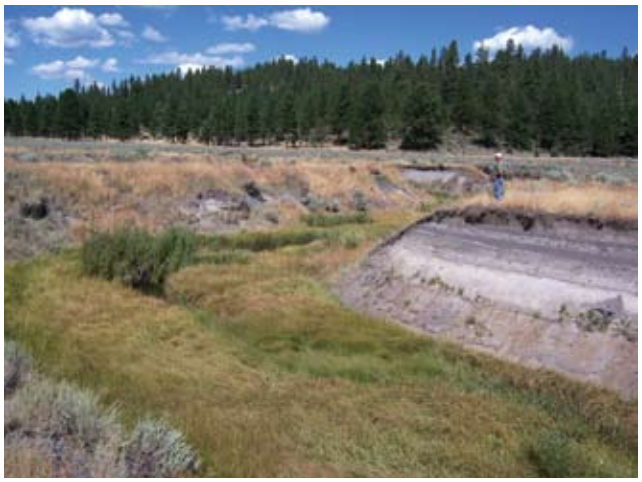

Figure 3. The restrictive soil layer is lower and the channel has downcut with a new floodplain. The water table is lowered. (Photo by J. Staats, NRST.)

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Livestock grazing that promotes and is compatible with healthy riparian vegetation contributes to sustainable levels of aboveground biomass, root growth, and root strength in streambanks. Through overbank flows, riparian vegetation is naturally defoliated or buried by stream and sediment deposition. Livestock can contribute to the maintenance of vegetation by defoliating dormant or dead growth in between these overflow events, thus increasing green matter and hence root strength and growth. If the root strength of riparian vegetation and the surface roughness is sufficient, sediments will be deposited, not eroded away. Riparian vegetation is critical in maintaining channel stability during high flows to allow maintenance of proper stream shape, pattern, sinuosity, and gradient. Vegetation is critical in most low- (<2 percent) and moderate-gradient (2-4 percent) streams. Riparian vegetation can play an important role in shading streams to improve or maintain water temperatures for fisheries by narrowing channels and intercepting solar radiation.

If the harmful impacts from grazing are greater than the recovery response, detrimental changes will occur in the system. Harmful impacts stem from defoliation of important plants at times that do not allow recovery, for long periods that lead to many repeated defoliations, or at intensities that set back plant growth. Fragile soils in some areas may require total livestock exclusion for at least a short period of time (2-5 years). Conversely, if the recovery of the vegetation or site is greater than the disturbance, then recovery should occur. For example, in 1977, Bear Creek in central Oregon was nonfunctional after years of continuous hot season grazing (Figure 4).

Figure 4. Bear Creek in central Oregon was nonfunctional in 1977.

A change in management to a late winter-early spring grazing strategy allowed this system to recover and increased the available animal unit months (AUMs) (Figure 5).

Figure 5. A change to late winter-early spring grazing allowed the Bear Creek system to recover (1996). (Bear Creek photos by Wayne Elmore, retired, BLM.)

Excess herbivory or trampling damage can lead to greater erosion or deposition, changes in channel geomorphology, and less soil moisture (Skovlin 1984, Legge et al. 1981). For example, Pearl Creek in Nevada in 1982 lacked the attributes needed to maintain bank stability under high-flow events. The streambanks lacked woody vegetation recruitment and the riparian herbaceous stabilizing species that would have maintained this system (Figure 6). In 1983, Pearl Creek had downcut, lowering the water table and losing frequent floodplain access (Figure 7). By 1988 Pearl Creek had stopped downcutting and had started to widen, creating a new floodplain at a much lower elevation (Figure 8).

Figure 6. In 1982, Pearl Creek in Nevada lacked bank stability.

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Figure 7. Pearl Creek had downcut in 1983.

Figure 8. Pearl Creek started to widen by 1988. (Pearl Creek photos by BLM.)

Understanding the relationship between vegetation and channel stability is critical in the planning and design of grazing management strategies that are compatible with riparian area maintenance or restoration. Understanding that the condition and management of the associated uplands can directly affect conditions in the riparian area is also important. Change in management of the upland should not be to the detriment of the riparian area and vice versa.

A. Vegetation

Vegetative attributes that can change in response to a grazing strategy include:

- Plant community composition, distribution, and production
- Plant species diversity
- Rooting characteristics (deep-rooted or shallow-rooted)
- Vegetation contribution to percentage of soil organic matter
- Amount of bare ground vs. vegetated ground cover
- Plant community structure including woody plant size, diverse age classes, location, and abundance

The U.S. Fish and Wildlife Service's *National List of Plant Species that Occur in Wetlands* (Reed 1988) rates each species on the estimated probabilities (frequency of occurrence) of plants in a wetland versus nonwetland area across the entire distribution of that species. These species have been further grouped into wetland community types and or plant associations or "an assemblage of native vegetation in equilibrium with the environment on a specific fluvial or water formed surface" (Kovalchik 1987).

Micheli and Kirchner (2002) have shown that riparian species, especially obligates, are six to ten times more effective in providing bank stability and in resisting the forces of water than those plant species adapted to drier environments. Riparian plant community types are important because they are more suitable for maintaining and enhancing the stability of streams. The roots of these plants have four basic characteristics that affect bank stability. They are:

- Root biomass
- Total root length
- Resistance to compressive force (hoof action)
- Linear or stretching strength.

In developing grazing management strategies, both woody and herbaceous vegetation communities should be considered for maintenance of channel and bank stability (Winward 2000, Cornwall 1998). Willow root biomass, including root length and depth, corresponds closely to the size of the aboveground stems and branches. This biomass relationship fits well with watershed protection needs of mountain and valley settings. However, some stream systems neither require, nor have the potential for, woody vegetation. Other systems need woody vegetation, such as willows and cottonwoods, and some require a conifer component as well.

B. Channel Stability

Plants differ in their ability to protect streambanks. Winward (2000) assigns riparian vegetation communities a stability class rating, ranging from 1 (least) to 10 (greatest), which reflects their ability to buffer the forces of moving water (Figure 9). A minimum rating of 7-8 is needed for some alluvial stream systems (0-2 percent slope), but on higher gradient streams (4–6 percent slope) minimum ratings can be as low as 6 if there is ample embedded large wood or rock.

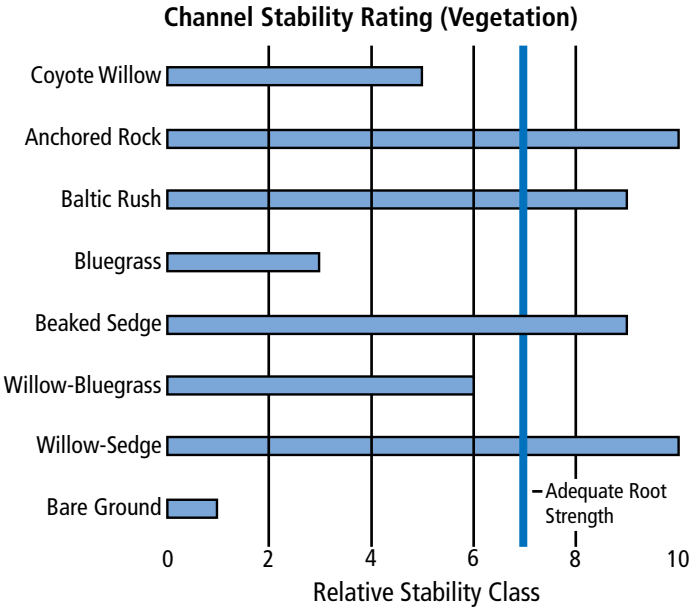

Figure 9. Channel stablility rating (adapted from Winward 2000).

Winward's rating system and others, such as the multiple indicator monitoring methodology (Cowley and Burton 2005), when integrated with existing classification documents, allow managers to assess riparian areas for site potential and set reasonable goals and objectives for maintenance or restoration, development of alternatives, and design of management strategies. These systems are also extremely important in assessing trend and ultimate attainment of desired plant communities.

One frequently overlooked period when grazing strategies can be critical for recovering streams is during droughts. These periods of low flows and reduced stream energies allow vegetation to expand roots and aboveground biomass into areas that were previously in the active channel. The increase in root biomass enhances stream stability and resistance to both lateral widening and vertical incision. This is especially important in alluvial systems composed of finer sediments. Grazing strategies should allow these processes to occur (Walters et al. 1980).

C. Upland Connection

Consideration must be given to management effects on other types of ecological sites within a pasture or watershed, including upland areas, when planning livestock grazing in riparian areas. There are many factors that need to be evaluated, including landscape and animal behavioral interactions. For example, cattle tend to use primarily riparian areas during the hot season on steep landscapes. If this condition is not adequately addressed during the planning stages, the result may cause significant degradation to the riparian area.

In many parts of the West, a reduction in fire frequency and intensity, primarily in pinyon and juniper woodlands, has allowed woody plants to encroach into grasslands. These additional shrubs and trees have caused a variety of effects. A shift from plant communities dominated by grasses and forbs to those dominated by woody plants can result in substantial changes to the hydrology of an area. For example, a switch from herbaceous to woody-dominated vegetation has the potential to alter runoff patterns, infiltration, and ground-water recharge or discharge. These changes can, in turn, alter the flow regime of area streams. In addition to altering the hydrology, woody plant encroachment may also affect livestock use patterns. Thick stands of woody plants may limit livestock access to portions of a pasture and consequently put more pressure on other more accessible areas of the pasture (Bartos and Campbell 1998). Prescribed fire is a tool that can be used to address such concerns. Wildfire effects can promote riparian health and restoration as well as create many riparian problems. Accumulated fuels can increase fire intensity and watershed effects leading to debris flows and flooding. Flood damage is likely to be more severe where riparian vegetation has been consumed in hot fires fueled by accumulated wood.

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III. GRAZING MANAGEMENT PLANNING

The development of a successful grazing management prescription requires consideration of riparian area functional attributes, ecological processes, and an understanding of grazing effects. This understanding is exercised during the basic planning process. Collaboration in the planning process is extremely helpful in designing successful grazing management strategies when two or more individuals or parties are involved (see Appendix B). There are numerous examples across the West of collaborative processes that have involved local communities in achieving resource goals. Coordinated resource management (CRM) is one such process that has brought diverse groups of people together to resolve resource management issues (Cleary and Phillippi 1993). People are generally more dedicated to plan implementation and adaptive management in an environment of collaboration.

In situations involving Federal land or dollars, National Environmental Policy Act (NEPA) and other legal requirements need to be met. The NEPA effects analysis should be broad enough to provide for effective adaptive management. Local, State, and Federal requirements, such as the Clean Water Act [303(d)/Total Maximum Daily Loads], Federal Advisory Committee Act, Endangered Species Act, and State best management practice requirements, also need to be followed, as applicable.

The basic components of a grazing management planning process are illustrated in Figure 10.

Because streamside vegetation is one of the primary ecological attributes affected by grazing, an inventory or assessment of current vegetation condition in relation to the potential condition is necessary to identify limitations or opportunities. Additional issues may be identified through social processes or legal requirements. Goals and objectives are developed to address issues associated with grazing management. These may include individual objectives of livestock operators and land managers as well as resource objectives and legal obligations required by the Endangered Species Act, Clean Water Act, and others.

Following the development of goals and objectives, a grazing management strategy with associated tools or improvements is developed and implemented to address all identified objectives. If planned management will not likely address one or more specific objectives, either the objective or the planned management should be

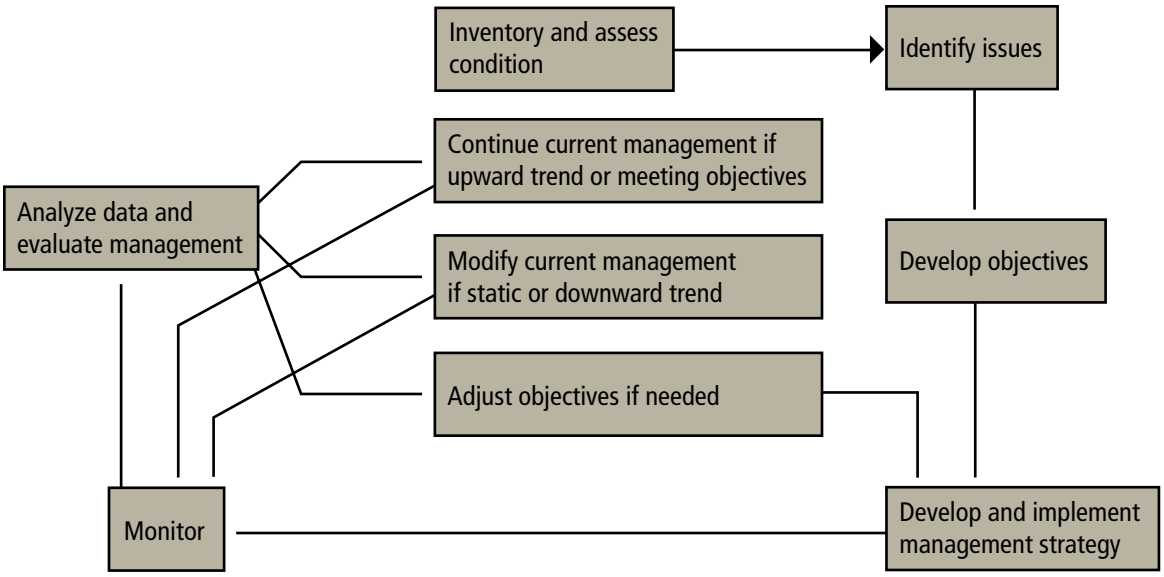

Figure 10. A grazing management planning process.

reconsidered. Monitoring data are collected to determine whether or not progress is being made toward meeting specific objectives. Therefore, it is critical that the monitoring plan is designed to collect useful, quantified data that addresses objectives. Short-term monitoring consists of collecting information on actual livestock use and indicators of use, as well as annual events such as weather, fire, disease to indicate whether long-term objectives can reasonably be achieved. Long-term monitoring consists of measurements to determine if progress is actually being made toward objectives or objectives have been achieved. Adaptive management consists of refinements to the management strategy based on annual analysis of short-term monitoring data or analysis of mid- and long-term monitoring information relative to short-term events and indicators. These analyses help determine whether or not additional resource information (inventory) may be needed, issues have evolved, objectives were reasonable and achievable, or any management strategy needs to be changed. Once adjustments are made, continued monitoring is necessary to determine the effectiveness of the changes. Monitoring is discussed in more detail in section III.E.

A. Assess Resource Conditions

A properly designed grazing strategy requires a basic understanding of the short- and long-term ecological processes that can occur within a riparian area. Soils, vegetation, hydrology, climate, geomorphology, and the animals using the resources are just a few of the important factors that require consideration (Meehan and Platts 1978). A variety of assessments and inventories are available to determine resource conditions and management concerns in riparian areas. They provide information needed to make adaptive management decisions and to monitor ecological change. Baseline information is critical for determining if the land and livestock goals and objectives are being achieved. A common question heard in planning meetings is, "How do you know where you are going if you don't know where you are?"

The following tools are useful for determining the potential, capability, and desired resource conditions of vegetation in an ecological site in different topographic locations. Contact local Bureau of Land Management (BLM), USDA Forest Service (USFS), Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts (SWCD), or county extension field offices for local information.

1. Classification

Riparian classification systems have been developed to help identify, describe, communicate about, and manage riparian communities. Determining the potential vegetation community is important in developing objectives and designing a grazing system that will restore the stream's ability to withstand moderately high-flow events and approach potential natural community. Several documents are available (or under development) that help determine what plant communities should exist in a particular setting and what the management implications are. Riparian classification systems have been completed in many of the Western States and are used to develop goals and objectives for grazing allotments or pastures. For example:

1. *Riparian Zone Associations: Deschutes, Ochoco, Fremont, and Winema National Forests* (Kovalchik 1987) and *Mid-Montane Wetland Plant Associations of the Malheur, Umatilla, and Wallowa-Whitman National Forests* (Crowe and Clausnitzer 1997) describe vegetation classification systems used in Oregon.
2. *Central Nevada Riparian Field Guide* describes plant associations but also considers the differing soil-water characteristics of a given fluvial surface. These differing soil-water characteristics result in different plant community expressions of the same potential (Weixelman et al. 1996).
3. The *Classification and Management of Montana's Riparian and Wetland Sites* (Hansen et al. 1995) is a system of wetland species dominance type (based on cover).
4. *Riparian Community Type Classification of Utah and Southeastern Idaho* (Padgett et al. 1989) is an abstract grouping of plant communities based on floristic and structural similarities.

2. Ecological Site Descriptions

Ecological site descriptions are currently being developed by the NRCS, in cooperation with other State and Federal agencies, to update the original range site

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descriptions. They are available in local NRCS field offices. Ecological site descriptions expand the original descriptions and add management implications. Grazing land ecosystems, including riparian areas, are complex (USDA NRCS 2003), and an adequate understanding of these ecosystems is essential to proper, sustainable management.

An ecological site is a distinct area of land that, because of its physical features, including soils, topography, and climate, will differ from other sites in its ability to produce a unique kind, abundance, and proportion of vegetation (USDA NRCS 2003). The plant community that is produced on an ecological site will differ from other sites in the composition of plant species, either in proportions or production.

Basic ecological relationships and dynamics essential for effective grazing management in riparian areas include nutrient cycling, energy capture, hydrologic and geomorphic conditions and processes, soil processes, and basic plant physiological requirements. All of these relationships are important on upland and riparian areas. However, the channel and floodplain hydrology and geomorphology are important in riparian area dynamics and thus must be included in the state and transition model. (See Appendix C for an explanation and example of a state and transition model.)

Ecological site descriptions also provide insights into the potential effects of grazing management strategies on different sites. Historic climax plant communities (HCPC) or potential plant communities for each site are also described in detail. The ecological processes, or pathways, that allow a site to return to HCPC and those that can move communities away from historic climax, are described as well. An example of an ecological site description can be found in the *National Range and Pasture Handbook* (USDA NRCS 2003), which is available in most NRCS field offices or online (See Appendix A).

3. Proper Functioning Condition Assessment

The current physical functionality of a stream is an important consideration that should be addressed at the start of a restoration, maintenance, or planning project. The USDA NRCS (2001) provides a variety of assessment and inventory techniques for determining conditions of riparian areas. The authors of this technical reference typically use the proper functioning condition (PFC) assessment (Prichard et al. 1998). The PFC method is not only an assessment tool, but also a communication tool.

PFC is one qualitative method of assessing the physical function of riparian areas while taking into account the system's potential and capability. The term PFC is used to identify the assessment process and a defined, on-the-ground condition of a riparian wetland area (Prichard et al. 1998). It has been shown to be a consistent approach for considering hydrology, vegetation, and soil erosion and deposition attributes and processes. A checklist used for the PFC assessment (Appendix D) synthesizes information that is foundational in determining the overall physical functionality of a riparian area. An interdisciplinary team determines a rating of proper functioning condition, functional–at risk, or nonfunctional based on the checklist information.

Proper functioning condition of riparian areas, as defined by Prichard et al. (1998), exists when adequate vegetation, landform, or large woody debris is present to:

- Dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality
- Filter sediment, capture bedload, and aid floodplain development
- Improve floodwater retention and ground-water recharge
- Develop root masses that stabilize streambanks against cutting action
- Develop diverse ponding and channel characteristics to provide the habitat and water depth duration, and temperature necessary for fish production, waterfowl breeding, and other uses
- Support greater biodiversity

Functional–at risk (FAR) riparian areas are still functioning; however, an existing attribute (soil, water, vegetation) makes them susceptible to degradation. Riparian areas that are clearly not providing adequate vegetation, landform, or large woody debris to dissipate stream

LFO_RMP_10174

energy, improve floodwater retention and ground-water recharge, and stabilize streambanks are **nonfunctional** and cannot sustain desired values.

On the ground, PFC refers to how well the physical processes are functioning. PFC reflects a state of resiliency that enables a riparian area to hold together during high-flow events (5-, 10-, or 20-year flows). This resiliency allows an area to produce desired values over time, such as fish habitat, neotropical migratory bird habitat, and livestock or wildlife forage. Management actions focus on functions important to all resource users by setting objectives and planning to, at a minimum, address the limiting attributes and processes identified by the PFC assessment (those "No" responses on the checklist that indicate particular attributes or processes are not functioning as they should be). A grazing strategy that is compatible with those objectives can be developed and implemented by understanding the condition of a riparian area and attributes that are important to sustain functionality and values.

To understand whether or not grazing management is facilitating riparian area recovery, an understanding of recovery rates and grazing impacts is necessary. As an example, BLM Idaho State Office compiled data from streams in southern Idaho showing recovery and degradation rates of herbaceous and woody vegetation, the channel, and water quality (Cowley 1997). The data showed that herbaceous and woody vegetation recovered first (Figure 11) and that water quality and channel configuration took 10-20 years to improve. Degradation rates showed the same pattern: vegetation degraded first and the channel and water quality last (Figure 12). Cowley's example suggests that water quality and channel measurements are not appropriate tools to evaluate grazing strategy changes in the short-term and that vegetation attribute measurements may be more appropriate. Recovery is highly variable due to the influences of climate, soils, available moisture, and streamflow. Recovery is also more of a "first come, first served" situation. If sedges and rushes are first to revegetate a recovering area, they can inhibit or delay woody species recruitment on sites that are fully capable of supporting woody vegetation. If riparian woody and shrub species are among the first species to come in, sod competition is not present to inhibit their increase in the riparian area.

After attending a PFC workshop, ranchers in Silver Lake, Oregon, were able to assess current management of riparian areas on their properties. They determined that one riparian area they felt was falling apart was actually recovering and another riparian area that appeared to be fine was functional–at risk with a downward trend. The assessment allowed the ranchers to adjust their management accordingly.

J.Eisner, BLM Fish Biologist

Understanding expected recovery rates for the specific riparian area is necessary to develop achievable objectives that can be met within a designated timeframe. Figure 13 illustrates a decision tree that may be used to assist in the planning process.

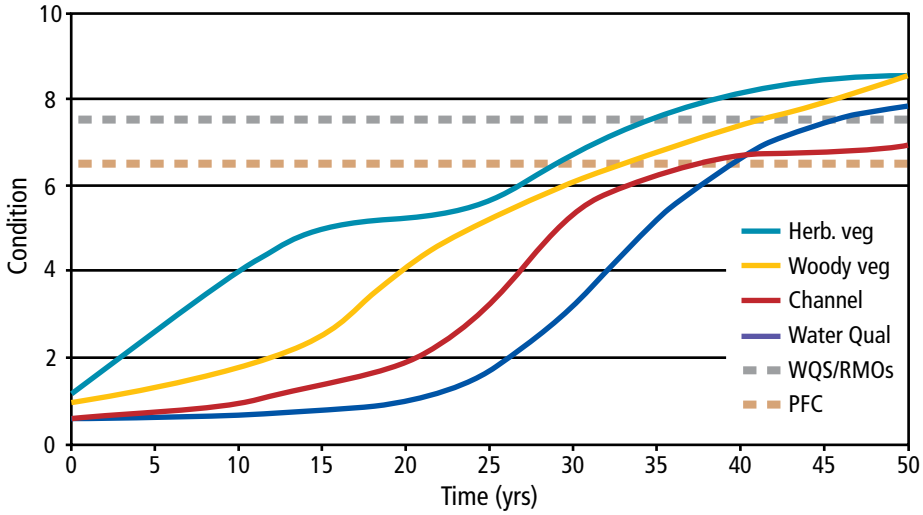

Figure 11. Recovery rates on a nonfunctional system in southern Idaho.

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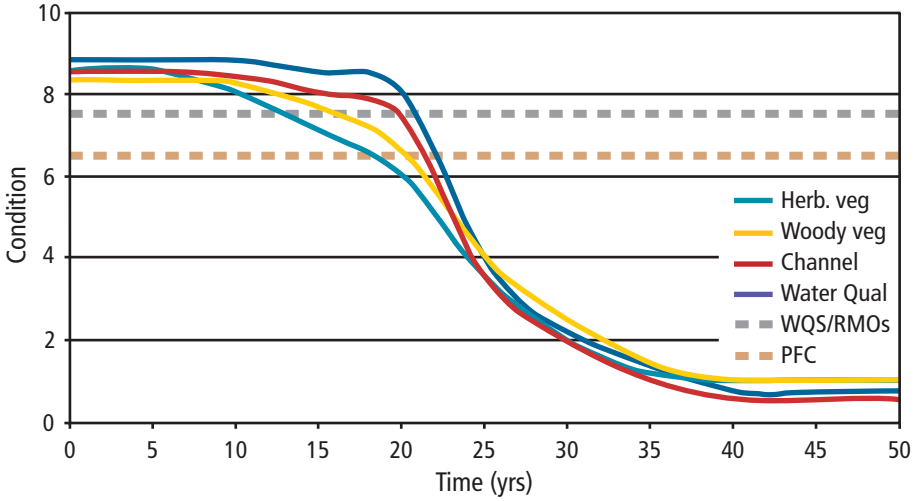

Figure 12. Degradation rates on a southern Idaho stream.

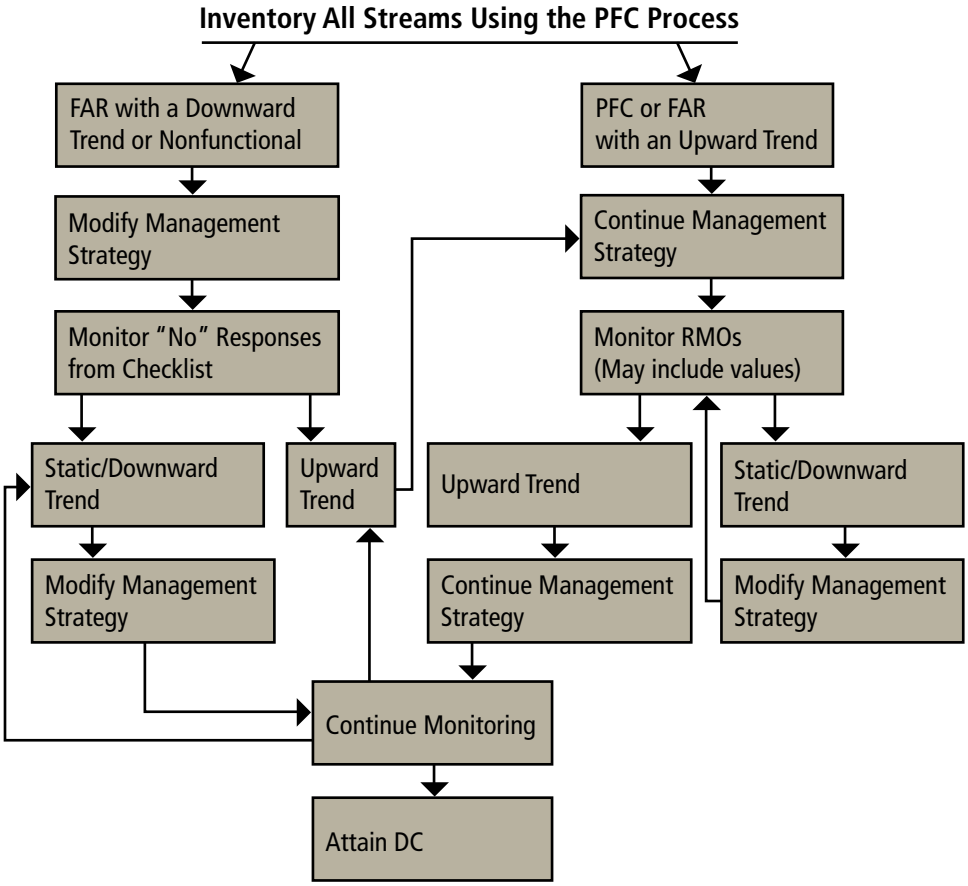

Figure 13. Proper functioning condition (PFC) assessment flow chart. RMOs = resource management objectives, FAR = functional–at risk, DC = desired condition.

B. Identify Issues

Issues are identified based on the inventories and assessments completed for the area, along with the associated management activities. The next step is to evaluate and prioritize resource concerns. For example, a high priority may be placed on those stream reaches that were assessed as functional–at risk in an unapparent or downward trend.

One method to organize the data and help identify issues is the Grazing and Spatial Analysis Tool (GSAT) (USDA NRCS 2005). Management objectives can be developed once the resource, economic, and social issues have been evaluated, which may focus management on specific areas.

C. Develop Management Objectives

The process of setting objectives helps livestock operators and land managers develop management plans that maintain or restore riparian values. Site-specific objectives (short- and long-term are most effective) should be tailored to the exact needs of the situation. For example, cattle, sheep, feral horses, and wildlife prefer different habitats and plants depending on the time of year. Management objectives that

anticipate animal preferences will help managers design grazing strategies that balance livestock needs with ecological processes and resource values. A thorough understanding of site conditions and limitations provides the information necessary for making decisions regarding objectives and practices.

Objectives developed for uplands do not necessarily translate into appropriate riparian area management. Livestock operators and land managers often need to include objectives and prescriptions specifically designed for riparian areas.

Riparian area function often changes through a sequence of events. Thinking through a series of events helps increase understanding of the link between the element of time and the important attributes for setting objectives. For example, planned grazing management may result in the following sequence of events:

1. A level of streambank vegetation residue is left that provides the opportunity for regrowth and recovery of plants, which
2. Allows colonizing herbaceous vegetation to induce sediment deposition along streambanks by slowing water movement, which
3. Provides a setting for streambank stabilizing plants to establish, with more of them having stronger and deeper roots, which
4. Allows an increase in stable streambanks, floodplain access, and effects that dissipate flood energy and resist erosion, which
5. Improves floodwater retention and ground-water recharge, which
6. Further improves the functionality of the riparian area, which
7. Leads to narrower and deeper streams, which
8. Creates hiding cover for fish and improves water quality.

Of all of these, improvements in the plant community are the most measurable and pivotal to subsequent improvement. They are also the improvements most influenced by grazing management. In this example, mid-term objectives (3 to 5 years) could focus on the anticipated vegetation changes (e.g., an increased proportion of selected plant communities along the greenline), with a long-term objective (10+ years) of improved channel form (e.g., a narrower active channel and, eventually, increased sinuosity) or a desired age-class distribution.

1. Objectives Based on Riparian Attributes

Development of site-specific riparian area objectives begins by describing the existing riparian attributes and how they need to change. These changes depend on hydrologic events as well as time for succession. The amount of change in a given time period is difficult to determine unless it addresses only very obvious and predictable responses to management. Fortunately, the stream reaches that are functional–at risk and most likely to be targeted for management and monitoring are often the reaches where change is most needed and most predictable in the coming years. Some riparian areas may change slowly because they are not ready to respond to management or because they have already changed and the rate of additional change will be slower. The key to successful riparian area management is the quality of the interdisciplinary (ID) team that makes the assessment and carries the information forward into the management objectives and plan. Those who demand a high degree of precision or even accuracy among managers' expectations and real opportunities for response may not be satisfied with the tools offered in many places. Those who recognize that the journey through adaptive management is the real meaning of management will find that setting objectives and learning from monitoring the attainment of those objectives is a good approach.

The amount of change needed for detection depends on the variation in the data (which depends on many factors) and on the amount of data. Generally, in monitoring, representative areas, key areas, or designated monitoring areas are used to indicate change or lack of change. Within these areas, subsamples are used to indicate the trend. This sampling method is different from replication needed for statistical significance, but it does help to indicate trend from variable data.

In general, objectives should:

- Describe the desired plant community, list key plant communities, or list key species and indicate

LFO_RMP_10174

where in the riparian area these attributes should be located or where their abundance should be increased.
- Be guided by the present condition and trend of the vegetation in relation to riparian functions and management goals and by the inherent potential for change.
- Consider the complexity and diversity of riparian areas, which often requires interdisciplinary expertise to ensure that systems have the potential to respond to planned management and meet objectives.
- Be set in close cooperation with other affected parties when necessary.
- Be achievable and measurable in the designated timeframe and worthy of the costs needed to accomplish and monitor them.
- Assume and clearly state that adaptive management is a part of the planning process and that if objectives are not met in a designated timeframe, either the management, the objective, or the timeframe may need to be adjusted.
- Be consistent with the letter and the spirit of the law.

An objective identifies the intended accomplishment in relation to an attribute that is important to the system. Objectives should be easily measured and identify specific milestones along the route to a longer term goal. They must be tied to clear, concise monitoring methods and be reaffirmed from the monitoring information. There must be a commitment to monitoring the associated riparian area or watershed in order to determine if the objectives are being met in an appropriate timeframe and to ensure that the appropriate information is collected to understand why they are or are not being met. The use of adaptive management requires that definite parameters and specific timeframes for evaluation are set. At the end of that time, another evaluation of the expectations, implementation, management scheme, **uncontrollable disturbances**, and time period may be necessary.

Short-term monitoring often focuses on the management actions. Considerations such as remaining residue or not-to-exceed amounts of bank trampling are **not** objectives for resource conditions. However, they often trigger management actions or provide an indication of relative success in implementing a management action plan. Short-term monitoring is important for interpreting information about the attainment of objectives through the implementation of management actions. This allows managers to update plans through the adaptive management process.

Management of riparian areas and rangeland is an art based on partial science rather than a direct application of science. Resource managers should not fall into the trap that they are required to prove they have met (or will meet) an objective in order to continue adaptive management. This would be a no-win situation and falsely assumes that "nothing" can be done. Any "nothing" would be a form of management, but it often would not be the best form of management.

2. Elements of an Objective

A good objective states (Maser 1988):

- The **component**
- What is to be **accomplished**
- The **amount** of **change**
- The **location**
- A **timeframe**

The component selected should reflect important processes in riparian areas and should vary in response to management rather than from unrelated natural processes. Often the components of objectives are derived from the "No" answers on a PFC assessment checklist. A component for an objective does not simply describe the trigger used for a management action in each year. Rather, it reflects the changes in attributes that result from cumulative impacts of management actions over time.

Each objective should specify where it applies. The component may change quickly or may depend on processes that take time or stem from several other processes. What is to be accomplished could be an increase, decrease, or no change. Although it is important to be clear about the amount of change expected, it is also important to realize that the amount of change often depends, in part, on natural events that are beyond the control of management. In many cases, it is simply unknown how much change can be expected in a given period because processes can depend on both management

and natural events. Therefore, objectives should be realistic and conservative and maintain flexibility. Objectives should be based on a full set of goals that reflect consideration of all resource issues and societal concerns.

Following is an example of a good objective relating to grazing management:

> Increase stabilizing or late seral riparian vegetation (Winward 2000) along Deer Creek greenline transect at Key Area 2 from the present 25 percent to 35 percent within 5 years after implementation of the grazing strategy.

For more examples of objectives, see Appendix E.

D. Develop and Implement Management Strategies

1. Management Strategy Factors

Once objectives have been formulated, appropriate management strategies should be developed to meet those objectives. As potential grazing strategies are discussed, the objectives should be continually reviewed. Objectives and management strategies must come together before either one is "established." Where current management practices are detrimental, the focus should first be on reducing [their] impacts, then on using prescribed grazing management as a tool to achieve objectives (Mosley 1996). Because it is easier to keep a riparian area degraded than it was to get it that way, changes in season, intensity, and frequency of use, or even temporary exclusion, might be necessary to initiate recovery. Other grazing strategies might be used to maintain or achieve objectives in plant composition, structure, etc. (See section III.D.3 for a discussion of these topics).

Grazing management strategies must also consider the sensitivity of different riparian areas to disturbance and their resiliency or ability to recover. Sensitive riparian areas experience a high degree of natural stress (or any natural attribute that makes them more sensitive to disturbance, such as noncohesive granitic soils), and therefore can tolerate little management-induced stress without degradation (Figure 14). Conversely, less sensitive systems have low levels of natural stress and therefore can tolerate more management-induced stress (Elmore and Kauffman 1994). Recovery potential is not always directly related to sensitivity to disturbance. Rosgen (1996) provides a guide to stream sensitivity and recovery potential.

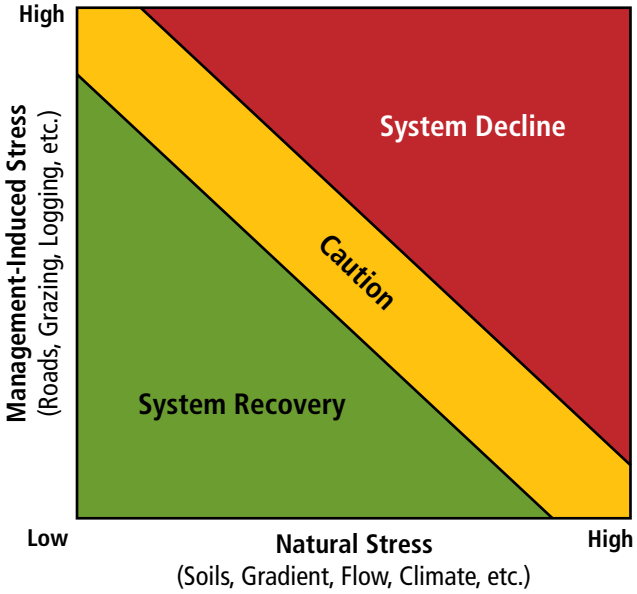

Figure 14. Management-induced stress vs. natural stress (Elmore and Kauffman 1994).

Even though stream classifications such as Rosgen's (1996) can help extrapolate responses of streams to grazing, structures, and other types of management, no two riparian areas are exactly alike. A grazing prescription must: 1) meet the needs of each specific riparian system, as well as other watershed components, 2) be compatible with the entire ranch operation, and 3) have the commitment of the operator/manager to achieve riparian objectives. These criteria have a higher probability of being met if the grazing strategy consciously incorporates: animal behavior, forage selectivity, plant responses, plant community change, hydrology, and practicality (Krueger 1996).

Plant responses, plant community change, and hydrology usually form the basis for achievable objectives and thus become the focus of many grazing strategies. Animal behavior affects those resource interactions and the **ability to achieve the objectives**. Understanding the

LFO_RMP_10174

principles of behavior can help improve the probability of successfully managing for riparian and other social, economic, and resource objectives.

Practicality is critical. A prescription should not only be feasible, it should be practical and achievable by the operator, with the flexibility built into the prescription to make adaptive management changes. As noted by Ehrhart and Hansen (1997), "the only *required* ingredients (for developing and implementing an appropriate prescription for any given riparian ecosystem) are a serious commitment and personal involvement on the part of operators and managers."

a. Animal Behavior

Animal behavior is a function of consequences (Provenza 2003). Positive consequences reinforce and lead to an increase in the associated behavioral response, whereas negative consequences typically lead to a decrease in that response. These behavioral responses can be influenced by (1) social management activities (e.g., low stress vs. high stress), (2) location on the landscape (e.g., upland vs. riparian), and (3) forage selection (e.g., nutrient requirement vs. nutrient and toxin contents of various plants and plant parts). Climate, soils, plants, herbivores, and people are interrelated facets of systems that change constantly. As stated by Provenza (2003), the "key to survival for herbivores and the people who manage them is to continually explore new possibilities and to know when to adapt." Some of the social, landscape, and forage selection factors that influence behavior are discussed below.

(1) Social

"When it comes to managing pastures and rangelands that contain a variety of foods and terrain, managers must understand how social factors influence both the foods creatures eat and the location where they forage, both of which influence carrying capacity" (Provenza 2003). Both also influence the use of riparian areas.

Howery et al. (1998) demonstrated the substantial influence of mother cows on the behavior of their young. Experiences early in life influenced the distribution patterns of offspring later in life, but peers and environmental factors also influenced distribution. In the 4-year study, researchers identified cows that had a propensity to spend time near either of two adjacent creeks in the same allotment. Calves from some of the cows from each creek were cross-fostered to cows from the other creek. Two other groups of cows and calves, one group from each creek, were also studied. Distribution behaviors of the four groups of calves were followed for 4 years; i.e. as calves, as yearlings, as first-calf heifers, and as second-calf 3-year-olds. During the first summer, calves stayed with their mothers (natural and foster) and stayed on their respective creeks. The fall of the first year, calves were weaned and wintered as a group. The second year, the influence of peers from wintering together resulted in a greater distribution of the yearlings away from the areas occupied by their mothers. During the third year, a drought dried up one of the creeks. The 2-year-olds from the dry creek drainage extended their range to access water. The animals from the drainage that continued to have streamflow stayed within their home range. During the fourth summer, all of the then 3-year-olds occupied the home range that they had occupied with their mothers during the first year. Results indicated that early learning from the mother had a substantial influence on subsequent behavior over the following 3 years. Peer influence and environmental conditions (e.g., drought) resulted in modified distribution, but the influence of the mother during the first year was still very strong. Management implications from this study include:

- Cull animals with undesirable habitat use characteristics.
- Retain those with desirable habitat use characteristics.
- Herd routinely to change distribution, and implement practices that foster a predictable social environment (e.g., separate young animals with desirable distribution patterns from young animals with undesirable distribution patterns).

Left to their own devices, cattle will form social groups similar to bison. Bison form intact family units including offspring, mothers, fathers, grandmothers, and grandfathers. Young animals benefit from the knowledge of social behavior, food, and habitat selection of older generations (Provenza 2003). Managing family or social units of livestock appears to have potential for modifying habitat preferences and reducing time spent in riparian areas. The Nature Conservancy's Red Canyon Ranch in Wyoming uses riders to move cattle subgroups (social

LFO_RMP_10174

units) to upland sites and to settle them as a group (Figure 15). Over a 3-year period, the riders were successful in modifying habitat preference from riparian to upland (3 years seems to be approximately how long it takes to adapt and perform with new management techniques). Individuals separated from their subgroup tended to return to their former location in an attempt to reunite with the group (Provenza 2003); however, if moved as a social or family group, they tended to stay together.

Figure 15. Moving cattle within their social group decreases stress and the desire to move back to their previous location. (Photo by F. Provenza, Utah State University.)

Social learning provides benefits to the animal and a tool for the manager to modify behavior and address management objectives. According to Provenza (2003), socializing enhances the learning efficiency of the group. For example, once one animal learns to drink from a water device that requires pressing a lever, others learn by example. Young learn the locations of water, forage, shade, and cover from their mothers. Experience carries over from generation to generation, which provides efficiency and an opportunity for behavior modification. In the Red Canyon Ranch example described above, the young learned along with their mothers that uplands were good places to be, and they then passed that experience to their young. Over a 3-year period, the behavior desired by the managers became adopted by the livestock and the preferred behavioral pattern became established.

(2) Landscape

Grazing managers must develop an understanding of the grazing patterns employed by the animals they manage (Stuth 1991), including the predisposition of a given species to forage. Foraging behavior involves three distinct levels of selection—spatial (landscape), species, and plant part choice.

An animal with experience in a given landscape will know its boundaries, routes of access and escape, plant communities and their spatial distribution, and the seasonality of desirable species (Table 1). Large grazers in particular focus their foraging strategies around free-standing water and are considered "central place foragers," with the central or home place centered on water (Stuth 1991). The nature of the terrain, distribution of shrubs, changes in forage availability due to drought, and mobility of an animal all influence spatial use patterns around water sources. Figure 16 (Stuth 1991) illustrates many of these points. In this depiction of a pasture, forage along the road is used as a result of animals entering or exiting through the upper gate. The rocky outcrop on the slope serves as a barrier, and the slope itself serves as an impediment to access to the forage on the slope. The upper left corner has no water, so it receives little use. The majority of the grazing use occurs at the bottom of the pasture, on level terrain, within easy reach of the only water in the pasture. The gully or ditch in the lower right corner and the dense stand of trees near the water trough also serve as barriers and restrict access to forage.

Table 1. Landscape characteristics that influence animal movement patterns (Stuth 1991).

Attribute	Components
Boundaries	Fences, home range, migration routes
Distribution of plant communities	Range [ecological] sites, soils, aspect, elevation, structure, species composition
Accessibility	Slope, gullies, water courses, shrub density, rockiness, roads, trails, fence lines, cut openings, pipeline and utility rights-of-way
Distribution of foci	Location of water, shade, loafing, and bedding sites and other convergent and divergent points in a landscape

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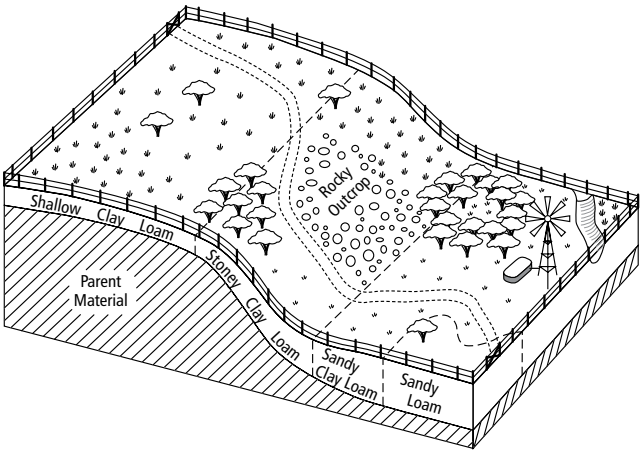

Figure 16. Landscape configuration reflecting the unique set of forage resources, water locations, and terrain constraints that affect use patterns by grazing animals. Reproduced from Stuth (1991) with permission.

An animal's selection of a given plant community for forage is largely related to those attributes of a site that influence plant species composition and density (Table 2). Plant species composition and density depend on site characteristics, past management, and the availability of nutrients and water.

Table 2. Attributes at the plant community and patch level that influence the animal's selection of forage sites (Stuth 1991).

Attribute	Function
Moisture-holding capacity of soil	Affects forage supply and stability
Species composition	Affects suitability and stability of the site for general dietary and nutritional needs
Plant frequency	Affects the probability of encounter of plant species by the animal and number of dietary decisions
Abundance	Affects the supply of nutrients
Structure	Affects accessibility and harvestability of plant species and nature of thermal niches provided
Continuity	Affects movement velocity
Size	Affects amount of search area available
Aspect	Affects the thermal characteristics of the site
Orientation in landscape	Position relative to needs foci affects frequency or exposure to grazing

Based on what is known about livestock behavior, grazing programs can be designed to entice animals to specific areas at specific times, encouraging grazing patterns that yield a desirable vegetative response. For example, livestock use of riparian areas is known to vary by season. During spring, livestock tend to disperse to uplands because of higher quality forage, better water distribution in shallow reservoirs and natural water pockets, and acceptable or preferable thermal conditions. During summer, livestock tend to be attracted to riparian areas because of water availability; relatively higher concentrations of nutritious, palatable forage; and, if trees or shrubs are part of the system, preferable thermal conditions. During fall, livestock still tend to be attracted to riparian areas primarily due to water availability and the potential availability of browse with higher nutrient content and palatability than cured upland forage. During winter, livestock might avoid riparian areas if they function as cold air pockets or drainages, or they might be drawn to them by the availability of wind protection and nutrients in available browse. The specifics of each riparian area and its associated upland areas, such as upland water distribution, determine appropriate management options.

Variable weather conditions also affect animal behavior by impacting conditions such as vegetation productivity and water distribution. For example, drought can cause the growing season to be earlier and shorter. As a result, animals may move to riparian areas much earlier, and dates of grazing may need to be adjusted. Conversely, a prolonged wet, cool spring and summer may result in less time spent in riparian areas and allow longer-than-normal use of a given pasture. This would allow deferment or rest of some other pasture as a possible beneficial treatment.

The kind (e.g., cattle or sheep), class (e.g., yearling or cows with calves), and previous experience of livestock influence behavior as well. Cows with calves are usually less mobile than yearlings or dry, mature cows. Cows experienced in a pasture prefer certain locations, much like big game home ranges, and they can be expected to head for and stay in a given area. Inexperienced animals initially search for the boundaries (e.g., walking the fenceline) of their environment before identifying preferred locations, with water being a primary factor. These behavioral attributes provide an opportunity to

train livestock to prefer habitats like uplands and to minimize time spent in riparian areas.

Bailey (2004a) has found that genetics may influence where cattle tend to spend their time. In a study of two groups of livestock, Bailey found that one group of cows used steeper slopes and traveled further horizontally and vertically from water than the comparison group. Both groups were crossbred from the same two breeds, but the breed that was dominant in each group differed. The group that traveled further had a greater percentage of a breed that was developed in mountainous country. The group that stayed closer to water and used more gentle topography had a greater percentage of a breed that was developed in more gentle terrain (Bailey et al. 2004c). Provenza (2003) also noted that genetics may have an influence on behavior, but he added that behavior can often be modified through appropriate training as illustrated by the Red Canyon Ranch in Wyoming and their use of low-stress stockmanship and working with social groups to change behavioral patterns [refer to the previous discussion in section III.D.1.a.(1)].

A rider may be able to train cows and calves to use uplands and discourage their use of riparian areas by consistently moving them away from riparian areas to other locations (Butler 2000). As described previously, this works best if family or social groups are moved intact, and if low-stress movement techniques are used (see section III.D.2). Behavioral principles can be used to determine the most effective timing of movement. When moving animals to another location to forage in a familiar environment, it works best to move them before they have fed and watered. At the new site they experience positive reinforcement from eating nutritious foods in the area (Provenza 2003). This allows the livestock to associate sites away from riparian areas with desirable qualities, thus making those sites preferred locations. If done repeatedly, cattle learn to move readily because good things happen when they do. When moving to new loafing areas, however, it works best to move cattle after they have fed and watered. Once they arrive, they are ready to settle down.

When cattle are regularly herded from riparian areas to uplands, generally the best practice is to herd cattle away from the stream after they have watered, during late morning or early afternoon (Butler 2000, Bailey 2004). Cattle travel to the streams during midday to drink and loaf. The goal is to allow animals to water and minimize the time they remain in the riparian area. If cattle are herded away from the stream early in the morning, they will likely return to the riparian area during midday to drink. Herding during midday after cattle water reduces the amount of riding required.

Like people, individual animals have their own personalities. Some do not respond to behavior modification. To achieve management objectives, they (and their offspring) may have to be culled.

Bailey and Welling (1999) found that strategic placement of a supplement resulted in cattle spending more time and grazing more in areas with the supplement than areas without. In this study, salt did not have much effect, but the low-moisture block supplement was effective. The effect was greater in moderate terrain than in difficult terrain. In a subsequent study, Bailey et al. (2001c) found that placement of low-moisture blocks in rugged topography attracted cattle use. Areas within 600 meters of the supplement were grazed by cattle even though the supplement sites were on some of the steepest terrain and in areas farthest from water. In ongoing research, Bailey (2004b) has found that herding combined with strategic placement of a desirable supplement appears to be even more effective in attracting cattle to graze previously underutilized areas than either supplement or herding alone. The technique requires less time and lessens the impact on riparian areas. Better distribution increases useable forage and thus capacity of a pasture or allotment. It may also result in the ability to keep livestock in management units longer because they spend less time in areas of concern, such as riparian areas.

(3) Forage Selectivity

In a general sense, forage selectivity varies by animal species, forage palatability, and preference. Palatability refers to characteristics of a plant that elicit a selective response by an herbivore. It changes throughout the annual plant growth cycle and can vary spatially as a result of soil characteristics. Preference is a behavioral function that involves proportional choice of one plant species from among two or more species. Preference for a particular plant species depends largely upon its abundance, morphological and phenological

LFO_RMP_10174

characteristics, the array of other species available, and the species of animal in question. Preference changes with season; weather; soil moisture; and forage palatability, availability, and variety. Thus, forage selectivity is a dynamic, situation-specific phenomenon. However, some generalizations can be applied. For example, in riparian areas, cattle generally don't browse woody plants much if they have a sufficient supply of palatable grass. On the other hand, where only a few woody plants are available, animals may seek them out to obtain dietary diversity. Grass becomes less palatable, less digestible, and loses nutrient content with maturity, whereas shrubs tend to retain nutrient content longer. To satisfy their nutritional needs, livestock preference tends to shift to shrubs as grasses senesce, even when the amount of grass available is not limiting (Figure 17). Most generalizations have exceptions though, and an animal's experience, health, stress level, and nutritional status have a great deal of influence on forage selectivity.

Figure 17. This cow is browsing rather than grazing even though sufficient grass appears to be available. (Photo by M. Borman, Oregon State University.)

Young animals learn about foods from their mothers (Provenza 2003). Provenza states that learning begins very early because the flavors of foods the mother eats are transferred *in utero* and after birth, in milk. Once they begin foraging, young learn from their mothers what to eat and what to avoid. Young also learn foraging skills from their mothers, which increases efficiency of ingesting foods of different forms (i.e., grasses, forbs, and shrubs).

As young animals age, they increasingly interact with peers and encourage one another to explore new foods and environments (Provenza 2003). As this occurs, adults learn from younger animals to explore different foods because the younger animals are more likely to eat novel foods.

Young animals cope with change more readily than adults because their food and habitat preferences are more malleable. Exposing young animals with their mothers to a variety of foods and locations, especially those they will experience later in life, can lessen problems with transitions. Animals make transition from familiar to unfamiliar environments better if they are moved to areas where the foods and terrain are similar to what they have experienced.

Palatability is more than a matter of taste (Provenza 2003). He found that animals associate flavors of specific foods with their postingestive consequences. If the consequences are positive (e.g., response to needed energy and protein), animals will increase intake of those foods until they become a regular part of their diets. If consequences are negative (e.g., nausea from intake of toxins), animals will limit intake of those foods in accord with the concentrations of toxins in the food. Satiation is also a factor in palatability. Plants that are deficient in energy or protein will tend to have low palatability, but palatability will also decrease for foods too high in energy or protein. Excess protein causes excess production of ammonia, which is toxic. Excess energy can result in acidosis, which reduces palatability. Each animal is unique. Some individuals need more energy or protein and some less. Some are better able to tolerate a larger intake of various toxins than others. Having a variety of foods available allows an animal to select for an appropriate balance of nutrients and toxins.

The physical structure of a plant also influences selectivity. Because of the size and shape of its mouth, a cow has a hard time selecting short or prostrate plants. Hall and Bryant (1995) noted that as stubble heights of preferred species drop below 3 inches, preference will tend to shift to other species of plants that have not yet been grazed to that height or to shrubs. Below a 3-inch stubble height, the vegetation becomes too short to be pulled in by the tongue. At that point cattle must begin to eat in bites, which take more time and effort to obtain sufficient fill. Cattle seldom graze below 2 inches from the ground unless forced to do so to obtain forage. A 3/4-inch stubble height effectively requires a shift to

LFO_RMP_10174

"Effective riparian grazing management should begin on the skyline rather than the greenline. Simply reducing numbers of livestock without developing improved grazing strategies will not solve a riparian problem."

Floyd Reed, Retired USFS Rangeland Management Specialist

another forage source because of physical limitations of a cow's mouth. "Wolfy" plants (plants containing standing dead material from previous growth) are also generally avoided, especially when plants without standing dead material are available. Separating green, nutritious leaves from among the dead leaves and stems slows the rate of intake and reduces the desirability of wolfy plants.

b. Principles of Grazing Management

To properly manage livestock grazing in riparian areas, it is important to recognize that:

- Grazing management practices that maintain or improve an upland site may or may not maintain or improve a riparian area and may be detrimental to them. Problematic upland watershed conditions, such as excess runoff and erosion, often reduce the effectiveness of management in the riparian area. Although riparian areas respond uniquely, they should not be considered independently of uplands.
- Passive, continuous grazing rarely improves a deteriorated riparian area or maintains a riparian area in good condition without reducing stocking levels to extremely low and uneconomic levels.
- The grazing management plan must address the livestock needs.

Finally, it is important to recognize that there are a number of other factors to consider in selecting management strategies to meet riparian objectives, including timing, duration, and frequency of grazing; distribution of livestock; stocking rates; utilization levels and patterns; pasture design, and wildlife management. These factors influence the economic feasibility and practicality of the management strategy, which are both essential if commitment to the strategy is to be achieved.

(1) Timing, Duration, and Frequency of Grazing

Successful grazing management strategies for riparian areas can usually be achieved by using a combination of options, including grazing treatments that:

- Limit grazing intensity, frequency, or season of use, thereby providing sufficient opportunity to encourage plant vigor, regrowth, and energy storage and minimize compaction of soils.
- Control the timing of grazing to prevent damage to streambanks, the transition area between the wet and dry area of the meadow or streambank, and wet and semiwet meadows when they are most vulnerable to trampling damage.
- Ensure sufficient vegetation during periods of high flow to protect streambanks, dissipate energy, and trap sediments.
- Intensify grazing, in certain situations, to increase hoof action to trample wolfy plants and stimulate regrowth while reducing time and duration of exposure so animals do not have adequate time or need to move to less preferred riparian plants (sedges and woody plants).

Timing of grazing is particularly important in pastures that are large and include a high proportion of upland forage. This upland forage is more palatable than riparian forage during certain seasons (generally spring, early summer, and fall if green-up occurs). Grazing in these seasons will shift use away from riparian areas especially if water is available close to the upland forage. Although preferences for certain areas are a factor in smaller riparian pastures, distribution is much more important as pastures increase in size and in their proportion of upland forage. The use of tools like the GRI (USDA USFS 1996) (Appendix F) may assist livestock managers in determining if the timing, intensity, and duration are appropriate for the grazing unit.

Parsons et al. (2003) found that season of use (early versus late summer) affected cattle distribution relative to the riparian area, with late summer pastures having more concentrated use of riparian vegetation. More uniform cattle distribution within the upland and riparian areas occurred in early summer than in late summer.

LFO_RMP_10174

In a study of 34 grazing systems in operation for 10-20 years in southwestern Montana, Myers (1989a) found timing of grazing, duration of use, and frequency of fall grazing were important factors in successful management (Table 3). The effectiveness of livestock grazing management was judged based on the vigor, regeneration, and utilization of woody species, as well as on bank stability.

Table 3. Criteria for successful grazing management (Myers 1989a).

Criteria Used	Successful Management	Unsuccessful Management
1. Time provided for post-grazing herbaceous regrowth (average number of days).	35	21
2. Duration of use – total days per season (average number of days).	28	59
3. Fall use duration (average number of days)	21	37
4. Percent of years fall use occurred (average)	31	51
5. Percent of grazing treatments providing residual cover* through rest or regrowth (average).	75	38

*Residual cover was defined as at least 30 days of regrowth.

Successful systems were defined as those demonstrating good or excellent riparian condition or fair condition with an upward trend. The results highlight the importance of adequate vegetation vigor and regeneration at the end of the growing season and the apparent critical nature of the frequency and duration of fall grazing treatments. Myers suggested that the duration of grazing treatments often prescribed for upland management (60-75 days) be shortened to 25-30 days. Shortening the duration and providing growing-season rest, deferment, or recovery in all pastures lessens animal impacts, provides for growth or regrowth, and causes livestock to be less selective in grazing (Provenza 2003).

(2) Stocking Rates

Stocking rate problems at the pasture, ranch, or allotment level are the exception rather than the rule in today's operations. However, there are some operations that are still simply overstocked. The apparent overstocking of some areas, while others are only moderately grazed or even ungrazed, will not be solved by simply reducing numbers if other factors are not also changed. Reducing stocking rates may reduce the percentage of area in unsatisfactory condition, but the impacts around the foci of highly used areas (e.g., riparian areas or other water) will remain the same until few, if any, animals remain. Many pastures, ranches, or allotments are appropriately stocked for the majority of the area, but a temporary reduction in the stocking rate may be necessary to allow recovery of localized problem areas. This is especially true in rest-rotation strategies where part of the area is removed from grazing for an entire season. The rest may not compensate for the increased use during grazing to achieve sufficient recovery. No strategy will work until stocking rates are at an appropriate level for the existing conditions and prescribed management. Stocking rates should be determined by evaluating current grazing effects (i.e., residual vegetation and distribution patterns), use periods in relation to growth periods, historical use and trend data, and management objectives.

> *"There are no cookbook or 'one size fits all' prescriptions for livestock grazing in riparian areas."*
>
> **Wayne Elmore,**
>
> **Retired BLM Riparian Ecologist**

(3) Utilization or Residual Levels and Patterns

If utilization, timing, duration, or residual vegetation is used to develop a grazing prescription, the primary focus is usually the physiology of key plant species that must stay healthy and reproduce. The key to associated management techniques is usually to improve livestock distribution and avoid grazing intensity problems. However, the effects are often intertwined and problems can be addressed in many ways. Utilization mapping is an excellent tool for checking the distribution of livestock use and for identifying management opportunities in a landscape setting. However, measurement of stubble height (residual vegetation) is often more straightforward and easier to interpret than utilization data. Use within a season may impact the physiology of key species and can be a guide to develop grazing strategies. However, annual measurements often vary

LFO_RMP_10174

among years and individual observers. Therefore, a range of utilization or stubble heights should be used to accommodate favorable and unfavorable production years (see section III.E for a discussion of short-term indicators).

Due to the variation among riparian sites and management objectives, one standard utilization or residual vegetation target is not appropriate. However, utilization or residual vegetation should be considered (along with regrowth potential) to ensure that vegetation stubble necessary for natural stream functions is present or other land use objectives are accomplished (e.g., residual nesting cover for waterfowl).

In most situations where both upland and riparian sites exist in the same pasture(s), portions of each pasture can be seasonally unusable or unused for grazing because of wet soils, lack of green forage, plant species preferences, length or steepness of slope, distance to or lack of water, and absence of shade, and other factors, as shown in Figure 18. In pasture A, as shown in the schematic below, the corridor along the stream is unsuitable due to saturated soils , and some of the uplands are not used due to lack of green forage.

There are no limitations in pasture B for that period of use.

In pasture C, portions of the uplands are unused due to lack of water and length and steepness of slope.

In pasture D, portions of the uplands are unused due to length and steepness of slope and lack of water . Also the stream corridor is of concern due to utilization of willow and bank trampling in excess of allowable limits that may occur during this period.

Water provided in the preferred grazing areas in pasture A could reduce the use of and damage to the saturated streambank areas.

In pastures C and D, frequent riding and herding of the livestock may increase utilization of the upland and relieve grazing pressure in the riparian areas. This would reduce the need to adjust season of use or numbers of livestock to compensate for heavy riparian area use.

(4) Pasture Design

Small stream sections and other small riparian areas such as springs and seeps within large pastures usually cannot be effectively managed without the use of exclusions. Exclusion fencing is often the most practical approach for small areas. In pasture planning, however, the pasture should include as much of a stream as possible and not use streams as fenced pasture boundaries (Myers 1981). Instead, Myers recommends trying to

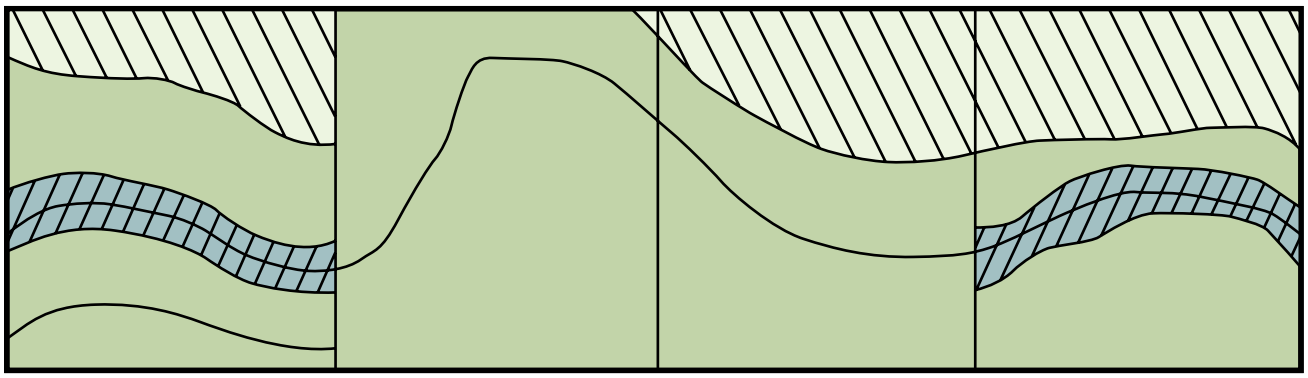

Figure 18. Examples of seasonally unused areas within pastures.

LFO_RMP_10174

center streams within a pasture where possible. When pasture boundary fences zig-zag across streams, livestock impacts tend to be concentrated near the stream. Livestock tend to concentrate near and trail along fences, accentuating trampling damage. Also, wire fences across streams tend to catch debris and frequently wash out (Figure 19).

Figure 19. Cross fence collecting debris is susceptible to washing out. (Photo by S. Wyman, NRST.)

Where a stream must serve as the division line, fencing one or both sides of the stream with water gaps to the stream, if needed, can effectively avert most riparian concentration. These parameters should be considered when developing riparian pastures as well [refer to section III.D.2.C.(3)].

(5) Wildlife Habitat Considerations

The development of a grazing management strategy should also consider wildlife habitat requirements. Concerns usually revolve around how wildlife and livestock compete while ignoring the positive influences wildlife and livestock have on each other (Knight 2004). Knight stated that minerals and supplemental food put out for cattle are often used by wildlife. In many parts of the West, water tanks, constructed and maintained for livestock, allow big game and other wildlife to use areas that would otherwise be used only during wet times of the year. Predator control to protect livestock also reduces predation on deer, antelope, and other wild prey. Livestock and wildlife forage and browse requirements may overlap or be compatible depending upon the species involved and the timing, frequency, and duration of grazing. For example, it may be beneficial to graze livestock in early summer to improve elk diets, but previous grazing by elk may reduce subsequent diet quality for cattle, deer, and elk (Damiran et al. 2003).

Livestock can also be purposely grazed at high stock densities to control wild ungulate distribution (Mosley 1999). Mosley states that livestock at high densities can help distribute wildlife away from highways in locales where wild ungulates are colliding with vehicles. Livestock grazing at high densities can also be used to deter wildlife depredation of nearby crops, pastures, or haystacks. Social dominance between ungulates and within species intensifies as resource conditions deteriorate, and subordinate animals are displaced (Mosley 1999). Mosley also stated that the knowledge of these relationships between social dominance and habitat selection can be used to improve management of rangeland, livestock, and wildlife resources.

The Deseret Land and Live stock Ranch in north-central Utah placed a band of sheep in Hornet Gulch to alter elk use patterns and improve riparian vegetation. There had been no cattle grazing in Hornet Gulch for over 20 years, but 300-400 elk calved and summered in this gulch. Sheep were placed with dogs on about June 15th to move elk out of the gulch. Elk avoided the area while sheep grazed the upland, al lowing for 3 to 4 weeks of rest on the riparian area. Elk use had suppressed willow growth, and with a month of rest, an increase in willow production has occurred.

R. Danvir, Deseret Wildlife Manager

Crane's (2002) research indicates that early spring and winter cattle grazing may improve forage conditions for elk. Results of habitat selection analyses demonstrated that elk preferred selected feeding sites where forage residue was reduced by summer cattle grazing and avoided ungrazed sites in all three seasons. In the winter and spring, elk preferred feeding sites with moderate amounts of forage residue. This condition corresponded to areas that were moderately grazed by cattle the preceding summer. These results suggest that elk respond to forage conditions that are mediated by the selection of feeding sites by summer cattle grazing and that

LFO_RMP_10174

moderate summer cattle grazing is a viable tool to enhance foraging opportunities for elk during critical winter and spring seasons (Crane 2002).

2. Management Tools and Techniques Common to All Grazing Strategies

Successful grazing strategies generally involve a combination of management tools and techniques that aid livestock managers. These tools can help extend grazing periods within pastures by promoting distribution. The economic implications of using various management tools and techniques should be evaluated during the development of the grazing plan. Livestock operators and land managers need to consider the cost of a variety of techniques, including the following:

- Installation of improvements and practices
- Loss of grazing area
- Extra hay, grazing land, and leases
- Decrease in stocking rate
- Change in management
  - Initial time and cost for setup
  - Amount of time involved in ongoing management practices and maintenance

Livestock operators and land managers should also consider the potential benefits of:

- Increased time and use (AUM) within a pasture or allotment
- Decreased use of leased land at a higher cost than privately owned or Federal land
- Accelerated upward trend of riparian and upland area (function and forage)
- Decreased peak and increased base waterflows
- Improved livestock health and weight gain
- Aesthetic benefits to interested public
- Recreational benefits of healthy streams and riparian areas (e.g., fishing, hunting, and wildlife viewing)
- Increased ranch value
- Quality of life for family

Economic considerations often determine the applicability of a grazing plan. Managers need to ask the right questions to determine what the costs and benefits could be with the implementation of various tools. Will the use of low-stress stockmanship and low-moisture nutrient supplement blocks increase the length of time a pasture or allotment may be grazed? Will it improve animal performance? Will the costs of installation or use of different techniques be offset by the benefits? Stillings et al. (2003) found that the installation of offsite water and salt on a ranch in northeast Oregon improved livestock distribution, increased consumption of upland forage before maximum riparian utilization was reached, and increased weight gain. Expected annual net returns to the ranch for the project ranged from $4,500 to $11,000 depending on cattle prices and precipitation levels. Economic outputs will vary on a case-by-case basis, as will the applicability of different grazing strategies.

Utilization patterns relative to total forage distribution reveal that livestock distribution, coupled with timing, duration, and frequency of grazing, is often the main problem with unsuccessful management approaches. Research in Idaho, Utah, and Nevada illustrates the importance of livestock distribution throughout the pasture and away from the riparian area. Platts and Nelson (1985) found that livestock took an average of 29 percent, and as much as 40 percent, more vegetation from riparian sites (wildlife use was trivial) than from adjacent upland sites. Although use on the allotments was moderate, use on riparian sites was heavy to severe. Managing and controlling the attractant features of riparian areas usually increases the use of, and improves distribution in, uplands. The degree to which livestock can be attracted away from riparian areas depends on season, topography, vegetation, weather, and behavioral differences (McInnis and McIver 2001).

Most successful grazing strategies include management tools and techniques that promote distribution of livestock, such as:

- Techniques that attract livestock away from riparian areas
- Herd management and animal husbandry practices that promote mobility
- Techniques that restrict livestock from riparian areas

LFO_RMP_10174

a. Techniques that Attract Livestock Away from Riparian Areas

(1) Offsite Water Developments

Water development in upland areas that lack water is often a key factor in reducing livestock concentrations in riparian areas. Ganskopp (2004) found that moving portable stock tanks or closing access to specific watering points within pastures is very effective at altering the distribution patterns of beef cattle on arid rangelands in Oregon. A south-central South Dakota rancher found that distributing water tanks throughout a large pasture and having the ability to turn the water on and off at each tank worked well to distribute livestock to various parts of the pasture and decreased the amount of interior fence needed in rough terrain.

Offsite water can be developed by installing solar, hydraulic ram, or conventional pumps; developing springs, seeps, wells, or guzzlers; and piping water to several troughs. Mobile systems can provide watering sites in different pastures with the use of one pump and existing water sources.

Solar-powered pumps provide offsite water opportunities in areas where electricity is not available or is too expensive to install (Figure 20). Mobile solar-powered pumps with portable tanks placed on the edge of the riparian area decrease the amount of time livestock spend in the riparian area (Figure 21). Livestock prefer to drink from a tank rather than from a stream (Chamberlain and Doverspike 2001). Livestock do not have to stretch their heads below their front feet to drink out of a tank. They prefer this because of problems with depth perception and behaviors adapted for predator avoidance. Tanks also provide easier access for the animals; they do not have to push themselves through shrubs or trees, so trampling impacts to young seedlings, sprouts, or saplings are reduced or eliminated.

Pasture nose pumps are another option for offsite use of water from the stream, pond, or shallow well (Figure 22). Nose pumps are most effective for small herd situations, and each pump is able to water 25-50 animals, depending upon the brand of pump. Livestock use their noses to pump water into a small trough. Pumps are portable and can be moved to different pastures as livestock are rotated.

Figure 20. Mobile solar powered pump.

Figure 21. Mobile solar powered pump and tank.
(Solar pump photos by D. Chamberlain, OSU Extension.)

Figure 22. Pasture nose pump mounted on railroad ties.
(Photo by S. Wyman, NRST.)

Frost-free nose pumps are becoming available for winter use (Kuipers 2002). Developed in Alberta, Canada, the frost-free pump can be used from a well or from stream or pond water diverted underground to the bottom of a culvert that supplies water to the pump. The nose-powered lever operates a piston pump submersed in the culvert, which is similar to how old hand pumps work. This pump requires no energy, other than the energy the cow uses to operate the lever.

Even within riparian areas or riparian pastures, water developments, ponds, or troughs can reduce streambank trampling damage (Miner et al. 1992). However, they tend to concentrate disturbance rather than distribute it. Water developments should not create new problems, such as excess soil erosion or vegetation and habitat impacts. Creating shade and locating rubbing posts and oilers nearby may augment the effectiveness of water development in helping to reduce the time livestock spend in riparian areas.

(2) Upland Seeding

Planting palatable forage species on depleted upland areas or cropland can attract livestock away from riparian areas. Livestock are drawn to the upland forage, decreasing time and use on the riparian area. When developing a seeding plan, the season of use (e.g., use cool-season grasses if trying to decrease early-season use within the riparian area) and the use of native or nonnative plant species should be considered. Contact your local County Extension or Natural Resources Conservation Service office for recommended species mixes and seeding rates.

(3) Prescribed Burning, Brush Beating, and Tree Clearing

Prescribed burning and other vegetation treatments that favor herbaceous plants, such as brush beating or tree clearing, often enhance forage production, accessibility and palatability, and correspondingly increase upland use. In fact, the attraction of livestock to the burned areas often enables temporary rest of riparian areas until vegetation recovers. Wildlife habitat needs should be considered when developing prescriptions. A mosaic pattern is more conducive to wildlife habitat needs than block-shaped treatment areas. However, treating only one or a few small patches may not be effective, and may unintentionally attract wildlife or livestock to these small areas.

In much of the West, plants and plant communities are adapted to periodic fire. Without a natural disturbance regime to shift the competitive balance, woody species increase and eventually dominate. Highly competitive shrub and tree species, such as juniper or pinyon pine, may displace herbaceous vegetation, leading to accelerated soil erosion, loss of habitat for some wildlife, hotter fires when the accumulated fuels eventually burn, and increased risk of invasion by noxious weeds or species such as cheatgrass or red brome. A well-designed treatment and followup management actions that are implemented before crossing an ecological threshold keep the watershed functioning and keep plant communities in a dynamic equilibrium. This equilibrium supports wildlife with a diversity of habitat needs through disturbance and succession cycles. Watershed areas benefit when treatments shift use away from impacted streams. Prescribed burning, brush beating, and tree clearing are alternatives that can be used to mimic or replace natural fire regimes.

(4) Grass Reserves

Grass reserves are pastures that are set aside for use when alternate forage sources are needed, such as during a drought or following a fire. A grass reserve was used by the Malpai Borderlands Group to provide forage in exchange for a conservation easement. The participating rancher was able to rest his land by grazing his livestock on the largest of the Malpai ranches in New Mexico (Gripne 2005).

The Wyoming Nature Conservancy also used grass reserves on its Heart Mountain Ranch near Cody to provide local producers with forage alternatives and promote long-term conservation improvements (e.g., prescribed burning or grazing deferment) on rangelands by providing forage at a discounted fee. Livestock forage values can be exchanged for a desired resource outcome on land that is under restoration while the cattle graze the grass reserve (Gripne 2005).

(5) Supplementation as a Livestock Distribution Tool

Placing salt, hay, grain, molasses, and other supplements only in upland areas away from riparian areas improves livestock distribution. In general, supplements should be placed no closer than 1/4 mile, and preferably 1/2 mile or more (depending on the topography), from riparian areas and intermittent drainages, except where

LFO_RMP_10174

salt and supplements are used intentionally to localize animal impacts (Riparian Habitat Committee 1982). If supplements are placed near riparian areas, livestock use of shrubs and other riparian forage may increase and needs to be closely monitored to prevent overuse.

Proper salting improves both distribution and utilization. At least one livestock operator relates that sawing salt blocks in half allows frequent movement of salt stations to minimize localized impacts of concentrated use. Although strategic salt placement is an inexpensive and effective distribution tool, recent research has shown that it is not as persuasive in modifying livestock distribution patterns as water developments (Ganskopp 2001) or the strategic placement of energy or protein supplements such as low-moisture blocks (Bailey and Welling 1999). Protein supplements containing products such as cottonseed or soybean meal can increase consumption of cured, low-quality grasses and are especially attractive to livestock as forage matures and becomes dormant.

On one Montana ranch, the use of low-moisture blocks increased the number of livestock that used the east half of the ranch by 35 percent. Low-moisture blocks were an effective attractant for cattle in both moderate and difficult terrain (Bailey and Welling 1999). Over a 7- to 10-day period, forage utilization increased by 20 to 25 percent in nearby areas when low-moisture blocks were placed in moderate terrain (10- to 20-percent slopes and 1/4 to 3/4 mile from water) and by 10 to 15 percent when placed in difficult terrain (15- to 25-percent slopes and 1/5 to 1-1/4 miles from water). In a comparable area within the same pasture that did not contain low-moisture blocks, forage utilization did not change during the same period. The increase in forage use extended for about 600 yards from the location where low-moisture blocks were placed. In a second Montana study (Bailey et al. 2001c), forage use in difficult terrain increased by 14 percent, from 6 to 20 percent, during a 2-week period for areas up to 600 yards from placements of low-moisture blocks.

The type of energy or protein supplement is an important consideration when it is used as a tool to modify livestock grazing patterns. "Self-fed" supplements can provide nutrients on a continuous basis and are more effective and often less costly to use than supplements that are "hand fed." The effectiveness depends on distribution costs, availability, and ease of providing the supplement. Low-moisture blocks are self-fed, and intake is restricted by the hardness of the product. Intake of low-moisture blocks has averaged 0.5 to 0.75 pounds/cow/day and new blocks are usually placed in a new location once every 2 weeks. Range cake (cubes) are usually hand fed several times per week. For example, many ranchers feed 4 pounds of cake per animal 3 times per week. In a Montana study, cows spent about 5 hours per day within 100 yards of low-moisture blocks and only 1 hour per day within 100 yards of where range cake was fed. After consuming the cake, cows appeared to return to preferred areas, while cows fed low-moisture blocks were more likely to remain nearby. The study showed that cattle fed strategically placed low-moisture blocks used higher elevations than cows that were hand fed range cake.

Liquid molasses supplements are self-fed and can be used to attract cattle, but they are more difficult to transport to rugged terrain than low-moisture blocks. Liquid supplements must be carried in a tank on a truck. In contrast, low-moisture blocks contain less than 5 percent moisture and can be readily transported to rugged terrain by using all-terrain vehicles (ATVs) (if allowed in the ATV's use guidelines and restrictions). Some ranchers have transported low-moisture blocks into mountainous rangeland using pack horses.

Ranchers also use pressed blocks and loose, dry mineral formulations to supplement livestock on rangeland. A study conducted in New Mexico (Bailey et al. 2004b) showed that both low-moisture supplements and pressed blocks attracted cattle to areas far from water, but low-moisture blocks were more effective. Consumption of the pressed blocks was lower than the low-moisture supplements and much lower than the manufacturer's recommendations for the pressed supplement. Supplements will not be as effective in luring animals to underused upland areas if the consumption of the supplement is relatively low.

Loose, dry mineral formulations are usually mixed with salt and fed in open containers. They, like salt, are attractive to livestock. A study conducted in Montana (Bailey and Welling 2002) found that although cattle were willing to travel to consume the dry mineral

product, low-moisture blocks were more effective for modifying cattle grazing patterns. Cows spent more time near low-moisture blocks than near the feeders containing dry mineral formulations.

Supplements should be placed in a restricted area so that social interactions among animals are more likely to occur and the placement site is more likely to become a loafing area. In research studies in Montana, eight low-moisture supplement containers were placed in a 200- by 200-yard area. Salt was also placed in this area because salt was not added to low moisture supplement products. If supplements are repeatedly placed in the same area, nearby forage use becomes excessive. New supplement barrels should be placed at least 300 yards from old sites to improve livestock distribution and forage use. This becomes an anticipated reward (conditioned response) when livestock are herded from one portion of the pasture to another.

Even though supplements are nutritious, animals must become familiar with a product and learn to prefer it before it can be used as an attractant. Offering animals a supplement in a dry lot or a small pen is the quickest and most effective method for getting animals to sample new supplements. A good time for training animals to consume new types of supplements is during calving when animals are near the ranch headquarters. Showing animals where a supplement is located is a good practice, especially if it is moved a long distance from its former location. Cows can be herded, "called," or "honked" to a new supplement location. Not all cows need to be shown the new location. Generally, the entire herd will find the location if 30 to 50 percent of the herd is shown the supplement site once. If new supplement barrels are placed only a short distance (200 to 400 yards) from their previous locations, animals will readily find them. With this method, animals only need to be herded to the first supplement location. The idea is to place the supplement along an area (e.g., ridge) that typically receives little grazing.

When placing supplements, other uses and values, such as wildlife needs, should be considered. For example, supplements should not be placed in elk winter use areas unless the goal is to reduce the amount of wolfy, decadent vegetation to stimulate more nutritious regrowth for elk use.

b. Herd Management and Animal Husbandry Practices

(1) Culling Practices

Culling practices are traditionally employed to improve some aspect of animal performance such as conception rates, weaning weights, or conformation. However, some operators also cull on habitat use tendencies and foraging characteristics. Several studies found that within herds, or even within breeds, certain individuals tend to spend more time in the bottoms while others tend to forage widely (Roath and Krueger 1982, Howery et al. 1996, Bailey 2004a).

A 3-year study in northern Montana demonstrated that individual animal selection has the potential to improve grazing distribution patterns (Bailey et al. in press; Bailey et al. 2004c). Differences in individual grazing patterns observed in common pastures persisted even after animals were separated. Cows that were previously observed on steeper slopes and in areas farther horizontally and vertically from water (hill climbers) continued to use steeper and higher terrain and areas farther from water than cows that were previously observed in gentler slopes near water (bottom dwellers). Terrain use of hill climber and bottom dweller cows not only differed statistically, but common forage stubble height standards for riparian areas (e.g., 5 inches) treatments were higher in the hill climber treatment area than in the bottom dweller treatment area.

Although the results from the Montana study were favorable, more research is needed before individual animal selection can be widely applied to improve uniformity of grazing. First, the selection pressure simulated in this study was high, because the herd was ranked and then split in half. Selection strategies based on culling (typically 10 to 20 percent of the herd are removed each year) would result in less selection pressure. Genetic progress from culling alone without sire selection is slow even when heritability is relatively high (Falconer 1960). Second, the relative contributions of genotype and early learning on terrain use patterns of cattle must be determined. If terrain use is reasonably heritable, grazing patterns can be modified by sire and family selection. If early learning is important (Howery et al. 1998), terrain use could be modified by management and training when replacement animals are calves.

LFO_RMP_10174

(2) Kind of Livestock

Changing or incorporating different kinds of livestock can affect both the distribution pattern and forage preference. Unrestricted use by those cow-calf pairs, which tend to concentrate, loaf, and forage in bottoms, may impact riparian areas more than use by some other kinds or classes of livestock. Yearling cattle, particularly steers, generally tend to be wider ranging and use more of the adjacent uplands. Horse grazing during the winter may result in bark being stripped from deciduous trees in some areas (Kindschy pers. comm.). However, horses are primarily regarded as grass eaters, and generally congregate less than cattle (Stoddart et al. 1975). They graze an area and then move onto an ungrazed area, whereas cattle tend to stay in a grazed area waiting for vegetation regrowth. A concentration of feral horses on riparian meadows was reported to adversely impact that area (Platts pers. comm.), and Crane et al. (1997) found that sedges in streamside and bog and meadow areas were important forage for feral horses. Problems have occurred in other locations because of concentrated use of springs or seeps by feral horses. Horses pull plants out by the roots from areas that have moist soils more than most other animals (Pieratt pers. comm.).

Herded sheep offer several options for achieving proper management in certain riparian areas. Sheep use may be more desirable than cattle use in some areas due to the herders' control over location, timing, degree, duration, and frequency of use. Sheep prefer hillsides to the confining nature of riparian bottoms. The herder can easily move sheep to upland or ridgetop areas rather than bedding them in a riparian area meadow. Generally, herders want to keep flocks or bands moving to facilitate forage selectivity. The quality of herding controls impacts to riparian areas and rates of gain in the lambs (Glimp and Swanson 1994). When properly herded, sheep cause less trampling damage than cattle (Stoddart et al. 1975).

Sheep and goats may do less physical damage to herbaceous plants due to their nibbling characteristics, whereas cattle and horses can dislodge plants from the soil because they graze with a pulling motion. Sheep and goats may also be used to control invasive plant species such as leafy spurge and knapweed. Because different animal species have different plant preferences, the integration of multiple grazing species may improve plant species composition. This integration could alleviate overuse of desired forage species, decrease the potential for increaser species to dominate an ecological site, and enable selective control of undesirable plant species without resorting to the use of herbicides, which is tightly restricted close to water.

As previously noted in section III.D.1.b.5, the Deseret Land and Livestock Ranch in north-central Utah placed a band of sheep in Hornet Gulch to alter elk use patterns to improve riparian vegetation (Danvir pers. comm.).

Free-roaming sheep (without a herder) consumed spring willow growth in Oregon even though adequate herbaceous forage was available. Heavy browsing of young willow growth by unherded sheep was also observed in southern Wyoming during spring, summer, and fall where the herbaceous vegetation was dominated by coarse forage such as sedges and rushes.

Goats can effectively control a variety of problems or invasive plants such as leafy spurge, multiflora rose, knapweed, and brush species. They can reduce the need for herbicides, fertilize the soil, and control weed species in areas that are difficult to treat with other methods. Ranchers have incorporated goats into their livestock operations to help maintain and increase herbaceous forage species through invasive plant control. Individuals will sometimes contract with ranchers and farmers to provide forage for the goats, which in turn control weed species. Goats typically prefer forb and browse species, so there is not an overlap of use by goats and cattle (Coffey 2002).

(3) Breed of Livestock

Most livestock operators would not consider a change in breed of livestock simply to improve distribution. However, grazing patterns might become a consideration in breed selection if an operator is considering a change for other reasons. Higher heat tolerance (and related foraging characteristics) of Brahman, Brahman crosses, and other Zebu types is often a consideration in Southern and Southwestern States. For example, Herbel and Nelson (1966) found that Santa Gertrudis cattle (3/8 Brahman) traveled further when foraging than Hereford cattle in a study in southern New Mexico.

LFO_RMP_10174

For extensive and rugged pastures, livestock producers and land managers may be able to improve uniformity of grazing by selecting breeds that were developed in more mountainous terrain. Tarentaise cattle developed in the French Alps consistently climbed higher and used higher elevations (greater vertical distance to water) than Herefords on northern Montana rangeland (Bailey et al. 2001b). Additional research compared terrain use of cows sired by Angus, Charolais, Piedmontese and Salers bulls. Cows sired by Piedmontese bulls used higher terrain than cows sired by Angus bulls (VanWagoner et al. 2006, Bailey et al. 2001a). Piedmontese cattle were developed in the foothills of the Italian Alps, whereas Angus cattle were developed in flatter terrain in eastern Scotland.

c. Techniques that Exclude Livestock Use or Promote Avoidance of Riparian Areas

(1) Fences

Fencing, when properly located, well constructed, and maintained, can be an effective tool for controlling distribution of livestock. Fencing facilitates management of riparian areas by either including or excluding livestock use, depending on management objectives. Sometimes exclusion fencing may be the most practical approach for initiating rapid riparian recovery or improving highly sensitive areas (Figures 23-25). It can also be a temporary measure for initiating recovery. The loss of forage from exclusion fencing may be inconsequential on streams in poor condition that lack vegetation. Fencing water sources at springs and seeps and piping the water to adjacent areas for use is often the only effective measure for protecting small riparian areas.

Figure 23. Mahogany Creek, 1975.

Figure 24. Mahogany Creek, 1978 after exclusion.

Figure 25. Mahogany Creek, 2004. (Mahogany Creek photos by BLM.)

Fencing may also restrict wildlife and livestock movements in an undesirable manner. In addition, fence construction and maintenance can be costly and time consuming. Temporary electric fencing can be an effective tool for improving distribution so that parts of a pasture can be grazed while others are rested (Figure 26). Temporary fencing is also useful for evaluating multiple placement locations before constructing more expensive permanent fencing. Using temporary fencing from year to year to break up grazing patterns and facilitate implementation of rangeland management practices provides flexibility in obtaining long-term objectives.

Livestock acclimate to temporary electric fencing easier in a controlled environment, such as a spring calving pasture, as opposed to much larger rangeland pastures. Livestock need to learn to respect the fence as a barrier. It is important to note that temporary electric fencing does not provide the same level of control as permanent

LFO_RMP_10174

Figure 26. A temporary fence is used to rest sections of the pasture while allowing grazing in the remainder of the pasture. (Photo by M. Borman, Oregon State University.)

barbed-wire or wooden-rail fencing and should be used to influence rather than control animal behavior.

Suspending panels of corrugated metal roofing over the stream, between ends of a fence, has proven effective in controlling livestock movement in Oregon. The panels swing with the flow of water, do not catch trash, and are avoided by livestock. Other forms of swing panels constructed of hanging pipe or heavy chain have also proven effective.

(2) Barriers

Barriers formed by placing trees and brush on streambanks may discourage livestock use and help stabilize eroding banks. Placing boulders (10 to 20 inches or larger) along streambanks where livestock trail and cause trampling damage can effectively displace livestock use and promote recovery (Myers pers. comm.).

(3) Hardened Crossing and Water Access Points

Hardened crossings and water access points are coarse gravel pads that provide livestock sure footing on a gentle grade to water, either for crossing a stream or for drinking (Figure 27). Livestock prefer gravel pads over steep, overhanging streambanks or soggy low areas to access the water in the stream channel (Milesnick pers. comm.). During a roundup, cows will run for the gravel pad before trying to negotiate the streambanks (Massman 1998). Berg and Wyman (2001) suggest locating crossings or access points in areas where the streambed is stable (Figure 28) and avoiding sites where:

- The channel grade or alignment changes abruptly
- The channel bed is unstable
- Head cuts exist
- Large tributaries enter the stream
- There is a recently located or constructed channel
- A culvert or bridge is immediately upstream or downstream
- Water velocity and depth are excessive

Figure 27. Hardened livestock crossing on a class 1 trout stream in Columbia County, Wisconsin (2000). (Photo by B. Nichols, NRCS.)

Figure 28. Stable livestock water access in Jefferson County, Montana (2001). (Photo by G. Kramer, NRCS.)

Locating water access in rocky areas (natural or manmade) minimizes trampling damage to streambanks and streambeds. Narrow water access (water gap) discourages livestock from loafing at the water source (Leonard et al. 1997)

LFO_RMP_10174

(Figure 29). Ice and high flows need to be considered when locating water access points and hardened crossings in some areas.

Figure 29. Narrow water access (water gap or gap) discourages loafing. (Photo by NRCS.)

Fish spawning and rearing areas should be considered when determining the location of the water gap or crossing. Although the vegetation has expressed itself in Figure 30, there are some key fisheries habitat areas (black ovals) that need to be addressed to ensure that a grazing strategy is successful. These include:

- *Pool formation and cover:* Are cattle impacts preventing pool formation and overhanging cover on the outside of the meanders?
- *Margin habitat:* Is there adequate vegetation in the margins to provide habitat for fry or minnow species?
- *Spawning area:* Are there trampling impacts to spawning areas?

The red oval at the end of the point bar is an area cattle would likely use to water due to the gentle gradient. The red line is another area cattle may use to water and where they would prefer to cross. This shallow at the break between a pool and a riffle is just downstream from where salmonids can spawn. Although the preferred livestock access areas are close to redds in this example, there are few observations of livestock trampling redds in the Western United States.

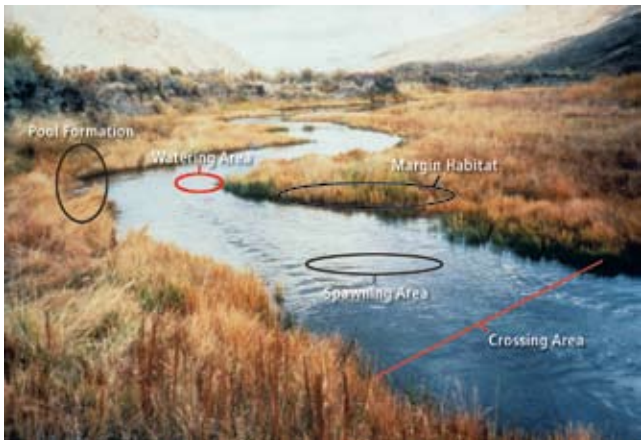

Figure 30. Areas of fish and livestock use.

(4) Bedding Grounds

Bedding grounds and other livestock handling facilities should be located away from riparian areas (Riparian Habitat Committee 1982). The use of low-stress stockmanship and salt, mineral, or other supplements (e.g., low-moisture blocks) may be useful for establishing or relocating bedding grounds away from riparian areas.

(5) Livestock Turnout Locations

Placing livestock far away from overused riparian areas when they are moved to a new pasture (turnout) may help regulate the timing, duration, and amount of riparian use in large pastures that contain adequate stock water (Gillen et al. 1985). It is beneficial to change turnout locations each year to vary behavior patterns.

(6) Drift Fencing

A drift fence is an open-ended fence used to retard or alter the natural movement of livestock; it is generally used in connection with natural barriers (SRM 2004). Drift fencing in conjunction with gullies, cliffs, and other natural barriers can regulate natural trailing or loafing by livestock in some riparian areas.

(7) Stockmanship

Frequent range riding and herding can effectively control livestock distribution in many situations. On some rough or poorly watered ranges, proper stock manship may increase breeding, conception, and calf

LFO_RMP_10174

crops (Stoddart et al. 1975). Several of the successful strategies reported by Massman (1998) and Masters et al. (1996a, 1996b) also incorporate riding and herding into overall management. Low-stress stockmanship techniques are once again becoming more popular as a tool to distribute livestock.

Low-stress stockmanship is a method of handling livestock with prompts rather than force. Age-old principles and techniques of animal handling take advantage of some inherent traits of livestock, encouraging herds to stay together where they are placed. Livestock usually become more controllable with these techniques and their productivity and health often improve because the handling is low-stress and their health is monitored more effectively by the riders. Well-handled range livestock will want to stay together, instead of scattering or hiding in favorite places (such as meadows and riparian areas). Properly placed animals will go to water, such as a creek or trough, drink, and then return to bed down and graze around the area in which they have been placed. This allows the rider or range manager to readily control the results of grazing to a high degree, even on large expanses of unfenced range and on steep or brushy terrain.

Successful application of low-stress stockmanship enables the rider or range manager to control the duration that plants and soils are exposed to grazing animals. This controls overgrazing and overresting, both of which lead to deterioration of range health. Proper handling can thus improve livestock distribution and rangeland condition and trend, and it can lead to improved riparian conditions that benefit fisheries and wildlife while improving water quality. Livestock can be moved away from critical habitats at critical times to minimize social displacement of wildlife (e.g., elk and deer winter range, fawning sites) (Mosley 1999).

Low-stress livestock handling facilitates all grazing management strategies because the animals are readily moved and are comfortable where they are settled. Whereas good stockmanship is important with high-intensity, short-duration grazing systems, it can mean the difference between success and failure with rest-rotation, deferred-rotation, and seasonal grazing strategies on large pastures or open range because areas within the large pastures may be overgrazed without intensive management. When management prescriptions require livestock grazing during one of the critical times, or in high livestock densities, a rotation grazing system can be used to provide wildlife the opportunity to move into pastures where livestock are not present (Mosley 1999). Incorporation of offsite water developments along with the placement of salt, mineral, and protein blocks has been found to complement low-stress stockmanship.

Bailey (2004b) evaluated moving cow-calf pairs during midday by using low-stress handling techniques (with and without low-moisture supplement) as a management tool to protect riparian areas. Bailey reported important differences between the free-roaming control cows and the herded cows (with and without supplement). The study clearly showed that herding (with and without supplement) can reduce the time cows spend near streams and riparian areas and increase the time spent in uplands, and the change in cattle grazing patterns with herding will result in less forage use and higher stubble heights near streams.

Learning low-stress stockmanship skills requires dedication and a shift in both attitude and how livestock are viewed. Also, the mishaps can be big if smaller herds are combined into one large herd. In some areas, existing water developments may lack the capacity to handle the number of animals in a larger herd. The herd may need to be kept split into smaller herds based on available water and forage.

See Appendix G for information about the benefits, economics, and sustainability of the ranch operation using low-stress stockmanship.

LIFO_RMP_10174

Case Study: Morgan Creek, Challis, Idaho (Gowan and Camper 2000)

The Morgan Creek allotment was converted from season-long grazing to a rest-rotation grazing strategy in 1972. A collaborative approach, considered state of the art at the time, resulted in improved upland conditions, but improvements in riparian function were not well documented or apparent.

The chinook salmon was added to the Federal endangered species list in 1992. Numerous requirements were put in place in an attempt to ensure compliance under the Endangered Species Act. Permittees found it difficult or impossible to comply with the new requirements, which were developed without their participation. By 1994 the management changes resulted in:

- Up to 13 riders patrolling the drainages daily to herd cattle off of riparian areas.
- Failing to meet grazing standards in 7 of 7 key areas.
- A 68 percent reduction of animal unit months on the allotment.
- Agricultural and environmental community dissatisfaction.
- An impasse between permittees, agencies, and other interested parties.

The Morgan Creek Team was formed, and through a combination of collaboration and low-stress stockmanship, it planned:

- On-the-ground management that emphasized a shared vision and goals.
- Continuation of rest on 1/3 of the pastures, but with much greater flexibility.
- Subdividing the three-pasture system into several smaller grazing units divided by topographic features rather than fences.
- Strict stubble height standards within riparian areas.
- Active monitoring, including photo points, of stream sediment, willow abundance, redds, bank stability, and disturbance.
- Flexible management with ongoing adjustments as the grazing season progressed.

Results (Figure 31):

- Standards were met or exceeded on 8 of 11 key areas the first year; greater success was achieved in subsequent years.
- Permittees were able to graze a full season.
- Consultation was shorter and less contentious.
- Costs were decreased. The Morgan Creek Cattleman's Association reported saving $10,000 in 3 months over one season, even with the cost of hiring two full-time riders.
- A positive environment for working together was established.
- Stress on both livestock and the environment was reduced.
- Livestock production increased; riparian conditions improved.
- The Forest Service received the Forest Service Chief's Award for Excellence in Rangeland Management.
- The system worked as long as there was institutional support and the collaborative process was followed.

LFO_RMP_10174

Morgan Creek Team requirements for application of low-stress stockmanship included:

- **Use livestock to mimic impacts of prehistoric wild ungulates.**
- **Allow animals to bite each plant only one time.**
- **Adopt Bud Williams' low-stress stockmanship techniques.**
- **Allow use of livestock as a vegetation management tool.**

Today the Morgan Creek Team still strives for sustainable resource management. Turnover in participating agency personnel and decreased institutional support in the collaborative process have created new obstacles for the group to overcome. As with any collaborative process, continued support by all parties is the key to long-term changes on the land.

Before (1995) **Year 3 (1997)** **Year 5 (1999)**

Figure 31. Changes to the Morgan Creek allotment, Idaho. (Photos by C. Gowan and R. Camper, USFS.)

3. Grazing Treatments

No matter which grazing treatment is selected, success ultimately depends on the livestock managers' cooperation or support of the grazing management plan (Ehrhart and Hansen 1998, Evans Draft). Ehrhart and Hansen (1997) analyzed 71 stream reaches, located primarily on private land throughout Montana, rated as functioning properly or in an upward trend. They found that the operators employed the full range of seasons of use as well as lengths of grazing periods and concluded that **"the manager is more important than a particular approach."** Selection of a grazing treatment differs depending upon the location, extent, and condition of the riparian area within the pasture(s), compatibility with the overall ranch management plan, people involved, agency requirements, weather patterns, livestock, wildlife, and so on.

The treatments described in this section have succeeded in many places and failed in many others. Any treatment that is implemented without at least some of the management tools and techniques mentioned earlier is likely to fail. The grazing treatment selected should be designed to meet the resource needs of the area, fit with the livestock operator's management plan, and be closely managed by the livestock operator.

Ecologic and economic considerations should be evaluated when designing a grazing treatment. Livestock that remain in the riparian area waiting for the vegetation to grow high enough to bite will not gain as much as those animals that are using upland areas and filling their stomachs in less time. It can take twice the effort and time for a cow to fill her stomach in areas with less than 3-inch stubble height due to a change in bite pattern and the amount of forage a cow can pull into her mouth with each bite (Hall and Bryant 1995). The result is a shift to more quickly eaten and less palatable forage and less weight gain.

Concerns about the detrimental affects of season of use on wildlife are based on the assumption that a single pasture is used the same season year after year. However, by maintaining the proper stocking rate, managing the duration of grazing, and monitoring, use during any season can benefit the plant community and selected wildlife species life cycle needs based on the land use plan (Miller pers. comm.).

As for the grazing systems themselves, the more intense systems (e.g., twice over, short-duration, high-intensity systems) can provide excellent benefits for waterfowl (Barker et al. 1990) and upland game birds (Kirby and Grosz 1995, Svedarsky and Van Amburg 1996). The short grazing periods allow for regrowth that provides cover later in the season, but intense systems may substantially reduce current-season nesting cover for many ground-nesting species depending upon timing of use. A short grazing period may provide excellent regrowth and residual cover for next year, but this year's nesting cover may be diminished in those particular pastures grazed at the time of year that affects cover. Kirby and Grosz (1995) hypothesize that grazed areas are centers of human and livestock activity and have reduced levels of cover for mammalian predators. These factors may make grazed areas unattractive to predators as foraging sites. In contrast, the seclusion and cover provided by nongrazed areas may actually attract greater numbers of predators.

Impacts to individual fish and their habitat differ depending on season of use, climate, fish species present, and other factors. Grazing strategy impacts are determined by short- and long-term effects on vegetative structure and the long-term effect of vegetation and livestock on channel morphology. Grazing strategies should address impacts to, or objectives for, cover because fish require overhead (canopy) and instream cover, including overhanging banks and deep pools. Strategies could also address factors that influence water quality, including temperature and dissolved oxygen, and spawning habitat components (clean gravel) if such changes are likely within the management timeframe. Eutrophication concerns should be addressed for areas with lakes and ponds.

One problem in multiple-pasture systems is allowing livestock to drift among pastures rather than moving them more quickly. In his evaluation of 30 grazing systems on 44 stream reaches in Montana, Myers (1981) and others concluded that livestock should be moved between pastures rather than left to drift over a period of several days or weeks. In this analysis, riparian vegetative response seemed to be better in allotments

LFO_RMP_10174

where the livestock were moved and the gates closed, as opposed to where livestock drifted and simultaneously used two pastures. **Movement requires a strong commitment from the livestock operator to clean the pasture**. Without it, some livestock will stay in a pasture eating regrowth even with adequate palatable forage in the next pasture. One recommended approach, which can minimize livestock stress and encourage better dispersal, is to open the gate in late afternoon on day one, allow drift on day two, and clean the pasture and close the gate on day three (Hagener pers. comm.). Supplements can also be used to help attract livestock to the next pasture. Techniques that work well will vary, depending on local conditions. Some ranches do not have adjoining pastures, which makes livestock movement more difficult. This is not an insurmountable obstacle if considered during the planning phase.

