



Tiger-Mill: Hydrology Effects Analysis

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For: Walla Walla Ranger District, Umatilla National Forest

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Effects Addressed

Is there potential for a significant environmental effect to your resource from the proposed activities?

YES

Would project effects approach a threshold for your resource?

YES

Is your resource related to an effect identified and approved by the responsible official for analysis?

YES

This section includes effects pertaining to hydrologic resources that have been identified for detailed analysis. Treatment alternatives will be evaluated based on their effect to hydrologic function and condition, water quality, and water yield.

Effect 1: The relationship between created openings in forested landscapes and changes in water yield and peak flows has been documented by numerous studies ([Stednick 1996](#)). Changes in forested stand and canopy density caused by harvest, fire, or insect and disease can change the distribution of the snowpack, increase the rate of melt of the snowpack, and cause the timing of the melt to be earlier. These factors may lead to changes in peakflows. In addition, reduction of stocking density reduces the overall vegetative use of water, increasing the amount of water available for runoff. Changes in water yield and in peak flows have the potential to destabilize channels, causing increased erosion and sedimentation in channels. Changes in these parameters would be of concern for aquatic habitat and biota, downstream water users, and for channel morphology.

Effect 2: The effects of roads on water quality and quantity have been studied for decades. [Gucinski et al \(2001\)](#) and [Sosa-Perez \(2016\)](#) summarized road-related scientific information and the reader is referenced to those documents for more detail. Road density is used as an indicator of potential for affects to hydrologic function (extension of the stream network) and water quality (sediment delivery to surface waters). Stream crossings are used as an indicator of the degree of connectivity between the road system and the drainage network. To the degree that roads are connected to the drainage network the risk of road sediment reaching surface waters is increased, the drainage network is lengthened and the potential for precipitation to drain more quickly, with less residence time in the watershed is increased. Roads have the potential to intercept surface and subsurface water, reducing infiltration and increasing the delivery of water to channels. Roads which are hydrologically connected are a risk to water quality. Sedimentation may be increased by surface erosion from roads and the ability of road drainage to route sediment to channels.

Effect 3: Exposure of small streams to direct solar radiation is the dominant process responsible for stream temperature increases ([Tiedemann et al 1978](#)). Water temperature can be increased by reductions in the density of shade over the water surface. Logging activities can initiate pronounced temperature changes by the removal of forest vegetation along channels ([Beschta et al 1987](#)). Maintaining shade in riparian zones can be used to avoid most temperature increases in small streams.

Effect 4: Undisturbed forests usually have low erosion rates (< 0.25 tons/ac/yr) ([Binkley and Brown 1993](#)). Many studies have been done on the effects of different forest management practices on erosion rates

and sediment production, and, in general, increased site disturbance will result in increased erosion and sedimentation ([Swank et al 1989](#)). Surface soil disturbances provide a sediment supply, but once the site revegetates, the site is less apt to continue eroding ([Stednick 2010](#)). Use of PDCs (Project Design Criteria) to protect soil quality and use of streamside buffers are effective in removing sediment from upslope overland flows.

Methodology

This section includes a description of the methods and data used in this analysis.

Hydrologic information for the area was obtained through field reconnaissance, Geographic Information System (GIS), aerial image and LiDAR (Light Detection and Ranging) analysis, stream temperature gauges, computer modeling, and review of past reports, streamflow data and SNOTEL (snow telemetry) data. LiDAR analysis was used to delineate streams more accurately on the landscape that may or may not be indicated in the existing National Hydrography Database (NHD) GIS dataset. Unstable areas (debris flows, landslides, actively eroding hillslopes, landslide prone areas) were mapped through a combination of field reconnaissance, remote image analysis (aerial photo imagery and LiDAR) and review of past debris flow mapping ([Fitzgerald and Clifton, No Date](#)).

Riparian-wetland areas in the Tiger-Mill Project area were mapped using a combination of existing databases and field reconnaissance. Databases queried included: National Wetlands Inventory, NHD water points, NHD water bodies and USFS constructed feature files layer. The final riparian-wetland points, lines and polygon features were consolidated to eliminate overlap from the various sources. Field reconnaissance in the Tiger-Mill planning area was done prior to implementation, and an effort was made to accurately map streams, springs and other riparian-wetland areas. Not every stream or potential wetland area was visited and/or documented. Unmapped riparian-wetland features requiring PACFISH buffers will also be identified in the field by layout crews.

GIS and on-the-ground inspection of roads, combined with modeling in the WEPP Roads ([Elliot et al 1999a, 1999b, 1999c](#)) module for sedimentation potential provided the basis for the aquatic risk of roads assessment. WEPP Road models sedimentation based on amount of use (high, low or none), road surface material, road geometry (insloped, outsloped, ditching) soil texture and length of road surface that contributes sediment to a cross drain culvert or stream crossing. Hillslope erosion was modelled using the WEPP Cloud online watershed-scale hydrologic modeling tool ([Lew et al 2022](#)) by uploading the FlamMap wildfire scenarios modeled by the fuels specialist (see Fuels Report) and process described by [Srivastava et al](#) (2015). WEPP simulates winter hydrology, surface hydrology and hydraulics, subsurface hydrology, vegetation regrowth and residue composition and sediment detachment from hillslopes and stream channels. WEPP FuME ([Elliot 2006](#)) is a hillslope model that was used to model relative maximum sedimentation from wildfire, prescribed fire and thinning and to compare overall effects of wildfire and vegetation treatments on sedimentation rates. Cumulative effects peak flow analysis was done using the Equivalent Clearcut Area (ECA) model ([Ager and Clifton 2005](#)).

Effects to water quality are based on the stream reaches identified by Oregon Department of Environmental Quality (ODEQ) and Washington Department of Ecology. The states designate beneficial uses of water resources and establishes water quality standards protective of those uses. The water quality parameters of concern related to Alternative A are sediment, turbidity, and temperature. Sedimentation is calculated and compared to background rates in tons/year, turbidity is an optical property measured with a turbidity meter and attainment of water temperature criteria is related to stream shading.

Resource Indicators and Measures

Treatment alternatives will be evaluated based on their effect to hydrologic function and condition, water quality, and water yield. Indicators used to analyze effects of Alternative A are as follows:

- Hydrologic Function, Floodplains and Wetlands:
 - road density (mi/mi²)
 - roads in RHCA's (mi)
 - road-stream crossings on haul routes and temporary roads (number)

- Water Quality:
 - water temperature (shade)
 - sediment (tons/year)
- Water Yield:
 - Equivalent Clearcut Area (ECA < 15-20% threshold)
 - road density (< 3 mi/mi²)
 - Relative volume (ac-ft)

Spatial and Temporal Context for Effects Analysis

The hydrologic system and the hydrologic effects of Alternative A were analyzed for National Forest System (NFS) lands by the 12-digit Hydrologic Unit Code (HUC), also known as a subwatershed (SWS). HUC is a hierarchical national level interagency map of the hydrologic system.

Effects to water quality are based on the stream reaches identified by Oregon Department of Environmental Quality (ODEQ) and Washington Department of Ecology (WDOE). The States designate beneficial uses of water resources and establish water quality standards protective of those uses. Sedimentation is compared to background rates in tons/year.

Cumulative effects analysis for water quality in this project area were analyzed at the stream reach scale, assessing past, present and reasonably foreseeable impacts to sedimentation and temperature. Effects to water quality were analyzed for short term (1 day to 1 week) and for long term, up to one year or longer for changes at the landscape scale. These time scales were chosen to display short term concentrated effects, and longer-term seasonal effects that are sometimes seen during spring runoff and for longer term (years) effects, whether beneficial or adverse, that can be expected to materialize.

Cumulative effects to water yield at the HUC12 scale are calculated using records of timber harvest activity. The Equivalent Clearcut Area (ECA) model has a 12-33 year time-frame for hydrologic recovery (collection, storage, and release of precipitation) depending on silvicultural prescription and plant association. Vegetation management proposed in the project would occur during the course of several years, and the calculation reflects the estimated time frame for thinning and prescribed burning provided by timber and fuels specialists.

Consistency with Relevant Laws, Regulations, and Policy

National Forest Management Act (NFMA) Land Management Plan Consistency

The Umatilla National Forest Land Management Plan provides standards and guidelines for Water Resources and Riparian Areas

Forest-Wide S&G: Riparian (4-59)

General:

1. Maintain or restore biological, chemical, and physical qualities of Forest fish habitats (Clean Water Act)
4. Meet the direction and processes for management of wetlands and floodplains in accordance with EO 11990 and EO 11988 and FSM 2527
5. Seeps, springs, bogs and other wet areas ...will be given appropriate levels of protection.

Best Management Practices (BMPs): Implement BMPs to meet water quality standards (Clean Water Act), FSM 2500) and protect streams and adjacent areas to maintain aquatic systems.

- Select, design, implement, enforce, monitor BMPs

Findings: Project design criteria for protection of soil quality, water quality, wetlands (including seeps and springs), floodplains and associated RHCAs are identified in the PDC table in Hydrology, Soils and Fisheries sections.

Forest-Wide S&G: Water (4-77)

Meet or exceed state requirements in accordance with the Clean Water Act

- Select, design, implement, enforce, monitor BMPs

Findings: Project design criteria for protection of water quality are identified in the PDC table in the Hydrology, Soils and Fisheries sections.

Forest-Wide S&G: Soil (4-80)

BMPs: Along all perennial streams, adjacent floodplains and riparian areas, take actions to prevent soil movement, including slumps, earth slides and other debris and material from moving downstream into higher class streams.

- Select, design, implement, enforce, monitor BMPs

Findings: Project design criteria for protection of soil productivity and slope stability are identified in the PDC table in the Hydrology, Soils and Fisheries sections. These PDCs would also benefit water quality by protecting soils and avoiding actions on unstable terrain.

Forest-Wide S&G: C5 Riparian (4-165)

Water: Meet Forest-wide S&Gs

Soil: Within 250 feet of all streams and wet areas associated with streams, limit the mineral soil exposed by ground-disturbing activities to 10 percent of the project area.

Transportation: Water quality and fisheries habitat problems caused by roads will be corrected.

Findings: Project design criteria for protection of water quality are identified in the PDC table in the Hydrology, Soils and Fisheries sections.

