INTRODUCTION

Resource of concern

Water Quality

Methodology

Measures/indicators

Stream Sediment

Stream sediment levels are a useful indicator of water quality in streams, wetlands, lakes and ponds (collectively referred to as surface waters), particularly with respect to stream channel stability and impacts on aquatic organisms. The greatest potential for negative sediment effects associated with the type of project proposed would be from increased sediment delivery to project streams due to increased log haul traffic on road (personal communication, K. Weinner, B-D Forest Hydrologist).

Surface Water Quantity

The primary way that timber harvest can influence water quantity is by removal of live vegetative cover to such an extent that it causes an increase in intensity and/or duration of stream run-off. Increased runoff intensity and duration has the potential to adversely affect stream function/stability and stream sediment levels through sediment deposition and increased channel bed and bank erosion.

Effects on Water Quality Impaired Streams

Forest management activities such as timber harvest, temporary road building, and increased traffic on existing roads have the potential to exacerbate existing water quality problems in streams classified as impaired and streams for which sediment or nutrient TMDLs have been developed.

Spatial and Temporal Scales

***Spatial Scale* -** Direct/Indirect and Cumulative Effects analysis areas.

For the purpose of water quality analysis the Project Area was treated as two discrete analysis areas, located roughly twenty miles apart, which are refered to as the Little Hogback Area and Meyers Area in this report.

The Little Hogback area lies entirely within the Upper Upper Willow Creek and Middle Upper Willow Creek HUC12 watersheds as shown in Table 1. These 12-digit Hydrologic Units (HU) are defined and maintained by the USGS in the Watershed Boundary Dataset (WBD). Within these HUC12 watersheds, the subwatersheds in which harvest and/or haul activities would take place were analyzed for direct/indirect and cumulative effects. These subwatersheds include: Beaver Creek, Bear Creek, Alder Gulch, Niles Gulch, Homestake Gulch, Deadwood Gulch, Cowan Gulch, Baboon Gulch, Miners Gulch, Cowan Gulch, Sawpit Gulch, Scotchman Gulch, several unnamed gulches, and Upper Willow Creek. In addition, potential downstream effects on Willow Creek and Rock Creek were assessed.

The Meyers Area lies within six HUC12 watersheds (Table 1). Within these HUC12 watersheds, the subwatersheds in which harvest and/or haul activities would take place were analyzed for direct/indirect and cumulative effects. These subwatersheds include: Lutz Creek, Copper Creek, Middle Fork Rock Creek, Senate Creek, Green Canyon Creek, and a tributary to Moose

Meadows Creek. In addition, potential downstream effects on Middle Fork Rock Creek and Rock Creek were assessed.

Table 1. HUC-12 watersheds that contain the Proposed Project Area.

Area	HUC-12 Watershed Name	HUC12Subwatershed Number
Little Hogback	Upper Upper Willow Creek	170102021102
Little Hogback	Middle Upper Willow Creek	170102021103
Meyers	Carpp Creek	170102020803
Meyers	Middle Ross Fork	170102020902
Meyers	Lower Middle Fork Rock Creek	170102020805
Meyers	Middle Middle Fork Rock Creek	170102020804
Meyers	Upper Middle Fork Rock Creek	170102020802
Meyers	Copper Creek	170102020801

Temporal Scale

The temporal context for the effects analysis is defined to accommodate fisheries as a beneficial use. Short term is considered to be 3 years or less. Long term is considered longer than 3 years.

Measurable sedimentation generated from increased traffic on project roads is considered short term, since any effects would likely be gone 1 year after hauling is completed. Measurable levels of sedimentation from ground disturbance related to harvest in timber units could persist for longer periods (Cline et al, 1991; Elliot et al, 1994). Based on Cline et al (1991) it was assumed for this analysis that the effects of harvest would persist for approximately six years after harvest operations cease.

Methodology for the analysis

The potential for the proposed timber harvest to measurably increase sedimentation to surface waters was addressed through assessment of the effectiveness of the Riparian Conservation Areas (RCAs) to provide effective filtration of harvest-related sediment. RCAs are defined on page 300 of the Beaverhead-Deerlodge Forest Plan, from here on referred to as the Forest Plan (USDA FS 2009). This assessment was based on fire severity mapping of the project area, RCAs widths prescribed by the Forest Plan, and on documented effectiveness of burned hillslope buffers in the montane environment.

The potential for increased road traffic (due to log haul) to increase sedimentation to surface waters was addressed by field identification and survey of road-sourced sediment delivery points and analysis of the survey data using the WEPP:Road model. Analysis results were used to predict the effects of increased project-related road traffic and the off-setting effects of prescribed road BMPs. Details of this assessment methodology and a description of the WEPP:Road model are included in the project record.

The potential for the project to affect water quantity was assessed based on existing post-fire stand conditions (i.e., tree mortality due to recent wildfires) and on the proposed harvest plan.

Potential effects on identified water quality listed streams were assessed based on the results of the sediment and water quantity analyses and the proximity of the project to water quality listed

streams.

Required Design Features

Riparian Conservation Areas

1. Salvage operations will avoid Riparian Conservation Areas (RCAs) and seasonally wet areas to meet Forest Plan standards for aquatic resources. Exceptions include where tree removal is needed to address threats or hazards to public safety or infrastructure, or where it is necessary to access salvage areas outside of the RCAs via temporary roads or skid trails. The Forest soil scientist, hydrologist, and fisheries biologist will work with the project implementation team to protect these areas prior to sale layout and preparation.
2. RCA width for fish bearing streams would be 300 feet slope distance from both sides of channel in accordance with the Forest Plan.
3. Forest Plan specified RCA widths for other water bodies and wetlands vary from 50-150 feet depending on the situation. To ensure effective sediment filtration adjacent to water bodies and wetlands the following rule would be followed: where specified Forest Plan RCA widths are less than 150 feet additional buffer width will be added such that the RCA width plus the additional buffer width totals 150 foot.
4. Project related storage of fuels and toxicants within Riparian Conservation Areas is prohibited. Refueling within Riparian Conservation Areas is prohibited except for emergency situations, in which case refueling sites must have an approved spill containment plan and appropriate spill kits (USDA FS 2009, p 21).

