STANDARD 1 – WATERSHED HEALTH

Within the potential of the ecological site (soil type, landform, climate, and geology), soils are stable and allow for water infiltration to provide for optimal plant growth and minimal surface runoff.

The Upper Colorado River Basin in this watershed assessment consists of three fourth order Hydrologic Unit Code (HUCs) watersheds: Muddy Creek, Little Snake River, and Vermillion Creek (Maps #4 & #5). All of Muddy Creek (630,446 acres) is included in this assessment. The portion of the Little Snake River (909,479 acres) in Wyoming and excluding MBNF lands is included in this assessment. The only portion of Vermillion Creek (171,621 acres) is the portion of Shell Creek (5th Order HUC) within Wyoming. Map #x and Table #2 depict the 5th Order HUCs, acreages, and groupings of these watersheds that will be discussed for Standard 1.

Table # 2 – Upper Colorado River Basin 4th and 5th Order Hydrologic Unit Code (HUC)

4th Order HUC	Acreage	5th Order HUC	Acreage	Assessment Name
Muddy Creek	630,446	Upper Muddy Creek	135,232	Upper Muddy Creek
		Barrel Springs Draw	241,238	Barrel Springs Draw
		Lower Muddy Creek	253,976	Lower Muddy Creek
Little Snake River	909,479	Savery Creek	225,616	Savery Creek
		Battle Creek	110,577	Savery Creek
		L. Snake River- Willow Cr	92,243	Little Snake River
		L. Snake River- Powder W	56,863	Little Snake River
		Lower Sand Creek	299,946	Sand Creek
		Upper Sand Creek	124,234	Sand Creek
Vermillion Creek	171,696	Shell Creek	171,696	Shell Creek
Total	1,711,621			

Upper Muddy Creek

1) Characterization:

Upper Muddy Creek contains the perennial headwater streams of Muddy Creek, Littlefield Creek, and McKinney Creek. As it drops in elevation, only ephemeral side drainages add to the creek before its confluence with Barrel Springs Draw. The headwater area is in a 12 to 18-inch precipitation zone with well-developed loamy soils. From the lower end of Littlefield Creek and McKinney Creek downstream, the soils are predominantly shale and clay-loam with higher runoff and erosion potential. Precipitation in the lower portion is between 8 and 12 inches annually. Elevation ranges from 6,500 at the confluence of Muddy Creek and Barrel Springs Draw to 8,200 ft at Rendle Rim and 8,400 ft at Miller Hill at the headwaters of Muddy Creek.

Wide meadows and active floodplains occur on the uppermost perennial and intermittent stream channels and where irrigation has been developed (picture 7-1). The majority of the main channel of Muddy Creek below the headwater areas is incised within 8 to 12 foot tall banks, with all high flow events confined in the channel (picture 7-2). Due to this downcutting and incisement, most erosion occurs from in-channel sloughing on outer banks as the stream widens the active floodplain and from gradient adjustment moving up ephemeral side channels. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows at the lower end of this watershed average between 30 to 50 cfs from March through June. Peak flows are highly variable during this time period, ranging from 150 cfs to 1200 cfs. Flows usually dry up at this lower end by July or August unless precipitation is above average. Flows are perennial out of the headwaters down to about the confluence with Long Draw or CY Draw. Gauging of flows just below the confluence of McKinney Creek and Muddy Creek shows flows in May (just after the peak runoff) of 70-85 cfs to fall base flows of 4-5 cfs.

The majority of stream channels in this watershed are either a C6 stream type or an E6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 8-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios (picture 8-2). Streambanks are stabilized with riparian vegetation similar to C6 stream types. Two other stream types are also worth mentioning. In the upper headwaters on steeper sloped portions of the Littlefield and McKinney Creek drainages are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 8-3). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996). Between two and six miles above its confluence with Barrel Springs Draw, Muddy Creek has been influenced by man-made spreaderdikes and irrigation systems since the early 1900s. These activities have created broad depositional areas reaching ½ mile or more in width and a D6 stream type. The D6 stream type is a multiple channel system found within broad alluvial valleys consisting of cohesive silt-clay depositional materials (Rosgen 1996). Channel gradients are very low, with excessive deposition and annual shifts of the bed location (picture 8-4). It may take several years for vegetation to stabilize new depositional areas.

Principal human uses in the headwaters area are livestock grazing and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Seasons of use at lower elevations are spring through fall with snow usually precluding year-round use. Season of use at higher elevations is usually from mid-May or June through September or October. Recreation is primarily related to hunting, fishing, or using the Continental Divide National Scenic Trail. The highest use period is during the fall hunting season (September through October). Associated with this use is an improved/unimproved road transportation system and off-highway vehicle use. In the lower half of the watershed are the previously described human uses and oil and gas field development, along with recent exploratory development for coalbed methane.

2) Issues and Key Questions:

Many of the issues and key questions within each watershed assessment area are similar, therefore they will be discussed in their entirety, and if there are additional specific concerns, they will be noted. In addition, they are listed in priority of importance.

1. Livestock Grazing: Livestock grazing has been and continues to be the principal factor affecting watershed values in the Upper Muddy Creek watershed (picture 8-5). Management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to stream channels, which affect bank stability and width/depth ratios. The key question is what further refinement in best management practices for livestock grazing or other actions need to be made to improve watershed health and meet desired resource conditions.

2. Erosion: Erosion from roads, both improved and unimproved, is the second most important factor relating to watershed health. The BLM, Carbon County, and various oil and gas companies all maintain improved roads within the watershed. The principal problem with improved roads is inadequate water control features, such as culverts, wing-ditches, and water-bars, to mitigate the effects of roads on upland runoff hydrology (picture 8-6). Road standards are based on how to build and maintain a safe road, rather than what effect the road has on altering the natural hydrology of the landscape. As a result, roads tend to collect water off a broad area and then release it in a more concentrated volume, in a draw or flared onto a hillside undeveloped for this flow, causing accelerated erosion (picture 8-7). For each mile of improved road there are probably ten miles of unimproved roads or two-tracks. Many of these two-tracks do not cause increased erosion, but where it does occur there is usually no maintenance to correct the problem. Use of road systems by all users, particularly in bad weather or when roads are wet, leads to increased erosion from roads. The increasing use of this country for recreation, and the increasing use of 4-wheel drives and off-highway vehicles, is creating new roads and new sources of erosion. The key questions here are: How do we improve the adequacy of water control features on improved roads? How can erosion sources from two-track roads best be addressed? What educational and management tools should be employed to reduce erosion impacts from recreation and other users of public lands?

3. Oil and Gas: Oil and gas field development is increasing in this watershed and across the region. Short and long-term sources of erosion are increasing with this development, but can often be mitigated with good reclamation practices. This is especially true for pipelines and more recently for active and reclaimed pads involving BP America (picture 9-1). However, most other companies are not performing the quality of pad reclamation to reduce impacts of mineral development on soil erosion. The key question is how to elevate the attention to reclamation by all mineral development companies to that achieved by BP America.

4. Woody Plant Health: The age and canopy cover of big sagebrush, mountain shrub, and juniper woodland plant communities is increasing, leading to lower herbaceous ground cover and water yield. Older shrub and tree communities use more water, have lower infiltration rates and greater surface erosion, all leading to reduced late-season stream flows. Prescribed burns conducted in this and adjacent watersheds have shown improvements in ground cover, reduced surface erosion, and improved late season stream flows. The key question is: How do we as an agency decide on what amounts of treatments should occur to promote higher stream flows and lower soil erosion levels and still address all of the resource values that we are obligated to manage?

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend, is not available. However, information from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management actions, grazing systems, range improvements, vegetative treatments, etc., will lead to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. As the channels narrow, the active floodplain width expands, including within incised banks where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. In a few locations, this includes gully movement through the dams or spillways of old reservoirs. Hydrologic function is improving due to the above-mentioned changes in stream channels and floodplains. However, the general lack of beaver ponds in this system results in faster movement of flow events and reduced water storage for late-season stream flow.

