



BLUE RIVER

**WATERSHED
HAZARD
ASSESSMENT**

2025

PREPARED BY
JW ASSOCIATES

PREPARED FOR
BLUE RIVER
WATERSHED GROUP



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INTRODUCTION

This report documents a watershed hazard analysis that was completed to support the Blue River Wildfire Ready Action Plan. The availability, reliability, and quality of the water supply is at risk from disturbances in the watersheds throughout the project area. Of particular concern are the potential conditions in the watersheds following wildfire and subsequent hydrologic changes. Depending on the severity of burn and the watersheds' characteristics, there is the potential for increased sediment yields, flooding, and debris flows.

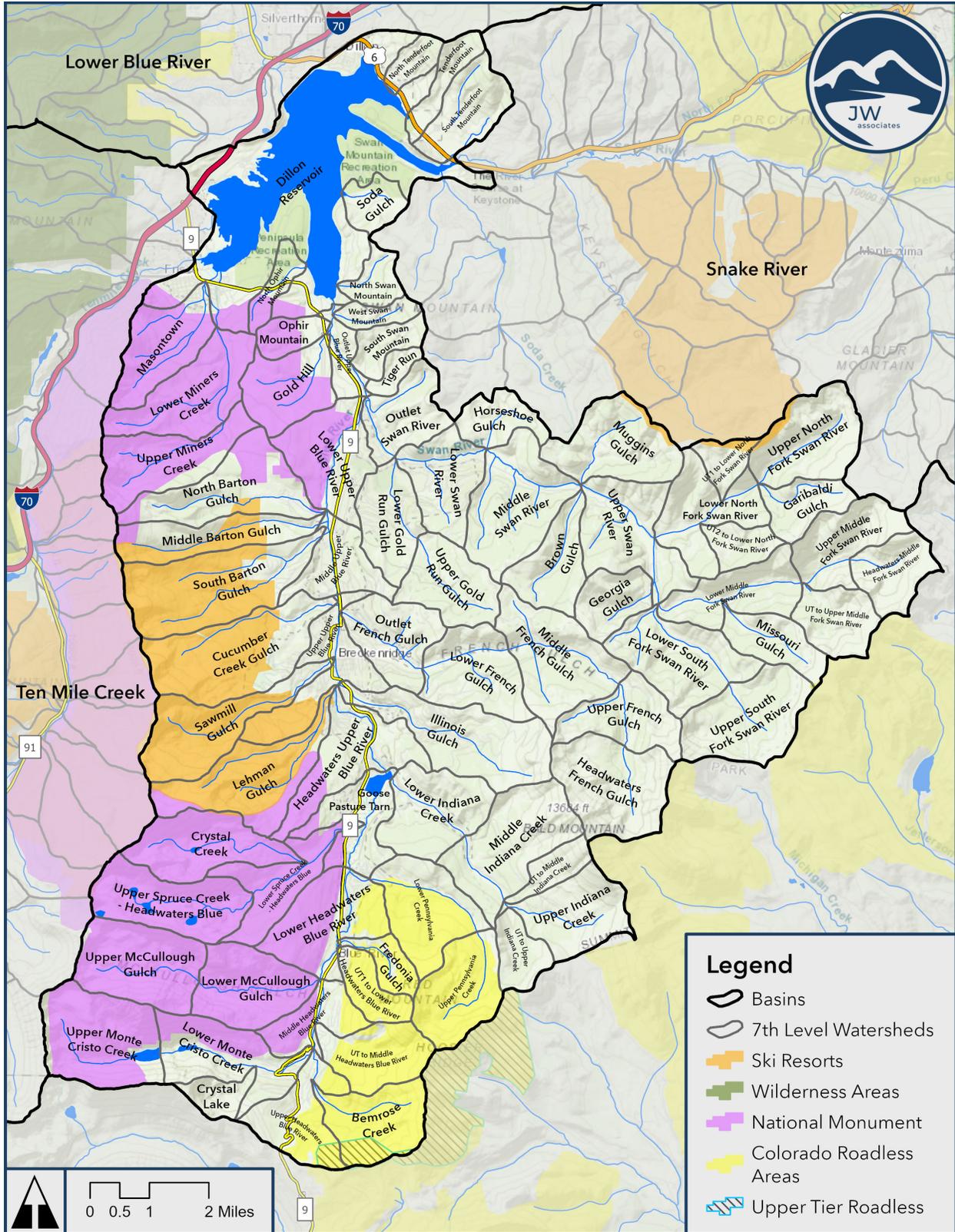
This report focuses on the impacts stemming from wildfire and potential post-fire hazards, and examines the long-term hazard that is posed by changes in climate. Other disturbances that can impact water supplies include recreation use and development. These additional factors are not directly part of this analysis; however, these factors will be discussed elsewhere in the Wildfire Ready Action Plan as they may affect individual watersheds and long-term watershed resiliency.

This assessment analyzes and ranks watershed hazards providing a prioritization framework for identifying specific areas for targeted management actions. The recommendations in the Blue River Wildfire Ready Action Plan are informed by the overlay of hazard rankings onto the water system and other Values at Risk to identify targeted management actions in areas that are most critical for infrastructure and the maintenance of a high quality and reliable water supply. The watershed hazard rankings are also used to provide direction for long term management strategies in areas that may not be immediately critical to the water supply system. This analysis is used to increase long-term watershed resiliency to wildfire, climate change and other impacts from recreation, roads or other development.

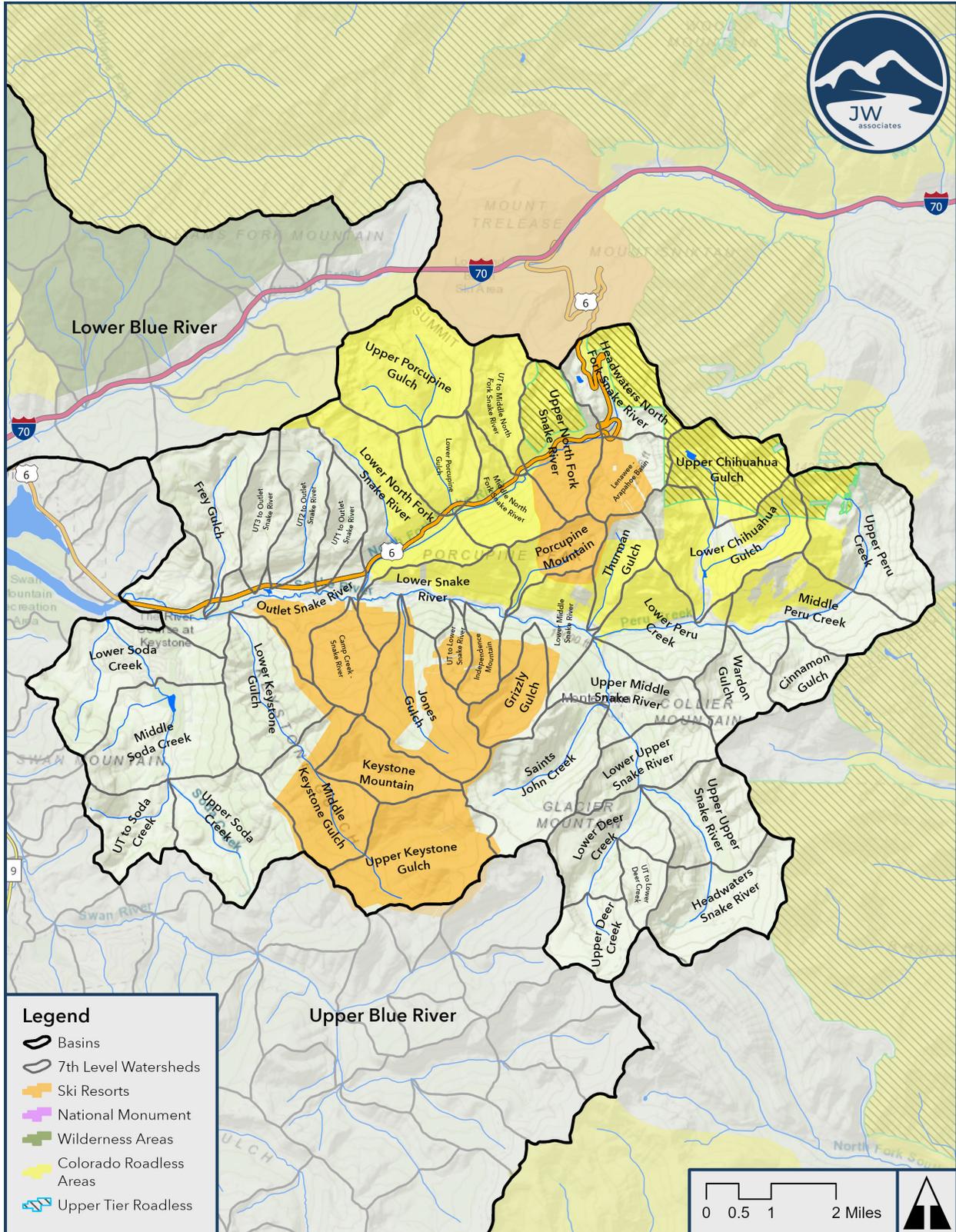
Four basins were included in the analysis and are listed in Table 1, including 19 6th Level (HUC12) watersheds. These 6th Level watersheds were further delineated into smaller 7th Level (HUC14) watersheds for the prioritization of specific hazards. For the purpose of this project, the 7th Level watersheds are grouped by basin area, as shown in Table 1. The total assessment area covers 437,215 acres and includes 346 7th Level watersheds (Table 1, Map 1-5 and Appendix A).

Table 1. 6th Level Watersheds Included in the Blue River Watershed Wildfire Hazard Assessment

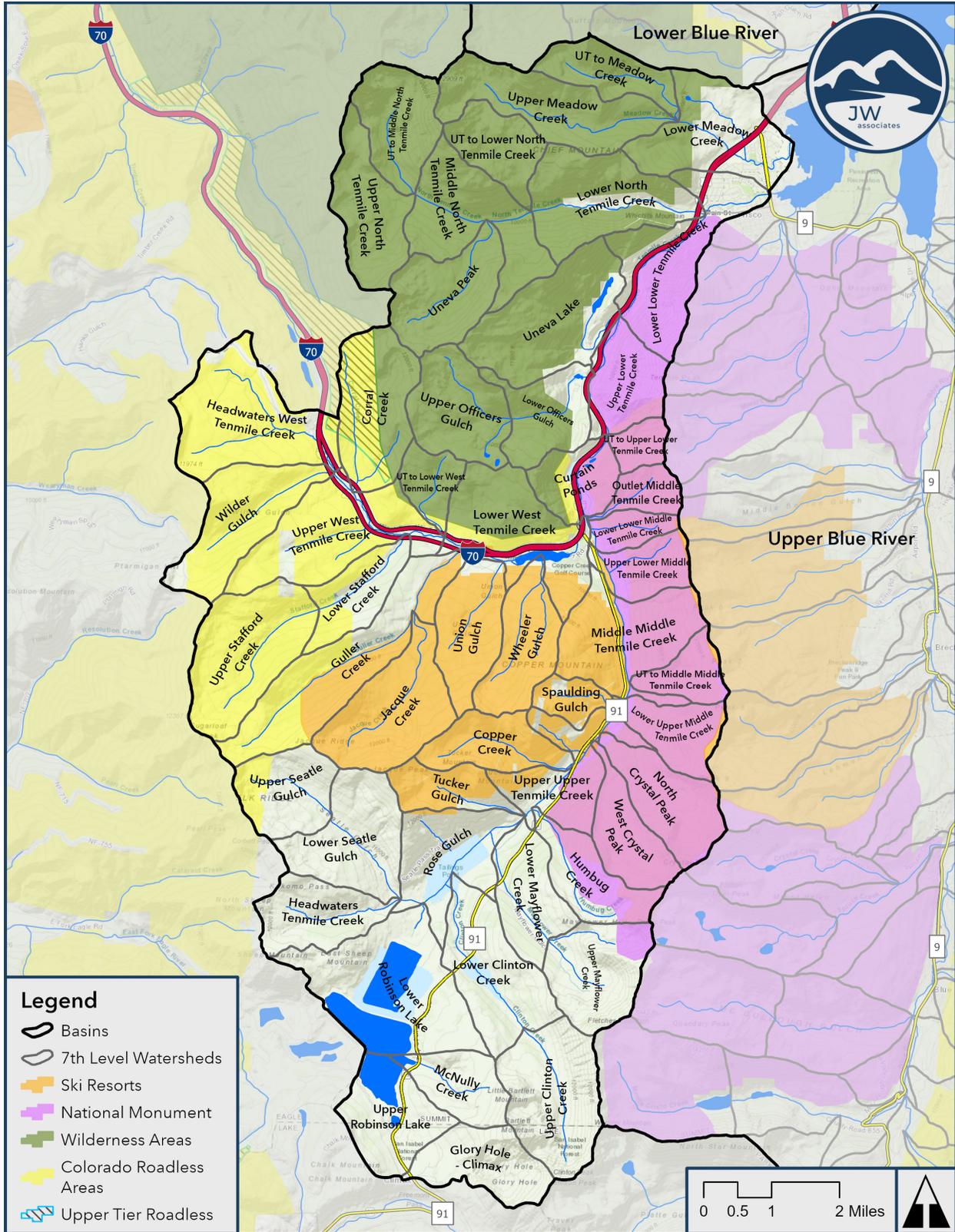
Basin	Area (acres)	Number of 7 th Level Watersheds
Upper Blue River	93,874	53
Snake River	56,363	77
Ten Mile Creek	63,521	45
Lower Blue River	223,456	171
Total	437,215	346

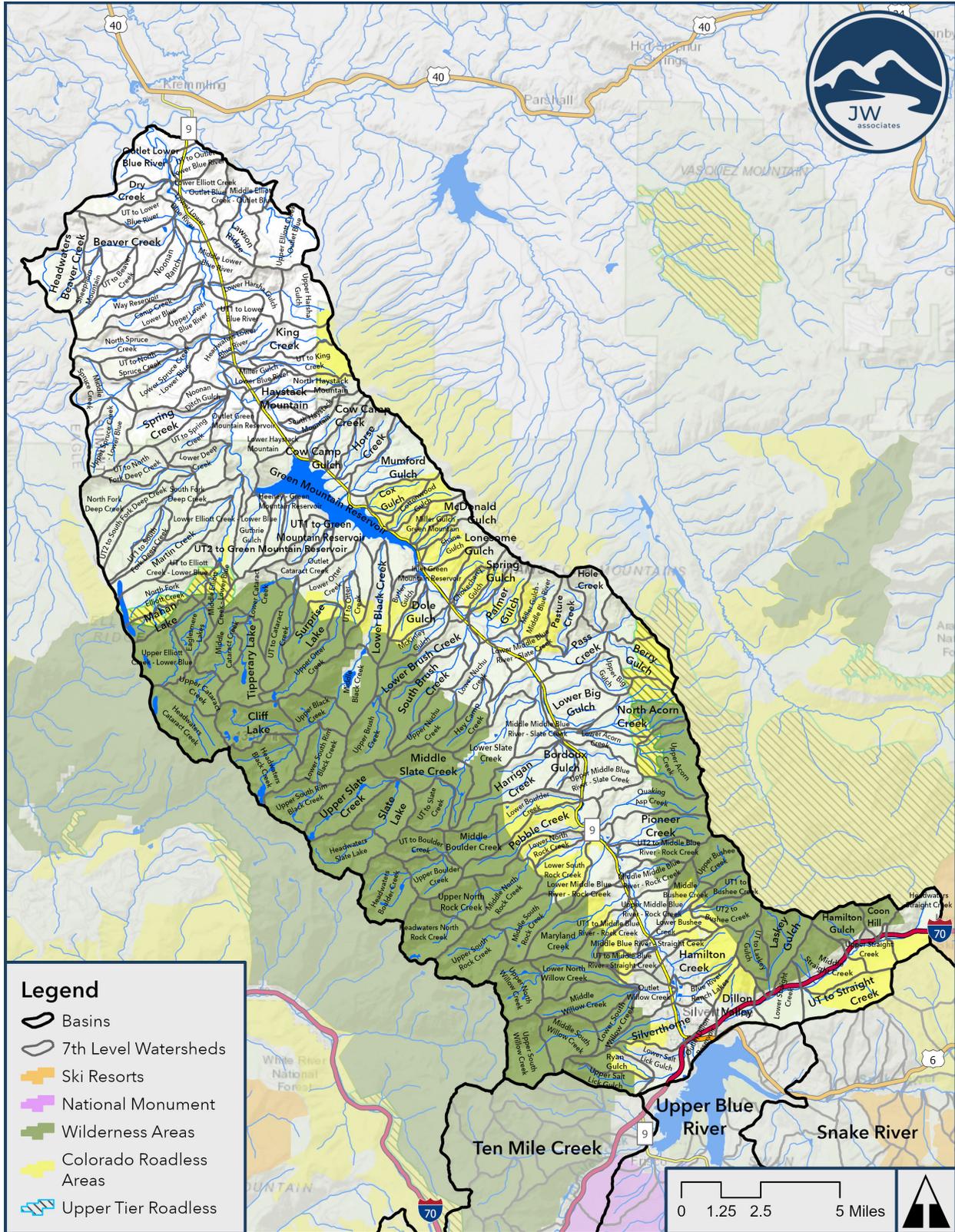


Map 2. Upper Blue River Basin Wildfire Ready Action Plan Area



Map 3. Snake River Basin Wildfire Ready Action Plan Area





WATERSHED WILDFIRE HAZARD ANALYSIS OVERVIEW

JWA WATERSHED/WILDFIRE HAZARD ANALYSIS DESCRIPTION

The 7th Level (or HUC14) watersheds were delineated with the goal of identifying hazards that may be targets of pre-fire or post-fire actions or other watershed protection measures. The Watershed/Wildfire Hazard Analysis creates hazard rankings for each small 7th Level watershed for the landscape components that are signals of potential post-fire issues. The components analyzed are characteristics that make a small watershed particularly hazardous post-fire. These hazards include:

- Wildfire Hazard
- Roads
- Debris Flow
- Hillslope Erosion

Each component (or hazard) is based on data analysis backed by longstanding scientific research and is assessed at the scale of individual small watersheds. These results are then assembled into a hazard ranking for each component, comparing all small watersheds in the study area relative to each other. Once all the components are analyzed and ranked, they are merged into a composite ranking that reflects the overlapping and amplifying hazards within each small watershed. The composite ranking provides five categories from lowest to highest hazard and is mapped to visually illustrate the results. This model is a valuable tool for identifying the most vulnerable points across a large area, and also provides a visual explanatory of watershed dynamics and response to wildfire.

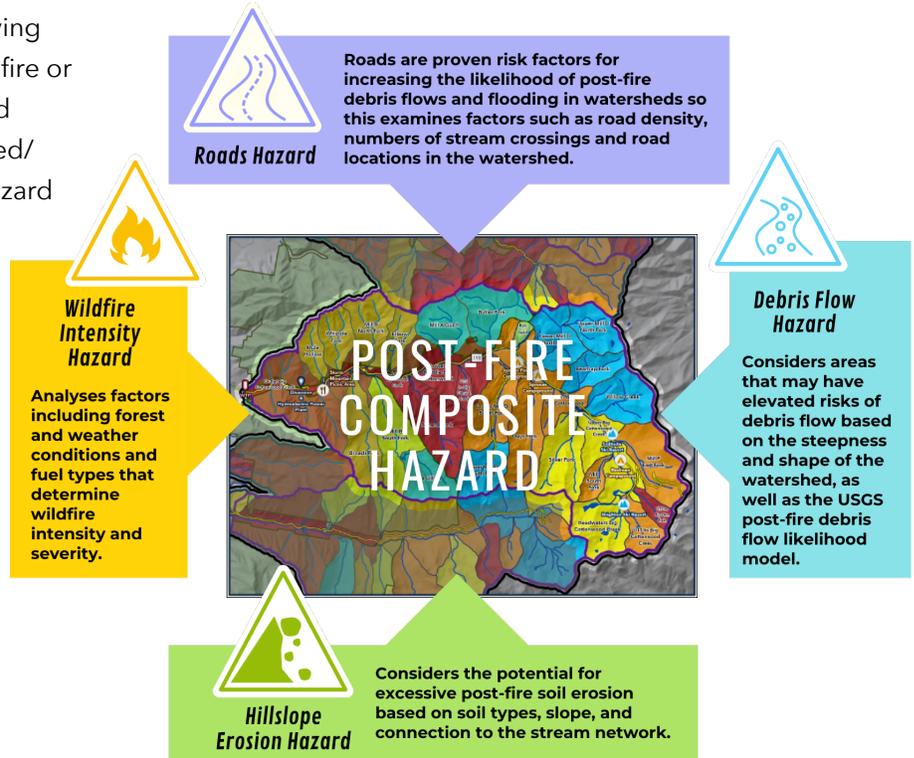


Figure 1. Components of the Watershed/Wildfire Hazard Analysis

COMPONENTS FOR ANALYSIS

All 7th level watersheds were ranked using two composite hazard categories. The first is the Post-Fire Composite Hazard, described above, which highlights wildfire characteristics and post-fire response. The watersheds were also analyzed and ranked using the Watershed Vulnerability Hazard which identifies characteristics that indicate overall watershed resilience, or a lack of resilience and therefore

increased hazard, due to landscape alteration or ability to adjust to future climate scenarios. The following diagrams (Figures 2 & 3) illustrate the various hazard components and their data inputs for this analysis.

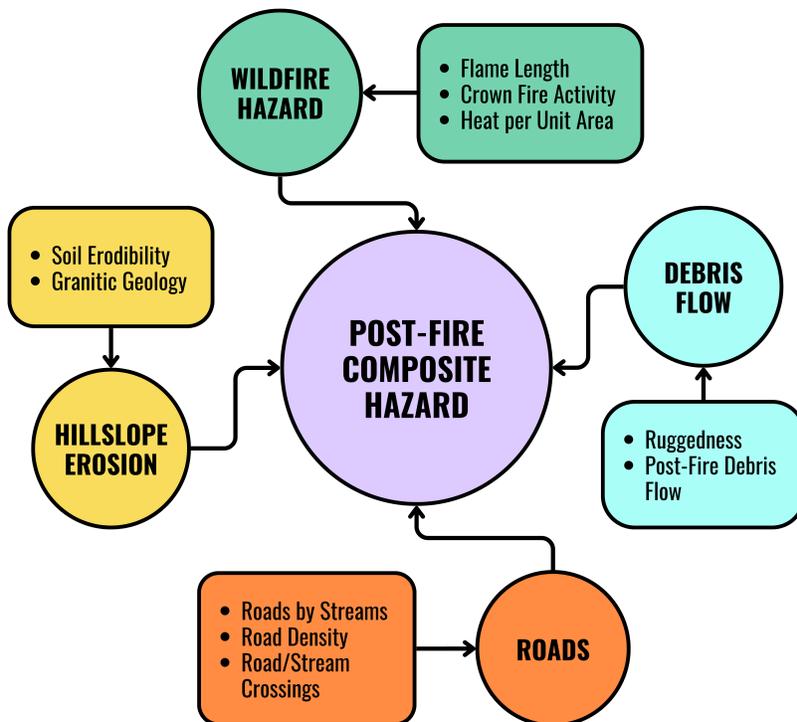


Figure 2. Factors used for Post-Fire Composite Hazard Analysis

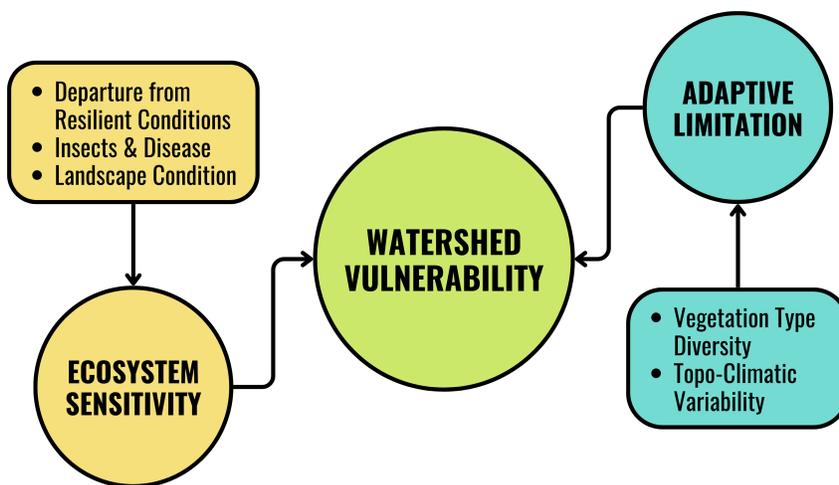


Figure 3. Factors used for Watershed Vulnerability Analysis

RANKING/CATEGORIZATION APPROACH

The methodology compares and ranks all of the 7th Level watersheds within the assessment area for each hazard component. The individual 7th Level watershed results for each hazard component are scaled to fall within categories ranging from lowest hazard to highest hazard based upon a ranked comparison to the other 7th Level watersheds. The result is an ordered ranking of watersheds by hazard that can be used to consider relative concerns and hazards in the assessment area. The calculation of this ranking was completed as follows:

1. Calculate the hazard based on the percent area of the watershed or average value of each 7th Level watershed (or other metrics, depending on hazard component).
2. Scale the numerical results so that they fall within five hazard rank categories, with a reasonable distribution that spans the range of hazards.
3. Round the scaled result to the nearest whole number, between 1 and 5 (retaining the original number for Composite Hazard Ranking calculations).
4. Create a map of the results using the following scheme:

Category 1	Lowest Rank
Category 2	Low Rank
Category 3	Moderate Rank
Category 4	High Rank
Category 5	Highest Rank

POST-FIRE COMPOSITE HAZARD ANALYSIS

WILDFIRE HAZARD

The Interagency Fuel Treatment Decision Support System (IFTDSS), an online implementation (www.iftdss.firenet.gov) of the FlamMap fire mapping and analysis system (Finney 2006, Stratton 2006), was used to assess the wildfire intensity hazard. The FlamMap analysis describes potential fire behavior for constant environmental conditions (weather and fuel moisture). The outputs from FlamMap are used to identify and compare combinations of hazardous fuel and topography. This information is used to aid fuel treatments priorities. FlamMap is widely used by the U.S. Forest Service, National Park Service, and other federal and state land management agencies in support of fire management activities. It should be noted that FlamMap does not calculate fire spread across a landscape. A number of assumptions were used in the modeling and are presented in Appendix B.

LANDFIRE (<https://landfire.gov>) is the source for the basic data used in the wildfire modeling, including data for vegetation and topography. LANDFIRE covers all ownerships and is updated frequently, which

are significant benefits of this data set. The latest update for LANDFIRE data was released in 2025, and includes data collected through 2024.

Several fire behavior model outputs were evaluated for this analysis. Flame length, crown fire activity, and heat per unit area were selected as the basis for the wildfire intensity hazard analysis after reviewing comparisons to past modeling efforts and in consultation with local experts. Considering the differing vegetation types across all watersheds in the assessment area, the combination of these three output variables helps to identify the locations where wildfire will burn with both high intensity and likely with high severity. Fire intensity is a measure of the heat output from the flames during burning, while fire severity is a measure of the overall impact the burn actually has on the ground conditions at the site, including post-fire soil conditions, erosion, and revegetation.

Flame Length

Flame length is determined by a combination of the Heat per Unit Area and Rate of Spread (Andrews and Rothermel, 1982; Figure 2). Tables 2 and 3 are provided as tools for interpreting the implications of the flame length analysis. Ground crews with simple hand tools are not effective against fires with flame lengths over three to four feet. Spotting beyond the immediate vicinity of the fire causes safety concerns and can also ignite several, if not numerous, independent fires downwind from the original blaze. Multiple spot fires can compromise firefighter and resident safety by cutting off escape routes to safety zones.

The flame length results were divided into six categories of wildfire hazard ranging from lowest (Category 0) to highest (Category 5). The flame length categories are

Flame Length Category 0: 0 feet

Flame Length Category 1: 1 to 4 feet

Flame Length Category 2: >4 to 8 feet

Flame Length Category 3: >8 to 12 feet

Flame Length Category 4: >12 to 25 feet

Flame Length Category 5: >25 feet

Table 2. Fire Suppression Implications of Flame Length

Flame Length (feet)	Interpretation
0-4	Persons using hand tools can generally attack fires at the head or the flanks. Handlines should hold the fire.
4-8	Fires are too intense at the head for direct attack by persons using hand tools. Handlines can't be relied upon to hold the fire. Equipment such as dozers, engines and retardant aircraft can often be effective on fires with these flame lengths.
8-11	Fires with these flame lengths may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire using dozers and engines will probably be ineffective. Attack using retardant aircraft may still be effective.
11+	Crowning, spotting, and major fire runs are common. Control efforts at the head of the fire, even with retardant aircraft, are usually ineffective.

Table 3. Rate of Spread Based on Flame Length¹

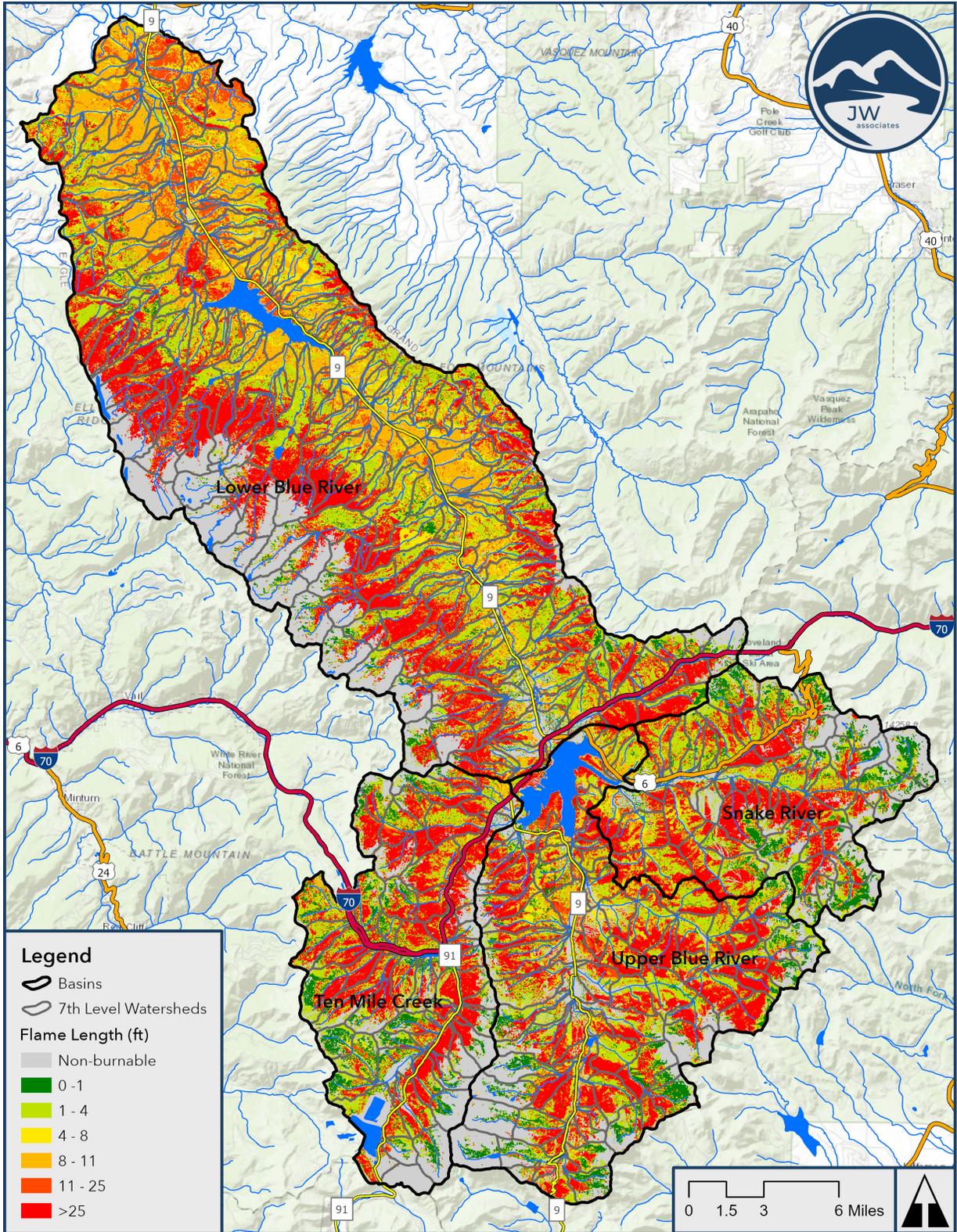
Flame Length (feet)	Rate of Spread (Chains/Hour)
0 - 1	0 - 2
1 - 4	2 - 5
4 - 8	5 - 20
8 - 11	20 - 50
11 - 25	50 - 150
> 25	> 150

Flame length categories were mapped throughout the assessment area. Within each 7th Level watershed, the areas in Flame Length Categories 3, 4 and 5 were weighted by severity to determine an overall score as follows (where WA = Watershed Area):

$$\text{Flame Length Metric} = [\text{WA in Category 3} + 2 * (\text{WA in Category 4}) + 3 * (\text{WA in Category 5})] / \text{WA}$$

All 7th Level watersheds were then ranked by the Flame Length Metric. Map 6 represents the result of this analysis.

¹ One chain equals 66 feet



Map 6. Blue River Flame Length Modeling Results

Crown Fire Activity

Crown fire occurs when the fire has climbed into the canopy, potentially burning and spreading along the canopy or tops of the trees. Crown fire can be either passive or active. These are defined by the National Wildfire Coordinating Group as:

Passive Crown Fire occurs where surface fire intensity is sufficient to ignite tree crowns, individually or in groups, but winds are not sufficient to support propagation from tree to tree.

Active Crown Fire occurs where surface and crown fire energy are linked. Surface intensity is sufficient to ignite tree crowns, and fire spread and intensity in the tree crowns encourages fire spread and intensity.

A combination of many factors are used in the modeling to determine crown fire activity including slope, aspect, wind speed and direction, the fuel model used, surface fuels, canopy fuels, canopy base height, vegetation types, and more. The crown fire activity modeling output presents results in the following four classifications:

Non-burnable: Category 0

Surface Fire: Category 1

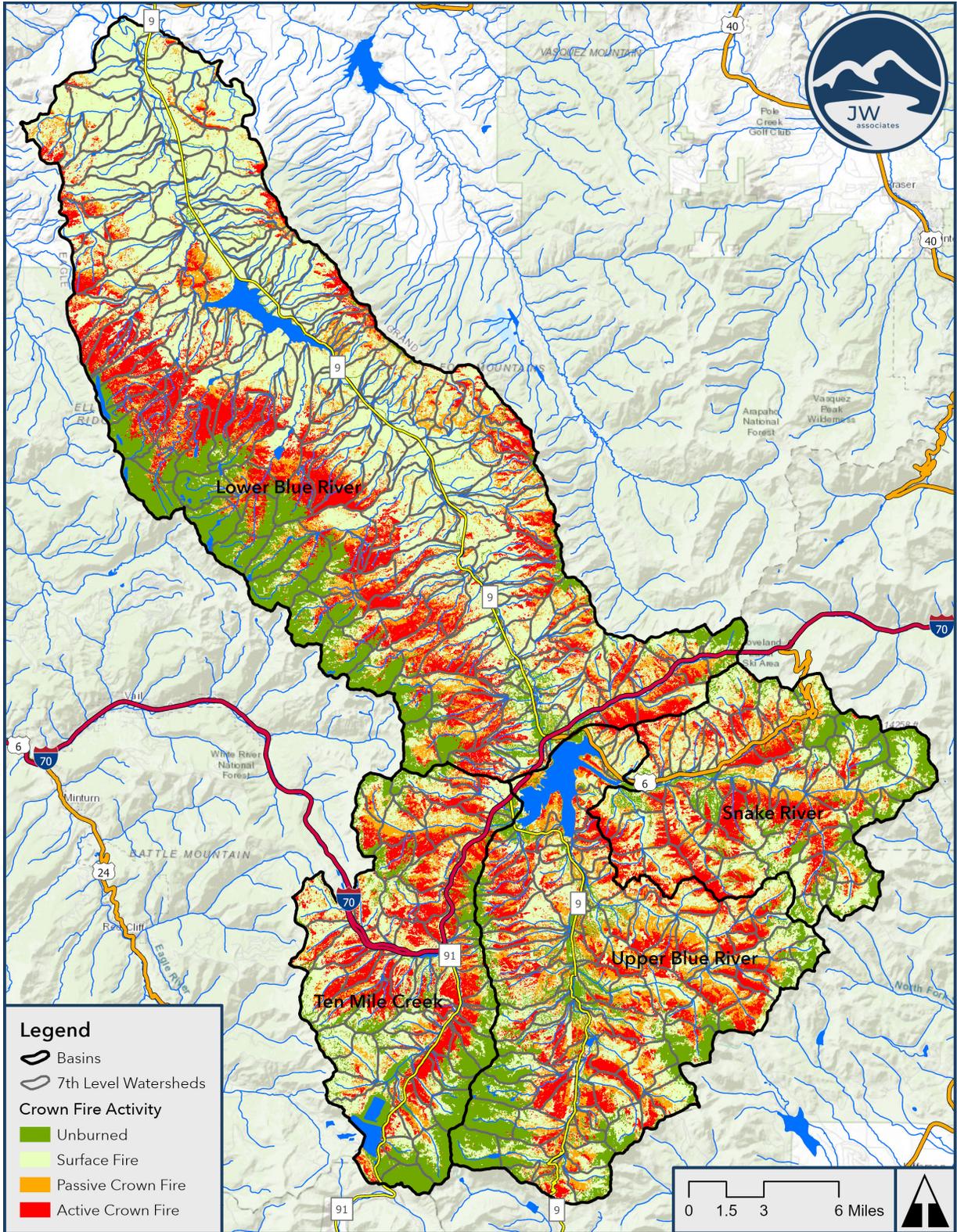
Passive Crown Fire: Category 2

Active Crown Fire: Category 3

The crown fire activity categories were mapped throughout the assessment area. As was done for the flame length metric, within each 7th Level watershed, the areas in Category 2 (Passive Crown Fire) and Category 3 (Active Crown Fire) were weighted by severity to determine an overall score as follows (where WA = Watershed Area):

$$\text{Crown Fire Activity Metric} = [\text{WA in Category 2} + 2 * (\text{WA in Category 3})] / \text{WA}$$

All 7th Level watersheds were then comparatively ranked by the crown fire activity metric. Map 7 represents the result of this analysis.



Map 7. Blue River Crown Fire Activity Modeling Results

Heat per Unit Area

Heat per Unit Area is a measure of the amount of heat that is directed at the ground within the burned area. It is directly related to fuel type and is not affected by wind speed, slope, or rate or direction of spread. Because of this, the Heat per Unit Area variable does not change based on many of the assumptions made for the wildfire modeling, such as weather and wind conditions. This measure is related to the direct effects of wildfire on the soil ecology and microbiology within the soil layers, which affects the post-fire ground conditions and the ability for vegetation to recover following a fire.

The Heat per Unit Area results were divided into seven categories of wildfire hazard ranging from lowest (Category 0) to highest (Category 6). The categories are

Category 0: 0 BTU/ft²

Category 1: >0 to 300 BTU/ft²

Category 2: >300 to 1,000 BTU/ft²

Category 3: >1,000 to 3,000 BTU/ft²

Category 4: >3,000 to 6,000 BTU/ft²

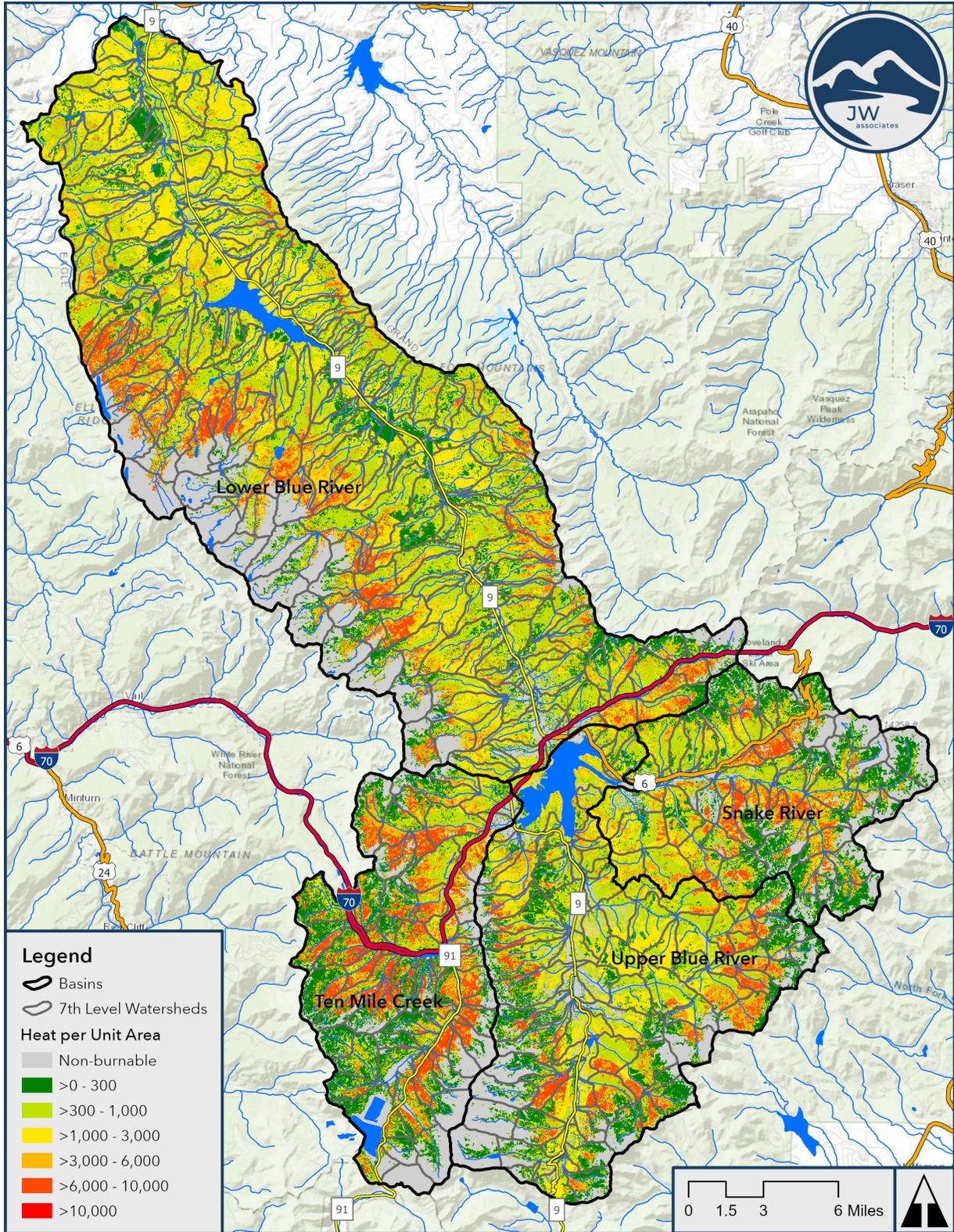
Category 5: >6,000-10,000 BTU/ft²

Category 6: >10,000 BTU/ft²

Heat per Unit Area categories were mapped throughout the assessment area. Within each 7th Level watershed, the areas in Heat per Unit Area Categories 4, 5, and 6 were weighted by severity to determine an overall score as follows (where WA = Watershed Area):

Heat per Unit Area Metric = $[WA \text{ in Category 4} + 2*(WA \text{ in Category 5}) + 3*(WA \text{ in Category 6})]/WA$

All 7th Level watersheds were then ranked by the Heat per Unity Area Metric. Map 8 represents the result of this analysis.