Best Management Practices

5. Standard Best Management Practices for Forestry in Montana (DNRC, 2006a) including Montana SMZ compliance rules (DNRC, 2006b) would be applied during design and implementation of harvest activities.
6. Timber operations would avoid wetland areas. No mechanical entry to wetlands or deposition of materials into wetlands would be permitted.
7. Road surfaces and drainage would be improved to protect water quality and fisheries. Federal road segments used for haul would be required to have BMP's installed before timber haul use. BMP's would include adequate road surface and ditch drainage, functioning ditches, adequate spacing of drain dips or ditch relief culverts, leadouts or drainage structures before stream crossings, road shaping to shed water off the surface and not into streams, and graveling of sediment point source locations where other drainage treatments may not be fully effective. All BMPs on haul routes would also be functional at the close of product removal activities.
8. Prior to log haul the road sediment sources connected to streams and floodplains (which have been identified by road sediment surveys) will be addressed through BMP maintenance and/or installation. These BMPs, which would include drive-able drain dips and other drainage features bracketing stream crossings, would be intentionally sited at locations adequately buffered from streams and wetlands such that sediment diverted from the road surface by BMPs would not be delivered to water bodies. These locations are listed in Table 2. In other cases, BMPs such as straw wattle or slash windrows would directly provide the sediment buffering.

Table 2. Road Sediment Delivery Points within Proposed Little Hogback and Meyers Project Areas.

Area	FS Road Number	BMP Location (nearest milepost)	BMP Location Description
Little Hogback	4325	16.5	Beaver Creek
	4325	16.5	Beaver Creek
	4325	16.7	Tributary to Beaver Creek
	4325	17.8	Bear Creek
	4325	18.1	Tributary to Upper Willow Creek
	4325	19.5	Tributary to Upper Willow Creek
	4325	20.5	Alder Gulch
	4325	21.5	Niles Gulch
	4325	22.1	Tributary to Upper Willow Creek
	5156	1.7	Tributary to Miners Gulch
	5156	2.2	Miners Gulch
	5156	2.4	Tributary to Miners Gulch
	5156	2.6	Tributary to Miners Gulch
	5156	3.0	Tributary to Miners Gulch
	5156	3.6	Baboon Gulch
	8730	0.0	Tributary to Upper Willow Creek
	8730	1.9	Sawpit Gulch
	8730	2.2	Roadside (Sawpit Gulch)
	8730	2.3	Roadside (Sawpit Gulch)
	8730	2.3	Roadside (Sawpit Gulch)
	8730	2.4	Roadside (Sawpit Gulch)
	78549	1.0	Tributary to Niles Gulch
Meyers	80	3.3	Roadside (Copper Creek)
	80	4.3	Roadside (Copper Creek)
	80	4.6	Tributary to Copper Creek
	5106	9.4	Tributary to Middle Fork Rock Creek
	5106	10.2	Roadside (Middle Fork Rock Creek)
	5106	10.5	Roadside (Middle Fork Rock Creek)
	5106	10.6	Roadside (Middle Fork Rock Creek)
	5106	12.8	Carpp Creek
	5107	1.0	Green Canyon Creek
	5107	1.0	Green Canyon Creek
	5121	0.3	Middle Fork Rock Creek
	5121	0.4	Middle Fork Rock Creek
	5121	3.0	Senate Creek
	5121	4.7	Tributary to Middle Fork Rock Creek
	5121	4.8	Tributary to Middle Fork Rock Creek
	5121	5.0	Tributary to Middle Fork Rock Creek
	8674	0.4	Tributary to Middle Fork Rock Creek

9. As part of log haul, short term BMP actions will be implemented on an as needed basis and would include silt fences, straw bales, or other temporary measures to prevent/reduce turbid water from reaching streams. Known sites where this added BMP protection would be implemented include the two temporary road segments that enter the RCA and terminate at Road 4325 in Sawpit Gulch (Little Hogback area).
10. Erosion control measures would remain functional until disturbed sites (roads, culverts, landings, etc.) are stabilized; typically for a minimum period of one growing season until vegetative cover stabilizes and reduces runoff potential. This would require regular inspection, in particular following rainfall events and prior to fall and spring runoff, and may require maintenance.
11. In the Meyers project area and for units 1-4 in the Little Hogback project area, all sediment generating activities including temporary road construction, BMP installation, and log skidding and hauling will occur between April 1 – October 15 during dry weather periods to protect spawning and rearing bull trout. As an exception, salvage activities (log skidding and hauling) within these areas are permitted to occur during winter when there is a minimum of 12 inches of compacted snow/ice and a minimum of six inches of frozen soil.
12. For snow removal: remove snow from the entire width of the road surface, including turnouts. If not possible, berms on the shoulder of the road shall have drainage holes that will be opened and maintained. Drainage holes shall be spaced as necessary to obtain satisfactory surface drainage without discharge on erodible fills and directed away from perennial channels. Remove snow, ice, and debris from ditches and culverts as needed so that the drainage the drainage system will function efficiently at all times. Flag and protect all culverts. Leave at least 2 inches of snow and ice to protect the road surface on all roads. Do not remove gravel or other surfacing material from the road surface.

Temporary Roads and Landings

13. Temporary roads will have water bars or other appropriate drainage structures to minimize erosion. Maximum cross drain spacing will be determined by the road grade using the following formula: 1,000 feet divided by the percent grade (i.e. 1,000 feet 5 percent results in maximum 200-foot spacing).

Stream Crossings

14. The proposed project does not include stream crossing culvert installation and replacement on haul routes. Any non-project stream culvert installation/replacement in the project area, including BAER treatment crossing upgrades, would be completed prior to log haul.
15. Road stream crossings would have an appropriate, minimum size culvert to assure proper drainage and would comply with the Standard Best Management Practices for Forestry in Montana (DNRC 2006a) including Montana SMZ compliance rules (DNRC 2006b). Temporary road culverts would be removed when harvest operations have been completed.
16. Water quality permits including the MFWP SPA 124 permit would be acquired by Beaverhead-Deerlodge NF prior to conducting any activity which proposes to modify the bed or banks of any stream. Instream work would be limited to July 15 - August 30, unless otherwise stated in the 124 permit.