Successful grazing strategy planning takes into account that:

- The grazing strategy needs to be designed for resource needs and for the rancher that will be implementing the strategy.
- No one size fits all.
- Commitment by the livestock manager is needed to succeed.
- There is often a 3-year learning curve between initial implementation and indications of success or improving trend (Provenza 2003) in the resource and livestock condition.
- The more intensive the management strategy, the better the chance for a serious mishap.
- The objectives and expectations need to be clearly understood by all concerned.

Following are descriptions and examples of various grazing treatments and their effectiveness for improving or maintaining riparian areas in specific situations.

a. Winter (Dormant-Season) Grazing

Winter grazing is the use of a pasture during the plants' dormant season. Dormant-season grazing provides total growing season rest every year. Though some browsing does occur on the riparian woody vegetation, such use is often minimal because drainages are colder than adjacent uplands. Normally, there is little or no vegetation growth during winter, so grazing affects plants less. Winter use is usually the least detrimental to soils (especially where they are frozen) and to dormant herbaceous vegetation. However, winter use also has the potential to remove excessive amounts of vegetation cover just prior to spring runoff. Most streambanks require carryover vegetation for bank protection and sediment trapping during high-flow events. Furthermore, winter may be the period of greatest use of woody browse species by both livestock and wildlife depending on temperatures, snow depth and duration, availability of other feed, animal concentration, forage and browse preference, and the extent of the woody plant community. Many riparian areas and some entire pastures are unavailable for grazing during a major part of the winter due to snow depth.

In areas that can be grazed, winter can be a season of use with minimal impact if grazing is closely monitored and controlled (especially use of woody plant growth and browse species). Even though plants are dormant, use levels should be managed because winter grazing can reduce residual herbaceous cover for ground-nesting birds and calving or fawning ungulates. Some woody plant communities can benefit from occasional, prescribed winter use. Light browsing can stimulate leader production, increasing the density (cover value) of individual shrubs. Winter grazing can reduce canopy cover, benefiting the herbaceous layer and preventing a secondary cycle of erosion on some soils (Miller pers.comm.).

Offstream water can be effective for reducing streambank impact during the dormant season and for helping livestock avoid slippery and icy streambanks. However, this requires keeping offsite water ice free.

On many ranches winter feeding costs are the most expensive component of raising livestock, and a grazing cost of even $18 per AUM compares very favorably to feeding hay at roughly $60-$70 per AUM. An analysis of Humboldt and Elko, Nevada, cow-calf budgets showed winter feed costs were about 36-42 percent of the total cost of the cow-calf enterprise. The cost with supplement tubs was $174 per AUM for Humboldt and $188 per AUM for Elko. Reducing winter feeding costs in the Great Basin can impact the financial stability of the operation by thousands of dollars (Riggs pers. comm. and Curtis et al. 2005a and 2005b).

LFO_RMP_10174

Wickiup Creek in northern Nevada has been grazed in the winter by cattle since 1910 (Masters et al. 1996a). Winter grazing has maintained stable riparian conditions for decades (Figures 32 and 33). In addition to winter grazing, management practices include placing salt well away from riparian areas, culling riparian loafers, and varying turnout locations from year to year.

Figure 32. Wickiup Creek, Nevada, 1939.

Figure 33. Wickiup Creek, Nevada, 1991.

Winter (Dormant) Season Grazing

Potential Advantages:

- Soil compaction and bank trampling are minimal if soils are frozen.
- Use of the herbaceous species is not detrimental if the plants are not grazed down enough to change the root crown temperature.
- It is usually easy to control livestock distribution.
- Total growing-period rest is provided every year.
- The fish-livestock interaction is usually minimal due to the unfavorable climate in the riparian area for livestock.

Potential Disadvantages:

- Browsing and damage to trees and shrubs occurs from trampling, rubbing, or possible bark chewing.
- There is potential for soil compaction if livestock are on thawed, moist soils.
- The removal of vegetation can reduce streambank protection, sediment entrapment, and fish cover just prior to runoff.
- There is a potential for livestock to impact fish spawning areas (species-dependent).
- Livestock may be using key wildlife winter range, causing wildlife to shift to lower quality habitat.

LFO_RMP_10174

Case Study: Winter Grazing Practices of the Five Dot Land and Cattle Company

The Five Dot Land and Cattle Company near Standish, California, which has been operated since 1959 by Todd Swickard, acquired a 3,000-acre pasture in 1985. Long Valley Creek is the primary water source in the pasture. The pasture had previously been grazed 8-10 months of the year, and Swickard's primary objective was to improve resource conditions on the upland and riparian areas. Although he wanted to produce forage, he also wanted to decrease erosion, increase wildlife, and heal the creek (Swickard pers. comm.).

Swickard's operation, which includes several BLM permits along with the Long Valley Creek pasture, changed to a dormant-season grazing prescription (October–January) with 500 cow/calf pairs in 1985. Leaf drop had already occurred on the willows, and vegetation was not as palatable in riparian trees as in upland areas where livestock spend most of their time. Because of the change to dormant-season use, Swickard saw an improvement in upland as well as riparian vegetation (Figures 34-37).

Today, Long Valley Creek supports a large variety of sedges, grasses, forbs, cottonwoods, and willows. Swickard hasn't done any planting or structural restoration to accomplish his objective of improving the riparian area to increase forage production. Noxious weeds, primarily whitetop (hoary cress or perennial pepperweed), are sprayed annually.

Figure 34. Long Valley Creek, 1986.

Figure 35. Long Valley Creek, 2000.

Figure 36. Long Valley Creek, 1987.

Figure 37. Long Valley Creek, 2000. (Long Valley Creek photos by T. Swickard, Five Dot Land & Cattle Co.)

LFO_RMP_10174

Swickard has started working with the BLM to increase bitterbrush browse for winter deer use. He recently adjusted his grazing plan on his private and public land pastures. Cattle are now moved onto the BLM pasture in early spring and then to the Long Valley Creek pasture in July and August. The creek is fed by several hot springs, and good regrowth occurs in late summer and early fall. He removes the cattle before they begin browsing willows.

Swickard is committed to remaining flexible, working collaboratively with agencies, and managing his livestock operation to maintain an ecologically and economically viable business.

b. Spring Grazing

Spring grazing is the use of a pasture during the early growing period when upland vegetation is highly nutritious. It enables riparian areas to be largely ungrazed during a large portion of the critical growing period. Cool-season vegetation growth begins and peaks in spring. Warm-season plants begin growing during mid- to late-spring. Spring use normally results in better livestock distribution between riparian and upland areas due to flooding, generally cooler temperatures of riparian areas, and highly palatable upland forage. In late summer, upland forage has senesced and is lower in quality than riparian vegetation. In contrast, forage quality of riparian areas and uplands are both high in spring and early summer. Consequently, livestock are likely to graze more uniformly, because alternative choices of sites to forage within the pasture are relatively similar (Bailey 2005). Spring use provides more opportunity for regrowth and plant recovery than summer or fall use and also results in more residual cover. Barker et al. (1990) concluded that the value of this cover far outweighs any disturbance or trampling factors for ground-nesting birds.

In a 10-year study on Stanley Creek in central Idaho, Clary (1999) found that riparian habitats are compatible with light to medium late-spring use by cattle. Improvements were found in stream channel configuration and riparian plant communities after all three treatments (none, light, and moderate grazing use) on historically heavily grazed pastures in a cold mountain meadow riparian area on the same creek.

Regrowth is important for sustaining the important physical functions of a riparian area (e.g., shading, insulation, sediment filtering), as well as for buffering the effects of peak runoff on streambanks. For example, in the BLM's Prineville District, in Oregon's sagebrush- and juniper-dominated high desert, spring grazing has been used to improve riparian conditions on Bear Creek. Prior to 1977, the area was a single pasture, permitted for 75 AUMs from April to September in most years. This strategy depleted streamside vegetation (low diversity and productivity) and deeply incised the stream channel, causing it to actively erode (Figure 38). Summer streamflow was often intermittent and low in quality.

In 1977, the BLM decided to rest the area to restore the productivity of the riparian area. After 3 years of attempted rest, the area was used for 1 week in September in 1979 and 1980. In 1983, juniper trees were removed from the uplands to improve range condition and watershed health. In 1985, a grazing treatment authorized use from the time of spring runoff (mid-February) until April 15 in a three-pasture system. In 1988, authorized grazing use (permitted AUMs) was nearly five times greater than the forage obtained from the area under season-long use. The permittee reportedly cut his annual hay bill by $10,000 (1988 dollars). The riparian area continues to improve (Figures 39 and 40). The resulting improvement in quality and quantity of streamflow allowed the reestablishment of redband trout in Bear Creek. Although this early-season riparian grazing treatment works well on this site's sandy loam soils, it might not work as well on medium- and heavy-textured soils with high moisture-holding capacity (clay).

LFO_RMP_10174

In the spring, seed and litter can be trampled into wet soil by hoof action. However, on some moist or saturated soils, grazing animals more easily uproot plants and compact soils or shear streambanks. Subsequent rest is often required to encourage root growth and other biological activity, which offsets the effects of soil

Figure 38. Bear Creek, Oregon, 1977.

Figure 39. Bear Creek, Oregon, 1996, after continued spring use.

Figure 40. Bear Creek, Oregon, 2003. (Bear Creek photos by W. Elmore and BLM.)

Late Winter–Early Spring Grazing

Potential Advantages:

- Use of riparian vegetation by livestock is reduced because upland plants have similar or higher nutritional content than riparian forage.
- The amount of riparian soil compaction and bank trampling is reduced because the cattle use the uplands.
- There is time for regrowth of vegetation.
- Palatable herbaceous plants reduce pressure on woody plant species.
- The fish-livestock interaction is usually minimal because of the unfavorable climate for livestock in the riparian area.
- Overhanging riparian herbaceous vegetation is usually not available for grazing because of high streamflows or the presence of trapped sediment in the vegetation.

Potential Disadvantages:

- The potential for soil compaction and bank trampling may be greater depending on soil type.
- Use occurs during the critical period of upland plant growth and development if grazing is extended until grasses are in the boot stage of phenology.
- Repeated grazing of desirable herbaceous species at this time may affect plant vigor (a short grazing season is beneficial).
- Wildlife may be adversely affected (calving, fawning, and nesting cover).
- There is a potential for livestock to impact fish spawning areas (species-dependent).

LFO_RMP_10174

compaction prevalent during spring. In a southwestern Montana study, most bank damage resulted when soil moisture was over 10 percent, which normally occurs prior to midsummer in arid and semiarid areas of the West (Marlow and Pogacnik 1985). The soil moisture content that minimizes bank damage differs with soil texture.

c. Hot-Season Grazing

Hot-season grazing is the use of pastures during the critical growing season for riparian plants. Summer is usually the period of greatest photosynthetic activity, especially for riparian and warm-season plants. Upland and cool-season plant growth and forage quality is diminished due to reduced soil moisture content. During the hot season, livestock concentrate in or near the riparian area when upland forage becomes rank or dry, water distribution is more limited, and the desire for shade is more intense. Where free-choice grazing is allowed in the summer, use of riparian vegetation is high and regrazing of the same plants can occur. Darambazar et al. (2003) suggest that cattle grazing in late summer in mountain riparian pastures will begin using shrubs intensively when the quality and quantity of grasses and the abundance of forbs decline. They recommend that late-summer grazing should be light or avoided if grasses have become dormant.

Streambank damage relates to many factors, including soil moisture content, soil type, absence of woody plants and root systems, bank rock content, stock density (animals per acre), availability of offstream water, and duration of grazing. Streambank damage due to livestock trampling of wet soils, and where other factors are not controlling, may be avoided by deferring grazing until bank soil moisture content is less than 10 percent.

Summer is also the time that grazing can cause the greatest levels of stress in most riparian plant species, which over time can reduce the abundance of desirable plants. There is less time for regrowth and replenishment of carbohydrate reserves during the summer than spring, and additional leaf area is needed. Continuous hot-season grazing can favor invasive plant species and can reduce residual herbaceous cover for ground-nesting birds, fish, and calving and fawning ungulates. However, most riparian areas should have available moisture and time for herbaceous plant regrowth, which can provide greater residual cover than that resulting from winter grazing. Woody species, where present, may suffer from browsing during the hot season. Long-term use of passive, continuous hot-season grazing may result in severely hedged (high-lined), single-age-class stands of woody plants.

Annual grazing throughout the hot season (essentially the same as season-long use) is nearly always detrimental to riparian vegetation, especially in large pastures with small riparian areas that are not managed separately. Therefore, some form of indicator or trigger is needed to monitor and reduce frequency, intensity, and duration of riparian use. One of the other grazing management strategies should be considered. Offsite water, herding, proper use of supplements, or other practices may be needed as well.

Myers (1981) found that in the foothills of southwestern Montana, the frequency of hot-season use from July 10 to September 1 (period of heavy use) appeared to be a critical factor in developing and maintaining satisfactory riparian area conditions. Grazing systems with hot-season use in more than 1 year out of 3 or 4 met riparian habitat goals on only 5 of 21 streams. Grazing systems lacking hot-season use, or with no more than 1 year of hot-season use in 3 or 4 years, met riparian habitat management goals on 18 of 20 streams evaluated. Utilization or residual vegetation data were not available in this study.

Myers (1989a) also analyzed the duration of hot-season (July 1-September 15) grazing treatments to determine the corresponding impacts on riparian areas. He found that successful treatments averaged only 12.5 days, whereas unsuccessful treatments averaged 33.4 days. In this study, willow utilization data was available. The length of the grazing period was also important from the standpoint of physical damage, regardless of utilization or regrowth potential, because livestock watered frequently and they preferred shade while loafing. The impact of the duration of grazing on the success of the grazing treatment depended on vegetation and stream type.

LFO_RMP_10174

There are situations where hot-season use works well. Most of these examples employ other management tools and techniques to facilitate proper use of the riparian areas. Deferring use in a riparian pasture until the hot season extends the green-feed period of nutritious forage and may provide an economic incentive for better riparian management. However, duration of use needs to be restricted to avoid repeat defoliation, overuse, and streambank trampling. Swamp Creek, a tributary to the North Fork of the Malheur River in Oregon provides an example of hot-season use (Figure 41). It is deferred during early summer and grazed every year from July or August through September. A 4-inch stubble height is required at the end of the growing season. There is offstream water, in most pastures, and some herding to keep livestock from "camping" on the river. One pasture that hasn't been grazed by livestock for 5 years had browse use by wildlife on the sprouts and young willow and alder similar to that in the grazed pastures.

Figure 41. Swamp Creek, Oregon, 2004. (Photo by S. Leonard, retired, BLM.)

Hot-Season Grazing

Potential Advantages:

- Streambanks are more stable than earlier in the year.
- There is frequently sufficient riparian soil moisture to allow for regrowth.
- Riparian herbaceous vegetation may be more palatable and nutritious than desiccated upland plant material.
- Bird nesting and calving and fawning by native ungulates is usually completed.
- Fish spawning and incubation is completed for some species and has not started for others.

Potential Disadvantages:

- There is a greater tendency for livestock to remain and concentrate their use in the riparian area and stream channel.
- There may be reduced plant vigor and possible changes in vegetation communities.
- Tree and shrub species may be damaged.
- Animal performance may be reduced.
- Adverse fish-livestock interactions are generally the greatest due to the tendency of livestock to remain in the riparian area and the stream channel.
- Possible damage to riparian herbaceous vegetation, which is needed for canopy and instream cover, may occur.
- There is an increased potential for conflict with recreationists.

LFO_RMP_10174

d. Late-Season (Fall) Grazing

Deferment is the delay of grazing to achieve a specific management objective (Society for Range Management 2004). Skovlin (1984) suggests that deferring use until the late season (fall), until restoration of habitat is acceptable, offers a good measure of protection without great expense.

Fall use is usually less critical than summer use because many perennial plants are completing their storage of carbohydrates and no longer need active leaf area. Upland cool-season species may again produce palatable forage, which, together with cooler temperatures, may shift livestock use to the uplands and relieve grazing pressure in riparian areas.

Livestock are often assumed to leave riparian areas to use upland range in fall, but they may not. On one long glaciated U-shaped valley in Idaho, Platts and Raleigh (1984) found that a late-season grazing system helped restore riparian quality because livestock moved to the uplands in late summer and fall when a cold air pocket formed over the bottomlands. However, at another study site in a flat broad valley 15 miles away, livestock were drawn to the riparian areas during the late season because those areas contained the only remaining succulent vegetation. The orientation of the drainage (valley) can affect use by cows (e.g., south-versus east-facing slopes). Heavy fall riparian use can leave streamside vegetation depleted and banks vulnerable to damage from floating ice or spring runoff.

Deferring grazing until after seedripe can benefit sedge and grass communities if sufficient residual vegetation protects banks and retains sediment during the next high-flow event (Elmore and Kauffman 1994). Woody species utilization must be carefully monitored because during the later part of the hot season, livestock tend to concentrate in riparian areas. Such concentrated use was found to retard woody plant succession on gravel bars even though the diversity and productivity of meadow communities were maintained (Green 1991). Kovalchik and Elmore (1991) noted that systems with late-season grazing may be incompatible with willow management.

Late-Season (Fall) Grazing

Potential Advantages:

- Fish-livestock interactions depend on the climate and precipitation cycle. If the riparian area is working as a cold air sink, then the advantages resemble winter or spring use. If the riparian area is providing thermal cover, then the advantages resemble summer use.
- Most herbaceous vegetation has completed its growth for the season, thus making it less susceptible to overgrazing.

Potential Disadvantages:

- Livestock are more likely to browse woody species, which can limit canopy cover and recruitment of instream cover.
- Regrowth of vegetation needed for instream cover and stream function generally does not occur.
- There is a potential for livestock to impact fish spawning areas (species-dependent).
- Livestock distribution is poor.

e. Passive, Continuous Grazing: Spring-Summer, Summer-Fall, or Season-Long Grazing

In this document, the term "passive, continuous grazing" means grazing throughout the growing period with little or no effort to control the amount, duration, or distribution of livestock use in particular areas. Riparian areas will usually be overgrazed under passive, continuous spring-summer, summer-fall, or season-long grazing (Figures 42 and 43). During hot portions of the grazing period, riparian sites are usually preferred by livestock

LFO_RMP_10174

over upland sites on arid and semiarid ranges, as they provide water, lush forage, cooler air, shade, and relatively flat terrain. Until use becomes excessive, livestock do not need to spend as much time and effort to forage in riparian areas as they do on uplands to satisfy their daily nutritional requirements (Skovlin 1984). In Montana, during August and September, approximately 80 percent of the forage used by livestock may come from riparian sites, even though these sites often make up less than 4 percent of the total pasture (Marlow 1985).

Figure 42. An example of typical impacts from passive, continuous grazing. (Photo by Wayne Elmore, retired, BLM.)

Figure 43. Passive, continuous grazing can result in bank hoof shear, lack of vegetation on point bars, encroachment of dry-land vegetation, willows well above the channel elevation, heavily hedged willows, presence of only one age class of willows, lack of adequate vegetation for sediment entrapment and bank protection, and wide, shallow stream profile. (Photo by USFS.)

Passive, Continuous Grazing: Spring-Summer, Summer-Fall, or Season-Long Grazing

The advantages and disadvantages are not listed for passive, continuous grazing as this treatment rarely works well for the maintenance or recovery of riparian function.

f. Spring and Fall Grazing

Spring and fall grazing in the same year may work in some cases, but it usually fails to meet riparian vegetation needs because it adds the potential limitations of spring grazing to those of fall grazing. If temperatures are still warm when fall grazing begins, livestock concentrate in the riparian area while palatability of both herbaceous plants and willows is high. Appropriate use on willows can easily be exceeded, and residual vegetation for protection of banks during high flows is removed before uplands are grazed (Figure 44). Livestock preference for the riparian area is compounded the following spring because the absence of standing dry matter increases the palatability of riparian forage over ungrazed upland plants. Excess stress may be added to upland plants that are already grazed in the spring if fall use of riparian areas is avoided due to cold in the bottoms and the palatability of upland fall greenup. Careful monitoring of grazing and browse use is essential for the success of this type of grazing strategy.

Figure 44. An example of winter use on the left compared to spring and fall use on the right.

LFO_RMP_10174

Spring and Fall Grazing

Potential Advantages:

- Use of riparian vegetation is reduced due to live stock focus on nutritious upland plants in spring and avoidance of cooler bottom areas in late fall.
- There is time for growth of vegetation before and after use.
- The pasture may be used more completely, with some areas being preferred in one season and other areas preferred in the other season.
- The period of nutritious forage may increase by focusing animals on upland vegetation when it is palatable and on riparian areas at other times.
- The ease of livestock movement may offset a disadvantage of any required light use.

Potential Disadvantages:

- Use occurs during the herbaceous growing season and when riparian woody plants are often browsed.
- The banks may not be protected during high-flow events if use is excessive.
- Use occurs when soils are most compactable (spring) and when soil is susceptible to dry ravel (fall).
- There is more opportunity for livestock to disturb nesting, calving or fawning and to impact fish spawning in spring or fall.
- Use may need to be more limited or the duration shortened to avoid the added negative effects of spring and fall use.
- A use pattern set up in spring may be perpetuated with the same areas used in fall.

Successful spring and fall grazing was observed by the National Riparian Service Team on a private, irrigated riparian pasture in south-central Idaho. Factors contributing to success in this case included plentiful herbaceous forage, water availability throughout the pasture, and a short duration of use (approximately 2 weeks) in the fall. Ehrhart found similar successes in several places in Montana. **The critical point in these examples is that the owner or operator monitored use daily and moved livestock when target use levels were met**.

g. Deferred and Rotational-Deferred Grazing

Deferred grazing is the delay of grazing in a nonsystematic rotation with other land units, and rotational-deferred (deferred-rotational) grazing is a systematic rotation of the deferment among pastures (SRM 2004). Both strategies have been successful in restoring and improving riparian areas. Both strategies were found to be statistically similar in the amount of bank sloughing that occurred on nongrazed controls on Meadow Creek in northeast Oregon (Buckhouse et al. 1981). The common thread of successful application, except for riparian pastures used in a deferred strategy, has been to use many pastures to shorten the duration of use and provide greater flexibility. Many riparian grazing successes in Montana use from 7-38 pastures (Massman 1998). Masters et al. (1996b) concluded, "Four-pasture, five-pasture (or more) rotation schemes with no rested pasture may be more suitable to areas that require increased streambank vegetation. The additional pastures or smaller riparian pastures allow for a shorter grazing season and greater flexibility in rotation schedules." Figure 45 shows Van Duzer Creek around 1900 when it was turned upside down with intense mining and overgrazing. By 1982, recovery had taken place (Figure 46), but with a change to a five-pasture deferred rotation strategy, even more recovery occurred (Figure 47).

LFO_RMP_10174

Figure 45. Van Duzer Creek was turned upside down with mining and overgrazing around 1900.

Figure 46. Recovery on Van Duzer Creek had taken place by 1982.

Figure 47. A five-pasture deferred rotation strategy allowed even better recovery by 1991 on Van Duzer Creek.

Deferred and Rotational-Deferred Grazing

Potential Advantages:

- Riparian area livestock grazing and concentration does not occur every year.
- The grazing season is shorter and changes in the timing, frequency, and intensity of grazing decrease the likelihood of multiple defoliations of desired riparian plant species, allowing for longer periods of plant recovery.
- Livestock may be less selective in pastures where use is concentrated into shorter periods.

Potential Disadvantages:

- Every year livestock will be in some pasture when they are most likely to concentrate in riparian areas and damage riparian vegetation or stream channels.
- This may or may not be offset by recovery in other years when the pasture is grazed in a different season.
- With few pastures, the duration of the grazing season may be too long for some riparian areas.
- There is an added expense for fence and fence maintenance.
- Fences may interfere with wildlife movement.

Research at the Red Bluff Research Ranch near Norris, Montana, suggests that implementation of a grazing system based on seasonal preference for riparian and upland forage may be beneficial. In this area, livestock spend most of their time during June and July in the uplands, moving to the riparian sites in late July where they graze until October. Bank trampling damage is reduced by deferring grazing until after late July when soil moisture content has decreased to 8-10 percent or less. This system requires a minimum of three pastures and uses a 3-year cycle. Stocking rates in the pasture used first are based on forage available on both the upland and riparian sites. Stocking rates on the two pastures used later are based on 20- to 30-percent utilization of forage on the riparian sites. Although this may appear to drastically limit the length of time a pasture can be used, riparian zones usually produce three to four times the forage of upland areas. The regrowth potential of riparian species is great enough that, during most years, regrazing of the same pasture can occur at 30- to 40-day intervals until frost. Consequently, there is little, if any, change in the amount of forage a rancher has available to his livestock in the grazing season. Once the target level of use is reached, livestock are moved to the next pasture. Each pasture receives 2 years of deferment during periods when soil moisture exceeds 10 percent (June-July). The pasture used early the first year is grazed progressively later during the second and third years.

Marlow (1985)

h. Rest-Rotation Grazing (Rotational Stocking)

Rotational stocking is a grazing method that uses recurring periods of grazing and rest among two or more paddocks in a grazing management unit throughout the period when grazing is allowed. Words such as "controlled" or "intensive" are sometimes used in an attempt to describe the degree of grazing management applied with this grazing method. These words are not synonyms for rotational stocking (SRM 2004). Rest-rotation grazing is a management scheme in which rest periods for individual pastures, paddocks, or grazing units, generally for the full growing season, are incorporated into a grazing rotation (SRM 2004). Rotational stocking differs from rotational deferred grazing in that the rotation includes a year (or full growing season) with no grazing for each pasture at least once in each cycle. Hormay (1976) emphasized that each rest-rotation system should be designed to meet the resource needs of the area. The amount of rest, stocking rate, and season of use should be determined based on the growth requirements of all the vegetation present. Rest-rotation does not dictate heavy grazing under any treatment.

As with deferred and deferred-rotation strategies, a system that uses more pastures is usually better than one that uses fewer; however, in practical application, rest-rotation grazing frequently has been a three-pasture system. Cost and simplicity have often been factors in choosing a three-pasture system, and riparian objectives historically have rarely influenced pasture design and grazing strategy.

There are great differences of opinion on the value of rest-rotation grazing, as generally applied, in the proper management of riparian areas. Variation in ecological conditions and among stream types with different sensitivities to disturbance have contributed to mixed results of rest-rotation systems. Successes and failures have occurred, sometimes in the same management unit. Elmore and Kauffman (1994) cited 10 years of continued channel degradation in a high-gradient, high-energy stream system under three-pasture, rest-rotation grazing (Figure 48). Yet, in the same allotment, with the same system and the same livestock, another stream made an excellent recovery (Figure 49). The differences are due to stream type, sensitivity to disturbance, vegetation potential, and kind and amount of vegetation required

LFO_RMP_10174

to stabilize each stream. Rest-rotation favors herbaceous bank-forming vegetation, which is entirely adequate for the low-gradient stream depicted in Figure 49. However, the high-energy stream in Figure 48 continued to show a downward trend because of the lack of willows needed to stabilize the streambanks. Buckhouse et al. (1981) found no statistical difference in the amount of bank sloughing between a properly managed rest-rotation pasture and nongrazed control pastures.

Masters et al. (1996b) provide examples of two, three-pasture rest-rotation strategies in Nevada; one was successful, the other was not. The goals on Strawberry Creek (Figure 50) were to maintain healthy streamside vegetation and stable channel conditions. The continued success since the strategy was implemented in 1969 is attributed to cooperation among agencies and the permittee, inherently stable stream channel conditions, long-term attention to resource conditions, and careful herd management practices, including salt placement and livestock herding to improve distribution. On Wildcat Creek (Figure 51), past management had resulted in unstable, eroding banks and deteriorated ecological conditions. Applying a three-pasture, rest-rotation strategy in a degraded system without adjusting livestock numbers resulted in the overgrazing of two pastures, and one year of rest did not allow system recovery. In this case, temporary exclusion to allow a "jump start" in the recovery process was probably warranted. In addition to limitations imposed by the initial conditions, **specified herd management practices were not followed, upland water developments failed, and salt blocks were still placed near the stream channel.**

Figure 48. Higgins Creek, 1984. Channel degradation continued with 10 years of a three-pasture, rest-rotation system. (Photo by W. Elmore, retired, BLM.)

Figure 49. Beaver Creek, 1984. A three-pasture, rest-rotation system provided recovery of herbaceous bank-forming vegetation and associated channel characteristics. (Photo by W. Elmore, retired, BLM.)

Figure 50. Strawberry Creek, Nevada, maintained properly functioning riparian conditions with a three-pasture, rest-rotation system.

Figure 51. Wildcat Creek, Nevada, did not improve under the same kind of system.

LFO_RMP_10174

Rest-Rotation Grazing

Potential Advantages:

- Plants periodically receive a full growing season of rest for recovery.
- The duration of grazing season is shortened from season-long and frequency of defoliations is decreased.
- The combination of a shorter grazing season with occasional or frequent periods of no grazing within the growing season allows plants to prosper in most, if not all, years.
- The timing of pasture rotation frequently corresponds to grass phenology, and many riparian grasslike plants respond well to this treatment and timing.

Potential Disadvantages:

- Moving animals to a pasture after seed ripening on upland grasses will likely concentrate animals in the riparian area.
- Resting a pasture for a complete year will either add pressure to other pastures or require a decrease in herd size.
- Every year livestock will be in some pasture when they are more likely to concentrate in the riparian areas and damage riparian vegetation or stream channels.
- This may or may not be offset by recovery in other years when the pasture is grazed in a different season.
- With few pastures, the duration of the grazing season may be too long for some riparian areas.

i. Short-Duration Grazing

A short-duration grazing strategy is characterized by relatively short periods (days) of grazing and longer periods (week to months) without grazing. Periods of grazing and nongrazing are based upon plant growth characteristics. Short-duration grazing is separate from intensity of grazing use (SRM 2004). The duration may be short (a matter of a few days, but the intensity can vary depending upon stocking rate and the size of the grazing area.

Short-duration grazing prevents frequent defoliations within a grazing period by moving livestock frequently when plants are growing rapidly. With grazing periods as short as a few days, few if any individual plants will have regrown sufficient leaf material to be regrazed. Thus regrowing plants have full opportunity to recover from defoliation without further defoliation stress.

LFO_RMP_10174

Short-Duration Grazing

Potential Advantages:

- Plant root and shoot growth is less impacted with no or with only a few repeated defoliations.
- There are long periods of growth and recovery.
- Depending on the season of use, ground-nesting birds and other wildlife species needing shade and cover may benefit.
- There is decreased time of exposure to grazing and trampling.
- Enhanced monitoring by the livestock operator is required.
- Fly problems are decreased as the livestock rotation breaks the fly larvae cycle.
- There is a decrease in potential diseases and the livestock manager can provide earlier treatment for sickness or injury.
- Animals may be less selective, using more areas (better distribution) and more plants (more forage).

Potential Disadvantages:

- Cover for ground-nesting birds and wildlife may not be adequate during and right after grazing.
- Intensive management is required (frequency of monitoring and moving animals).
- There are high fencing requirements unless herding techniques are used.
- Mistakes in the timing of moves can lead to excessive grazing intensity with animal concentration.

Case Study: Short-Duration Grazing at Milesnick Ranch

Tom and Mary Kay Milesnick are the third generation on the Milesnick Ranch north of Belgrade, Montana. The ranch was purchased in 1936 and expanded over the years to the current 1,400 acres in the Belgrade unit and 4,800 acres of mountain pasture near Livingston, Montana. The Milesnicks raise Red Angus-Simmental cattle commercially.

From 1936 to 1970, all of the cattle were run in a single herd. They grazed a single pasture continuously and were fed supplemental forage during most of the winter months. From 1970 to 1991, the herd was rotated through three pastures, grazing each for 20 to 22 days, and resting each for 45 days before regrazing.

In 1992, Milesnick's interest in the environment led him to make some fundamental changes in grazing management on the home ranch. Public environmental pressures stressed a need for all riparian areas to be fenced from livestock use, but Tom wished to demonstrate that cows could effectively use the riparian areas on the "world-class fly-fishing streams" that run through his property. He began a 17-pasture short-duration system, with grazing periods ranging from ½ to 3-½ days and grazing up to five times per year in any one pasture with 250 cow/calf pairs. Two 12-hour pastures are grazed at night to accommodate fishermen who use the property during the day.

The short-duration grazing schedule has completely eliminated historical asthma problems in the cattle. Cattle gains have increased from 450 pounds to 675 pounds since 1972 because of genetics and short-duration grazing (Milesnick pers. comm.).

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The Milesnicks use a variety of tools to facilitate their grazing plan. They have installed water access points to decrease streambank trampling. Size depends upon how many animals are watered at one time. An 8-foot width has been sufficient if there are fewer than 175 head. They also use spring water to provide offsite water 50 feet from a meandering stream on the Livingston unit to decrease the amount of time cattle spent in and along the stream channel (Figure 52).

Milesnick strives for a 6-inch stubble height on sedges and rushes when removing cattle from the pasture. He does not manage stubble height on Kentucky bluegrass as it is not the primary (key) species. He attempts to leave adequate leaf material for photosynthesis to occur on key plant species for plant vigor and maintenance and to provide more shade for fishery habitat.

Milesnick also recognized the need to diversify his operation and started the Milesnick Recreation Company in 1999, which provides fee fishing (Figure 53), waterfowl hunting, and archery elk hunting. The Milesnicks are managing the vegetative resources for fish habitat. Fishing and hunting supply approximately 5 percent of the gross profits of the ranch, but the fishing and hunting operation yields an 80 percent net profit.

Figure 52. Offsite water from a spring has allowed this stream channel at Milesnick Ranch, Montana, to heal.

Figure 53. Cattle grazing on a blue-ribbon trout stream at Milesnick Ranch in Montana. (Photos on this page by T. Milesnick.)

LFO_RMP_10174

j. High-Intensity, Low-Frequency Grazing

High-intensity, low-frequency grazing strategies are multipasture, single herd systems (USDA NRCS 2003). Stock density is high to extremely high; however, the length of the grazing period is moderate to short, with a long rest period. Dates for moving livestock are set by the use of forage, and grazing units typically are not grazed the same time of year each year. The number of grazing units and grazing capacity of each unit determines how often, if ever, the same grazing unit is grazed during the same period of the following year (USDA NRCS 2003). Intensive grazing management attempts to increase production or utilization per unit area or production per animal through a relative increase in stocking rates, forage utilization, labor, resources, or capital. Intensive grazing management is not synonymous with rotation grazing (SRM 2004).

Unlike short-duration grazing, use periods are not based on the rate of plant growth. However, grazing periods may be short. The purpose of high-intensity grazing is to avoid use patterns, overresting of plants adapted to herbivory, unused forage, and favoring of less palatable plants. With all or most plants used well, forage plants have an equal opportunity to recover. This diminishes tendencies for increasers to outcompete decreasers. The low frequency is provided by having many pastures and long recovery/growth periods. Desirable forage species often benefit from this grazing system, but animal nutrient intake and corresponding livestock performance usually decline because the forced higher utilization levels reduce selectivity (Hart et al. 1993, Pfister et al. 1984, Pieper et al. 1978, and Smoliak 1960).

Trlica et al. (2000) found that in a montane riparian ecosystem along a small headwater stream in northern Colorado, heavy grazing may result in increased nonpoint source pollution if grazing occurs in close proximity to the stream. Runoff rates from heavily grazing plots were 70 percent greater than runoff rates from ungrazed control plots.

High-Intensity, Low-Frequency Grazing

Potential Advantages:

- Long periods of rest are allowed.
- Ground-nesting birds and other wildlife species needing shade and cover may benefit, except during or soon after intensive use.
- There is decreased time of exposure to grazing and trampling.
- Enhanced monitoring by the livestock operator is required.
- Fly problems are decreased as the livestock rotation breaks the fly larvae cycle.
- There is a decrease in potential diseases.
- The livestock manager can provide earlier treatment for sickness or injury.
- The long period of rest provides for adequate litter and ground cover.
- The competitive advantage of unpalatable plants is reduced.

Potential Disadvantages:

- Adequate cover for ground-nesting birds and other wild life may not be available during and right after grazing.
- Intensive management is required (frequency of moving animals).
- There are high fencing requirements unless herding techniques are used.
- Soil compaction is possible if grazed when soils are wet.
- High intensity in the fall may fail to provide adequate vegetation cover for trapping spring sediment.
- High levels of grazing intensity may reduce livestock performance.
- Heavy grazing may result in reduced stream water quality if grazing occurs in close proximity to the stream (Trlica et al. 2000).

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Case Study: High-Intensity, Low-Frequency Grazing at Banister Ranch

The Ray Banister Ranch is located in Wibaux County in eastern Montana. Banister manages 5,500 acres of private rangeland by using a high-intensity, low-frequency grazing strategy (what Banister calls "Boom-Bust") that consists of intensive periods of grazing followed by two growing seasons of rest (Provenza 2003). He uses half of his 38 pastures each year (Massman 1998). Although pasture sizes differ, each pasture is grazed heavily by the herd for about 20 days every other year. This method stresses soils, plants, and herbivores with intensive grazing pressure and then allows them to recover. High-intensity grazing allows the cattle to open up thick patches of brush. Once sunlight penetrates dense, brushy areas, grasses can compete better with noxious weeds. This type of "hard hit" on a pasture helps trample grass seed into the soil and makes room for the establishment of new seedlings. Banister found that after providing a long rest, it is not necessary to vary the season of grazing, and the short amount of time in each pasture decreases the opportunity for regrazing individual plants. He also allows light grazing of the pastures during dormancy. Banister worked with the Natural Resources Conservation Service to develop livestock water (Figure 54), pasture and hayland renovation, and cross fencing.

Banister feels that the riparian areas are healthy because the high-intensity, low-frequency strategy allows 23 months of rest (Figure 55). Riparian vegetation becomes rank, palatability is lower, and cattle preference increases for plants on the uplands increases (Banister pers. comm.).

Banister's Hereford cattle had to adapt from eating the most palatable plants that were available to eating all the plants. The 220 cow/calf pairs, 20 heifers, and 10 bulls are allowed to move only when they have used high levels of the least palatable plants (sagebrush, snowberry, and various weeds). This reduces the competitive advantage unpalatable plants have over more preferred plants. It took Banister's cattle 3 years to adapt to this style of management. Weaning weights of calves plunged from well over 500 pounds to 350 pounds, and then rebounded back to over 500 pounds. Weight gains or losses will vary depending upon the situation, current health of livestock, and livestock requirements. Banister recommends allowing a minimum of 3 years to allow livestock to adapt to new management changes before deciding whether the strategy will or will not work. "There is no control over anything in riparian areas. There are too many variables, so the best strategy is to follow the rules of proper management" (Banister pers. comm.).

Banister has found that this grazing strategy is beneficial for a large variety of wildlife species, including mule deer, white tail deer, antelope, greater sage-grouse, Columbian sharptailed grouse, and ring-neck pheasants, and many other bird and wildlife species, as well as the health of his land (Banister pers. comm.).

Figure 54. Excellent wetland vegetation along a stockwater pond under high-intensity, low-frequency grazing system at Banister Ranch in Montana. (Photo by R. Banister.)

Figure 55. Willows after grazing under a high-intensity, low-frequency strategy at Banister Ranch in Montana. (Photo by R. Banister.)

LFO_RMP_10174

k. High-Intensity, Short-Duration Grazing

High-intensity, short-duration grazing management is used to concentrate animal impacts in time and space, thereby avoiding regrazing and overresting of plants adapted to herbivory. This treatment copies the short-duration idea of not regrazing a plant during a grazing period by moving animals faster during rapid growth. It also uses the high-intensity idea of grazing all or most plants severely so that regrowth is balanced among species. To do this well requires appropriate numbers of animals to balance the forage available with the proper timing and desired use level. This treatment often uses many more pastures than high-intensity, low-frequency or short-duration grazing, so animal numbers must be sufficient in order to still meet goals, because use periods can be very short. Depending on how well it is planned and implemented, this technique can be good for riparian management.

High-Intensity, Short-Duration Grazing

Potential Advantages:

- The positive plant regrowth opportunities of short duration are combined with the positive plant stimulus and equal recovery benefits of high intensity.
- Riparian concentration is diminished with more equal use of the uplands.
- Depending upon the season of use, riparian vegetation recovery is possible over an extended period due to availability of soil moisture.

Potential Disadvantages:

- Residual cover for ground-nesting birds and other wildlife may be inadequate immediately after grazing.
- High-intensity use after the growing season may leave riparian areas with little cover for trapping sediment during high-flow events.
- Stocking rates need to be adequate for proper intensity of use of vegetation, which varies depending upon amount and timing of precipitation.
- Intensive management and an increase in fencing (unless low-stress stockmanship is used to move livestock) are required.
- Livestock performance may suffer if grazing intensity levels are sufficient to reduce animal selectivity.

LIFO_RMP_10174

Case Study: High-Intensity, Short-Duration Grazing at Deseret Ranch

High-intensity, short-duration grazing has been used to improve general range and riparian conditions on the Deseret Land and Livestock Company Ranch in northeast Utah. Prior to implementation of this method, much of the rangeland on the ranch was in a deteriorated condition (Secrist pers. comm.). Sagebrush filled many gullies in the lower elevations. Muddy water flowed in the drainages during snowmelt or following heavy rains. Riparian herbaceous vegetation was absent in most drainages and no willows could be found.

A high-intensity, short-duration grazing program was initiated on the ranch in 1979, with the objective of making a profit while improving the health of the range. Because grazing animals were originally part of the ecosystem, livestock were chosen as the tool for accomplishing this objective. Cattle, sheep, elk, and buffalo are managed to control the timing and duration of grazing, as well as animal impact. Adaptive management is practiced by evaluating research and monitoring information, applying rangeland restoration projects, and revising the grazing strategy as needed (Danvir pers. comm.).

Flexibility in time control has been achieved by grouping animals into large herds (from 2,000 yearling heifers to 5,000 cow/calf pairs and 2,000 yearling steers) and creating more pastures through fencing. Three cattle herds and two bands of sheep use 100 pastures on the ranch. Depending on range conditions, vegetation, and economic goals, pastures are used one to three times per year; the majority is only used once and usually receives more than 12 months of rest. Stock density has ranged from 0.5 to 3.5, depending on pasture size. Time in each pasture is determined by how fast plants are growing. When growth is rapid, pasture moves are frequent. When growth is slow, the livestock stay longer in each pasture. When plants are dormant, lack of forage and animal performance determine when livestock are moved. Time in each pasture has ranged from 3 days (during rapid growth) to 60 days (during dormancy). During the growing season, the grazing animals are moved from pasture to pasture in an attempt to graze each plant only once, and then allow it to recover from the effects of defoliation before it is grazed again. Sheep and cattle are moved by herding; however, most cattle have learned to move to the next pasture (with their calf at their side) when gates are opened (Danvir pers. comm.).

The Deseret Ranch manager believes that animal impacts resulting from herding include: (1) hooves break up soil crusts, enrich soil, and provide cover by incorporating manure, litter, and seeds into the soil surface (this can be detrimental in areas where microbiotic crusts are an important component), (2) urine adds urea to the soil, (3) hoof prints create seedbeds and pockets for collection of litter and precipitation where seeds are pressed into contact with mineral soil, and (4) grazing, trampling, crushing, etc., prune plants to stimulate new plant growth. New plants result in additional pathways for water to get into the soil reservoir where it is stored, purified, and slowly released into riparian areas. Animal impact, when properly managed, is very important to the health of these rangelands. The herding effects, particularly the hoofprint seedbeds, improve microsite conditions for the germination of seeds and establishment of seedlings, which can be the weakest link in the natural function of many range ecosystems.

The ranch manager believes that this method of grazing results in an increase in ground cover, water infiltration, and soil moisture and restores some of the natural hydrologic function to the watershed. Riparian vegetation has reestablished in the drainages, serving as a sediment trap that raises the water table. As this process continues, the bottom of the drainage rises in elevation, thus deepening and widening the riparian aquifer. As a result, riparian vegetation expands into the edges of the uplands and floods sagebrush.

LFO_RMP_10174

Clear water flows year-round, and willows have established themselves where they did not exist before. The streambed in one drainage has raised more than 6 inches in elevation. Gully banks are slumping and are being vegetated by riparian plants. Sagebrush is dying where the riparian areas expand. Though precipitation and runoff were far above normal, the additional ground cover in the uplands and the improvement in the riparian habitat prevented significant erosion damage on the ranch in spite of increased stocking rates (Table 4) (Simonds pers. comm.). The ranch continues to sustain higher stocking levels of cattle and elk than in 1979 (Danvir pers. comm.).

Table 4. Stocking levels on the Deseret Land and Livestock Company Ranch.

	1979	1986	2005
Cattle	4,500	10,460	9,000
Sheep	12,000	10,000	3,000
Elk	350	1,500	2,300
Buffalo	0	230	0

Case Study: High-Intensity, Short-Duration Grazing at Rio Oxbow Ranch

The Rio Oxbow Ranch in the San Luis Valley of Colorado is owned by Alan and Patricia Lisenby and managed by Dale and Anne Pizel. The 1,600-acre ranch is located at the headwaters of the Rio Grande and borders the Rio Grande National Forest in the San Juan Mountain Range.

The Lisenbys and Pizels use a time-controlled grazing strategy to maintain and restore properly functioning riparian areas. Their primary objectives are to improve the riparian areas, fisheries for fly fishing, and wildlife habitat. The ranch was rested from 60 years of overgrazing for 5 years along 6 miles of the Rio Grande River (Figure 56). Intensive grazing through 6 pastures with 1,000 cow/calf pairs of the neighbor's cattle began in the fall of 2000. The cattle graze in the spring or fall, which has proven effective in transforming vertical river banks to more normal angles of repose and stimulating new plant growth of riparian grasses, willows, and cottonwoods (Figure 57). Noticeable results occurred in the first year. The riverbank stabilized and the rocky shoals, which had no growth for many years, sprouted numerous willows throughout the river's 6 mile reach (Pizel pers. comm.). Livestock are turned in around June 10 and again around October 10 and are in each pasture 2-5 days. The dates are adjusted according to weather conditions (drought) and USFS adjustment of turn-in dates. They also try to rest each pasture every couple of years.

Riverbank stabilization and wildlife enhancement projects were completed with the help of the NRCS Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Improvement Program (WHIP) (Blenden 2003). Projects included installation of rock barbs and extensive willow and cottonwood plantings. Pizel found that most of the willows died and undercutting of the reshaped banks occurred. It wasn't until livestock were used that recovery started to occur. Minimal fencing to allow for better control and use of the riparian area and to maintain a wildlife-friendly ranch has been installed. Fencing allows for careful control of the time and timing of grazing, which aids in riparian function improvement.

LFO_RMP_10174

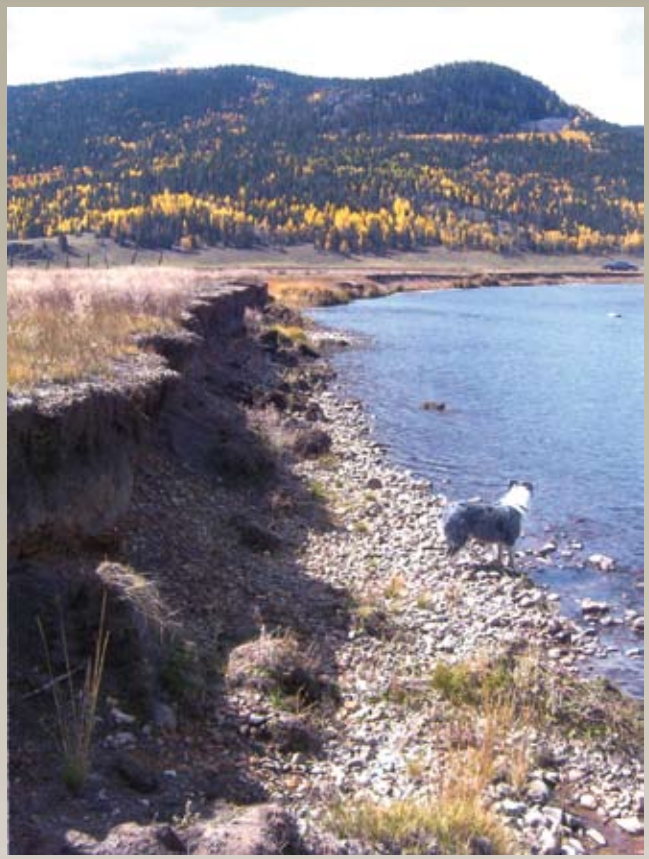


Figure 56. Rio Oxbow Ranch, Colorado, after 5 years of rest from overgrazing (2000).

Figure 57. Rio Oxbow Ranch, Colorado, 3 years later (2003), with grazing. Young age class willows are present. (Photos by D. Pizel, Rio Oxbow Ranch.)

The Rio Oxbow Ranch is an example of using livestock to improve wildlife habitat and riparian area function. "Livestock are a tool, just like a hammer is a tool. If you hit your thumb with the hammer, you are using the tool incorrectly. The same analogy can be said of livestock grazing" (Pizel, pers. comm.).

The effects of this grazing treatment are strikingly evident in photos of two pastures on the ranch. "Both pastures had not been grazed for 5 years. This is spring on the exact same day, a couple of hours apart. The brown pasture (Figure 58) had not been grazed the year before. The green pasture (Figure 59) was grazed with 1000 pair for 30 days, the fall before. Again this is the same day, different sides of the fence, in very comparable environments. It is May 1st and as you can see one side has a good start on summer, and at 9000 feet that is important. What was shocking to me was the life. The brown side of the ranch appeared dead, it even smelled bad. There were no elk, birds, ducks, bugs, and frogs; there was silence. I would not let my children touch it. On the green side the life was deafening. There were ducks that refused to leave, water insects, and the frogs were quite honestly deafening. They were loud. They were everywhere! My little girls took their pants off and went wading, (swimming, when they were done). It was life re-born! They had moved back in, in one season. We really have to manage the elk now as they are causing overgrazing; they won't leave" (Pizel, pers. comm.).

LFO_RMP_10174

This type of change can occur when decadent and dead plant material is removed exposing plants to solar energy, allowing for earlier greenup. Insects, amphibians, waterfowl, and wildlife are attracted to the exposed green leafy material.

Figure 58. A pasture at Rio Oxbow Ranch, Colorado, that was not grazed the previous year lacked flora and fauna vigor and life.

Figure 59. In another pasture at Rio Oxbow Ranch, Colorado, livestock grazing removed dead material, exposing new, growing leaf material. (Photos by D. Pizel, Rio Oxbow Ranch.)

l. Rest

Depending on the riparian area objectives, available tools and finances, and time prescribed for achieving objectives, temporary nonuse may be the best alternative for realizing the most rapid improvement. A deteriorated riparian area with few trees or shrubs, or one where the objective is to get woody plant regeneration above the reach of livestock, may require rest, at least for a few years (Davis 1982).

Skovlin (1984) found that exclusion of livestock has produced improved riparian and aquatic habitat following 4 to 7 years of rest, woody plant (shrub) recovery following 5 to 8 years of rest, a doubling of fish biomass following 3 to 5 years of rest, and attendant positive responses in birds and small mammals. A study on Big Creek in northeast Utah concluded that a minimum of 6 to 8 years of rest was necessary to restore a deteriorated streamside riparian area to the point where livestock grazing could be allowed at reduced levels (Duff 1983). However, substantial recovery of streambanks and vegetation was observed following 4 years of rest from grazing through the use of fencing.

Elmore and Kaufmann (1994) state that riparian exclusion should only be used in conjunction with an upland management plan designed to restore the entire landscape or when there are situations where the most rapid recovery possible is necessary (i.e., for habitat restoration of federally listed threatened or endangered salmonids).

LFO_RMP_10174

Rest

Potential Advantages:

- Plants are not affected by herbivory, and streambanks are not affected by livestock trampling.
- Woody riparian plants are allowed to reach escapement height.
- There is a quick recovery period, especially in the first few years after grazing is eliminated.
- Areas outside that are still grazed can be compared and evaluated.
- Residual vegetation may be used as cover by fish and wildlife.
- The time to build up fuel for prescribed burns in riparian areas is decreased.

Potential Disadvantages:

- Plants may become decadent with rest.
- Nutrients can become tied up and residual plant material can impede light getting to young seedlings and sprouts.
- The rested area may attract wildlife and replace livestock herbivory, so goals and objectives may not be met.
- Without herbivory, some plants become less palatable, and residual dead vegetation can prevent wildlife foraging on live material.
- Some weeds may flourish in the absence of grazing as a biological control.
- Economic hardship may occur.

m. Riparian Pasture

Riparian pastures are designed to protect riparian values. They may be smaller areas of rangeland containing both upland and riparian vegetation that are managed together as a unit to achieve riparian objectives, or they may be streamside pastures containing only riparian vegetation.

In riparian pastures containing both upland and riparian vegetation, the balance of forage between upland and riparian areas is important. Forage in the upland sites should not limit proper distribution or use. For example, there should be enough forage in the upland and riparian areas so that livestock do not overgraze either when managed for overall appropriate use. Forage balance may vary with changes in forage preference, depending on season of use and kind or class of livestock.

Platts and Nelson (1985) found that on six 10-acre pastures in Idaho, Nevada, and Utah, the timing and location of grazing in specially managed riparian pastures could be controlled much more effectively than in large allotment pastures, providing an easier way to make grazing compatible with other resource uses. Using riparian pastures offers alternatives to eliminating livestock grazing and fencing riparian boundaries, which can be costly. By experimenting with different types of riparian and upland range, different sizes and shapes of pastures, and different ratios of riparian forage to upland forage, it may be possible to efficiently graze riparian vegetation without damaging this sensitive area. In mountain meadow ranges, special management pastures would need to be larger to better match the costs of fencing with benefits derived from improved riparian and fish habitat. The influence of a livestock herd's home range on grazing use requires careful analysis; pastures may have to be larger than a herd's home range in less productive ecological types, in which case, techniques to draw the herd to all parts of the pasture are essential. When fencing narrow streamside corridors or eliminating livestock are the only alternatives for maintaining productive riparian and aquatic habitats, the cost of special management pastures may not seem exorbitant.

Riparian pasture use is applicable in areas where riparian areas encompass a large enough area to be managed

LFO_RMP_10174

separately from uplands (Elmore and Kauffman 1994). Each riparian area may be managed individually or in combination with other allotments or pastures and can be grazed or rested depending on current conditions and stream riparian needs (Elmore and Kauffman 1994). Riparian pastures can be used seasonally, in conjunction with rotation strategies, or as special-use pastures (e.g., gathering pastures, horse pastures, bull pastures). Considerations when developing riparian pasture designs include:

- Desired grazing period and duration.
- Ability to control use of riparian area.
- Benefit to degraded stream types.
- Cost of installation and maintenance (including possible offsite water developments).
- Ability to meet livestock manager objectives.
- Inclusion of upland area in pasture to decrease pressure on riparian area.
- Need for close monitoring to avoid switch from livestock grazing to browsing.

Figures 60 and 61 show results of a change from season-long use on the North Fork of the Humboldt River in Nevada in 1994 to a riparian pasture for use by yearling bulls and cows for several weeks between late April and late June. Figure 62 shows continued recovery through 2004.

Figure 60. North Fork of the Humboldt River, Nevada, 1989.

Figure 61. North Fork of the Humboldt River, Nevada, 1994.

Figure 62. North Fork of the Humboldt River, Nevada, 2004. (North Fork photos by C. Evans, BLM.)

The Goosey Lake Flat (Nevada) riparian pasture (Figures 63 and 64) has generally been used as a gather or turnout pasture since it was changed from continuous, season-long use. The grazing plan calls for use in early June for 1 year out of 3 and for 2 weeks in September for gathering during the remaining 2 years (Masters et al. 1996b).

LFO_RMP_10174

Figure 63. Goosey Lake Flat Creek, Nevada (1965).

Figure 64. Goosey Lake Flat Creek, Nevada (1991). (Goosey Lake Flat Creek photos by BLM.)

Riparian Pasture

Potential Advantages:

- There is closer management and control to achieve goals and objectives.
- It is possible to graze these pastures more fre quently, but they should be evaluated on a case-by-case basis.
- A riparian pasture can be used as seasonal pasture, in conjunction with rotational strategies, or for a special use (i.e., ultimate flexibility without forgo ing use of uplands).
- Upland use objectives can be met without sacrific ing the riparian resource condition.
- Use of the riparian area is allowed.

Potential Disadvantages:

- It is often short in duration.
- Close management is required.
- Riparian areas may provide the only water for sur rounding uplands.
- Riparian fences without a proper design can be a problem for recreationists and wildlife.
- The amount of upland needed to prevent upland overuse within the riparian pasture must be care fully determined.
- Topographic features may inhibit development of riparian pastures or employing other practices.
- Fencing may be more expensive than for a riparian exclosure due to size.

LFO_RMP_10174

E. Monitor Vegetation

1. General

No discussion of grazing management would be complete without addressing monitoring. Once objectives have been established and a grazing strategy selected and implemented, the only way to evaluate whether or not objectives are being achieved is through monitoring. All stated management objectives require some strategy for monitoring their attainment. Likewise, all monitoring should tie directly to the analysis and accomplishment of specified objectives. This may seem obvious, but an analysis of 20 public land grazing allotment management plans in northeastern California and northwestern Nevada found that none combined all the elements of a systematic process by linking goals, issues, and objectives with action, monitoring, and evaluation (Olson 1989 and Olson and Burkhardt 1992).

Olson stated, "Management objectives, overall, were not measurable or realistic, providing no solid vegetative benchmarks for determining management successes. In the cases where management objectives were both measurable and obtainable, the supporting monitoring studies and evaluations were incomplete." Other subsequent program reviews have identified similar problems in virtually every location to one degree or another. Monitoring that has no direct relationship to objectives is a frequent problem that increases costs and usually detracts from necessary monitoring and administrative tasks. Private land monitoring plans also have similar problems, although public land situations may be more complicated due to budgets, personnel, administrative needs, and so on.

Due to seasonal, annual, and cyclic events such as fire, insect infestations, disease, weather, and associated hydrologic phenomena, success in grazing management depends on adaptive management. Adaptive management treats each management practice as an experiment and evaluates and adjusts the practice over the short- and long-term. Monitoring plans should include implementation (within season and end-of-season) and effectiveness (mid- and long-term) strategies to support adaptive management. Implementation monitoring includes annual documentation of implementation activities, events, and interpretive measurements (annual indicators) or observations of effects that influence progress toward objectives. Effectiveness monitoring documents achievement of and should measure trend toward objectives, usually over a period of years. Many agency, interagency, and cooperative extension references guide the planning, method selection, analysis, and interpretation of monitoring data. Therefore, the following discussion will present general concepts common to all and primarily address vegetation monitoring. Initial baseline data may also include channel morphology and stream measurements and macroinvertebrate inventories to evaluate water quality (Rasmussen et al 1998).

a. Key and Critical Areas

In many grazing operations, riparian areas, or portions of riparian areas, are "key areas" for management, and their condition may indicate whether grazing management is proper for the entire pasture or operation. In other cases, riparian areas may be "critical areas" for management of site-specific concerns and objectives. In critical areas, proper management may severely limit upland use from what would otherwise be acceptable. Key areas and critical areas must be differentiated for analysis and subsequent management recommendations.

When selecting key areas to be monitored, consideration should be given to how these areas represent the use that is occurring and the objectives to be reached. Collectively, key areas should possess (or have the potential to produce) all the specific elements contained in the objective(s) because these will provide data for evaluating all management efforts. In many cases, it is appropriate to first select the key areas that represent important or common resource values, situations, and general goals, and then develop objectives specific to each.

Stream reaches that are functional–at risk, with an unapparent or downward trend that can be attributed to livestock use, often are prime candidates for designation as key areas. The limiting factors to proper functioning condition can guide the selection of attributes to monitor, as well as needed management changes. For example, if adequate vegetative cover is the primary limiting factor, then the objective and long-term monitoring may focus on the percent of the greenline in riparian species. Short-term monitoring would focus

on incidence of use on those woody species or stubble height on those herbaceous species that would expand next along the greenline or possibly in adjacent flood-prone areas. Monitoring the dates of use, kind and class of animal, and other management factors would help interpret long-term trends relative to short-term results and help adjust management toward desired conditions. Limiting factors to PFC can also help determine locations to monitor. For example, along a stream with little floodplain access due to incision, the best place(s) to monitor would be where the incision had already widened. Newly formed floodplain or floodable areas that could become a vegetated floodplain are appropriate locations as well.

b. Key Plant Species

Key plant species are forage plants that indicate the degree of use on associated species and those species that must, because of their importance, be considered in the management program (Interagency Technical Team 1996). In riparian areas, key species selected for monitoring should be necessary to natural stream functions, directly related to vegetation management objectives, and sufficiently abundant to respond to management and meet those objectives. Key species for riparian areas should have root masses capable of withstanding high-streamflow events. These plants are most commonly the more robust sedges, rushes, and bulrushes, as well as a very few grass species such as bluejoint reedgrass. Bluegrass species, most tame pasture grasses, or forbs typically do not root to an adequate depth or produce a root mass dense enough to withstand high-streamflow events.

Manning et al. (1989) compared the length and mass of roots of four species: Nebraska sedge, Baltic rush, Douglas sedge, and Nevada bluegrass. The results showed a significantly higher (remarkably so) amount of roots under Nebraska sedge compared to the other species, especially Douglas sedge and Nevada bluegrass. Nebraska sedge contained over 200 cm of root length per cm3 of soil. This translates to over 22 miles of roots in a column of soil 12″x12″x16″, making these plants effective in protecting streambanks and riparian areas. Douglas sedge was similar to Kentucky bluegrass and Nevada bluegrass, as expected of an upland species, had fewer roots. There was also a significant difference in root mass, with Nebraska sedge having the greatest root mass, followed closely by Baltic rush and then Douglas sedge. Although having much less root length, Baltic rush has a much higher root mass per length with more rhizomes and coarser roots than the other species.

Understanding the physiological and ecological requirements of key species (whether woody or herbaceous) is essential to designing a proper management program (Thomas et al. 1979, Winward 2000). In addition, the grazing impacts on the particular growth characteristics of the species involved and the probable outcomes of plant community and channel change from the plant species requirements need to be determined.

Key plant species may differ with the potential of each individual site. A mix of vegetation increases channel roughness and dissipates stream energy. Willows and other large woody plants filter larger water-borne organic material, and their root systems provide bank stabilization. Sedges, rushes, grasses, and forbs filter out and capture finer materials, while their root masses help stabilize banks and colonize deposited sediments. On sites with potential for both woody and herbaceous vegetation, the combined plant diversity greatly enhances stream function.

Additional plants away from the greenline may also be key species because of their unique resource values, e.g., aspen and subirrigated meadow species. Cross sections, utilization measures, or other methods can be used to monitor these areas away from the greenline. Ecological site descriptions and plant community classifications may aid in determining key species for a particular site.

c. Unusual Events

Monitoring studies require documentation of important unusual events such as fire, insect or disease infestations, severe weather, and associated hydrologic phenomena. Such effects must be distinguished from the effects of grazing when making evaluations. Fires, floods, and droughts have beneficial and detrimental effects on riparian plant communities and channel characteristics.

Wildfire effects can promote riparian health and restoration as well as create many riparian problems. Fire, depending upon the intensity of the burn, may kill the vegetation in the upland and riparian area.

LFO_RMP_10174

The accumulation of too much fuel can increase fire intensity and watershed effects leading to debris flows and flooding. Flood damage is likely to be more severe where riparian vegetation has been consumed in hot fires fueled by accumulated wood. The removal of litter and canopy cover may increase water runoff and sediment from sheet and rill action into the stream system from the watershed. Fire may also open up the canopy, allowing new herbaceous growth, and initiate new plant suckering of various woody plant species (willows and cottonwoods). A prescribed burn plan should evaluate the current conditions and the effects of too little or too much fuel in any given situation. Livestock may be used to reduce an overabundance of fine fuels to reduce the heat of a fire.

Floods may widen channels and increase width/depth ratios, which is generally not beneficial. However, floods may also redistribute sediments to floodplains, recharge shallow aquifers, and initiate recruitment of many plants (especially willows and cottonwoods) depending on timing, discharge, channel shape, and floodplain access. Key points to be considered in monitoring are:

- whether or not livestock management before or after a flood led to additional widening or to the capture of sediment along banks and the formation of appropriate channel features
- whether the grazing strategy allowed for establishment of plant species that depend on floods for recruitment

Droughts increase moisture stress on plants and tend to cause livestock and wildlife to concentrate in riparian areas even more than they normally do. Pastures slated for rest are sometimes grazed during periods of drought. However, low flows associated with droughts reduce the stress on streambanks, and there is often enough water in channels to continue to support hydric, bank-forming vegetation. Given the opportunity, most perennial vegetation aids in channel narrowing and bank building with fine sediments transported after reduced flows. Key points to be considered in monitoring are

- whether or not the timing, intensity, and duration of grazing during the drought allowed for plant colonization and stabilization of exposed banks or wide channel edges
- whether the grazing strategy left enough residual vegetation (or regrowth) to trap and retain fine sediments for bank building

2. Implementation Monitoring

Implementing a grazing system as planned is critical. The best management plan is likely to fail if it is not properly implemented. However, it may also fail if it is blindly followed without consideration of, and modification in response to, changing conditions such as within-season precipitation patterns or temperature regimes that are different than those expected. Deviations in the grazing plan should be documented to evaluate the effectiveness of management changes and to avoid criticism of a planned grazing strategy that was not used. Implementation monitoring, which includes within-season monitoring and end-of-season monitoring, is essential to successful adaptive management.

a. Within-Season Monitoring

The manager needs to document whether livestock are in the right place, at the right time, in the right numbers and that any additional measures necessary to improve distribution, such as use of offsite water, supplements, or riding, are being recorded. For example, when livestock are moved from a management pasture, it is often easy for a few animals to be overlooked. If a few undetected livestock remain or drift back to a grazed pasture through faulty fences or ineffective natural barriers, they can quickly "undo" any progress that deferment or rest might have accomplished. It only takes a few days or weeks of unplanned use or overgrazing to set back years of progress in improving riparian areas (Duff 1983). In one stream, Myers (1981) found that annual use by a few head of livestock left in the pasture throughout most of the hot season had nullified positive riparian habitat responses of an otherwise excellent grazing system. When such things happen, they should be recorded to ensure proper interpretation of other monitoring results. Trigger indicators that define when livestock should be moved should also be noted. These indicators include stubble height, streambank alteration, or use of willows or other important riparian species.

b. End-of-Season Monitoring

Along with documenting annual timing, frequency, and duration of livestock use, endpoint indicators should be considered as a means to assess resource impacts of current-year grazing. Endpoint indicators provide information to help determine if the annual timing, frequency, and duration of livestock use **appear** to be appropriate in relation to desired objectives. As such, they are not purely for implementation monitoring, but rather, they help bridge the gap between pure implementation monitoring and effectiveness monitoring. The critical time for discussing triggers is at the end of the growing season when the results become apparent. Without end-of-season monitoring, there is no timely way to verify that the established trigger ensures that the stream and associated riparian area will be in a condition that remains steady or is moving toward management objectives. Although other monitoring procedures that measure such parameters as vegetative cover, composition, and channel morphology are useful in establishing trend over the mid- to long-term (at least 3–5 years, up to decades), endpoint indicators can help determine whether current-year management has been appropriate.

As discussed previously, livestock grazing primarily affects riparian areas and stream systems through herbivory or direct mechanical damage (both to plants and streambanks). The most appropriate endpoint indicators for stream and riparian areas measure vegetation (herbaceous or woody riparian species) that can protect and build streambanks and evaluate any mechanical damage that can leave streambanks vulnerable to the increased energies experienced during high flows. The appropriate time to measure and evaluate endpoint indicators is typically after the end of the current growing and grazing season and before the next high-flow event that may reach or exceed the bankfull stage, often the following spring. The following elements should be considered when choosing triggers and endpoint indicators:

1. Measure residual vegetation height on preselected **key riparian species** on the greenline (not the average height on all herbaceous species).
2. Measure residual vegetation height **and** percentage ground cover on drier riparian "islands" within the riparian area, where species such as Kentucky bluegrass dominate settings away from the greenline, if these areas were identified by management objectives.
3. Record incidence of use on key riparian woody browse species (trees and shrubs).
4. Record streambank alteration as a result of livestock grazing (bank trampling).
5. Measure residual vegetation height or utilization of selected herbaceous species or incidence of use of key woody species in **upland settings**, such as threatened and endangered species or regenerating quaking aspen where they need special concern and attention.

Note that the above list expands the focus beyond the greenline, including upland sites. This expanded focus is important because effects on soil and vegetation outside the immediate greenline can also have critical adverse effects on aquatic systems.

It is a relatively common practice to factor in expected regrowth when setting within-season triggers for vegetation, particularly herbaceous stubble height. In these cases, end-of-season monitoring is important to evaluate if the trigger is appropriate. At times, expected regrowth does not materialize either due to lower than expected precipitation or overly optimistic estimates of the actual length of the growing season or rate of growth.

When using both within-season triggers and endpoint indicators, allowable numeric values should be established. The monitoring strategy must not only ensure that measurements are recorded and used to determine whether or not the allowable numeric value was met, but also evaluate whether the numeric value used as the criterion is correct. Due to site-specific differences across the landscape, the initial determination of allowable numeric values must rely largely on professional judgment. Current research can provide a starting point, but it is not precise enough to apply in a "cookbook fashion" so site-specific data collection is needed.

The lack of site-specific information reinforces the need for adaptive management, which involves using the selected within-season triggers, endpoint indicators, or other indicators to evaluate whether these numeric values are useful in making management adjustments

LFO_RMP_10174

to meet riparian objectives. These values also should be continually refined along with the current management prescription to determine if desired results are being achieved. Determining proper numerical criteria for annual indicators may, in some cases, require trial and error through monitoring, analysis, and evaluation of the results after adjusting management. Because initial results may differ from expectations, the manager should not hesitate to change key species or utilization guidelines to meet established objectives.

Although the triggers and endpoint indicators appear simple and straightforward, there are important considerations that must be examined when selecting and using each indicator.

(1) Residual Vegetation Height

Residual vegetation height can be an excellent tool for warning of impending damage to riparian areas (Hall and Bryant 1995). However, residual vegetation height as an annual indicator of grazing use in riparian areas should only be used where existing science suggests that it is an appropriate indicator and in combination with long-term monitoring of vegetation and channel parameters. Measuring progress toward long-term resource objectives, such as increases in bank-stabilizing plant communities, key species, stream narrowing, or fish habitat is the real measure of successful management and may require years of intervening management.

Residual vegetation height has been shown to be related to two areas of concern: (1) the effect of grazing on the physiological health of the individual plant, and (2) the ability of the vegetation to provide streambank protection and filter out and trap sediment from overbank flows. A summary of the literature (Clary and Leininger 2000) suggests that residual vegetation heights can also be correlated to streambank trampling and shrub (willow) browsing on the greenline. Boyd and Svejcar (2004) also found that adequate regrowth occurred on most sites tested in Oregon by leaving a 4- to 6-inch stubble height. They concluded that it is important to have an understanding of how various stubble heights impact belowground production dynamics and the role of residual vegetation in influencing bank building processes and site development.

Residual vegetation height sampling is relatively quick and simple and reasonably accurate. It can be used to monitor large areas in less time than traditional utilization study protocols require. In some situations, however, accuracy can be adversely affected by stand characteristics. Difficulties with stubble height arise, for example, in irregularly grazed nonhydric bunchgrasses or stands of inconsistent plant composition with varying palatability. Stubble height measurements should focus on key riparian plant species or species groups important for providing bank stability, minimizing surface runoff, and filtering sediments. Also, although streambank or greenline residual height is the critical factor for trapping sediments and providing bank stability, residual height farther from the edge of the bank or greenline may be a better indicator of livestock use (Marlow and Finck 2002). Kentucky bluegrass is not desirable with respect to bank stabilization, but it is highly preferred by livestock and is useful for determining if changes in grazing management have been effective in minimizing the time cattle spend in riparian areas.

(2) Utilization

Utilization maps describe the pattern of livestock use relative to topography, vegetation, water, salt and other supplements, season, and all other management factors. Utilization mapping relative to plant growth and community distribution can provide more insight to the appropriateness of a particular grazing strategy than utilization of a key area alone. It can guide adjustments better than most other forms of monitoring information. However, accuracy and precision limitations of utilization measurements should be recognized in all interpretations. There is often high sampling variability among sites and among observers, especially for shrubs. Because of these limitations, high confidence levels require intensive sampling and more time and money. In addition, relative utilization (utilization determined at any time other than peak standing crop) may have little relationship with utilization at peak standing crop for determining plant or community response to defoliation. Interpretations should be made with caution!

In spite of the potential limitations of utilization and because they lack a better tool, many managers have chosen to establish utilization guidelines for short-term management considerations. To establish utilization

LFO_RMP_10174

guidelines, knowledge of the growth habits and characteristics of the key plant species; of their response to grazing and browsing; and of the characteristics, preferences, and requirements of the grazing and browsing animals is needed. When using utilization information to make management changes, consideration should be given to the timing of utilization of key species with respect to plant phenology, which often affects subsequent growth and reproduction more than the amount of utilization does. Rasmussen et al. (1998) provide one example of worksheets used to record utilization measurements along with an example of a utilization gauge. Many of the Western States have developed a State monitoring guide, which may be available in local county extension offices in your State.

(3) Woody Species Monitoring

The amount and timing of defoliation of riparian shrubs and trees can have tremendous effects on their growth and survival. Unfortunately, utilization measurements by traditional methodologies appear impossible to accurately replicate either between individuals or over time (Hall and Max 1999). Until more acceptable methodologies are developed, it is suggested that preference changes be used as a within-season trigger. Stubble height and greenness of herbaceous species are critical elements in palatability and cause shifts in cattle forage preference, such as changing from grasses and sedges to shrubs (Hall and Bryant 1995). These preference changes, especially later in the season, should be used as a trigger to manage the livestock and protect sprouts and young of the woody species. The end-of-season indictor would be incidence of use, which is the proportion of browsed twigs versus unbrowsed twigs. Although there is no relationship to the amount of material removed, there is a relationship to degree of impact on the plant. The method is quick and repeatable. It is especially important that measurements be taken on sprouts and young, as these plants must have an opportunity to develop into mature plants over time (Winward 2000).

(4) Streambank Alteration

Streambank alteration results from both hydraulic (e.g., channel-altering flows) and mechanical processes (e.g., herbivores such as elk, moose, deer, cattle, sheep, goats, and horses walking along streambanks or across streams; beaver activity; or uncontrolled off-highway vehicle activity). The protocol used to measure streambank alteration should identify the degree of impact attributable to domestic livestock for subsequent use in management decisions. Discrimination is necessary for considering modifications of the current grazing strategy.

Setting numerical criteria to manage mechanical impact from livestock can be complex. The type of soil composing the streambank greatly influences the degree of alteration produced by a particular level of livestock use. Vegetation cover and composition also affect the degree of impact from livestock. A site with well-developed, dense plant communities composed of sedges, rushes, bulrushes, and spike rushes will exhibit significantly less impact than a site with a less developed plant community or one composed of species that do not have the desired rooting characteristics. The establishment of numerical criteria for use in reducing mechanical impacts from livestock in riparian areas should be treated as an adaptive experiment, with ongoing refinement that reflects site-specific experience.

3. Mid- and Long-Term Monitoring

If the relationships between objectives and monitoring are clear, and management and monitoring are maintained, mid- and long-term trend studies are well underway. Useful and appropriate monitoring techniques vary widely because of the inherent variety in appropriate management objectives. No short list could be complete, and each technique requires a detailed description to guide its proper application. However, there is one aspect of vegetation trend monitoring in riparian areas that is sometimes confusing and significantly different from monitoring in uplands. Riparian ecological sites or plant communities move as streams move. They change their distribution and extent over time as attributes such as the water table change (Winward 2000, Gebhardt et al. 1990, Winward and Padgett 1986,). Objectives tied to kind, proportion, or amount of vegetation may be monitored either by methods that account for changes along the stream edge as it moves (greenline) or throughout the riparian complex (valley cross sections) (Winward 2000). Other methods account for dynamic changes along the riparian area (e.g., Rasmussen et al. 1998, Cowley and Burton 2005). Winward's (2000)

LFO_RMP_10174

three-part monitoring also includes woody species regeneration along the greenline.

a. Greenline

The kind, amount, and location of vegetation are crucial to the function of most riparian systems. Greenline monitoring measures the vegetation along the edge of streams. It samples community type composition on both sides of a stream in a selected section of a stream (within one riparian complex) and compares the composition with past measurements and objectives. Objectives may be based on a "standard" required for proper functioning of that particular stream type. Winward (2000) suggests the standard and rates each community type's ability to buffer the forces of moving water. Greenline data can be used to develop a rating of both ecological status, (i.e., the existing kind and amount of vegetation on that particular section of stream in relation to the amount and kind of vegetation that might potentially occur on that stream section) and average physical strength for buffering the effects of moving water (streambank stability). Greenline data at the same location through time can be used to evaluate long-term trend.

b. Vegetation Cross Section

Vegetation cross sections provide a quantitative measurement of the nature of riparian vegetation across the valley floor. Many earlier vegetation measurement processes calculate changes in species composition. This process measures change in percentage of area occupied by different community types. Trend is determined by whether the changes are moving toward preferred types (desired condition) or desired ecological status. Ecological site descriptions, plant community classifications, or reference areas that have similar soils, hydrology, and geomorphology but are managed differently are helpful in determining potential and setting objectives.

c. Woody Species Regeneration

Woody species regeneration provides a measurement of the density and age-class structure of each woody plant species that occurs along a greenline. It provides a way to compare changes in woody structure through time. It is based on the premise that populations require reproduction and growth to attain appropriate population levels or maintain themselves through time.

4. Photo Monitoring

Photographic monitoring is quick and effective for documenting changes in vegetation and determining if management in an area has been successful (Hall 2001, 2002). Permanent photo points are recommended, no matter what monitoring plan is developed. Pictures are relatively inexpensive and provide a wealth of information: they truly are "worth a thousand words." The photo sites should also be tied to specific management goals and objectives. The characteristics of the vegetation or landscape that the photos address and how those characteristics will be evaluated require careful consideration when developing the photo monitoring plan (Reynolds 1998). Advances in digital photography, both still and video, have made it possible to take large numbers of high resolution photos for little cost or no more cost than that incurred in getting to and from monitoring locations. An added bonus is that images can (and should) be reviewed while still on location and, if necessary, more or better photos can be taken at the time (Hilliard pers. comm.).

Photographic monitoring should be conducted during the same season each year (Rasmussen et al. 1998). Vegetation structure and color change seasonally, making comparisons among different seasons difficult in many community types. Other tips for improved interpretation are to:

1. Include the skyline or prominent features to help the photographer reshoot the same scene and the viewer to recognize the area
2. Include a card or slate in the photo with the date and location (large enough and exposed correctly so that it can be read)
3. Include something for scale (location card, person, ruler, etc.) to help viewers gain perspective
4. Use lighting and exposure conditions to illuminate attributes related to objectives
5. Avoid too much sky or sunlight reflecting off water because this tends to darken the areas of interest
6. Use the same lens or focal length so the picture angle remains constant

7. Avoid using a lens with too wide of an angle (26-35 mm) which can make the objects of interest too small in the photo, and a lens with too much telephoto or zoom, which makes objects of interest lose their context
8. Check the readability of the card or slate in the photo and label the photos with location, date, camera or lens
9. Print out digital photos, store them in a safe place, and back up digital data so that changes in technology do not make historically valuable photos unusable

A variety of photo monitoring methods is available, consequently the complexity, scale, time, and cost of the photo method should be considered when developing the monitoring plan.

5. Cooperative Monitoring

A recent large-scale evaluation of the University of Arizona Cooperative Extension's rangeland monitoring program, indicates that cooperative monitoring programs have: (1) made a positive difference in the knowledge, skills, and practices of individual participants; (2) shown a strong association between rangeland monitoring and the implementation of beneficial land and grazing management by permittees; and (3) demonstrated improved relationships among permittees and agency staff (Fernandez-Gimenez et al., 2005). In an effort to build on these types of successes, the Public Lands Council (representing sheep and cattle ranchers in 15 Western States who hold Federal grazing permits) recently signed a memorandum of understanding (MOU) with both the USFS and the BLM for the implementation of a cooperative rangeland monitoring program (USDA USFS 2004, USDI BLM 2004). "The MOU establishes a framework for voluntary, collaborative work [among] grazing permittees and the USFS (and BLM) to improve the quality and quantity of short and long-term, allotment level monitoring information on public rangelands" (USDA USFS 2004). Supporters note that this approach will benefit all involved "by improving the relationships [among] parties and by producing the information needed for sound stewardship of the resources" (USDA USFS 2004).

Case Study: Cooperative Monitoring with Eastfork Livestock Ranch

The Eastfork Livestock Ranch, owned and operated by Joel Bousman, is a family-run cow-calf and yearling operation located in Sublette County, Wyoming. In 1996, Bousman participated as a member of the Silver Creek Grazing Association in an effort to develop a voluntary permittee monitoring program that allowed permittees to actively and cooperatively monitor their rangeland on the Forest Service (USFS) Silver Creek common allotment. He organized a committee of cattlemen, sheepmen, and agency personnel to work with the University of Wyoming Extension office (Bousman 2003).

The committee worked cooperatively to develop short- and long-term monitoring objectives relating to grazing management changes made in 1989 and identify basic, field-based, achievable methods for collecting data (Bousman 2003) (Figure 65). Short-term monitoring focused on utilization, production, precipitation, and AUMs by season with dates. Long-term monitoring focused on the collection of trend data. Specifically, the group used 100-foot trend transects with permanent photo points to determine cover by life form. They also relied on the Winward (2000) methodology (supported by photos) to identify streambank stability and vegetation condition over time (Bousman 2003).

According to Bousman (2003), the monitoring reports were viewed as cooperative statements because all of the monitoring activities were conducted as a group. Signatures were included on the monitoring report to certify that the data had been collected, documented, and cooperatively approved by the USFS and

LFO_RMP_10174

the grazing association. The cooperative report then became part of the official USFS allotment files. In addition to collecting monitoring information, the group also led public tours of the allotment at various times during the year.

"Those truly concerned with benefiting the land understand that real conservation will only occur with the participation and concurrence of all stakeholders. Litigation only serves to drive wedges between people who should be working together…."

Eisenberg (2004)

Advantages of Cooperative Monitoring:

1. Cattle distribution and performance improved after 1989 management changes, but it was the monitoring program and associated documentation of improved resource condition that enabled the Bousmans to increase their grazing season by 2 weeks. This resulted in about $5,000 in savings.

2. The program helped develop and maintain trust, understanding, and good working relationships. Getting the parties involved to talk about conditions, concerns, and objectives on the ground helped provide a learning opportunity for the permittees, agency officials, and the public. It also helped reduce the stress and uncertainty of one party not knowing what another party wants or thinks is possible.

3. The program helped demonstrate accountability and responsibility and documented stewardship. Public land grazing remains a controversial issue—one that is constantly in the public spotlight, which can be seen as a problem or as an opportunity. The permittees, who have initiated or participated in similar voluntary cooperative rangeland monitoring programs, have embraced the public spotlight as an opportunity to demonstrate their good stewardship of the land.

Disadvantages of Cooperative Monitoring:

1. There is an initial economic cost to the livestock manager (monitoring equipment, camera, report preparation, film development, etc.) (Bousman pers. comm.).

2. There is a time requirement by livestock managers, agencies, universities, and others to properly set up the monitoring program (Bousman pers. comm.).

(Note: In the long-term, the costs should be more than recouped by improvement in the resource and the trust ultimately developed among the cooperating partners. It is hard to place a dollar value on trust, but it is a benefit to everyone.)

Figure 65. Silver Creek Common Allotment, USFS, WY, 1997. Permittees and USFS and BLM staff teaching and learning monitoring techniques together. (Photo by E. Peterson, Univ. of Wyoming Extension.)

LFO_RMP_10174

F. Evaluate Progress

Grazing prescriptions and associated management of riparian areas should be monitored, evaluated, and reconsidered regularly. Managers should not hesitate to identify problems and make changes in grazing treatments. They should use adaptive management when taking risks and trying new alternatives to achieve objectives. **Flexibility to change or adjust** should be part of any grazing management plan. But along with that flexibility, it is important to document conditions under which each system does and does not work.

Decisions will need to be made regarding future management prescriptions when the monitoring data and current year's grazing management plan have been evaluated. The decision may be to:

- Continue current management if it is meeting objectives or if there is an upward trend
- Modify current management if it is static or in a downward trend
- Adjust objectives if needed

Any riparian monitoring plan should include before and after photos, with backup data, to show the effects of management. Photos can often clarify the data, allowing people to see and understand riparian trends (Sipple and Swanson 1995). Documentation of pretreatment resource conditions provides a basis for interpreting results, avoiding past mistakes, and providing a "springboard" for exploring other options. Documentation of successes, as well as of failures, is essential for learning from past efforts.

The Grazing Response Index (GRI) (Reed et al. 1999 USDA USFS 1996,) was developed to evaluate the effects of annual grazing pressures and the effects of repetitive defoliation during the growing season. The GRI was developed to assess the use of herbaceous species in both the riparian and upland plant communities. The assessment is particularly well suited to be conducted from horseback so that a more complete assessment of the entire grazing unit can be accomplished, rather than having to be restricted to only key areas. It assesses how much of a plant was grazed, when it was grazed, and how many times it was defoliated during the growing season. The index is a way to incorporate a number of factors into a general evaluation of what potential effects the current grazing system may have on rangeland plants. It puts grazing use (utilization or stubble height) in context with season and duration of use. Multiple options can be considered when making adjustments to a grazing program. It is relatively easy to learn, easy to communicate, and is based on general observations rather than time-consuming, precise measurements. The GRI is not intended to be the only method for resolving major conflicts. **It should be used for situations where resource issues are considered to be at a low to moderate level of intensity**. (See Appendix F for GRI forms and directions.)

The use of state and transition models is one way to evaluate whether current management is achieving long-term objectives (Appendix C). These models show management pathways and potential plant communities for a particular ecological site. They increase a manager's ability to invest wisely for achievable and important objectives. Information obtained from monitoring and evaluation of vegetation responses can also be helpful to fine tune the model, particularly for specific site conditions.

LFO_RMP_10174

IV. CARDINAL RULES FOR PLANNING AND MANAGING LIVESTOCK GRAZING IN RIPARIAN AREAS

Though each management situation is unique, there are still some general rules that can help ensure successful riparian area management:

- Adapt grazing management to the conditions, problems, potential, objectives, public concerns, and livestock management considerations on a specific site.
- Include all those willing to learn the details and contribute ideas or work for enhanced management throughout the planning process.
- Consider overall watershed goals and objectives and all important resource issues including watershed dynamics and issues associated with the receiving water or the stream reach the grazing activities are located on (water quality and quantity, threatened and endangered species concerns).
- Manage grazing so there is sufficient vegetation growth and postgrazing stubble on the banks and overflow zones to permit the stream to function naturally.
- Identify and implement alternatives to passive, continuous grazing.
- Employ rest or deferment from livestock grazing whenever appropriate.
- Take advantage of seasonal livestock preference for uplands in grazing prescriptions.
- Ensure that expertise from appropriate professional disciplines is represented on the planning team.
- Ensure that everyone involved clearly understands the issues and agrees with the management objectives, as well as understands the changes that can occur and how they can benefit from proper management and improved riparian conditions.
- Build flexibility into grazing management to accommodate any changes that are needed.
- Implement frequent (sometimes daily) supervision by the parties involved once management is in progress, so that adverse impacts (e.g., trampling damage and excessive utilization) can be foreseen and avoided.
- Don't rely on a grazing system alone to improve conditions. Management tools and techniques work hand in hand with selected grazing systems.
- Document mistakes so they are not repeated.
- Use management successes to encourage proper management in the future and to promote good riparian area management elsewhere.

LFO_RMP_10174

APPENDIX A
REFERENCE WEB SITES

More information about grazing management and related topics may be found on the following Web sites. This is not meant to be a comprehensive listing of all Web sites, but is intended to provide a few sites that the reader may access for more information.

Agencies and Organizations:

Boise Aquatic Sciences Lab (Research and Publications)
http://www.fs.fed.us/rm/boise/teams/techtran/techtran_home.htm

Cows and Fish Program, Alberta's Riparian Habitat Management Society
http://www.cowsandfish.org

Environmental Management Systems
http://www.epa.gov/ems

Grassbank (Grass Reserves)
http://www.grassbank.net

National Riparian Service Team
http://www.or.blm.gov/nrst

Natural Resources Conservation Service
http://www.nrcs.usda.gov

Quivira Coalition
http://www.quiviracoalition.org

Society for Range Management
http://www.rangelands.org/srm.shtml

Stream Systems Technology Center
http://www.stream.fs.fed.us

Sustainable Rangelands Roundtable
http://sustainablerangelands.cnr.colostate.edu

The Western Rangelands Partnership
http://rangelandswest.org

Articles and Publications:

BEHAVE (Behavioral Education for Human, Animal, Vegetation and Ecosystem Management)
http://www.behave.net

Behavioral Principles of Livestock Handling
by Dr. Temple Grandin
http://www.grandin.com/references/new.corral.html

Helping Livestock Expand Their Diets and Their Turf plus Herding and Supplementation Studies
by Derek Bailey.
http://www.behave.net/projects/riparian_bailey2003.html

Monitoring Streambanks and Riparian Vegetation—Multiple Indicators
by Ervin Cowley and Tim Burton
http://www.id.blm.gov/techbuls/05_02

National Management Measures to Control Nonpoint Source Pollution from Agriculture
http://www.epa.gov/owow/nps/agmm

Natural Resources Conservation Service Electronic Field Office Technical Guide (EFOTG)
http://www.nrcs.usda.gov/technical/efotg
http://www.glti.nrcs.usda.gov

Ranching for Profit
http://www.ranchmanagement.com

Riparian and Wetland Tools for the Great Basin and Intermountain West Regions
http://plant-materials.nrcs.usda.gov/idpmc/riparian.html

University of Idaho Stubble Height Study Report (2004)
http://www.cnrhome.uidaho.edu/documents/Stubble_Height_Report.pdf&pid=74895&doc=1

LFO_RMP_10174

APPENDIX B
COLLABORATIVE PLANNING

The successful use of grazing management strategies in the maintenance and recovery of riparian areas has been widely documented. However, riparian grazing remains one of the most pervasive issues facing rangeland managers. The management of these areas is socially, as well as technically, complex. Successful management cannot be achieved through reliance on scientific and technical information alone. Riparian and watershed resources are typically geographically nested within a complex maze of jurisdictional and administrative boundaries, so a collaborative approach is often needed.

A. What is Collaboration?

Collaboration is the pooling of appreciations or tangible resources (e.g., information, money, or labor), by **two or more stakeholders** to solve a set of resource problems that no one party can solve individually (Gray 1985). It is grounded in a belief that if the right people are brought together, in constructive ways, with good information, they will produce better, more informed, effective, sustainable, and popular decisions; improved relationships; and sustainable communities and landscapes (Field and McKinney 2004). The range management community has been using this collaborative philosophy for many years under the name of coordinated resource management (CRM). CRM is a proactive process in planning for improvement of natural resources (Cleary and Phillippi 1993).

Within this document, collaborative planning is presented as a process designed to strengthen existing planning and decisionmaking approaches (e.g., expert-based, NEPA-based, litigation, legislation, and regulation). Collaborative planning can work very effectively when it is integrated with the NEPA public involvement and analysis process (Swanson 1994). When addressing complex issues, collaboration is a good tool for promoting decisions that are informed, understood, accepted, and feasible (USDA 1999). However, participation in collaborative efforts is strictly voluntary, and individuals remain free to pursue more traditional approaches at any time. Furthermore, pursuit of a collaborative approach does not interfere with the exercise of private property rights nor does it suggest that Federal or other land managers abdicate their decisionmaking authority.

The collaborative model has shown advantages over more traditional planning and decisionmaking approaches under the following conditions (Gray 1989):

1. The problems are ill-defined, or there is disagreement about how they should be defined.
2. Several interdependent stakeholders have a vested interest in the problem.
3. The stakeholders are not necessarily known in advance or organized in any systematic way.
4. There may be differences in power or resources for dealing with the problems among stakeholders.
5. Stakeholders may have different levels of expertise and different access to information about the problems.
6. The problems are often characterized by technical complexity and scientific uncertainty.
7. Differing perspectives on the problems have resulted (or could result) in adversarial relationships among the stakeholders.
8. Existing processes for addressing the problems have proved insufficient and may even be making them worse.

Successful collaborative efforts adapt to the conditions of a particular situation **(there is not a recipe or cookie-cutter approach)**. Typically, successful efforts focus on

A 'stakeholder' is defined as a person or organization that:

1. *Has an interest or concern (self-identified),*
2. *May be needed to implement the outcome or solution, or*
3. *May try to undermine your effort.*

Examples are:

- *Federal and State grazing permittees*
- *Public and private landowners and managers*
- *Livestock managers*
- *Interested publics*
- *Other user groups*

LFO_RMP_10174

"It is important that all of the people who need to be there are there. Even though it [the subject] may be a contentious issue, it is important that everybody is there together so they can hear the same things, talk and come to conclusions as a group. Simply getting a copy of a written report is just not the same thing as having been there and been part of that conversation."

J. Staats, USFS Hydrologist

a particular place; secure the involvement of all relevant stakeholders upfront; and identify durable, practical, and flexible solutions (adaptive management). Finally, they often rely on the use of a trained, neutral facilitator or conflict manager and the use of consensus-building techniques. The intent is not to dispel conflict, but to help groups or individuals reach enough agreement that they are able to do something mutually beneficial on the ground. Often this involves creating a new solution that no individual had thought of or could implement alone.

B. Collaborative Planning Process

The first step in collaborative planning is to define the planning area. The planning area should include public and private lands as necessary to allow the development of a comprehensive management plan to resolve the problem. However, the participation of private landowners in a specific planning effort is strictly voluntary.

The next step is to engage key stakeholders. The exact makeup of a collaborative group will be different in each situation. Depending on the size and scope of the planning area and the nature of the issues involved, collaborative efforts can be as small as two private landowners working together to build and maintain a fence or as large as a multicommunity working group tasked with developing a watershed plan. The key is that in each of these efforts, participants are working together to develop and implement mutually beneficial solutions, rather than one party imposing a solution on another.

Securing the voluntary participation of key players early in the planning process is critical to future success. To ensure participation, it is often necessary to reach out with personal invitations, phone calls, or face-to-face conversations.

Riparian issues often include multidisciplinary, science-intensive disputes. They affect multiple stakeholders who have different interests and levels of scientific understanding. As with most natural resource issues, they typically include a mix of both information- and value-based conflicts. **Information-based conflicts** are those in which people argue over information. There may be too little information or people may disagree about the assumptions or methods of others. Either way, scientific and technical information is a lynchpin for addressing the conflict. **Value-based conflicts**, on the other hand, cannot be resolved simply through better technical information because they address issues concerning economic, political, recreational, aesthetic, or spiritual values.

Agreed-upon resource decisions must be scientifically sound, as well as socially and economically acceptable. Because issues, groups, and options change, a collaborative planning process should be designed to foster ongoing deliberation among stakeholders and resource specialists (USDA 1999). To engage effectively in the deliberation and negotiation required for reaching common ground, individuals must feel safe in their social environment. Individuals must be able to examine, share, and broaden their perspectives in a nonthreatening and respectful manner. This requires attention to the physical and social setting within which group interactions take place (Smith 2002).

Once a group of diverse stakeholders and resource specialists has been organized, they must work to create a common vision for productive and sustainable ecosystems and communities. Studies demonstrate that individuals who have built relationships and trust within a group are able to develop and use their individual knowledge and skills more effectively (Coleman 1988). It is through relationship building and mutual learning that individuals build ownership and commitment to the planning process, other individuals, underlying information, and ultimately, final decisions. Once a certain social context has been established within a

LFO_RMP_10174

Differences in feelings of power among individuals tend to be equalized when a group is seated in a circle versus when they are positioned in an auditorium-style seating arrangement where the "expert" is addressing an audience from a raised podium.

Individuals are more likely to develop relationships or connections to each other, as well as to a particular place, when they are working together in small groups to solve a problem on the ground.

Laura Van Riper,

National Riparian Service Team

group, individuals are more likely to understand and take collective action in response to information. Furthermore, adults learn best when they apply new knowledge to real-life situations, and most collaborative planning requires learning by all participants.

One of the most important factors in stream restoration is the commitment by the people involved to make it work. Given the inherent resiliency of riparian areas, almost any action that relieves an important stressor, or limiting factor, will result in improvement. The key is helping people understand that things can get better. This is not to say that science and technical information are not important attributes of successful management efforts but rather that such information can only be put to work if individuals are willing to change the beliefs and associated behaviors that caused the resource conditions.

Given the scientific complexity of natural resource issues, it is important to integrate science and technical information into a collaborative planning process. One of the most effective ways to meet this objective is to incorporate joint factfinding as part of the ongoing deliberation among resource specialists and stakeholders (Yaffee et al. 1997). When possible, it is best to go to the field together. Strangely, many people are prepared to decide whether a person is a good manager without ever looking at their land and are willing to decide whether the land is healthy without ever seeing it (Dagget 1998). However, to move forward on resolving conflict and improving the land, it is important to focus on what information the land provides.

Because riparian issues are interdisciplinary by nature, successful management relies upon resource specialists, representing multiple disciplines, who are able to read the land and effectively communicate what they see. By involving stakeholders in the joint factfinding process, research is enriched and studies become more relevant. The process helps resolve key areas of uncertainty and creates a common understanding (shared knowledge) about on-the-ground processes (ecosystem functions). Later, the group can discuss new management ideas with the understanding needed to overcome philosophical positions in pursuit of site-specific, interest-based solutions. Finally, joint factfinding strengthens personal relationships and builds trust among participants.

It is important to use a collaborative process through all planning phases (e.g., determining existing condition, identifying limiting factors, creating management objectives, and monitoring). Following the joint collection and consideration of preliminary information, group members must reach agreement on the existing situation (resource condition), problems (limiting factors), and opportunities. This information will then guide the creation of agreed-upon management objectives (practical and measurable), as well as a list of possible strategies and actions. The group should then review suggestions and identify those that are the most practical, workable, and likely to solve the problem. Once the action items have been narrowed, they should be listed in logical sequence that leads to the accomplishment of a particular management objective. For each item, a lead person and the estimated date of completion should be identified. The next step is to outline a monitoring system, indicating how progress toward each specific objective will be measured. This will serve as a feedback system for providing corrections and adjustments to the plan. As the group implements the plan, some will play more active roles than others. However, the whole group needs to periodically review

LFO_RMP_10174

"Involving stakeholders in forums designed to share knowledge, build relationships, establish trust and encourage creative problem solving is more likely to produce socially acceptable decisions… Even when the decisions are the same, people need the oppor tunity to engage as partners in the decision-making process so they have ownership in the outcome."

Wondolleck and Yaffee (2000)

progress. Taking time to note what has been accomplished and the results helps to keep people committed to remaining tasks and necessary adjustments.

In the long term, successful collaborative management keeps people involved through adaptive management and through shared experiences that build relationships. As with any process, there are many downsides, and collaboration isn't always appropriate and doesn't always work. Success is dependent upon the commitment of all the involved parties.

LFO_RMP_10174

APPENDIX C
ECOLOGICAL STATE AND TRANSITION MODEL EXAMPLES

Ecological site descriptions contain state and transition (S&T) models, which outline some of the various plant communities that can occur on a particular site. This outline provides a diagram of the functional relationships among the plant communities and disturbances that may cause them to shift or change. It depicts the potential results of current management or a planned action; thus, it helps managers avoid the possibility of crossing a threshold that would result in an irreversible consequence. Avoiding an irreversible consequence can be extremely important if the site has the potential to provide habitat for wildlife, fish, or plants of special concern. S&T models are based on processes, not on species lists. Plant communities are an expression of the reduction in ecological function occurring on the site. Primary processes include energy flow, nutrient cycling, and water storage. In riparian areas, the hydrology of the site is primary.

The community composition is an assemblage of plants that are **in dynamic equilibrium** with their surroundings and are able to shift in composition or production as a result of natural variables. There are many factors and processes involved in the changes from one plant community to another within a state. These variations in plant community are natural or management-induced and do not result in an irreversible consequence. Variations in climate, elevation, depth to water table, frequency and duration of flooding, soils, landform and geology, stream channel morphology, fire, and grazing all play a role in determining plant communities that will be expressed at a site.

When the primary processes of an ecological state are altered past the point of self-repair, a **threshold** is crossed, resulting in a plant community that often has only a few remnant members of the original natural community. From a process perspective, it is appropriate to have a different suite of species as long as they fill the same functional role. However, if the ecological processes are compromised, resulting in a plant community that is functionally different, then a threshold has been crossed. Once established, these new communities (e.g., Kentucky bluegrass, reed canarygrass) can become very stable and will not return to one resembling the potential natural plant community through the use of grazing management or extended rest alone (Stringham et al. 2003). Significant inputs, along with extended rest, are generally required to restore a primary ecological process that has been lost and to return to a vegetative community that resembles the original. However, if a site recovers through just a minor change in grazing management or by restoring wildfire to the system, then it has not crossed a threshold. Once an ecological threshold has been crossed, management focus should be on restoring the damaged ecological processes, not on reestablishing a specific plant community (Stringham et al. 2003). Economic, social, or political thresholds or processes may also need to be dealt with in certain situations.