Forest-Wide PACFISH Amendment:

PACFISH standards and guidelines relevant to this project related to hydrologic resources: TM-1, RF-1, RF-2, RF-3, RF-4, RF-5, RA-2, RA-4, RA-5, WR-3 (full descriptions are located in Appendix C pages C10-C18 of the PACFISH EA, which was amended into the Umatilla National Forest Plan). In addition to Forest Plan requirements to meet state water quality standards, PACFISH also requires that management actions will have no measurable increase in maximum water temperature.

Findings: Streams, seeps, springs and wetlands have been mapped within the project area and PACFISH buffers would be applied. During the course of project implementation, if unmapped streams, seeps, springs and wetlands are encountered they would be buffered and prescriptions would be modified to meet PACFISH requirements. Project design criteria for RHCA buffers and are identified in the PDC table.

Other Relevant Law, Regulation, and Policy Consistency

Clean Water Act

The Clean Water Act of 1972 and amendments require the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. Forest Service responsibilities under the Clean Water Act are defined in a MOU between ODEQ and the Forest Service ([USFS 2023](#)) and MOA between WDOE and USFS ([USFS 2018](#)). The MOU/MOA designates the Forest Service as the management agency responsible for meeting the Clean Water Act on NFS lands and recognizes best management practices (BMPs) as the primary mechanism to control nonpoint source pollution on NFS lands. This means the Forest Service is responsible for defining and implementing appropriate BMPs for National Forest Lands to meet the Clean Water Act (see USFS 2012 for the National BMP Manual).

Beneficial uses for streams in the analysis area have been identified by the State of Oregon. All waters within the project area have the following use designations: public and private domestic water supply, irrigation, livestock watering, wildlife and hunting, fish and aquatic life, fishing, boating, water contact recreation, aesthetic quality and hydro power. [OAR 340-041-0330 – Basin-Specific Criteria \(Walla Walla\): Beneficial Uses to Be Protected in the Walla Walla Basin \(public.law\)](#)

Water quality standards are based on life stages of fish and the most restrictive need sets the standard. Water temperature, turbidity and sediment are the main water quality parameters related to the Alternative A. Temperature criteria are shown in [Table 1](#). No more than a ten percent cumulative increase in natural stream turbidities may be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. Oregon statute provides a narrative description that would include sedimentation: maintain overall water quality at the highest possible levels and other deleterious factors at the lowest possible levels; road building and maintenance activities must be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

Table 1. Water Quality Standards for Temperature, Oregon streams

Water Body	Aquatic Life Uses	Temperature ¹	Time of Year
Mill Creek below Mile 25.2, Tiger Canyon, West Tiger Canyon, Webb Canyon, Henry Canyon	core cold water	16°C (60.8°F)	year round
Mill Creek below Mile 25.2, Tiger Canyon below West Tiger	salmon and trout rearing and migration	13°C (55.4°F)	Jan 01 – June 15
Mill Creek and all tribs upstream of mile 25.2, NF and SF Walla Walla Rivers	bull trout spawning and rearing	12°C (53.6°F)	year round

¹ 7-day moving average of daily maximum temperature; OAR 340-041-0007, Basin-Specific Criteria, Beneficial Uses to Be Protected in the Walla Walla Basin ([Oregon Secretary of State Administrative Rules \(temperature\)](#))

Beneficial uses for streams in the analysis area have been identified by the State of Washington. All waters within the project area have the following use designations: aquatic life, primary contact (recreation), domestic, industrial, agricultural, and stock water supply uses, wildlife habitat, fish harvesting, commerce and navigation, boating and aesthetics. Aquatic life uses are for char spawning and (<http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A-602>)

Water quality standards are based on life stages of fish and the most restrictive need sets the standard. Water temperature, turbidity and sediment are the main water quality parameters related to the Alternative A. Temperature criteria are shown in [Table 2](#). Turbidity shall not exceed 5 NTU over background when background is 50 NTU or less OR < 10% increase when background > 50 NTU. The aquatic life fine sediment narrative criteria states 'water bodies shall not contain excess fine sediment (< 2 mm diameter) from human-caused sources that could impair designated uses.

Table 2. Water Quality Standards for Temperature, Washington streams

	Aquatic Life Uses	Temperature ¹	Time of Year
All streams	char spawning and rearing	12°C (53.6°F)	year round
Wolf Fork			8/21-5/15
Mill Creek, NF Mill Ck, Paradise Ck, Green Fork, Burnt Fork	supplemental char spawning	9°C (48.2°F)	9/1-5/15

¹ 7-day moving average of daily maximum temperature; Washington Department of Ecology Webmap ([Water Quality Atlas - Start Page](#))

State agencies have assessed attainment of the water temperature standards and developed Total Maximum Daily Loads for streams not meeting the standard. The most recent water quality assessment in Oregon State and approved by EPA was made in 2022

(<https://www.oregon.gov/deq/wq/pages/epaapprovedir.aspx>). The most recent water quality assessment in Washington State and approved by EPA was made in 2018

(<https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d>).

Mill Creek Municipal Supply Watershed

The Mill Creek Municipal Watershed (UNF Plan Management Area F2) was established by cooperative agreement between the City of Walla Walla and the Secretary of Agriculture in 1918 (USDA 1918) to protect the City's water supply from human-caused pollution. The Agreement acknowledges that *measures necessary for the proper protection and care of the forests* (including vegetation management and related infrastructure) are consistent with the objectives of the Agreement when project design criteria are implemented to protect the water supply.

The Safe Drinking Water Act (SDWA) was passed by Congress in 1974, with amendments added in 1986 and 1996, to protect our drinking water (US EPA 2004). Under the SDWA, the U. S. Environmental Protection Agency (EPA) sets the standards for drinking water quality and monitors states, local authorities, and water suppliers who enforce those standards. The EPA sets standards and regulations for many different contaminants in public drinking water, including disease-causing germs, animal wastes, chemicals, and naturally occurring substances that can contaminate drinking water.

The City of Walla Walla relies on water from the Umatilla National Forest for drinking. The SDWA requires actions to protect drinking water and its sources and sets national standards for drinking water to protect against naturally occurring and man-made contaminants. A 1996 amendment to the SDWA requires each state to implement Source Water Assessment Programs (SWAP). The SWAP program in Washington is administered by the state Department of Health Office of Drinking Water. There is one State-designated surface water protection area within the project area. The SWAP area aligns with the boundary of the Upper Mill Creek subwatershed.

Findings: There would be no measurable increase in water temperature, streamflow or sediment from this project which could degrade downstream beneficial uses when the prescribed water quality PDCs (in addition to PDCs prescribed by the soil scientist and fisheries biologist) are implemented, monitored, and adjusted (if needed). All of the activities proposed in this project were designed to be consistent with the Clean Water Act and States of Oregon and Washington Water Quality Standards. Through adherence to Forest Plan Standards and project design criteria the Mill Creek Municipal Watershed source water area would not be adversely impacted.

EO 11988 Floodplains

Executive Order 11988 requires the Forest Service to avoid “to the extent possible the long- and short-term adverse impacts associated with the occupation or modification of floodplains ... and...restore and preserve the natural and beneficial values served by floodplains by managing Federal lands and conducting Federal programs affecting land use including water and related land resources planning”.

Findings: Alternative A would avoid harvest and equipment entry into all floodplains (except on roads at existing crossings). The implementation of project design criteria and BMPs would result in no change to current floodplain condition. This project is consistent with this executive order.

EO 11990 Wetlands

Executive Order 11990 requires the Forest service to “avoid to the extent possible the long and short-term adverse impacts associated with the destruction or modification of wetlands”.

Findings: All seeps, springs and other wetlands (including stream-associated floodplain wetlands) would retain buffers where harvest and equipment entry would be restricted. The implementation of project design criteria and BMPs would result in no change to current wetland condition. This project is consistent with this executive order.

Environmental Impacts

Potentially Affected Environment

The Tiger-Mill project boundary contains about 38,471 acres of National Forest Service lands located in portions of ten subwatersheds ([Table 3 and Figure 1](#)) and these include approximately 300 miles of perennial, intermittent, and ephemeral streams. Elevation ranges from 2,300 to more than 5,500 feet along ridgetops. Maritime influence is strong with annual precipitation ranging from 40-70 inches, mostly arriving between November and April as snowfall, with average annual streamflow peaking in April as the snowpack melts ([Figure 2](#)). Proposed actions in the Blue Creek and Headwaters Dry Creek subwatersheds contain only small acreages, would occur near ridgetops and in discontinuous parcels and there would be no direct, indirect, or cumulative effects to hydrologic resources, therefore, there will be no further discussion of these areas in this analysis.

Table 3: Subwatersheds within the Tiger-Mill Analysis Area

Subwatershed (HUC12)	SWS Name	SWS acres	NFS acres in SWS	Project Acres in SWS	% Project Area in SWS-FS
170601060301	Upper South Fork Wenaha River	20250	20250	129	< 1 %
170601060303	North Fork Wenaha River	17586	17586	477	< 3 %
170701020101	Upper South Fork Walla Walla River	17595	17595	1013	6 %
170701020104	North Fork Walla Walla River	28573	9780	3234	33 %
170701020201	Upper Mill Creek	21440	19348	19348	100 %
170701020202	Middle Mill Creek	20560	7853	7853	100 %
170701020203	Blue Creek	12653	48	48	100 %
170701020303	Wolf Fork	26757	6765	1038	15 %
170701020304	South Fork Touchet River	27932	4654	4654	100 %
170701020801	Headwaters Dry Creek	28837	2	2	100 %