Regulatory framework

The Forest Plan directs management to attain and maintain desired water quality, timing of runoff, and water yields to promote functioning riparian areas and aquatic ecosystems,

attain/maintain wetlands, and support native aquatic species. It also promotes reduction of sedimentation from roads.

The Forest Plan complies with the National Forest Management Act of 1976 (NFMA); the regulations for the National Forest Land and Resource Management Planning (36 CFR Part 291); and the National Environmental Policy Act (NEPA) of 1969.

The Clean Water Act ***(Federal Water Pollution Control Act of 1972 (Public Law 92-500) as amended in 1977 (Public Law 95-217) and 1987 (Public Law 100-4))*** regulates federal actions, which may affect water bodies, regardless of their beneficial uses: The objective is to restore and maintain the chemical, physical, and biological integrity of our Nation's waters.

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

> 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.*"
>
> Non-numeric standards applied to Water Quality include:
>
> *f) No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318 ,*
>
> *d) The maximum allowable increase above naturally occurring turbidity is five nephelometric turbidity units (NTUs) except as permitted in 75-5-318 , MCA.*

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 finalizes them, making the 303(d) list part of the biennial Montana 305(b) Report.

Executive Order 11990 calls for the identification, assessment, and protection of wetlands by requiring Federal agencies to avoid, if possible, and practicable, adverse impacts to wetlands and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

AFFECTED ENVIRONMENT

Existing Conditions within the Analysis Area

The following sections describe existing conditions for hydrologic resources in the project area and include discussion of: general sub-watershed characteristics, analysis area, past management activities, mapped wetlands, and water quality descriptions. Project implementation is expected to commence in Fall 2018. Therefore, the existing condition descriptions for water resources include both the effects of the recent wildfires and the expected watershed response to the 2018 spring runoff and summer thunderstorm season.

Analysis Area

As mentioned previously the proposed project would take place within two distinct areas. The Little Hogback project area lies within the southern portion of the John Long Mountains approximately 12 miles west northwest of Philipsburg. The topography is characterized by relatively gentle mountainous topography derived primarily from granitic parent material. The Meyers project straddles the southern end of the north-south trending Sapphire Mountain Range and the northern portion of the Pintler Range, approximately 25 miles south southwest of Philipsburg. Parent material in the area is Belt Series quartzites, with granitic inclusions.

Topography of the Meyers project area is generally more rugged than the Little Hogback area. Within the Little Hogback and Meyers areas stream peak flow is driven by spring snowmelt, and groundwater contributions maintain the base flows throughout the fall and winter. As is typical for mountain streams, larger streams within the project area are perennial in their lower reaches and ephemeral and/or intermittent in headwaters areas.

Wildfire History

2017 Wildfires

The Little Hogback and Meyers fires occurred during the summer of 2017 on the Pintler Ranger District of the Beaverhead-Deerlodge National Forest. The Little Hogback fire burned approximately 12,913 acres of Forest Service managed land in an area generally covered by Douglas fir and lodgepole pine stands on the lower and middle elevations with white bark pine in the upper zones. The Meyers fire burned about 49,412 acres on the Beaverhead-Deerlodge National Forest, with much of that occurring in the Anaconda Pintler Wilderness and the Sapphire Wilderness Study Area. This area is forested primarily with a mix of Douglas fir, spruce/fir, and lodgepole pine with whitebark pine on the upper slopes. Also present are scattered ponderosa pine, engelmann spruce, sub-alpine fir, and other species. Limber pine is known to occur in the southern most reaches of this area.

Little Hogback Fire burn severity was high within 4% of the proposed Little Hogback project area, moderate within 18% of the area, and low within 56% of the area (Table 3). In headwater areas lying upstream from the project area boundary high and moderately burned areas were generally more extensive than within the project area. Based on estimated mortality maps, 37% of the pre-fire forest cover within the Little Hogback project area is currently dead or dying due to the effects of the 2017 wildfire (Table 3).

The Meyers Fire burn severity was high within 0.5% of the proposed Meyers project area, moderate within 26% of the area, and low within 19% of the area (Table 3). Based on estimated mortality maps, 24% of the pre-fire forest cover within the Meyers project area is currently dead or dying due to the effects of the 2017 wildfire (Table 3).

Table 3. Burn Severity within Proposed Little Hogback and Meyers Project Areas.

Area	Percent of Project Area High Severity Burn	Percent of Project Area Moderate Severity Burn	Percent of Project Area Low Severity Burn	Percent of Project Area Unburned	Estimated Percent Reduction in Forest Cover within Project Area due to 2017 Wildfire
Little Hogback	4	18	56	22	37
Meyers	0.5	26	19	55	24

Other Recent Wildfires

Due to their relatively recent occurrence and large size, several other past wildfires may still effect water yield and/or peak flows within the project area. In the Little Hogback project area the Fisher Point Fire of 2007 burned approximately 35% of the Beaver Creek and 25% of the Bear Creek subdrainages in the Little Hogback project area. Aerial photos from 2014 indicate a high tree mortality rate from this fire.

The Meyers project was affected by the Coyote Fire in 2000, Table Mountain Fire in 2009, and Moose Meadows Fire in 2013.

Past and Current Management Activities

Livestock grazing, range improvements, mining, irrigation diversion, noxious weed control, dispersed recreation, motorized vehicle use on roads and trails, commercial timber harvest, firewood cutting, prescribed burning, wildfire, wildfire suppression and rehabilitation are all activities that have occurred within the project area and/or the hydrology cumulative effects analysis area.

There are numerous roads, both on private and NFS lands within the analysis area. Roads that have been constructed for past timber harvest, mining activity and livestock grazing exist across the project area. Maintenance of forest roads by the Forest Service occurs across the project area.

Timber harvest has occurred within the analysis area in the past. Effects of past timber harvest may have included increases in stream sediment and water yield, the residual effects of which may still be present.