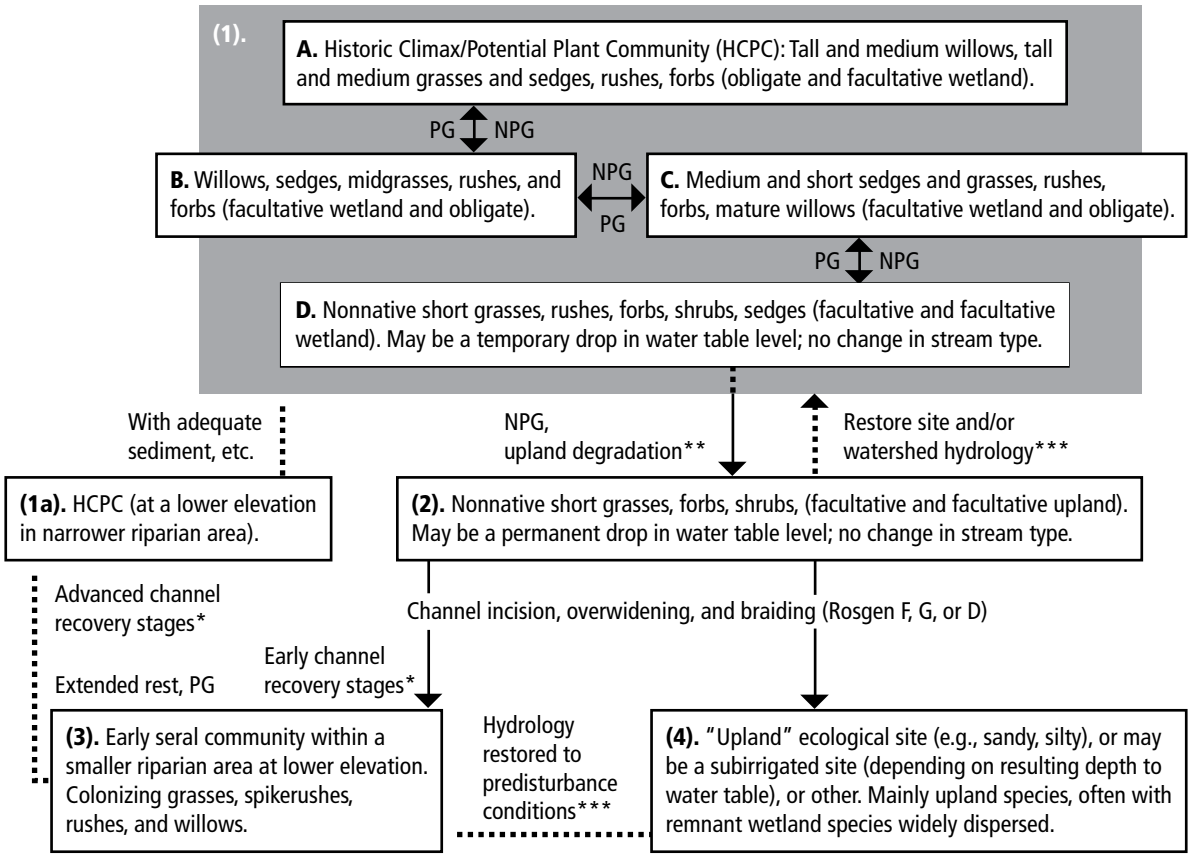
State and transition models for riparian plant community dynamics are still preliminary, and further investigation is warranted (Stringham pers. comm.). Disturbances that impact channel form and water table depth (incision, braiding, or overwidening) may alter the plant community to such a point that recovery to predisturbance conditions is not possible. Should the stream experience such significant degradation (i.e., incision), the channel itself usually must go through a recovery process (Schumm 1977, Jensen et al.1989) before the vegetative community can reestablish. In some cases, predisturbance stream morphology must be restored by physically altering or recontouring streambanks and floodplains in order to achieve these goals in a reasonable timeframe.

The following riparian subirrigated state and transition model for the north Rocky Mountain valleys in Montana is one example of a riparian model that is currently under development (Figure 66). A second component to the model has been added to provide a functional

comparison of each state (Figure 67). Photos provide examples of several of the states found within different states within this description (Figure 68-72). Continued discussions of riparian ecological site descriptions are needed to incorporate the complexities inherent in dynamic riparian systems.

Figure 66. Riparian Subirrigated (RSb), North Rocky Mountain Valleys, Montana, 15- to 19-inch Precipitation Zone
Part 1 – State and Transition Pathway Model
(Typically occurs along riffle-pool streams, i.e., Rosgen C type).

Plant Communities and Transitional Pathways (State and Transition Model Diagram): Transitions in plant community composition occur along a gradient. Many processes, including climatic patterns, topography and landform, flood frequency and duration, elevation, soils, amounts and kinds of sediment available, fire pattern and history, and grazing are involved in the changes from one community to another. The following model outlines the various plant communities that may occur on this site and provides a diagram of the relationship between plant community and type of use or disturbance.



* Refer to the appropriate channel evolution/recovery model (e.g., Schumm 1977, Jensen et al. 1989) for details. This recovery may occur over many years.
** Upland degradation may occur from dewatering, lack of fire, conifer encroachment, or drought.
*** Restore hydrology by prescribed fire, timber harvest/thinning, irrigation system adjustments, or change in grazing management with accelerating (e.g., expensive stream restoration [Rosgen], range seeding) and/or facilitating (e.g., stock water, fencing) practices.

PG = Prescribed Grazing: A planned grazing strategy that balances animal forage demand with available forage resources. Timing, duration, and frequency of grazing are controlled, and a grazing rotation is applied to allow for plant recovery following grazing.
NPG = Nonprescribed Grazing: Grazing that does not control the factors listed above, or grazing that occurs when animal forage demand is higher than the available forage supply.

Smaller boxes within a large box indicate that these communities will normally shift among themselves with slight variations in depth to permanent water table, herbivory, and other factors. Moving outside the larger box indicates the community has crossed a threshold (heavier line) and will require intensive treatment to return to community A, B, C, or D. Dotted lines indicate a reduced probability for success without major inputs (e.g., accelerating practices).

(NRCS, Montana Draft 2005)

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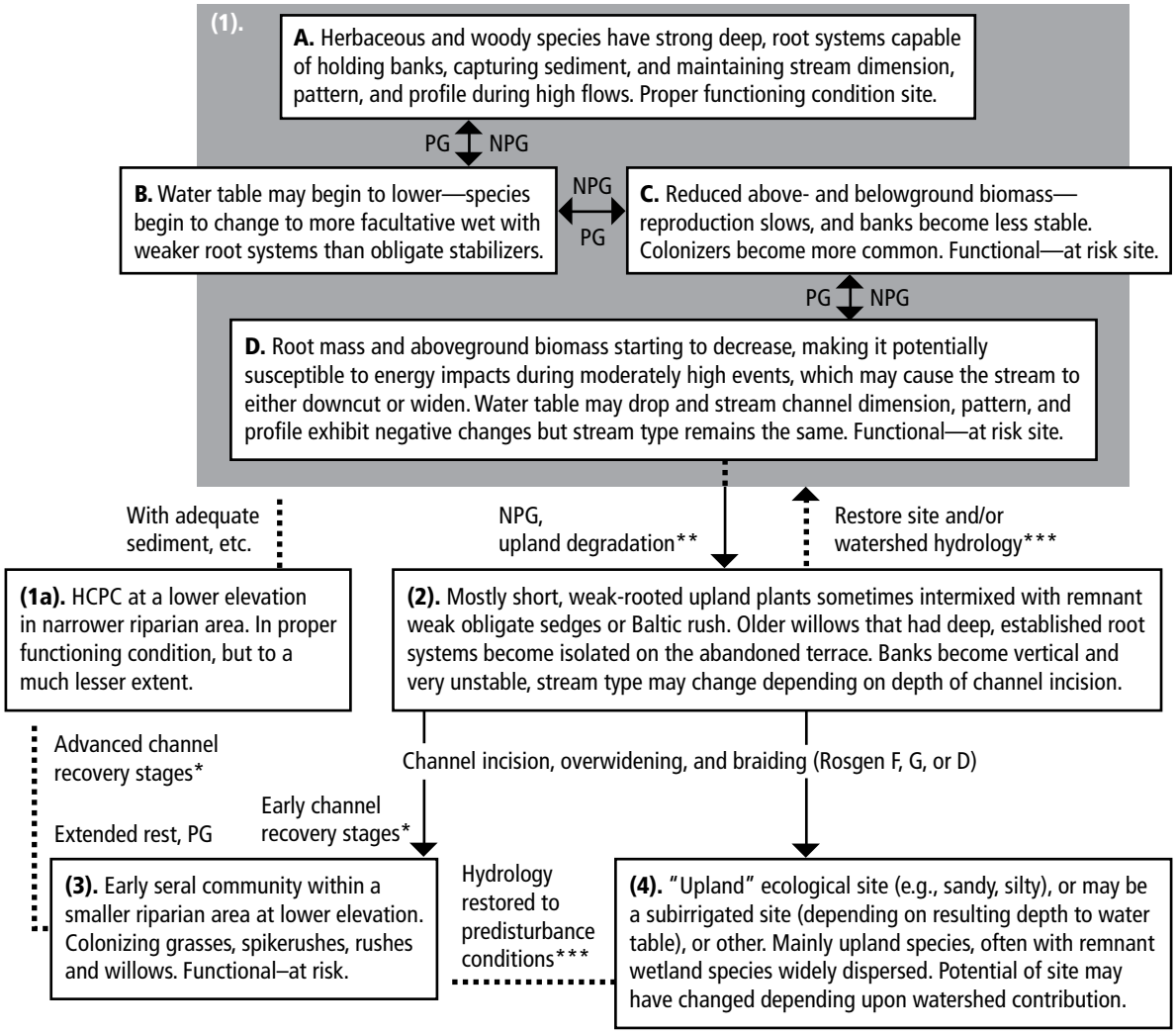
Figure 67. Riparian Subirrigated (RSb), North Rocky Mountain Valleys, Montana, 15- to 19-inch Precipitation Zone
Part 2 – Functional Comparison
(Typically occurs along riffle-pool streams, i.e., Rosgen C type).



* Refer to the appropriate channel evolution/recovery model (e.g., Schumm 1977, Jensen et al. 1989) for details. This recovery may occur over many years.
** Upland degradation may occur from dewatering, lack of fire, conifer encroachment, or drought.
*** Restore hydrology by prescribed fire, timber harvest/thinning, irrigation system adjustment, or change in grazing management with accelerating (e.g., expensive stream restoration [Rosgen], range seeding) and/or facilitating (e.g., stock water, fencing) practices.

PG = Prescribed Grazing: A planned grazing strategy that balances animal forage demand with available forage resources. Timing, duration, and frequency of grazing are controlled, and a grazing rotation is applied to allow for plant recovery following grazing.
NPG = Nonprescribed Grazing: Grazing that does not control the factors as listed above, or grazing that occurs when animal forage demand is higher than the available forage supply.

Smaller boxes within a larger box indicate that these communities will normally shift among themselves with slight variations in depth to permanent water table, herbivory, and other factors. Moving outside the larger box indicates the community has crossed a threshold (heavier line) and will require intensive treatment to return to community A, B, C, or D. Dotted lines indicate a reduced probability for success without major inputs (e.g., accelerating practices).

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Figure 68. Overview of an example of a Rosgen C channel type.

Figure 69. Example of state 1B.

Figure 70. Example of state 1A.

Figure 71. Example of a state between 3 and 1A.

Figure 72. Braided Rosgen D channel type. Could become a state 3 or 4. (Photos this page by Bob Leinard, retired, NRCS.)

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APPENDIX D
PROPER FUNCTIONING CONDITION OF RIPARIAN-WETLAND AREAS ASSESSMENT CHECKLIST (LOTIC)

Name of Riparian-Wetland Area: _____

Date: _____ Segment/Reach ID: _____

Miles: _____ Acres: _____

ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Floodplain above bankfull is inundated in "relatively frequent" events
			2) Where beaver dams are present are they active and stable
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
			4) Riparian-wetland area is widening or has achieved potential extent
			5) Upland watershed is not contributing to riparian-wetland degradation
			VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
			10) Riparian-wetland plants exhibit high vigor
			11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)
			EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

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Remarks

_____
_____
_____
_____
_____
_____
_____

Summary Determination

Functional Rating:

___ Proper Functioning Condition
___ Functional–At Risk
___ Nonfunctional
___ Unknown

Trend for Functional–At Risk:

___ Upward
___ Downward
___ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?

___ Yes
___ No

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify) _____

LFO_RMP_10174

APPENDIX E
EXAMPLES OF GOOD OBJECTIVES

Objectives should be based on the **current** and **potential** condition of the site and allow for adjustments due to climatic conditions, monitoring methods, and **adaptive management** decisions. The PFC or other assessment methods, as well as other inventory data, should be used as guides to develop objectives.

1. Increase the length of cross-valley transects having any late seral riparian area community types (Winward 2000) on Rose Creek from 55 to 65 percent within 10 years (2015).
2. Facilitate willow establishment on the point bars of Fish Creek in the south pasture (DMA 2) so that by 2015 at least 65 percent of the greenline has a willow overstory or a willow plant within 1 meter of the greenline.
3. Increase bank stability along Sand Creek so that by 2010 stable streambanks within DMA 3 increase from 50 percent to 65 percent.
4. Allow aspen regeneration to escape at or near Rock Spring, resulting in an increase from 5 percent to 10 percent in sprout and seedling age classes by 2011.
5. Increase sprout and young willows along the 6-foot-wide, greenline-centered, belt transect at Greenline Monitoring Station 4 on Gravelly Creek so that there are more willows in sprout, young, and sapling than in dead age classes within 10 years after grazing plan has been implemented.
6. Decrease perennial pepperweed by 90 percent of the known population in the Elderberry Creek watershed by 2010.
7. Increase colonizing and stabilizing vegetation along the bottom of the now widened Gray Gulch Gully (DMA 4) so that the greenline to greenline width decreases from the approximate width of the gully to the width of a substantially narrower streambank along 80 percent of the reach within 5 years.

LFO_RMP_10174

APPENDIX F
GRAZING RESPONSE INDEX
(Excerpt from USFS Rocky Mountain Region Rangeland Analysis and Management Guide)

Exhibit GRI: Grazing Response Index
R2 2200 GRI

General Discussion

The Grazing Response Index (GRI) is used to assess the effects of annual grazing pressures, and the effects of repetitive defoliation during the growing season. Understanding plant physiology and plant response to grazing is essential in the development of allotment management plans. Consequently, there is a need for a monitoring tool which adequately estimates rangeland use due to grazing. The tool must not only assess how much of the plant was grazed, but also when the plant was grazed and how many times it was defoliated during the growing season. GRI can be an effective tool to assess grazing systems or complications associated with situations such as early season big game use followed by livestock use.

The Grazing Response Index was developed to assess effects of use during the current year, and to aid in planning the grazing pattern for the following year. Consequently, GRI is based on general determinations of annual grazing use. GRI is not intended to be the only method for resolving major conflicts. *It should be used for situations where resource issues are considered low to mid level intensity,*

GRI considers three key concepts related to plant health: frequency, intensity, and opportunity.

Frequency

Frequency is the number of times forage plants are defoliated during the (actual or planned) grazing period. It is dependent on the length of time plants are exposed to the grazing animals. Approximately 7-10 days [are] required for a plant to grow enough to be grazed again during late spring or early summer when plants are experiencing rapid growth. Local knowledge of the area is needed to determine how fast the plants are growing.

To obtain an estimate of how many times plants were (or will be) defoliated during a grazing period, divide the number of planned grazing days by 7 (or up to 10 if growth is slower). Using 7 is more conservative, because it will give the highest probable number of times the plants could be grazed. An index value of **+1 to -1** is assigned to as follows:

Number of Defoliations	Value
1	+1
2	0
3 or more	-1

Intensity

Intensity of defoliation is the amount of leaf material removed during the grazing period. The primary concern is *the amount of photosynthetically active leaf material remaining for the plant to recover from grazing*. This is <u>not</u> an estimate of percent utilization; generally, less than 40 percent defoliation will not inhibit plant growth. It is related to stocking rate. Intensity is described using three general levels of use.

Amount of Use	Percent	Value
Light	< 40 percent	+1
Moderate	40-55 percent	0
Heavy	> 55 percent	-1

Opportunity

Opportunity is the amount of time plants have to grow prior to grazing or regrow after grazing. This factor is related to time of use. Opportunity is the one factor most highly related to long term health and vigor of the vegetation. It [is] dependent on soil moisture, temperature, and leaf area. This factor is very important for sustaining healthy plants, thus the relative rankings for this attribute are doubled.

The index values for opportunity to grow or regrow forage are as follows:

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Determining opportunity is a judgment call based on appearance of vegetation at the end of the growing season. If the plants look like they were not grazed or just barely used, then a value of +2 is appropriate. If the plants look like they were used, but regrew fairly well, then use +1. Obviously, if the area has the appearance of being heavily used with no regrowth, assign a -2 value.

Even though opportunity is based upon appearance of the vegetation at the end of the growing season, there are some general guidelines that can help you make the determination. For example a pasture or allotment that is used season long can be expected to rate -2 (no chance). An allotment with 2 pastures will likely be in the 0 (some chance) or -1 (no chance) range. Allotments with multiple pastures that are used or rested at different times each year will usually receive the higher ratings of +2 or +1. These guidelines can help you get started, but the final rating should be based upon the appearance of the vegetation.

Overall Rating

The values for frequency, intensity, and opportunity are additive. The overall rating of the *expected response to grazing* is the sum of all three values. This result is a numerical value that is either positive, neutral, or negative. The index is a simple method to evaluate whether the grazing system has long term beneficial, neutral, or harmful effects to the rangeland forage. GRI gives a more comprehensive basis to plan future use that will maintain or improve plant health, structure, and vigor.

> ***This index is based on grazing use that occurs during the growing season. This only marginally applies to grazing use when plants are dormant. Dormant season usually occurs after plants have had full opportunity to grow prior to use, hence an opportunity value of +2. Also, intensity is not as critical a parameter during the dormant season, because we are not concerned with producing regrowth.***

Training

The GRI method does not require intensive training. Examiners can develop their eye for estimating light, moderate, or heavy use. This coupled with practical observations of timing and time of use will provide the information needed.

Personnel and Equipment

With a small amount of training, an individual can assess the amount of use and correlate that use to both time and timing of the grazing period. Form R2-2200-GRI is used to record data for each area of interest.

Sampling Procedure

Areas important to observe are: representative, special (critical or key areas), or treatment areas. The examiner should be familiar with the presence of these areas in the allotment or pasture to be rated. Also, it is important to have an idea of whether only one primary plant species, a group of species, or all forage plants in the area are to be monitored. The examiner should spend enough time to become familiar with grazing use patterns and levels of use across the area being rated. Rate the characteristics, record their ranking on the GRI form, and sum the rankings to obtain the GRI Index.

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Grazing Response Index (R2-2200-GRI)

Forest Bighorn NF	**District** Buffalo Rd	**Spatial ID** FS 02 12 10 373010830 0045 94
Allotment Name and Number Table Mountain	**Pasture** Pat Park	
Kind/Class & Number of Animals 825 C/C	**Period of Use** 6/1 - 7/15	**Actual Use** 1238 Animal Months
Date 07/21/94	**Examiner(s)** J. Dawkins	

# of Defoliations	Value
1	+1
2	0
3	-1

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Amount of Use	Percent	Value
Light	<40 percent	+1
Moderate	40-55 percent	0
Heavy	>55 percent	-1

Pasture	Frequency	Intensity	Opportunity	Total GRI
1	+1	-1	+1	+1
2	0	0	-1	-1
3	0	0	+1	+1
4	-1	-1	-2	-4
5	+1	0	+2	+3
6	0	0	+1	+1
7	+1	+1	-1	+1
8	-1	0	-1	-2
9	0	+1	0	+1
10	0	-1	+1	0

References:

Caldwell, M.M. 1984. Plant requirements for prudent grazing. From: Developing strategies for rangeland management. Westview Press, Boulder CO. pp 117-152.

Richards, J.H.; Caldwell, M.M. 1985. Soluble carbohydrates, concurrent photosynthesis and deficiencies in regrowth following defoliation: a field study with Agropyron species. Journal of Applied Ecology 22:907-920.

Pond, F.W. 1960. Vigor of Idaho fescue in relation to different grazing intensities. Journal of Range Management 13:28-30.

Mueggler, W.F. 1972. Influence of competition on the response of bluebunch wheatgrass to clipping. Journal of Range Management 25:88-92.

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Grazing Response Index

Use this method to evaluate each pasture, or several sites within a pasture. Each row represents one GRI rating. **To determine the GRI, add all three values (frequency, intensity, and opportunity)** and record the sum in the Total column. Several sites within a pasture can be averaged to obtain an overall rating for the entire pasture. Complete the Site Information Form for each site or pasture.

Unit Name_____ Pasture Name_____

Transect ID_____ Date _____ Observer_____

Grazing System_____ Season of Use _____ to _____

# of Defoliations	Value
1	+1
2	0
3	-1

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Amount of Use	Percent	Value
Light	<40 percent	+1
Moderate	40-55 percent	0
Heavy	>55 percent	-1

Pasture Name	Site ID	Frequency	Intensity	Opportunity	GRI (Total)

LFO_RMP_10174

APPENDIX G
LOW-STRESS STOCKMANSHIP

For a description of low-stress stockmanship, see section III.D.2.c.(7). Benefits of low-stress stockmanship include:

Riparian Benefits

- Avoiding sensitive areas is easier.
- The time of exposure to grazing and trampling is decreased.
- Enhanced monitoring by the livestock operator is possible.
- The area may be aesthetically more pleasing to some recreation users.
- Riparian conditions and trends improves.
- Bank stability improves.
- Water quality improves.

Rangeland Benefits

- Use of upland forages increases and use of riparian areas decreases.
- Increased control over livestock allows the use of prescribed grazing as an ecological management tool. Livestock may be used as a tool to influence plant community composition, age structure, etc.
- Rangeland conditions and function may be enhanced by improving the efficiency of the water, energy, and nutrient cycles.
- Cattle can be placed on the range, eliminating problems in riparian areas and other hot spots.
- Plant nutrition, palatability, and productivity increase.
- Herd effect is applied where it is appropriate or to achieve high density impacts to control brush, decrease fire hazard, and increase grass seed germination.
- The proportion of plants grazed at a low to moderate level of use increases.

Herd Health

Low-stress stockmanship allows for decrease of fly problems as the herd can be moved before flies hatch; decrease in diseases such as pink-eye, pneumonia, leptospirosis, and scours; decrease or elimination of death losses and injuries from stress; high-strung and low-condition stock gain better and are healthier; and overall improved herd health.

Economics and Sustainability of Ranching Operations

Bradford and Allen (1999), Smith (1998), and Cote (2004) as well as numerous testimonials from Cote, Westfall, and Leonard suggest that using low-stress stockmanship methods:

- Increases the pounds/acre of forage produced.
- Increases overall weight gains of animals, particularly on the range.
- Increases weight gains on weaned calves by reducing stress at weaning time. Animals go directly to feed and water.
- Allows use for the full grazing season even during periods of drought, because permittees can increase the ability to avoid riparian grazing triggers.
- Improves ease of handling and overall behavior in stock.
- Improves milk production.
- Improves the ease of sorting and shipping.
- Reduces expenditures by minimizing the need for fences and high-tech handling facilities.
- Reduces fencing needed as stock can be kept together or moved and placed in large pastures. Pasture units may be divided and grazed separately without the use of cross fences.
- Increases gains and improves health of previously high-strung and low-condition stock.
- Allows greater flexibility in pasture management.
- Increases carrying capacity on rangelands.
- Increase the number of head of livestock that can be handled efficiently by an individual.
- Saves time in gathering.
- Stops livestock from leaving the range and returning home before desired.

- Reduces dark cutters and bruising of meat caused by bumping, crowding, and shoving during sorting, loading, and routine handling.
- Reduces damage to facilities such as loosened gate posts, bent panels, etc.
- Improves the safety of livestock handlers.
- Achieves higher conception rates.
- Reduces pharmaceutical costs.
- Improves working relationships among ranchers, ranch employees, agency personnel, and other interested parties.

All results may not be achieved everywhere depending on past practices and performance.

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GLOSSARY OF TERMS

Adaptive Management – an interdisciplinary planning and implementation process that identifies desired conditions, defines criteria for modifying management when progress toward achieving the desired conditions is not being made, and specifically defines the monitoring strategy and protocols.

Capability – the highest ecological status an area can attain given political, social, or economic constraints, which are often referred to as limiting factors.

Collaboration – the pooling of appreciations or tangible resources (e.g., information, money, or labor) by **two or more stakeholders** to solve a set of resource problems that no one party can solve individually. Also referred to as cooperation or coordination.

Decreasers – For a given plant community, those species that decrease in amount as a result of a specific abiotic/biotic influence or management practice (SRM 2004).

Dry Ravel – soil particles dislodging and rolling down a slope or bank under the influence of gravity. Ravel occurs most rapidly when a cohesionless soil on a steep slope dries out. Ravelling is dramatically increased when frost acts on the exposed soil. Ravel on some steep, bare cutbanks can quickly fill ditches and supply sediment that is then eroded and moved to nearby ditch relief culverts or streams by concentrated ditch flow (FishNet 4C et al. 2004).

Dynamic Equilibrium – the approximate balance between work done and imposed load, as the landscape is lowered by erosion and solution, then is uplifted, or as processes alter with changing climate, adjustments occur that maintain this approximate balance.

Eutrophication – designation of a body of water in which the increase of mineral and organic nutrients has reduced the dissolved oxygen, producing an environment that favors plant life over animal life.

Facultative – Plants that are equally likely to occur in wetlands or nonwetlands (34-66 percent).

Facultative Upland – Plants that usually occur in nonwetlands (67-99 percent) but are occasionally found in wetlands (1-33 percent).

Facultative Wetland – Plants that usually occur in wetlands (67-99 percent) but are occasionally found in nonwetlands.

Foci – center of interest or clarity.

Greenline – the first perennial vegetation that forms a lineal grouping of community types on or near the water's edge. Most often it occurs at or slightly below the bankfull stage.

Historic Climax Plant Community – the plant community considered to best typify the potential plant community of an ecological site prior to the advent of European settlers. It may no longer be one of the potential plant communities for the site (SRM 2004).

Increaser – For a given plant community, those species that increase in amount as a result of a specific abiotic/biotic influence or management practice (SRM 2004).

Intermittent or Seasonal – a stream that flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.

In Utero – during growth and development before birth.

Low-Moisture Block – a free-choice nutritional supplement block for livestock containing not more than 5 percent moisture. Intake is controlled due to its hardness; it must be licked as it cannot be bitten or chewed. It may sometimes be referred to as a cooked block.

Morphological – relating to structure, shape, or form.

Obligate Upland – plants that may occur in wetlands in another region, but occur almost always (>99 percent) under natural conditions in nonwetlands in the region specified.

Obligate Wetland – plants that occur almost always (>99 percent) under natural conditions in wetlands.

Pathways – reversible changes in or among plant communities or phases within one state.

Phenological – relating to a plant's stage of growth.

Plant Association – used to group together all those stands of climax vegetation occurring in environments so similar that there is much floristic similarity throughout all layers of the vegetation.

Plant Community Type – a repeating classified and recognizable assemblage or grouping of plant species. Riparian community types represent the existing structure and composition of plant communities with no indication of successional status. They often occur as patches, stringers, or islands and are distinguished by floristic similarities in both their overstory and understory layers.

Potential – the highest ecological status a riparian-wetland area can attain given no political, social, or economic constraints. This status is often referred to as the potential natural community (PNC).

Proper Functioning Condition – a riparian-wetland area is considered to be in proper functioning condition when adequate vegetation, landform, or large woody debris is present to:

- dissipate stream energy associated with high water-flows, thereby reducing erosion and improving water quality
- filter sediment, capture bedload, and aid floodplain development
- improve floodwater retention and ground-water recharge
- develop root masses that stabilize streambanks against cutting action
- develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses
- support greater biodiversity

Satiation – having had enough or more than enough so that all pleasure or desire is lost.

Senesce – mature

State – a recognizable soil and plant complex that resists change and usually self-repairs after disturbance. The state reflects a site's natural variability with a suite of plant communities specific to the functioning of the ecological processes.

Threshold – a "boundary" between two states that, once crossed, does not allow the community to "self-repair" to a former state because one or more ecological processes has become too degraded.

Transition – changes in vegetation or soil ecological processes (natural or management-induced) that will make one state change to another. Transitions can be reversed until a threshold has been crossed to another state.

Wolfy – plants containing accumulated standing dead material from previous growth. They often have a larger size due to selective use of nearby nonwolfy plants.

LFO_RMP_10174

LITERATURE CITED

Abernethy, B. and I.D. Rutherford. 2001. The distribution and strength of riparian tree roots in relation to riverbank reinforcement. Hydrological Processes 15:63-79.

American Fisheries Society, Western Division. 1982. The best management practices for the management and protection of western riparian stream ecosystems. Riparian Habitat Committee. 45 pp.

Bailey, D.W. 2004a. Can we improve livestock distribution with selection? In: Abstracts of Papers, 57th annual meeting, Society for Range Management, Salt Lake City, UT.

_____. 2004b. Management of cattle distribution patterns through strategic supplement placement and herding to protect riparian areas and increase uniformity of grazing in rugged rangeland. In: Abstracts of Papers, 57th annual meeting, Society for Range Management, Salt Lake City, UT.

_____. 2004c. Management strategies for optimal grazing distribution and use of arid rangelands. J Anim Sci 82 (E. Suppl.):E147-E153.

_____. 2005. Identification and creation of optimum habitat conditions for livestock. Rangeland Ecol & Manage 58:109-118.

Bailey, D.W., M. Keil, and L.R. Rittenhouse. 2004a. Research observations: Grazing patterns of hill climbing and bottom dwelling cows. J Range Manage 54:11-22.

Bailey, D.W., D.D. Kress, D.C. Anderson, D.L. Boss, and K.C. Davis. 2001a. Evaluation of F1 crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise and Hereford sires, V: Grazing distribution patterns. Proc, West Sec Amer Soc Anim Sci 52:110-113.

Bailey, D.W., D.D. Kress, D.C. Anderson, D.L. Boss and E.T. Miller. 2001b. Relationship between terrain use and performance of beef cows grazing foothill rangeland. J Anim Sci 79:1883-1891.

Bailey, D.W., K. Long, and B. Long. 2004b. Evaluation of low-moisture blocks and pressed blocks for manipulating cattle grazing distribution. In: Abstracts of Papers, 57th annual meeting, Society for Range Management, Salt Lake City, UT.

Bailey, D.W., H.C. VanWagoner, and R. Weinmeister. In Press. Individual animal selection has the potential to improve uniformity of grazing on foothill rangeland. Rangeland Ecology & Management.

Bailey, D.W. and G.R. Welling. 1999. Modification of cattle grazing distribution with dehydrated molasses supplement. J Range Management 52(6):575-582.

_____. 2002. Comparison of low-moisture molasses blocks and loose dry mineral mixes as delivery systems for supplementing trace minerals to rangeland cattle. In: Abstracts of Papers, Society for Range Management. Kansas City, MO.

Bailey, D.W., G.R. Welling and E.T. Miller. 2001c. Cattle use of foothills rangeland near dehydrated molasses supplement. J Range Manage 54:338-347.

Banister, R. 2005. Rancher. Banister Ranch, MT. Personal communication.

Barker, W.T., K.K. Sedivec, T.A. Messmer, K.F. Higins, and D.R. Hertel. 1990. Effects of specialized grazing systems on waterfowl production in southcentral North Dakota. North Dakota State University Animal and Range Sciences Department.

Bartos, D.L. and R.B. Campbell, Jr. 1998. Water depletion and other ecosystem values forfeited when conifer forests displace aspen communities. In: Potts, D.F. (ed.). Rangeland management and water resources: Proceedings of the AWRA specialty conference. American Water Resources Association, Reno, NV. pp. 427-434.

LFO_RMP_10174

Behnke, R.J., and R.F. Raleigh. 1978. Grazing and the riparian zone: Impact and management perspectives. Proceedings of the symposium: Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Callaway Gardens, GA. General Technical Report WO-12. U.S. Department of Agriculture, Forest Service. pp.262-267.

Berg, F. and S.K. Wyman. 2001. Livestock water access and ford stream crossings. Engineering Technical Note No. MT-13. U.S. Department of Agriculture, Natural Resources Conservation Service. 10 pp.

Blenden, M. 2003. Nomination for Colorado Riparian Association 2003. Excellence in Riparian Management Award. 2 pp.

Bousman, J. Eastfork Livestock Ranch, Boulder, WY. Personal communication.

_____. 2003. Voluntary cooperative monitoring. Presentation at grazing management for riparian areas workshop, Lander, WY.

Boyd, C.S. and T.J. Svejcar. 2004. Regrowth and production of herbaceous riparian vegetation following defoliation. J Range Manage 57(5):448-454.

Bradford, D. and S. Allen. 1999. Herding: how it works in the West Elks. Quivera Coalition 2(3). 20 pp.

Buckhouse, J.C., J.M. Skovlin, and R.W. Knight. 1981. Streambank erosion and ungulate grazing relationships. J Range Manage 34(4):339-340.

Butler, P.J. 2000. Cattle distribution under intensive herded management. Rangelands 22:21-23.

Chamberlain, D.J. and M.S. Doverspike. 2001. Water tanks protect streambanks. Rangelands 23(2):3-5.

Clary, W.P. 1999. Stream channel and vegetation responses to late spring cattle grazing. J Range Manage 52(3):218-227.

Clary,W.P. and W.C. Leininger. 2000. Stubble height as a tool for management of riparian areas. J Range Manage 53:562-573.

Clary, W.P. and B.F. Webster. 1989. Managing grazing of riparian areas in the Intermountain Region. General Technical Report INT-263. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 11 pp.

Cleary, C.R. and D. Phillippi. 1993. Coordinated resource management: Guidelines for all who participate. Society for Range Management, Denver, CO.

Coffey, L. 2002. Sustainable goat production: Meat goats livestock production guide. Appropriate Technology Transfer for Rural Areas. 20 pp.

Coleman, J.S. 1988. Social capital in the creation of human capital. American Journal of Sociology 94(Supplement):S95-S120.

Cornwall, C.X. 1998. Stream stabilizing traits in six riparian graminoids common to semi-arid alluvial streams. Master's thesis, Department of Botany, Arizona State University, Tempe, AZ.

Cote, S. 2004. Stockmanship: A powerful tool for grazing lands management. U.S. Department of Agriculture, Natural Resources Conservation Service, Boise, ID. 149 pp.

Cowley, E.R. 1997. Idaho riparian proper functioning condition (PFC) assessment training material. Unpublished data.

Cowley, E.R. and T.A. Burton. 2005. Monitoring streambanks and riparian vegetation–multiple indicators. Technical Bulletin No. 2005-2. U.S. Department of the Interior, Bureau of Land Management, Boise, ID.

Crane, K.K. 2002. Influence of cattle grazing on feeding site selection by Rocky Mountain elk. Ph.D. dissertation. University of Wyoming, Laramie, WY.

Crane, K.K., M.A. Smith, and D. Reynolds. 1997. Habitat selection patterns of feral horses in southcentral Wyoming. J Range Manage 50(4):374-380.

LFO_RMP_10174

Crowe, E.A. and R. Clausnitzer. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla and Wallowa-Whitman National Forests. No. R6-NR-ECOL-TP-22-97. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

Curtis, K.R., W.W. Riggs, and B. Shulz. 2005a. Humboldt county cow-calf production costs and returns. University of Nevada, Reno, Fact Sheet.

Curtis, K.R., W.W. Riggs, R. Torell, and T.R. Harris. 2005b. Elko county cow-calf production costs and returns. University of Nevada, Reno, Fact Sheet.

Dagget, D. 1998. Beyond the rangeland conflict: Toward a West that works. Good Stewards Project, Flagstaff, AZ. 104 pp.

Damiran, D., T. DelCurto, S.L. Findholt, G.D. Pulsipher, and B.K. Johnson. 2003. Influence of previous cattle and elk grazing on the subsequent quality and quantity of diets for cattle, deer, and elk grazing late-summer mixed-conifer rangelands. Proceedings, Western Section, American Society of Animal Science 54:325-328.

Danvir, R. 2005. Wildlife Manager. Deseret Land and Livestock, UT. Personal communication.

Darambazar, E., T. DelCurto, C. Ackerman, G. Pulsipher, and D. Damiran. 2003. Changes in forage quantity and quality with continued cattle grazing in a mountain riparian pasture. Proceedings, Western Section, American Society of Animal Science. 54:325-328.

Davis, J. 1982. Livestock and riparian habitat management - Why not? In: Proc. of 62nd Western Association of Game and Fish Commissioners Meeting. Las Vegas, NV. pp. 225-232.

Duff, D.A. 1983. Livestock grazing impacts on aquatic habitat in Big Creek, Utah. In: Menke, J.W. (Ed.) Proceedings of the workshop on livestock and wildlife–fisheries relationships in the Great Basin. Special Publication 3301. University of California, Berkeley, CA. pp. 129-142.

Ehrhart, R.C. and P.L. Hansen. 1997. Effective cattle management in riparian zones: a field survey and literature review. Riparian Technical Bulletin No. 3. U.S. Department of the Interior, Bureau of Land Management, Montana State Office, and Riparian and Wetland Research Program, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT. 92 pp.

_____. 1998. Successful strategies for grazing cattle in riparian zones. Riparian Technical Bulletin No. 4. U.S. Department of the Interior, Bureau of Land Management, Montana State Office, and Riparian and Wetland Research Program, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT. 47 pp.

Eisenberg, J. 2004. Litigation is the wrong answer for conservation (statement from Jeff Eisenberg, Executive Director, Public Lands Council and Director of Federal Lands for the National Cattlemen's Beef Association). Internet document. *http://www.beefusa.org/newslitigationisthewronganswerforconservation3558.aspx*

Elmore, W. and B. Kauffman. 1994. Riparian and watershed systems: Degradation and restoration. In: Ecological implications of livestock herbivory in the west. Vavra, M., W.A. Laycock, and R.D. Pieper (Eds.). Society for Range Management, Denver, CO. 297 pp.

Evans, C. (Draft). Characteristics of successful riparian grazing systems on public lands in northern Nevada.

Falconer, D.S. 1960. Introduction to quantitative genetics. Ronald Press, New York, NY.

Fernandez-Gimenez, M. E., G. Ruyle, and S. Jorstad McClaran. 2005. An evaluation of Arizona cooperative extension's rangeland monitoring program. Rangeland Ecol & Manage 58(1):89-98.

Field, P. and M. McKinney. 2004. Natural resource collaborative action and conflict management: environmental conflict management. Training Binder (course number 1620-25), Bureau of Land Management, National Training Center, Phoenix, AZ.

LFO_RMP_10174

FishNet 4C, MFG, Inc., Prunuske Chatham, Inc., and Pacific Watershed Associates 2004. Guidelines for protecting aquatic habitat and salmon fisheries for county road maintenance.

Ganskopp, D. 2001. Manipulating cattle distribution with salt and water in large arid-land pastures: A GPS/GIS assessment. Appl Anim Behav Sci 73:251-262.

_____. 2004. Affecting beef cattle distribution in rangeland pastures with salt and water. Range Field Day Report 2004: Current Forage and Livestock Production Research. Special Report 1052. Eastern Oregon Agricultural Research Center. pp. 1-3.

Gebhardt, K., S. Leonard, G. Staidl, and D. Prichard. 1990. Riparian area management: Riparian classification review. TR 1737-5. U.S. Department of the Interior, Bureau of Land Management, Service Center, Denver, CO. 56 pp.

Gillen, R., W. Krueger, and R. Miller. 1985. Cattle use of riparian meadows in the Blue Mountains of northeastern Oregon. J of Range Manage 38(3):205-209.

Glimp, H.A. and S.R. Swanson. 1994. Sheep grazing and riparian and watershed management. Sheep Research Journal, Special Issue:65-71.

Gowan, C.M. and R.H. Camper. 2000. Low stress stockmanship: A method for handling livestock that results in increased productivity for the stockman, reduced riparian impacts and improved rangeland conditions. Presentation at Society for Range Management Annual Meeting, Boise, ID.

Gray, B. 1985. Conditions facilitating interorganizational collaboration. Human Relations 38(10):911-936.

_____. 1989. Collaborating: Finding common ground for multiparty problems. Jossey-Bass, San Francisco. 358 pp.

Green, D.M. 1991. Soil conditions along a hydrologic gradient and successional dynamics in a grazed and ungrazed montane riparian ecosystem. Ph.D. Dissertation, Oregon State University, Corvallis, OR. 236 pp.

Gripne, S.L. 2005. Grassbanks: Bartering for conservation? Rangelands 27(1): 24-28.

Hagener, L. Range Conservationist. Bureau of Land Management, Dillon, MT. Personal communication.

Hall, F.C. 2001. Ground-based photographic monitoring. General Technical Report PNW-GTR-503. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 340 pp.

_____. 2002. Photo point monitoring handbook: Part A—Field procedures. General Technical Report PNW-GTR-526. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 48 pp.

Hall, F.C. and L. Bryant. 1995. Herbaceous stubble height as a warning of impending cattle grazing damage to riparian areas. General Technical Report PNW-GTR-362. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 9 pp.

Hall, F.C. and T. Max. 1999. Technical note: Test of observer variability in measuring riparian shrub twig length. J Range Manage 52(6):633–636.

Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Misc. Publications No. 54. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT.

Hart, R.H., J. Bissio, M.J. Samuel, and J.W. Waggoner, Jr. 1993. Grazing systems, pasture size, and cattle behavior, distribution and gains. J Range Manage 46:81-87.

Herbel, C.H. and A.B. Nelson. 1966. Activities of Hereford and Santa Gertrudis cattle on the southern New Mexico range. J Range Manage 19:173-181.

Hilliard, M. Wildlife Biologist. Bureau of Land Management. Boise, ID. Personal communication.

LFO_RMP_10174

Hormay, A. 1976. Telephone conversation with Bruce, Smith, Fisheries Biologist, on rest-rotation grazing management. BLM Memo 1220-3806-NR-01 to Manager, BLM Rock Springs District, WY.

Howery, L.D., F.D. Provenza, and R.E. Banner. 1998. Social and environmental factors influence cattle distribution. Appl Anim Behav Sci. 55:231-244.

Howery, L.D., F.D. Provenza, R.E. Banner and C.B. Scott. 1996. Differences in home range and habitat use among individuals in a cattle herd. Appl Anim Behav Sci 49:305-320.

Interagency Technical Team. 1996. Sampling vegetation attributes. U.S. Department of the Interior, Bureau of Land Management, National Applied Resource Sciences Center, Denver, CO. 172 pp.

Jensen, S., R. Ryel, and W.S. Platts. 1989. Classification of riverine/riparian habitat and assessment of non-point source impacts, North Fork Humboldt River, Nevada. Report to U.S. Department of Agriculture, Forest Service, Intermountain Research Station. White Horse Associates, Smithfield, UT. 165 pp.

Kinch, G. 1989. Riparian area management: Grazing management in riparian areas. TR 1737-4. U.S. Department of the Interior, Bureau of Land Management, Service Center, Denver, CO. 44 pp.

Kindschy, R. Wildlife Biologist. Bureau of Land Management, Vale, OR. Personal communication.

Kirby, D. and K.L. Grosz. 1995. Cattle grazing and sharp-tailed grouse nesting success. Rangelands 17(4):124-126.

Knight, J.E. 2004. Big game influences on ranch sustainability. Mountains & Minds. Montana State University. 2 pp.

Kovalchik, B. 1987. Riparian zone associations—Deschutes, Ochoco, Fremont, and Winema National Forests. No. R6 ECOL TP-279-87. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

Kovalchik, B. and W. Elmore. 1991. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. In: Symposium on ecology and management of riparian shrub communities. Sun Valley, ID. pp. 111-119.

Krueger, W.C. 1996. Managing ungulates to allow recovery of riparian vegetation. In: Proceedings of sustaining rangeland ecosystems. Agriculture Experiment Station Special Report 952. Oregon State University, Corvallis, OR. pp. 160-164.

Kuipers, A. 2002. Winter watering with frost free nose pumps. Prairie Water News. 12(1).

Legge, T.A., D.J. Herman, and B. Zamora. 1981. Effects of cattle grazing on mountain meadows in Idaho. J of Range Manage 34(4):324-328.

Leonard, S., G. Kinch, V. Elsbernd, M. Borman, and S. Swanson. 1997. Riparian area management: Grazing management for riparian areas. TR 1737-14. U.S.Department of the Interior, Bureau of Land Management, Service Center, Denver, CO. 63 pp.

Lucas, R.W., T.T. Baker, M.K. Wood, C.D. Allison, and D.M. Vanleeuwen. 2004. Riparian vegetation response to different intensities and seasons of grazing. J of Range Manage 57(5):466-474.

Manning, M.E., S.R. Swanson, T. Svejcar, and J. Trent. 1989. Rooting characteristics of four intermountain meadow community types. J Range Manage 42(4):309-312.

Marlow, C.B. 1985. Controlling riparian zone damage with little forage loss. Montana Agricultural Research Station. 2(3):1-7.

Marlow, C.B. and R. Finck. 2002. Using a greenline approach for monitoring livestock grazing in riparian zones: A critique of the method. Abstracts, 55th annual meeting, Society for Range Management, Kansas City, MO. pp. 31.

Marlow, C.B. and T.M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambanks. In: Proc. of the First N. Am. Riparian Conf. General Tech. Report RM- 120. U.S. Department of Agriculture, Forest Service. pp. 279-284.

Maser, C. 1988. Six guidelines for framing and writing objectives. U.S. Department of the Interior, Bureau of Land Management.

Massman, C. (Ed.). 1998. Riparian grazing successes on Montana ranches. Conservation Districts Bureau, Montana Department of Natural Resources and Conservation, Helena, MT. 30 pp.

Masters, L., S. Swanson, and W. Burkhardt. 1996a. Riparian grazing management that worked: I. Introduction and winter grazing. Rangelands 18(5):192-195.

_____. 1996b. Riparian grazing management that worked: II. Rotation with and without rest and riparian pastures. Rangelands 18(5):196-200.

McInnis, M.L. and J. McIver. 2001. Influence of off-stream supplements on streambanks of riparian pastures. J of Range Manage 54(6):648-652.

Meehan, W.R. and W.S. Platts. 1978. Livestock grazing and the aquatic environment. Journal of Soil and Water Conservation 33(6):274-278.

Micheli, E.R. and J.W. Kirchner. 2002. Effects of wet meadow riparian vegetation on streambank erosion. 1. Remote sensing measurements of streambank migration and erodibility. Earth Surface Processes and Landforms 27:627-639.

Milesnick, T. Rancher. Belgrade, MT. Personal communication.

Miller, M. State Biologist. Natural Resources Conservation Service. Albuquerque, NM. Personal communication.

Miner, J.R., J.C.Buckhouse, and J.A. Moore. 1992. Will a water trough reduce the amount of time hay-fed livestock spend in the stream (and therefore improve water quality)? Rangelands 14(1):233-236.

Mosley, J.C. 1996. Grazing management to enhance riparian habitat. Presentation at 25th annual Pacific Northwest Range Management Short Course, Boise, ID.

_____. 1999. Influence of social dominance on habitat selection by free-ranging ungulates. Grazing behavior of livestock and wildlife. Idaho Forest, Wildlife and Range Experiment Station Bulletin #70, University of Idaho, Moscow, ID. pp 109-118.

Myers, L. Wildlife Biologist. Bureau of Land Management, Dillon, MT. Personal communication.

_____. 1981. Grazing on stream riparian habitats in southwestern Montana. In: Proc. Montana Chapter of the Wildlife Society Meeting.

_____. 1989. Grazing and riparian management in southwestern Montana. Fifteen years of experience. Proceedings: Practical Approaches to Riparian Resource Management an Educational Workshop. Billings, MT. pp 117-120.

Olson, N.C. 1989. Quality assessment of twenty allotment management plans from the Surprise Valley Resource Area. Master's thesis, University of Nevada, Reno. 89 pp.

Olson, N.C. and J.W. Burkhardt. 1992. Land management planning: An assessment. Rangelands 14(3):150-152.

Padgett, W.G., A.P. Youngblood, and A.H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. Tech. Paper R4-ECOL-89-01. U.S. Department of Agriculture, Forest Service, Intermountain Region, Ogden, UT. 191pp.

Parsons, C.T., P.A. Momont, T. Delcurto, M. McInnis, and M.L. Porath. 2003. Cattle distribution patterns and vegetation use in mountain riparian areas. J Range Manage 56(4):334-341.

Pfister, J.A., G.B. Donar, R.D. Pieper, J.D. Wallace, and E.E. Parker. 1984. Cattle diets under continuous and four-pasture, one-herd grazing systems in south-central New Mexico. J Range Manage 37:50-54.

LFO_RMP_10174

Pieper, R.D., G.B. Dohnart, E.E. Parker, and J.D. Wallace. 1978. Livestock and vegetation response to continuous and 4-pasture, 1-herd, grazing systems in New Mexico. Proceedings, First International Rangeland Congress, Society for Range Management 1:560-562.

Pieratt, B. 2005. Rangeland Management Specialist. Bureau of Land Management, Prineville, OR. Personal communication.

Pizel, D. 2004. Ranch Manager. Rio Oxbow Ranch, CO. Personal communication.

Platts, W.S. Research Fishery Biologist. Intermountain Forest and Range Experiment Station, Boise, ID. Personal communication.

Platts, W.S. and R. Nelson. 1985. Will the riparian pasture build good streams? Rangelands 7(l):7-10.

Platts, W.S. and R. Raleigh. 1984. Impacts of grazing on wetlands and riparian habitat. In: Developing Strategies for Rangeland Management. National Research Council/National Academy of Sciences. Westview Press, Boulder, CO. pp. 1105-1128.

Prichard, D., J. Anderson, C. Correll, J. Fogg, K. Gebhardt, R. Krapf, S. Leonard, B. Mitchell, and J. Staats. 1998. Riparian area management: A user guide to assessing proper functioning condition and the supporting science for lotic areas. TR1737-15. U.S. Department of the Interior, Bureau of Land Management, National Applied Resource Sciences Center, Denver, CO. 126 pp.

Provenza, F.D. 2003. Foraging behavior: Managing to survive in a world of change. Department of Forest, Range, and Wildlife Sciences, Utah State University, Logan, UT. 63 pp.

Rasmussen, A.G., M.P. O'Neill, and L. Schmidt. 1998. Monitoring rangelands: Interpreting what you see. Utah State University Cooperative Extension Service NR 503. 41 pp.

Reed, F., R. Roath, and D. Bradford. 1999. The grazing response index: A simple and effective method to evaluate grazing impacts. Rangelands 21(4):3-6.

Reed, Jr., P.B. 1988. National list of plant species that occur in wetlands. Biological Report 88 (24). U.S. Department of the Interior, Fish and Wildlife Service, Research and Development, Washington, DC. 244 pp.

Reynolds, D.A. (comp.) 1998. Rangeland monitoring manual: A field reference for managers. B-1065. University of Wyoming Cooperative Extension Service. 54 pp.

Riggs, W. Extension Educator, University of Nevada, Reno. Eureka, NV. Personal communication.

Roath, L.R. and W.C. Krueger. 1982. Cattle grazing and behavior on a forested range. J Range Manage 35:332-338.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO. 390 pp.

Schumm, S.A. 1977. The fluvial system. John Wiley & Sons. New York. 338 pp.

Secrist, G. Range Conservationist. Bureau of Land Management. Washington, DC. Personal communication.

Simonds, G. Manager. Deseret Ranch, Woodruff, UT. Personal communication.

Sipple, E. and S. Swanson. 1995. Photo-point analysis of winter and spring grazing effects on temperate streams. In: Fifth International Rangelands Congress. Society for Range Management. Salt Lake City, UT. p. 520.

Skovlin, J. 1984. Impacts of grazing on wetlands and riparian habitat: A review of our knowledge. In: Developing Strategies for Rangeland Management. National Research Council/National Academy of Sciences. Westview Press. Boulder, CO. pp. 1101- 1103.

Smith, B. 1998. Moving 'em: A guide to low stress animal handling. The Graziers Hui, Kamuela, Hawaii. 351 pp.

Smith, P. 2002. Citizen participation observed: social distance in planning and zoning hearings. (Unpublished manuscript). 10 pp.

Smoliak, S. 1960. Effects of deferred rotation and continuous grazing on yearling steer gains and shortgrass prairie vegetation of southeastern Alberta. J Range Manage 21:47-50.

Staats, J. 2000. Hydrologist. National Riparian Service Team, U.S. Forest Service, Prineville, OR. Personal communication.

Society for Range Management. 2004. Glossary of terms used in range management, 4th Edition. 32 pp.

Stillings, A.M., J.A. Tanaka, N.R. Rimbey, T. Delcurto, P.A. Momont, and M.L. Porath. 2003. Economic implications of off-stream water developments to improve riparian grazing. J Range Manage 56(5):418-424.

Stoddart, L., A. Smith, and T. Box. 1975. Management for proper range use. In: Range Management, Third Edition. McGraw-Hill Book Co. New York, NY. pp. 256-289.

Stringham, T.K. Assistant Professor. Department of Rangeland Resources, Oregon State University, Corvallis, OR. Personal communication.

Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2003. State and transition modeling: An ecological process approach. J Range Manage 56(2):106-113.

Stuth, J.W. 1991. Foraging behavior. In: Heitschmidt, R.K. and J.W. Stuth (Ed.). Grazing management: An ecological perspective. Timber Press, Inc., Portland, OR. 259 pp.

Svedarsky, D and G. Van Amburg. 1996. Integrated management of the greater prairie chicken and livestock on the Sheyenne National Grassland. North Dakota Game and Fish Department, Bismarck, ND. 113 pp.

Swanson, S. 1994. Viewpoint: Integrating CRM (Coordinated Resource Management) and NEPA (National Environmental Policy Act) processes. J Range Manage 47(2):100-106.

Swickard, T. Rancher, Five Dot Land & Cattle Company, Susanville, CA. Personal communication.

Thomas, J.W., C. Maser, and J.E. Rodiek. 1979. Riparian zones in managed rangelands—their importance to wildlife. In: Proc. of the Forum on Grazing and Riparian Stream Ecosystems. Trout Unlimited. Denver, CO. pp. 21-31.

Trlica, M.J., E.A. Nibarger, W.C. Leininger, and G.W. Frasier. 2000. Runoff water quality from grazed and ungrazed montane riparian plots. Proc.: International Conference on Riparian Ecology and Management in Multi-Land Use Watersheds. Portland, OR. pp. 263-268.

USDA. 1999. Sustaining the people's lands: Recommendations for stewardship of the national forests and grasslands into the next century. Committee of Scientists Report. Washington DC. 193 pp.

USDA NRCS. 2001. Stream corridor inventory and assessment techniques: Watershed Science Institute Technical Report. U.S. Deparment of Agriculture, Natural Resources Conservation Service. 30 pp.

_____. 2003. National range and pasture handbook. U.S. Department of Agriculture, Natural Resources Conservation Service. Washington, DC.

_____. 2005. Grazingland and spatial analysis tool (GSAT). U.S. Department of Agriculture, Natural Resources Conservation Service. In production.

USDA USFS. 1996. Rangeland analysis and management training guide. U.S. Department of Agriculture, Forest Service, Rocky Mountain Region, Denver, CO.

_____. 2004. Allotment monitoring under the cooperative rangeland monitoring program MOU with the public lands council. U.S. Department of Agriculture, Forest Service official letter (2200/2260-1). Washington, DC. 2 pp.

LFO_RMP_10174

USDI BLM. 2004. Cooperative rangeland monitoring letter/memorandum of understanding (MOU) and request for permittee/lessee list of participants. U.S. Department of the Interior, Bureau of Land Management Instruction Memorandum No. 2004-179. Washington, DC. 2 pp.

VanWagoner, H.C., D.W. Bailey, D.D. Kress, D.C. Anderson, and K.C. Davis. 2006. Differences among beef sire breeds and relationships between terrain use and performance when daughters graze foothill rangelands as cows. Appl Anim Behav Sci 97(2):105-121.

Walters, M.A., R.O. Teskey, and T.M. Hinckley. 1980. Impact of water level changes on woody riparian and wetland communities. Vol.VII: Mediterranean Region, Western Arid and Semi-Arid Region. FWS/ORS 78/93. U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services Report.

Weixelman, D., D. Zamudio, and K. Zamudio. 1996. Central Nevada riparian field guide. No. R4-ECOL-96-01. U.S. Department of Agriculture, Forest Service, Intermountain Region.

Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. General Technical Report RMRS-GTR-47. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 pp.

Winward, A.H. and W.G. Padgett. 1986. Special considerations when classifying riparian areas. In: Proceedings—Land classifications based on vegetation: Applications for resource management. Gen. Tech. Rep. INT-257. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. pp 176-179.

Wondolleck, J.M. and S.L. Yaffee. 2000. Making collaboration work: Lessons for innovation in natural resource management. Island Press, Washington, DC. 277 pp.

Yaffee, S.L, J.M. Wondolleck, and S.R. Lippman. 1997. Factors that promote and constrain bridging: A summary and analysis of the literature. Technical Report PNW 95-0728. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, and University of Michigan, School of Natural Resources and Environment, Ann Arbor, MI. 43 pp.

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"Riparian Area Management – A Guide to Managing, Restoring, and Conserving Springs in the Western United States – Technical Reference 1737-17 2001"

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RIPARIAN AREA MANAGEMENT

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Grazing Management for Riparian-Wetland Areas

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RIPARIAN AREA MANAGEMENT

Grazing Management for Riparian-Wetland Areas

by

Steve Leonard
Riparian Ecologist/Grazing Management Specialist
National Riparian Service Team
Prineville, Oregon

Gene Kinch
District Manager (retired)
Bureau of Land Management
Rock Springs, Wyoming

Van Elsbernd
Rangeland Management Specialist
Forest Service
Ft. Collins, Colorado

Dr. Mike Borman
Extension Rangeland Resources Specialist
Oregon State University
Corvallis, Oregon

Dr. Sherman Swanson
Range Extension Specialist
University of Nevada Reno
Reno, Nevada

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U.S. Department of the Interior
Bureau of Land Management
National Applied Resource Sciences Center
P.O. Box 25047
Denver, CO 80225-0047

Dedication

This publication is dedicated to the memory of Jim Lewis, who for over 35 years devoted his life to the restoration and management of natural resources. Jim believed very strongly in working together to solve problems, maintaining the dignity of lifestyles, and restoring and ensuring proper use of natural resources. Until his untimely death, he continually worked on documentation for this publication because of his strong land use ethic and commitment to helping people find solutions to land use issues.

Acknowledgments

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Preface

This material was originally issued in 1989 as BLM Technical Reference 1737-4, Grazing Management in Riparian Areas, by Gene Kinch. Most of the information in the original reference is as valid today as it was in 1989, and therefore, is included in this document. Since 1989, numerous management actions have been implemented and evaluated, literature has been produced, and policies have emerged, and this information has been added to the original material. We hope the additional information will enhance the reader's ability to develop and implement successful riparian grazing management strategies over the full spectrum of land ownership and land types.

The original title has been changed to reflect the inclusion of wetlands as a component of riparian areas. Although the term riparian is used alone throughout the document, riparian-wetland is implied. Most of the examples feature running water (lotic) types of riparian-wetlands, but the principles apply to standing water or saturated (lentic) types of riparian-wetlands as well.

Contents

Page

Dedication i

Acknowledgments iii

Preface v

I. Introduction 1

II. Compatibility of Grazing in Riparian Areas 3

III. Management Objectives, Key Areas, and Key Species 5
- A. Management Objectives 5
  - 1. Vegetation 5
  - 2. Wildlife 6
  - 3. Water 6
  - 4. Geomorphic 6
- B. Key Areas and Critical Areas 7
- C. Key Plant Species 7

IV. Grazing Management Principles and Concepts 9
- A. Livestock Behavior 10
- B. Forage Selectivity 12

V. Grazing Management Strategies 13
- A. Key Management Considerations 13
  - 1. Timing, Duration, and Frequency of Grazing 14
  - 2. Distribution of Livestock 15
  - 3. Stocking Rates 15
  - 4. Utilization Levels and Patterns 16
  - 5. Pasture Design 17
- B. Grazing Treatments 17
  - 1. Passive, Continuous Grazing; Spring-Summer, Summer-Fall, or "Season-Long" Grazing 18
  - 2. Spring and Fall Grazing 23
  - 3. Riparian Pasture 23
  - 4. Winter (Dormant-Season) Grazing 27
  - 5. Spring Grazing 28
  - 6. Hot-Season Grazing 30
  - 7. Deferment Until the Late Season (Fall Grazing) 31
  - 8. Deferred and Rotational Deferred Grazing 33
  - 9. Rest-Rotation Grazing (Rotational Stocking) 36
  - 10. Holistic Resource Management 39
  - 11. Total Rest 41

C. Techniques that Attract Livestock Away from Riparian Areas 41
D. Techniques that Exclude or Promote Avoidance of Riparian Areas 42
E. Herd Management and Animal Husbandry Practices 43

VI. Monitoring 45
A. General 45
B. Short-Term Monitoring 46
1. Implementation 46
2. Seasonal, Annual, and Cyclic Events 46
3. Utilization and Stubble Height 47
C. Long-Term Monitoring 48

VII. Learning from Experience 49

VIII. Cardinal Rules for Planning and Managing Grazing in Riparian Areas 51

Appendix A 53

Literature Cited 57

Grazing Management for Riparian-Wetland Areas

I. Introduction

Generally, riparian areas are among the most resilient ecosystems. Depending on condition and potential, they usually respond more quickly than drier upland ranges to changes in management. This document presents information from various land managers and researchers to guide livestock management in riparian areas using their unique responsiveness to accomplish management objectives. However, management of riparian areas cannot be extricated from management of the larger landscape. Riparian areas, as interfaces between the aquatic and upland components of the ecosystem, comprise mosaics of landforms, communities, and environments within the larger landscape. The structure and processes of riparian areas, more than any other ecosystem, are influenced by their connectivity to adjacent ecosystems. Riverine ecosystems, in particular, connect headwaters with lowlands to provide for the transfer of water, nutrients, sediment, particulate matter, and organisms both laterally and downstream (Gregory et al. 1991). An ecosystem perspective provides an ecological basis for evaluating current grazing practices and other land uses, identifying riparian management objectives, and developing future management alternatives.

Livestock grazing management in riparian areas is one of the most pervasive issues facing rangeland managers. Most public and private rangeland is grazed, and even though riparian areas constitute only about 8 percent of the total public land acreage, and less than 1 percent of the public land in many of the more arid Western States (USDI 1995), most grazing allotments, including some desert allotments, contain some riparian acreage. Riparian area management is also one of the most complex issues for rangeland managers because:

- Most riparian acreage is privately controlled or intermingled with other ownerships
- Riparian areas are often the primary, and sometimes the only, watering place for livestock that graze on arid rangelands
- Public use of riparian areas is increasing
- Other resource values are concentrated in and dependent on those areas
- Grazing affects a number of resources and uses, both on-site and off-site
- The value of properly functioning riparian systems is not widely understood
- Traditional management practices are often inadequate and difficult to change

Because of these complexities, the involvement and cooperation of private landowners, ranchers, recreationists, other watershed users, and many different disciplines is critical to the success of riparian area management programs.

No single grazing management system has resulted in consistent recovery of degraded riparian areas. Many combinations of sites, resource conditions, and impacts, as well as human perspectives, are involved. The grazing management system for an

area should be tailored to the conditions, problems, potential, objectives, and livestock management considerations on a site-specific basis. From the standpoint of achieving livestock management objectives and minimizing soil, vegetation, and water quality impacts, grazing management plans will vary. There is no set formula for identifying the type of grazing system or management plan that will be best for any livestock operation or allotment. Water quality impacts are closely related to soil erosion and sedimentation, which are often associated with vegetation cover and concentration of livestock. The grazing system must be designed on the basis of soil and vegetation capabilities, water quality considerations, and livestock and wildlife requirements (Moore et al. 1979).

Ehrhart (in press) concluded that the common denominator among riparian areas that were functioning properly, or at least improving, in eastern and central Montana was continual involvement by the operator or manager. As long as there is control of livestock distribution and grazing intensity, the specific grazing system employed may not be important (Clary and Webster 1989). There are, however, grazing strategies and practices that, under given circumstances, make control of livestock distribution and grazing intensity easier or at least achievable.

II. Compatibility of Grazing in Riparian Areas

Livestock grazing can be a compatible use in riparian areas when managed in harmony with land management objectives, and when the function, capability, and potential of the site and the needs of the riparian vegetation guide the development of the grazing management prescription. Regardless of other differences in management objectives, grazing must be compatible with achieving or maintaining "proper functioning condition" to be considered sustainable. Proper functioning condition of riparian areas, as defined by Prichard et al. (1993 and 1994), is when adequate vegetation, landform, or large woody debris is present to:

- Dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality
- Filter sediment, capture bedload, and aid floodplain development
- Improve flood-water retention and ground-water recharge
- Develop root masses that stabilize streambanks against cutting action
- Develop diverse ponding and channel characteristics to provide the habitat and water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses
- Support greater biodiversity

Livestock grazing in riparian areas, however, may not always be entirely compatible with other resource uses or values. Where soils in riparian areas are unstable, the vegetation complex is fragile, threatened and endangered plants and/or animals are affected, aquatic or recreation values are high, municipal watersheds are involved, etc., special livestock management prescriptions must be applied. In some cases, excluding livestock grazing may be the most logical and responsible course of action (at least for a time sufficient to achieve a level of recovery and stability that can support grazing in the context of the management objectives).

The compatibility of grazing in riparian areas depends on the extent to which grazing management considers and adapts to certain basic ecological relationships. Prior to developing grazing management prescriptions for riparian areas, the manager should have some understanding of grazing effects on:

- Natural functions of riparian ecosystems
- Growth and reproduction of woody and herbaceous plants on the site
- Dependency of other animals (mammals, fish, birds, and amphibians) on riparian areas
- Hydrologic and geomorphic conditions and processes
- Soils
- Water quality

III. Management Objectives, Key Areas, and Key Species

A. Management Objectives

Grazing management based only on objectives for nonriparian areas (uplands) does not often maintain or improve riparian areas in the same pasture. Therefore, where maintenance or improvement of riparian areas is desired, land use plan and activity plan objectives (or ranch plan objectives for private lands) and management prescriptions must be attuned specifically to riparian area features while considering the needs of the entire watershed. As mentioned previously, proper functioning condition, as defined by Prichard et al. (1993 and 1994), is the minimum acceptable condition; objectives related to achieving or maintaining proper functioning condition are paramount. Additional objectives related to desired future conditions for land uses and other values are important; however, they should be differentiated from functionality objectives because perceptions of land use and people's values are subject to change over time.

Establishing specific objectives, describing the desired plant community, and selecting key species should be an interdisciplinary effort carried out in close cooperation with range users and other interested parties. Objectives should be dictated by the present condition and trend of the riparian habitat in relation to management goals, the resource potential for change, and the importance of other resource values. Good management objectives should be achievable, measurable, and worthy of the costs incurred to accomplish and monitor them. Major considerations in establishing management objectives include:

1. Vegetation

a. Historical conditions and disturbance regimes.

b. Present plant community.

c. Ecological site potential and capability.

d. Proper functioning condition.

1) Development and/or maintenance of different age classes of plant species for maintenance or recovery.

2) The complex of vegetation cover necessary to minimize trampling damage and reduce the erosive effects of runoff events.

3) Stabilization of streambanks and elimination of bank hoof shearing.

4) Amount and kind of vegetation required to trap and hold sediment deposits during runoff events to rebuild streambanks and restore aquifers.

e. Desired plant community.

1) Health and reproduction of both woody plants and herbaceous vegetation (depending on the riparian objectives and site potential).

2) Vegetation structure necessary for wildlife cover diversity.

3) Value of the site for forage production.

4) Aesthetic effect of a riparian area in good to excellent condition.

5) Period of time that is acceptable or necessary for restoration.

2. Wildlife

a. Restoration or maintenance of aquatic and/or waterfowl habitat.

b. Importance of the riparian community to riparian-dependent wildlife and to wildlife species that occur primarily on upland sites, but that are attracted periodically to riparian areas. In the Great Basin, 79 percent of terrestrial wildlife species are dependent on riparian areas (Thomas et al. 1986); in Arizona and New Mexico, 80 percent of all vertebrates depend on riparian areas for at least half of their life cycle (Cheney et al. 1990).

3. Water

a. Raise in or maintenance of the present water table elevation.

b. Restoration or maintenance of water quality and quantity.

c. Restoration or maintenance of natural hydrologic regimes. In degraded systems, this often means reducing peak flow discharge and increasing minimum flows.

4. Geomorphic

a. Establishment of proper stream channel, bank, and floodplain conditions and their related functions.

b. Maintenance of long-term adjustment processes that may affect channel/riparian zone conditions. Processes may include gully widening and aggradation, bank and floodplain development, meandering, etc. (Van Haveren and Jackson 1986).

c. Reduction of upland erosion and stream sediment load and restoration or maintenance of soil productivity.

See Appendix A for additional information that can be used to formulate objectives.

B. Key Areas and Critical Areas

In many allotments, riparian areas are "key areas" for management, and their condition may indicate whether grazing management is proper for the entire allotment. In other cases, riparian areas may be "critical areas" for management of site-specific concerns and objectives. In critical areas, proper management may severely limit upland use from what would otherwise be acceptable. Key areas and critical areas must be differentiated for analysis and subsequent management recommendations if needed.

As riparian objectives are developed, key areas for monitoring and judging the propriety of management must be located in representative portions of both the riparian area and the uplands. Key areas must possess (or have the potential to produce) all the specific elements contained in the objective(s) because these will provide data for evaluating management efforts. In many cases, it is appropriate to select the key areas first to represent important and/or common resource values and situations, and then develop objectives specific to each.

When an area is functioning properly, stream reaches that are functioning at-risk, with an unapparent or downward trend attributable to livestock use, are prime candidates for key areas. The limiting factors to proper functioning condition can guide the selection of attributes to monitor, as well as management changes needed. For instance, if adequate vegetative cover is the primary limiting factor, monitoring may focus more on annual physical bank damage and residual vegetation relative to duration of pasture use. On the other hand, if type of plant community and recruitment of key species are the primary limiting factors, short-term monitoring may focus more on utilization, incidence of use, or stubble height relative to season of use and/or recovery periods. Community composition would also be monitored in the long-term.

C. Key Plant Species

Key plant species are: 1) forage species that indicate the degree of use of associated species, and 2) those species that must, because of their importance, be considered in the management program (Interagency Technical Team 1996a). Key species should be necessary to natural stream functions, directly related to vegetation management objectives, and monitored as an indicator of grazing management performance relative to those objectives.

Key plant species will vary with the potential of each individual site. A mix of vegetation increases channel roughness and dissipates stream energy. Willows and other large woody vegetation filter larger water-borne organic material, and their root systems provide bank stabilization. Sedges, rushes, grasses, and forbs capture and filter out finer materials, while their root masses help stabilize banks and colonize filtered sediments. On sites with potential for both woody and herbaceous vegetation, the combined plant diversity greatly enhances stream function.

Understanding the physiological and ecological requirements of key woody species (in addition to key herbaceous species) is essential to designing a proper management

program (Thomas et al. 1979). This includes determining the effects of grazing on the particular growth characteristics of the species involved and the probable outcomes in community change.

IV. Grazing Management Principles and Concepts

Once objectives have been formulated, the resource manager, in consultation with the range user and other involved parties, must tailor grazing management strategies to meet those objectives. As potential grazing strategies are discussed, the objectives should be reviewed. Objectives and management must come together before either one is "established." Where management is detrimental, the focus should first be on reducing negative impacts, then on using prescribed grazing management as a tool to achieve objectives (Mosley 1996). Because "it is easier to keep a riparian area degraded than it was to get it that way" (Elmore pers. comm.), changes in season, intensity, and frequency of use, or even temporary exclusion, might have to be implemented to initiate recovery. Then other prescriptive grazing strategies might be used to achieve objectives in plant composition, structure, etc.

Grazing management strategies must also consider the sensitivity of different riparian areas to disturbance, and their resiliency, or ability to recover, once degraded. Sensitive riparian areas experience a high degree of natural stress (or any natural attribute that makes them more sensitive to disturbance, such as noncohesive granitic soils), and therefore can tolerate little management-induced stress without degradation. Conversely, less sensitive systems have low natural stress, and therefore can tolerate more management-induced stress (Elmore and Kauffman 1994). Recovery potential is not always directly related to sensitivity to disturbance. Rosgen (1996) provides a guide to stream sensitivity and recovery potential.

Even though classifications such as Rosgen's can help extrapolate responses of streams to grazing, structures, and other types of management, no two riparian systems are exactly alike. A grazing prescription must: 1) meet the needs of each specific riparian system, as well as other watershed components, 2) be compatible with the entire ranch operation, and 3) have the commitment of the operator/manager to achieve riparian objectives. These criteria have a higher probability of being met if the grazing strategy consciously incorporates (Krueger 1996):

- Animal (livestock) behavior
- Forage selectivity
- Plant responses
- Plant community change
- Hydrology
- Practicality

Plant responses, plant community change, and hydrology usually form the basis for achievable objectives, and thus become the focus of many grazing strategies. However, animal behavior and forage selectivity are the driving grazing management forces affecting those resource interactions.

A. Livestock Behavior

Cattle predominate rangeland, and especially riparian, grazing management concerns. Sheep are generally less of a problem because they tend to avoid low areas where they feel vulnerable to predation (Glimp and Swanson 1994). The switch from sheep or sheep and cattle that has been occurring throughout this century has often increased riparian management problems. Thus, most of this publication focuses on cattle management considerations. However, because any large herbivore (including wild horses, elk, deer, etc.) could cause similar problems or react similarly in specific situations, the term "livestock" will be used throughout this document.

Grazing managers must develop an understanding of the grazing patterns employed by the animals they manage (Stuth 1991). This involves understanding the predisposition of a given species to forage. Foraging behavior involves three distinct levels of selection—spatial (landscape), species, and plant part choice.

An animal with experience in a given landscape will know its boundaries, routes of access and escape, plant communities and their spatial distribution, and the seasonality of desirable species (Table 1). Free-standing water is the principal focus around which most large grazers orient their foraging strategies. Large herbivores are "central place foragers," with the central or home place centered on water (Stuth 1991). The nature of the terrain, concentrations of shrubs, changes in forage availability due to drought, and mobility of an animal all influence spatial use patterns around water sources.

Table 1. Landscape characteristics that influence animal movement patterns (Stuth 1991).

Attribute	Components
Boundaries	Fences, home range, migration routes
Distribution of plant communities	Range sites, soils, aspect, elevation, structure, species composition
Accessibility	Slope, gullies, water courses, shrub density, rockiness, roads, trails, fence lines, cut openings, pipeline/utility rights-of-way
Distribution of foci	Location of water, shade, loafing and bedding sites and other convergent and divergent points in a landscape

An animal's selection of a given plant community is largely related to those attributes of a site that influence its ability to harvest nutrients (Table 2).

Table 2. Attributes at the plant community and patch level that influence the animal's selection of forage sites (Stuth 1991).

Attribute	Function
Moisture-holding capacity of soil	Affects forage supply and stability
Species composition	Affects suitability/stability of the site for general dietary and nutritional needs
Plant frequency	Affects the probability of encounter of plant species by the animal and number of dietary decisions
Abundance	Affects the supply of nutrients
Structure	Affects accessibility and harvestability of plant species and nature of thermal niches provided
Continuity	Affects movement velocity
Size	Affects amount of search area available
Aspect	Affects the thermal characteristics of the site
Orientation in landscape	Position relative to needs foci affects frequency of exposure to grazing

It is difficult to force an animal to perform in a matter that is contrary to natural preferences and instincts. Based on what is known about livestock behavior, grazing programs can be designed to attract animals to specific areas at specific times, encouraging grazing patterns that yield a desirable response to the vegetation. For example, livestock use of riparian zones is known to vary by season. During spring, livestock tend to disperse because of better forage on uplands, better water distribution in shallow reservoirs and natural water pockets, and acceptable or preferable thermal conditions on uplands. During summer, livestock tend to be attracted to riparian zones due to water availability; generally higher concentrations of nutritious, palatable forage; and, if trees or shrubs are part of the system, preferable thermal conditions. During fall, livestock still tend to be attracted to riparian zones primarily due to water availability, and possibly to availability of browse with higher nutrient content and palatability than mature upland forage; however, fall greenup can be a mitigating factor. During winter, livestock might avoid riparian zones if they function as cold air pockets or drainages. The specifics of each riparian zone and its associated upland areas, such as upland water distribution, determine appropriate management options.

Variable weather conditions also affect animal behavior by impacting vegetation production, water distribution, etc. For example, a drought can cause the growing

season to be earlier and shorter. As a result, animals may prefer riparian zones much earlier, and dates of grazing may need to be adjusted. Conversely, a prolonged wet, cool spring and summer may result in longer-than-normal use of a given pasture, which would allow deferment or rest of some other pasture as a possible beneficial treatment. Riparian zones would also be relatively less attractive under such conditions.

The kind (cattle, sheep, etc.), class (yearling, cows with calves, etc.), and previous experience of livestock influence behavior as well. Cows with calves are usually less mobile than yearlings or dry, mature cows. Cows experienced in a pasture prefer certain locations, much like home ranges of big game, and can be expected to head for and stay in a given area. Inexperienced animals initially search for the boundaries of their environment and then for preferred locations, with water being a primary factor. These behavior attributes may provide a means to select animals that use areas beneficial to management objectives, cull those that don't, and train replacement animals appropriately.

B. Forage Selectivity

Selectivity varies by animal species, forage palatability, and preference. Palatability refers to characteristics of a plant that elicit a selective response by a herbivore. It changes throughout the annual plant growth cycle and can vary spatially as a result of soil characteristics. Preference is a behavioral function that involves proportional choice of one plant species from among two or more species. Preference for a particular plant species depends largely upon its abundance, morphological/phenological characteristics, the array of other species available, and the species of animal in question. Preference changes with season, weather, soil moisture (and palatability), and forage availability. Thus, forage selectivity is a dynamic, situation-specific phenomenon. However, some generalizations can be applied. For example, in riparian areas, livestock generally don't browse woody plants if they have a sufficient supply of palatable grass, but, where only a few woody plants are available, animals may seek them out to obtain dietary diversity. Most generalizations have exceptions though, so management must be refined to fit the specific situation.

V. Grazing Management Strategies

A. Key Management Considerations

To properly manage livestock grazing in riparian areas, it is important to recognize that:

- Grazing management practices that improve or maintain an upland site may neither improve nor maintain a riparian area. While riparian areas respond uniquely, they should not be considered independently of uplands. Problematic upland watershed conditions, such as excess runoff and erosion, often reduce the effectiveness of management in the riparian zone. To be managed effectively, the whole pasture containing the riparian zone and the whole watershed containing the pasture should be considered.

- Passive, continuous grazing rarely improves a deteriorated riparian area or maintains a riparian area in good condition without reducing stocking levels to extremely low and uneconomic levels.

- Grazing management must provide an adequate cover and height of vegetation on the banks and overflow zones to promote natural stream functions (sediment filtering, bank building, flood energy dissipation, aquifer recharge, and water storage).

It is also important to recognize that there is a lot of public concern about management of riparian areas. Gaining the understanding and cooperation of everyone involved in riparian area management, including land managers, landowners, users, and the public, improves the chances for success. Through consultation and cooperation with livestock managers, changes can be implemented that benefit other users of riparian areas. Workshops and demonstration areas can promote an understanding and appreciation for the value of properly functioning riparian systems and build support for a sound program. Recognizing operators who have implemented management practices that improved riparian area conditions can demonstrate the benefits of good stewardship and help expand good management into other areas. Ranchers who have experienced the benefits of proper grazing management in riparian areas are some of the best salespeople for changing traditional riparian area management practices.

Finally, it is important to recognize that there are a number of other factors to consider in selecting management strategies to meet riparian objectives, including timing, duration, and frequency of grazing; distribution of livestock; stocking rates; utilization levels and patterns; and pasture design, including topography and seasonal implications of topography. These factors influence the economic feasibility and practicality of the management strategy, which are both essential if commitment to the strategy is to be achieved.

1. Timing, Duration, and Frequency of Grazing

Successful grazing management strategies for riparian areas can usually be achieved using a combination of options, including grazing "prescriptions" that:

- Limit grazing intensity, frequency, and/or season of use, thereby providing sufficient rest to encourage plant vigor, regrowth, and energy storage and minimize compaction of soils.

- Control the timing of grazing to prevent damage to streambanks when they are most vulnerable to trampling.

- Ensure sufficient vegetation during periods of high flow to protect streambanks, dissipate energy, and trap sediments.

In a study of 34 grazing systems in operation for 10-20 years in southwestern Montana, Myers (1989a) found timing of grazing, duration of use, and frequency of fall grazing were important factors in successful management (Table 3). The effectiveness of livestock grazing management was judged based on the vigor, regeneration, and utilization of woody species, as well as on bank stability.

Table 3. Criteria for successful grazing management (Myers 1989a).

Criteria Used	Successful Management	Unsuccessful Management
1. Time provided for postgrazing herbaceous regrowth (average number of days).	35	21
2. Duration of use - total days per season (average number of days).	28	59
3. Fall use duration (average number of days).	21	37
4. Percent of years fall use occurred (average).	31	51
5. Percent of grazing treatments providing residual cover* through rest or regrowth (average).	75	38

*Residual cover was defined as at least 30 days of regrowth.

Successful systems were defined as those demonstrating good or excellent riparian condition or an upward trend if in fair condition. The results highlight the importance of adequate vegetation vigor and regeneration at the end of the growing season and the apparent critical nature of the frequency and duration of fall grazing treatments. Myers suggests that the duration of grazing treatments often prescribed for upland management (60-75 days) be shortened to 25-30 days. Shortening the duration and providing growing season rest in all pastures lessens animal impacts, provides regrowth, and allows stock to be more selective in grazing.

2. Distribution of Livestock

Utilization patterns relative to total forage distribution reveal that livestock distribution, coupled with timing, duration, and frequency of grazing, are often the main problems. Most successful grazing strategies or "prescriptions" also include additional practices or techniques that promote distribution of livestock, such as:

- Techniques that attract livestock away from riparian areas, including stock water development, developing alternative or improved forage, prescribed fire in uplands, careful salt and supplement placement, and fertilization in uplands.

- Techniques that restrict livestock from riparian areas, including fencing or fence relocation, barriers such as thickets or brush wind rows, water gaps in erosion-resistant stream reaches, hardened crossings or water access, and relocation of bed grounds and management facilities.

- Herd management and animal husbandry practices that promote mobility, including herding and culling practices, and managing the kind (sheep versus cattle, etc.), class (steers versus cows with calves, etc.), and breed of livestock.

Research in Idaho, Utah, and Nevada illustrates the importance of livestock distribution throughout the pasture and away from the riparian area. Platts and Nelson (1985) found that livestock took an average of 29 percent, and as much as 40 percent, more vegetation from riparian sites (wildlife use was trivial) than from adjacent upland sites. Although use on the allotments was moderate, use on riparian sites was heavy to severe. Managing and controlling the attractant features of riparian areas usually increases the use of, and improves distribution in, uplands.

Proper distribution of livestock can be an effective and economical tool in managing riparian areas. In some areas that are degraded, some rest may be required, especially where woody species are part of the management objective.

3. Stocking Rates

Total stocking rate problems at the pasture, ranch, or allotment level are the exception rather than the rule in today's operations. The apparent overstocking of some areas while others are only moderately grazed or even ungrazed will not be solved by simply reducing numbers if other factors are not also changed. Reducing stocking rates may reduce the percentage of area in unsatisfactory condition, but the impacts around the foci of highly utilized areas (e.g., riparian areas, other waters, etc.) will remain the same until few, if any animals remain. Many pastures, ranches, or allotments are appropriately stocked for the majority of the area, but a temporary reduction in the stocking rate is necessary to allow recovery of localized problem areas. This is especially true in rest-rotation strategies where part of the area is removed from grazing for an entire season. The rest may not compensate for the increased use during grazing until sufficient recovery is achieved. There are also some operations that are still simply overstocked. No strategy will work until

stocking rates are at an appropriate level for the existing conditions and prescribed management.

4. Utilization Levels and Patterns

If utilization, timing, and residual vegetation are factors in developing a grazing prescription, the primary focus is usually the physiology of key plant species that must stay healthy and reproduce. The primary focus of associated management techniques is often to achieve better livestock distribution and avoid grazing intensity problems. However, the effects are often intertwined and problems can be addressed in many ways. Utilization mapping is an excellent tool for checking the distribution of livestock use and for identifying management opportunities. However, measurement of stubble height (residual vegetation) is often more straightforward and easier to interpret. Relative use or seasonal use may impact the physiology of key species and guide development of a grazing strategy, but annual measurements vary among years and individual observers. Therefore a range of utilization or stubble heights should accommodate favorable and unfavorable production years.

Due to the variation in riparian sites and management objectives, one standard utilization and/or residual vegetation target is not appropriate. However, utilization and/or residual vegetation should be considered (together with regrowth potential) to ensure that vegetation stubble necessary for natural stream functions is present or other land use objectives (e.g., residual nesting cover for waterfowl) are accomplished. Management plans should recognize that an average stubble height or utilization level generally represents rather complete use of certain plants and partial or no use of others. The first bite may reduce all eaten stems to close to ground level. Other stems on that plant and adjacent plants remain uneaten at first.

In most situations where both upland and riparian sites exist in the same pasture(s), portions of each pasture can be seasonally unusable or unused for grazing because of wet soils, lack of green forage, length or steepness of slope, distance to or lack of water, and absence of shade, etc., as shown in Figure 1 (Elmore pers. comm.).

In pasture A, the corridor along the stream is unsuitable due to saturated soils, and some of the uplands are not used due to lack of green forage .

In pasture C, portions of the uplands are unusable due to lack of water and unused due to length and steepness of slope.

In pasture D, portions of the uplands are unused due to length and steepness of slope and lack of water . Also the stream corridor is of concern due to utilization of willow and bank trampling in excess of allowable limits that may occur during this period.

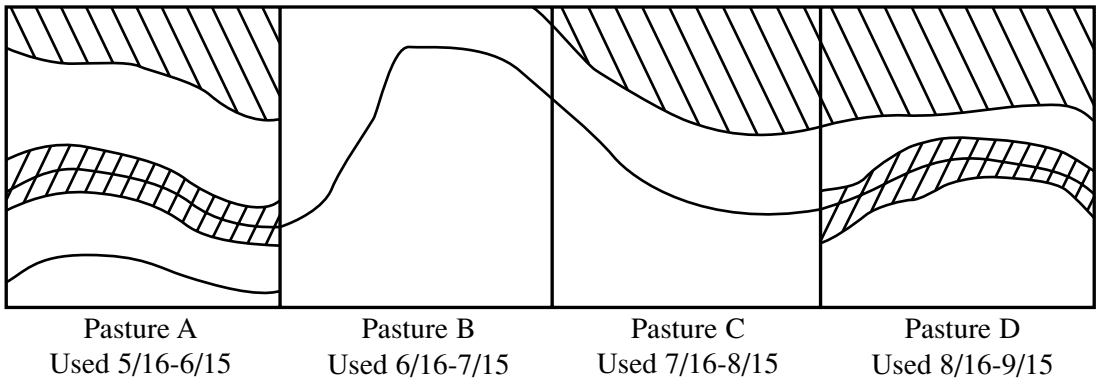

Figure 1. Examples of seasonally unused areas within a pasture.

In pastures C and D, frequent riding and herding of the livestock may increase utilization of the upland and relieve grazing pressure in the riparian areas. This would reduce the need to adjust season of use or numbers of livestock to compensate for heavy riparian area use.

5. Pasture Design

In pasture planning, the pasture should include as much of a stream as possible and not use streams as fenced pasture boundaries (Myers 1981). Small stream sections and other small riparian areas such as springs and seeps within large pastures usually cannot be effectively managed. Exclusion fencing is often the most practical approach for small areas. When pasture boundary fences zig-zag across streams, livestock impacts tend to be concentrated near the stream. Livestock tend to concentrate near and trail along fences, accentuating trampling damage. Also, wire fences across streams tend to catch trash and frequently wash out. Myers recommends trying to center streams within a pasture where possible.

Where a stream must serve as the division line, fencing one or both sides of the stream with water gaps to the stream, if needed, can effectively avert most riparian concentration. Suspending panels of corrugated metal roofing over the stream, between ends of a fence, has proven effective in controlling livestock movement in Oregon. The panels swing with the flow of water, do not catch trash, and are avoided by livestock (Elmore pers. comm.). Other forms of swing panels constructed of hanging pipe or heavy chain have also proven effective.

B. Grazing Treatments

Following are descriptions and examples of grazing treatments for riparian areas. Generalized responses to grazing treatments are provided in Table 4 (Platts and Nelson 1989), Table 5 (Buckhouse and Elmore 1991), and Table 6 (Kovalchik and Elmore 1991). Elmore and Kauffman (1994) caution that the ratings presented in these tables are based on observations in different riparian/stream systems. However they do express similarities for assessing the potential for management success in the northern Rocky Mountain and Pacific Northwest regions.

Table 4. Evaluation and rating of grazing strategies for stream riparian habitats (Platts and Nelson 1989).

Strategy	Level to which riparian vegetation is commonly used	Control of animal distribution (allotment)	Streambank stability condition	Brushy species regrowth potential	Seasonal plant rehabilitative	Stream-riparian	Rating
Continuous season-long (cattle)	heavy	poor	poor	poor	poor	poor	1[a]
Holding (sheep or cattle)	heavy	excellent	poor	poor	fair	poor	1
Short duration-high intensity (cattle)	heavy	excellent	poor	poor	poor	poor	1
Three herd-four pasture (cattle)	heavy to moderate	good	poor	poor	poor	poor	2
Holistic (cattle or sheep)	heavy to light	good	poor to good	poor	good	poor to excellent	2-9
Deferred (cattle)	moderate to heavy	fair	poor	poor	fair	fair	3
Seasonal suitability (cattle)	heavy	good	poor	poor	fair	fair	3
Deferred-rotation (cattle)	heavy to moderate	good	fair	fair	fair	fair	4
Stuttered deferred-rotation (cattle)	heavy to moderate	good	fair	fair	fair	fair	4
Winter (sheep or cattle)	moderate to heavy	fair	good	fair	fair to good	good	5
Rest-rotation (cattle)	heavy to moderate	good	fair to good	fair	fair to good	fair	5
Double rest-rotation (cattle)	moderate	good	good	fair	good	good	6
Seasonal riparian preference (cattle or sheep)	moderate to light	good	good	good	Fair	fair	6
Riparian pasture (cattle or sheep)	as prescribed	good	good	good	good	good	8
Corridor fencing (cattle or sheep)	none	excellent	good to excellent	excellent	good to excellent	excellent	9
Rest rotation with seasonal preference (sheep)	light	good	good to excellent	good to excellent	good	excellent	9
Rest or closure (cattle or sheep)	none	excellent	excellent	excellent	excellent	excellent	10

[a] Rating scale based on 1 (poorly compatible) to 10 (highly compatible with fishery needs).

Table 5. Generalized relationships between grazing system, stream system characteristics, and riparian vegetation response (adapted from Buckhouse and Elmore 1991).

Grazing system	Steep low sediment load		Steep high sediment load		Moderate low sediment load		Moderate high sediment load		Flat low sediment load		Flat high sediment load	
No Grazing	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0	banks	0 to +	banks	0	banks	+	banks	+	banks	+
Winter or Dormant Season	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0	banks	0 to +	banks	+	banks	+	banks	+	banks	+
Early Growing Season	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0	banks	0 to +	banks	+	banks	+	banks	+	banks	+
Deferred or Late Season	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0 to -	banks	0 to -	banks	0 to +	banks	+	banks	+	banks	+
Three-Pasture Rest-Rotation	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0 to -	banks	0 to -	banks	0 to +	banks	+	banks	+	banks	+
Deferred Rotation	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	+
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0 to -	banks	0 to -	banks	+ to 0	banks	+	banks	+	banks	+
Early Rotation	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+	shrubs	+
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0 to -	banks	0 to +	banks	+ to 0	banks	+	banks	+	banks	+
Rotation	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+	herbs	+
	banks	0 to -	banks	0 to -	banks	0 to +	banks	+	banks	+	banks	+
Season-Long	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-
	banks	0 to -	banks	0 to -	banks	-	banks	-	banks	-	banks	-
Spring and Fall	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-
	banks	0 to -	banks	0 to -	banks	-	banks	-	banks	- to 0	banks	0 to +
Spring and Summer	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-	shrubs	-
	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-	herbs	-
	banks	0 to -	banks	0 to -	banks	-	banks	- to 0	banks	- to 0	banks	0 to +

Note: - = decrease; + = increase; 0 = no change. Stream gradient: 0 to 2% = flat; 2 to 4% = moderate; >4% = steep.

Table 6. Generalized relationships between grazing system and willow and sedge response on willow-dominated plant associations (Kovalchik and Elmore 1991).

Systems highly compatible with willow management		
Corridor fencing	Willows	⇧
	Sedges	⇧
Spring grazing	Willows	⇧
	Sedges	⇧
Riparian pasture	Willows	⇧
	Sedges	⇧
Winter grazing	Willows	⟺ to ⇧
	Sedges	⇧
Systems moderately compatible with willow management		
Two-pasture rotation	Willows	⟺ to ⇧
	Sedges	⇧
Three-pasture deferred rotation	Willows	⟺ to ⇩
	Sedges	⟺ to ⇧
Three-pasture rotation	Willows	⟺ to ⇩
	Sedges	⇧
Systems incompatible with willow management		
Spring-fall grazing	Willows	⇩
	Sedges	⟺ to ⇩
Late-season grazing	Willows	⇩
	Sedges	⇩
Deferred grazing	Willows	⟺ to ⇩
	Sedges	⟺ to ⇩
Season-long grazing	Willows	⇩
	Sedges	⇩

⇧ = highly compatible, ⇩ = incompatible, ⟺ = no change

1. Passive, Continuous Grazing; Spring-Summer, Summer-Fall, or "Season-Long" Grazing

In this document, the term "passive, continuous grazing" means grazing throughout the growing period, with little or no effort to control the amount or distribution of livestock use in particular areas. Riparian areas will usually be overgrazed under passive, continuous grazing (Figures 2 and 3). During portions of the grazing period when air temperatures are hot, riparian sites are usually preferred by livestock over upland sites on arid and semiarid ranges due to the presence of water, lush forage, more consistent regrowth, cooler air, shade, and relatively flat terrain. Until utilization becomes excessive, livestock do not need to spend as much time and effort in riparian areas as they do on uplands to satisfy their daily nutritional requirements (Skovlin 1984). In Montana, during August and September, approximately 80 percent of the forage used by livestock may come from riparian sites, even though they often comprise less than 4 percent of the total pasture (Marlow 1985).

Similarly to passive, continuous grazing, riparian areas may also be overgrazed under a program of deferred rotation or rest-rotation grazing with an extended season of use. Use on adjacent uplands in such pastures may be moderate or light. This concentrated use of areas next to water in effect results in the creation of "upland exclosures," and often reduces the effectiveness of the grazing prescription for the uplands (Elmore pers. comm.).

Figures 2 & 3. Typical impacts from passive, continuous grazing. Note bank hoof shear, lack of vegetation on point bars, encroachment of dry land vegetation, willows well above the channel elevation, heavily hedged willows, presence of only one age class of willow, lack of adequate vegetation for silt filtering and bank protection, and the wide, shallow stream profile.

2. Spring and Fall Grazing

Spring and fall grazing in the same year may work in some cases, but it usually fails to meet riparian vegetation needs because it doubles the potential limitations of either spring grazing or fall grazing alone. If temperatures are still warm when fall grazing begins, livestock concentrate in the riparian zone while palatability of both herbaceous plants and willows is high. Appropriate use on willows can easily be exceeded and residual vegetation for protection of banks during high flows is removed before uplands are grazed (Figure 4). Livestock preference for the riparian area is compounded the following spring because the removal of standing dry matter increases the palatability of riparian forage over ungrazed upland plants.

Successful spring and fall grazing was observed by BLM's National Riparian Service Team on a private, irrigated riparian pasture in south-central Idaho. Factors contributing to success in this case included plentiful herbaceous forage, water availability throughout the pasture, and a short duration of use (approximately 2 weeks) in the fall. Above all, the owner/operator observed use daily.

Figure 4. An example of typical spring and fall use on the right compared to winter use on the left.

3. Riparian Pasture

Riparian pastures may be smaller areas of rangeland containing both upland and riparian vegetation that is managed together as a unit to reach riparian objectives. They may also be streamside pastures containing only riparian vegetation. They differ from other pastures that are managed primarily to achieve results in upland

areas. A riparian pasture is particularly applicable where the riparian zone encompasses an area large enough to be managed separately from the uplands. Because it is separate from the rest of the ranch or allotment, it can be grazed or rested depending on current conditions and stream riparian needs (Elmore and Kauffman 1994), providing the ultimate in control and flexibility. Riparian pastures can be used seasonally, in conjunction with rotation strategies, or as special use pastures (i.e., gathering pasture, bull pasture, etc.).

In the design of riparian pastures containing both upland and riparian vegetation, the balance of forage between upland and riparian areas is important. Forage in the upland sites should not limit proper distribution or utilization; for example, there should be enough forage in the upland areas so that livestock are not forced to the riparian areas to find sufficient forage. Forage balance may change with changes in season of use and kind or class of livestock.

Platts and Nelson (1985) found that on six 10-acre pastures in Idaho, Nevada, and Utah, the timing and location of grazing in specially managed riparian pastures could be controlled much more effectively than in large allotment pastures, providing an easier way to make grazing compatible with other resource uses. Using riparian pastures offers alternatives to eliminating livestock grazing and fencing riparian boundaries, which can be costly. By experimenting with different types of riparian and upland range, different sizes and shapes of pastures, and different ratios of riparian forage to upland forage, it may be possible to efficiently graze riparian vegetation without damaging this sensitive zone.[1] In mountain meadow ranges, special management pastures would need to be larger to better match benefits derived from improved riparian and fish habitat with the costs of fencing. The influence of a livestock herd's home range on grazing use requires careful analysis; pastures may have to be larger than a herd's home range in less productive range types. When fencing narrow streamside corridors or eliminating livestock from the allotment are the only alternatives for maintaining productive riparian and aquatic habitats, the cost of special management pastures may not seem exorbitant.

[1] This may not be practical in many cases due to cost.

Figures 5 and 6 depict change from season-long use on the North Fork of the Humboldt River in Nevada to a riparian pasture for use by yearling bulls several weeks prior to mid-June.

Figure 5. North Fork of the Humboldt, 1989.

Figure 6. North Fork of the Humboldt, 1994.

The Goosey Lake Flat (Nevada) riparian pasture (Figures 7 and 8) has generally been used as a gather or turnout pasture since it was changed from continuous season-long use. The grazing plan calls for use in early June for 1 year out of 3, and for 2 weeks in September for gathering during the remaining 2 years (Masters et al. 1996b).

Figure 7. Goosey Lake Flat Creek, 1965.

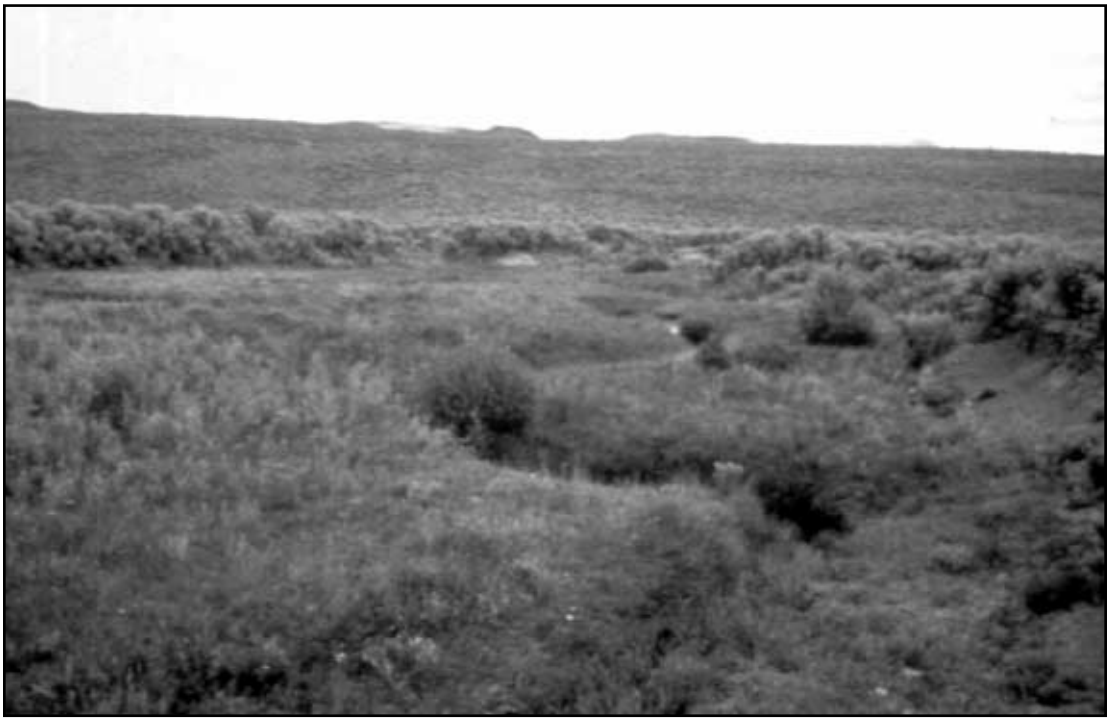

Figure 8. Goosey Lake Flat Creek, 1991.

4. Winter (Dormant-Season) Grazing

Normally, there is little or no vegetation growth during winter. Winter use is usually the least detrimental to soils (where they are frozen) and to dormant herbaceous vegetation. However, it may be the period of greatest use of browse species by both livestock and wildlife depending on temperatures, snow depth and duration, availability of other feed, animal concentration, forage/browse preference, and the extent of the woody plant community. Many riparian areas are unavailable for grazing during a major part of the winter due to snow depth. In areas that can be grazed, winter can be a season of use with minimal impact when grazing is closely monitored and controlled (especially use of woody plant growth).

Winter use can reduce a user's winter feed costs in some areas. In Oregon, this has amounted to as much as $30 per head per season (Elmore 1987). However, winter use also has the potential to remove excessive amounts of vegetation cover just prior to spring runoff. Most streambanks need carryover vegetation for bank protection and sediment trapping during spring runoff.

Wickiup Creek in northern Nevada has been grazed in the winter by cattle since 1910 (Masters et al. 1996a). Winter grazing has maintained stable riparian conditions for decades (Figures 9 and 10). Additional management practices include placing salt well away from riparian areas, culling riparian loafers, and varying turnout locations from year to year.

Winter grazing has also improved riparian conditions on Meadow Valley Wash in southern Nevada (Masters et al. 1996a), Comes Ranch in Montana (Massman ed. 1995), and Texas Creek in Colorado (Prichard et al. 1993).

Figure 9. Wickiup Creek, 1939.

Figure 10. Wickiup Creek, 1991.

5. Spring Grazing

Cool-season vegetation growth begins and peaks in spring. Warm-season plants begin growing during mid- to late spring. Spring use normally results in better livestock distribution between riparian and upland areas due to flooding of riparian areas and presence of highly palatable forage (including many annuals) on the uplands.

In the spring, seed and litter can be trampled into wet soil by hoof action. However, on some moist or saturated soils, grazing animals more easily uproot plants and compact soils or shear streambanks. Subsequent rest is often required to encourage root growth and other biological activity, which offsets the effects of soil compaction prevalent during the spring season. In a southwestern Montana study, most bank damage resulted when soil moisture was in excess of 10 percent, which normally occurs prior to late July/early August in arid/semiarid areas of the West (Marlow and Pogacnik 1985). The soil moisture content that minimizes bank damage may vary with differences in soil texture.

Spring use provides more opportunity for regrowth and plant recovery than summer or fall use. Regrowth is important for sustaining the important physical functions of a riparian system (e.g., shading, insulation, sediment filtering), as well as for buffering the effects of peak runoffs on streambanks. For example, in the BLM's Prineville District, which is in Oregon's sagebrush- and juniper-dominated high desert, spring grazing has been used to improve riparian conditions on Bear Creek. Prior to 1976, the area was a single pasture licensed for 72 animal unit months (AUMs) from April to September. This strategy depleted streamside vegetation (low diversity and productivity) and deeply incised the stream channel, causing it to be unstable and actively eroding. Summer streamflow was often intermittent and low in quality.