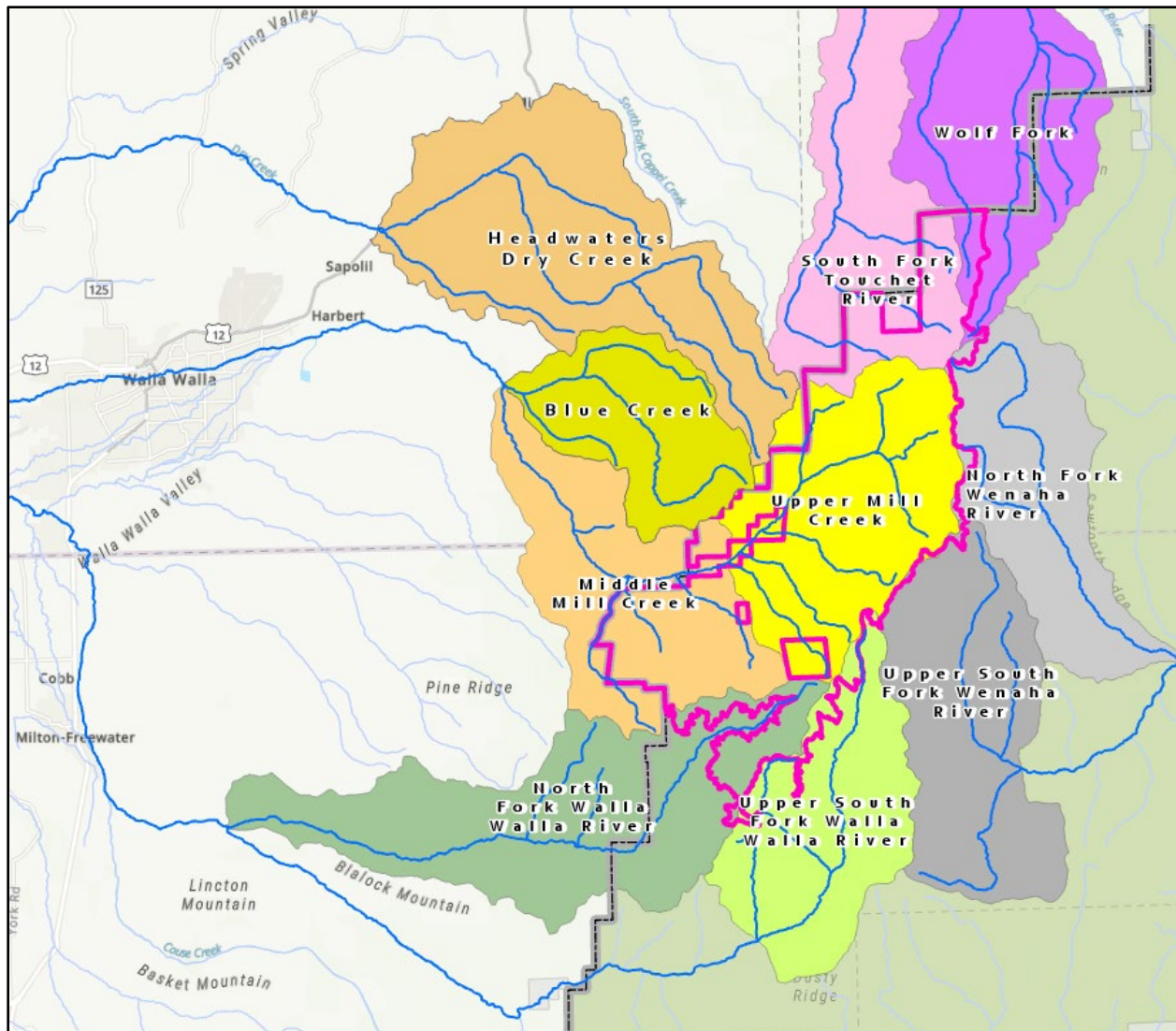


Figure 1. Subwatersheds of the Tiger-Mill Project Area

Snow can accumulate throughout the project area but is transient below 2,500-3,000 feet, and variable year to year between 2,500 and 4,000 feet, the so-called "rain-on-snow" (ROS) zone. Above 4,000 feet, snow generally persists through the winter months. The project area occurs predominantly (63%) in the snow dominated (SD) zone, with about 37% in the ROS zone and < 1% in the rain-dominated zone. Forested areas account for 75% of the landscape in the SD zone (~ 18,500 acres) and 66% (~ 9,500 acres) in the ROS zone. Proposed commercial thinning would occur on about 4,500 SD acres and 1,500 ROS acres.

Floods-of-record (> 100-year return interval flows) recorded at USGS Mill Creek gauge 14013000, 2 miles downstream of the mouth of Henry Canyon and 4 miles downstream of the City of Walla Walla water intake, occurred in 1931, 1965, 1996, and 2020 as a result of rain-on-snow events. These types of events can result in mass movements in the form of hillslope slides and channelized debris flows. Mapped slides/debris flows attributed to the 1996 event include 10 in the Upper Mill Creek subwatershed and 4 in the Middle Mill Creek subwatershed. Mapped slides/debris flows after the 2020 event include 57 in the Upper Mill Creek subwatershed and 12 in the Middle Mill Creek subwatershed. All of these

flows/slides occurred in the rain-on-snow zone and nearly all originated in ephemeral and intermittent drainages and most extended downstream into perennial streams. In addition, a June 2022 rain event caused localized flooding along Mill Creek, downstream of Tiger Canyon.

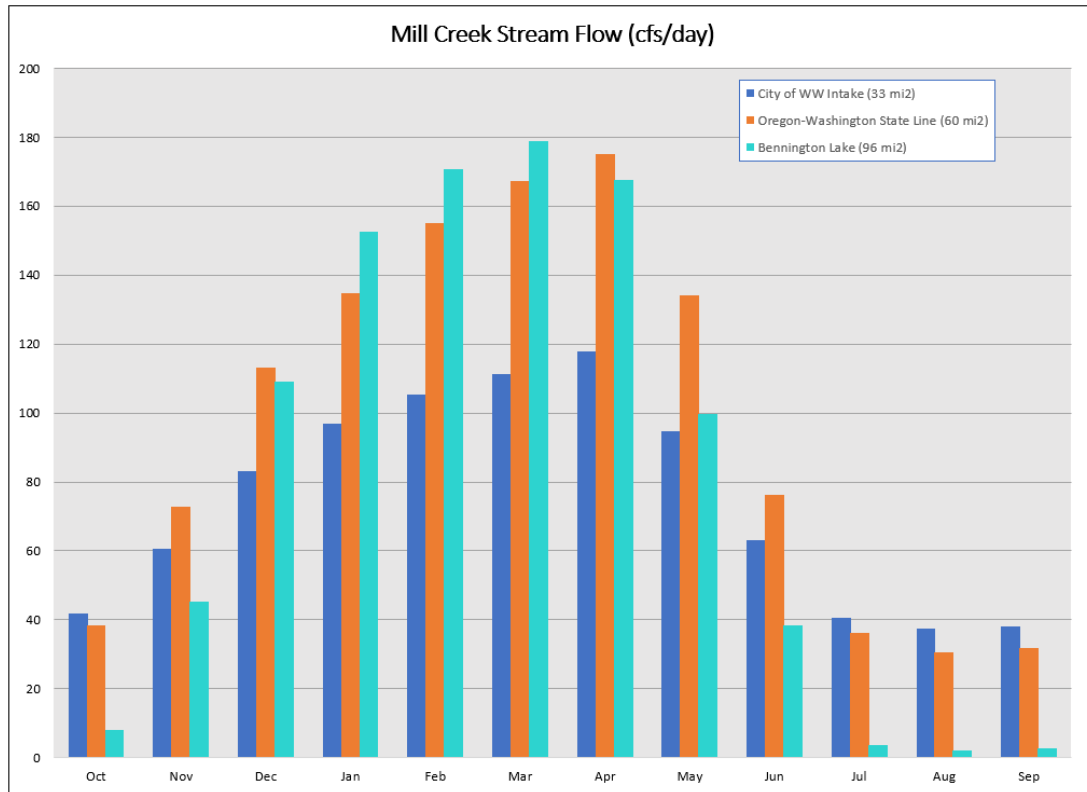


Figure 2. Average annual streamflow of Upper Mill Creek, illustrating its importance for maintaining year-round flow for adequate water supply and downstream uses. (data from USGS gauges 14013000 and 14015000, [USGS Current Water Data for Washington](#) and Pierson 2018)

Watershed response to changing climate and modified by increased size and severity of wildfires are well-documented ([Collar et al 2022](#), [Smoot and Gleason 2021](#), [Gustine et al 2021](#)). The Climate Change vulnerability assessment for the Blue Mountains ([Halofsky and Peterson 2017](#)) highlighted the following considerations based on current and modeled future trends due to a warming climate:

- Changes from snow to rain-dominated precipitation (not necessarily net change in amount; declining snowpack due to less precipitation falling as snow, more rain-on-snow events, more frequent and intense summer thunderstorms)
- Changes to timing of water yield (earlier snowmelt and peak flows, lower summer flows)
- Stream water temperatures increase (warmer ambient air temperature, lower summer flows)
- Increased extent, duration, severity of forest insect, disease, and fire frequency
- Increased sedimentation related to changes in precipitation patterns and disturbance regimes

Tiger Creek Fire (October 2024)

The Tiger Creek Fire perimeter contains approximately 314 acres in the Low Creek drainage of the Upper Mill Creek subwatershed (Tiger Creek Fire Incident GIS database). The fire pattern resulted in a mosaic of unburned to high soil burn severity and vegetation mortality. Within the fire perimeter, only about 4% burned with moderate to high severity (Table 4). Vegetation mortality using the RAVG protocol identified

only 20% of area with > 10% basal area loss (includes grass, shrub and tree; Table 5). The fire perimeter included about 0.7 miles of category 4 stream channels and 10 acres of category 4 RHCAs with unburned to low SBS and almost no mortality. The fire perimeter included about 110 acres of proposed noncommercial hand treatments and all of the area is proposed for prescribed fire under Alternatives A and B. Approximately 12 miles of hand line were constructed during fire suppression and subsequently rehabbed as specified in the Tiger Creek Fire Suppression Repair Plan (USFS 2024).

Table 4: Soil Burn Severity Acres in the Upper Mill Creek Subwatershed

HUC12 USFS-Project	Low Creek	Burn Perimeter*	Soil Burn Severity			
			High	Moderate	Low	Low-Unburned
19,348	2,600	299	3	8	154	134

*acres at time of BAER assessment, total burn perimeter ~ 314 acres

Table 5: Basal Area Mortality Acres in the Upper Mill Creek Subwatershed

HUC12 All Ownership	HUC12 USFS-Project	Burn Perimeter*	Basal Area Mortality			
			> 50%	10 – 50%	< 10%	unknown
19,348	2,600	300	27	30	240	3

*acres at time of assessment, total burn perimeter ~ 314 acres

The hydrology report for the Tiger Creek Burned Area Emergency Response (BAER) summarizes burn severity and potential post-fire hydrologic implications (Corrigan 2024). Modeling results indicated unmeasurable increases in peak flows of 1.02 times pre-fire peak flow for Low Creek which would result in no change to water or sediment runoff patterns that would adversely channel morphology or water quality.