Wildfire Hazard Ranking

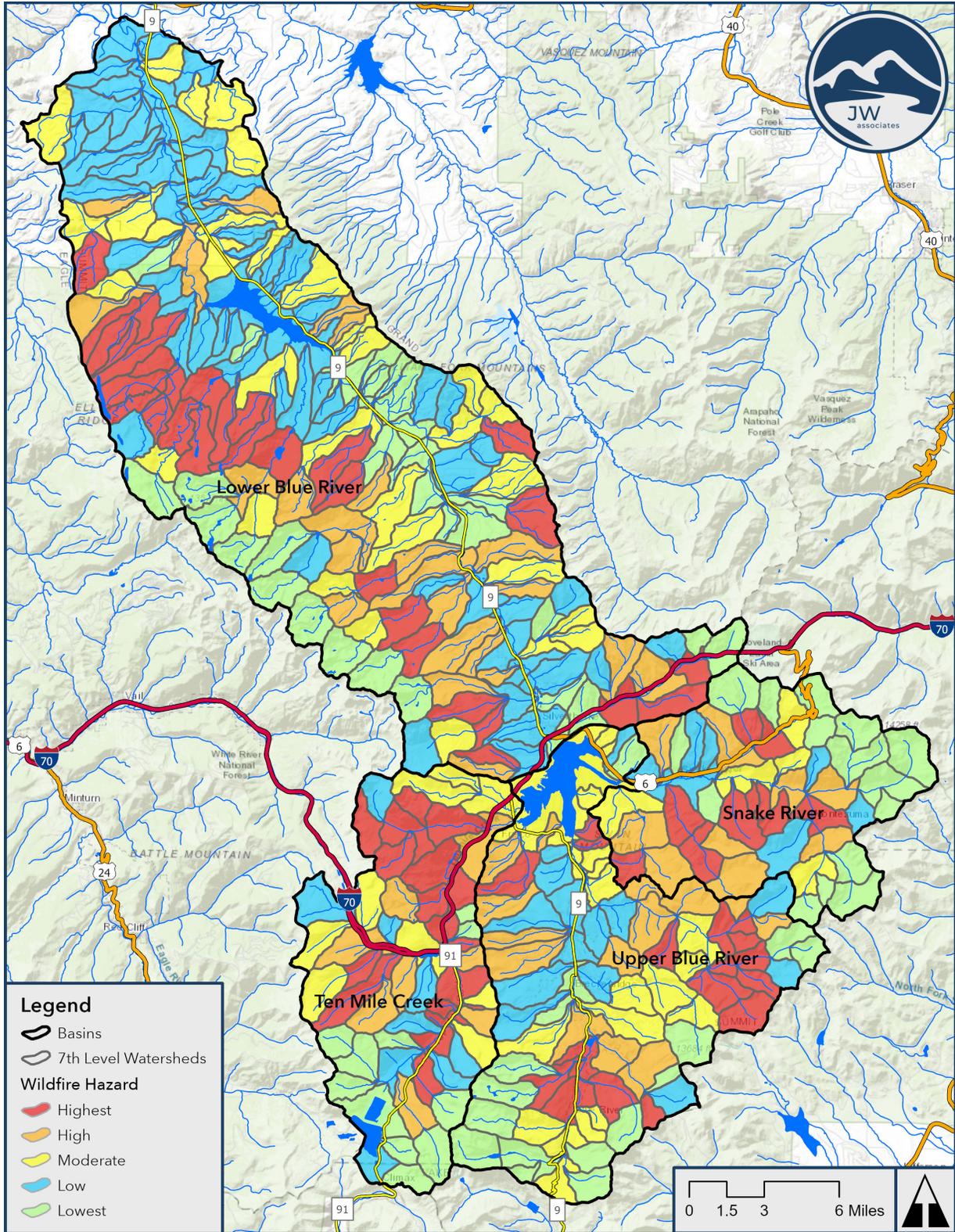
To form the wildfire hazard ranking, the individual rankings for Flame Length, Crown Fire Activity, and Heat per Unit Area were combined. Using the combined score, watersheds were ranked into five roughly equal categories from 1 (lowest overall wildfire hazard) to 5 (highest overall wildfire hazard). Map 9 presents the result of this analysis for all 7th Level watersheds. Of these, 71 7th Level watersheds were ranked as Highest Hazard for Wildfire and are identified in Table 4. The complete categorization listing can be found in Appendix B.

Table 4. Highest Ranked 7th Level Watersheds for Wildfire Hazard

Basin Name	7 th Level Watershed Name
Upper Blue River	Lower Headwaters Blue River
	Lower Pennsylvania Creek
	Lower Spruce Creek - Headwaters Blue
	UT to Upper Indiana Creek
	Goose Pasture Tarn
	Upper South Fork Swan River
	Lower South Fork Swan River
	Missouri Gulch
	Lower Middle Fork Swan River
	UT2 to Lower North Fork Swan River
	Lower North Fork Swan River
	Brown Gulch
	West Swan Mountain
	Lower Miners Creek
	North Swan Mountain
Snake River	Middle North Fork Snake River
	Lower Porcupine Gulch
	Upper Middle Snake River
	Grizzly Gulch
	Independence Mountain
	UT to Lower Snake River
	Jones Gulch
	Middle Keystone Gulch
	Lower Keystone Gulch
	UT to Soda Creek
Ten Mile Creek	Lower Mayflower Creek
	Lower Stafford Creek
	Guller Creek
	Upper Upper Tenmile Creek
	Spaulding Gulch
	Middle Middle Tenmile Creek

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Basin Name	7 th Level Watershed Name
Ten Mile Creek	Lower Lower Middle Tenmile Creek
	Curtain Ponds
	Lower Officers Gulch
	Upper Lower Tenmile Creek
	Uneva Lake
	Upper North Tenmile Creek
	Uneva Peak
	Middle North Tenmile Creek
	UT to Lower North Tenmile Creek
	Lower North Tenmile Creek
Lower Blue River	Upper Straight Creek
	UT to Straight Creek
	Lower Straight Creek
	Ryan Gulch
	Middle Willow Creek
	Lower South Willow Creek
	Middle South Rock Creek
	Middle North Rock Creek
	Middle Boulder Creek
	Upper Acorn Creek
	Berry Gulch
	Upper Nuchu Creek
	South Brush Creek
	Middle Black Creek
	Upper Otter Creek
	Surprise Lake
	Middle Cataract Creek
	Tipperary Lake
	Lower Cataract Creek
	UT to Cataract Creek
	Eaglesmere Lakes
	Mahan Lake
	North Fork Elliott Creek
	Middle Elliott Creek - Lower Blue
	UT to Elliott Creek - Lower Blue
	Martin Creek
	UT1 to South Fork Deep Creek
	UT2 to South Fork Deep Creek
	South Fork Deep Creek
	Upper Spruce Creek - Lower Blue



Map 9. Blue River Wildfire Hazard Ranking

DEBRIS FLOW HAZARD

Rapid runoff from burned areas can result in high peak flows that may overwhelm the stream bank armoring. These events can rapidly destabilize the stream channel and potentially initiate a debris flow. Debris flows contain water but can also carry sediment, rocks, boulders, woody debris, and whole trees. A recent example of this kind of destructive and tragic event is the Black Hollow debris flow that occurred in 2021 after the Cameron Peak Fire, Upper Poudre Watershed, Colorado. This event destroyed six homes and killed four people. It additionally had major water quality impacts on the Cache La Poudre River, killed fish for miles downstream, and altered the stream channel (Blumhardt, 2022). The types of unstable stream channels that produce debris flows often yield continuous sources of increased stream bank sediment for years following the event. The 2022 water quality report from the City of Fort Collins describes this debris flow event, its impact on the Poudre River and the water treatment processes:

“The initial surge of debris and sediment resulted in extremely high turbidity levels in the CLP river (several thousand NTU), which required water treatment facilities to shut down their intakes on the CLP river and treat alternate water supplies. Turbidity remained elevated and highly variable for several weeks following the event, which continued to pose treatment challenges. The extreme amount of sediment from this event eventually settled on the banks and bottom of the river channel providing an additional source of sediment during subsequent flood events in August and snowmelt runoff in 2022. The sediment and ash that were stored on the bottom and banks of the Poudre River in 2021 were mobilized during snowmelt runoff in 2022, leading to elevated turbidity and suspended sediment. Turbidity levels in 2022 were much higher and more variable than pre-fire conditions and required water treatment plants to shut down their intakes on the CLP river on several occasions to avoid the polluted water.”

-Heath and Thorp (2023)



Black Hollow Debris Flow 2021 - Cameron Peak Fire

The rapid movement of water, sediments and debris from flooding and debris flows can potentially overwhelm or damage water supply infrastructure in the short term. The material deposited in-stream can also cause longer term problems as the sediments and other larger materials may continue to move downstream for months to years after the actual event has occurred. Debris flow likelihood is influenced predominantly by the steepness or ruggedness of the watershed and the rainfall intensity of a storm event, combined with the amount of moderate or high burn severity following wildfire.

Ruggedness

Watershed steepness or ruggedness is an indicator of the relative sensitivity to debris flows following wildfires (Cannon and Reneau 2000). The more rugged the watershed, the higher its sensitivity to generating post-fire debris flows (Melton 1957). The Melton ruggedness factor uses upslope catchment height and the catchment area to create a slope index. Numerous studies have shown that the Melton ruggedness number is a valuable evaluation tool to discriminate between basins with debris flow potential and those where sediment transport processes are more dominated by bedload (Marchi and Fontana, 2005). Melton (1957) defines ruggedness, R , as;

$$R = H_b A_b^{-0.5}$$

Where A_b is basin area and H_b is basin height measured from the point of highest elevation along the watershed divide to the outlet.

For this analysis, the Ruggedness Number (R) in some watersheds was adjusted because the value did not accurately reflect the steepness of some of the contributing tributaries. This most commonly occurs in composite watersheds that are disconnected from their headwaters. These watersheds can have a higher hazard for debris flows than is indicated by the ruggedness calculation because they contain a main stem of a creek or river which does not reflect the steepness of the first order streams that enter the main stem as tributaries. In those situations, the ruggedness calculation was adjusted up.

Once Ruggedness was calculated, the results for all 7th Level watersheds watersheds were grouped into roughly equal categories from lowest to highest ruggedness.

Post-Wildfire Debris Flow Hazard

The United States Geological Survey (USGS) created a method for estimating the post-fire debris flow hazards for a watershed before wildfire occurs (Staley et. al., 2018). This technique combines wildfire modeling with other debris-flow indicators including slope and soil erodibility to predict the post-fire debris flow hazards in response to a triggering rainfall event.

The model was run for a triggering rainfall intensity from a 2-year storm. The probability of this type of rain event causing a debris flow was calculated for each 7th Level watershed. The watersheds were then grouped into roughly equal categories from lowest to highest hazard.

The variables used in the debris flow estimation model are discussed below.

Soil Burn Severity and Slope

IFTDSS crown fire activity modeling output was used as a surrogate for assigning predicted burn severity as follows,

Non-burnable: Unburned

Surface Fire: Low Burn Severity

Passive Crown Fire: Moderate Burn Severity

Active Crown Fire: High Burn Severity

Slope is calculated in degrees from a 10-meter digital elevation model (DEM). The proportion of watershed area burned at high or moderate burn severity with gradient in excess of 23 degrees is used in the model equation.

difference Normalized Burn Ratio (dNBR)

The USGS completes an Emergency Assessment of Post-Fire Debris-Flow Hazards following western US wildfires. This assessment uses the difference Normalized Burn Ratio (dNBR) image from remote sensing and field validated soil burn severity. The Normalized Burn Ratio (NBR) is an index designed to highlight burned areas in large fire zones by calculating a ratio from two different infrared satellite images. The difference between the pre-fire and post-fire NBR obtained from the images is used to calculate the dNBR, which then can be used to estimate the burn severity.

In lieu of this data for pre-fire estimation of post-fire debris flow hazard, the USGS defined a range of potential fire severities for a given area based on the historical statistical distribution of burn severity metrics in each vegetation class. The dNBR values are estimated using the vegetation classes from the Landfire vegetation type, and then used in the debris-flow hazard model.

Actual burn severity depends on a number of variables in addition to vegetation type, including soil moisture deficit, fuels, wind direction, etc. In order to narrow the range of possible dNBR values calculated, a simple scaling variable (Pdsim, between 0-1) is used to control the severity of the simulated fire (Staley et al., 2018). In modeling for this assessment, JWA used a value of Pdsim = 0.75. The severity of a wildfire can be quite variable depending on conditions, but the intensity and severity of wildfires across the western United States have been increasing since the mid-1980's (Westerling, 2016). A value of 75% produces dNBR values that predict a fire on the more severe end of the intensity spectrum, while maintaining a burn character across the entire area that is similar to what we have seen in recent years. After simulating dNBR values for the 2020 fires in Colorado, and comparing the values to the actual post-fire remote sensing images, this value for Pdsim produced a dNBR image in line with what we have recently experienced.

Soil Erodibility

Soil erodibility is the inherent susceptibility of soil to erosion for the fine fraction of soils (KF-factor), from the STATSGO and SSURGO databases (see description below with the Soil Erodibility Hazard Ranking).

15-min rainfall intensity in mm/hr

The National Oceanic and Atmospheric Administration (NOAA) produces point precipitation frequency estimates across the country. These estimates are then used to produce a spatially interpolated GIS grid for precipitation frequency estimates using the Parameter-elevation Regressions on Independent Slopes Model (PRISM) at a 30 arc-seconds resolution (OHD-HDSC-NOAA). These estimates are determined for both a duration (5-min to 60 day) and storm return interval (1 year to 1,000 years).

A design storm is needed as input for the USGS post-fire debris flow model. The 15-min storm duration at a 2-year return interval, partial duration series, is used for the design storm. In a post-fire situation, a storm with a return interval greater than 2 years will cause most watersheds to produce a debris flow in the model; therefore, in order to attain distinctions between watersheds for this ranking method, the 2-year storm is used. Even though it may not seem like a very large event, this storm has a 50% chance of happening every year and in a post-fire situation is likely to produce debris flows.

The mean of all pixels in the watershed for the partial duration series 15-min duration, 2-year return interval storm was calculated from the NOAA precipitation frequency grid data. The mean storm amount in mm/hr was used as the design storm input in the USGS post-fire debris flow model.

Debris Flow Hazard Ranking

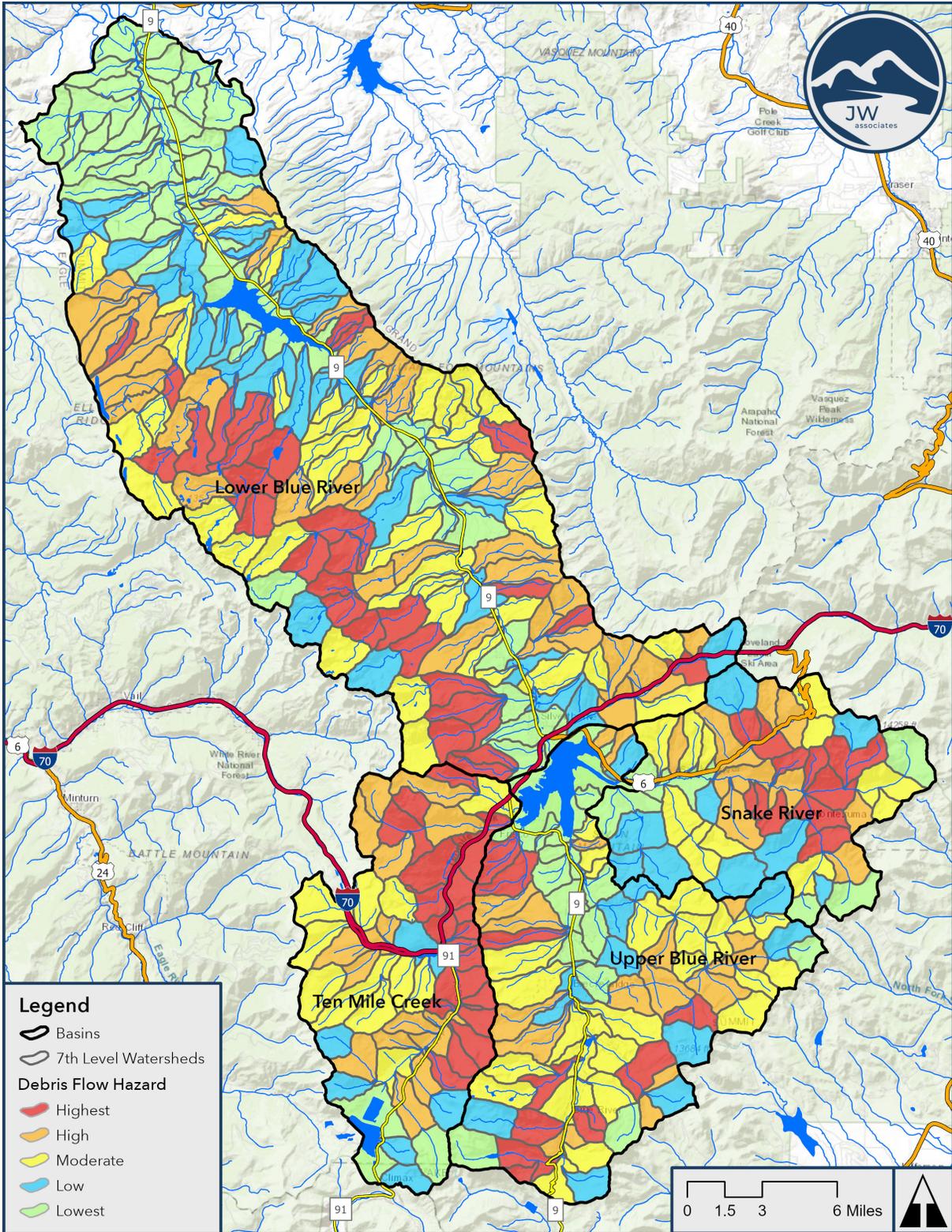
The Debris Flow Hazard combines the Ruggedness and Post-Wildfire Debris Flow Hazards. This ranking was calculated for all 7th Level watersheds, and the watersheds were grouped into five roughly equal categories from lowest to highest Debris Flow Hazard. Map 10 and Appendix B present the results of this categorization. Based upon this analysis, there are 71 7th Level watersheds that received a Debris Flow Hazard rank of Highest in the watershed assessment area (Table 5).

Table 5. Highest Ranked 7th Level Watersheds for Debris Flow Hazard

Basin Name	7 th Level Watershed Name
Upper Blue River	Crystal Lake
	Lower Monte Cristo Creek
	Lower McCullough Gulch
	UT1 to Lower Headwaters Blue River
	Fredonia Gulch
	Lower Spruce Creek - Headwaters Blue
	Middle Indiana Creek
	Upper French Gulch
	Middle Barton Gulch
	Lower Miners Creek
	Masontown
	Upper Straight Creek
	Upper Salt Lick Gulch
	Snake River
Lower Porcupine Gulch	
Lower Upper Snake River	
Upper Middle Snake River	
Lower Chihuahua Gulch	
Lower Peru Creek	
Thurman Gulch	
Grizzly Gulch	
Porcupine Mountain	
Independence Mountain	
UT to Lower Snake River	
Ten Mile Creek	Humbug Creek
	West Crystal Peak
	North Crystal Peak
	Spaulding Gulch
	Lower Upper Middle Tenmile Creek
	UT to Middle Middle Tenmile Creek
	Middle Middle Tenmile Creek
	Upper Lower Middle Tenmile Creek
	Lower Lower Middle Tenmile Creek
	Outlet Middle Tenmile Creek
	Curtain Ponds
	UT to Upper Lower Tenmile Creek
	Lower Officers Gulch
	Upper Lower Tenmile Creek
	Uneva Lake
	Middle North Tenmile Creek
UT to Lower North Tenmile Creek	

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Basin Name	7 th Level Watershed Name
Ten Mile Creek	Lower Lower Tenmile Creek
	UT to Meadow Creek
Lower Blue River	Ryan Gulch
	Lower North Willow Creek
	Middle Willow Creek
	Middle South Willow Creek
	Lower South Willow Creek
	UT1 to Bushee Creek
	UT2 to Middle Blue River - Rock Creek
	Middle South Rock Creek
	Upper North Rock Creek
	Middle North Rock Creek
	UT to Boulder Creek
	Upper Boulder Creek
	Slate Lake
	UT to Slate Creek
	Middle Slate Creek
	Berry Gulch
	McDonald Gulch
	Miller Gulch - Green Mountain
	Lower South Rim Black Creek
	Upper Black Creek
	Middle Black Creek
	Upper Otter Creek
	Surprise Lake
	Upper Cataract Creek
Tipperary Lake	
UT to Cataract Creek	
Middle Elliott Creek - Lower Blue	
UT1 to South Fork Deep Creek	



Map 10. Blue River Debris Flow Hazard Ranking

ROADS HAZARD

Roads pose a potential hazard to healthy watershed function and can amplify post-fire or flooding impacts. When roads convert subsurface runoff to surface runoff, and then route the surface runoff in a ditch or on the road surface to stream channels, they can increase both peak flows and suspended sediment in the stream (Megan and Kidd 1972, Ice 1985, and Swanson et al. 1987). Often culverts on forest roads are not adequately sized for the conditions that may occur during peak flows, especially post-fire. This can lead to over-topping of the road, increasing erosion of the road fill, and the risk of debris flows initiating from road failure. Even if culverts are adequately sized, road erosion and the subsequent transport of sediments during high flow events can be a significant contributor to in-stream sediments. Forest roads are usually the largest source of long-term sediment in forested watersheds (Elliott 2000, MacDonald and Stednick 2003).

The potential hazard posed by roads in these watersheds was evaluated by considering the density of different road features that pose risks for flooding and possible contributions to debris flows in vulnerable watersheds.

Within each watershed, road data was checked visually against digital imagery data. The roads data used on National Forest System (NFS) lands was from the U.S. Forest Service data set, which is the most accurate and current information for NFS land. On all other lands, Open Street Maps roads data was used, extracted through BBBike; this data appeared to be the most accurate to include many more smaller local roads throughout the study area than other available roads datasets.



Road Blowout in the East Troublesome Fire Area, CO 2022

Road Densities

Overall Road Density

Watersheds with higher road densities have a higher sensitivity to increases in peak flows, and therefore flooding, following wildfires. Road density in miles of road per square mile of watershed area was used as an indicator of flooding hazard. The watersheds were then ranked from lowest to highest for overall road density.

Roads Close to Streams

Roads close to streams can become major sources of sediment during flooding or higher post-fire peak flows. In order to quantify this effect, the density of roads near streams was determined by calculating the length of roads located within a 100-meter stream buffer.

The total length of each road type within the 100-meter stream buffer in each 7th Level watershed was divided by the watershed area. The watersheds were then ranked from lowest to highest density for roads close to streams.

Road/Stream Crossings

Road/stream crossings are locations where overtopping of roads, clogging of culverts and subsequent erosion and possible blow-out can occur. The number of road/stream crossings were manually acquired using the road and stream layers in combination with aerial imagery verification.

The total number of crossings for each road type in each 7th Level watershed was divided by the watershed area. The watersheds were then ranked from lowest to highest density for road/stream crossings.

Roads Hazard Ranking

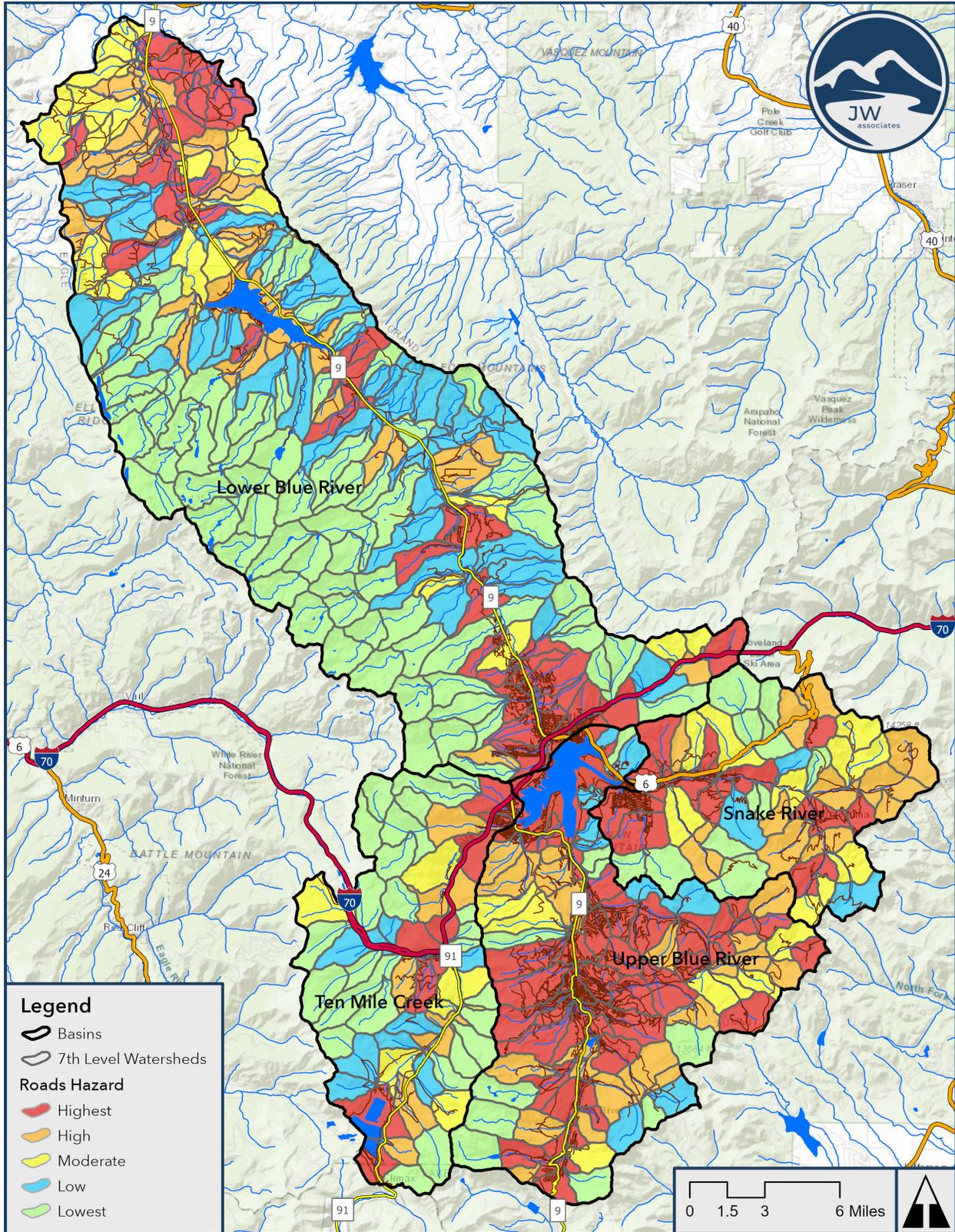
The results for all three road density rankings were combined and the results were grouped into roughly equal categories ranked from 1 (lowest) to 5 (highest) to create the Roads Composite Hazard Ranking. Map 11 and Appendix B present the results of this categorization. Based upon this analysis, there are 83 7th Level watersheds that received a Roads Hazard rank of Highest in the watershed assessment area (Table 6).

Table 6. Highest Ranked 7th Level Watersheds for Roads Hazard

Basin Name	7 th Level Watershed Name
Upper Blue River	Upper Headwaters Blue River
	Lower Monte Cristo Creek
	Middle Headwaters Blue River
	Fredonia Gulch
	Lower Headwaters Blue River
	Lower Spruce Creek - Headwaters Blue
	Lower Indiana Creek
	Illinois Gulch
	Lehman Gulch
	Headwaters Upper Blue River
	Sawmill Gulch
	Middle French Gulch
	Lower French Gulch
	Outlet French Gulch
	Cucumber Creek Gulch
	Upper Upper Blue River
	Upper South Fork Swan River
	Headwaters Middle Fork Swan River
	Georgia Gulch
	Garibaldi Gulch
	UT1 to Lower North Fork Swan River
	Lower North Fork Swan River
	Upper Swan River
	Middle Swan River
	Lower Swan River
	Upper Gold Run Gulch
	Lower Gold Run Gulch
	Outlet Swan River
	South Barton Gulch
	Middle Upper Blue River
	Outlet Upper Blue River
North Ophir Mountain	
Dillon Reservoir	
Snake River	Lenawee - Arapahoe Basin
	Lower Deer Creek
	Upper Middle Snake River
	Wardon Gulch
	Lower Snake River
	Camp Creek - Snake River
	UT1 to Outlet Snake River
Snake River	Frey Gulch
	Outlet Snake River

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Basin Name	7 th Level Watershed Name
Snake River	Middle Soda Creek
	Lower Soda Creek
Ten Mile Creek	Upper Robinson Lake
	Lower Robinson Lake
	Wheeler Gulch
	Lower West Tenmile Creek
	Curtain Ponds
	Lower Lower Tenmile Creek
	Lower Meadow Creek
Lower Blue River	Headwaters Straight Creek
	Lower Straight Creek
	Dillon Valley
	Outlet Dillon Reservoir
	Lower Salt Lick Gulch
	Silverthorne
	Outlet Willow Creek
	Blue River Ranch Lakes
	Hamilton Creek
	UT to Middle Blue River - Straight Creek
	Middle Blue River - Straight Creek
	Lower Bushee Creek
	UT1 to Middle Blue River - Rock Creek
	Lower Middle Blue River - Rock Creek
	Lower Boulder Creek
	Upper Middle Blue River - Slate Creek
	Bordoux Gulch
	McKinley Gulch
	Inlet Green Mountain Reservoir
	Shane Gulch
	UT1 to Green Mountain Reservoir
	Spring Creek
	Miller Gulch - Lower Blue River
	Headwaters Lower Blue River
	Upper Lower Blue River
	Middle Lower Blue River
	Sheephorn Mountain
	Upper Elliott Creek - Outlet Blue
	Lawson Ridge
	Middle Elliott Creek - Outlet Blue
Lower Blue River	Lower Elliott Creek - Outlet Blue
	UT to Outlet Lower Blue River



Map 11. Blue River Roads Hazard Ranking

HILLSLOPE EROSION HAZARD

High-severity fires may affect critical watershed function, significantly altering runoff and erosion processes in watersheds. This impact can be amplified by post-fire, high-intensity rainfall events. Sediment yields from hillslopes that have been burned at a moderate to high severity tend to be an order of magnitude higher than those burned at low severity (Johansen et al. 2001, Gannon et al. 2017). High-severity fires consume more of the forest floor than low severity fires, exposing forest soils and thereby increasing both sediment and water yields (Wells et al. 1979, Robichaud and Waldrop 1994, Soto et al. 1994, Neary et al. 2005, and Moody et al. 2008).

Hydrophobic soil layers are often a byproduct of high-severity fires. These layers are formed by the heat and fire-induced volatilization of organics, which creates a waxy, water repellent layer. These hydrophobic layers reduce infiltration rates and exacerbate runoff (Hungerford et al. 1991).

The delivery of hillslope sediments to surface waters has numerous ramifications for water supply infrastructure, including the physical effects of sediment deposition in surface waters and chemical changes to water quality. An increase in sediments delivered to the streams or reservoirs can alter and/or increase treatment requirements. Sediments that are deposited in surface waters bring nutrients that may promote the growth of algae, affecting water taste and odor. Dissolved organic carbons can form potentially carcinogenic by-products during disinfection. An increase in sediments can also mean an increase in metals delivered to water treatment facilities. Increases in any of these types of factors will lead to a subsequent increase in treatment costs (Writer and Murphy 2012).

Drinking water treatment processes are most efficient when source water quality remains constant. The effects of wildfire varies spatially and temporally, and when combined with the high variability of precipitation events, can result in unequal system loading and the need for site specific treatment plans (Writer and Murphy 2012). The magnitude and duration of post-fire water quality effects is difficult to predict making it complicated for water providers to evaluate risks and develop management strategies (Writer and Murphy 2012, Bladon et al. 2014, Martin 2016).



Soil movement initiates high in the watershed and forms rills or gullies below that channel erosion. Photo: signs of this process occurring, following the Cameron Peak Fire.

Soil Erodibility

The soil erodibility analysis used a combination of two standard erodibility indicators: the inherent susceptibility of soil to erosion (K factor) and land slope derived from United States Geological Survey (USGS) 30-meter digital elevation models. The USDA - Natural Resources Conservation Service (NRCS) more detailed SSURGO data (generally ranges from 1:12,000 to 1:63,360) covers most of the watersheds in this analysis. For the watersheds that do not have available SSURGO data, the more coarse NRCS STATSGO soils data, created at a scale of 1:250,000, was used. The K factor data from the STATSGO and SSURGO spatial databases was combined with a slope grid using NRCS (USDA NRCS 1997) slope-soil relationships to create a classification grid divided into Slight, Moderate, Severe and Very Severe erosion hazard ratings (Table 7).

Table 7. NRCS Criteria for Determining Potential Soil Erodibility

Percent Slope	K Factor <0.1	K Factor 0.1 to 0.19	K Factor 0.2 to 0.32	K Factor >0.32
0-14	Slight	Slight	Slight	Moderate
15-34	Slight	Slight	Moderate	Severe
35-50	Slight	Moderate	Severe	Very Severe
>50	Moderate	Severe	Very Severe	Very Severe

The Soil Erodibility metric was calculated with the following formula.

$$\text{Soil Erodibility Metric} = (\% \text{ Moderate} + 2 \times \% \text{ Severe} + 3 \times \% \text{ Very Severe})$$

The Soil Erodibility Metric was calculated for each 7th Level watershed. The watersheds were then grouped by this metric into five roughly equal categories and ranked from 1 (lowest soil erodibility) to 5 (highest soil erodibility) to create the Soil Erodibility Ranking.

Granitic Geology

The presence of granitic parent material and granitic soils in the watershed increases potential soil erosion. Slope failures, landslides, debris flows, and rockfall avalanches are all characteristic failures in areas with granitic parent material (Durgin, 1977). Soil scientists have observed that the K-factor alone does not adequately identify soil erodibility on granitic soils. Therefore, the erodibility rating was augmented for those watersheds where substantial areas of granitic parent material or granitic soils exist.

The Colorado State Geology layer was used to identify areas of granitic and granitoid geology. The 7th Level watersheds were then ranked by percent area of granitic parent material or granitic soil, using the assessment categorization scheme.

Hillslope Erosion Hazard Ranking

Due to the low resolution of the available soils data, there was minimal differentiation between soil types throughout the study area and therefore the Soil Erodibility Ranking mainly highlighted

watersheds based on their slope. To address this data gap and ensure the Hillslope Erosion Ranking captured the difference in soil types, the granitic geology was preferentially weighted. The results for both the Soil Erodibility and Granitic Geology Ranks were combined using the following formula:

$$\text{Hillslope Erosion Metric} = (\text{Soil Erodibility Rank} + 2 \times \text{Granitic Geology Rank})$$

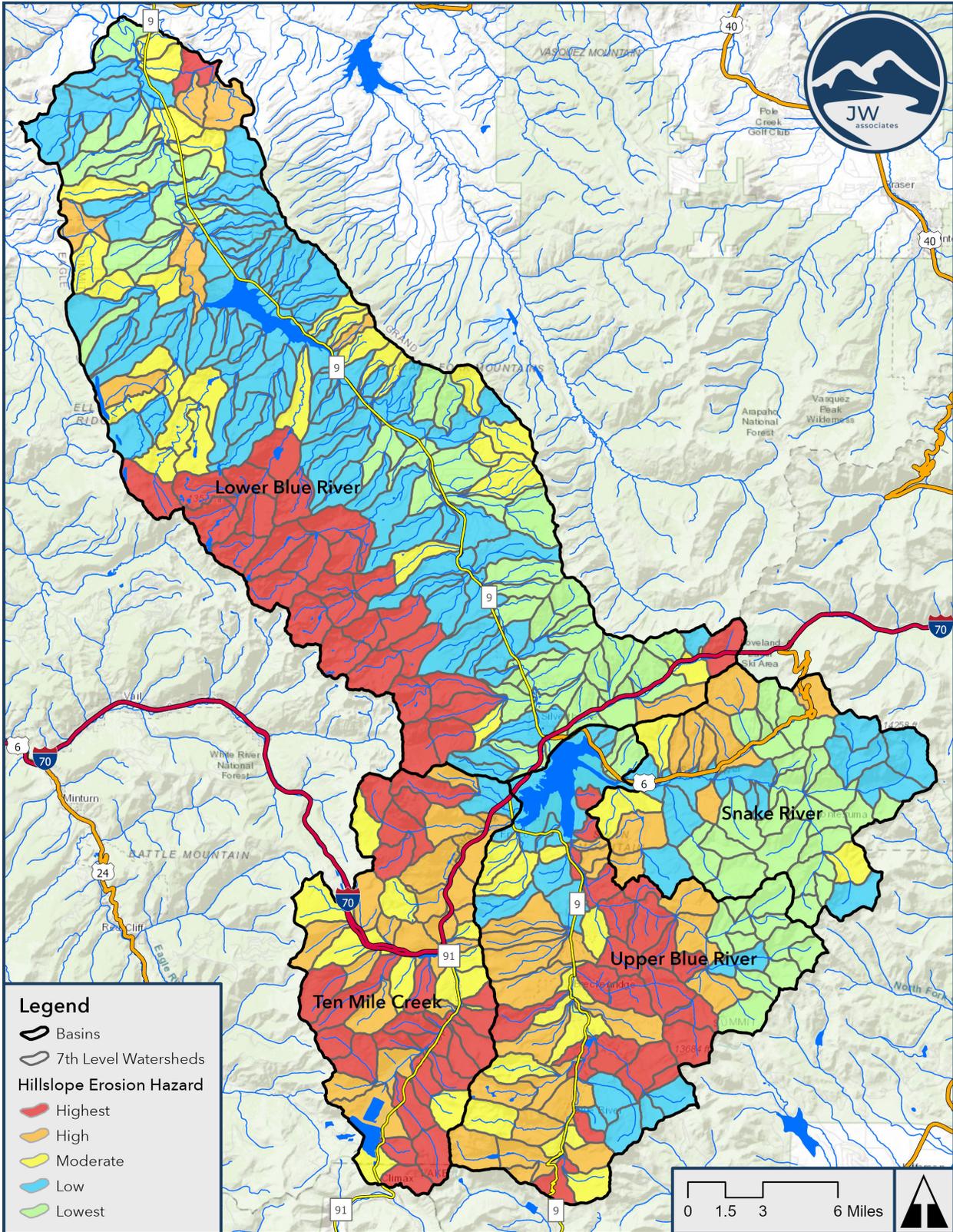
The results were grouped into roughly equal categories ranked from 1 (lowest soil erodibility) to 5 (highest soil erodibility) to create the Hillslope Erosion Ranking. These results are presented in Appendix C and on Map 12. Based upon this analysis, there are 74 7th Level watersheds that received a Hillslope Erosion rank of Highest in the assessment area (Table 8).

Table 8. Highest Ranked 7th Level Watersheds for Hillslope Erosion Hazard

Basin Name	7 th Level Watershed Name
Upper Blue River	Upper Headwaters Blue River
	UT1 to Lower Headwaters Blue River
	UT to Middle Indiana Creek
	Middle Indiana Creek
	Lower Indiana Creek
	Goose Pasture Tarn
	Sawmill Gulch
	Headwaters French Gulch
	Upper French Gulch
	Middle French Gulch
	Lower French Gulch
	Outlet French Gulch
	Georgia Gulch
	Brown Gulch
	Middle Swan River
	Horseshoe Gulch
	Lower Swan River
	Upper Gold Run Gulch
	Outlet Swan River
	Outlet Upper Blue River
North Swan Mountain	
Soda Gulch	
Ten Mile Creek	Glory Hole - Climax
	McNully Creek
	Upper Seattle Gulch
	Lower Seattle Gulch
	Upper Clinton Creek
	Lower Clinton Creek
	Lower Mayflower Creek
	Upper Stafford Creek
	Guller Creek
	Wheeler Gulch

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Basin Name	7 th Level Watershed Name
Ten Mile Creek	Tucker Gulch
	Humbug Creek
	Copper Creek
	West Crystal Peak
	North Crystal Peak
	Upper Upper Tenmile Creek
	Lower Upper Middle Tenmile Creek
	UT to Middle Middle Tenmile Creek
	UT to Middle North Tenmile Creek
	Uneva Peak
	Middle North Tenmile Creek
	UT to Lower North Tenmile Creek
	Upper Meadow Creek
	Lower Blue River
Upper North Willow Creek	
Lower North Willow Creek	
Middle Willow Creek	
Upper South Willow Creek	
Middle South Willow Creek	
Upper South Rock Creek	
Middle South Rock Creek	
Headwaters North Rock Creek	
Upper North Rock Creek	
Middle North Rock Creek	
Headwaters Boulder Creek	
UT to Boulder Creek	
Upper Boulder Creek	
Middle Boulder Creek	
Headwaters Slate Lake	
Slate Lake	
Upper Slate Creek	
UT to Slate Creek	
Middle Slate Creek	
Upper Brush Creek	
Headwaters Black Creek	
Cliff Lake	
Upper South Rim Black Creek	
Lower South Rim Black Creek	
Upper Black Creek	
Middle Black Creek	
Headwaters Cataract Creek	
Middle Elliott Creek - Outlet Blue	



Map 12. Blue River Hillslope Erosion Hazard Ranking

POST-FIRE COMPOSITE HAZARD RANK

The Post-fire Composite Hazard Ranking is a combination of wildfire hazard and post-fire hazards related to flooding, debris flows, roads and hillslope erosion. The composite ranking is calculated by adding together the following respective rankings for each 7th Level watershed and then recategorizing the results.

1. Wildfire Hazard
2. Debris Flow Hazard
3. Roads Hazard
4. Hillslope Erosion

The total scores are grouped into 5 categories as was done for the subcomponents and assigned a final rank from 1 (lowest Wildfire Composite Hazard) to 5 (highest Wildfire Composite Hazard). The categorized Post-fire Composite Hazard Rank by watershed are displayed in Appendix B and on Map 13. Based upon this analysis, there are 78 7th Level watersheds that received a Post-fire Composite Hazard Rank of Highest in the assessment area (Table 9).