The meadow complex located in the vicinity of the George Dew homestead at the lower end of this watershed has a great influence on stream flow and erosion. Created during the early and mid-1900s, and more recently maintained, this four-mile long and ½-mile wide wetland/riparian habitat both stores water and catches sediment from upstream sources. Stream gauging in 1987 recorded water storage in this meadow complex of 10,000 acre-feet of water. The low gradient and perennial vegetation act as a filter to remove sediment eroded from sources higher in the watershed.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities range from 50 to 60 percent, with only 30 to 40 percent in saltbush steppe and juniper woodland communities. The lowest amounts of cover occur in greasewood/playa locations. This is primarily a function of the natural conditions, going from wettest to driest.

The primary natural type of disturbance occurring in this watershed is beaver activity (picture 9-2). Habitat for beaver (large woody material like aspen, willows, and waterbirch) is limited, probably due to historic grazing by livestock and other practices that reduced willows, such as lack of fire needed to regenerate aspen and downcutting and gradient adjustment processes. There is one larger active complex in lower

Littlefield Creek canyon, which is supported by healthy communities of waterbirch and Booth and Geyer willows. However, most streams have little woody plant species. The few beaver which occur elsewhere in the watershed tend to move into a stretch of creek, build one or two dams until the present material is exhausted, then move on to a new area the next year when their little dams wash out during spring runoff. This process initially appears to be pointless and just sets back the existing, struggling willows. Upon closer scrutiny, this process helps saturate upper banks that collapse into the stream, thereby helping to widen the floodplain, expand riparian habitat, and supply sediment to build and narrow banks downstream. The sediment caught behind the dam becomes a seedbed for new willows and a more diverse community of early succession species, which in a few years will be taken over by the more dominant sedges and grasses. Existing willows will regrow until the cycle repeats itself.

4) Reference Conditions:

Howard Stansbury, an army topographer, made the earliest documentation of the Muddy Creek watershed in 1850. Stansbury reached Muddy Creek on September 18, making camp about 25 miles north of Baggs. He wrote: “The only vegetation at this camp was a few scattering clumps of small willows and some black currant-bushes, the supply of grass was scanty. Muddy Creek runs between perpendicular cut clay-banks, forty feet apart, the water at the present stage being only four feet wide and four inches deep.” On the following day, moving upstream he wrote: “The ground was rough and filled with gullies made by the rush of the spring freshlets. The soil was loose and sandy, and the waters had cut numerous deep and narrow channels across the valley, whose perpendicular banks obliged us to pass along the base of the bluffs, in order to head, and thus avoid them. The creek had to be crossed some six or eight times, and, upon the whole, this has been the roughest and most difficult part of the route.” That night the party camped along Muddy Creek near Sulphur Springs. Stansbury wrote: “We turned down into a pretty little bottom, fringed with willows, currant-bushes, and birch, and encamped having made only fourteen miles. We found the creek filled, at short intervals, with beaver dams . . . . The stream furnishes some small fish, among which were speckled trout.”

Lieutenant F. T. Bryan in 1856, in charge of the Bryan Wagon Road Survey, wrote in crossing over from Sage Creek Basin to Muddy Creek: “The thick growth of sage was very much in our way, obstructing the passage of the wagons, and fatiguing men and animals very much. The water in Muddy Creek was running slowly, some trout were taken in the pools of Muddy Creek. The only grass in this part of the country lies along the small streams, where they issue from the hills. We found it necessary to herd our animals on those spots . . . no one place having sufficient for the whole of them. On this account, a large train could scarcely travel through this country, much less remain any time in it.”

In December of 1857, John Bartletson traveled up Muddy Creek towards Sulphur Springs and wrote: “After traveling about five miles we came to a canon with high mountains on each side, which it would be impossible to pass. It would be very difficult to pass through having to cross the creek three times in about half a mile, which has very steep banks and a deep muddy channel, which would have to be bridged to allow anything like a wagon pass. We found after about one mile through this canon that the bottom got wider, with very tall sage brush, which is very bad to get through, crossed a great many bad ravines, and came to one in particular which would have to be bridged . . . .” The next day, passing above Sulphur Springs, Bartletson wrote: “Crossed the creek three times in about a mile on account of the hills being too steep to cross; these crossings are very bad, the banks of the creek being about fifteen feet high, with two or three feet of water in the channel, bottom very miry; we there took the hill side for about two miles, which was very good. We then came to another canon, where the high mountains came entirely down to the creek, where we would have to cross the creek again about ten to twelve times if we came up the canon; but we found the crossing too bad to cross with pack mules, and we took along the mountain sides in a narrow lodge pole trail which crosses very deep ravines every few yards, hill side very steep.”

These accounts and others indicate that Muddy Creek flowed between high perpendicular banks that were hard to cross by travelers, and that side ravines and tall thick sagebrush were common. Stream vegetation, particularly grass for forage by saddlestock, was spotty and scant in many places (pictures 10-1, 10-2). The channel bottom was miry and difficult to cross except on rock riffles. Beaver ponds and willows appear to be common upstream from Sulphur Springs, but only occurred in isolated clumps below Sulphur Springs.

5) Synthesis and Interpretation:

From the historical accounts described above, in-channel and upland gully erosion are common, naturally-occurring processes, which attributed to how Muddy Creek got its name. The tall, dense sagebrush, which was so hard to get wagons through, would indicate the general lack of fire in this area for a long time. The isolated clumps of willow, observed below Sulphur Springs, are not so different than what is present today. However, the significant difference is the presence of beaver dams and speckled trout, which require habitat parameters that are not present in much of the watershed at this time. An interesting side-note to this is the general lack of forage for saddle stock, even apparently along the creek. Does this indicate concentrated grazing by wildlife due to limited sources of water, and would this influence the ability of riparian vegetation to stabilize stream banks? Regardless of this question, the riparian habitat in the 1850s was not described as the lush mix of willows, sedges, and grasses that we see now and know is within our capabilities to manage for.

What have been the changes in the watershed over the last 150 years? The answer is obviously livestock grazing, as well as irrigation of private lands along Muddy Creek; removal of willows and trapping out the beaver, which in some cases were promoted by government agencies and policies; and the public perception (via Smokey Bear) that fire and fire effects are all bad. Motorized vehicles and roads to access the country has also helped change the landscape around us. All of these factors influence resource conditions and all can be manipulated to achieve desired results.

Impacts from historic sheep use relate primarily to areas where sheep were concentrated or repeatedly used, such as bed grounds, lambing sites, and adjacent to reliable water located between the foothills and the desert where extensive use in the spring and fall months was made. These areas are spotty in occurrence and typically have a higher percent bare ground, compacted soils, produce more runoff, and support more invader and increaser species like cheatgrass, annual forbs, and prickly-pear cactus. These areas are slowly healing with an increase in perennial grass species and cover.

Impacts from historic and current cattle use relate to duration and distribution of use and the lack of pasture fencing or herding to control them. In many cases, the lack of reliable upland water sources and thick brush on the deeper soils in the valley bottoms also contributed to cattle spending too much time along streams and riparian systems. This promoted overuse of deep-rooted sedges, grasses, and willows, leaving bare ground or shallow-rooted, grazing resistant species like Kentucky bluegrass which does not hold stream banks together well. As a result, in-channel erosion increased, bank stability decreased, and stream channels became wider and shallower. This in turn reduced the water storage capability of the riparian system leading to higher peak flows and lower late season stream flow.

Other factors contributed to the degradation of these riparian systems. Flow alterations for irrigation will raise the floodplain as sediment loads are deposited, and channels below diversion points will narrow in response to lower flows. When irrigation no longer occurs, these raised floodplains become sediment sources for the stream flow to cut through and move somewhere else. The narrowed channel below the diversion must widen to accommodate the increased flow levels. Both of these actions can cause head-cuts to occur in a gradient readjustment process that increases erosion. Although irrigation is on private lands, the impacts from head-cutting often move onto or affect adjacent public lands. The control of willows and beaver to increase the amount of water and space available for livestock use has just the opposite results. Reliable, long-term supplies of water come from slowing it down and storing it in banks and pools, which is just what beaver do.