Water Quality

Wildfire is known to effect watershed processes including overland flow, stream discharge, soil erosion, and sedimentation processes (DeBano et al, 1998). Over the next 5-10 years the effects of the 2017 wildfires on water quality and quantity issues will be additive with, and likely overshadow, effects of past human activities and natural disturbance on water quality within the project area. Thus, the effects of the 2017 wildfires formed the basis of existing condition and effects analyses presented in this report. The descriptions, results, and conclusions presented below would not be substantively altered by adding in the effects of past disturbance or the 2017 wildfire suppression, post-suppression, or BAER activities.

Sediment

As stated above, although sediment effects of past wildfires and management activities may still be present in the project area it is expected that the 2017 wildfires will exert an overriding influence upon the existing surface water sediment conditions in the project area at the time of proposed project implementation.

Watersheds affected by wildfire typically yield large amounts of post-fire sediment (Troendle et al, 2010). Post-fire reports prepared for the Little Hogback and Meyers project areas in fall 2017 predicted increased post fire soil erosion and runoff that might result in localized flooding, scouring and/or deposition of materials in surface waters (USDA-BDNF, 2017a; USDA-BDNF, 2017b). The reports also noted that recovery of pre-fire slope stability and watershed hydrologic response is dependent on many factors and typically occurs within 3-5 years following the fire.

Principal factors that will influence the effects of the 2017 fires on surface water sedimentation include burn severity, post-fire vegetative recovery rates, and precipitation patterns. Given that high and

moderate severity burn covered 22-26 percent of the Little Hogback and Meyers project areas, it is likely that sediment delivery to local surface waters will significantly increase beginning in spring 2018 and remain at high levels for 3-5 years as stated in post-fire reports. Lingering effects of the resulting increased in-stream sediment levels on stream morphology and aquatic habitat may persist for decades (Leonard et al. 2017). In addition, because sediment can be a carrier of nutrients (particularly phosphorus) instream sediment-related nutrient levels can be expected to increase in local streams due to post-fire increases in sediment delivery to streams.

Water Quantity

As stated above, effects of past wildfires and management activities on water quantity may still be present in the project area at the time of proposed project implementation. However it is assumed that the 2017 wildfires will exert an overriding influence upon the existing surface water quantity in the project area at the time of project implementation.

The primary way that timber harvest can influence water quantity is by removal of live forest cover substantially enough to increase the intensity and/or duration of stream run-off. In a benchmark study Hibbert (1967) reviewed 39 watershed studies that examined the effect of forest cover removal (primarily by timber harvest) on water yield and concluded that "reduction of forest cover increases water yield" and "establishment of forest cover on sparsely vegetated land decreases water yield." Increased runoff duration and/or intensity (i.e., peak flows) has the potential to adversely affect stream function/stability and sediment levels through increased channel bed and bank erosion and associated sediment deposition.

This does not mean, however, that any given reduction in forest cover will result in a *detectable* increase in water yield. Literature examining the effects of forest harvest practices on water yield has generally agreed that a minimum of 20 percent of the forest cover must be removed from a forested watershed in order to produce a detectable change in water yield (Hibbert, 1967; Bosch and Hewlett, 1982; Troendle, 1983). Analysis of water yield at the regional level suggests that the threshold for detectible change in water yield may be 15-20 percent forest cover removal in the Rocky Mountain/Inland Intermountain Region (MacDonald et al., 1997; Stednick, 1996).

As shown previously in Table 3, forest cover mortality in the 2017 fires is estimated to be 37% and 24% within the Little Hogback and Meyers areas, respectively. Based on the 2017 wildfire effects (additive with lingering effects from other recent fires and timber harvest) it is likely that water yield in some or all subwatersheds under existing conditions is measurably higher than it was before the 2017 fires. Because the Little Hogback and Meyers Fires affected varying portions of HUC12 watersheds, this conclusion also applies to the HUC12 watersheds in which they lie (Table 4). More specifically, it is possible that water yield in some or all subwatersheds under existing conditions is measurably higher than it was before the 2017 fires in the following HUC12 watersheds: Middle Upper Willow Creek; Middle Ross Fork; Carpp Creek; Middle Middle Fork Rock Creek; Upper Middle Fork Rock Creek; and Copper Creek.

Table 4. Areal Percentages of HUC12 Watersheds lying within Little Hogback and Meyers Fire Boundaries

HUC12 Watershed	Total Area of Watershed (acres)	Area within Little Hogback Fire (acres)	Area within Meyers Fire (acres)	Percent of HUC12 Watershed affected by fire
Upper Upper Willow Cr.	17,603	2,859	0	16%
Middle Upper Willow Cr.	19,287	11,965	0	62%
Carpp Cr.	11,355	0	4,074	36%

HUC12 Watershed	Total Area of Watershed (acres)	Area within Little Hogback Fire (acres)	Area within Meyers Fire (acres)	Percent of HUC12 Watershed affected by fire
Middle Ross Fork	25,004	0	4,882	20%
Lower Middle Fork Rock Cr.	20,898	0	159	1%
Middle Middle Fork Rock Cr.	13,982	0	9,380	67%
Upper Middle Fork Rock Cr.	14,065	0	11,094	79%
Copper Cr.	17,818	0	13,999	79%

Similar to water yield, peak flow increases are thought become detectible once 15-20 percent of forest cover is removed from a watershed (MacDonald et al., 1997; Stednick, 1996; Troendle et al, 2010). Thus, based on the 2017 wildfire effects (additive with lingering effects from other recent fires and timber harvest) it is likely that peak flows in some or all subwatersheds under existing conditions are measurably higher than they were before the 2017 fires. In addition, timing of runoff may be altered (occur slightly earlier) due to effects of the fire on snowpack distribution and melt rate (Peterson et al, 2009). Because the Little Hogback and Meyers Fires affected varying portions of HUC12 watersheds, this conclusion also applies to the HUC12 watersheds in which they lie (Table 4). More specifically, it is possible that peak flows are higher, and runoff timing earlier,in some or all subwatersheds under existing conditions than prior to the 2017 fires within the following HUC12 watersheds: Middle Upper Willow Creek; Middle Ross Fork; Carpp Creek; Middle Middle Fork Rock Creek; Upper Middle Fork Rock Creek; and Copper Creek.

