# EXISTING CONDITION OF HYDROLOGY / RIPARIAN

## ANALYSIS AREA

The analysis area includes two major watersheds, Upper Basin and Blacktail Creeks, plus two minor watersheds, China Gulch and Herman Gulch (Appendix B, Map 28). Upper Basin comprises 7,802 acres, and considers all contributing lands draining into Basin Creek and other tributaries supplying the lower reservoir, a municipal water supply. Ninety-three percent of the ownership is USFS, with Butte-Silver Bow County owning patented claims in many of the stream bottom areas. Private ownership occurs on small parcels near the Moose Creek Road. While water from Fish Creek (Appendix B, Map 28) is also diverted into the reservoir, no actions are proposed for this extremely resilient watershed. Any actions outside of this analysis area will not contribute to water quality changes to the reservoir system. The lowest point of the analysis area of Blacktail Creek is where it crosses the northern boundary of Thompson Park, comprising of 9,697 acres. About 12 percent or 1,200 acres is under private ownership. Herman Gulch has 1,660 acres total, with 200 acres under state ownership and about 300 acres of private. China Gulch has 1,606 acres total, with about 40 acres of private land near its mouth. Lower Basin Creek lies below the dam down to the USFS boundary and has 1,829 acres, with about 240 acres of private land. These watersheds are located at the very head of the Clark Fork River, a major tributary of the Columbia River basin. Analysis at this scale provides the proper context for determining watershed effects.

## WATERSHED CHARACTERISTICS

These watersheds lie within the Elkhorn Mountains-Boulder Batholith Ecoregion (Level IV Ecoregions of Montana). Elevations range from 5,900 to 8,150 feet in Basin Creek and 6,000 to 8,000 in Blacktail Creek, with annual precipitation from 18 to 30 inches. Elevation ranges from 5,800 to 6,600 feet for both Herman and China Gulch, with annual precipitation about 20 inches. Landforms, parent material and soils are similar for all watersheds with few exceptions. Granite comprises the geologic parent material, with a local exception near the Highland mine where dolomite is found. Geomorphic processes responsible for landform development include stream erosion and deposition. Soil formation results from interactions between parent material, geomorphic processes, vegetation and climate. General soil groups discussed below imply broad management limitations. Hydrologic Soil Group classification relates to permeability and depth to groundwater. Hydrologic Soil Groups range from Group A (high permeability and deep groundwater) to Group D (low permeability and shallow groundwater).

The predominant soil type occurs on the stream-eroded uplands. Most soils are shallow to moderately deep, with sandy textures and little soil profile development. Some areas develop a surface organic layer, or a subsurface clay horizon. Productivity rates low to moderate, surface erosion potential rates high, while mass-wasting potential is low. Soil-bearing strength and sediment delivery potential are high. The soils are permeable, with low water holding capacity, and classify in Hydrologic Soil Group A. Stream deposited material in valley bottoms make up a minor overall soil component. These soils are usually deep with sandy or loamy textures, little profile development and free water at or near the surface. Productivity and surface erosion potential are high soil bearing strength and mass wasting potential are low. These soils typically fall in Hydrologic Soil Group C or D.

# DESIGNATED BENEFICIAL WATER USES

Water uses that might potentially be impacted include any water rights, and beneficial uses of water as specified by State water quality standards. The Upper Clark Fork basin is presently going through a judicial process (adjudication) under Montana Water Law to determine water rights. The following interests, including their respective beneficial use(s), hold claims to water rights: The Butte Silver Bow Water Utility District (BSBWUD) (municipal), US Forest Service (USFS) (stockwater), and the Butte Highlands Mining Company (mining). Because the Upper Clark Fork basin has only gone through the Temporary Preliminary Decree portion of the adjudication process, no claims have become final. The municipal water claim by BSBWUD includes 24.66 cubic feet per second (cfs) on Basin Creek.

The designated beneficial uses of water are specified by the Surface Water Quality Standards, as stated under Title 17, Chapter 30, Sub-Chapter 6 - SURFACE WATER QUALITY STANDARDS, in the Administrative Rules of Montana (ARM). The classification of waters within the analysis area includes A-Closed waters. The beneficial uses under this classification, and a reference to the water quality standards designed to protect them are listed below:

> A-Closed Classification (ARM 17.30.621) are waters suitable for drinking, culinary and food processing purposes after simple disinfection. Water quality is suitable for swimming, recreation, growth and propagation of fishes and associated aquatic life, although access restrictions to protect public health may limit actual use of A-Closed waters for these uses. Public access and activities such as livestock grazing and timber harvest are to be controlled by the utility owner under conditions prescribed and orders issued by the Department of Environmental Quality (DEQ). Specific water quality standards for waters classified A-Closed are given in ARM 17.30.621 3(a) through 17.30.621 3(i).

To avoid filtration, the BSBWUD must meet water quality conditions stated in 40 CFR 141.71.

Blacktail Creek, Herman Gulch and China Gulch classify as B-1 waters (ARM 16.20.618). Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

# WATER QUALITY

Responsibility for monitoring falls on the BSBWUD, summarized in an annual report that includes any violation disclosures. Contaminants or parameters tested for include microbiological, synthetic organics, volatile organics (total trihalomethanes), turbidity, and sulfate. Potential sources for turbidity include point and non-point (diffuse) sources of soil erosion and nutrient inputs into the reservoir system that may trigger algae blooms. Control of algae is also important in preventing the formation of trihalomethanes, which occur when water tainted with algae interacts with chlorine. Erosion from roads and trails, and livestock grazing represent the most likely sources. Other *potential* contaminant sources include human and animal fecal wastes, past mining activities, and petroleum spills from vehicles. Volatile and Non-volatile contaminants originating from petroleum products are not reported in the annual report. A partial review of monitoring records and summary reports shows waiver compliance associated with PWS-3 (Annual Drinking Water Quality Report, BSB Department of Public Works, Water Utility Division).

A water quality analysis at the Highland mine was performed in 1976, which included a standard chemical suite. The analysis was prepared by the Montana Bureau of Mines and Geology.

# WATER QUANTITY

On Basin Creek, Butte-Silver Bow Water Utility Division collects inflow, outflow, and reservoir elevation data for the lower reservoir. Stream flow regimes rely heavily on snowmelt, with peak flows in late May. No formal data collection takes place for Blacktail Creek, and Herman or China gulches. Blacktail Creek flow regime is similar to the natural portion of Basin Creek flows. Herman and China Gulches have earlier snowmelt peaks due to their lower elevations. Water diverted from Fish Creek also originates mainly from snowmelt, with peaks normally occurring in early/mid June.

# STREAM MORPHOLOGY

Stream function was determined through quantitative and qualitative methods. The Rosgen Stream Classification Methodology (Rosgen, 1996) is a hierarchal method of describing a streams behavior from its appearance. Entrenchment, width/depth, sinuosity, slope and substrate are attributes that define the dimensions, patterns and profile that a stream exhibits. The classification system can be used to determine hydrologic function in terms of floodplain access, sediment transport capability, and interaction with the water table. Qualitative assessments include Proper Functioning Condition Assessments (BLM Technical Reference 1737-15, 1998).

## Upper Basin Creek

Stream inventories have been done at four sites on Upper Basin Creek. Three sites are located above the upper reservoir, and one between the upper and lower reservoirs. The uppermost reach is a functioning Rosgen A4 channel type. This stable channel is located above the Fish Creek diversion where the valley bottom becomes narrow.

A second reach above the Fish Creek diversion is a functioning-at-risk Rosgen E5 channel, located where the valley bottom becomes wider. This stream reach has many dead and dying willows, with limited loss of vertical and lateral stability.