In 1976, the BLM decided to rest the area to restore the productivity of the riparian zone (Figure 11). After 3 years of attempted rest, the area was used for 1 week in September in 1979 and 1980. In 1983, juniper trees were removed from the uplands to improve range condition and watershed health. In 1985, a grazing treatment was designed authorizing use from the time of spring runoff (mid-February) until April 15 in a three-pasture system. In 1988, permitted AUMs were nearly five times the forage obtained from the area under season-long use. Furthermore, the permittee has reportedly cut his annual hay bill by $10,000. The riparian zone continues to improve (Figure 12). The resulting improvement in quality and quantity of streamflow has allowed the reestablishment of rainbow trout. Though this early season riparian grazing treatment works well on this site's sandy loam soils, it might not work as well on soils with high moisture content.

Figure 11. Bear Creek, 1976.

Figure 12. Bear Creek, 1996, after continued spring use.

Additional examples where spring grazing has worked well include allotments on Bully Creek and the South Fork of the Crooked River in Oregon (Elmore pers. comm.) and T-Creek, Tabor Creek, and Pie Creek in Nevada (Evans pers. comm.).

6. Hot-Season Grazing

Summer is usually the period of greatest photosynthetic activity, especially for riparian and warm-season plants. Upland and cool-season plant growth diminishes due to reduced soil moisture content. Summer use is generally regarded as the most critical. During the hot season, livestock concentrate in or near the riparian area when upland forage becomes rank or dry, water distribution is more limited, and the desire for shade is more intense. Where free-choice grazing is allowed, summer use usually results in greater utilization of riparian vegetation. Summer is also when grazing causes the greatest stress in most plant communities. There is less time for regrowth and replenishment of carbohydrate reserves than with spring use, and more need for leaf area than later in the growing season.

Annually repeated grazing throughout the hot season is nearly always detrimental to riparian vegetation (essentially the same as season-long use), especially in large pastures with small riparian areas that are not managed as riparian pastures. Therefore, some form of deferred rotation, rest-rotation, short-duration rotation, utilization or bank trampling limits, or exclusion is needed to reduce frequency, intensity, and/or duration of riparian use. Deferring use in a riparian pasture until the hot season extends the green feed period of nutritious forage and may provide an economic incentive for better riparian management. However, duration of use needs to be restricted to avoid repeat defoliation, overuse, and streambank trampling.

Myers (1981) found that in the foothills of southwestern Montana, the frequency of hot-season use from July 10 to September 1 (period of heavy use) appeared to be a critical factor in developing and maintaining satisfactory riparian area conditions. Grazing systems with hot-season use in more than 1 year out of 3 or 4 met riparian habitat goals on only 24 percent of 21 streams. Grazing systems lacking hot-season use, or with no more than one hot-season treatment in 3 or 4 years, met riparian habitat management goals on 90 percent of 20 streams evaluated. Utilization data were not available in this study.

Myers (1989a) also analyzed duration of hot-season (7/1-9/15) grazing treatments and found that successful treatments averaged only 12.5 days, whereas unsuccessful treatments averaged 33.4 days. In this case, utilization of willows was important. However, duration was important from the standpoint of physical damage, regardless of utilization or regrowth potential, because of more frequent watering requirements and preference for shade while loafing. Duration of successful grazing treatments varied greatly depending on vegetation and stream type.

7. Deferment Until the Late Season (Fall Grazing)

Deferment is the postponement or delay of grazing to achieve a specific management objective (Forage and Grazing Terminology Committee 1991). Skovlin (1984) suggests that deferring use until the late season, until restoration of habitat is acceptable, offers a good measure of protection without great expense.

In fall, warm-season plants stop growing. Some cool-season species may grow where moisture and temperatures allow. Fall use is usually less critical than summer use because many perennial plants are completing their storage of carbohydrates and no longer need active leaf area. Upland cool-season species may again produce palatable forage, which, together with cooler temperatures, shifts livestock use to the uplands and relieves grazing pressure in riparian areas.

While livestock are often assumed to be leaving riparian areas to use upland range, that may not always be the case. On one study site in a long glaciated U-shaped valley in Idaho, Platts and Raleigh (1984) found that a late grazing system helped restore riparian quality because livestock moved to the uplands in late summer and fall when a cold air pocket formed over the bottomlands. However, at another study site in a flat, broad valley 15 miles away, livestock were drawn to the riparian areas during late season because those areas contained the only remaining succulent vegetation.

Heavy fall riparian use can leave streamside vegetation depleted and banks vulnerable to damage during spring runoff. Streambank damage relates to many factors, including soil moisture content, soil type, absence of woody plants and root systems, bank rock content, stock density, availability of off-stream water, and duration of grazing. Streambank damage due to livestock trampling of wet soils, and where other factors are not controlling, may be avoided by deferring grazing until bank soil moisture content is less than 10 percent. This usually occurs by late July or early August in most of the arid and semiarid western range (Marlow and Pogacnik 1985).

Deferring grazing until after seedripe can benefit sedge/grass communities if sufficient regrowth (or residual vegetation) protects banks and retains sediment during the next high-flow event (Elmore and Kauffman 1994). Furthermore, woody species utilization must be carefully monitored because use often begins during the later part of the hot season when livestock tend to concentrate in riparian areas. Levels of utilization that maintain the diversity and productivity of meadow communities were found to retard woody plant succession on gravel bars (Green 1991). Kovalchik and Elmore (1991) noted that systems with late-season grazing are incompatible with willow management.

On the Smiths Fork Allotment in the Kemmerer Resource Area of the Rock Springs District in Wyoming, deferred grazing, together with good herding and salting practices, resulted in improved riparian and fish habitat in the Huff Creek drainage. Prior to treatment, Huff Creek was in a deteriorated state. It had changed from a cold-water fishery in good condition to a warm waterway with severe streambank erosion and excessive siltation. Willows had been replaced by sagebrush (Smith pers. comm.). During 1976 to 1979, in order to protect and enhance habitat for the rare Bear river cutthroat trout population, two exclosures were built, instream habitat improvement structures were added to one exclosure, and deferred grazing was initiated outside the exclosures (Figures 13 and 14). Livestock use in Huff Creek was limited to August 15 to September 30 each year. The range rider salted the ridges away from water and kept the 500 livestock distributed over the entire watershed. Livestock were moved away from the stream every 2 to 3 days, thus reducing impacts in the riparian area (Netherly and Hendersen pers. comm.).

The Wyoming Game and Fish Department monitored Huff Creek during 1978 to 1984 (Binns and Remmick 1986). As a result of the treatments and management applied in Huff Creek, trout habitat improved at all study stations inside and outside the

Figure 13. Riparian conditions in grazed area on Huff Creek below lower enclosure, July 1986.

Figure 14. Looking upstream into lower Huff Creek exclosure from grazed area, July 1986.

exclosures by 57 percent. Trout cover increased 214 percent. Bank stability improved except inside the small exclosure. Trout 6 inches and larger increased 300 percent in one exclosure, 92 percent in the other exclosure, and 72 percent in the grazed area. Field personnel credited the local grazing association's and range rider's control of the livestock as the key to riparian area improvement outside the exclosures.

8. Deferred and Rotational Deferred Grazing

Deferred grazing is a nonsystematic rotation with other land units, and rotational deferred grazing is the systematic rotation among land areas within a grazing management unit (Forage and Grazing Terminology Committee 1991). Both strategies have been successful in restoring and improving riparian areas. Deferred and rotational deferred grazing strategies are often combined with rotational stocking (rest-rotation). The common thread of successful application, except for riparian pastures used in a deferred strategy, has been to use many pastures to shorten duration of use and provide greater flexibility. Many riparian grazing successes in Montana use seven pastures or more (up to 38) (Massman ed. 1995). Masters et al. (1996b) concluded, “Four-pasture, five-pasture (or more) rotation schemes with no rested pasture may be more suitable to areas that require increased streambank vegetation. The additional pastures or smaller riparian pastures allow for a shorter grazing season and greater flexibility in rotation schedules.”

One common problem in multiple-pasture systems is allowing livestock to drift between pastures rather than moving them in a timely fashion. In his evaluation of 30 grazing systems on 44 stream reaches in Montana, Myers (1981) concluded that livestock should be moved between pastures rather than left to drift over a period of

several days. In this analysis, riparian vegetative response seemed to be better in allotments where the livestock were moved and the gates closed, as opposed to the use of livestock drift and simultaneous use of two pastures. Other field personnel also emphasize the need to move livestock and not expect drift to accomplish the desired movement. Some livestock will stay in a pasture eating regrowth even though there is adequate palatable forage in the next pasture. One recommended approach, which can minimize livestock stress and encourage better dispersal, is to open the gate in late afternoon of day one, allow drift on day two, and clean the pasture and close the gate on day three (Hagener pers. comm.).

Based on research at the Red Bluff Research Ranch near Norris, Montana, Marlow (1985) suggests a grazing system based on seasonal preference for riparian and upland forage. In this area, livestock spend most of their time during June and July in the uplands, moving to the riparian sites in late July where they graze until October. Bank trampling damage is reduced by deferring grazing until after late July when soil moisture content had decreased to 8 to 10 percent or less. This system requires a minimum of three pastures and uses a 3-year cycle. Stocking rates in the pasture used first are based on forage available on both the upland and riparian sites. Stocking rates on the two pastures used later are based on 20 to 30 percent utilization of forage on only the riparian sites. Although this may appear to drastically limit the length of time a pasture can be used, riparian zones usually produce three to four times the forage of upland areas. The regrowth potential of riparian species is great enough that, during most years, regrazing of the same pasture can occur at 30- to 40-day intervals until frost. Consequently, there is little, if any, change in the amount of forage a rancher has available to his livestock in the grazing season. Once the target level of use is reached, livestock are moved to the next pasture. Each pasture receives 2 years of deferment during periods when soil moisture exceeds 10 percent (June-July). The pasture used early the first year is grazed progressively later during the second and third years.

Using riparian habitat as a key management area in conjunction with a deferred rotation grazing system has improved riparian area conditions on the Little Sandy Allotment in the Green River Resource Area of the Rock Springs District. This success is the result of sufficient flexibility, use supervision, and cooperation by permittees and the Wyoming Game and Fish Department. The sagebrush and grassland allotment is grazed by 2,500 cattle from May 1 to November 15 using five pastures, with riparian areas in each pasture. Herding and drift fencing control livestock movement from lower to higher range. Pasture moves are made so as to prevent adverse impacts in the riparian areas, avoiding bank trampling damage and excessive utilization. Sixty percent utilization of key herbaceous vegetation in riparian areas is used as a general rule to prompt pasture moves. One of the two lower pastures is always used first each spring due to elevational effects on range readiness, and the other is used last in the fall. Livestock graze the middle pasture twice per season going to and coming from the upper part of the allotment. They alternately graze the upper two pastures after seedripe each year.

This management system has been in effect since 1980. Prior to that, bank trampling damage was evident, much of the streambanks lacked protective cover, plant

vigor was poor, willow reproduction was very limited, and wildlife habitat was nonproductive (Smith pers. comm.). After 16 years, conditions are much improved (Figures 15 and 16). Willow reproduction is apparent, banks are stabilized, plant vigor is improved, and the fish, beaver, moose, and duck habitat is productive again (Krosting and Christensen pers. comm.).

Figure 15. Riparian conditions on Little Sandy River in Little Sandy Allotment following July grazing treatment, 1986.

Figure 16. Riparian conditions on Lander Creek in Little Sandy Allotment, July 1986.

9. Rest-Rotation Grazing (Rotational Stocking)

Though the term "rotational stocking" is recommended over the term "rest-rotation grazing" (Forage and Grazing Terminology Committee 1991), rest-rotation is still commonly used in both application and literature, and thus, it is retained throughout this document. Rest-rotation is a grazing method that uses recurring periods of grazing and rest among two or more paddocks in a grazing management unit throughout the period when grazing is allowed. It differs from rotational deferred grazing in that it includes a year (or full growing season) with no grazing in the rotation for each pasture at least once in each cycle. There are great differences of opinion on the value of rest-rotation grazing, as generally applied, in the proper management of riparian areas.

Hormay (1976) emphasized that each rest-rotation system should be designed to meet the resource needs of the area. The amount of rest, stocking rate, and season of use should be determined by the manager based on the growth requirements of the vegetation present, all species considered. Rest-rotation does not dictate heavy grazing under any treatment (emphasis added).

As with deferred and deferred rotation strategies, a system that uses more pastures is usually better than one that uses fewer; however, in practical application, rest-rotation grazing has often used a three-pasture system. Cost and simplicity have often been factors in choosing a three-pasture system, and riparian objectives have rarely influenced pasture design and grazing strategy. Variation in ecological conditions and among stream types with different sensitivities to disturbance have contributed to mixed results, sometimes in the same management unit.

Masters and others (1996b) provide examples of two, three-pasture rest-rotation strategies in northern Nevada; one worked, the other did not. The goals on Strawberry Creek, (Figure 17) were to maintain healthy streamside vegetation and stable channel conditions. Continued success since the strategy was implemented in 1969 was attributed to cooperation between agencies and the permittee, inherently stable stream channel conditions, long-term attention to resource conditions, and careful herd management practices, including salt placement and herding livestock to improve distribution. On Wildcat Creek (Figure 18), past management had resulted in unstable eroding banks and deteriorated ecological conditions. Applying a three-pasture, rest-rotation strategy in a degraded system without adjusting livestock numbers resulted in the overgrazing of two pastures, and 1 year of rest did not allow system recovery. (Authors' note: In this case, temporary exclusion to allow a "jumpstart" in the recovery process was probably warranted.) In addition to limitations imposed by the initial conditions, specified herd management practices were not followed, upland water developments had failed, and salt blocks continued to be placed near the stream channel.

Figure 17. Strawberry Creek maintained riparian condition with a three-pasture, rest-rotation system.

Figure 18. Wildcat Creek did not improve under the same kind of system.

Elmore and Kauffman (1994) cite 10 years of continued channel degradation in a high-gradient, high-energy stream system under three-pasture, rest-rotation grazing (Figure 19). Yet, in the same allotment, with the same system and the same livestock, another stream made an excellent recovery (Figure 20). The differences are due to stream type, sensitivity to disturbance, vegetation potential, and kind of

vegetation required to stabilize each stream. Rest-rotation favors herbaceous bank-forming vegetation, which is entirely adequate for the low-gradient stream depicted in Figure 20. However, willows needed for stabilizing the high-energy stream in Figure 19 continued to show a downward trend.

Figure 19. Higgins Creek, 1984. Channel degradation continued with 10 years of three pasture rest-rotation.

Figure 20. Beaver Creek, 1984. Three-pasture rest-rotation provided recovery of herbaceous bank-forming vegetation and associated channel characteristics.

Other successes with forms of rest-rotation in allotments with riparian areas have been reported:

- On several allotments in the Tonto National Forest in Arizona, rest-rotation systems, together with proper stocking and other management, resulted in cottonwood and willow regeneration along perennial streams. These systems incorporated high-intensity, short-duration grazing, with each pasture receiving spring-summer rest for 2 years out of 3. In 1978, the Sedow Allotment (34,800 acres) on the Globe Ranger District was placed under this system after the permitted 11,125 AUMs were reduced to 5,800 AUMs. When the system was initiated, the Walnut Spring area of the Storm Canyon pasture did not have cottonwood or willow between 0.1 and 10.2 cm (0.4 to 4 inches) in diameter. By 1982, the area supported 650 cottonwoods and 2,275 willows per hectare (263 and 920 per acre, respectively) in this size class (Davis 1982). The Superior Allotment is another that has responded positively to this same grazing system (Flanigan pers. comm.).

- On the Humboldt National Forest in north-central Nevada, a three-pasture, rest-rotation system in effect for 12 years has improved areas of degraded riparian habitat. The Wilson Creek Pasture Allotment is comprised of mixed sagebrush-grassland, with scattered stands of aspen and smaller quantities of fir and spruce. The grazing system provides for rest following seedripe on the upland key species (Idaho fescue) in the first year, followed by rest from turnout (July 1) to seedripe in the second year, and season-long rest in the last year of the cycle. This management has resulted in aspen and willow rejuvenation, streambank stabilization, and recovery of some of the former fishery (Easton pers. comm.). Although no utilization was sampled in the riparian area, utilization in the uplands was in the 35-40 percent range in 1985.

- Cooperation from permittees and the U.S. Forest Service, frequent use supervision, and a rest-rotation strategy have maintained and improved riparian habitat in the White Acorn Allotment of the Green River Resource Area of the Rock Springs District. This sagebrush grassland allotment with riparian areas and wet and dry meadows was formerly grazed by sheep, but is now grazed by 800 cattle (Krosting and Christensen pers. comm.). Three pastures are managed under a deferred rotation system, while three other pastures are grazed under a rest-rotation system. Concern with riparian habitat is focused primarily in the three pastures on Blucher Creek. Prior to the change in management (1981), plant vigor was low, bank trampling damage was apparent, willows were the size of garbage cans, and wildlife habitat was in poor condition (Smith pers. comm.). The allotment management plan required herding for maintaining even distribution and control of livestock in each pasture. Riparian values are being maintained and improved under this management strategy. Most streambanks are stable, willow of all age classes are present, plant vigor is good, and the wildlife habitat is much improved.

10. Holistic Resource Management

Holistic Resource Management (HRM) was developed by Allan Savory. HRM, with its associated grazing and other practices, does not specify any set strategy. However, most HRM applications use “time-control grazing” to concentrate animal

impacts in time and space, thereby avoiding regrazing before recovery and overresting plants adapted to herbivory. Time-control grazing is like high-intensity, short-duration grazing except that the rate of rotation varies with the rate of plant growth. Depending on how well it is planned and implemented, it can be good for riparian management. Because it specifies that management should focus on objectives and uses many pastures, there is limited opportunity for livestock distribution problems. At any time, a pasture can be skipped if site-specific management needs warrant it.

HRM has been used to improve general range conditions and riparian conditions on the Desert Land and Livestock Company ranch in north-central Utah. Prior to implementation of HRM, much of the rangeland on the ranch was in a deteriorated condition (Secrist pers. comm.). Many sagebrush-filled gullies were present in the lower elevations. Muddy water flowed in the drainages during snowmelt or following heavy rains. Riparian herbaceous vegetation was absent in most drainages including Saleratus, Negro Dan, Stacy Hollow, and others, and no willows could be found.

An HRM program was initiated on the ranch in 1979, with the objective of making a profit while improving the health of the range. Since grazing animals were originally part of the ecosystem, livestock were chosen as the tool for accomplishing this objective. Cattle, sheep, and buffalo are managed to control the timing and duration of grazing, as well as animal impact.

Flexibility in time control has been achieved by grouping animals into large herds (from 1,300 yearling heifers to 3,500 pairs and 6,000 yearling steers) and creating more pastures through fencing. Three cattle herds and six bands of sheep use 100 different pastures on the ranch. Depending on range conditions, vegetation, and economic goals, pastures are used one to three times per year; the majority are only used once. Stock density (animals per acre) has ranged from 0.5 to 3.5, depending on pasture size. Time in each pasture is determined by how fast plant growth is occurring. When growth is rapid, pasture moves are frequent. When growth is slow, the livestock stay longer in each pasture. When plants are dormant, lack of forage and animal performance determine when livestock are moved. Time in each pasture has ranged from 3 days (during rapid growth) to 100 days (during dormancy). During the growing season, the grazing animals are moved from pasture to pasture in an attempt to graze each plant severely only once, and then allow it to recover from the effects of defoliation before it is grazed again. Yearling cattle and sheep are moved by herding. The 3,500 pairs are trained to move from pasture to pasture by responding to a whistle.

Herd effects result in animal impact: 1) hooves break up (physical) soil crusts, enrich soil, and provide cover by incorporating manure, litter, and seeds into the soil surface, 2) urine adds urea to the soil, 3) hoofprints create seedbeds and pockets for collection of litter and precipitation where seeds are pressed into contact with mineral soil, and 4) grazing, trampling, crushing, etc., prunes plants to stimulate new plant growth. Animal impact, when properly managed, is very important to the health of these rangelands. The herd effects, particularly the hoofprint seedbeds, improve microsite conditions for the germination of seeds and establishment of seedlings, which can be the weakest link in the natural function of many range ecosystems.

New plants result in additional pathways for water to get into the soil reservoir where it is stored, purified, and slowly released into riparian areas. (Note: The physical effects described above can be detrimental in areas where microbiotic crusts are an important component and/or on soils with vesicular crusts.)

The ranch manager believes that this method of grazing results in an increase in ground cover, water infiltration, and soil moisture, and restores some of the natural hydrologic function to the watershed. Riparian vegetation has reestablished in the drainages, serving as a sediment trap that raises the water table. As this healing process continues, the bottom of the drainage rises in elevation, thus deepening and widening the riparian aquifer. As a result, riparian vegetation expands into the edges of the uplands and floods sagebrush. Clear water flows year-round and willows have established themselves where they did not exist before. The streambed in one drainage has increased more than 6 inches in elevation. Gully banks are slumping and are being vegetated by riparian plants. Sagebrush is dying as the riparian areas expand. Though precipitation and runoff were far above normal, the additional ground cover in the uplands and the improvement in the riparian habitat prevented significant erosion damage on the ranch in spite of increased stocking rates (Table 7) (Simonds pers. comm.).

Table 7. Stocking levels on the Desert Land and Livestock Company ranch.

	1979	**1986**
Cattle	4,500	10,460
Sheep	12,000	10,000 (approximate)
Elk	350	1,500
Buffalo	0	230

11. Total Rest

Depending on the riparian area objectives, tools and finances available, and time prescribed for reaching objectives, nonuse may be the best alternative for realizing the most rapid improvement. A deteriorated riparian area with few trees or shrubs, or one where the objective is to get woody plant regeneration above the reach of livestock, may require total rest, at least for a few years (Davis 1982).

Exclusion of livestock has produced improved riparian and aquatic habitat following 4 to 7 years of total nonuse, woody plant (shrub) recovery following 5 to 8 years of total rest, a doubling of fish biomass following 3 to 5 years of total rest, and attendant positive responses in birds and small mammals (Skovlin 1984). A study on Big Creek in northeast Utah concluded that a minimum of 6 to 8 years of nonuse was necessary to restore a deteriorated streamside riparian area to the point where livestock grazing could be allowed at reduced levels (Duff 1983). However, substantial recovery of streambanks and vegetation was observed following 4 years of exclusion of grazing by fencing.

C. Techniques that Attract Livestock Away from Riparian Areas

- Water development in upland areas that lack water is often a key factor in reducing livestock concentrations in riparian areas. Where feasible, water development can be achieved by installing solar, hydraulic ram, or conventional pumps; developing springs, seeps, wells, or guzzlers; and piping water to several troughs once collected. Even within riparian areas or riparian pastures, water developments, ponds, or troughs can reduce streambank trampling damage. However, they tend to concentrate disturbance rather than distribute it. Any water development should avoid creating new problems, such as excess soil erosion or vegetation/habitat impacts. Creating shade and locating rubbing posts and oilers nearby may augment water development and help reduce the time livestock spend in riparian areas.

- Planting palatable forage species on depleted upland areas can attract livestock away from riparian areas.

- Prescribed burning often enhances forage production, palatability, and upland use. In fact, the attraction often forces temporary rest until vegetation recovers.

- Placing salt, hay, grain, molasses, and other supplements only in upland areas away from riparian areas improves distribution. Except where salt and supplements are used to intentionally localize animal impacts, they should generally be placed no closer than 1/4 mile, and preferably 1/2 mile or more, from riparian areas and intermittent drainages (Riparian Habitat Committee 1982). Proper salting improves both distribution and utilization. At least one livestock operator relates that sawing salt blocks in half allows frequent movement of salt stations to minimize localized impacts of concentrated use.

  Supplements can affect forage preference and selectivity. Energy supplements can increase browse utilization (although it may also depress utilization of fiber). High-protein supplements, such as cottonseed or soybean meals or cake, balance diets and increase consumption of cured grass that is protein-deficient. However, there is anecdotal evidence that supplements such as cottonseed meal were also used extensively to get livestock to rid pastures of “unwanted” willows.

- Residual vegetation from previous years decreases forage palatability and quality and diverts grazing from new areas. Use patterns perpetuate themselves, and thus, when carefully planned, periodic forced intense use of pastures (e.g., by dry cows in an off season), can reduce “wolf plant” problems, improve distribution, and increase forage quantity and quality.

D. Techniques that Exclude or Promote Avoidance of Riparian Areas

- When properly located, well-constructed, and maintained, fencing can be an effective tool for controlling distribution. Fencing facilitates management of riparian areas by either including or excluding livestock use, depending on

management objectives. Sometimes exclusion fencing can be the most practical approach for initiating rapid riparian recovery or improving highly sensitive areas, or it can be a temporary measure for initiating recovery. The loss of forage from exclusion fencing may be inconsequential in many allotments. On 365 miles of Oregon streams, riparian areas comprise only 3.5 acres, 7 AUMs, or 100 cows for 2 days per mile (Elmore pers. comm.). Fencing water sources at springs and seeps and piping the water to adjacent areas is often the only effective measure for protecting small riparian areas. However, fencing may restrict wildlife and livestock movements in an undesirable manner. In addition, fence construction and maintenance can be costly and time-consuming.

- Barriers formed by placing trees and brush on streambanks may discourage livestock use and help stabilize eroding banks. Placing boulders (10 to 20 inches or larger) along streambanks where livestock trail and cause trampling damage can effectively displace livestock use and promote recovery (Myers pers. comm.).

- Hardened crossings and water access points are gravel pads that provide livestock sure footing on a gentle grade to water, either for crossing a stream or for drinking. Livestock prefer gravel pads over trying to negotiate steep, overhanging streambanks. During a roundup, cows will run for the gravel pad before trying to cross the stream (Massman ed. 1995).

- Frequent riding and herding can effectively control livestock distribution in some situations. On some rough or poorly watered ranges, proper herding may increase breeding, conception, and calf crops (Stoddart et al. 1975). Several of the successful strategies reported by Massman (1995) and Masters et al. (1996a and 1996b) also incorporate riding and herding into overall management.

- Bed grounds and other livestock handling facilities should be located away from riparian areas (Riparian Habitat Committee 1982).

- Locating livestock turnouts far away from overused riparian areas may help regulate the timing, duration, and amount of riparian use in large pastures that contain adequate stock water (Gillen et al. 1985).

- Gap fencing in conjunction with gullies, cliffs, and other natural barriers can regulate natural trailing or loafing by livestock in some riparian areas.

- Locating water gaps in rocky areas (natural or manmade) minimizes trampling damage to streambanks and streambeds. Narrow water gaps discourage livestock from loafing at the water source.

E. Herd Management and Animal Husbandry Practices

- Culling practices are traditionally aimed at improving animal performance in conception rates, weaning weights, conformation, etc. However, some operators also cull on habitat use tendencies and foraging characteristics. Roath (1980)

and Bailey et al. (1996) indicate that within breeds, or even herds, certain individuals tend to spend more time in the bottoms while others tend to forage widely. George (in press) found that culling could rid herds of individuals that spend disproportionate time in the bottoms. The permittee on the Bruneau Allotment in Nevada culled "riparian loafers" and stated that this practice led to a more robust herd of mother cows that remained on hillslopes more and produced larger calf crops with higher weaning weights.

- Unrestricted use by cow-calf pairs generally impacts riparian areas more than use by other kinds/classes of livestock. They tend to concentrate, loaf, and forage in bottoms. Yearling cattle, particularly steers, generally tend to be wider ranging and use more of the adjacent uplands.

- Changing the kind of livestock adjusts both the distribution pattern and forage preference. Herded sheep offer several options for achieving proper management in certain riparian areas. Sheep use may be more desirable than cattle use in some areas due to the herders' control over location, timing, degree, duration, and frequency of use. Sheep prefer hillsides to the confining nature of riparian bottoms. If not bedded in a riparian area meadow, the herder can easily move them to uplands or ridge tops. Generally, herders want to keep flocks or bands moving so as to facilitate forage selectivity. The quality of herding controls riparian effects and the rate of gain (Glimp and Swanson 1994). Sheep may do less physical damage to herbaceous plants due to their nibbling characteristics, whereas cattle and horses can dislodge plants from the soil because they graze with a pulling motion. When properly herded, sheep cause less trampling damage than cattle (Stoddart et al. 1975).

  Sheep under unherded conditions have been observed to consume spring willow growth in Oregon when adequate herbaceous forage was available (Elmore, pers. comm.). Heavy browsing of young willow growth by unherded sheep was observed in southern Wyoming during spring, summer, and fall where the herbaceous vegetation was dominated by coarse forage such as sedges and rushes.

  Horse use during the winter in some areas may result in bark being stripped from deciduous trees (Kindschy pers. comm.). However, horses are primarily regarded as grass eaters, and they generally congregate less than cattle (Stoddart et al. 1975). The concentration of wild horses on riparian meadows has been reported to result in severe riparian impacts (Platts pers. comm.). Concentrated spring or seep use causes problems in other areas.

- Most livestock operators would not consider a change in breed of livestock simply to improve distribution. However, breed habits might become a consideration if an operator is considering a change for other reasons. Higher heat tolerance (and related foraging characteristics) of Brahman, Brahman crosses, and other zebu types is often a consideration in southern and southwestern states, for example. Extension livestock specialists are a good source of information about animal characteristics and habits.

VI. Monitoring

No discussion of grazing management would be complete without considering monitoring. Once objectives have been established and a grazing strategy selected and implemented to achieve those objectives, the only way to evaluate success or failure is through monitoring. Monitoring should include both short-term and long-term strategies. Short-term monitoring includes annual documentation of implementation activities, events, and interpretive measurements or observations of effects that influence progress toward objectives. Long-term monitoring documents and measures trends toward or achievement of objectives, usually over a period of years.

Many agency, interagency, and extension references guide planning, method selection, and analysis and interpretation of monitoring data. A few examples are presented below (full citations are presented in the References section):

- Rangeland Monitoring - Planning For Monitoring (USDI 1984) and others in the BLM TR 4400 series
- Methods for Evaluating Riparian Habitats With Applications to Management (Platts et al. 1987)
- Inventory and Monitoring of Riparian Areas (Myers 1989b)
- Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams (Bauer and Burton 1993)
- Herbaceous Stubble Height as a Warning of Impending Cattle Grazing Damage to Riparian Areas (Hall and Bryant 1995)
- Rangeland Analysis and Management Training Guide (USDA 1996) and other USFS regional guides
- Sampling Vegetation Attributes (Interagency Technical Team 1996a)
- Utilization Studies and Residual Measurements (Interagency Technical Team 1996b)

It would not be feasible to summarize the measurement techniques in these references or even list all of the applicable references, but there are a few points worth emphasizing.

A. General

All stated management objectives require some strategy for monitoring their accomplishment. Likewise all monitoring should tie directly to the analysis of and accomplishment of specified objectives. This may seem obvious, but in an analysis of 20 grazing allotments in northeastern California and northwestern Nevada, Olson (1989) found that not one combined all the elements of a systematic process by

linking goals, issues, and objectives with action, monitoring, and evaluation. Olson states, "Management objectives, overall, were not measurable or realistic, providing no solid vegetative benchmarks for determining management successes. In the cases where management objectives were both measurable and obtainable, the supporting monitoring studies and evaluations were incomplete." Subsequent program reviews have identified similar problems in virtually every location to one degree or another. Monitoring that has no direct relationship to objectives is another frequent problem that increases costs and usually detracts from necessary monitoring and administrative tasks.

B. Short-Term Monitoring

1. Implementation

The best strategy will surely fail if it is not followed. Therefore, implementation or "compliance" monitoring is essential. Implementation monitoring is simply ensuring that livestock are in the right place, at the right time, in the right numbers, and that any additional measures to improve distribution are being taken. Without tracking what was done and where which animals were when, managers will not understand why strategies worked or failed.

Compliance with a grazing system is critical. When stock are moved from a management pasture, it is commonplace for a few animals to be overlooked. If a few undetected livestock drift back or reenter a grazed pasture through faulty fences or ineffective natural barriers, they can quickly "undo" any progress that deferment or rest might have accomplished. It only takes a few weeks of unauthorized use or overgrazing to set back years of progress in improving riparian systems (Duff 1983). In one stream, annual use by a few head of unauthorized livestock throughout most of the hot season period has nullified positive riparian habitat responses in an otherwise excellent grazing system (Myers 1981).

2. Seasonal, Annual, and Cyclic Events

Long-term monitoring studies or use maps require documentation of seasonal, annual, and cyclic events such as fire, insect infestations, disease, weather, and associated hydrologic phenomena. Such effects must be distinguished from the effects of grazing for evaluation. The effects of weather-associated phenomenon are often less distinct. Floods and droughts can have both beneficial and detrimental effects on riparian plant communities, as well as on channel characteristics.

Floods may widen channels and increase width/depth ratios, which is generally not beneficial. However, floods may also redistribute sediments to floodplains, recharge shallow aquifers, and initiate recruitment of many plants (especially willows and cottonwoods) depending on timing, discharge, channel shape, and floodplain access. Key points to be considered are: 1) whether or not livestock grazing or bank disturbance before or after a flood led to additional widening, and 2) whether the grazing strategy allowed for establishment of plant species dependent on floods for recruitment.

Droughts increase moisture stress on plants and plant communities, which tends to concentrate livestock and wildlife in riparian areas even more than normal. They also tempt the use of pastures slated for rest. However, low flows associated with droughts reduce the stress on banks, and there is usually enough water in channels to continue to support hydric, bank-forming vegetation. Given the chance, most perennial vegetation helps channel narrowing and bank building with fine sediments transported after reduced flows. Key points to be considered are: 1)whether or not the timing, intensity, and duration of grazing during the drought allowed for plant colonization and stabilization of exposed banks or wide channel edges, and 2) whether the grazing strategy leaves enough residual vegetation (or regrowth) to trap and retain fine sediments for bank building.

3. Utilization and Stubble Height

Measurements of utilization and stubble height (residual vegetation) help interpret whether or not long-term objectives were met. Utilization or stubble height can be monitored annually or more frequently, and can guide stock movement decisions where needed or appropriate. However, measuring progress toward long-term resource objectives, such as bank stabilization, rebuilding of the streamside aquifer, or reestablishment of beaver, fish, or moose habitat, requires years of intervening management. Herbaceous stubble height is usually easier to document. It is easier to measure what is there than what is gone. Stubble height can be an excellent tool for warning of impending damage to riparian areas (Hall and Bryant 1995).

Timing of utilization of key species with respect to plant phenology often affects subsequent growth and reproduction more than amount of utilization. Therefore utilization mapping relative to plant growth and community distribution can provide more insight to the appropriateness of a particular grazing strategy than utilization of a key area alone. Utilization maps also describe the pattern of livestock use relative to topography, vegetation, water, salt, season, and all other management factors. It therefore can guide adjustments better than most other forms of monitoring information. However, accuracy and precision limitations of utilization measurements should be recognized in all interpretations. There is often high sampling variability among sites and among observers, especially for shrubs. Because of these limitations, high confidence levels require intensive sampling and more time and money. In addition, relative utilization (utilization determined at any time other than peak standing crop) has little relationship with utilization at peak standing crop for determining plant or community response to defoliation. Therefore, interpretations should be made with caution!

In spite of the potential limitations and for lack of a better tool, many managers have had to establish utilization guidelines for short-term management considerations. To establish utilization guidelines, the manager should know and consider the growth habits and characteristics of the important plant species; how they respond to grazing and browsing; and the characteristics, preferences, and requirements of the grazing-browsing animals. Utilization guidelines, where used for riparian areas and riparian pastures, should:

- Maintain both herbaceous and woody species (where present) in a healthy and vigorous condition and facilitate their ability to reproduce and maintain different age classes in the desired riparian plant community.

- Leave sufficient plant residue to protect banks, filter sediment, and dissipate flood energy during runoff events.

- Maintain consistency with other resource values and objectives; e.g., esthetics, water quality, etc.

- Limit streambank shearing and trampling to acceptable levels. (However, bank trampling guidelines should be set separately for stream reaches where this is important.)

In some cases, setting proper utilization guidelines requires trial and error through monitoring, analysis, and evaluation of the results after adjusting management. Because initial results may vary from expectations, the manager should not hesitate to change key species or utilization guidelines to meet objectives.

C. Long-Term Monitoring

If the relationships between objectives and monitoring are maintained, the establishment of long-term trend studies is well underway. Because of the central role and inherent variety in appropriate management objectives, useful and appropriate measurement/monitoring techniques vary widely. No short list could be complete, and each technique requires a detailed description to guide its proper application.

However, there is one aspect of long-term vegetation monitoring in riparian areas that is significantly different than monitoring in uplands and often leads to confusing interpretations. Riparian ecological sites or plant communities can move as streams move and change their distribution and extent over time (Gebhardt et al. 1990) (Winward and Padgett 1986) with changing water tables, etc. Many objectives tied to kind, proportion, or amount of vegetation are best monitored by methods that account for changes along the stream edge (green line) or throughout the riparian complex. The Integrated Riparian Evaluation Guide (USDA 1992) and others describe methods to account for these phenomena rather than rely on a fixed point or plot as is common for upland sites.

VII. Learning from Experience

Grazing prescriptions and associated management of riparian areas should be monitored, evaluated, and reconsidered regularly. Managers should not hesitate to identify problems and make changes in grazing treatments, and to take risks and try new alternatives to achieve objectives. But along with this, it is important that the conditions under which each system does and does not work be documented.

Existing documentation of successful grazing management in riparian areas is only marginal. Documentation of successes, as well as of failures, is essential for learning from past efforts. Any riparian monitoring plan should mandate before and after photos, with backup data, to show the effects of management. Documenting pre-treatment resource conditions provides a basis for interpreting results and avoiding past mistakes, and provides a "springboard" for exploration of other options. Successes and lessons learned should be shared through presentations at meetings of professional societies, the livestock community, conservation groups, and agency workgroups, and in professional and popular publications.

VIII. Cardinal Rules for Planning and Managing Grazing in Riparian Areas

- Adapt grazing management to the conditions, problems, potential, objectives, public concerns, and livestock management considerations on a site-specific basis.

- Manage grazing to grow and leave sufficient vegetation stubble on the banks and overflow zones to permit the stream to function naturally.

- Identify and implement alternatives to passive, continuous grazing.

- Take advantage of seasonal livestock preference for uplands in grazing prescriptions.

- Employ rest from livestock grazing whenever appropriate.

- Consider the whole watershed and all important resource issues.

- Include all those willing to learn the details and contribute ideas or work for better management, including the livestock user and other interests. Everyone involved should understand and agree on the problems and objectives, as well as understand the changes that can occur and how they can benefit from proper management and improved riparian conditions.

- Involve the livestock user in designing the grazing system and monitoring the results.

- Build flexibility into grazing management to accommodate changes based on need.

- Implement frequent (sometimes daily) use supervision by the parties involved once management is in progress so that adverse impacts (e.g., trampling damage and excessive utilization) can be foreseen and avoided.

- Document mistakes so they are not repeated.

- Use management successes to promote good riparian area management elsewhere.

Appendix A

I. Indicators of High-Quality Riparian Habitat

Riparian areas are the most important wildlife habitat type. Following are indicators of quality habitat which can be considered when designing management objectives for riparian area management in the Great Basin and similar areas, including the Great Plains, and toward which grazing management practices can be designed. These factors can also be used as indicators of quality habitat for other species as well.

A. Fish Habitat

Platts et al. (1977) list the following indicators of good fish habitat in the Great Basin (these are also good indicators of bank stability):

- Adequate vegetation canopy to maintain acceptable water temperatures for the fish species involved
- Well-vegetated streambanks to minimize soil loss and trampling damage
- Overhanging vegetation (within 1-2 feet of water surface) on 50 percent or more of the streambank, and especially on outside bends of streams, to provide fish cover

Individual sites may possess limitations that preclude accomplishing all of the above. However, the type, density, height, diameter, and age class of vegetation needed for good fish habitat should be included in the management objectives.

Bisson et al. (1992) provide further that management practices for quality fish habitat should:

- Provide for habitat complexity—land use practices that have led to simplified streams characterized by straightened, confined channels have had the most pervasive cumulative impacts on fish populations
- Preserve physical and biological linkages between streams, riparian zones, and upland areas that provide transfer processes for woody debris, coarse sediment, and organic matter
- Provide a greater range of vegetative species and structural diversity, thus providing future sources of large woody debris, floodplain connections, and other linkages important to ecosystem function

In designing grazing systems to improve fisheries, a fisheries biologist should be consulted to ensure the treatments are tailored to the site-specific and watershed resources present.

B. Waterfowl Habitat

Mazzoni et al. (1977) made several recommendations for management of waterfowl production habitat in the Omat Basin:

- Manage for native plant communities where possible. Where this is not practical, manage for introduced species best adapted to the site that give the greatest density with the tallest and most erect growth form.

- Ideally, areas managed for production should contain one-third open water and two-thirds marsh vegetation.

- Fence critical areas or place salt, water, and supplements for livestock away from critical production areas. Where fencing is impractical, islands or artificial structures are recommended.

- Where maximum nest density and nesting success is desired, manage for high, erect growth forms in 80-acre or larger blocks. These areas should be ungrazed until the vegetation begins to mat.

- Several years of nonuse may be required to promote homing, larger clutches, and earlier nesting of waterfowl species.

- Most nesting starts before the current year's vegetative growth is useable (tall enough or long enough) for nesting. Grazing should be managed to provide for increases in residual nesting cover which will carry over for the following year. This carryover should be comprised of abundant ground litter and erect and recumbent vegetation. These characteristics help deter predation and provide ideal temperature and moisture conditions for a good hatch.

- Grazing formulas that prescribe deferred grazing in areas with good residual vegetation from the previous year provide maximum benefits to nesting waterfowl (Mazzoni et al. 1977).

In a study of rest-rotation grazing and waterfowl production in Montana, Gjersing (1975) suggested that:

- Livestock should be moved from the pasture and gates closed at the end of the early treatment (spring and summer grazing) to provide for residual cover and regrowth.

- Grazing of these or other rested pastures with residual cover should be delayed the following year until incubation is complete (Gjersing 1975).

II. Willow and Cottonwood Stand Regeneration and Management

Although the following items do not specifically relate to grazing management, some are indirectly related and may prove useful in planning for proper management.

A. Willows

Pillmore (1983) reported the following findings on willow:

- Bare soil with moisture above or at the surface and temperatures above freezing are required for germination.
- The duration of seed viability is short (6-7 weeks).
- For survival, seedlings require continuous high soil moisture availability.
- Willows can tolerate 2 to 4 weeks of flooding, but no more than 200 to 400 mg/L of total dissolved solids.
- Willows can only tolerate 2 to 4 weeks of moisture stress and require that the water table be within 12 feet of the surface.

There are many species of willow native to the western rangeland. Habitat preference and growth form vary widely.

B. Cottonwoods

Cottonwoods usually don't regenerate naturally in existing stands until the overstory has declined due to harvest or death. This is due to competition for moisture and light. The best conditions for seed germination are moist gravel, sand, or silt exposed to full sun.

Soil disturbance or exposure is usually necessary to achieve sprouting or reproduction from seed (Beeson 1983). Seed viability is short-lived. A constant supply of moisture is essential during the first few weeks of seedling growth to ensure survival. Cottonwood seedlings frequently appear following high runoff and silt deposition in conjunction with peak seed dispersal (Fenner et al. 1985).

Studies on cottonwood in northeastern Colorado indicated that although the most important factor in cottonwood regeneration is water management, livestock and fire are beneficial in controlling competition from herbaceous vegetation during the period of the summer when cottonwood seed is disseminated and seedling growth is likely (Crouch 1979). If an area contains inadequate forage, grazing will likely result in loss of seedlings.

There should also be a number of age classes of cottonwoods. To obtain this result, the manager will need to ensure suitable site conditions and require protection from browsing or other damage of seedlings during establishment. Additionally, Pillmore (1983) found that cottonwoods:

- Can stand flooding for only 7-16 days
- Can tolerate only 200 to 400 mg/L of total dissolved solids
- Are capable of living under only 24 weeks of moisture stress
- Can survive when the water table is within 20 feet of the soil surface

Some streams in Colorado with much greater concentrations of dissolved solids support cottonwoods.

Willow, cottonwood, and aspen sprout from stumps and roots. Livestock, especially cattle, annually consume this reproduction when "overgrazing" during summer and fall is allowed. Beaver play a natural role in stimulating suckering and sprouting. If good beaver habitat is to be maintained, it is essential that stumps be protected from summer livestock use for 3 to 5 years following cutting by beaver (Kindschy pers. comm.). USDA (1985) provides an exhaustive treatment of aspen ecology and management.

Literature Cited

Bailey, D.W., J.E. Gross, E.A. Laca, L.R. Rittenhouse, M.B. Coughenour, D.M. Swift, and P.L. Sims. 1996. Mechanisms that result in large herbivore grazing distribution patterns. J. of Range Manage. (49)5.

Bauer, S.B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. Idaho Water Resources Research Institute, University of Idaho. Moscow. 179 p.

Beeson, T. 1983. Monitoring the cottonwood - willow association. In: Management of cottonwood - willow riparian associations below elevation 8000 in Colorado. Colorado Chapter-The Wildlife Society. p. 37-39.

Binns, M. and R. Remmick. 1986. Effect of drainage-wide habitat management on Bear River cutthroat trout (Salmo clarki Utah) populations and habitat. In: Proc. Colorado-Wyoming Chapt. Am. Fish. Soc. Ann. Meeting. Fort Collins, CO.

Bisson, P.A., T.P. Quinn, G.H. Reeves, and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. In: Naiman, R.J. (Ed.). 1992. Watershed management. Springer-Verlag, New York. 542 p.

Buckhouse, J.C. and W. Elmore. 1991. Grazing practice relationships: predicting riparian vegetation response from stream systems. In Bedell, T.E. (Ed.), Watershed management guide for the interior Northwest. Oregon State University Publication EM 8436. Oregon State University, Corvallis.

Cheney, E., W. Elmore, and W.S. Platts. 1990. Livestock grazing on western riparian areas. U.S. EPA, Northwest Information Center, Inc., Eagle, ID. 45 p.

Clary, W.P. and B.F. Webster. 1989. Managing grazing of riparian areas in the Intermountain Region. Ogden, UT:USDA, Forest Service, Intermountain Research Station. Gen. Tech. Rep. INT-263. 11 p.

Crouch, G. 1979. Long-term changes in cottonwoods on a grazed and an ungrazed plains bottomland in northeastern Colorado. USDA, Forest Service. Rocky Mountain For. and Range Exp. Sta. Res. Note RM-370. Fort Collins, CO.

Davis, J. 1982. Livestock and riparian habitat management - Why not? In: Proc. of 62nd Western Assoc. of Game and Fish Commissioners Meeting. Las Vegas, NV. p. 225-232.

Duff, D.A. 1983. Livestock grazing impacts on aquatic habitat in Big Creek, Utah. In: Menke, J.W. (Ed.) Proc. of the Workshop on Livestock and Wildlife - Fisheries Relationships in the Great Basin. May 3-5, 1977. Sparks, NV. Special Publication 3301. University of California, Berkeley. p. 129-142.

Easton, R. Jarbidge District Ranger. USFS, Buhl, ID. Personal communication.

Ehrhart, R. (In press). Riparian grazing guidelines and techniques. University of Montana extension bulletin. University of Montana, Missoula, MT. 11 p.

Elmore, W. Riparian Management Specialist. BLM, Prineville, OR. Personal communication.

———. 1987. Riparian management - back to basics, the public lands during the remainder of the 20th Century. Unpublished paper presented at "The Public Lands During the Remainder of the 20th Century," 8th Annual Summer Program, Natural Resources Law Center, University of Colorado School of Law, Boulder, CO. June 8-10, 1987. 8 p.

Elmore, W. and B. Kauffman. 1994. Riparian and watershed systems: degradation and restoration. In: Ecological implications of livestock herbivory in the west. Vavra, M., W.A. Laycock and R.D. Pieper (Eds.). Society for Range Management, Denver, CO. 297 p.

Evans, C. Fisheries biologist. BLM, Elko District, NV. Personal communication.

Fenner, P., W. Brady, and D. Patton. 1985. Effects of regulation of water flows on the regeneration of Fremont cottonwood. J. of Range Manage. 38(2):135-138.

Flanigan, D. District Range and Wildlife Staff Officer. USFS, Globe, AZ. Personal communication.

Forage and Grazing Terminology Committee. 1991. Terminology for grazing lands and grazing animals. Pocahontas Press, Inc., Blacksburg, VA. 38 p.

Gebhardt, K., S. Leonard, G. Staidl, and D. Prichard. 1990. Riparian area management—riparian classification review. TR 1737-5. USDI, Bureau of Land Management - Service Center, Denver, CO. 56 p.

George, M. (In press). Management practices to change livestock behavior in grazed watersheds. In: S. Swanson, M. George, J. Buckhouse and R. Larson. Evaluation of effectiveness of livestock and range management practices in grazed watersheds. U.S. EPA. 42 p.

Gillen, R., W. Krueger, and R. Miller. 1985. Cattle use of riparian meadows in the Blue Mountains of northeastern Oregon. J. of Range Manage. 38(3):205-209.

Gjersing, F. 1975. Waterfowl production in relation to rest-rotation grazing. J. of Range Manage. 28(l):37-42.

Glimp, H.A. and S.R. Swanson. 1994. Sheep grazing and riparian and watershed management. Sheep Research Journal, Special Issue: 65-71.

Green, D.M. 1991. Soil conditions along a hydrologic gradient and successional dynamics in a grazed and ungrazed montane riparian ecosystem. Ph.D. Diss. Oregon State University, Corvallis, OR. 236 p.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. Bioscience 41:540-551.

Hagener, L. Range Conservationist. BLM, Dillon, MT. Personal communication.

Hall, F.C. and L. Bryant. 1995. Herbaceous stubble height as a warning of impending cattle grazing damage to riparian areas. GTR PNW-GTR-362. Portland, OR. USDA, Forest Service, Pacific Northwest Research Station. 9 p.

Hormay, A. 1976. Memo to Manager, BLM Rock Springs District, WY, documenting a discussion with Bruce Smith, Fisheries Biologist.

Interagency Technical Team. 1996a. Sampling vegetation attributes. USDI, Bureau of Land Management - National Applied Resource Sciences Center, Denver, CO. 172 p.

———. 1996b. Utilization studies and residual measurements. USDI, Bureau of Land Management - National Applied Resource Sciences Center, Denver, CO. 176 p.

Kindschy, R. Wildlife Biologist. BLM, Vale, OR. Personal communication.

Kovalchik, B.L. and W. Elmore. 1991. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. In: Symposium on ecology and management of riparian shrub communities. May 29-31, 1991.Sun Valley, ID. p. 111-119.

Krosting, D. and T. Christensen. Range Conservationists. BLM, Rock Springs, WY. Personal communication.

Krueger, W.C. 1996. Managing ungulates to allow recovery of riparian vegetation. In: Proceedings of Sustaining Rangeland Ecosystems, August 1994, La Grande, OR. Agric. Exp. Sta. Special Rpt. 952, Oregon State University, Corvallis.

Marlow, C. 1985. Controlling riparian zone damage with little forage loss. Montana Agresearch. Fall 1985. 2(3):1-7.

Marlow, C. and T. Pogacnik. 1985. Time of grazing and cattle-induced damage to stream banks. In: Proc. of the First N. Am. Riparian Conf. U.S. Dep. Agric., For. Serv. General Tech. Report RM- 120. p. 279-284.

Massman, C. (Ed.). 1995. Riparian grazing successes on Montana ranches. Conservation Districts Bureau, Montana Dept. of Nat. Resources and Conservation, Helena. 30 p.

Masters, L., S. Swanson, and W. Burkhardt. 1996a. Riparian grazing management that worked: I.Introduction and winter grazing. Rangelands 18(5) 192-195.

———. 1996b. Riparian grazing management that worked: II. Rotation with and without rest and riparian pastures. Rangelands 18(5) 196-200.

Mazzoni, J., M. Barber, R. Critchlow, and W. Miller, and G. Studenski. 1977. Livestock and waterfowl. In: Proc. of the Workshop on Livestock and Wildlife - Fisheries Relationships in the Great Basin. May 3-5, 1977. Sparks, NV. University of California, Berkeley. Special publication 3301. p. 87-91.

Moore, E., E. James, F. Kinsinger, K. Pitney, and J. Samsbury. 1979. Summary of best management practices for minimizing or preventing adverse water quality impacts. In: Livestock Grazing Management and Water Quality Protection (State of the Art Reference Document) - EPA Publication 9190/9-79-67. p. 13-19.

Mosley, J. 1996. Grazing management to enhance riparian habitat. Presentation at 25th Annual Pacific Northwest Range Management Short Course, Boise, ID.

Myers, L. 1981. Grazing on stream riparian habitats in southwestern Montana. In: Proc. Montana Chapter of the Wildlife Society Meeting.

———. Wildlife Biologist. BLM, Dillon, MT. Personal communication.

———. 1989a. Grazing and riparian management in southwestern Montana. Fifteen years experience. Proc., Practical Approaches to Riparian Resource Management an Educational Workshop. Billings, Montana.

———. 1989b. Riparian area management—inventory and monitoring of riparian areas. TR 1737-3. USDI, Bureau of Land Management - Service Center, Denver, CO. 89 p.

Netherly, P. and D. Hendersen. Range Conservationists. BLM, Kemmerer, WY. Personal communication.

Olson, N.C. 1989. Quality assessment of twenty allotment management plans from the Surprise Valley Resource Area. MS thesis, University of Nevada - Reno. 89 p.

Pillmore, R. 1983. Maintaining the cottonwood - willow association. In: Management of cottonwood-willow association below elevation 8000 in Colorado. Colorado Chapter - The Wildlife Society. p. 37-39.

Platts, W.S. Research Fishery Biologist. Intermountain Forest and Range Experiment Station, Boise, ID. Personal communication.

Platts, W.S. and R. Nelson, 1985. Will the riparian pasture build good streams. Rangelands, 7(l):7-10.

Platts, W.S. and R.L. Nelson. 1989. Characteristics of riparian plant communities with respect to livestock grazing. In: Gresswell, R.E. (Ed.), Practical approaches to riparian resource management, May 8-11 1989, Billings, MT. USDI, Bureau of Land Management. p. 73-81.

Platts, W.S. and R. Raleigh. 1984. Impacts of grazing on wetlands and riparian habitat. In: Developing Strategies for Rangeland Management. p. 1105-1128.

Platts, W.S., C. Armor, G.D. Booth, M. Bryant, J.L. Burford, P. Cuplin, S. Jensen, G.W. Lienkemper, G.W. Minshall, S.B. Monson, R.L. Nelson, J.R. Sedell, and J.S. Tuhy. 1987. Methods for evaluating riparian habitats with applications to management. GTR INT-221. Ogden, UT: USDA, Forest Service, Intermountain Research Station. 177 p.

Platts, W.S., R.J. Behnke, J.C. Buckhouse, O.E. Casey, E.W. Claire, J. Cooper, D.A. Duff, W.A. Evans, G. Haugen, P.E. Marcuson, W.R. Meehan, R.W. Phillips, R.F. Raleigh, and J.M. Skovlin. 1977. Livestock interactions with fish and their environments. In: Menke, J.W. (Ed.). Proc. of the Workshop on Livestock and Wildlife - Fisheries Relationships in the Great Basin. May 3-5, 1977. Sparks, NV. Special Publication 3301. University of California, Berkeley. p. 36-41.

Prichard, D., H. Barrett, J. Cagney, R. Clark, J. Fogg, K. Gebhardt, P.L. Hansen, B. Mitchell, and D. Tippy. 1993. Riparian area management—process for assessing proper functioning condition. TR 1737-9. USDI, Bureau of Land Management - Service Center, Denver, CO. 60 p.

Prichard, D., C. Bridges, R. Krapf, S. Leonard, and W. Hagenbuck. 1994. Riparian area management—process for assessing proper functioning condition for lentic riparian-wetland areas. TR 1737-11. USDI, Bureau of Land Management - Service Center, Denver, CO. 46 p.

Riparian Habitat Committee - Western Division American Fisheries Society. 1982. The best management practices for the management and protection of western riparian stream ecosystems. American Fisheries Society, Western Division. 45 p.

Roath, L.R. 1980. Cattle grazing and behavior on a forested mountain range and their relationship to acute dietary Bovine Pulmonary Emphysema. Ph.D. dissertation. Oregon State University, Corvallis.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

Secrist, G. Range Conservationist. BLM Washington, DC. Personal communication.

Simonds, G. Manager, Desert Ranch. Woodruff, UT. Personal communication.

Skovlin, J. 1984. Impacts of grazing on wetlands and riparian habitat: A review of our knowledge. In: Developing Strategies for Rangeland Management. p. 1101- 1103.

Smith, B. Wildlife Biologist. BLM, Rock Springs, WY. Personal communication.

Stoddart, L., A. Smith, and T. Box. 1975. Management for proper range use. In: Range Management, Third Edition. McGraw-Hill Book Co. New York, NY. p. 256-289.

Stuth, J.W. 1991. Foraging behavior. In: Heitschmidt, R.K. and J.W. Stuth (Ed.). Grazing management: an ecological perspective. Timber Press, Inc., Portland, OR.

Thomas, J.W. and C. Maser (Eds.). 1986. Wildlife habitats in managed rangelands - The Great Basin of southeastern Oregon, Riparian zones. USDA Forest Service and USDI Bureau of Land Management General Tech. Report PNW-80. Special edition. Portland, Oregon. 18 p.

Thomas, J.W., C. Maser, and J.E. Rodiek. 1979. Riparian zones in managed rangelands - Their importance to wildlife. In: Proc. of the Forum on Grazing and Riparian Stream Ecosystems. Trout Unlimited. Denver, CO. p. 21-31.

USDA. 1985. Aspen: Ecology and management in the western United States. General technical report RM-119. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station. 283 p.

———. 1992. Integrated riparian evaluation guide. USDA, Forest Service. Intermountain Region, Ogden, UT.

———. 1996. Rangeland analysis and management training guide. USDA, Forest Service. Rocky Mountain Region. Denver, CO.

USDI. 1984. Rangeland monitoring—planning for monitoring. TR 4400-1. USDI, Bureau of Land Management - Service Center, Denver, CO. 25 p.

———. 1995. Riparian-wetland initiative for the 1990's - annual report of accomplishments for fiscal year 1995. USDI, Bureau of Land Management. 43 p.

Van Haveren, B. and B. Jackson. 1986. Concepts in stream riparian rehabilitation. In: Trans. 51st North American Wildlife and Natural Resources Conference. Wildlife Management Institute. Washington, DC. p. 280-289.

Winward, A.H. and W.G. Padgett. 1986. Special considerations when classifying riparian areas. In: Proceedings—Land classifications based on vegetation: applications for resource management. USDA Forest Service Intermountain Research Station. Gen. Tech. Rep. INT-257:176-179.

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This document presents information from various land managers and researchers to guide livestock management in riparian areas using their unique responsiveness to accomplish management objectives. An ecosystem approach, in which riparian areas are considered as part of a larger landscape, is used. Development of site-specific grazing prescriptions based on the function, capability, and potential of the site is discussed, and examples of grazing treatments are provided

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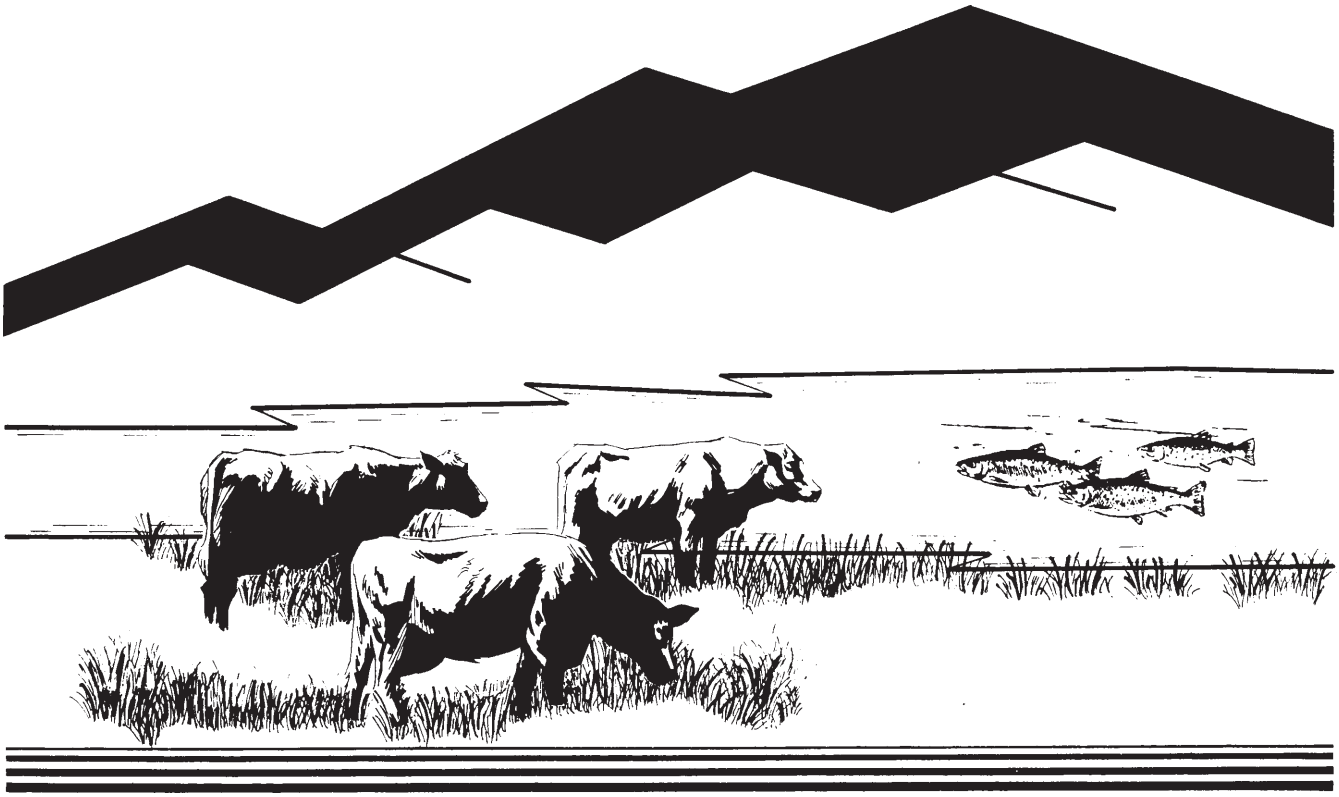
Managing Grazing of Riparian Areas in the Intermountain Region

Warren P. Clary
Bert F. Webster



THE AUTHORS

WARREN P. CLARY is project leader for the Riparian-Stream Ecosystems research work unit at the Intermountain Station's Boise, ID, Forestry Sciences Laboratory. He has a B.S. degree in agriculture from the University of Nebraska, and an M.S. degree in range management and a Ph.D. degree in plant ecology from Colorado State University. He joined the Forest Service in 1960 and has conducted research on forested and nonforested rangelands in Arizona, Louisiana, Utah, Idaho, Oregon, and Nevada.

BERT F. WEBSTER is range, wildlife, and fisheries staff officer for the Sawtooth National Forest, Intermountain Region, Forest Service, Twin Falls, ID. He has a B.S. degree in range management from Utah State University. He joined the Forest Service in 1961. He served as a range conservationist in Wyoming and Idaho, as a District Ranger in Nevada and Idaho, and on the Regional staff for range adminstration and improvements.

FOREWORD

The riparian grazing management recommendations in this paper are intended as guidance for planning and implementing riparian grazing procedures on National Forest System lands in the Intermountain Region. They are general criteria that with some modification and site-specific adjustments can be applied to a variety of situations. The application of these basic concepts along with riparian standards and guidelines in a Forest Plan will achieve the desired objective of healthy riparian systems.

J. S. Tixier
Regional Forester
Intermountain Region

CONTENTS

Page
Introduction 1
Background 1
Livestock Grazing 1
Recent On-the-Ground Experience 2
Grazing Management Recommendations 2
Suggested Initial Actions 3
Ecological Status - Early Seral 3
Ecological Status - Mid Seral 3
Ecological Status - Late Seral 3
Environmentally Sensitive Areas 3
References 3
Appendix I: General Review of Grazing Systems 6
Appendix II: Current Information on Grazing Riparian Areas 7
Grazing Effects 7
Grazing Systems 8
Utilization 8
Season of Use 9
Appendix III: Calculating Ecological Status and Resource Value Ratings in Riparian Areas (A. H. Winward) 10
Ecological Status 10
Resource Value Ratings 11

Intermountain Research Station
324 25th Street
Ogden, UT 84401

Managing Grazing of Riparian Areas in the Intermountain Region

Warren P. Clary
Bert F. Webster

INTRODUCTION

This paper was prepared as a guidance document for planning riparian grazing procedures on National Forests of the Intermountain Region of the Forest Service, U.S. Department of Agriculture. Much of the supporting information is broadly based; therefore the recommendations should be applicable beyond the Intermountain Region. Recent research information on grazing systems and grazing-riparian interactions was combined with our experience in various areas within the Intermountain Region to form a basis to guide future riparian grazing management.

These riparian grazing management recommendations have been developed as an aid in reducing nonpoint source pollution in western streams and as suggestions that could be incorporated in appropriate State Best Management Practices. "Best Management Practices" (BMP) means a practice or combination of practices that are determined by a State or designated areawide planning agency to be the most effective and practical means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality and related riparian-stream habitat goals. These are determined after problem assessment, examination of alternative practices, and appropriate public participation (Federal Register 1975). Designation of grazing management actions as Best Management Practices to protect water quality requires approval by the water quality management agencies of individual States. The Forest Service's Intermountain Region and the Intermountain Research Station are coordinating with the States within their respective boundaries to incorporate appropriate management into the States' recognized Best Management Practices.

The recommendations in this document are generic: they are general criteria that can be applied to a variety of situations. Selection of specific actions to accomplish the required result on a site-specific basis should normally be made by the land/resource/livestock managers based on soils, climate, special problems, management objectives, and water quality requirements. The recommendations may also be useful guides for reduction of grazing impacts on other resources in addition to reduction of nonpoint source pollution.

BACKGROUND

Improper livestock management, through excessive grazing and trampling, can affect riparian-stream habitats by reducing or eliminating riparian vegetation, causing channel aggradation or degradation, causing widening or incisement of stream channels, changing streambank morphology, and as an accumulative result often lowering surrounding water tables (Platts 1986). Once a riparian-grazing problem has been identified, the possible solutions depend upon the following (Skovlin 1984): How depleted is the riparian and aquatic habitat? How critical is the habitat for riparian-dependent resources such as water quality, fisheries, or recreation, and does the habitat contain any threatened or endangered species? What is the timetable goal for restoration? And what level of restoration is acceptable for reinstituting grazing?

A six-step planning process for grazing riparian zones has been suggested (in part from Dwyer and others 1984): (1) determine what factor, such as bank instability or loss of woody plants, is of primary concern, (2) determine site potential and capability, (3) determine the suitability of the affected sites for livestock grazing, (4) determine the kind and class of livestock and duration and intensity of livestock grazing best suited to the area, (5) determine the best grazing strategy, and (6) apply the proper grazing intensity in keeping with animal distribution patterns.

Livestock Grazing

Interest is high concerning livestock grazing, particularly cattle grazing, on riparian habitats. Grazing systems typically used for riparian areas are similar to those developed to maintain or improve conditions of upland vegetation types. However, no grazing system has been devised for ensuring proper use of small riparian meadows within extensive upland range. In addition, the most recent information on grazing uplands suggests that although conventional grazing systems have great intuitive appeal, they are less effective at maintaining ecological quality and livestock production than previously thought (see appendix I).

The most obvious benefit of a grazing system is to help provide the necessary livestock control to do a good management job. **The level of utilization occurring on a site—including riparian areas—is the most important consideration.** In fact, most riparian grazing results suggest that the specific grazing system used is not of dominant importance, but good management is—with control of use in the riparian area a key item (see appendix II). Specially designed grazing systems that control degree and timing of use in the riparian area can be highly beneficial.

Another item of importance is season of use. Spring grazing of riparian areas has several advantages (see appendix II). Grazing early usually results in a better distribution of use between the riparian area and adjacent uplands. This is likely due to more similarity in vegetation succulence between riparian and upland areas than would be the case later in the season, cooler temperatures in the early season, and in some cases livestock may avoid streamside areas that are often wet in the spring. Early grazing, followed by complete livestock removal, allows riparian plant regrowth to occur before the dormant period in the fall. Fall grazing is a second choice in most areas but is probably acceptable if utilization levels are carefully controlled to leave protective vegetation cover for the following winter-spring high streamflow periods. Grazing riparian areas during the summer should be limited or carefully controlled because of the strong tendency of cattle to concentrate there in the hot and often dry months.

Managers of rangelands are accustomed to giving primary consideration to plant physiological vigor. **However, a major additional need in most riparian areas is to consider the requirements of other riparian-dependent resources including maintenance of streambank structure and channel form—key factors in fisheries habitat and hydrologic function.** Careful control of grazing pressure results in maintenance of the streambank vegetation and limitation of trampling, hoof slide, and accelerated streambank cave-in (see appendix II). Residual streamside vegetation biomass encourages trapping and deposition of sediments as a basis for maintaining or rebuilding streambanks. Concentrated livestock use, as often occurs in uncontrolled season-long continuous and certain rotational grazing systems, may cause unacceptable damage to woody plants and streambank morphology.

Recent On-the-Ground Experience

In a recent inventory of almost 250 miles of National Forest riparian areas, no single grazing strategy was found to be effective in every riparian situation (USDA FS 1987). However, a few key points seemed to be important. Grazing conflicts with riparian-dependent resources were usually not severe in type A stream channels or in most type B stream channels (stream types identified by Rosgen 1985). Generally, these stream channels are in narrow valleys occupied by woody species and are armored by rocks providing resistance to erosion and trampling damage. The greatest conflicts occurred in type B channels with medium- to fine-textured, easily eroded soil materials and most type C channels. The latter channel types are typically associated with meadow complexes that are attractive to livestock and are often important fishery habitats. In these channel types a vigorous plant community is important for protecting streambanks against erosive forces and for trapping sediments (Swanson 1989).

Riparian areas associated with medium- to fine-textured B channels and most C channels were generally: (1) in a late seral status if they were only grazed in the spring or, if grazed in the fall, the fall grazing was light and late in the season; (2) in a mid seral status where summer grazing was light; and (3) in a late or improving seral status with vigorous riparian species and stable streambanks after receiving complete rest for several years (see appendix III for description of seral status). Reduction of shrubs in the riparian plant community appeared to be due to grazing of young reproduction age classes rather than due to the mechanical damage to the older shrub age classes by rubbing and bedding.

GRAZING MANAGEMENT RECOMMENDATIONS

Once it has been determined that livestock grazing can and should continue on a particular riparian area, management practices in any grazing system must provide for regrowth of riparian plants after use, or should leave sufficient vegetation at the time of grazing for maintenance of plant vigor and streambank protection. To achieve this **it is recommended that a minimum herbage stubble height be present on all streamside areas at the end of the growing season, or at the end of the grazing season if grazing occurs after frost in the fall. The residual stubble or regrowth should be at least 4 to 6 inches in height to provide sufficient herbaceous forage biomass to meet the requirements of plant vigor maintenance, bank protection, and sediment entrapment.** Also, for pastures grazed in the fall, the retention of this standing crop of herbaceous forage will normally detour significant feeding on willows and most other riparian woody plants (see appendix II). The stubble height criterion should be adhered to regardless of the grazing system used. To help achieve this goal:

1. On most National Forest pastures grazed in spring only, utilization of streamside herbaceous forage should be limited to about 65 percent of the current growth, and livestock should normally be removed by July 15 to allow sufficient time for plant regrowth. On lower elevation National Forest pastures the appropriate spring removal date may be substantially earlier.

2. Streamside utilization of herbaceous forage in summer-grazed pastures should not exceed 40 to 50 percent of the current growth.

3. Fall use of streamside vegetation should not exceed about 30 percent, and the herbaceous stubble remaining at the end of the grazing period should meet the 4- to 6-inch criterion.

4. Season-long grazing should be limited to those situations where animal use and distribution can be carefully controlled, such as by the use of riparian or other special use pastures, and where the stubble height requirements can be met.

5. Special situations such as critical fisheries habitats or easily eroded streambanks may require stubble heights of greater than 6 inches.

The utilization guides for these recommendations are based on use in pastures in good to high ecological status and on information in appendix II.

Degraded riparian areas may require complete rest to initiate the recovery process. In systems requiring long-term rest, the rest period will be highly variable

depending upon the situation. It may be as short as 1 year or it may be 15 years or longer. Recovery of degraded streambank form usually will require more time than the recovery of plant community composition, in some cases much more time, particularly if the channel has become incised and confined. Once an area has improved to a mid or late seral status through the use of rest or careful management, rotation management systems may allow riparian habitats to remain in good condition while being grazed. However, no rotation system will allow recovery or maintenance of the riparian system unless all livestock are removed after the use period. In any event, rest-rotation or any other conventional grazing system should not be considered the sole answer to riparian grazing needs.

Riparian area managers must have a commitment to do whatever is necessary to control livestock use and distribution. A wide variety of management techniques are available to do this including establishment of special use riparian pastures, development of alternate water sources away from riparian areas, location of stock driveways outside of these areas, periodic herding of livestock away from the areas, salting outside of riparian areas, and other common range management practices that may help reduce concentration of livestock. Whatever approach or approaches are used will likely be successful if use rates are carefully controlled and, if possible, grazing is avoided during mid and late summer.

The practices described in this section should provide for plant and streambank requirements under most grazing situations. The specific management approach used to meet the recommendations will need to be determined on a site-specific basis. Physical factors such as stream type, geology, climate, and elevation greatly influence the recovery of riparian areas. Therefore, the specific management action must be tailored to fit local conditions.

Monitoring should be an integral part of any management change designed to improve riparian habitats. When recovery does not occur or is progressing too slowly, further changes in management practices are warranted.

SUGGESTED INITIAL ACTIONS

Ecological Status - Early Seral

1. "A" and most "B" channel types (inherently stable types):

   Apply rest or the recommended riparian grazing management practices until the ecological status improves.

2. "B" channel types with medium to fine easily eroded soil materials and most "C" channel types:

   Apply rest until the ecological status improves.

Ecological Status - Mid Seral

1. "A" and most "B" channel types (inherently stable types):

   Continue present management or apply the recommended riparian grazing management practices.

2. "B" channel types with medium to fine easily eroded soil materials and most "C" channel types:

   Apply the recommended riparian grazing management practices.

Ecological Status - Late Seral

1. All types:

   Continue current management or apply the recommended riparian grazing management practices.

Environmentally Sensitive Areas

1. Streambanks subject to early season grazing damage:

   Where a combination of high soil moisture and fine soil texture results in streambanks susceptible to trampling damage, grazing may need to be delayed to a late season period. The herbaceous stubble height criterion would still apply.

2. Habitats where threatened, endangered, or sensitive species occur, or where streambanks/channels are highly erodible:

   The herbaceous stubble height criterion may need to be increased to greater than 6 inches. Under extreme conditions, the area may need permanent protection, or at a minimum, grazing may need to be removed for long periods.

REFERENCES

Blackburn, W. H.; Knight, R. W.; Wood, M. K. 1982. Impacts of grazing on watersheds. MP 1496. College Station, TX: Texas A & M University System, Texas Agricultural Experiment Station. 32 p.

Bohn, Carolyn. 1986. Biological importance of streambank stability. Rangelands. 8(2): 55-56.

Branson, Farrel A. 1985. Vegetation changes on western rangelands. Range Monograph 2. Denver: Society for Range Management. 76 p.

Bryant, Larry D. 1985. Livestock management in the riparian ecosystem. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David R.; Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses: first North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 285-289.

Bryant, Larry D. 1988. [Personal communication.] LaGrande, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Forestry and Range Sciences Laboratory.

Clary, Warren P. 1987a. Herbage production and livestock grazing on pinyon-juniper woodlands. In: Everett, Richard L., compiler. Proceedings—pinyon-juniper conference; 1986 January 13-16; Reno, NV. Gen. Tech. Rep. INT-215. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 440-447.

Clary, Warren P. 1987b. Livestock effects on riparian vegetation and adjoining streambanks. Study plan on file at: Forestry Sciences Laboratory, Intermountain Research Station, Forest Service, U.S. Department of Agriculture, Boise, ID. 26 p.

Clary, Warren P. 1988. Data on file at: Forestry Sciences Laboratory, Intermountain Research Station, Forest Service, U.S. Department of Agriculture, Boise, ID.

Crouse, Michael R. 1987. New approaches to riparian area management on public lands. In: Wetland and riparian ecosystems of the American West: Proceedings of the Society of Wetland Scientists' eighth annual meeting; 1987 May 26-29; Seattle, WA: 32-35.

Dwyer, Donald D.; Buckhouse, John C.; Huey, William S. 1984. Impacts of grazing intensity and specialized grazing systems on the use and value of rangeland: summary and recommendations. In: Developing strategies for rangeland management. Boulder, CO: Westview Press: 867-884.

Eckert, Richard E., Jr.; Spencer, John S. 1986. Vegetation response on allotments grazed under rest-rotation management. Journal of Range Management. 39(2): 166-174.

Eckert, Richard E., Jr.; Spencer, John S. 1987. Growth and reproduction of grasses heavily grazed under rest-rotation management. Journal of Range Management. 40(2): 156-159.

Elmore, Wayne. 1988. Stream processes and grazing strategies. Presentation at: Riparian management workshop: challenges and opportunities; 1988 May 3; Elko, NV: Nevada Cooperative Extension.

Elmore, Wayne; Beschta, Robert L. 1987. Riparian areas: perceptions in management. Rangelands 9(6): 260-265.

Federal Register. 1975. EPA amends policies and procedures for State continuing planning process. Federal Register 40(230): 55338.

Gillen, R. L.; Krueger, W. C.; Miller, R. F. 1985. Cattle use of riparian meadows in the Blue Mountains of northeastern Oregon. Journal of Range Management. 38(3): 205-209.

Goodman, Tim; Donart, Gary B.; Kiesling, Herman E.; Holcheck, Jerry L.; Neel, James P.; Manzanares, Daniel; Severson, Kieth E. 1989. Cattle behavior with emphasis on time and activity allocations between upland and riparian habitats. In: Gresswell, Robert E.; Barton, Bruce A.; Kershner, Jeffery L., eds. Practical approaches to riparian resource management: an educational workshop; 1989 May 8-11; Billings, MT. Billings, MT: U.S. Department of the Interior, Bureau of Land Management: 95-102.

Green, Douglas. 1989. [Personal communication]. Corvallis, OR: Oregon State University, Department of Rangeland Resources.

Heady, Harold F. 1970. Grazing systems: terms and definitions. Journal of Range Management. 23(1): 59-61.

Heady, Harold F. 1984. Concepts and principles underlying grazing systems. In: Developing strategies for rangeland management. Boulder, CO: Westview Press: 885-902.

Hormay, A. L.; Evanko, A. B. 1958. Rest-rotation grazing—a management system for bunchgrass ranges. Misc. Paper 27. Berkeley, CA: U.S. Department of Agriculture, Forest Service, California Forest and Range Experiment Station. 11 p.

Kauffman, J. Boone; Krueger, William C.; Vavra, Martin. 1982. Impacts of a late season grazing scheme on nongame wildlife in Wallowa Mountain riparian ecosystem. In: Peek, James M.; Dalke, P. D., eds. Wildlife-livestock relationships symposium: Proceedings 10; 1981 April 20-22; Coeur d'Alene, ID. Moscow, ID: University of Idaho, Forest, Wildlife and Range Experiment Station: 208-220.

Kauffman, J. Boone; Krueger, W. C.; Vavra, M. 1983. Effects of late season cattle grazing on riparian plant communities. Journal of Range Management. 36(6): 685-691.

Kauffman, J. Boone; Krueger, W. C. 1984. Livestock impacts on riparian ecosystems and streamside management implications—a review. Journal of Range Management. 37(5): 430-438.

Kinch, Gene. 1987. Riparian area management. Draft technical reference on grazing management in riparian areas. Denver, CO: U.S. Department of the Interior, Bureau of Land Management. 47 p.

Knopf, Fritz L.; Cannon, Richard W. 1982. Structural resilience of a willow riparian community to changes in grazing practices. In: Peek, James M.; Dalke, P. D., eds. Wildlife-livestock relationships symposium: Proceedings 10; 1981 April 20-22; Coeur d'Alene, ID. Moscow, ID: University of Idaho, Forest, Wildlife and Range Experiment Station: 198-207.

Kothmann, Mort M. 1984. "Concepts and principles underlying grazing systems": a discussant paper. In: Developing strategies for rangeland management. Boulder, CO: Westview Press: 903-916.

Kovalchik, Bernard L. 1987. Riparian zone associations: Deschutes, Ochoco, Fremont, and Winema National Forests. Region 6 Ecol. Tech. Pap. 279-87. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 171 p.

Krueger, William C. 1989. [Personal communication]. Corvallis, OR: Oregon State University, Department of Rangeland Resources.

Laycock, W. A.; Conrad, P. W. 1981. Responses of vegetation and cattle to various systems of grazing on seeded and native mountain rangelands in eastern Utah. Journal of Range Management. 34(1): 52-58.

Marlow, Clayton B.; Olson-Rutz, Kathrin; Atchley, Jennifer. 1989. Response of a southwest Montana riparian system to four grazing management alternatives. In: Gresswell, Robert E.; Barton, Bruce A.; Kershner, Jeffery L., eds. Practical approaches to riparian resource management: an educational workshop; 1989 May 8-11; Billings, MT. Billings, MT: U.S. Department of the Interior, Bureau of Land Management: 111-116.

Marlow, Clayton B.; Pogacnik, Thomas M.; Quinsey, Shannon D. 1987. Streambank stability and cattle grazing in southwestern Montana. Journal of Soil and Water Conservation. 42(4): 291-296.

Meehan, William R.; Platts, William S. 1978. Livestock grazing and the aquatic environment. Journal of Soil and Water Conservation. 33(6): 274-278.

Myers, Lewis H. 1981. Grazing management vs. riparian management in southwestern Montana. Abstracts 34th Annual Meeting, Society for Range Management; Tulsa, OK. Denver, CO: Society for Range Management: 30.

Myers, Lewis H. 1989. Grazing and riparian management in southwestern Montana. In: Gresswell, Robert E.; Barton, Bruce A.; Kershner, Jeffery L., eds. Practical approaches to riparian resource management: an educational workshop; 1989 May 8-11; Billings, MT. Billings, MT: U.S. Department of the Interior, Bureau of Land Management: 117-120.

Pieper, R. D.; Heitschmidt, R. K. 1988. Is short-duration grazing the answer? Journal of Soil and Water Conservation. 43(2): 133-137.

Platts, William S. 1982. Sheep and cattle grazing strategies on riparian-stream environments. In: Peek, James M.; Dalke, P. D., eds. Wildlife-livestock relationships symposium: Proceedings 10; 1981 April 20-22; Coeur d'Alene, ID. Moscow, ID: University of Idaho, Forest, Wildlife and Range Experiment Station: 251-270.

Platts, William S. 1983. Those vital streambanks. Western Wildlands. 3(9): 7-10.

Platts, William S. 1986. Riparian-stream management. In: National range conference proceedings; 1985 November 6-8; Oklahoma City, OK. Washington, DC: U.S. Department of Agriculture: 70-74.

Platts, William S. 1989. Compatibility of livestock grazing strategies with fisheries. In: Gresswell, Robert E.; Barton, Bruce A.; Kershner, Jeffery L., eds. Practical approaches to riparian resource management: an educational workshop; 1989 May 8-11; Billings, MT. Billings, MT: U.S. Department of the Interior, Bureau of Land Management: 103-110.

Platts, William S.; Nelson, Rodger Loren. 1985. Impacts of rest-rotation grazing on stream banks in forested watersheds in Idaho. North American Journal of Fisheries Management. 5: 547-556.

Platts, William S.; Raleigh, Robert F. 1984. Impacts of grazing on wetlands and riparian habitat. In: Developing strategies for rangeland management. Boulder, CO: Westview Press: 1105-1117.

Pond, Floyd W. 1961. Effect of three intensities of clipping on the density and production of meadow vegetation. Journal of Range Management. 14(1): 34-38.

Range Term Glossary Committee. 1974. A glossary of terms used in range management. 2d ed. Denver, CO: Society for Range Management. 36 p.

Range Inventory Standardization Committee. 1983. Guidelines and terminology for range inventories and monitoring: report of the Range Inventory Standardization Committee. Denver, CO: Society for Range Management. 13 p.

Ratliff, Raymond D.; George, Melvin R.; McDougald, Neil K. 1987. Managing livestock grazing on meadows of California's Sierra Nevada: a manager-user guide. Leaflet 21421. Berkeley, CA: University of California Division of Agriculture and National Resources Cooperative Extension. 9 p.

Rosgen, David L. 1985. A stream classification system. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David R.; Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses: first North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 91-95.

Shaw, Nancy. 1988. Natural regeneration of willows and cottonwoods. Preliminary report on file at: Forestry Sciences Laboratory, Intermountain Research Station, Forest Service, U.S. Department of Agriculture, Boise, ID. 3 p.

Siekert, Ronald E.; Skinner, Q. D.; Smith, M. A.; Dodd, J. L.; Rodgers, J. D. 1985. Channel response of an ephemeral stream in Wyoming to selected grazing treatments. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David R.; Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses: first North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 276-278.

Skovlin, Jon M. 1984. Impacts of grazing on wetlands and riparian habitat: a review of our knowledge. In: Developing strategies for rangeland management. Boulder, CO: Westview Press: 1001-1103.

Storch, Robert L. 1979. Livestock/streamside management programs in eastern Oregon. In: Proceedings of the forum—grazing and riparian/stream ecosystems. Denver, CO: Trout Unlimited: 56-59.

Swanson, Sherman. 1989. [Personal communication]. Reno, NV: University of Nevada-Reno, Department of Range, Wildlife and Forestry.

Trlica, M. J., Jr. 1977. Effects of frequency and intensity of defoliation on primary producers of arid and semi-arid rangelands: Proceedings second U.S./Australia Rangeland Panel; Adelaide, South Australia. Perth, Western Australia: 27-56.

U.S. Department of Agriculture, Forest Service. 1987. Data on file at: Sawtooth National Forest, Twin Falls, ID.

Van Poollen, H. Walt; Lacey, John R. 1979. Herbage response to grazing systems and stocking intensities. Journal of Range Management. 32(4): 250-253.

Volland, Leonard A. 1978. Trends in standing crop and species composition of a rested Kentucky bluegrass meadow over an 11-year period. In: Hyder, Donald N., ed. Proceedings of the first international rangeland congress; 1978 August 14-18; Denver, CO. Denver, CO: Society for Range Management: 526-529.

Winward, A. H. 1989. Ecological status of vegetation as a base for multiple-product management. Abstracts 42nd Annual Meeting, Society for Range Management; Billings, MT. Denver, CO: Society for Range Management: 277.

APPENDIX I: GENERAL REVIEW OF GRAZING SYSTEMS

The sensitivity to grazing of many Western native forage plants was recognized in the early 1900's, but realization of the significance of this developed slowly, and serious application of known information lagged. For 30 years grazing systems have been advocated by public land management agencies for use on Western ranges in the hope of achieving better livestock distribution, greater herbage and livestock production, and improved range condition. Grazing systems, which combine periods of use and nonuse, were originally proposed to improve ranges that had deteriorated under improper grazing (Hormay and Evanko 1958). A grazing system is defined as "A specialization of grazing management which defines systematically recurring periods of grazing and deferment for two or more pastures or management units" (Range Term Glossary Committee 1974). Deferred-rotation, rest-rotation, high intensity-low frequency, and short duration are forms of grazing systems (Kothmann 1984).

Past reviews of grazing systems have pointed out, first, that grazing systems were originally proposed as a means to improve deteriorated ranges through judicious use of seasonal grazing and periods without grazing. Second, more emphasis is being given to grazing systems as means to increase animal productivity. Third, grazing systems facilitate application of other range improvement practices such as fencing, water development, brush control, and seeding. The review papers point out, however, that (1) every grazing system has shown a wide variation in attaining improvement in range condition, (2) livestock productivity has varied from significant increases to significant decreases when systems were compared, (3) differences in results have been inconsistent and unexplained, (4) grazing systems that do well on one kind of rangeland may not work at all in another region, and (5) few analyses of the cost effectiveness of grazing systems have been made (Heady 1984). The one certainty is that there is no single grazing system that will improve rangeland everywhere (Dwyer and others 1984).

The success of grazing systems depends in part upon managerial control of time, place, and degree of forage utilization. The new fencing and additional livestock watering points that are required to initiate a grazing system also result in smaller pastures, better distribution of animals, and hence more even use of the forage plants across the pasture. Movement of animals from one pasture to another gives the manager some control over severity and timing of use (Heady 1984). These systems with additional pastures and movement of livestock often provide incentive and opportunity for vegetational manipulations such as brush control, seeding, and pitting, which can result in improved range condition and livestock production. Confusion occurs when results are ascribed to the grazing system when in fact they are due to the whole range management program (Heady 1970). Laycock and Conrad (1981) provided a case in point. Their study compared native sagebrush-grass range summer-long grazing every year, summer-long every other year, and a three-unit rest rotation system. Plant cover, production, and composition, and average daily gains of cattle were similar after 7 years of study. The key to this result was that each system had adequate fencing, good distribution of water and salt, and adequate riding to ensure uniform cattle distribution. In other words good range management was practiced regardless of the grazing system. Unfortunately, results of whole range management programs have often been attributed to grazing systems alone (Heady 1970).

Numerous hydrologic studies have upheld the conclusions of Blackburn and others (1982), who stated that little information supports claims for grazing systems. In a review of recent studies, Pieper and Hietschmidt (1988) found no results to suggest that the application of short-duration grazing has a different effect on hydrologic performance and soil characteristics than does any other grazing system. They concluded that heavy stocking would result in long-term downward trend in hydrologic characteristics and that vegetation growth response in a short-duration grazing system is similar to that expected from any other grazing system. There was no consistent advantage for individual livestock gains under short-duration grazing on arid and semiarid rangeland. The authors concluded that much of the success attributed to short-duration grazing is not directly attributable to that system but rather to improved overall management. They suggested that stocking rate is and always will be the major factor affecting the degradation of rangeland resources. No grazing system can counteract the negative impacts of overstocking on a long-term basis.

Generally, defoliation reduces the capacity of a plant to grow. A corresponding reduction in production usually occurs as either the frequency or intensity of defoliation increases (Trlica 1977). Vegetation appears to be more affected by grazing intensity than by grazing systems. Van Poollen and Lacey (1979) reviewed 18 studies comparing continuous grazing and the implementation of grazing systems at a moderate rate of use, and they compared 14 studies on grazing intensities of light, moderate, and heavy rates. Their analysis showed a 13 percent increase in forage production in favor of grazing systems over continuous use. However, the herbage production response to reductions in grazing intensity was much greater. Reduction in level of use from heavy to moderate increased production 35 percent, while reducing use from moderate to light increased production 28 percent. This value is in line with a review of herbage production that showed grazed areas usually produced less than 800 lb per acre, while ungrazed areas often exceeded 1,200 lb per acre (Clary 1987a). Such results suggest that managers should place more emphasis on proper stocking intensity and less on grazing system implementation (Van Poollen and Lacey 1979). The concentrated use of grazed pastures is not compensated for during rest years if grazing use is heavy (Eckert and Spencer 1986, 1987).

In summary, although grazing systems have great intuitive appeal, they are apparently of less consequence than once thought. In fact, as long as good management is practiced so that there is control of livestock distribution and grazing intensity, the specific grazing system employed may not be significant.

APPENDIX II: CURRENT INFORMATION ON GRAZING RIPARIAN AREAS

Although some riparian areas are resistant to damage from grazing livestock, others are vulnerable. If damage occurs it usually includes reduction or elimination of riparian vegetation, modifying streambank and channel morphology, increasing stream channel width or incisement, increasing stream sediment transport, and lowering surrounding water tables. Few examples exist of careful grazing system study within riparian areas. Numerous case history studies and experience of a variety of people suggest that no specific grazing system has proven universally successful.

Grazing Effects

Documentation shows that cattle, given the opportunity, will spend a disproportionate amount of time in a riparian area as compared to adjacent xeric upland areas. This may be five to 30 times higher than expected based on the extent of the riparian area. Features that contribute to higher use levels in riparian areas are: (1) higher forage volume and relative palatability in the riparian area as opposed to the uplands, (2) distance to water, (3) distance upslope to upland grazing sites, and (4) microclimatic features (Skovlin 1984).

Although many of the riparian-fisheries-grazing studies have been deficient in design, measurement, or documentation (Platts and Raleigh 1984), a great deal of case history and observational information has been accumulated. Concerning grazing impacts on riparian areas, four components were most often studied: (1) fish habitat in the aquatic system, (2) woody vegetation components of the riparian area relating to fish and bird habitat, (3) herbaceous utilization and grazing levels that can influence yields of plants, small mammals, and invertebrates, and (4) watershed conditions of cover and soil compaction on the floodplain and runoff from upland range (Skovlin 1984).

Platts and Raleigh (1984) summarized direct effects of livestock grazing:

1. Higher stream temperatures from lack of sufficient woody streamside cover.
2. Excessive sediment in the channel from bank and upland erosion.
3. High coliform bacteria counts from upper watershed sources.
4. Channel widening from hoof-caused bank sloughing and later erosion by water.
5. Change in the form of the water column and the channel it flows in.
6. Change, reduction, or elimination of vegetation.
7. Elimination of riparian areas by channel degradation and lowering of the water table.
8. Gradual stream channel trenching or braiding depending on soils and substrate composition with concurrent replacement of riparian vegetation with more xeric plant species.

Kauffman and Krueger (1984), in an extensive review of livestock impacts on riparian ecosystems, documented many factors interrelated with grazing effects, primarily dealing with instream ecology, terrestrial wildlife, and riparian vegetation. However, as with many others, the authors were not able to find much information other than that abusive grazing practices are damaging to many features of riparian ecosystems. Little information is available on how well-managed grazing affects riparian-stream systems. Criticisms of conventional grazing systems such as rest-rotation typically contain no information on actual grazing intensity or degree of plant utilization (Meehan and Platts 1978; Storch 1979).

Permanent removal of grazing will not guarantee maximum herbaceous plant production. Volland (1978) found that a protected Kentucky bluegrass meadow reached peak production in 6 years and then declined until production was similar to the adjacent area grazed season-long. Similar results were reported by Bryant (1988) and Green (1989) in northeastern Oregon. The accumulation of litter over a period of years seems to retard herbage production in wet meadow areas. Thus, some grazing of riparian areas could have beneficial effects. This is a response similar to that documented by Branson (1985).

Resistance of common riparian woody plants to defoliation has not been investigated. However, genera commonly represented in riparian areas such as dogwood, maple, cottonwood, willow, and birch appear to be more resistant to foliage and twig removal than genera common to xeric uplands. Light to moderate grazing generally appears to have little adverse effect and in some cases may stimulate growth (Skovlin 1984). Severe overgrazing almost invariably is detrimental to willow communities (Kauffman and Krueger 1984). Knopf and Cannon (1982) reported that cattle altered the structure of a high-altitude willow community by changing the size, shape, volume, and quantity of live and dead stems per bush, and the spacing of plants. They concluded that 10 to 12 years was not sufficient time for a riparian willow community to recover from a history of excessive grazing. Alternatively, Skovlin (1984) reported that reestablishment of acceptable wildlife habitat often occurred about 5 years after release of remnant shrubs from heavy grazing. Little information is available on how careful grazing affects willow communities except for observations that leaving a residual herbaceous stubble of about 4 inches usually results in little or no use of willows (see "Utilization" section in this appendix).

While Skovlin (1984) suggested that vegetation recovery after release from excessive grazing generally can occur within 5 to 15 years, Platts and Raleigh (1984) pointed out that impacts on fishery environments go far beyond the riparian vegetation. Channel and bank morphology, instream cover, and water flow regimens are important factors. Little is known about the recovery time for these factors in different environments. Skovlin suggested that sediment delivery to the stream was the most detrimental impact of trampling to fisheries. Platts and Raleigh, however, pointed out that the retention of bank morphology and stability are probably more important. The maintenance of streambank structure and function is a key item

in riparian-stream habitats from both fisheries and hydrologic standpoints (Bohn 1986; Platts 1983).

Vegetation plays a dominant role not only in the erosional stability of streambanks but also in the rebuilding of degraded streambanks. Streamside vegetation serves as a natural trap to retain sediments during high flows. These sediments form the physical basis for new bank structure (Elmore and Beschta 1987).

Grazing Systems

An evaluation of the effects of rest-rotation grazing on streambanks was conducted on forested watersheds in Idaho (Platts and Nelson 1985). Forage in the streamside zone was used at a higher rate than on either immediately adjacent range or the grazing allotment. Relative use of streamside vegetation was less during the early grazing period than during the late grazing period. Small treatment pastures experienced 11 percent higher average use of streamside vegetation with late grazing than with early grazing. This was suggested to be the result of "a general tendency for cattle to avoid certain streamside zones early in the season when the soils and vegetation may be wet" (Platts and Nelson 1985). Also, the vegetation on adjacent rangeland was more succulent during the early growing season.

Platts (1989) provided an evaluation of several livestock grazing systems based on his own observations. He identified, described, and evaluated 17 grazing "strategies" on a scale of 1 to 10. All strategies that were described as having use levels of heavy or heavy to moderate were rated on the lower half of the scale (1 to 5). Those strategies that incorporated moderate or moderate to light use rated in the mid-upper portion of the scale (6 to 8). Those management strategies that featured light or no use were rated at the top of the scale (9 to 10). Although the strategies, use levels, and ratings described above are largely qualitative in nature, they do provide support for the opinions of several other authors (Van Poollen and Lacey 1979; Skovlin 1984) in that use levels seem to be the most important factor in a grazing situation.

In a test of different grazing systems at Meadow Creek, Starkey Experimental Forest and Range, deferred-rotation, rest-rotation, and season-long grazing all resulted in increases in production of floodplain herbage when utilization at the end of the grazing period was 70 percent or less. Likewise, each of these grazing systems produced almost twice as much herbage as ungrazed plots after 6 years (Bryant 1985). Bryant (1988) concluded that probably any grazing system, even season-long, would be acceptable for floodplains if use was controlled. However, Bryant made no grazing study of the streamside vegetation.

Other studies have also shown little net benefit from specific grazing approaches. Gillen and other (1985) showed that the same residual standing crop of herbage was present on dry meadows under both continuous and deferred-rotation grazing systems. Marlow and others (1989) found little difference in streambank stability among four grazing strategies studied during three drought years. Platts and Raleigh (1984) quoted Myers' (1981) results as showing no correlation between riparian condition and type of grazing system used. The grazing intensity was an important factor in the resulting riparian condition but not as important as amount of vegetation used during the hot season of the year. Vegetation did not respond when defoliated during that period.

As more studies of grazing systems are completed, it appears that the complex array of factors in rangelands tends to buffer the theoretical benefits of many systems. This has been true in a number of comparisons of upland grazing, and experience in riparian areas has generally failed to show an advantage to any specific grazing system.

Utilization

Few guidelines are available on what the allowable use of riparian plant communities should be to maintain ecosystem integrity. Allowable use could be described in terms of percentage of weight removed, residual biomass, or residual stubble height. Ratliff and others (1987) suggested that for site protection the herbage remaining after grazing should equal the proportion of production that decomposes annually. This translated into utilization rates of 35 to 45 percent on excellent-condition meadows down to 20 to 30 percent on poor-condition meadows. Platts (1982) suggested that rest-rotation grazing with 65 percent use or higher resulted in altered riparian habitat conditions while 25 percent use or less had little effect. Based on studies at Meadow Creek, Bryant (1985, 1988) thought that use of floodplain herbage could be up to 70 percent regardless of grazing system if about 3 inches of forage stubble height remained. Similar opinions on stubble height were given by Krueger (1989). Kauffman and others (1983) report observations by F. C. Hall that a shift to shrub use does not generally occur (except in the case of highly palatable shrubs) if 4 inches of herbaceous stubble remains. Elmore (1988) suggested that 3 to 4 inches of stubble height would maintain plant vigor, provide streambank protection, and aid deposition of sediments to rebuild degraded streambanks. Elmore also suggested that in some situations the use on willows begins when use on herbaceous plants reaches about 45 percent. An evaluation of 34 grazing systems in place for 10 to 20 years showed the importance of providing residual vegetation cover (Myers 1989). Vigorous woody plant growth and at least 6 inches of residual herbaceous plant height at the end of the growing/grazing season typified the riparian areas in excellent, good, or rapidly improving condition. This residual plant cover appeared to provide adequate streambank protection and sediment entrapment during high streamflow periods.

An approximate relationship between percentage utilization and stubble height of riparian graminoids was developed based on 1988 data from the Stanley Creek (mountain meadow ecosystem) and Pole Creek (sagebrush ecosystem) studies (Clary 1987b). The data suggest that

average utilization levels of 24 to 32 percent were obtained when riparian graminoids were grazed to a 6-inch stubble height, that average use levels of 37 to 44 percent were obtained when grazing to a 4-inch stubble height, and that average use levels of 47 to 51 percent were obtained when grazing to a 3-inch stubble height (Clary 1988). This relationship shows some continuity between recommendations of 40 to 50 percent utilization and recommendations of leaving 3 to 4 inches of residual stubble height for maintenance of plant vigor. However, additional stubble height, such as 6 inches or more, may be necessary to protect riparian ecosystem function (Myers 1989).

Season of Use

Seasonal distribution of use often varies from heavy riparian area use in the summer to little riparian area use in winter (Goodman and others 1989). Myers (1989) reported that livestock are much less likely to disperse across a large grazing unit during the hot portion of the growing season than in the spring, particularly if the upland vegetation has ceased growth. The resulting summer concentration of use in the riparian zone becomes a key factor in severity of trampling and mechanical damage, soil compaction, and plant utilization.

Kauffman and others (1982) suggested late-season grazing for riparian zones on the basis of livestock production, maintenance of plant vigor and production, and minimum disturbance of wildlife populations. Clipping studies by Pond (1961) showed a similar response by the plant community. Results in southwestern Montana suggested that streambanks were most stable when grazed in late summer (Marlow and others 1987). Others, however, feel that fall grazing is not necessarily the optimum on many sites (Kinch 1987). A fall-grazed plant community, particularly a heavily grazed plant community, has a reduced ability to protect existing banks and to trap new sediments as part of the streambank building process. Although late season grazing may be a good approach from the standpoint of some plant communities and some terrestrial wildlife situations, spring grazing may be preferred in many situations to maintain proper streambank structure and function (Elmore and Beschta 1987).

A promising approach is to graze riparian areas in the spring, then remove all livestock and allow forage plants to regrow for the remainder of the season. This should provide vegetation cover for streambank protection during the following winter and early spring high streamflow periods. Several of the riparian grazing examples given by Elmore (1988) showed substantial improvements when grazed in spring only. Crouse (1987) reported beneficial results from spring grazing. Platts and Nelson (1985) recorded less severe use of streambanks in the spring than occurred in the fall relative to the surrounding uplands. Cattle use was more evenly distributed in the spring and therefore not as concentrated in the riparian zone. In Wyoming, relatively intense short-term spring grazing appeared to have no adverse effect on channel morphology of an ephemeral stream, while changes did occur during summer grazing (Siekert and others 1985). Animal sightings in the riparian zone and use of riparian species in the spring were less than half those occurring later in the season. In Oregon cattle avoid many riparian areas until late summer because of wet soil conditions. Thus, little grazing occurs during spring-only grazing strategies (Kovalchic 1987).