Wildfire suppression policies and actions have created negative impacts to both fire-stimulated species like aspen and chokecherry and fire-sensitive species like big sagebrush. Aspen are a fast growing species, providing the largest and most durable building material for beaver dams. The relationship between beaver and aspen is critical to maintaining riparian systems, in terms of stream flows and stability due to large woody debris. Only half of the aspen present in 1938 are still here today, and that is largely due to lack of fire in this ecosystem. Fire-sensitive species like big sagebrush have become decadent with higher canopy cover. This results in lower species diversity and lower herbaceous cover and production, creating more surface runoff and soil erosion. Fire, therefore, is a necessary component of a healthy, functioning watershed.

And last, but not least, are the problems associated with roads and off-highway vehicle use. Improved roads are needed to access the country for the different uses people have in either making a living or enjoying our public lands. Identifying and fixing problems associated with these roads can and should happen (picture 12-1). The tougher issues deal with using roads when they are wet or impassable, which results in tearing them or the country up and increasing soil erosion. The other increasing problem is off-highway use, which results in creation of new roads, with tracks and ruts, which catch and funnel water leading to new gullies and new sources of erosion. People who try to cross streams where the banks or channel are too soft can also increase erosion. There appears to be a real need for public education about vehicle use, erosion, and how users' decisions and practices affect the public lands they want to enjoy.

Initial attempts to address resource issues associated with livestock grazing involved development of allotment management plans (AMPs) in the 1960s. However, emphasis on improved management of wetland and riparian habitat was lacking. More recent attention to these AMPs in the 1980s and expansion of these efforts to a watershed scale through the Muddy Creek CRM in the early 1990s has led to significant improvement in resource values.

Management changes relating to livestock grazing include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, development of upland water sources to reduce dependence on streams as water sources, and prescribed burns on uplands to reduce dense brush and increase forage production, availability, and palatability. Improvements relating to roads include: installation of new stream crossings, additional culverts, replacing straight culverts with drop-culverts, waterbars, roadside pits, and closure of a few roads on steep slopes and where two roads reach the same point (picture 12-2). Other actions taken include instream structures for gradient control, vegetative plantings to speed up the rate of bank stabilization and, at the lower end of the watershed, reconstruction of two gradient control dikes/diversion structures and construction of four new spreader-dikes (picture 12-3).

These changes in management and range improvements, implemented over the last 15 years, have resulted in the following improvement in resource conditions. In most locations, surface stream width (at base flows) has been reduced by 50 percent or more. Graphs #1 and #2 and pictures 12-4 thru 12-7 show change in stream channel morphology from Littlefield Creek and Muddy Creek. The figures and pictures both show reduced width/depth of the channel, interior bank building and stabilization with perennial riparian vegetation, and flows at both locations are at higher levels during late-season low flow periods than they were previously. Vegetative bank cover has increased significantly, starting at 25 percent or less and currently exceeding 90 percent. Photographs x through y show locations on Muddy Creek which have stabilized with vegetation and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. This is supported by observations of turbidity, which is only seen now during high runoff and after storm events compared to being commonly observed on a year-round basis prior to management changes. The bank building and expansion of riparian habitat (due to narrowing of stream channels), in addition to vegetative treatments, have led to increased late-season flows in all perennial streams.

Improvements to roads have led to healing and reduced occurrence of gullies along roads. Water flows are spread into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Improved or closed-off stream crossings have reduced vehicular disturbance to channels and banks (picture 12-8). Drop-culverts have eliminated the large splash holes below roads, leading to lower erosion and vegetative stabilization along these ephemeral channels (picture 12-9). There is still a need for further work on nearly all improved roads to reach an adequate level of practices to minimize or eliminate overland flow alterations and erosion caused by roads. Prescribed burns have also helped to heal gullies and increase water infiltration by replacing decadent shrubs with herbaceous vegetation and litter.

Several types of gradient control structures have been constructed, from steel or plastic sheet-piling to fish barriers to repairing old earth berm spreader-dikes. These structures have stabilized active headcuts, reduced in-channel erosion, restored water levels in old floodplains, and accelerated the process of vegetation stabilization on these sites (pictures 13-1, 13-2). In the lower part of the watershed, new spreader-dikes have expanded the width of the functioning floodplain, which dissipates the impacts of high flow events and increases water storage within the system.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the majority of Upper Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active headcuts due to gradient readjustment processes. These areas affect approximately 2,500 acres in Holler Draw and upper Muddy Creek. Current livestock grazing practices are not contributing to the nonattainment of Standard #1. However, where headcuts are associated with water developments in need of maintenance, permittees may be assigned responsibility to help correct these spot problems. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats (picture 13-3). Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Continue to eliminate or control active headcuts, along with the necessary livestock management, in order to promote long-term, vegetative stabilization of these sites.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. Possibly move from an <u>existing</u> roads and trails policy to a <u>designated</u> roads and trails system.

Continue to implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from roads and off-highway vehicular activities.

Barrel Springs Draw

1) Characterization:

Barrel Springs Draw is a large ephemeral watershed, containing numerous draws and the Red Lakes enclosed basin, that empties into Muddy Creek about 20 miles north of Baggs, Wyoming. In addition to Barrel Springs Draw, which splits into the north and middle forks, other drainages include Coal Gulch Draw, Windmill Draw, South Barrel Springs Draw, and Wild Rose Draw. The lower end of Barrel Springs Draw is sometimes referred to as Red Wash, due to the red soils found there. The entire area is in a 7 to 9-inch precipitation zone with predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential (picture 13-4). Topography is flat to gently rolling landscape for the most part, becoming moderately-steep to steep close to rims and badlands. Elevation ranges from 6,500 at the confluence of Barrel Springs Draw and Muddy Creek to 7,500 ft at Delaney Rim and 7,600 ft at the Haystacks in the northwest corner and 7,400 ft on West Flat Top on the southern border (picture 13-5).

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. In some locations the channels and floodplains are confined within incised high banks. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows are erratic and short-term, with no recording of perennial flows.

The only site with stream flow where channel classification was determined was a two-mile stretch of Middle Barrel Springs Draw, which is a C6 stream type, and a mile stretch of North Barrel Springs Draw, which is an E6 stream type (picture 14-1). The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition (picture 14-2). The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios. Streambanks are stabilized with riparian vegetation similar to C6 stream types.

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. Natural gas development has occurred in the area for many years. However, it has expanded in scope of area as well as in-field drilling over the last 10 years (picture 14-3). On the north end of the watershed closest to Wamsutter, well density is reaching an 80-acre spacing, whereas in most areas 160-acre spacing is more common. Livestock use is primarily cattle, both cow/calf and yearling operations. Sheep use also still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Recreation is largely related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas-(please refer to issues identified for Upper Muddy Creek on page 8)

3. Livestock Grazing- In addition to the issues mentioned in Upper Muddy Creek earlier, impacts are more related to plant cover and litter values compared to percent bare ground with less emphasis on stream channel impacts.

4.Woody Plant Health-(please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Quantifiable data about current erosion levels, stream flows, and range condition and trend, are not available. Stream flow data for Barrel Springs Draw was collected by the University of Wyoming in the mid-1980s to the early 1990s. Other information is available from photo-points, upland cover transects, and personal observations.

Stream flow information is calculated by subtracting data collected at the Dad station (1½ miles above confluence of Muddy Creek and Barrel Springs Draw) from the Snyder Gas Pad station (located ¼ mile below the confluence of above two watersheds). Monitoring at these two sites was collected between March and November, which correlates to ice-free conditions in the spring and when the channel goes dry in the fall. Unfortunately, high flows from Barrel Springs Draw often occur before the ice melts out of Muddy Creek. Stream flows were documented between 1986 and 1991. During this time period, the driest year was 1986 with almost zero runoff recorded. The wettest year was 1987, when mean daily flows in

April were 43.5 cfs, with a peak daily flow recorded on March 8 of 457 cfs. The months of March and April generally have the highest mean daily flows, while the months of August and September usually have zero or very low mean daily flows. Flows are flashy due to the low amount of vegetative cover and the fast rate over a large amount of land that runoff

Stream channels are well vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. Much of this is considered background or natural rates of erosion, compared to accelerated rates of erosion caused by impacts from roads or poor grazing practices.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush plant communities to 28 to 45 percent on saltbush steppe plant communities, the two most common vegetation types in this watershed. Greasewood flats and playas are in the 20 to 30 percent range. While this would appear to meet the conditions listed above for accelerated sediment yield, this is not the case, since these sites are on flats and are often the endpoints for water flow off adjacent slopes. The water will pond on these sites with nearly a sealed soil surface due to salts and clays, resulting in most of the water leaving the site as evaporation. This is particularly true for the Red Lakes area in the north part of the watershed and within a closed basin. In general, the overall ground cover appears good, but in many locations can still be improved with the use of Best Management Practices (BMPs).