Below the Fish Creek diversion, a non-functioning Rosgen G4c reach exists within the meadow complex. Increased stream energy results from additional flow from Fish Creek. This has caused channel incision and loss of flood plain access (Figures 3.29 and 3.30). The end result is vertical and lateral instability with a drop in the water table. Changes in riparian and wetland species occur as the meadow system becomes drier. The channel between the reservoirs is a non-functioning Rosgen F4. This stream reach exhibits vertical and lateral instability, possibly from sudden waters releases associated with dam breaching at the upper reservoir

Figure 3.29: Basin Creek below Fish Creek diversion.

Figure 3.30: Basin Creek below Fish Creek diversion.

The stream-dissected nature of the Upper Basin watershed lends to a high density of stream channels, despite relatively low precipitation. Wet meadow complexes are associated with low-gradient, 1st order (small) streams. Willow and sedge communities support stream stability on these stream types. Willow communities appear stressed, and may be vulnerable to complete loss. Most of these 1st order channels are presently in functioning condition, but stream stability may be at risk if loss of willow communities continues. Steeper, forested reaches generally rely on rock substrate and woody debris for stability. Most of these reaches are functioning and stable. Stream channels in the Fish Creek portion of the watershed are steep, stable systems with high rock content. These channels are properly functioning with very little sediment routed into Upper Basin Creek via the pipeline.

## Blacktail Creek

One stream inventory is located on Blacktail Creek, about 0.2 mile above Forest Road 8492. Below this point, it becomes difficult to characterize stream type on Forest Service land due to variability inherent with old beaver activity. The stream enters private land a short distance below Forest Road 8492, with limited segments flowing through Forest Service land. Forest Service land does provide a significant amount of contributing area until the lowest point of the analysis area. Blacktail Creek at the survey site is a functioning A4 channel type. No qualitative or quantitative evaluations have been made on private land upstream of Roosevelt Drive (FR 84). Qualitative evaluations of Blacktail Creek along Roosevelt Drive and State Highway 2 indicate changes in pattern, profile, and dimensions due to sedimentation, encroachment by the roads, and loss of woody species. These reaches can be characterized as functioning-at-risk or non-functioning.

## China Gulch

A ¼ mile reach of China Gulch exhibits measurable stream characteristics immediately above the Forest boundary. A stream inventory on this reach indicates E4 and B4c stream types. This variability indicates a shift in function, with the E4 cross section representing a functioning condition, and the B4c cross section representing non-functioning. Loss of function can be attributed to historical grazing. Above this reach, the stream flows through a complex of old beaver dams within a relatively broad valley bottom, and lacks

channel definition. Above the broad valley bottom section, the stream flows through a narrow, steep valley bottom that appears functioning. Cattle do not access this section of stream due to the steep and rocky nature.

## Herman Gulch

Only qualitative assessments exist on this small stream due to a lack of channel definition. Sediment and poor road/trail location create a non-functioning condition through most of its length. Two areas contribute the biggest impacts. The first is the upper reach where an old road system exists on top of the riparian area, capturing runoff and causing extensive downcutting and deposition above the pasture fence. The second is sediment derived from private land and the county road for about 1½ miles above its junction with Basin Creek. Significant storm events create large depositional features on the private hay meadows. Sediment routing to Basin Creek is likely limited except during significant flow events.

## Summary of Stream Survey Information

Table 3.59: Stream Survey Information

| Stream Reach | Stream Type | Entrenchment | Width/Depth | Sinuosity | Slope | Functioning Class |
|---|---|---|---|---|---|---|
| Blacktail | A4 | 1.5 | 9.4 | 1.14 | 0.053 | Functioning |
| Basin Down | F4 | 1.3 | 16.6 | 1.19 | 0.018 | Non-Functioning |
| Basin below Fish | G4c | 1.08 | 8.6 | 1.53 | 0.015 | Non-Functioning |
| Basin Up | E5 | 4.3 | 4.09 | 3.16 | 0.017 | At-Risk |
| Basin Up (2nd Reach) | A4 | 3 | 7.1 | 1.25 | 0.061 | Functioning |
| China Gulch Down | B4c | 1.9 | 13.8 | 1.37 | 0.0157 | Non-Functioning |
| China Gulch Up | E4 | 5 | 3.6 | 1.37 | 0.0157 | At-Risk |

# PAST AND PRESENT LAND MANAGEMENT

## Basin Creek Water System Development History and Use

The Butte Water Company (BWC) began construction of the water supply system in the late 1890s, and managed the system until transferring ownership to the county of Butte Silver Bow, Water Utility Division (BSBWUD) in1991. BWC completed construction of the lower Basin Creek reservoir in 1895. Water from Fish Creek was diverted into the Basin Creek reservoir beginning in 1895 via a wooden flume. The flume was replaced with a wooden pipeline, with work completed in 1912. Due to severe leakage problems (up to 1 million gallons/day), BSBWUD replaced the original pipe in 1996 and 1997 with metal and plastic pipe.

The smaller (upper) reservoir has no existing control valve for draw-down. The dam partially breached in the past, reducing storage capacity to about 200 acre-feet. Drawdown control does exist for the lower reservoir, with a capacity of 1135 acre-feet at full pool.

This system currently supplies an average of 4 million gallons per day, up to 40 percent of the total supply provided by BSBWUD. The filtration waiver combined with the gravity flow system offer considerable cost advantages over water supplied from the Big Hole River and Moulton Reservoir. Costs for Basin Creek water runs $8 per million gallons, compared to $240 and $120 per million gallons for water supplied by the Big Hole and Moulton systems (Dave Schultz, personal communication, December, 2001)

A general system outline includes a 4½-mile pipeline for diverting water from Fish Creek into Basin Creek, two reservoirs on lower Basin Creek, a settling basin immediately above the lower reservoir, a chlorination treatment facility below the lower dam, and the distribution system for serving the city of Butte. Most maintenance and improvement actions fall within the jurisdiction of the BSBWUD, because facilities are located on private land.

## Livestock Grazing

Livestock grazing occurs under the Blacktail Allotment, and a small portion of the Moose-Camp Allotment at the head end of Basin Creek. The Blacktail Allotment is permitted for 92 cow/calf pair between June 16 and September 30, and currently scheduled for management revision. The Twin Calf pasture of the Blacktail Allotment includes four small tributary streams which feed Basin Creek or directly into one of the reservoirs. The BSBWUD holds maintenance responsibility for the pasture fence section above the reservoir and Basin Creek, which provides about a 1/8-mile buffer. Past use on the pasture showed light use on the tributaries, especially toward the lower fence. Changes in livestock management to address water quality concerns were discussed during a meeting involving representatives from USFS, DEQ, BSBWUD, and Robert Peccia & Associates (Meeting Summary, 9-27-1991). Possible management changes include additional fencing or elimination of grazing in the Twin Calf pasture. The opportunity for implementing any management changes exists through the annual operation plan or during the next allotment revision process.

The BSBWUD has raised concerns over the role cattle might play in losing the filtration waiver granted by DEQ. Specifically, the concern lies with the contamination by Cryptosporidium, a parasitic protozoan known to cause gastrointestinal illness (letter to Butte RD Ranger from David Schultz, 6-5-1998). Cryptosporidium is recognized as a significant threat to immune-compromised individuals. The Surface Water Treatment Rule for the SWDA emphasizes filtration because chlorination does not eliminate threats from either Giardia or Cryptosporidium. In addition to cattle, many wildlife species also host both Cryptosporidium and Giardia. The Beaverhead-Deerlodge National Forest provides habitat for many of these wildlife species. (*Appendix D, Drinking Water from Forests and Grasslands, General Technical Report SRS-39*).