Consideration of No Action: What would happen if we take no action?

The ability to maintain existing high-quality habitats and to restore degraded habitats will be influenced by climate change over the next several decades with projected higher average air temperatures, more winter precipitation falling as rain versus snow, and diminishing winter snowpacks resulting in earlier snowmelt and lower summer baseflows. Changes in timing and amount of precipitation and runoff associated with climate change affects every resource, including terrestrial vegetation, wildlife, riparian and aquatic species, and water availability for human use. As a surrogate for water yield, current ECA values for all subwatersheds are low compared to threshold values.

Species composition and structural changes at the landscape scale described in the Vegetation Report would remain on its current trajectory further away from landscape range of variation. As described in the Fuels Report, the risk of uncharacteristic fire would remain elevated across the landscape. Weeds treatment would continue to occur along roads and in areas described in the Invasives Report and implementation would follow design features described in the Umatilla National Forest Weeds EIS (2010) and the Invasive Plants Report (2015). Motor vehicle and recreational off-road vehicle use would continue to occur on routes designated on the Umatilla National Forest motor vehicle use map (MVUM). Erosion and sedimentation from roads would continue as roads are used and maintained according to their respective maintenance level. Continued deferred maintenance of the majority of system roads would be the primary management related sources of accelerated erosion. There would continue to be elevated risk of large-scale high severity fire due to vegetation and fuels conditions.

Natural disturbance events such as fires and floods could affect stream temperature and sediment regimes over time if these events cause large-scale changes to vegetation or stream channel morphology. [Smoot and Gleason](#) (2021) found that forest fires have widespread and persistent impacts on snow hydrology in the Pacific Northwest by reducing snow-water storage and resulting in earlier snow disappearance. They reported that high severity burned forests increase snowmelt rates for at least 10 years following fire. In addition to the immediate risk of increased risk of degraded water quality from erosion and sedimentation, decreased snow-water storage, and earlier melt as a result of high severity fire put the health of downstream water quality and habitats at greater risk during the summer months as a result of decreased stream volume and increases in stream temperature related to lower flow volume and reduction in overstory shade.

Environmental Impacts of Alternative A and Alternative B

Treatment alternatives will be evaluated based on their effect to hydrologic function and condition, water quality, and water yield. Indicators used to analyze effects of Alternative A are as follows:

- Hydrologic Function, Floodplains and Wetlands:
 - road density (mi/mi²)
 - roads in RHCAs (mi)
 - road-stream crossings on haul routes and temp roads (number)
- Water Quality:
 - water temperature (shade)
 - sediment (tons/year)
- Water Yield:
 - Equivalent Clearcut Area (ECA < threshold value of 15-20%)
 - road density (< 3 mi/mi²)

Hydrologic Function and Condition

Measures: road density, roads within RHCAs and road-stream crossings

The mapped stream system in the Tiger-Mill Project area (including City of Walla Walla lands) includes 313 miles of perennial, intermittent, and ephemeral streams. These streams represent the channeled system. The analysis area also contains numerous unchanneled swales and ephemeral draws.

The Umatilla NF Land and Resource Management Plan as amended by PACFISH, identifies four stream categories ([Table 4](#)). PACFISH designated default riparian habitat conservation areas (RHCAs) associated with each stream category to provide for management and protection of water quality, habitat features and microclimate.

Table 4: PACFISH Stream Categories and default buffer widths

	Fish Bearing	Permanently Flowing Non-Fish Bearing	Ponds, lakes, reservoirs and wetlands > 1 acre	Seasonally flowing or intermittent streams, wetlands < 1 acre, landslides and landslide prone areas
PACFISH Category	1	2	3	4
RHCA Buffer (ft)	300	150	150	100

[Table 5](#) summarizes stream miles within the project area. Note that PACFISH Category 1 streams can also include non-perennial streams, if they provide habitat during portions of the year.

Table 5: Tiger-Mill Project Area Stream Miles (acres)*

Subwatershed	RHCA Category	Stream miles	RHCA acres
North Fork Wenaha River	1	---	---
	2	0.3	11
	4	0.2	4
Upper SF Walla Walla River	1	0.8	57
	2	1.2	43
	4	2.5	61
North Fork Walla Walla River	1	---	---
	2	5.7	209
	4	11.4	276
Upper Mill Creek	1	25.4	1849
	2	32.8	1191
	4	101.8	2468
Middle Mill Creek	1	7.1	513
	2	9.6	349
	4	46.8	1134
Wolf Fork	1	1.9	136
	2	0.6	24
	4	4.6	111
South Fork Touchet River	1	1.1	78
	2	9.2	336
	4	28.2	684

* includes City of Walla Walla lands

The effects of roads on water quality and quantity have been studied for decades. [Gucinski et al](#) (2001) and [Sosa-Perez](#) (2016) summarized road-related scientific information and the reader is referenced to those documents for more detail. [Al-Chokhachy et al](#) (2010) found a negative relationship between the biotic integrity index scores in managed reaches and road density, indicating that the effects of high road densities and the activities associated with forest roads (e.g., timber harvest) can significantly reduce the overall condition of instream physical habitat.

Measures used to assess effects to RHCAs include road density, roads within RHCAs, and road-stream crossings ([Table 6](#)). Road density is used as an indicator of potential for affects to hydrologic function (extension of the stream network) and water quality (sediment delivery to surface waters). Stream crossings are used as an indicator of the degree of connectivity between the road system and the drainage network. To the degree that roads are connected to the drainage network the risk of road sediment reaching surface waters is increased, the drainage network is lengthened and the potential for precipitation to drain more quickly, with less residence time in the watershed is increased. Roads have the potential to intercept surface and subsurface water, reducing infiltration and increasing the delivery of water to channels. Roads which are hydrologically connected are a risk to water quality. Sedimentation may be increased by surface erosion from roads and the ability of road drainage to route sediment to channels.

Table 6: Road density at the subwatershed scale and road miles within the Tiger-Mill Project Area

Subwatershed	SWS-NFS	Project Area		
	Road Density* (mi/mi ²)	Roads* (miles)	Roads* in RHCAs (miles)	Alt A Temp Roads (miles)
Upper SF Wenaha River	0.4	4.2	0	0.2
North Fork Wenaha River	0.5	9.4	0.3	0.6
Upper SF Walla Walla River	0.6	11.5	1.2	1.5
North Fork Walla Walla River	2.0	31.8	3.4	3.8
Upper Mill Creek	0.1	5.6	0.1	0
Middle Mill Creek	1.6	20.2	3.1	2.9
Blue Creek	N/A	N/A	---	---
Wolf Fork	2.4	6.4	0.2	1.0
South Fork Touchet River	0.4	3.2	0.1	0.7
Headwaters Dry Creek	N/A	N/A	---	---

*includes NFS roads and motorized trails

The sediment transport rate from unpaved road surfaces at stream crossings proposed for log haul using the WEPP model (Elliot et al 1999b). Table 7 summarizes sedimentation from roads that currently have low or no motorized use and which would experience temporary, increased traffic during log haul. WEPP modeling calculated that the current low/no use road system is adding almost 100 tons per year of sediment across the 5 subwatersheds, with 97% resulting from 7 crossings and 92% from 4 crossings (see PDC table for road ID, location and work needed beyond standard maintenance).

Table 7: Comparison of sedimentation from low or no traffic haul routes at stream crossings (tons/year)

Subwatershed	Stream Crossings (No.)	Existing Condition	Maintenance Scenario 1	Maintenance Scenario 2
North Fork Wenaha River	8	73	5.8	1.9
North Fork Walla Walla River	39	26	2.1	1.2
Middle Mill Creek	4	0.1	0.4	0.2
Wolf Fork	4	0.4	1.3	0.2
South Fork Touchet River	1	0.04	0.2	0.05
total	56	100	9.9	3.5

Scenario 1 - Surface blading to remove ruts and restore outsloping/insloping surface drainage, ditches are not bladed and there is the same road length contributing runoff to culvert crossings as existing condition

Scenario 2 - Surface blading with no ditch blading, and relief drainage every 200 ft (or < 200 ft if currently less); FSH 7709.56 Chapter 40 provides design specs ([7709.56 - 40 - Design | US Forest Service \(usda.gov\)](#))

Forest Service Road (FSR) 65 is the main access road into the project area and was modeled as a high traffic road. Although short term log haul is not expected to change existing condition of drainage features or sedimentation rates, field review of 60 drainage features along 7.7 miles of FSR65 identified 23 segments where improved maintenance would result in a 65% reduction of road-related sedimentation to Tiger Creek and Mill Creek, from 15 to 6 tons/mile.

Floodplain Function (Executive Order 11988)

Measures: road density, road-stream crossings and roads within RHCAs

Executive Order 11988 is applicable to those Federal actions which will occur in or which will impact upon flood prone areas. Floodplains or flood prone areas along all streams in the project area are generally confined, due to the narrow valley corridors in which the streams occur. Channel changes due to large flood events are a normal process but can be exacerbated by management actions such as road construction, channel manipulation, and other types of development on floodplains and riparian areas, or removal of large woody material and bank stabilizing vegetation.

The Tiger-Mill Project area contains 89 miles of perennial streams and 276 miles of intermittent streams, which, by definition, have floodplains and flood prone areas (adjacent areas susceptible of being inundated). Floodplain health is directly linked to channel morphology and riparian condition, therefore floodplain functions (energy dissipation, flood flow retention, sediment and bedload routing and retention, habitat diversity, wetland development and maintenance) must not be adversely altered by Alternative A.

Wetlands (Executive Order 11990) and Groundwater Dependent Ecosystems (GDE)

Measures: roads within RHCAs and road-stream crossings

Wetlands are those areas that are inundated by surface or ground water with a frequency sufficient to support and that, under normal circumstances, do or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction (FSM 2527). The objective of E.O. 11990 is to avoid to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to enhance the natural and beneficial values of wetlands.

The National Wetlands Inventory mapped riverine wetlands along all perennial and intermittent streams in the USGS National Hydrography Database. Field inventory documented 148 seep and spring associated wetland areas (most of these are < 0.1 acre and nearly all arise in or in close proximity to channel bottoms), three developed ponds and one old spring box. RHCAs associated with springs and wetlands are summarized in Table 8.