A hydrologic recovery period of approximately 30 years (Tobin-Scheer, 1992) can be assumed for water yield in the forest/landscape type found in the assessment area. This recovery does not proceed in a linear fashion, however, and in the case of water yield about 50% of the recovery can be expected to take place within the first 10 years after harvest. It can be assumed that hydrologic recovery with respect to peak flow increase and runoff timing would follow a similar timeline.

As discussed in the Existing Conditions section, tree mortality associated with the 2017 wildfires (plus past management activities and wildfire) will likely result in water yield and peak flows being measurably higher than pre-fire levels in some or all project area subwatersheds and some HUC12 watersheds. In addition, spring runoff may occur slightly earlier. In the absence of future management activity or natural disturbance any existing increase in water yield or peak flows, or change in runoff timing, would decrease naturally over time as forest cover regenerates, and would be expected to disappear completely within approximately 30 years.

Impaired Water Bodies and TMDL Streams

There are two TMDL listed and one 303(d) listed water bodies in or near the project area watersheds which could potentially be affected by project activities (MDEQ, 2013). Those streams include Upper Willow Creek, which is included on the 2016 Montana 303(d) list of water quality limited water bodies (MDEQ, 2016), and Miners Gulch and Scotchman Gulch for which TMDLs have been developed (Table 5). Both Miners Gulch and Scotchman Gulch have sediment TMDLs. Although it is classfied as impaired, identified impairments for Upper Willow Creek result from pollution categories that do not require a TMDL (Table 5).

As stated above, it is likely that sediment levels in local surface waters (which includes

impaired water bodies and TMDL streams) will significantly increase beginning in spring 2018, with continued heightened post-fire sediment delivery expected to continue for approximately 6 years. The effects of this increase in stream sediment on stream morphology and aquatic habitat may persist for decades (Leonard et al, 2017). Because sediment can be a carrier of nutrients (particularly phosphorus) instream sediment-related nutrient levels may increase in local streams due to expected large post-fire increases in sediment delivery to streams.

In addition, water yield and peak flows will likely be measurably higher than pre-fire levels in some or all project area subwatersheds and some HUC12 watersheds. Such increases in water yield or peak flows would recover (decrease) naturally over time as forest cover regenerates, with full recovery from the 2017 fire effects expected in approximately 30 years.

Table 5. Water bodies within or in close proximity downstream of the project area that are on the 2016 Montana 305(b) Report's 303(d) list or have TMDLs.

Waterbody and Description	Water Quality Category	TMDL Status	TMDL Pollutant Category	TMDL Pollutant Category (for Miner Creek and Scotchman Gulch) Impairment Cause Name (for Upper Willow Creek)	Impairment Source Name
Miners Gulch	4A*	Approved 2014	Sediment	Sediment	Grazing in Riparian or Shoreline Zones. Impacts from Abandoned Mine Lands. Silviculture Activities.
Scotchman Gulch	4A*	Approved 2014	Sediment Nutrients Metals	Sediment Nitrogen and Phosphorus (Total) Aluminum	Agriculture, Forest Roads, Placer Mining, Rangeland Grazing, Silviculture Harvesting. Grazing in Riparian or Shoreline Zones. Impacts from Abandoned Mine Lands
Upper Willow Creek	4C**	N/A	N/A	Alteration in streamside littoral or vegetative covers. Low flow alterations. Physical substrate habitat alterations	Grazing in riparian or shoreline zones. Irrigated crop production.

* All TMDLs required to mitigate identified impairments or threats have been completed and approved.

** Identified threats or impairments result from pollution categories that do not require a TMDL, such as dewatering or habitat modification.

Wetlands

An assessment of existing wetland type and extent was carried out using wetland and riparian mapping information obtained from the Montana Heritage Heritage Program Website (http://mtnhp.org/nwi/). In the creation of these maps, wetlands were identified and classified using the Cowardin classification system (Cowardin, 1979) adopted by the National Wetland Inventory. There are a total of 492.5 acres of mapped wetlands within the project area. No known wetlands lie within the proposed harvest unit boundaries. Wetland types and acreages are shown in Table 6.

Table 6. Summary of Mapped Wetlands in the Project Area

Area	Wetland Types					
	Freshwater Scrub-Shrub (acres)	Freshwater Emergent (acres)	Freshwater Forested (acres)	Riverine (acres)	Lake (acres)	Total (acres)
Little Hogback	0	41.5	1.6	0	0	43.1
Meyers	164.0	247.4	2.1	13.2	22.7	449.4

ENVIRONMENTAL CONSEQUENCES

Past, Present, and Future activities used in the Analysis

Livestock grazing, range improvements, mining, irrigation diversion, noxious weed control, dispersed recreation, motorized vehicle use on roads and trails, commercial timber harvest, prescribed burning, fuels treatments, wildfire, wildfire suppression/rehabilitation and BAER treatments are all activities that are occurring; have recently occurred or are likely to occur in the near future, within the project area and/or the hydrology cumulative effects analysis area. Wildfire suppression, post-suppression, and BAER treatments for the 2017 wildfires are expected to be completed prior to commencement of the proposed project activities and were therefore considered past activities in this analysis.

Alternative 1

By definition, direct and indirect effects (40 CFR 1508.8), and cumulative effects (40 CFR 1508.7) result from the proposed action alternatives and thus are not germane to the No Action alternative.

Sediment

As discussed in the Existing Conditions section the 2017 wildfires resulted in high and moderate severity burn covering 22-26 percent of the Little Hogback and Meyers project areas (Table 3). As a result of the fire, it is likely that sediment levels in local surface waters will significantly increase beginning with spring runoff in 2018. Under the Alternative 1 this wildfire-caused increase in surface water sediment levels would recover (decrease) naturally over time. Effects on stream morphology and aquatic habitat may persist for decades (Leonard et al, 2017).