In a mountain meadow on Stanley Creek in Idaho, grazing in late June and early July resulted in slightly less use of streamside areas than the adjacent dry meadows (Clary 1988). This apparently occurred in part because of level topography and because the succulence (moisture content) of the herbage was similar between streamside vegetation and adjacent "dry" meadows in early summer. A similar distribution of use between streamside vegetation and dry meadows occurred in the fall after heavy frosts had "browned off" all vegetation.

In a study on Pole Creek in eastern Oregon, the natural regeneration of willows, cottonwoods, and other woody riparian shrubs was monitored in the protected, moderate spring-grazed, moderate fall-grazed, and heavy season-long pastures (Shaw 1988). Although topographic variability among pastures and heavy year-around browsing by deer complicated evaluations, two trends seemed apparent after two growing seasons: (1) total seedling density of willows and cottonwoods in the heavy use season-long pastures was less than a fourth that of any other treatment, and (2) willow and cottonwood seedling densities were somewhat greater in the spring-grazed pastures than any of the other treatments.

APPENDIX III: CALCULATING ECOLOGICAL STATUS AND RESOURCE VALUE RATINGS IN RIPARIAN AREAS

A. H. Winward

Regional Ecologist, Intermountain Region, Forest Service, U.S. Department of Agriculture, Ogden, UT

Ecological Status

Ecological status is used to relate the degree of similarity between current vegetation and potential vegetation for a site. It can be measured on the basis of species composition within a particular community type or on the basis of community type composition within a riparian complex. The categories for ecological status include: early seral, mid seral, late seral, and potential natural community(ies) (PNC) based on the degree of similarity to the potential natural community. Similarity between the present vegetation and the PNC can be calculated by a coefficient of similarity ($2w/a+b$) where a is the sum of species values for measured factors of present vegetation, b is the sum of values in the PNC, and w is the sum of the values common to both (table 1) (Range Inventory Standardization Committee 1983).

Composition values for the species or PNC's must be obtained by sampling sites in as natural a condition as possible. If no representative undisturbed areas are available, extrapolation of composition from ecological settings approximating the PNC may be necessary. Only those species or community types known to be native to a particular ecological setting may be used for establishing PNC values. Tables 2 and 3 provide examples of several ecological status ratings in different riparian settings using community type composition values.

Table 1—Example of ecological status of vegetation using coefficient of community similarity on foliar cover data

Species	Potential natural community	Present community	Amount in common
	Percent		
Booth willow	65	30	30
Water sedge	5	2	2
Beaked sedge	85	35	35
Kentucky bluegrass	0	53	0
Solomon-seal	5	0	0
	a=160	b=120	w=67

Similarity to PNC	Ecological status
Percent	
0-25	Early seral
26-50	Mid seral
51-75	Late seral
76+	PNC

Therefore, similarity index of (2*67/160+120) = 48 percent or mid seral status

Table 2—Example of an ecological status rating in the mountain alder/dogwood-steep gradient riparian complex (Rosgen channel A) using community type composition values

Community type	Potential natural composition	Present composition	Amount in common
	Percent		
Alder/dogwood	65	50	50
Booth willow/dogwood	5	5	5
Booth willow/horsetail	5	5	5
Booth willow/bluejoint reedgrass	5	5	5
Booth willow/mesic grass	5	2	2
Wooly sedge	10	5	5
Winged sedge	5	0	0
Kentucky bluegrass/redtop	0	28	0
	a=100	b=100	w=72

Therefore, similarity index of (2*72/100+100) = 72 percent or late seral status

Table 3—Example of an ecological status rating in the Nebraska sedge-low gradient riparian complex (Rosgen channel D) using community type composition values

Community type	Potential natural composition	Present composition	Amount in common
	Percent		
Coyote willow/bar	3	1	1
Nebraska sedge	85	10	10
Water sedge	5	2	2
Baltic rush	2	20	2
Mesic forb	3	10	3
Silver sagebrush/hairgrass	2	2	2
Kentucky bluegrass/redtop	0	55	0
	a=100	*b*=100	*w*=20

Therefore, similarity index of (2*20/100+100) = 20 percent or early seral status

Table 4—Examples of a resource value ratings (RVR) in the Booth willow/beaked sedge-moderate gradient riparian type (Rosgen channel C) using community type composition values

Community type	Desired composition	Present composition		Amount in common	
		Area A	Area B	Area A	Area B
	Percent				
Booth willow/beaked sedge	20	16	3	16	3
Wolfs willow/hairgrass	5	3	1	3	1
Water sedge	7	2	1	2	1
Beaked sedge	60	50	8	50	8
Baltic rush	3	10	10	3	3
Kentucky bluegrass	0	5	47	0	0
Mesic forb	3	13	30	3	3
False-hellebore	2	1	0	1	0
	a=100	*b*=100	*b*=100	*w*=78	*w*=19

Similarity to desired *Percent*	Resource value rating (RVR)
0-25	Poor
26-50	Fair
51-75	Good
76+	Excellent

Therefore, area A similarity index of (2*78/100+100) = 78 percent or excellent.
Therefore, area B similarity index of (2*19/100+100) = 19 percent or poor.

Or, alternatively, using a similarity criterion of >75 percent:

Area A similarity index of 78 percent = meeting management objectives;
Area B similarity index of 19 percent = not meeting management objectives.

Additional factors such as ground cover, soil compaction, streambank breakage, or channel form may be used to refine ecological status. These values will likewise be based on percentage of similarity to values obtained in an undisturbed setting.

Resource Value Ratings

We often choose to manage vegetation for some seral stage other than PNC. In these cases, another approach used to evaluate status or condition of riparian areas is to compare the present species or community type composition of an area to a desired set of species or community types capable of occurring in that area (Winward 1989). On public lands, the "desired values" are developed by professionals in an interdisciplinary setting. Similarity values between "present" and "desired" are calculated using a process similar to that used in developing ecological status ratings. Categories for rating the site are poor, fair, good, and excellent as in past range condition ratings (table 4). Or, categories can be developed to determine whether the site is or is not meeting management objectives. Information from the Range Inventory Standardization Committee Report (1983) suggested that a value of 75 percent similarity or greater may be used to differentiate between meeting and not meeting management objectives.

Clary, Warren P.; Webster, Bert F. 1989. Managing grazing of riparian areas in the Intermountain Region. Gen. Tech. Rep. INT-263. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 11 p.

Concern about livestock grazing in riparian habitats and its effect upon riparian-dependent resources has resulted in numerous controversies about the appropriate management approach. This document provides guidance for grazing of riparian areas in a manner that should reduce both nonpoint source pollution and potential grazing impacts on other riparian-dependent resources.

KEYWORDS: nonpoint source pollution, utilization, stubble height, grazing systems, streambanks

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WWP Exhibit 16

Grazing and Riparian Management in Southwestern Montana

LEWIS H. MYERS

Bureau of Land Management
Dillon, Montana 59725 USA

Abstract.—A subjective analysis of riparian vegetation response in 34 grazing systems was completed. Most traditional grazing systems developed for uplands did not accommodate riparian recovery. Grazing systems that do not improve riparian vegetation must be documented to avoid their future misapplication. Common denominators to both poor and good riparian management are discussed and recommendations are provided.

The purpose of this paper is to document management observations on long-term livestock grazing management systems where stream riparian resources occur. As is typical of most management situations, data on riparian parameters are somewhat limited, consisting of permanently monumented photographic transects on woody species. Positive woody species response was interpreted as indicative of a successful grazing system. Select grazing system characteristics were compared on successful and unsuccessful systems. Though not a research endeavor, the author believes that management experience, combined with limited monitoring, has value both in providing potential grazing research topics and better insight for both managers and researchers in developing riparian grazing guidelines.

Study Area

The Dillon Resource Area of the Butte District, U. S. Bureau of Land Management, is located in southwestern Montana. Landform is largely foothill and mountain. Climate is typical semi-arid intermountain. Elevation varies from 1,585 to 3,350 m, with most grazing allotments ranging between 1,800 to 2,300 m.

Precipitation in study allotments ranges from 30 to 50 cm per year; however, precipitation in the mountain areas is much greater (120 cm or more). Peak precipitation occurs in May and June. The growing season is short, averaging about 90 d.

Temperatures range from -40° C in winter to 38° C in summer. Freezing temperatures occur as late as mid-June and as early as the first of September.

Most streams are first order through third order tributaries to the Red Rock, Big Hole, and Ruby rivers. Stream gradients are moderate (1-3%).

Upland vegetation is dominated by sagebrush steppe, foothills prairie, Douglas-fir forest, and western spruce-fir associations (Kuchler 1964).

The vegetative aspect of riparian communities is dominated by shrubs, including willows *Salix* spp., alder *Alnus sinuata*, birches *Betula* spp. and dogwood *Cornus stolonifera*. Aspen *Populus tremuloides*, cottonwoods *Populus angustifolia*, *P. trichocarpa*, and juniper *Juniperus scopulorum* occur on small portions of the streams. Riparian herbaceous communities are diverse, with a variety of sedges *Carex* spp., rushes *Juncus* spp., grasses Gramineae, and forbs.

Methods

Stream riparian vegetation response was evaluated on 34 grazing allotments which had grazing management systems of 10 to 20 years duration. Class of livestock was cow-calf pairs or yearling cattle.

Initial condition of stream riparian sites was established through inventories of deciduous woody species and their vigor, age-classes, and utilization using procedures described by Myers (1987). Woody species characteristics on comparison areas plus judgment were used in deriving riparian condition.

Trend in riparian vegetation response was assessed by recording the response of deciduous woody species on permanently established photographic transects using procedures described by Myers (1987). Emphasis was placed on interpretation of photo records duplicated over time. Twelve fenced livestock exclosures were also established in 1981 on a variety of riparian sites. Exclosure sites served as comparison area data sources with which to characterize vegetation recovery and to correlate woody species response with total plant community response.

On one allotment, regrowth and utilization of sedge species was assessed by measuring heights of all plants on paired, 1-m^2 plots, with one being ungrazed (caged) and the other being grazed.

Successful grazing systems were defined as those with good or excellent riparian condition or, if in fair condition, an upward trend and a high rate of woody riparian vegetation response was demonstrated in the photographic transects.

Successful and unsuccessful grazing systems were statistically compared using a two-tailed student's *t*-test for the following characteristics: (1) stocking rates, (2) average number of days provided for regrowth following grazing treatments, (3) average percentage of grazing treatments providing residual herbaceous cover through rest or sufficient regrowth, (4) average days duration of hot season grazing treatments, (5) average days duration of all grazing treatments, and (6) average days duration of fall grazing treatments.

Results

Of the 34 grazing systems evaluated, 25 (74%) were unsuccessful in accommodating a positive riparian vegetation response within a 10- to 20- year period. Upland areas (watersheds) did show positive responses on most of these systems.

Successful systems had lower average stocking rates (4.9 hectares/AUM) than unsuccessful systems (3.8 hectares/AUM) though the difference was not statistically significant. This 22% difference in stocking rate would not be expected to appreciably influence riparian vegetation response to a grazing system.

The success or failure of livestock grazing systems in providing for stream riparian site recovery is related to

Livestock Use Behavior in Riparian Areas

Livestock utilize riparian sites much more intensively than uplands (Skovlin 1984). Riparian areas provide water, shade, forage diversity, rubbing sites, and sources of succulent forage that uplands provide only seasonally or not at all. In southwestern Montana rangelands, riparian areas sustain almost all of the livestock use during July through early September. This period may be referred to as the hot season. Marlow (1985) documented similar cattle response on small, fenced research pastures in southwestern Montana. Bryant (1979) observed the opposite response in the Blue Mountains of Oregon, with heavy use of riparian areas early in the grazing season and dispersal to uplands slopes during late summer and fall.

Observations in the study allotments showed good dispersal of cattle and use of uplands during spring through early summer until upland forage plants became less succulent, approximately 1 July. Some dispersal of stock occurred in September in response to cooler temperatures and especially in response to precipitation and fall green-up. However, fall dispersal was not as significant as that of spring-early summer.

On the study area, successful grazing systems were found to have significantly ($P = 0.01$) less grazing during the "hot season" (12.5 d) than unsuccessful systems with 33.4 d (Table 2). Likewise, the duration of all livestock treatments was significantly ($P = 0.001$) shorter in successful systems (28.2 d) compared to 59.3 d in unsuccessful systems. Given the reluctance of cattle to disperse from riparian areas, the duration of grazing treatments becomes a key factor in determining the severity of impacts such as trampling and mechanical damage, soil compaction, and utilization. In a rest-rotation system Platts (1981) noted significant riparian habitat alterations at 65% utilization levels, but no detectable impacts at 25% utilization.

Utilization of deciduous woody species appeared to increase sharply as duration of grazing treatments increased, possibly in response to declining herbaceous forage availability. On one allotment with July and August grazing, utilization of willow species increased greatly after 36 d of use (Table 3). This documents the need to adjust the duration of grazing treatments based upon site-specific monitoring results. Each management pasture will likely differ, and a few days' difference in utilization could be significant.

Observations of cattle indicated that utilization of deciduous woody species increased about late August and remained heavy through the fall period. A similar observation was made in Oregon (Kinch 1987). Woody species dominate the aspect of study area streams and have critical roles in riparian site stability and productivity.

On the study area successful grazing systems were found to have significantly ($P = 0.10$) less grazing during the fall period (20.8 d) than did unsuccessful systems with 36.5 d (Table 2). Fall grazing treatments also occurred less frequently (31.3%) in successful systems than in unsuccessful systems (51.1%). A combination of longer duration and more frequent fall grazing deteriorated woody species vigor and regeneration, contributing to diminished floodplain function and reduced riparian dependent values.

TABLE 3.—Relationship between duration of July-August cattle use and utilization of willows, Sourdough Creek, Montana.

			Utilization[a]	
Year	Days use	Days use/ hectare	*Salix geyeriana*	*Salix boothii*
1984	26	9.9	Trace	1-5%
1986	36	14.1	5-10%	20-25%
1987	38	15.8	30%	45

[a]Ocular estimates on 75 shrubs

Discussion

In the past few years, fisheries biologists have questioned whether grazing systems, especially certain forms of rest-rotation, are providing adequate maintenance or improvement of the aquatic habitat (Skovlin 1984). In southwestern Montana, grazing systems which consider only upland plant growth requirements will generally not meet stream riparian site requirements. The 74% failure rate documented here may be attributed largely to excessive duration in grazing treatments leading to greater physical damage plus deterioration in vegetation vigor, failure to provide residual cover (through regrowth or non-use) during most years, and excessive use during the hot season and fall periods.

Riparian site needs were provided for on successful systems through provision of residual riparian cover and by minimizing the potential adverse impacts resulting from cattle behavior through the design of grazing treatment season and duration.

At the time these grazing systems were developed, the importance of riparian areas was often not recognized, and most managers believed that a single grazing system would meet the needs of all rangeland resources. These "upland grazing systems" were not designed to be responsive to floodplain function, riparian area livestock behavior, nor riparian plant phenology.

Management of riparian sites within a multiple use mandate is one of the most difficult tasks in resource management. Findings here suggest that it can be done, however. Present managers are deeply concerned with answers to the riparian-grazing challenge. Researchers alone cannot provide the answers. Managers must provide insight and practical advice based upon experience with multiple-use management situations, which often differ from carefully controlled research environments. Managers must implement riparian monitoring programs and document both successes and failures in riparian management.

Approaches to riparian management must differ from the traditional approaches to management of uplands, which generally include deferred and rest-rotation principles with long duration grazing treatments and frequent "hot season" and fall grazing. Some well-meaning managers are still implementing "upland grazing systems" in hopes of attaining riparian site recovery.

It is recognized that this analysis is an oversimplification of a complex set of both natural and man-controlled factors. Other factors not considered here also influence the riparian response to a grazing system. These include, but are not limited to:

(1) kind and class of stock
(2) learned behavior of livestock social groups
(3) non-riparian water and shade sources
(4) terrain and weather influences
(5) herding, riding, and salting practices
(6) fencing locations
(7) grazing system compliance
(8) wildlife use, especially beaver and big game
(9) soils

(10) bank and channel vulnerability to detachment
(11) stream gradient and sediment load

Recommendations

Many factors must be considered in managing grazing on stream riparian sites. Some stream systems may be too frail or unstable to warrant grazing use either temporarily or permanently. Special riparian management pastures give the manager much more control in meeting recovery needs, while still allowing livestock use and simplifying management of upland sites.

The following are recommendations for the development of grazing systems where sites are similar to those in southwestern Montana and where stream riparian maintenance or recovery is an objective. Hopefully, research will provide more definitive recommendations in the future.

Provide for residual vegetative cover either through regrowth or rest treatments during at least 75% of the years, or annually if possible. Residual cover needs will vary on different streams. Vigorous woody growth plus at least 15.25 cm of residual herbaceous growth was used with this study.

Through on-site studies, determine how much time is required to provide adequate herbaceous regrowth to meet floodplain function needs and incorporate this into the grazing prescription. Removing stock by about early August was required at the 1,830 m elevation in the study area.

Reduce the duration of grazing treatments to the greatest extent practical. Grazing treatments averaged 28 d in successful systems and 59 d in unsuccessful ones. Many rest-rotation and deferred grazing systems prescribe 60-75 d of use per treatment and are generally unsuitable. Establish suitable length of grazing treatments by monitoring trampling impacts, utilization of woody species, particularly regeneration, plus sufficient time to provide necessary regrowth of herbaceous species.

To the greatest extent practical, design grazing treatments to take advantage of favorable seasonal livestock dispersal behavior. This will vary regionally, based on precipitation patterns and plant phenology. Good dispersal of stock was noted in the study area from early May through early July, and the poorest dispersal was noted during the "hot season" (early July to mid-September). Hot season grazing averaged 13 d in successful systems, compared to 33 d in unsuccessful ones.

Incorporate sufficient growing season rest to provide for good vigor and regeneration in all riparian plants. This does not mean that a full year of nonuse is required. Often, growing season rest can be increased by using pastures more frequently with shorter duration use.

Where deciduous woody species are important in the composition, limit the frequency of fall grazing treatments to about one year in four. Duration of fall treatments should be limited to the greatest extent practical. Fall grazing averaged 21 d in successful systems and 37 d in unsuccessful ones. Close monitoring is required to avoid excessive use on woody species during this period.

Insist upon strict grazing system compliance. A few cattle remaining in a pasture after the prescribed use period can negate the benefits of a good system. Stray animals invariably spend the bulk of their time in stream bottoms. Ninety percent compliance with a grazing system is not adequate.

Standardized approaches to riparian grazing management are not practical. Riparian areas differ in their potential for response and in various unique site factors. These other variables must be considered in the design of a grazing system.

References

Brinson, M.M., B. L. Swift, R.C. Plantico, and J.S. Barclay. 1981. Riparian ecosystems: their ecology and status. U. S. Fish and Wildlife Service, Biological Service Program, FWS/OBS - 81/17.

Bryant, L. 1979. Livestock response to riparian zone exclusion. Master's thesis. University of Idaho, Moscow.

Elmore, W., and R. L. Beschta. 1987. Riparian areas — perceptions in management. Rangelands 9(6):260-265.

Kinch, G. 1987. Riparian area management. U. S. Bureau of Land Management, Draft Technical Reference, Denver, Colorado.

Kuchler, A. 1964. Potential natural vegetation of the conterminous U. S. American Geographical Society, Special Publication No. 36.

Marlow, C. 1985. Controlling riparian zone damage with little forage loss. Montana Agriculture Research, Fall 1985. Montana Agricultural Experiment Station, Bozeman.

Myers, L. 1987. Montana BLM riparian inventory and monitoring. U. S. Bureau of Land Management, Riparian Technical Bulletin 1, Billings, Montana.

Platts, W. 1981. Sheep and cattle grazing strategies on riparian-stream environments. Pages 251-270 *in* Wildlife-Livestock Relationships Symposium Proceeding 10. University of Idaho, Forest, Wildlife and Range Experiment Station, Moscow.

Skovlin J. 1984. Impacts of grazing on wetlands and riparian habitat: a review of our knowledge. *In* Development strategies for rangeland management. National Research Council/National Academy of Sciences. Westview Press, Boulder, Colorado.

WWP Exhibit 17

1977. IN: PROCEEDINGS OF THE WORKSHOP ON LIVESTOCK AND WILDLIFE-FISHERIES RELATIONSHIPS IN THE GREAT BASIN

LIVESTOCK GRAZING IMPACTS ON AQUATIC HABITAT IN BIG CREEK, UTAH[1/]

Donald A. Duff[2/]

Abstract: In 1970, the Bureau of Land Magagement constructed a 1/4 mile-long exclosure, fencing off 3,300 feet of Big Creek, Rich County, Utah, to monitor the recovery of riparian habitat from grazing impacts. Fish sampling in 1973 showed 3.6 times more trout inside the exclosure (470 trout per mile) compared to 130 trout per mile in the grazed downstream reach outside the exclosure. Habitat studies from 1973 to 1976 showed the habitat inside the exclosure recovered significantly due to rest, while areas outside the exclosure continued to decline under continued livestock use. Instream bank stabilization and fisheries improvement structures washed out in grazed areas but remained functional and in place within the ungrazed area. Only the benthic organisms more tolerant of silt-sediments were common in the creek. Native willow stems began to show some vigor and growth after 4 years rest. In degraded habitats, such as existed on Big Creek, a minimum rest period of 6 to 8+ years would be necessary to restore aquatic riparian habitat. Grazing systems need to be developed now by land managers to consider aquatic-riparian vegetative types separately from terrestrial vegetative types and provide for future recovery of the habitat and multiple-use management.

In order to provide for the management of aquatic-riparian habitat along Bureau of Land Management (BLM) administered sections of Big Creek, the BLM Salt Lake District developed a habitat management project for the stream. The project and follow-up monitoring study objective was to improve aquatic-riparian habitats for fisheries resources. This improvement included the recovery of riparian vegetation, increased streambank soil stability, and improved water quality which had deteriorated from excessive cattle and sheep grazing. The project was designed to include riparian zone fencing, vegetative bank plantings, bank stabilization structures, and instream improvement structures.

Big Creek is located in Rich County, south of Big Lake near Randolph, Utah. The creek originates on the Cache National Forest and flows northeast 20 miles before entering the Bear River. Big Creek drains an area of about 52 square miles and is one of the larger tributaries of the Bear River in Rich County. During a normal water year, Big Creek has an annual flow of about 11,370 acre-feet, with a mean flow of 15.7 cubic feet per second. The maximum discharge on record is 337 cfs and the minimum discharge is 0.90 cfs as recorded by a U.S. Geological Survey gaging station, located 3.5 miles downstream from Randolph Creek junction, for the 21-year period of record, 1949-70.

The BLM administers a portion of Big Creek, amounting to only 5 stream miles. The remaining land along the stream consists of private holdings (13 stream miles), and lands in the upper stream reach (2 stream miles) administered by the U.S. Forest Service. Big Creek is only one of 17 streams in the Randolph Planning Unit consisting of 170,200 acres of public land administered by the BLM. However, it is the largest stream of the group and was chosen for multiple use development because of its present and potential habitat and fisheries resources and its proximity to public access and recreational use.

Big Creek originates from spring sources near 8000 feet elevation in the Cache National Forest; the mouth enters the Bear River at 6245 feet elevation. The BLM-administered portion of the Creek is centered around the 6596 feet elevation.

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The drainage basin consists primarily of a sagebrush community on riparian alluvium, in a rolling hill landform (fig. 1) which gives way to an aspen-coniferous mountain community in its extreme upper reaches. The watershed consists mainly of a west-to-east slope of Tertiary Wasatch (Knight) sedimentary formation, with some limited exposures of Twin Creek limestone in the headwaters, and alluvium and Lake Bonneville deposits in the lower valley near Randolph.

The BLM-administered public land on Big Creek is located in the upper reaches some 15 miles above the mouth. The land's primary use is for cattle and sheep grazing; it is managed under criteria set up within the Big Creek Allotment Management Plan. This allotment, within which Big Creek lies, covers 31,540 acres and provides grazing for 600 cattle and 450 sheep during the period mid-May through mid-October or 3000 animal unit months (AUMs) for cattle and 2250 for sheep.

Fisheries resources consist primarily of rainbow, brown, brook and cutthroat trouts, with nongame species such as the mottled sculpin, carp, and sucker. The majority of these nongame fishes occur in the lower reaches of the creek but have been occurring more frequently in mid-stream reaches as habitat changes occur. The Utah Division of Wildlife Resources (DWR) stocks Big Creek annually with catchable rainbow trout and cutthroat trout fry. Some cutthroat remain in the stream through natural propagation.

Because most grazing use on Big Creek occurs within the riparian streambed zone, the condition of the vegetative cover, streambank soil stability, streambed gravels, and water quality has been degraded significantly. In many instances the habitat has been eliminated (fig. 2). At the time of the study this deteriorated habitat condition had also led to reduction in game fish populations within the lower reach of the stream and begun to extend into the upper reaches.

METHODS

In 1970, the BLM fenced off a stream area of about 2/3 mile (3300 ft. of stream) and constructed 17 instream improvement structures (figs. 3 and 4). The structures, placed inside and outside of the exlosure, consisted of gabions and trash-catchers designed to improve pool-riffle habitat in the stream. Access gates were located along the fence to allow visitor entry for recreational uses. The fence allowed for future grazing uses inside the exclosure, once vegetative productivity was restored, by providing a gateway at the upper and lower ends of the exclosure. A large information sign was erected at the downstream end of the exclosure to inform the public of the management intent.

In 1971, an additional 26 instream structures were constructed within the exclosure. During the following years, monitoring of the recovery of the habitat and fisheries resources was not accomplished as planned. In 1973 intensive habitat monitoring studies were begun on Big Creek, both inside and outside the exclosure. Physical habitat measurements were made in the riparian zone (Bureau of Land Management 1975). Habitat stations were established within the exclosure as well as downstream and upstream. Habitat stations outside the exclosure consisted of 5 transects each, spaced at 100 foot intervals for Stations 1 (downstream from exclosure) and 3 (upstream from exclosure. Station 2 consisted of the entire 3300 foot section within the exclosure, or 33 transects spaced at 100 foot intervals. These transects were designed to inventory and assess stream conditions, including streambank vegetative cover, soil stability, stream bottom gravels, pool-riffle areas, and water quality.

Water chemistry measurements were made annually using both field test kits and certified laboratory analyses. Included in the water quality analyses were samples for bacteriological content: total coliform and fecal coliform. Bacteriological analyses were performed by the Utah Division of Health Laboratory in Salt Lake City. Fish populations were sampled in 1973 by the Utah Division of Wildlife Resources at habitat stations 1 and 2 (transects 1-5 only). Macroinvertebrate sampling began in 1975 and continued in 1976 under contract to Brigham Young University's (BYU) Center for Health and Environmental Studies. The 1976 work also included some streambed gravel analysis using a modiifed McNeil core type sampler (U.S. Forest Service design). These core samples were placed in bags onsite, and taken to the BYU laboratory for analysis. The BLM also conducted some streambed gravel sampling in 1975 and 1976 using the McNeil sampler at selected gravel-riffle areas inside and outside the exclosure. Onsite core analysis was done for these samples using the volumetric water-displacement method.

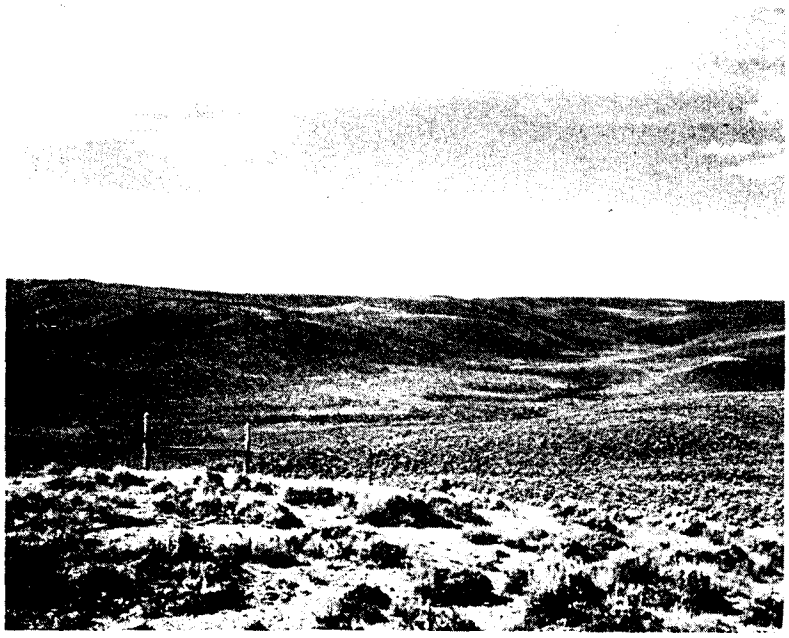

Figure 1-- Big Creek lies within a sagebrush-sedimentary alluvium environment in northeastern Utah south of Bear Lake.

Figure 2 -- Big Creek, on land administered by the Bureau of Land Management, is subject to heavy livestock use, which has destroyed streambank vegetation and soil conditions and degraded fisheries habitat.

Figure 3 -- Big Creek fencing and stream improvement structures have aided in recovery of streambank vegetation and soil, and of fisheries habitat resources within the exclosure.

Figure 4-- Within the Big Creek exclosure, streambank vegetation and soil conditions have recovered substantially in 4 years of rest. Instream structures have aided in streambank soil stabilization in areas of severe bank erosion.

RESULTS

Of the five habitat stations on Big Creek, only Stations 1, 2 and 3 (Table 1) will be discussed in detail because of their environmental homogeneity and close proximity to each other in relation to concentrated livestock use in the study area. Stations 4 and 5 were inventoried only in 1973 during the initial stream survey, and exhibit additional stream factors, such as beaver ponds and headwater reaches, which do not allow direct comparisons to lower stations. They show the diversity of habitat types and stream condition at increased elevation levels, however.

Channel Width

Mean channel widths in the grazed portions (Stations 1 and 3) increased by 1.4 feet and 0.7 feet, respectively, in 4 years, whereas mean channel widths inside the exclosure (Station 2) decreased by 2.5 feet. Several areas outside the exclosure lost up to 3 feet of stream bank annually because of trampling by livestock. Station 2 exhibited a mean 1 foot channel loss in 1974, attributable to trespass livestock being allowed within the exclosure for 6 weeks. This loss, however, was regained in 1975 and streambank recovery continued in 1976 to a mean channel width of 16 feet. By comparison the mean channel width outside the exclosure was 27 feet.

At the end of the study the stream's thalweg at the site of the gabion instream structure in the grazed area outside the exclosure was 10 feet removed from a once-stabilized streambank. The original right bank of the gabion structure became the left bank of the water's edge as a result of continued livestock trampling.

Similarly, mean water widths increased and water depths decreased with widening of channel banks. Station 1 increased water width by a mean of 1 foot in 4 years, while mean depths decreased by 0.22 feet. Class 1 and 2 pools within Station 1 decreased in quality and use for fisheries to Class 4 and 5 pools, lacking depth and cover requirements. These pools, which were 4 to 5 feet deep in 1973, were no more than 1.5 feet deep in 1976 due to channel changes and silt depositions attributed to livestock grazing and trampling.

At Station 2, inside the exclosure water widths decreased to a mean of 1.1 feet in 4 years as channel banks stabilized. Mean depths within the channel decreased a mean of 0.26 feet in 4 years, from a mean of 1.1 to 0.8 feet deep. This factor did not signfiicantly reduce fisheries habitat, since deep pools of Class 1 rating in 1973 remained in the same class in 1976 with no loss in depth. Although some stream areas in midchannel had a small depth loss, additional depth and cover area was obtained from stabilized undercut banks.

Sediment and Spawning Gravels

Spawning gravels were rated according to their frequency along transect lines and consisted of fine gravels (0.1-1.0 inches) and coarse gravels (1-3 inches). Their occurrence at Stations 1, 2, and 3 decreased yearly by 48, 21 and 35 percent, respectively (table 1). Station 2, within the exclosure, decreased the least amount, dropping from 42 percent occurrence in 1973 to 33 percent in 1976. Unstable channel conditions outside the exclosure contributed heavy silt deposition to the streambed, either covering spawning gravels or washing them downstream.

Although the streambottom contained a heavy silt load, the substrate was very porous and loose, shifting during spring and flood flows. The decrease in spawning gravels was related to an increase in sediments over the 4-year period. Sediments were classified as percent occurrence along each transect, and some bottom core samples were taken in 1975-76 by BLM and BYU. Sediment occurrence on streambottom materials increased annually by 46, 16, and 166 percent on Stations 1, 2, and 3, respectively. Station 2 increased the least, even though the 3300-foot exclosure reach acted as a silt settling basin because of reduced gradient and instream structures. The structures, however, all were functioning properly, in both upstream and downstream pools, and sediments chiefly occurred in downstream pool eddies and point bars at stream meander bends.

Streambed core samples taken by BLM in 1975-76 and by BYU in 1976 show similar results on station sites sampled, although one was analyzed in the field and the other in the laboratory (tables 2 and 3). Fine materials less than 0.84 mm ranged from 23.1 to 26.5 percent below the exclosure, whereas inside the exclosure the range was from 22.4 to 28.5 percent. BLM's sample at the upstream end of the exclosure (26.9 percent) compared favorably to BYU's sample just upstream. Past studies (Bjornn 1969) relating to survival and emergence of steelhead trout and chinook salmon show survival varies inversely with amounts of

Table 1-- Summary of selected physical habitat ratings on stations 1, 2, and 3, 1973 to 1976.

Habitat Parameter	Habitat Ratings by Year and Habitat Station											
	1973			1974			1975			1976		
	1	2	3	1	2	3	1	2	3	1	2	3
Pools (percent)	72	80	34	-	81	-	74	81	64	59	77	66
Pool quality (percent)	56	39	61	-	37	-	48	37	72	45	42	37
Pool:riffle ratio	56	40	68	-	38	-	52	38	72	82	46	68
Cover (percent)	25	40	28	-	26	-	25	40	25	25	35	25
Stability (percent)	43	84	45	-	72	-	45	83	63	43	82	53
Desirable streambottom (percent)	82	75	85	-	92	-	93	79	86	99	79	94
Habitat optimum (percent)	52	56	57	-	53	-	52	56	64	59	57	55
Channel width (feet)	26.2	17.5	26.6	-	18.5	-	27.1	16.5	27	27.6	16	27.3
Water width (feet)	16.4	15.5	16.4	-	15.1	-	16.4	15	14.4	17.4	14.4	12.4
Depth (feet)	1.04	1.1	0.52	-	1.57	-	0.83	1.0	0.64	0.82	0.84	0.62
Spawning gravels (percent)	54	42	82	-	46	-	32	31	56	28	33	53
Sediment (percent)	35	45	15	-	39	-	44	50	40	51	52	40
Ungulate damage rating	-	-	-	-	-	-	-	-	-	30	83	25

Table 2-- Mean percent composition by weight of stream substrates within and outside of exclosure, Big Creek, Rich County, Utah, sampled August 23 and October 8, 1976.[1/]

Sediment[2/]	Below exclosure		Within exclosure		Above exclosure	
	August	October	August[3/]	October	August	October
Gravel: 3 inch to 4.76 mm	71.6	60.5	61.8	56.5	66.0	54.6
Coarse sand: 4.75 - 2.00 mm	8.4	10.0	8.8	8.2	7.2	10.4
Medium sand: 1.99 - 0.42 mm	13.2	16.3	13.2	20.1	14.4	20.1
Find sand: 0.41 - 0.074 mm	6.5	12.9	15.7	14.5	12.1	14.5
Silt and clay: < 0.073 mm	0.3	0.3	0.5	0.7	0.3	0.4
Mean percent fines, <0.085 mm	14.0	23.1	24.0	28.5	20.6	27.3
Range of percent fines	12-18	9-34	16-34	20-53	17-26	11-64

1/ Four samples were taken from gravel beds in stream riffles on each date at each place, and were analyzed at the Brigham Young University laboratory.

2/ ASTM designation D-422.

3/ Mean based on 8 samples.

Table 3-- Summary of sediment sampling, within and outside of exclosure, Big Creek, Utah, 1975-76.

Sampling date and site	Percent < 6.35 mm	Percent < 0.84 mm	Number of samples
1975, August 7 (discharge 11 cfs)			
Below exclosure	42.9	34.2	5
At fence, outside, below exclosure	51.9	22.8	5
Inside exclosure, middle	46.9	26.4	5
Inside exclosure, upper	56.6	32.8	5
Mean	49.6	29.1	5
1976, July 9 (discharge 8 cfs)			
Below exclosure	48.4	25.3	2
At fence, outside, below exclosure	54.3	32.8	2
Inside exclosure, middle	-	-	-
Inside exclosure, upper	42.6	20.2	2
Mean	48.4	26.1	2
September 10 (discharge 8.39 cfs)			
Below exclosure	52.8	26.5	5
At fence, outside, below exclosure	47.1	24.3	5
Inside exclosure, middle	51.5	22.4	5
Inside exclosure, upper	44.0	26.9	5
Mean	48.9	25.0	5

fine materials in gravels. The percent of materials passing the 6.35 mm sieve (caught by 0.84 mm sieve) showed that chinook salmon fry experienced difficulty in emerging from 20 to 40 percent fines, and few emerged from 40 percent fines (sand). Only 50 percent of steelhead fry emerged from gravels with 50 percent sand, and only 10 percent emerged from gravels with 55 percent sand. Egg mortalities of 60-80 percent for chinook salmon and 40-60 percent for steelhead trout occur when gravel interstices fill with 30-40 percent sand material possing the 6.35 mm sieve.

Sediment samples (BLM) on Big Creek in all areas showed fine materials less than 6.35 mm as greater than 48 percent and materials less than 0.84 mm as greater than 25 percent. Based on these figures, in relation to salmon-steelhead studies, it can be theorized that smaller salmonid species would have high egg mortality in Big Creek from natural spawning efforts, because of the high sand-silt deposition on the streambed.

Pool-Riffle Quality

The percentage of pools decreased in Stations 1 and 2 over 4 years by 18 percent and 4 percent respectively, but increased in Station 3 by 94 percent. The large increase in pools above the exclosure, Station 3, was the result of channel cutting and shifting from stream gradient changes. However, pool quality at Station 3 decreased by 39 percent in 4 years because channel changes created a wider stream channel and shallower water depths.

Station 1 (below exclosure) decreased in pool quality by 26 percent over the 4-year period but pool-riffle ratios increased to 82 percent of optimum (if a 50:50 ratio is considered optimum). However, the increase of pools on this site was not favorable since their quality for fisheries use is minimal due to a wide channel and shallow depths.

Station 2 (inside exclosure) increased in pool quality by 8 percent over 4 years due to hydrologic actions of instream structures. At the end of the study, pools had a quality rating of 42 percent. Most pools remained as Class 1, based on size and depth requirements, despite heavy silt loads passing through the reach from continued livestock use upstream. As the instream structures settled and stabilized, permanent pools were dug out and riffles formed on the downstream end. Additional riffle areas formed above instream structures as stream gradient changes have occurred from structure settling. The structures remain operational because of adequate gradient, despite the heavy movement of silt moving downstream through the exclosure.

Streambank Cover Stability

Stations 1 and 3 both showed similar cover (fig. 5) and stability ratings (fig. 6) reflecting livestock use of the riparian zone. Native willows and grasses were heavily used and in most places eliminated from streambank zones.

Based on cover/stability rating criteria (BLM 1975) both stations showed lowest possible ratings of 25 percent and bare or sparsely grass-covered banks affording no streatmside shade-pool cover. Station 3 was poorly vegetated in 1973 (29 percent) but in the following years, what little vegetation remained was removed, exposing streambanks (25 percent rating). While Station 1 stability ratings remained at 43 percent throughout the 4 years, Station 3 increased slightly from 45 percent to 53 percent stability. This was due to lower bank heights, and although banks lack woody vegetation, vertical cut banks were rounded off and began to stabilize somewhat. Since this area of Station 3 was only about 500 feet long and was located between the upper exclosure fence and a BLM boundary fence, its use by livestock was not as intense as that below the exclosure. However, it was still very poor habitat.

After exclosure construction cover increased from a low 25 to a 40 percent rating (grass or brush covered, medium height) in a 4-year period ending in 1973. Similarly, stability increased from about 43 percent (similar to Stations 1 and 3) in 1970 to 84 percent in 1973, going from mostly unstable to greater than 50 percent stable. In 1974 vandals cut the exclosure fence in several spots and trespass cattle used the area for 6 weeks. As a result of this intense grazing use, after 4 years rest, cover ratings dropped by 5 percent and stability by 14 percent. Native willow stock propagation and plantings by Boy Scout troops were eliminated or browsed back to basal stems. Resprouting willow stems that had grown to 48-inch maximum height in 4 years and were just starting to show vigorous growth were reduced to basal stems. Streambanks which had become grass-covered and begun to stabilize were refractured and began sloughing into the creek due to livestock

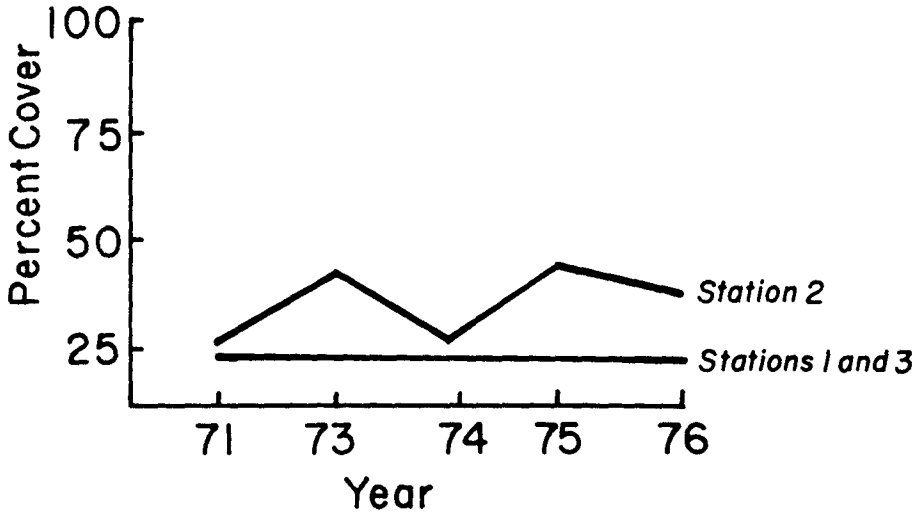

Figure 5-- Summary of vegetative bank cover rating, 1973-76.

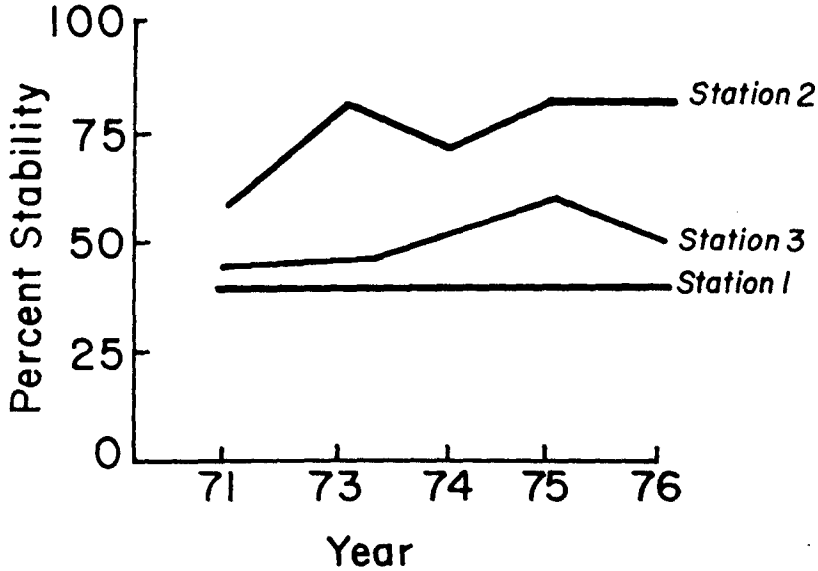

Figure 6-- Summary of streambank stability ratings, 1973-76.

trampling. In several instances 3 feet of streambank were lost by excessive trampling. Trampling also caused end-cutting around six instream structures, whch required maintenance to arrest erosive streambank conditions.

In the 2 years following fence cutting, quality of cover and stability increased by 35 and 14 percent, respectively, to habitat ratings of 35 percent and 82 percent in 1976, almost reaching the habitat levels of 1974, before the trespass. Willow shoots resprouted and stems reached a maximum height of 24 inches in 1976. Additional native willow stem plantings cut in the field and planted by Boy Scouts in the spring of 1976 showed about 40 percent survival in 2 years. Six-month survival rate for the 500 willow stems planted in vertical and horizontal stem-cut patterns in 1975 was 90 percent, but this decreased in 1976 because of bank scouring from high discharges and trampling from increased fisherman use within the exclosure.

Clippings of vegetative grass species in 1975 showed areas outside the exclosure adjacent to the stream to support only 4 to 22 pounds per acre biomass in July after 2 months' use by livestock. Inside the exclosure "wet meadow" grasses adjacent to the stream produced 6300 pounds (biomass) per acre and adjacent "dry meadow" grasses produced 1800 pounds (biomass) per acre following 2 years recovery from grazing use. High cover and stability ratings (BLM) within exclosure areas reflected habitat that was 90 to 100 percent free of impact from grazing use, whereas areas outside the exclosure with no cover and unstable soil banks reflected extensive grazing use with 90 to 100 percent environmental damage.

Streambank Materials and Benthic Productivity

Streambottom materials rated desirable from a productivity level of benthic organisms for fish food are rubbles, gravels, silts, muck, and organic debris (leaves, sticks, etc.). (Excessive silt depositions were not counted in this determination--only those fine silt layers covering bottom materials.)

All three stations increased in these materials in the 4-year monitoring period; values were 21, 5, and 11 percent for stations 1, 2, and 3, respectively. Ratings indicated a 99, 79, and 94 percent desirability rating for occurrence of these materials at stations 1, 2, and 3, respectively. These increases were attributable to increases in fine settled sediments as well as to exposure of gravel materials below and above the exclosure, by the stream's gradient-cutting action.

These increases in desirable materials for benthic organism production were not truly representative of a healthful status of the stream. In benthic macroinvertebrate sampling done for the BLM (1975-76 by BYU, results (1975) showed that the creek was dominated by dipterans (mostly Chironomidae), averaging 81 and 51 percent of the samples in June and August, respectively. Low community diversity at all sites in June samples reflected this chironomid dominance (table 4). No difference appeared in macroinvertebrate distributional patterns between sites outside and within the exclosure, either by numbers or biomass. In the August sample, diversity values had increased at all sites, reflecting the simultaneous decrease in dipteran (chironomid) dominance and increase in numbers of ephemeropterans (mayflies). *Baetis* spp. accounted for about 95 percent of the mayfly dominance. Samples in 1976 showed similar comparisons, with chironomid dominance being 50 percent in August and 24 percent in October samples. Diversity values were higher than in 1975, but very similar between sampling dates and sites (table 4). Higher values reflect increases in numbers of ephemeropterans (mayflies) and trichopterans (caddisflies). *Baetis* spp. and *Ephemerella* spp. accounted for mayfly dominance, and *Hydropsyche* spp. and *Brachycentrus americanus* accounted for caddisfly dominance. In both years there were very few plecopterans (stoneflies) in the system except the forms more tolerant of pollution, such as *Pteronarcella* sp. and *Isoperla* sp.

Water Quality

The water quality in Big Creek is good and the creek was classed as a moderately hard, bicarbonate-buffered cold-water mountain stream. Nutrient levels were adequate to ensure good algal productivity. Nitrate and phosphate levels remained at a fairly high level throughout the summer, probably due to cattle grazing in the bottomlands. In natural streams the nutrients are high during spring runoff and then decrease throughout the summer. Other measured water-quality standards appeared to be within the Utah criteria for Class CC waters (waters suited for coldwater fisheries).

Total and fecal coliform counts were at relatively low levels both years, considering the number of cattle grazing in the area; however, on June 19, 1975 and August 24, 1976 bacterial levels were relatively high. This could have resulted from rains and runoff during the preceding two or three days. Levels were still below Utah standards for Class CC waters but higher than those of other mountain stream waters with no intense livestock grazing concentrations.

In 1975 mean minimum and maximum water temperatures were 8.0 and 15.5 C, respectively (for a 75-day period) with a maximum temperature of 19.5 C on July 13. In 1976 mean minimum and maximum temperatures were 9.2 C and 17.3 C, respectively (for a 61-day period), with a maximum of 21.5 C on July 10. Unlike 1975 when temperatures greater than 18 C decreased after August 6, similar temperatures above 18 C continued until sometime after August 10 (instrument malfunctioned on this date and no further data were obtained).

These temperatures reflect conditions of the stream within the middle of the exclosure in pool areas. Recording thermographs were not available for temperature monitoring below the exclosure; however, pocket thermometer readings taken during field trips indicated maximum temperatures were only 2 to 3 C higher in the Station 1 reach below the exclosure during the same time periods. These higher temperatures reflect the widened and shallow stream channel reaches devoid of vegetative cover.

Habitat Optimum Values

Values for optimum habitat ratings were based on summaries of pool-riffle ratios, pool quality, desirable streambottom materials, and streambank covers and stability ratings (Duff and Cooper 1976).

At Stations 1 and 2, total habit values increased by only 13 and 2 percent, respectively, since 1973. Habitat ratings in 1976 were 59 and 57 percent of habitat optimum. Station 3 decreased 3.5 to 55 percent of optimum in 1976. Although these values were intended to reflect overall quality of a stream's habitat environment, they tended to be somewhat misleading. Station 2, inside the exclosure, which showed habitat recovery, had a lower rating by 2 percent than Station 1 which was subject to heavy livestock use. This can be accounted for by the high value ratings on Station 1 for pool-riffle ratio and desirable streambottom materials. Though high, these Station 1 ratings did not reflect quality habitat, since depth, cover, and stability ratings were low, resulting in less desirable fish habitat as shown by low fish numbers. These summary ratings then must be interpreted along with results reported for individual habitat station characteristics, in order to represent the true habitat condition for comparison of the stream reaches under investigation. Possibly as additional annual sample data are collected, a more meaningful picture of habitat optimum ratings values will emerge. In this manner habitat optimum values can be established for each stream reach from which future changes in habitat condition can be compared.

Fish Populations

Fish populations at habitat monitoring sites were sampled only in 1973 (table 5). Station 2, inside the exclosure, had 3.6 times more fish than Station 1 outside the exclosure. Numbers of fish per mile in grazed and ungrazed portions of Big Creek were 130 fish per mile for Station 1 as compared to 470 fish per mile in Station 2. Similar comparisons were noted for biomass in pounds per acre of fish produced, from 7.22 lb/acre in Station 1 to 26.22 lb/acre in Station 2.

Station 4, although removed in distance from the immediate vicinity of the exclosure and Stations 1, 2, and 3, had fish sampling conducted as well. These results will be discussed briefly since it relates to habitat impacted by livestock grazing. Station 4 had higher fish populations in some categories than the lower two stations but not as much as one would expect in a beaver-pond-stream environment. Station 4 had 5.2 times more fish than Station 1 and 1.5 times more fish than Station 2. Numbers of fish per mile were 680 or 1.5 times greater than Station 2. However, biomass was only 26.63 lb/acre, only 0.4 lb/acre greater than Station 2. This station is about 3 miles upsteam above the exclosure where the creek has numerous beaver ponds. This area marks the lowest downstream habitat area acceptable to beaver. Large willows are common in this area and most have withstood impacts from livestock better than downstream areas where heavy concentrations of livestock occur. However, loss of low vegetative bank cover and trampling has caused bank instability in this reach also, which probably is the

Table 4-- Summary of macroinvertebrates sampled at Big Creek, Utah, 1975 and 1976.[1/]

Sampling Station and Date	No. of Taxa	No. per square meter	Dry weight, gms per square meter	Diversity indices value
1975				
1. June	26	48,850	15.9	1.52
August	27	39,683	5.1	2.95
2. June	30	54,521	13.0	1.98
August	28	44,708	4.0	2.57
3. June	27	38,628	10.5	0.81
August	29	41,405	6.9	2.43
4. June	31	40,415	19.9	1.17
August	31	28,406	6.6	2.99
5. June	28	21,412	5.1	1.01
August	28	25,189	5.0	2.67
6. June	30	46,548	13.5	1.84
August	29	50,830	7.0	2.69
1976				
1. August	25	58,162	13.1	2.96
October	25	21,996	16.5	3.40
2. August	24	48,983	13.4	3.00
October	21	21,262	4.4	2.96
3. August	26	39,640	15.8	2.99
October	22	21,821	13.5	3.34
4. August	29	88.589	26.3	2.45
October	22	14,340	10.1	3.44
5. August	23	42,773	11.9	2.23
October	23	35,605	10.9	3.18

[1/] Work performed by Brigham Young University; four samples taken on each date (June 17 and August 21) at each station in 1975; five samples (August 23) and four samples (October 8) in 1976.

Sampling	Species	No. of fish	Mean length (mm)	Mean weight (g)	Fish per mile	Biomass lb/acre
1. Outside exclosure	Cutthroat (9) Rainbow (4) Sculpin (common)	13	165.2	68.8	130	7.22
2. Within exclosure	Cutthroat (43) Rainbow (3) Sucker (1) Crayfish (common) Sculpin (abundant)	47	152.4	47.2	470	26.22
4. Outside exclosure with beaver ponds	Cutthroat (64) Brook (4)	68	137.56	34.1	680	26.63

[1/] Work performed by Utah Division of Wildlife Resources.

reason why much larger increases in fish populations were not noted in this reach as compared to Station 2.

SUMMARY AND CONCLUSIONS

Data gathered during the habitat monitoring period following exclosure construction has shown that riparian habitat can recover through rest from intense livestock use. Degraded riparian soil and vegetative streambank components recovered substantially in the 4-year period (1971-74) following fencing while similar components outside the exclosure continued to decline.

Streambank soils began to stabilize and riparian vegetation was beginning to show growth and vigor potential after 4 years' of rest. However, trespass livestock use for 6 weeks in 1974 reduced these habitat components to near prefencing ratings (1971) for vegetative cover, and to improvement ratings for stability achieved 2 years earlier. Streambanks were re-fractured along "old" fracture lines and channel width increased by a mean of 1 foot from loss of bank soil. Positive habitat response achieved from 4 years of rest had been negated by six weeks intense livestock grazing.

Native willow stock that had been reduced to decadent basal stems began to show signs of vigor and stem growth the fourth year of rest. But this 1974 trespass use again reduced woody stems to basal sprouts. In 1976 after 2 years of rest from grazing the woody stems again began to exhibit growth. However, at present growth rates this willow would probably need an additional 4 years of rest to recover substantially to provide for adequate stream cover. Unless stands of willow occur together for protection, livestock would be attracted to scattered single willow stands and eliminate them in a short time.

Riparian habitat recovery within the exclosure has shown that a poor streamside environment, i.e. Big Creek subject to grazing, would need a minimum of 6 to 8+ years' of rest before livestock grazing could be resumed at reduced levels. Within the exclosure it should also be noted that the riparian-wetland vegetation is migrating inland from the stream as the ground water table increases in the area, while in grazed areas terrestrial-dryland vegetative species continue to encroach toward the streambank. Since similar poor habitat values are present on other streams in Rich County managed by BLM it assumed that similar rest periods given to these degraded riparian before recovery will allow for lin grazing use without further substantial habitat loss or decline.

Initial fish sampling indicated the habitat preference of fish. Some 3.6 times more fish were shown to be inside the exclosure, where habitat had significantly recovered, than were found in stream reaches above and below the exclosure, where the habitat continued in degraded condition. Additional fisheries sampling would have been extremely beneficial in years following initial sampling (1973) in order to ascertain correlations between the degree of habitat recovery and fish population, composition, and biomass response. However, this data was not obtainable from the Utah Division of Wildlife Resources.

All reaches sampled, even the improved stream reach inside the exclosure, showed an increase in sediments covering streambottom gravel materials. Continued livestock grazing above the exclosure was the primary reason for this sedimentation which was carried by streambank instability and erosion from trampling use. The upper stream reaches did not contain enough manageable BLM land in which to control grazing impacts, and as a result this private land grazing use was continuing to contribute sediments to downstream reaches. Although sedimentation was prevalent within the exclosure (Station 2) and the instream improvement structures were operating to some degree as silt retention basins, all were functioning properly. Some sediment and silt covered upstream pool basins above the instream structures, but a slight gradient was present to maintain adequate flushing conditions through each structure. Pools below the structures continued to be Class 1 quality pools (greater than 3 feet deep). Sediment deposition occurred in pools with side eddies below the instream structures and in point bars at channel meanders and bends. Instream structures will probably continue to function adequately within the exclosure, although continued sediment movement is present within the reach. It is anticipated that the streambottom will not cleanse itself unless complete restoration (rest) of the upper watershed riparian reaches is accomplished. This is not possible because of private ownership patterns and grazing uses in these upper reaches.

These studies have shown the poor ability of instream structures to function properly on stream reaches with heavy grazing use. Although design and placement may be correct from a stream engineering viewpoint, the continued use of livestock on streambanks can accelerate bank instability and erosion, leading to end-cutting and wash-out of instream structures. Of six structures placed outside the exclosure in 1970-71, only two remained operational 6 years later. The two remaining were in poor condition and subject to washout from bank trampling impacts. Although instream structures can aid in streambank soil stabilization, their oprational usefulness should be studied in view of present and future grazing uses, installation costs, annual maintenance costs and life span. Instream structures are a useful habitat improvement tool to arrest deteriorating streambank soil, vegetative cover, and stream pool quality conditions, but their uses along streams receiving continued livestock grazing will negate any anticipated benefits expected by their placement.

Although riparian habitat has been shown to recover within the exclosure areas relative to reaches outside the exclosure, full aquatic habitat recovery has not been achieved, because of impacts on the stream environment from uncontrolled grazing upstream. Sediments and high nutrient loads continue to affect flora and fauna within the exclosure and degrade physical, chemical, and biological water quality values, as shown by indicator elements and species. Because of these uncontrollable conditions in the upper watershed, it is impossible to evaluate adequately habitat and fish recovery as well as to specify livestock stocking rates and length of use. Big Creek habitat stations will be monitored in future years, but a more intensive study is needed within a controlled watershed where livestock grazing systems and habitat improvement alternatives can be evaluated in detail. Such studies are needed now for multiple-use management of all physical and biological resource components of the watershed.

LITERATURE CITED

Bjornn, Ted C.
1969 Embryo survival and emergence studies. Idaho Fish and Game Dep., Job Completion Report F-49-R-7, Job 5. 11 p.

Bureau of Land Management, U.S. Dep.
1975 Stream surveys. Utah State Office Manual Suppl. 6671, Release 6-7. 80 p.

Duff, Don A. and J. Cooper
1976 Techniques for conducting stream habitat surveys on national resource lands. BLM Techn. Note 283. 75 p.

WWP Exhibit 18

Caribou National Forest Riparian Grazing Implementation Guide Version 1-2

Riparian Process Paper
By R.L. Leffert
Forest Hydrologist, Caribou/Targhee National Forest
7/03/2002
Updated 12/28/2005

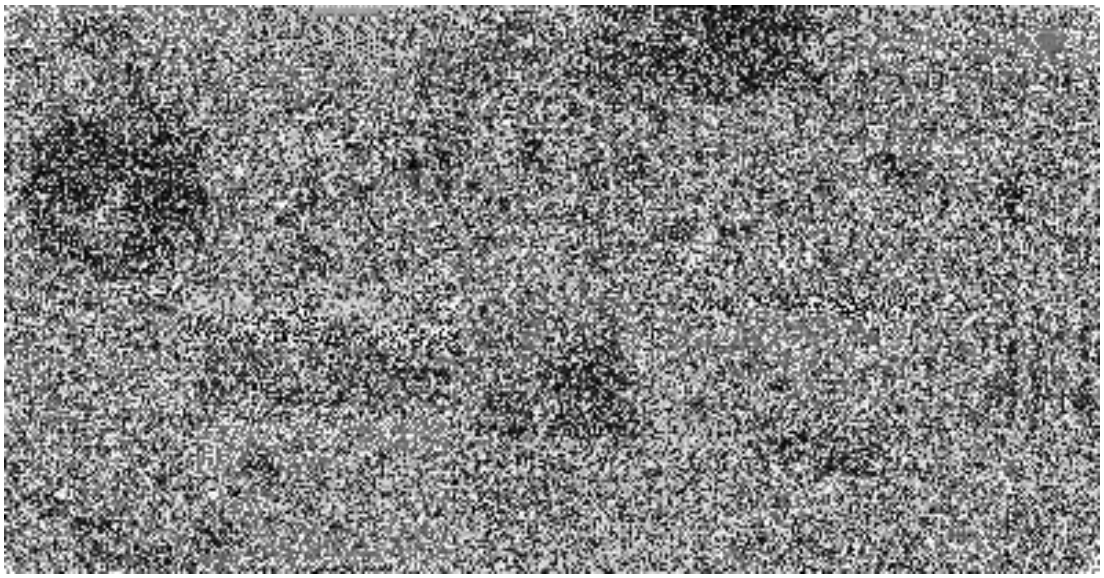

Table of Contents

	Page
Introduction…….	**4**
Streamside Vegetation and Channel Morphology……..	**6**
Grazing Strategies in Riparian Areas…….	**9**
Monitoring Parameters……	**12**
Stubble Height……..	**12**
Percent Plant Utilization……	**16**
Bank Disturbance……..	**19**
Soil Disturbance…….	**24**
Riparian Zone ground cover and plant utilization…….	**27**
Factors and Techniques that Affect the Distribution Of Livestock and Resource Impacts……	**30**
Table A – Management Practices and Expected Benefits…….	**34**
Water Quality and Aquatic Habitat……	**36**
Table B - Grazing Strategies and Stream/Riparian Habitats……	**38**
Impact Guidelines…….	**39**
Goal…….	**40**
Implementation……..	**41**
Similarity…….	**41**
Resiliency…….	**42**
Table 1 – Greenline Key Species Forage Utilization……...	**45**
Table 2 - Woody/Shrubby Species Utilization ……	**45**
Table 3 –Greenline Stubble Height …….	**46**
Table 4 - Riparian Zone Soils Disturbance ……	**46**

Table 5/5A - Bank Alteration/Stability….. …… 47

Table 6/6A – Riparian Zone Utilization and Stubble Heights……. 48

Key to Determine Allowable Use Parameters……..... 49

Figure 1 - Succession of States for Alluvial/Nongraded Valley Bottom Types . 59

Ecological Status of Riparian Vegetation…… 60

Table 7 - Stream Channel Characteristics…… 61

Figure 2 - Rosgen Channel Classification Table……... 62

Table 8 - Riparian/Stream Channel Morphology Objectives…….. 63

Monitoring…… 66

Field Guide for Measuring Riparian Area Impacts……. 69

Streambank Alteration……..... 72

Stubble Height……. 74

Forage Utilization……. 75

Willow Utilization…… 76

Woody Species Regeneration……. 77

Riparian Soil Disturbance…….. 78

Glossary…… 80

References…… 83

Riparian Monitoring Parameters and Management Systems

Introduction

Riparian areas are those lands adjacent to water bodies that are considered to be the transition between water bodies (aquatic systems) and uplands (terrestrial systems). They have distinct vegetation and soil characteristics that are influenced by high water tables or the presence of near-surface water. Riparian ecosystems are characterized by a combination of high species diversity and densities and high productivity. Continuous interactions occur between riparian, aquatic and adjacent terrestrial ecosystems through exchanges of energy, nutrients and species (Windell, *et al*, 1986).[1]

Stream systems develop a dynamic equilibrium with the variables of climate, geology, vegetation and surrounding land uses. Any change in any one of these variables can evoke an adjustment response in streams and their valleys (Fitch and Adams, 1998). Nelle (2004) found that a properly functioning creek, along with its riparian floodplain can help ameliorate and buffer irregular pulses of water over space and time and can help keep water more evenly distributed on the land longer. He stated that the essence of riparian function is to efficiently catch, store and release floodwaters, while capturing sediment and improving water quality. Even though these lands may make up a minor (1%-2%) portion of the landscape, they are important for a variety of reasons (Chaney, *et al* 1991, US GAO 1988). Vegetation found within these areas not only provides habitat for wildlife species but exercises important controls over physical and biological conditions and functions in the stream environment.

Vegetation acts as a roughness element that reduces the velocity and erosive energy of water flowing down the channel, reducing not only channel erosion, but assisting in reducing peak flow levels and improving low flows (Fitch and Adams, 1998). Riparian vegetation produces the bulk of the detritus that provides up to 90 percent of the organic matter and 99 percent of the energy necessary to support headwater stream communities. Large woody debris and other obstructions assist in the detention and concentration of organic matter locally, rather than being washed downstream, and serve as substrates for microbial and invertebrate organisms.

Riparian vegetation also provides shade that moderates water temperature fluctuations. The roots of trees, shrubs and herbaceous vegetation assist in stabilizing streambanks, provide cover for wildlife and act as a filter to reduce or prevent upslope sediment from entering the stream system (Kaufman *et al* 1984).

Cattle may spend from five to thirty times the amount of time in riparian areas as in adjacent xeric upland areas. Factors for this disproportionate time include: higher forage volume and relative palatability of riparian plant species; distance to available water; distance upslope to upland grazing sites; and microclimatic features (Clary & Webster 1989).

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[1] In Mosley, Jeffrey C., Philip S. Cook, Amber J. Griffis, and Jay O'Laughlin, *Guidelines for Managing Cattle Grazing in Riparian Areas to Protect Water Quality: Review of Research and Best Management Practices Policy*, Report No. 15, Idaho Forest, Wildlife and Range Policy Analysis Group, University of Idaho, 1997, pg.6.

This is not to say that grazing is totally incompatible with riparian areas. In fact, proper grazing may co-exist with sustainable riparian systems (Larsen *et al* 1998; Elmore & Kauffman, 1994[2]; Buckhouse 2000; Armour, *et al*, 1994), or even in some cases is beneficial for plant density and vigor, which assists in stabilizing soil, slowing erosion and decreasing in-stream sediment (WDEQ 1997). Leonard *et al* (1997) also found that livestock grazing can be a compatible use in riparian areas when managed in harmony with land management objectives, and when the function, capability, and potential of the site and the needs of the riparian vegetation guide the development of the grazing management prescription.

For example, in a Kentucky bluegrass meadow peak production occurred after six years of rest then declined until production was similar to that in an adjacent area grazed season-long (Clary & Webster 1989). In other studies, removal of apical dominance in grass tillers caused more shoots to grow, resulting in a thickening of the grass stand (Mosley *et al* 1997). Hayes (1978)[3] found that in the absence of livestock utilization, species richness and species diversity decreased in dry and moist meadow communities. In "brittle" environments, especially those in low rainfall areas, Savory (1999) found that lack of grazing actually had a worse impact on some upland watersheds than grazing. Under certain circumstances he found the grassland vegetation either shifts toward woody vegetation and "weeds" or to algae and lichens if not grazed.

Laycock (1994)[4] suggested that many vegetation types on public lands are currently in a stable state condition and even if livestock were completely removed, overall watershed condition would change little. Green and Kauffman (1995) found that after ten years of non-grazing in dry meadows, bluegrass remained the most dominant species while the abundane of other species declined. In moist meadows, they found *Carex rostrata* to remain dominant, while other species declined.

However, literature suggests that if **excessive** disturbances are allowed to continue through improper management, detrimental impacts may outweigh benefits (Clary & Webster 1989). Mathews (1996) found that trout density and biomass per unit area were significantly higher in ungrazed than in grazed areas in three of four comparisons. She found that ungrazed areas consistently had greater canopy shading, stream depths and bankfull heights and smaller stream widths than grazed areas. Effects of adverse grazing impacts can be long lasting, requiring a channel system to evolve through an evolutionary process that may take a significant period of time (Rosgen 1996).

The effects of livestock grazing on riparian areas, including stream channel stability, aquatic habitat, and water quality, have been studied and documented by numerous authors. Most agree that livestock can and do have impacts if improperly managed and can adversely affect the general characteristics and functions of riparian areas (Chaney *et al* 1991; Fitch and Adams 1998). Belsky *et al* (1999) concluded there were no positive effects of grazing and, at best, grazing had neutral effects. He found that livestock grazing negatively affects water quality and seasonal quantity, stream channel morphology, hydrology, riparian zone soils,

[2] In Vavra, Martin, William A. Laycock and Red D. Pieper eds. 1994. Ecological Implications of Livestock Herbovory in the West. Society for Range Management, Denver, CO.

[3] In Green, DM. and Boone Kauffman. 1995. Succesion and livestock Grazing in a Northeastern Oregon Riparian Ecosystem. Journal of Range Management. 48:307-313.

[4] Ibid

instream and streambank vegetation, and aquatic and riparian wildlife.

Effects include:

- Higher stream temperatures from lack of sufficient streamside cover;
- Excessive sediment in the channel from bank and upland erosion;
- High coliform bacteria counts from upper watershed sources;
- Channel widening from hoof-caused bank sloughing and later erosion by water;
- Change in the form of the water column and the channel it flows in;
- Change, reduction or elimination of vegetation;
- Elimination of riparian areas by channel degradation and lowering of the water table;
- Gradual stream channel trenching or braiding depending on soils and substrate composition with concurrent replacement of riparian vegetation with more xeric plant species (Clary 1989).

In addition Winegar (1977)[5] found severe icing conditions existed on a stream in Oregon within a reach grazed by livestock, but observed only light channel icing conditions within an adjacent ungrazed reach containing ungrazed riparian vegetation. He also observed that streamflows in an ungrazed stream reach changed from ephemeral to perennial conditions. Similar changes in flow conditions from intermittent to perennial have also been observed in Goodheart Creek, located on the Caribou National Forest after a reach was protected from grazing by fencing (Leffert, 2000).

EPA (1994) has also summarized grazing effects on riparian areas, as well as Chaney, *et al,* 1991; Myers (no date); Platts, *et al,* 1984, 1985 and 1991; Hall & Bryant 1995; and others.

Vegetation and ecosystem responses can be highly site-specific. No single formula or template can be used to anticipate or evaluate success or failure in all situations (Elmore & Kauffman 1994). The interacting factors that drive change, desired future vegetation and channel structure and condition, and how ungulates interact with the entire system should be the foundation of any practical grazing management strategy or restoration effort (Larsen *et al* 1998).

Riparian areas cannot be looked at as an entity in itself. A fundamental interdependence exists between upper watershed condition and riparian health and function (Chaney *et al* 1991; Elmore & Kauffman 1994)). Livestock grazing in the upland, for example, can increase soil compaction, decrease plant cover and soil surface litter that can reduce water infiltration capacities, which in turn, can increase overland flows and the volume of eroded material moving into riparian areas. Reduced conditions of the surrounding uplands may act to increase sediment-laden streamflows and increase stream erosive power, which can greatly impact riparian areas (Clary *et al* 1996a).

Streamside Vegetation and Stream Morphology

Streamside vegetation serves many ecological roles. These include reducing surface water flows, increasing water

[5]In Platts, William S. and Fred J. Wagstaff, *Fencing to Control Livestock Grazing on Riparian Habitats Along Streams: Is it a Viable Alternative?* North American Journal of Fisheries Management 4:266-272, 1984.

infiltration, decreasing erosion, capturing sediments, moderating soil and water temperatures, moderating seasonal stream flows, and facilitating nutrient cycling and energy flows (McInnis 1997). Riparian vegetation can have a significant influence on the stability of certain stream types (Rosgen 1996).

For many stream channels, a combination of riparian vegetation with woody root systems, deep rooted grasses and other vegetation provides a physical barrier to the effects of high water velocities and stream energy, which can control channel shape and function (Fitch and Adams 1998). The controlling influence of riparian vegetation can vary from low to high, depending on the stream type. Changes in the composition, vigor, and density of riparian vegetation produce corresponding changes in rooting depth, rooting density, shading, water temperature, physical protection from bank erosion processes, terrestrial insect habitat and contribution of detritus to the channel.

Water quality and aesthetic values are also affected by changes in riparian vegetation (Rosgen 1996). Where excessive livestock impacts occur, there is often a lowering of the surrounding water table (Clary *et al* 1996).

Summer solar radiation accounts for about 95 percent of the heat input into Rocky Mountain streams during midday. The presence of streamside vegetation can substantially reduce the amount of solar radiation reaching a stream, which serves to moderate summertime stream temperatures. Conversely, the same streamside vegetation can act as an insulator and preserve wintertime heat. Clary, *et al*, (1997) observed thick buildups of anchor ice in a reach of an Oregon stream where streamside vegetation was reduced by grazing, where an ungrazed reach had only light icing.[6]

The potential for change within a riparian system is related to the amount and kind of stress it receives. For example, a stream system with highly erodible banks has a high degree of potential natural stress. In this situation, management induced stresses (e.g. heavy livestock grazing) should be limited to avoid adjustments by the stream system into a lower or less stable successional state (McInnis 1997).

Indicators of stress include widening channel, channel downcutting, more than 10 percent eroding banks, increasing frequency of new streambars, noxious weeds or unvegetated streambanks, encroaching upland shrub species, lack of shrub and tree regeneration, and/or hedged shrubs (Harper *et al* 2000).

Conversely, stream morphology can have a direct influence on the type and densities of vegetation that may grow along a streambank. Knowing the stream type can assist in determining the potential succession of riparian vegetation communities (Overton *et al* 1995). The understanding of this interrelationship is critical to the proper management of livestock.

For example, when deep-rooted woody species are converted to shallower rooted grass/forb communities, the ability of plants to protect the bank from flow sheer stress changes, and a series of channel adjustments can take place. This can include an increase in sediment deposition, bank erosion, sediment supply, changes in channel shape, and channel slope, and decreases in meander

[6]In Platts, William S. and John N. Rinne, *Riparian and Stream Enhancement Management and Research in the Rocky Mountains*, North American Journal of Fisheries Management, Vol. 5, No. 2A, 1985.

length ratios and sinuosity. The resultant channel instability is often followed by a degradation of fish habitat (Rogsen 1996). Rosgen (1996) has described channel sensitivity to disturbance, recovery potential, streambank erosion potential and vegetation controlling influence by channel type (See Table 7, page 61)

Recent studies have indicated that the contribution of streambank erosion to total sediment yields has been greatly underestimated (Rosgen 1996). Rosgen (1996) identified five basic variables that influence the amount of potential bank erosion:

- Bank Height/Bankfull Height ratio;
- Root Depth/Bank Height ratio;
- Root Density;
- Bank Angle; and
- Surface Protection.

Of these five variables, three either directly or indirectly relate to the species and density of plants growing along the stream. Once a streambank begins to erode, two basic kinds of stream system adjustment responses occur in terms of erodibility characteristics: vertically and laterally (USDI 1990).

Vertically unstable streams will cut down causing an incised channel and lowered water tables. Henszey (1993)[7] explored the relationship of riparian plant communities to depth-to-groundwater. He found that the Wet Meadow type supported mostly a tall sedge plant community, where a Moist-Wet Meadow type supported tall and short growing sedges and tufted hairgrass. A Moist meadow consisted of mostly tufted hairgrass and Kentucky bluegrass, where a Dry Meadow contained mostly bluegrass. All communities were flooded about the same, but the Moist-Wet, Moist and Dry Meadows had increasingly longer periods of sub-surface water below the rooting depth of the plants. This suggests that depth to groundwater, rate of drainage, and availability of water to plants may cause a change in plant species composition along stream channels as they evolve through a successional sequence from mature to degraded.

Laterally unstable streams will not cut down, because of a restriction, such as rock, but can expand laterally through bank erosion (McInnis 1997). Lateral migration rates of the stream channel can be accelerated when variables, such as vegetation, are altered, especially those variables affecting detachment of bank material and flow stresses in the near-bank region (Rosgen, 1996). Some channel types are naturally armored and have an inherent ability to resist erosion and corresponding channel adjustment (Rosgen 1996; Elmore & Kauffman 1994). Channels containing bedrock or boulder substrate are examples.

However, in most stream types, the ability of streambanks to resist erosion is determined by:

- The ratio of streambank height to bankfull stage;
- The ratio of riparian vegetation rooting depth to streambank height;
- The degree of rooting density; the composition of streambank materials;
- Streambank angle;
- Bank material; and

[7]In Heitschmidt, Rod, Kenneth D. Sanders, E. Lamar Smith, W.A. Laycock, G Allen Rasmussen, Quentin D. Skinner, Frederick C. Hall, Richard Lindenmuth, Larry W. Van Tassell, James W. Richardson, et. al., *Stubble Height and Utilization Measurements, Uses and Misuses*, Agricultural Experiment Station, Oregon State University, Station Bulletin 682, May, 1988.

- Bank surface protection afforded by debris and vegetation.

If any of these variables are altered, a corresponding adjustment in the channel may be initiated (Rosgen 1996). The response of a given channel to stress depends on the inherent level of resilience of the system and how much stress is placed on the system (Elmore & Kauffman 1994).

Several methods of rating riparian and channel condition, stability, and stress have been developed. These include: Channel Stability (Pfankuch) Evaluation and Stream Classification Summary (Level III) (Rosgen 1996); Bank Erosion Hazard Index (BEHI) (Rosgen 1996); and the Properly Functioning Condition assessment procedure (Prichard 1998). Table 8 (page 63) describes desirable channel features. These features are designed after INFISH Riparian Management Objectives (RMOs).

Grazing Strategies in Riparian Areas

Stream channels, in association with adjacent riparian zones, adopt forms and modes of function that allow efficient transport of water and sediment (Leopold and Langbein, 1962).[8] Stream and channel form, in turn, contributes to the physical and biological makeup of the riparian system (Brussock, *et al*, 1985).[9] Channels continuously respond to changes in controlling factors such as discharge, sediment delivery, or changes in channel bed and/or bank conditions (BLM 1990). Increased channel sediment reduces channel capacity, increases width/depth ratios and induces bank erosion and other instabilities. Alternatively, excessive water reaching a stream system without additional sediment loading can erode the channel bottoms, thus incising the channel (Clary *et al* 2000). These adjustments can be rapid or evolve over a long period of time. Adjustments can also be nominal or severe, depending on a variety of factors (BLM 1990).

Riparian areas should be managed within the context of the entire watershed. A balance exists between health, diversity and productivity of riparian communities and the watershed conditions where they are contained. All tributary effects accumulate to influence riparian health and stability. Upland watersheds in satisfactory condition absorb storm energies, provide stormflow regulation through the soil mantle and contribute stability to the entire watershed. In contrast watershed that have experienced past abuse often have developed channel systems, including gully networks, throughout the watershed in response to the increased surface flows. These gully networks cause rapid, concentrated surface runoff with increased peak flows and sediment loads. In general, small streams are more affected by hillslope activities than larger streams, and, as adjacent slopes become steeper, the likelihood of disturbance from in-stream effects increases (Clary *et al* 2000).

In general, channel adjustments are characterized by either downcutting or widening. Excessive downcutting may not directly remove vegetation from the riparian zone, but may lower the water table, effectively de-watering the riparian zone,

[8] In Bureau of Land Management. 1990. *Riparian Management and Channel Evolution*, Course Number SS1737-2, Phoenix Training Center.
[9] Ibid

which effects the vegetation. A second scenario is channel widening, which can directly affect riparian vegetation through the loss of the channel bank and flood plain (Leffert 2000).

Throughout the western United States, deeply downcut channels are widespread and frequently occur in fine-grained, deep alluvial deposits where streambeds are unconstrained and non-resistant. These downcut channels result from either downstream base-level lowering or localized gullying initiated by changes in runoff rates or lowered resistance to erosion. Advancing gully systems may increase peak discharges, making the stream more efficient at scouring channel beds and banks (Wallace and Lane, 1976)[10]. Channel bed degradation produces a corresponding drop in the local water table, which imposes a subsequent water stress on the riparian vegetation (Groeneveld and Griepentrog 1985). A loss of riparian vegetation in turn lowers the resistance to flow, allowing higher flow velocities which increases scouring, which perpetuates the cycle (Schumm and Meyer 1979)[11].

In comparison, coarse alluvial channels or channels with structurally controlled beds tend to respond to direct riparian impacts by becoming wider and shallower with less-steep banks (Kauffman, *et al*, 1983, Duff 1977). In addition to providing poor aquatic habitat attributes (Kauffman & Krueger 1984), channels impacted by lateral scouring may become less capable of properly transporting high flows and may directly impact riparian areas through bank cutting or channel realignment during high flow periods. Riparian area problems caused by this type of channel condition are aggravated by increased in-stream sediment loads resulting from upstream erosion (Jackson 1984)[12] which may cause further channel adjustments, perpetuating the cycle.

Management options will vary depending on the type of channel adjustment (downcutting vs. channel widening). Deep, narrow downcut channels, especially those still active that have not reached a firm or resistant bed level, are the least responsive to various management options. Designed structures can be very expensive to install and the probability of improving the overall condition is minimal. Removing or reducing livestock impacts also provides minimal response. Once in this condition, the channel must be allowed to progress through the evolutionary process to the next phase or stage (BLM 1990; Rosgen 1996).

On the other hand, channels that have bed controls and adjust laterally tend to respond directly to riparian vegetation conditions. Stream banks and floodplains generally can be rehabilitated relatively rapidly, provided the water table has not been affected by excessive channel downcutting. In this scenario, elimination or reduction of livestock grazing in the riparian zone generally results in quick recovery (Platts and Rinne 1985). The need to understand the cause of stream/riparian degradation, and work with the natural recovery process operating in a stream system needs to be emphasized (Cairns, *et al*, 1979)[13].

Rehabilitation should emphasize establishing the physical and biological conditions that favor rapid recovery by natural processes. Stream systems undergoing major channel adjustments should not be treated with extensive habitat improvements until the channel has reached a new dynamic equilibrium (BLM 1990). Dynamic

[10] In BLM 1990
[11] Ibid
[12] Ibid
[13] Ibid

equilibrium has been described by Rosgen (1996), Prichard (1998), and others.

For example, Magilligan and McDowell investigated four gravel-bedded, steep alluvial streams in eastern Oregon, with cattle exclosures greater than 14 years old. Results indicated that significant changes occurred, with reductions in bankfull dimensions and increases in pool area being the most common and identifiable changes. At the four sites, bankfull widths narrowed by 10% to 20%, and the percentage of the channel area occupied by pools increased by 8% to 15%. Increase in pool area was offset by a reduction in the percent glide area. However, they also stated that not all channel properties demonstrated adjustment, indicating that not all variables may show a significant change in that time period. Platts and Nelson (no date) noted a substantial difference in stream morphology between grazed and ungrazed pastures, as did Clifton (no date). Platts and Nelson (no date) also noted channel improvements were observed after 4 years of removing livestock from the pasture. Kondolf (1993) noted that channel adjustment to grazing pressure may lag behind plant changes because of the time required to erode and deposit sediment along the banks of a stream channel.

Strategies for grazing in riparian areas vary somewhat between authors, but most have a common theme. These themes include: Limit grazing intensity, frequency, and/or season of use, thereby providing sufficient rest to encourage plant vigor, regrowth and energy storage and minimize compaction of soil; control the timing of grazing to prevent damage to streambanks when they are most vulnerable to trampling; and ensure sufficient vegetation during periods of high flow to protect streambanks, dissipate energy and trap sediments (Leonard *et al* 1997; Platts & Nelson 1985; Ehrhart & Hansen 1998; Chaney, *et al*, 1991; Mosley, *et al*, 1997).

Reduction or elimination of negative livestock impacts to streambanks within western riparian zones requires an understanding of the interaction between climatic patterns, riparian zone soils and livestock behavior (Marlow 1987). Before a specific grazing strategy is implemented in response to an observed channel condition, several items must be known to properly apply the most beneficial and cost/effective management approach. Normal channel adjustments associated with water/sediment processes may actually serve to enhance or rejuvenate riparian conditions. Excessive adjustments, however, associated with rapid responses to changes may temporarily or permanently impair normal stream channel and riparian conditions (BLM 1990). Management responses or strategies in turn require: a) a description or classification of riparian area degradation; and b) an identification of the cause(s) of impaired riparian conditions (BLM 1990).

Passive, continuous grazing rarely improves deteriorated riparian areas or maintains riparian areas in good condition. Grazing must provide an adequate cover and height of vegetation on streambanks and overflow zones to promote natural stream functions (sediment filtering, bank stability, aquifer recharge and water storage) (Leonard, *et al*, 1997).

Platts (1991)[14] highlights three major considerations for maintaining or restoring riparian areas. First, grazing management must consider the needs of those plant species that establish riparian function.

[14] In Meehan 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. AFS Spec. Publ. 19, Bethesda, MD. p. 289-423

Species with deep fibrous roots provide sod mats, plant diversity provides multi-layered vegetation cover, and woody species provide roots and large woody debris. Second, there must be adequate plant cover and residue to attenuate high flows. Third, protection from grazing is required during vulnerable periods when banks are saturated and easily damaged or in autumn when woody species are most vulnerable to browsing.

Perry (2005) suggested several ways to manage livestock impacts within riparian areas. He emphasized that fencing must remain as a possible alternative, but it should be the **last** choice, after every other management option has been considered. Other options include:

- Develop off-stream watering in as many places as possible.
- Create "hardened crossings" where there are steep banks which are vulnerable to livestock damage, or during muddy conditions.
- Provide culverts or bridges as an easy way for cattle to cross a stream without needing to ford the stream.
- On wooded or densely brushed streams, a physical barrier made up of felled trees or logs may work in places where animals are causing damage.
- Graze in the spring in areas susceptible to bank damage.
- Locate salt and nutrient blocks well away from the riparian zone.
- Riding to move animals away from water, works well in many cases.
- Burn, mow or intensively graze or in some other way remove some old, un-grazed forage on suitable sites away from streams, making palatable re-growth more accessible.
- Remove animals from the herd that habitually hang in the riparian zone, and conversely, keep older animals that do not.

Davison & Newfield (2005) suggested that constructing off-riparian shade structures in rangelands lacking shade would also assist in reducing livestock impacts in riparian zones.

Monitoring Parameters

In order to assess the condition and use of riparian areas by livestock and other users and impacts, various authors have suggested several parameters that could be effectively monitored. Stocking rates, percent utilization of plants and stubble heights have all been used to describe grazing intensity. Each measurement has its purpose, benefits, and shortcomings (Mosley *et al* 1997). Rosgen (1996) and others have suggested other parameters, such as bank stability and soil disturbance. The following section details the most popular parameters.

Stubble Height

The height of grassy and herbaceous vegetation on a site has been termed "stubble height" (Heitschmidt *et al* 1998). Stubble height is a surrogate for plant vigor and streambank and riparian protection/rebuilding capabilities. It is not only a way to measure utilization by grazing, but it also has value in evaluating how well vegetation and grazing management meets channel stability goals and objectives. Several researchers have advocated specific residual stubble heights following grazing to maintain plant vigor and protect or improve stream banks (Heitschmidt *et al* 1998).

Plant growth occurs from meristematic tissue. The growing points of grasses are located in the crown of the plant close to the ground, until the culm elongates to produce a seedhead. During the seedhead stage, the growing point is elevated and is exposed to

grazing animals. When a grass is grazed without removing the growing point, leaf growth will continue so long as there is adequate soil moisture and nutrients. When grazing removes the growing point, growth of that tiller stops and the plant must begin growth from a new bud. Development of these tillers will be slower than ungrazed tillers. Growth, form, palatability and vigor of these tillers may be different between grazed and ungrazed plants.

Some grasses, such as Kentucky bluegrass do not elevate their growing points until just before the reproductive phase. These plants are more resistant to close grazing than other species that elevate their growing point earlier in their development (McInnis 1997). As a result, different plants may require different grazing strategies to maintain plant health and vigor (Marlow 2001).

Plant vigor can be measured or evaluated in many different ways. One common way is to measure the change in the relationship or the ratio of underground biomass to above-ground biomass over time. Studies show that grazing can alter above-ground biomass to such an extent that undergound biomass is reduced. Not only is the photosynthesizing capacity of the plant diminished, but the carbohydrate root reserves that support growth and regrowth are reduced. Research offers strong support for measuring stubble height to monitor grazing effects on plant vigor (Heitschmidt *et al* 1998).

Clary & Webster (1989) recommended that a minimum herbage stubble height be present on all streamside areas at the end of the growing season, or at the end of the grazing season if grazing occurs after frost in the fall, to maintain plant vigor and health. They suggest residual stubble or regrowth should be at least four to six inches to provide sufficient herbaceous forage biomass to meet the requirements of plant vigor maintenance, bank protection and sediment entrapment. The stubble height criterion should be adhered to regardless of the grazing system used (Clary & Webster 1989). Clary & Webster (1995) suggested that a stubble height of ten centimeters (four inches), or about 30 percent utilization, appears to be required to ensure full biomass production in high mountain meadow (greater than 1,900 meters) sedge communities.[15]

Clary (1999) found that most measurements of streamside variables moved closer to those beneficial for salmonid fisheries when pastures were grazed to a ten centimeter (four inches) graminoid stubble height, while virtually all measurements improved when pastures were grazed to fourteen centimeters (six inches) stubble height.

The Rocky Mountain Region, Watershed Conservation Handbook, (September 1996) advocates removal of livestock from riparian areas when average stubble height on key species reaches four inches in early-use pastures and six inches or more in late-use pastures. Hockett and Roscoe (1993) advocate greenline end-of-season stubble heights of at least twenty centimeters (eight inches) and ten to fifteen centimeters (four to six inches) for riverine systems of high to low sensitivity levels, respectively, and more than 75 percent and 35-50 percent of ungrazed plant height for high and low sensitivity level palustrine systems,

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[15]In Clary, WP, *Vegetation and soil responses to grazing simulation on riparian meadows*, J. Range Management 48, 18-25, 1995; in USDI, BLM, List of References on the Use of Utilization Guidelines and on the Effects of Lower Stocking Rates on the Recovery of Rangelands, 17 September, 1997.

respectively, in southwest Montana that are designed to comply with State of Montana water quality standards.

Caution should be used when working with different plant communities. Existing Forest Service guidelines (Clary & Webster 1989) are based largely on minimum stubble heights in communities dominated by Kentucky bluegrass. If the riparian area is dominated by taller grass species, like timothy, mountain brome, streambank wheatgrass, tufted hairgrass, fowl Mannagrass for fowl bluegrass, adherence to the recommended stubble heights will lead to 80 percent or more utilization. In these situations, eight to nine-inch stubble heights equate to about 50 percent utilization (Marlow 2001).

If the channel has been degraded and streambanks need to be rebuilt, a key element for the restoration process is the entrapment and retention of sediment at or below bank top. Sediment deposition in a degraded stream system is an essential building material for the natural recovery of channel form (Clary *et al* 1996). Streambank vegetation has been shown to increase channel roughness. Increased channel roughness, in turn, dissipates energy and promotes sediment deposition (Heitschmidt *et al* 1998). Total sediment retention appears to be at or near maximum for flexible stubble heights up to six inches during the depositional phase (when sediment is being deposited) of the hydrograph, although longer length vegetation appears to retain a larger portion of the sediment deposited during the flushing phase (when sediments are being flushed through the system) of the hydrograph (Clary *et al* 1996).

In addition to the physical attributes of stubble height, palatability of vegetation species also changes as stubble height is lowered. Because of their preferred eating habits, cattle prefer vegetation greater than three inches high. As stubble heights are grazed below three inches for the most palatable species, vegetation preference will change, forcing cattle onto less desirable areas or eating less desirable species, such as changing from grass to sedges to shrubs (Hall & Bryant 1995).

Other researchers found a shift in preference from herbaceous vegetation to shrubs below a stubble height of four to six inches, or about 45 percent utilization. Stubble heights below two to four inches induced excessive browsing of willows (Mosley *et al* 1997, Pelster *et al* in press). This in turn can influence the vigor and distribution of riparian vegetation, which in turn can directly affect channel stability. Therefore, stubble height not only has a direct correlation to physical channel stabilizing attributes but reflects a point at which livestock may change from consuming grassy and herbaceous species to other species such as sedges and willows. This switch may not be preferable in relation to channel maintenance features, water quality and/or fisheries habitat (Hall & Bryant 1995).

Platts (1991)[16] suggests that trees, brush, grasses and forbs each play an important role in building and maintaining productive stream ecosystems. Grasses and grass-like plants, especially sod-forming types, help build and bind bank materials, and reduce erosion. As well-sodded banks erode, they create the undercuts important as hiding cover for fish. Even though he does not suggest specific stubble heights, he emphasizes the importance of streamside

[16]In Meehan, William R., *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats*, American Fisheries Society Special Publication 19, Bethesda, MD, 1991

vegetation for cover. This suggests that one-inch or even six-inch stubble heights may not be enough to provide needed protection, but longer stubble heights that bend over the bank may be needed for cover and protection as well as provide thermal moderation in smaller streams.

In 2004, the University of Idaho issued "Stubble Height Study Report". In responding to requests of both the Forest Service and Bureau of Land Management, the University put together a team to review the use of stubble height and make recommendations on its use. The 33 page report thoroughly examined 10 questions: 1) What agency objectives are we trying to achieve with stubble height? 2) What is the appropriate use of stubble height? 3) How are the agencies in fact using it? 4) What are the limitations of its use? 5) How appropriate is it to use to address annual long-term management strategies? 6) What additional research might be needed, if any, to affirm or refine this measure? 7) What other measures might be used in its place? 8) What other measures might be needed to achieve management objectives in riparian areas? 9) How much rest or change in management is needed when stubble height objectives are not met? and 10) Can we adjust the stubble height objective if a grazing management system is in place? Conclusions of the report are as complex as the questions.

Conclusion

Stubble height appears to be an appropriate parameter to monitor potential effects on plant vigor, bank stability and regeneration, and movement of livestock to other plant types and species. Maintaining a minimum stubble height helps preserve forage plant vigor, retain sufficient forage to reduce cattle browsing of willows, stabilize sediments, indirectly limit streambank trampling, maintain cattle gains and provide an easily communicated management criterion (Clary and Leininger 2000).

It appears that stubble heights less than two to three inches is an indicator of detrimental effects to plant vigor, movement to other plant species, bank stability and bank building. Maintenance of plant vigor, which includes roots, is extremely important for bank stability. High elevation (greater than 1,900 meters) mountain meadow sedge communities appear to require at least four inches residual to ensure full biomass production. Other species at lower elevations with longer growing seasons could withstand clipping down to two inches and still maintain vigor depending on the regrowth from the end of the grazing period to the end of the growing season. Changes in palatability and preference begin to appear below six inches and appears to be profound below two inches. Clary and Leininger (2000) recommend a four-inch stubble height be a minimum starting point. Monitoring should be conducted to determine if adjustments are needed.

Bank sediment holding capacity is diminished below two inches and maximized during the sediment deposition phase of the hydrograph at six inches. Therefore, two inches appears be an absolute minimum allowable stubble height under any circumstances, no matter what the channel type or overall riparian condition. For most applications, four to six inches residual appears to be all that is necessary to maintain bank-building process and reduce livestock migration to less palatable species. As a result, a range in stubble heights between two inches and six inches appears to be appropriate to maintain bank stability, plant vigor and riparian plant integrity, with a medium range of four to six inches being appropriate for most circumstances.

However, Clary and Leininger (2000) also found that stubble heights may have little application where streambanks are naturally stabilized by coarse substrates, or where the channels are deeply incised.

In some situations, such as fish cover, water quality protection and thermal moderation, stubble heights in excess of six inches may be needed. This may be especially important along smaller or non-forest streams where overhead shrub and tree cover may be lacking. Hockett and Roscoe (1993) appeared to recognize this and advocated an end-of-season stubble height of at least eight inches on sensitive streams.

Stubble height is NOT an appropriate performance standard to be used as a management standard as a desired condition, end-point or trend. It can be used, however, as a guideline or indicator for evaluating and/or changing annual management in Annual Operating Instructions. Stubble height is appropriately used as a short-term indicator of grazing effects on meeting long-term riparian management objectives, such as channel stability or vegetation composition. Stubble height criteria can vary depending upon local environmental variables, condition and trend of the stream, species composition on the greenline and the season, frequency and duration of livestock use. Stubble height criteria not only can but should be adjusted through adaptive management, based on riparian conditions and trend (University of Idaho 2004).

Percent Plant Utilization

The impact of grazing on plant communities may be estimated in two ways: by estimating the height of vegetation that remains after grazing (stubble height), or by the amount of vegetation that has been consumed (utilization) (Heitschmidt *et al* 1998). Some authors argue that individual plants differ in physiology and have different inherent growing heights. For example, 35 percent utilization might result in a 5-inch stubble height for Agsp (bluebunch wheatgrass), a 2-inch stubble height for Feid (Idaho fescue) and Pose (sandberg bluegrass), and a 2.5-inch stubble height for Koer (junegrass) (USDA 1999). A 50 percent utilization of taller grasses like timothy, mountain brome, streambank wheatgrass, etc. will equate to an eight- to nine-inch stubble height (Marlow 2001). Further, during some seasons or periods with low moisture levels, some plants may not achieve a specific stubble height. Therefore, in these situations, the percent of the plant used may be a better indicator of use than the physical height of the plant remaining (Clary & Webster 1989) unless specific on-site correlations can be made.

Determining percent utilization can be a time-consuming process and subject to error, depending on a variety of factors. By definition, measuring utilization requires knowing the total production for the year for the species in question. This requirement makes a true measurement of utilization difficult. Total yearly production cannot be effectively measured before the end of the growing season. The best that can be done in a one-time effort prior to that time is to estimate peak standing crop of current-year production. Measurement before the point of peak standing crop results in a low estimate of total biomass, because annual production has not been completed. Low estimates can occur after peak growth due to losses from weathering, insects and decay (Heitschmidt *et al* 1998). Because of these factors, it is difficult for the manager to use percent utilization as an accurate and effective tool during the growing season to indicate allowable conditions have been achieved and livestock should be moved.

Nevertheless, some researchers and authors have suggested specific utilization standards. Clary & Webster (1989) suggested a maximum utilization of riparian herbaceous vegetation during spring, summer and fall grazing periods not to exceed 65 percent, 40-50 percent, and 30 percent respectively, within riparian pastures in good to high ecological status. Clary & Webster (1995) also found that if utilization guidelines are used, those rates that do not exceed 30 percent of the annual biomass production in mountain meadow sedge communities will likely maintain production the following year. Clary (1999) found that light grazing (20-25 percent) utilization, and medium grazing (35-50 percent) during late June, improved stream channel width/depth ratios and channel bottom embeddedness over conditions resulting from past traditional heavier use rates. The Rocky Mountain Region's (R-2) Water Conservation Practices Handbook advocates a maximum use of 40-45 percent of annual production in riparian areas (USDA 1996). Hockett and Roscoe (1993) advocate allowable utilization levels of less than 30-45 percent along high sensitivity streams, lakes and wetlands and 45-60 percent utilization along moderate and low sensitivity waterbodies. Fitch and Adams (1998) state that recommended utilization levels reviewed in literature tend to fall in the range of 25-65 percent, but levels should be set to maintain herbaceous productivity, leave adequate protective cover during high runoff periods to protect banks, filter or trap sediment and dissipate stream energy. Clary (1999) equated light grazing to 20-25 percent utilization and medium intensity grazing to 35-50 percent utilization during late June. Both the light and moderate grazing intensities resulted in improved riparian and stream channel conditions that resulted from past heavy grazing.

Upland utilization levels have been well documented. For example, Beale (1984) tested the effects of various sheep utilization levels on animal production per unit area in semi-arid rangelands west of Queensland, Australia. They found the optimum utilization rate appeared to be about 30 percent. Gray (1968) concluded that net returns on rangelands are highest when the grazing rate is moderate (30-50 percent). Holechek (1988) summarized acceptable stocking rates as those that resulted in utilization of 30-40 percent within semi-desert grasslands and shrublands, coniferous forests, mountain shrublands and oak woodlands.

Higher utilization levels can be allowed on ranges in good condition, while lower utilization levels should be used on poorer rangeland conditions. Holechek (1994)[17] suggested that moderate (40- 45 percent) utilization appears more profitable and less risky than heavy (60-65 percent) on shortgrass ranges in New Mexico. Houston (1966)[18] concluded that utilization of both western wheatgrass and needle-and-thread grass should not exceed 33-37 percent by weight for optimum productivity. Hyder (1951)[19] argued for utilization levels of 30-40 percent for most sagebrush-grass rangelands. Johnson (1953)[20] found that average herbage production decreased with heavy grazing (greater than 50 percent), while production increased with light to moderate grazing (less than 40 percent) in central Colorado. Klipple

[17] In Willoughby, John, Letter and enclosed *List of References of Utilization Guidelines and on the Effects of Lower Stocking Rates on the Recovery of Rangelands*, to Dr. Jerry Holechek, College of Agriculture and Home Economics, Department of Animal and Range Sciences, Las Cruces, NM, USDI, BLM, Sacramento, CA.,Sept. 25, 1997.
[18] Ibid
[19] Ibid
[20] Ibid

(1960)[21] concluded that 60 percent utilization was too heavy, either for maintaining satisfactory range condition or making best gains by the cattle, while 40 percent utilization maintained or improved range condition and maintained the cattle in thrifty condition. Vallentine (1990)[22] suggested proper use of 35-45 percent for western mountain grasslands, shrublands and coniferous forests. Holechek (1988) found percent use of key species for moderate grazing ranges between 30-40 percent in semidesert grass and shrublands, sagebrush grasslands, coniferous forests, mountain shrublands, and oak woodlands. He also suggests a percent reduction of grazing capacity based on slope. For example, slopes ranging from 31-60 percent should have grazing capacity reduced by 60 percent. Lacey (1988) suggested most plants can maintain vigor if no more than 30-50 percent of their growth is removed during the growing season. Although plants may tolerate 60-65 percent utilization during non-growth periods, sufficient litter and stubble must be left to reduce evaporation, protect growth buds, catch snow, protect plant crowns from freezing and retard soil erosion. He suggests overall range condition will usually improve or be maintained under a moderate (31-60 percent) degree of grazing use.

Several authors have described the relationship between stubble height and percent utilization. Clary & Webster (1989) described an approximate relationship between percentage utilization and stubble height of riparian graminoids based on a 1988 study from the Stanley Creek (mountain meadow ecosystem) and Pole Creek (sagebrush ecosystem) studies. These data suggest that average utilization levels of 24-32 percent were obtained when riparian graminoids were grazed to a six-inch stubble height, use levels of 37 to 44 percent equated to a four-inch stubble height, and use levels of 47-51 percent were obtained at a three-inch stubble height. Heitschmidt, *et al*, (1998) found that 50 percent utilization of Kentucky bluegrass, tufted hairgrass and Nebraska sedge equated to 3 inches, 2 inches and 6 inches respectively.