## Timber Harvest

Extensive timber harvest occurred during the late 1800s and early 1900s throughout most of the analysis area in support of the mining industry. Many stands are presently about 100 years old, with widespread mountain pine beetle infestations currently in progress. A substantial loss of trees could result in an increase in annual flow and large woody debris on hillslopes and stream systems. Clearcuts done in the

1970s located in the upper Blacktail drainage are now considered hydrologically recovered. Recent harvest activities in 1999 were limited to small-scale salvage or clearing activities at the head of a small tributary to Upper Basin Creek. Ground disturbance was minimal due to helicopter yarding, or harvest done near the main road. Salvage operations to address safety concerns were performed within Thompson Park during the winter of 2003. Harvest took place in the early 1990s below Forest Road 84 just south of the upper reservoir on private land. No erosion is associated with this harvest.

## Roads and Trails

The 1996 Deerlodge Forest Area Travel Management Plan designates a large portion of Basin Creek as *closed to all motorized vehicles*, with the exception of the Highland Road (Forest Road 84) and the Bear Gulch Trail (108). The *Off-Highway Vehicle Record of Decision and Plan Amendment* (January, 2001) eliminates wheeled motorized cross-country travel with some exceptions on USFS lands in Montana. Within the Blacktail drainage, roads and trails create significant sediment concerns within Thompson Park due to poor design and lack of proper maintenance (Roads Analysis, FS-643).

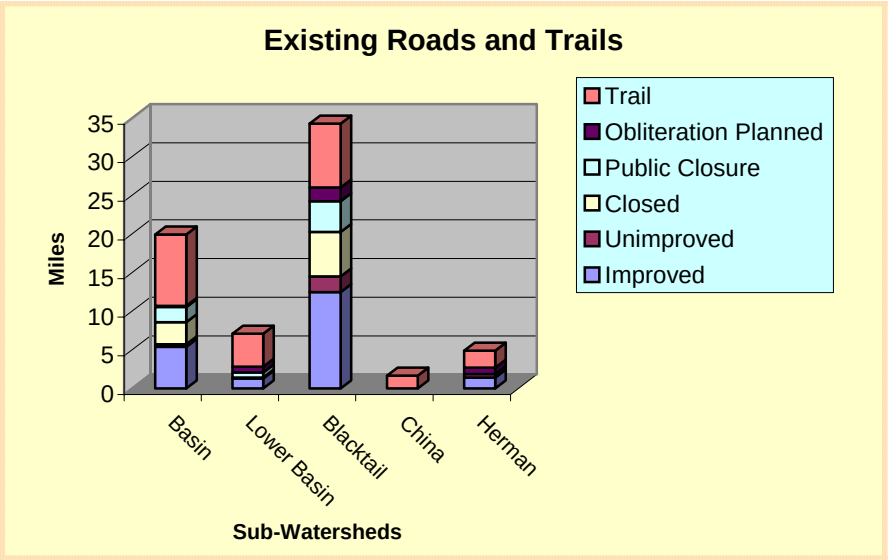


Figure 3.31: Existing Roads and Trails in Basin Creek Project Area

## Rural Homes

The Roosevelt subdivision includes over 80 homes that occupy several hundred acres within Blacktail basin. Within Basin Creek, the potential for home development exists on private land parcels (patented mining claims) in the eastern portion of the watershed. Presently, one home exists above the Basin Creek Road, but not near any surface water.

## Water System Maintenance

Infrastructure maintenance within the Basin watershed includes work on both dams (upper and lower reservoirs) and the Fish Creek diversion system. Ground disturbing activities create the potential for erosion, sedimentation and stream channel alterations. Though not related to the municipal water supply, the power line owned by Montana Power presents a maintenance need along Basin Creek. Due to a blowdown incident in the mid 1990s, sections of the power line within the watershed were converted to underground in 1997.

## Mining

While mineral rights exist within the Basin watershed, there are no active mining or exploration activities. The Highland Mine, located at the very headwaters of Basin Creek, represents the most significant historic mining activity. This hard rock-gold operation extracted sub-surface ore from dolomite found in the Gallatin Formation. A mill was erected on-site in 1932, but then quickly moved to the Middle Fork Moose Creek site due to water quality concerns by the Butte Water Company. Water flowing from the adit reaches Basin Creek via surface flow. Recent investigations detected metals in the adit water after interacting with waste rock material high in pyrite, located below the adit opening. The remedy involved routing adit water around the waste rock. (*Montana Department of State Lands, Abandoned Mine Reclamation Bureau, 1993*).

## Recreation

The Fish Creek portion of the Basin watershed receives very light levels of non-motorized recreational use. No recreational developments exist. Within Basin Creek, public access is limited to travel on the Highland Road and the Bear Gulch Trail. The remainder of the watershed is off limits to recreation or trespass, with BSBWUD responsible for signing and patrolling. Montana Fish Wildlife and Parks Department and USFS Law Enforcement personnel provide support for the closures. The Blacktail basin receives heavy recreation use within Thompson Park and around the Roosevelt subdivision.

# REGULATORY FRAMEWORK

Policies and laws that directly regulate domestic water supplies include:

Safe Drinking Water Act of 1974 (SDWA), 1986 amendment included the filter requirement

- Surface Water Treatment Rule for the SDWA
- Montana Water Quality Act (MWQA)

The Administrative Rules of Montana (ARM) Title 17, Chapter 30, Subchapter 6 supplements the MWQA with surface water quality standards and procedures. The Basin watershed classifies as A-Closed (ARM 17.30.607.1.d). A-Closed classification standards are found in ARM 17.30.621. Department of Environmental Quality Circular WQB-7 *"Montana Numeric Water Quality Standards"* establishes limits for toxic, carcinogenic, bioconcentrating and other harmful pollutants.

The Surface Water Drinking Rule for the SDWA requires filtration of public water supplies, unless a certain level of purity can be demonstrated. To avoid filtration, the BSBWUD must meet water quality conditions stated in 40 CFR 141.71.

The SDWA Amendments of 1996 require states to perform source water assessments (SWA) of all public drinking water sources and make the results public by 2003. Forest and grassland managers with public water supplies will be involved as participants in developing and implementing SWAs. The information provided in this plan may be used in developing a SWA. Each SWA needs to include the following:

- Delineation of boundaries showing source areas for public drinking water systems.
- Identification of significant potential sources of contamination.
- Susceptibility of each drinking water system to contamination.

Other laws that govern federal actions with potential to affect public water supplies include the Organic Act of 1897, the Multiple Use-Sustained Yield Act, the National Environmental Policy Act, the Clean Water Act, the Forest and Rangeland Renewable Resources Act and the National Forest Management Act. Principal agencies responsible for upholding these policies and laws include the Environmental Protection Agency and the Montana Department of Environmental Quality. The following sections of the Clean Water Act (1972, Amended 1987) apply to any federal action, which may affect a water body, regardless of its beneficial use:

Section 101> The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

Section 208(2)(F)> A process to identify agriculturally and silviculturally related nonpoint sources of pollution, and set forth procedures and methods to control to the extent feasible such sources.

Section 303> States have responsibility to develop and review water quality standards.

Section 313> Requires all Federal Agencies to control and abate water pollution under all Federal, State, and local requirements. Executive Order 12088 specifies this compliance.

Section 319> Requires Federal consistency with the State Non-Point Source (NPS) program. The State NPS program includes a process for identifying Best Management Practices (BMPs) to control identified sources.

Compliance with State requirements for protection of waters within Montana means that "land management activities must not generate pollutants in excess of those that are naturally occurring, regardless of the stream's classification. 'Naturally occurring' is defined by the Administrative Rules of Montana as that water quality condition resulting from runoff or percolation over which man has no control or from developed lands where all 'reasonable' land, soil and water conservation practices have been applied." Forest Service Handbook 2509.22, Soil and Water Conservation Practices Handbook, lists Soil and Water Conservation Practices (SWCPs), some of which may be recognized through a memoranda of understanding as BMPs by the state. Compliance with Montana water quality law requires: 1)BMPs or SWCPs are applied, 2) Beneficial Uses are not impaired, and 3) Monitoring takes place to test whether BMPs are protecting Beneficial Uses.