Table 9. Highest Ranked 7th Level Watersheds for Post-fire Composite Hazard

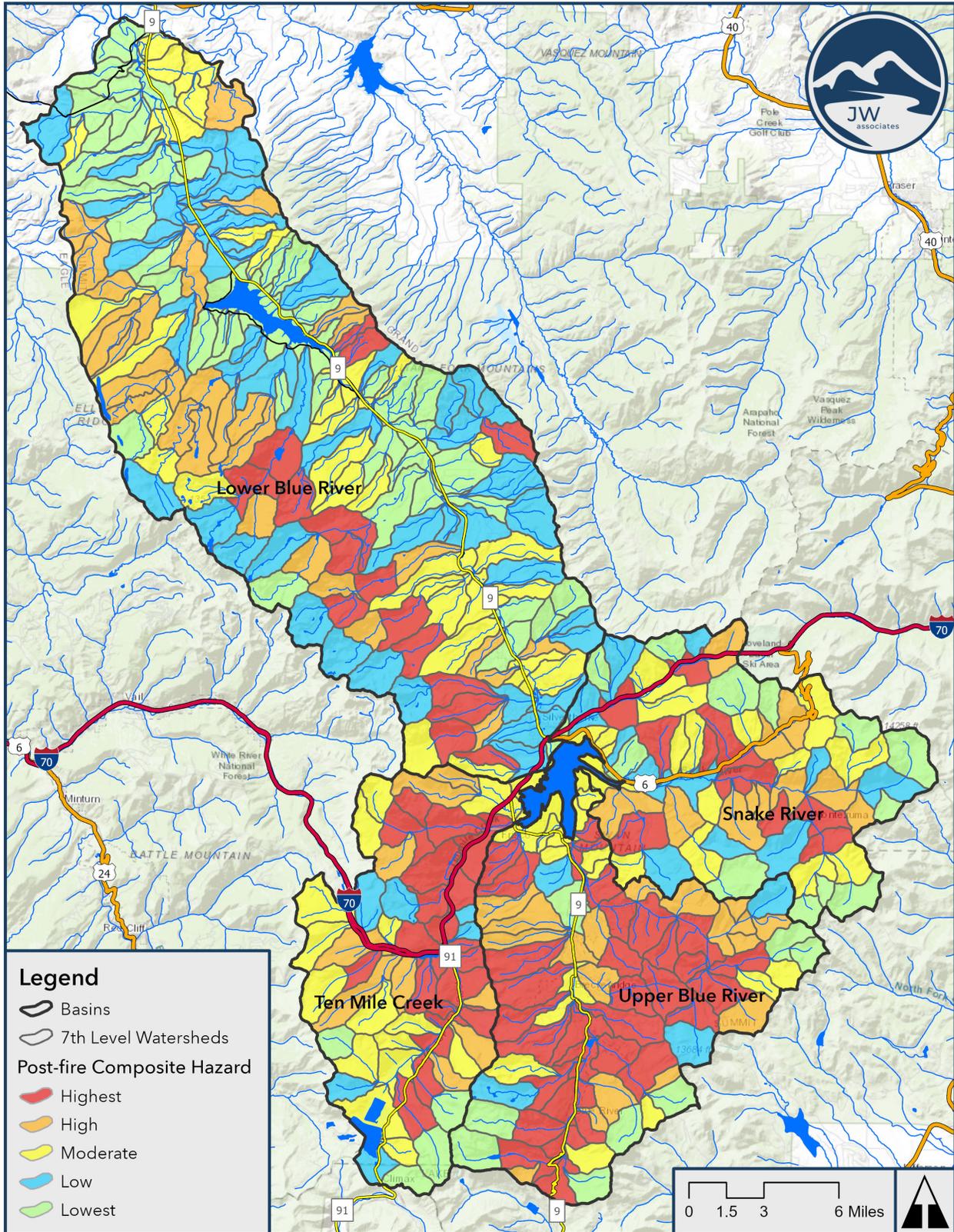
Basin Name	7 th Level Watershed Name	Wildfire Hazard	Debris Flow Hazard	Roads Hazard	Hillslope Erosion Hazard
Upper Blue River	Upper Headwaters Blue River	Moderate	Moderate	Highest	Highest
	Lower Monte Cristo Creek	Lowest	Highest	Highest	High
	Lower McCullough Gulch	Moderate	Highest	High	High
	Middle Headwaters Blue River	Moderate	High	Highest	Moderate
	UT1 to Lower Headwaters Blue River	Moderate	Highest	High	Highest
	Lower Headwaters Blue River	Highest	Moderate	Highest	High
	Lower Spruce Creek - Headwaters Blue	Highest	Highest	Highest	High
	Middle Indiana Creek	High	Highest	High	Highest
	Lower Indiana Creek	High	Moderate	Highest	Highest
	Goose Pasture Tarn	Highest	Moderate	High	Highest
	Illinois Gulch	Moderate	Moderate	Highest	High
	Lehman Gulch	Moderate	High	Highest	High
	Headwaters Upper Blue River	High	Moderate	Highest	Moderate
	Sawmill Gulch	Low	High	Highest	Highest
	Upper French Gulch	Moderate	Highest	High	Highest
	Middle French Gulch	Moderate	High	Highest	Highest
	Lower French Gulch	Moderate	High	Highest	Highest
	Cucumber Creek Gulch	Low	Moderate	Highest	High
	Lower South Fork Swan River	Highest	High	Moderate	High
	Lower Middle Fork Swan River	Highest	High	High	Low
Georgia Gulch	Moderate	Moderate	Highest	Highest	
Upper Swan River	Moderate	Moderate	Highest	High	

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Basin Name	7 th Level Watershed Name	Wildfire Hazard	Debris Flow Hazard	Roads Hazard	Hillslope Erosion Hazard
Upper Blue River	Brown Gulch	Highest	High	High	Highest
	Middle Swan River	High	Moderate	Highest	Highest
	Lower Swan River	Low	Low	Highest	Highest
	Upper Gold Run Gulch	High	Low	Highest	Highest
	Outlet Swan River	Moderate	Lowest	Highest	Highest
	South Barton Gulch	High	Moderate	Highest	High
	West Swan Mountain	Highest	High	Low	High
	Outlet Upper Blue River	Moderate	Lowest	Highest	Highest
	Lower Miners Creek	Highest	Highest	High	Moderate
	Masontown	High	Highest	High	Moderate
	North Swan Mountain	Highest	Moderate	Low	Highest
Snake River	Lower North Fork Snake River	High	High	Moderate	High
	Lower Upper Snake River	High	Highest	High	Lowest
	Upper Middle Snake River	Highest	Highest	Highest	Lowest
	Grizzly Gulch	Highest	Highest	High	Lowest
	Lower Snake River	Moderate	High	Highest	Low
	UT1 to Outlet Snake River	Low	Moderate	Highest	High
	Frey Gulch	High	Moderate	Highest	Moderate
	Middle Soda Creek	High	Low	Highest	High
Ten Mile Creek	Lower Clinton Creek	High	High	High	Highest
	Lower Mayflower Creek	Highest	High	Low	Highest
	Lower Stafford Creek	Highest	High	Lowest	High
	Wheeler Gulch	Low	Moderate	Highest	Highest
	Lower West Tenmile Creek	Moderate	Low	Highest	High
	Upper Upper Tenmile Creek	Highest	High	High	Highest
	Spaulding Gulch	Highest	Highest	Moderate	High
	Lower Upper Middle Tenmile Creek	High	Highest	Lowest	Highest
	Middle Middle Tenmile Creek	Highest	Highest	Moderate	Moderate
	Upper Lower Middle Tenmile Creek	High	Highest	Low	Moderate
	Lower Lower Middle Tenmile Creek	Highest	Highest	Lowest	High
	Curtain Ponds	Highest	Highest	Highest	High
	Lower Officers Gulch	Highest	Highest	High	High
	Upper Lower Tenmile Creek	Highest	Highest	High	High
	Ueva Lake	Highest	Highest	Moderate	High
	Middle North Tenmile Creek	Highest	Highest	Lowest	Highest
	UT to Lower North Tenmile Creek	Highest	Highest	Lowest	Highest
	Lower North Tenmile Creek	Highest	High	High	High
Lower Lower Tenmile Creek	High	Highest	Highest	High	
Lower Blue River	Upper Straight Creek	Highest	Highest	High	Moderate

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Basin Name	7 th Level Watershed Name	Wildfire Hazard	Debris Flow Hazard	Roads Hazard	Hillslope Erosion Hazard
Lower Blue River	Lower Straight Creek	Highest	High	Highest	Lowest
	Ryan Gulch	Highest	Highest	High	Low
	Lower North Willow Creek	High	Highest	Lowest	Highest
	Middle Willow Creek	Highest	Highest	Lowest	Highest
	Middle South Willow Creek	Moderate	Highest	Lowest	Highest
	Middle South Rock Creek	Highest	Highest	Lowest	Highest
	Middle North Rock Creek	Highest	Highest	Lowest	Highest
	Upper Boulder Creek	High	Highest	Lowest	Highest
	Middle Boulder Creek	Highest	High	Lowest	Highest
	UT to Slate Creek	High	Highest	Lowest	Highest
	Middle Slate Creek	High	Highest	Lowest	Highest
	Berry Gulch	Highest	Highest	Low	Moderate
	Upper Brush Creek	High	High	Lowest	Highest
	Shane Gulch	Moderate	High	Highest	Moderate
	McDonald Gulch	Moderate	Highest	Low	High
	Upper Black Creek	High	Highest	Lowest	Highest
	Middle Black Creek	Highest	Highest	Lowest	Highest



Map 13. Blue River Post-fire Composite Hazard Ranking

WATERSHED VULNERABILITY AND RESILIENCE

The stress on ecosystems due to alterations in short and long-term weather patterns is triggering a transformation of natural communities at regional and local scales with varying speed and magnitude (Comer et al, 2019). Alterations in temperature and precipitation patterns can disrupt an ecosystem's natural dynamics and balance by altering a range of factors including, but not limited to, plant growth and stability within an eco-zone, streamflows and timing of runoff, frequency and intensity of wildfire, and habitat suitability for flora and fauna (Halofsky et al., 2018). These changes can cascade through natural communities, potentially altering ecosystem conditions to a degree that leads to species extinctions, ecological degradation, or even potential collapse (Comer, et al, 2019).

WATERSHED VULNERABILITY IN COLORADO

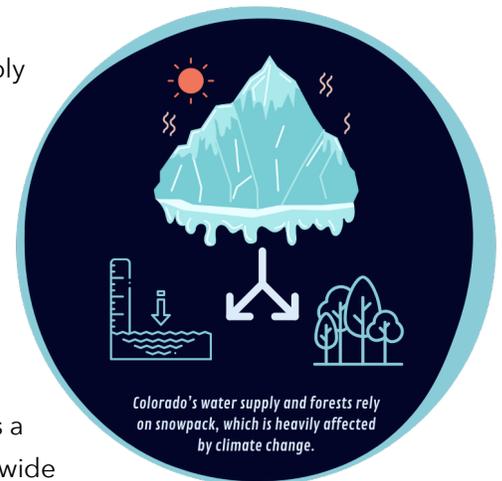
Colorado is one of many states in the west that rely on a dependable winter snowpack to provide a sustainable water resource for its population. Across Colorado, forests and ecosystems are highly adapted to a snowpack dominated water system.

Researchers have found that temperatures at higher elevations are warming faster than at sea level. Around the world, this will impact communities and ecosystems that are dependent on the winter snowpack for water supply and ecosystem sustainability through the summer and fall months. Warmer winters will have shorter periods of minimum temperatures below freezing. This shrinks the period of time for snowpack accumulation and increases the likelihood that precipitation will fall as rain, rather than snow. Warmer temperatures are also likely to reduce the snowpack during winter months through direct sublimation of the snow surface.

The current trend of statewide annual temperatures in Colorado shows a steep increase beginning in 1900 and accelerating around 1980. Statewide annual average temperatures have increased by 2.3°F since 1980 (Bolinger et al., 2024). It should be noted that by 1980, the average temperature had already risen significantly from the pre-1900 average, as indicated in Figure 4 below.

As we approach mid-century, the Colorado statewide annual average temperatures are likely to warm another 1-4°F, under the medium-low emissions scenario RCP4.5. At this rate, the average year in Colorado will be as warm as the warmest years on record to date. Summer and fall are likely to warm slightly more than winter and spring (Bolinger et al., 2024). These increasing temperatures will further impact changes that Colorado is already experiencing throughout the state. The magnitude of ecological disturbance is likely to increase in both extent and frequency.

Like a sponge, the evaporative demand of the atmosphere increases with temperature. In Colorado that effect is projected to increase evaporation by 8-17% by 1950 (Bolinger et al., 2024). This will not



only reduce snowpack and alter spring runoff due to direct sublimation from the snow surface and faster and earlier snowmelt, but once soils are exposed, they will dry out more rapidly in the spring. This creates a feedback loop that increases local surface warming: the sun's energy is first used to dry out soils, but when the moisture is depleted that energy goes into direct heating of the soil surface, rather than evaporation.

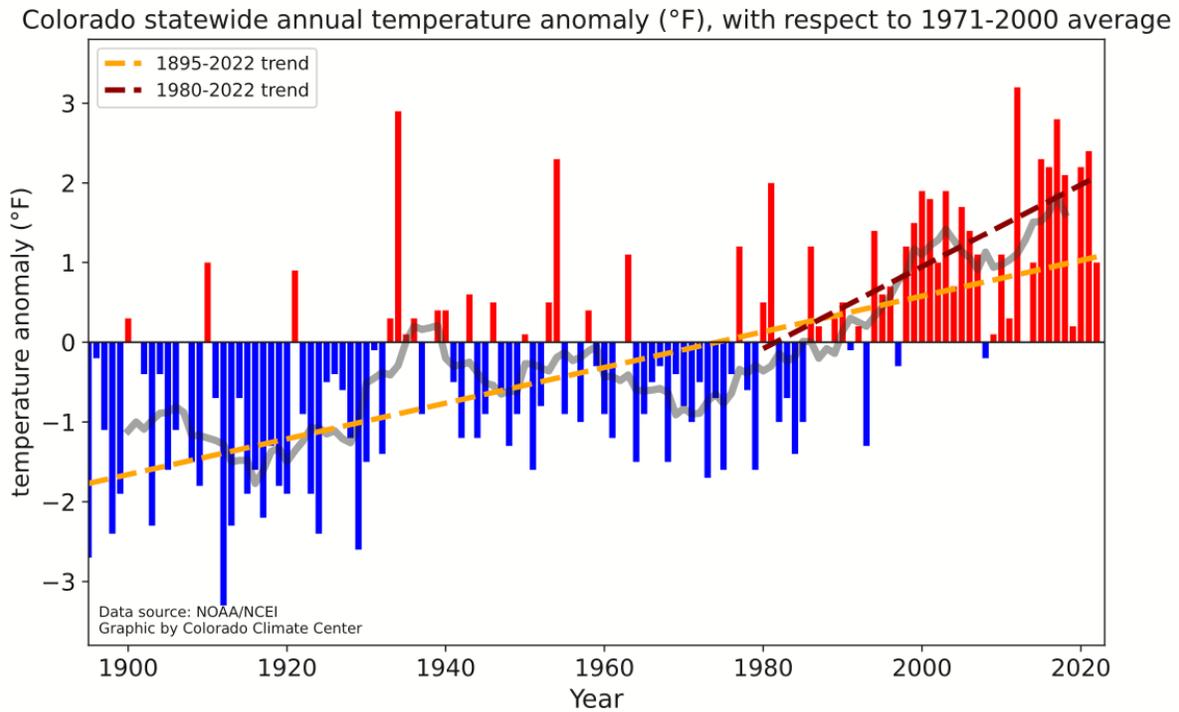


Figure 4. Colorado statewide temperature anomaly (°F) with respect to the 1971-2000 average of 45.1°F. The 1895-2022 trend (yellow dashed) and 1980-2022 trend (red dashed) lines are included. Adapted from Figure 2.3 (Bolinger et. al., 2024).

Impacts from warming will not be limited to higher temperatures but will also include changes in precipitation patterns. These changes will affect the entire ecosystem by altering habitat suitability, impacting a wide variety of flora and fauna. These alterations include changes in stream flows and the timing of runoff, intensity and duration of storms, the frequency and intensity of wildfire, rapid temperature changes that make adaptation to new conditions difficult, availability of sustained soil moisture for spring growth, and stress from heat.

The change in precipitation patterns and increase in heat and evaporation will reduce snowpacks and cause drier soils during the growing season. This will subsequently alter the timing of runoff and lower streamflows. However, despite an overall reduction in streamflows, flooding events are likely to increase due to the increased precipitation as rain, potential torrential rainfall events, and an accompanying increase in rain on snow events. The watersheds in this study area have many high-gradient streams that have a high vulnerability for flooding and debris flows. These types of floods can

create excessive sediment input through erosion and debris flows potentially restructuring channels, damaging or destroying infrastructure, and destroying important fish habitat.

The combination of drought, lower streamflows, and higher temperatures poses a risk to riparian vegetation (Naiman et. al., 2010). Stressed vegetation in the riparian zone will be more vulnerable to additional disturbances from cattle grazing, ungulate browsing and expansion of invasive species into the riparian ecosystem. Willows and low-elevation cottonwoods are among the most intolerant of drought. A healthy riparian ecosystem is important to maintain bank stability, maintain cooler in-stream water temperatures, and as a source of woody debris and nutrients to the streams, which support aquatic insects and fish. Riparian vegetation also provides a filter for hillslope erosion that carries sediments into floodplains or riparian areas. This filter prevents sediments from being transported downstream and contributing nitrogen and sediment bound phosphorus to the water system, improving water quality (Naiman et. al., 2010).

WATERSHED/ECOSYSTEM RESILIENCE

Resiliency is determined by the particular ecosystem's ecological ability to respond to stresses and changes in the natural environment. Holling (1973) defined ecological resiliency as:

"The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"

When ecosystem resilience is examined through the lens of healthy and functional watersheds, the following are characteristics that allow a watershed to experience disturbance and recover relatively quickly:

- Forests that are diverse in terms of both forest types and density
- Areas of high wildfire hazard that are relatively small and separated from other watersheds that have high wildfire hazard
- Intact, functional riparian areas that can respond quickly after disturbances
- Healthy, native riparian vegetation
- Floodplains are connected to streams that flood during larger runoff events
- Upland areas have appropriate ground cover, comprised of mostly native vegetation, that can recover quickly following disturbances
- Roads that have minimal impacts on watershed functions
- Where development occurs in watersheds, it has minimal impacts on watershed functions

Comer et al. (2019) has designed an assessment to help determine which communities are at most risk of impacts from alterations in short- and long-term weather patterns, providing a warning of elevated risk for affected communities. Comer's (2019) Habitat Vulnerability Index (HVI) integrates variables from other previous assessments and provides a framework for assessing vulnerability based on natural community types focusing on major vegetation types. The analysis provided here uses components of this framework to assess relative vulnerability within the studied watersheds.

The HVI examines a community's 1) exposure to induced stress and 2) resilience to that stress. Areas most at risk are those that are likely to experience the most severe changes in temperature and

precipitation (high exposure) but which have limited capacity to adapt or absorb these changes (low resilience).

Exposure

In Comer et al. (2019), Exposure refers to

"the rate, magnitude and nature of climate-induced stress on the community. Exposure encompasses trends in climate, such as changes in temperature and precipitation regimes and any predicted effects on ecosystem-specific processes."

The stressors from these environmental changes include temperature and rainfall patterns (both drought and increased precipitation) but also changing disturbance regimes such as wildfire.

The scale of this analysis is relatively small compared with the ecoregion analysis for most climate exposure modeling (Halofsky et al., 2018). Exposure across the assessment area is consistent and does not provide for differentiations between watersheds to assess relative risk. The study watersheds have been determined to have high exposure to these changing environmental conditions as discussed above. Therefore, exposure is not used as a differentiating component in this assessment of watershed vulnerability. However, it should be assumed that throughout the watersheds being discussed, exposure is consistently high.

Watershed/Ecosystem Resilience

Comer et al. (2019) looked at measuring an ecosystem's resilience to changing environmental conditions through two subcategories: Sensitivity and Adaptive Limitation. Where,

Ecosystem Sensitivity - reflects the numbers, intensity and types of ecosystem stressors that are independent of, but likely to interact with, environmental changes

Adaptive Limitation- the natural characteristics, or lack of, that allow for an ecosystem to respond and adapt to environmental changes.

These factors are modified slightly and used in this analysis to provide an evaluation tool for the watersheds in the assessment area. This results will allow decision makers to target management strategies to lessen the impacts of alterations in short and long-term weather patterns in particularly sensitive watersheds or to protect water supply systems from changes in the watershed that may be inevitable.

ECOSYSTEM SENSITIVITY HAZARD

Ecosystem sensitivity includes both intrinsic or natural factors that place stress on an ecosystem, as well as human alterations to ecosystem function. Examples of these types of stressors include landscape fragmentation, invasive species, fire regimes across the landscape, and insects and disease. Landscape fragmentation potentially inhibits or prevents the migration of flora or fauna in the face of rapid alterations in short and long-term weather patterns, increasing the vulnerability of communities within the landscape. The introduction of non-native species can intensify competition for increasingly limited

niches or habitats as well as altering fire regimes or increasing the landscape's vulnerability to fire. Historic human fire suppression, fragmentation and wildland-urban interface zones, which have already altered historical fire patterns, exacerbate the effects of increasing temperature and periods of drought. Insects and disease, endemic to forests ecosystems, may increase as a disruptive factor in the face of changing conditions that increase stress on vegetation, making them more vulnerable. With warmer average temperatures and variable precipitation, different types of insects and diseases adapted for warmer areas may also move into forests that have not previously developed resiliency. All of these factors interact with each other and can describe the sensitivity to current and future environmental conditions for a specified area such as a watershed.

Landscape Condition

The amount of existing and potential fragmentation and human-induced stress within a landscape is reflected by the road network that has been established. As discussed by Ritters and Wickham (2003) the ecological impacts of roads extend tens to hundreds of meters from the road itself and include disrupting wildlife movements, modifying habitats, altering water drainage patterns, contributing to debris flow risk during flooding, and introducing non-native species. Roads also follow economic constraints and are designed to create connections, movement and development including further expansion of the road network. They often cross natural boundaries so their influence is not limited by natural constraints.



Roads effectively break up a landscape which reduces mobility of species, as well as changes the routing of water and other hydrological and ecosystem functions.

For this analysis, the NatureServe Landscape Condition Model was used to assess the landscape condition of each 7th Level watershed (Hak and Comer, 2017). This model is a spatially-based 90 meter resolution assessment of the relative ecological effects of human land uses such as built transportation or urban and industrial infrastructure, including mining, and land cover changes such as for agriculture. The model also uses a decay parameter to account for the effect of each land use as it diminishes with distance away from the site. Each pixel value is scored from 1-100 on this relative landscape condition scale. The watershed mean landscape condition value was used in our ranking.

Forest Resilience

Forested watersheds that are resilient have a diverse forest canopy and age structure. Forest types can be classified into groups and assigned disturbance regimes, with an associated range of conditions that would be resilient within the current and future conditions. The forest types used in this analysis include: xeric and mesic ponderosa pine, xeric and mesic mixed conifer, lodgepole pine, and spruce-fir. The 2025 Landfire vegetation types and canopy closure data was used for this analysis which reflects current conditions as of 2024.

Forest Type Resilience Descriptions

The resilient conditions were defined for each forest type using scientific research and stakeholder review and input. The detailed descriptions are provided in Appendix D and summarized in Tables 10 and 11.

Table 10. Resilient Forest Conditions Descriptions

Vegetation Type	Forest Life Zones	Historical Fire Regime	Vegetation Description	Stand Diversity
Xeric Ponderosa Pine	Lower Montane	Frequent, low intensity fires: open canopy conditions.	The historical montane forest was likely quite open with fewer trees, greater age diversity between stands, and larger openings than the area displays today. Variation in frequency and severity of fires created a varied vegetative pattern across the landscape.	Gambel oak/mountain mahogany. A more open forested condition than the mesic ponderosa areas with some clumps of dense trees.
Mesic Ponderosa Pine		Mixed severity fire regime: variety of stand structures and age classes.	The historical montane forest was likely quite open with fewer trees, greater age diversity between stands, and larger openings than the area displays today. Variation in frequency and severity of fires created a varied vegetative pattern across the landscape.	Relatively open forested conditions with larger clumps (both in overall size and number of trees present per clump) compared to the xeric systems.
Xeric Mixed Conifer		Mixed severity fire regime: mean 20yr return interval with range of 1-125 yrs.	Douglas-fir, lodgepole pine, aspen, ponderosa pine and some true firs. Mixed conifer areas vary substantially with aspect: warm-dry (xeric) types are found on south-facing aspects.	A mix of ages of seedlings, saplings, and mature trees, with less than 1/3 of the watershed in any one class.
Mesic Mixed Conifer	Upper Montane Subalpine /Alpine	Mixed severity fire regime: lower frequency than xeric mixed conifer.	Douglas-fir, lodgepole pine, aspen, ponderosa pine and some true firs. Mixed conifer areas vary substantially with aspect: cool-moist (mesic) types are found on north-facing aspects.	A mix of ages of seedlings, saplings, and mature trees, with less than 1/3 of the watershed in any one class.
Aspen		In general, large and severe fires would increase the extent of aspen and the lack of fires would allow the successional replacement of aspen by conifers. Disturbance regimes in aspen are generally similar to adjacent conifer stands.	Usually occur as closed canopy stands between 5,000 to 10,000 feet in elevation. They require adequate moisture and are usually found on north aspects or sites that are mesic. However, at higher elevations they are found on southern aspects because the northern aspects are too cold.	A mix of ages of sapling and mature trees, so that the mature class does not comprise more than 1/2 of the watershed. Conifer encroachment that is limited to older aspen stands.
Lodgepole Pine		Natural fire frequency ranges from a few years to 200+ years. Low to moderate severity surface fires: mean ~30yr return interval. Stand-replacing fires are generally less frequent.	Grows on a wide range of sites, typically 7,500-10,000 ft in pure or mixed stands. Mostly shade intolerant and can exist as a climax species in some stands but is often a seral species that is eventually replaced by spruce and fir. Lodgepole pine is susceptible to bark beetles, mistletoe, blowdown and fire.	A mix of ages of seedlings, saplings, and mature trees, with less than 1/3 of the watershed in any one class.
Spruce-Fir		Not fire adapted, 300+yr fire return interval. Very likely to produce stand-replacing crown fires.	Typically composed of the slow-growing Engelmann spruce, with the smaller, narrow-crowned subalpine fir. The spruce-fir combination often reaches a climax-type forest at high elevations, despite the existence of many uneven-aged stands. Both species are shade tolerant and tend to quickly repopulate shaded gaps in the forest.	A mix of ages of seedlings, saplings, and mature, with less than 1/2 of the watershed in any one class.

Table 11. Resilient Forest Type Characteristics

Vegetation Type	Forest Life Zones	Openings	Canopy Cover Range	Average Canopy Cover	Elevation		Elevation		Elevation		Elevation	
					Aspect	Below 6,500 ft	Aspect	6,500-7,500 ft	Aspect	7,500-8,500 ft	Aspect	8,500-9,500+ ft
Xeric Ponderosa Pine	Lower Montane	Up to 40 acres in size, 25% of total area	15-25%	20%	N E S W	Ponderosa	E S W	Ponderosa & Douglas-fir	S W Ridges	Ponderosa & Douglas-fir		
Mesic Ponderosa Pine		Up to 20 acres in size, 20% of total area	20-35%	25%			N	Ponderosa	N E	Ponderosa	N E S W	Ponderosa
Xeric Mixed Conifer		Up to 20 acres in size, 20% of total area	20-35%	25%			S W	Mixed Conifer	S W	Mixed Conifer		
Mesic Mixed Conifer	Upper Montane Subalpine /Alpine	Up to 20 acres in size, 10% of total area	35-50%	45%			N E	Mixed Conifer	N E	Mixed Conifer	N E	Douglas-fir
Aspen					N E	Aspen, Mixed Conifer with Aspen	N E W	Aspen, Mixed Conifer with Aspen	E S W	Aspen, Mixed Conifer with Aspen	S W	Aspen, Mixed Conifer with Aspen
Lodgepole Pine			50-90%	75%					N E S W	Lodgepole	N E S W	Lodgepole
Spruce-Fir			50-90%	75%					N E S W	Spruce-fir	N E S W	Spruce-fir

Montane Forest Ranking

The following forest types are part of the Montane Forest analysis: xeric ponderosa pine, mesic ponderosa pine, xeric mixed conifer, and mesic mixed conifer. Determination of resilient and non-

resilient areas used the resilient definitions presented above in Tables 10 & 11, compared to the existing canopy closure (See also Appendix D). In this analysis, the area with a canopy closure value above the average of the resilient canopy closure for that forest type was considered non-resilient forested area. The non-resilient area within each 7th Level watershed was then divided by the total area of the watershed to determine the Montane Forest Rank Metric, using the following formula:

$$\text{Montane Forest Rank Metric} = \frac{(\text{Area Xeric PP} > 20\% \text{ CC} + \text{Area Mesic PP} > 30\% \text{ CC} + \text{Area Xeric MC} > 30\% \text{ CC} + \text{Area Mesic MC} > 40\% \text{ CC})}{\text{Watershed Area}}$$

Subalpine/Alpine Forest Ranking

Spruce and true firs are the dominant tree species in the Subalpine/Alpine Zone, with aspen stands on mostly northern aspects and more mesic sites. The canopy cover for the Subalpine/Alpine forest type is generally much higher than the montane forest, with an average of 75 percent (Table 11 and Appendix D). Spruce-fir is shade tolerant and therefore populates much denser stands than are common in the montane forest type. It is therefore not reasonable to predict resilience based on canopy closure alone. Because the canopy closure is typically high in these high elevation forest types, landscape-level diversity is important for maintenance of resilient conditions in this forest type.

For this analysis, the resilience in subalpine/alpine forests was predicted using a canopy closure diversity index. For the spruce-fir forest type, Simpson's Diversity Index (Simpson 1949) was calculated for canopy closure, providing the density diversity for this forest type in each watershed.

Simpson's Diversity Index is a measure that characterizes species diversity in a community. This analysis uses the index to characterize density diversity within forest types. The two main factors are richness (the number of different canopy cover values present in a particular area, here a 7th Level watershed) and evenness (the similarity of the areas of each of the canopy cover values present). The equation used for the diversity index is the following:

$$D = \frac{\sum n(n-1)}{N(N-1)} ;$$

where, n = total area within one canopy closure value and N = total area within all canopy closure values.

Using this index, a D of 0 represents infinite diversity and 1 represents no diversity. A D value was calculated for each 7th level watershed. The total non-resilient area for spruce-fir was found by multiplying D by the total acres of that vegetation type in the watershed.

Forest Resilience Ranking

The composite ranking was calculated by adding the Montane Ranking to the Subalpine/Alpine Ranking for a new Forest Resilience Metric, which was then re-categorized using the assessment categorization scheme. The final rankings were categorized from 1 (lowest hazard, high resilience) to 5 (highest hazard, low resilience). The categorized Forest Resilience Ranking by 7th Level watershed is displayed in Appendix C.

Insects and Disease

Climate change and human disturbance can affect the risk of damage and stress from insects and disease in multiple ways. Human disturbance often introduces non-native species to the ecosystem. Increasingly mild winters augment the overwintering survival rate of both native and introduced insect species. Drought and temperatures out of the range of normal can stress vegetation that is adapted to a cooler and wetter climate. These compounding factors may increase the impact of insects and disease as a disturbance agent, affecting forest health and ultimately stand structure and vegetative composition. Higher mortality rates from insects and disease over historical conditions may increase fuel loadings and further intensify wildfires.

In the last two decades, Colorado has experienced epidemics of mountain pine beetles and spruce beetles. These epidemics have caused high tree mortality across large swaths of forested landscapes. Colorado has also experienced many small to very large wildfires that have burned areas of those beetle-killed forests. Early research on the impacts of beetle mortality to wildfire behavior proposed that once trees lose their needles, fire behavior would be less intense compared to green trees.

However, Hoffman et al. (2013) argued that the reduction in canopy biomass can result in greater wind penetration into the canopy which can increase wildfire rate of spread. The consensus of the firefighting community and technical post-fire restoration experts is that wildfires in beetle-killed forests have shown much more extreme wildfire behavior and resulted in larger fires that have areas of high burn severity within areas of past beetle mortality.



Effects of Mountain Pine Beetle mortality seen within a forest stand in northwest CO.

Current Mortality

The insect mortality area and severity mapping created by Rodman et al. (2021) was used to calculate the average insect mortality in each 7th Level watershed. This research used the Landsat time series products, as well as field data and Random Forest models to develop 30-m resolution maps of the presence and severity (cumulative percent basal area mortality) of beetle-caused tree mortality between 1997-2019 in subalpine forests across the Southern Rocky Mountains. For each 7th Level watershed, the mean pixel severity from 0-100 was calculated to create an insect mortality metric, accounting for both presence and severity across the entire watershed.

The current insect mortality severity was mapped throughout the project area. All 7th Level watersheds were then comparatively ranked by the insect mortality metric.

Future Mortality

The National Insect and Disease Risk Map defines forest areas where, “the expectation that, without remediation, at least 25% of standing live basal area greater than one inches in diameter will die over a

15-year timeframe (2013–2027) due to insects and diseases” (Krist et al. 2013). The mapping was updated in 2018 to account for reductions in hazard due to previous and ongoing tree mortality.

For the Blue River watershed assessment area, the insects that apply to forested areas include:

- Mountain pine beetle
- Douglas-fir beetle
- Spruce beetle
- Western balsam bark beetle
- Western spruce budworm
- Aspen and cottonwood decline
- White pine blister rust

The *2018 National Insect and Disease Risk Map Update* is a 240-meter resolution map that represents areas of remaining risk for predicted future biomass loss. The area of remaining risk for each watershed was divided by the total watershed area. These scores produce an estimated hazard of predicted biomass loss in each 7th Level watershed. Watersheds are then ranked to indicate the relative risk of loss due to insects and disease within the wider study area.

Combined Insects and Disease Ranking

The current canopy mortality ranking was combined with the future risk of insect and disease rank. All watersheds were then comparatively ranked by the overall insect mortality metric. The categorized Insect and Disease Hazard by small watershed are displayed in Appendix C.

Ecosystem Sensitivity Hazard Ranking

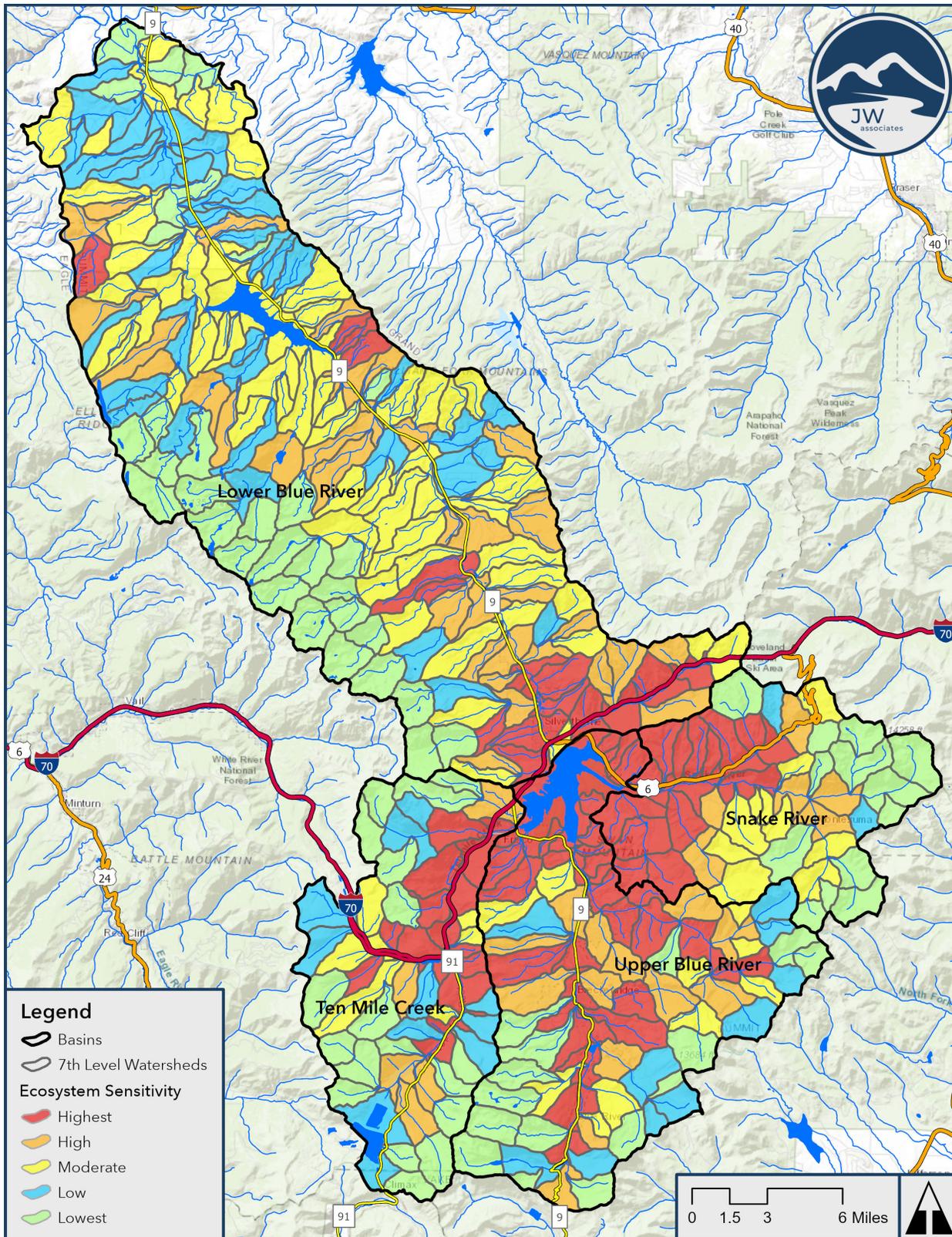
The Ecosystem Sensitivity Hazard Ranking was calculated by summing the Landscape Condition, Forest Resilience, and Insect and Disease Risk rankings. The results of this calculation were ranked from 1 (lowest Ecosystem Sensitivity Hazard) to 5 (highest Ecosystem Sensitivity Hazard) to create the Ecosystem Sensitivity Hazard Ranking. The categorized Ecosystem Sensitivity Hazard Rank by watershed are displayed in Appendix C and Map 14. Based upon this analysis, there are 72 7th Level watersheds that received an Ecosystem Sensitivity Hazard Rank of Highest in the assessment area (Table 12).

Table 12. Highest Ranked 7th Level Watersheds for Ecosystem Sensitivity Hazard

Basin Name	7 th Level Watershed Name	Landscape Condition	Forest Resilience	Insect & Disease
Upper Blue River	Middle Headwaters Blue River	Highest	High	Highest
	Lower Headwaters Blue River	Highest	High	High
	Goose Pasture Tarn	Highest	High	High
	Illinois Gulch	Highest	High	High
	Headwaters Upper Blue River	Highest	Highest	High
	Lower French Gulch	High	Highest	Highest
	Upper Upper Blue River	Highest	High	High
	Lower Middle Fork Swan River	Low	Highest	Highest
	Upper Swan River	Low	Highest	Highest
	Middle Swan River	Low	Highest	Highest
	Horseshoe Gulch	Low	Highest	Highest
	Lower Swan River	Highest	Highest	Highest
	Outlet Swan River	Highest	Highest	High
	South Barton Gulch	High	Highest	High
	Middle Upper Blue River	Highest	High	Moderate
	Tiger Run	High	Highest	Moderate
	South Swan Mountain	High	Highest	Moderate
	Ophir Mountain	Highest	High	Moderate
	West Swan Mountain	Highest	Highest	Moderate
	Outlet Upper Blue River	Highest	High	Moderate
	Lower Miners Creek	Low	Highest	Highest
	Masontown	Highest	Highest	Highest
	North Ophir Mountain	Highest	High	Moderate
	North Swan Mountain	Highest	Highest	Moderate
	Soda Gulch	Highest	High	Moderate
	South Tenderfoot Mountain	Highest	High	High
	Tenderfoot Mountain	High	Highest	Highest
	North Tenderfoot Mountain	Highest	Highest	Highest
Dillon Reservoir	Highest	High	Moderate	
Snake River	Middle North Fork Snake River	Highest	High	Highest
	Lower Porcupine Gulch	Moderate	High	Highest
	Lower North Fork Snake River	Highest	Highest	Highest
	Lower Snake River	High	Highest	Highest
	UT1 to Outlet Snake River	High	High	Highest
	UT2 to Outlet Snake River	Moderate	Highest	Highest
	UT3 to Outlet Snake River	Moderate	Highest	Highest
	Lower Keystone Gulch	Moderate	Highest	Highest
	Frey Gulch	Low	Highest	Highest
Outlet Snake River	Highest	High	Moderate	

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Basin Name	7 th Level Watershed Name	Landscape Condition	Forest Resilience	Insect & Disease
Snake River	Upper Soda Creek	Lowest	Highest	Highest
	UT to Soda Creek	Low	Highest	Highest
	Middle Soda Creek	High	Highest	Highest
	Lower Soda Creek	Highest	High	Moderate
Ten Mile Creek	Lower Stafford Creek	High	High	High
	UT to Lower West Tenmile Creek	Highest	Low	High
	Lower West Tenmile Creek	Highest	High	High
	Upper Upper Tenmile Creek	Highest	Moderate	High
	Middle Middle Tenmile Creek	Highest	Moderate	Highest
	Upper Lower Middle Tenmile Creek	Highest	High	Highest
	Lower Lower Middle Tenmile Creek	Highest	High	Highest
	Curtain Ponds	Highest	Highest	Highest
	Lower Officers Gulch	Highest	Highest	Highest
	Upper Lower Tenmile Creek	Highest	Highest	Moderate
	Uneva Lake	Highest	Highest	Highest
	Lower North Tenmile Creek	High	Highest	Highest
	Lower Lower Tenmile Creek	Highest	High	Moderate
	Lower Blue River	Upper Straight Creek	Highest	High
Middle Straight Creek		Highest	High	Highest
Lower Straight Creek		Highest	Highest	Moderate
Dillon Valley		Highest	High	Moderate
Lower Salt Lick Gulch		Highest	High	Moderate
Silverthorne		Highest	High	Moderate
Lower South Willow Creek		Moderate	Highest	Highest
Blue River Ranch Lakes		Highest	High	Moderate
Hamilton Creek		Highest	Highest	Moderate
Middle Blue River - Straight Ceek		Highest	High	High
Lower North Rock Creek		High	Highest	Moderate
Pebble Creek		High	Highest	Moderate
Shane Gulch		High	High	High
McDonald Gulch		Highest	Highest	High
Miller Gulch - Green Mountain		High	Highest	High
Upper Spruce Creek - Lower Blue		Low	Highest	Highest



Map 14. Blue River Ecosystem Sensitivity Hazard Ranking

ADAPTIVE LIMITATION HAZARD

Adaptive Limitation is the inability of an ecosystem to respond to external stressors such as the effects of climate change. Landscapes that are more diverse provide more opportunities for organisms to find climate refuge than those that are relatively homogenous (Comer et al., 2019). Conversely, an ecosystem that has little variability in microclimates or elevational change lacks buffers for species to move into new areas as the climate shifts. Therefore an indication of a landscape or watershed's adaptive limitation can be found in the relative diversity of topography and microclimates.

The adaptive limitation of an ecosystem is also influenced by its diversity of species and their sensitivity to shifts in climate or ability to migrate within the landscape to new areas with suitable microclimates (Comer et al., 2019). There are several useful measures of the ability of an ecosystem to absorb climate change. Comer et al. (2019) defines three factors, which in combination provide an indicator of the potential for a given landscape to successfully buffer the effects of climate change.

Vegetation Type Diversity

Since individual species respond differently to disturbances, the more diverse the taxonomy of a landscape, the more likely it is that a function can be performed by more than one species should individual species be lost as the climate changes. Simpson's Diversity Index (Simpson, 1949) was used as an indicator for the vegetation diversity within watersheds.² This index is a well-established method to quantify the diversity of plant and/or animal species as well as the abundance of each species. Accounting for diversity in terms of both richness and evenness is important because although two communities may have the same number of species (richness), the community dominated by just one or two of those species is considered less diverse than the one in which many different species have a similar abundance (evenness). Simpson's Index (D) is calculated with the following formula:

$$D = \sum (n/N)^2;$$

where n = total acres of a particular species, and N = total acres of all species.

This index produces a scale from 0 (high diversity) to 1 (low diversity). The value of D was calculated for each watershed and the watersheds were then ranked from 1 (high diversity, low hazard) to 5 (low diversity, high hazard). The categorized Vegetation Type Diversity Rank by 7th Level watershed is displayed in Appendix C.

Topo-Climatic Variability

The distribution of a natural community is determined by both regional and micro-climatic factors of temperature and precipitation. For example, limited topographical relief may provide a wide area of

² Comer et al. (2019) uses a diversity component called Functional Species Groups (FSGs). Ecosystems or communities with FSGs that have rich internal diversity tend to be more resilient to external stressors (Folke et al. 2004, Walker et al. 2004, Nyström et al. 2008). However, the data on the FSGs for the area of study are incomplete and the relative difference between the known FSGs in the study area are too small to create a useful ranking scheme. Therefore, Simpson's Diversity Index was used instead.



Example of a landscape with a range of micro-climates within variable topography.

distribution but only gradual change over distance, while rugged canyons and mountain ranges offer numerous microclimates that provide opportunities for rapid change in vegetation types over short distances. The idea of climate change “velocity” has been proposed as a measure of climate change exposure and the concept reflects the interaction of changing climate with topography (Loarie et al. 2009). Areas with rugged topography and significant elevational gradients (low velocity) will support a greater diversity of microclimates as compared with areas of flat topography (high velocity). Given the same degree of climate change over the same time period, a species in a rugged topographic environment would be required to migrate a shorter distance than a species in an expansive and flat landscape (Comer et al. 2019).

Maps of terrain ruggedness express the influence of topography on microclimate variability (Comer et al. 2018). Riley et al. (1999) provided a terrain ruggedness index (TRI) that can be used to arrive at a measure of this influence. This analysis was completed and then an average TRI calculated for each watershed. The categorized Topo-Climatic Variability by 7th Level watershed is displayed in Appendix C.

Adaptive Limitation Hazard Rank

The Adaptive Limitation Hazard Rank was calculated by summing the Vegetation Type Diversity and Topo-Climatic Variability ranks³. The results were ranked from 1 (the lowest Adaptive Limitation Hazard or best ability to adapt to changes) to 5 (highest Adaptive Limitation Hazard or the least ability to adapt to changes) to create the Adaptive Limitation Hazard Ranking. The categorized Adaptive Limitation Hazard Rank by watershed are displayed in Appendix C and on Map 15. Based upon this analysis, there are 67 7th Level watersheds that received an Adaptive Limitation Hazard Rank of Highest in the assessment area (Table 13).