Water Quantity

As discussed in the Existing Conditions section, tree mortality associated with the 2017 wildfires (plus past management activities and wildfire) will likely result in water yield and peak flows being measurably higher, and spring runoff slightly earlier, than pre-fire levels in some or all project area subwatersheds and some HUC12 watersheds.

Under Alternative 1 any existing increase in water yield or peak flows would recover (decrease) naturally over time as forest cover regenerates, with full recovery from the 2017 fire effects

expected in approximately 30 years.

Impaired Water Bodies and TMDL Streams

As a result of the 2017 wildfires the local TMDL streams (Miner and Scotchman Gulch) and 303(d) listed stream (Upper Willow Creek) are likely to be affected by increased sediment and/or secondary effects of water quantity increases such as adverse affects on stream function and stability. Such effects may persist for decades.

As mentioned previously, sediment can be a carrier of nutrients (particularly phosphorus) and instream sediment-related nutrient levels in local streams may increase due to expected large post-fire increases in sediment delivery to streams.

Alternative 2 (Proposed Action)

Sediment

As in Alternative 1, and to the same degree:

- It is likely that sediment levels in local surface waters will significantly increase beginning with spring runoff in 2018, with continued heightened post-fire sediment delivery expected to continue for approximately 3-5 years.
- This wildfire-caused increase in surface water sediment levels would recover (decrease) naturally over time.
- Effects of increased sedimentation on stream morphology and aquatic habitat may persist for decades (Leonard et al, 2017).

The following text describes additional potential effects due to implementation of Alternative 2

Sediment from Harvest Units

Recent field study of the sediment buffering effectiveness of burned hillsides concluded that a buffer width of 200 feet provides effective sediment filtration under high burn severity conditions (after the passage of one growing season) while a buffer width of 100 feet provides effective sediment filtering in low burn severity areas (Bone, 2017). By interpolation it can be assumed that a buffer width of 150 feet would provide effective sediment buffering on moderately burned hillslopes after one growing season.

The buffering capacity of the areas lying directly downslope from proposed harvest units was assessed in light of the recommended buffer widths from Bone (2017). In all such locations the area between proposed units and water bodies/wetlands was either unburned or was a combination of unburned, low severity burned, and/or moderate severity burned areas. In these locations a 150 foot buffer from water bodies and wetlands would be expected to provide an effective buffer preventing harvest-related sediment from reaching streams (Bone, 2017).

Salvage operations would avoid Riparian Conservation Areas (RCAs). RCA width for fish bearing streams would be 300 feet slope distance from both sides of channel in accordance with the Forest Plan. Forest Plan specified RCA widths for other water bodies and wetlands vary from 50-150 feet depending water body classification. **To ensure effective sediment filtration adjacent to water bodies and wetlands the following Design Criteria would be applied:**

where specified Forest Plan RCA widths are less than 150 feet additional buffer width would be added such that the RCA width plus the additional buffer width totals 150 foot.

Because the streamside and wetland sediment buffers provided by the RCAs and added buffers are expected to effectively trap sediment related to logging activities, any increase in sediment levels in water bodies and wetlands due to project harvest activities would be non-existent or non-measureable.

Sediment from Existing Roads

Road-sourced sediment concerns focused on potential water body/wetland sediment increases due to BMP installation, increase in traffic on Forest roads during log haul, road maintenance,and construction/use/decomissioning of temporary project roads. The Proposed Action does not include any culvert replacement on any perennial streams.

BMP Installation

BMPs that resulted from road sediment data collection and analysis are included in Design Feature #8 presented in the Design Features section of this report. These BMPs, which would include drive-able drain dips bracketing stream crossings, would be intentionally sited at locations adequately buffered from streams and wetlands such that sediment diverted from the road surface by BMPs would not be delivered to water bodies. In other cases, such as straw wattle or slash windrow installation, the BMPs themselves would provide the sediment buffering. Therefore, the relatively minor amount of sediment released by ground disturbance associated with BMP installation would occur in locations from which that sediment would be unlikely to reach streams. This heightened sedimentation potential would also be short termed (likely < 1 year) as road surfaces would become compacted relatively quickly by traffic and loose soil would be stabilized by moisture and regrowth of vegetative cover from roots and seed. Therefore, the potential sediment effects associated with installation of BMPs would be short-termed and the effects on sediment delivery to streams would be non-existent or non-measurable.

Existing Roads

Increased Road Traffic Due to Log Haul. As described in the Methodology section of this report, all of the project haul roads to be utilized by this project were surveyed, sediment delivery sites were identified, and the WEPP-Roads model was used to estimate sediment reductions that would be realized by installing/repairing road drainage features at the sediment delivery sites. BMP installation at the identified sediment delivery sites prior to log haul is a required design feature. The location of BMP installation and calculated reductions in road-sourced sediment delivered to streams as a result of road BMPs is shown in Tables 7 and 8.

As shown in Table 7, Little Hogback Area haul road-sourced sediment delivery to streams during project implementation would be 15% less than under existing conditions. Long term (i.e., post-project) sediment delivery would be approximately 57% less than that which occurs under existing conditions. Thus, the required project road BMPs would considerably reduce the volume of road-sourced sediment entering project area streams compared to existing conditions, even during project implementation and associated log haul.

Similarly, Meyers Area haul road-sourced sediment delivery to streams during project implementation would be approximately 66% less than under existing conditions. Long term sediment delivery would be approximately 81% less than that which occurs under existing conditions (Table 8). Thus, the required project road BMPs would considerably reduce the volume of road-sourced sediment entering project areas streams in the Meyers Area as compared to existing conditions, even during project implementation and associated log haul.