4) Reference Conditions:

When Howard Stansbury traveled up Muddy Creek in 1850, he also crossed Barrel Springs Draw after he left Bitter Creek and before he arrived on the banks of Muddy Creek. He initially came down the valley of North Barrel Springs Draw and wrote the following. “From this landmark (The Haystacks) we traveled in nearly an eastern direction, gradually descending, for six miles, to the valley of a small branch of Muddy . . . and encamped in its valley, although the water was so strongly impregnated with alkali that the animals drank it with evident reluctance and disgust. The valley is here much cut off by abrupt gullies and ravines, formed by the wash from the hills, and in many places the ground is covered by a crust of impure soda to the depth of half an inch. The grass, since our noon halt, has been very scarce, and our poor mules have fared rather badly.”

The next day Stansbury wrote: “Our course lay down the valley . . . for three and a-half miles, when it opens suddenly between two high cliffs of red and green indurated clay . . . . To this opening we gave the name of Red Gate.” This would have been where North Barrel Springs Draw passes through Delaney Rim and then turns south towards the Flat Tops. He then wrote: “The little stream whose valley we had followed to the Gate, pursued a wandering course to the south-east through the prairie, its existence marked only by an occasional clump of willows. A few buffalo bulls were quietly grazing upon the plain, and now and then a small herd of antelope, bounding away over the hills, gave life and spirit to the picture. The soil from this point to Muddy Creek is for the most part of an excellent quality, but, from want of moisture, can never be appropriated to any other purpose than grazing. The grass, though thin, is very nutritious. Small sage, salt grass, greasewood, a purple aster, together with bunch-grass, and, in the more sandy portions, small cacti, were the principal plants.”

This account and others describe the alkali around the seeps in North Barrel Springs draw and the ravines in this area. They also describe the gently rolling hills between Delaney Rim and Muddy Creek, with thin grass some years and lush grass other years, but available forage for stock, even if they had to travel a few miles away from the trail to find it. This was probably due in part to the variability in moisture and vegetation that occurred each year.

5) Synthesis and Interpretation:

The account described above is similar to what could be observed today in terms of landscape and vegetation. The principal changes are the roads, gas wells, and fences relating to the existing land uses. Road improvements are probably the most visible recent change seen in this part of the Muddy Creek watershed. This includes gravelling some of the more-frequently used roads used by industry, and using additional culverts and wing-ditching. There is still a large need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads (pictures 16-1, 16-2). This issue is getting larger rather than smaller, with the creation of more roads associated with expanding development of natural gas fields.

The other visible change has been the reclamation efforts around operating wellheads, particularly by BP America, to reduce bare ground that is exposed to wind and water erosion. Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation (pictures 16-3, 16-4). Reclamation of pipelines and dry hole locations is generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits were converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. The principal area of impact, still observable today, is the old trail and bed grounds near Dad at the lower end of Barrel Springs Draw. Sheep herds would be sheared and cross Muddy Creek here, which led to a confined trail area with a waiting period to get through. Plant cover and species composition, as well as soil compaction, were negatively affected by this impact, with site recovery still occurring.

Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. Oil and gas field development has also contributed significantly to creating new sources of water, which are usually made available for livestock and wildlife use. Control of livestock is also complicated by mineral development activities, which can involve lack of maintenance on cattle-guards, leaving gates open or fences down, and inadequate construction techniques.

On the south side of South Barrel Springs Draw are several large reservoirs and approximately 3,000 acres of upland spreader-dikes dating back to watershed improvement work completed in the 1950s and 1960s. A watershed plan developed in the early 1950s for the entire Muddy Creek watershed identified the area from South Barrel Springs Draw down to Cottonwood Creek, which drains east off the Flat Tops, as most in need of action to address watershed values. These projects helped to slow water runoff and promote vegetative cover to reduce soil erosion. They are still largely intact and have received some maintenance attention in the 1990s, but more attention is still needed.

Other improvements include the construction of several spreader-dikes adjacent to Red Wash, just above Muddy Creek, to create wetland and riparian habitat. These projects have only a small impact on watershed values. They blocked off several small drainages, which will reduce upland and channel erosion by a small amount. The water flow that enters Red Wash from these dikes may increase vegetative cover along the last mile of channel before it enters Muddy Creek, which should reduce in-channel erosion.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Barrel Springs Draw watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Lower Muddy Creek

1) Characterization:

Lower Muddy Creek is a large, mostly-ephemeral watershed, which begins at the confluence of the Upper Muddy Creek and Barrel Springs Draw watersheds and ends where Muddy Creek empties into the Little Snake River at Baggs, Wyoming. Muddy Creek is intermittent to perennial in nature, depending on annual and long-term climate conditions. The headwaters of several tributaries on the east side of the watershed are also intermittent to perennial, including Cow Creek, Deep Gulch, Wild Cow Creek, Cherokee Creek, Deep Creek, and the lower portion of Cottonwood Creek on the west side of the watershed (picture 17-1). Principal ephemeral draws are Dry Cow Creek, Blue Gap Draw, Robber's Gulch, and Little Robber's Gulch. The lower elevations in the north end of Lower Muddy Creek are in a 7 to 9-inch precipitation zone. As you move up in elevation and south towards Baggs, precipitation increases into the 10 to 14-inch zone. North and east slopes which blow in with snow at the highest elevations are in a 15 to 19-inch precipitation zone (picture 17-2). Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. The exception to this are the Sandhills in the upper end of the Dry Cow Creek drainage, which have deep sands with excellent infiltration and low runoff and erosion potential. Topography is flat to gently rolling landscape at lower elevations, becoming moderately steep to steep close to rims and badlands and at higher elevations. Elevation ranges from 6,250 ft at Baggs to 7,800 ft at North Flat Top on the west border and Browns Hill on the east border to a maximum of 8,200 ft at Rendle Rim and the headwaters of Deep Gulch and Wild Cow Creek drainages.

Channels are weakly-formed in ephemeral drainages, and moderately to well-formed in intermittent and perennial drainages. At the upper ends of drainages, floodplains are broad and gentle with no channel confinement. However, the lower portions of side drainages and the entire Muddy Creek channel are confined within incised high banks. These may reach 12 to 15 feet in height. Erosion sources include in-channel mass wasting, side channel gradient adjustment, and some upland soil erosion. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March from low elevations and in April or May from the higher elevations. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows are similar to the lower end of the Upper Muddy Creek watershed, with an average of 30 to 50 cfs from March through June, becoming dry in late summer or fall depending on climate conditions. Peak flows are highly variable, ranging from 150 cfs to 1500 cfs.

Stream channels in this watershed are classified as either a C6 stream type, typical of upper headwater drainages, or an E6 stream type, characterized by Muddy Creek. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 18-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley, and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios. Streambanks are stabilized with riparian vegetation similar to C6 stream types (picture 18-2).

Principal human uses in this watershed are oil and natural gas development, livestock grazing, and recreation. Oil and gas development has occurred in the area for many years. However, it has expanded in scope and density over the last 10 years. There is currently exploratory development for coalbed methane resources on the east portion of the watershed. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Sheep use still occurs on a few allotments. Seasons of use for livestock will vary by allotment and range from spring through fall. Recreation is mostly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Livestock Grazing- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

3. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page8)

4. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

5. Gradient Adjustment: Gradient adjustment is occurring up side drainages to Muddy Creek and in the old upland spreader-dikes. Soils in these areas often have high to severe limitations for use in construction and have high potential for piping. The key question is how to best address this active gully erosion to reduce sedimentation into the upper Colorado River watershed.