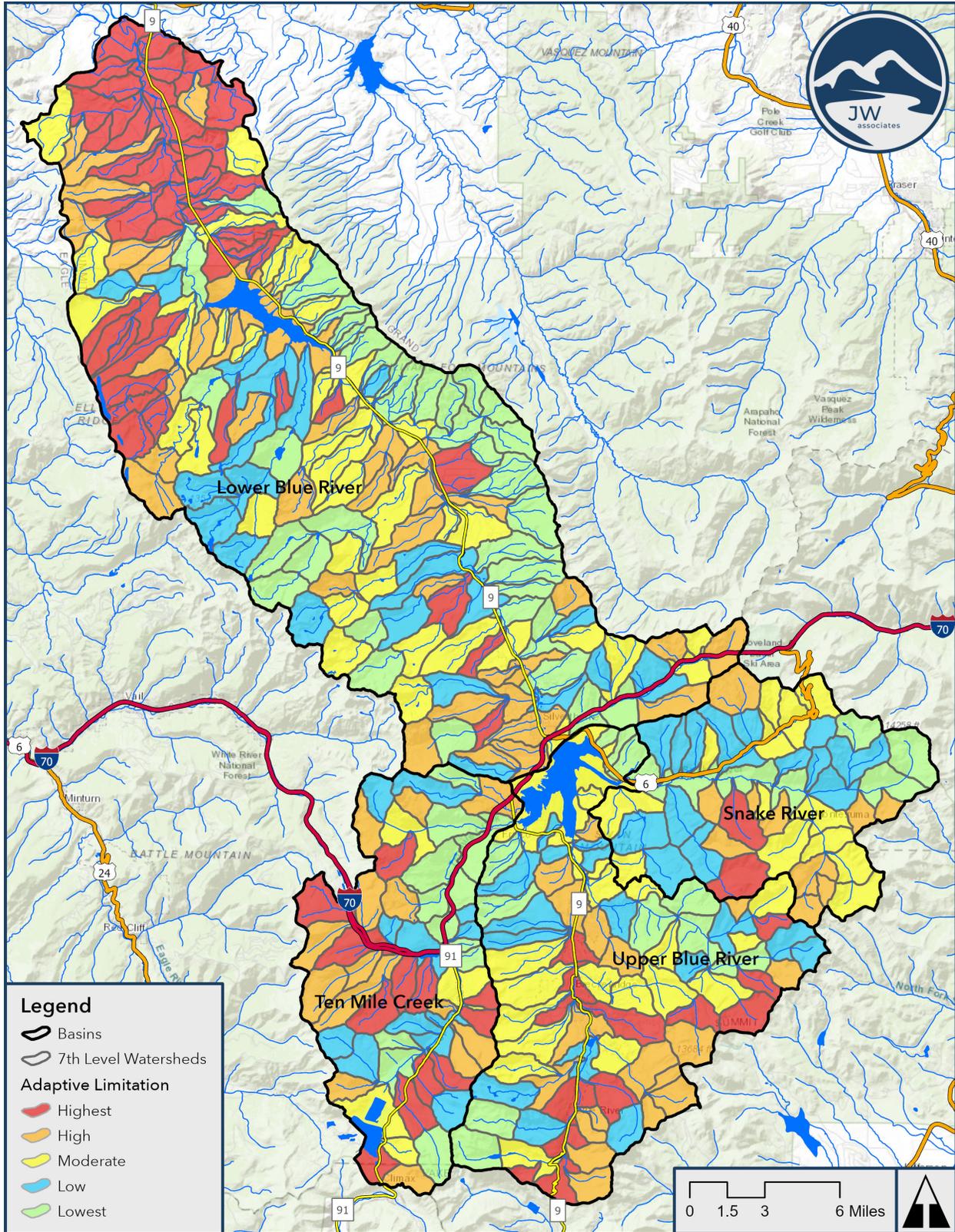
³ Adaptive Limitation may also be affected by the vulnerability of individual species who provide “keystone” functions for the ecosystem. However, while this concept as a vulnerability measure provides an important metric to the vulnerability of an ecosystem, it is often difficult to identify and assess species for each vegetative category given current knowledge (Comer et al. 2019). Within the Southern Rockies ecoregion, there is only one identified and scored keystone species for woodlands and forests, Aspen. Because of the very limited number of keystone species this component of the analysis was not used.

Table 13. Highest Ranked 7th Level Watersheds for Adaptive Limitation Hazard

6 th Level Watershed Name	7 th Level Watershed Name	Vegetation Type	Topo-Climatic
Upper Blue River	Upper Headwaters Blue River	Highest	High
	Crystal Lake	Highest	Low
	Middle Headwaters Blue River	Highest	Moderate
	Lower Headwaters Blue River	High	Moderate
	Lower Pennsylvania Creek	Highest	Low
	Illinois Gulch	Highest	Moderate
	Upper French Gulch	Highest	Low
	Upper Upper Blue River	Low	Highest
	Upper South Fork Swan River	Highest	Low
	Missouri Gulch	Highest	Low
	Garibaldi Gulch	Highest	Low
	Middle Upper Blue River	Low	Highest
	Snake River	Jones Gulch	Highest
Upper Keystone Gulch		Highest	Low
Ten Mile Creek	Upper Robinson Lake	High	High
	Lower Clinton Creek	Highest	Moderate
	Lower Mayflower Creek	Highest	Moderate
	Headwaters West Tenmile Creek	Low	Highest
	Upper West Tenmile Creek	High	Highest
	Jacque Creek	Highest	Low
	Union Gulch	Highest	High
	Wheeler Gulch	Highest	Low
	Humbug Creek	Highest	Low
	Lower Upper Middle Tenmile Creek	Highest	Low
	UT to Middle Middle Tenmile Creek	Highest	Low
	Uneva Peak	Highest	Low
Lower Blue River	Lower South Willow Creek	Moderate	Highest
	UT1 to Middle Blue River - Rock Creek	Low	Highest
	Lower South Rock Creek	Moderate	Highest
	Lower Big Gulch	Moderate	Highest
	Dole Gulch	Low	Highest
	UT to Otter Creek	Low	Highest
	UT to Cataract Creek	Highest	High
	Cow Camp Gulch	Moderate	High
	Upper Elliott Creek - Lower Blue	Highest	High
	Eaglesmere Lakes	High	Highest
	Mahan Lake	High	High
	North Fork Elliott Creek	High	Highest
	Martin Creek	Low	Highest
	UT1 to South Fork Deep Creek	Highest	Highest
	UT2 to South Fork Deep Creek	Low	Highest

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6 th Level Watershed Name	7 th Level Watershed Name	Vegetation Type	Topo-Climatic
Lower Blue River	South Fork Deep Creek	Low	Highest
	Haystack Mountain	High	High
	South Haystack Mountain	High	High
	Lower Haystack Mountain	Moderate	Highest
	Noonan Ditch Gulch	Highest	Highest
	Miller Gulch - Lower Blue River	Highest	Highest
	King Creek	High	High
	UT to North Spruce Creek	Low	Highest
	Lower Spruce Creek - Lower Blue	Low	Highest
	Headwaters Lower Blue River	Highest	Highest
	UT1 to Lower Blue River	Highest	Highest
	Upper Lower Blue River	High	Highest
	Camp Creek - Lower Blue	Moderate	Highest
	Lower Harsha Gulch	Highest	Moderate
	Middle Lower Blue River	Moderate	Highest
	UT to Beaver Creek	Low	Highest
	Noonan Ranch	High	Highest
	Beaver Creek	Moderate	Highest
	UT to Lower Blue River	High	Highest
	Upper Elliott Creek - Outlet Blue	High	Highest
	Middle Elliott Creek - Outlet Blue	Highest	Highest
	Lower Elliott Creek - Outlet Blue	Highest	Highest
	Dry Creek	Moderate	Highest
	Lower Lower Blue River	Moderate	Highest
	UT to Outlet Lower Blue River	High	High
Outlet Lower Blue River	Highest	Highest	



Map 15. Blue River Adaptive Limitation Hazard Ranking

WATERSHED VULNERABILITY RANK

The Watershed Vulnerability Rank was calculated by summing the Adaptive Limitation Hazard and Ecosystem Sensitivity ranks. The results of this calculation were ranked from 1 (lowest Watershed Vulnerability) to 5 (highest Watershed Vulnerability). The categorized Watershed Vulnerability Rank by watershed are displayed in Appendix C and on Map 16. Based upon this analysis, there are 73 7th Level watersheds that received a Watershed Vulnerability Rank of Highest in the assessment area (Table 14).

Table 14. Highest Ranked 7th Level Watersheds for Watershed Vulnerability

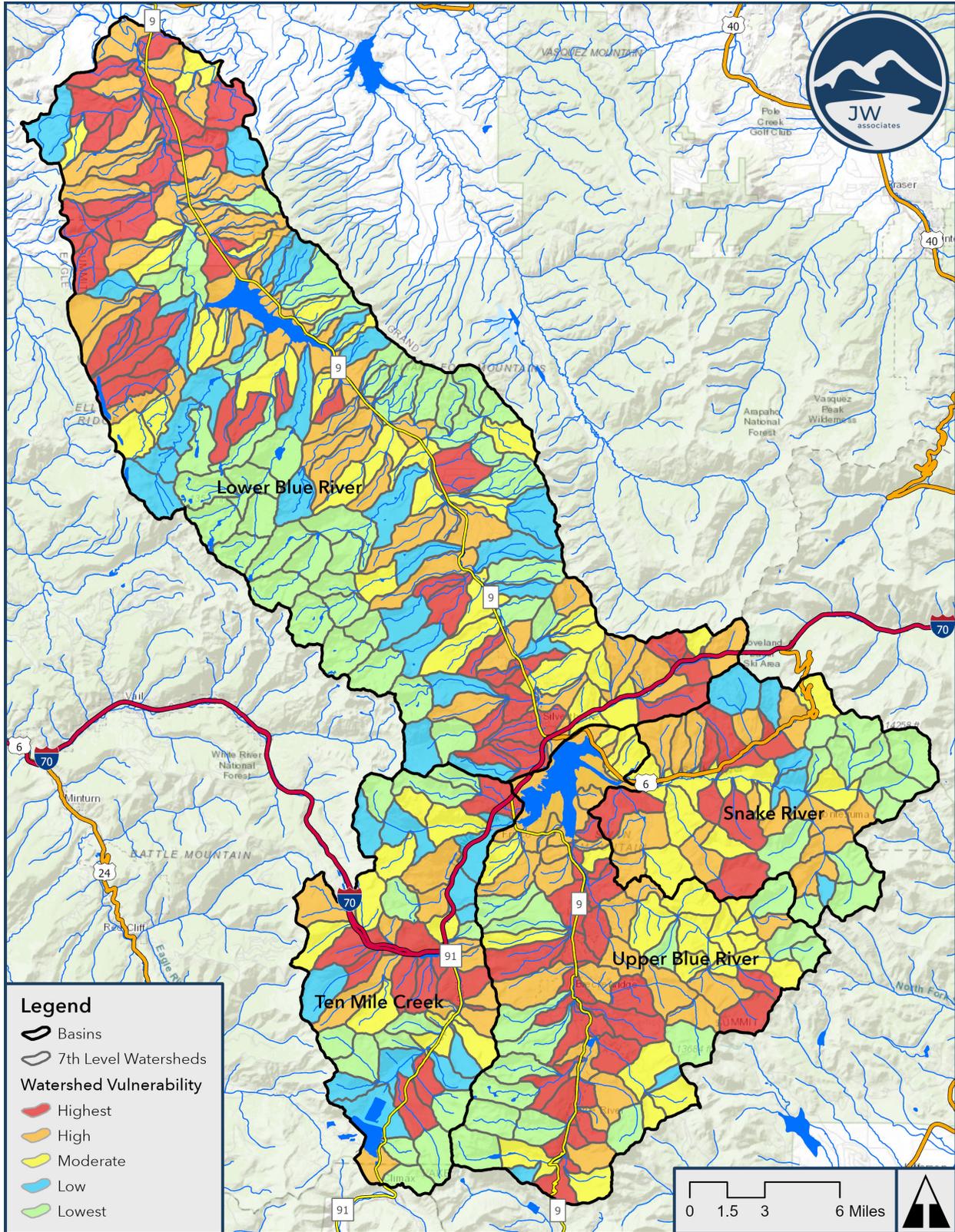
6 th Level Watershed Name	7 th Level Watershed Name	Ecosystem Sensitivity	Adaptive Limitation
Upper Blue River	Upper Headwaters Blue River	High	Highest
	Middle Headwaters Blue River	Highest	Highest
	UT1 to Lower Headwaters Blue River	High	High
	Lower Headwaters Blue River	Highest	Highest
	Lower Spruce Creek - Headwaters Blue	Moderate	High
	Lower Indiana Creek	High	Moderate
	Illinois Gulch	Highest	Highest
	Headwaters Upper Blue River	Highest	High
	Lower French Gulch	Highest	Moderate
	Upper Upper Blue River	Highest	Highest
	Upper South Fork Swan River	Low	Highest
	Missouri Gulch	Moderate	Highest
	Lower Gold Run Gulch	High	High
	Outlet Swan River	Highest	Moderate
	South Barton Gulch	Highest	Moderate
	Middle Upper Blue River	Highest	Highest
	Lower Upper Blue River	High	High
	Tiger Run	Highest	Moderate
	Outlet Upper Blue River	Highest	Moderate
	North Swan Mountain	Highest	High
Snake River	Middle North Fork Snake River	Highest	Moderate
	Lower North Fork Snake River	Highest	Low
	Jones Gulch	Moderate	Highest
	Camp Creek - Snake River	High	High
	UT1 to Outlet Snake River	Highest	Moderate
	Upper Keystone Gulch	Moderate	Highest
	Lower Soda Creek	Highest	Moderate
Ten Mile Creek	Lower Clinton Creek	High	Highest
	Lower Mayflower Creek	High	Highest
	Lower Stafford Creek	Highest	High

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6 th Level Watershed Name	7 th Level Watershed Name	Ecosystem Sensitivity	Adaptive Limitation
Ten Mile Creek	Upper West Tenmile Creek	Moderate	Highest
	Union Gulch	High	Highest
	Wheeler Gulch	Low	Highest
	Lower West Tenmile Creek	Highest	Low
	Middle Middle Tenmile Creek	Highest	Moderate
	Lower Meadow Creek	High	High
Lower Blue River	Hamilton Gulch	High	High
	Upper Straight Creek	Highest	Moderate
	UT to Straight Creek	High	High
	Ryan Gulch	High	High
	Lower Salt Lick Gulch	Highest	High
	Silverthorne	Highest	High
	Lower South Willow Creek	Highest	Highest
	Outlet Willow Creek	High	High
	UT to Middle Blue River - Straight Creek	High	High
	Middle Blue River - Straight Creek	Highest	High
	UT1 to Middle Blue River - Rock Creek	High	Highest
	Lower North Rock Creek	Highest	High
	Lower South Rock Creek	High	Highest
	Lower Big Gulch	Low	Highest
	Dole Gulch	Moderate	Highest
	Surprise Lake	Moderate	High
	UT to Otter Creek	Moderate	Highest
	UT to Cataract Creek	High	Highest
	North Fork Elliott Creek	Low	Highest
	UT to Elliott Creek - Lower Blue	High	High
	Martin Creek	High	Highest
	UT1 to South Fork Deep Creek	Moderate	Highest
	South Fork Deep Creek	Moderate	Highest
	Lower Haystack Mountain	Moderate	Highest
	Upper Spruce Creek - Lower Blue	Highest	Moderate
	Middle Spruce Creek	High	High
	UT to North Spruce Creek	High	Highest
	Lower Spruce Creek - Lower Blue	Moderate	Highest
	Upper Lower Blue River	Low	Highest
	Lower Harsha Gulch	Low	Highest
	Middle Lower Blue River	Low	Highest
	UT to Beaver Creek	Moderate	Highest
Beaver Creek	Low	Highest	

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6 th Level Watershed Name	7 th Level Watershed Name	Ecosystem Sensitivity	Adaptive Limitation
Lower Blue River	Upper Elliott Creek - Outlet Blue	Moderate	Highest
	Dry Creek	Low	Highest
	Lower Lower Blue River	Moderate	Highest
	UT to Outlet Lower Blue River	Moderate	Highest



Map 16. Blue River Watershed Vulnerability Ranking

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APPENDICES

BLUE RIVER WRAP - WATERSHED HAZARD ASSESSMENT - APPENDIX A

14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/ Lakes (acres)
14010002010101	Bemrose Creek	1,238	Headwaters Blue River	0	1,238
14010002010102	Upper Headwaters Blue River	1,145	Headwaters Blue River	0	1,145
14010002010103	Upper Monte Cristo Creek	1,883	Headwaters Blue River	48	1,834
14010002010104	Crystal Lake	392	Headwaters Blue River	2	390
14010002010105	Lower Monte Cristo Creek	1,482	Headwaters Blue River	13	1,469
14010002010106	UT to Middle Headwaters Blue River	1,069	Headwaters Blue River	1	1,067
14010002010107	Upper McCullough Gulch	1,684	Headwaters Blue River	32	1,652
14010002010108	Lower McCullough Gulch	1,403	Headwaters Blue River	2	1,401
14010002010109	Middle Headwaters Blue River	782	Headwaters Blue River	1	780
14010002010110	UT1 to Lower Headwaters Blue River	572	Headwaters Blue River	0	572
14010002010111	Fredonia Gulch	425	Headwaters Blue River	0	425
14010002010112	Lower Headwaters Blue River	1,560	Headwaters Blue River	22	1,538
14010002010113	Upper Pennsylvania Creek	1,327	Headwaters Blue River	0	1,326
14010002010114	Lower Pennsylvania Creek	1,451	Headwaters Blue River	5	1,446
14010002010115	Upper Spruce Creek - Headwaters Blue	1,566	Headwaters Blue River	55	1,511
14010002010116	Crystal Creek	1,424	Headwaters Blue River	13	1,410
14010002010117	Lower Spruce Creek - Headwaters Blue	1,079	Headwaters Blue River	7	1,072
14010002010118	UT to Upper Indiana Creek	570	Headwaters Blue River	0	570
14010002010119	Upper Indiana Creek	1,266	Headwaters Blue River	0	1,265
14010002010120	UT to Middle Indiana Creek	427	Headwaters Blue River	0	427
14010002010121	Middle Indiana Creek	1,854	Headwaters Blue River	0	1,854
14010002010122	Lower Indiana Creek	1,412	Headwaters Blue River	7	1,405
14010002010123	Goose Pasture Tarn	1,041	Headwaters Blue River	234	806
14010002010201	Illinois Gulch	1,950	French Gulch-Blue River	0	1,950
14010002010202	Lehman Gulch	1,797	French Gulch-Blue River	5	1,791
14010002010203	Headwaters Upper Blue River	1,464	French Gulch-Blue River	3	1,461
14010002010204	Sawmill Gulch	1,547	French Gulch-Blue River	3	1,544
14010002010205	Headwaters French Gulch	1,740	French Gulch-Blue River	12	1,728
14010002010206	Upper French Gulch	1,111	French Gulch-Blue River	0	1,111
14010002010207	Middle French Gulch	1,788	French Gulch-Blue River	0	1,788
14010002010208	Lower French Gulch	1,376	French Gulch-Blue River	0	1,376
14010002010209	Outlet French Gulch	1,148	French Gulch-Blue River	1	1,147
14010002010210	Cucumber Creek Gulch	2,189	French Gulch-Blue River	16	2,173
14010002010211	Upper Upper Blue River	1,242	French Gulch-Blue River	5	1,237
14010002010301	Upper South Fork Swan River	1,631	Swan River	0	1,631
14010002010302	Lower South Fork Swan River	1,629	Swan River	0	1,629
14010002010303	Headwaters Middle Fork Swan River	870	Swan River	0	870
14010002010304	UT to Upper Middle Fork Swan River	857	Swan River	0	857
14010002010305	Upper Middle Fork Swan River	1,145	Swan River	0	1,145
14010002010306	Missouri Gulch	795	Swan River	0	795
14010002010307	Lower Middle Fork Swan River	1,171	Swan River	4	1,167
14010002010308	Georgia Gulch	725	Swan River	0	725
14010002010309	Upper North Fork Swan River	1,470	Swan River	0	1,470
14010002010310	Garibaldi Gulch	685	Swan River	0	685
14010002010311	UT1 to Lower North Fork Swan River	385	Swan River	0	385
14010002010312	UT2 to Lower North Fork Swan River	473	Swan River	0	473
14010002010313	Lower North Fork Swan River	1,309	Swan River	0	1,309
14010002010314	Upper Swan River	1,606	Swan River	4	1,602
14010002010315	Brown Gulch	1,002	Swan River	0	1,002
14010002010316	Muggins Gulch	1,498	Swan River	0	1,498
14010002010317	Middle Swan River	1,828	Swan River	1	1,828
14010002010318	Horseshoe Gulch	634	Swan River	1	634
14010002010319	Lower Swan River	1,160	Swan River	0	1,160
14010002010320	Upper Gold Run Gulch	1,160	Swan River	0	1,160
14010002010321	Lower Gold Run Gulch	1,063	Swan River	7	1,055
14010002010322	Outlet Swan River	976	Swan River	3	972
14010002010401	South Barton Gulch	2,230	Gold Hill-Blue River	23	2,207
14010002010402	Middle Barton Gulch	1,180	Gold Hill-Blue River	5	1,175
14010002010403	North Barton Gulch	1,693	Gold Hill-Blue River	2	1,690
14010002010404	Middle Upper Blue River	903	Gold Hill-Blue River	0	903
14010002010405	Lower Upper Blue River	1,419	Gold Hill-Blue River	5	1,414
14010002010406	Tiger Run	249	Gold Hill-Blue River	1	248
14010002010407	South Swan Mountain	474	Gold Hill-Blue River	0	474
14010002010408	Gold Hill	1,137	Gold Hill-Blue River	2	1,135
14010002010409	Ophir Mountain	406	Gold Hill-Blue River	0	406
14010002010410	West Swan Mountain	326	Gold Hill-Blue River	0	326
14010002010411	Outlet Upper Blue River	414	Gold Hill-Blue River	0	414

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14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/ Lakes (acres)
14010002020101	Lenawee - Arapahoe Basin	819	North Fork Snake River	0	818
14010002020102	Headwaters North Fork Snake River	1,305	North Fork Snake River	11	1,294
14010002020103	Upper North Fork Snake River	1,382	North Fork Snake River	1	1,382
14010002020104	UT to Middle North Fork Snake River	878	North Fork Snake River	2	876
14010002020105	Middle North Fork Snake River	998	North Fork Snake River	0	998
14010002020106	Upper Porcupine Gulch	2,041	North Fork Snake River	2	2,039
14010002020107	Lower Porcupine Gulch	920	North Fork Snake River	0	920
14010002020108	Lower North Fork Snake River	1,895	North Fork Snake River	3	1,891
14010002020201	Upper Deer Creek	838	Peru Creek-Snake River	21	817
14010002020202	UT to Lower Deer Creek	422	Peru Creek-Snake River	0	422
14010002020203	Lower Deer Creek	1,300	Peru Creek-Snake River	2	1,299
14010002020204	Headwaters Snake River	1,590	Peru Creek-Snake River	31	1,559
14010002020205	Upper Upper Snake River	1,338	Peru Creek-Snake River	2	1,337
14010002020206	Lower Upper Snake River	1,071	Peru Creek-Snake River	0	1,071
14010002020207	Saints John Creek	1,939	Peru Creek-Snake River	4	1,935
14010002020208	Upper Middle Snake River	1,284	Peru Creek-Snake River	0	1,284
14010002020209	Upper Peru Creek	2,151	Peru Creek-Snake River	4	2,147
14010002020210	Cinnamon Gulch	575	Peru Creek-Snake River	0	575
14010002020211	Wardon Gulch	757	Peru Creek-Snake River	0	757
14010002020212	Middle Peru Creek	1,772	Peru Creek-Snake River	1	1,772
14010002020213	Upper Chihuahua Gulch	1,268	Peru Creek-Snake River	10	1,258
14010002020214	Lower Chihuahua Gulch	1,920	Peru Creek-Snake River	53	1,867
14010002020215	Lower Peru Creek	1,404	Peru Creek-Snake River	6	1,398
14010002020216	Thurman Gulch	662	Peru Creek-Snake River	0	662
14010002020217	Grizzly Gulch	794	Peru Creek-Snake River	0	794
14010002020218	Porcupine Mountain	669	Peru Creek-Snake River	0	668
14010002020219	Lower Middle Snake River	1,054	Peru Creek-Snake River	4	1,050
14010002020220	Independence Mountain	424	Peru Creek-Snake River	0	424
14010002020221	UT to Lower Snake River	291	Peru Creek-Snake River	0	291
14010002020222	Jones Gulch	1,732	Peru Creek-Snake River	0	1,732
14010002020223	Lower Snake River	1,429	Peru Creek-Snake River	6	1,423
14010002020301	Camp Creek - Snake River	774	Keystone Gulch-Snake River	0	773
14010002020302	UT1 to Outlet Snake River	597	Keystone Gulch-Snake River	0	597
14010002020303	UT2 to Outlet Snake River	1,067	Keystone Gulch-Snake River	0	1,067
14010002020304	UT3 to Outlet Snake River	743	Keystone Gulch-Snake River	1	742
14010002020305	Upper Keystone Gulch	2,039	Keystone Gulch-Snake River	1	2,039
14010002020306	Keystone Mountain	908	Keystone Gulch-Snake River	0	908
14010002020307	Middle Keystone Gulch	1,487	Keystone Gulch-Snake River	0	1,487
14010002020308	Lower Keystone Gulch	1,619	Keystone Gulch-Snake River	0	1,619
14010002020309	Frey Gulch	1,490	Keystone Gulch-Snake River	0	1,490
14010002020310	Outlet Snake River	2,124	Keystone Gulch-Snake River	8	2,116
14010002030101	Glory Hole - Climax	1,042	Upper Tenmile Creek	0	1,042
14010002030102	McNully Creek	808	Upper Tenmile Creek	27	781
14010002030103	Upper Robinson Lake	1,182	Upper Tenmile Creek	213	969
14010002030104	Lower Robinson Lake	2,429	Upper Tenmile Creek	894	1,536
14010002030105	Headwaters Tenmile Creek	1,024	Upper Tenmile Creek	0	1,023
14010002030106	Upper Seattle Gulch	1,027	Upper Tenmile Creek	2	1,025
14010002030107	Lower Seattle Gulch	1,461	Upper Tenmile Creek	0	1,461
14010002030108	Upper Clinton Creek	1,696	Upper Tenmile Creek	2	1,694
14010002030109	Lower Clinton Creek	1,542	Upper Tenmile Creek	111	1,432
14010002030110	Rose Gulch	1,320	Upper Tenmile Creek	261	1,059
14010002030111	Upper Mayflower Creek	1,261	Upper Tenmile Creek	0	1,261
14010002030112	Lower Mayflower Creek	1,019	Upper Tenmile Creek	0	1,019
14010002030201	Headwaters West Tenmile Creek	2,008	West Tenmile Creek	1	2,007
14010002030202	Wilder Gulch	1,423	West Tenmile Creek	1	1,422
14010002030203	Corral Creek	1,477	West Tenmile Creek	0	1,477
14010002030204	Upper Stafford Creek	1,832	West Tenmile Creek	0	1,831
14010002030205	Lower Stafford Creek	812	West Tenmile Creek	0	812
14010002030206	Upper West Tenmile Creek	1,848	West Tenmile Creek	0	1,848
14010002030207	UT to Lower West Tenmile Creek	500	West Tenmile Creek	0	500
14010002030208	Jacque Creek	1,608	West Tenmile Creek	2	1,606
14010002030209	Guller Creek	2,112	West Tenmile Creek	0	2,111
14010002030210	Union Gulch	1,097	West Tenmile Creek	0	1,097
14010002030211	Wheeler Gulch	1,086	West Tenmile Creek	0	1,086
14010002030212	Lower West Tenmile Creek	1,745	West Tenmile Creek	10	1,735
14010002030301	Tucker Gulch	653	Middle Tenmile Creek	0	653
14010002030302	Humbug Creek	921	Middle Tenmile Creek	0	921
14010002030303	Copper Creek	900	Middle Tenmile Creek	1	900

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14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/ Lakes (acres)
14010002030304	West Crystal Peak	862	Middle Tenmile Creek	1	861
14010002030305	North Crystal Peak	1,112	Middle Tenmile Creek	0	1,112
14010002030306	Upper Upper Tenmile Creek	1,188	Middle Tenmile Creek	0	1,188
14010002030307	Spaulding Gulch	387	Middle Tenmile Creek	0	387
14010002030308	Lower Upper Middle Tenmile Creek	770	Middle Tenmile Creek	0	770
14010002030309	UT to Middle Middle Tenmile Creek	535	Middle Tenmile Creek	0	535
14010002030310	Middle Middle Tenmile Creek	1,648	Middle Tenmile Creek	0	1,648
14010002030311	Upper Lower Middle Tenmile Creek	659	Middle Tenmile Creek	0	659
14010002030312	Lower Lower Middle Tenmile Creek	375	Middle Tenmile Creek	0	375
14010002030313	Outlet Middle Tenmile Creek	407	Middle Tenmile Creek	0	407
14010002030401	Curtain Ponds	764	Lower Tenmile Creek	34	730
14010002030402	UT to Upper Lower Tenmile Creek	322	Lower Tenmile Creek	0	322
14010002030403	Upper Officers Gulch	1,263	Lower Tenmile Creek	11	1,252
14010002030404	Lower Officers Gulch	981	Lower Tenmile Creek	12	968
14010002030405	Upper Lower Tenmile Creek	923	Lower Tenmile Creek	0	923
14010002030406	Uneva Lake	1,901	Lower Tenmile Creek	29	1,872
14010002030407	Upper North Tenmile Creek	1,211	Lower Tenmile Creek	20	1,191
14010002030408	UT to Middle North Tenmile Creek	1,116	Lower Tenmile Creek	0	1,116
14010002030409	Uneva Peak	1,311	Lower Tenmile Creek	15	1,296
14010002030410	Middle North Tenmile Creek	1,611	Lower Tenmile Creek	0	1,611
14010002030411	UT to Lower North Tenmile Creek	823	Lower Tenmile Creek	11	812
14010002030412	Lower North Tenmile Creek	1,705	Lower Tenmile Creek	5	1,700
14010002030413	Lower Lower Tenmile Creek	1,734	Lower Tenmile Creek	4	1,729
14010002040101	Upper Miners Creek	1,397	Dillon Reservoir-Blue River	4	1,393
14010002040102	Lower Miners Creek	1,559	Dillon Reservoir-Blue River	0	1,559
14010002040103	Masontown	1,252	Dillon Reservoir-Blue River	4	1,248
14010002040104	Upper Meadow Creek	1,665	Dillon Reservoir-Blue River	15	1,650
14010002040105	UT to Meadow Creek	791	Dillon Reservoir-Blue River	2	789
14010002040106	Lower Meadow Creek	1,623	Dillon Reservoir-Blue River	10	1,613
14010002040107	North Ophir Mountain	374	Dillon Reservoir-Blue River	1	373
14010002040108	North Swan Mountain	431	Dillon Reservoir-Blue River	0	431
14010002040109	Soda Gulch	483	Dillon Reservoir-Blue River	4	479
14010002040110	Upper Soda Creek	1,757	Dillon Reservoir-Blue River	0	1,757
14010002040111	UT to Soda Creek	933	Dillon Reservoir-Blue River	1	932
14010002040112	Middle Soda Creek	1,962	Dillon Reservoir-Blue River	15	1,947
14010002040113	Lower Soda Creek	1,939	Dillon Reservoir-Blue River	3	1,936
14010002040114	South Tenderfoot Mountain	1,014	Dillon Reservoir-Blue River	0	1,014
14010002040115	Tenderfoot Mountain	501	Dillon Reservoir-Blue River	1	500
14010002040116	North Tenderfoot Mountain	343	Dillon Reservoir-Blue River	5	338
14010002040117	Dillon Reservoir	7,614	Dillon Reservoir-Blue River	3,215	4,400
14010002050101	Headwaters Straight Creek	1,583	Straight Creek-Blue River	0	1,583
14010002050102	Coon Hill	576	Straight Creek-Blue River	0	576
14010002050103	Hamilton Gulch	929	Straight Creek-Blue River	0	929
14010002050104	Upper Straight Creek	921	Straight Creek-Blue River	0	921
14010002050105	UT to Straight Creek	1,638	Straight Creek-Blue River	0	1,637
14010002050106	Middle Straight Creek	1,875	Straight Creek-Blue River	0	1,875
14010002050107	UT to Laskey Gulch	833	Straight Creek-Blue River	0	833
14010002050108	Laskey Gulch	1,637	Straight Creek-Blue River	0	1,637
14010002050109	Lower Straight Creek	1,325	Straight Creek-Blue River	0	1,325
14010002050110	Dillon Valley	1,329	Straight Creek-Blue River	0	1,329
14010002050111	Outlet Dillon Reservoir	506	Straight Creek-Blue River	0	506
14010002050112	Upper Salt Lick Gulch	905	Straight Creek-Blue River	4	901
14010002050113	Ryan Gulch	783	Straight Creek-Blue River	9	774
14010002050114	Lower Salt Lick Gulch	1,246	Straight Creek-Blue River	9	1,238
14010002050115	Silverthorne	1,791	Straight Creek-Blue River	5	1,786
14010002050116	Upper North Willow Creek	1,548	Straight Creek-Blue River	31	1,517
14010002050117	Lower North Willow Creek	1,429	Straight Creek-Blue River	10	1,419
14010002050118	Middle Willow Creek	1,545	Straight Creek-Blue River	4	1,541
14010002050119	Upper South Willow Creek	1,669	Straight Creek-Blue River	3	1,666
14010002050120	Middle South Willow Creek	1,442	Straight Creek-Blue River	1	1,441
14010002050121	Lower South Willow Creek	729	Straight Creek-Blue River	2	727
14010002050122	Outlet Willow Creek	957	Straight Creek-Blue River	9	948
14010002050123	Blue River Ranch Lakes	904	Straight Creek-Blue River	40	865
14010002050124	Hamilton Creek	1,902	Straight Creek-Blue River	22	1,880
14010002050125	UT to Middle Blue River - Straight Creek	472	Straight Creek-Blue River	0	472
14010002050126	Middle Blue River - Straight Creek	807	Straight Creek-Blue River	10	798
14010002050127	Upper Bushee Creek	1,114	Straight Creek-Blue River	1	1,113
14010002050128	Middle Bushee Creek	806	Straight Creek-Blue River	0	806

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14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/o Lakes (acres)
14010002050129	UT1 to Bushee Creek	707	Straight Creek-Blue River	0	707
14010002050130	UT2 to Bushee Creek	1,024	Straight Creek-Blue River	0	1,024
14010002050131	Lower Bushee Creek	627	Straight Creek-Blue River	4	624
14010002050201	Upper Middle Blue River - Rock Creek	1,409	Rock Creek-Blue River	5	1,403
14010002050202	UT1 to Middle Blue River - Rock Creek	803	Rock Creek-Blue River	1	802
14010002050203	Maryland Creek	2,192	Rock Creek-Blue River	0	2,191
14010002050204	Middle Middle Blue River - Rock Creek	1,006	Rock Creek-Blue River	7	999
14010002050205	UT2 to Middle Blue River - Rock Creek	881	Rock Creek-Blue River	3	878
14010002050206	Pioneer Creek	1,763	Rock Creek-Blue River	1	1,763
14010002050207	Upper South Rock Creek	1,842	Rock Creek-Blue River	41	1,801
14010002050208	Middle South Rock Creek	1,503	Rock Creek-Blue River	10	1,493
14010002050209	Headwaters North Rock Creek	1,758	Rock Creek-Blue River	51	1,708
14010002050210	Upper North Rock Creek	1,034	Rock Creek-Blue River	8	1,025
14010002050211	Middle North Rock Creek	1,672	Rock Creek-Blue River	14	1,658
14010002050212	Lower North Rock Creek	682	Rock Creek-Blue River	2	680
14010002050213	Lower South Rock Creek	1,632	Rock Creek-Blue River	12	1,620
14010002050214	Lower Middle Blue River - Rock Creek	1,449	Rock Creek-Blue River	13	1,435
14010002050215	Quaking Asp Creek	1,913	Rock Creek-Blue River	5	1,908
14010002050216	Pebble Creek	2,081	Rock Creek-Blue River	11	2,069
14010002050217	Headwaters Boulder Creek	1,895	Rock Creek-Blue River	69	1,826
14010002050218	UT to Boulder Creek	982	Rock Creek-Blue River	6	975
14010002050219	Upper Boulder Creek	1,124	Rock Creek-Blue River	8	1,116
14010002050220	Middle Boulder Creek	1,148	Rock Creek-Blue River	17	1,131
14010002050221	Lower Boulder Creek	1,247	Rock Creek-Blue River	11	1,236
14010002050301	Upper Middle Blue River - Slate Creek	1,874	Slate Creek-Blue River	0	1,874
14010002050302	Harrigan Creek	2,137	Slate Creek-Blue River	15	2,121
14010002050303	Bordoux Gulch	485	Slate Creek-Blue River	5	480
14010002050304	North Acorn Creek	2,197	Slate Creek-Blue River	1	2,196
14010002050305	Upper Acorn Creek	2,233	Slate Creek-Blue River	0	2,233
14010002050306	Lower Acorn Creek	926	Slate Creek-Blue River	1	925
14010002050307	Headwaters Slate Lake	1,740	Slate Creek-Blue River	61	1,679
14010002050308	Slate Lake	1,467	Slate Creek-Blue River	37	1,430
14010002050309	Upper Slate Creek	1,913	Slate Creek-Blue River	89	1,824
14010002050310	UT to Slate Creek	1,130	Slate Creek-Blue River	6	1,124
14010002050311	Middle Slate Creek	2,150	Slate Creek-Blue River	18	2,132
14010002050312	Lower Slate Creek	2,246	Slate Creek-Blue River	13	2,233
14010002050313	Upper Big Gulch	747	Slate Creek-Blue River	0	746
14010002050314	Lower Big Gulch	2,106	Slate Creek-Blue River	0	2,106
14010002050315	Middle Middle Blue River - Slate Creek	1,929	Slate Creek-Blue River	4	1,925
14010002050316	Berry Gulch	1,441	Slate Creek-Blue River	0	1,441
14010002050317	Hole Creek	1,031	Slate Creek-Blue River	0	1,031
14010002050318	Pasture Creek	1,087	Slate Creek-Blue River	0	1,087
14010002050319	Pass Creek	2,182	Slate Creek-Blue River	0	2,182
14010002050320	Miller Gulch - Middle Blue River	1,358	Slate Creek-Blue River	0	1,358
14010002050321	Lower Middle Blue River - Slate Creek	847	Slate Creek-Blue River	0	847
14010002050322	Upper Nuchu Creek	1,245	Slate Creek-Blue River	0	1,245
14010002050323	Hey Camp Creek	994	Slate Creek-Blue River	8	986
14010002050324	Lower Nuchu Creek	1,377	Slate Creek-Blue River	5	1,372
14010002050325	Spring Gulch	560	Slate Creek-Blue River	0	560
14010002050326	Palmer Gulch	1,618	Slate Creek-Blue River	0	1,618
14010002050401	Upper Brush Creek	1,570	Green Mountain Reservoir-Blue	27	1,543
14010002050402	South Brush Creek	2,041	Green Mountain Reservoir-Blue	5	2,036
14010002050403	Lower Brush Creek	1,753	Green Mountain Reservoir-Blue	7	1,746
14010002050404	Chokecherry Gulch	508	Green Mountain Reservoir-Blue	0	508
14010002050405	McKinley Gulch	930	Green Mountain Reservoir-Blue	0	930
14010002050406	Lonesome Gulch	702	Green Mountain Reservoir-Blue	0	702
14010002050407	Dole Gulch	594	Green Mountain Reservoir-Blue	0	594
14010002050408	Butler Gulch	647	Green Mountain Reservoir-Blue	0	647
14010002050409	Inlet Green Mountain Reservoir	1,354	Green Mountain Reservoir-Blue	34	1,319
14010002050410	Shane Gulch	1,095	Green Mountain Reservoir-Blue	0	1,095
14010002050411	McDonald Gulch	512	Green Mountain Reservoir-Blue	0	512
14010002050412	Miller Gulch - Green Mountain	585	Green Mountain Reservoir-Blue	0	585
14010002050413	Headwaters Black Creek	1,848	Green Mountain Reservoir-Blue	112	1,735
14010002050414	Cliff Lake	1,700	Green Mountain Reservoir-Blue	80	1,619
14010002050415	Upper South Rim Black Creek	1,440	Green Mountain Reservoir-Blue	46	1,394
14010002050416	Lower South Rim Black Creek	1,368	Green Mountain Reservoir-Blue	0	1,368
14010002050417	Upper Black Creek	1,612	Green Mountain Reservoir-Blue	8	1,604
14010002050418	Middle Black Creek	2,044	Green Mountain Reservoir-Blue	126	1,918

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14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/ Lakes (acres)
14010002050419	Lower Black Creek	1,681	Green Mountain Reservoir-Blue	8	1,673
14010002050420	Cottonwood Gulch	788	Green Mountain Reservoir-Blue	0	788
14010002050421	Upper Otter Creek	1,445	Green Mountain Reservoir-Blue	27	1,418
14010002050422	Surprise Lake	1,151	Green Mountain Reservoir-Blue	8	1,143
14010002050423	UT to Otter Creek	586	Green Mountain Reservoir-Blue	0	586
14010002050424	Lower Otter Creek	1,795	Green Mountain Reservoir-Blue	6	1,789
14010002050425	Cox Gulch	856	Green Mountain Reservoir-Blue	0	856
14010002050426	Headwaters Cataract Creek	1,978	Green Mountain Reservoir-Blue	63	1,916
14010002050427	Upper Cataract Creek	1,045	Green Mountain Reservoir-Blue	42	1,003
14010002050428	Middle Cataract Creek	1,348	Green Mountain Reservoir-Blue	8	1,340
14010002050429	Tipperary Lake	1,604	Green Mountain Reservoir-Blue	60	1,544
14010002050430	Lower Cataract Creek	1,600	Green Mountain Reservoir-Blue	51	1,549
14010002050431	UT to Cataract Creek	1,160	Green Mountain Reservoir-Blue	9	1,151
14010002050432	Outlet Cataract Creek	1,143	Green Mountain Reservoir-Blue	2	1,141
14010002050433	UT1 to Green Mountain Reservoir	589	Green Mountain Reservoir-Blue	0	588
14010002050434	Mumford Gulch	2,113	Green Mountain Reservoir-Blue	1	2,112
14010002050435	Horse Creek	1,360	Green Mountain Reservoir-Blue	0	1,360
14010002050436	Cow Camp Creek	779	Green Mountain Reservoir-Blue	0	779
14010002050437	Cow Camp Gulch	682	Green Mountain Reservoir-Blue	0	682
14010002050438	Heeney - Green Mountain Reservoir	768	Green Mountain Reservoir-Blue	3	765
14010002050439	UT2 to Green Mountain Reservoir	508	Green Mountain Reservoir-Blue	2	506
14010002050440	Guthrie Gulch	1,290	Green Mountain Reservoir-Blue	1	1,289
14010002050441	Green Mountain Reservoir	5,866	Green Mountain Reservoir-Blue	2,013	3,853
14010002060101	Upper Elliott Creek - Lower Blue	1,514	Elliott Creek	53	1,460
14010002060102	Eaglesmere Lakes	927	Elliott Creek	31	896
14010002060103	Mahan Lake	818	Elliott Creek	26	791
14010002060104	North Fork Elliott Creek	1,561	Elliott Creek	25	1,537
14010002060105	Middle Elliott Creek - Lower Blue	641	Elliott Creek	0	641
14010002060106	UT to Elliott Creek - Lower Blue	789	Elliott Creek	2	787
14010002060107	Martin Creek	1,908	Elliott Creek	20	1,888
14010002060108	Lower Elliott Creek - Lower Blue	1,456	Elliott Creek	16	1,440
14010002060201	UT1 to South Fork Deep Creek	667	Deep Creek-Blue River	1	666
14010002060202	UT2 to South Fork Deep Creek	898	Deep Creek-Blue River	2	895
14010002060203	South Fork Deep Creek	1,995	Deep Creek-Blue River	6	1,989
14010002060204	UT to North Fork Deep Creek	952	Deep Creek-Blue River	2	950
14010002060205	North Fork Deep Creek	1,818	Deep Creek-Blue River	0	1,818
14010002060206	Lower Deep Creek	1,062	Deep Creek-Blue River	2	1,060
14010002060207	Haystack Mountain	779	Deep Creek-Blue River	0	778
14010002060208	South Haystack Mountain	427	Deep Creek-Blue River	0	427
14010002060209	Lower Haystack Mountain	1,264	Deep Creek-Blue River	0	1,264
14010002060210	North Haystack Mountain	1,280	Deep Creek-Blue River	2	1,278
14010002060211	UT to Spring Creek	1,009	Deep Creek-Blue River	1	1,007
14010002060212	Spring Creek	1,375	Deep Creek-Blue River	2	1,373
14010002060213	Noonan Ditch Gulch	563	Deep Creek-Blue River	0	563
14010002060214	Outlet Green Mountain Reservoir	1,934	Deep Creek-Blue River	0	1,934
14010002060215	Miller Gulch - Lower Blue River	728	Deep Creek-Blue River	1	727
14010002060216	UT to King Creek	1,119	Deep Creek-Blue River	0	1,118
14010002060217	King Creek	1,424	Deep Creek-Blue River	1	1,423
14010002060218	Upper Spruce Creek - Lower Blue	1,654	Deep Creek-Blue River	4	1,649
14010002060219	Middle Spruce Creek	1,421	Deep Creek-Blue River	1	1,419
14010002060220	UT to North Spruce Creek	762	Deep Creek-Blue River	0	762
14010002060221	North Spruce Creek	1,548	Deep Creek-Blue River	1	1,547
14010002060222	Lower Spruce Creek - Lower Blue	1,774	Deep Creek-Blue River	1	1,773
14010002060223	Headwaters Lower Blue River	1,641	Deep Creek-Blue River	3	1,638
14010002060301	UT1 to Lower Blue River	719	Beaver Creek-Blue River	0	719
14010002060302	Upper Lower Blue River	1,566	Beaver Creek-Blue River	0	1,566
14010002060303	Camp Creek - Lower Blue	1,021	Beaver Creek-Blue River	2	1,019
14010002060304	Upper Harsha Gulch	1,599	Beaver Creek-Blue River	0	1,598
14010002060305	Lower Harsha Gulch	1,283	Beaver Creek-Blue River	0	1,282
14010002060306	Way Reservoir	1,567	Beaver Creek-Blue River	10	1,557
14010002060307	Middle Lower Blue River	1,437	Beaver Creek-Blue River	12	1,426
14010002060308	Headwaters Beaver Creek	2,182	Beaver Creek-Blue River	3	2,179
14010002060309	Sheephorn Mountain	691	Beaver Creek-Blue River	0	690
14010002060310	UT to Beaver Creek	629	Beaver Creek-Blue River	0	629
14010002060311	Noonan Ranch	1,005	Beaver Creek-Blue River	2	1,003
14010002060312	Beaver Creek	2,266	Beaver Creek-Blue River	20	2,247
14010002060313	UT to Lower Blue River	940	Beaver Creek-Blue River	2	938
14010002060314	Upper Elliott Creek - Outlet Blue	1,981	Beaver Creek-Blue River	10	1,971