Table 8: Tiger-Mill Project Area Spring-Wetlands*

Subwatershed	Springs
Upper SF Wenaha River	---
North Fork Wenaha River	5
Upper SF Walla Walla River	24
North Fork Walla Walla River	35
Upper Mill Creek	59
Middle Mill Creek	17
Blue Creek	---
Wolf Fork	5
South Fork Touchet River	3
Headwaters Dry Creek	---

*includes City of Walla Walla lands

Water Quality

Forest Service requirements to comply with water quality standards are identified above in the Consistency with Relevant Laws, Regulations, and Policy section.

The planning area has no 303(d) listed (water quality impaired) stream segments and streams within the project area are covered by the Walla Walla River Temperature TMDL (total maximum daily load) for both Oregon ([ODEQ 2005](#)) and Washington ([WDOE 2007a and b](#)). The TMDLs identify load allocations for perennial streams based on bankfull width and stream orientation and relies on the Forest Service to implement interim PACFISH buffers and other BMPs needed to protect water quality. The TMDLs use percent shade as a surrogate for water temperature and provide stream shading curves based on bankfull channel width and dominant vegetation type for forested streams ([Figure 3](#)). The load allocations are expected to result in water temperatures that are equivalent to the temperatures that would occur under natural conditions. Therefore, the load allocations are expected to result in water temperatures that meet the water quality standard. Streams within the analysis area are < 30 ft wide (except for the lower reach of Mill Creek on City of Walla Walla lands), therefore, the TMDL target is at 80-95% shade from overstory vegetation, depending on stream width.

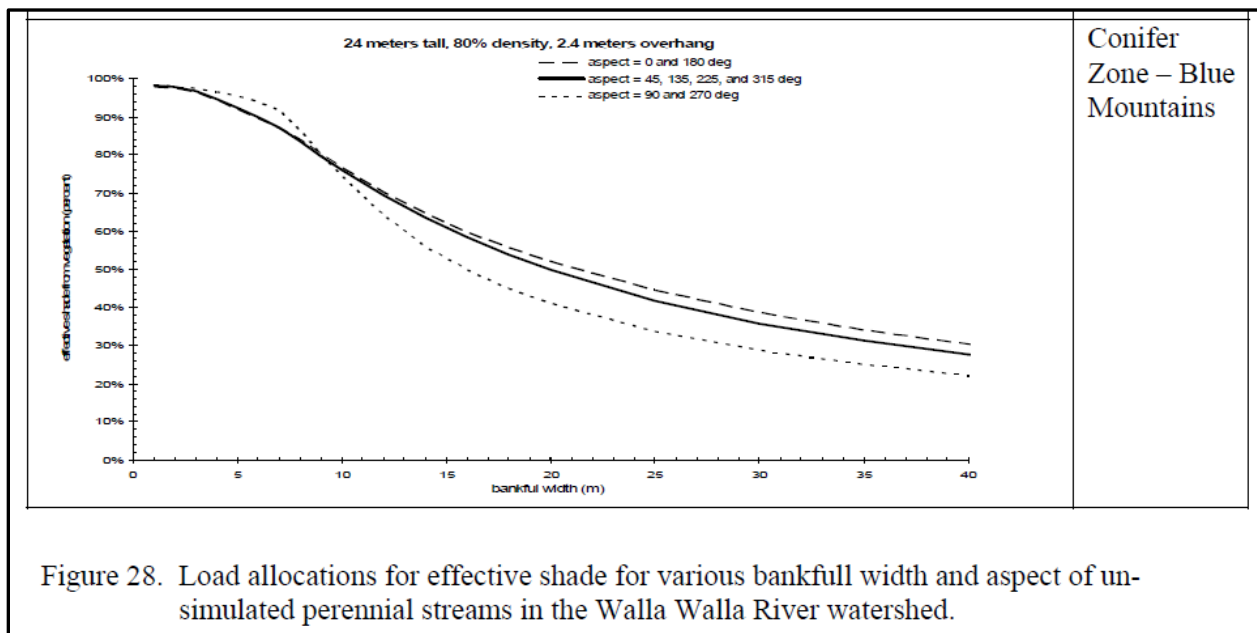


Figure 3. Walla Walla Temperature TMDL, page 57 (WA DOE 2007)

Water Yield

Measures: ECA (<15-20%) and road density (<3 mi/mi²)

The relationship between created openings in forested landscapes and changes in water yield and peak flows has been documented by numerous studies. Changes in forested stand and canopy density caused by harvest, fire, or insect and disease can change the distribution of the snowpack, increase the rate of melt of the snowpack, and cause the timing of the melt to be earlier. These factors may lead to changes in peakflows. In addition, reduction of stocking density reduces the overall vegetative use of water, increasing the amount of water available for runoff. Changes in water yield and in peak flows have the potential to destabilize channels, causing increased erosion and sedimentation in channels. Changes in these parameters would be of concern for aquatic habitat and biota, downstream water users, and for channel morphology.

[McCammon](#) (1993) describes the relative risk to watershed function of the potential effects on the magnitude and timing of runoff as the result of altered interception and soil moisture utilization resulting from changes in vegetation condition. He assigned risk to watersheds from changes in cover and evapotranspiration in the form of an equivalent clearcut area as follows: low (< 15%), moderate (15

– 30%) and high (> 30%). The PACFISH B.O. (USDI 1995) identified a 15% ECA as the lower limit threshold of concern for the Umatilla National Forest.

Reviews of literature demonstrate that the relationship is highly variable (Stednick 1996 and Scherer 2001). Generally, effects are not seen below 20% ECA and in a local study, effects were not seen below 50% ECA (Helvey and Fowler 1995). Grant et al (2008) reported that increased peakflows could occur at ≥20% ECA and that the potential for effects to channel morphology is in the 5-10 year recurrence interval flow ranges.

A GIS database was used to determine acres of past actions including harvest, roads, and fire and acres of proposed thinning and fuels treatments and these values were entered into the ECA model (Table 9).

Table 9. Equivalent Clearcut Area Modeling Summary – Existing Condition - 2025

Subwatershed*	Past Treatments	Roads**	Fire	Total ECA
Upper South Fork Walla Walla River	0.05%	0.2%	0%	0.3%
North Fork Walla Walla River	0.04%	0.9%	0%	0.9%
Upper Mill Creek	0.05%	0.03%	0.6%	0.7%
Middle Mill Creek	0%	0.5%	0.7%	1.2%
Wolf Fork Touchet River	0.6%	0.2%	3.1%	3.9%
South Fork Touchet River	0%	0.1%	0%	0.1%

*other subwatersheds in Table 3 are not included because there would be < 75 acres of proposed treatments in each and that small area would not be measurable at the subwatershed analysis scale

**includes motorized trails

Subwatersheds in the planning area are below the 15% threshold of concern established by NMFS and the 20% threshold for hydrologic impacts reported in relevant studies. Based on model inputs and assumptions, management induced changes in water yield, timing of flow, or peak flow are currently negligible.

Roads

Roads have the potential to intercept surface and subsurface water, reducing infiltration and speeding the delivery of water to channels. Sedimentation may be increased by surface erosion from roads and the ability of road drainage to route sediment to channels. Road density alone does not indicate slope position, another critical factor. Valley bottom roads have the most direct effect on streams and riparian areas because of accelerated erosion and loss of streamside shade. Mid-slope roads intercept subsurface runoff, extend channel networks and accelerate erosion, and ridge top roads can influence watershed hydrology by channeling flow into small headwater swales, which may accelerate channel development.

McCammon (1993) assigned three watershed risk classes based on road density (mi/mi²) to assess the potential of road impacts to adversely affecting hydrologic function and water quality: low (< 3), moderate (3.1-4.5) and high (> 4.5). Road densities are shown in Table 4.

Prescribed Burning

The Walla Walla Ranger District has an active prescribed burning program. Troendle et al (2010) summarized the hydrological effects of prescribed fire, which are largely a function of fire severity and area burned. Fires are typically set during times when flame lengths are expected to be low, fire residence times short, and soil heating expected to be low. Because the low severity of prescribed fires

do not cause a high degree of mortality or litter combustion, the effects to overstory canopy, evapotranspiration and forest floor water storage are generally too small to measurably change shade or watershed-scale water yields. Post-burn monitoring by the Umatilla National Forest of the 4,000 acre Bear Prescribed Fire (Pfeifer 2005) found that mineral soil exposure was < 10%, mortality of trees 8"-20" dbh was 13%, mortality of trees 20" - 30" dbh was 8% and there was no mortality of trees > 30" dbh.

A study of the effects of prescribed fire on surface erosion and sedimentation was conducted in the Lick Creek (Pomeroy Ranger District) and Skookum Creek (North Fork John Day Ranger District) drainages from 2002-2005. The study is described in Wondzell and Clifton (2005 and 2009), Zamora and Martin (2006) and Harris et al (2007). They concluded that prescribed fire and fuels treatments in uplands that were conducted under normal operating conditions are unlikely to add measurable amounts of sediment to streams and that BMPs such as not igniting in RHCA's were effective in preventing hillslope erosion from entering into streams. The study is available on the Umatilla National Forest website: <https://www.fs.usda.gov/detail/umatilla/landmanagement/resourcemanagement/?cid=stelprdb520881>
1

Environmental Consequences of Alternative A (Modified Proposed Action)

Direct and Indirect Effects

Hydrologic Function

The existing road system would not change in Alternative A (no new roads are proposed and the project would not decommission any National Forest System roads) and temporary road construction would be located and managed such that there would be no effect to the drainage network. Road maintenance would occur on up to 102 miles of National Forest System and non-system roads used by timber sales and could include blading, ditch relief culvert cleanout, spot rock and ditch cleanout as needed (see Transportation Report). Sedimentation from ditch cleanout would be short term, less than one year. Closed roads would be left in a self-maintaining condition after completion of the project.

Alternative A would require the development of 10.6 miles of temporary roads to access vegetation treatment units within 7 subwatersheds. Road density in the subwatersheds would increase slightly under Alternative A, as a result of temporary road construction, but remain in their respective risk category. There would be no increase in roads in RHCA's or number of stream crossings and planned road maintenance would improve drainage from road surfaces, therefore, there would be no direct or indirect effects to hydrologic function in the analysis area.