The Clean Water Act Section 303(d) and 40 CFR (Part 130) require each state to identify water quality limited water bodies. After water quality limited water bodies have been identified, they are prioritized and

targeted for TMDL (Total Maximum Daily Load) development. EPA grants the final approval, making the 303(d) list part of the annual Montana 305(b) Report. There are no water bodies identified as water quality limited within the analysis area.

The NFMA requirements for the conservation of soil and water resources is listed in 36 CFR 219.27 (a)(e)(f). "Conservation of soil and water resources involves the analysis, protection, enhancement, treatment, and evaluation of soil and water resources and their responses under management and shall be guided by instructions in official technical handbooks.

# POLICY

The Deerlodge Forest Plan (FP) standard for protecting municipal watersheds requires application of the Specific Surface Water Quality Standards of the state of Montana, as stated on II-26 of the FP. This standard supplements any National and/or Regional policies, as found in Forest Service Manual (FSM) 2542.02. The Butte-Silver Bow Master Plan (BSBMP) provides goals and objectives for ensuring consistency with any federal or state land-use plans (Objective G, page II-4, BSBMP).

The watershed and both reservoirs supply a “Community Water System” (FSM 2543.03), and contain the following MAs: MC3 (wildlife goals), J3 (Research Natural Area), and ME1 (timber goals). Policy described in FSM 2542.03 prescribes only use of proven management techniques, and requires a cost determination of any unusually restrictive practices required to meet Best Management Practices. Do not rely solely on management practices to provide pure drinking water. Consider formal agreements only when intensified multiple-use management fails to meet the needs of the water user (36 CFR 251.9). The Forest Supervisor holds the authority to approve watershed plans, and should secure full understanding by the municipality before implementation (FSM 2543.12, R-1 Supplement).

# ENVIRONMENTAL EFFECTS TO HYDROLOGY / RIPARIAN

## INTRODUCTION

Proposed activities that could potentially affect water resources include fuels reduction and yarding, temporary road construction and burning. Potential effects include direct, indirect and cumulative. Each alternative will be analyzed for the impacts of associated treatments in addition to past, present and reasonably foreseeable future actions. Each alternative considers the projected loss of vegetation due to insect, disease and catastrophic fire. All alternatives will be analyzed for potential changes in slope and channel stability. Changes in slope stability entail an evaluation of potential surface erosion. Changes in channel stability expressed in terms of functioning status, represent the ultimate analysis of cumulative effects, and relate to changes in sediment and/or inputs of water. Potential channel responses to increased flow include increased width and meander length, increased sediment supply due to bank instability, and downcutting. Potential channel responses to increased sediment inputs are increased width, decreased depth, decreased sinuosity, change in substrate composition and increased meander length and radius of curvature. Channel type plays an important role in determining the sensitivity to changes in stream channel stability resulting from changes in flow and sediment (Rosgen, 1996 and Metzler, 1992). Changes in potential nutrient loading to the lower reservoir are discussed in the Soils section.

## Timber Harvest

### *Streamflow*

Fuels reduction and removal of timber can potentially affect the timing and magnitude of streamflows, usually on third order or smaller basins. Studies on larger order watersheds do not show appreciable increases, either from harvest or fire (Troendle and Bevenger, 1996). Research on small basins (< 3 square miles) indicates a measurable increase when more than 20 percent of the cover is removed (Stednick, 1996). Consideration should be given to the relationship between flow and sediment. Increased sediment is often due to channel scour from longer duration of peak flows resulting from vegetation removal (Troendle and Olsen, 1994; Troendle and Bevenger, 1998). Changes in timing and magnitude of snowmelt rates and peak flows are most affected by mature tree removal on mid-slope positions, with a 1 percent annual water yield increase for each 4 to 5 percent of cover removed (Farnes, 1999; McCaughey and Farnes, 2001).

### *Sediment*

Fuels reduction and timber harvest can increase onsite soil loss and sedimentation. The yarding system applied during harvest plays a large role in determining soil disturbance. A summary of studies by Megahan (1981) found that helicopter yarding caused the least soil disturbance of all logging systems, with an average total area of disturbance of 4 percent. Other systems reviewed included skyline (9.1 percent), ground cable (23.9 percent), and tractor (33.5 percent). The quantity of sediment produced is determined to a large degree by the care taken by the operator (Rice et. al., 1979; Burwell, 1970). This emphasizes the importance of good sale administration. A study by Megahan, King and Seyedbagheri (1995) showed

site preparation (broadcast burning) responsible for most of the accelerated surface erosion on an area where helicopter logging occurred.

**Direct effects** are caused by the action occurring at the same time and place. Tractor yarding across a stream would constitute a direct effect if sediment were introduced at the time of the action. **Indirect effects** are caused by the action and occur at a later time or farther removed in distance. **Cumulative effects** result from the incremental effects of the proposed action when added to other past, present and reasonably foreseeable future actions. Cumulative effects are usually expressed in terms of changes in channel stability that result from changes in sediment and flow at the proper analysis scale, typically a third order basin.

## Road Construction/Maintenance

Roads make up the primary source of sediments from logging activities in the western United States rather than timber management activities (Megahan and Kidd, 1972; Ice G., 1985, Swanson et. al., 1987; Packer P.E., 1967). About 70 percent of sediment deposition occurs the first year after road construction (Ketcheson G.L. and Megahan W.F., 1996). Travel distance of sediment derived from fill slopes, drain dips, berm drains, and landings is a function of sediment volume and obstructions. The travel distance for sediment derived from culvert cross drains is a function of sediment volume, obstructions, hillside gradient and source area (Ketcheson G.L. and Megahan W.F., 1996). Other research shows slope being another key factor in sediment transport distance (Trimble and Sartz, 1957; Swift, 1986). A literature review by Belt, O'Laughlin, and Merrill (1992) found that sediment transport in non-channelized flow rarely travels more than 300 feet. Problems with road drainage were ranked as the number one problem in terms of water quality impacts according to the1998 Forestry Best Management Practice (BMP) Audit Report. Reducing sediment delivery to streams is accomplished two ways: (1) reduce the volume of erosion through onsite erosion control practices; or (2) Reduce sediment delivery by increasing retention on hillslopes.

Sediment introduced directly into a stream channel, such as during construction of a stream crossing, constitutes a **direct effect**. **Indirect effects** include changes to the sediment and/or water supplied to a stream system. This is especially true where roads are hydrologically connected to stream channels. Road construction that results in sediment at some later time is one example. See the **Appendix B, Maps 2 - 5** for a display of proposed temporary roads.

## Burning

The **direct effects** of fire are usually associated with burning material entering a waterbody, potentially resulting in elevated temperatures and/or nutrient levels. The **indirect effects** include possible decreases in interception and infiltration, with possible increases in surface and mass erosion, nutrient loading, sedimentation. Fire that includes significant amounts of high burn severity can greatly increase erosion rates, often from 100 to 1000 times natural (Elliot and Miller, 2002). Erosion and sedimentation rates due to wildfire typically recover to normal levels in 3 years for low severity fires, and 7 and 14 years for moderate and high severity fires respectively (Robichaud et. al. 2000). Changes in streamflow regime due to changes in snow accumulation/melt patterns and evapotranspiration can also result. The significance of effects may vary as a function of parameters including but not limited to fire intensity/duration, soil characteristics, precipitation patterns, vegetative cover types, slope, and aspect. Any discussion addressing the effects of fire will relate to changes in slope and/or channel stability. A distinction should be drawn between prescribed burning and wildfire. Prescribed fire is a planned event designed to minimize

effects to soil/water function. In watersheds where fire suppression and succession has allowed forests to reach mature stages, water yields may approach a minimum level. However, continued fire suppression may result in fuel buildups that could result in catastrophic fires that could ultimately impact stream channels through post-fire flood flows (Farnes, et. al. 2000). Potential changes in the nutrient regime are discussed in the soils section.