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14 code HUC	7th Level Watershed Name	Watershed Area (acres)	6th Level Watershed Name	Waterbody Area (acres)	Watershed Area w/o Lakes (acres)
14010002060315	Lawson Ridge	982	Beaver Creek-Blue River	0	982
14010002060316	Middle Elliott Creek - Outlet Blue	1,154	Beaver Creek-Blue River	1	1,153
14010002060317	Lower Elliott Creek - Outlet Blue	1,072	Beaver Creek-Blue River	0	1,072
14010002060318	Dry Creek	1,081	Beaver Creek-Blue River	0	1,081
14010002060319	Lower Lower Blue River	1,123	Beaver Creek-Blue River	1	1,122
14010002060320	UT to Outlet Lower Blue River	789	Beaver Creek-Blue River	9	780
14010002060321	Outlet Lower Blue River	1,634	Beaver Creek-Blue River	2	1,631

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002010101	Bemrose Creek	Lowest	Lowest	Low	Moderate	Lowest
14010002010102	Upper Headwaters Blue River	Moderate	Highest	Moderate	Highest	Highest
14010002010103	Upper Monte Cristo Creek	Lowest	Lowest	Lowest	High	Lowest
14010002010104	Crystal Lake	Lowest	High	Highest	High	High
14010002010105	Lower Monte Cristo Creek	Lowest	Highest	Highest	High	Highest
14010002010106	UT to Middle Headwaters Blue River	Lowest	Moderate	Moderate	High	Moderate
14010002010107	Upper McCullough Gulch	Lowest	Lowest	Low	Moderate	Lowest
14010002010108	Lower McCullough Gulch	Moderate	High	Highest	High	Highest
14010002010109	Middle Headwaters Blue River	Moderate	Highest	High	Moderate	Highest
14010002010110	UT1 to Lower Headwaters Blue River	Moderate	High	Highest	Highest	Highest
14010002010111	Fredonia Gulch	Moderate	Highest	Highest	Low	High
14010002010112	Lower Headwaters Blue River	Highest	Highest	Moderate	High	Highest
14010002010113	Upper Pennsylvania Creek	Lowest	Low	Lowest	Low	Lowest
14010002010114	Lower Pennsylvania Creek	Highest	High	Moderate	Low	High
14010002010115	Upper Spruce Creek - Headwaters Blue	Lowest	Lowest	Moderate	High	Low
14010002010116	Crystal Creek	Lowest	High	Moderate	Moderate	Moderate
14010002010117	Lower Spruce Creek - Headwaters Blue	Highest	Highest	Highest	High	Highest
14010002010118	UT to Upper Indiana Creek	Highest	Lowest	High	Low	Moderate
14010002010119	Upper Indiana Creek	Low	Low	Low	Low	Lowest
14010002010120	UT to Middle Indiana Creek	Lowest	High	High	Highest	High
14010002010121	Middle Indiana Creek	High	High	Highest	Highest	Highest
14010002010122	Lower Indiana Creek	High	Highest	Moderate	Highest	Highest
14010002010123	Goose Pasture Tarn	Highest	High	Moderate	Highest	Highest
14010002010201	Illinois Gulch	Moderate	Highest	Moderate	High	Highest
14010002010202	Lehman Gulch	Moderate	Highest	High	High	Highest
14010002010203	Headwaters Upper Blue River	High	Highest	Moderate	Moderate	Highest
14010002010204	Sawmill Gulch	Low	Highest	High	Highest	Highest
14010002010205	Headwaters French Gulch	Lowest	Lowest	Low	Highest	Low
14010002010206	Upper French Gulch	Moderate	High	Highest	Highest	Highest
14010002010207	Middle French Gulch	Moderate	Highest	High	Highest	Highest
14010002010208	Lower French Gulch	Moderate	Highest	High	Highest	Highest
14010002010209	Outlet French Gulch	Low	Highest	Lowest	Highest	High
14010002010210	Cucumber Creek Gulch	Low	Highest	Moderate	High	Highest
14010002010211	Upper Upper Blue River	Lowest	Highest	Low	Moderate	Moderate
14010002010301	Upper South Fork Swan River	Highest	Highest	Moderate	Lowest	High
14010002010302	Lower South Fork Swan River	Highest	Moderate	High	High	Highest
14010002010303	Headwaters Middle Fork Swan River	Lowest	Highest	Lowest	Lowest	Lowest
14010002010304	UT to Upper Middle Fork Swan River	Low	High	Moderate	Lowest	Moderate
14010002010305	Upper Middle Fork Swan River	Lowest	Moderate	Low	Lowest	Lowest
14010002010306	Missouri Gulch	Highest	Moderate	Moderate	Lowest	Moderate
14010002010307	Lower Middle Fork Swan River	Highest	High	High	Low	Highest
14010002010308	Georgia Gulch	Moderate	Highest	Moderate	Highest	Highest
14010002010309	Upper North Fork Swan River	Low	High	Low	Lowest	Low
14010002010310	Garibaldi Gulch	High	Highest	Moderate	Lowest	High
14010002010311	UT1 to Lower North Fork Swan River	High	Highest	High	Lowest	High
14010002010312	UT2 to Lower North Fork Swan River	Highest	High	High	Lowest	High
14010002010313	Lower North Fork Swan River	Highest	Highest	Moderate	Lowest	High

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002010314	Upper Swan River	Moderate	Highest	Moderate	High	Highest
14010002010315	Brown Gulch	Highest	High	High	Highest	Highest
14010002010316	Muggins Gulch	High	Low	Moderate	High	High
14010002010317	Middle Swan River	High	Highest	Moderate	Highest	Highest
14010002010318	Horseshoe Gulch	High	Low	Low	Highest	High
14010002010319	Lower Swan River	Low	Highest	Low	Highest	Highest
14010002010320	Upper Gold Run Gulch	High	Highest	Low	Highest	Highest
14010002010321	Lower Gold Run Gulch	Low	Highest	Lowest	Moderate	High
14010002010322	Outlet Swan River	Moderate	Highest	Lowest	Highest	Highest
14010002010401	South Barton Gulch	High	Highest	Moderate	High	Highest
14010002010402	Middle Barton Gulch	High	Lowest	Highest	High	High
14010002010403	North Barton Gulch	Low	Moderate	High	High	High
14010002010404	Middle Upper Blue River	Low	Highest	Lowest	High	High
14010002010405	Lower Upper Blue River	Low	High	Lowest	Low	Lowest
14010002010406	Tiger Run	Moderate	Lowest	Moderate	High	Moderate
14010002010407	South Swan Mountain	Moderate	Lowest	Moderate	High	Moderate
14010002010408	Gold Hill	Low	High	Lowest	Low	Low
14010002010409	Ophir Mountain	Low	High	Lowest	Moderate	Moderate
14010002010410	West Swan Mountain	Highest	Low	High	High	Highest
14010002010411	Outlet Upper Blue River	Moderate	Highest	Lowest	Highest	Highest
14010002020101	Lenawee - Arapahoe Basin	Lowest	Highest	Moderate	Lowest	Moderate
14010002020102	Headwaters North Fork Snake River	Lowest	High	Moderate	High	Moderate
14010002020103	Upper North Fork Snake River	Moderate	High	High	Lowest	High
14010002020104	UT to Middle North Fork Snake River	Lowest	Lowest	High	Lowest	Lowest
14010002020105	Middle North Fork Snake River	Highest	Lowest	Highest	Lowest	High
14010002020106	Upper Porcupine Gulch	Lowest	Lowest	Low	High	Lowest
14010002020107	Lower Porcupine Gulch	Highest	Lowest	Highest	Lowest	Moderate
14010002020108	Lower North Fork Snake River	High	Moderate	High	High	Highest
14010002020201	Upper Deer Creek	Lowest	Moderate	Lowest	Lowest	Lowest
14010002020202	UT to Lower Deer Creek	Lowest	Moderate	Low	Lowest	Lowest
14010002020203	Lower Deer Creek	Moderate	Highest	Moderate	Lowest	Moderate
14010002020204	Headwaters Snake River	Lowest	Low	Lowest	Low	Lowest
14010002020205	Upper Upper Snake River	Lowest	Moderate	High	Moderate	Moderate
14010002020206	Lower Upper Snake River	High	High	Highest	Lowest	Highest
14010002020207	Saints John Creek	Low	High	Low	Lowest	Low
14010002020208	Upper Middle Snake River	Highest	Highest	Highest	Lowest	Highest
14010002020209	Upper Peru Creek	Lowest	High	Lowest	Low	Lowest
14010002020210	Cinnamon Gulch	Lowest	High	Moderate	Lowest	Lowest
14010002020211	Wardon Gulch	Low	Highest	High	Lowest	High
14010002020212	Middle Peru Creek	Lowest	High	Moderate	Low	Low
14010002020213	Upper Chihuahua Gulch	Lowest	Moderate	Low	Low	Lowest
14010002020214	Lower Chihuahua Gulch	Lowest	Moderate	Highest	Low	Moderate
14010002020215	Lower Peru Creek	High	High	Highest	Lowest	High
14010002020216	Thurman Gulch	Low	Lowest	Highest	Lowest	Low
14010002020217	Grizzly Gulch	Highest	High	Highest	Lowest	Highest
14010002020218	Porcupine Mountain	Moderate	Low	Highest	Lowest	Moderate
14010002020219	Lower Middle Snake River	High	Moderate	High	Lowest	High
14010002020220	Independence Mountain	Highest	Lowest	Highest	Low	High

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002020221	UT to Lower Snake River	Highest	Lowest	Highest	Low	High
14010002020222	Jones Gulch	Highest	Low	High	Lowest	High
14010002020223	Lower Snake River	Moderate	Highest	High	Low	Highest
14010002020301	Camp Creek - Snake River	Lowest	Highest	Low	High	Moderate
14010002020302	UT1 to Outlet Snake River	Low	Highest	Moderate	High	Highest
14010002020303	UT2 to Outlet Snake River	Low	Moderate	Moderate	High	Moderate
14010002020304	UT3 to Outlet Snake River	Lowest	High	High	High	Moderate
14010002020305	Upper Keystone Gulch	High	Lowest	Low	Lowest	Lowest
14010002020306	Keystone Mountain	High	Lowest	Moderate	Lowest	Low
14010002020307	Middle Keystone Gulch	Highest	High	Moderate	Lowest	Moderate
14010002020308	Lower Keystone Gulch	Highest	Moderate	Moderate	Low	High
14010002020309	Frey Gulch	High	Highest	Moderate	Moderate	Highest
14010002020310	Outlet Snake River	Low	Highest	Lowest	Low	Low
14010002030101	Glory Hole - Climax	Lowest	Lowest	Low	Highest	Lowest
14010002030102	McNully Creek	Lowest	High	Low	Highest	Moderate
14010002030103	Upper Robinson Lake	Low	Highest	Lowest	Moderate	Low
14010002030104	Lower Robinson Lake	Lowest	Highest	Lowest	High	Moderate
14010002030105	Headwaters Tenmile Creek	Lowest	Low	Low	High	Low
14010002030106	Upper Seattle Gulch	Lowest	Lowest	Low	Highest	Lowest
14010002030107	Lower Seattle Gulch	Lowest	Low	High	Highest	Moderate
14010002030108	Upper Clinton Creek	Lowest	Lowest	Lowest	Highest	Lowest
14010002030109	Lower Clinton Creek	High	High	High	Highest	Highest
14010002030110	Rose Gulch	Low	Moderate	Moderate	High	Moderate
14010002030111	Upper Mayflower Creek	Lowest	Moderate	Low	Moderate	Lowest
14010002030112	Lower Mayflower Creek	Highest	Low	High	Highest	Highest
14010002030201	Headwaters West Tenmile Creek	Low	Moderate	Moderate	Moderate	Moderate
14010002030202	Wilder Gulch	Moderate	Lowest	Moderate	High	Moderate
14010002030203	Corral Creek	Moderate	Lowest	Moderate	High	Low
14010002030204	Upper Stafford Creek	Moderate	Lowest	Moderate	Highest	Moderate
14010002030205	Lower Stafford Creek	Highest	Lowest	High	High	Highest
14010002030206	Upper West Tenmile Creek	High	Low	High	Moderate	High
14010002030207	UT to Lower West Tenmile Creek	Low	Low	High	High	Moderate
14010002030208	Jacque Creek	High	Lowest	Moderate	High	Moderate
14010002030209	Guller Creek	Highest	Lowest	Moderate	Highest	High
14010002030210	Union Gulch	High	High	Moderate	Moderate	High
14010002030211	Wheeler Gulch	Low	Highest	Moderate	Highest	Highest
14010002030212	Lower West Tenmile Creek	Moderate	Highest	Low	High	Highest
14010002030301	Tucker Gulch	Lowest	Low	High	Highest	Moderate
14010002030302	Humbug Creek	Low	Lowest	Highest	Highest	High
14010002030303	Copper Creek	Low	Low	High	Highest	Moderate
14010002030304	West Crystal Peak	Low	Lowest	Highest	Highest	Moderate
14010002030305	North Crystal Peak	Moderate	Lowest	Highest	Highest	High
14010002030306	Upper Upper Tenmile Creek	Highest	High	High	Highest	Highest
14010002030307	Spaulding Gulch	Highest	Moderate	Highest	High	Highest
14010002030308	Lower Upper Middle Tenmile Creek	High	Lowest	Highest	Highest	Highest
14010002030309	UT to Middle Middle Tenmile Creek	Moderate	Lowest	Highest	Highest	High
14010002030310	Middle Middle Tenmile Creek	Highest	Moderate	Highest	Moderate	Highest
14010002030311	Upper Lower Middle Tenmile Creek	High	Low	Highest	Moderate	Highest

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002030312	Lower Lower Middle Tenmile Creek	Highest	Lowest	Highest	High	Highest
14010002030313	Outlet Middle Tenmile Creek	Lowest	Lowest	Highest	Moderate	Low
14010002030401	Curtain Ponds	Highest	Highest	Highest	High	Highest
14010002030402	UT to Upper Lower Tenmile Creek	Lowest	Lowest	Highest	High	Low
14010002030403	Upper Officers Gulch	High	Lowest	Moderate	Moderate	Low
14010002030404	Lower Officers Gulch	Highest	High	Highest	High	Highest
14010002030405	Upper Lower Tenmile Creek	Highest	High	Highest	High	Highest
14010002030406	Uneva Lake	Highest	Moderate	Highest	High	Highest
14010002030407	Upper North Tenmile Creek	Highest	Lowest	High	Moderate	Moderate
14010002030408	UT to Middle North Tenmile Creek	Low	Lowest	High	Highest	Moderate
14010002030409	Uneva Peak	Highest	Lowest	High	Highest	High
14010002030410	Middle North Tenmile Creek	Highest	Lowest	Highest	Highest	Highest
14010002030411	UT to Lower North Tenmile Creek	Highest	Lowest	Highest	Highest	Highest
14010002030412	Lower North Tenmile Creek	Highest	High	High	High	Highest
14010002030413	Lower Lower Tenmile Creek	High	Highest	Highest	High	Highest
14010002040101	Upper Miners Creek	High	Moderate	High	Low	High
14010002040102	Lower Miners Creek	Highest	High	Highest	Moderate	Highest
14010002040103	Masontown	High	High	Highest	Moderate	Highest
14010002040104	Upper Meadow Creek	Moderate	Lowest	High	Highest	High
14010002040105	UT to Meadow Creek	Moderate	Lowest	Highest	High	High
14010002040106	Lower Meadow Creek	Moderate	Highest	Moderate	Low	Moderate
14010002040107	North Ophir Mountain	High	Highest	Lowest	Low	Moderate
14010002040108	North Swan Mountain	Highest	Low	Moderate	Highest	Highest
14010002040109	Soda Gulch	Moderate	Low	Lowest	Highest	Moderate
14010002040110	Upper Soda Creek	High	Lowest	Low	Low	Low
14010002040111	UT to Soda Creek	Highest	Lowest	Low	High	Moderate
14010002040112	Middle Soda Creek	High	Highest	Low	High	Highest
14010002040113	Lower Soda Creek	Moderate	Highest	Lowest	Moderate	High
14010002040114	South Tenderfoot Mountain	Lowest	Low	Low	Lowest	Lowest
14010002040115	Tenderfoot Mountain	Low	Lowest	High	Lowest	Low
14010002040116	North Tenderfoot Mountain	Moderate	Low	High	Low	Moderate
14010002040117	Dillon Reservoir	Moderate	Highest	Lowest	Low	Moderate
14010002050101	Headwaters Straight Creek	Lowest	Highest	Low	Highest	High
14010002050102	Coon Hill	Lowest	Moderate	High	Low	Low
14010002050103	Hamilton Gulch	Low	Moderate	Moderate	Lowest	Lowest
14010002050104	Upper Straight Creek	Highest	High	Highest	Moderate	Highest
14010002050105	UT to Straight Creek	Highest	Lowest	Moderate	High	Moderate
14010002050106	Middle Straight Creek	High	Low	High	Lowest	Moderate
14010002050107	UT to Laskey Gulch	Low	Lowest	Moderate	Lowest	Lowest
14010002050108	Laskey Gulch	High	Lowest	High	Lowest	Low
14010002050109	Lower Straight Creek	Highest	Highest	High	Lowest	Highest
14010002050110	Dillon Valley	Lowest	Highest	Low	Lowest	Low
14010002050111	Outlet Dillon Reservoir	Lowest	Highest	Lowest	Lowest	Lowest
14010002050112	Upper Salt Lick Gulch	High	Lowest	Highest	Low	Moderate
14010002050113	Ryan Gulch	Highest	High	Highest	Low	Highest
14010002050114	Lower Salt Lick Gulch	Low	Highest	Lowest	Lowest	Low
14010002050115	Silverthorne	Low	Highest	Lowest	Low	Low
14010002050116	Upper North Willow Creek	Lowest	Lowest	Moderate	Highest	Low

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002050117	Lower North Willow Creek	High	Lowest	Highest	Highest	Highest
14010002050118	Middle Willow Creek	Highest	Lowest	Highest	Highest	Highest
14010002050119	Upper South Willow Creek	Low	Lowest	Moderate	Highest	Moderate
14010002050120	Middle South Willow Creek	Moderate	Lowest	Highest	Highest	Highest
14010002050121	Lower South Willow Creek	Highest	Lowest	Highest	Moderate	High
14010002050122	Outlet Willow Creek	Low	Highest	Lowest	Lowest	Low
14010002050123	Blue River Ranch Lakes	Lowest	Highest	Low	Lowest	Low
14010002050124	Hamilton Creek	Low	Highest	Moderate	Lowest	Moderate
14010002050125	UT to Middle Blue River - Straight Creek	High	Highest	Moderate	Low	High
14010002050126	Middle Blue River - Straight Creek	Low	Highest	Low	Lowest	Moderate
14010002050127	Upper Bushee Creek	Low	Lowest	High	Lowest	Lowest
14010002050128	Middle Bushee Creek	Lowest	Low	High	Lowest	Lowest
14010002050129	UT1 to Bushee Creek	Moderate	Lowest	Highest	Lowest	Low
14010002050130	UT2 to Bushee Creek	Moderate	Lowest	High	Lowest	Low
14010002050131	Lower Bushee Creek	Moderate	Highest	High	Low	High
14010002050201	Upper Middle Blue River - Rock Creek	Low	Moderate	Lowest	Low	Lowest
14010002050202	UT1 to Middle Blue River - Rock Creek	High	Highest	Moderate	Low	High
14010002050203	Maryland Creek	High	Lowest	High	Low	Moderate
14010002050204	Middle Middle Blue River - Rock Creek	Low	Lowest	Moderate	Lowest	Lowest
14010002050205	UT2 to Middle Blue River - Rock Creek	High	Low	Highest	Lowest	Moderate
14010002050206	Pioneer Creek	Moderate	Low	High	Lowest	Low
14010002050207	Upper South Rock Creek	Lowest	Lowest	Low	Highest	Low
14010002050208	Middle South Rock Creek	Highest	Lowest	Highest	Highest	Highest
14010002050209	Headwaters North Rock Creek	Lowest	Lowest	Moderate	Highest	Low
14010002050210	Upper North Rock Creek	Moderate	Lowest	Highest	Highest	High
14010002050211	Middle North Rock Creek	Highest	Lowest	Highest	Highest	Highest
14010002050212	Lower North Rock Creek	Low	Moderate	Moderate	Low	Moderate
14010002050213	Lower South Rock Creek	High	Low	Moderate	Low	Moderate
14010002050214	Lower Middle Blue River - Rock Creek	Low	Highest	Low	Low	Moderate
14010002050215	Quaking Asp Creek	High	Low	High	Low	Moderate
14010002050216	Pebble Creek	High	Low	Moderate	Low	Moderate
14010002050217	Headwaters Boulder Creek	Lowest	Lowest	Low	Highest	Low
14010002050218	UT to Boulder Creek	Moderate	Lowest	Highest	Highest	High
14010002050219	Upper Boulder Creek	High	Lowest	Highest	Highest	Highest
14010002050220	Middle Boulder Creek	Highest	Lowest	High	Highest	Highest
14010002050221	Lower Boulder Creek	High	Highest	High	Moderate	High
14010002050301	Upper Middle Blue River - Slate Creek	Lowest	Highest	Lowest	Low	Low
14010002050302	Harrigan Creek	Moderate	Low	Moderate	Low	Low
14010002050303	Bordoux Gulch	Lowest	Highest	Lowest	Low	Low
14010002050304	North Acorn Creek	Moderate	Lowest	High	Moderate	Low
14010002050305	Upper Acorn Creek	Highest	Lowest	Moderate	Lowest	Low
14010002050306	Lower Acorn Creek	Lowest	Moderate	Low	Lowest	Lowest
14010002050307	Headwaters Slate Lake	Lowest	Lowest	Lowest	Highest	Lowest
14010002050308	Slate Lake	Low	Lowest	Highest	Highest	High
14010002050309	Upper Slate Creek	Lowest	Lowest	Moderate	Highest	Low
14010002050310	UT to Slate Creek	High	Lowest	Highest	Highest	Highest
14010002050311	Middle Slate Creek	High	Lowest	Highest	Highest	Highest
14010002050312	Lower Slate Creek	Moderate	Lowest	Low	Low	Lowest

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002050313	Upper Big Gulch	Low	High	Moderate	Moderate	Moderate
14010002050314	Lower Big Gulch	Low	High	Lowest	Lowest	Lowest
14010002050315	Middle Middle Blue River - Slate Creek	Lowest	Low	Lowest	Lowest	Lowest
14010002050316	Berry Gulch	Highest	Low	Highest	Moderate	Highest
14010002050317	Hole Creek	Moderate	Lowest	Moderate	Moderate	Low
14010002050318	Pasture Creek	Low	Low	Moderate	Lowest	Low
14010002050319	Pass Creek	Moderate	Low	Moderate	Low	Low
14010002050320	Miller Gulch - Middle Blue River	Low	Low	Moderate	Lowest	Lowest
14010002050321	Lower Middle Blue River - Slate Creek	Lowest	Lowest	Lowest	Low	Lowest
14010002050322	Upper Nuchu Creek	Highest	Lowest	High	Low	Moderate
14010002050323	Hey Camp Creek	High	Lowest	High	Low	Moderate
14010002050324	Lower Nuchu Creek	Lowest	High	Lowest	Lowest	Lowest
14010002050325	Spring Gulch	Lowest	Low	High	Moderate	Moderate
14010002050326	Palmer Gulch	Lowest	Low	High	Low	Lowest
14010002050401	Upper Brush Creek	High	Lowest	High	Highest	Highest
14010002050402	South Brush Creek	Highest	Lowest	Moderate	Low	Moderate
14010002050403	Lower Brush Creek	Moderate	Low	Moderate	Low	Low
14010002050404	Chokecherry Gulch	Lowest	Low	Moderate	Low	Lowest
14010002050405	McKinley Gulch	Low	Highest	Moderate	Low	Moderate
14010002050406	Lonesome Gulch	Lowest	Lowest	High	Moderate	Low
14010002050407	Dole Gulch	Low	High	Moderate	Low	Moderate
14010002050408	Butler Gulch	Low	Lowest	Low	Low	Lowest
14010002050409	Inlet Green Mountain Reservoir	Lowest	Highest	Low	Low	Moderate
14010002050410	Shane Gulch	Moderate	Highest	High	Moderate	Highest
14010002050411	McDonald Gulch	Moderate	Low	Highest	High	Highest
14010002050412	Miller Gulch - Green Mountain	High	Lowest	Highest	Moderate	High
14010002050413	Headwaters Black Creek	Lowest	Lowest	Moderate	Highest	Low
14010002050414	Cliff Lake	Lowest	Lowest	High	Highest	Moderate
14010002050415	Upper South Rim Black Creek	Lowest	Lowest	Moderate	Highest	Low
14010002050416	Lower South Rim Black Creek	Moderate	Lowest	Highest	Highest	High
14010002050417	Upper Black Creek	High	Lowest	Highest	Highest	Highest
14010002050418	Middle Black Creek	Highest	Lowest	Highest	Highest	Highest
14010002050419	Lower Black Creek	Low	Low	Low	Moderate	Low
14010002050420	Cottonwood Gulch	High	Low	High	Moderate	High
14010002050421	Upper Otter Creek	Highest	Lowest	Highest	Low	High
14010002050422	Surprise Lake	Highest	Lowest	Highest	Low	High
14010002050423	UT to Otter Creek	Low	Lowest	Moderate	Low	Lowest
14010002050424	Lower Otter Creek	Moderate	Low	Low	Low	Low
14010002050425	Cox Gulch	Low	Lowest	Low	Low	Lowest
14010002050426	Headwaters Cataract Creek	Lowest	Lowest	Moderate	Highest	Low
14010002050427	Upper Cataract Creek	Moderate	Lowest	Highest	Moderate	Moderate
14010002050428	Middle Cataract Creek	Highest	Lowest	High	Moderate	High
14010002050429	Tipperary Lake	Highest	Lowest	Highest	Moderate	High
14010002050430	Lower Cataract Creek	Highest	Lowest	High	Moderate	High
14010002050431	UT to Cataract Creek	Highest	Lowest	Highest	Low	High
14010002050432	Outlet Cataract Creek	Low	High	Low	Low	Low
14010002050433	UT1 to Green Mountain Reservoir	Lowest	Highest	Lowest	Low	Low
14010002050434	Mumford Gulch	Moderate	Low	Low	Low	Low

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002050435	Horse Creek	Low	Lowest	Low	Low	Lowest
14010002050436	Cow Camp Creek	Low	Lowest	Moderate	Low	Lowest
14010002050437	Cow Camp Gulch	Moderate	Low	High	Low	Moderate
14010002050438	Heeneey - Green Mountain Reservoir	Low	Low	Low	Low	Lowest
14010002050439	UT2 to Green Mountain Reservoir	Low	Low	Low	Low	Lowest
14010002050440	Guthrie Gulch	Low	Low	Low	Low	Lowest
14010002050441	Green Mountain Reservoir	Low	High	Lowest	Low	Lowest
14010002060101	Upper Elliott Creek - Lower Blue	Low	Lowest	Moderate	Low	Lowest
14010002060102	Eaglesmere Lakes	Highest	Lowest	Moderate	Low	Moderate
14010002060103	Mahan Lake	Highest	Lowest	High	Moderate	High
14010002060104	North Fork Elliott Creek	Highest	Lowest	High	High	High
14010002060105	Middle Elliott Creek - Lower Blue	Highest	Lowest	Highest	Moderate	High
14010002060106	UT to Elliott Creek - Lower Blue	Highest	Low	High	Moderate	High
14010002060107	Martin Creek	Highest	Lowest	High	Low	Moderate
14010002060108	Lower Elliott Creek - Lower Blue	Low	High	Moderate	Low	Low
14010002060201	UT1 to South Fork Deep Creek	Highest	Low	Highest	Low	High
14010002060202	UT2 to South Fork Deep Creek	Highest	Low	High	Lowest	High
14010002060203	South Fork Deep Creek	Highest	Lowest	High	Low	High
14010002060204	UT to North Fork Deep Creek	Moderate	Moderate	High	Moderate	High
14010002060205	North Fork Deep Creek	High	Low	High	Low	Moderate
14010002060206	Lower Deep Creek	Low	Lowest	Low	Moderate	Lowest
14010002060207	Haystack Mountain	Low	High	Low	Low	Moderate
14010002060208	South Haystack Mountain	Low	High	Low	Low	Low
14010002060209	Lower Haystack Mountain	Moderate	Moderate	Lowest	Low	Low
14010002060210	North Haystack Mountain	Moderate	Low	Moderate	Low	Low
14010002060211	UT to Spring Creek	Lowest	Low	Lowest	Lowest	Lowest
14010002060212	Spring Creek	Low	Highest	Low	Lowest	Low
14010002060213	Noonan Ditch Gulch	Moderate	High	Lowest	Lowest	Low
14010002060214	Outlet Green Mountain Reservoir	High	Moderate	Low	High	High
14010002060215	Miller Gulch - Lower Blue River	Low	Highest	Lowest	Lowest	Low
14010002060216	UT to King Creek	High	Moderate	High	Low	High
14010002060217	King Creek	Low	High	Lowest	Low	Low
14010002060218	Upper Spruce Creek - Lower Blue	Highest	Moderate	Moderate	Moderate	High
14010002060219	Middle Spruce Creek	Moderate	High	Low	High	High
14010002060220	UT to North Spruce Creek	High	Low	Low	Low	Low
14010002060221	North Spruce Creek	Low	Low	Lowest	Moderate	Lowest
14010002060222	Lower Spruce Creek - Lower Blue	Moderate	Low	Lowest	Low	Lowest
14010002060223	Headwaters Lower Blue River	Low	Highest	Lowest	Lowest	Low
14010002060301	UT1 to Lower Blue River	Low	Moderate	Lowest	Lowest	Lowest
14010002060302	Upper Lower Blue River	Low	Highest	Lowest	Lowest	Lowest
14010002060303	Camp Creek - Lower Blue	Low	High	Lowest	Lowest	Low
14010002060304	Upper Harsha Gulch	Moderate	Moderate	Low	Low	Low
14010002060305	Lower Harsha Gulch	Low	High	Lowest	Moderate	Low
14010002060306	Way Reservoir	Low	High	Lowest	Lowest	Lowest
14010002060307	Middle Lower Blue River	Low	Highest	Lowest	Moderate	Moderate
14010002060308	Headwaters Beaver Creek	Moderate	Moderate	Lowest	Low	Low
14010002060309	Sheephorn Mountain	Low	Highest	Lowest	Low	Moderate
14010002060310	UT to Beaver Creek	Low	Moderate	Lowest	Lowest	Lowest

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HUC14	7th Level Watershed Name	WILDFIRE HAZARD	ROADS HAZARD	DEBRIS FLOW HAZARD	HILLSLOPE EROSION	POST-FIRE COMPOSITE HAZARD
14010002060311	Noonan Ranch	Low	High	Lowest	Lowest	Lowest
14010002060312	Beaver Creek	Low	Moderate	Lowest	Low	Lowest
14010002060313	UT to Lower Blue River	Low	High	Lowest	Low	Lowest
14010002060314	Upper Elliott Creek - Outlet Blue	Moderate	Highest	Lowest	High	High
14010002060315	Lawson Ridge	Moderate	Highest	Lowest	High	Moderate
14010002060316	Middle Elliott Creek - Outlet Blue	Low	Highest	Lowest	Highest	Moderate
14010002060317	Lower Elliott Creek - Outlet Blue	Moderate	Highest	Lowest	Moderate	Moderate
14010002060318	Dry Creek	Low	Moderate	Lowest	Low	Lowest
14010002060319	Lower Lower Blue River	Low	High	Lowest	Low	Lowest
14010002060320	UT to Outlet Lower Blue River	Low	Highest	Lowest	Moderate	Moderate

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HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002010101	Bemrose Creek	Lowest	Lowest	Lowest	High	High	Highest	Low	Moderate
14010002010102	Upper Headwaters Blue River	High	Highest	Low	High	Highest	Highest	High	Highest
14010002010103	Upper Monte Cristo Creek	Lowest	Lowest	Lowest	Lowest	Lowest	Low	Lowest	Lowest
14010002010104	Crystal Lake	Lowest	Low	Lowest	Lowest	Highest	Highest	Low	Low
14010002010105	Lower Monte Cristo Creek	Low	Highest	Low	Lowest	Moderate	Highest	Lowest	Moderate
14010002010106	UT to Middle Headwaters Blue River	Low	Low	Low	High	High	Highest	Low	High
14010002010107	Upper McCullough Gulch	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002010108	Lower McCullough Gulch	Lowest	Moderate	Low	Lowest	Low	High	Lowest	Lowest
14010002010109	Middle Headwaters Blue River	Highest	Highest	High	Highest	Highest	Highest	Moderate	Highest
14010002010110	UT1 to Lower Headwaters Blue River	High	High	Low	High	High	Highest	Lowest	Highest
14010002010111	Fredonia Gulch	Moderate	Low	Low	Highest	High	Highest	Lowest	High
14010002010112	Lower Headwaters Blue River	Highest	Highest	High	High	Highest	High	Moderate	Highest
14010002010113	Upper Pennsylvania Creek	Lowest	Lowest	Lowest	Lowest	Low	Moderate	Low	Lowest
14010002010114	Lower Pennsylvania Creek	Moderate	Low	Moderate	High	Highest	Highest	Low	High
14010002010115	Upper Spruce Creek - Headwaters Blue	Lowest	Lowest	Lowest	Lowest	Low	High	Lowest	Lowest
14010002010116	Crystal Creek	Lowest	Lowest	Lowest	Lowest	Moderate	High	Lowest	Lowest
14010002010117	Lower Spruce Creek - Headwaters Blue	Moderate	Low	High	High	High	High	Moderate	Highest
14010002010118	UT to Upper Indiana Creek	Low	Lowest	Low	High	High	Highest	Low	Moderate
14010002010119	Upper Indiana Creek	Low	Low	Lowest	Moderate	High	High	Moderate	Moderate
14010002010120	UT to Middle Indiana Creek	Lowest	Lowest	Lowest	Moderate	High	Highest	Low	Low
14010002010121	Middle Indiana Creek	Low	Lowest	Low	High	High	Highest	Low	Moderate
14010002010122	Lower Indiana Creek	High	Moderate	Highest	High	Moderate	Moderate	Moderate	Highest
14010002010123	Goose Pasture Tarn	Highest	Highest	High	High	Low	Low	Moderate	High
14010002010201	Illinois Gulch	Highest	Highest	High	High	Highest	Highest	Moderate	Highest
14010002010202	Lehman Gulch	Lowest	Low	Low	Low	Moderate	Moderate	Low	Lowest
14010002010203	Headwaters Upper Blue River	Highest	Highest	Highest	High	High	Low	Highest	Highest
14010002010204	Sawmill Gulch	Lowest	Moderate	Low	Lowest	Moderate	High	Low	Lowest
14010002010205	Headwaters French Gulch	Lowest	Lowest	Lowest	Lowest	High	Highest	Lowest	Lowest
14010002010206	Upper French Gulch	Moderate	Low	Low	Highest	Highest	Highest	Low	High
14010002010207	Middle French Gulch	High	Low	High	Highest	Moderate	Moderate	Moderate	High
14010002010208	Lower French Gulch	Highest	High	Highest	Highest	Moderate	Moderate	Moderate	Highest
14010002010209	Outlet French Gulch	High	Highest	Highest	Lowest	Moderate	Lowest	High	High
14010002010210	Cucumber Creek Gulch	High	Highest	High	High	Moderate	Low	High	High
14010002010211	Upper Upper Blue River	Highest	Highest	High	High	Highest	Low	Highest	Highest
14010002010301	Upper South Fork Swan River	Low	Lowest	Moderate	High	Highest	Highest	Low	Highest
14010002010302	Lower South Fork Swan River	High	Lowest	Highest	Highest	Moderate	High	Low	High
14010002010303	Headwaters Middle Fork Swan River	Lowest	Lowest	Lowest	Lowest	Low	High	Lowest	Lowest
14010002010304	UT to Upper Middle Fork Swan River	Low	Lowest	Low	High	High	Highest	Lowest	Moderate
14010002010305	Upper Middle Fork Swan River	Lowest	Lowest	Lowest	Low	Low	Moderate	Lowest	Lowest
14010002010306	Missouri Gulch	Moderate	Lowest	Moderate	Highest	Highest	Highest	Low	Highest
14010002010307	Lower Middle Fork Swan River	Highest	Low	Highest	Highest	Lowest	Moderate	Lowest	Moderate
14010002010308	Georgia Gulch	Moderate	Low	High	Moderate	Low	Moderate	Moderate	Moderate
14010002010309	Upper North Fork Swan River	Low	Lowest	Low	High	Moderate	High	Low	Lowest
14010002010310	Garibaldi Gulch	Low	Lowest	Low	Highest	Highest	Highest	Low	High
14010002010311	UT1 to Lower North Fork Swan River	Moderate	Lowest	Moderate	Highest	High	Moderate	Moderate	Moderate
14010002010312	UT2 to Lower North Fork Swan River	Moderate	Lowest	Moderate	Highest	Moderate	High	Low	Moderate
14010002010313	Lower North Fork Swan River	High	Low	High	Highest	Low	Moderate	Low	Moderate
14010002010314	Upper Swan River	Highest	Low	Highest	Highest	Lowest	Low	Low	Moderate
14010002010315	Brown Gulch	Lowest	Lowest	High	Lowest	Moderate	Moderate	Moderate	Lowest
14010002010316	Muggins Gulch	High	Lowest	Highest	Highest	Lowest	Low	Low	Moderate
14010002010317	Middle Swan River	Highest	Low	Highest	Highest	Lowest	Low	Moderate	Moderate
14010002010318	Horseshoe Gulch	Highest	Low	Highest	Highest	Moderate	Lowest	High	High
14010002010319	Lower Swan River	Highest	Highest	Highest	Highest	Low	Lowest	High	High
14010002010320	Upper Gold Run Gulch	High	Moderate	Highest	Moderate	High	Low	High	High
14010002010321	Lower Gold Run Gulch	High	Highest	High	Lowest	High	Low	Highest	Highest
14010002010322	Outlet Swan River	Highest	Highest	Highest	High	Moderate	Low	High	Highest
14010002010401	South Barton Gulch	Highest	High	Highest	High	Moderate	Low	Moderate	Highest
14010002010402	Middle Barton Gulch	High	Moderate	Highest	Moderate	Low	Low	Moderate	Moderate
14010002010403	North Barton Gulch	Low	Low	Moderate	Moderate	Low	Lowest	High	Lowest
14010002010404	Middle Upper Blue River	Highest	Highest	High	Moderate	Highest	Low	Highest	Highest
14010002010405	Lower Upper Blue River	High	Highest	High	Low	High	Lowest	Highest	Highest
14010002010406	Tiger Run	Highest	High	Highest	Moderate	Moderate	Low	High	Highest

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HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002010407	South Swan Mountain	Highest	High	Highest	Moderate	Low	Low	Moderate	Moderate
14010002010408	Gold Hill	Moderate	High	High	Low	High	Lowest	Highest	High
14010002010409	Ophir Mountain	Highest	Highest	High	Moderate	Low	Lowest	High	High
14010002010410	West Swan Mountain	Highest	Highest	Highest	Moderate	Low	Low	Moderate	High
14010002010411	Outlet Upper Blue River	Highest	Highest	High	Moderate	Moderate	Lowest	Highest	Highest
14010002020101	Lenawee - Arapahoe Basin	Lowest	High	Lowest	Lowest	Low	High	Lowest	Lowest
14010002020102	Headwaters North Fork Snake River	Moderate	Highest	Lowest	Moderate	Moderate	High	Lowest	Moderate
14010002020103	Upper North Fork Snake River	High	Highest	Moderate	Moderate	Moderate	Highest	Lowest	High
14010002020104	UT to Middle North Fork Snake River	Low	Low	Low	Moderate	Moderate	High	Low	Low
14010002020105	Middle North Fork Snake River	Highest	Highest	High	Highest	Moderate	Highest	Lowest	Highest
14010002020106	Upper Porcupine Gulch	Lowest	Lowest	Low	Low	High	High	Low	Low
14010002020107	Lower Porcupine Gulch	Highest	Moderate	High	Highest	Low	Moderate	Low	High
14010002020108	Lower North Fork Snake River	Highest	Highest	Highest	Highest	Low	Moderate	Low	Highest
14010002020201	Upper Deer Creek	Lowest	Lowest	Lowest	Lowest	High	Moderate	Moderate	Lowest
14010002020202	UT to Lower Deer Creek	Lowest	Lowest	Lowest	Moderate	High	Highest	Low	Low
14010002020203	Lower Deer Creek	Moderate	Low	Low	Highest	High	Highest	Low	High
14010002020204	Headwaters Snake River	Lowest	Lowest	Lowest	Low	Moderate	Moderate	Low	Lowest
14010002020205	Upper Upper Snake River	Lowest	Lowest	Lowest	Low	Moderate	Highest	Lowest	Lowest
14010002020206	Lower Upper Snake River	Moderate	Moderate	Low	Highest	Moderate	Highest	Low	High
14010002020207	Saints John Creek	Lowest	Low	Lowest	Moderate	Moderate	High	Low	Lowest
14010002020208	Upper Middle Snake River	High	Moderate	Moderate	Highest	Moderate	High	Low	High
14010002020209	Upper Peru Creek	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002020210	Cinnamon Gulch	Lowest	Low	Lowest	Lowest	High	Highest	Lowest	Lowest
14010002020211	Wardon Gulch	Low	Low	Lowest	High	High	Highest	Lowest	High
14010002020212	Middle Peru Creek	Lowest	Low	Lowest	Lowest	Lowest	Low	Lowest	Lowest
14010002020213	Upper Chihuahua Gulch	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002020214	Lower Chihuahua Gulch	Lowest	Low	Lowest	Low	Low	Moderate	Lowest	Lowest
14010002020215	Lower Peru Creek	High	Low	High	Highest	Low	Moderate	Lowest	Moderate
14010002020216	Thurman Gulch	Lowest	Lowest	Low	Moderate	Low	Moderate	Lowest	Lowest
14010002020217	Grizzly Gulch	Moderate	Lowest	Low	Highest	High	Highest	Lowest	High
14010002020218	Porcupine Mountain	Moderate	Lowest	Low	Highest	Low	High	Low	Low
14010002020219	Lower Middle Snake River	High	Low	High	Highest	Lowest	Low	Lowest	Low
14010002020220	Independence Mountain	Moderate	Lowest	High	Highest	Moderate	Highest	Lowest	Moderate
14010002020221	UT to Lower Snake River	Moderate	Lowest	Moderate	Highest	High	Highest	Lowest	High
14010002020222	Jones Gulch	Moderate	Lowest	Moderate	Highest	Highest	Highest	Low	Highest
14010002020223	Lower Snake River	Highest	High	Highest	Highest	Lowest	Low	Lowest	Moderate
14010002030101	Camp Creek - Snake River	High	Highest	Lowest	Highest	High	High	Moderate	Highest
14010002030201	UT1 to Outlet Snake River	Highest	High	High	Highest	Moderate	Low	Moderate	Highest
14010002030301	UT2 to Outlet Snake River	Highest	Moderate	Highest	Highest	Low	Low	Moderate	High
14010002030401	UT3 to Outlet Snake River	Highest	Moderate	Highest	Highest	Low	Low	Moderate	High
14010002030501	Upper Keystone Gulch	Moderate	Low	Low	Highest	Highest	Highest	Low	Highest
14010002030601	Keystone Mountain	Moderate	Lowest	Low	Highest	High	High	Low	Moderate
14010002030701	Middle Keystone Gulch	High	Moderate	Moderate	Highest	Low	Moderate	Low	High
14010002030801	Lower Keystone Gulch	Highest	Moderate	Highest	Highest	Low	Moderate	Low	Moderate
14010002030901	Frey Gulch	Highest	Low	Highest	Highest	Low	Moderate	Moderate	High
14010002030101	Outlet Snake River	Highest	Highest	High	Moderate	Lowest	Lowest	Moderate	Moderate
14010002030101	Glory Hole - Climax	Lowest	Moderate	Lowest	Lowest	High	Highest	Lowest	Lowest
14010002030102	McNully Creek	Lowest	Moderate	Lowest	Lowest	Moderate	Moderate	Moderate	Lowest
14010002030103	Upper Robinson Lake	Low	Highest	Lowest	Lowest	Highest	High	High	High
14010002030104	Lower Robinson Lake	Low	Highest	Lowest	Lowest	Moderate	Low	High	Low
14010002030105	Headwaters Tenmile Creek	Lowest	Low	Lowest	Low	High	Moderate	Moderate	Low
14010002030106	Upper Seattle Gulch	Lowest	Lowest	Lowest	Lowest	Low	Low	Moderate	Lowest
14010002030107	Lower Seattle Gulch	Lowest	Low	Lowest	Low	Low	Moderate	Low	Lowest
14010002030108	Upper Clinton Creek	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002030109	Lower Clinton Creek	High	Highest	Low	High	Highest	Highest	Moderate	Highest
14010002030110	Rose Gulch	High	Highest	Low	High	Lowest	Low	Low	Low
14010002030111	Upper Mayflower Creek	Lowest	Lowest	Lowest	Lowest	Low	Moderate	Lowest	Lowest
14010002030112	Lower Mayflower Creek	High	Highest	Moderate	High	Highest	Highest	Moderate	Highest
14010002030201	Headwaters West Tenmile Creek	Low	Highest	Low	Lowest	Highest	Low	Highest	High
14010002030202	Wilder Gulch	Low	Moderate	Low	Moderate	High	Moderate	Moderate	Moderate
14010002030203	Corral Creek	Moderate	Highest	Low	Low	High	Moderate	Moderate	Moderate
14010002030204	Upper Stafford Creek	Lowest	Lowest	Low	Low	High	High	Moderate	Low