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend, are not available. However, information is available from photo-points, channel cross-sections, and personal observations, which show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. The principal exception to this is in the Cherokee allotment where long duration cattle use still occurs, compared to the East Muddy allotment to the north (see graph #3 and pictures 18-3, 18-4). As the channels narrow, the active floodplain width expands, including within incised banks where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. Where detention dams have been constructed, either for watershed purposes or livestock waters, active head-cuts have been stopped and healing of these channels is occurring. On drainages without any dams with drop pipes, active head-cutting continues. Wild Horse Draw in the Cherokee allotment is a good example, and there are a number of sites in the Cottonwood Creek, Robbers' Gulch, and Little Robbers' Gulch drainages. Hydrologic function is improving due to the changes mentioned above in stream channels and floodplains. However, the confinement of channels within incised banks still contributes to faster movement of flow events and reduced water storage for late-season stream flow.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities range from 50 to 60 percent, with only 30 to 40 percent in saltbush steppe and juniper woodland communities. The lowest amounts of cover occur in greasewood/playa locations. This is primarily a function of the natural conditions, going from wettest to driest. However, livestock management practices will influence which side of the range for each community type the data tends to fall within.

Stream flow information was collected for several years near the mouth of Muddy Creek. The channel at this point with bank-full conditions will hold about 1200 cfs before flows start spilling onto private land meadows. As stated above, average flows and peak flows are similar to those measured or observed at the lower end of the upper Muddy Creek watershed. Although the drainage expands in size as you move downstream, much of the water infiltrates into the streambed, making Muddy Creek a losing stream (Goertler 1992). The months of March and April generally have the highest mean daily flows, while the months of August and September usually have zero or very low mean daily flows. Flows are flashy on the west side drainages and the lower elevations of the east side drainages due to the low amount of vegetative cover and the fast rate over a large amount of land that runoff. The higher elevations of east side streams, such as Cow, Wild Cow, Cherokee, and Deep Creeks, have higher amounts of cover and generally do not produce the high, flashy flows. Stream banks are well-vegetated with broad floodplains that store and help slow down high runoff events. Snow pack and drifts in these upper drainages also melt at a slower rate, which largely infiltrates into the soil and adds to later season flows.

4) Reference Conditions:

There are no historical references for pre-settlement conditions in the Lower Muddy Creek watershed. In 1983, Sid Weber spoke about growing up in Baggs during the early 1900s and what he recalled about lower Muddy Creek. Prior to the mid-1920s, the channel width of Muddy Creek was narrow enough for a rider on horseback to jump across. This likely would relate to a channel width of no more than four feet. In the mid-1920s, the creek started to down-cut, a process which was further exacerbated by the drought in the 1930s. This probably follows the peak in sheep numbers in Carbon County that occurred around 1911, and which continued to decline from over half a million to only 20,000 today. Looking at the old floodplain adjacent to Muddy Creek, the down-cutting event mentioned by Sid Weber probably lowered the stream channel by 10 to 12 feet.

Steve Adams also spoke about conditions he remembers as a boy growing up in the 1930s and 1940s. He recalled that in the Sand Gap area, just north of Peach Orchard Flats, a person could tell the number of sheep herds in the area by the number of dust clouds you could see from this high point of ground. Few water developments existed, so the herds had to water at Muddy Creek, then trail miles away to find forage before returning to water at Muddy Creek again.

5) Synthesis and Interpretation:

Existing management and changes in management along with range improvements, at least indirectly, should relate to improved resource conditions. Historic sheep use in this area generally took place in the spring and fall, between summer use on the MBNF and winter use in the desert. Use on the forest had set on and off times, and use in the desert was dependent on winter snow for water. So both spring and fall use occurred for several months each along the creeks with reliable water, resulting in high intensity and long durations of use. The sheep trail at Dad also extended downstream along Muddy Creek to Jerry's corner on the freight line, before dispersing up the various side drainages. Plant cover and species composition, as well as soil compaction, were negatively affected by this impact, with site recovery still occurring.

The paragraph above and the section on reference conditions support the conclusion that the Lower Muddy Creek watershed, as a whole, was the most impacted portion of the entire Muddy Creek watershed by historic livestock grazing. This is further substantiated by the fact that one of the earliest watershed improvement plans developed was in the early 1950s for Muddy Creek, and the area in most need of help was from South Barrel Springs Draw down to Cottonwood Creek on the east side of the Flat Tops. In the 1950s and 1960s, several large watershed projects were completed. These include 25 large retention dams and additional small reservoirs, 2,800 acres of contour furrowing and 1,500 acres of upland spreader-diking (all seeded), 2,000 acres of sagebrush control, cactus control projects, and allotment fencing (picture 20-1). These projects helped to slow water runoff and promote vegetative cover to reduce soil erosion. They are still largely intact and received some maintenance attention in the 1990s, but more attention is still needed. Lee Jons, a current permittee, who has grazed livestock in this area since the 1950s, tried to give a perspective about the vegetative conditions prior to these improvements. He stated that the ground cover was so poor that a man could not jump from one plant to the next closest plant. Cover is much better now, the contour furrows have filled in with native plants along with the crested wheatgrass (picture 20-2).

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 20 to 30 years as sheep permits have been converted to cattle. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. This may mean rotation between allotments or creating fenced pastures within allotments to control season or duration of use. This type of management has also provided the capability to rest and manage livestock use following prescribed burns. Two examples of this are the Doty Mountain allotment (83,000 acres) and the Deep Gulch allotment (35,000 acres), which were cross-fenced in the mid-1980s and mid-1990s respectively. New water developments are used to improve livestock distribution and to create more reliable water sources in order to get through periods of drought. To accomplish this, there has been more emphasis on wells, pipelines, seep developments, and larger reservoirs over the last ten years. Oil and gas field development has created some artesian wells, which have become important water sources for livestock and wildlife.

Wildlfire suppression has created negative impacts to both fire-stimulated species such as aspen and chokecherry and fire-sensitive species such as big sagebrush. Aspen are a fast growing species and provide the largest and most durable building material for beaver dams. The relationship between beaver and aspen is critical to maintaining riparian systems in terms of stream flows and stability due to large woody debris. Aspen habitat is greatly reduced today, and that is largely due to lack of fire in this ecosystem (picture 20-3). Every stream drainage has evidence of old beaver dams, with aspen logs laying on the ground, but little or no regeneration, and shrub dominance by big sagebrush and serviceberry. People who grew up in this area during the early 1900s recall shaking chokecherries into their buckboards to make jams and syrup with. In many areas the chokecherries are gone or in low abundance and vigor. Fire-sensitive species like big sagebrush have become decadent with higher canopy cover. This results in lower species diversity and lower herbaceous cover and production. This in turn creates more surface runoff and soil erosion. Prescribed burns over the past 15 years have been conducted on approximately 10,000 acres in this watershed, with about 4,000 acres affected by wildfires. These have improved ground cover, species and cover diversity, healed small gullies and roads, and improved stream flows. However, much more is needed.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have begun to be graveled to reduce long-term maintenance (picture 20-4). Simple practices such as wing-ditching have generally become the standard operating procedure. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. There is still a need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads (picture 20-5).

There is a lower standard observed in reclamation efforts around operating wellheads, compared to what can be done as evidenced by BP America, to reduce bare ground that is exposed to wind and water erosion.

Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation (picture 21-1). Reclamation of pipelines is generally good.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of stream channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the cooperation of livestock permittees in implementing best management practices, it is determined that the majority of the Lower Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active head-cuts due to gradient readjustment processes. These areas affect approximately 6,000 acres. Current livestock grazing practices are not contributing to the non-attainment of Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to eliminate or control active head-cuts, along with the necessary livestock management, in order to promote long-term, vegetative stabilization of these sites.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Savery Creek

1) Characterization:

Savery Creek is a perennial stream system, with perennial and intermittent tributaries, which headwater on the MBNF or the foothills to the Sierra Madre mountain range (picture 21-2). It flows from north to south, emptying into the Little Snake River at Savery, about 12 miles east of Baggs. Savery Creek is formed by the confluence of the North Fork, East Fork, and Dirtyman Fork of Savery Creek. Major tributaries include Little Savery Creek, Bird Gulch, Big and Little Sandstone Creeks, Loco Creek, and Big Gulch. The entire drainage is in a 12 to 18-inch precipitation zone with well-developed loamy soils. Elevation ranges from 6,500 at the confluence of Savery Creek and the Little Snake River to 7,800 ft at Browns Hill, 8,200 ft at Rendle Rim and Middlewood Hill, to over 10,000 ft in the MBNF.

Wide meadows and active floodplains occur along the main channel of Savery Creek, with smaller and narrower floodplains found along tributary streams, particularly on higher gradient segments on or adjacent to the MBNF (picture 21-3). On the middle and lower portion of Savery Creek, irrigation has been developed to support grass and alfalfa hay production for winter livestock feed. There are some stream segments where incisement has occurred, primarily on the western portion of the watershed, where soils are silt and clay loams and there is little rocky substrate. The majority of the watershed has either a gravel or rocky base which promotes more lateral stream movement with disturbance, rather than down-cutting. Stream channels are generally stable with perennial vegetation cover, including willows and cottonwood. Average annual flow contributed by the Savery Creek watershed is around 89,000 acre-feet. Flows are highest in May and June and lowest during September.

The majority of stream channels in this watershed are a C4 stream type, with C6 and B4 stream types also present. The C4 stream type is found in broad, gentle gradient alluvial valleys, with predominantly gravels and lesser amounts of cobble, sand, and silt/clay (picture 22-1). They are slightly entrenched, meandering, riffle/pool channels with well developed floodplains. These systems are characterized by the presence of point bars and other depositional features. Rates of lateral adjustment are influenced by the presence and condition of riparian vegetation (Rosgen 1996). The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well- developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition. Headwater streams on steeper gradients are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 22-2). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996).

Principal human uses in this watershed are livestock grazing, hay production, timber production, and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Seasons of use at lower elevations are spring through fall with snow usually precluding year-round use. Season of use at higher elevations is usually from mid-May or June through September or October. A small amount of sheep use occurs, generally in the spring and fall, with summers spent on the MBNF. Hay production involves ground preparation and fertilization in the spring, summer irrigation, putting up hay in August or September, and feeding during the winter. Timber production occurs primarily on the MBNF and involves firewood, rails and posts, and small lumber products. Recreation is primarily related to hunting, fishing, or using the Continental Divide National Scenic Trail. The highest use period is during the fall hunting season (September through October). Associated with this use is an improved/unimproved road transportation system and off-highway vehicle use. A large dam is currently being constructed by the State of Wyoming on the middle portion of Savery Creek to provide reliable irrigation water and recreational use (boating and fishing).

2) Issues and Key Questions:

1. Livestock Grazing: In addition to the previously mentioned impacts, this area's impacts are primarily to stream channels, which affect bank stability and width/depth ratios, but also include management which either promotes increased shrub dominance or reduces aspen vigor and regeneration .

2. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

3. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend are not available. However, information is available from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. As the channels narrow, the active floodplain width expands, including both lateral expansion on gravel-bottomed streams and within incised banks of silt/clay-bottomed streams where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. The county road in McCarty Canyon, where it follows Little Savery Creek, is also contributing sediment into the stream system. Hydrologic function is improving due to the above-mentioned changes in stream channels and floodplains. However, the general lack of beaver ponds in this system results in faster movement of flow events and reduced water storage for late-season stream flow.

Vegetative cover and litter on uplands are generally very good except on steep south-facing canyon walls, due to precipitation levels and good soils. In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities may range down to 50 to 60 percent, with lower amounts occurring on drier, south-facing slopes; shallow, rocky soils; and where shrub densities and grazing impacts have reduced understory herbaceous cover.

Like Upper Muddy Creek, the primary natural type of disturbance occurring in this watershed is beaver activity. The concerns and identified habitat issues are the same as stated previously.

4) Reference Conditions:

The earliest (1844) documented conditions of the Savery Creek watershed come from John C. Fremont, an army topographer. The following account comes from the publication, “The Wyoming Landscape, 1805 – 1878.” Upon heading north up the Savery Creek drainage from the Little Snake River, the expidition turned more northward across the hills “where every hollow had a spring of running water, with good grass.” They shortly began seeing buffalo. On “St. Vrain’s fork” (Savery Creek) they killed some bighorn sheep and buffalo. The creek was only wooded with willow thickets. There were aspen groves on the hills above. A band of elk was chased from one of these groves. Antelope were running over the hills and herds of buffalo could be seen on the opposite river plains. They also shot some deer. “The country here appeared more variously stocked with game than any part of the Rocky Mountains we had visited; and its abundance is owing to the excellent pasturage, and its dangerous character as a war ground.”

5) Synthesis and Interpretation:

From the above historical accounts, it appears that the Savery Creek watershed is much the same today, with good water sources, forage, and a mixture of vegetation, which support wildlife and human uses. What has altered the watershed over the last 150 years? The answer is livestock grazing, as well as irrigation, removal of willows and trapping out beaver (which in some cases were promoted by government agencies and policies), and the public perception via Smokey Bear that fire and fire effects are all bad. Motorized vehicles and roads to access the country has also helped change the landscape around us. All of these factors influence resource conditions and all can be manipulated to achieve desired results.

Like the areas discussed earlier, impacts from historic and current livestock use, wildfire suppression, and road problems and off-highway vehicle use has also contributed to degradation of the watershed.

Best management practices for livestock grazing that have been implemented in this watershed include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, development of upland water sources to reduce dependence on streams as water sources, and prescribed burns on uplands to reduce dense brush and increase forage production, availability, and palatability. These changes in management and range improvements, implemented over the last 10 years, have resulted in the following improvement in resource conditions. Surface stream width (at base flows) have been reduced by 50 percent or more in many locations. Graph #4 and pictures 23-1 and 23-2 show change in stream channel morphology from Loco Creek. The figure and pictures both show reduced width/depth of the channel, interior bank building and stabilization with perennial riparian vegetation, and flows at both locations are at higher levels during late-season low flow periods than they were previously. Vegetative bank cover has increased significantly, starting at 25 percent or less and currently exceeding 90 percent. These sites have stabilized with vegetation and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. This is supported by observations of turbidity, which is only seen now during high runoff and after storm events compared to being commonly observed on a year-round basis prior to management changes. The bank building and expansion of riparian habitat (due to narrowing of stream channels), in addition to vegetative treatments, have led to increased late season flows in all perennial streams.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have been graveled or a harder surface developed to reduce long-term maintenance. Simple practices such as wing-ditching have become the standard operating procedure. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. Improved or closed off stream crossings have reduced vehicular disturbance to channels and banks. There is still a need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads. The county road in McCarty Canyon where it follows Little Savery Creek is a major problem, which needs immediate attention.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the Savery Creek watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Identify and correct problems with improved roads, which affect water flows and soil erosion, in particular the county road along Little Savery Creek. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed (pictures 24-1, 24-2).

Continue to implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion, and promote reliable, late-season stream flows.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Little Snake River – Willow Creek and Powder Wash segments

1) Characterization:

These two fifth order watersheds follow the main stem of the Little Snake River, and except for Willow Creek, which is primarily located in Colorado, the tributaries and side-drainages are small and ephemeral in nature. Other named side drainages include Rye Grass, McCargar, and Coal Bank Draws above Savery; Dutch Joe Creek, Cottonwood Creek, and Burbank Draw near Dixon; and Garrish, Poison, and Cherokee Draws below Baggs (picture 24-3). The entire area is in a 10 to 14-inch precipitation zone with predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Topography is flat to gently rolling landscape along the valley floor and adjacent foothills and plateaus, becoming moderately steep to steep close to rims, badlands, and higher elevations (picture 24-4).