Table 7. Summary of WEPP-Road Model Output for Little Hogback Area

Road Number	Mile-post*	Sediment Delivery Existing Condition (lbs/yr)	Sediment Delivery without BMP's during Haul (lbs/yr)	Estimated BMP Effective - ness (%)	Sediment Delivery with BMP's During Haul (lbs/yr)	Sediment Delivery with BMP's Post-Haul (lbs/yr)	Location Description
4325	16.5	3	5	75	1	0.8	Beaver Creek
4325	16.5	3	6	25	4	3	Beaver Creek
4325	16.7	86	174	75	44	22	Tributary to Beaver Cr.
4325	17.8	55	117	0	117	55	Bear Creek
4325	18.1	195	361	25	271	146	Tributary to Upper Willow Cr
4325	19.5	54	84	75	21	14	Tributary to Upper Willow Cr
4325	20.5	130	293	50	147	65	Alder Gulch
4325	21.5	27	45	0	45	27	Niles Gulch
4325	22.1	65	154	50	77	33	Tributary to Upper Willow Cr
5156	1.7	36	93	75	23	9	Tributary to Miners Gulch
5156	2.2	130	257	60	103	52	Miners Gulch
5156	2.4	32	80	75	20	8	Tributary to Miners Gulch
5156	2.6	41	80	80	16	8	Tributary to Miners Gulch
5156	3.0	19	37	75	9	5	Tributary to Miners Gulch
5156	3.6	54	147	75	37	14	Baboon Gulch
8730	0.0	95	40	75	10	24	Tributary to Upper Willow Cr
8730	1.9	25	65	60	26	10	Sawpit Gulch
8730	2.2	10	13	50	7	5	Roadside (Sawpit Gulch)
8730	2.3	1	1	65	0.5	0.3	Roadside (Sawpit Gulch)
8730	2.3	7	11	75	3	2	Roadside (Sawpit Gulch)
8730	2.4	2	3	70	1	0.5	Roadside (Sawpit Gulch)
78549	1.0	169	328	80	66	34	Tributary to Niles Gulch
Total Sediment Delivery (lbs/yr)		1239	2394		1050	538	

** Field adjustments may be made during BMP installation*

Table 8. Summary of WEPP-Road Model Output for Meyers Area

Road Number	Mile-post*	Sediment Delivery Existing Condition (lbs/yr)	Sediment Delivery without BMP's during Haul (lbs/yr)	BMP Effective-ness (%)	Sediment Delivery with BMP's During Haul (lbs/yr)	Sediment Delivery with BMP's Post-Haul (lbs/yr)	Location Description
80	3.3	20	32	50	16	10	Roadside (Copper Cr)
80	4.3	34	53	95	3	2	Roadside (Copper Cr)
80	4.6	118	186	80	37	24	Tributary to Copper Cr
5106	9.4	19	27	99	0.3	0.2	Tributary to Middle Fk Rk Cr
5106	10.2	21	36	40	22	13	Roadside (Middle Fork Rock Cr)
5106	10.5	26	43	40	26	16	Roadside (Middle Fork Rock Cr)
5106	10.6	88	148	50	74	44	Roadside (Middle Fork Rock Cr)
5106	12.8	19	30	75	8	5	Carpp Cr
5107	1.0	5	9	50	5	3	Green Canyon Cr
5107	1.0	22	43	70	13	7	Green Canyon Cr
5121	0.3	212	454	90	45	21	Middle Fork Rock Creek
5121	0.4	88	145	90	15	9	Middle Fork Rock Creek
5121	3.0	59	125	85	19	9	Senate Cr
5121	4.7	49	97	75	24	12	Tributary to Middle Fk Rk Cr
5121	4.8	69	138	90	14	7	Tributary to Middle Fk Rk Cr
5121	5.0	150	293	90	29	15	Tributary to Middle Fk Rk Cr
8674	0.4	45	87	90	9	5	Tributary to Middle Fk Rk Cr
Sum of Total Sediment Delivery (lbs/yr)		1044	1946		357	199	

** Field adjustments may be made during BMP installation*

Maintenance. Miscellaneous road maintenance activities such as road grading, ditch cleaning, and sediment trap cleanout can damage surface vegetation and loosen the soil surface, making the soil surface more vulnerable to soil detatchment and transport. This heightened sedimentation potential is short termed (likely < 1 year) as road surfaces would become compacted relatively quickly by traffic and loose soil on the margins of the road surface would be stabilized by moisture and regrowth of vegetative cover from roots and seed. Additionally, because Design Feature #8 specifically prescribes effective BMP implementation to mitigate sediment delivery at field-identified delivery points, most sediment related to maintenance activities will be shunted off the road prism at locations where it is adequately buffered from water bodies. In areas very near to stream crossings, where there would be higher potential for maintenance-related sediment to be delivered to streams, project design features would

include short term BMP actions to be implemented on an as needed basis including silt fences, straw bales, or other temporary measures to prevent/reduce turbid water from reaching streams. The combination of project BMPs described above would effectively make road maintenance-related sediment both minor/negligible and short-termed. This minor, short-termed increase in sediment delivery would be far outweighed by the long term benefits of BMP implementation detailed in Tables 8 and 9 and would be consistent with the Forest Plan requirements.

Temporary Roads

Temporary project roads would be located primarily on ridgetops and relatively low gradient hillsides and would be buffered by over 150 feet from water bodies (with the exception of two locations discussed below). There would be no stream crossings on temporary roads.

It would be necessary for temporary roads to enter streamside RCAs adjacent to Units 10 and 11 Sawpit Gulch in the Little Hogback Area. In this case three temporary roads would connect with existing Forest Service Road #8730 within the RCA. In accordance with project design feature requirements, BMPs would be installed at field-identified sediment delivery sites on Road #8730. In addition, as required by Design Criteria #9, short term BMP actions (such as straw wattles, slash windrows, or silt fence) would be installed as needed on the temporary roads and at the junction of the temporary roads with Road #8370 to prevent/reduce sediment from reaching streams.

Required project design features for all temporary project roads would include the following.

- In order to minimize ground disturbance and facilitate post-project rehabilitation, temporary roads would be constructed to the minimum standards necessary for log haul.
- Temporary road layout and construction would include water bars and/or other appropriate drainage structures to minimize erosion.
- After use, temporary roads would be rehabilitated by obliteration, in which the entire road prism would be re-contoured to match the existing ground contour. Slash, stumps, and woody debris would be placed on top of the corridor to effectively block vehicle travel and facilitate revegetation.

Because of prescribed temporary road location, construction practices, rehabilitation, and required project BMPs it is expected that temporary road-related sediment delivery to surface waters would be non-existent or non-measurable.