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HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002030205	Lower Stafford Creek	Highest	High	High	High	High	High	Low	Highest
14010002030206	Upper West Tenmile Creek	Moderate	Highest	Moderate	Low	Highest	High	Highest	Highest
14010002030207	UT to Lower West Tenmile Creek	Highest	Highest	Low	High	Low	Low	Moderate	High
14010002030208	Jacque Creek	Lowest	Lowest	Low	Lowest	Highest	Highest	Low	Moderate
14010002030209	Guller Creek	Moderate	Low	Low	High	High	Highest	Low	High
14010002030210	Union Gulch	High	High	Low	Highest	Highest	Highest	High	Highest
14010002030211	Wheeler Gulch	Low	High	Lowest	Low	Highest	Highest	Low	Highest
14010002030212	Lower West Tenmile Creek	Highest	Highest	High	High	Low	Low	Moderate	Highest
14010002030301	Tucker Gulch	Lowest	Lowest	Lowest	Lowest	Lowest	Low	Lowest	Lowest
14010002030302	Humbug Creek	Lowest	Low	Lowest	Lowest	Highest	Highest	Low	Low
14010002030303	Copper Creek	Low	Lowest	Moderate	Low	Low	Moderate	Low	Lowest
14010002030304	West Crystal Peak	Lowest	Lowest	Lowest	Lowest	High	Highest	Lowest	Low
14010002030305	North Crystal Peak	Low	Lowest	Low	High	High	Highest	Lowest	Moderate
14010002030306	Upper Upper Tenmile Creek	Highest	Highest	Moderate	High	Low	Moderate	Low	Moderate
14010002030307	Spaulding Gulch	Moderate	High	Moderate	Moderate	High	High	Low	High
14010002030308	Lower Upper Middle Tenmile Creek	Low	Low	Low	High	Highest	Highest	Low	High
14010002030309	UT to Middle Middle Tenmile Creek	Low	Lowest	Low	Highest	Highest	Highest	Low	High
14010002030310	Middle Middle Tenmile Creek	Highest	Highest	Moderate	Highest	Moderate	High	Low	Highest
14010002030311	Upper Lower Middle Tenmile Creek	Highest	Highest	High	Highest	Lowest	Moderate	Lowest	High
14010002030312	Lower Lower Middle Tenmile Creek	Highest	Highest	High	Highest	Lowest	Moderate	Lowest	High
14010002030313	Outlet Middle Tenmile Creek	Moderate	High	Low	Moderate	Low	High	Lowest	Lowest
14010002030401	Curtain Ponds	Highest	Highest	Highest	Highest	Lowest	Low	Lowest	Moderate
14010002030402	UT to Upper Lower Tenmile Creek	Moderate	Highest	Low	Low	Low	Highest	Lowest	Low
14010002030403	Upper Officers Gulch	Lowest	Lowest	Low	Lowest	High	High	Low	Lowest
14010002030404	Lower Officers Gulch	Highest	Highest	Highest	Highest	Lowest	Low	Low	High
14010002030405	Upper Lower Tenmile Creek	Highest	Highest	Highest	Moderate	Lowest	Moderate	Lowest	Low
14010002030406	Uneva Lake	Highest	Highest	Highest	Highest	Lowest	Low	Low	High
14010002030407	Upper North Tenmile Creek	Lowest	Lowest	Low	Lowest	High	Highest	Low	Low
14010002030408	UT to Middle North Tenmile Creek	Lowest	Lowest	Low	Lowest	Low	High	Lowest	Lowest
14010002030409	Uneva Peak	Lowest	Lowest	Low	Low	Highest	Highest	Low	Moderate
14010002030410	Middle North Tenmile Creek	Low	Lowest	Moderate	Moderate	Moderate	High	Low	Low
14010002030411	UT to Lower North Tenmile Creek	Low	Lowest	Low	High	High	High	Low	Moderate
14010002030412	Lower North Tenmile Creek	Highest	High	Highest	Highest	Lowest	Low	Lowest	Moderate
14010002030413	Lower Lower Tenmile Creek	Highest	Highest	High	Moderate	Lowest	Low	Lowest	Low
14010002040101	Upper Miners Creek	Moderate	Lowest	Moderate	Highest	Lowest	Low	Low	Lowest
14010002040102	Lower Miners Creek	Highest	Low	Highest	Highest	Low	Moderate	Low	High
14010002040103	Masontown	Highest	Highest	Highest	Highest	Lowest	Low	Low	Moderate
14010002040104	Upper Meadow Creek	Lowest	Lowest	Low	Lowest	Low	Moderate	Low	Lowest
14010002040105	UT to Meadow Creek	Lowest	Lowest	Moderate	Low	Lowest	Moderate	Low	Lowest
14010002040106	Lower Meadow Creek	High	Highest	Moderate	High	High	Lowest	Highest	Highest
14010002040107	North Ophir Mountain	Highest	Highest	High	Moderate	Low	Lowest	High	High
14010002040108	North Swan Mountain	Highest	Highest	Highest	Moderate	High	High	Moderate	Highest
14010002040109	Soda Gulch	Highest	Highest	High	Moderate	Moderate	Lowest	High	High
14010002040110	Upper Soda Creek	Highest	Lowest	Highest	Highest	Low	Low	Moderate	Moderate
14010002040111	UT to Soda Creek	Highest	Low	Highest	Highest	Moderate	Low	Moderate	High
14010002040112	Middle Soda Creek	Highest	High	Highest	Highest	Low	Lowest	High	High
14010002040113	Lower Soda Creek	Highest	Highest	High	Moderate	Moderate	Lowest	High	Highest
14010002040114	South Tenderfoot Mountain	Highest	Highest	High	High	Lowest	Lowest	Moderate	Moderate
14010002040115	Tenderfoot Mountain	Highest	High	Highest	Highest	Lowest	Lowest	Moderate	Moderate
14010002040116	North Tenderfoot Mountain	Highest	Highest	Highest	Highest	Lowest	Lowest	Low	Moderate
14010002040117	Dillon Reservoir	Highest	Highest	High	Moderate	Moderate	Lowest	Highest	High
14010002050101	Headwaters Straight Creek	Moderate	Highest	Lowest	Low	High	Highest	Lowest	High
14010002050102	Coon Hill	Moderate	Highest	Lowest	Low	Moderate	Highest	Low	Moderate
14010002050103	Hamilton Gulch	High	Highest	Low	High	High	Highest	Low	Highest
14010002050104	Upper Straight Creek	Highest	Highest	High	High	Moderate	Highest	Lowest	Highest
14010002050105	UT to Straight Creek	High	Moderate	Moderate	Highest	High	Highest	Low	Highest
14010002050106	Middle Straight Creek	Highest	Highest	High	Highest	Low	Moderate	Low	High
14010002050107	UT to Laskey Gulch	High	Low	Moderate	Highest	Low	Moderate	Low	Moderate
14010002050108	Laskey Gulch	High	Moderate	Moderate	Highest	Moderate	Moderate	Low	High
14010002050109	Lower Straight Creek	Highest	Highest	Highest	Moderate	Lowest	Moderate	Low	Moderate
14010002050110	Dillon Valley	Highest	Highest	High	Moderate	Lowest	Lowest	Moderate	Moderate
14010002050111	Outlet Dillon Reservoir	Moderate	Highest	Moderate	Lowest	Moderate	Lowest	Highest	High

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HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002050112	Upper Salt Lick Gulch	Moderate	Moderate	Moderate	Moderate	Low	Low	Moderate	Low
14010002050113	Ryan Gulch	High	Highest	Moderate	Moderate	High	Lowest	Highest	Highest
14010002050114	Lower Salt Lick Gulch	Highest	Highest	High	Moderate	High	Lowest	Highest	Highest
14010002050115	Silverthorne	Highest	Highest	High	Moderate	High	Lowest	Highest	Highest
14010002050116	Upper North Willow Creek	Lowest	Lowest	Lowest	Lowest	Moderate	Highest	Lowest	Lowest
14010002050117	Lower North Willow Creek	Low	Lowest	High	Moderate	Low	Moderate	Low	Low
14010002050118	Middle Willow Creek	Moderate	Lowest	High	High	High	Moderate	Moderate	High
14010002050119	Upper South Willow Creek	Lowest	Lowest	Lowest	Lowest	High	Highest	Low	Low
14010002050120	Middle South Willow Creek	Lowest	Lowest	Low	Low	Lowest	Moderate	Lowest	Lowest
14010002050121	Lower South Willow Creek	Highest	Moderate	Highest	Highest	Highest	Moderate	Highest	Highest
14010002050122	Outlet Willow Creek	High	Highest	Moderate	Moderate	High	Lowest	Highest	Highest
14010002050123	Blue River Ranch Lakes	Highest	Highest	High	Moderate	Low	Lowest	High	High
14010002050124	Hamilton Creek	Highest	Highest	Highest	Moderate	Lowest	Lowest	Moderate	Moderate
14010002050125	UT to Middle Blue River - Straight Creek	High	Moderate	Highest	Moderate	High	Low	Highest	Highest
14010002050126	Middle Blue River - Straight Creek	Highest	Highest	High	High	High	Lowest	Highest	Highest
14010002050127	Upper Bushee Creek	Moderate	Lowest	Moderate	Highest	High	Highest	Low	High
14010002050128	Middle Bushee Creek	Low	Lowest	High	Moderate	Lowest	Lowest	Low	Lowest
14010002050129	UT1 to Bushee Creek	High	Lowest	Highest	Highest	Low	Moderate	Low	Moderate
14010002050130	UT2 to Bushee Creek	Moderate	Lowest	High	Moderate	Moderate	High	Low	Moderate
14010002050131	Lower Bushee Creek	High	Moderate	Highest	Moderate	Lowest	Lowest	Moderate	Low
14010002050201	Upper Middle Blue River - Rock Creek	High	Highest	High	Low	Moderate	Lowest	Highest	High
14010002050202	UT1 to Middle Blue River - Rock Creek	High	Low	Highest	Moderate	Highest	Low	Highest	Highest
14010002050203	Maryland Creek	Moderate	Low	High	High	Moderate	Lowest	High	Moderate
14010002050204	Middle Middle Blue River - Rock Creek	Moderate	Moderate	Moderate	Low	Lowest	Lowest	Moderate	Lowest
14010002050205	UT2 to Middle Blue River - Rock Creek	High	Low	Highest	High	Lowest	Lowest	Low	Low
14010002050206	Pioneer Creek	Moderate	Moderate	High	Moderate	Lowest	Lowest	Moderate	Lowest
14010002050207	Upper South Rock Creek	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002050208	Middle South Rock Creek	Low	Lowest	Moderate	Moderate	Moderate	Moderate	Moderate	Low
14010002050209	Headwaters North Rock Creek	Lowest	Lowest	Lowest	Lowest	Moderate	Highest	Lowest	Lowest
14010002050210	Upper North Rock Creek	Lowest	Lowest	Low	Lowest	Lowest	Moderate	Lowest	Lowest
14010002050211	Middle North Rock Creek	Moderate	Lowest	High	High	Low	Moderate	Moderate	Low
14010002050212	Lower North Rock Creek	Highest	High	Highest	Moderate	High	Moderate	High	Highest
14010002050213	Lower South Rock Creek	High	Lowest	Highest	High	Highest	Moderate	Highest	Highest
14010002050214	Lower Middle Blue River - Rock Creek	High	Highest	High	Low	Low	Lowest	High	Moderate
14010002050215	Quaking Asp Creek	Moderate	Moderate	Moderate	Moderate	Lowest	Lowest	Moderate	Low
14010002050216	Pebble Creek	Highest	High	Highest	Moderate	Low	Lowest	High	High
14010002050217	Headwaters Boulder Creek	Lowest	Lowest	Lowest	Lowest	Low	High	Lowest	Lowest
14010002050218	UT to Boulder Creek	Lowest	Lowest	Low	Lowest	High	Highest	Lowest	Lowest
14010002050219	Upper Boulder Creek	Lowest	Lowest	Low	Low	Moderate	Highest	Lowest	Lowest
14010002050220	Middle Boulder Creek	Moderate	Lowest	Highest	High	Moderate	Moderate	Low	Moderate
14010002050221	Lower Boulder Creek	Moderate	Low	High	High	Low	Low	Moderate	Low
14010002050301	Upper Middle Blue River - Slate Creek	High	Highest	Moderate	Moderate	Moderate	Lowest	High	High
14010002050302	Harrigan Creek	Moderate	Lowest	Highest	Low	High	Lowest	Highest	High
14010002050303	Bordoux Gulch	High	Highest	High	Moderate	Moderate	Lowest	Highest	High
14010002050304	North Acorn Creek	Moderate	Lowest	High	Moderate	Lowest	Lowest	Low	Lowest
14010002050305	Upper Acorn Creek	High	Lowest	Highest	Highest	Lowest	Low	Low	Low
14010002050306	Lower Acorn Creek	Moderate	High	Moderate	Low	High	Lowest	Highest	Moderate
14010002050307	Headwaters Slate Lake	Lowest	Lowest	Lowest	Lowest	Lowest	Low	Lowest	Lowest
14010002050308	Slate Lake	Lowest	Lowest	Lowest	Lowest	Lowest	High	Lowest	Lowest
14010002050309	Upper Slate Creek	Lowest	Lowest	Lowest	Lowest	Lowest	Moderate	Lowest	Lowest
14010002050310	UT to Slate Creek	Lowest	Lowest	Low	Low	Moderate	Highest	Lowest	Lowest
14010002050311	Middle Slate Creek	Moderate	Lowest	Highest	High	Lowest	Low	Low	Lowest
14010002050312	Lower Slate Creek	Moderate	Lowest	High	Moderate	Moderate	Lowest	High	Low
14010002050313	Upper Big Gulch	Low	Lowest	High	Moderate	Lowest	Lowest	Low	Lowest
14010002050314	Lower Big Gulch	Low	Highest	Lowest	Low	Highest	Moderate	Highest	Highest
14010002050315	Middle Middle Blue River - Slate Creek	Moderate	Highest	Low	Low	High	Lowest	Highest	Moderate
14010002050316	Berry Gulch	High	Lowest	Highest	Highest	Lowest	Low	Low	Moderate
14010002050317	Hole Creek	Moderate	Lowest	Highest	Highest	Lowest	Lowest	Lowest	Lowest
14010002050318	Pasture Creek	Moderate	Lowest	High	High	Lowest	Lowest	Low	Lowest
14010002050319	Pass Creek	Low	Low	High	Low	Lowest	Lowest	Low	Lowest
14010002050320	Miller Gulch - Middle Blue River	Moderate	Lowest	High	High	Lowest	Lowest	Low	Lowest
14010002050321	Lower Middle Blue River - Slate Creek	High	Highest	Moderate	Low	Moderate	Lowest	High	High

BLUE RIVER WRAP - WATERSHED HAZARD ASSESSMENT - APPENDIX C

HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002050322	Upper Nuchu Creek	Moderate	Lowest	Highest	High	Moderate	Low	High	Moderate
14010002050323	Hey Camp Creek	Moderate	Lowest	Highest	Moderate	High	Low	High	High
14010002050324	Lower Nuchu Creek	Low	Moderate	Moderate	Low	High	Lowest	Highest	Moderate
14010002050325	Spring Gulch	Low	Low	Low	Moderate	Lowest	Lowest	Low	Lowest
14010002050326	Palmer Gulch	Moderate	High	High	Low	Lowest	Lowest	Moderate	Lowest
14010002050401	Upper Brush Creek	Lowest	Lowest	Low	Lowest	High	Highest	Low	Low
14010002050402	South Brush Creek	High	Lowest	Highest	Highest	Moderate	Lowest	Highest	High
14010002050403	Lower Brush Creek	High	Moderate	Highest	High	Moderate	Lowest	Highest	High
14010002050404	Chokecherry Gulch	Lowest	Moderate	Lowest	Lowest	Low	Low	Moderate	Lowest
14010002050405	McKinley Gulch	Moderate	Lowest	High	High	High	Lowest	Highest	High
14010002050406	Lonesome Gulch	High	Moderate	High	High	Lowest	Lowest	Low	Lowest
14010002050407	Dole Gulch	Moderate	Lowest	Highest	Moderate	Highest	Low	Highest	Highest
14010002050408	Butler Gulch	Moderate	Low	High	Moderate	Moderate	Lowest	Highest	Moderate
14010002050409	Inlet Green Mountain Reservoir	High	Highest	Moderate	Low	Moderate	Low	High	High
14010002050410	Shane Gulch	Highest	High	High	High	Lowest	Lowest	Low	Low
14010002050411	McDonald Gulch	Highest	Highest	Highest	High	Lowest	Lowest	Lowest	Moderate
14010002050412	Miller Gulch - Green Mountain	Highest	High	Highest	High	Lowest	Lowest	Lowest	Low
14010002050413	Headwaters Black Creek	Lowest	Lowest	Lowest	Lowest	Low	High	Lowest	Lowest
14010002050414	Cliff Lake	Lowest	Lowest	Lowest	Lowest	Low	Highest	Lowest	Lowest
14010002050415	Upper South Rim Black Creek	Lowest	Lowest	Lowest	Lowest	Low	High	Lowest	Lowest
14010002050416	Lower South Rim Black Creek	Lowest	Lowest	Low	Lowest	Moderate	Highest	Lowest	Lowest
14010002050417	Upper Black Creek	Low	Lowest	Moderate	Moderate	Low	High	Lowest	Lowest
14010002050418	Middle Black Creek	High	Lowest	Highest	Highest	Lowest	Low	Low	Lowest
14010002050419	Lower Black Creek	Moderate	Low	High	Low	Low	Low	Moderate	Low
14010002050420	Cottonwood Gulch	High	High	Highest	Moderate	Lowest	Lowest	Low	Lowest
14010002050421	Upper Otter Creek	Low	Lowest	Moderate	Moderate	Low	Moderate	Low	Lowest
14010002050422	Surprise Lake	Moderate	Lowest	High	Highest	High	Moderate	High	Highest
14010002050423	UT to Otter Creek	Moderate	Lowest	Highest	High	Highest	Low	Highest	Highest
14010002050424	Lower Otter Creek	Moderate	Lowest	High	High	Low	Lowest	High	Moderate
14010002050425	Cox Gulch	Moderate	High	Moderate	Low	Moderate	Moderate	Moderate	Moderate
14010002050426	Headwaters Cataract Creek	Lowest	Lowest	Lowest	Lowest	High	Highest	Lowest	Low
14010002050427	Upper Cataract Creek	Lowest	Lowest	Lowest	Lowest	High	Highest	Lowest	Low
14010002050428	Middle Cataract Creek	Low	Lowest	Moderate	Moderate	Moderate	Moderate	Moderate	Low
14010002050429	Tipperary Lake	Lowest	Lowest	Low	Lowest	Moderate	Highest	Lowest	Lowest
14010002050430	Lower Cataract Creek	High	Lowest	Highest	High	Lowest	Low	Moderate	Low
14010002050431	UT to Cataract Creek	High	Lowest	Highest	Highest	Highest	Highest	High	Highest
14010002050432	Outlet Cataract Creek	Low	Low	High	Lowest	Low	Lowest	High	Lowest
14010002050433	UT1 to Green Mountain Reservoir	Low	Moderate	Moderate	Lowest	Moderate	Low	Highest	Low
14010002050434	Mumford Gulch	Moderate	Moderate	High	Moderate	Lowest	Lowest	Moderate	Lowest
14010002050435	Horse Creek	Low	High	Lowest	Low	Moderate	Moderate	Moderate	Low
14010002050436	Cow Camp Creek	Low	Moderate	Lowest	Moderate	Moderate	Moderate	Moderate	Low
14010002050437	Cow Camp Gulch	Low	Moderate	Moderate	Low	Highest	Moderate	High	High
14010002050438	Heaney - Green Mountain Reservoir	Moderate	Low	High	High	High	Lowest	Highest	High
14010002050439	UT2 to Green Mountain Reservoir	Moderate	Moderate	High	Moderate	Moderate	Lowest	Highest	Moderate
14010002050440	Guthrie Gulch	Moderate	Low	High	Moderate	High	Low	Highest	Moderate
14010002050441	Green Mountain Reservoir	Moderate	Highest	Moderate	Lowest	High	Moderate	High	High
14010002060101	Upper Elliott Creek - Lower Blue	Lowest	Lowest	Lowest	Moderate	Highest	Highest	High	Moderate
14010002060102	Eaglesmere Lakes	Lowest	Lowest	Moderate	Lowest	Highest	High	Highest	Moderate
14010002060103	Mahan Lake	Low	Lowest	Low	High	Highest	High	High	High
14010002060104	North Fork Elliott Creek	Low	Lowest	Moderate	Moderate	Highest	High	Highest	Highest
14010002060105	Middle Elliott Creek - Lower Blue	Moderate	Lowest	High	Highest	High	Moderate	Moderate	High
14010002060106	UT to Elliott Creek - Lower Blue	High	Lowest	Highest	Highest	High	Moderate	High	Highest
14010002060107	Martin Creek	High	Lowest	Highest	High	Highest	Low	Highest	Highest
14010002060108	Lower Elliott Creek - Lower Blue	Low	Low	High	Low	Moderate	Low	High	Low
14010002060201	UT1 to South Fork Deep Creek	Moderate	Low	Moderate	Highest	Highest	Highest	Highest	Highest
14010002060202	UT2 to South Fork Deep Creek	Low	Low	Highest	Lowest	Highest	Low	Highest	High
14010002060203	South Fork Deep Creek	Moderate	Lowest	Highest	Moderate	Highest	Low	Highest	Highest
14010002060204	UT to North Fork Deep Creek	Moderate	Low	High	High	Low	Lowest	High	Low
14010002060205	North Fork Deep Creek	High	Low	Highest	Moderate	Moderate	Low	High	High
14010002060206	Lower Deep Creek	Moderate	Low	Moderate	Moderate	Low	Lowest	Moderate	Lowest
14010002060207	Haystack Mountain	Low	High	Lowest	Moderate	Highest	High	High	High
14010002060208	South Haystack Mountain	Lowest	Moderate	Lowest	Lowest	Highest	High	High	Moderate

BLUE RIVER WRAP - WATERSHED HAZARD ASSESSMENT - APPENDIX C

HUC14	7th Level Watershed Name	ECOSYSTEM SENSITIVITY	Landscape Condition	Forest Resilience	Insect & Disease	ADAPTIVE LIMITATION	Vegetation Type Diversity	Topo-Climatic Variability	WATERSHED VULNERABILITY
14010002060209	Lower Haystack Mountain	Moderate	Highest	High	Lowest	Highest	Moderate	Highest	Highest
14010002060210	North Haystack Mountain	High	High	High	Moderate	Moderate	Low	High	High
14010002060211	UT to Spring Creek	Low	Lowest	High	Moderate	High	Lowest	Highest	Moderate
14010002060212	Spring Creek	Moderate	Moderate	High	Moderate	High	Lowest	Highest	High
14010002060213	Noonan Ditch Gulch	Lowest	Moderate	Lowest	Lowest	Highest	Highest	Highest	Moderate
14010002060214	Outlet Green Mountain Reservoir	Moderate	Low	Moderate	High	Lowest	Lowest	Low	Lowest
14010002060215	Miller Gulch - Lower Blue River	Low	Highest	Lowest	Lowest	Highest	Highest	Highest	High
14010002060216	UT to King Creek	Low	Lowest	Moderate	Moderate	Lowest	Lowest	Moderate	Lowest
14010002060217	King Creek	Low	High	Lowest	Low	Highest	High	High	High
14010002060218	Upper Spruce Creek - Lower Blue	Highest	Low	Highest	Highest	Moderate	Lowest	High	Highest
14010002060219	Middle Spruce Creek	High	High	Highest	Moderate	High	Lowest	Highest	Highest
14010002060220	UT to North Spruce Creek	High	Low	Highest	Moderate	Highest	Low	Highest	Highest
14010002060221	North Spruce Creek	Moderate	Moderate	Moderate	Low	High	Lowest	Highest	High
14010002060222	Lower Spruce Creek - Lower Blue	Moderate	Low	High	Moderate	Highest	Low	Highest	Highest
14010002060223	Headwaters Lower Blue River	Lowest	High	Low	Lowest	Highest	Highest	Highest	High
14010002060301	UT1 to Lower Blue River	Low	Highest	Lowest	Lowest	Highest	Highest	Highest	High
14010002060302	Upper Lower Blue River	Low	Highest	Low	Lowest	Highest	High	Highest	Highest
14010002060303	Camp Creek - Lower Blue	Low	Moderate	Lowest	Moderate	Highest	Moderate	Highest	High
14010002060304	Upper Harsha Gulch	Moderate	Moderate	Moderate	Low	Moderate	Low	Moderate	Low
14010002060305	Lower Harsha Gulch	Low	Moderate	Lowest	Moderate	Highest	Highest	Moderate	Highest
14010002060306	Way Reservoir	Low	Moderate	Moderate	Low	High	Low	Highest	High
14010002060307	Middle Lower Blue River	Low	Highest	Low	Lowest	Highest	Moderate	Highest	Highest
14010002060308	Headwaters Beaver Creek	Moderate	Low	High	Low	Moderate	Lowest	Highest	Low
14010002060309	Sheepom Mountain	Low	Lowest	High	Low	High	Lowest	Highest	Moderate
14010002060310	UT to Beaver Creek	Moderate	Low	High	Low	Highest	Low	Highest	Highest
14010002060311	Noonan Ranch	Low	High	Lowest	Moderate	Highest	High	Highest	High
14010002060312	Beaver Creek	Low	Moderate	Moderate	Lowest	Highest	Moderate	Highest	Highest
14010002060313	UT to Lower Blue River	Lowest	Low	Lowest	Low	Highest	High	Highest	High
14010002060314	Upper Elliott Creek - Outlet Blue	Moderate	Low	Moderate	Moderate	Highest	High	Highest	Highest
14010002060315	Lawson Ridge	Moderate	Low	Moderate	High	High	Moderate	High	High
14010002060316	Middle Elliott Creek - Outlet Blue	Lowest	Low	Lowest	Lowest	Highest	Highest	Highest	Moderate
14010002060317	Lower Elliott Creek - Outlet Blue	Lowest	High	Lowest	Lowest	Highest	Highest	Highest	High
14010002060318	Dry Creek	Low	Low	High	Low	Highest	Moderate	Highest	Highest
14010002060319	Lower Lower Blue River	Moderate	Highest	Moderate	Lowest	Highest	Moderate	Highest	Highest
14010002060320	UT to Outlet Lower Blue River	Moderate	Highest	Moderate	Lowest	Highest	High	High	Highest
14010002060321	Outlet Lower Blue River	Lowest	Highest	Lowest	Lowest	Highest	Highest	Highest	High

RESILIENT FOREST DESCRIPTIONS BY VEGETATION TYPE

The following paragraphs describe the forest vegetation types of the Crested Butte Watersheds and the expected disturbance regimes within each type. The resilience components by forest type are also summarized in Tables 9 and 10 of the main report.

PONDEROSA PINE

The historical montane forest was likely quite open with fewer trees, greater age diversity between stands, and larger openings than the area displays today. Openings are defined as areas capable of producing forest, but that have no trees, or only a very small number of trees per acre arranged as individuals or small groups. Studies have indicated that, historically, fire typically served to maintain open mature stands, as well as to maintain some areas as openings. Brown et al. (1999) and Kaufmann et al. (2000) provide evidence that frequent, mixed-severity fires were most common in ponderosa pine stands from 1000 to 1870 AD. The area of severe fires were relatively small in extent, but they were critical in creating openings of 20 to 40 acres that were maintained by the dry site conditions until regeneration occurred. The open forest was protected from extensive fires because of the distance between tree crowns and the openings.

Smaller surface fires that did not move into the crowns would have encouraged the maintenance of ponderosa pine on these sites and limited the spread of Douglas-fir, which does not tolerate fire well, to sites where fires were infrequent, particularly wetter, north-facing slopes. The smaller fires would also have kept the forest more open by limiting the growth of understory trees.

Variation in frequency and severity of fires created a varied vegetative pattern across the landscape. This mosaic pattern would have been maintained, as the patch-like variations of age classes, densities, and openings, caused fires to skip around rather than kill the majority of trees over large areas in a single fire event. Some stands would have had many age classes from seedlings to trees more than 400 years old. There were probably few snags (standing dead trees) and cavities in live trees. A few stands would have been nearly even-aged due to stand-replacing fires followed by even-aged regeneration.

One key to the sustainability of the historical forest was the open condition, which played a role in preventing the development of large crown fires. Compared to current conditions, the historical forest conditions would have had larger distances between tree crowns combined with larger openings, reducing the likelihood of large crown fires. Openings may have covered 20 to 25 percent of the area, and some of these openings may have persisted for decades due to climatic and seed source limitations. Regeneration would have begun immediately on other burned sites. Therefore, post-fire patterns of regrowth would have had variations both in space and time, contributing to the complexity of the landscape.

Ponderosa pine can be divided into two classifications; xeric and mesic (Kaufmann et al. 2006). Each of these classifications had their own forest structure and species distribution that contributed to resilient conditions. There is no xeric ponderosa pine in the Twin Lakes project area and only small patches of mesic ponderosa pine exists, in the area surrounding Twin Lakes.

Xeric Ponderosa Pine

Xeric ponderosa pine sites consist of mostly ponderosa pine as the dominant vegetation, with smaller areas having no dominant tree type but having Gambel oak/mountain mahogany. These systems had a history of frequent, low intensity fires, which created more open forested conditions.

Xeric ponderosa pine is classified as:

1. Ponderosa pine stands below an elevation of 6,500 feet,
2. Ponderosa and Douglas-fir stands between 6,500 and 7,500 feet in elevation except on north slopes,
3. Ponderosa and Douglas-fir stands between 7,500 and 8,500 feet in elevation on south and west aspects, and exposed ridges.

Based upon the documented historic conditions and expected future conditions considering climate change, resilient xeric ponderosa pine areas would have the following characteristics:

- A more open forested condition than the mesic ponderosa areas,
- Some clumps of dense trees,
- Openings where at most individual trees are present, ranging in size from 1 to 40 acres, and covering 25 percent of the xeric ponderosa pine area,
- An average canopy cover between 15 to 25 percent,
- Connections to other xeric ponderosa pine areas or other areas of dense forest that are minimized by lower density ridge lines, openings or other natural features.

Mesic Ponderosa Pine

Mesic ponderosa pine likely developed under a mixed severity fire regime (Crane 1982 and Kaufmann et al. 2006), which created a greater variety of stand structures and ages than would have developed on the drier (more xeric) ponderosa pine sites.

Mesic ponderosa pine is classified as:

1. Ponderosa pine stands between 6,500 and 7,500 feet in elevation on north aspects,
2. Ponderosa pine stands between 7,500 and 8,500 feet in elevation on north and east aspects,
3. Ponderosa pine stands between 8,500 and 9,500 feet in elevation on all aspects.

Based upon the documented historic conditions and expected future conditions considering climate change, resilient mesic ponderosa pine areas would have the following characteristics:

- Relatively open forested conditions,
- Larger clumps (both in overall size and number of trees present per clump) compared to the xeric systems,
- Stand densities between 40 to 120 basal area (square feet per acre),
- Openings ranging in size between 1 to 20 acres and covering 20 percent of the mesic ponderosa pine area,
- An average canopy cover between 20 to 35 percent,
- Connections to other mesic ponderosa pine areas or other areas of dense forest that are minimized by lower density ridge lines, openings or other natural features.

MIXED CONIFER

Mixed conifer areas are generally composed of Douglas-fir, lodgepole pine, aspen, ponderosa pine and some true firs. Mixed conifer areas vary substantially with aspect: cool-moist (mesic) types are found on north-facing aspects while the warm-dry (xeric) types are found on south-facing aspects (Romme et al. 2009). The historical disturbance regime was mixed-severity fires with a fire recurrence interval of 30-100 years (Crane 1982). In the Front Range, mixed conifer has a mean fire return interval between 17-22 years (Veblen et al. 2000) but with a range of 1-125 years.

The mixed severity fire regime in mixed conifer created a mosaic of forest conditions. Higher elevation mixed conifer forests experienced lower fire frequency with patches of stand-replacing fire, in addition to some areas of low severity surface fires (Veblen et al. 2000, Kaufmann et al. 2007). The mosaic conditions included even-aged stands created by stand-replacing fires, uneven-aged stands created and maintained by low severity fire, and some openings due to episodic tree regeneration (Schoennagel et al. 2004). Fire-created openings have been documented to persist for as long as 148 years (Kaufmann et al. 2000). In the study watershed, climate is the main driver of fire in mixed conifer forests. Years that experience warm and dry spring and summer periods are strongly associated with widespread fire (Bessie and Johnson 1995, Veblen et al. 2000).

Based upon the documented historic conditions and expected future conditions considering climate change, resilient mixed conifer areas would have the following characteristics:

- An average canopy cover between 20 to 35 percent,
- Openings ranging in size between between 1 to 20 acres and covering 20 percent of the mixed conifer area,
- In mesic mixed conifer, a canopy cover of 35-50 percent with an average of 40 percent,
- Openings in mesic mixed conifer across 10 percent of the area,
- A mix of ages of seedlings, saplings, and mature trees, with less than 1/3 of the watershed in any one class,
- Connections to other mixed conifer areas or other areas of dense forest that are minimized by lower density ridge lines, openings or other natural features.

Xeric Mixed Conifer

Because xeric mixed conifer areas are generally adjacent to upper montane ponderosa pine, they experience similar fire frequency and therefore exhibit similar forest structure influenced by mixed severity fire regime (Reynolds et al. 2013). Xeric mixed conifer areas, however, do have more species diversity than ponderosa pine forests. Mesic mixed conifer also experience mixed severity fire regimes but with a lower frequency due to wetter conditions (Reynolds et al. 2013).

Xeric mixed conifer is classified as:

1. All mixed conifer cover types on south and west aspects.

Mesic Mixed Conifer

Mesic mixed conifer is classified as:

1. All mixed conifer cover types on north and east aspects,

2. Douglas-fir cover types between 7,500 and 9,000 feet in elevation on north and east aspects.

LODGEPOLE PINE

Lodgepole pine grows on a wide range of sites, typically between 7,500 and 10,000 feet and can occur in pure or mixed stands (Shepperd and Alexander 1983). Lodgepole pine is a mostly shade intolerant species that can exist as a climax species in some stands but is often a seral species that is eventually replaced by spruce and fir. Stand-replacing fires are natural in lodgepole pine and, because the majority of the cone production from the lodgepole species is serotinous (cones being covered in sap), the cones generally open up after a fire, creating even-aged seedlings soon after a fire. The frequency of natural fires in Rocky Mountain lodgepole pine stands ranges from a few years to 200 or more years (Davis et al. 1980). Low to moderate severity surface fires are likely to have a return interval on the order of a few decades, while stand-replacing fires are generally less frequent (Crane 1982). Lodgepole pine is susceptible to bark beetles, mistletoe, blowdown and fire (Lotan 1964).

Based upon the documented historic conditions and expected future conditions considering climate change, resilient lodgepole pine areas would have the following characteristics:

1. Canopy cover ranging from 50-90 percent with an average of 75 percent,
2. A mix of ages of seedlings, saplings, and mature trees, with less than 1/3 of the watershed in any one class,
3. Connections to other lodgepole pine areas or other areas of dense forest that are minimized by lower density ridge lines, openings or other natural features.

SPRUCE-FIR

Spruce-fir stands are typically composed of the slow-growing Engelmann spruce, in association with the smaller, narrow-crowned subalpine fir. The spruce-fir combination often reaches a climax-type forest at high elevations, despite the existence of many uneven-aged stands. This is because both species are shade tolerant and tend to quickly repopulate shaded gaps in the forest.

The return interval for naturally occurring fires within the spruce-fir forest may be 300 years or longer. Unlike many other Colorado forest types, spruce-fir forests are not adapted to fire. Thin bark and the persistence of dead lower limbs increases the spruce's susceptibility to fire as well as the likelihood of intense crown fires and tree mortality. In the case of a stand-replacing fire, it may take as long as 300-400 years for a spruce-fir forest to regenerate.

Based upon the documented historic conditions and expected future conditions considering climate change, resilient spruce-fir areas would have the following characteristics:

1. A mix of ages of seedlings, saplings, and mature, with less than 1/2 of the watershed in any one class,
2. Connections to other spruce-fir stands or other areas of dense forest that are minimized by lower density ridge lines, openings or other natural features.

ASPEN

Aspen usually occur as closed canopy stands. They are generally found between 5,000 to 10,000 feet in elevation. Because they require adequate moisture, they are usually found on north aspects or sites that are mesic. However, at higher elevations they are found on southern aspects because the northern aspects are too cold. Fire has been important in maintaining the vigor and extent of aspen by suckering from long-lived clones that prosper following fire. Aspen provides many benefits to the landscape, including natural fire breaks, species diversity and important

wildlife habitat. Bartos (2000) argues that aspen has declined by 49 percent in Colorado due to encroachment by conifers. However, other researchers (Kulakowski and Veblen, 2006) do not agree that the magnitude of aspen reduction has been as great as that suggested by Bartos. In general, the occurrence of large and severe fires would increase the extent of aspen and the lack of fires would allow the successional replacement of aspen by conifers (Veblen and Donnegan 2005).

Disturbance regimes in aspen are generally similar to adjacent conifer stands (Veblen and Donnegan, 2005). In the study watershed, aspen occur adjacent to ponderosa pine, lodgepole pine, and mixed conifer forests that have mixed severity fire regimes with fire return intervals of between 30 and 100 years.

Aspen areas are defined as:

1. Aspen cover type,
2. Lodgepole pine, ponderosa pine, and mixed conifer cover types that are adjacent to aspen stands.

Based upon the documented historic conditions and expected future conditions considering climate change, resilient aspen areas would have the following characteristics:

- A mix of ages of sapling and mature trees, so that the mature class does not comprise more than 1/2 of the watershed,
- Conifer encroachment that is limited to older aspen stands.