The reason for the differences is the physiology of the plants. Herbage weight of leaves and shoots of Nebraska sedge is somewhat evenly distributed from the plant's crown to its top. In contrast, most herbage weight of Kentucky bluegrass and tufted hairgrass is near the ground surface as leaves and only a small portion of the overall biomass is elevated as stems and flowers. Forest Service Handbook 2209.21 (1993) describes average utilization levels of riparian graminoids of 24-32 percent equated to a six-inch stubble height, 37-44 percent equates to a four-inch stubble height, and 47-51 percent equates to a three-inch stubble height.

Conclusion

Percent utilization, as stubble height, is a surrogate for plant vigor and streambank protection/rebuilding capabilities. The inherent difficulties of measuring percent utilization aside, the literature appears to support utilization rates less than 50 percent for most riparian herbaceous vegetation types in most climatic and geographic areas. The better the range site condition, the more allowable utilization. Acceptable utilization rates appear to be somewhat higher across-the-board in riparian areas than on some upland ranges, primarily because of the available moisture that supports regrowth. In riparian areas, because of the increased

[21] Ibid
[22] Ibid

moisture levels, it appears that utilization rates can be adjusted by season of use (early, mid, late) that allows for plant regrowth potential following use. Clary & Webster (1989) suggested a maximum utilization of spring, summer and fall grazing periods not to exceed 65 percent, 40-50 percent, and 30 percent respectively, within riparian pastures in good to high ecological status. He does not specifically suggest any use rates for areas in less than acceptable condition, other than citing other researchers such as Ratliff.

Ratlif, *et al*, (1987) suggested utilization rates for site protection should be 35-45 percent on excellent condition meadows, down to 20-30 percent on poor condition meadows (condition descriptions for 'excellent' and 'poor' are undefined). Hockett and Roscoe (1993) suggested utilization levels between 30 percent and 60 percent, depending on the system and sensitivity level. Clary (1999) suggested that riparian and stream condition improved with light to moderate utilization with levels ranging from 20-50 percent. Burkhardt (1997), suggested that proper season of use and just plain rest are far more effective for dealing with most riparian grazing problems than are utilization use limits.

Several authors have described the relationship between percent utilization and stubble height. The relationship between percent utilization and stubble height shows continuity between recommendations of 30-50 percent utilization and recommendations of leaving three to six inches stubble height for maintenance of plant vigor.

For example, Kovalchik, *et al* (1992)[23] equated 45 percent riparian herbaceous vegetation utilization to four- to six-inch stubble height, and two to four inches to 65 percent utilization. Schmutz (1978) described the relationship between southwestern upland species using photographic guides to compare portions of plant remaining to percent utilization. Lacey (1988) also evaluated upland range grass stubble height to percent utilization. Forty-five percent utilization (moderate use) had corresponding stubble heights ranging from two inches (Blue grama) to nine inches (Indian Ricegrass), depending on the species and site. However, most evaluated species had corresponding moderate use stubble heights in the five-inch to six-inch range. As is the situation with stubble height, it should be used as a short-term indicator, not as an end-point, condition or trend.

Bank Disturbance (Alteration) and Stability

The cornerstone for proper stream function is stability (Kaufman 1984; Marcuson 1977; Platts *et al* 1983). Various stream types have different inherent channel stabilities which must be considered when determining potential effects of livestock grazing or any other uses or activities on water quality or aquatic habitat (Rosgen 1996). Consideration must not only be given to damage potential but to the recovery potential of affected channels. Overgrazing can cause bank slough-off creating false setback banks and accelerated sedimentation

[23] In Mosley, Jeffrey C., Philip S. Cook, Amber J. Griffis, and Jay O'Laughlin, *Guidelines for Managing Cattle Grazing in Riparian Areas to Protect Water Quality: Review of Research and Best Management Practices Policy*, Report No. 15, Idaho Forest, Wildlife and Range Policy Analysis Group, University of Idaho, 1997.

and subsequent silt degradation of spawning and food producing areas. This can result in decreased fish biomass and percent of salmonid fishes in the total fish composition (Kaufman, *et al* 1984, Platts 1990).

Myers and Swanson (1992) found that bank damage from ungulates had different effects on different stream types and even on different parts of their cross-sections. Vegetation is more important for stability on certain stream types than on other types. Streams with non-cohesive sand and gravel banks are most sensitive to livestock grazing. They concluded that range managers should consider the stream type when setting local standards, writing management objectives or determining riparian grazing strategies.

High forage removal, high amounts of foraging time along banks, and heavy uses of palatable sedges along the bank have been shown to significantly increase the probability of bank slough-off occurring during the grazing season (Kaufman *et al* 1984). Duff (1979)[24] found the stream channel width in a grazed area was 173 percent greater than the stream channel not grazed for eight years.

Platts & Rinne (1985) found that streamside grazing probably does as much or more damage through bank alteration than through changes in vegetative biomass. Further, he suggested that bank conditions do not improve during a single rest period, but rather, regrowth of vegetation tends to mask unstable reaches. He found that prolonged use of streamside vegetation not only will alter a bank but will also retard the rehabilitation of previously altered banks.

Similar conclusions have been reported by other authors, where overgrazing and excessive trampling caused a decrease in bank undercuts, increases in channel widths, and a general degradation of fish habitat (Kaufman *et al* 1984). For example, VanVelson (1979)[25] found rough fish made up 88 percent of a fish population before relief from grazing and only 1 percent of the population after eight years of rest. Kaufman *et al* (1984) had similar observations.

Geomorphologists, such as Rosgen (1996), have determined sensitivity to disturbance, streambank erosion potential, and vegetation controlling influences for each major channel type. Rosgen determined that bank erosion is a factor of physical bank features such as bank angle, percent surface protection and plant root depth/bank height ratios, and near-bank sheer stresses. This information can in turn be used to determine potential short-term and long-term implications of various impacts, such as grazing, on stream channels.

Platts & Rinne (1985) found that rest-rotation grazing in Idaho had a higher use rate in the stream-side zone than on the remainder of the allotment. He also observed that stream-bank alteration occurred soon after cattle were turned into ungrazed meadows. Clary *et al* (1996) found that vegetation protection potential of some streambanks is extremely important, and lack of rhizomatous grass-like species left streambanks poorly protected. As a result, all grazing intensities, except no grazing, under these conditions, experienced an increase in stream channel width-depth ratios. He concluded that recovery of the degraded riparian zone of the subject study

[24] In Kaufman, J. Boone and W.C. Krueger, *Livestock Impacts on Riparian Ecosystems and Streamside Management Implications Review*, Journal of Range Management 37(5), Sept. 1984, pg 430-438.

[25] In Kaufman, J. Boone and W.C. Krueger, *Livestock Impacts on Riparian Ecosystems and Streamside Management Implications Review*, Journal of Range Management 37(5), Sept. 1984, pg 430-438.

area would require many years, if not decades to recover. Further, simply resting an area may or may not be sufficient to restore more natural conditions.

One study showed that existing herbaceous plant species increased in growth and vigor under reduced grazing (ungrazed and moderate grazing) but there was no measurable increase in occurrence of bank protecting rhizomatous wetland species (Clary *et al* 1996). Therefore, if a species is not on site, at least in limited numbers, or if there is no seed source, one cannot expect to reestablish desirable deep-rooted species simply by resting. However, if the species is already on site, the presence of wetland species can be expected to increase through resting (Clary *et al* 1996).

The Beaverhead National Forest (USDA BNF, undated) conducted a thorough review of livestock impacts on streams. They concluded that a number of researchers recognize that livestock can have an effect on streambank stability. For example, Clifton (1989) stated "Livestock impacts can be divided into impacts on streamside vegetation and impacts on the adjacent channel. Impacts on the stream channel include increased channel bank instability, channel shape adjustments and changes in sediment and discharge volumes."

Platts, *et al*, (1989) stated "Considerable [streambank] structural difference was observed between grazed sites and sites where grazing had been suspended or greatly reduced..." Platts (1990) stated "Streambank effects are trampling, shearing and overhanging bank caving." Trimble, *et al*, (1995) stated "The net results of grazing in riparian areas... can be: 1) direct modification of stream channels and banks; and 2) reduction of resistance to higher flows which promotes channel erosion. Trampling in the stream may break up armored layers and expose the substrate. When resistance is breached by grazing, it is conceivable that such reaches may degrade even with no change in streamflow regime."[26]

The inherent stability of stream banks has not been thoroughly explored in the literature. Rosgen (1996) describes sensitivity levels of various channel types, but does not define inherent stability. Overton *et al* (1995) described bank stability for streams representing natural conditions within the Salmon River basin by gross channel type as defined by Rosgen (1996) and others (e.g. A, B, C, etc.), but did not further define channel type by substrate, though geological descriptors were included. They found the mean inherent stability for "A" channel types was 97 percent; for "B" channels was 87 percent, and "C" channels 85 percent.

The Beaverhead National Forest (BNF, 1997) developed allowable disturbance founded on existing vegetation communities and sensitivity levels based on soil/vegetation biodiversity, fisheries, recreation, wildlife and water considerations. A table determines an allowable percentage of natural stability that should be maintained to ensure a stable system persists. Natural stability is based on vegetation communities present along the streambank, ranging from 20 percent to 100 percent (Bengeyfield and Svoboda, 2000).

INFISH (1995) states as a Riparian Management Objective that all non-forested streams, regardless of the geographic setting or channel type, should have banks greater than 80 percent stable. No bank stability objective is set for forested systems.

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[26]In USDA Forest Service, *Allowable Streambank Alteration and the Beaverhead Riparian Guidelines*, Beaverhead National Forest, USFS R-1, undated.

Riparian Management Objectives can be modified through a site-specific analysis. Harper (2000 b) agrees that at least 80 percent of the streambank should be in stable condition, though total vegetative cover can be as little as 50 percent of the total stream area. Bauer and Ralph (1999) advocate 90 percent bank stability to maintain water quality and aquatic habitat. Again, these are generic values, without regard to any specific geophysical features.

Forest Service Region Two (USDA-FS R2, 1996) has a Standard that states: "Maintain the extent of stable banks in each stream reach at 80 percent or more of reference conditions. Limit cumulative stream bank alteration (soil trampled or exposed) at any time to 20-25 percent of any stream reach." Forest Service Regions 1 and 4 Soil and Water Conservation Practices Handbook states: "The appropriate percent stream bank disturbance to be allowed for each riparian area is established using vegetation condition and soils information coordinated with stream types (Rosgen), to estimate the amount of streambank that should be stable under ungrazed conditions. The percent will vary, depending on site-specific conditions. An example of the percent disturbance that might be identified may be a range from as low as 10 percent above what occurs naturally on the areas with most sensitivity to 40 percent disturbance on areas of least sensitivity" (USDA-FS, 1995).

The Handbook further states: "The overriding concept behind measuring bank disturbance is making sure that the integrity of the streambank remains." "Physical alteration of the bank by trampling results in widening of the stream channel, and leads to a scenario that eventually results in a loss of riparian functions." "Bank alteration should be approached not only by asking, 'Is it causing erosion?' but 'is it preventing recovery'?"

Hockett and Roscoe (1993) advocate maximum allowable bank disturbance standards of 10 percent or less for sensitive streams and 10-25 percent for moderate to low sensitivity streams. Rosgen (1996) does not advocate any specific standards, only that "Grazing standards should focus... on percentage allowable bank damage seasonally..." and "... allowable annual bank damage by hoof shear by stream type."

Channel adjustment will occur if sufficient channel modifications and disturbances occur. These modifications include changes in: the ratio of streambank height to bankfull stage; the ratio of riparian vegetation rooting depth to streambank height; the degree of rooting density; the composition of streambank materials; streambank angle; and bank surface protection afforded by debris and vegetation (Rosgen, 1996).

Besides the physical attributes of bank stability, Williams *et al* (2004) studied the economic benefits of bank stabilization. They concluded that net gains are realized from the value of hectares not lost erosion. Conversely, it would follow that economic gains would be realized by not having to clean out downstream diversion facilities and reservoirs that serve as a depository for upstream erosion.

Conclusion

Streambank “stability” and streambank “disturbance/alteration”, though two different concepts, have been used interchangeably by many authors and managers. The two parameters, however, are substantially different. Streambank “stability” is an indicator of the effectiveness of management in achieving **long-term** goal and objectives for stream, riparian and aquatic resources. It is usually defined in four to six categories, evaluated as a percentage: Covered Stable;

Uncovered Stable; Covered Unstable; Uncovered Unstable; and may include False Bank and Unclassified, or Other. The "stability" is the result of all or cumulative impacts to a stream, not just livestock. Bank "disturbance/ alteration", on the other hand, is used for annual or **short-term** monitoring that may be used to make annual adjustments to livestock grazing management practices to meet long-term stability goals and objectives. It describes the linear percentage of a streambank that is altered by animals walking along the streambank. Hoof sheering is the most obvious form of alteration. Shearing exposes bare soil, which increases the risk of erosion to the streambank (Cowley and Burton 2005).

Little specific research was found in reference to inherent natural bank stability by channel type or the amount of acceptable or allowable bank disturbance to maintain overall channel stability.

The Beaverhead National Forest found a correlation between vegetation communities and inherent stability. Stream types are used in the determination of Sensitivity Levels. Using their information, desirable deep-rooted carex and salix communities can be 80-100 percent stable under unimpaired conditions. Overton *et al* (1995) found A, B, and C reference channel types to be 97 percent, 87 percent and 85 percent stable respectively within the study area. Observations by Leffert (2000) found that if an adjustable channel is more than about 20-30 percent disturbed, channel adjustment processes begin to occur. This is not an 'instantaneous' or specific threshold-induced adjustment, rather it initiates a more continuous series of channel adjustments over time to accommodate changes in channel dimension, sediment loading and/or flow changes (Rosgen 1996).

INFISH advocates greater than 80 percent of any channel type should be stable, while R-2 states that a channel should be within 80 percent of reference conditions. R1/R4 states that possible allowable disturbance could range between 10 percent and 40 percent, depending on sensitivity. Hockett and Roscoe (1993) advocate allowable levels between 10 percent or less to 25 percent, depending on stream sensitivity.

Monitoring on the Beaverhead National Forest found that channel disturbance criteria were normally met before other parameters, such as stubble height or percent utilization (Dallas 1997). For example, with only a minor exception noted in a meadow complex with a C (low gradient) stream channel, the streambank disturbance guideline was found to be the limiting factor across the entire Upper Rubby allotment. The allotment riders have become so adept at managing streambank disturbance, other parameters, such as stubble height, were discontinued. Maintaining the bank disturbance guideline resulted in stream improvement, and in some cases, significant improvement of streams throughout the allotment.

It appears that inherent, undisturbed bank stability of channels functioning at full potential ranges from about 70 percent to near 100 percent, depending on the type of channel and streamside vegetation. The literature suggests that allowable disturbances may range from less than 10 percent to as much as 40 percent, depending on the type of channel and residual vegetation. Streams that contain smaller bank particle sizes (gravels, sands, silts/clays) are more sensitive to disturbance than banks containing larger materials (Rosgen 1996). Therefore, banks consisting of smaller particle sizes may not tolerate as much disturbance as banks containing larger particle sizes. Further, banks that have only a

few plants with shallow root systems cannot protect banks as well as many plants with deeper and denser rooting systems. Banks having fewer plants with shallow roots may need more protection from impacts than banks containing many, deeper rooted plants. Therefore, a range of disturbances, based on channel type and residual vegetation may be appropriate. Platts & Meehan (1977) suggested the following guidelines:

1) Most stream surfaces should have 80 percent or more canopy cover to prevent unacceptable water temperatures;
2) Streambanks should be well vegetated to hold soil in place, and to keep livestock trampling damage to a minimum; and
3) Overhanging vegetation (within one to two feet of the stream surface) should be available on 50 percent or more of the streambank to provide fish cover.

This is especially important on the outside bends of streams. Though this doesn't specifically address the morphology of a stream channel, it suggests a minimum range of physical conditions needed to support aquatic dependent species and it roughly coincides with the range of desired morphological conditions described above.

As is the situation with stubble height, bank disturbance/stability should be used as a short-term indicator, not as an end-point, condition or trend.

Soil Disturbance

The condition of the soils within the riparian area is a key for plant vigor and density, as well as hydrologic processes that occur through the soil profile. Changes in the soil structure can adversely affect plant condition and distribution, as well as stream/riparian area interactions and functions.

Trampling of the soil surface by grazing animals can impact soil properties by:

1) Reducing vegetative cover and decreasing soil surface protection;

2) Churning or tilling the soil by hoof action;

3) Degrading surface crusts (both physical and biological); and

4) Compacting the surface and sub-surface soils (Kaufman, *et al*, 1984).

Gosz (no date) found trampling may seriously affect the productivity and nutrient uptake capability of upper soil layers under an aspen canopy. Soils under an aspen canopy are more nutrient rich than that under conifers. Disturbance of aspen-influenced soils often cause significant losses of nutrients. This resulted in a marked difference in the density and composition of the understory vegetation and highly significant reductions in total understory biomass. Soil compaction decreases water infiltration and hydraulic conductivity, and increases erosion rates by decreasing macropore space.

Rauzi and Hanson (1966)[27] found soil compaction increased linearly with increases in grazing intensity, and after twenty-two years of grazing, found soil properties had been changed. Willatt and Pullar (1984) found that grazed pastures with various stocking rates showed increases in bulk

[27]In Kaufman, J. Boone and W.C. Krueger, *Livestock Impacts on Riparian Ecosystems and Streamside Management Implications..A Review*, Journal of Range Management 37(5), Sept. 1984, pg 430-438.

density and bearing capacity of the soil, and decreases in hydraulic conductivity occurred with increased stocking rates. They also found pasture plant composition was also changed over time. Coarse-textured soils are least susceptible to bulk density increases, while fine-textured soils appear to be most susceptible.

Trampling of moist or wet soils may produce surface crusts, which can further impede infiltration (USDA DNF, 1995). Valentine (1970)[28] suggested that maintenance of stubble height and seedstalks remaining after grazing relate directly with maintenance and reproduction of the plants and protection of the soil. Thurow (1988)[29] concluded that pastures that had moderate continuous and high-intensity, low frequency grazing were able to recover from drought and maintain initial infiltration rates and interrill erosion. In contrast, infiltration rates decreased and interrill erosion increased on heavily stocked pastures, both continuous and short duration. The stocking rate, rather than grazing strategy, is a major factor influencing hydrological responses. Yong-Zhong (2005) found that continuous grazing resulted in a considerable decrease in ground cover, which accelerates soil erosion, leading to further coarseness in surface soil, loss of soil organic C and N, and a decrease in soil biological properties.

Residual litter is important both to promote infiltration and to protect against rill erosion.[30] Bare ground in riparian areas is exposed to water erosion in two ways. The first is channel erosion. The second, which affects all rangelands, is rain-splash. The top layer of soil is usually the most permeable and fertile and often the most resistant to detachment. Loss of this layer reduces fertility and infiltration. This results in a downward trend in plant productivity and increases overland flows, which leads to accelerated erosion (Warren *et al* 1986; Holechek no date). The closer the impact is to the steam channel, the less distance detached soil particles have to travel before entering a water way and adding to the sediment loading of the stream.

Significant amounts of sediment can cause a channel to adjust, which in turn can create more streambank erosion, which can cause more channel adjustments. Scholl (1989) concluded that all soil textural classes except sand show significant compaction from trampling in both spring and fall, with a tendency for spring trampling to cause greater compaction. Compaction altered bulk density and macroporosity in all textures but sand and sandy loam, and hydraulic conductivity was substantially reduced on sandy loam and loam sites. Warren *et al* (1986) concluded that short-term, high intensity livestock trampling on silty clay soil had a negative effect on physical properties, with negative effects increasing with increasing stocking rates. Trampling on dry soil caused disruption of naturally occurring aggregates and compaction of the surface soil layer. Trampling on moist soil deformed existing aggregates and led to the creation of a flat, comparatively impermeable surface layer composed old dense, unstable clods.

Region 4 has developed soil quality standards for Forests in Idaho, Utah, Nevada and portions of Wyoming (USDA FS R4, 1995). One standard deals with soil disturbance.

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[28]In Willoughby, John, Letter and enclosed *List of References of Utilization Guidelines and on the Effects of Lower Stocking Rates on the Recovery of Rangelands*, to Dr. Jerry Holechek, College of Agriculture and Home Economics, Department of Animal and Range Sciences, Las Cruces, NM, USDI, BLM, Sacramento, CA.,Sept. 25, 1997.

[29]Ibid

[30]Ibid

"Detrimentally disturbed soil is soil that has been detrimentally displaced, compacted, puddled, or severely burned. At least 85 percent of the total area within an activity area must have soil that is in satisfactory condition." An activity area can be interpreted as a riparian area.

Forest Service Handbook 2209.21 also describes effects of livestock on soils. The handbook describes two major effects: disturbance of litter, and compaction. Some results of compaction are reduced infiltration capacity and slower water movement in the soil, an increase in surface runoff, accelerated soil erosion and reduced pore space which restricts air circulation, resulting in poor aeration of the plant roots. Researchers Kaufman *et al* (1984), Willoughby (1997), and Scholl (1989) have shown that the main factors related to declines in soil productivity are losses in site organic matter and soil porosity. Livestock have been observed to adversely affect both factors (Scholl 1989; Warren *et al* 1986).

Noble (1963) researched potential soil erosion along the Wasatch range in Utah. He concluded that in the Intermountain West, a minimum of 60-70 percent ground cover[31] is needed to effectively control surface runoff of water and erosion associated with summer storms. He found that when ground cover was reduced to less than 60 percent, overland flow and soil losses increased at extremely increased rates. For example, in watersheds containing “good” ground cover (greater than 60 percent), only 2 percent of an intense rainfall resulted in surface runoff, and soil loss was about 0.05 tons per acre. Conversely, watersheds with “poor” ground cover (about 90 percent bare ground) had over 70 percent of the rainfall become overland flow, with a 5.5 ton per acre soil loss.

Hervivory is also thought to influence the mycorrhizal associations between plants and their fungal symbionts by limiting the amount of photosynthate available to the fungus. Klironomis *et al* (2004) found that previous studies of the herbivory/mycorrhizal relationship have not yielded consistent results. They studied this relationship in Canada and concluded the same findings found in the literature – that it is difficult to generalize the effects of herbivory on plant and fungal responses, even when dealing with the same plant species.

Conclusion

It appears livestock can, and in certain situations, do have negative impacts on soil properties and hydrologic function. R-4 soil quality standards limit the amount of an area that can have detrimental soil disturbance in order to protect the overall integrity and function of the soils. If these standards are exceeded it appears that degraded soil properties could result. Different soil types and moisture conditions appear to play important roles on determining the amount of detrimental impacts to the soils within the riparian area.

For example, Scholl (1989) concluded that all soil textural classes except sand show significant compaction from trampling in both spring and fall, with a tendency for spring trampling to cause greater compaction. However, coarse-textured soils appear to be least susceptible to bulk density increases, while fine-textured soils appear to be most susceptible. Therefore riparian areas containing fine-textured soils should have limited wet-season grazing. Grazing impacts on other soils should be limited to the capacities of the soils and associated

[31] Ground cover is defined as basal vegetation, litter, moss lichen or rock greater than ¾ inch diameter (O’Brien *et al* 2003)

vegetation to withstand the influences of trampling and compaction. The R4 guidelines offer such limitations.

At least 60 percent ground cover appears to be needed to control runoff and soil loss. If grazing reduces ground cover below 60 percent through foraging and trampling (either on the uplands or within the riparian area), erosion and runoff rates increase exponentially. Therefore, it appears that maintaining at least a 60 percent ground cover within and adjacent to the riparian area is essential to maintain riparian health and channel stability.

Riparian Zone Ground Cover and Plant Utilization

To this point, literature has concentrated on impacts and utilization in the "near-bank" area – that is that area directly adjacent to the stream channel. Impacts of livestock within a "zone of influence" have not been thoroughly explored. This zone is extremely important and has been recognized as a critical area by some.

For example, INFISH (1995) establishes a Riparian Habitat Conservation Area (RHCA) that has specific established Goals, Objectives, Standards and Guidelines. The intent is to recognize the importance of these areas and control land management activities that could reduce the important associated values. INFISH identifies specific widths or boundaries based on the kind of waterbody and the presence or absence of fish. However, INFISH is silent on specific criteria that must be maintained within RHCAs, such as vegetation utilization or ground cover. Rather, the focus is on stream channel habitat features and generic Goals for the RHCA address water quality, stream channel integrity, instream flows, water tables and overall plant productivity and diversity (INFISH, 1995).

Geomorphologists, such as Leopold (1994, 1997) and Rosgen (1996) have long known how streams develop and the value of the flood prone area adjacent to the stream channel. Different kinds of streams have different kinds of floodplains of varying widths, characteristics and importance (Rosgen 1996). The shape of any stream is a function of the flow, the amount of sediment in motion through the channel, and the character or composition of the materials (including vegetation) that make up the bed and banks of the channel. When flows exceed the capacity of the channel, water overflows into the floodplain (Leopold 1994). If the floodplain is unprotected or damaged, the channel can respond quickly, sometimes with undesirable results (Leopold 1994).

The health, vigor, density and diversity of vegetation within the streamside zone holds the key to maintaining channel stability and providing quality water for aquatic species and human uses (Brinson *et al* 1981). The hydrology of riparian systems can have an effect on the metabolism and growth of vegetation in three basic ways. First is water supply. Second, is nutrient supply, and third is facilitation of soil ventilation and gaseous exchange such as oxygen, carbon dioxide and methane (Brinson *et al* 1981). Implications for removal of riparian vegetation include the disruption of coarse particulate matter input, which in turn shifts energy flows and balances, accompanied by changes in channel hydrology, sediment and nutrient loading and physical water quality changes, such as temperature. The shift to a higher energy, more eutrophic environment will produce conditions to which only a few of the existing species of aquatic invertebrates and fishes may be adapted. Leaving a protective buffer

of riparian vegetation will help to maintain the integrity of at least some of the energy sources and organic matter processing mechanisms (Brinson *et al* 1981).

Maintaining a healthy streamside zone will also serve to buffer sediment and other pollutants from upland sources. Belt *et al* (1992) discussed five functions of effective buffer areas. These include:

- Trapping sediment or nutrients;
- moderating stream temperatures;
- Providing food and cover for wildlife;
- Providing large organic debris for channel processes and aquatic habitat; and
- Moderating cumulative watershed effects.

These characteristics are essentially echoed by Lawrance *et al* (1985). Cited benefits include streambank stabilization, sediment filtering, temperature regulation, and uptake and long-term storage of nutrients. Braun (1986) added increased groundwater recharge, near-bank water exchange, and bank cover that provides habitat, food and cover for aquatic species

The literature is relatively silent on the effects of livestock grazing on the characteristics and effectiveness of buffers. Most of the available literature deals with logging activities and associated roads (e.g. Belt *et al* 1992; Swift 1986; Ketcheson and Megehan 1996). Observations and findings of these authors can be applied to grazing activities.

For example, Belt *et al* (1992) found that as surface roughness increased, filtering capacities of buffers for non-channelized surface flows also proportionally increased. This can be applied to grazing. In general, the more vegetation left on-site, the greater the buffering ability. As vegetation is consumed or trampled, the roughness coefficient can be reduced, reducing the capability of the area to provide desired functions and processes.

Pfankuch (1978) characterized channel stability based on several features. One feature is what he terms the "upper bank," which is described in general terms as the floodplain zone and adjacent landforms. Vegetation is one component of the evaluation. "Excellent" is defined as trees, shrubs, grass and forbs combined cover more than 90 percent of the ground. "Good" has 70-90 percent ground cover. "Fair" has 50-70 percent ground cover, and "Poor" has less than 50 percent ground cover.

A standard in the Targhee National Forest Land Management Plan specifies that within the riparian zone, away from the direct streamside, at least three inches of stubble will be left for key riparian plant species at the end of the grazing period (Targhee NF 1997).

In 1993, FS Region 4 issued Range Management Standards for the Region. Standards for key species grass and herbaceous plants in riparian rangeland ecosystems were divided into season-long grazing and rotation grazing schemes, and subdivided with standards for satisfactory and unsatisfactory range conditions for each of the systems. For pastures that have season-long grazing, unsatisfactory condition standards are 30 percent utilization and a six-inch stubble height. For satisfactory range conditions, 55 percent utilization and four-inch stubble height. Pastures with rotation grazing have 50 percent/four-inch, and 65 percent/four-inch for unsatisfactory and satisfactory range conditions, respectively. If there is a conflict between percent utilization and stubble height, stubble height prevails.

Holechek (1999) researched "classic" grazing studies and provided a brief synopsis of findings. When averaging all the studies, they found that "heavy" grazing averaged 57 percent use of the primary forage species. "Moderate" grazing averaged 43 percent use, and "Light" grazing averaged 32 percent. They defined "heavy" as a degree of herbage utilization that does not permit desirable forage species to maintain themselves. "Moderate" grazing is a degree of herbage utilization that allows the palatable species to maintain themselves, but usually does not permit them to improve in herbage producing ability. "Light" grazing allows palatable species to maximize their herbage producing ability. Heavy stocking consistently caused a downward trend in ecological condition, light stocking caused an upward trend and moderate stocking maintained or slightly improved condition.

FSH 2209.21-93-1, R4 Amendment Effective 5/18/93 describes six classes of herbaceous utilization. They are: No Use – 0-5 percent; Slight – 6-20 percent; Light – 21-40 percent; Moderate – 41-60 percent; Heavy – 61-80 percent; and Severe – 81-100 percent. The Handbook states that removal of half or more of the foliage during the growing season upsets the functioning of the root system and the plant as a whole. The reduction of growth in grass plants after cutting or grazing is due partly to the inability of defoliated plants to absorb water.

Conclusion

Relatively little information is available concerning the needs of the entire riparian zone. The literature, however, is clear that this zone is extremely important for a variety of functions and processes needed for aquatic habitat, channel integrity, water quality, wildlife and so forth. Without healthy riparian zones, these functions and processes can be jeopardized, reduced, or even eliminated.

The width of these influence zones to provide needed functions is also in question. Fixed widths are relatively easy to define and administer (Belt *et al* 1992) but may not provide adequate protection in some situations and may be too comprehensive in others. INFISH defines variable widths depending on several factors including channel and floodplain characteristics, actual extent of riparian vegetation, or a minimum fixed width, which ever is greater.

For controlling the influence of livestock grazing within these influence zones, it appears as a buffer zone using the actual extent of riparian vegetation would be in order, along with some kind of minimal ground cover and/or vegetation utilization that could equate to stubble height. However, depending on the channel type, the actual extent and influence of riparian vegetation can be and is highly variable (Rosgen 1996). The extent of riparian vegetation can vary greatly along the same stream and even vary on either side of the channel.

For example, a C-type channel (Rosgen 1996) can be cutting into a terrace on one side and have a well-developed point bar on the other. On the terrace side, it is possible that no riparian vegetation will exist at all. On the point bar side, riparian vegetation could be well developed, extending well away from the side of the channel. Potential ground cover on the upland terrace side may not exceed 60 percent, while potential ground cover on the point bar may be 100 percent. Potential stubble height of un-grazed grasses on the terrace may not exceed six inches, with moderate grazing utilization stubble heights residuals only an inch or two (See Percent Utilization section). On the other

side of the channel, potential stubble height may be several feet, with moderate utilization stubble heights exceeding six inches. Further, a deeply downcut channel may have no associated riparian vegetation on either side of the channel, whereas an E-type channel (Rosgen 1996) or an extended beaver complex could have associated riparian vegetation extending hundreds of feet on either side of the channel.

It appears as variable criteria for zone width, and disturbance limitations, such as ground cover, and plant utilization is appropriate. Variable zone widths as defined in INFISH for the different waterbody types and the presence or absence of fish appears to be suitable and sufficient to maintain the integrity of this zone and protect associated values of aquatic habitat and water quality. Even though channel types vary in their ability to promote and sustain riparian vegetation, there are too many physical and biological variables to try to isolate zone widths to specific channel types.

Plant stubble heights and allowable utilization rates, along with ground cover requirements, should vary according to plant community types. For ease of management and monitoring, these community types can be subdivided into two main categories – riparian and upland.

For riparian plant communities, allowable utilization and stubble heights should not exceed those normally associated with light to moderate grazing. The literature generally supports utilization rates less than 50 percent for riparian vegetation. Clary & Webster (1989) suggest a maximum streamside utilization of 65 percent for spring, 40-50 percent for summer and 30 percent for fall grazing, which allows for regrowth. Clary (1999) defined "moderate" grazing as up to 50 percent use. Ratlif *et al* (1987) suggests maximum allowable use up to 45 percent for meadows in "good" condition and 20-30 percent for areas in poor condition. Therefore, a maximum allowable use of 50 percent for spring grazing in areas in "good" condition may be appropriate, reduced to 20 percent for late season grazing on areas in poorer condition. Kovalchik & Elmore (1992)[32] equated 45 percent utilization to four- to six-inch stubble height, depending on the plant species.
Upland plant utilization should follow similar levels as riparian vegetation. Holechek (1988) found percent use of key species for moderate grazing ranges between 30-40 percent (FSH equivalent is "Light"). Lacy (1988) found that most upland plants can maintain vigor if no more than 50 percent of their growth is removed during the grazing period, and should not exceed 60 percent (FSH equivalent is "Moderate). FSH 2209 states that plant function is upset with utilization levels greater than 50 percent, which falls into the FSH definition of "Moderate" grazing. Unlike riparian vegetation, the potential for regrowth of upland vegetation following grazing is reduced, depending on the plant species and available moisture. Therefore, a utilization rate by season is probably not appropriate.

Factors and techniques that affect the distribution of livestock and resource impacts

The use of forage by livestock is dependent on a number of factors. These include: season of use; physical conditions of forage and relative palatability; distance to water and salt; sideslope steepness and microclimatic features. In riparian areas, the biomass of wet meadow herbage is often ten

[32] In W.P. Clary, ED. Proceedings – Symposium on Ecology and Management of Riparian Shrub Communities. USDA Forest Service General Technical Report INT-289. Ogden, Ut.

to twenty times higher than that of surrounding uplands; the distance to water is minimal, the terrain is flatter and summertime temperatures can be cooler. Therefore, animals expend less time and energy in obtaining their daily intake in riparian areas than on adjacent upland range (Skovlin 1984).

Even though riparian meadows often cover only 1-2 percent of the range area, they may produce up to 20 percent of the available forage, and in some areas 80 percent of the forage consumed within a pasture may come from these meadows (Clary & Webster 1980).

There are also seasonal differences in the way livestock utilize their environments. Cattle tend to be more widely distributed early in the grazing season compared to later when they may concentrate in riparian areas (McInnis 1997); although it has been found that cattle will also distribute themselves during the latter, cooler, portion of the grazing season as well (WDEQ 1997). Clary & Webster (1990) found that cattle may consume most of the forage in the riparian zone in the first four weeks (30 days) of the grazing season. However, even when a majority of the forage has been consumed, cattle traditionally will not voluntarily venture up the slopes, away from the riparian zone during the warmer portion of the grazing season. Clary & Booth (1993) also observed that spring grazing of riparian areas may be a good management strategy because of a reduced tendency for cattle to concentrate along streams during that season. Streamside graminoid utilization averaged about 24 percent (4.5- to 5-inch stubble height) under light stocking, and about 37 percent (3- to 4-inch stubble height) under medium intensity grazing. Parsons *et al* (2003) found that during early summer, cattle were further from the stream than during late summer. Cows were observed closer to the stream when ambient air temperatures were higher. Forage quality varied between seasons, with early summer forages having lower dry matter, greater crude protein, lower fiber and greater in situ dry matter disappearance compared with late summer forages. Utilization of riparian vegetation was lower and use of upland vegetation was greater during early summer than late summer.

Some studies show that livestock distribution combined with timing, duration and frequency of grazing are often the main factors in utilization patterns within riparian areas. Stocking rate problems are usually not a factor, and simply reducing total numbers is usually not a solution for proper riparian management.

Cattle form family groups and like to stay together. When they are split up forcibly for better distribution, they tend to return to a place of gathering, which more likely than not is in the riparian area. Leonard *et al* (1997) suggested successful grazing strategies that protect or improve riparian condition include techniques that:

1) Attract, not force, livestock away from riparian areas, including stock water developments, alternate or improved forage, and careful salt and supplement placement outside of riparian areas;

2) Restrict livestock use in riparian areas, which includes fencing, barriers such as thickets or brush wind rows, water gaps in erosion resistant stream reaches and relocation of bed grounds and management facilities; and

3) Provide herd management and animal husbandry practices that promote mobility, including herding and culling practices and managing the kind and class and breed of livestock.

Platts (1991)[33] suggested five strategies:

1) Control of animal distribution and access to water;
2) Control of grazing intensity (forage utilization);
3) Control of grazing frequency and rest periods;
4) Control of timing of grazing use (season); and
5) Total exclusion of grazing.

Studies of cattle behavior in riparian zones during summer grazing in mountain pastures in east central Oregon found that 80 percent of the herbage used under moderate stocking came from streamside meadows that constituted 2 percent of the unit area. In heavier, more dissected terrain, even salting and additional alternate watering contributed little to draw cattle away from riparian meadows (Skovlin 1984). Roath (1980)[34] found that cattle exhibited distinctive home range patterns in which certain groups of cattle preferred upland sites, and other groups preferred riparian sites. As forage became limiting on stream bottoms, some cattle actually decrease intake rather than move away from the riparian zone. Roath (1980)[35] also suggested selective culling of these cattle and replacing them with those that prefer uplands may be beneficial for the livestock operator as well as for the riparian zone. He also found that herding livestock on a somewhat daily basis has been successful in limiting the number of livestock that visit stream bottoms, while improving utilization of upland areas.

Skovlin (1984) suggested ten options available to range managers for restoring riparian and stream habitats:

1) Do nothing;
2) Improve animal distribution;
3) Change season of use;
4) Implement specialized grazing seasons and strategies;
5) Rest entire grazing units for five years or longer until recovery occurs;
6) Fence the entire riparian zone;
7) Fence the streamside corridor;
8) Combinations of the above;
9) Revegetate with woody cover; and
10) Eliminate grazing.

Grazing strategies, such as rest rotation, are not an answer in themselves. Several authors have reported rest-rotation grazing systems increased vigor and increases in upland vegetation quality and quantity (Platts & Rinne 1985). However, Hughes (1979)[36] found no corresponding improvement in riparian conditions. One study found that streamside forage was 8-12 percent more heavily used than adjacent range forage on all studied allotments.

For example, Platts & Rinne (1985) found forage utilization along streams was about 50 percent greater during the late season than during the early season under similar grazing conditions. Consequently, if the allotment were managed for moderate (26-50 percent)

[33] In Fitch and Adams 1998. *Can Cows and Fish Co-Exist?* Canadian Journal of Plant Science; Vol 78, No. 2. Ibid p. 191-198.

[34] In Kaufman, J. Boone and W.C. Krueger, *Livestock Impacts on Riparian Ecosystems and Streamside Management Implications..A Review*, Journal of Range Management 37(5), Sept. 1984, pg 430-438

[35] Ibid

[36] In Platts, William S. and Rodger Loren Nelson, *Impacts of Rest-Rotation Grazing on Stream Banks in Forested Watersheds in Idaho*, North American Journal or Fisheries Management 5:547-556, 1985.

grazing intensity throughout the allotment, the streamside zone could easily accommodate heavy grazing (51-75 percent) utilization (Platts & Rinne 1985). It was suggested that measures such as placing salt away from the riparian area, or the timing of grazing appeared to influence the use of streamside vegetation and would help in balancing vegetation uses.

Platts (1981, 1985) found that streamside grazing probably does as much or more damage through bank alteration than through changes in vegetative biomass. Further, he suggested that bank conditions do not improve during a single rest period, but rather, regrowth of vegetation tends to mask unstable reaches. He found that prolonged use of streamside vegetation not only will alter a bank but will also retard the rehabilitation of previously altered banks. He suggests that land managers "should give serious consideration to using special riparian pastures"... to "encourage a more equitable use of all available forage and would allow the intensity of use to be carefully controlled"...without the need for expensive fencing.

Even though fencing has been shown to provide the maximum protection and the best chance for rehabilitation in the shortest amount of time (with the exception of eliminating grazing), it has been estimated that the cost of fencing fish-bearing streams on BLM lands throughout the west would cost $90 million dollars and another $9.4 million for maintenance over a twenty-year period. Because of this, it has been suggested that the cost-effectiveness of management actions, such as fencing, be evaluated and the most valuable stream reaches be identified and necessary management strategies implemented that those streams deserve (Platts & Wagstaff 1984).

Rosgen (1996) suggested that channel types requiring the presence of deep-rooted plants to maintain channel stability (e.g. C3-6 stream types) should have grazing limited to early season, especially for large riparian pastures. He cited plant palatability, water availability, temperatures, nuisance insects, impacts to woody species, and post-grazing rest and plant regrowth as reasons.

Fitch and Adams (1998) suggest that proper riparian grazing strategies can improve wildlife habitat, help stabilize channels, improve water quality and shift intermittent streamflows to perennial flows. They state that the obvious primary benefit of a successful riparian grazing strategy is that the livestock operator can retain access to a dependable and productive forage supply, which will improve both the quality and quantity of forage for livestock. Improved riparian management may more than double forage availability over those riparian areas in poorer conditions. In short, if proper strategies are applied, cows and fish can co-exist.

Management strategies should be based on range type and condition, range site potential and soil type, plant growth rates, seasons of use, precipitation, stocking rates and type and class of livestock (WDEQ 1997). The FAO (2003) identified four world-wide grazing priorities. One priority was effective drought management policies. They found that land degradation in arid zones originates as a result of high stocking rates during droughts. They suggest managers de-stock as rapidly as possible during these periods, rather than seeking to maintain normal stock numbers and durations. Rosgen (1996) also recommended that channel type and inherent channel stability be factored into the equation. Some grazing management

practices recommended by Clary and Webster (1990) include:

1) Grazing practices provide for regrowth of riparian plants after use, or should leave sufficient vegetation at the time of grazing for maintenance of plant vigor and streambank protection. A minimum herbage stubble height of four to six inches is recommended.
2) Springtime grazing of herbaceous vegetation should not exceed 65 percent and livestock should be removed when the primary forage plants are still in the vegetative state.
3) Summertime pastures should be used cautiously, as livestock tend to concentrate in riparian areas during the hot months. Forage utilization should not exceed 50 percent.

4) Fall grazing should be monitored carefully to ensure utilization standards are not exceeded, since there will be little if any regrowth. A four- to six- inch stubble height is recommended which equates to 30-40 percent utilization on most riparian herbaceous plants.
5) Limit season long grazing to situations where grazing can be strictly monitored and stubble heights can be met.
6) Special situations where critical fisheries habitat or streambanks are easily eroded, stubble heights greater than six inches may be appropriate.
7) The length of rest required to initiate a recovery process will depend on vegetative composition and streambank condition. It may take as little as one year or fifteen years or more. Degraded streambanks usually require more time to recover than vegetation.
8) Ensure **all** livestock are removed at the end of the specified use period. Recovery and/or maintenance of riparian ecosystems are not likely if even a few animals remain after the use period.

Other practices recommended by Meyers (no date) include:

1) Limit total time in pasture to 30 days or less; limit time in pasture during the hot season to less than 15 days.
2) Allow 30 or more days for plant regrowth.
3) Where deciduous woody species are important in the composition, limit the frequency of fall grazing to about 1 year in four. Limit duration of fall grazing to 21 days or less.

The following is a summary of suggested management practices described above and the anticipated functions or processes those practices are trying to address, as interpreted by this author.

Table A. Management Practices and Expected Benefits

Practice	Expected Benefit
Provide for regrowth of riparian plants after use, or leave sufficient vegetation at the time of grazing for maintenance of plant vigor and streambank protection. A minimum herbage stubble height of 4-6 inches is recommended	1) Increased plant vigor/health composition. 2) Improved streambank stability/rebuilding

Practice	Expected Benefit
Springtime grazing of herbaceous vegetation should not exceed 65 percent and livestock should be removed when the primary forage plants are still in the vegetative state.	1) Increased plant vigor/health/ composition.
Summertime pastures should be used cautiously, as livestock tend to concentrate in riparian areas during the hot months. Forage utilization should not exceed 50 percent.	1) Increased plant health/vigor/ composition 2) Improved bank condition 3) Improved soil condition
Fall grazing should be monitored carefully to ensure utilization standards are not exceeded, since there will be little, if any, regrowth. A 4-6 inch stubble height is recommended which equates to 30-40 percent utilization on most riparian herbaceous plants.	1) Increased plant health/vigor/ composition
Special situations where critical fisheries habitat or streambanks are easily eroded, stubble heights greater than 6 inches may be appropriate.	1) Decreased streambank erosion and improved stability 2) Aquatic habitat protection
The length of rest required to initiate a recovery process will depend on vegetative composition and streambank condition. It may take as little as one year or fifteen years or more. Degraded streambanks usually require more time to recover than vegetation.	1) Increased plant health/vigor/ composition; 2) Reduced soil compaction; 3) Improved streambank stability/protection; 4) Improved aquatic habitat 5) Improved water quality
Ensure all livestock are removed at the end of the specified use period. Recovery and/or maintenance of riparian ecosystems is/are not likely if even a few animals remain after the use period.	1) Increased plant health/vigor/ composition; 2) Decreased soil compaction; 3) Improved streambank stability/protection; 4) Improved aquatic habitat 5) Improved water quality
Limit total time in pastures to 30 days or less; limit time in pastures during the hot season to less than 15 days.	1) Increased plant health/vigor/ composition; 2) Reduced soil compaction; 3) Improved streambank stability/protection; 4) Improved aquatic habitat 5) Improved water quality
Allow 30 or more days for plant regrowth.	1) Increased plant health/vigor/ composition
Where deciduous woody species are important in the composition, limit the frequency of fall grazing to about one year in four.	1) Increased woody species health/vigor/ composition
Limit duration of fall grazing to 21 days or less.	1) Increased plant health/vigor/ composition; 2) Reduced soil compaction; 3) Improved streambank stability/protection; 4) Improved aquatic habitat 5) Improved water quality
Allow grazing on riparian vegetation only before July 1.	1) Increased plant health/ vigor/ composition; 2) Increased streambank protection
Implement stubble height standards.	1) Increased plant health/vigor/ composition; 2) Improved streambank protection
Implement utilization standards	1) Improved plant health/vigor/ composition; 2) Improved streambank protection
Implement streambank disturbance standards	1) Improved streambank protection; 2) Improved water quality; 3) Improved aquatic habitat
Close stream to grazing for up to five years.	All factors
Begin moving livestock before required standards are achieved so that by the time the standards are met, the last	All factors

Practice	Expected Benefit
animal is moved from the pasture.	

Additionally, besides the physical implications, economics also come into play. Stillings *et al* (2003) used a multi-period bioeconomic model to evaluate the long-term economics of management practices within a riparian zone. They found that restricting utilization to 35% for a 300 calf-cow operation, the cattle distributed more evenly and gained more weight. The economic impacts of this were increased annual net returns to the ranch in addition to improved riparian quality.

Water Quality and Aquatic Habitat

Maintenance of riparian areas is not necessarily an end in itself. Stable, healthy riparian areas are a means to other values, such as clean water that meets designated beneficial uses and high quality aquatic habitat that is capable of sustaining a variety of water-dependent species, including insects, fish and amphibians.

Livestock can affect several water quality parameters. Most noted are sediment, bacteria and nutrients, primarily nitrates and phosphates (Buckhouse 2000). Braun (1986) concluded that cattle are the cause or source of several types of water pollution. On uplands, cattle accelerate erosion when removing vegetation and trampling soil. Through runoff, eroded soil eventually finds its way into streams leading to sedimentation and turbidity. Sediment destroys stream habitat in at least two ways. Suspended sediment reduces light penetration causing reduction in aquatic plant photosynthesis and dissolved oxygen levels. Sediment clogs gravel areas used by spawning fish for egg deposition and can entomb various aquatic life forms that are major sources of food for fish. In addition, cattle discharge urine and manure, which produce chemical and biological pollution.

George *et al* (2004) surmised that in general, streams flowing through areas partly or fully covered with pastures were more contaminated than those flowing through forest and cultivated areas. Rainfall increased the suspended solid content of small streams as well as their fecal contamination, as bacteria are adsorbed on particles. In a study by Coltharp and Darling (1973)[37], three pastures were studied with different combinations of animals grazing and browsing: wildlife only, wildlife and sheep and wildlife and cattle. Highest concentrations of bacteria were found in the wildlife-cattle pasture. Carter (1999) in a study conducted on the Cache National Forest in Idaho and Utah, found elevated concentrations of fecal coliform bacteria within days of cattle entering a pasture. Immediately following removal of cattle, fecal coliform counts declined t much lower levels and eventually declined to zero. He also found that during the spring and early summer, prior to the introduction of livestock into the pasture, the numbers of fecal coliform bacteria gradually increased in response to runoff and increasing water temperatures. He concluded that organisms residing in the watershed and stream sediments since the previous grazing season contributed to the source. Biske and others (1988)[38] found that 90 percent of bacteria that reaches a stream channel precipitated to the steam bottom and attached to sediments. Sediment samples collected over a period of several weeks found that 90 percent that had lodged into the sediment died within forty days.

[37] In Buckhouse (2000)
[38] Ibid

Johnson (1978) studied two adjacent pastures in central Colorado and found that bacterial contamination significantly increased in the grazed pasture. Following removal of cattle from the grazed pasture bacterial counts dropped to levels similar to those in the ungrazed pasture. Platts (1981) also attributes high concentrations of coliform bacteria in study streams to livestock grazing. He concluded that bacterial concentrations did not directly affect the suitability of habitat for fish; they are nonetheless important indicators of water quality. This typifies the dynamic nature of the quality of surface water, particularly from nonpoint sources. Leffert (2000) sampled surface water quality in Arizona within a variety of grazing pastures. He observed that base streamflows contained very little fecal coliform bacteria content the majority of the time when samples were collected. However, during runoff flows, when rainstorms generated overland flow to the stream channels, fecal coliform levels increased exponentially, well in excess of state water quality standards. Following the runoff event, when the stream hydrograph returned to base flow rates, bacteria concentrations quickly returned to pre-event levels.

Vinten *et al* (2004) described the potential risk of coliform bacteria contamination from farm management practices. They summarized agricultural practices to mitigate the risk. They found that buffer strips, off-stream watering, grassed surface drainage channels, controlled walkways, etc, have potential for reducing coliform inputs to watercourses, all being related more to animal access to streams than to overall stocking densities within a pasture. This was echoed by Collins and Rutherford (2004). In upland situations, it was postulated that stream bed entrainment quickly exhausts the burden of stream bed E. *coli* bacteria and found no significant sedimentation of E. *coli* in water samples. They also found that transport through the soils is not the dominant route of E. *coli* transport at high flows.

Other water quality parameters that may be affected by livestock include suspended solids, temperature, dissolved oxygen, total dissolved solids, specific conductance, ammonia, orthophosphates, and nitrate nitrogen (Johnson *et al* 1978). Johnson *et al* (1978) in a Colorado study did not find any significant increases in any of these other parameters directly attributable to livestock grazing. Buckhouse (2000) cited a nutrient study on the Wood River in Oregon. There was a concern that nutrient loading would be increased when water flowed through grazed land due to fecal contamination. The data refuted this hypothesis, in fact, phosphate and nitrate levels actually decreased. It was speculated that the wetlands in the system acted as a natural nutrient sink, reducing the amount of free nitrate and phosphate concentrations in the water.

Platts (1981) cited studies by Clarie and Storch (1977) and others that found that removal of streamside vegetation contributed to increases in water temperatures in small headwater streams as well as influencing suspended sediment concentrations. Increased sediments have been found to diminish total productivity of the aquatic system, decrease water permeability of channel materials used by fish for spawning, smother fish embryos, and deplete the food supply for fish by filling channel interstices.
Harper (2000) suggested several riparian and channel conditions that contribute to optimum aquatic habitat:

1) At least 60 percent of the stream is shaded between 10:00 am and 4:00 pm during summer months;
2) At least 80 percent of the streambank is in stable condition;

3) Not more than 15 percent of the gravel/rubble substrate is covered by inorganic sediment;
4) At least 80 percent of the site potential for grass-forb, shrub, and trees is achieved;
5) Instream cover should be about 50 percent of the total stream area; and
6) Overhanging banks occur on at least 50 percent of the streambanks.

It should be noted that the ability of any specific stream to achieve one or more of these values depends on the channel type, geological and physiographic setting, riparian community type and serial stage (Leffert, 2000). Marcuson (1977) found floristic composition and density of herbaceous vegetation were markedly different between grazed and un-grazed pastures in Montana. The un-grazed area had a better soil profile and 80 percent less stream channel alteration. This resulted in a 256 pound per acre decrease of fish in the grazed pasture stream as compared to fish densities in the un-grazed area stream.

Platts (no date), discussed "Compatibility of Livestock Grazing Strategies with Fisheries". He evaluated and rated various common grazing strategies based on personal observations as related to stream-riparian habitats. The following summarizes those observations:

Table B: Grazing Strategies and Stream/Riparian Habitats

Strategy	Common Utilization Levels	Stream Bank Stability	Seasonal Plant Regrowth	Rehab Potential
Continuous Season Long (cattle)	Heavy	Poor	Poor	Poor
Short Duration/ High Intensity (cattle)	Heavy	Poor	Poor	Poor
Three Herd/ Four Pasture (cattle)	Heavy to Moderate	Poor	Poor	Poor
Holistic (cattle or sheep)	Heavy to Light	Poor to good	Good	Poor to excellent
Deferred (cattle)	Moderate to Heavy	Poor	Fair	Fair
Seasonal Suitability (cattle)	Heavy	Poor	Fair	Fair
Deferred Rotation (cattle)	Heavy to Moderate	Fair	Fair	Fair
Stuttered deferred rotation (cattle)	Heavy to Moderate	Fair	Fair	Fair
Winter (sheep or cattle)	Moderate to Heavy	Good	Fair to Good	Good
Rest Rotation (cattle)	Heavy to Moderate	Fair to Good	Fair to Good	Fair
Double Rest Rotation (cattle)	Moderate	Good	Good	Good
Riparian Preference (cattle or sheep)	Moderate to Light	Good	Fair	Fair
Corridor Fencing (cattle or sheep)	None	Good to Excellent	Good to Excellent	Excellent

Saunders and Fausch (2005) studied livestock grazing influence on terrestrial invertebrate prey for trout in Wyoming rangeland streams. Two grazing types were observed: high-intensity/
short-duration (HISD) and season-long grazing (SLG). They found there was both greater vegetative production and vegetation cover at sited under HISD management than at sites under SLG management and the biomass of terrestrial invertebrates falling into streams with HISD was 70% greater and more variable than that entering streams under SLG in June and July. Measurements of fish abundance during summer in rangeland streams suggested that sites under HISD supported higher density and biomass of trout than sites managed for SLG.

The Clean Water Act addresses water quality in streams and requirements to "restore and maintain the chemical, physical and biological integrity of the Nations waters." Section 303(d) of the act addresses water quality standards to support designated beneficial uses of waterbodies. Each state is required to sample all waterbodies within its boundaries and develop protocols for maintaining those waterbodies in good condition and improve those that are degraded. The development and application of Total Maximum Daily Loads (TMDLs) is required for all streams for which beneficial uses are not attained. The Forest is required, as are all other landowners, to comply with TMDL requirements. Depending on established requirements, action plans need to be developed that will specify specific actions taken to comply with the regulations and TMDL requirements. These requirements may override all other standards and requirements developed by the Forest, if TMDLs are more stringent than Forest Standards and Guidelines.

Similarly, the Endangered Species Act may dictate allowable activities within a watershed and specifically within a riparian area or waterbody. Currently there are no listed endangered or threatened aquatic or riparian dwelling species within the Caribou or Targhee National Forests.

The Yellowstone and Bonneville cutthroat trout have both been petitioned to be listed as threatened under the Act. The U.S. Fish and Wildlife Service dismissed the petitions stating, at the present time, listing is not warranted. However if these fish species, or other aquatic or riparian-oriented species are listed some time in the future, specific allowable standards would be established by the U.S. Fish and Wildlife Service, or other agencies, which could override any standards and guidelines established by the Forest.

Impact Guidelines

If interdisciplinary efforts and cooperation occur, reasonable approaches can be developed and implemented to provide forage for domestic livestock while improving and maintaining habitat for fish and wildlife (Armor *et al* 1991).

Grazing systems can be used without intractable damage to riparian ecosystems if key riparian plant species are monitored as indicators of forage production and use. This would allow plant vigor and density to be maintained, which, in turn, wildlife, fish and habitat abundance could be sustained and unstable streambanks and poor soils would be able to recover (Armor *et al* 1991). This is strengthened by Bengeyfield (in press). Through paired measurements of physical channel parameters at permanent sites over 5 to 7 years, he showed that moving livestock between pastures based on prescribed levels of annual streambank alteration led to channel improvement. Streams became less entrenched, had smaller width/depth ratios and lower levels of fine sediment.

Numerous management strategies are available to implement the following guidelines. Fencing, various rotation systems, riding, watering, salting, or other methods can all have an effect on resources within the riparian zone. How these guidelines are achieved are left to the manager and must be determined for individual situations and conditions. An alternative to these guidelines is non-use. For example, if a channel is in State B or E, complete rest for one or more years may be appropriate to restore a B State to an A State or accelerate improvement of an E State to an F State. Cowin (no date), based on his experience, concluded that it may take twenty or more years for a channel to reach Properly Functioning Condition if the channel is vertically unstable, more than 70 percent of the streambanks are actively eroding, and/or stabilizing herbaceous plants are limited in density or distribution.

Deferred or delayed use can also have other positive effects. For example, when willows are being affected by livestock, limiting or eliminating access to the riparian zone during the fall may reduce impacts on these woody species. Pelster *et al* (no date) suggested that spring grazing of riparian pastures was preferable to late-season use to minimize browsing on willows. They found that willow consumption increased substantially as herbaceous stubble height was reduced to 10 and 18 cm during the spring and early-summer grazing periods, respectively. Herbaceous stubble heights greater than 20 cm were needed to reduce willow consumption when they were most preferred during the late-summer and fall grazing periods in a tall sedge/willow riparian community. Conversely, if banks or riparian soils are being damaged during the early season, when banks and soils are saturated from the spring runoff, delaying grazing until the fall when the banks and soils are dry and less susceptible to sheering and compaction may be useful. If plant density and vigor are a problem, removing livestock early, while the plants are still growing and allowing adequate time for regrowth before dormancy may be an option.

Goal

Maintain or move toward desired riparian, stream channel, aquatic and water quality conditions. The desired condition is to preserve the function (both physical and biological) of riparian areas and stream channels, associated water quality and aquatic habitat, considering the inherent characteristics of the riparian areas and stream channels and their existing conditions and capabilities*. Additional desired conditions may be developed for specific watersheds or landscapes. This could include the preservation/restoration of native fish habitat or the maintenance/improvement of water quality in imperiled water bodies.

> * *Protection and enhancement of the resource is the primary goal. However, cost efficiency and practicability may have to be considered in the overall analysis process.*

Explanation

Standards are necessary to maintain or restore the function of riparian areas and stream channels. These standards are designed to protect or improve the integrity of water quality and aquatic habitat through the protection of riparian areas, stream channels and associated flood plains; to restore or enhance water flows, bank water storage and water table interchange, and sediment controlling functions; and maintain or increase the number and kind of riparian plant species, which reflect a variety of natural communities that would be expected to grow within a site, reach, watershed or landscape.

These riparian standards are based on inherent characteristics and capabilities as well as the exiting condition of the different stream types across the Forest as suggested by Myers and Swanson (1991). Stream type aggregates provide a context to integrate historical, existing and foreseeable future valley bottom features and associated stream and riparian characteristics and desired conditions.

Implementation

These riparian standards have five measurable parameters to monitor impacts in riparian areas. The parameters are bank disturbance, soil disturbance, grass/sedge stubble height, woody vegetation utilization and key vegetation species utilization. Allowable disturbance levels are tailored to specific stream-type groups depending on both similarity ratings and resiliency. Additionally, a time-related feature is provided for situations when monitoring time or intensity may be less than that needed to assure assigned parameters are fully met. This feature is intended to provide a reasonable and prudent alternative to situations or circumstances when time, personnel and/or monetary constraints restrict or preclude effective monitoring.

It needs to be emphasized that stubble height, streambank disturbance, woody stem use, etc. are all short-term indicators of grazing effects on meeting long-term management objectives. Each can be used in the appropriate situation, as indicators of good management, and as a target to achieve in the annual operating plan, with the objective of achieving the long-term riparian management goals.

Similarity refers to how similar the riparian area and stream channel are to desired conditions.

High Similarity:

Those areas that reflect characteristics within a natural range of variation. The soils reflect inherent properties and processes. The plant communities are generally those within a desired condition or trending toward a desired seral stage, ecological status or condition (See page 60 for a method of determining plant ecological status/similarity). The channels should be within the range of variation of the desired channel type as defined by Rosgen (1996). Aquatic habitat should reflect the capabilities of the desired channel type, as measured by percent fines in spawning gravel, pool habitat quantity and quality, cobble embeddedness, stream bank stability, particle size distribution, etc.

This can be equated with *Properly Functioning Condition* (Prichard 1998*)*. This process considers hydrology, vegetative and erosion deposition components of riparian areas and stream channels. When all these components are in place and functioning, the system is considered to be in properly functioning condition.

***Moderate Similarity*:**

Those riparian areas that are midway between High Similarity and Low Similarity and may have characteristics of both. These areas may include areas that were disturbed at one time but are trending toward high similarity or the reverse.

This can be equated to the Functional-at-Risk category. This is described as areas that may be in a functional condition, but an existing, soil, water or vegetation attribute makes them susceptible to degradation, or an attribute is in less than a

desirable condition, but not in degraded (low similarity) condition.

Low Similarity:

Those riparian areas that reflect characteristics below a natural range of variation. These areas have usually been disturbed and provide less than desirable characteristics. These characteristics include soils, vegetation, channel stability, floodplain condition and so forth. Detrimental soil disturbance can be evidenced by extensive puddling, compaction, trails and wallows, hummocky soils, topsoil displacement and bare ground. Plant communities have limited flora, which may contain weedy species. Shrub communities are often absent even where the site historically supported them, or are comprised of decadent individuals of species adapted to constant disturbance. Streams would display characteristics outside the range of variation normally associated with a particular channel type. Adverse stream features may include high width/depth ratios, shifted particle size distribution, trampled banks, increased percent fines in spawning gravel, pool habitat missing or shifted outside the natural range for desired channel type, raw or deteriorating stream banks, etc.

This can be equated to Functional-at-Risk, to Non-Functional, depending on the degree of disturbance. A Non-Functional system is one that clearly does not provide adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc. There is an absence of certain physical attributes such as a floodplain where one should be.

Caveat - If the channel has deeply downcut and is evolving to another state of channel development (e.g. between state C and D as defined in Prichard (1998), standards for High Similarity may be applied).

This is because the time required for a channel to evolve from one state to another may take several decades, or more, to complete. Even if livestock are completely removed from the site, there may be no effect, either positively or negatively, on the evolution process. In this situation, since livestock grazing will not have any real impact on the evolution process, they may as well graze the site to the fullest extent allowable by the standards.

<u>Resiliency</u> is the ability of the riparian area/stream channel to resist impacts or to recover once disturbed. It is a factor of parent material soils, existing vegetation and stream characteristics.

Stream characteristics have been defined by channel type (Rosgen 1996). These include sensitivity to disturbance, recovery potential, sediment supply potential, streambank erosion potential and vegetation controlling influence. Each Stream type has been consolidated into groups containing like characteristics (See Table 6). These groups have been further consolidated into a High, Moderate or Low Resiliency rating. For example: The B2 stream type is within Stream Group 4 (See Table 6). Stream Group 4, by definition, has a High Resiliency to disturbance.

Measurement of the parameters described herein, except Riparian Disturbance, will usually be within the bankfull flow floodplain zone between the edge of the water and the riparian area, depending on the channel type, vegetation type and composition and the

amount of protection needed. Three values are given for early, mid and late grazing seasons.

Movement of livestock within a pasture or to the next pasture will occur when a selected parameter level within these tables is reached. If, for example, the streambank disturbance parameter is reached before the stubble height parameter, livestock must be moved because one parameter has been attained. However, if livestock can be kept out of the stream area where a parameter has been reached, they may stay in the grazing pasture or unit until upland utilization is reached, but only if no other riparian parameters are exceeded.

Standards are set to either maintain the site in a high similarity situation or reverse the downward trend if in a low similarity situation. This in turn will protect water quality/wildlife values in those areas where they presently meet or exceed required or needed values, or improve degraded areas to meet those values. Those areas with low resiliency and low similarity have more conservative values for the parameters to be measured than high resiliency, high similarity areas. This is because once low resiliency areas are damaged they may take longer to recover. The speed at which a riparian area will recover depends on the resiliency of the site, the overall condition, and the magnitude and duration of impacts that continue to influence the site.

To use the following tables, determine the stream group (See Table 7) and the similarity rating for each stream or segment of interest. In the utilization and stubble height tables, three figures are shown for each combination of similarity and resiliency. (e.g. 40/30/20) These are in reference to the timing and use. The first number is early season use (normally the beginning of the growing season to mid July), the second is mid season (usually mid July to mid August), and the third is late season (normally mid August to the end of the growing season). Seasonal climatic and elevational variations will affect the exact dates or time periods of each of the seasons.

For instance, some observers of vegetation in Southeastern Idaho state that most of the cool season vegetation growth occurs during the first six weeks of the growing period, slowing in early to mid-July in "normal" years, followed by the growth of warm season vegetation. Late season (late August to the end of the grazing season) is normally when upland plants stop growing, through some riparian species may continue growing until hard freeze. As such, greater utilization is allowed for those plants grazed earlier in the season because of the re-growth potential. Those plants grazed in mid-season have a reduced re-growth potential and, therefore have a reduced amount of allowable utilization. Plants grazed in the late season have the least potential for re-growth, thus have the least allowable utilization. However, this rule-of-thumb should be used with caution. Smith (2001) studied sedge re-growth in a small spring-fed stream in southeastern Idaho. He found variability in plant re-growth even on the same stream. Two plots experienced over 10 inches re-growth, while two plots had no re-growth at all. He also concluded that consistent re-growth cannot be expected after mid-July and that managers should be cautions when prescribing early season stubble height criteria because of the variability in re-growth responses.

Some literature suggests that standards should be different depending on the socio-political class or sensitivity of the stream, or the kind of grazing, i.e. season-long vs. rest rotation. In these situations, stream classes or sensitivities are based on risk, the presence of certain uses, such sensitive species, and so

forth. These concepts have merit. The purpose of the standards listed below is to protect all riparian areas and stream channels from degradation. However, socio-political factors, such as the presence of threatened or endangered species, or listing of the stream under section 303(d) of the Clean Water Act may warrant additional protection or accelerated restoration. As such, more restrictive standards may be justified than those advocated within the tables. For example Forest Service Handbook 2209.21 (1993) states that stubble heights of greater than 6 inches may be necessary to protect special riparian ecosystem functions, such as critical fisheries. FSH 2209.21 further states that where riparian and fishery habitats as well as other sensitive areas are involved, grazing animals must be totally removed from the grazing unit when proper use has been attained. Failure to do so could negate the objectives of the grazing system.

Table 1. Greenline - Key Species Forage Utilization (Percent).

Stream Group	Properly Functioning Condition	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (States C & D)
0,1,2,3,4, 12,16	55/45/35	45/40/30	40/30/20	45/40/30
5,6,9,10 13,14,15	50/40/30	40/30/25	30/25/20	40/30/25
7,8,11 17	40/30/20	30/25/20	20/20/20	30/25/20

Key Species Utilization:

This is the percent of total weight of **greenline** key species utilized by livestock while grazing the affected riparian area. In some areas of high similarity (PFC) it will be forage species, such as *Carex aquatilis*. Under lower similarity (Functioning at Risk to Non Functioning) the focus may be on all grass species present, since one would not expect to find an abundance of desired species if the area has been over-utilized by ungulates.

Table 2. Woody/Shrubby Species Utilization (Percent).

Stream Group	Properly Functioning Condition	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (States C & D)
0,1,2,3,4, 12,16	50/50/50	50/50/40	50/40/35	50/50/40
5,6,9,10 13,14,15	50/50/45	50/45/40	50/40/30	50/40/30
7,8,11 17	40/40/35	40/35/30	30/20/15	40/35/30

Woody/Shrubby Species Utilization:

This is the utilization of the annual growth of woody species such as willows, aspen, dogwood, etc. by livestock **and** wildlife within the riparian area. Emphasis will be on individual plants closest to the stream bank. Utilization is compared to a similar plant, or a portion of the same plant, that has not been browsed. Lower utilization rates for lower resiliency/similarity segments are not particularly based on plant physiology, or the ability of plants to withstand grazing pressures, but rather on emphasizing plant regeneration and/or reestablishment.

Table 3. Greenline - Stubble Height (Inches).

Stream Group	Properly Functioning	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (states C & D)
0,1,2,3,4, 12,16	2/3/5	3/4/5	4/5/6	3/4/5
5,6,9,10 13,14,15	3/4/5	4/5/6	5/6/8	4/5/6
7,8,11,17	4/6/6	5/6/8	6/8/8	5/6/8

Stubble Height:

This is the height of standing **greenline** herbaceous vegetation at the time of measurement. These values take into consideration any anticipated regrowth. Measurement can be in one of two ways. It can be an average of all the forage within the bankfull zone, or it can focus on one or several Key species within the bankfull zone. The bankfull zone is normally associated with the so-called "greenline", which is the first perennial vegetation from the water's edge. It is realized that some species may not naturally grow to a desired length, or natural conditions such as a drought may stagnate growth. If this occurs, percent utilization may be a better parameter than stubble height.

Table 4. Riparian Zone Soils Disturbance (Percent)*

*These parameters are appropriate where ground cover (a combination of vegetation, litter and rock fragments (larger than ¾ inch in diameter) protect, and are in contact with the soil. If total ground cover within the riparian emphasis area is less than **80%,** use the next lower resiliency or similarity parameter.

Stream Group	Properly Functioning	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (states C & D)
0,4,6,10	15%	15%	10%	15%
1,2,5,7, 12,16	15%	15%	10%	15%
3,8,9,11, 13,14,15, 17	10%	10%	5%	10%

Riparian Soils Disturbance:

This refers to detrimental soil disturbance within the riparian area. This differs from bank disturbance in that the entire riparian area is assessed, rather than just the stream bank. Characteristics of detrimental soil disturbance include puddling (results in hummocky soils), compaction and displacement. It can be associated with high amounts of bare soil. Soil disturbance will not necessarily be measured exclusively within bankfull zone, but will be measured in the larger floodplain area or sensitive low terrace, depending on the channel type. Soil is considered bare if not protected by vegetation, moss, litter or rock. Other soil factors, such as displacement, compaction, and/or puddling, in addition to burning and on-site organic matter (litter and large woody debris), may also be considered per FSH 2509.18 – Soil Management Handbook, Region 4 Supplement No. 2509.18-95-1 and other appropriate Regional standards and guidelines.

Table 5. Bank Disturbance/Alteration - One Year (Percent)

Stream Group	Properly Functioning	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (States C & D)
0,3,4,6,12,16	25%	20%	15%	20%
1,2,5,13	20%	15%	15%	15%
7,8,9,10,11,14,15,17	15%	10%	10%	10%

Table 5A. Bank Stability - Cumulative (Percent)

Stream Group	Properly Functioning Condition	Functioning at Risk (High to Moderate)	Functioning at Risk (Low) to Non Functioning	Non Functioning (States C & D)
0,3,4,6,12,16	85%	80%	75%	80%
1,2,5,13	80%	75%	70%	75%
7,8,9,10,11,14, 15,17	75%	70%	65%	70%

Bank Disturbance/Alteration refers to short-term (annual) physical disturbance of alteration of the bank by livestock trampling. Characteristics of bank disturbance/alteration are bare soil exposed to running water, bank erosion or sloughing. Bank disturbance is measured from the low water line to the top of the bank and as far away from the shoreline as necessary to properly assess conditions that may lead to a section of the bank eroding or falling into the stream during higher flows.

Bank Stability refers to long-term bank structure, expresses as a percentage of the streambank in one of six stability classes. It is intended for long-term trend monitoring and should be read on 3-5 year intervals. It includes damage from natural processes, such as floods, and human caused impacts, such as mining or recreation vehicle crossings, as well as from livestock.

Other socio-political requirements or constraints may supersede these parameters. For example, Total Maximum Daily Load (TMDL) requirements for a Clean Water Act, Section 303(d) stream may require 80% of the banks to be in a stable condition. This requirement would supersede the above parameters, unless they are more stringent than the TMDL requirement.

Table 6. Riparian Zone Forage Utilization and Stubble Heights *(Riparian** Vegetation).

Season of Use	Properly Functioning Condition (%/Stubble Height)	Functioning at Risk (High to Moderate) (%/Stubble Height)	Functioning at Risk (Low) to Non Functioning (%/Stubble Height)	Non Functioning (States C & D) (%/Stubble Height)
Spring	**65/2**	**55/3**	**45/4**	**55/3**
Summer	**55/3**	**45/4**	**35/5**	**45/4**
Fall	**45/4**	**35/5**	**20/6+**	**35/5**

Table 6A. Riparian Zone Forage Utilization and Stubble Heights (*Upland** Vegetation).

These parameters are appropriate where ground cover (a combination of vegetation, litter and rock fragments (larger than ¾ inch in diameter) protect, and are in contact with the soil. If total ground cover within the riparian emphasis area is less than **60 percent,** use the next lower resiliency or similarity parameter.

Properly Functioning Condition (% Utilization)	Functioning at Risk (High to Moderate) (% Utilization)	Functioning at Risk (Low) to Non Functioning (% Utilization)	Non Functioning (States C & D) (% Utilization)
50%	**40%**	**30%**	**40%**

* ***Riparian*** vegetation is considered those grasses and sedges normally associated with wet or anerobic soil conditions. ***Upland*** vegetation consists primarily of grasses normally associated with dryer soil conditions.

Percent Utilization:
The percent of total weight of key species within the Riparian Zone utilized by livestock while grazing the affected riparian area.

Stubble Height:
The height of standing herbaceous vegetation at the time of measurement. Measurement can be in one of two ways. It can be an average of all the upland forage within the Riparian zone, or it can focus on one or several Key Species within the Riparian zone. It is realized that some species may not naturally grow to a desired length, or natural conditions such as a drought may stagnate growth. If this occurs, percent utilization may be a better parameter than stubble height.

Only a percent utilization is given since residual stubble heights associated with utilization rates can be highly variable depending on the plant species and growing conditions.

Key To Determine Allowable Use Parameters Within Riparian/Wetland Areas

A managerial dilemma is deciding what monitoring parameter to apply to a particular situation. Two basic schools-of-thought polarize the issue. One school-of-thought is based on a simplistic one-size-fits-all concept that loosely reasons that if one component of the system is in satisfactory condition, the rest of the components will follow accordingly. Stubble height is one parameter that seems to have defaulted, in some areas, to this universal status; reasoning that stubble height is relatively easy to measure and it provides a somewhat accurate picture of grazing impacts. Depending on actual on-the-ground situations, the one-size-fits-all stubble height parameter, in itself, may not represent a true picture of impacts to riparian vegetation, channel stability, water quality and aquatic habitat.

The opposite school-of-thought lies in the camp of intensively monitoring a multitude of parameters, on a regular basis throughout the entire affected area. Though this methodology may reflect a more accurate picture of actual impacts and effects, the time and effort required to conduct such monitoring is prohibitive on any large-scale landscape. The answer lies somewhere in the middle.

Clary and Leininger (2000) suggest that no single management approach is best for all situations and no management tool serves all purposes. Other 'experts' assert that application of specific parameters depends on the type of landscape and intensity of impacts, but cannot offer any substantial suggestions without "looking on-the-ground" with a full interdisciplinary team. Again, this concept is well intended, but, in practice, the time and effort required for such intensive reviews on every area is impractical.

There is a need to adapt monitoring parameters to physical conditions found on the ground. Rather than instituting a universal, one-size-fits-all parameter, such a stubble height, the manager needs to be able to key in on the cause of any problems, rather than monitoring the symptom.

This concept is reinforced by Clary and Leininger (2000). They suggest that many managers tend to look at short-term impacts in the form of single monitoring parameters (such as stubble height), rather than looking at long-term management objectives such as the concepts of Potential Natural Community, Desired Future Condition or Properly Functioning Condition. They suggest that a manager should have a clear picture of the desired long-term structure and function of a riparian and channel system before setting any specific standards, such as stubble height. This is also emphasized in the University of Idaho, Stubble Height Study Report (2004)

Leonard *et al* (1997) stressed that regardless of other differences in management objectives, grazing must be compatible with achieving or maintaining "Properly Functioning Condition" (PFC) to be considered to be sustainable. PFC is achieved when adequate vegetation, landform, and/or large woody debris is present to:

- Dissipate stream energy associated with high waterflows, theregy reducing erosion and improving water quality
- Filter sediment, capture bedload, and aid floodplain development
- Improve flood-water retention and ground-water recharge
- Develop root masses that stabilize streambanks against cutting action
- Develop diverse ponding and channel characteristics to provide the habitat and water depth, duration and

temperature necessary for fish production, waterfowl breeding and other uses
- Support greater biodiversity

They go on to say that livestock grazing may not always be entirely compatable with other resource uses or values. In some of these situations, excluding livestock grazing may be the most logical and responsible course of action. The compatibility of grazing in riparian areas depends on the extent to which grazing management considers and adapts to certain basic ecological relationships. Prior to developing grazing management prescriptions, the manager should have some understanding of grazing effects on ecosystem functions such as soils, water quality and hydrologic/ geomorphic conditions and processes.

The following key is designed to help the manager focus in on the parameter or parameters that may be monitored in an effort to obtain a more efficient and accurate reflection of short-term impacts, while maintaining or moving toward desired riparian and channel conditions over the long term. Use of the key can be accomplished in a relatively short amount of time without requiring the need of large interdisciplinary teams. However, the use of ID teams is still encouraged when and where possible.

Use of the key requires a basic knowledge of the Properly Functioning Condition[39] concept. The quasidichotomous key is subdivided into three parts. The first part consists of socio-political factors. These factors attempt to address the human values placed on a certain riparian area or reach of stream. The second part addresses the resource values themselves. These values are developed using the Properly Functioning Condition assessments. Beaver change the natural conditions of a stream channel and riparian area and are addressed separately.

Again, it is emphasized that a short-term or annual monitoring parameter (i.e., five-inch greenline stubble height, etc.) is NOT the desired condition. It is merely a surrogate for achieving long-term goals and desired conditions. These desired conditions are determined by the manager. They can be Properly Functioning Condition, some seral state or stage of vegetative communities, some state or stage of channel stability, water quality, aquatic habitat and so forth. These can and should be set by an ID team prior to establishing standards.

Once a parameter, or parameters is/are established, monitoring is required to determine if the parameter(s) are sufficient to attain the desired goal or condition. If not, parameters can and should be adjusted so that long-term conditions are achieved and maintained.

Use of the key is a several-step process. First, a desired condition must be determined. Secondly, the existing condition must be known. The key is based on a desired future condition of Properly Functioning Condition. To this end, the 17 checklist questions (USDI 1998)[40] must be answered. The third step is to go through the key, answering the yes-no questions until the suggested parameter or parameters are determined.

To use the tables, channel type must be known. To determine Stream Group used in the tables, go to Table 7 in this guide. The channel type is found in the extreme left column, the associated Stream Group is found in the adjacent column to the right. Find the

[39] USDI, Bureau of Land Management, 1998. Riparian Area Management, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas, TR 1737-15, National Applied Resource Sciences Center, Denver, Co.

[40] Ibid

appropriate stream group along the extreme left side of the parameter table(s), locate the existing condition along the top of the table(s) and at the intersection of the Stream Group row and the existing condition column are the suggested parameter(s).

For example, using Table 3 (Greenline Stubble Height) the numbers at the intersection of Stream Group 4 and Function At Risk-High to Moderate are the numbers 3/4/5. This means key species greenline vegetation can be grazed to 3 inches in the early season, to 4 inches in the mid-season, and to 5 inches if grazed in the late season. The exact dates or times of "early", "mid" and "late" can vary between Forests or even between years, therefore are not specified. However, for the Caribou National Forest, "early" is usually defined as the beginning of the growing season to mid July, "mid" season from mid July to mid August, and "late" season from mid August to the end of the growing season (see Impact Guidelines section for more detail).

Socio-political Factors:

1) **AIZ* contains TE species and/or stronghold for Sensitive Species**
*These parameters are appropriate where ground cover (a combination of vegetation, litter and rock fragments (larger than ¾ inch in diameter) protect, and are in contact with the soil. If total ground cover within the riparian emphasis area is less than **60 percent,** use the next lower resiliency or similarity parameter.

   YES Control grazing to protect species habitat. Increase protection at least one Resiliency or Similarity Level: e.g. area is determined to be PFC/High Similarity, use guidelines for Functional-at-Risk/Moderate Similarity; If already at Low Resiliency/Similarity, rest the area for one or more years until condition reaches Moderate Similarity; go to 2

   NO Go to 2

2) **AIZ contains a 303(d) stream**

   YES Increase protection at least one Resiliency or Similarity level(i.e. high to moderate or moderate to low); If already at Low Resiliency/Similarity, rest the area for 1 or more years until condition reaches Moderate Similarity; go to 3

   NO Go to 3

3) **A 303(d) stream or Riparian/Aquatic TES species is immediately below (within 1 mile) Forest boundary**

   YES Consider increasing protection one Resiliency or Similarity Level; If already at Low Resiliency/Similarity, rest the area for 1 or more years until condition reaches Moderate Similarity; go to 3a

   NO Go to 3a

   3a) **A 303(d) stream or Riparian/Aquatic TES species is one to ten miles below Forest boundary and within 1 stream order**

   YES Consider increasing protection one Resiliency or Similarity Level; If already at Low Resiliency/Similarity, consider resting the area for 1 or more years until condition reaches Moderate Similarity; go to 3b

NO Go to 3b

3b) **A 303(d) stream or Riparian/Aquatic TES species is greater than 10 miles below Forest boundary or is two or more stream orders greater than the stream order at the Forest boundary.**

YES Use evaluated Similarity Level; go to 4

NO Go to 4

Physical Factors:

4) AIZ is at Properly Functioning Condition (PFC)

YES Go to 5

NO Go to 4a

4a) AIZ is Functioning At Risk (FAR)

YES Go to 6

NO Go to 4b

4b) AIZ is Non Functioning (NF)

Go to 6

5) **If AIZ is at PFC, are there any rated factors within control rated "No"?**

YES Go to 6

NO Maintain current grazing scheme; great work!!

6) Are any "Hydrology" factors rated "No"?

YES Go to 7

N0 Go to 6a

6a) Are any "Vegetation" factors rated "No"?

YES Go to 10b

NO Go to 6b

6b) Are any "Erosion/Deposition" factors rated "No"?

YES Go to 8

NO Go to 7

Floodplain and Channel Characteristics

7) Is floodplain inundated in relatively frequent (1 to 3 years) events?

YES Go to 8

NO Go to 7a

7a) Is the channel Type F or G? (See page 60, Figure 2)

YES Go to 7b

NO Go to 8

7b) Is the channel in State B or E? (See page 57, Table 1)

YES Go to 8

NO Go to 7c

7c) Is the channel in State C or D? (see page 57, Table 1)

YES Use "High Similarity/High Resiliency guidelines; go to 8

NO Go to 8

8) Are the floodplain and channel characteristics adequate to dissipate energy?

YES Go to 9

NO Go to 8a

8a) Are channel characteristics changing (i.e. widening, deepening, bank cutting)?

YES Go to 8b

NO Go to 9

8b) Are Stream Type Groups 05, 07, 08, 09, 11, 13, 14, 15 or 17?

YES Go to 8c

NO Go to 9

8c) Is adequate vegetative cover present to protect banks and dissipate energy during high flows?

YES Go to 9

NO Go to 8d

8d) Is bank soil structure, texture and cohesive strength such that extensive root and surface mass is needed to maintain bank stability (i.e. silty alluvial soils)(e.g. C3-C6, DA4-DA6 and E3-E6 Channel Types)?

YES Go to 8e

NO Go to 9

8e) Are livestock suppressing vegetative cover?

YES Use stubble height guidelines (Table 3); go to 9

NO Go to 9

9) Are channels in balance with the landscape setting?

YES Go to 10

NO Go to 9a

9a) Is sinuosity within acceptable parameters for the channel type?

YES Go to 9d

NO Go to 9b

9b) Has the channel been artificially straightened or meanders being cut off?

YES Go to 9c

NO Go to 9d

9c) Are livestock aggravating channel straightening?

YES Use bank disturbance, vegetation and/ or woody/shrubby species utilization guidelines (Tables 1, 2, and/or 5/5A); go to 10

NO Go to 9d

9d) Are overhanging banks present in good condition?

YES Go to 9f

NO Go to 9e

9e) Is overhanging bank sheering aggravated by livestock?

YES Use bank disturbance guidelines (Table 5/5A); go to 10

NO Go to 9f

9f) Is width/depth ratio greater than normal for the Channel Type?

YES Go to 9g

NO Go to 9h

9g) Is bank sheering/instability aggravated by livestock?

YES Use bank disturbance, forage utilization, stubble height and/or woody/shrubby species guidelines (Tables 1, 2, and/or 5/5A); go to 10

NO Go to 9h

9h) Is lateral movement of stream channels within natural ranges?

YES Go to 9k

NO Go to 9i

9i) Are stream banks eroding excessively? (Greater 30 percent)

YES Go to 9j

NO Go to 9k

9j) Are livestock contributing to excessive lateral migration?

YES Use bank disturbance, vegetation utilization and/or woody/shrubby species guidelines (Tables 1, 2, and/or 5/5A); go to 10

NO Go to 9k

9k) Is the stream channel vertically stable?

YES Go to 10

NO Go to 9l

9l) Is the channel downcutting or aggrading at an accelerated rate? (e.g. headcutting or excessive sediment buildup)

YES Go to 9m

NO Go to 10

9m) Are livestock aggravating the condition?

YES Use stubble height, bank disturbance, soil disturbance and/or woody/shrubby species utilization guidelines (Tables 2, 3, 4, and/or 5/5A); go to 10

NO Go to 10

10) Is the flow/sediment ratio in balance (no excessive erosion or deposition)?

YES Go to 11

NO Go to 10b

Vegetation Characteristics;

10b) In B and C channel Types, are point bars being colonized and stabilized with willows and/or sedges? For other channel types go to 10c.

YES Go to 11

NO Go to 10c

10c) Are livestock retarding vegetation establishment?

YES Use vegetation utilization, stubble height and/or woody/shrubby utilization guidelines (Tables 1, 2 and/or 3); go to 11

NO Go to 11

11) Is the riparian area widening or has achieved its potential extent?

YES Go to 12

NO Go to 11a

11a) Is riparian vegetation capturing upslope sediment?

YES Go to 11b

NO Go to 11b

11b) Are livestock retarding riparian vegetation vigor and density?

YES Use riparian stubble height/utilization and/or soils disturbance guidelines (Tables 4, and/or 6/6A); go to 12

NO Go to 11c

11c) Is riparian vegetation capturing instream sediment?

YES Go to 12

NO Go to 11c

11d) Are livestock aggravating the lack of greenline vegetation?

YES Use stubble height guidelines (Table 3); go to 12

NO Go to 12

12) Are there at least two age-classes of deep-rooted riparian/wetland vegetation?

YES Go to 13

NO Go to 12a

12a) Is young age-class recruitment or replacement vegetation present?

YES Go to 13

NO Go to 12b

12b) Are livestock suppressing recruitment or replacement of vegetation?

YES Protect replacement vegetation – use vegetation utilization guidelines (Table 1) for streamside vegetation and stubble height/utilization guidelines (Table 6/6A) for area-wide guidelines. Increase protection at least one Resiliency or Similarity Level until at least two age classes are established; go to 13

NO Go to 13

13) Is there a diverse (two or more species) composition of deep-rooted (e.g. sedges/willows) riparian vegetation with high vigor?

YES Go to 15

NO Go to 13a

13a) Are livestock suppressing vigor?

YES Use vegetation utilization and/or woody/shrubby utilization guidelines (Tables 1, 2 and/or 6/6A); go to 14

NO Go to 14

14) Are plant communities an adequate source of coarse and/or large woody material?

YES Go to 15

NO Go to 14a

14a) Is coarse and/or large woody debris needed to dissipate energy and capture bedload?

YES Go to 14c

NO Go to 14b

14b) Is sufficient material available to dissipate energy and capture bedload?

YES Go to 14c

NO Use Woody/Shrubby Species guidelines (Table 2); go to 15

14c) Is sufficient material available to maintain/replace woody material?

YES Go to 15

NO Go to 14d

14d) Are livestock suppressing recruitment of adequate plant communities?

YES Use Woody/Shrubby Species guidelines (Table 2); go to 15

NO Go to 15

Beaver;

15) Are beaver dams active and stable?

YES Go to 15a

NO Go to 15a

N/A Use guidelines established above.

15a) Are willows/wood available for dams/food?

YES use guidelines established above.

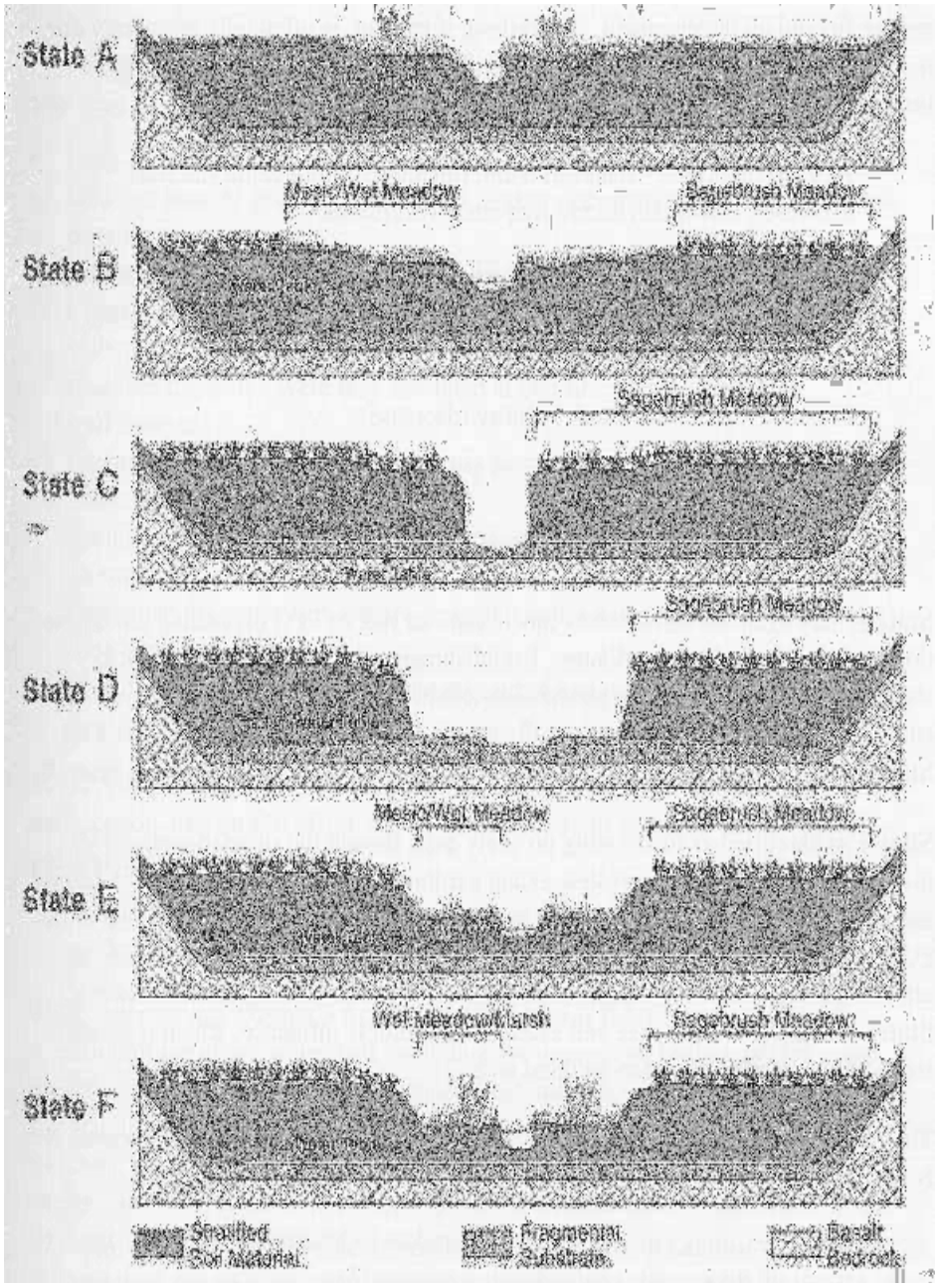
NO Consider beaver management; Go to 15b

15b) Are livestock contributing to lack of willows/wood?

YES Use Woody/Shrubby Species Utilization Guidelines (Table 2)

NO Go back to 6 if applicable; otherwise use guidelines established above.

Figure 1. Succession of States for Alluvial/Nongraded Valley Bottom Types*



* From Prichard, ISDI, 1998, p. 11-13

Ecological Status/Successional State/Similarity[41]

Since there is often limited information concerning which community types indicate unnatural disturbances and because it is extremely difficult to find examples of PNC situations in riparian areas, the following procedures may be used to broadly rate riparian areas as to their successional status.

A list has been developed of all community types known to occur on lands administered by the Intermountain Region. In this list, each community type has been assigned an "L" if they are known to occur in latter successional stages, or an "E" for types known to occur in earlier stages of succession. Percent composition of each community type from measurements can be used to determine the ecological status, thus the Similarity to the natural range of variation and desired conditions.

Ecological Status

- Arrange the community type compostiion values to either an "Early or "Late" column (found in the R-4 Integrated Riparian Evaluation Guide, Appendix 1).

- Summarize all types that occur in the "Late" column and divide by the percent of the vegetation that should be represented by late seral community types. This value will range from 75-95 percent.

- Rating of ecological status is then determined by comparing this number with those assigned to each of the five seral status values:

  1-15 = very early,
  16-40 = early,
  41-60 = mid,
  61-85 = late, and
  86+ = PNC

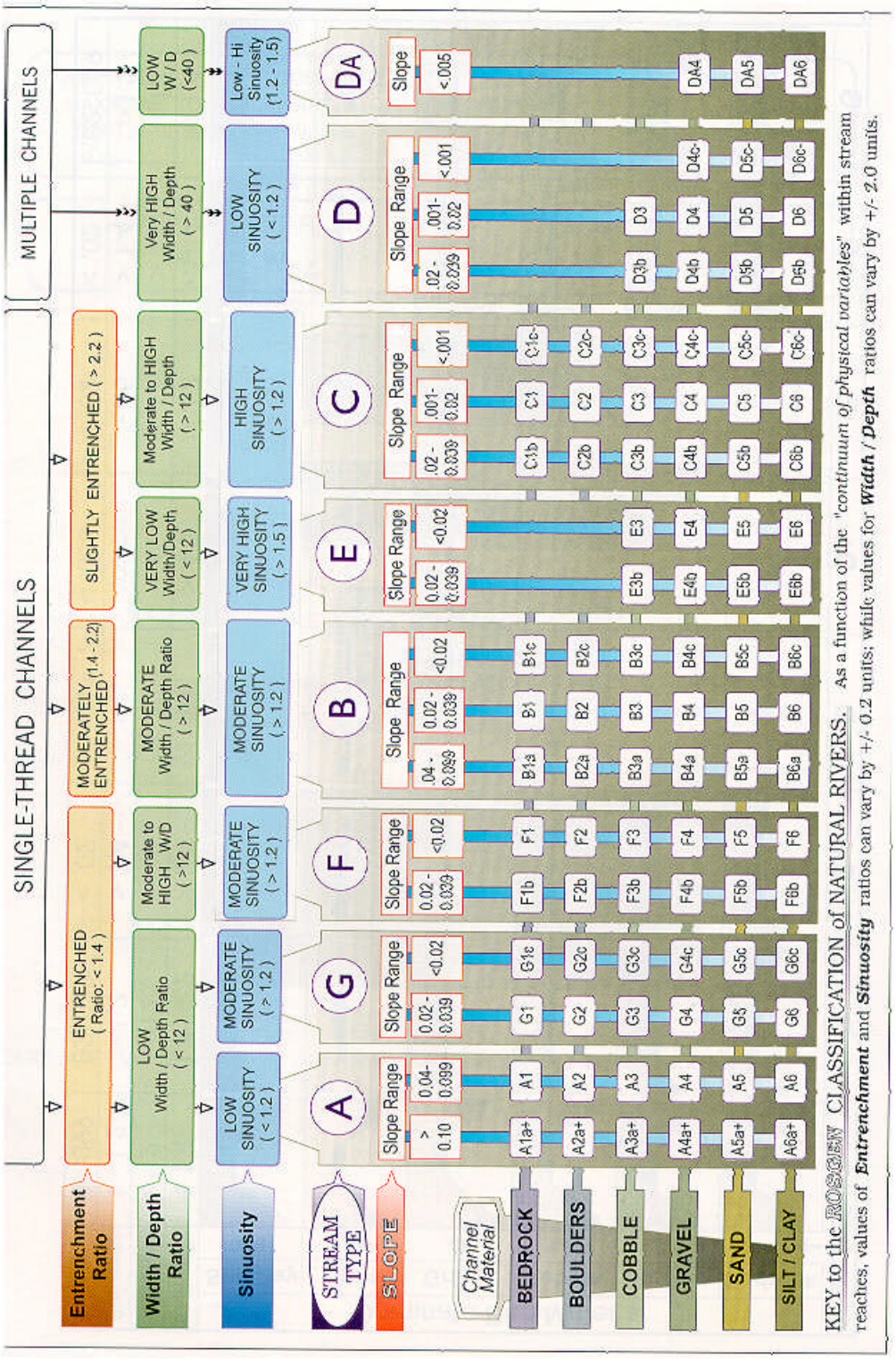
These ecological status ratings may now be evaluated against standards or desired conditions set for the area being evaluated.

[41] In USDA Forest Service, Intermountain Region. 1992. Integrated Riparian Evaluation Guide – Intermountain Region, March 1992.

Table 7. Summary of Stream Channel Characteristics and Sensitivity to Disturbance
(Source: Modified from D. L. Rosgen, Applied River Morphology, 1996 pg 8-9.)

Stream Type	Stream Group	Sensitivity to Disturbance	Recovery Potential	Sediment Supply	Stream Bank Erosion Potential	Vegetation Controlling Influence
A1, A2	SG-00	Very low	Excellent	Very low	Very low	Negligible
A3	SG-01	Very high	Very poor	Very high	Very low to very high	Negligible
A4, A5	SG-02	Extreme	Very poor	Very high	Very high	Negligible
A6	SG-03	High	Poor	High	High	Negligible
B1, B2, B3	SG-04	Very low to low	Excellent	Very low to low	Very low to low	Negligible to moderate
B4, B5, B6	SG-05	Moderate	Excellent	Moderate	Low to moderate	Moderate
C1, C2	SG-06	Low	Very good	Very low to low	Low	Moderate
C3	SG-07	Moderate	Good	moderate	Moderate	Very high
C4, C5, C6	SG-08	Very high	Fair to good	High to very high	High to very high	Very high
D3, D4, D5, D6	SG-09	High to very high	Poor	High to very high	High to very high	Moderate
DA4, DA5, DA6	SG-10	Moderate	Good	Low to very low	Low to very low	Very high
E3,. E4, E5, E6	SG-11	High to very high	Good	Low to moderate	Moderate to high	Very high
F1, F2	SG-12	Low	Fair	Low to moderate	Moderate	Low
F3	SG-13	Moderate	Poor	Very high	Very high	Moderate
F4	SG-14	Extreme	Poor	Very high	Very high	Moderate
F5, F6	SG-15	Very high	Poor to fair	High to very high	Very high	Moderate
G1, G2	SG-16	Low to moderate	Fair to good	Low to moderate	Low to moderate	Low
G3, G4, G5, G6	SG-17	Very high to extreme	Very poor to poor	High to very high	High to very high	High

Figure 2. Rosgen Channel Classification Key.



(Source: D. L. Rosgen, Applied River Morphology,1996, pg 5-6.)

Table 8. Riparian/Stream Channel Morphology Objectives.

Channel Type	Pool Frequency	Pool Type	Width/ Depth Ratio	Deep-Rooted Vegetation	Percent Bank Stability	Large Woody Debris	Stability Rating
A1	Irregular	Scour step	<12	Not important	>60	Not important	<44
A2	Irregular	Scour step	<12	Not important	>60	Not important	<44
A3	Irregular	Scour step	<12	Not important	>70	Important for pools - irregular spacing	<91
A4	Irregular	Scour step	<12	Not important	>60	Important for pools - irregular spacing	<96
A5	Irregular	Scour step	<12	Not important	>60	Important for pools - irregular spacing	<96
A6	Irregular	Scour step	<12	Not important	>60	Important for pools - irregular spacing	<81
B1	Infrequent	Scour step	>12	Not important	>60	Not important	<46
B2	Irregular	Scour step	>12 <21	Not important	>60	Not important	<46
B3	Irregular 3-5 bankfull widths	Scour step	>12 <22	Important	>60	Important for pools	<61
B4	Irregular 3-5 bankfull widths	Scour	>12 <20	Important	>65	Important for complexity	<65
B5	Irregular 3-5 bankfull widths	Scour	>12 <20	Important	>65	Important for complexity	<69
B6	Irregular 3-5 bankfull widths	Scour	>12 <20	Important	>65	Important for complexity	<61
C1	Irregular	Backwater and scour	>12	Important woody /sedge	>65	Important for pools	<51
C2	Irregular	Backwater and scour	>12	Important woody /sedge	>65	Important for pools	<51
C3	Irregular 5-7 bankfull widths	Riffle/scour pool	>12 <37	Important woody /sedge	>70	Important for complexity	<86

Channel Type	Pool Frequency	Pool Type	Width/ Depth Ratio	Deep-Rooted Vegetation	Percent Bank Stability	Large Woody Debris	Stability Rating
C4	Irregular 5-7 bankfull widths	Riffle/scour pool	>12 <29	Important woody /sedge	>70	Not important	<91
C5	Irregular 5-7 bankfull widths	Riffle/scour pool	>12 <30	Important woody /sedge	>70	Not important	<91
C6	Irregular 5-7 bankfull widths	Riffle/scour pool	>12	Important woody / sedge	>70	Not important	<86
D3-6	Irregular	Scour/ debris dams	>40	Very important woody /sedge	>65	Not important	<108
E3	Irregular	Riffle/scour pool	>6 <10	Very important sedge/ woody	>65	Not important	<64
E4	Irregular	Riffle/ scour pool	>2 <6	Very important sedge/ woody	>65	Not important	<76
E5	Irregular	Riffle/ scour pool	>2 <7	Very important sedge/ woody	>65	Not important	<76
E6	Irregular	Riffle/ scour pool	<12	Very important sedge/ woody	>65	Not important	<64
F1-6	Irregular 5-7 bankfull widths	Scour/ debris dam	>12 <40	Not important	>65	Important for pools	<116
G1-6	Irregular	Scour step	<12	Important woody /sedge	>70	Not important	<113

Column Definitions:

Channel Type: As defined by Rosgen 1996

Pool Frequency:

Infrequent - Due to physical channel conditions, pools are infrequent within any given reach. There is no set pool spacing or number of pools within any given reach.