Sediment Summary

Based on analysis of sediment delivery to surface waters from harvest units and roads, Alternative 2 would have a net positive effect on stream sediment levels in both the Little Hogback and Meyers the project areas (and downstream areas) by considerably reducing the volume of road-sourced sediment entering local streams (Table 9). This net reduction of sediment would be present during project implementation and in the long term. The road-sourced sediment reductions would result from road BMP's being implemented at sediment delivery sites prior to log haul.

Water Quantity

Because the primary way that timber harvest can influence water quantity is by removal of live vegetative cover, and because Alternative 2 would involve removal of dead and dying trees (with

negligible removal of healthy trees), effects of Alternative 2 on water quantity would be non-existent or non-measurable (Table 9). Spring runoff might occur earlier than it would under Alternative 1 due to the effect of removal of salvaged trees on snowpack distribution and melt rate dynamics (Peterson et al, 2009; Winkler et al, 2017). Due to the multiple variables that affect runoff timing, any effects on runoff timing caused by Alternative 2 would likely not be detectible.

Table 9. Summary Table of Predicted Effects of Alternatives 1 and 2

Measure/ Indicator	Expected Existing Conditions in Fall 2018	Predicted Effects of Alternative 1	Predicted Effects of Alternative 2
Water Quality	Significantly increased stream sediment levels due to 2017 wildfires, with continued heightened post-fire sediment delivery expected to continue for approximately 3-5 years. Instream phosphorus and other nutrients in local streams also likely to increase as a result of the fires.	None	Net decrease in sediment delivered to water bodies: • Harvest activities, and temporary road construction/use/decommissioning would result in non-existent or non-measurable effects on stream sediment levels. • Sediment generated by BMP installation would be short-termed and the effects on sediment delivery to streams would be non-existent or non-measurable • Road BMPs installed prior to project implementation would result in considerable decreases in road-sourced stream sediment in both the short and long term.
Water Quantity	Water yield and peak flows would likely be measurably higher than pre-fire levels in some or all project area subwatersheds and some HUC12 watersheds.	None	Effects on water quantity would be non-existent or non-measureable. Spring runoff may occur slightly earlier than under Alternative 1 due to the effect of removal of salvaged trees on snowpack distribution and melt rate dynamics.
Effects on Water Quality Impaired Streams	As a result of the 2017 wildfires the local TMDL streams (Miner and Scotchman Gulch) and 303(d) listed stream (Upper Willow Creek) are likely to be affected by increased sediment and sediment-related nutrients and/or secondary effects of water quantity increases such as adverse affects on stream function and stability.	None	Neutral or net decrease (non-dectectable) in sediment and sediment-related nutrient levels in waterbodies, including those located downstream from the project areas.

Effects on identified water quality impaired streams

As stated previously, sediment analysis indicates that Alternative 2 would have a net positive effect on sediment delivery to surface waters from harvest units and roads in both the Little Hogback and Meyers areas. As a result Alternative 2 would be expected to have a neutral or slight positive effective on sediment and sediment-related nutrient levels in water bodies classified as impaired and streams for which sediment TMDLs have been developed, including streams located downstream from the project areas (Table 10). Given the expected significant, natural increase in sediment delivery to waterbodies throughout the project areas in the wake of the 2017 wildfires, it is not likely that any effects of Alternative 2 would be detectable.

Table 10. Expected effects on water bodies within or in close proximity downstream of the project area that are on the 2016 Montana 305(b) Report's 303(d) list or have TMDLs.

Waterbody and Description	Water Quality Category	TMDL Status	TMDL Pollutant Category	TMDL Pollutant Category (for Miner Creek and Scotchman Gulch) Impairment Cause Name (for Upper Willow Creek)	Predicted Effects of Alternative 2
Miners Gulch	4A*	Approved 2014	Sediment	Sediment	Neutral or slight positive (non-detectible) effect on sediment and nutrient levels in Miners Gulch.
Scotchman Gulch	4A*	Approved 2014	Sediment Nutrients Metals	Sediment Nitrogen and Phosphorus (Total) Aluminum	Neutral or slight positive (non-detectible) effect on sediment and nutrient levels in Scotchman Gulch.
Upper Willow Creek	4C**	N/A	N/A	Alteration in streamside littoral or vegetative covers. Low flow alterations. Physical substrate habitat alterations	Neutral or slight positive (non-detectible) effect on sediment and nutrient levels in Upper Willow Creek.

* All TMDLs required to mitigate identified impairments or threats have been completed and approved.

** Identified threats or impairments result from pollution categories that do not require a TMDL, such as dewatering or habitat modification.

CUMULATIVE EFFECTS

Cumulative effects for the Proposed Action are expressed as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Because analysis has indicated that effects of the Proposed Action on water quality would be non-existent, negligible, or positive (decreased road sediment delivery to water bodies) there would be no cumulative effects expected with other past, present, and reasonably foreseeable future actions.

FOREST PLAN CONSISTENCY

The project would comply with Forest Plan direction. See the Forest Plan Consistency Table for detailed explanation of how each standard would be met under the proposed action.

REGULATORY FINDINGS

The project would comply with the Forest Plan because it would not measureably effect desired water quality, timing of runoff, and water yields and would result in reduction of sedimentation from roads.

The project would comply with the Clean Water Act because proposed activities would not generate pollutants in excess of those that are naturally occurring (as defined by the Administrative Rules of Montana) and would not cause increases above naturally occurring concentrations of sediment or suspended sediment.

Federal and State Water Quality Regulations

Because effects of the Proposed Action on water quality would be non-existent, negligible, or positive (decreased road sediment delivery to water bodies) the project would comply with Federal and State water quality regulations.

Federal Wetland and Floodplain Regulations

The project would comply with Executive Order 11990 because wetland areas and associated RCAs (with added buffer width as required by the project Design Criteria) would be avoided.

The project would comply with Executive Order 11988 because it would not include floodplain occupancy or modification and would protect floodplain areas from sediment effects by requiring avoidance of streams, streamside/wetland RMAs, and additional buffers as required by the project Design Criteria.

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