# TOOLS USED IN EFFECTS ANALYSIS

Field reconnaissance, GIS analysis and modeling all play a role in determining direct, indirect and cumulative effects from implementing any alternative, including the no action. The Equivalent Clearcut Area (ECA) analysis and the WEPP (Water Erosion Prediction Project) model (Elliot and Hall, 1997) can help support a determination of indirect and cumulative effects.

The ECA analysis provides a context for determining changes in stream flow regimes. The scale for this analysis is generally a 3rd order watershed, and can help determine potential increases in stream flow and channel scour. The basis for determining ECA is the equivalent amount of vegetation management expressed in terms of clearcut area within a given watershed. The subwatersheds being analyzed tend to be smaller than 3rd order, but the ECA analysis can still provide a broad perspective on changes on a watershed basis when also considering field analysis and professional judgment. Every 4-5 percent removal of vegetation (fire, harvest, insect epidemics) results in about a 1 percent increase in annual water yield, but varies due to cover type, aspect, slope position (elevation) and climatic characteristics (Farnes, 1999).

The WEPP Model can determine indirect effects of erosion and sedimentation from timber harvest and road construction activities and fire. The WEPP model is process-based that considers complex interactions driven by climate, geology, soils, topography, and vegetative cover. The results can be expressed in terms of sediment delivered to stream channels for roads. Natural and man-caused disturbances like fire and harvest are expressed as sediment leaving the on-site profile. Sediment delivered to streams from these disturbances is highly variable, with many factors playing a role (see discussions above). Slope position of the disturbance is a key determinant for risk of delivering sediment to a stream. WEPP predicts actual amounts of erosion and sediment, including mean annual averages (see project file). Both the ECA analysis and WEPP model can be used to express relative differences of effects between alternatives.

# EFFECTS COMMON TO ALL ACTION ALTERNATIVES

## Fuels Reduction and Timber Harvest

***Direct Effects:*** Because Inland Native Fish Strategy (INFISH) standards and guidelines will be followed, no fuels reduction and harvest activities are planned within any stream or wetland corridor, and thus no direct effects are expected.

***Indirect Effects:*** Determination of indirect effects is based on implementation of features common to all alternatives, including Soil and Water Conservation Practices (recognized as Best Management Practices by the state of Montana), standard and guidelines (TM-1) as defined by the Inland Native Fish Strategy (INFS), soil quality standards and guidelines and adherence to the Montana Streamside Management Zone Law and Rules. All potential streams were field checked to validate their flow regime

status. Many first-order streams actually exist as wetlands or meadows within broad valley bottoms, limiting or preventing any sediment movement to downstream areas. Important features include buffer strips defined by INFISH and a 15 percent limitation to soil disturbance defined by the soil quality standards. The WEPP model results provide an additional basis for determining indirect effects. WEPP predicts no erosion from skid trails, very little from thinning treatments (.01 tons/acre) and the potential for moderate erosion for lodgepole regeneration units (up to 1.09 tons/acre). The risk of sediment reaching streams is very low as treatments are adequately buffered from areas with channelized flow. On-site soil loss would recover to near pre-disturbance levels in three years or less.

The location of treatment units provides a better determination of water yield effects. When considering watersheds with a broad range of elevations, treatments in mid-slope positions offer more potential for watershed response than those located on upper or lower slope positions on snowmelt dominated runoff regimes. Peak flows generally occur as snow melts from mid-slope regions of the watershed. Precipitation patterns, which correlate to slope position, also influence effects from treatments. Treatments that exist on areas receiving less than 16 inches of annual precipitation generally show little if any measurable effects from vegetation manipulation (Adams and Coppock, 1986). This corresponds approximately to areas below 6,400 feet in elevation within the analysis area (PRISM Model, developed by NOAA & OSU, et. al.). The subwatersheds have the following amount of area above 6400 feet: Herman Gulch 17 percent, China Gulch 31 percent, Upper Basin 71 percent, Lower Basin (within USFS) 52 percent, and Blacktail Creek (within USFS) 71 percent. Sensitivity to channel impacts from vegetation manipulation must consider existing channel conditions, artificial flow regulation/augmentation, size of watershed and amount of area above 6,400 feet. Given these factors, Upper Basin rates highly sensitive, Blacktail rates moderately sensitive, and China Gulch, Herman Gulch, and Lower Basin (within USFS) all rate low.

## Road Construction

***Direct Effects:*** Between two and four stream crossings are proposed with the temporary road package, depending on the alternative. One existing crossing on the present Herman Gulch Road may need replacement to meet INFISH standards, which requires passage of a 100-year storm event. Proposed crossings would likely consist of culverts, located within the Herman and China Gulch watersheds. The 100-year storm flow ranges from 10 cfs for the smaller crossings, to 32 cfs for the China Gulch crossing. Proper location, design, installation and removal of these crossings can minimize sediment introduction, through proper implementation of appropriate Soil and Water Conservation Practices (see Appendix D), the 124 Stream Permit process administered by the State of Montana Fish Wildlife and Parks and the 404 Section of the Clean Water Act administered by the Army Corps of Engineers. The risk to local sediment delivery is highest during installation and removal of culverts. Because crossing design can be specified and administrated as part of the temporary road package, sediment risks will be minimized.

***Indirect Effects:*** Miles of proposed temporary roads by watershed and alternative are displayed in the Fisheries section Table 3.58, p. 3.171. Determination of indirect effects is based on implementation of features common to all alternatives, including BMPs, standard and guidelines (RF-1 through RF-5) as defined by INFISH, soil quality standards and guidelines and adherence to the Montana Streamside Management Zone Law and Rules. The WEPP model results in no sediment delivery to streams for all road segments with two exceptions within Herman Gulch and China Gulch as discussed below. The predicted on-site erosion on the remaining roads by WEPP is about 2.6 tons per mile, but these roads are located far enough from streams with a minimal if any risk sediment delivery. Obliteration of temporary

roads would occur no later than three years after construction. Erosion rates after obliteration would return to near pre-disturbance levels within about two years.

## Burning

***Direct Effects:*** Implementation of buffer strips as defined by INFS on all treatment areas will mean minimal risk of any direct effects.

***Indirect Effects:*** Determination of indirect effects is based on implementation of features common to all alternatives, including BMPs, standard and guidelines (FM-1 through FM-5) as defined by INFISH, soil quality standards and guidelines and adherence to the Montana Streamside Management Zone Law and Rules. Colonized parks that are slated for burn treatments have relatively light fuel loadings. Examinations of recent prescribed burning on similar landscapes indicate fire severities below damaging levels (Ratio Mountain Rx burn, 2003). While exceptions may occur on a local scale, the overall expected effect on any one watershed is that the soil/water function will be maintained. Slash disposal through broadcast burning or burning of piles will occur on an as-needed basis. These activities must operate within soil quality standards including large woody debris retention and ground disturbance. The WEPP model predicts a potential for moderate on-site erosion (up to 0.99 tons/acre). However, sediment delivery to streams is expected to be minimal or nonexistent due to adequate buffer strips.