Irregular - Due to physical channel conditions, pools are irregularly spaced within any given reach. There is no set pool spacing or number of pools within any given reach.

Bankfull widths - Channel geometry is such that pools are spaced at specified intervals based on the bankfull width of the channel. e.g. 5-7 bankfull widths - if the bankfull width is 10 ft., pools would be expected to be spaced 50 to 70 feet apart within any given reach; or within a 1,000 ft. reach, 14 to 20 pools would be expected to occur.

Pool Type:

Scour step - Due to the steepness of the channel bed, the stream "steps" down the slope. Water plunging over these "steps" scours a pool below the obstacle. "Steps" may be formed by rock or organic debris.

Scour - Channel steepness is not enough to form plunge pools, but do support sufficient velocities for water to scour pools as it works its way over and between rocks and organic debris.

Backwater - Small dams are formed within the channel by rock and organic debris. Water pools behind these barriers rather than forming scour pools below the obstacle.
Riffle/scour pool - This stream type exhibits a sequencing of steeps (riffles) and flats (pools) that are linked to meander geometry. The spacing interval is predictable depending on channel type and width.

Scour/debris dam - Pools are formed as a result of bank and bottom scouring and small dams formed by organic debris. Rocks do not play an important role in pool formation.

Width/Depth Ratio: The ratio of the bankfull (approx. 2.5 year reoccurrence flood level) surface width to the mean depth of the bankfull channel.

Deep Rooted Vegetation: Some channel types do not contain sufficient rock, large wood, etc. content in the banks to suppress bank erosion. In this situation, vegetation having deep and dense root systems is necessary to bind the soil and suppress bank erosion.

Woody/Sedge - Though sedges are important to be maintained on-site, woody plant species (willow, alder, dogwood, etc.) are more desirable to be maintained than sedges because of potential high bank heights. Woody species' roots generally extend deeper than sedges.

Sedge/Woody - Though woody species may be desired, sedges are sufficient to protect potential bank erosion.

% Bank Stability: Minimum percent of stable banks needed to maintain channel stability. This is a total of both banks within a stream reach.

Stability Rating: As developed by Pfankuch (1975) (also known as R1/R4 Stream Reach Inventory and Channel Stability Evaluation). Ratings by channel type are those reflecting channel stability of "Good" or better as defined by Rosgen (1996).

Monitoring

Monitoring objectives should be dictated by the present condition and trend of the riparian habitat in relation to management goals, the resource potential for change and the importance of other resource values. Good monitoring objectives should be achievable, measurable and worthy of the costs incurred to accomplish and monitor them (Leonard *et al* 1997).

The six monitoring parameters are intended to be the minimum requirements. Other, more comprehensive monitoring protocols may be used as necessary and are described in documents such as the R-4 Integrated Riparian Evaluation Guide (1992) and may be used as needed to properly assess and evaluate a specific situation. The Beaverhead/Dearlodge National Forest, as well as other Forests and BLM offices, have also developed bank disturbance and other monitoring guidelines.

As a minimum, monitoring will be within Key Areas. Monitoring will include:

1) Administrative monitoring of one or more of the six parameters, as appropriate, and

2) Longer term effectiveness monitoring to gauge progress toward desired conditions.

If the effectiveness monitoring confirms movement toward the desired condition, then the similarity level may move to a higher level. Poor outcomes will result in reevaluation of the current standards and possibly more restrictive or application of different measures.

Specific Key Areas should be determined through an interdisciplinary team process, conferring with the permittee. Key areas should be representative of the riparian aggregates within the grazing area. Care should be taken to avoid inclusions that are not representative of the area.
The objectives of these standards are to protect the riparian and aquatic resources. Key Area and Key Species selection should be done with this in mind.

For example: A stream flowing through an allotment has two major stream types. One falls into a category that is highly resilient, and another, smaller, portion falls into a lower resiliency category. A chain is as strong as its weakest link. Therefore, the manager may want to consider either applying the more stringent standards to the entire stream or making the less resilient reach a special management area, such as a riparian pasture, applying the more stringent standards.

Another scenario may be the identification of Key plant species. If it is known that an ungulate may key in on one plant species and leave other plant species in sufficient densities to protect the bank, then perhaps the focus should be on the remaining plants, not a single species. This is why each situation should be discussed in an interdisciplinary setting and the specific needs of the area considered.

In lieu of Monitoring

The above parameters require time and effort on the behalf of the Range Manager or permittee. Someone must be physically on-the-ground on at least a weekly, if not daily basis, especially when a parameter is close to being exceeded. In some cases, this is not possible. Therefore, an alternative to comprehensive monitoring is offered. This alternative is simply time-in-pasture. If a pasture contains a riparian area that cannot be

monitored as necessary to assure and insure instituted parameters are not exceeded, or if previous monitoring has not determined time-in-pasture as it relates to allowable uses and impacts, then a **30-day** limit within the pasture is advocated as a starting point. This is supported in the literature by several authors (e.g. Myers 1989). Five to ten days may be a maximum time allowed within riparian pastures. However, this is not to be construed to be a total default to monitoring specific parameters as described above.

Monitoring is essential to ensure the health of the riparian areas, stream channels, water quality and aquatic habitat is maintained or improved as necessary. Further, this time period may have to be adjusted on an individual basis, depending on the existing climatic conditions, densities and distribution patterns of livestock within each pasture and conditions of riparian areas and stream channels. This time period may be shortened or lengthened, depending on specific monitoring of the above parameters. This time limit also means that livestock will be moved from the pasture *within* the time limit, **not** that livestock will *begin* to be moved at the time limit with residual livestock removed sometime after.

Caveat - These S&Gs are based on resource needs, structured from published literature and on-the-ground experience of resource professionals. It is conceded that socio-political or other resource conditions or constraints may require selecting one or more options that meets the needs of management to protect the resource, yet allow continued use of the resources.

For example: A stream within a pasture is in Stream Group 8. This stream group is highly sensitive to disturbance. The current vegetation and physical features of the riparian area and stream channel within the allotment have a low similarity of desired conditions. The standard for allowable bank disturbance is 10 percent or less. It may be improbable that the livestock can continue to use the riparian area at present rates with this small amount of allowable bank disturbance...a dilemma.

This leaves the manager with several options.

1) Do not allow any livestock within the allotment;

2) Fence the riparian area;

3) Keep the livestock out of the riparian area through the use of a rider, salting, alternative water and shade sources, etc;

4) Reduce the number and/or duration of livestock using the area;

5) Change or modify the grazing system;

6) Use a parameter other than bank disturbance (such as stubble height) that will provide resource protection, yet allow some bank disturbance to occur; or

If the livestock owner is dependent on the use of the allotment for maintaining his livelihood, elimination of all livestock use, or substantially reducing numbers or duration, may not be a realistic social alternative, even though it may be a reasonable environmental alternative. Fencing is expensive to install and maintain and may take several years to install and funding may be limited. Keeping the livestock out of the riparian zone with no physical barriers is difficult if not impossible in some situations. That leaves selecting other parameters that will protect the resource, yet allow grazing to continue.

Protection of the resource is a primary goal. As long as trend is in the direction of that goal, the manager has the discretion to use a single or multiple parameters, depending on the requirements of that site. It has been shown in the literature that maintaining a minimum stubble height, for example, is effective in moving a stream channel toward equilibrium in some situations, even though some physical bank damage may be still occurring. If the stream has a low fisheries or riparian value, options may be greater than if the stream has a critical value.

Keeping options open for the manager is essential. Key areas are selected by an interdisciplinary team. The team may also suggest other parameters to monitor. Based on this input, the manager can select those parameters that best meets the needs of the land and resources under management. However, the manager needs to be extremely careful when selecting a parameter. Selection has to be justified based on the situation and the resource to be managed. In the case of the Example Allotment, the standards allow minimized bank disturbance. This value is based on the characteristics of the resource. Simply selecting another parameter based on convenience or personal bias may foster scrutiny from a variety of sources.

FIELD GUIDE FOR THE MEASUREMENT OF IMPACTS ON RIPARIAN SYSTEMS

I. Site Selection

The goal is to sample the stream reach (or reaches) that represents and reflects management activities and resource conditions. That is it should be representative of the habitat type or stream group being impacted and reflect a typical result or consequence of the impact.

A) **Key Riparian Area** -- A key riparian area is defined as an indicator site that reflects the direct impacts of the uses over a larger area or stratum. It may represent all or part of the length of a stream/riparian zone, a critical fragile meadow or a wetland. The selection criteria for a Key Area are:

1) A key area should be representative of the stratum in which it is located. Identify a stratum first by homogeneous landtype, soil type or habitat type. Then make sure your sampling site falls within a homogeneous stream type group.

2) The site should enable the manager to measure the direct impacts the activity to be monitored on one or more of the parameters for that specific stream group. A direct impact measurement requires that the highest resource concerns are identified and sample for those parameters that involve those concerns. For example, if resource concerns in a sedge dominated wet meadow are bank stability and plant vigor, then a Key Area site inside that meadow that will produce direct measurements of bank alteration and plant utilization within the meadow would be selected. Do not use measurements on a fringe around the outside of the meadow as an indicator of what's happening inside the meadow.

   If there are specific management concerns and objectives for a fringe area (such as maximizing bluegrass vigor by holding use to a certain percentage), then establish a Key Area within the bluegrass fringe and monitor the most meaningful parameters for that specific site. Extrapolating impacts between stream groups or habitat types can lead to inaccuracies and reduce the defensibility of conclusions.

3) A Key Area should be capable of, and likely to, show response to management actions. The measurements should be indicative of the impacts that are occurring in the stratum of concern. For example, do not select a microsite that is seldom used by ungulates when the riparian area of concern shows an obvious higher ungulate impact level.

4) A Key Area may be selected to represent special or unique situations such as: a wet meadow that supports a sensitive plant or animal species; a

relatively short but significant stream reach in poor condition that is being impacted, etc.

B) **Numbers of Sites** -- The number of sample sites depends on the size of a homogeneous stratum; the variability of impacts within that homogeneous stratum; the mix of strata along the length of a stream; or a mix of sensitivity levels. For example: If there are three stream type groups within a reach of the stream, you may need to place at least one transect within each of the stream groups; or select the most sensitive and monitor it.

Personnel, funding and time constraints may force taking quantitative measurements on one site and perform ocular estimates (see Section II) on the other different sites. In any situation, 1) visit as much of the riparian area as possible and 2) make sure that your samples accurately represent the impacts on a larger scale, or at least represent impacts to the most sensitive areas. The number of sample sites may vary also with the experience level of the person measuring the impacts.

II. Sampling Methodology

Monitoring Plans should include both short-term and long-term parameters. Annual (short-term) measurements are intended to measure the impacts of uses on the basic riparian parameters within the current season of use and are not intended to evaluate trend or condition. Long-term parameters are re-visited over a period of years and are used to determine condition or trend.

Adaptive Management

Since no single grazing methodology or monitoring parameter will work for every situation every time, adaptive management may be necessary to change monitoring parameters or management schemes to achieve management goals and objectives. Adaptive management requires knowledge of the current conditions, potential or capability of riparian sites, current management and effects of the management on the resources; and management changes that may be made to move the current condition toward the desired condition. Single indicators of condition or trend are usually not adequate to make good decisions about on-ground situations. Information on the condition and trend of the vegetation and streambank plus knowledge of the current management practices, help establish “cause-and-effect” relationships that are important to make appropriate management decisions. Such information allows refinement and development of more appropriate, locally-derived livestock management techniques and monitoring criteria to meet desired conditions (University of Idaho 2005, Cowley and Burton 2005).

Monitoring Flow Chart (from Herrick *et al* 2005)

Define Management and Monitoring Objectives

Select Monitoring Sites and Indicators

Establish and describe monitoring sites
and record long-term monitoring data (baseline)

Year 1:
Establish long-term
monitoring program

Record short-term monitoring data

Every Year:
Maintain Annual
Event Record

Adjust management as needed (adaptive management)

Year 3 to 5:
Repeat long-term
monitoring

Repeat long-term monitoring measurements:
Compare data with baseline and annual
measurements and interpret changes.

Refine Management Strategy (Adaptive Management)
as needed to achieve long-term goals and objectives;
and/or implement Administrative action if warranted.

Cowley and Burton (2005) suggested a "multiple indicator" monitoring protocol that monitors both long- and short-term parameters. They suggest that three indicators (*greenline, woody species regeneration, and streambank stability*) can be used for long-term effectiveness monitoring. These indicators assess the effectiveness of local livestock grazing management strategies and actions in achieving the long-term goals and objectives for stream, riparian and aquatic resources. Short-term monitoring parameters (*woody plant utilization, stubble height and streambank alteration*) provide data and information that can be used to determine if current season's livestock grazing is meeting intended standards or criteria for use in riparian areas to accomplish long-term goals and objectives.

Procedures outlined by the protocol provide information useful for making decisions in the adaptive management process. They include placement of a defined plot at paced intervals along the greenline, or first perennial vegetation on the streambank above the water line. The placed plot approach uses a Daubenmire plot which more closely focuses the observations by the user, reducing chances for variation among users and increasing repeatability. A designated monitoring area (DMA) is located in the riparian area along the streambank. DMAs are not necessarily "key areas" in the classic sense; rather they are areas that are representative of grazing within a riparian area. They do not necessarily reflect "average" use in all riparian areas, rather they reflect typical livestock use where they enter and use vegetation in riparian areas immediately adjacent to the stream. DMAs may be selected where livestock use exceeds the apparent average use of the riparian zone. The thinking is that the condition at that monitoring site would reflect the worst possible condition, such that if the DMA meets objectives at that point, then the rest of the riparian zone is also meeting the objectives. If Riparian Proper Functioning Condition (Prichard 1998) is used, PFC should be assessed within the DMA. In addition to the above criteria, DMAs should:

- Have the potential to respond to and measure changes in grazing management. Livestock trails associated with livestock use of the riparian area may be included in the DMA;
- Avoid selecting sites where vegetation is not a controlling factor, such as cobble, boulder and bedrock armored channels;
- Do not place DMAs on high-gradient streams unless they have a distinctly developed floodplain;
- Avoid water gaps and small trail areas such as along fences that do not represent livestock grazing impacts along the riparian area. These areas may be monitored, but they should not be considered for specific DMA monitoring.

Parameter Sampling

1) STREAMBANK ALTERATION and STABILITY

What: Bank alteration and bank stability are two different parameters used to measure short-term (alteration) and long-term (stability) effects of livestock grazing. Bank

alteration measures the reduction in streambank integrity whereas *stability* measures changes in stream channel condition over time.

Alteration

This parameter is a tool that focuses on mechanical damage, such as ungulate hoof action, and is not a measure of stream health or long-term trends (USFS R1 2005). The definition of a measurable impact includes:

- sheering off a portion of the streambank by ungulate hooves that leaves a smooth vertical surface and an indentation of a hoof print at the bottom or along the sides;
- trampling that leaves an indentation of a hoof print and exposes roots or soil resulting in a depression at least ½ inch deep or soil displacement at least ½ inch upwards (simple impressions on heavy herbaceous ground cover do not constitute measurable impacts);
- trailing that exposes or compacts the soil, as evidenced by a very hard soil surface layer or numerous animal tracks that sink into and /or displace the soil ½" or more.
- trailing or trampling on top of terraces, above the active floodplain is NOT considered streambank alteration.

Stability

Stability is an indicator of the condition of the channel bank. It monitors the effectiveness of the grazing management program to achieve desired riparian condition goals or objectives. Banks are categorized into one of six conditions and expressed as a percentage of the linear stream bank in that condition. Natural abiotic disturbances (such as current year bank collapse from inherent soil instability) are counted and not distinguished from biotic disturbances (ungulates, etc.). The inherent stability ratings for stream groups are factored into allowable impact percentage.

Where: Measure streambank alteration/stability in the zone between the greenline and the scour line (elevation of the bottom of undercut bank or the lower limit of perennial vegetation). When greenline is away (> 3 meters or 10 ft) from the stream channel or terrace wall, streambank alteration/stability is read along the edge of the terrace wall or along the top of the streambank.

There is no need to evaluate impacts on mid-channel bars because they will either lag behind or parallel the impacts on main channel streambanks.

Crossings are generally counted, unless they are stabilized. If a crossing is not representative of a significant stream reach, then the disturbance may be highly localized and it may be prudent to select another transect location. Conversely, if a crossing or series of crossings are representative of a stream reach, the impacts should be measured.

How: Bank alteration/stability is a linear measurement, not an area measurement. Transects should be permanently marked on both sides of the stream at the beginning and end of the key area or DMA. They should extend at least 110 meters on each side of the

stream, varying according to site complexity. Normally, 40 to 50 plots on either side of the stream channel (80 to 100 total) will account for site variability and provide an adequate sample size. If severely disturbed, more sites may be needed. For complete instructions, refer to "Monitoring Streambanks and Riparian vegetation – Multiple Indicators" by Cowley and Burton (2005).

a) Select a representative site. This can either be within a key area or a DMA

b) Pace off at least 110 meters or 361 feet on the left and right bank. Check your pace beforehand with a 100-foot tape. Make sure that you include all the undulations in the bank that experience contact with active channel stream flow.

c) Use a Daubenmire plot for both alteration and stability readings. For *alteration*, use the entire 42 X 50 cm plot with the center bar on the greenline. Determine the number of lines (0 to 5) that intersect streambank alteration. For *stability*, use the width of the frame (50 cm). Record the condition of the bank within that 50 cm width. Use the categories: Covered and Stable (CS); Covered and Unstable (CU); Uncovered and Stable (US); Uncovered and Unstable (UU); false bank (FB); or unclassified (UN). Record findings as a percentage of the linear distance measured.

d) When done on one side, cross the stream and repeat the measurements on the opposite bank, parallel to the transect on the previous bank.

e) Record your measurements separately for the right and left banks (state which way one is facing - upstream or downstream)

f) Allow up to a 10 percent difference between samplers as an acceptable variation.

2) **STUBBLE HEIGHT**

What: Streamside vegetation serves numerous roles in riparian settings. It serves as a forage source, an element of habitat for birds, fish and mammals, it buffers the force of water, filters out sediments, collects sediments and provides aesthetic variety. Without appropriate vegetation, riparian areas deteriorate, streambanks are more susceptible to erosion, sediment delivery to the channel may increase, in-stream sediment caught may decrease, and overall riparian condition and function can be adversely impacted.

A minimum amount of residual herbaceous vegetation is required to provide the above benefits. Cattle can affect the density and vigor of herbaceous vegetation two ways. One is by physical damage through trampling. The second is through direct consumption. Overuse can change the vegetation from protective sedges to non-protective forbs and grasses.

Cattle generally prefer green grasses and forbs to woody vegetation. Maintaining green grasses and forbs can reduce browsing on riparian shrubs. Foraging preferences change if green grasses and forbs are consumed below a certain residual height. Plant physiology

can also change if the plant is damaged beyond a certain point, reducing overall plant vigor or causing the plant itself to be replaced with another species, which may not be as desirable to maintain riparian function.

Where: Measure stubble height along the "greenline". The "greenline" is the first perennial vegetation from the water's edge. Seral status of the vegetation may create different greenline characteristics and patterns. For example, a greenline of high seral status may exhibit a continuous line of vegetation, where a lower seral status or unstable channels may create discontinuous patterns or have perennial vegetation higher on the bank.

How: Like the bank disturbance parameter, this is a linear measurement. Measurements can be done by pace or by measuring with a tape or calibrated rod or stick. Measurement can also be part of Multiple Indicator sampling (Cowley and Burton 2005). Following is the minimum needed to measure this parameter. If Multiple Indicator, or other sampling method is used, follow the procedure specified in that protocol(s).

a) A total of at least 20 sample points are needed.

b) At ten foot intervals along your first 100-foot transect, measure the leaf length of the nearest graminoid to your sample point, if all vegetation types are used. If a specific species is being measured, use the same procedure, but measure the nearest key species.

c) Repeat the procedure on the opposite bank and average the results from both streambanks. If both banks have about the same use, average the two. If one bank is impacted heavier than the other, just the most impacted bank.

3) **FORAGE UTILIZATION**

What: If stubble heights are not appropriate or practicable, forage utilization can be monitored. Utilization is described as a percent and can be monitored on an area or transect basis. Two methods are available for most riparian communities. A third method may be used for bluegrass stands and mountain meadows. BLM and USFS have described these methods in separate manuals.

Where: Forage utilization can be used along the greenline, within the riparian zone or on the uplands.

How:

a) **Utilization Cages**: Use the same clip/weigh procedure established for upland sites. It is important to sack and air-dry samples from riparian sites before weighing for the most accurate calculations. This is because the grazed riparian plants tend to dry out proportionally more than the un-grazed samples. Without air-drying the samples before

weighing, the un-grazed samples will have a higher proportion of water than the grazed samples and thus will distort the utilization figure significantly. Correction factor charts are available for riparian species and should be used if you do not air-dry your samples.

b) **Photographic**: Photographic Utilization Guide for Riparian Graminoids, Kinney and Clary, Intermountain Research Station General Technical Report INT-GTR-308, June, 1994. This publication employs height/weight correlation charts to determine utilization. In order to use it correctly, you must identify the graminoid species you are sampling.

c) **Grazed loop**: USFS Region 1 Handbook 2209.21 outlines a grazed loop or equivalent method for bluegrass bottoms and mountain meadows (tufted hairgrass, some sedges, timothy, bluegrass, some redtop). Regression charts are available in the handbook for these two community types. Generally, the charts are reliable up to 45 percent utilization. Above that use level, reliability decreases. It may be necessary to check this method against clipped and weighed samples.

4) **WILLOW/ SHRUB UTILIZATION**

What: Utilization is a short-term or annual indicator tool used to determine if current season's livestock grazing is meeting the planned grazing requirements. Utilization is NOT intended to define long-term goals, objectives or trends.

Willows are an important component in maintaining proper riparian function. They provide shade, cover and streambank protection. Livestock and wildlife browse these shrubs, especially when herbaceous vegetation is either limited or has become undesirable. Direct browsing of willows reduces the cover and shade they provide over the stream and within the riparian area and, if grazed excessively, could reduce vigor or prevent regeneration. If the willows are providing streambank protection, reduced vigor and or densities of willows could result in decreased stream channel stability.

Where: Along the streambank and within the riparian zone of the representative reach. The representative reach can be a key area or DMA, depending on the protocol used. Each shrub or a random sample of shrubs can be monitored, depending on the density of the shrub community, the severity of impacts and the issues involved.

How:

a) Utilization is measured on shrub species within a 6 ft. zone adjacent to the water's edge. Exclude from consideration plants that have more than 50% of the active growing stems above the normal reach (3-5 ft) of the animal grazing the site. Compare browsed and un-browsed shrubs. Scan the shrub to be measured to determine if the measurements are representative of the seasonal growth on the entire shrub. Use will be classified into one of five categories: None to Slight; Slight to Light; Moderate; Heavy to Severe; Extreme. (See Cowley and Burton 2005 for more information).

b) The number of leaders or the number of individual plants to be measured will depend on the kind and number of plants along the transect. If use by itself, try to observe at least two leaders on at least ten different plants on each bank. Average the results from the left and right banks. If one bank has obviously more use than the other, use the results from the most impacted bank. If only one bank is available to ungulates, the double the sample size on the single bank. Select only those plants that are available to grazing animals. If the measurement occurs in the spring before measurable growth commences, measure the previous year's growth. If the measurement occurs during the mid or late season, use the current year's growth. If the Multiple Indicator protocol is used, measure utilization within the DMA, per protocol instructions.

5) WOODY SPECIES REGENERATION

What: Regeneration is a long-term indicator of riparian condition used as a goal or objective in managing livestock. It can be used for trend analysis to determine changes over time. Information on the condition and trend of the vegetation and knowledge of current management practices can help establish "cause-and-effect" relationships that are important to make appropriate management decisions. This helps the manager to make better, more informed decisions concerning livestock grazing within the riparian area (Cowley and Burton 2005).

Where: Within a 2 meter (6 ft.) zone along the greenline or edge of the stream. The 2 meter zone is established one meter on either side of the greenline. This extends the measurement zone into the stream in many cases. This is necessary because willows and other woody vegetation may grow below the greenline or extend into the stream on a gravel bar, for example. Measurement, however, should not extend into the stream more than ½ the width of the stream. This precludes measuring woody vegetation on the opposite bank in the case of a narrow stream channel less than 3 ft. wide.

The transect length would coincides with the DMA, or if used separately, a minimum of 363 feet. This results in a sample size of about 0.1 acres.

How: Within the sample zone, record the species and age class. If the Multiple Indicator protocol is used, this will be within each sample plot. If measured separately, all, or selected woody plants within the 2 meter boundary along the transect are recorded.

Each plant will be recorded as being in an age class. Age classes are:

- Sprout – 1 stem at the ground surface
- Young – 2 to 10 stems at the ground surface
- Mature – greater than 10 stems at the ground surface
- Dead – 0 stems alive

In addition, a 5th category can be used: Decadent – greater than 10 stems but less than ½ the stems are alive.

For single-stemmed species, such as aspen, cottonwood, etc. similar age classes apply, but are defined differently. See Cowley and Burton (2005) or Winward (2000).

6) RIPARIAN SOIL DISTURBANCE

What: Detrimentally disturbed soil is soil that has been detrimentally displaced, compacted, puddled or severely burned as defined in the soil quality standards and guidelines found in FSH 2509.18-95-1.

Definitions of Detrimental Soil Disturbance:

Detrimental soil diplacement--the loss of either 5 centimeters or one-half of the humus-enriched topsoil (A horizon), whichever is less, from a 1 by 1 meter area or larger.

Detrimental compaction--compaction that doubles the soil strength or reduces porosity by 10 percent or more from undisturbed values. In sandy soils, a reduction of 12 percent or more from undisturbed values is detrimental.

Detrimental puddling--clearly identifiable ruts with berms or hoof prints deforming/shearing the soil surface, affecting infiltration and permeability.

Severely burned soil--the loss of either 5 centimeters or one-half of the naturally occurring litter layer, whichever is less.

Where: Within the Riparian Management Area. This area will vary according to Category.

How: Areal extent sampling is the most appropriate method for sampling soil displacement, soil puddling, and qualitative estimation of soil compaction in riparian areas. Two stategies are used to measure aerial extent of detrimentally disturbed soils.

a) Strategy 1--grid points or line transects are used to sample an entire activity area (in this case across the riparian area) and each point or line segment is simply determining whether the impact is or is not detrimental according to the guidelines.

b) Strategy 2--soil delineations within the activity area (riparian area) are stratified by management impact and sampled to determine differences between impact areas. This method is used to sample continuous variables such as bulk density and ground cover. Disturbed soil is compared to this method using the Student's t-test.

Qualitative and Quantitative Measurements:

Displacement--at each point or line segment, measure depth of topsoil loss comparing with surrounding undisturbed areas using a meter stick. If the site has lost less than 5 cm or one-half the A horizon in 1 by 1 meter area, consider it within guidelines.

Compaction--at each point or line segment, qualitatively compare soil strength and structure by using a tile spade to penetrate and break the soil apart. Compare with surrounding undisturbed areas. Cone penetrometer may also be used.

Strong platy structure indicates detrimental compaction.

Puddling--at each point or line segment, qualitatively note any deformation of the soil by rutting or hoof action. Clay content plays a significant role.

Severely burned soil--measure depth of litter layer or crust at soil surface.

Percent disturbance is then calculated from the point grid or transect.

GLOSSARY

BANKFULL and BANKFULL WIDTH: The point on the streambank and the width of the channel at a stage typically defined by the annual high flow.

CLIMAX: The highest ecological development of a plant community capable of perpetuation under prevailing climate and soil conditions.

COMMUNITY: Any assemblage of populations of plants and/or animals in a common special arrangement.

COMMUNITY TYPE: An aggregation of all plant communities distinguished by floristic and structural similarities in both overstory and undergrowth layers. A unit of vegetation within classification system.

COMPOSITION: Relative percentage of a biotic (eg. plant species) or abiotic (eg. gravel substrate feature present for a given area.

COVER, PERCENT: The area covered by the combined aerial parts of plants and vegetative ground covering expressed as a percent of the total area.

ENTRENCHMENT: The degree to which the stream channel is cut into the surrounding floodplain.

FLOODPLAIN: The area adjacent to the active stream channel which is inundated during flows which exceed bankfull level.

GREENLINE VEGETATION: The first perennial vegetation from the water's edge.

HABITAT TYPE: An aggregation of all land areas capable of producing similar plant communitites at climax.

KEY AREA: See Section I (Site Selection)

KEY SPECIES: A species that is an indicator of change. It may or may not be a forage species.

LANDTYPE: A portion of a landtype association having unique geomorphic processes, soils, landforms and habitat types. Usually mapped at scales of 1:30,000 to 1:60,000 and encompassing from less than ten acres to hundreds of acres.

LANDTYPE ASSOCIATION: A grouping of landtypes based on similar landforms, soils and habitat types. Usually mapped at scales from 1:60,000 to 1:125,000 and encompassing hundreds to thousands of acres.

NON-SUITABLE (RIPARIAN) RANGE: Does not produce grazing or browsing forage on a sustained yield basis and is not accessible by domestic livestock.

POINT BAR: A deposit formed on the inside or convex side of a stream bend by lateral accretion. The top level of the point bar is generally at the height of the floodplain and the elevation of the bankfull stage.

RIPARIAN MANAGEMENT AREA: An area in which management for riparian attributes are emphasized. Riparian Management Areas (RMAs) fall within 4 Categories

STREAM TYPE: A characterization of stream channels based on entrenchment, width/depth, sinuosity, slope and substrate.

STRATUM: A portion of a riparian system that is relatively homogeneous based on land type, soil type, habitat type or the stream channel features of geomorphology, stream flow, geology and sinuosity.

SUITABLE (RIPARIAN) RANGE: Any area with the inherent capability to produce grazing or browsing forage on a sustained yield basis and is accessible to domestic livestock. Suitable upland range requires that water also be reasonably available.

References Cited

Armour, C.L., D.A. Duff and W. Elmore. 1991. *The Effects of Livestock Grazing on Riparian and Steam Ecosystems*. American Fisheries Society Position Statement. Fisheries, Vol. 16, No.1, Jan-Feb 1991.

Armour, C.L., DA Duff and W. Elmore. 1994. *The Effects of Livestock Grazing on Western Riparian and Stream Ecosystem*. American Fisheries Society Position Statement, Fisheries, Vol. 19, No. 9, Sept. 1994.

Bauer, Stephen B and Stephen C. Ralph. 1999. Aquatic Habitat Indicators and their Application to Water Quality Objectives within the Clean Water Act. EPA-910-R-99-014. US EPA, Region 10, Seattle WA.

Beaverhead National Forest. 1997. *Beaverhead Forest Plan Riparian Amendment, Final Environmental Impact Statement, Appendix A,* September 1997.

Belsky, A.J., A. Matzke, and S. Uselman. 1999. *Survey of Livestock Influences on Stream and Riparin Ecosystems in the Western United States*. Journal of Soil and Water Conservation, First Quarter 1999.

Belt, George H, Jay O'Laughlin and Troy Merrill. 1992. *Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature*. Idaho Forest, Wildlife and Range Policy Analysis Group, Report No. 8, University of Idaho, Moscow, ID.

Bengeyfield, Pete. In press. The Effectiveness of Allowable Use Levels in Recovering Streams Affected by Livestock.

Bengeyfield, Pete and Dan Svoboda. 2000. *Determining Allowable Use Levels for Livestock Movement in Riparian Areas.* Proceedings: Specialty Conference on Rangeland Management and Water Resources.

Braun, Richard H. 1986. *Emerging Limits on Federal Land Management Discrimination: Livestock, Riparian Ecosystems and Clean Water Law.* Environmental Law Vol. 17:43.

Brinson, M.M., B.L. Swift, R.C. Plantico and J.S. Barclay. 1981. *Riparian Ecosystems, Their Ecology and Status.* FWS/OBS-81/17, Biological Services Program, USDI Fish and Wildlife Service, August 1981.

Buckhouse, John C. 2000. *Chapter 14, Domestic Grazing*. In: Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature, USDA Forest Service, Southern Research Station. P. 153-157.

Burkhardt, J. Wayne. 1997. *Grazing Utilization Limits: An Ineffective Management Tool*, Rangelands 19(3), June 1997.

Carter, John C. 1999. *Watersheds, Livestock and Water Quality: A Case Study from the Cache National Forest, Utah and Idaho*. Willow Creek Ecology, Publication 99-01, Mendon, UT.

Chaney, Ed, Wayne Elmore and William S. Platts. 1991. *Livestock Grazing on Western Riparian Areas*, EPA, Northwest Resource Information Center, Eagle ID, January 1991.

Clary, Warren P. and Wayne C. Leininger. 2000. *Stubble Height as a Tool for Management of Riparian Areas*, Journal of Range Management 53: 562-573, November 2000.

Clary, Warren, Larry Schmidt and Leonard DeBano. 2000. *The Watershed-Riparian Connection: A Recent Concern?* USDA Forest Service Proceedings RMRS-P-13. pg 221-226.

Clary, Warren P. and Bert F. Webster. 1980. *Riparian Grazing Guidelines for the Intermountain Region*. Rangelands, 12 (4), August 1980. p. 209-212.

Clary, Warren P and Bert F. Webster. 1989. *Managing Grazing of Riparian Areas in the Intermountain Region*, USDA Forest Service, Intermountain Research Station, General Technical Report INT-263, May, 1989.

Clary, Warren P. and Bert F. Webster. 1990. *Riparian Grazing Guidelines for the Intermountain Region*, Rangelands 12(4), August 1995.

Clary, Warren P. 1995. *Vegetation and soil responses to grazing simulation on Riparian Meadows*, Range management, 48, pg. 18-25

Clary, Warren P., Christopher Thornton and Steven Abt. 1996a. *Riparian Stubble Height and Recovery of Degraded Streambanks*, Rangelands 18(4), August 1996, pg. 137-140.

Clary, Warren P., Nancy Shaw, Jonathan Dudley, Victoria Saab, John Kinney, Lynda Smithman. 1996. *Response of a Depleted Sagebrush Steppe Riparian System to Grazing Control and Woody Plantings*, USDA Forest Service, Intermountain Research Station, Research Paper INT-RIP-492, December 1996.

Clary, WP. 1997. *Vegetation and Soil Responses to Grazing Simulation on Riparian Meadows*, J. Range Management 48, 18-25, 1995; in USDI, BLM, List of References on the Use of Utilization Guidelines and on the Effects of Lower Stocking Rates on the Recovery of Rangelands, 17 September, 1997

Clary, Warren P. 1999. *Stream Channel and Vegetation Responses to Late Spring Cattle Grazing*, J. Range Management, 52:218-227, May 1999.

Clary, Warren P. and Gordon D. Booth. 1993. *Early Season Utilization of Mountain Meadow Riparian Pastures,* Journal of Range Management, 46:493-497, November 1993.

Clifton, Catherine. No date. Effects of Vegetation and Land Use on Channel Morphology. Unknown Publication. pg. 121-129.

Collins, Rob, and Kit Rutherford. 2004. *Modelling Bacterial Water Quality in Streams Draining Pastoral Land.* Water Research 38 (2004) 700-712.

Cowley, Evern R. and Timothy Burton. 2005. *Monitoring Streambanks and Riparian Vegetation – Multiple Indicators.* Technical Bulletin No. 2005-2. USDI BLM, Idaho State Office, Boise ID, March 2005.

Dallas, Dan S. 1997. *Managing Livestock with a Focus on Riparian Areas in the Ruby River Watershed*, USDA Forest Service, Beaverhead National Forest, 1997.

Davidson, J. C. and J. D. Neufeld. 2005. Can Shade Structures Help Riparian Areas? A look at using constructed shaeds to pull cattle off riparian areas in northeastern Nevada. Rangelands, Society for Range Management, April 2005. p 24-30.

Ehrhart, Robert C. and Paul L. Hansen. 1998. *Successful Strategies for Grazing Cattle in Riparain Zones.* Montana BLM Riparian Technical Bulletin No. 4, Riparian and Wetland Research Program, Montana Forest and Conservation Experiment Station, University of Montana, Missoula MT, January 1998.

Elmore, Wayne and Boone Kauffman. 1994. *Riparian and Watershed Systems: Degradation and Restoration.* In: Vavra, Martin, William A. Laycock and Rex D. Pieper. 1994. Ecological Implications of Livestock Herbivory in the West, Society for Range Management, Denver, CO.

EPA. 1994. *Background for NEPA Reviewers, Grazing on Federal Lands*, EPA 300-B-94-004, February 1994.

FAO. 2003. Chapter 2: *Livestock Grazing Systems & the Environment*. In, A changing World – The Role of Livestock in this Changing World – The Implications for Global Natural Resources, Food and Agriculture Organization of the United Nations, 8/1/2003.

Fitch, L. and B.W. Adams. 1998. *Can Cows and Fish Co-Exist?* Canadian Journal of Plant Science; Vol 78, No. 2. p.191-198.

George, Isabelle, Adriana Anzil, and Pierre Servais. 2004. *Quantification of Fecal Coliform Inputs to Aquatic Systems through Soil Leaching*. Water Research 38 (2004) 611-618.

Gosz, James. No date. *Impacts of Trampling on Understory Vegetation and Water Quality in Aspen and Conifer Stands*, Eisenhower Consortium Study (EC 365) Grant RM-80-114-GR, no date.

Green, Douglas M. and J. Boone Kauffman. 1995. *Succession and Livestock Grazing in a Northeastern Oregon Riparian Ecosystem.* Journal of Range Management, 48:307-313, July 1995.

Groeneveld, David P. and Thomas E. Griepentrog. 1985. *Interdependence of Groundwater, Riparian Vegetation and Streambank Stability: A Case Study*. Paper presented at the Symposium on Riparian Ecosystems and their Management. Tuscon, AZ, April 16-18, 1985. pg. 444-48.

Hall, Frederick C. and Larry Bryant. 1995. *Herbaceous Stubble Height as a Warning of Impending Cattle Grazing Damage to Riparian Areas*, USDA, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-362, September, 1995.

Heitschmidt, Rod, Kenneth D. Sanders, E. Lamar Smith, W.A. Laycock, G Allen Rasmussen, Quentin D. Skinner, Frederick C. Hall, Richard Lindenmuth, Larry W. Van Tassell, James W. Richardson, et. al.. 1988. *Stubble Height and Utilization Measurements, Uses and Misuses*, Agricultural Experiment Station, Oregon State University, Station Bulletin 682, May, 1988.

Harper, John, Ken Tate and Mel George, Fact Sheet No. 18: *Stream Channel and Riparian Area Monitoring for Ranchers*, UCCE Rangeland Water Quality Fact sheet #18, University of California, September 2000.

Harper, John, Ken Tate and Mel George. 2000. *Fact Sheet No. 14: Grazing Effects on Riparian Areas*, UCCE Rangeland Water Quality Fact sheet #14, University of California, September 2000.(b)

Herrick, Jeffery E., Justin W. Van Zee, Kris M. Havstad, Laura M. Burkett and Walter G. Whitford. 2005. *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems*. USDA –ARS Jornada Experimental Range, Las Cruces, New Mexico. 36 p.

Hockett, Brian L. and James W. Roscoe. 1993. *Livestock Management Guidelines for Grazing in Southwest Montana Riparian-Wetland Areas*. Workshop on Western Wetlands and Riparian Areas: Public/Private Efforts in Recovery, Management, and Education, Snowbird, UT, p. 102-106.

Holechek, Jerry L. 1988. *An Approach for Setting the Stocking Rate,* Rangelands 10(1), February 1988.

Holechek, J. L. 1994. *Financial Returns from Different Grazing Management Systems in New Mexico*. Rangelands 16:237-240

Holechek, Jerry L., Hilton Gomez, Francisco Molinar and Dee Galt. 1999. *Grazing Studies: What We've Learned*. Rangelands 21(2), April, 1999.

Holechek, Jerry L. no date. *Managing Stocking Rates to Achieve Range Resource Goals*, no date.

Johnson, R. Roy and Steven W. Carothers. 1982. *Riparian Habitat and Recreation – Interrelationships and Impacts in the Southwest and Rocky Mountain Region.* Eisenhower Consortium for Western Environmental Forestry Research, Bulletin 12., 24 pages.

Kaufman, J. Boone and W.C. Krueger. 1984. *Livestock Impacts on Riparian Ecosystems and Streamside Management Implications..A Review*, Journal of Range Management 37(5), p. 430-438, Sept. 1984

Ketcheson, Gary L. and Walter F. Megahan. 1996. *Sediment Production and Downslope Sediment Transport from Forest Roads in Granitic Watersheds.* USDA Forest Service, Intermountain Research Station, Research Paper INT-RP-486, Ogden, UT.

Klironomos, John N., Jenny McCune and Peter Moutoglis. 2004. *Species of Arbuscular Mycorrhizal Fungi Affect Mycorrhizal Responses to Simulated Herbivory*. Applied Soil Ecology 26 (2004) 133-141.

Kondolf, G. Mathias. 1993. *Lag in Stream Channel Adjustment to Livestock Exclosure, White Mountains, California*. Restoration Ecology, Society for Ecological Restoration, December 1993. pg. 226-230.

Johnson, Steven R., Howark L. Gary and Stanley L. Ponce. 1978. *Range Cattle Impacts on Steam Water Quality in the Colorado Front Range*, Research Note RM 359, USDA Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado, September 1978.

Lacey, John R. and William P. Volk. 1988. *Forage Use – A Tool for Planning Range Management,* EB 30, Montana State University, July 1988.

Larsen, Royce E., William C. Krueger, Melvin R. George, Mack R. Barrington, John C. Buckhouse and Douglas E. Johnson. 1998. *Viewpoint: Livestock Influences on Riparian Zones and Fish Habitat: Literature Classification*. Journal of Range Management; Vol 51, No. 6. (Nov. 1998) p. 661-664.

Lawrance, Richard, Ralph Leonard and Joseph Sheridan. 1985. *Managing Riparian Ecosystems to Control Nonpoint Pollution.* Journal of Soil and Water Conservation, Vol. 40 No. 1, Jan-Feb 1985.

Laycock, W.A. 1994. *Implications of Grazing vs. No Grazing on Today's Rangelands.* In Vavra, Martin, William a. Laycock and Rex D. Pieper, editors. 1994. Ecological Implications of Livestock Herbivory in the West, Society for Range Management, Denver, CO.

Leffert, Robert. 2000. Forest Hydrologist, Caribou/Targhee NF, personal observations

Leonard, Steve, Gene Kinch, Van Elsbernd, Dr. Mike Borman, Dr. Sherman Swanson. 1997. *Riparian Area Management*, Technical Reference 1737-14, USDI, BLM, National Applied Resource Sciences Center, Denver, CO, 1997 pg. 13-15.

Marcuson, Patrick E. 1977. *Overgrazed Streambanks Depress Fishery Production in Rock Creek, Montana*, Presented at the Workshop on Livestock and Wildlife-Fisheries Relationships in the Great Basin, Sparks, Nevada, May 3-5, 1977.

Magilligan, Francis J. and Patricia F. McDowell. 1997. *Stream Channel Adjustments Following Elimination of Cattle Grazing.* Journal of the American Water Resources Association, American Water Resources Association, Vol. 33, No. 4, August 1997.

Marlow, Clayton B. 1987?. *Mitigating Livestock Impacts to Streams Within Northern Rocky Mountain Foothills Riparian Zones.* Unknown Publication. Pg. 147-150

Marlow, Clayton B. 2001. *Notes on the Utility of Stubble Height Measurements*. Montana State University, Bozeman, MT (17 January 2001).

Mathews, Kathleen R. 1996. *Livestock Grazing, Golden Trout, and Streams in the Golden Trout Wilderness, California: Impacts and Management Implications*, North American Journal of Fisheries Management, 16:805-820, 1996.

McInnis, Michael L. 1997. *Principles of Successful Livestock Grazing in Riparian Ecosystems*, The Grazier No. 291, Oregon State University Extension Service, March 1997.

Mosley, Jeffrey C., Philip S. Cook, Amber J. Griffis, and Jay O'Laughlin. 1997. *Guidelines for Managing Cattle Grazing in Riparian Areas to Protect Water Quality: Review of Research and Best Management Practices Policy*, Report No. 15, Idaho Forest, Wildlife and Range Policy Analysis Group, University of Idaho, 1997.

Myers, Lewis H. 1989. *Grazing and Riparian Management in Southwestern Montana*, Bureau of Land Management, Dillon, Montana, no date, pg. 117-120.

Myers, Thomas J. and Sherman Swanson. 1991. *Aquatic Habitat Condition Index, Stream Type and Livestock Bank Damage in Northern Nevada*. Water Resources Bulletin, American Water Resources Association, Vol. 27 No. 4, August 1991.

Myers, Thomas J. and Sherman Swanson. 1992. *Variation of Stream Stability with Stream Type and Livestock Bank Damage in Northern Nevada*. Water Resources Bulletin, American Water Resources Association, Vol. 28, No. 4, August 1992. pg. 743-754.

Nelle, Steve. 2004. *Riparian Notes – Ribbons of Gold*. Note Number 9, December 2004, NRCS, San Angelo, TX. 1 pg.

Overton, C. Kerry, John McIntyre, Robyn Armstrong, Shari Whitwell, Kelly Duncan. 1995. *User's Guide to Fish Habitat: Descriptions that Represent Natural Conditions in the Salmon River Basin, Idaho*, USDA Forest Service, Intermountain Research Station, GTR INT-GTR-322, August 1995.

Noble, Edward L. xxxx. *Sediment Reduction Through Watershed Rehabilitation*, USDA Intermountain Region, Ogden, Utah.

O'Brien, Renee A., Curtis M. Johnson, Andrea M. Wilson and Van C. Elsbernd. 2003. *Indicators of Rangeland Health and Functionality in the Intermountain West*. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-104, June 2003.13 p.

Parsons, Cory T., Partick A. Momont, Timothy Delcurto, Michael Mcinnis and Marni L. Porath. 2003. *Cattle Distribution Patterns and Vegetation Use in Mountain Riparian Areas.* Journal of Range Management 56(4), July 2003. p. 334-341.

Pelster, Andrew J., Wayne C. Leininger, M. J. Trlica, Steven G. Evans and Warren P. Clary. In press. *Steer Diets in a Montane Riparian Community*.

Perry, Chuck. 2005. *Riparian Grazing Ideas and Alternatives – when cattle graze in riparian areas, creek fencing should be the last choice*. Rangeland, Society for Range Management, August 2005. p. 37-39.

Pfankuch, Dale. 1978. *Stream Reach Inventory and Channel Stability Evaluation*. USDA Forest Service, Northern Region, Missoula MT.

Platts, William S. no date. *Compatibility of Livestock Grazing Strategies with Fisheries*. Unknown Publication. pg. 103-110.

Platts, William S. 1981. *Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America – Effects of Livestock Grazing*, General Technical Report PNW 124, USDA Pacific Northwest Forest and Range Experiment Station, Boise, Idaho, 1981.

Platts, William S. 1981. *Impairment, Protection and Rehabilitation of Pacific Salmonid Habitats on Sheep and Cattle Ranges*. Pacific Northwest Symposium, October 15-17,

1981, Humboldt State University, California Cooperative Fishery Research Unit, Arcata CA. pg. 82-92.

Platts, William S. 1990. *Managing Fisheries and Wildlife on Rangelands Grazed by Livestock. A Guidance and Reference Document for Biologists.* Nevada Department of Wildlife, December 1990.

Platts, William S. and William R. Meehan. 1977. *Livestock Grazing and Fish Environments: Situation and Needs.* Paper presented at the Workshop on Livestock and Wildlife-Fisheries Relationships in the Great basin, Sparks, NV, May 3-5, 1997.

Platts, William S., Robert J. Behnke, John Buckhouse and others. 1983. *Livestock Interactions with Fish and their Environment,* In: Menke, John W. ed. Proceedings of the workshop on livestock and wildlife-fisheries relationships in the Great Basin, Sparks NV., Special Publication 3301, Berkley CA, 1983. pg. 36-41.

Platts, William S. and Fred J. Wagstaff. 1984. *Fencing to Control Livestock Grazing on Riparian Habitats Along Streams: Is it a Viable Alternative?* North American Journal of Fisheries Management 4:266-272, 1984.

Platts, William S. and John N. Rinne. 1985. *Riparian and Stream Enhancement Management and Research in the Rocky Mountains*, North American Journal of Fisheries Management, Vol5, No. 2A, 1985.

Platts, William S., Fred J. Wagstaff and Ed Channey. 1989. *Cattle and Fish on the Henry's Fork*. Rangelands, Vol. 11, No. 2, April 1989. p. 58-62.

Platts, William S. and Rodger Loren Nelson. 1995. *Impacts of Rest-Rotation Grazing on Stream Banks in Forested Watersheds in Idaho*, North American Journal or Fisheries Management 5:547-556, 1985.

Platts, William S. and Roger L. Nelson. No date. Characteristics of Riparian Plant Communities and Streambanks with Respect to Grazing in Northeastern Utah. Unknown publication. pg 73-81

Prichard, Don. 1998. *A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas, Riparian Area Management*, TR 1737-15, USDI, BLM, 1998

Rosgen, David. 1996. *Applied River Morphology*, Wildland Hydrology, Pagosa Springs, 1996, pg 6-7 - 6-15, 6-29 - 6-35, 8-9, 8-11.

Saunders, W. Carl and Kurt D. Fausch. 2005. *How Does Livestock Grazing Influence Input of Terrestrial Invertebrate Prey that Feed Trout Populations in Rangeland Streams in Wyoming?* Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins, CO. October 2005. 62 p.

Savory, Allan. 1999. *Letter to Shane Jimerfield*, Unpublished, Nov. 25, 1999.

Schmutz, Ervin M. 1978. *Estimating Range use with Grazed Class Photo Guides*, Bulletin A-73 (Revised), Cooperative Extension Service and Agricultural Experiment Station, University of Arizona, 1978.

Scholl, David G. 1989. *Soil Compaction from Cattle Trampling on a Semiarid Watershed in Northwest New Mexico*, New Mexico Journal of Science, v. 29, no 2, Dec. 1989.

Skovlin, Jon M. 1984. *Impacts of Grazing on Wetlands and Riparian habitat: A Review of Our Knowledge, in Developing Strategies for Rangeland Management*, A Report prepared by the Committee on Developing Strategies for Rangeland Management, National Research Council/National Academy of Sciences, Westview Press, 1984. pg. 1001-1101.

Smith, Steven J. 2001. *Rethinking Riparian Regrowth*. Rangelands 23(3). Pg. 14-16.

Stillings, Amy M., John A. Tanaka, Neil R. Rimbey, Timothy Delcurto, Patrick A. Momont and Marni L. Porath. 2003. *Economic Implications of Off-Stream Water Developments to Improve Riparian Grazing*. Journal of Range Management, Vol. 56, No. 5 (Sept 2004) p. 418-424.

Swift, Lloyd W. Jr. 1986. *Filter Strip Widths for Forest Roads in the Southern Appalachians.* Southern Journal of Applied Forestry, Vol 10, No 1, Feb 1986. p. 27-34.

Trimble, Stanley W., and Alexandra C. Mendel. 1995. *The Cow as a Geomorphic Agent – A Critical Review*. Geomorphology 13 (1995) p. 322-253.

University of Idaho. 2004. *University of Idaho Stubble Height Study Report*. University of Idaho Stubble Height Review Team, University of Idaho Forest, Wildlife and Range Experiment Station, July 2004. 38 p.

USDA Forest Service. 1999. *FSH 2209.13 – Grazing Permit Administration Handbook*, R-6 Supplement 2209-99-01, Chapter 15.13b – Special Terms and Conditions, 1999.

USDA Forest Service. No date. *Allowable Streambank Alteration and the Beaverhead Riparian Guidelines*, Beaverhead National Forest, USFS R-1.

USDA FS. 1995. *Effects of Livestock Grazing at Proper Use on the Dixie National Forest*, USDA Forest Service, Dixie National Forest, October 1995. pg 42.

USDA FS, R1. 2005. Final Report. *Proposed Standardized Protocol for Measuring Bank Alteration on Grazing Allotments for Region One National Forests*. April 26, 2005.

USDA FS, R1/R4. 1995. *Soil and Water Conservation Handbook 2509.22, part 17.05*, USDA Forest Service, updated 4/95.

USDA FS. 1995. *Inland Native Fish Strategy Environmental Assessment*, USDA Forest Service, Intermountain, Northern and Pacific Northwest Regions, 1995.

USDA FS. 1996. *Watershed Conservation Practices Handbook*, USDA Forest Service, Rocky Mountain Region, September, 1996.

USDA FS. 1992. *Integrated Riparian Evaluation Guide*, Intermountain Region, Ogden, UT

USDA FS. 1995. *FSH 2509.18 – Soil Management Handbook*, Region 4 Supplement No. 2506.18-95-1, Effective November 29, 1995, Ogden, UT.

USDA FS. 1993. *Range Management Standards.* USDA Forest Service, Intermountain Region, Ogden, UT.

USDA Forest Service, Targhee National Forest. 1997. 1997 Revised Forest Plan. Caribou/Targhee National Forest, Idaho Falls, ID.

USDI. 1990. *Riparian Management and Channel Evolution*, Bureau of Land Management, Course Number SS 1737-2, Phoenix Training Center, Phoenix, AZ, 1990.

US GAO. 1988. *Public Rangelands – Some Riparian Areas Restored but Widespread Improvement Will Be Slow*. United States Government Accounting Office, Resources Community and Econoic Development Division, B-230548, 85 p.

Vinton, Andrew J.A., D.R. Lewis, M. McGechan, A. Duncan, M. Aitken, C. Hill and C. Crawford. 2004. *Predicting the Effect of Livestock Inputs of E. Coli on Microbiological Compliance of Bathing Waters.* Water Research 38 (2004) 3215-3224.

Warren, S.D., M.B. Nevill, W.H.Blackburn and N.E. Garza. 1986. *Soil Responses to Trampling Under Intensive Rotation Grazing*, Soil Scientists Society of America Journal, 50:1336-1341, 1986.

Willat, S.T. and D. M. Pullar. 1984. *Changes in Soil Physical Properties under Grazed Pastures*, Australian. Journal of Soil Resources (No. 3) 22, 343-348, June 1984.

Willoughby, John. 1997. Letter and enclosed *List of References of Utilization Guidelines and on the Effects of Lower Stocking Rates on the Recovery of Rangelands*, to Dr. Jerry Holechek, College of Agriculture and Home Economics, Department of Animal and Range Sciences, Las Cruces, NM, USDI, BLM, Sacramento, CA.,Sept. 25, 1997.

Williams, J. R., P.M. Clark and P.G. Balch. 2004. Streambank Stabilization: An Economic Analysis from the Landowner's Perspective. Journal of Soil and Water Conservation. November/December 2004. pg 252-259.

Winward, Alma H. 2000. *Monitoring the Vegetation Resources in Riparian Areas*. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-47, April 2000. 49 p.

Wyoming Department of Environmental Quality. 1997. – Nonpoint Source Pollution Program, *Best Management Practices for Grazing*, 1997.

Yong-Zhong, Su, Li Yu-Lin, Cui Jian-Yuan and Zhao Wen-Zhi. 2005. *Influences of Continuous Grazing and Livestock Exclusion on Soil Properties in a Degraded Sandy Grassland, Inner Mongolia, Northern China.* Catena 59 (2005) 267-278.

_____, *Overview of Riparian Literature by Heading*, unpublished, undated.

Version 1-1 updates table of contents page numbers and several Table/page number cross references.

Version 1-2 adds several more recent citations and modifies bank disturbance/stability criteria and monitoring techniques.

WWP Exhibit 19

EFFECTS OF CATTLE GRAZING SYSTEMS ON WILLOW-DOMINATED PLANT ASSOCIATIONS IN CENTRAL OREGON

Bernard L. Kovalchik
Wayne Elmore

ABSTRACT

Early fur trappers reported seeing extensive willow stands throughout western rangelands. By the early 1900's, many of these stands were severely damaged or eliminated through cattle overuse. The Taylor Grazing Act of 1934 helped improve upland range conditions, but rangeland management strategies have been slow to improve willow riparian zone conditions, a factor largely due to grazing systems that include mid- and late-summer use. Eleven common cattle grazing systems are ranked by their impacts on willow plant associations.

INTRODUCTION

Riparian zones are identified by the presence of vegetation that requires free or unbound water or conditions that are more moist than normal (fig. 1) (Franklin and Dyrness 1973). Riparian zone plant associations on the National Forests of central Oregon were described by Kovalchik (1987). That study described 54 common riparian plant associations and community types, six of which are dominated by tall willows, usually with sedges dominating the ground layer (table 1). Other "rare" willow-dominated associations are not described in this paper. The classification system provides a useful framework by which research and management experience can be applied to specific riparian sites and plant associations and communities.

Better information about the effects of grazing systems on riparian vegetation is needed. Past recommendations have often been general, failing to account for extreme variation in site and vegetation associated with riparian zones. Findings from experiments in small pastures may not apply to large pastures and grazing systems appropriate for one vegetation type may not work on another. To better address riparian management, we have reviewed willow literature and combined pertinent information with practical experience to describe grazing system effects on willow-dominated plant associations in central Oregon. The conclusions are applicable to willow-dominated plant associations in other areas of western rangeland.

Paper presented at the Symposium on Ecology and Management of Riparian Shrub Communities, Sun Valley, ID, May 29-31, 1991.
Bernard L. Kovalchik is Riparian Ecologist for eastern Washington, Forest Service, U.S. Department of Agriculture, Colville, WA 99114; Wayne Elmore is Natural Resource Specialist for eastern Oregon, Bureau of Land Management, U.S. Department of the Interior, Prineville, OR 97754.

STUDY AREA

Effects of grazing systems on willow plant associations were observed within 4,500,000 and 8,300,000 acres of land managed by the Forest Service and Bureau of Land Management (BLM). The area extends from the crest of the Cascade Mountains from Mount Jefferson in the north to the California border in the south and eastward through the Deschutes, Winema, Ochoco, and Fremont National Forests and the Prineville, Burns, and Lakeview Districts of the BLM.

Annual precipitation ranges from about 9 to 60 inches, except in the Cascades where it rises to over 100 inches along the crest. In general, precipitation is substantially less than in areas west of the Cascades due to orographic effects. Most precipitation falls as winter snow. Summers are droughty.

Elevations range from approximately 2,000 to 11,500 feet in an area with remarkable diversity of geology and landforms, including volcanic peaks, fault block mountains, pluvial lake basins, flat-lying and tilted plateaus, outwash plains, and deeply dissected volcanic uplands. Volcanoes and fault block uplifts and tilting have dominated the geologic history of the area for the past 40 million years (Chitwood 1976).

Vegetation types are diverse. Juniper (*Juniperus occidentalis*) and sagebrush (*Artemisia tridentata*) steppe dominate foothills and large intermountain basins and valleys. Ponderosa pine (*Pinus ponderosa*), lodgepole pine (*P. contorta*), Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), white fir (*Abies concolor*), mountain hemlock (*Tsuga mertensiana*), Engelmann spruce (*Picea engelmannii*), and subalpine fir (*A. lasiocarpa*) are prominent forest types in the mountains.

IMPORTANCE OF RIPARIAN ZONES

Riparian zones are a minor landscape component in the extensive, dry uplands of the Western United States (Thomas and others 1979). They generally comprise less than 2 percent of the total area. Periodic flooding, coupled with biotic interactions, has produced heterogenous ecosystems of riparian plant communities varying in age class and seral stages (Kauffman 1987). Riparian ecosystems are rich in plant, animal, and aquatic life (Platts and Nelson 1989; Skinner and others 1986; Thomas and others 1979).

Riparian zones provide preferred habitat for both domestic and wild ungulates because they contain:

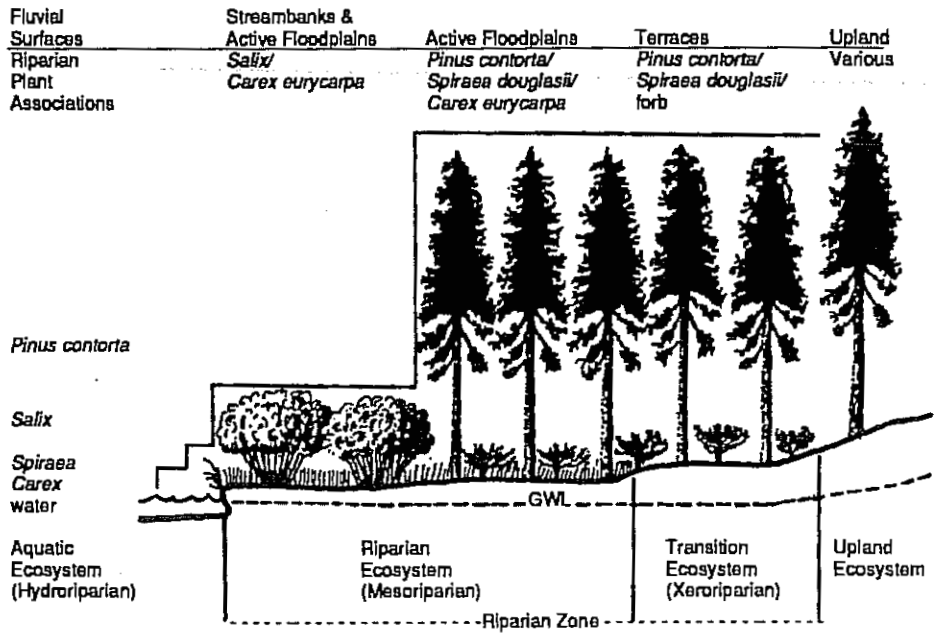


Figure 1—Riparian zones are identified by the presence of vegetation that requires free or unbound water or conditions that are more moist than normal.

Table 1—Constancy[1] and average cover[2] of important plants on six willow-dominated plant associations in central Oregon

	Plant association and number of plots					
Plants	Willow/ Kentucky bluegrass (7)	Willow/ wooly sedge (7)	Willow/ widefruit sedge (19)	Willow/ aquatic sedge (7)	Willow/ Sitka sedge (11)	Wil bea se (
All shrubs	10(50)	10(63)	10(66)	10(36)	10(64)	10
Bog birch (*Betula glandulosa*)	1(t[3])	.....	6(6)	5(4)	5(18)	
Booth willow (*Salix bebbii*)	.....	7(26)	5(25)	5(9)	.....	7
Bog blueberry (*Vaccinium occidentalis*)	.....	.....	3(5)	.....	4(9)	
Douglas spiraea (*Spiraea douglasii*)	.....	.....	7(10)	.....	7(7)	
Eastwood willow (*Salix eastwoodii*)	.....	.....	2(6)	.....	2(10)	
Geyer willow (*Salix geyeriana*)	10(32)	7(7)	8(19)	3(5)	6(22)	8
Lemmon willow (*Salix lemmonii*)	3(7)	4(24)	1(t)	3(13)	4(9)	
All grasses	10(42)	10(16)	10(6)	10(12)	6(2)	10
Kentucky bluegrass (*Poa pratensis*)	10(37)	10(12)	5(1)	7(1)	1(t)	5
All sedges	9(13)	10(38)	10(47)	10(55)	10(61)	10
Aquatic sedge (*Carex aquatilis*)	3(1)	1(1)	.....	10(35)	.....	2
Beaked sedge (*C. rostrata*)	.....	3(1)	5(3)	2(1)	3(6)	8
Inflated sedge (*C. vesicaria*)	1(t)	1(t)	3(3)	.....	1(t)	2
Sitka sedge (*C. sitchensis*)	.....	.....	3(3)	.....	10(55)	
Widefruit sedge (*C. eurycarpa*)	1(t)	.....	10(38)	2(1)	2(2)	
Wooly sedge (*C. lanuginosa*)	3(1)	10(29)	1(1)	2(t)	1(t)	3
All forbs	10(30)	10(28)	10(13)	10(39)	10(8)	1
Common horsetail (*Equisetum arvense*)	1(t)	1(t)	2(t)	2(t)	4(2)	
Glabrate monkeyflower (*Mimulus guttatus*)	1(t)	1(t)	2(t)	7(2)	.....	
Largeleaved avens (*Geum macrophyllum*)	9(4)	9(2)	4(1)	10(3)	.....	
Longstalk clover (*Trifolium longipes*)	1(3)	3(1)	1(t)	3(5)	.....	
Northwest cinquefoil (*Potentilla gracilis*)	7(2)	4(1)	.....	3(1)	.....	
Small bedstraw (*Galium trifidum*)	.....	.....	5(2)	3(t)	4(1)	
Starry solomonplume (*Smilacina stellata*)	6(1)	4(2)	2(1)	5(1)	1(t)	
Sweetscented bedstraw (*Galium triflorum*)	.....	6(4)	1(t)	2(t)	1(t)	
Watson's willowweed (*Epilobium watsonii*)	3(1)	.....	3(t)	10(2)	3(t)	
Western yarrow (*Achillia millefolium*)	9(3)	6(2)	3(1)	7(1)	.....	

[1]Constancy is the percent of plots in which the species occurred. Code to constancy values: 1 = 5-15 percent, 2 = 15-25 percent, 3 = 25-35 percent, 4 = 35-percent, 5 = 45-55 percent, 6 = 55-65 percent, 7 = 65-75 percent, 8 = 75-85 percent, 9 = 85-95 percent, 10 = 95-100 percent.

[2]Average canopy cover (in parentheses) is calculated for all plots in each willow-dominated plant association.

[3]t = trace of cover.

- Easily accessible water.
- More favorable terrain.
- Hiding cover.
- Soft soil.
- A more favorable microclimate.
- An abundant supply of lush palatable forage (partially from Behnky and Raleigh 1979; Krueger 1983; Platts and Nelson 1989; Skovlin 1984).

A study in eastern Oregon and Washington found that 1 acre of moist meadow had a grazing capacity equal to that of 10 to 15 acres of upland (Reid 1946). These meadows comprise 1 to 2 percent of the total land area, yet produce about 20 percent of the available summer forage. In a study of a Blue Mountains cattle allotment, Roath and Krueger (1982) found the riparian zone covered 2 percent of the area and produced 20 percent of the summer forage, yet provided 81 percent of the total forage consumed. In this case, utilization was high, as the cattle used 75 percent of the current year's herb growth and 30 to 50 percent of the current year's willow growth in the riparian zone.

IMPORTANCE OF WILLOWS IN RIPARIAN ZONES

Willows are prominent in several riparian plant associations (Kovalchik 1987) (table 1), and they help establish and maintain physical stability and biological diversity in riparian zones (Smith 1980). Willow roots help protect streambanks from erosion while aboveground stems and foliage bend during high flows and dissipate flood energy, thus protecting floodplains from scour erosion (Crouch and others 1987; Crouch and Honeyman 1986; Elmore and Beschta 1987; Platts and others 1987; Skinner and others 1986). Willows also filter overland water flow, trapping sediments from upstream erosion and surface flow from adjacent uplands (Platts and others 1987). In our opinion, streambank stability is largely a function of the effectiveness of riparian vegetation in performing these functions, especially in lower gradient valleys.

Status of Riparian Zones

Fur trappers and explorers reported extensive broadleaf woody vegetation on the floodplains of central Oregon in the early 1880's (Claire and Storch 1973; Storch 1979). With beaver trapping came the first changes caused by people in the structure and function of riparian zones (Kauffman 1987). The elimination of beavers from streams altered site hydrology with subsequent changes in stream processes and riparian habitat. Today, the presence of water, diversity and productivity of plant and wildlife communities, and attraction of people and livestock to the riparian zone continue to cause conflict between various resource uses such as timber harvest, livestock grazing, road location, recreation, mining, and water use (Thomas and others 1979). These uses have greatly altered riparian zones in the past 150 years (Kauffman 1987; Kindschy 1985).

Of these uses, unwise use by livestock is considered the most common cause of deteriorated riparian zones in western rangelands (Knopf and Cannon 1981). Overuse of rangeland in central and eastern Oregon began in the 1860's and first became apparent in the 1880's when severe winter conditions, coupled with depleted forage supplies, resulted in widespread livestock mortality (Kindschy 1987). Livestock abuse was highest during the 1920's as a result of post-World War I reconstruction and increased again with increased red meat demand during World War II (Claire and Storch 1977).

The days of unregulated open range came to an end with the Taylor Grazing Act of 1934. The Act made it possible to control and regulate range use on public lands (Behnke and Raleigh 1979). Improved upland grazing systems were introduced and livestock numbers and length of grazing seasons were reduced (Claire and Storch 1977). Upland range conditions improved in many areas, but not generally in riparian zones. Grazing systems designed for uplands (such as deferred and rotation grazing) have not been effective in riparian zones and are bringing public agencies to legal confrontation with the public over riparian grazing strategies (Behnke and Raleigh 1979).

Status of Willows in Riparian Zones

Willow-dominated plant associations in good condition (dominated by willows and sedges) produce large amounts of forage (2,000 to 5,000 dry pounds per acre, we estimate), yet livestock grazing systems often do not maintain these communities (Smith 1983). Improper use by livestock, sometimes in conjunction with poorly managed big-game herds, has degraded the majority of willow-dominated sites, decreased forage production, and reduced or entirely eliminated willows from many suitable habitats (Kindschy 1985; Kovalchik 1987; Munther 1981; Swenson and Mullins 1985) (figs. 2 and 3). Many older willow stands are dead or dying and little natural regeneration is occurring on poorly managed range allotments.

Figure 2—Silver Creek, Ochoco National Forest, showing streambanks anchored by a good-condition willow/wooly sedge plant association. Geyer and Booth willows dominate the tall shrub layer. The association continues across a wide active floodplain.

Figure 3—Egypt Creek (near Silver Creek), showing severe change in composition due to many decades of season-long grazing. Big and silver sagebrush, Kentucky and Cusick bluegrass, and annual grasses and forbs dominate the now xeric floodplain. Nebraska sedge dominates the dished stream bottom. The vegetation potential is the same as Silver Creek.

WILLOW RESPONSES TO LIVESTOCK GRAZING

Sheep find willows very palatable, but do little damage to stands if good herding practices are followed. Cattle prefer willows less than do sheep, but are more destructive when they congregate in riparian zones (Smith 1982). Since cattle do more damage, the remaining discussion focuses on their grazing.

Mature Willow Responses

Cattle damage willow stands by both browsing and physically breaking lower branches as they seek summer shade and other palatable forage (Knopf and Cannon 1981). Willows become a principal source of cattle browse as other more palatable forage resources are depleted or as the palatability of the alternate forage decreases. Therefore, most browsing damage to willows occurs in late summer (Kauffman and others 1983; Smith 1982). There is little change in protein levels in the twigs of willows (about 7 percent) from early to late summer (Thilenius 1990). Early season upland grasses have crude protein levels of 15 to 17 percent, but levels fall below 5 percent as grasses mature. As this occurs, cattle increase the amount of available palatable forbs and browse in their diets and soon move into the riparian zone. Then a shift to willows occurs as riparian forage supplies become exhausted, usually toward the end of the grazing season. Willow use can also occur earlier in the summer if a range allotment is overstocked for too long. As long as palatable herbaceous forage is available in the riparian zone, willow utilization will remain minor (Kauffman and others 1983).

Our observations for mid- to late-season grazing indicate that cattle begin using the current annual growth on willows when riparian forage use reaches about 45 percent of total available forage (4- to 6-inch stubble height). Use increases again at 65 percent (2 to 4 inches), and cattle eat all the willows they can when utilization is 85 percent or more (<2 inches). Overused willow stands show a "grazing line" where all young shoots have been grazed. With continued overuse, dead and dying plants suggest former willow abundance. Excessive grazing may eliminate a willow stand within 30 years (Kovalchik 1987).

Willow Seedling Responses

First-year willow seedlings are very sensitive to grazing. Shoots and roots at this age are usually less than 12 and 8 inches in length, respectively (authors' observation). Browsing of first-year shoots often kills the entire plant, because the plants are easily pulled from the ground or are killed by trampling. Sites otherwise suitable for willow establishment and growth may be poorly stocked with willow regeneration under inappropriate grazing systems, such as season-long grazing. Poor willow recruitment can retard succession from immature to mature willow stands. Without recruitment, willow stands develop unbalanced age structures and eventually die (Kauffman 1987).

Site Response to Eliminating Stands

Natural erosion of streambanks is a long process and usually occurs in equilibrium with bank rebuilding (Platts 1984). Changes in streambank geomorphology occur as erosion-resistant dominants are replaced by more xerophyllic species such as Kentucky and Cusick bluegrass, big and silver sagebrush, and annual forbs and grasses (fig. 4). Without willow plant associations and their sedge undergrowth, stream channel processes and functions are severely altered (Smith 1980). Under excessive cattle use during the past century this balance has been upset and banks are eroding faster than they can be built. Hydrologic changes in response to altered community composition and grazing include:

- Soil compaction, lower soil infiltration rates, and increased surface erosion.
- Accelerated loss of streamside and instream cover with increasing bank and streambed erosion.
- Increased stream channel capacity with less dissipation of flood energy over the floodplain.
- Straightening of the stream channel resulting in higher water velocity, especially at headcuts and cut meanders.
- Increased peak flow and lower summer flow.
- Increased flood energy causing either downcutting or (if bedrock is near the surface) braiding.
- Lowered floodplain water tables and reduced availability of soil moisture.
- Increased silt deposition on spawning gravels and in vertebrate food production areas.
- Increased water temperature (Behnke and Raleigh 1979; Kauffman and Krueger 1984).

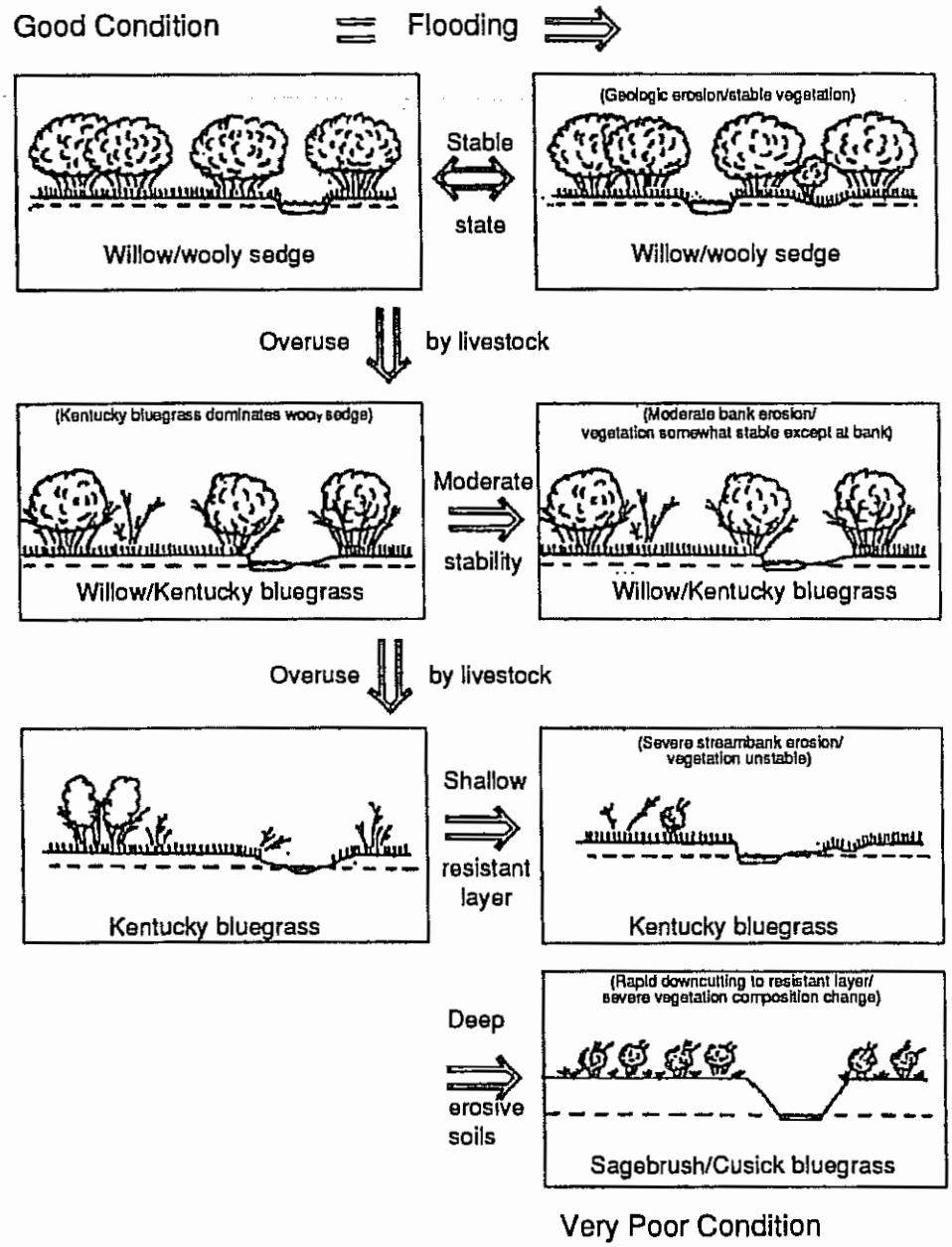


Figure 4—Deterioration of sites supporting the willow/wooly sedge plant association with flooding and improper use by livestock.

Eventually, hydrologic changes reach a threshold, after which the stream proceeds into a cycle of gully development or braiding (fig. 4). The opportunity for natural dominants (such as willows) to maintain previous hydrologic conditions and community diversity and productivity is lost. Recovery may take years, decades, or centuries depending on the size and nature of the system and on interim management (Swanson 1989; VanHovern and Jackson 1986).

GRAZING SYSTEMS FOR WILLOW STANDS

To restore forage and willow production in riparian zones, grazing systems must become whole ecosystem-oriented, not just upland-oriented (Kauffman and others 1983; Smith 1981). Most traditional grazing systems were developed for upland grasses and not riparian species (Platts 1986). While grazing systems such as deferred or rotation have improved the condition of most upland range in the last 50 years, they encourage concentrated livestock use in riparian zones during mid- and late-summer periods and have resulted in minimal improvements in riparian conditions (Platts 1986).

Riparian habitats require site-specific management (Platts 1986). Several stream reaches, each with a different mosaic of plant associations and communities, may occur in a single grazing allotment (Kovalchik 1987). These communities have different tolerances to grazing (Behnke and Raleigh 1979). Grazing systems that are compatible

with one community may harm another (Kauffman and others 1983). Therefore, to maintain diversity of plant associations along each stream reach, grazing systems must be carefully designed for the communities that are present or desired.

Grazing Systems' Compatibility With Willow-Dominated Plant Associations

In our opinion, the switch from grazing to browsing is the single most important factor in the decline of willow-dominated plant associations to less stable communities (fig. 4). Unless grazing systems allow for sufficient forage height growth during the mid- to late-summer period, they will fail to maintain willow-dominated plant associations. Sufficient forage height acts to prevent excess browsing, provides for regrowth of riparian plants after use, and leaves sufficient vegetation for streambank protection (Clary and Webster 1989).

The degree to which browsing of willows is compatible with long-term stream and plant community maintenance depends on the relative number of willows present. Few willows (where there should be many) should dictate conservative use. Use can be greater where willows are abundant or where management objectives do not call for increased numbers of willows.

The following discussion rates common grazing systems by their effects on willow-dominated plant associations in fair to good condition. The discussion assumes the riparian zone is included within larger upland pastures (except in the cases of corridor fencing and riparian pastures). Discussions refer specifically to ecological requirements of willows and sedges. Rankings partially reflect failures of range managers to effectively manage grazing systems in riparian zones. For instance, incompatible grazing systems might become moderately compatible with willow management if moderate forage height is retained at the end of the summer, an unlikely scenario given past performance.

Highly Compatible Systems

Corridor Fencing—Fencing is the easiest way to obtain rapid improvement in riparian conditions by protecting riparian zones from improper cattle use (Platts and Raleigh 1984). Though fences are expensive to build and maintain, corridor fencing will maintain or restore willow plant associations, even those in poor condition. Fencing may cost less than improper, inappropriately placed, or poorly managed grazing systems (Platts and Raleigh 1984). The BLM has lost only about 8 animal-unit months per mile of fenced stream in central Oregon, an insignificant loss of available forage from grazing allotments (authors' observation).

Response of willow associations to corridor fencing varies greatly between riparian zones. For example, high-sediment watersheds rebuild streambanks more quickly than low-sediment watersheds (authors' observation). An alternative to costly fencing and fence maintenance is to use a willow-compatible grazing system.

Riparian Pasture—Riparian pastures are small pastures set aside to achieve desired vegetation response (Platts and Nelson 1985). Pastures include enough upland to achieve balanced use between upland and riparian forage. Larger tracts of upland can be used only if managers are willing to write management prescriptions based on riparian considerations alone. In small pastures, all forage is reached with normal cattle movement, encouraging them to go to uplands to vary their diets (Platts and Nelson 1985). Grazing can be controlled more easily when compared to larger pastures, and cattle are removed when forage utilization levels or plant phenology stages are reached (Platts 1984).

If managed properly, the system results in better livestock distribution, grazing intensity, and timing. This leads to increased willow and sedge production and reduced effects on stream morphology (Platts 1986). Willow response is better if the riparian pasture is grazed early or after fall "green up" (regrowth of upland grass following fall rains). Close monitoring of forage use avoids the switch from grazing to browsing.

Spring (Early-Season) Grazing—In the spring, cattle often avoid riparian zones because of cold temperatures, soil wetness, and forage immaturity (Krueger 1983). Therefore, spring grazing encourages cattle to graze uplands where forage maturity and climate are more favorable compared to the riparian zone (Platts 1984). As a result, spring-grazed riparian zones have less than half the cattle occupancy compared to fall use (Krueger 1983). As spring grazing precludes late-summer use, willow browsing is light and seedling survival high.

Response of riparian vegetation is good, even on sites in poor condition. Vigorous willow and sedge regrowth provide excellent streambank protection, and soil and water relationships remain favorable to continued willow and sedge production.

Winter Grazing—Winter grazing is seldom used in mountains because of deep snow. However, it is reasonably compatible with riparian habitat needs and has been used successfully on lower elevation ranges (authors' observation). Riparian forage is not very palatable in the winter and may not receive much use. If used, forage is consumed during the dormant season and there is no regrowth, which results in less sediment trapped during early spring runoff. This potentially negative impact on stream morphology has not been a problem, possibly because soils are frozen and less susceptible to trampling and mass wasting.

Platts (1984) observed little difference between winter pastures and adjacent ungrazed sites except for the larger numbers of willows established on ungrazed sites. Observations vary in central Oregon. Willow seedlings are infrequent on some winter pastures because of browsing and trampling. Best willow establishment and recovery occurs where drainages are colder than adjacent uplands and open south slopes reduce use in the riparian zone.

Moderately Compatible Systems

Two-Pasture Rotation Grazing—Two-pasture rotation grazing is used on BLM lands but apparently not by the Forest Service. The system provides late-summer rest and regrowth on both pastures every year. The very early period of use responds similarly to spring grazing systems.

Use on the critical-season pasture (when the grass flower stalks emerge from the basal meristem) can retard maintenance or recovery of willows if it extends into the hot summer season and results in the shift to browsing.

Pastures respond best to this system if cattle are removed from the critical-use pasture before summer drought, allowing lightly used willows and sedges to regrow through the remainder of the growing season. Two-pasture rotation grazing may not improve pastures in poor condition (authors' observation). Adding years of rest, especially on degraded pastures, and careful monitoring of forage use will increase the effectiveness of the system for willows.

Three-Pasture Rest-Rotation Grazing—Three-pasture rest-rotation allows one pasture to be rested an entire season while the others support the grazing. Sedge communities may respond favorably to this system, as a vegetative mat is left on streambanks in most years (Elmore 1989; Platts 1986). However, the system may not improve either willow or sedge production on pastures in poor condition (Smith 1989). In theory, willows should respond favorably to this system because of the rest period. In practice, 2 or 3 years of willow growth are often removed on the late pasture (Platts 1984).

Smith (1980) and Kindschy (1989) found that less than half of heavily clipped or browsed willow stems survive into the following year. Of the survivors, regrowth was half the growth of ungrazed stems. Therefore, 3 or more years of rest may be necessary for heavily used willows to recover. Adding more rest and removing cattle before 45 percent use of forage in the late-season period will better protect willows when using this system.

Three-Pasture Deferred-Rotation Grazing—Three-pasture deferred-rotation grazing moves cattle from early to critical-season pastures at a predetermined date or at some level of forage use (Platts 1984). The third pasture is used after seeds of upland grasses have ripened, and cattle are removed when desired use of upland grasses is reached. This grazing system seems desirable for sedges because of 2 years of late-summer rest. However, overuse by concentrated cattle may cause sedges to decline, especially if stubble height during spring runoff is too short to resist erosion. In theory, this system is beneficial for willows, with late-season grazing occurring in 1 of 3 years.

Unfortunately, difficulty in managing cattle distribution and forage use often results in a shift to browsing on mid- as well as late-summer pastures, resulting in 2 years of overuse followed by decline in willow cover and vigor (Platts 1984). The system as applied in central Oregon often fails to maintain good-condition willow stands, which degrade to sedge communities or worse. Nor does it improve sites in poor condition. It can be improved for willows by adding more rest and ending mid- and late-season grazing before 45 percent forage use.

Incompatible Systems

Spring-Fall Pastures—Spring-fall pastures are used for a short period in the spring before summer pastures are ready and again in the fall before cattle are moved to winter pasture. Rest occurs during the critical growing season. This system has not maintained or enhanced willow stands in central Oregon because of the late grazing period. If spring-fall grazing is to be effective, attention must be paid to forage use during late-season period.

Spring-fall grazing is acceptable in good-condition riparian zones if early use is ended before the critical growing period, fall use is delayed to forage regrowth on adjacent hillsides, and fall use is ended at 45 percent forage use. Concentrating animals for a short period of time may have the same effect as light grazing and is acceptable for maintaining willow vigor and cover.

Deferred Grazing—Deferred grazing is used where there is a long period of time between the convenience of early season grazing and later maturation of forage plants. For example, sedges may not be convenient for spring grazing because of wet soils, but they continue to regrow and may be used until mid-October or November. If sedge use is ended in September, regrowth can provide substantial cover for streambank protection. However, sites in poor condition (without willows or sedges) have not responded to the deferred grazing system (Smith 1989).

With deferred grazing, cattle soon concentrate in the riparian zone. As riparian forage is overused, use shifts to browsing. Willow stands are converted to sedge communities or worse (Kauffman and others 1983). Removing cattle before 45 percent forage use will improve the usefulness of the system for willows only if willow cover and vigor are already good. Other grazing systems should be used on sites in need of recovery.

Late-Season Grazing—As usually practiced, late-season grazing is not much different than season-long or deferred grazing in its effects on willows (Kauffman and Krueger 1984; Platts 1984). Willow stands soon degrade to sedge communities or worse. Late-season use can be made more effective for willow stands by removing cattle at 45 percent forage use or delaying grazing until regrowth of upland grasses, at which time cool temperatures in riparian zones disperse cattle to uplands.

In theory, the system could be improved by reducing cattle numbers to prevent overuse of riparian forage, a difficult way to reduce riparian grazing at a time when cattle prefer riparian vegetation. The system can be improved for sedges if cattle are removed early enough to allow fall regrowth, thus providing streambank protection during spring runoff. In practice, the system is incompatible with willow and sedge management unless large pastures are grazed solely for riparian objectives and become, in essence, a riparian pasture.

Season-Long Grazing—In the season-long grazing system, livestock are released into an allotment in the early spring (actual time depends on average upland forage readiness and soil conditions) and removed in the fall (Platts 1984). Season-long pastures will not support fair or better condition willow stands. Early use of the pasture is often acceptable for the reasons outlined under spring grazing. However, cattle soon congregate in the riparian zone during the hot summer months. Overuse of riparian forage occurs by mid-summer and cattle use switches to willows, eventually eliminating the stand. In addition, season-long grazing never gives sedges a chance

to replace carbohydrate reserves, and they are soon replaced by increaser plants such as Kentucky bluegrass and unpalatable forbs.

Reducing the number of cattle does not counter the negative impacts of the system, it just prolongs the outcome. The system is incompatible with both willow and sedge management.

SUMMARY

Improper cattle grazing has severely affected the stability of riparian zones, especially those once dominated by willows. There is considerable variation in the effects of common grazing systems on the stability of willows and sedges (fig. 5). Spring grazing is a good example of a system that avoids late-summer use and is compatible with willow management. Compatible systems should be considered where willows have significant cover or where managers wish to restore willows. Moderate-impact grazing systems such as three-pasture rest-rotation were designed for uplands and should be used only where their negative effects on willows can be mitigated by strict enforcement of riparian forage use to prevent the switch from grazing to browsing. Otherwise, their use will result in downward condition trends in willow-dominated plant associations. Systems such as late-season grazing are incompatible with willow management because of late-season use and the switch to browsing. Incompatible systems should be discouraged where the goal of management is to maintain or recover willow stands.

Systems highly compatible with willow management			
Corridor fencing	Willows ⇑ Sedges ⇑	Riparian pasture	Willows ⇑ Sedges ⇑
Spring grazing	Willows ⇑ Sedges ⇑	Winter grazing	Willows ⇔ to ⇑ Sedges ⇑
Systems moderately compatible with willow management			
Two-pasture rotation	Willows ⇔ to ⇑ Sedges ⇑	Three-pasture rotation	Willows ⇔ to ⇓ Sedges ⇑
Three-pasture deferred rotation	Willows ⇔ to ⇓ Sedges ⇔ to ⇑		
Systems incompatible with willow management			
Spring-fall grazing	Willows ⇓ Sedges ⇔ to ⇓	Deferred grazing	Willows ⇔ to ⇓ Sedges ⇔ to ⇓
Late-season grazing	Willows ⇓ Sedges ⇓	Season-long grazing	Willows ⇓ Sedges ⇓

⇑ = highly compatible
⇓ = incompatible
⇔ = no change

Figure 5—Generalized relationships between grazing system and willow and sedge response on willow-dominated plant associations.

REFERENCES

Behnke, R. J.; Raleigh, R. F. 1979. Grazing and the riparian zone: impact and management perspectives. In: Proceedings, symposium on strategies for protection and management of floodplains, wetlands, and other riparian ecosystems; Atlanta, GA: 263-267.

Claire, E. W.; Storch, R. L. 1977. Streamside management and livestock grazing: an objective look at the situation. Presented at: Wildlife livestock and fisheries workshop; 1977 May 4-6; Reno, NV. 57 p. Unpublished report.

Clary, W. P.; Webster, B. F. 1989. Managing grazing of riparian areas in the Intermountain Region. Gen. Tech. Rep. INT-263. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 11 p.

Crouch, R. J.; Honeyman, M . N. 1986. The relative salt tolerance of willow cuttings. Journal of Soil Conservation. 42(2): 103-104.

Elmore, W. 1989. Riparian management, Oregon recipes. Presented at: Wild Trout IV. 1989 September 18-19; Yellowstone National Park; Mammoth, WY. 6 p.

Elmore, W.; Beschta, R. 1987. Riparian areas: perceptions in management. Rangelands. 9(6): 260-265.

Franklin, J. F.; Dyrness, C. T. 1973. Natural vegetation of Oregon and Washington. Gen. Tech. Rep. PNW-8. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 417 p.

Kauffman, J. B. 1987. The status of riparian habitats in Pacific Northwest forests. In: Raedke, K. J., ed. Streamside management: riparian, wildlife and forestry interactions. Contrib. 59. Seattle, WA: University of Washington, Institute of Forest Resources: 45-55.

Kauffman, J. B.; Krueger, W. C. 1984. Livestock impacts on riparian ecosystems and streamside management implications...a review. Journal of Range Management. 37(5): 430-438.

Kauffman, J. B.; Krueger, W. C.; Vavra, M. 1983. Effects of late season cattle grazing on riparian plant communities. Journal of Range Management. 36(6): 685-691.

Kindschy, R. R. 1985. Response of red willow to beaver in southeastern Oregon. Journal of Wildlife Management. 49(1): 26-28.

Kindschy, R. R. 1987. Riparian reminiscences. Rangelands. 9(2): 71-74.

Kindschy, R. R. 1989. Regrowth of willows following simulated beaver cutting.Wildlife Society Bulletin. 17: 290-294.

Knopf, F. L.; Cannon, R. W. 1981. Structural resilience a willow riparian community to changes in grazing practices. In: Proceedings of wildlife-livestock relationships symposium; 1981; Coeur d'Alene, ID. Moscow, ID: University of Idaho: 198-207.

Kovalchik, B. L. 1987. Riparian zone associations: Deschutes, Ochoco, Fremont, and Winema National Forests. R6-ECOL-TP-279-87. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 171 p.

Krueger, W. C. 1983. Cattle grazing in managed forests. In: Forestland grazing symposium: 1983 February 23-25; Spokane, WA. 14 p.

Loft, E. R.; Menke, J. W.; Kie, J. G. 1986. Interaction of cattle and deer on mountain rangeland. California Agriculture. 40(1/2): 6-9.

Munther, G. L. 1981. Beaver management in grazed riparian ecosystems. In: Wildlife-livestock relationships symposium; 1981 April 20-22; Coeur d'Alene, ID. Moscow, ID: University of Idaho Forest and Range Experiment Station: 233-241.

Platts, W. S. 1984. Compatibility of livestock grazing strategies with riparian-stream systems. In: Range watershed riparian zones and economics: interrelationships in management and use short course. Corvallis, OR: Oregon State University: 67-74.

Platts, W. S. 1986. Riparian stream management. Transactions Western Section of the Wildlife Society. 22: 90-93.

Platts, W. S.; Nelson, R. L. 1985. Impacts of rest-rotation grazing on streambanks of forested watersheds in Idaho. North American Journal of Fisheries Management. 5: 547-556.

Platts, W. S.; Nelson, R. L. 1989. Characteristics of riparian plant communities with respect to livestock grazing in northeastern Utah. In: Riparian resource management: an educational workshop; 1989 May 8-11; Billings, MT: 73-81.

Platts, W. S.; Raleigh, R. F. 1984. Impacts of grazing on wetlands and riparian habitat. In: Developing strategies for rangeland management. National Research Council. National Academy of Sciences. Boulder, CO: Westview Press: 1105-1117.

Platts, W. S.; [and others]. 1987. Methods for evaluating riparian habitats with applications to management. Gen. Tech. Rep. INT-221. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 124 p.

Reid, E. H. 1946. Gauging mountain meadow range condition in eastern Oregon and eastern Washington. Circ. 748. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 31 p.

Roath, L. R.; Krueger, W. C. 1982. Cattle grazing influence on a mountain riparian zone. Journal of Range Management. 35(1): 100-104.

Skinner, Q. D.; Smith, M. A.; Dodd, J. L.; Rodgers, J. D. 1986. Reversing desertification of riparian zones along cold desert streams. In: Wyoming water and streamside zone conference: Wyoming's water doesn't wait while we debate. 1986; Casper, WY: 95-101.

Skovlin, J. M. 1984. Impacts on grazing of wetlands and riparian habitat: a review of our knowledge. In: Developing strategies for rangeland management. National Research Council. National Academy of Sciences. Boulder, CO: Westview Press: 1001-1103.

Smith, B. H. 1980. Riparian willow management: its problems and potentials, within the scope of multiple use management. Presented to: University of Wyoming—shrub ecology workshop; 1980 June 5-6; Lander, WY. Rock Springs, WY: U.S. Department of the Interior, Bureau of Land Management. 15 p. Unpublished paper.

Smith, B. H. 1981. The ecosystem approach to stream habitat management. In: Rocky Mountain regional soil-water-air-workshop; 1981 February 2-6; Jackson Hole, WY. Rock Springs, WY: U.S. Department of the Interior, Bureau of Land Management. 5 p. Unpublished paper.

Smith, B. H. 1982. Livestock-riparian-fisheries interrelationships; or, functional applications of adaptation for personal survival. In: Proceedings 17th annual meeting American Fisheries Society; 1982 March 3-4; Fort Collins, CO. 4 p.

Smith, B. H. 1983. Restoration of riparian habitats within the BLM-Rock Springs District. Presented to: Native Plants Inc.: Wildlife habitat rehabilitation and reclamation symposium; 1983 January 10-11; Salt Lake City, UT. Rock Springs, WY: U.S. Department of the Interior, Bureau of Land Management. 8 p. Unpublished paper.

Smith, S. 1989. [Personal communication]. Ecologist, U.S. Department of Agriculture, Forest Service, Modock National Forest, Alturas, CA.

Storch, R. L. 1979. Camp Creek, a catalyst in positive management direction for streamsides. John Day, OR: U.S. Department of Agriculture, Forest Service, Malheur National Forest. 13 p. Unpublished paper.

Swanson, S. 1989. Priorities for riparian management. Rangelands. 11(5): 228-230.

Swenson, E. A.; Mullins, C. L. 1985. Revegetating riparian trees in southwestern floodplains. In: Johnson, R. R.; [and others], tech. coords. First North American riparian conference, riparian ecosystems and their management: reconciling conflicting uses; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 135-138.

Thilenius, J. F. 1990. Dimensional weights and forage quality of Barclay willow and sweetgale on moose ranges in the wetlands of the Copper River Delta, Alaska. Forest Ecology and Management. 33/34: 463-483.

Thomas, J. W.; Maser, C.; Burnham, K. P. 1979. Riparian zones: wildlife habitats in managed rangelands—the Great Basin of southeastern Oregon. Gen. Tech. Rep. PNW-80. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 18 p.

VanHovern, B.; Jackson, B. 1986. Concepts in stream riparian rehabilitation. Transactions 51st North American Wildlife and Natural Resource Conference. Washington, DC: Wildlife Management Institute: 280-289.