Floodplains

There would be no direct or indirect effects to floodplains in the analysis area. The only actions that would occur in floodplains are associated with log haul on existing routes that occur in floodplain areas. Log haul itself would not alter floodplain condition. Danger trees may be cut in floodplains and they would be left on-site where large woody material would help to dissipate stream energy associated with high stream flows.

Water Temperature

Water temperature can be increased by reductions in the density of shade over the water surface. Logging activities can initiate pronounced temperature changes by the removal of forest vegetation along channels (Beschta et al 1987). Prescribed burning and hazard tree falling in riparian areas have the potential to reduce existing vegetation.

Danger trees would be felled along haul routes used in the proposed timber sales. They would be left on the ground inside RHCAs and commercially removed elsewhere. Danger trees felled on haul routes within RHCAs of perennial streams would have negligible effect on shade density for affected streams.

Alternative A would not adversely affect water temperature because harvest, thinning and burning would not measurably remove the shade component along any stream channel. Because there would be no change to shade, there would be no adverse effect to beneficial uses and no effect on the 303(d) impairment status of streams.

Sediment

Harvest and Fuels Treatments

Harvest, thinning and prescribed burning would produce lower short- and long-term sedimentation rates than a higher severity wildfire based on WEPP model runs and assumed background levels. In addition, the longer-term benefit of treatments would be to reduce the severity of future wildfires commensurate with changes to desired fire regime condition classes (see Fuels Section), which would result in lower erosion and sedimentation rates. This effect is expected to last for decades because of the reduced fuel loading from proposed treatments. Soil condition would continue to meet Forest Plan criteria and sedimentation from vegetation treatments resulting in water quality degradation would be temporary and provide longer term benefits by helping to maintain hillslope sedimentation within the natural range that would occur under desired forest composition, structure and density and fuels conditions described in the Purpose and Need and Fuels and Silviculture Reports.

PACFISH (1995) reported that the effectiveness of RHCAs in influencing sediment delivery from non-channelized flow was highly variable and concluded that the interim RHCA widths were adequate to protect streams from non-channelized sediment inputs. There would be a low risk of sediment entering into stream channels when design features are implemented.

Roads

There would be log haul on approximately 7 noncontiguous miles of unpaved roads within RHCAs. Erosion from increased traffic due to log haul on unpaved roads would be more likely to increase suspended sediment in streams than haul outside of RHCAs. Roads inside RHCAs and with culvert problems are the most likely to contribute sediment to surface waters currently. Sediment modelling of 56 stream crossings on low or no traffic unpaved haul routes shows a potential 90-95% reduction in road-related sediment (from existing condition) when maintenance occurs for logging traffic (see PDC table for road ID and location).

Sediment modelling of FSR 65 indicates that needed maintenance actions would result in an 65% reduction of road-related sedimentation to Tiger Creek and Mill Creek. Needed improvements include: restoring a crowned surface geometry in which about half of the road surface would be insloped to a vegetated or rock-lined ditch and half would be outsloped to disperse flow across the unchanneled fillslope; removing leadout ditches that concentrate flow from wheel ruts into Tiger Creek; restoring cross drains for road segments that are insloped to ditches; installing 5 new cross drains; installing drop pipes and rock dissipators at the end of 4 culverts that discharge to Tiger Creek (see PDC Table for details).

Design features related to timing of activities and installation of physical erosion measures would further minimize the risk of erosion in the short and long term. Road maintenance and reconstruction followed by closing/stabilizing 35.6 miles of ML 1 roads (see Transportation Report) and obliteration of new temporary roads would reduce road-related sediment during the longer term. Design features such

as halting log haul during wet conditions, adding spot surfacing, and blading ditches only where needed, would further mitigate the adverse effects of wet weather or winter haul. Road surface stability is influenced by the amount and class of vehicle. Road surface sedimentation due to increased use during log haul is temporary and when traffic patterns return to pre-haul conditions, the sediment increases displayed in Table 7 would also decline.

Approximately 10.6 miles of temporary road construction is proposed Alternative A in the 7 subwatersheds. Temporary roads include 64 segments ranging from 0.03 to 0.7 miles long. Temporary roads would occur on existing disturbed areas such as old roads and new construction would occur on stable terrain. All temporary routes would be restored to production, as required in the Forest Plan.

Water Yield

Direct and indirect effects to water yield could occur if expansion of the road network increases landscape dissection and effectively routes water off the landscape via the road system. Additional effects could occur if road-stream interactions increase such that the road system becomes an extension of the stream network. Alternative A would add about 10.6 miles of temporary roads (see [Table 6](#)). All temporary roads would occur in upland areas, above the point on the landscape in which snowmelt or rainfall runoff enters a defined channel and road density would remain in low-risk category for all subwatersheds. There would be no new road crossings that would extend the stream network farther into upland areas. As a result, there would be no measurable increase in streamflow at the subwatershed scale. Therefore, there would be no direct or indirect effect to water yield or peak flows from these actions under this alternative.

Cumulative Effects Common to All Alternatives

Motor vehicle and recreational off road vehicle use would continue to occur on routes designated on the Umatilla National Forest motor vehicle use map (MVUM, [Umatilla National Forest - Home \(usda.gov\)](#)). Erosion and sedimentation from roads would continue as roads/trails are used and maintained according to their respective maintenance level. Continued deferred maintenance of the majority of system roads would be the primary management related sources of accelerated erosion.

The Recreation section describes the various forms of recreational activities that occur within the project area. The MVUM shows National Forest Service roads and trails that are designated for motor vehicle use, in addition to types of vehicles and seasonal use restrictions. Motorized uses are administered via the MVUM, including unauthorized use and resource damage. Effects related to roads are described above. As described in the Soils Report, recreational uses not related to system roads and trails likely have localized effects to soil condition.

The invasive plants database identifies about 630 acres of invasive species within the project area with and the Botany and Invasives Report describes treatments. Implementation would follow design features described in the Umatilla National Forest Weeds EIS (2010).

Natural disturbance events such as fires and floods could affect stream temperature and sediment regimes over time, if these events cause large-scale changes to vegetation, ground cover or stream channel morphology. Natural recovery of Tiger, Webb, China Creek channel morphology will occur gradually over the course of decades or longer, as large wood accumulates and facilitates retention of bedload and sediment needed to build functional floodplains and associated riparian-wetland areas.

The Tiger Creek Fire burned 314 acres in the headwaters of Low Creek in the Upper Mill Creek subwatershed in 2024. Post-fire review of soil and vegetation conditions indicate that the fire would not result in adverse effects to water or sediment yield (USFS 2024b).

Cumulative Impacts Analyses:

Effects of past harvest and road building, proposed harvest, and activity fuels treatments on water yield and peak flows were analyzed with the Equivalent Clearcut Area (ECA) Model ([Ager and Clifton 2005](#)) for the subwatersheds shown in Table 9. Figure 4 shows the modeled ECA for Alternative A (ECA is not shown for Alternative B because fewer acres would be treated in each subwatershed over the same time frame, therefore, the ECA would be lower than Alternative A) . When RHCA's are buffered and treatments spread out over several years, ECA would not exceed the 20% level at which effects to water yield, peakflows, or timing of peakflows, have been reported in various studies ([Stednick 1996](#), [Scherer 2001](#), [Grant et al 2008](#)). When the landscape is managed toward the range of variation because of planned treatments intended to result in a more resilient composition, structure, density and fuel loading, watershed processes of precipitation capture, storage and runoff and associated hillslope and channel processes of erosion and deposition are expected to also represent the natural range of variability for those processes.

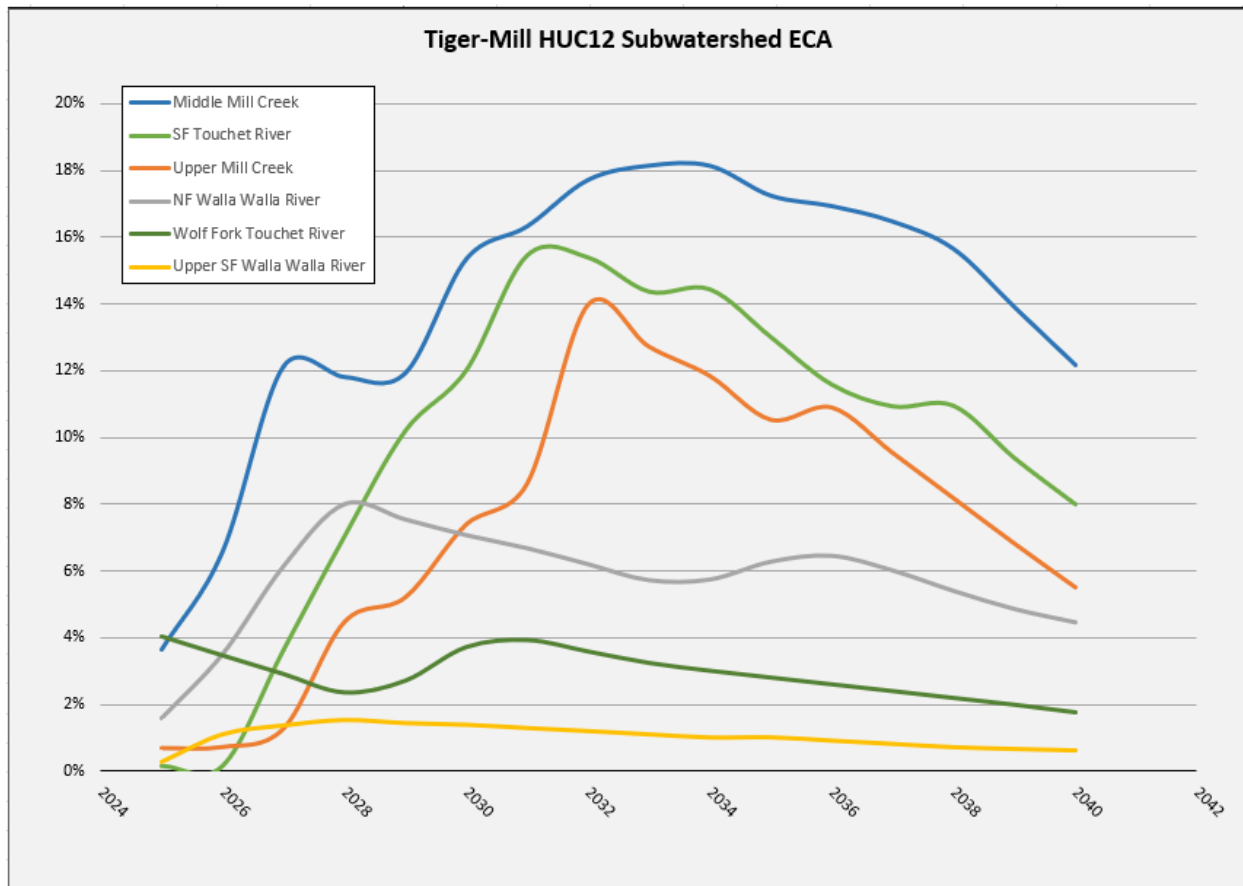


Figure 4. Tiger-Mill Project Equivalent Clearcut Area Model Summary for Alternative A