## Potential Changes in Flow Regime

Assuming 70 percent kill of lodgepole pine by mountain pine beetle over 70 percent of the analysis area, approximately 50 percent of the watersheds will experience deforestation (0.7 times 0.7 = .49). Lodgepole pine is the dominant overstory vegetation in the critical water-producing zone (over 6,400 feet elevation). This estimation assumes even distribution of lodgepole pine over all the watersheds. In watersheds where deforestation occurs due to insect epidemics, similar responses of increased streamflow that result from fire or vegetation removal can be expected (Love, 1955). Conceptually, slight differences in water yield between a clearcut and fire or insect deforestation could be attributed to greater evaporation in clearcut areas due to a complete eradication of shade.

Because of the magnitude of the insect epidemic, the greatest factor in determining changes in streamflow is natural losses of vegetation. Any changes in streamflow due to vegetation management activities proposed in any action alternative along with those occurring on private and state lands will be masked by deforestation by mountain pine beetle. Much of the area proposed for harvest targets lodgepole pine which is already affected by mountain pine beetle. The relative contribution of increased water yield from harvest of non-lodgepole pine stands (not affected by mountain pine beetle) is small, within the range of variability determined by annual precipitation. In conclusion, annual water yields will increase on all watersheds approximately 10-15 percent even without harvest as shown in the Table 3.60 below. The risk to channel instability is greatest on stream reaches that lack adequate bank integrity and/or floodplain access. These stream reaches under risk, in order of decreasing risk, include Upper Basin Creek from the Fish Creek diversion down to the lower reservoir, Blacktail Creek, a short reach of China Gulch in the West half of Section 6, and the portion of China Gulch under the influence of past beaver activity in Section 36. These old beaver dam complexes create substantial wetlands, and are at risk of failure due to lack of maintenance by beavers. Increased flow may increase the risk of breaching these dams, resulting in a loss of wetlands in a shorter timeframe.

An account of vegetation treatments includes only proposed units over 6,400 feet in elevation unaffected by mountain pine beetle (Douglas-fir). Under the most aggressive treatment alternative (4), Herman Gulch and China Gulch may experience slightly higher annual water yields than expected due only to natural deforestation. However, an appreciable difference in stream stability would be difficult to detect. All watersheds have areas with less than 1percent in roads under the most active alternative, less than percentages considered necessary for influencing streamflow regimes (King and Tennyson, 1984).

Table 3.60: Changes in cover types

| | Upper Basin | Lower Basin | Blacktail | China Gulch | Herman Gulch |
|---|---|---|---|---|---|
| Alternative 4 (all cover types) | 17% | 14% | 2% | 18% | 17% |
| Alternative 4 (Douglas Fir cover types only) | 2% | 0% | 1% | 7% | 10% |
| Estimate of natural deforestation (MOUNTAIN PINE BEETLE) | 50% | 50% | 50% | 50% | 50% |
| Natural plus additional removal (Alternative 4) | 52% | 50% | 51% | 57% | 60% |
| Predicted increase of annual water yield from natural deforestation | 12.5% | 12.5% | 12.5% | 12.5% | 12.5% |
| Predicted increase of annual water yield from natural and additional removal (Alt. 4) | 13% | 12.5% | 12.75% | 14.25% | 15% |

## Potential Changes in Sediment

Differences in sediment delivery exist between alternatives, particularly between the no action and the action alternatives. See the cumulative effects for alternative descriptions.

## Past, Present, and Reasonably Foreseeable Future Actions

The potential of past, present and reasonably foreseeable future management activities to contribute effects to water resources are discussed here. These effects apply to all alternatives. The numbers refer to the list in Chapter 2. Actions that hold an appreciable potential to affect water resources will also be considered in the alternatives discussion below. In addition, consideration must be given to the mountain pine beetle outbreak. The present flight of mountain pine beetle (summer 2003) indicates an exponential increase in infestation, which is projected to kill approximately 60-80 percent of lodgepole pine, a species that covers about 70 percent of the analysis area (Bruce Schuelke, Forester, personal communications).

1.a. Historic timber harvest: Considered in Existing Condition for all watersheds.

b. Wood Creek Salvage: No appreciable effects to Upper Basin Creek. This sale involved helicopter yarding with no ground disturbance.

c. and d. Thompson Park Hazard Tree Removal: No appreciable effects to Blacktail Creek. This sale was examined during the summer of 2003, with no discernable effects noted.

e. Limekiln Timber Sale: This project as last proposed included watershed restoration work with no predicted appreciable effects to Blacktail Creek. Due to planned road obliteration projects, a net reduction in long-term sediment production was predicted.

f. Thompson Park Salvage Proposal: No appreciable effects to Blacktail Creek. Much of the proposed harvest exists on dry ground that will likely be helicopter yarded. Harvest near streams must comply with INFS standards and guidelines.

2.a. DNRC salvage logging: No appreciable effects to Herman Gulch. The area proposed for harvest was examined during the summer of 2003. The likelihood of sediment delivery to Herman Gulch is low due to the distance between the unit and the stream.

b. Private land salvage logging: No appreciable effects to Blacktail or Lower Basin Creeks. Harvest on private lands has been scattered areas on dry slopes at lower elevations. The potential for sediment delivery is very low.

3.a. CD Trail: No appreciable effects for all watersheds, as the trail is mostly located on ridgetop areas far from streams.

b. Bear Gulch Trail: Trail improvements should reduce erosion and sedimentation, but no appreciable effects are expected for any analysis watershed due to the small-scale nature of the project.

c. Herman Gulch Road: Conversion to trail and restoration activities planned for the upper watershed would have appreciable effects in improving riparian function by reducing sediment and allowing recovery of riparian areas presently badly gullied in the upper reaches of Herman Gulch Creek.

4. Livestock Grazing: This activity is considered under Existing Condition.

5. Rural homes: Considered in the Existing Condition. No appreciable changes in home density are expected, meaning no change in effects for all watersheds.

6. BSBWUD: While copper sulfate treatments may affect aquatic productivity in the lower reservoir, no appreciable effects to stream or slope stability are expected on Lower Basin Creek. The reduction in flow in Lower Basin Creek due to municipal water use has created a non-functioning stream system as described in Existing Condition.

7.a.b.c.d.e. Special Use Authorizations: No appreciable effects for all watersheds as these permits involve actions too minor to affect water quality.

8. Noxious Weeds: While weeds can increase soil erosion and sedimentation, the limited amount of area affected by weeds means no appreciable effects for all watersheds.

9. Thompson Park and Blacktail Creek Watershed Restoration Plan: This proposal will have appreciable effects in terms of reduced sediment delivery to Blacktail Creek by mitigating or obliterating existing roads and trails.

10. Wright Mining Plane of Operations: The very minor work proposed on dry lands should have no appreciable effects on China Gulch.

11. Small Tracts Acquisition: While lands proposed for acquisition may receive better management under Federal ownership, measurable effects on Herman Gulch are not expected.

12. Mountain Pine Beetle infestation: Discussed in Effects Common to all Action Alternatives.

# ALTERNATIVE 1: NO ACTION

## Fuels Reduction/Timber Harvest and Road Construction

***Direct Effects:*** None. No stream crossings are proposed.

***Indirect Effects:*** None. No fuels reduction, harvest or road construction, reconstruction or obliteration is planned.

## Burning

***Direct Effects:*** None for prescribed fire. Because the consequences of not treating fuels will likely occur at a later time, there are no direct effects associated with no action.