TABLES AND MAPS

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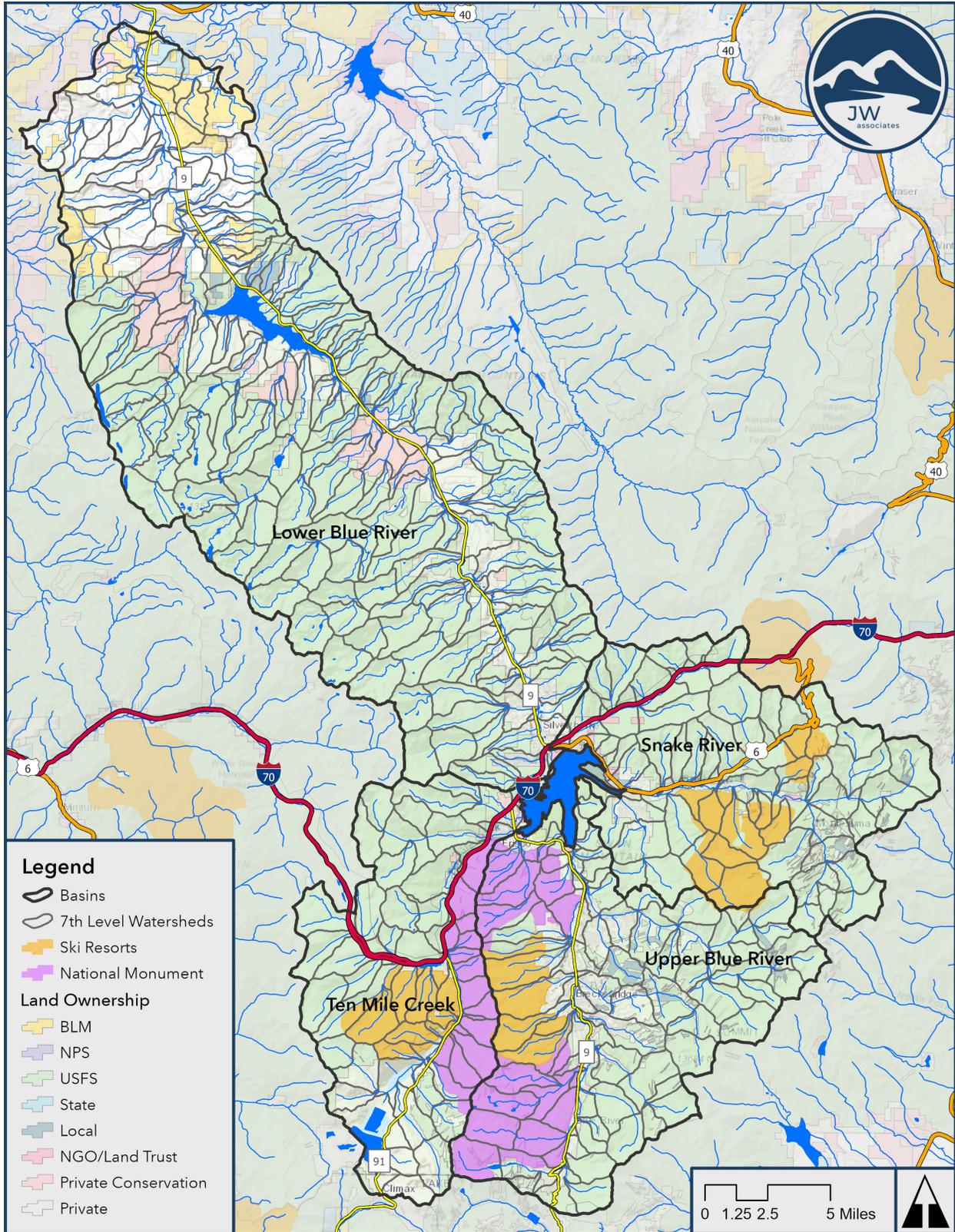
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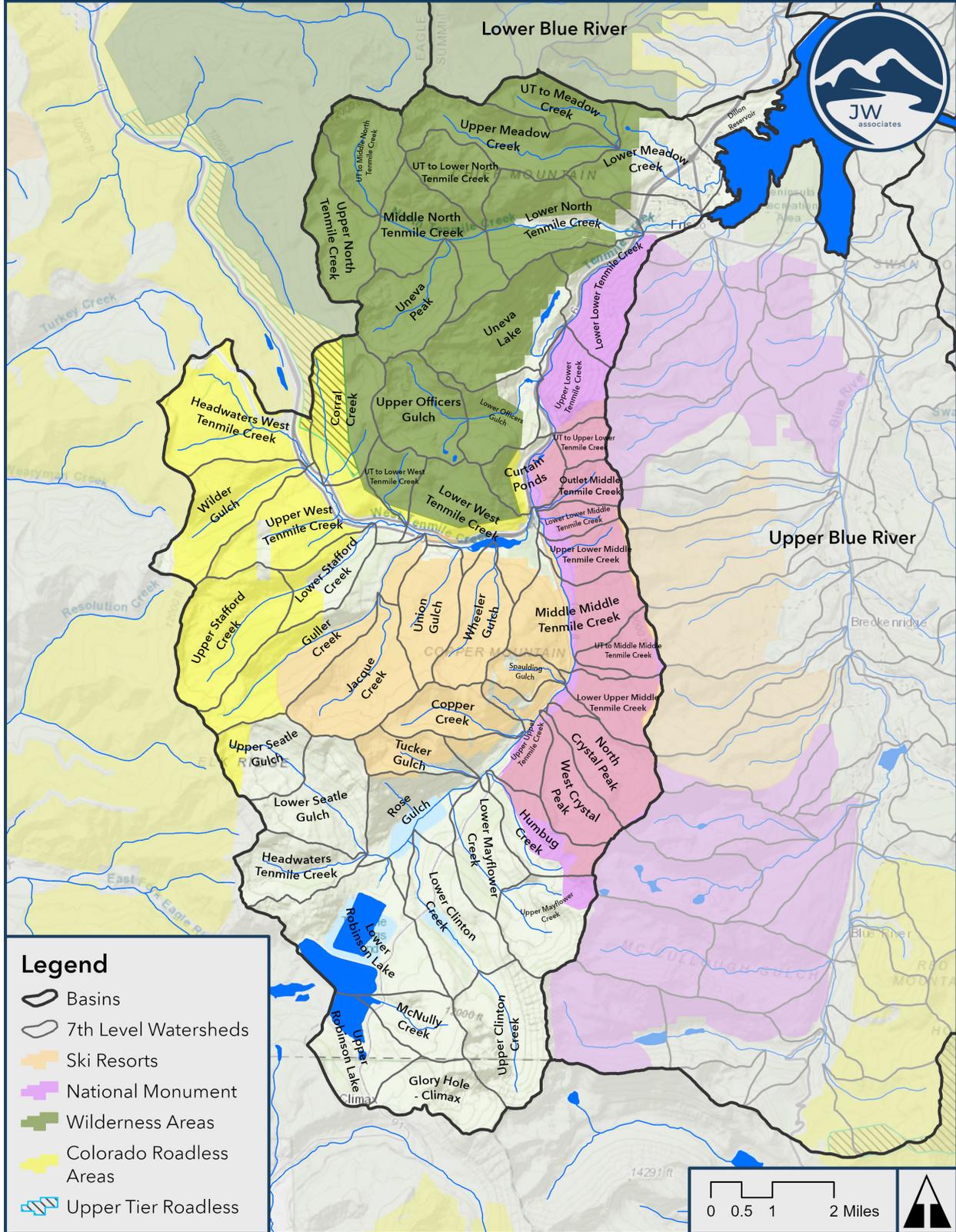
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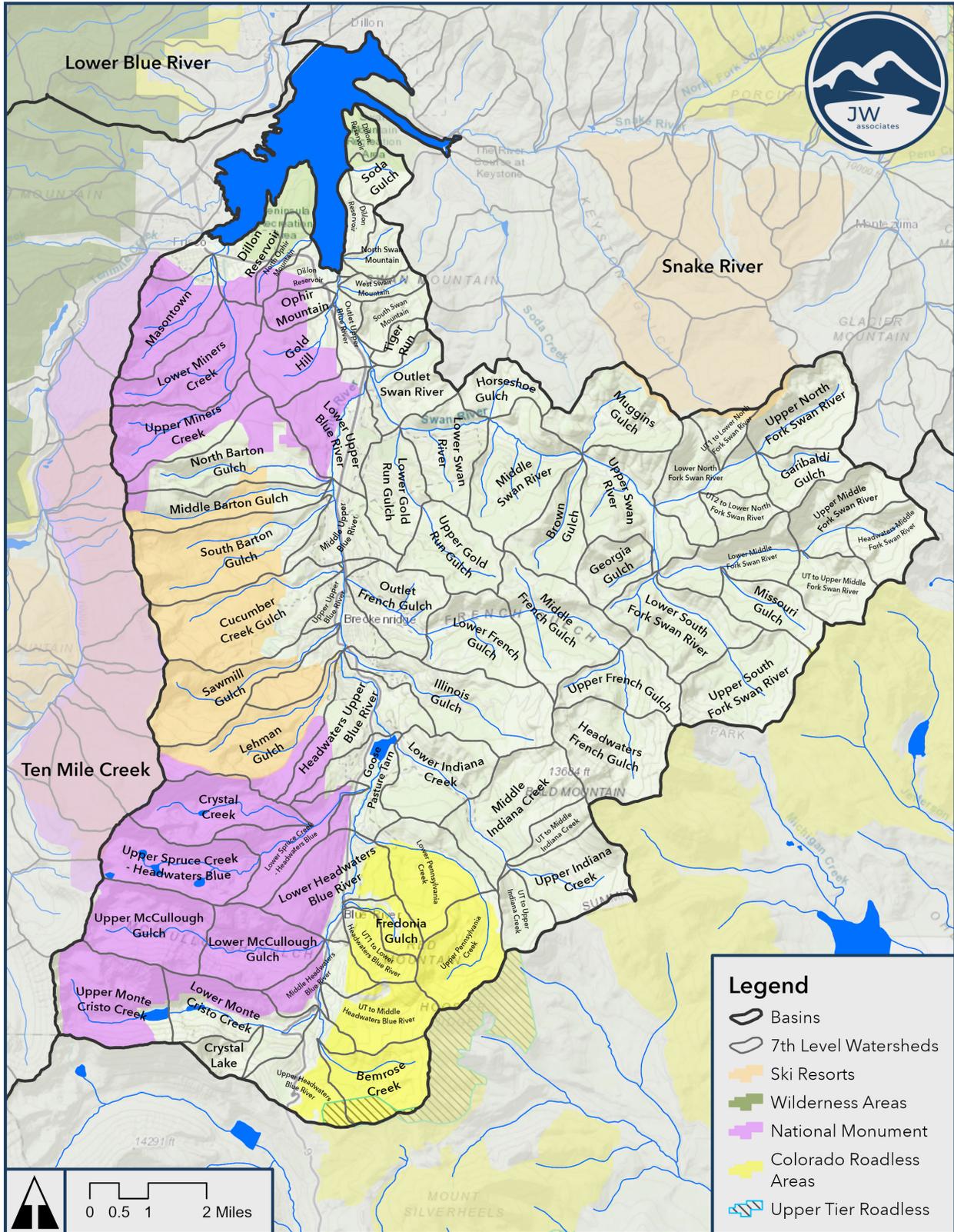
Table 1. 6th Level Watersheds in the Blue River Watershed Wildfire Hazard Assessment

6 th Level Watershed	12 Code HUC	Area (acres)	Number of 7 th Level Watersheds
Headwaters Blue River	140100020101	27,051	23
French Gulch-Blue River	140100020102	17,351	11
Swan River	140100020103	24,074	22
Gold Hill-Blue River	140100020104	10,430	11
North Fork Snake River	140100020201	10,239	8
Peru Creek-Snake River	140100020202	26,685	23
Keystone Gulch-Snake River	140100020203	12,849	10
Upper Tenmile Creek	140100020301	15,813	12
West Tenmile Creek	140100020302	17,548	12
Middle Tenmile Creek	140100020303	10,419	13
Lower Tenmile Creek	140100020304	15,663	13
Dillon Reservoir-Blue River	140100020401	25,638	17
Straight Creek-Blue River	140100020501	35,562	31
Rock Creek-Blue River	140100020502	30,014	21
Slate Creek-Blue River	140100020503	39,020	26
Green Mountain Reservoir-Blue River	140100020504	54,433	41
Elliott Creek	140100020601	9,614	8
Deep Creek-Blue River	140100020602	28,092	23
Beaver Creek-Blue River	140100020603	26,720	21
Total		437,215	346

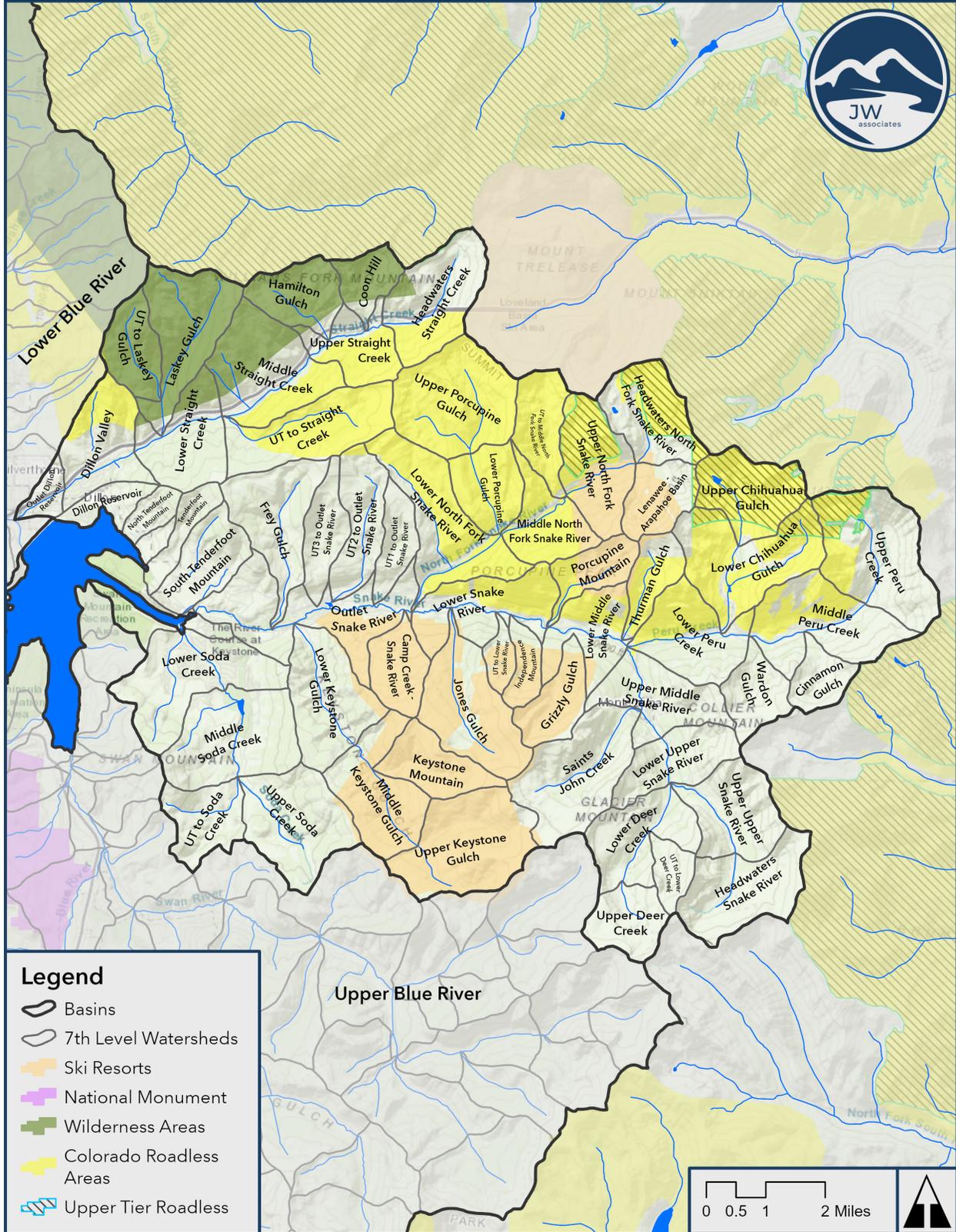


Map 1. Blue River Wildfire Ready Action Plan Area

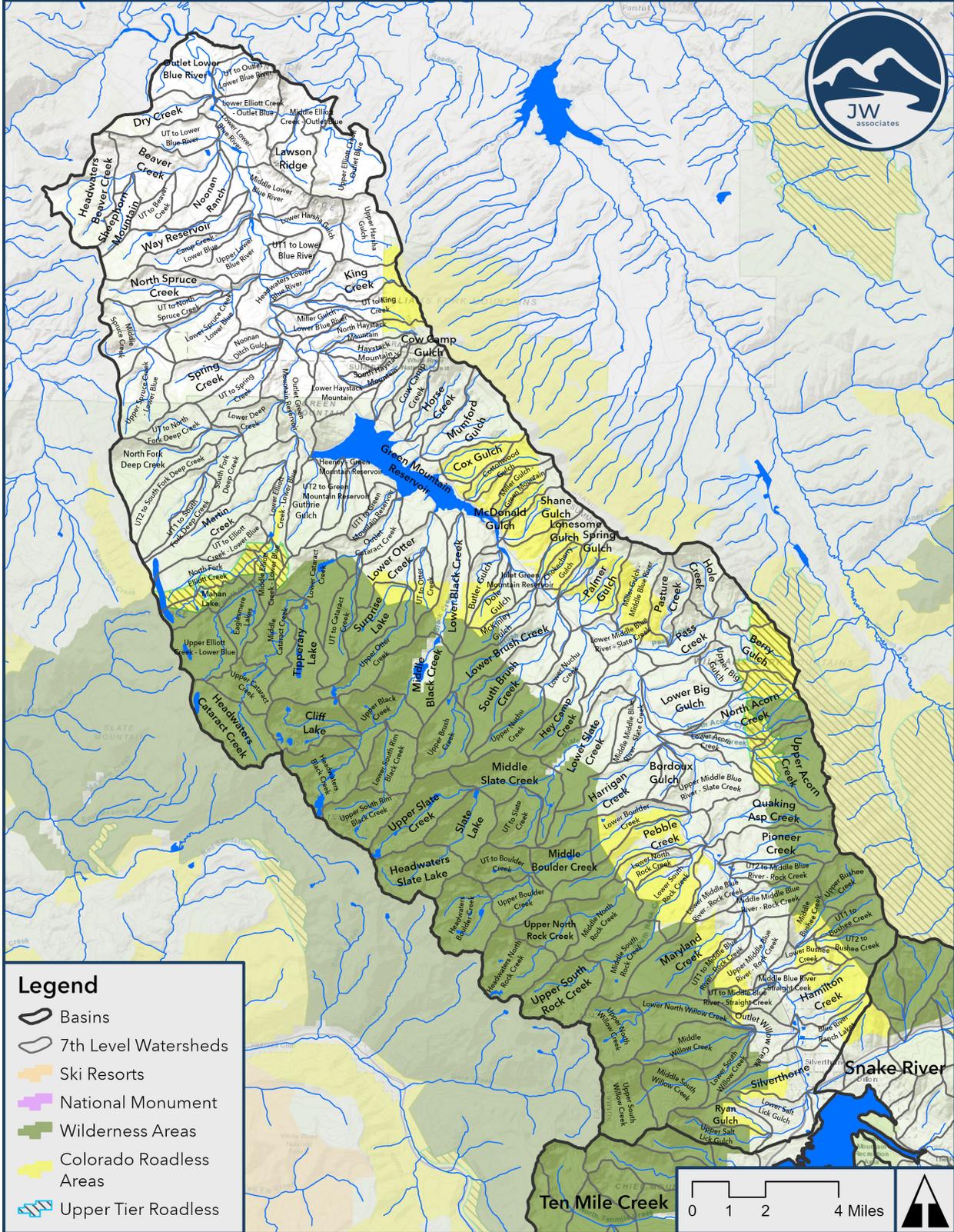




Map 3. Upper Blue River Basin Wildfire Ready Action Plan Area



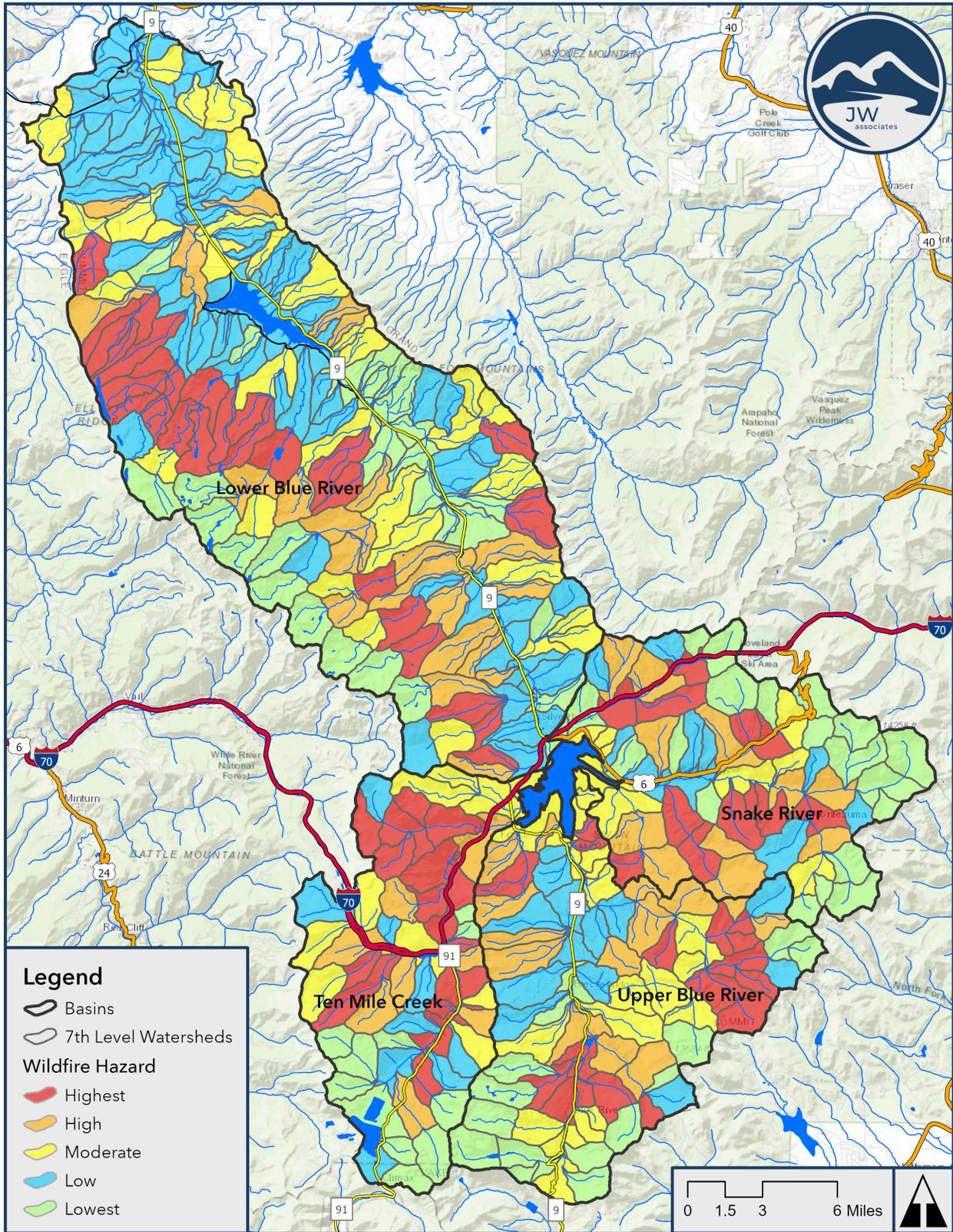
Map 4. Snake River Basin Wildfire Ready Action Plan Area

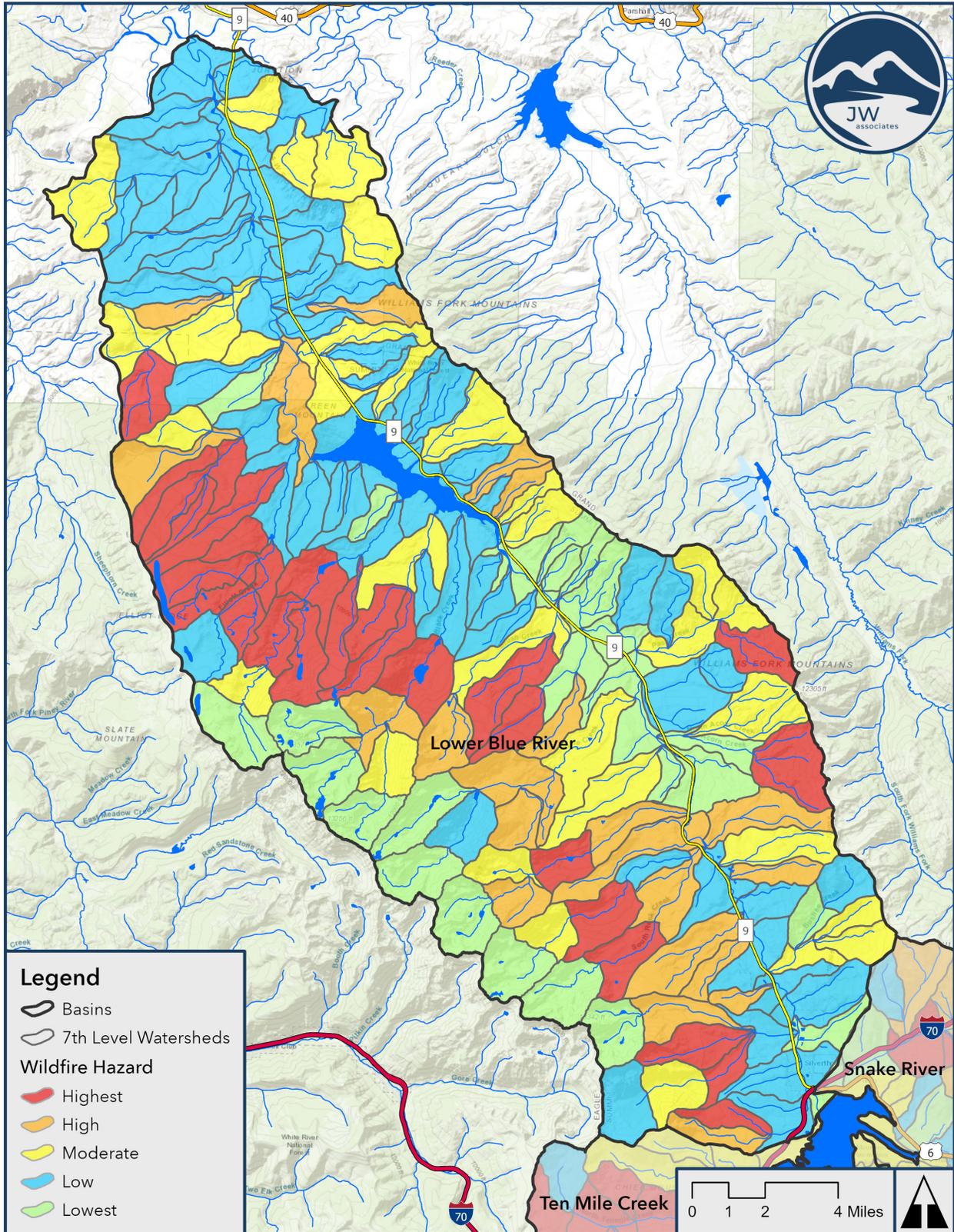


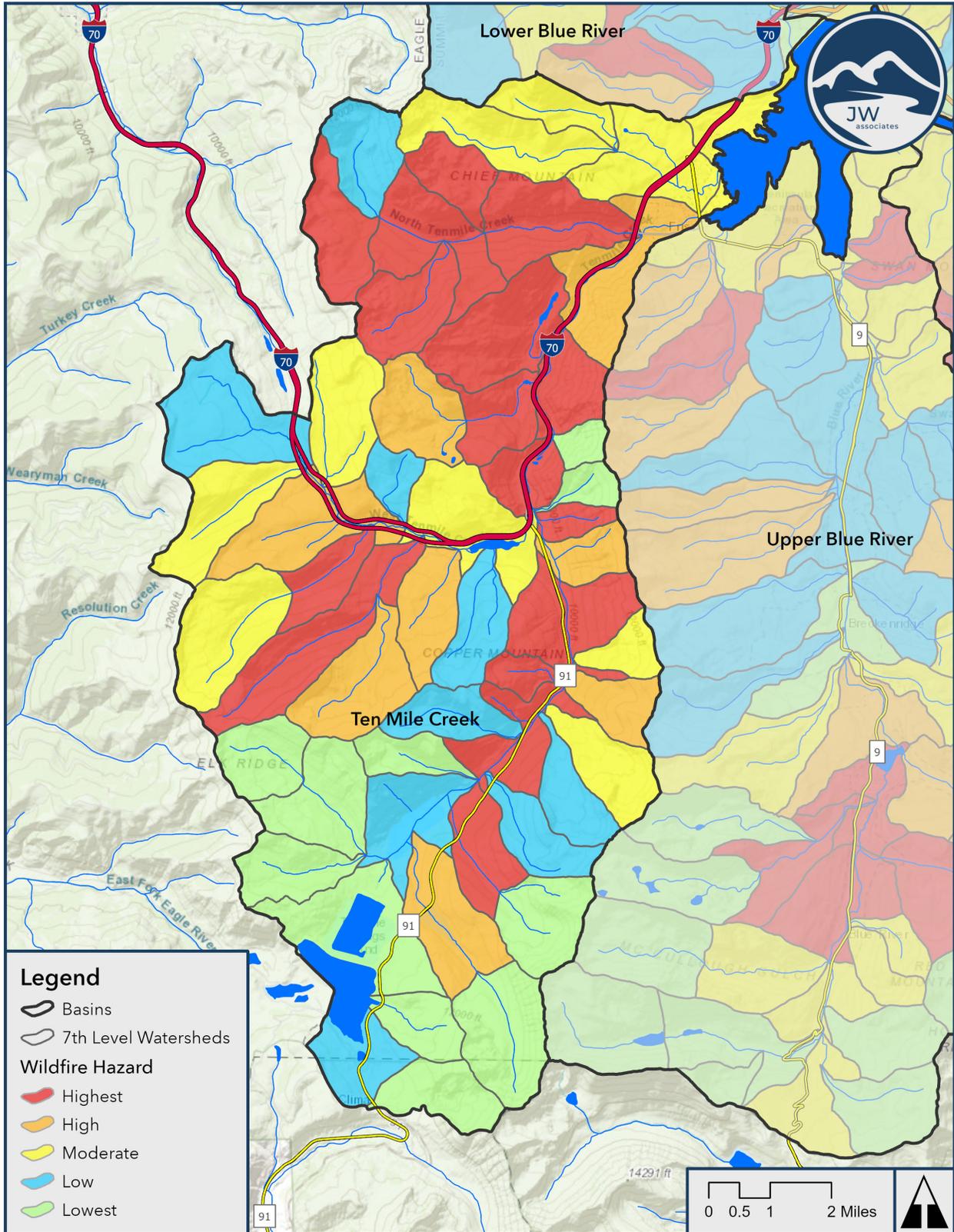
Map 5. Lower Blue River Basin Wildfire Ready Action Plan Area

Table 2. Highest Ranked 7th Level Watersheds for Wildfire Hazard

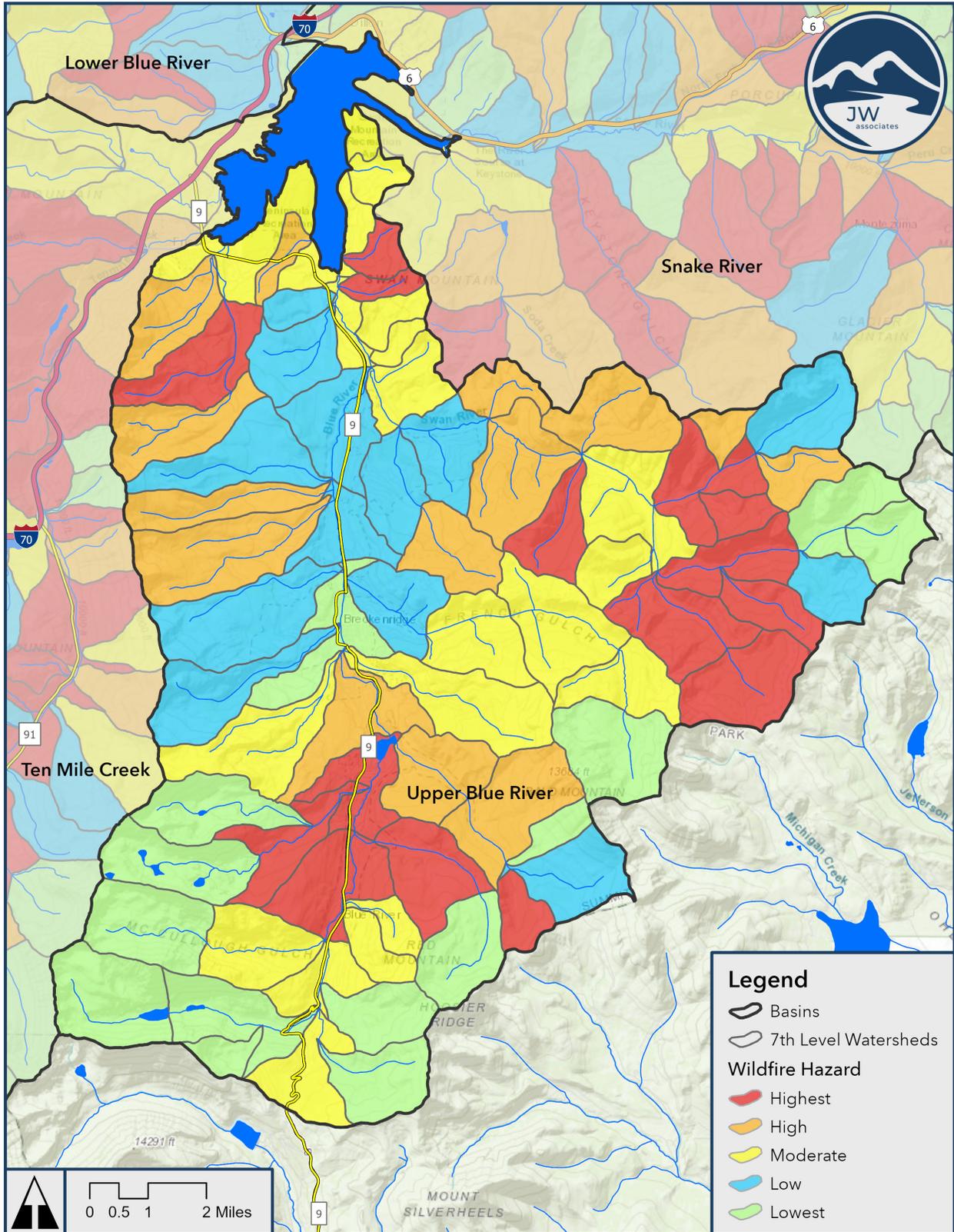
6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME
Coal Creek	Independence Basin
	Upper Coal Creek
	Coon Basin
	Outlet Coal Creek-Crested Butte
Washington Gulch-Slate River	Meridian Lake
	Mount Crested Butte
	Lake Grant
	Upper Lower Slate River
	Middle Lower Slate River
	Outlet Slate River
Ruby Anthracite Creek	Lake Irwin
	Ruby Anthracite Below Lake Irwin



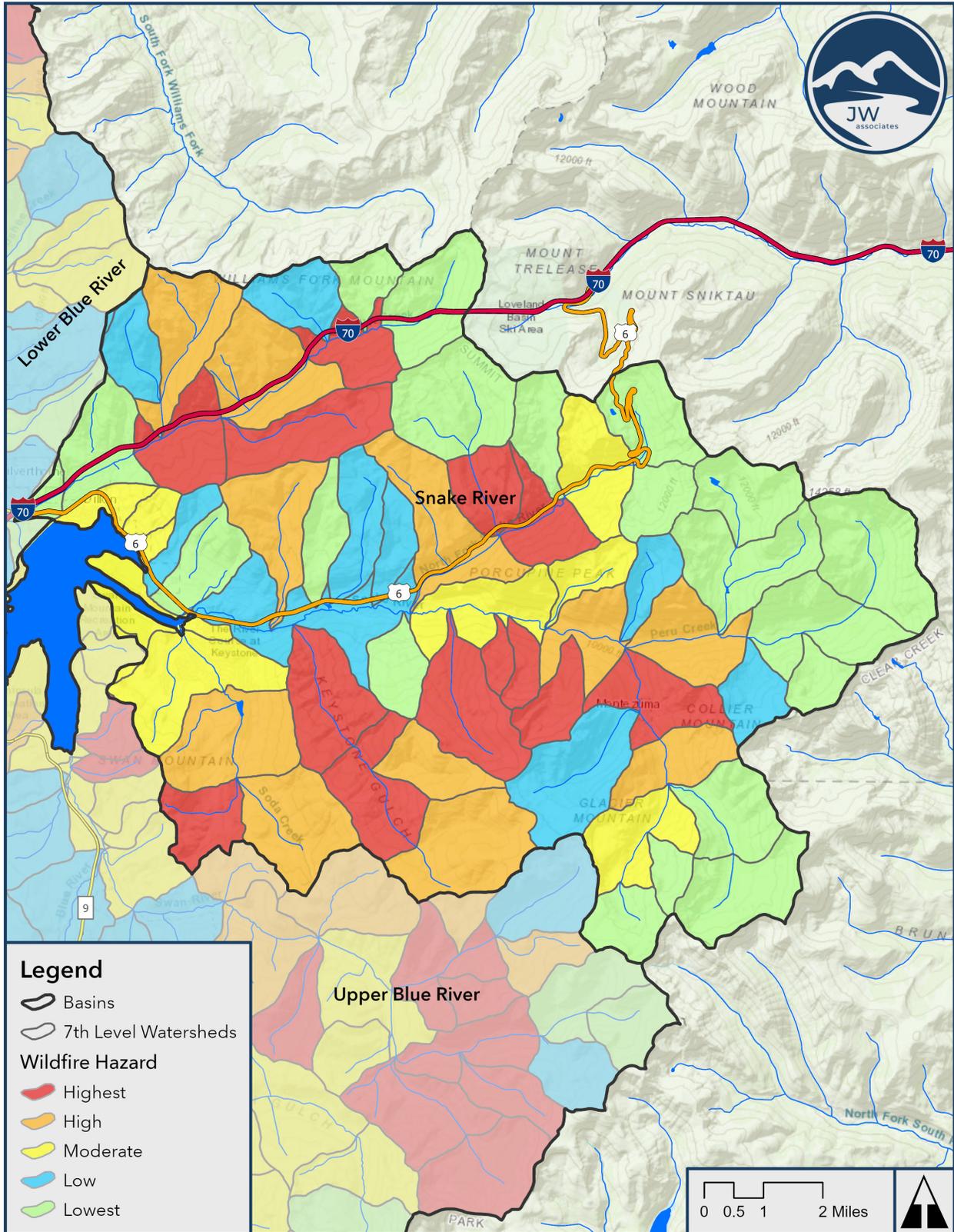




Map 4. Ten Mile Creek Basin Wildfire Hazard Ranking



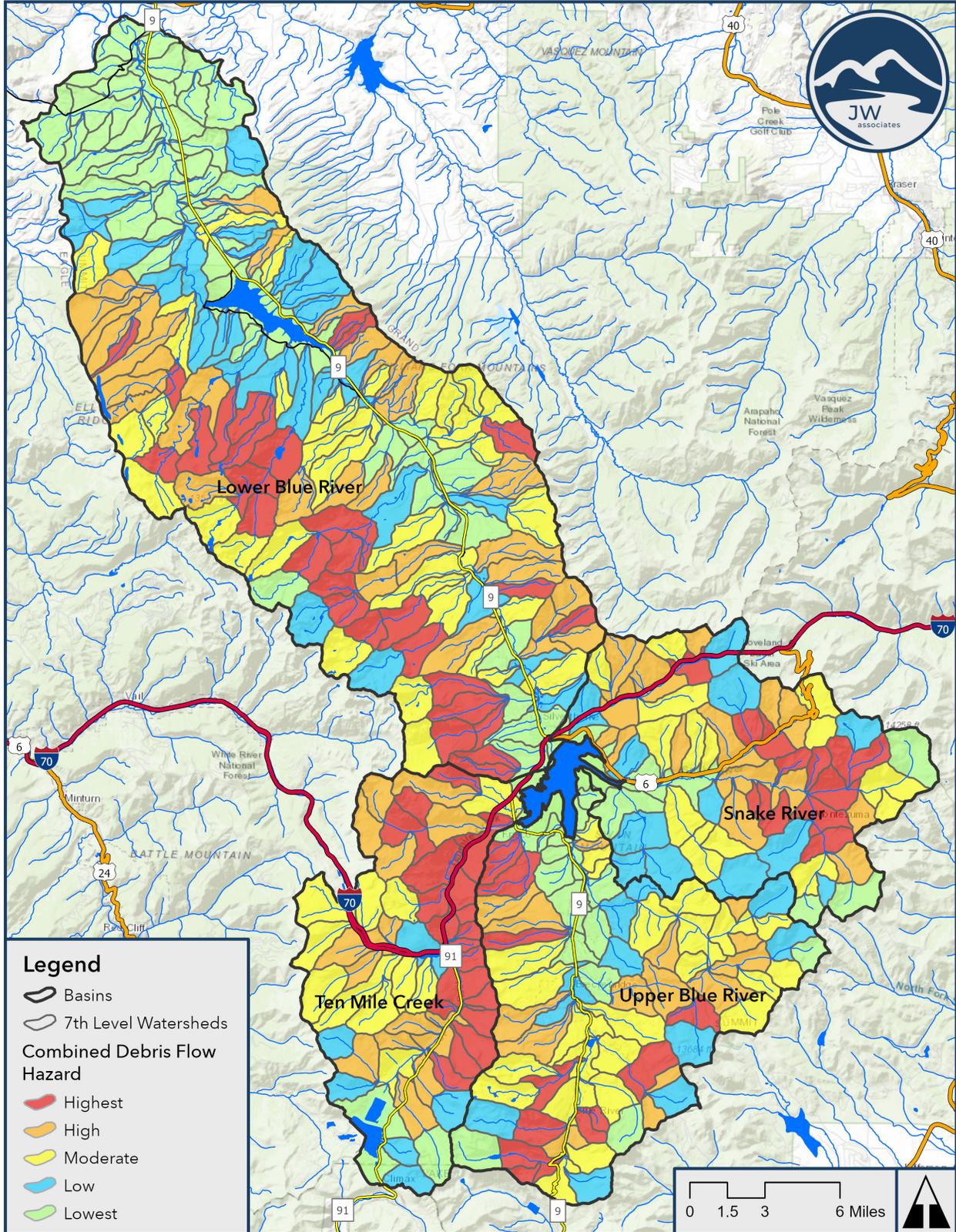
Map 4. Upper Blue River Basin Wildfire Hazard Ranking



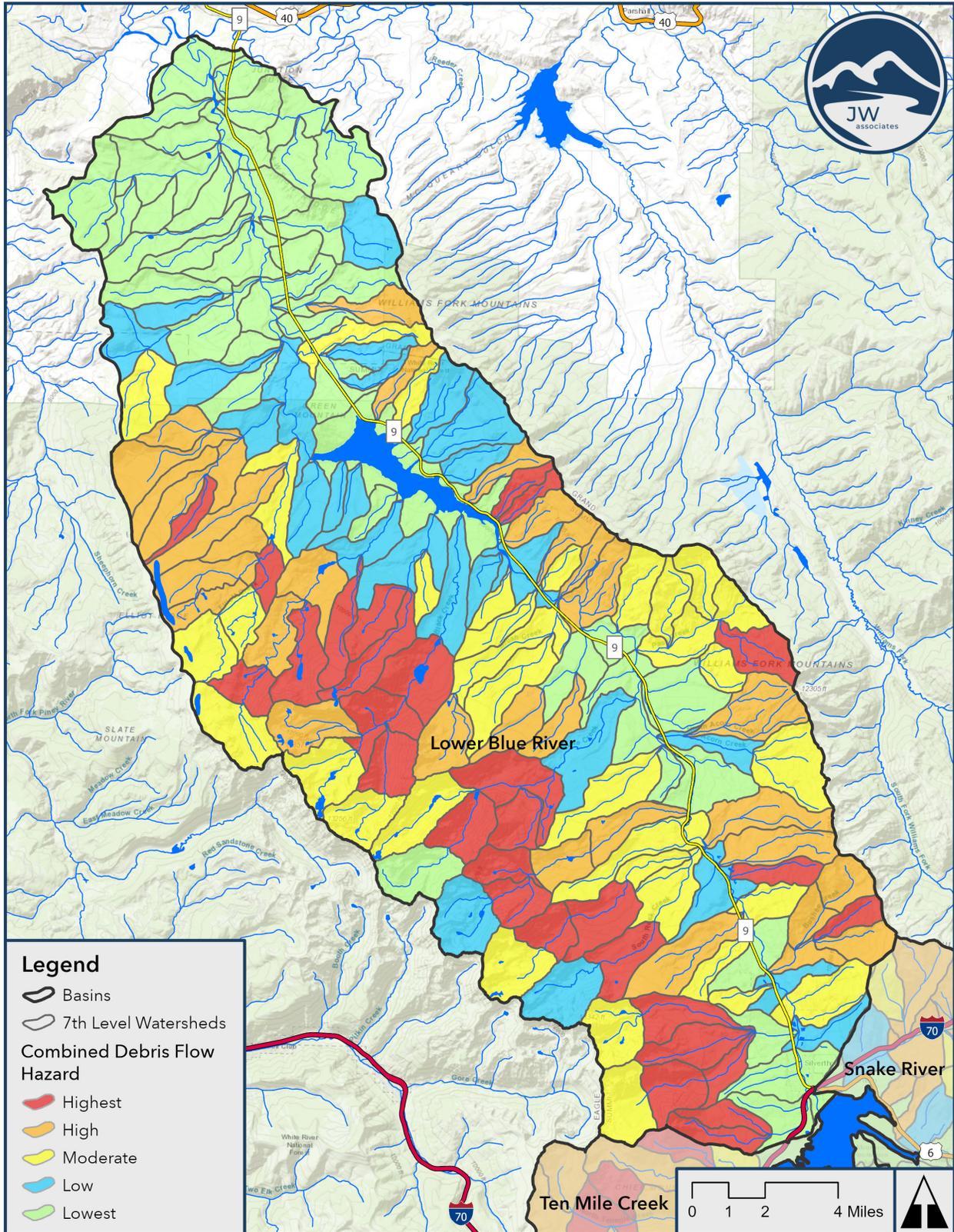
Map 5. Snake River Basin Wildfire Hazard Ranking

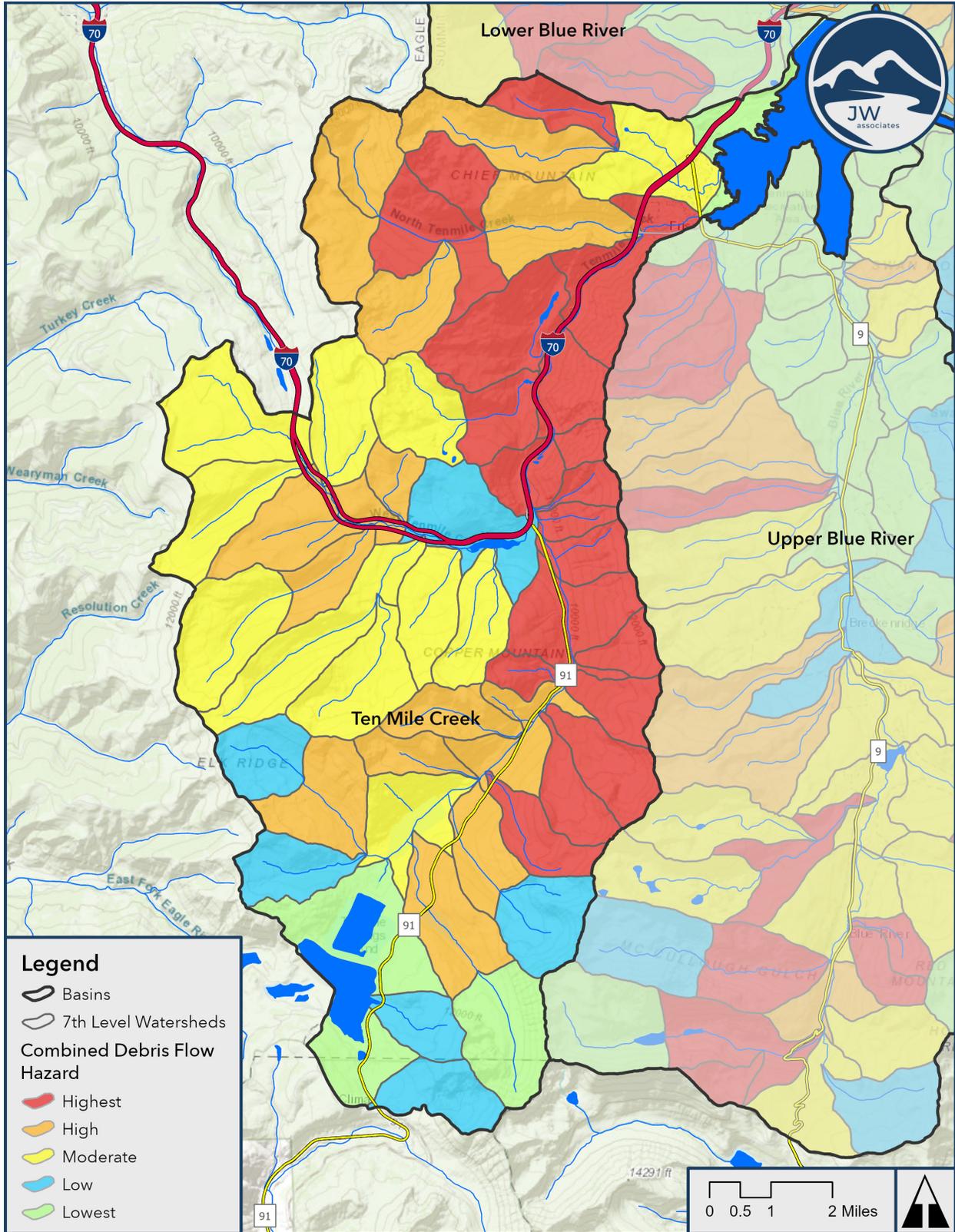
Table 3. Highest Ranked 7th Level Watersheds for Combined Debris Flow Hazard