Based on the assumptions of the ECA model and the literature cited, the proposed thinning and fuels treatments would not have a measurable effect to hydrologic functions (capture, storage, and release of water) in the any of the subwatersheds when combined with past actions, based on modelling and implementation assumptions. The temporary addition of about 16 acres of temporary road would add a

negligible amount to overall ECA. Because ECA would remain below threshold values, no adverse changes to channel condition from silvicultural treatments are predicted because water yield and peak flow will not be affected, and morphological stream channel changes which could affect stream temperature would not occur. As a result, stream channel morphology and streambank stability would not measurably change from the existing condition (see Fisheries Report for summary of habitat condition). Maintenance of RHCA buffers and implementation of thinning guidelines will improve forest health, thereby retaining effective shade. Therefore, there will be no long term negative cumulative impacts to effective shade or stream temperature from this project.

Based on the assumptions of the ECA model and the literature cited, the proposed thinning and landscape burning would not have a measurable effect to hydrologic functions (capture, storage, and release of water) in any of the subwatersheds when combined with past actions. As a result, stream channel morphology and streambank stability would not be altered (see Fisheries Report).

Road construction has reduced shade along some stream segments. This may have an impact on the current temperature of water in those areas. Implementation of RHCA buffers and no new disturbance in RHCAs area will allow vegetation to grow to maturity, offering more effective shade along perennial streams. Therefore, there will be no long term negative cumulative impacts to current levels of effective shade or stream temperature from this alternative.

Deferred road maintenance would continue to increase and the condition of system roads within the project area would deteriorate over time. The project design criteria associated with this project together with the applicable road maintenance specifications (see Transportation Report) and engineering design standards would be implemented to control, minimize, and mitigate for the known detrimental effects of system roads and temporary project roads.

The proper maintenance of roads and culverts will reduce sedimentation risks of the existing road system, and storage or decommissioning of roads, skid trails, landings, and non-system roads will reduce the amount of sedimentation available for transport to streams (for example, the lower 1.5 miles of Forest Road 65 along Tiger Creek would be resurfaced as described in the Transportation Report and this would have a net positive benefit to water quality). Therefore, there will be no long term negative cumulative impacts to sedimentation from the proposed action.

The Soils Report describes the importance of maintaining and protecting the organic layer during management activities and concluded that proposed actions would meet Forest Plan standards for soil quality. Hillslope erosion because of high severity wildfire could increase sedimentation by several orders of magnitude during the initial rainfall immediately following a wildfire. Vegetation treatments are expected to reduce the severity and extent of landscape fire (see Purpose and Need in NOPA and Fuels section), and future fires would be expected to burn with lower severity, which would have a positive long-term effect on hillslope sedimentation.

The WEPP Cloud model was used to compare pre- and post-treatment wildfire burn severity on water and sediment yields for the major drainages of the project area. [Table 9](#) compares changes to soil burn severity, water yield and sediment yield. Modeling indicates that substantial reductions in both fire severity (tree mortality, see Fuels Report) and soil burn severity (see [Figure 5](#)) could be achieved as a result of proposed treatments.

Table 9. Relative changes to average annual water and sediment yields as a result of modeled wildfire soil burn severity before and after treatments.

Tiger-Mill: Hydrology Effects Analysis

Modeled Watershed	Area Acres	Wildfire M-H SBS		Water Yield (ac-ft/yr)				Sediment Yield (tons/yr)		
		Pre-trt	Post-trt	Unburn	Pre-trt	Post-trt	Difference*	Pre-trt	Post-trt	Difference
Mill Ck Municipal	21000	49%	17%	45900	61980	59700	35%	24000	8300	-290%
Tiger Creek	4400	39%	4%	6200	9870	9640	60%	8400	860	-980%
Webb Creek	1300	64%	25%	1600	2680	2755	67%	1800	840	-215%
NF Walla Walla	4600	47%	27%	9410	12625	12400	34%	5100	3500	-145%
Burnt Fork	3500	63%	40%	6660	9400	9400	41%	8500	6100	-140%
Griffin Fork	1500	84%	20%	2750	4130	3900	50%	3500	550	-635%
Wolf Fork	1100	30%	4%	2270	2980	2270	31%	460	75	-610%

M-H = Moderate to High Soil Burn Severity

* Difference is compared to the unburned condition; Effects to water yield are similar for both wildfire scenarios due to reductions to vegetation densities as a result of mortality due to fire and fuel reduction treatments

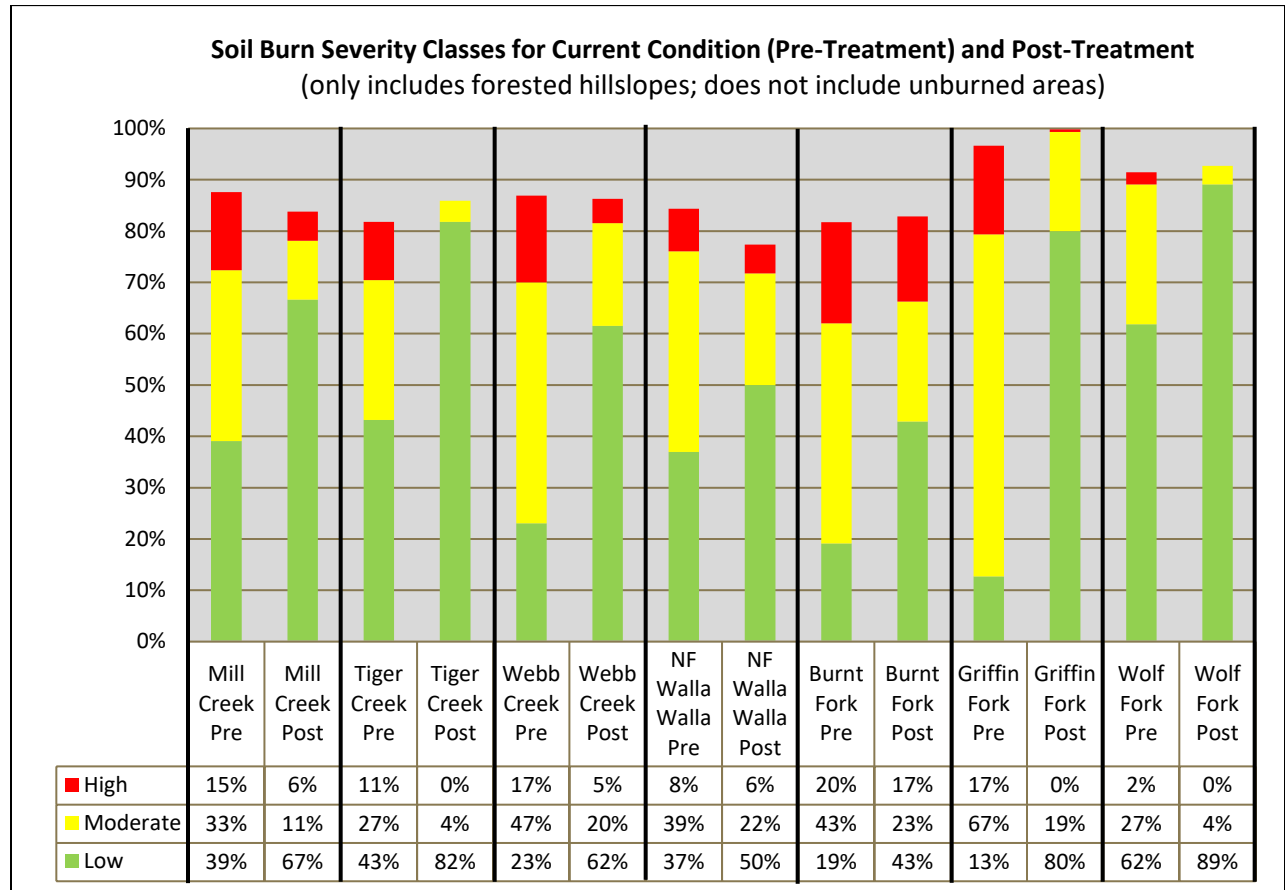


Figure 5. Comparison of soil burn severity from pre- and post-vegetation treatments for the modeled watersheds showing reductions in high and moderate SBS.

FlamMap model runs assume that the landscape all burns at the same time and that treatments are implemented concurrently. The WEPP output displays average annual water and sediment yield based on these assumptions. Recent fire occurrences in the northern Blue Mountains indicate that high severity, large-scale wildfire is a reasonable scenario. Because vegetation treatments would occur asynchronously across the landscape and be implemented during the course of 10-15 years or longer,

the increase in post-treatment water yield is expected to be less than the modeled amounts shown, on an annual basis. [Figure 6](#) displays average annual water yield under undisturbed conditions, after wildfire burning under current fuel loads and after wildfire burning after proposed treatments are implemented.