***Indirect Effects***: None for prescribed fire. The probable long-term consequence of not treating fuels is a large fire event (see fuels write-up). The FARSITE fire model predicts a future risk (next 25 years) of a 5-day fire within the analysis area comprising an average of 5,157 acres. Discerning actual long-term effects from a major fire event is difficult due to variability in location of fire and fuel types, depending on the model run. The worst-case scenario would concentrate a major wildfire event in a sensitive watershed in heavy timber, namely Upper Basin Creek particularly above the upper reservoir. Appreciable changes in slope stability, runoff, and sediment may occur. WEPP model results predict the potential for 2.71 tons per acre of soil loss following a high severity fire, a representative figure for the entire analysis area. Wildfires burn indiscriminately without regards to mitigation normally associated with prescribed burning including buffer strips, fuel loading and burn severity. The structure and function of riparian areas has changed in many areas due to grazing, flow regulation, shifts in plant species composition and loss of beaver. This can lead to changes in fire behavior during drought and extreme fire weather within these riparian areas (Dwire and Kauffman, 2003, Naiman et. al. 1994). Post-wildfire effects concentrated within a particular watershed could have large effects in terms of sediment delivery. Under a worst-case scenario, WEPP predicts that a 5,157-acre fire could potentially deliver 3,400 tons of sediment to streams within Upper Basin. A best-case scenario would spread the fire on lower slopes (below 6400 feet) on low sensitive watersheds like Herman Gulch, China Gulch and Lower Basin Creek that have light fuel loadings (grass/sagebrush). All watersheds within the analysis area are at some risk of excessive sediment loads if 30 delete or more of its area receives a high severity burn.

Upper Basin is high risk to indirect effects of catastrophic fire; Blacktail Creek is moderate to high risk; and Lower Basin, China Gulch and Herman Gulch are low to moderate risk. Recovery of slope stability would occur within 5 years.

## Cumulative Effects

Upper Basin Creek: When effects of this alternative are added to the past and present effects which have caused shifts in stream stability due to flow augmentation from water diverted from Fish Creek, an increase in channel instability is likely, further degrading a non-functioning channel segment from the diversion input down to the lower reservoir. Recovery to pre-fire levels for channel stability may require 20 years or more.

Lower Basin Creek: The effects of a major fire event, when considered with the past and present effects of dewatering from municipal water use, would cause a downward trend in channel function for 10 – 20

years in a system currently non-functioning. Any increase in sediment delivery would undergo a slow rate of recovery in terms of sediment transport due to reduced streamflow in Basin Creek. No recovery above the non-functioning condition is expected at any time.

Blacktail Creek: The effects of catastrophic wildfire considered with the past and present effects of roads and reasonably foreseeable future effects of road and trail obliteration and reconstruction projects (#9) result in a downward trend in channel stability and riparian function is expected. In the event of a large wildfire, it may take 10-20 years for recovery of channel function to its present condition.

China Gulch: The effects of catastrophic wildfire considered with the past effects of livestock grazing, means a loss of channel stability is likely, along with a loss of wetland habitat in the lower reach where beaver dams presently exist. Functioning-at-risk reaches would likely degrade to a non-functioning status for a 10-20 year period following a catastrophic wildfire event.

Herman Gulch: The effects of catastrophic wildfire, when considered with the effects of past management activities associated with roads and reasonably foreseeable future positive effects of road obliteration and watershed restoration efforts within the upper watershed (#3.c.) may cause a downward trend of proper function in riparian areas for up to 10 years. Improvements in riparian function are expected after 10 years. Even in the event of catastrophic wildfire, some positive effect on riparian function from road obliteration and water restoration efforts should occur.

## ALTERNATIVE 2

This alternative treats a modest amount of fuels around the perimeter of the wildland urban interface (WUI). Consequently, it has relatively minor effect in preventing or reducing the impacts from a catastrophic fire as described under the No Action Alternative in one or more of the watersheds. See the Fire and Fuels section.

## Fuels Reduction/Timber Harvest and Road Construction

***Direct Effects:*** Four stream crossings proposed. Effects are similar as Effects Common to all Action Alternatives.

***Indirect Effects:*** The proposed road segments that run proximal (within 150 feet) of Herman Gulch and China Gulch exhibit some risk for sediment delivery to the stream channel. WEPP predicts about .05 to .10 tons/year delivered to China Gulch. Best Management Practices will be employed on all temporary roads, minimizing risk and complying with state water quality standards. The effects of remaining temporary roads are similar as Effects Common to all Action Alternatives.

## Burning

***Direct Effects:*** Effects for prescribed burning are similar as Effects Common to all Action Alternatives. Because the consequences of any catastrophic fire will likely occur at a later time, there are no direct effects.

***Indirect Effects***: Effects for prescribed burning are similar as Effects Common to all Action Alternatives. Effects for catastrophic wildfire are similar as Alternative 1.

Effects from wildfire are similar to Alternative 1 for Upper Basin and Blacktail Creek watersheds. Effects from wildfire are slightly less than those described in Alternative 1 for Lower Basin, China Gulch, and Herman Gulch watersheds.

## Cumulative Effects

Upper Basin Creek: Potential effects are similar to Alternative 1.

Lower Basin Creek: Potential effects are similar to Alternative 1.

Blacktail Creek: Potential effects are similar to Alternative 1.

China Gulch: Potential effects are similar to Alternative 1.

Herman Gulch: Potential effects are similar to Alternative 1.

# ALTERNATIVE 3

This alternative treats fuels around the perimeter of the WUI as in Alternative 2, along with additional treatments within China Gulch, Herman Gulch, Upper Basin and Lower Basin watersheds.

## Fuels Reduction/Timber Harvest and Road Construction

***Direct Effects:*** Two stream crossings proposed. Effects are similar to Effects Common to all Action Alternatives.

***Indirect Effects:*** Effects are similar as Alternative 2.

## Burning

***Direct Effects:*** Effects for prescribed burning are similar as Effects Common to all Action Alternatives. Because any consequences of catastrophic fire will likely occur at a later time, there are no direct effects.

***Indirect Effects***: Effects for prescribed burning are similar as Effects Common to all Action Alternatives. Effects from catastrophic fire would be relatively less than those described in Alternative 2, especially in Upper Basin, China Gulch and Herman Gulch. The effects in terms of preventing or reducing the impacts from a catastrophic fire as described under Alternative 1 is greater in these four watersheds than in Alternative 2.

Effects from wildfire as described in Alternative 1are moderately reduced for Upper Basin, appreciably reduced for China Gulch and Herman Gulch, and the same as effects described in Alternative 1 for Lower Basin and Blacktail.

## Cumulative Effects

Upper Basin Creek: When effects from wildfire are considered with past and present effects from flow augmentation associated with the Fish Creek diversion, some threat in terms of further loss of channel

stability exists for functioning-at-risk and non-functioning stream reaches. Any loss of channel stability may take 20 years to return to a pre-fire condition.

Lower Basin Creek: Potential effects are similar to those described in Alternative 1.

Blacktail Creek: Potential effects are similar to Alternative 1.

China Gulch: Effects from a catastrophic fire occur as described in Alternative 1 when considered with past effects from livestock grazing would be appreciably less than all other alternatives. This means that threats to channel stability and riparian function are best minimized under this alternative. An upward trend in riparian function is most likely under this alternative.

Herman Gulch: Effects from a catastrophic fire occur as described in Alternative 1 when considered with past effects from roads and foreseeable future positive effects of road obliteration and watershed restoration would be appreciably less than under Alternatives 1 and 2. Improvements in riparian function due to restoration activities (#3.c.) would occur whether or not a wildfire occurs.

# ALTERNATIVE 4

This alternative treats most of the fuels as in Alternative 3, along with additional treatments within Upper Basin, Lower basin, Herman Gulch and Blacktail watersheds.

## Fuels Reduction/Timber Harvest and Road Construction

***Direct Effects:*** Two stream crossings proposed. Effects are similar as Effects Common to all Action Alternatives.

***Indirect Effects:*** The road segment proximal (within 150 feet) of Herman Gulch exhibit some risk for sediment delivery to the stream channel. WEPP predicts about 0.2 tons/year delivered to Herman Gulch. Best Management Practices will be employed on temporary roads, minimizing risk and complying with state water quality standards. The remaining effects are the same as Effects Common to all Action Alternatives

## Burning

***Direct Effects:*** Effects for prescribed burning are similar to Effects Common to all Action Alternatives. Because the consequences of catastrophic fire will likely occur at a later time, there are no direct effects.