Elevations along the Little Snake River vary from around 6,000 ft at the lower Colorado state line to 6,600 ft at the upper Colorado state line. Higher points of elevation include: Powder Rim at 7,600 ft, the Bluffs above Baggs at 6,900 ft, Muddy Mountain at 7,900 ft, Horse Mountain at 8,000 ft, and Battle Mountain in the MBNF at just over 9,000 ft.

Channel formation is well-defined along the Little Snake River and perennial sections of a few side drainages and poorly-developed for most side draws. The principal floodplain is along the river, which is primarily influenced by human activities to stabilize it and maintain irrigation capabilities. Side draws often cut through steeper terrain, forming narrow, deep gullies. Some of these are well-vegetated and some are not. Soil cover is naturally low on many slopes, particularly downstream from Baggs. However, grazing by livestock and browsing by big game have also contributed to poorer vegetative cover on erosion-prone soils in specific locations. Erosion sources include in-channel bank sloughing, gullies and side-draw gradient adjustment, and uplands. Flows in these watersheds derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in March or April below Baggs and in April or May higher up in the watershed. These flows contribute small amounts to the Little Snake River prior to the highest flows, which originate from snowpack in the MBNF. Average annual flow contributed by the entire Little Snake River watershed (recorded at the lower Colorado state line) is around 449,000 acre-feet, with May and June being the peak flow months and September being the lowest flow month. The small drainages and draws are not large enough to have been individually gauged for stream flow.

The only site with stream flow in Wyoming where channel classification was determined is the Little Snake River, which is a C6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition.

Principal human uses in this watershed are livestock grazing, grass and alfalfa hay production, oil and gas development, and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Sheep use still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Hay production involves ground preparation and fertilization in the spring, summer irrigation, putting up hay in August or September, and feeding during the winter. Oil and gas development has occurred in the area for many years. However, it has expanded in scope of area as well as in-field drilling over the last 10 years. There is currently exploratory development for coalbed methane in the area north of Baggs and Dixon. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion: - (please refer to issues identified for Upper Muddy Creek on page 7)

2. Livestock Grazing: Livestock grazing, both historic and current, is the other major factor affecting watershed values in the Little Snake River watershed. Grazing has occurred here since the valley was settled in the 1870s. Sites adjacent to the river and homesteads were probably used for long periods of time each year, just out of convenience. Although these areas were probably overused, which led to lower vegetative cover and more bare ground, they are generally in the middle for condition. Current management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to plant cover and litter values compared to percent bare ground. The key question is what refinement in best management practices for livestock grazing or other actions need to be taken to improve watershed health and meet desired resource conditions.

3. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

4. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly-melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately-vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Active gullies often have some shrubs and grasses, but are generally less well-vegetated. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. While much of this is considered background or natural erosion, roads and past grazing practices still have a large effect on contributing to erosion in this watershed.

Vegetative cover and litter on uplands vary with the soils, slope, aspect, elevation, and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush and mountain shrub plant communities to 35 to 50 percent on shale/saltbush steppe and juniper woodland plant communities. Erosion is more prone on the sites with lower vegetative cover and steeper slopes.

4) Reference Conditions:

One of the earliest references to the Little Snake River valley was from John C. Fremont in 1844. On the "Elk Head" (Little Snake) River in the Baggs area, he noted that the river "is a considerable stream, fifty to a hundred yards in width, handsomely and continuously wooded with groves of the narrow-leaved cottonwood, with these were thickets of willow and buffaloberry. The characteristic plant along the river is greasewood, which generally covers the bottoms; mingled with this, are saline shrubs and sagebrush . . . . The country on either side was sandy and poor, scantily wooded with cedars [juniper], but the river bottoms afforded good pasture." In 1873, W. A. Richards wrote about the country west of Baggs, "Camped on [a] dry creek [Cherokee Draw] . . . . The country here perfectly worthless. Nothing but sagebrush and greasewood. Soil sandy clay."

5) Synthesis and Interpretation:

The account described above is similar to what could be observed today in terms of landscape and vegetation for the uplands. The principal changes are the irrigation, roads, gas wells, and fences relating to the existing land uses. Although sagebrush and greasewood still occur in the Little Snake River floodplain, they have largely been replaced with irrigated pastures. Cottonwoods, willows, and buffaloberry are still common. The river channel is narrower, due to water diversions, bank stabilization, and return flow irrigation. Adjacent hillsides do not appear to have changed much, with patches of juniper intermixed with sagebrush and grasses, looking good in wet years and poorer in dry years. Roads are the most visible blemish on the landscape, with developed, graded roads most apparent and winding two-tracks less obvious.

Roads and off-highway vehicle use continue to expand. There is still a large need for further work on nearly all improved roads to reach an adequate level of improvement practices (gravelling, additional culverts, wing-ditching, water-bars) to minimize or eliminate overland flow alterations and erosion caused by roads (picture 26-1). This issue is getting larger rather than smaller, with the creation of more roads associated with further development of oil and gas resources. Recreational use of roads is also increasing, and more troublesome, the off-highway activities associated with hunting, joy-riding, and more recently, antler collecting. Greater availability of four-wheel drive pickups, motorcycles, and three/four wheelers have exacerbated this problem, particularly in areas with easy access and proximity to towns and rural habitations.

Management changes that relate to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution (picture 27-1). These practices have been occurring over the last 50 years as sheep permits have been converted to cattle. Historic sheep use in this area generally took place either year-round with small farm flocks or in the spring and fall with larger range flocks. Cattle and sheep use occurs on the bottoms during the winter, and on adjacent uplands when irrigated pastures are being worked, irrigated, and hayed. This promotes use during most or all of the growing season, reducing vegetative vigor and cover and promoting increaser species like wheatgrass and shrubs. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought.

6) Recommendations:

Although the existing condition and vegetative cover on uplands could be improved, it is adequate for watershed function. Considering that the number of management issues still needing to be addressed are limited, the existing condition of primarily ephemeral channels, and the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, it is determined that the Little Snake River watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, thus minimizing the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly relating to impacts from road and off-highway vehicular activities.

Sand Creek – Upper and Lower segments

1) Characterization:

Sand Creek is a large ephemeral watershed, which contains numerous drainages and draws, that empties into the Little Snake River about 10 miles west of Baggs, Wyoming. In addition to Sand Creek, other drainages include Willow Creek, Skull Creek, Red Creek, Hangout Wash, Hartt Cabin Draw, Reader Cabin Draw, and Haystack Wash. The majority of the area is in a 7 to 9-inch precipitation zone, rising to a 10 to 12-inch precipitation zone along Powder Rim and the Flat Tops (picture 27-2). Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Sandy soils and small sand dunes occur in some areas. Topography is flat to gently-rolling landscape for the most part, becoming moderately steep to steep close to rims and badlands (picture 27-3). Elevation ranges from 6,100 at the confluence of Sand Creek and the Little Snake River to 7,100 ft at Adobe Town Rim on the west side, 7,400 to 7,800 ft at the Flat Tops on the east side, and 7,600 ft at the Haystacks on the north border and at Powder Rim on the south border.

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. The floodplains of Sand Creek and Willow Creek are wide and shallow, due to both low gradient and sandy banks (picture 28-1). In some locations the channels and floodplains are confined within incised high banks. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow contributed by the entire Sand Creek watershed is not monitored. However, since it contributes the largest drainage area below Muddy Creek into the Little Snake River, a majority of the 18,000 acre-feet of annual stream flow recorded below Muddy Creek is from the Sand Creek watershed.

The only site where channel classification was determined was the main stems of Sand Creek and Willow Creek, which are both D5 stream types. The D5 stream type is described as a braided stream, found within broad alluvial valleys, with predominantly sand channel bed material, interspersed with silts and clays (picture 28-2). The braided system consists of interconnected distributary channels formed in depositional environments. Channel gradients are generally less than 2% with very high width/depth ratios of 40 to 50 up to 400 or larger. The braided channel system is characterized by high bank erosion rates, excessive deposition occurring as both longitudinal and transverse bars, and annual shifts of the bed location (Rosgen 1996).