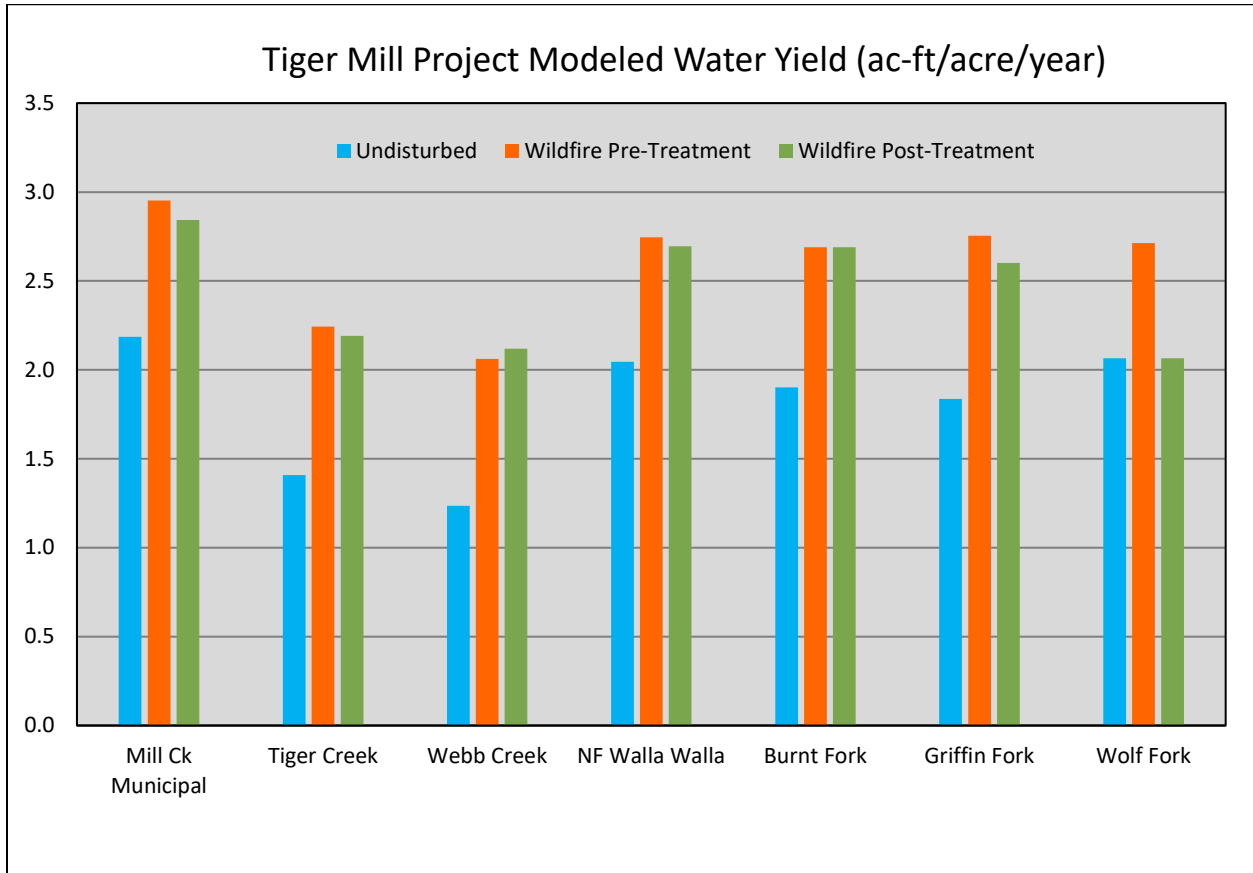


Figure 6. WEPP Cloud modeled results of average annual water yield from undisturbed landscape and pre- and post-treatment wildfire.

The main factor that determines the effects of burning on runoff and erosion is the amount of disturbance to the forest floor organic material that protects the underlying mineral soil. and when this duff layer is highly altered, erosion and runoff can be greatly increased ([Robichaud et al 2010](#)). Proposed vegetation treatments following PDCs would be implemented to maintain soil productivity (see Soils Report) and reductions in hillslope and channel sedimentation of 140-980% compared to higher severity wildfire are reasonable expectations and support the purpose and need to protect water quality for municipal supply and aquatic life uses, as illustrated in Figure 7, which shows both water and sediment yield on annual per acre basis for modeled drainages.

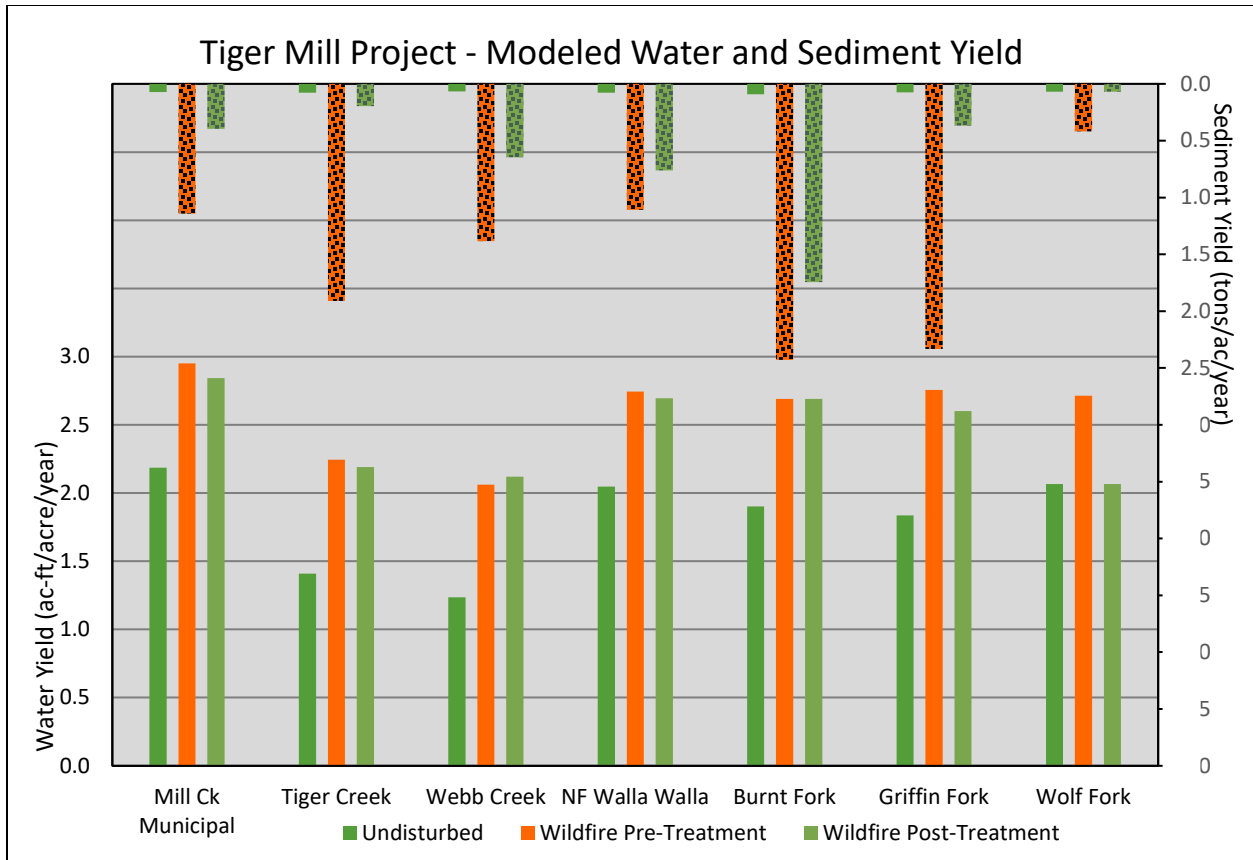


Figure 7. WEPP Cloud modeled results of comparing relative water yield and sedimentation from pre- and post-treatment wildfire, normalized on a per acre basis.

WEPP FuME was used to model hillslope sediment yields of proposed treatments on a 60% hillslope for lower elevation more frequent fire regime to higher elevation longer term fire regime in the year of disturbance. WEPP FuME does not consider PDCs designed to protect soil productivity and ground cover, and for this analysis is only used to illustrate the overall effectiveness of treatments to reduce the short- and long-term impacts of high severity wildfire. As shown in [Table 10](#) potential hillslope sedimentation during the first runoff producing events immediately post-fire could be up to 2 orders of magnitude higher than current average modeled background rate, when ash and surface soils are mobilized during high intensity, short duration storms that often occur during fire season.

Table 10. WEPP FuME results for potential post-fire hillslope and background sediment delivery

Precipitation Zone (Avg)	Fire Regime*	Mean Return Interval (yrs)	Year Zero Sedimentation (t/mi ²)	Average Hillslope Sedimentation (t/mi ² /yr)	Average Hillslope Sedimentation (t/ac/yr)
46"	1, 3	20, 55	6330	77	0.12
52"	1, 3, 4	20, 55, 140	9606	134	0.21
57"	3, 4	55, 140	11712	115	0.18

*Forested Fire Regimes: FR1 = 7%; FR3 = 46%; FR4 = 21% of the project area (See Fuels Report)

Conclusion

Existing roads, landings, and skid trails increase risk of sedimentation to streams. Proper post-harvest closure of system roads and decommissioning of non-system roads would reduce this risk for the future. A brief sediment pulse will occur from ground-disturbing activities such as road maintenance and closure, and this will quickly be flushed through the system in the following winter/spring runoff with no long-term negative impacts. Stream shade levels will not be impacted by the proposed activities and stream temperatures will likely remain consistent with past temperatures, although climate change scenarios predict increasing stream temperatures. Likewise, no adverse impacts to stream morphology are anticipated in the analysis area. Future wildfire risk will decline as forest fuels are removed. Forest treatments would reduce the risk of future wildfire extent and severity from high to low, the slight short-term increase in erosion associated with the proposed activities will be offset by the reduced risk of fire and associated reduction in hillslope and channel erosion risk as a result of large scale, high severity fire.

Environmental Consequences of Alternative B (Action Alternative)

Direct, Indirect and Cumulative Effects

Summary: The Alternative B proposes 4,877 acres of commercial thinning, and 6,991 acres of non-commercial thinning. This constitutes an approximate 26% reduction in soil disturbing commercial activities. Construction of 4.81 miles of temporary roads is proposed under the Alternative B, a reduction in temporary roads of approximately 55%. Treatment areas and temporary road locations under this alternative would be in the same locations as Alternative A, therefore, the direct, indirect and cumulative effects of this alternative would be less than for Alternative A and further analysis would be redundant.

Implementation of the Alternative B would not cause additional, measurable changes to the direct, indirect, or cumulative effects to the resource measures for hydrologic resources. As required by the Clean Water Act and Forest Plan, BMPs that apply to this project are identified in the PDC Table.

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Tiger-Mill: Hydrology Effects Analysis

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