***Indirect Effects***: Effects for prescribed burning are similar as Effects Common to all Action Alternatives.

The effects in terms of preventing or reducing the impacts from a catastrophic fire as described under Alternative 1 is relatively greatest for all watersheds except China Gulch. Appreciable reductions in effects of catastrophic wildfire as described in Alternative 1 are realized for Upper Basin, Lower Basin, China Gulch and Herman Gulch. No appreciable reduction in effects is expected for Blacktail Creek.

## Cumulative Effects

Upper Basin Creek: The effects of this alternative, when considered with past and present effects of flow augmentation, offers the least threat in terms of further loss of channel stability of all alternatives. No change from existing condition is expected for the functioning-at-risk and non-functioning reaches.

Lower Basin Creek: The effects of this alternative, when considered with past and present effects of flow reduction, offers the least threat in terms of further loss of channel stability of all alternatives. No change is expected in the non-functioning reach.

Blacktail Creek: Effects are similar to Alternative 1.

China Gulch: The effects of catastrophic fire occur when considered with the past effects of grazing means the loss of channel stability and proper functioning status would be appreciably less than all other alternatives except Alternative 3. An upward trend in riparian function is likely under this alternative.

Herman Gulch: The effects of catastrophic fire, should it occur, when considered with past and present effects of roads and reasonably foreseeable future actions of restoration, means the loss of riparian function would likely be much less than Alternatives 1 and 2, and slightly less than Alternative 3. Improvements in riparian function due to restoration activities (#3.c.) should occur whether or not a wildfire happens.

# ALTERNATIVE 5

This alternative treats fuels similar to Alternative 4, except without treatments within the roadless. This reduces treatment acres substantially in Upper Basin and Lower Basin watersheds. The remaining watersheds have treatments very similar to Alternative 4.

## Fuels Reduction/Timber Harvest and Road Construction

***Direct Effects:*** Two stream crossings proposed. Effects are similar as Effects Common to all Action Alternatives.

***Indirect Effects:*** Similar to effects in Alternative 4.

## Burning

***Direct Effects:*** Effects for prescribed burning the same as Effects Common to all Action Alternatives. Because the consequences of catastrophic fire will likely occur at a later time, there are no direct effects.

***Indirect Effects***: Effects for prescribed burning the same as Effects Common to all Action Alternatives. The effects in terms of preventing or reducing the impacts from a catastrophic fire as described under Alternative 1 is similar to Alternative 4 for Blacktail, China Gulch, and Herman Gulch watersheds. For Upper and Lower Basin watersheds, the effects are similar to Alternative 3.

## Cumulative Effects

Upper Basin Creek: The effects of this alternative, when considered with past and present effects of flow augmentation, ranks second among all alternatives in terms of reducing the risk or threat of further loss of channel stability. No change from existing condition is expected for functioning-at-risk and non-functioning reaches.

Lower Basin Creek: Potential effects are similar to those described in Alternative 2.

Blacktail Creek: Potential effects are similar to those described in Alternative 4.

China Gulch: Potential effects are similar to those described in Alternative 4.

Herman Gulch: Potential effects are similar to those described in Alternative 4.

# SUMMARY OF EFFECTS BY ALTERNATIVE

The relative effectiveness of fuel treatments in each alternative for all watersheds was analyzed by dividing the total treatment acres by watershed acres. The results are displayed in Figure 3.32 below. This provides a general analysis of the reduction in risk to the occurrence of a catastrophic wildfire event, or by reducing fire behavior should a fire occur on an individual watershed basis. Because fire can start and then spread into surrounding watersheds, there may be some reduction in risk from treatments in adjacent watersheds not accounted for in this analysis. For example, the increased ability to suppress a fire in a nearby treated watershed may prevent spread into a non-treated watershed.

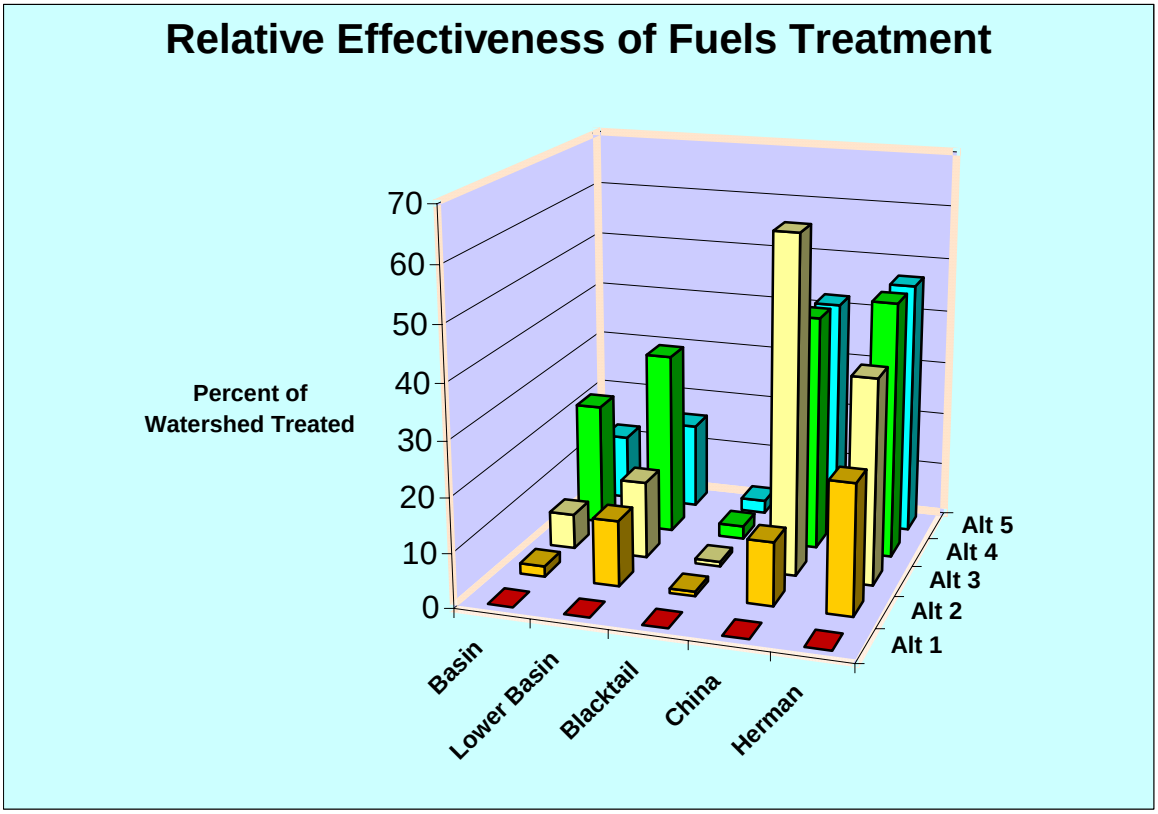


Figure 3.32

# CONSISTENCY WITH LAWS, REGULATIONS AND POLICY

Considering short-term consequences, each alternative will be consistent with Forest Plan water resource standards, Clean Water Act, State Water Quality standards and management requirements listed in 36 CFR 219.27 (a), (b), (e), and (f). (See Regulatory Framework in Chapter III, Hydrology). Long-term consequences may result in increased erosion and sedimentation under the No Action Alternative and to a similar or lesser degree under the Action Alternatives, depending on the effectiveness of fuel treatments for a particular watershed. Because predicting long-term fire risks and post-fire consequences in absolute terms is not possible, ascertaining consistency within the regulatory framework can only be done in relative terms as described under cumulative effects for each alternative.