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. There is also a large wild horse herd. Natural gas development has occurred in the area for many years. However, it has slowly expanded into this watershed over the last 30 years, with increasing development over the last 10 years (picture 28-3). Livestock use is primarily cattle and sheep, employing cow/calf and herded range sheep operations. Seasons of use for livestock vary by allotment, but can be made at any time of the year. Winter use is somewhat dependent on annually climate conditions. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

3. Wild Horses: Wild horse populations are 2.5 times the Appropriate Management Level (AML). In a low precipitation desert watershed, with some drought years, when livestock operators are asked to do what's best for the land and reduce livestock use, why does the BLM continue to shirk its responsibility to achieve AML? In this area, use by wild horses is now three times the actual use made by livestock (36,000 AUMs to wild horses and 12,000 AUMs to livestock in 2001). How can monitoring be used to determine a proper population level if wild horse populations are not reduced to the AML? Wild horse use becomes concentrated around a small number of reliable water sources in dry years and the horses move out of the HMA into allotments with developed water for livestock. Why isn't adequate funding provided to develop adequate water for wild horses, manage and resolve distribution of use problems, and properly monitor and resolve impacts to watershed and other resources caused by wild horses?(picture 28-4).

4. Livestock Grazing: Livestock grazing is also a factor affecting watershed values in the Sand Creek watershed. Management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to plant cover and litter values compared to percent bare ground. The mixtures of seasons, types of livestock, and generally low actual use have tended to make this a smaller management issue in specific locations. Due to dry conditions and high numbers of wild horses, livestock operators have voluntarily reduced their use levels by half. About one-third of this use is made by winter sheep, which have a low diet overlap and compete less with wild horses than cattle. The key question is what further refinement in best management practices for livestock grazing or other actions need to be taken to improve watershed health and meet desired resource conditions.

5. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well-vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately-vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Active gullies often have some shrubs and grasses, but are generally less well vegetated. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. While much of this is considered background or natural erosion, roads and past/current grazing practices are large contributors to erosion in this watershed.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush plant communities to 35 to 50 percent on saltbush steppe plant communities, the two most common vegetation types in this watershed. Shale flats and badlands fall into the 5 to 30 percent range. These sites do yield some soil erosion, but not as much as one might think. The silts and salts in these soils seem to seal when they get wet, so that most moisture is shed with only small amounts of erosion. This can be observed in reservoir sites, when built close to badlands, they will almost always have water and take a long time to silt in.

4) Reference Conditions:

Due to the remoteness and dry climate of this watershed, there is little historical documentation about rangeland conditions prior to settlement by Euro-Americans. The area was used by several different tribes of nomadic Native Americans on a seasonal basis due to climatic conditions.

5) Synthesis and Interpretation:

The principal changes observed today compared to pre-settlement are the roads, gas wells, and fences that relate to the existing land uses. Roads and off-highway vehicle use continue to expand. There is still a large need for further work on nearly all improved roads to reach an adequate level of improvement practices (gravelling, additional culverts, wing-ditching, water-bars) to minimize or eliminate overland flow alterations and erosion caused by roads (picture 29-1). This issue is getting larger rather than smaller, with the creation of more roads associated with further development of oil and gas resources. Use of seismic testing vehicles in oil and gas exploration is relatively low impact. However, some of these routes evolve into roads through continual use by hunters (picture 29-2). Recreational use of roads is also increasing and more troublesome are the off-highway activities associated with hunting, joy-riding, and more recently, antler collecting. Greater availability of four-wheel drive pickups, motorcycles, and three/four wheelers has exacerbated this problem, particularly in areas with easy access and proximity to towns and rural habitations.

There is a lower standard observed in reclamation efforts around operating wellheads, compared to what can be done as evidenced by BP America, to reduce bare ground that is exposed to wind and water erosion.

Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation. Reclamation of pipelines is generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits have been converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. The long-term decline of the sheep industry across this region reduces management options and flexibility. Some allotments will likely never convert to cattle due to terrain, plant species composition, and competition with wild horses. In a study just north of this area, dietary overlap between horses and cattle during the summer averaged 72% and increased to 84% during the winter (Krysl et. al., 1984). Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. The lack of fencing in much of this area requires a greater control of livestock through herding, which in some cases is not adequate, leading to trespass livestock use on adjoining allotments. Control of livestock is also complicated by mineral development activities, which can involve lack of maintenance on cattle-guards, leaving gates open or fences down, and inadequate construction techniques (picture 30-1).

Horses were brought into this country by the Spanish in the 1500s. Early historical accounts from adjacent watersheds never mention wild horses, but do mention buffalo, antelope, and other big game species. Most wild horses are the result of domestic horses getting away and becoming wild or older horses being turned loose. A market for horses developed during World War I and many current-day livestock producers made their start by capturing and selling wild horses. It was a source of extra money to help get by with, above the living made with livestock. The ranches tried to manage wild horses along with their livestock (in a general sense) according to what the land could support. With the advent of the Wild Horse and Burro Act in 1971, responsibility for managing wild horses was given to the BLM. However, adequate funding for roundups, management, and monitoring has been lacking. The current population of wild horses in Adobe Town is higher than ever, and even without quantifiable data, is damaging vegetative cover and other watershed values.

6) Recommendations:

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Sand Creek watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Reduce and maintain wild horse populations in the Adobe Town HMA from the current level of approximately 2,400 wild horses to the AML of 600 to 800 wild horses. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, in order to minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter and, therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Shell Creek

1) Characterization:

Shell Creek is a large ephemeral watershed, just to the west of Sand Creek and is a tributary of Vermillion Creek, which empties into the Little Snake River in Colorado. Small, ephemeral side draws contribute seasonal flows into Shell Creek. The majority of the area is in a 7 to 9-inch precipitation zone, rising to a 10 to 12-inch precipitation zone along Powder Rim and Kinney Rim. Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Sandy soils and small sand dunes occur in some areas. Topography is flat to gently rolling landscape for the most part, becoming moderately steep to steep close to rims and badlands. Elevation ranges from 6,650 at the state line to 7,100 ft at Adobe Town Rim to the north, 7,600 ft at Powder Rim to the east, and 8,000 ft at Kinney Rim on the west border (picture 31-1).

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. The main stream channel and floodplain of Shell Creek is well-defined, with lower slopes to uplands in the upper basin and more incised banks and steep slopes in the lower basin. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow from the portion of Shell Creek watershed in Wyoming is not monitored.

The only site where channel classification was determined was the main stem of Shell Creek, which is a C6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition (picture 31-2).

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. There is also a large wild horse herd. Natural gas development has occurred in the area for many years. However, it has slowly expanded into this watershed over the last 30 years, with increasing development over the last 10 years. Livestock use is cattle and sheep, employing cow/calf and herded range sheep operations. Seasons of use for livestock will vary by allotment, but can be made at any time of the year. Winter use is somewhat dependent on annual climate conditions. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

3. Wild Horses- (please refer to issues identified for Sand Creek on page 27)

4. Livestock Grazing- (please refer to issues identified for Sand Creek on page 27)

5. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well vegetated in the few areas with yearlong or long-term water flow as stated in the earlier Sand Creek discussion earlier. Vegetative cover and litter also is similar to Sand Creek and will not be repeated here.

4) Reference Conditions:

Due to the remoteness and dry climate of this watershed, there is little historical documentation about conditions prior to settlement by Euro-Americans. The area was used by several different tribes of Native Americans in a nomadic and seasonal manner due to climatic conditions.

5) Synthesis and Interpretation:

As discussed in the Sand Creek section, the principal changes observed today compared to pre-settlement are the roads, gas wells, and fences that relate to the existing land uses. Road-related factors (both commercial and recreational) and well reclamation efforts are the important issues to address.

Management changes that relate to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits were converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. The lack of fencing in much of this area requires a greater control of livestock through herding, which in some cases is not adequate, leading to trespass livestock use on adjoining allotments.

Wild horses in this assessment area have the same impacts as those previously described in the Sand Creek section.

6) Recommendations:

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Shell Creek watershed is meeting

Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Reduce and maintain wild horse populations in the Adobe Town HMA from the current level of approximately 2,000 wild horses to the AML of 600 to 800 wild horses. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, in order to minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.