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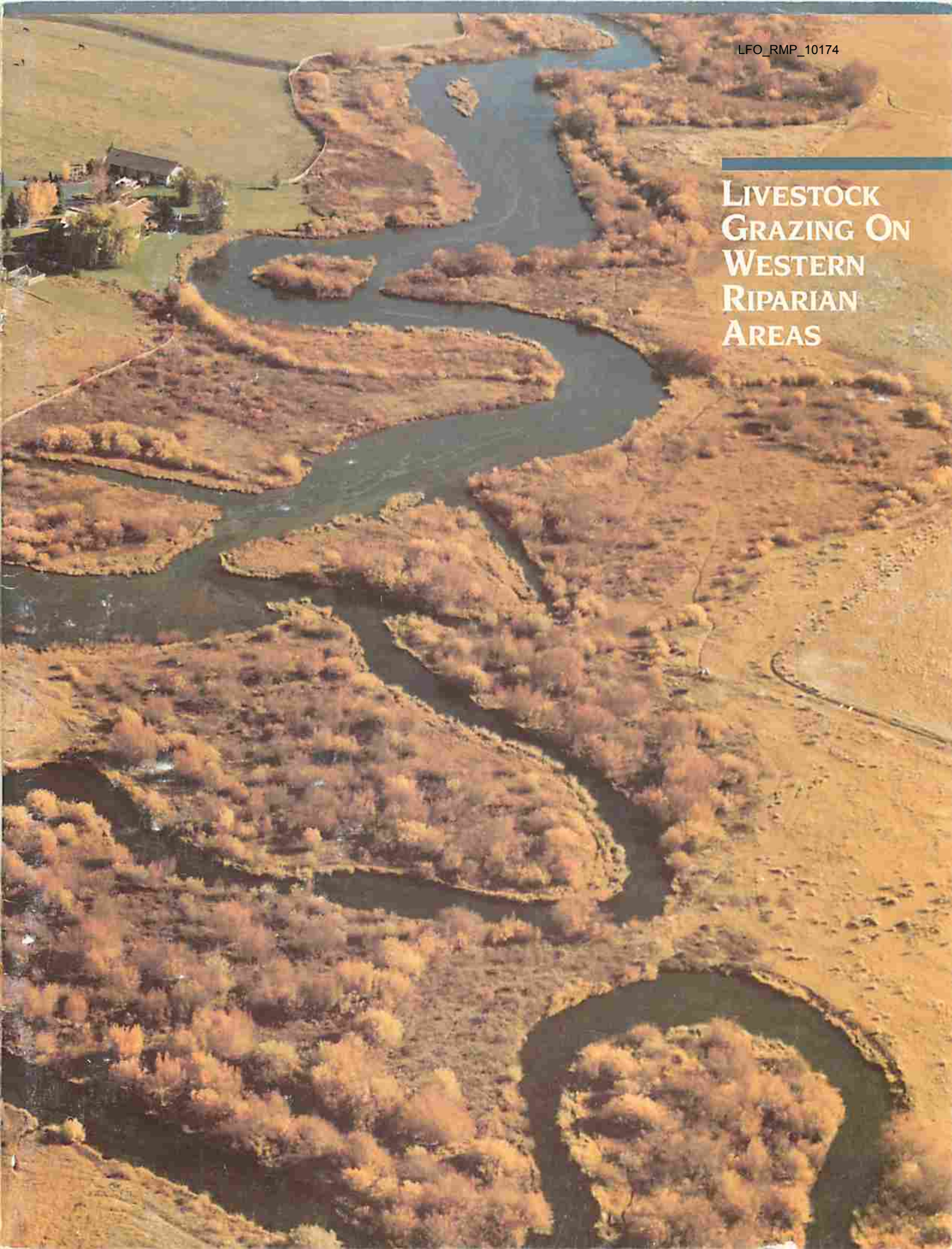

Livestock Grazing On Western Riparian Areas

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Livestock Grazing On Western Riparian Areas

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Produced for the U.S. Environmental Protection Agency by the Northwest Resource Information Center, Inc., Eagle, Idaho.
Authors: Ed Chaney, Wayne Elmore and William S. Platts, Ph.D.
Project Officers: Roger Dean and Daniel L. Merkel

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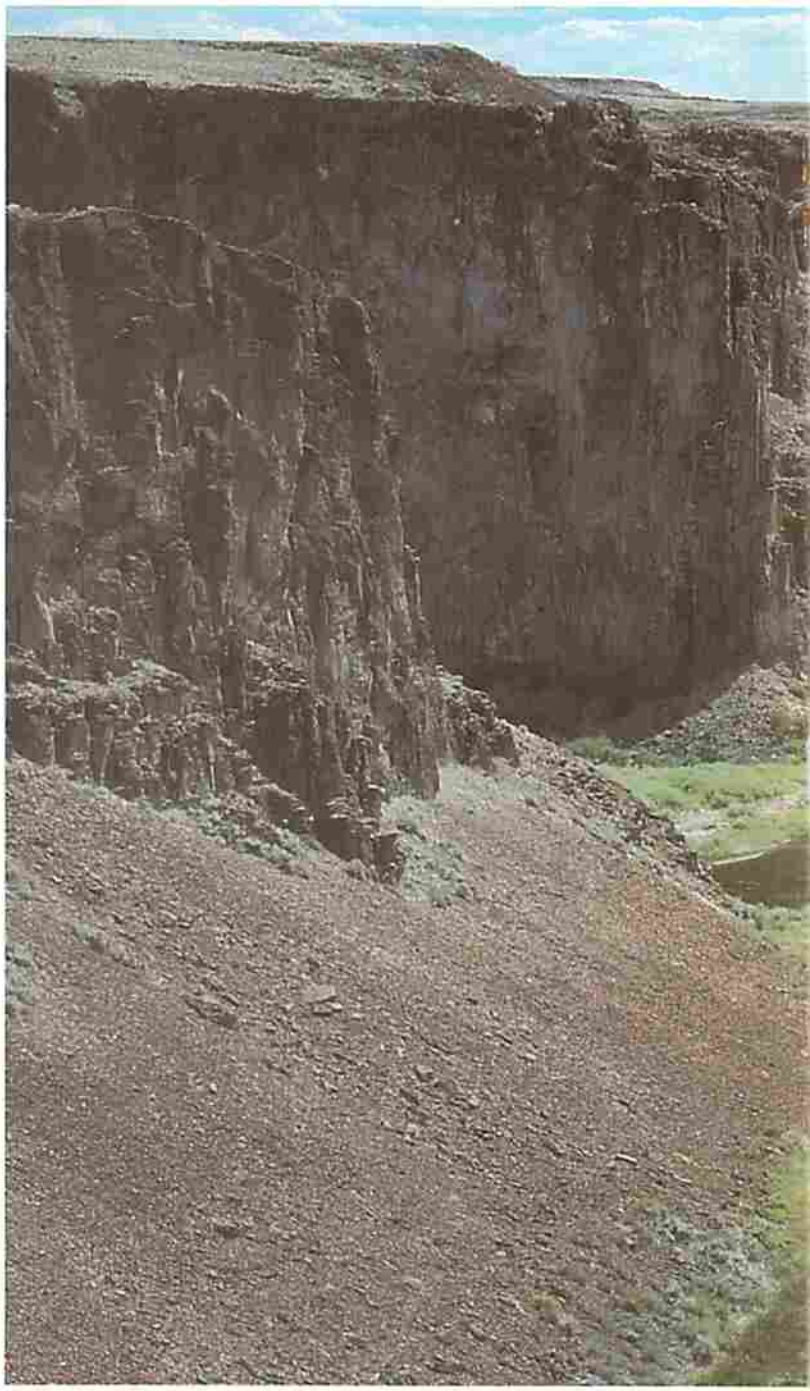

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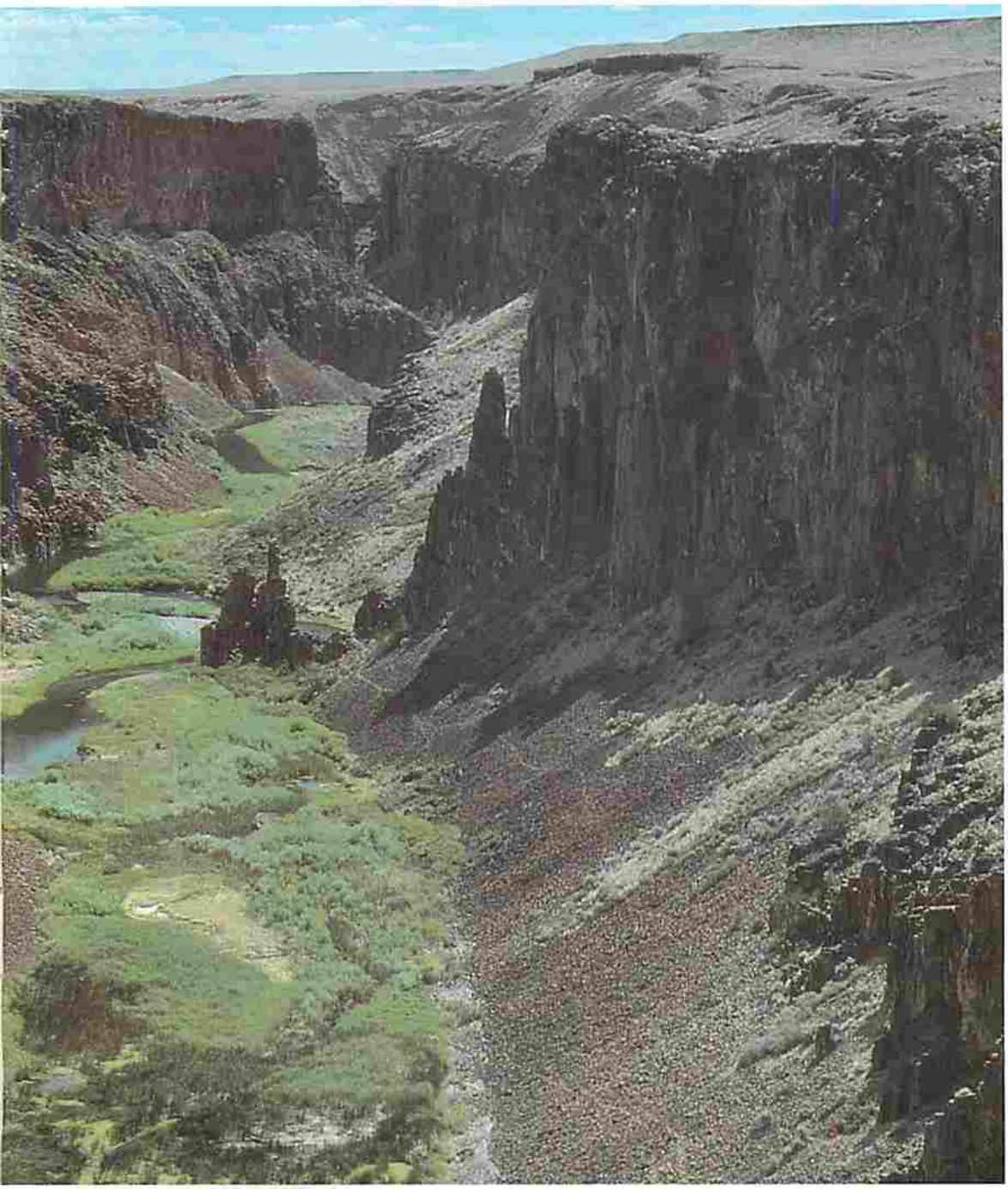
THE national Clean Water Act provides for states to assess nonpoint sources of water pollution from a wide range of land-use activities, and to develop Best Management Practices that will meet state and national water quality objectives.

This document is aimed at the broad and growing audience of people interested in improved management of livestock grazing on western riparian areas and adjacent uplands. Its purpose is to provide general insight into the problems and opportunities. A follow-up EPA publication will provide livestock owners, land managers, state regulatory personnel and others detailed technical guidance for developing grazing strategies to restore and protect riparian areas.



CONTENTS

FUNCTIONS and values of western riparian areas;

CAUSES and effects of riparian area degradation;

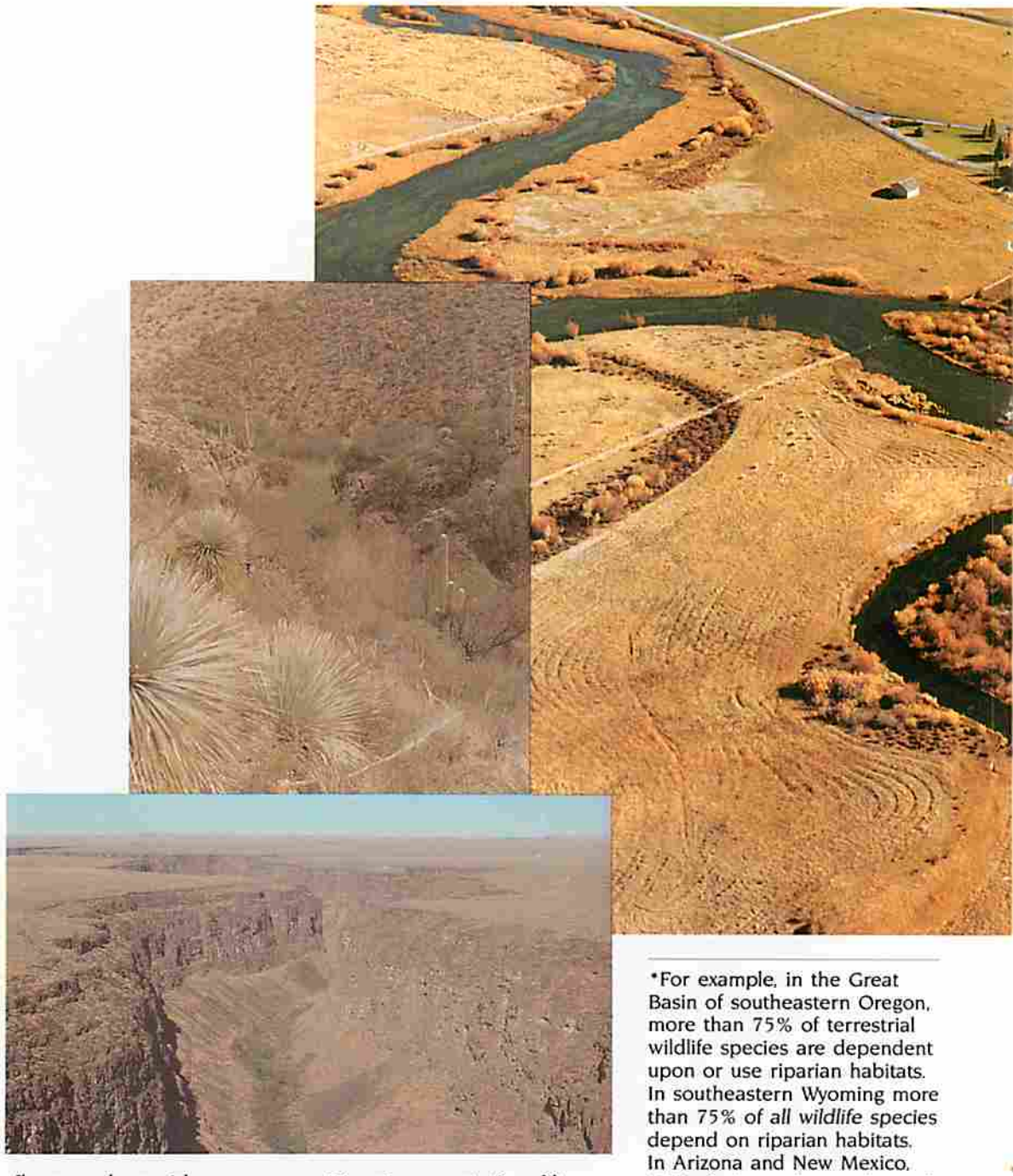
CASE studies representative of the problems and opportunities for improving livestock grazing on riparian areas;

COMMON denominators and practical rules of thumb for developing riparian grazing strategies;

SOCIAL, economic and institutional obstacles to widespread application of proven riparian grazing technology;

OPPORTUNITIES for cooperative efforts to enhance the social, economic and environmental benefits from western riparian areas.

Riparian Functions, Values and Issues



Riparian areas are lands adjacent to creeks, streams and rivers where vegetation is strongly influenced by the presence of water. Riparian areas may comprise less than 1% of the area in the western United States, but they are among the most productive and valuable of all lands.

The presence of water and green vegetation makes riparian areas attractive and important to domestic livestock grazing adjacent, drier uplands. Fish, of course, are totally dependent upon the surface waters within riparian areas. These areas are the most important habitat for the majority of western wildlife species, and are essential to many.*

Many other values of riparian areas are not well known, and commonly are misunderstood. While occupying relatively small areas of land, riparian areas can strongly influence how watersheds function. By influencing the timing and quality of water produced, the condition of riparian areas can have significant, far-reaching, economic and environmental consequences.

Diversity of vegetation is an important characteristic of riparian areas in good condition. Woody and herbaceous plants slow flood flows and provide a protective blanket against the erosive force of water. Their foliage shields the soil from wind and sunlight, which keeps soil temperatures low and reduces evaporation. They produce a variety of root systems that bind the soil and hold it in place.

Riparian vegetation filters out sediment which builds streambanks and forms productive wet meadows and floodplains and reduces sedimentation of water supply and hydroelectric reservoirs.

*For example, in the Great Basin of southeastern Oregon, more than 75% of terrestrial wildlife species are dependent upon or use riparian habitats. In southeastern Wyoming more than 75% of *all wildlife* species depend on riparian habitats. In Arizona and New Mexico, 80% of all vertebrates depend on riparian areas for at least half their life cycles; more than half of these are totally dependent on riparian areas. Riparian areas *provide habitat* for more species of birds than all other western rangeland vegetation types combined. More than half of all bird species in the southwestern U.S. are completely dependent upon riparian areas.

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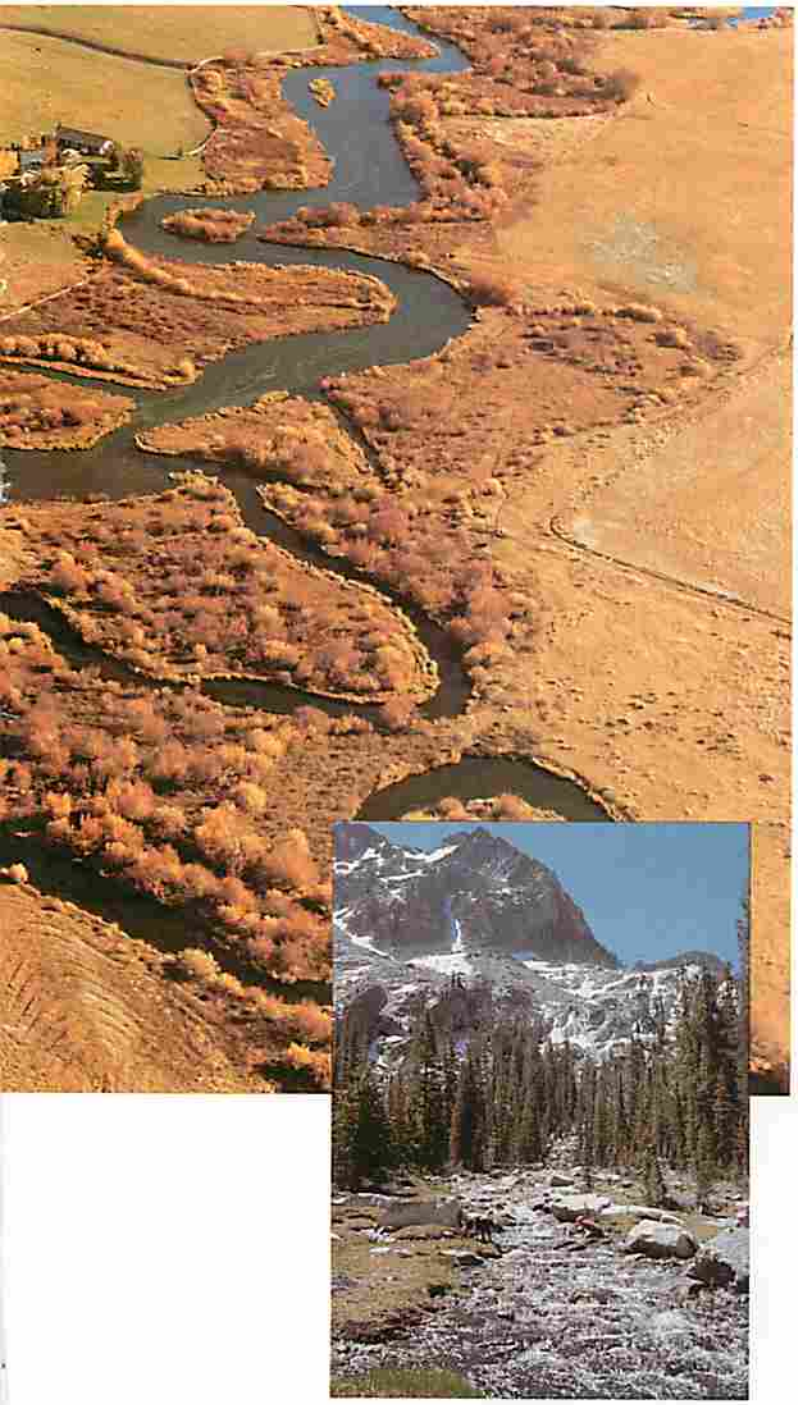
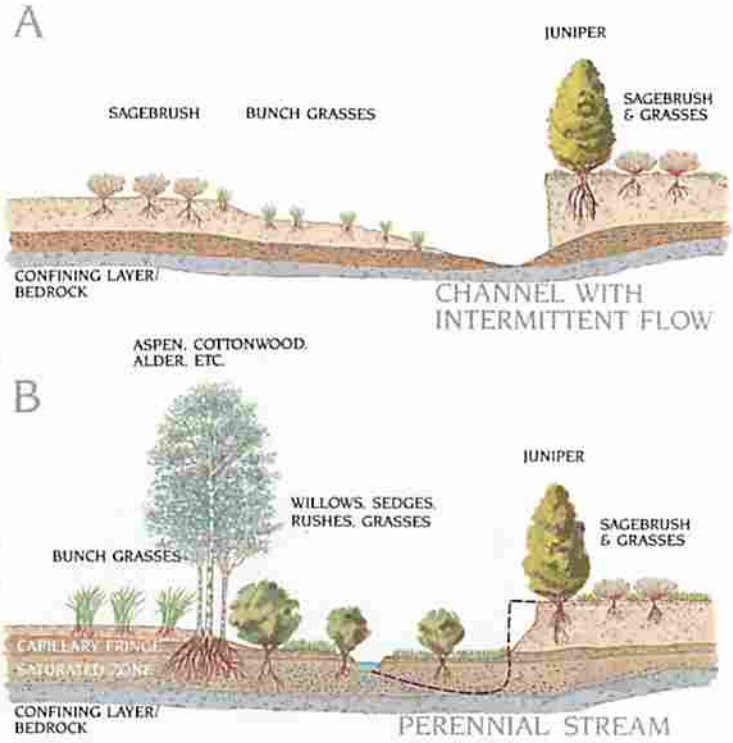


Riparian areas in good condition slowly release water to stream channels, thus increasing seasonal quantity and quality of water.

The inherent productivity of riparian lands, the proximity of water, and relatively gentle terrain attract a variety of human activities. Consequently, riparian areas are the most modified land type in the West. Riparian functions and values have been widely and severely impacted by cultivation, road building, mining, urbanization, logging, and damming of rivers. Livestock grazing — the focus of this document — has had the most geographically extensive effects. The resulting economic and environmental costs have captured the attention of growing numbers of people concerned about the long-term productivity of western watersheds.



General Characteristics and Functions of Riparian Areas

A Degraded Riparian Area (*top*)

- Little vegetation to protect and stabilize streambanks and shade stream
- Lowered water table and saturated zone, reduced subsurface water storage
- Reduced or no summer streamflow
- Warm water in summer and icing in winter
- Poor habitat for fish and other aquatic organisms
- Poor habitat for wildlife
- Reduced amount and quality of livestock forage

B Restored Riparian Area (*bottom*)

- Diverse vegetation and root systems protect and stabilize streambanks; stream shaded
- Elevated water table and saturated zone, increased subsurface water storage
- Increased summer streamflow
- Cooler water in summer, reduced icing in winter
- Improved habitat for fish and other aquatic organisms
- Improved habitat for wildlife
- Increased quantity and quality of livestock forage

THE nation's wetlands include a wide variety of coastal and inland marshes, prairie potholes, bogs, swamps, river bottomlands and riparian areas, springs and seeps. Together they comprise less than 5% of the land area in the coterminous forty-eight states. But wetlands increasingly are recognized as among the nation's most productive, valuable and threatened natural resources.

Wetlands perform many functions and produce many products of significant social and economic value. Wetland vegetation protects shorelines and streambanks from erosion, slows flood flows, filters out sediment, captures and breaks down nutrients and water pollutants.

Wetlands can store, cleanse and slowly release water, thereby extending the supply and quality of water for agricultural, industrial, municipal, hydroelectric and recreational uses. Wetlands play critical roles in the life cycle of many commercially, recreationally and esthetically important fish and wildlife species.

Most riparian ecosystems — streams and adjacent land they strongly influence — contain wetlands. The Clean Water Act provides jurisdictional wetlands regulatory protection from discharges of dredged or fill materials and other pollutants. Non-wetland portions of riparian areas are outside the regulatory protection of the Act.

Best Management Practices (BMPs) developed pursuant to the nonpoint source provisions of the Clean Water Act provide a mechanism for protecting non-wetland riparian values, and provide additional protection for wetlands.

During the past decade growing national and international attention has been directed to protecting and restoring wetlands.

This document focuses on the effects of improper and improved livestock grazing on stream corridor riparian/wetland areas. Many of the problems and opportunities also apply to lake, pothole, marsh and spring/seep wetlands.

A followup technical field manual will address strategies for protecting and restoring both riparian and wetland values through improved grazing management.

Improper grazing can seriously reduce wetland values.

Proper grazing management can protect or restore productive wetland vegetation.

"BEFORE about 1880, the Gila River channel from Santa Cruz Junction to Yuma was narrow with firm banks bordered by cottonwoods and willows, but by the early 1890s it occupied a sandy waste from one-quarter to one-half mile wide."

— J.J. Wagoner, History of the Cattle Industry in Southern Arizona

"...DROUGHT does not cause desertification. Rather, it exacerbates the problem of management of arid lands for sustained production and exaggerates the impact of mismanagement. Drought is, after all, a normal episodic feature of arid regions, just as dust storms and floods are."

— H.E. Dregne, Desertification, Resource and World Development, 1987.

"THE wells are nearly all dried up and have to be dug deeper. At the present time the prospect for next year is a gloomy one for the farmers, and in fact, all, for when the farmer is affected, all feel the effects. The stock raisers here are preparing to drive their stock to where there is something to eat. This country, which was one of the best ranges for stock in the Territory, is now among the poorest: the myriads of sheep that have been herded here for the past few years, have almost destroyed our range."

— Salt Lake City Deseret News, 1879

THE extensive deterioration of western riparian areas began with severe overgrazing in the late nineteenth and early twentieth centuries. Native perennial grasses were virtually eliminated from vast areas and replaced by sagebrush, rabbitbrush, mesquite and juniper, and by exotic plants or shallow-rooted native vegetation less suited for holding soils in place. This unleashed natural forces that literally transformed large areas of the western landscape.

Exposed topsoil thousands of years in the making was quickly stripped from the land by wind and water erosion. Runoff was concentrated and accelerated. Unchecked flood flows eroded unprotected streambanks and downcut streambeds. Water tables lowered. Perennial streams became intermittent or dry during most of the year. Formerly productive riparian areas dried out or eroded away. These conditions contributed significantly to desertification — drying out of the land — which has reduced the productivity of an estimated 225 million acres in the West.

Rangeland was rated on the difference between the land's present vegetation and the ecological potential of the site. Land rated "good" had vegetation at between 61 and 100 percent of potential; "fair" 41%–60% of potential; "poor" 21%–40% of potential; "very poor" 20% or less of potential. Source: USDA 1981, Resources Planning Act

In 1980 the United States Department of Agriculture estimated the vegetation on more than half all western rangelands was deteriorated to less than 40% of potential productivity, and to less than 60% of potential on more than 85% of the rangeland.

Rangeland conditions reportedly have significantly improved in many areas since 1980. However, improved upland conditions do not necessarily mean improved riparian conditions. In fact, extensive field observations in the late 1980's suggest riparian areas throughout much of the West were in the worst condition in history.

The deteriorated condition of watersheds represents an enormous economic loss of potential livestock forage forgone. The loss of other values also is high. Many once-productive fish and wildlife populations have been eliminated or greatly reduced over wide areas of land. Degradation of streams and riparian habitats for migratory fish and waterfowl adversely affects economies thousands of miles away.

Erosion-produced sediments reduce the quality and seasonal quantity of water supplies and shorten the economic life of irrigation and hydroelectric reservoirs critical to many western economies.

The legacy of past land abuse and resultant deterioration in overall productivity has important implications for contemporary management: It has made remaining healthy riparian areas both more valuable and more vulnerable.

Their relative scarcity enhances the value of riparian areas for livestock forage, for fish and wildlife, and for regulating the seasonal timing and quality of water yielded from watersheds.

Deteriorated riparian areas are more vulnerable to the increased stress of concentrated and accelerated runoff from degraded uplands. Depleted upland vegetation furthers the natural tendency of livestock to concentrate in riparian areas.

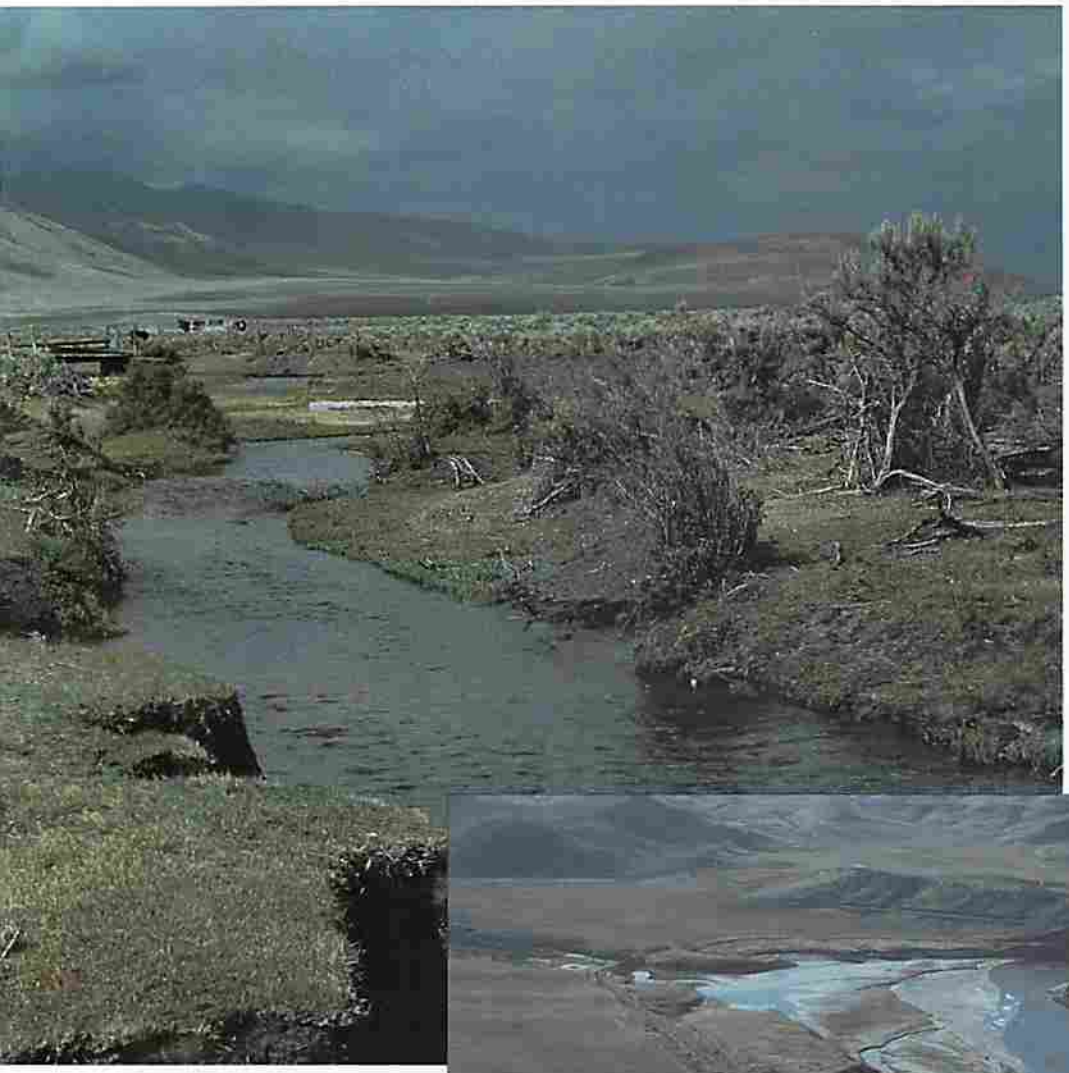
Even riparian areas in good condition are susceptible to damage by concentrations of livestock at the wrong time, in too great a number, for too long, or any combination of these factors.

Moist soils are susceptible to compaction which reduces water infiltration and plant growth. Streambanks can be broken down and eroded. Vegetation critical to the soil's ability to resist erosion and hold water, to slow and filter upland runoff and to provide food and cover for fish and wildlife can be drastically reduced or eliminated by improper grazing.

When riparian areas are in a deteriorated condition they are far more sensitive to improper livestock grazing. Unless the season, duration and intensity of grazing are controlled, damage can be severe, long-lasting and in some cases, irreversible.

Proper grazing management can restore the long-term productivity of most riparian areas and associated uplands. However, grazing tradition, the vast geographical extent of the problem, and the gap between short-term costs and long-term benefits of improved management, all present significant obstacles to the necessary changes in grazing practices.

PROPER *grazing management can restore the long-term productivity of most riparian areas and associated uplands.*



Deteriorated upland vegetative conditions increase runoff stress on riparian areas. When riparian areas also are depleted of protective vegetation, serious damage may result.

Sediment produced from overgrazed watersheds can drastically reduce the capacity and economic life of irrigation, water supply, flood control and hydroelectric reservoirs.

IMPROPER *livestock grazing can result in what are for all practical purposes permanent changes in the landscape and loss of long-term productivity.*

This stream in northern Nevada is representative of conditions affecting a large number of western streams and riparian areas. It once was lined with aspen and willow, flowed year-round and supported native cutthroat trout.

Deterioration of upland vegetation accelerated runoff. Loss of riparian vegetation weakened streambanks. The stream downcut through 15-20 feet of fine material deposited over thousands of years to a layer of coarse, porous material and now disappears into the ground by mid summer.

The once-productive riparian area eroded away or dried out with lowering of the water table. Aspen, willow, forbs and grasses were replaced by sagebrush and other less desirable vegetation.

Stemming the ongoing degradation of streams in this condition must start with improving upland conditions to reduce the erosive power of runoff. Restoring productive riparian areas will be a long, slow process.

Many streams throughout the West are littered with the remains of what were once vigorous aspen groves. Aspen reproduce by sending up shoots from roots. If these young plants are constantly grazed off, eventually the parent trees will die of old age and aspen will disappear from the site.

This transformation of riparian area vegetation is accelerated when deteriorated upland conditions result in downcut or widened stream channels, lowered water tables and drying out of riparian areas.

Case Studies

In recent years western riparian areas have been the focus of unprecedented public and political attention. Several factors working together contributed to this encouraging development.

The environmental, economic and social costs of deteriorated riparian areas are more widely understood. The 1987 nonpoint source amendments to the Clean Water Act provided requirements and authorized resources for states to deal with the problem. Perhaps most important to heightened awareness is the work of a growing number of public and private land managers who have conclusively demonstrated improved grazing management can dramatically improve the productivity of riparian areas and adjacent uplands.

The following case studies are representative of broad areas of land in the western United States, and of diverse environmental, political and economic conditions. They broadly illustrate the problems and the promise of improved management of riparian areas and adjacent uplands.

"The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters."

Clean Water Act

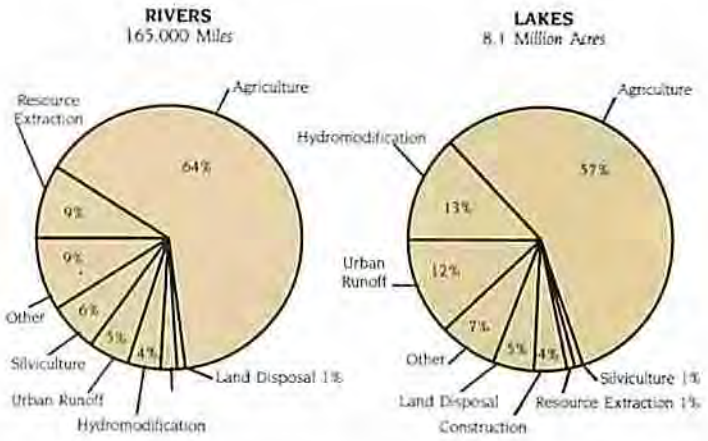
The Clean Water Act of 1977 established a national objective "... to restore and maintain the chemical, physical, and biological integrity of the Nations waters."

The act initially focused on reducing or preventing degradation of water quality by easily identifiable discharges — "point sources" — of pollutants. The act was amended by the Water Quality Act of 1987; section 319 addresses "nonpoint" sources of water pollution.

Nonpoint source pollution is broadly defined as being any human-caused degradation of surface or groundwater quality. This includes all sources not regulated as point sources, such as runoff from construction sites, urban areas, forest lands and agricultural lands — including lands used for livestock grazing.

States are required to identify nonpoint sources of pollution and to develop procedures and practices — Best Management Practices — to achieve state and national water quality objectives.

The current approach to controlling most nonpoint sources of pollution is to seek voluntary compliance through nonregulatory programs of technical and financial assistance, education, training, technology transfer, demonstration watershed projects, and monitoring.



Relative amount of state assessed waters impacted by various categories of nonpoint source pollution. Source: Environmental Protection Agency.

"We have been persuaded to take a path somewhat different from that taken for point sources. States are given flexibility to identify priorities. And based on commitments made in this legislative cycle, it is the expectation of Congress that this program will result in significant improvement in water quality and nationwide reduction in pollutant loadings from nonpoint sources. We will, of course, revisit this question in the next legislative cycle on the Clean Water Act. We will not find this program adequate if real improvement in water quality has not occurred. We are not so much interested in elements of a State program as we are concerned with meeting the goals and objectives of the Clean Water Act."

— Senator Durenberger, Senate debate on nonpoint source pollution amendments to Clean Water Act.

TONTO National Forest—Arizona

The Tonto National Forest in central Arizona encompasses almost 3 million acres of land. This area, just slightly smaller than

Connecticut, contains a wide variety of riparian and upland habitats subject to diverse climatic, grazing and political conditions.

The Tonto Forest has been grazed by domestic livestock since the mid-1800s. Intensive, unregulated grazing in the early years severely depleted uplands and riparian areas of native vegetation. This resulted in the familiar chain reaction of events leading to deterioration of watersheds and loss of productivity.

Grazing eventually was brought under better control, but watersheds and their riparian areas remained in a deteriorated condition.

In the late 1970s the Forest Service took aggressive steps to improve upland vegetation and encourage regeneration of cottonwood, willow and other vegetation in the largely denuded riparian areas.

Grazing strategies were designed to fit specific site potential and condition. A number of grazing allotments were switched from continuous, season-long grazing to a five-pasture, rest-rotation system providing high intensity, short duration grazing and spring-summer rest two out of every three years.

Tonto Creek, 1982

The 34,800 acre Sedow Allotment is at about 5,000 feet elevation. Precipitation is approximately nineteen inches per year, about 60% occurring in winter. Vegetation ranges from semi-desert grasses to chaparral-juniper. In 1978, riparian areas with potential for cottonwood and willow were characterized by a few large, decadent trees scattered along otherwise bare creek banks. In one study area there were no cottonwoods or willows between 0.25 and 25.9 inches in diameter. The Forest Service

Tonto Creek, 1926.

"TONTO Creek was timbered with the local creek bottom type of timber from bluff to bluff, the water seeped rather than flowed down through a series of sloughs and fish over a foot in length could be caught with little trouble. Today this same creek bottom is little more than a gravel bar from bluff to bluff. The old trees are gone. Some were cut for fuel, many others were cut for cattle during droughts and for winter feed, and many were washed away during the floods that rushed down the stream nearly every year since the range started to deplete. The same condition applies to practically every stream on the Tonto."

— Fred Croxen, Senior Forest Ranger, Tonto National Forest, 1926

reduced grazing on the allotment by 50% and implemented the five-pasture, rest-rotation grazing system.

By 1984 upland vegetation had improved. In addition, cottonwood, willow and other riparian vegetation had regenerated in profusion. There were more than 1,000 cottonwoods and 3,200 willows 0.25-25.9 inches in diameter per 100 acres where previously there were none.

On this site reduced numbers of livestock and a rest-rotation grazing strategy allowed sparse, decadent riparian vegetation to regenerate rapidly and in profusion.

In 1987 the livestock permittee remarked that he had been on the allotment for more than fifty years and that the riparian areas had "always looked bad." That areas which had been nothing but sandy draws for decades now had flowing water, and abundant vegetation and wildlife.

The Roosevelt Allotment is located at about 4,000 feet elevation. Precipitation is approximately ten inches per year. Upland vegetation is characterized by semi-desert grasses, prickly pear and cholla. Riparian vegetation is dominated by cottonwood, willow and sycamore.

The permittee on this allotment had voluntarily reduced numbers of livestock without studies or procedural delay because the problem was obvious and he was concerned about the long-term productivity of the land and value of the grazing permit his children would inherit. Upland vegetation benefitted from this stewardship, but riparian vegetation remained in largely deteriorated condition.

Implementing a five-pasture, rest-rotation grazing system resulted in cottonwoods increasing from 20 per 100 acres in 1978 to more than 2,000 in 1984. Willow increased from 28 to 225 per 100 acres. These results occurred concurrent with a 27% increase in the amount of livestock forage grazed from the allotment.

■ Decades of improper livestock grazing on riparian areas reduced woody plants to widely scattered, decadent trees. They provided a source of seed, but continuous heavy livestock grazing eliminated young plants.

■ The Sedow Allotment was so overstocked a drastic reduction in livestock numbers plus a new grazing strategy were required to improve upland and riparian vegetation.

■ The permittee on the Sedow Allotment resisted reducing animal numbers and changing grazing strategy in part because in his half-century on the allotment, riparian areas had "always" looked the way they did in 1978.

■ The necessary changes in grazing management on these allotments were encouraged by the National Audubon Society's concern that improper grazing prevented regeneration of trees essential to nesting bald eagles.

In this area with 10 inches annual precipitation, cottonwoods, willows and other riparian vegetation regenerated quickly under a rest-rotation grazing strategy that concurrently increased livestock forage.

■ On the significantly more arid Roosevelt Allotment, animal numbers were in better balance with available upland forage, but riparian vegetation was severely deteriorated. Implementing an improved grazing strategy produced more livestock forage while restoring riparian vegetation.

■ The riparian healing process began and progressed most rapidly in the upper watershed. Riparian recovery in lower areas was retarded by rapid runoff from deteriorated uplands which were slower to recover than riparian areas.

DUCK Creek/
Henry's Lake — Idaho

Henry's Lake covers approximately 6,500 acres along the continental divide in eastern Idaho.

The lake and immediately adjacent grazing lands are at about 6,500 feet elevation. Annual precipitation averages about thirty inches and comes mainly as snow. Peak runoff in tributary streams generally occurs in mid June. Lakeside pastures have been grazed since the late 1800s from about mid May until early October.

Henry's Lake is fed by numerous large springs. Several small tributary streams provide spawning habitat for cutthroat and brook trout. Juvenile fish migrate to the lake, grow to large size and attract anglers from around the U.S.

The once world-renowned fishery in the lake declined precipitously over the past two decades. Livestock grazing of tributary riparian areas was identified as a significant contributing factor.

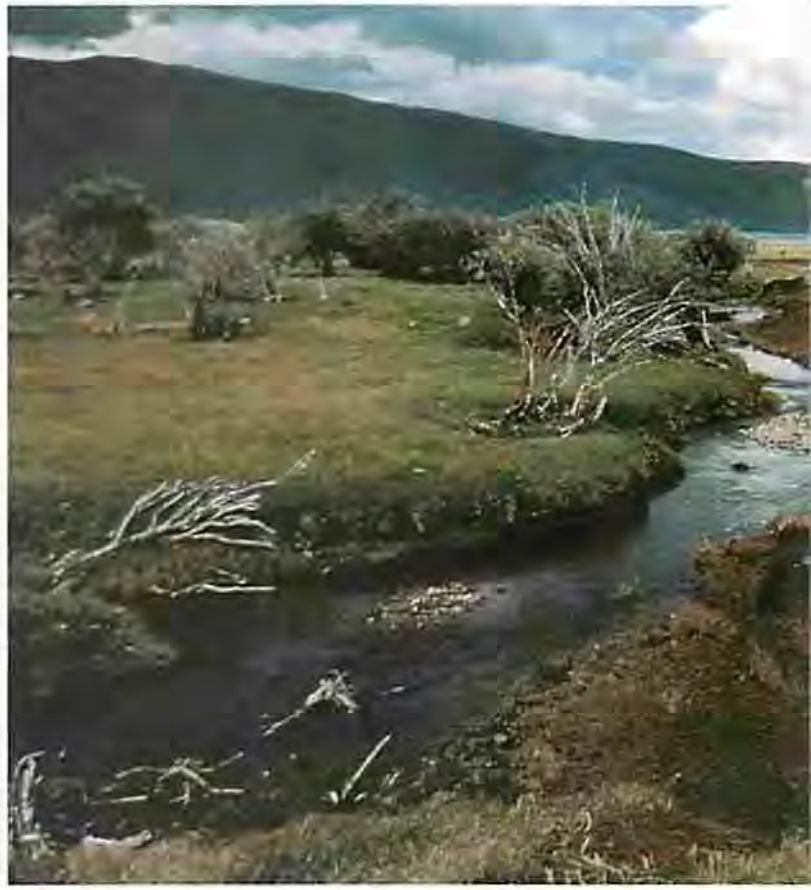
Livestock had depleted streamside vegetation and trampled streambanks. Summer water temperatures had increased; streambanks were eroding, and trout spawning gravels were smothered with sediment. Streams carried small but cumulatively significant amounts of livestock manure and urine into the shallow, naturally nutrient-rich lake, accelerating the natural aging process.

The Idaho Department of Fish and Game developed a plan to rehabilitate the lake fishery. Concerned fishermen, summer home owners, local ranchers and business owners formed the Henry's Lake Foundation to raise money and manpower to help revitalize the lake fishery and dependent local economy.

The foundation's most important role was to get fishermen, recreational property owners, business operators and lakeside ranchers working together toward common, mutually beneficial objectives for tributary riparian areas.

The first tributary riparian restoration demonstration project was constructed in the fall of 1985 on private land bordering Duck Creek, an important trout spawning and rearing stream.

Riparian vegetation was severely deteriorated. Willows were drastically reduced in abundance and there was little regeneration due to constant grazing during their summer growth period. Streambanks were eroding. The stream channel was wide, shallow and full of sediment from trampled and eroded streambanks.



The foundation raised money from its members to permanently exclude livestock from the riparian area along a half-mile reach of stream. Foundation members took time off from jobs and vacations to build the fence to the rancher's specifications. The foundation paid the rancher a modest fee to cover the cost of maintaining the fence.

Even after decades of impact from livestock grazing, loafing and trailing, the area fenced from livestock responded dramatically the first growing season.

Vegetation rapidly reestablished on eroded streambanks and began the natural process of trapping sediments and narrowing and deepening the stream channel. The small amount of livestock forage forgone within the exclosure is thought to have been offset by denying livestock their preferred loafing area so they would spend more time eating the abundant irrigated forage outside the fence.

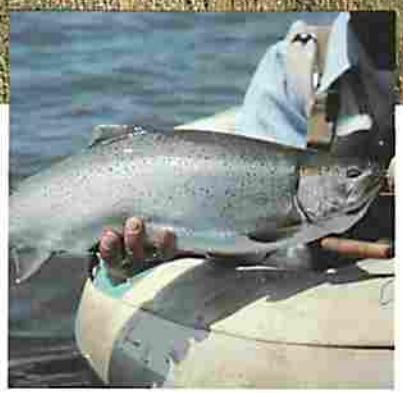
This small pilot project demonstrated the value of fishery interests and livestock operators working together for mutual benefit. The spirit of cooperation proved to be *contagious*. It led to cooperative screening of irrigation diversions to prevent fish losses, and to construction of addi-

tional riparian protection fences on this and other streams around the lake on private, state and federal land.

Duck Creek pilot riparian recovery project, September 1985.

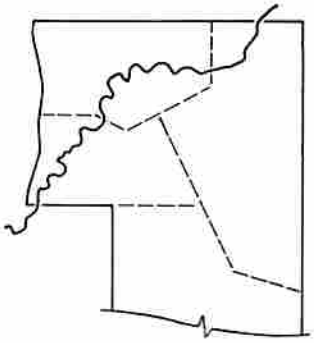
Duck Creek pilot riparian recovery project, September 1986. The initial response of vegetation to rest from grazing was dramatic, but this was just the first step. Full recovery and stabilization of the riparian area and stream channel will take years.

Three years into the pilot project on Duck Creek, the rancher, foundation and Fish and Game Department cost-shared a pasture subdivision project which will provide increased livestock forage production and complete protection for the riparian area and stream channel.



One objective of improved riparian management on Henry's Lake tributaries.

■ The key to success was cooperation among fishermen, landowners and businesses with a stake in restoring and maintaining the overall long-term economic productivity of the area.



The stream corridor fence was integrated into a revised pasture system. Providing more pastures, and separating unirrigated, well- and poorly-drained irrigated pastures allows the rancher to increase forage production while protecting the riparian area.

■ Fishermen with a stake in improved riparian management were instrumental in overcoming traditional barriers between fishery and agricultural interests. The key was their willingness to cost-share mutually beneficial solutions instead of simply blaming riparian landowners for the problem.

■ By forming a mutually beneficial partnership with the private landowner, the Henry's Lake Foundation avoided spending years and many thousands of its members' dollars on studies to "prove" the obvious. Instead they invested their money and energy in implementing solutions which produced quick results instead of paper.

BEAR Creek – Oregon

Bear Creek is located at 3,500 feet elevation in the high desert of central Oregon. Precipitation

averages approximately twelve inches per year. Peak runoff normally occurs in mid to late February and summer thunderstorms are frequent.

This site within the Prineville District of the Bureau of Land Management has been grazed by domestic livestock since the late 1800s.

Prior to 1976 the riparian area was within a single pasture licensed for 72 animal unit months (AUMs) of forage from April-September. (One AUM = the amount of forage necessary to sustain a cow and calf for one month.)

Under this grazing strategy streamside vegetation was low in diversity and productivity. Streambanks were actively eroding. The stream channel was deeply incised and contained medium to high sediment loads. Summer streamflow was often intermittent and low in quality.

In August 1976 Bear Creek was wide, shallow, sediment-laden and warm. The stream was actively eroding the cutbank on the left.

In 1976-78, the BLM partially rested the area from grazing to restore the productivity of the riparian area.

In 1979 and 1980, the area was grazed for one week in September. In 1981-84 it was not grazed. In 1983 juniper trees on adjacent uplands were thinned to improve livestock forage and watershed conditions.

In 1985, the BLM divided the pasture containing the riparian area into three pastures and allowed grazing from the time of spring runoff (mid February) until April 15. Vegetation was allowed to regrow the rest of the year to protect streambanks against high runoff from summer thunderstorms and runoff the following spring. This regrowth also provided livestock forage for the following year.

As a result, streambanks stabilized, reducing erosion and sediment production. This increased stability minimized stream channel damage from a major thunderstorm in 1987 that extensively damaged comparatively poor condition

In August 1986 the cutbank had been stabilized by vegetation. The stream channel had narrowed as vegetation filtered out and stabilized sediment from upstream erosion. (Reduced numbers of juniper in the background are the result of efforts to improve upland ecological condition.)

riparian areas immediately downstream. In some areas one to two feet of sediment from upstream were deposited within the restoring riparian area.

The resulting improvement in water quality and general habitat conditions allowed rainbow trout to be re-established in this reach of Bear Creek.

By 1989, the licensed amount of forage had increased to 354 AUMs, nearly five times the amount previously grazed from the area. The livestock permittee reportedly reduced his annual cost of hay by $10,000.

- The principal management objective for the riparian area was to protect streambanks against erosion by high flows during spring runoff and during high-intensity summer thunderstorms.

- The grazing system was designed to improve the riparian area and stream by improving both riparian and upland vegetation.

- By grazing pastures containing riparian areas early, livestock were less inclined to concentrate on riparian vegetation and better utilized adjacent upland forage.

- Improvements in upland vegetation were required for full recovery of the riparian area and for the increase in livestock forage.

- This early season riparian grazing system worked well on this site's sandy loam soils. It might not work as well or at all under different climatic or streamflow conditions, or on soils with high moisture content which are susceptible to shearing and compaction by livestock trampling.

MAHOGANY Creek — Nevada

The Mahogany Creek watershed lies at approximately 5,300-6,900 feet

elevation in northern Nevada. Precipitation in the case study area averages about fifteen inches per year and comes mainly as snow. Peak runoff normally occurs in May and June.

Mahogany Creek is approximately eleven miles long. The lower three miles of the stream flow through the Summit Lake Indian Reservation. Six miles of the stream are located on public land administered by the Bureau of Land Management. Two miles of Mahogany Creek plus its major tributary flow through private land.

Mahogany Creek is one of two areas in the U.S. where a lake-dwelling population of Lahontan cutthroat trout reproduce naturally. These fish are listed as a threatened species under the Endangered Species Act. Trout from Summit Lake annually migrate into the creek to spawn. The resulting juvenile fish migrate back to the lake to mature and eventually repeat the cycle.

Mahogany Creek, Fall of 1975.

The area has been grazed by livestock for at least seventy-five years. It was used heavily by both cattle and sheep in the summer. Improper grazing severely degraded the riparian area and surrounding uplands.

The riparian area was virtually stripped of vegetation. Streambanks were badly eroded. Streamflows

had declined and increased in temperature and sediment load. Spawning and rearing habitat for the threatened Lahontan cutthroat was severely degraded.

In 1974 the BLM attempted to demonstrate riparian area restoration by simply reducing grazing in the allotment. However, even reduced grazing pressure prevented substantial recovery of the degraded riparian area. In addition, the agency was unable to prevent unauthorized grazing.

In 1976 the grazing permit for the allotment was relinquished by the permittee. The BLM used the opportunity to fence most of the creek and much of the watershed to exclude livestock.

Riparian vegetation responded dramatically to rest from grazing and installation of a few instream structures to improve trout habitat by raising water levels and reducing erosion. Native perennial grasses increased throughout the fenced area. Previously decadent aspen groves expanded. Curlleaf mountain mahogany began reproducing within the fenced area while outside the fence almost no seedlings survived grazing.

Streambanks stabilized and erosion was reduced. The stream channel narrowed and deepened. Summer streamflow increased 400%, and depth of water increased 50%. Water temperatures and sediment load decreased. The improvement in fish habitat resulted in a significant increase in the threatened Lahontan cutthroat population.

■ Simply reducing the number of livestock in the allotment did not allow substantial recovery of the severely degraded riparian area and stream channel; livestock still overused the riparian area.

Mahogany Creek, Fall of 1985.

■ Even where riparian deterioration was severe and a threatened fish species was at stake, it was only after the grazing permit for the allotment was relinquished that the BLM was able to fence most of the creek and adjacent uplands.

■ Long-term rest from grazing was required to overcome the effects of long-term improper grazing.

■ Even under these long-standing, severely deteriorated conditions, ten years of rest resulted in dramatic improvement of riparian and upland vegetation, and increased the quality and quantity of summer streamflow.

■ Achieving similar improvements in the entire Mahogany Creek watershed would require a cooperative effort by numerous federal, tribal and private landowners and grazing permittees.

WEST Rocky Creek—Texas

West Rocky Creek is located at 1,800 feet elevation in the porous limestone Edwards Plateau

region which covers more than 10 million acres in west Texas. Annual rainfall averages about eighteen inches. Peak runoff usually occurs in late spring and fall as a result of thunderstorms.

Prior to the introduction of livestock in the mid 1800s, the landscape of the West Rocky Creek watershed was dominated by native grasses characteristic of the southern Great Plains. The U.S. Soil Conservation Service estimates vegetation was comprised of 85% grasses, 10% forbs and 5% woody plants. Trees and brush were largely confined to riparian corridors due to thick prairie turf and periodic fires which limited seedling survival on the uplands.

Native grasses such as sideoats grama, buffalograss, curly mesquite and tobosa, shielded the soil from the sun and from wind and water erosion. Dense root systems allowed rainfall to soak into the soil to recharge groundwater and keep streams flowing year-long.

Early ranchers didn't understand range ecology and lacked experience in this environment necessary

Representative West Rocky Creek riparian area before upland treatments and improved grazing management.

Representative West Rocky Creek riparian area after upland treatments and improved grazing management.

to predict the effects of overgrazing. By 1885, vegetation within the watershed had been dramatically altered by livestock overgrazing. Removal of the native grasses decreased infiltration of water into the soil. Man's fire suppression activities allowed brush seedlings to establish. The invading brush lowered water tables, accelerated runoff and soil erosion.

Dense stands of mesquite and juniper began to dominate the landscape. These deeper-rooted plants used groundwater below the depth grass roots could reach, depleting water that previously had recharged springs and streams. West Rocky Creek, which once flowed year-round, became intermittent in 1918, and dried up completely in the 1930s. The stream flowed sporadically during periods of above average rainfall. Without the protective cover of

grasses, flooding and stream channel erosion increased.

In the early 1960s, five ranchers began a range rehabilitation program on their privately owned land with technical assistance and cost-sharing under the Great Plains Conservation Program. They removed brush, reseeded grasses and implemented a variety of improved grazing strategies on about half the 74,000-acre watershed. Livestock forage increased. Soil erosion and sedimentation of downstream municipal water supply reservoirs decreased.

By 1970, springs that had been dry for decades began to flow again on all five ranches. West Rocky Creek began to flow year-round, yielding from 150–4000 gallons per minute during the severe 1984 drought. Riparian vegetation re-established. Streambanks and the stream channel stabilized. Fish and riparian dependent wildlife re-established.

Improving the productivity of the West Rocky Creek watershed produced significant downstream economic benefits to the city of San Angelo. The quantity and quality of water yielded to water supply reservoirs increased. Reduced sedimentation increased the economic life of reservoirs and decreased water treatment costs. Flooding reduced in severity.

Removing brush, reseeding grasses and good grazing management restored this site to near-pristine appearance and productivity. Continued good grazing management is required to keep it that way.

This nearby site received the same brush removal and reseeding treatments, but was improperly grazed. An improved grazing strategy is required to prevent the site from deteriorating further and eventually becoming reinfested with brush.

Overgrazing and fire suppression created conditions that encouraged thick infestations of juniper and mesquite in the West Rocky Creek drainage.

■ The dramatic decline in the productivity of the West Rocky Creek watershed resulted in largest part from poor livestock grazing practices, notably continuous, year-long, heavy grazing.

■ Extensive, costly brush removal and grass reseeding were required in addition to improved grazing practices in order to repair the damaged watershed and restore streamflows and riparian areas.

■ Proper grazing management is essential to maintain the improved condition and protect the substantial investment in restoring the watershed's productivity.

■ Restoring diverse, more productive upland and riparian plant communities benefitted livestock, fish and wildlife, and downstream water users.

■ Technical assistance with private and public cost-sharing were essential to finance high cost watershed improvements. The economic and environmental benefits extended far beyond the private lands that were restored in productivity.

Big Creek — Utah

Big Creek rises from springs at about 8,000 feet elevation in the northeast corner of Utah on the Wasatch-Cache National

Forest and flows about twenty miles to the Bear River. Elevation in the case study area is about 6,600 feet. Precipitation averages approximately seventeen inches per year and comes mainly as snow. Peak run-off normally occurs in May or early June.

Beginning about fifteen miles above its confluence with the Bear River, Big Creek flows through land administered by the Bureau of Land Management for about five miles. Downstream, and for about three miles immediately upstream, the creek flows through private land. The upper two miles of the stream flows through land managed by the Forest Service.

The area managed by the BLM traditionally has been grazed continuously May-October. Consequently, riparian vegetation, streambanks and water quality were severely degraded.

In the late 1960s the BLM proposed a 1.5 mile riparian improvement project. The objectives were to improve fish habitat and overall riparian conditions, and to demonstrate for livestock operators the rate of recovery and vegetative potential of the riparian area. The proposal was resisted by local livestock interests and the area temporarily fenced off from livestock was reduced to 0.5 mile of streambank. Fish habitat improvement structures were placed in the stream within and outside the fenced area in 1970 and 1971.

Despite occasional unauthorized grazing within the fenced area, riparian vegetation and the stream responded dramatically to rest from grazing.

Grazed area immediately below the Big Creek riparian protection fence, September 1988.

Big Creek inside fence, August 1987. Note heavy sediment load from deteriorated upstream watershed.

Streambanks became more stable. The stream narrowed and deepened. The riparian area widened due to the raised water table.

However, fish habitat improvements within the fenced area were counteracted by poor watershed conditions upstream. Instream structures trapped large amounts of sediment from upstream erosion. Instream structures outside the exclosure ceased to function and were washed out because of unstable streambanks caused by poor grazing management.

■ Unauthorized grazing inside the fence was a problem because the permittee was not a cooperator in the demonstration project.

■ It was difficult to implement a small demonstration project on this public land site, even though riparian areas and the stream were severely deteriorated.

Riparian conditions inside and outside the Big Creek riparian restoration demonstration fence, September 1981.

The deteriorated condition of the watershed and results of the sixteen-year demonstration/research project led to recommendations for short-term reductions in grazing and changes in the grazing strategy for the allotment. These recommendations were not implemented. Riparian areas outside the exclosure continued to be heavily grazed season-long.

■ Sixteen years of research and demonstrated success at improving riparian, stream and grazing conditions were inadequate to overcome resistance to changing the grazing strategy on this allotment.

■ Some riparian and stream management objectives were not achievable because the watershed upstream remained in poor condition due to poor grazing management.

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BAD River — South Dakota

The Bad River Basin is the smallest of the major river basins which flow into the Missouri River from western South Dakota. The 3,152

square mile basin is mostly private land and National Grassland Administered by the U.S. Forest Service. The basin is representative of the Northern Shale Plains which covers about 67 million acres in the Northern Great Plains.

Annual precipitation in the Bad River Basin averages approximately fifteen inches with about 80% occurring between April and September. Peak rainfall months are May and June, but intense thunderstorms are common throughout the summer months.

Introduction of livestock and improper grazing practices accelerated the naturally high rate of sheet, rill and gully erosion within the drainage. Overgrazing and livestock trailing to water activated gully erosion and increased runoff from steep, weakly-developed upland soils.

Overgrazing of native grasses reduced water infiltration into the soil and exposed the soil surface to the erosive force of accelerated overland runoff. The increased rate of runoff eroded and downcut gullies and stream channels weakened by livestock trailing and trampling and removal of riparian vegetation.

These conditions intensify the naturally extreme seasonal variations in runoff. Since 1928 Bad River flows ranged from 0 to 4,290 cubic feet per second. Exposed upland and riparian soils produce prodigious amounts of sediment and bedload material which are transported out of the Bad River Basin and eventually into the Missouri River.

During one extreme event on May 14, 1982, Bad River discharged 949,300 tons of sediment. On the average, each square mile of the basin annually produces 1,418 tons of sediment and bedload material.

Erosion in the Bad River drainage has far-reaching adverse effects. Bad River sediment deposits in the Missouri River restrict the channel. Resulting ice buildups reduce the water release capacity of Oahe Dam. This, in turn, results in reduced generation of electricity and periodic flooding of portions of the city of Pierre.

The poor condition of the Bad River watershed also adversely affects fishing in the Missouri River which is important to the Pierre-Fort Pierre area economy. Bad River sediment deposits reduce fish production by smothering eggs. In addition, for six to eight weeks following major runoffs, suspended sediments from Bad River muddy water and greatly reduce fishing success in twenty to thirty miles of the Missouri River.

Improved grazing strategies can significantly reduce erosion in the Bad River drainage. Moderate and flexible stocking rates are essential due to the wide fluctuations in timing and amounts of annual precipitation. Cross fencing and stock water developments can improve livestock distribution, provide better

control of grazing intensity. and take pressure off riparian areas by changing grazing patterns and reducing trailing.

Various rest-rotation grazing strategies can keep livestock off streambanks and other fragile areas during the times they are most vulnerable to damage.

Typical degraded riparian area in the Bad River drainage. The channel is downcut and banks are near vertical walls 8-12 feet high. There is little riparian vegetation to protect streambanks against further erosion or to slow runoff and reduce transport of sediment and bedload downstream.

This riparian area in the Bad River drainage shows the vegetative potential of the degraded area in the photograph above. This area is maintained in a healthy condition by being included in a separate pasture that is not grazed during the growing season. Dormant season grazing has allowed both woody and herbaceous plants to maintain vigor and regenerative capabilities. The vigorous growth slows and provides a protective blanket against high spring and summer runoff. Inset: close-up view of the same area dominated by cottonwoods, willows, and western snowberry.

Alternating seasons of use in pastures can allow warm or cool season grasses to be rested during critical reproductive phases.

- Cross fencing and off-stream water developments are important tools to reduce overgrazing and trailing impacts on vulnerable riparian and drainage areas.
- Multiple pastures and rest-rotation grazing strategies allow riparian areas to be protected when they are most vulnerable to livestock damage.
- Restoring and protecting riparian areas requires decreasing the rate of runoff from uplands, restoring riparian vegetation, and protecting streambanks from livestock during vulnerable periods.
- The adverse effects of accelerated erosion and runoff due to improper grazing in the Bad River watershed are felt far beyond the drainage.

SAND Creek — Idaho

Sand Creek is located in southwestern Idaho at about 2,200 feet elevation. Annual precipitation is approximately nine inches

and comes mainly as snow and spring and fall rain.

In the early 1930s this privately-owned site was cleared and leveled to flood irrigate 170 acres of pasture. In recent years approximately 125 cows, 3 to 4 bulls and their offspring were grazed year-round. Portions of the area were grazed for short periods and devoted to producing hay for winter feed.

Earthen irrigation and drain ditches and streambanks were trampled and eroding. Ditch maintenance was a major operating cost. Significant amounts of sediment were entering Sand Creek.

In late 1987 the property was sold. The new owner set a goal of maximizing profit. Protection of riparian areas or reducing nonpoint source pollution were not planning considerations.

Additional pastures and high animal density allowed forage to be grazed to the proper stubble height and properly rested to encourage optimum regrowth.

After Planning

Before Planning

With the traditional pasture configuration and season-long, continuous grazing, livestock could not be economically managed to optimize forage production (or protect riparian areas, reduce erosion of irrigation and drain ditches and streambanks, and minimize sediment contribution to Sand Creek).

Steam corridor fencing allows vegetation to stabilize and protect the steep bank on the left, and to create wildlife habitat. With careful management, livestock grazing can be controlled to prevent damage to the streambank on the right. Without careful management, the very high intensity grazing system on this property could be disastrous for riparian values.

The 170 acres were divided into fifteen pastures and grazed April-October by a single herd of 600 yearling steers. Fences blocked livestock from Sand Creek and all earthen drain and irrigation ditches. Stock water was piped to troughs.

The grazing system was designed to meet the physiological needs of the dense stand of fescue, and thereby maximize forage production. Plants were allowed to reach Soil Conservation Service-recommended height before animals were turned in. High animal density encouraged uniform forage utilization. When the recommended minimum stubble height was achieved, animals were moved to the next pasture.

Grazed pastures received the SCS-recommended amount of rest for regrowth before livestock were reintroduced. The recommended minimum stubble height was maintained late in the growing season to encourage storage of energy for forage production the following spring.

This grazing system more than doubled the pounds of beef traditionally produced on this property. The cost of grazing improvements was recovered during the first year of operation.

Fencing livestock out of earthen irrigation and drain ditches reduced operating costs and production of sediment. Denying livestock access to streambank loafing areas reduced erosion. Streambank vegetation fenced off from livestock provides excellent habitat for waterfowl, upland game birds and other wildlife, and filters irrigation water running off pastures.

- Achieving the long-term benefits of restored riparian areas and reduced nonpoint source water pollution was compatible with short-term profits.

- Meeting the physiological needs of the forage plants was the key to maximum profit.

- This grazing strategy obtained dramatic, profitable results by applying centuries-old grazing concepts and commonly available forage management guidelines and technical assistance.

HUFF Creek — Wyoming

Huff Creek is located at 6,600 feet elevation in the mountain foothills of southwestern Wyoming. Precipitation averages

approximately sixteen inches per year and comes mainly as snow. Peak run-off normally occurs in April or May.

Huff Creek is one of several streams within a 91,000 acre multiple-permittee allotment in the Rock Springs District of the Bureau of Land Management.

Prior to livestock grazing, the riparian area probably was dominated by sedges, rushes and willows. The area was predominately grazed by sheep from the late 1800s until the late 1960s when most permittees converted to cow/calf operations. This conversion prompted aerial spraying of herbicides to kill upland and riparian shrubs and increase grass for continuous, May-September grazing.

Herbicides and intensive grazing eliminated riparian willows and, consequently, beavers. The water table dropped and streambanks eroded. The riparian area shrank and was invaded by sagebrush and rabbitbrush. Stream water temperatures and silt load increased.

Once a popular cutthroat trout fishery, the Wyoming Game and Fish Department estimated Huff Creek's trout population declined from 222 fish per mile in 1958 to 36 per mile by 1978.

In the mid-1970s the trout in Huff Creek were identified as a pure strain of Bonneville cutthroat, then under consideration for listing as a threatened species under the Endangered Species Act. To provide the fish emergency protection, in 1976 and 1979 livestock were excluded from two stream reaches totaling about one mile in length. Instream structures and rock riprap were installed to elevate the water table, improve trout habitat and reduce streambank erosion.

The area inside the fences responded dramatically. Streambanks healed. The stream channel narrowed

Huff Creek, September 1976

Huff Creek, November 1980

and deepened. Within five years the riparian area had roughly doubled in width due to the elevated water table. Vegetation shifted from sagebrush and rabbitbrush back to grass. Grass inside the fences was dense and over two feet high. One stockman remarked he had never seen anything like it in that area. Grass outside the fence was sparse, less than two inches tall, and dominated by sagebrush.

The demonstrated potential for increasing livestock forage while simultaneously protecting other riparian values prompted the livestock association to change its grazing strategy for the six mile long Huff Creek drainage.

A rider was hired to herd stock in the north half of the allotment. Grazing in the Huff Creek valley bottom was delayed until late August through September. The lower half of the valley received light grazing because the herder accelerated the animals' natural drift pattern.

Herding and strategically placed salt blocks improved livestock distribution and provided ungrazed forage for stock being trailed to winter pastures.

The number of calves and weight gains improved. In three years riparian vegetation outside the fence looked the same as vegetation inside the fence. Huff Creek had narrowed by about one-third, doubled in depth, and water temperatures had declined. The percentage of eroding streambanks decreased from about 80% to 20%. The number of Bonneville cutthroat increased to 444 per mile, an 1,100% increase over 1978 levels.

The success on Huff Creek and similar efforts elsewhere removed the immediate threat to survival of the Bonneville cutthroat. In 1987 the U.S. Fish and Wildlife Service decided to wait until 1992 to review the results of habitat recovery projects before deciding whether to proceed with listing the fish as a threatened species.

■ Herding livestock to fresh forage, and providing grazed forage proper rest for regrowth, are ancient arts that still work. Animal weight gains improved concurrently with improved riparian conditions.

■ Steep terrain and natural barriers facilitated herding by restricting livestock movement between drainages.

Inside (left) and outside (right) a Huff Creek riparian protection fence in 1984 after improved grazing management through herding.

■ Herding was successful at keeping cattle out of a drainage; it was not successful at keeping cattle out of the riparian area once they were in the drainage.

■ Herding was as effective as fences in controlling livestock grazing of riparian areas.

■ The effective rider clearly understood the objective of the riparian improvement grazing strategy, was dedicated to the project and worked the cattle daily.

■ The area had been in a deteriorated condition for so long local stockmen were surprised by the vegetative potential revealed by improved grazing management.

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HENRY'S Fork River — Idaho

The Henry's Fork River rises on the continental divide on the west side of Yellowstone Park and drains a 4,000 square mile

area in eastern Idaho. The elevation of this case study site is about 6,200 feet. Annual precipitation averages approximately forty-five inches which comes mainly as snow and to a lesser extent from summer thunderstorms.

The river is fed by numerous large springs; Big Springs alone discharges approximately 0.5 million gallons per day. The spring water provides excellent growing conditions for rainbow trout which attract anglers from all over the world. The spring water keeps much of the river from freezing, thereby providing good winter conditions for fish and wildlife, including the threatened trumpeter swan.

Bison, antelope, moose, elk and deer grazed the watershed for thousands of years. Cattle and sheep have grazed the area since the late 1800s, numbering more than 3 million animals in their heyday.

In the 1960s and mid 1970s the 12,700 acre Railroad Ranch — famed world-wide in trout fishing circles — was donated to the State of Idaho. Forty-seven hundred acres became Harriman State Park. An adjacent 1,000 acres, called Harriman East, are managed by the Idaho Foundation for Parks and Lands. Together they encompass six miles of some of the best rainbow trout habitat in the U.S.

Deeds transferring the property contained strong convenants to protect the environment. Livestock numbers were drastically reduced on Harriman East. Nonetheless, mid June to mid October continuous grazing still resulted in poor utilization of upland forage, damage to riparian vegetation and streambanks, and increasing conflict with growing numbers of fishermen.

In 1984 the single pasture was divided into four pastures, one of which was a narrow "set-back" pasture parallel to both sides of the river. This pasture included more land area than a typical stream corridor exclosure, but less area than normally would be included in a riparian pasture.

Livestock were grazed under a rest rotation system. The set-back pasture won't be grazed until riparian and streambank recovery objectives are met. Then it will be grazed under special prescription.

Implementing this grazing system allowed the livestock permittee to continue grazing the same number of animals to start, and increase animal numbers by 25% in the fourth year of operation, despite two consecutive years of drought. The non-profit Park Foundation continued to get badly needed grazing revenue. The set-back pasture eliminated fishermen-livestock conflict, and allowed future livestock use of streambanks to be carefully controlled to protect fish habitat.

The adjacent area now within the 4,700 acre Harriman State Park traditionally was grazed June-October by large numbers of livestock. After the park was formed, grazing was restricted to approximately 2,500 acres. The grazing period was limited to a few weeks in late fall to eliminate conflicts with spring waterfowl nesting and brood rearing in the riparian area and adjacent uplands, and to eliminate summer livestock conflicts with growing numbers of fishermen.

This grazing system accomplished its objectives by forgoing the majority of the area's livestock forage potential. However, it had the unintended consequence of concentrating livestock on Henry's Fork streambanks.

By late fall upland grasses are mature and dormant. Livestock naturally are attracted to the green vegetation in the riparian area. Streambank vegetation was overgrazed and banks were trampled which degraded important shoreline trout habitat. This eventually led to increasing complaints from the public that livestock grazing was

not compatible with the park's mandate to protect the high quality Henry's Fork trout fishery.

In 1988 the Henry's Fork Foundation, a private organization of fishermen, local businessmen and property owners, proposed to cost-share with the State of Idaho a solution to livestock/fishery conflicts in the park. Within a few months a plan was developed, approved, funded and implemented.

Both sides of the Henry's Fork River were fenced to exclude livestock from streambanks; alternative stock water was available.

The fence was strategically located far enough back from the river to provide generous area for waterfowl nesting and brood rearing, and abundant cover from predators. Additional design considerations included providing adequate loafing area for fishermen, birders and picnickers, and minimizing visual obtrusiveness of the fence from the river.

The fence eliminated all sources of conflict that had severely limited and threatened to end livestock grazing on the park. It provided park managers the option of capitalizing on the significant revenue potential for increasing grazing on virtually all of the 2,500 acres available to livestock.

■ Drastically reducing both the number of livestock and the grazing season were not sufficient to achieve riparian management objectives on Harriman State Park.

■ Innovative, practical solutions were possible even when extremely high riparian and stream resource values appeared to be irreconcilable with livestock grazing.

■ Private and public cost-sharing and win-win solutions, facilitated quick, efficient riparian protection. On the Harriman East site, the solution was devised and implemented almost immediately due to cooperation of the livestock grazing permittee.

■ Livestock grazing on these park lands almost certainly would have been eliminated if riparian conflicts had not been speedily resolved. The solutions not only maintained livestock grazing, but allowed it to increase. Nonetheless, some livestock interests strenuously opposed fencing to protect Henry's Fork streambanks from the effects of livestock grazing.

Henry's Fork River, 1985. Trampling by livestock and loss of vegetation caused streambanks to slough and lay back. This resulted in loss of important shoreline habitat for juvenile and trophy trout.

Slightly different spot, 1988. A good grazing strategy encourages shoreline vegetation and more vertical streambanks. Some sites take much longer to show major change than others. Here the growing season is short and the winters are severe. Because Henry's Fork flow and sediment load are controlled by an upstream reservoir, streambank building is a slow process.

HORSE Heaven Creek — Oregon

Horse Heaven Creek is located in central Oregon. Elevations in the case study area range from about 3,600 feet to 4,500

feet. Annual precipitation ranges from nine inches in the lower areas to fifteen inches in the higher elevations.

This area has been grazed by domestic livestock for more than a century. In this case study the rancher runs a cow/calf operation on 43,000 acres of private and public land. The rancher cleared over 6,000 acres of juniper on his private land to improve upland range conditions by encouraging native grasses. Before and after studies showed treated areas improved from 19 acres per animal unit month (AUM) to 2.7 acres per AUM.

In spite of improved upland conditions, the rancher was still concerned about his livestock "... lying on the creeks and starving to death." His cattle tended to concentrate on and overgraze riparian areas and underutilize abundant upland forage.

To solve this problem, he fenced over six miles of Horse Heaven Creek into separate pastures. They were rested from grazing for a three-year recovery period, then grazed under a high intensity short-duration spring grazing system. At the rancher's request, the U.S. Forest Service also fenced the riparian area on his allotment upstream, which is grazed in the same manner.

The rancher's cattle now graze the uplands more, and more uniformly. The riparian areas and creek have improved dramatically.

The combination of improved upland and riparian vegetation has reduced erosion and improved streamflows. Streams that used to go dry in some years now flow in years with half as much precipitation.

Summer of 1988 after the riparian pasture had been rested from grazing for three growing seasons (1983-85), followed by high intensity short duration spring grazing 1986-88. Willows grew profusely and stabilized the stream channel above the reservoir. As the result of reduced sediment loads and generally improved habitat conditions, trout now spawn in the stream feeding the lake.

Summer of 1984 after riparian areas were fenced into separate pasture and rested for two growing seasons. Note sediment deposited in upper end of reservoir from poor condition uplands after summer thunderstorms.

Improvements in upland and riparian vegetation allowed the rancher to increase his cow/calf numbers by 50% and improve the average weaning weights of calves by 150 lbs. Improved riparian conditions attracted more elk and beaver. According to this successful rancher, "The best environment for raising cattle is also the best environment for wildlife." He considers beaver a positive influence on watershed recovery. "I wish I had more of the irrigating [expletive deleted]."

Restoring vigorous riparian vegetation led to increased beaver activity. Beaver dams stored water and trapped sediments. Elevated water levels subirrigated adjacent land, which expanded riparian areas and provided more livestock forage and more wildlife habitat.

He credits good diversity in upland and riparian vegetation with providing more stability to his livestock operation, especially during dramatic variations in weather patterns. His ranching philosophy is, "The closer that you can have it to like nature would have it the better off you are in the long run. Its more economically sound."

"THE closer that you can have it to like nature would have it the better off you are in the long run. It's more economically sound."

■ Despite availability of abundant upland forage, cattle tended to concentrate in and overuse riparian areas.

■ Fencing riparian areas into separate pastures allowed the rancher to obtain optimum utilization of upland and riparian forage and improve watershed conditions.

■ Improved management of upland and riparian vegetation combined to reduce erosion and sedimentation of streams and irrigation and fishing reservoirs, and to enhance summer streamflows.

■ Improved riparian vegetation encouraged beaver activity which raised stream water levels and expanded the riparian area. This increased livestock forage and wildlife habitat and decreased erosion and sedimentation.

■ Good riparian management was an integral part of increasing the ranch's long-term productivity and profitability.

THE preceding case studies are representative of a wide range of riparian area conditions, problems, and opportunities.

For the most part, they demonstrate that the productivity of degraded riparian areas can be restored, usually with a net gain in livestock forage.

This runs counter to the common perception that improved management of riparian areas is a zero-sum game where improvements in fish and wildlife habitat, water quality and other watershed values can only be achieved at the expense of livestock forage.

These case studies also demonstrate there is no cookbook of simple, universal recipes for successful riparian grazing strategies.

There are virtually infinite variations in hydrologic and climatic conditions, in geology, soils, and stream character, and in plant species and plant communities. Local site condition, trend and potential also vary widely. This natural variation and complexity is compounded by variations in local grazing traditions, and in the economic status, attitudes and objectives of livestock operators.

FOR the most part... the productivity of degraded riparian areas can be restored, usually with a net gain in livestock forage.

As illustrated in this infrared photograph, riparian areas over much of the western United States are thin lines of green across vast areas of arid and semi-arid land. Traditional grazing strategies for the most part have been designed for the far more extensive upland vegetation. In consequence, riparian vegetation has been overgrazed and riparian areas and streams degraded over large areas of land.

A successful riparian grazing strategy must be custom designed to fit the specific circumstances. However, many years of experience and research have tested and proven some common denominators and practical rules of thumb.

RIPARIAN Management Objective

A clearly defined objective or desired future condition for the riparian area is the foundation of a successful grazing strategy.

This seemingly obvious step actually represents a fundamental departure from traditional livestock grazing management on most western lands.

Grazing typically has been targeted on the far more extensive upland forage, predominately grasses. This, of course, was unlikely to result in proper grazing of riparian grasses, forbs or woody plants. In fact, until very recent years, some livestock grazing manuals referred to streamside areas as "sacrifice areas."

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SITE Potential, Condition and Trend

IN order to establish realistic objectives for riparian areas, it is important to know the vegetation potential of the site under proper grazing management.

Unless the riparian area is in extremely degraded condition, or the stream is rapidly depositing soil from upstream sources, the potential of the site for various species of plants may be obvious. If it isn't, this insight may be available from similar sites in the local area.

Some riparian areas are so badly degraded there is little evidence to support predictions of vegetation potential. Some areas have been degraded for so long, or the deterioration has been so gradual, that no one can recall what vegetation used to be there. In these cases, relic areas—areas inaccessible to livestock because of terrain, or early man-made livestock exclosures may provide useful insight. Rapidly evolving ecological classification technology can be used to help predict or confirm vegetation potential.

The present condition and trend of the desired riparian vegetation also may strongly influence the choice of grazing strategy. For example, different strategies might be used to restore severely deteriorated vegetation, to encourage an improving trend, or to maintain a desired condition once it is achieved.

Laterally unstable stream channel. Loss of upland vegetation and topsoil concentrates and increases the speed of runoff. Doubling the velocity of streamflow quadruples its erosive power and gives it 64 times more bedload and sediment carrying power.

Vertically unstable stream channel.

The condition and trend of streambanks also will influence the design of grazing strategies to protect or restore riparian areas. Fragile or actively eroding streambanks likely will require a different grazing strategy than might be appropriate under more stable conditions.

Streams work off energy by constantly cutting and filling their channels in response to changes in flow, sediment load, and streambank condition. Riparian plant communities in good condition resist the cutting and stabilize the fill.

In areas with deep alluvial soils, accelerated downcutting of the stream channel can be triggered by increased rate of runoff resulting from loss of upland vegetation and topsoil. Downcutting lowers the streambed and the

groundwater table, reduces the riparian area and destabilizes streambanks. If downcutting isn't blocked by resistant geologic formations or man's intervention, it could migrate upstream and potentially disrupt the hydrologic function of the entire watershed.

Where streams with gravel or rock bottoms resist downcutting, laterally unstable stream channels can result from activities that degrade riparian vegetation and otherwise destabilize streambanks. Weakened streambanks are more vulnerable to erosion. The stream channel becomes progressively wider and shallower at the expense of the riparian area and water quality.

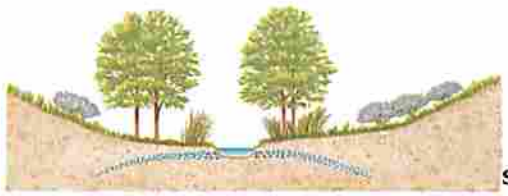
STRUCTURES *treat symptoms of the problem. If used as a substitute for changes in grazing necessary to improve riparian and upland conditions, investments in structures may be wasted.*

PROPER *management of riparian and upland grazing usually is the best, most cost-effective treatment for stream channel instability and watershed deterioration caused by improper grazing. In some cases, instream structures such as weirs, rip rap and gabions can help reduce streambank erosion, stabilize the stream channel, reduce downcutting of the streambed and lowering of the water table, and trap sediment to rebuild streambanks.*

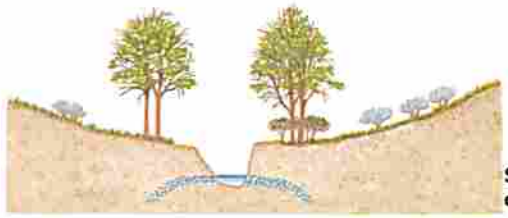
Structures treat symptoms of the problem. If used as a substitute for changes in grazing necessary to improve riparian and upland conditions, investments in structures may be wasted. If improperly designed or deployed, instream structures may accelerate stream channel and riparian damage.

In streams prone to downcutting, instream structures have the greatest payoff when used during Stage 1 conditions to prevent downcutting and keep it from migrating upstream. Instream structures used to combat Stage 2, 3 and 4 conditions can be very expensive to build and maintain and have high risk and rate of failure.

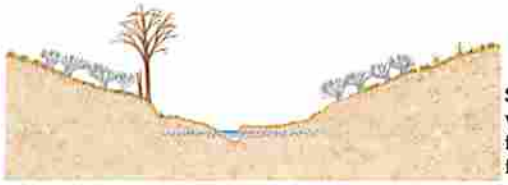
In streams prone to lateral or sideways channel movement, instream structures generally can be justified as a first resort only when there is not enough soil left to support adequate riparian vegetation. Or when the stream channel is so unstable it prevents recovery of the riparian zone within an acceptable period of time.



Stage 1: Unincised

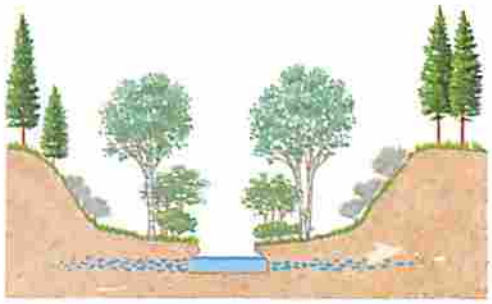


Stage 2: Rapid downcutting

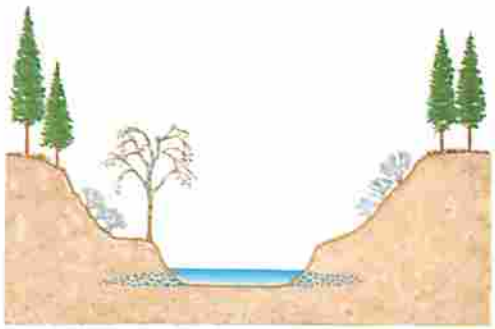


Stage 3: Channel widening and forming new floodplain

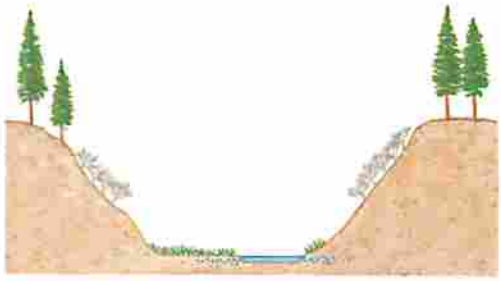
Stage 4: Channel widened enough to form a new stable channel and floodplain



Streambanks and channel in good condition

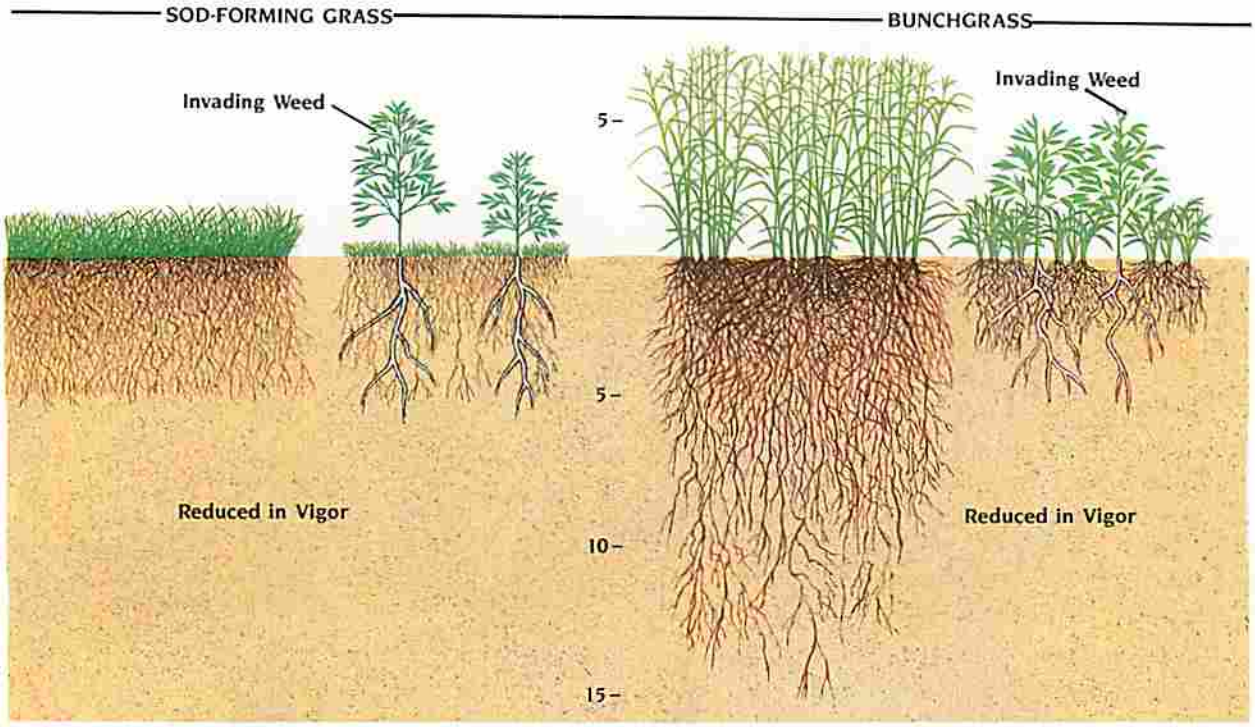


Stream channel widens and shallows in response to deteriorating upland and/or riparian conditions



Stream channel very wide and shallow; stream moves back and forth in channel until stabilized by vegetation

EFFECTS *of overgrazing on root production, plant vigor and species composition. From: Understanding Grass Growth: The Key to Profitable Livestock Production*



When plants are severely grazed, root growth stops. Regrowth of foliage takes precedence over providing energy for root growth. Continuous severe grazing causes roots to die back, reducing plant vigor. Plants then produce less livestock forage, are more susceptible to low soil moisture, and may be replaced by plants less palatable to livestock and less beneficial to protection of upland watershed conditions, riparian areas and stream channels.

Grazing strategies which provide for foliage to be properly pruned, and which allow sufficient rest from grazing for plant regrowth and energy storage in roots, will produce more livestock forage over the long term than strategies that allow continuous grazing during the growing season.

PLANT Physiology

A successful riparian grazing strategy will fit the plant(s) one wants to encourage. Desirable plants that are grazed too severely, too often, or at the wrong time, will be reduced in vigor, suppressed by less palatable plants, or killed.

Riparian vegetation characteristically is quite different than the plants on adjacent uplands. A grazing strategy targeted on upland grasses, for example, may result in severe overgrazing of riparian grasses, forbs, shrubs and tree seedlings.

A grazing strategy designed to protect or encourage only riparian plants may adversely affect upland grasses and/or result in substantial under-utilization of upland forage.

Grazing strategies either must be designed to: (a) concurrently meet the needs of both upland and riparian vegetation over time; (b) include riparian areas in separate pastures to allow special management; or (c) exclude livestock from riparian areas through herding or fencing.

Under continuous, season-long grazing, riparian vegetation likely will be severely grazed late in the growing season. At this critical time foliage is needed to manufacture and store energy for root growth and for initial foliage production the following spring.

In this area, willows put on new growth in mid-summer. This new growth becomes particularly attractive to livestock when upland forage dries out and riparian grasses have been depleted.

This riparian area had been subject to continuous, season-long grazing for many years. When this photograph was taken, livestock had been excluded from the area right of the fence for one year.

GRAZING Strategies

Decreasing the number of livestock is commonly offered as the simple solution to degraded riparian conditions. But even under light stocking rates livestock tend to concentrate on riparian vegetation during various seasons of the year. Unless the reduction were extreme, it might not achieve the desired improvement in riparian conditions. This is especially likely if the riparian area is in a deteriorated condition with slow recovery potential.

In short, restoring degraded riparian areas generally requires managers to change the way livestock are grazed.

A successful riparian grazing strategy will fit the unique circumstances of each site, including watershed and stream conditions, riparian and upland vegetation, terrain, class or kind of livestock, and the management capability and objectives of the livestock operator.

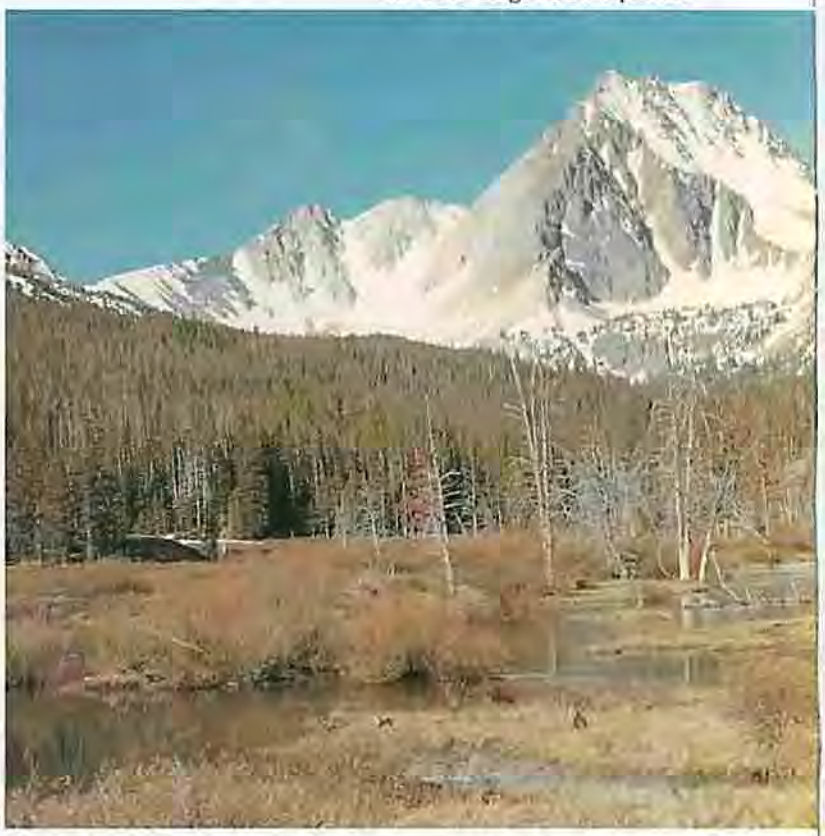
These circumstances occur in virtually infinite variation across the West. No one grazing strategy will fit all situations. The most promising strategies for protecting or restoring riparian areas incorporate one or more of the following features:

- Including the riparian area within a separate pasture with separate management objectives and strategies.
- Fencing or herding livestock out of riparian areas for as long as necessary to allow vegetation and streambanks to recover.
- Controlling the timing of grazing to: (a) keep livestock off streambanks when they are most vulnerable to damage; and (b) coincide with the physiological needs of target plant species.
- Adding more rest to the grazing cycle to increase plant vigor, allow streambanks to heal, or encourage more desirable plant species composition.
- Limiting grazing intensity to a level which will maintain desired species composition and vigor.
- Changing from cattle to sheep to obtain better animal distribution through herding.
- Permanently excluding livestock from riparian areas at high risk and with poor recovery potential when there is no practical way to protect them while grazing adjacent uplands.

RESTORING and protecting riparian areas is a long-term job requiring a long-term commitment.

TIME

The deterioration of western riparian areas and associated uplands didn't happen overnight. In many areas the process began more than a century ago. In many areas it is continuing, despite reported improving trends in upland conditions.



Loss of topsoil and the gullies and arroyos resulting from improper land management for all practical purposes have permanently altered and diminished the productivity of large areas.

On high gradient streams where the channel is unstable, or where seed sources for native riparian plants are absent or in short supply, or where sediment loads are low, recovery may take decades.

In areas with shallow soils and where streams carry limited sediment to rebuild streambanks, it might take centuries to restore productive riparian areas.

In high elevation glaciated stream basins with little soil building potential, and in some areas where stream channels are severely downcut, restoration of degraded riparian areas probably won't occur until the passing of another ice or volcanic age.

However, as the preceding case studies demonstrate, many riparian sites have potential for dramatic recovery.

Even severely degraded riparian areas can be restored when site conditions and management are right. For example, on low gradient streams flowing through alluvial valley bottoms, particularly where the stream carries a large sediment load at high

flows, the right grazing strategy can produce dramatic recovery of riparian vegetation and streambanks.

This initial recovery of vegetation should not be confused with achieving the desired long-term condition for the riparian area. Nor is it a substitute for changes in upland grazing management that may be required to restore and maintain the long-term productivity of the watershed.

The longer it takes to implement improved grazing strategies on deteriorated riparian areas and adjacent uplands, the higher the cost in forgone watershed values, including livestock forage, water quality, and fish and wildlife. And the higher the risk of essentially irreversible damage.

Harsh climatic conditions, thin soils and low stream sediment levels put many riparian areas at high risk of irreversible damage from improper grazing.

Flexibility

Rigid application of a paper grazing system can be a prescription for failure on the ground.

It may be difficult to accurately predict how the riparian area will respond to variables in weather, human and animal behavior, stream runoff and other conditions. In addition, if the riparian area is in a degraded condition, it probably will require a different grazing strategy to start than might be used to maintain the desired condition once it has been achieved.

Commitment

Commitment to steady progress is important to achieve and maintain the desired riparian condition.

Restoring and protecting riparian areas is a long-term job requiring a long-term commitment. A riparian improvement grazing strategy that is contingent upon favorable short-term circumstances, for example, good weather, low hay prices, a strong market for livestock, etc., probably is doomed to eventually fail.

The initial dramatic increase in vegetation possible on many riparian areas is just the first step toward recovery. If this first new growth proves irresistably attractive to a grazier fallen on temporary hard times, years of progress and investment could be quickly wiped out.

Any grazing strategy probably will fail to meet riparian improvement objectives if the livestock operator, or in the case of public lands, the permittee and the land manager, are not committed to making it work.

Everyone involved in the grazing/land management operation should have a clear understanding of the problem, including the on- and off-site costs of degraded riparian areas and uplands. They need to understand where they are starting from. Where they are trying to go. Specifically how they are going to get there. The eventual payoff in increased long-term productivity. And how progress toward the goal will be evaluated.

Monitoring & Evaluation

Many progressive livestock operators routinely monitor their riparian and upland pastures because it is good business.

Monitoring and evaluation are essential to determine progress or lack of progress toward riparian and upland objectives. To signal if, when, and how grazing strategies should be changed in response to changing conditions.

However, monitoring obviously deteriorated conditions, without first changing the management responsible for those conditions, does not seem to be a wise investment. These resources could be better spent monitoring and evaluating the results of implementing new grazing strategies to increase productivity of riparian areas and adjacent uplands.

The nonpoint source provisions of the Clean Water Act bring a new dimension to monitoring of grazed watersheds. States will systematically monitor and evaluate chemical, physical and biological water quality indicators such as sediment load, temperature, dissolved oxygen and fish populations. The results will be used to ensure compliance with state programs adopted to achieve the act's mandate to attain and maintain designated beneficial uses such as drinking water, agricultural water supplies and fish and wildlife production.

Obstacles & Opportunities

Progressive stockmen and land managers have long demonstrated there are no insurmountable technological barriers to restoring and protecting the long-term productivity of western riparian areas and adjacent uplands.

Nonetheless, many millions of acres of private and public land and associated riparian areas are in need of improvement; vast areas are in desperate need. This clearly indicates there are formidable educational, economic and social barriers to widespread transfer of proven technology to the ground.

The preceding case histories are representative of broad areas of land in the West. They reflect a large reservoir of riparian improvement knowledge and practical experience. This experience strongly suggests that initiatives in the following areas would help break down barriers to improved grazing management on western riparian areas.

Education

Traditional grazing practices are resistant to change. It is frequently and widely acknowledged that education about the techniques and benefits of improved riparian grazing managment should have highest priority. In most cases, however, education has no priority in budgets. Therefore, it is not surprising there is widespread lack of understanding and acceptance of proven riparian management technology. And of the enormous direct and indirect costs of deteriorated western riparian areas and adjacent uplands.

It is difficult, but not impossible, to capture these costs in economic terms. For example, Harold Dregne, Professor of Soil Science at Texas Tech University, roughly estimates the value of potential forage lost due to past and present overgrazing of western rangelands to be approximately $200 million per year. Even greater economic losses may be attributed to reduced quality and quantity of usable water, diminished fish and wildlife populations, shortened economic life of water supply and hydroelectric reservoirs, and other costs of deteriorated watersheds.

It is important to know more about the nature, magnitude and distribution of these costs in order to marshall private, public and political support for remedial actions. But the cost of present deteriorated riparian conditions is the dark side of the problem. It is equally important to quantify the social and economic benefits of improving the long-term productivity of western riparian areas and associated uplands.

POCKETBOOK
Economics

The preceding case studies and similar projects throughout the West demonstrate that protecting and restoring riparian areas need not be a zero-sum game where gains to fish, wildlife and water quality come at the expense of livestock grazing. In many cases there can be a net gain in livestock forage.

In some cases this can occur concurrently with riparian restoration through improved management of riparian areas and associated uplands. In some cases reductions in grazing may be unavoidable to restore severely damaged riparian areas or protect extemely vulnerable ones. But even in most of these latter instances, the eventual payoff is likely to include disproportionately large increases in future livestock forage production.

The gap between paying now and benefitting later is the biggest challenge confronting improved management of private and public riparian areas.

Given understanding of the problem and the technology for solving it, livestock operators who can afford to make investments in long-term productivity are likely to do so out of enlightened self-interest like any other business person. Unless they are in the livestock business for philanthropic purposes, however, cash flow and assurance of future dividends will be important considerations in their investment strategies.

Many livestock operators, no matter how well intended, simply cannot afford to change their present grazing strategies if that change requires lost revenue or additional time or money.

A successful program for achieving the private and public benefits of improved riparian management will be responsive to both situations. It will include innovative approaches to attract long-term private and public investments in enhanced productivity, and to offset or mitigate politically untenable short-term social and economic costs.

THE gap between paying now and benefitting later is the biggest challenge confronting improved management of private and public riparian areas.

TECHNOLOGY Transfer by Demonstration

Small scale, "postage stamp," demonstration projects have proven value for demonstrating the techniques and benefits of improved riparian management. They have helped overcome the inertia of tradition and other resistance to change in many areas, and should be strategically targeted on new market areas. However, the emphasis must now shift from micro demonstration projects to full-scale application focused on economic units and complete watersheds. This is the intent of Congressionally authorized appropriations under Section 319 of the Clean Water Act.

INCENTIVES & Disincentives

The complex system of governmental economic incentives and disincentives applicable to western grazing lands offers untapped opportunities for encouraging protection and restoration of riparian areas.

In recent years Congress enacted anti sod- and swamp-buster laws to discourage activities that reduce long-term productivity. There is precedent, opportunity, and need for similar riparian amendments to laws applicable to grazing land.

WINDOWS of Opportunity

Windows of opportunity are created when grazing allotments on public land become vacant or permits are transferred. Opportunity to allow riparian areas and adjacent uplands to heal before resuming grazing. To change permitted grazing strategies. To hold restored allotments in reserve for use in times of drought, or to take the pressure off degraded riparian areas elsewhere. Elimination of any statutory or administrative barriers to these opportunities should have high priority.

The dramatic contrast in riparian conditions upstream (private land) and downstream (public land) of this fence line is representative of a fundamental, pervasive problem.

"... IT is profitable, under the present system of agricultural technologies, markets, and policies, to mine the inherent productivity of the fragile cropland and rangeland sites as if they were nonrenewable resources. In doing so, long-term productivity is sacrificed for shorter-term profits."

— Congressional Office of Technology Assessment, 1981.

PRIVATE/Public Cost-Sharing

Both public and private land graziers own extensive riparian areas and associated uplands. The costs of deteriorated riparian areas and adjacent uplands don't stop at property lines. Neither do the many benefits of improving riparian and upland conditions. This provides the basis for expanding on a long tradition of private-public cost sharing.

Existing statutes, policies and programs such as the federal small watershed program, should be reviewed for opportunities to encourage creative riparian improvement cost-sharing.

There is growing public awareness of the value of western riparian areas, and of the costs resulting from their deteriorated condition. Hunters, fishermen, other outdoor recreationists and the businesses they support increasingly recognize they have a stake in the productivity of public lands that comprise the majority of some western states. They represent millions of potential allies for the approximately 30,000 livestock permittees who graze public lands and for livestock operators who only graze private land.

Fish and wildlife enthusiasts particularly are increasingly willing to help fund cooperative riparian/upland fish, wildlife and livestock habitat improvement projects. This opportunity could be enhanced by expanding state and federal challenge cost-share programs and dedicating a percentage of grazing fees to that purpose.

THE ultimate solution to restoring and maintaining the productivity of western riparian areas is to restore and maintain the productivity of watersheds. This requires special consideration for and emphasis on restoring and protecting riparian areas.

The preceding case studies and similar projects throughout the West demonstrate it can be done.

Rapidly growing public awareness of the value of riparian areas presents a unique opportunity for a new private/public partnership to enhance livestock forage, fish and wildlife populations, water quality and other values produced on western watersheds.

A growing number of individuals and organizations contribute labor and money to watershed improvement projects on both private and public lands.

"To protect your rivers, protect your mountains."

— Emperor Yu of China, 1,600 B.C.

For More Information:

Understanding Grass Growth: The Key to Profitable Livestock Production: Waller, Moser & Reece. Trabon Printing Co., Inc., Kansas City, Missouri.

Range Site Descriptions: U.S. Soil Conservation Service field offices.

Field Office Technical Guide: U.S. Soil Conservation Service field offices.

Impacts of Technology on U.S. Cropland and Rangeland Productivity: Congressional Office of Technology Assessment. Library of Congress Catalogue Card # 82-600596.

Desertification of the United States; Sheridan, 1981, Council on Environmental Quality, Washington, D.C.

Rangeland Management: Some Riparian Areas Restored but Widespread Improvement will be Slow: Government Accounting Office, June 1988. Report # RCED-88-105.

Protecting America's Wetlands: An Action Agenda — The Final Report of the National Wetlands Policy Forum: The Conservation Foundation, Washington, D.C.

Preserving Communities & Corridors: Defenders of Wildlife, Washington, D.C.

Videos

Riparian Management and Channel Evolution: U.S. Bureau of Land Management, Phoenix Training Center.

Cooperative Rangeland Management—The Riparian Approach: U.S. Bureau of Land Management, Phoenix Training Center.

Riparian Areas & Grazing Management: U.S. Environmental Protection Agency.

Riparian Management — A Challenge for Our Future: Bureau of Land Management, Prineville, Oregon.

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