6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME
Coal Creek	Independence Basin
	Upper Coal Creek
	Splains Gulch
	Elk Creek
	Wildcat Creek
	Coon Basin
	Gibson Ridge
	Outlet Coal Creek-Crested Butte
Oh-be-Joyful Creek-Slate River	Middle Middle Slate River
Washington Gulch-Slate River	UT2 to Middle Washington Gulch
	Middle Washington Gulch
	Halazon Ditch-Crested Butte
	Upper Baxter Gulch
	Lower Baxter Gulch
	UT3 to Lower Lower Slate River
	North Red Mountain

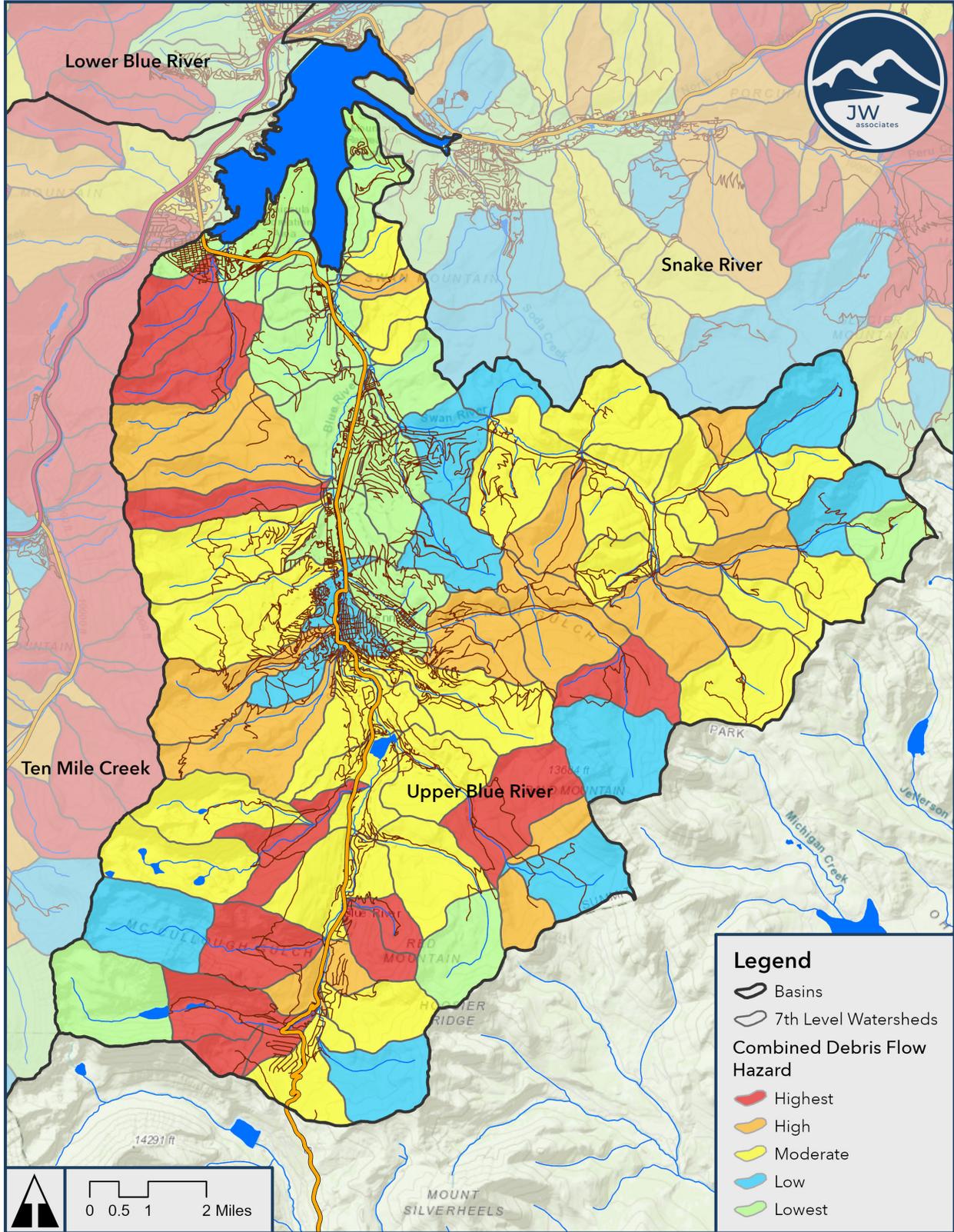


Map 6. Blue River Combined Debris Flow Hazard Ranking

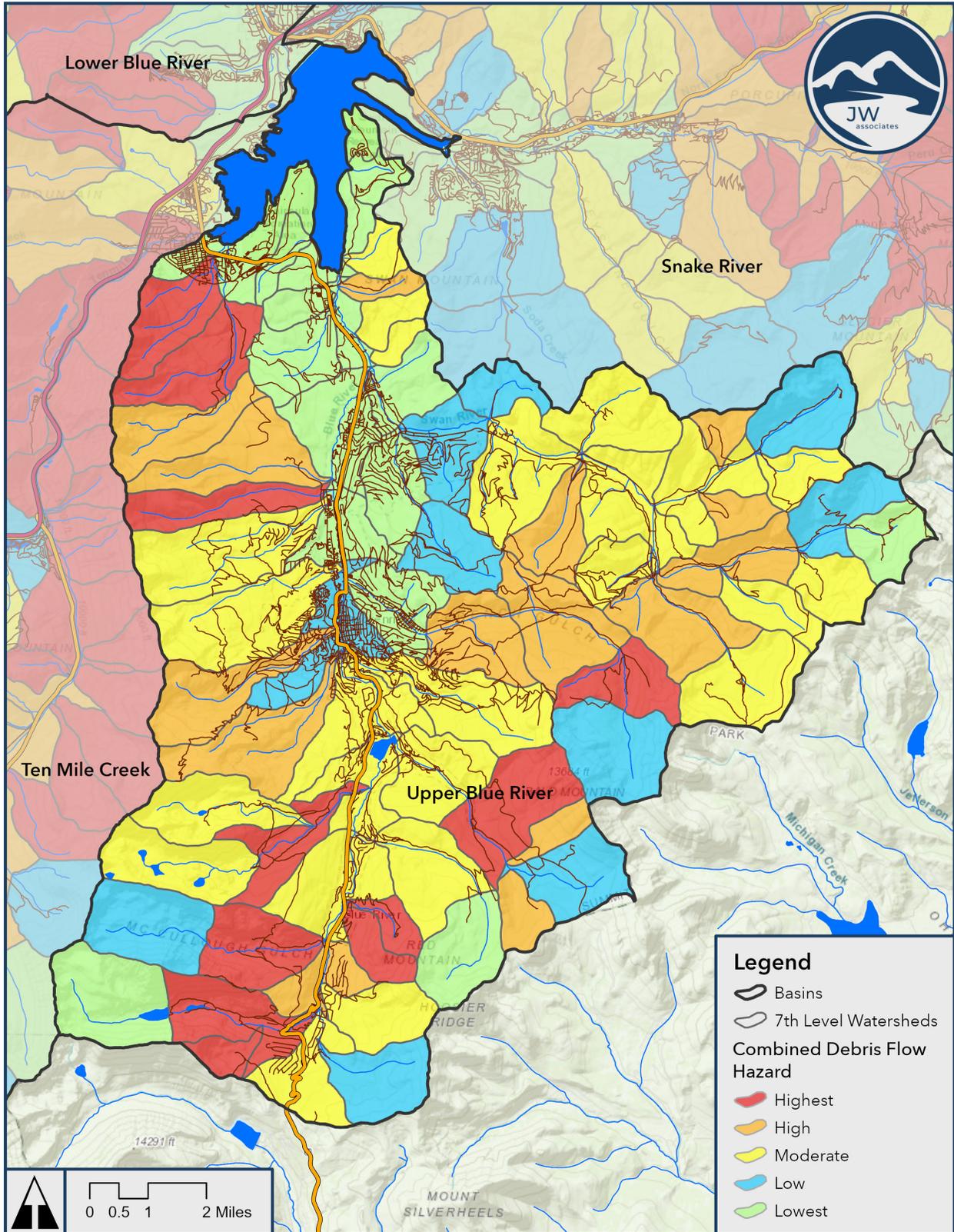




Map 8. Ten Mile Creek Basin Combined Debris Flow Hazard Ranking



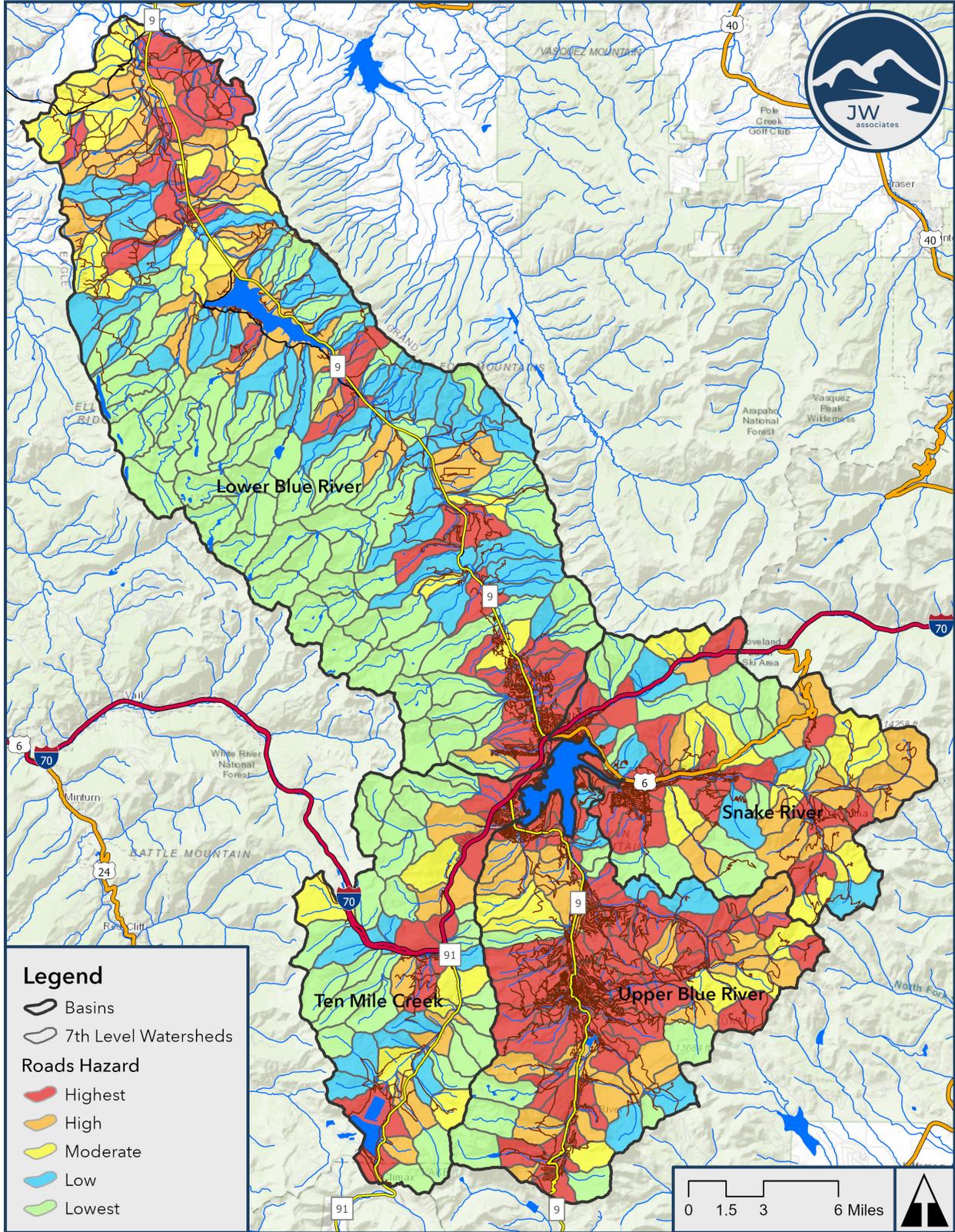
Map 9. Upper Blue River Basin Combined Debris Flow Hazard Ranking

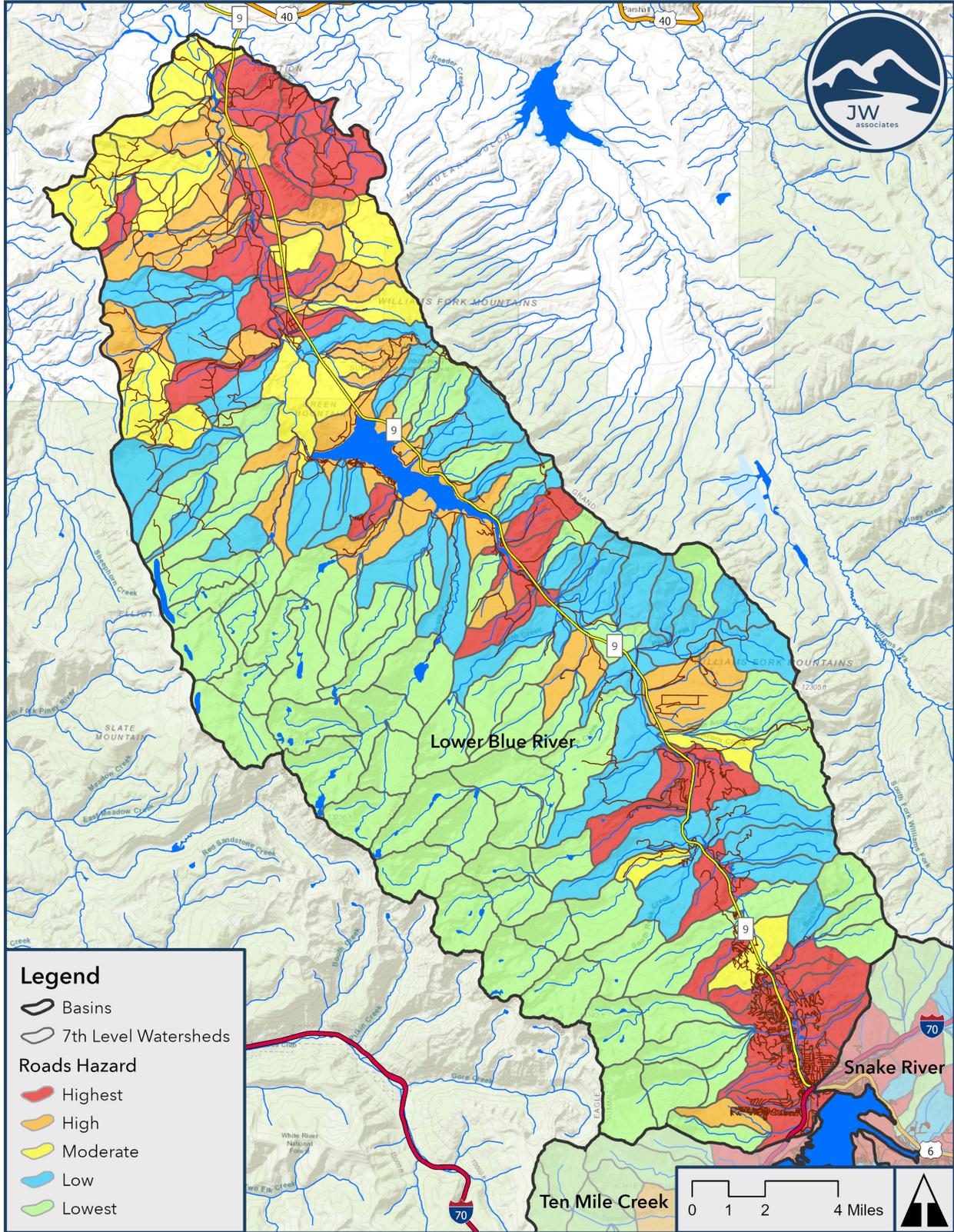


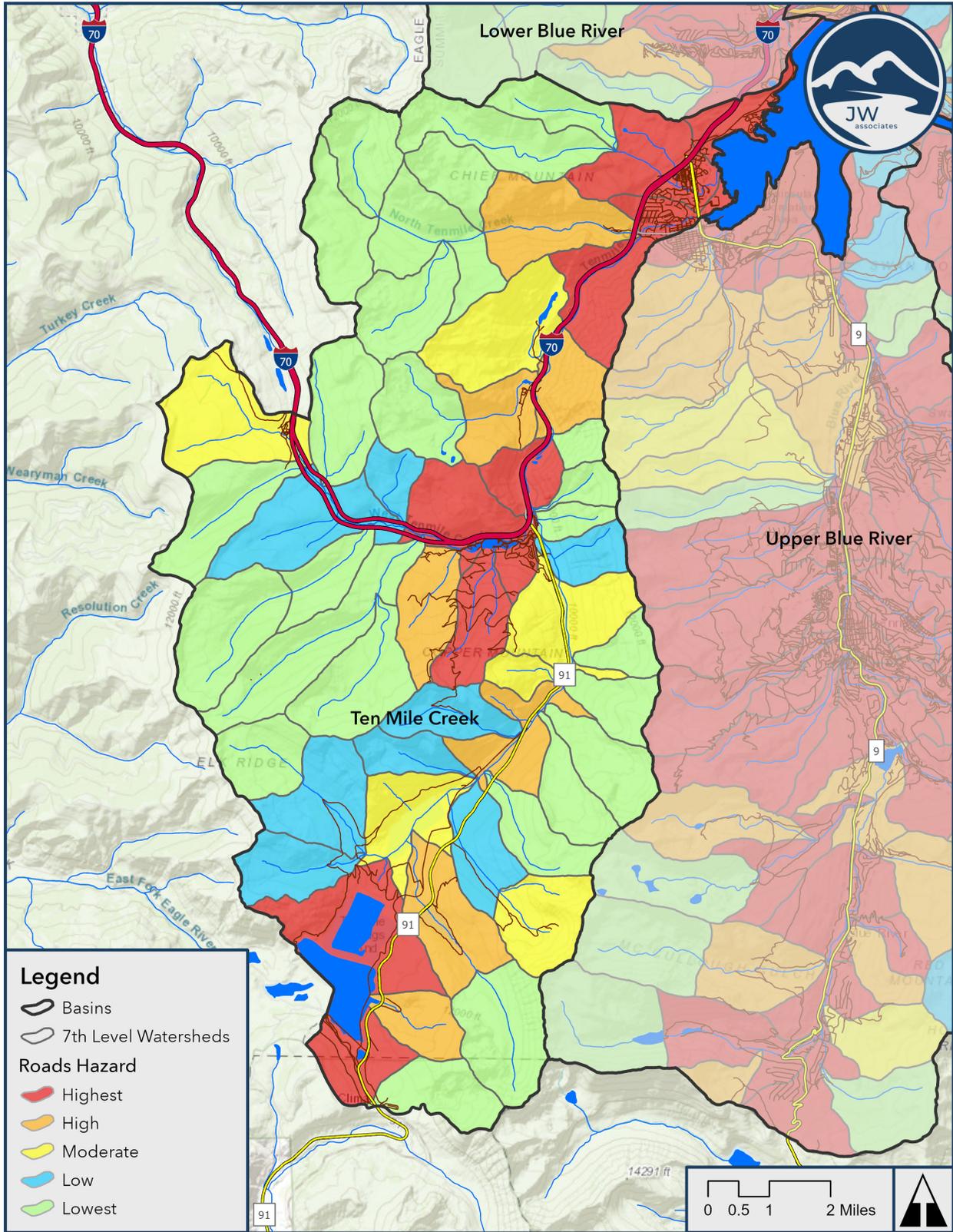
Map 10. Snake River Basin Combined Debris Flow Hazard Ranking

Table 4. Highest Ranked 7th Level Watersheds for Roads Hazard

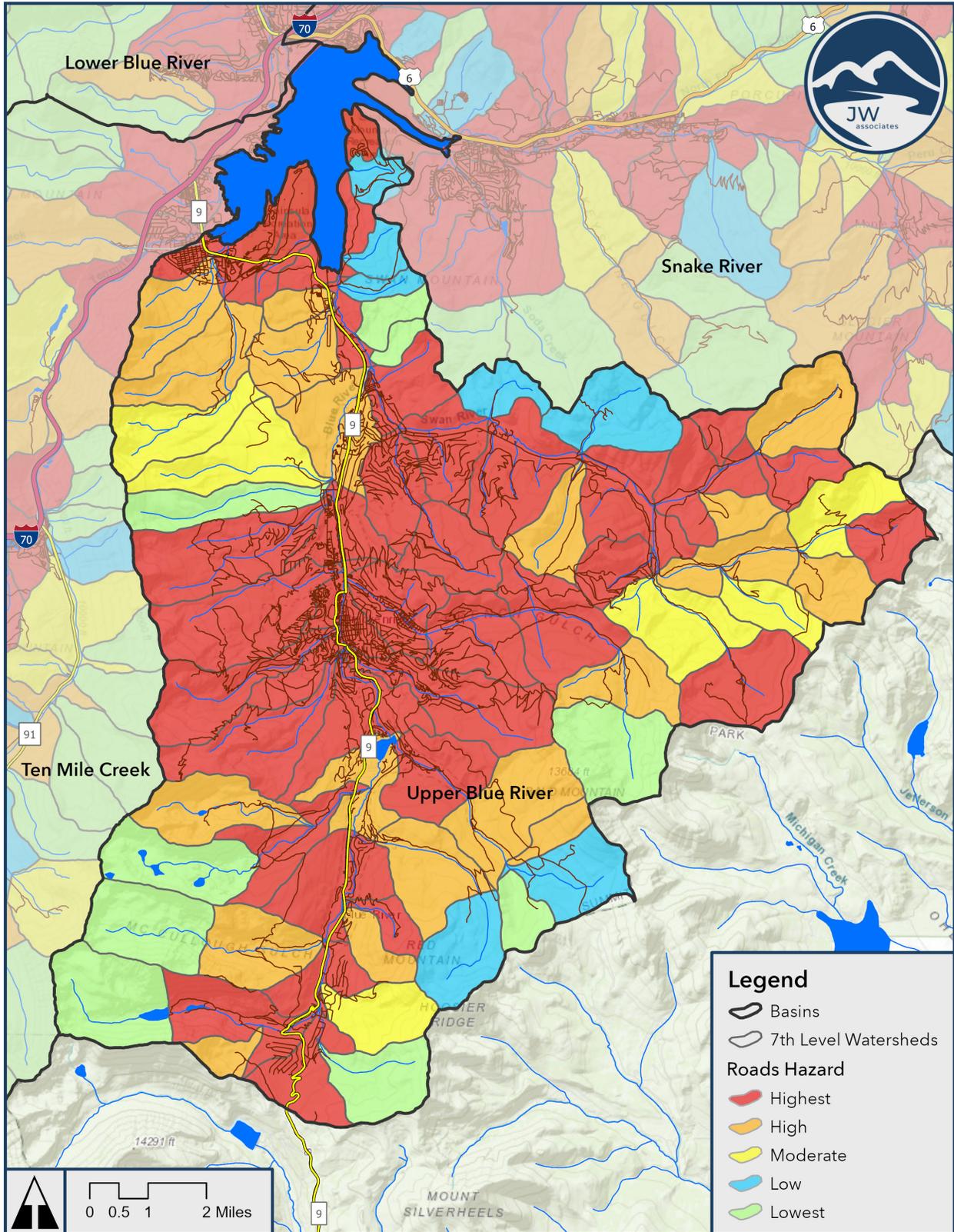
6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME
Coal Creek	Independence Basin
	Upper Coal Creek
	Splains Gulch
	Elk Creek
	Wildcat Creek
	Coon Basin
	Gibson Ridge
	Outlet Coal Creek-Crested Butte
Oh-be-Joyful Creek-Slate River	Middle Middle Slate River
Washington Gulch-Slate River	UT2 to Middle Washington Gulch
	Middle Washington Gulch
	Halazon Ditch-Crested Butte
	Upper Baxter Gulch
	Lower Baxter Gulch
	UT3 to Lower Lower Slate River
	North Red Mountain



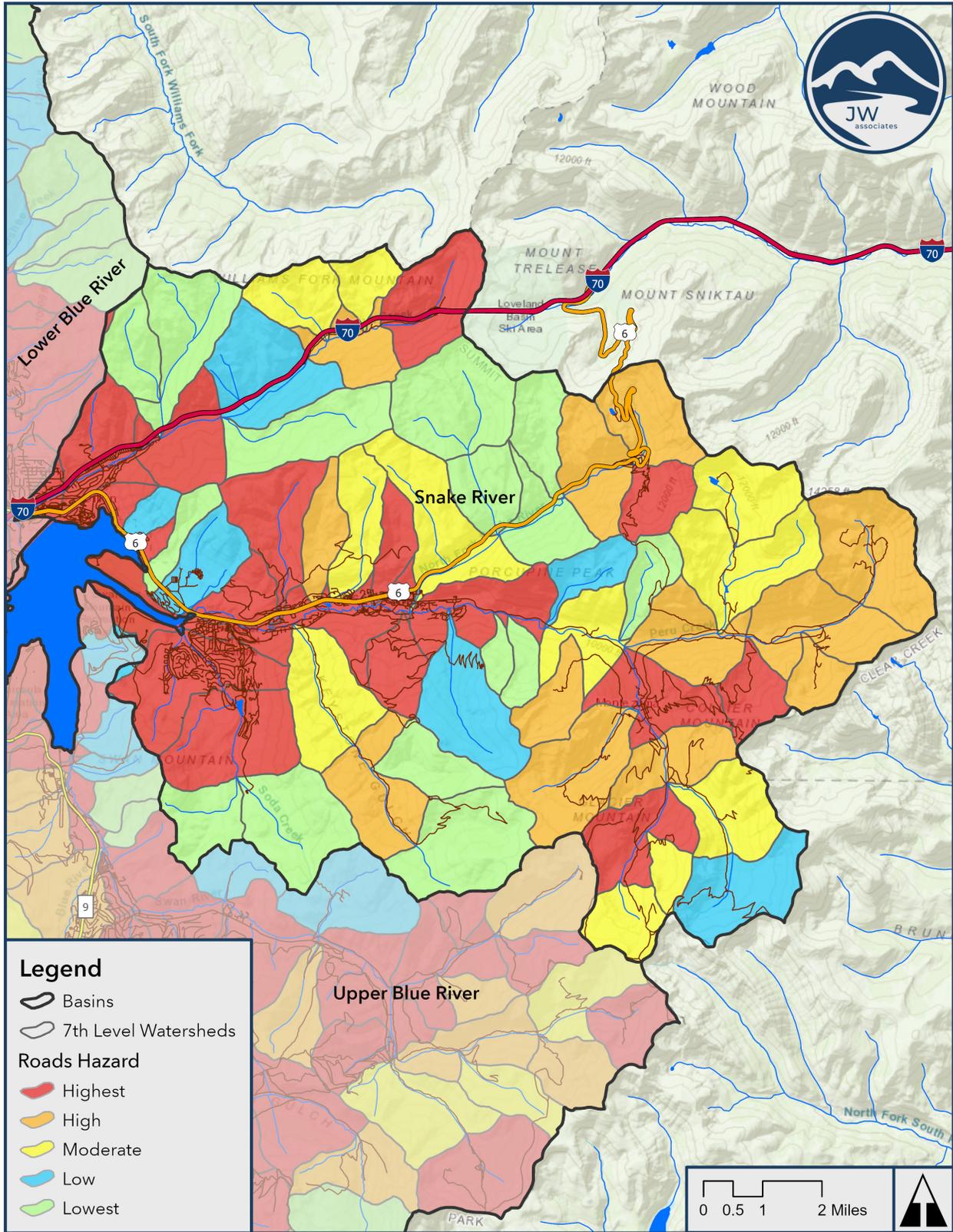




Map 13. Ten Mile Creek Basin Roads Hazard Ranking



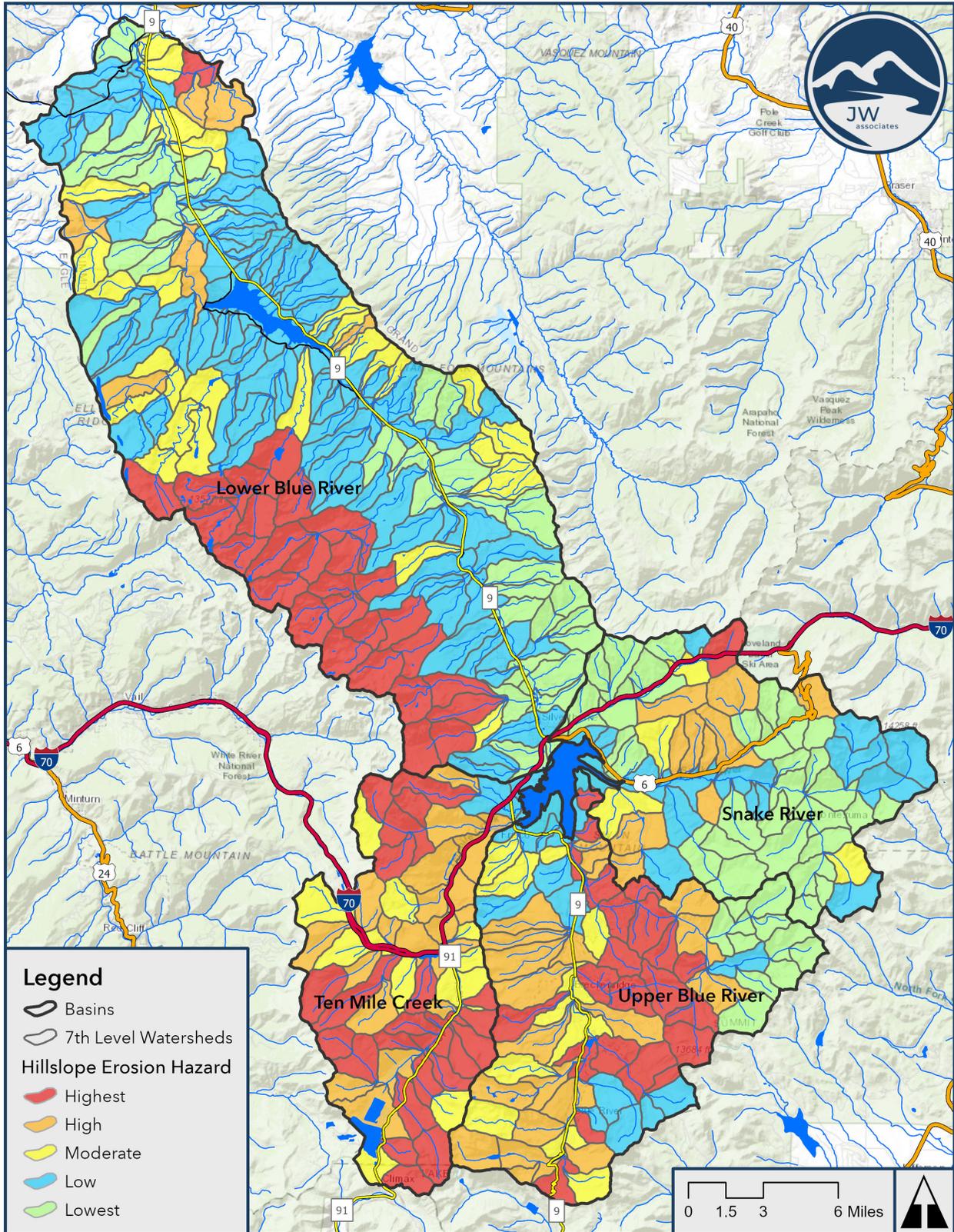
Map 14. Upper Blue River Basin Roads Hazard Ranking



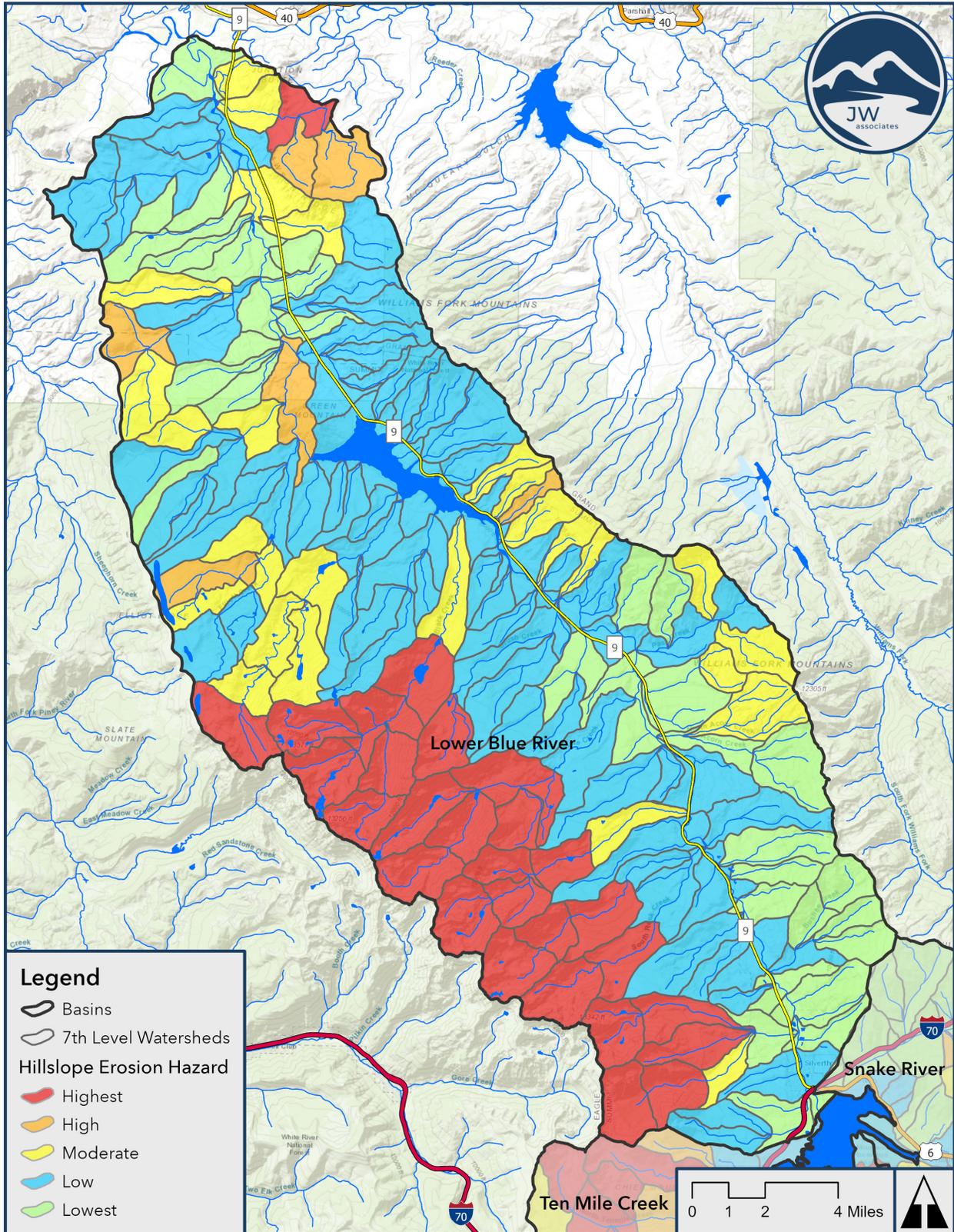
Map 15. Snake River Basin Roads Hazard Ranking

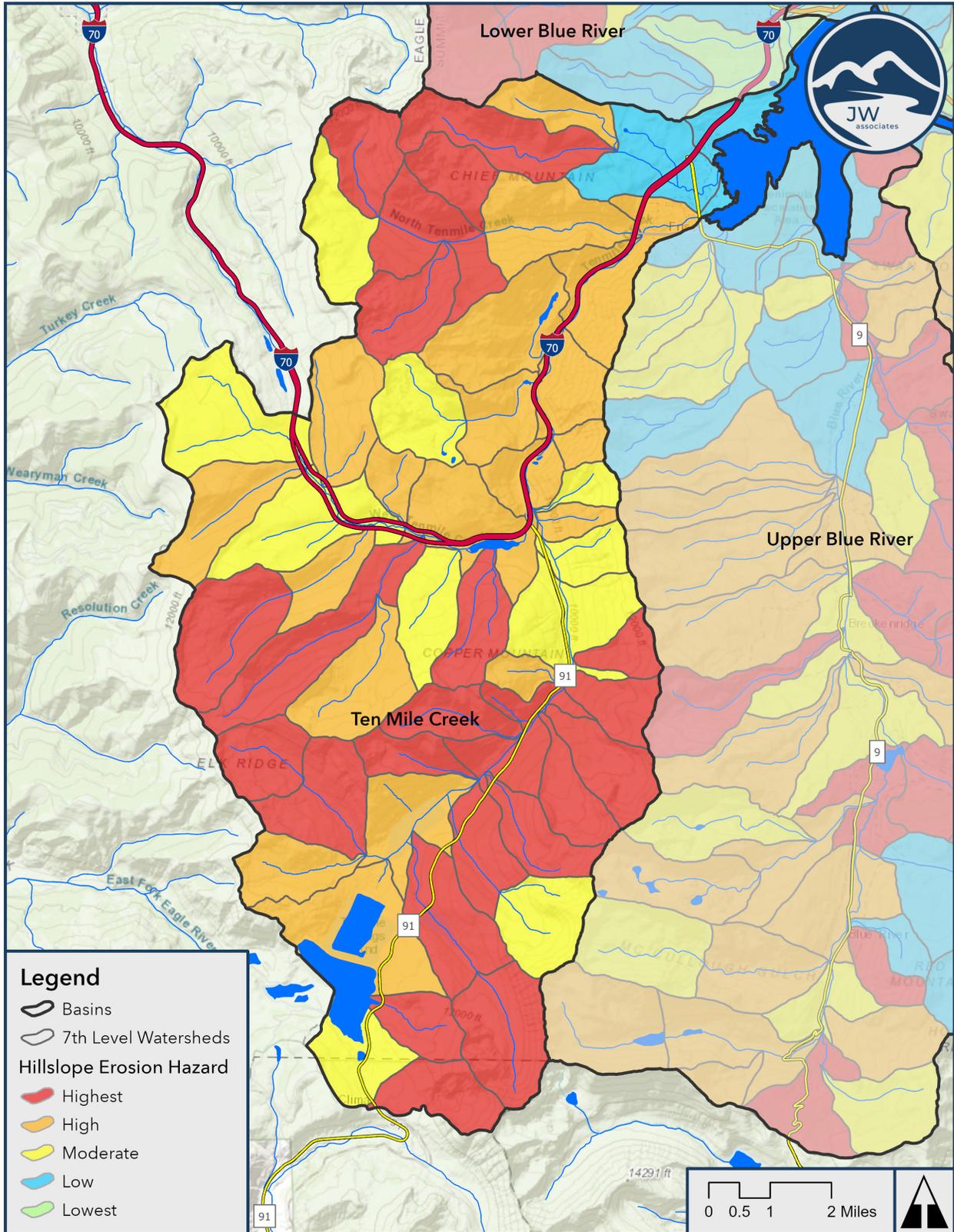
Table 5. Highest Ranked 7th Level Watersheds for Hillslope Erosion Hazard

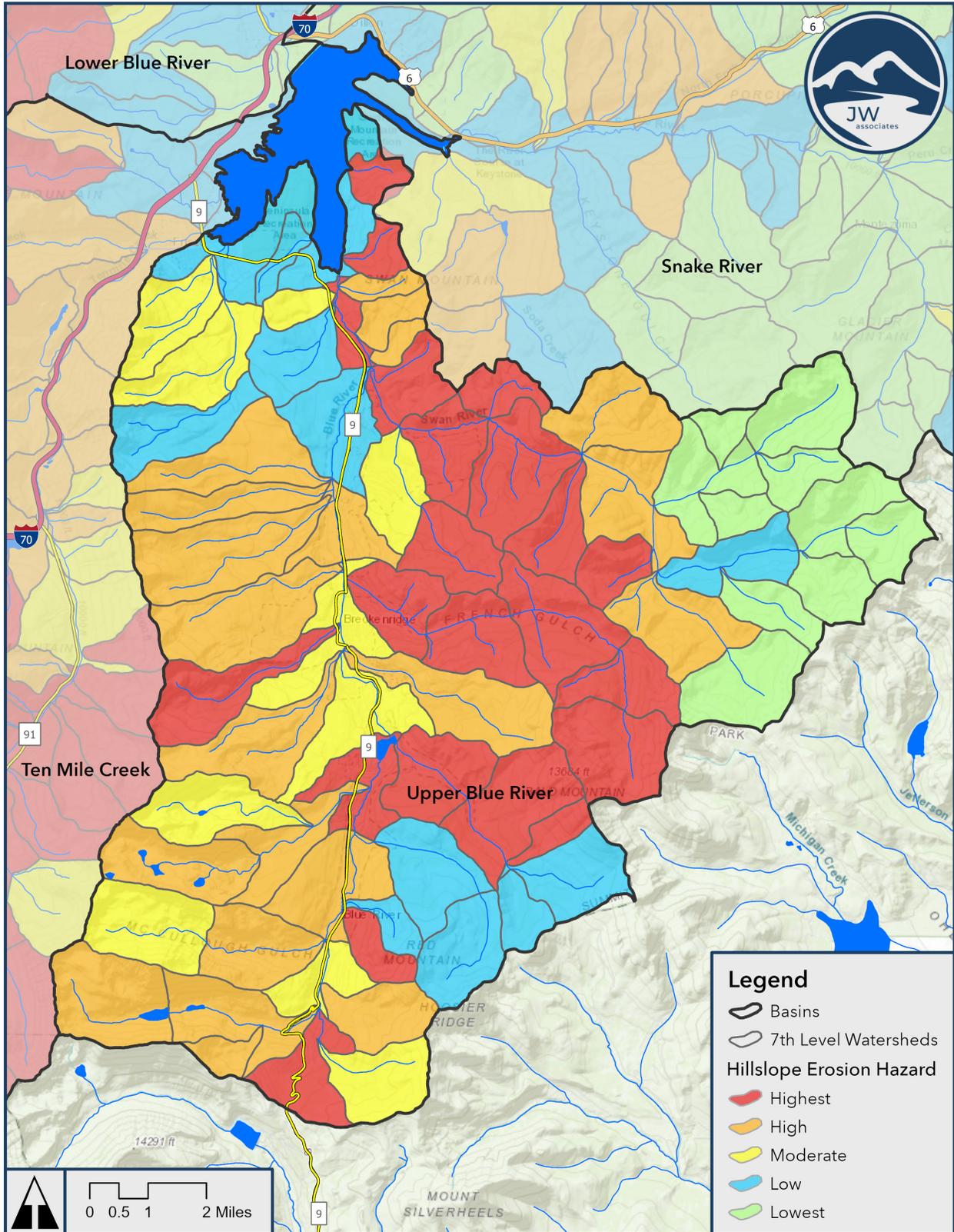
6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME
Coal Creek	Independence Basin
	Upper Coal Creek
	Splains Gulch
	Elk Creek
	Wildcat Creek
	Coon Basin
	Gibson Ridge
	Outlet Coal Creek-Crested Butte
Oh-be-Joyful Creek-Slate River	Middle Middle Slate River
Washington Gulch-Slate River	UT2 to Middle Washington Gulch
	Middle Washington Gulch
	Halazon Ditch-Crested Butte
	Upper Baxter Gulch
	Lower Baxter Gulch
	UT3 to Lower Lower Slate River
	North Red Mountain



Map 16. Blue River Hillslope Erosion Hazard Ranking







Map 19. Upper Blue River Basin Hillslope Erosion Hazard Ranking

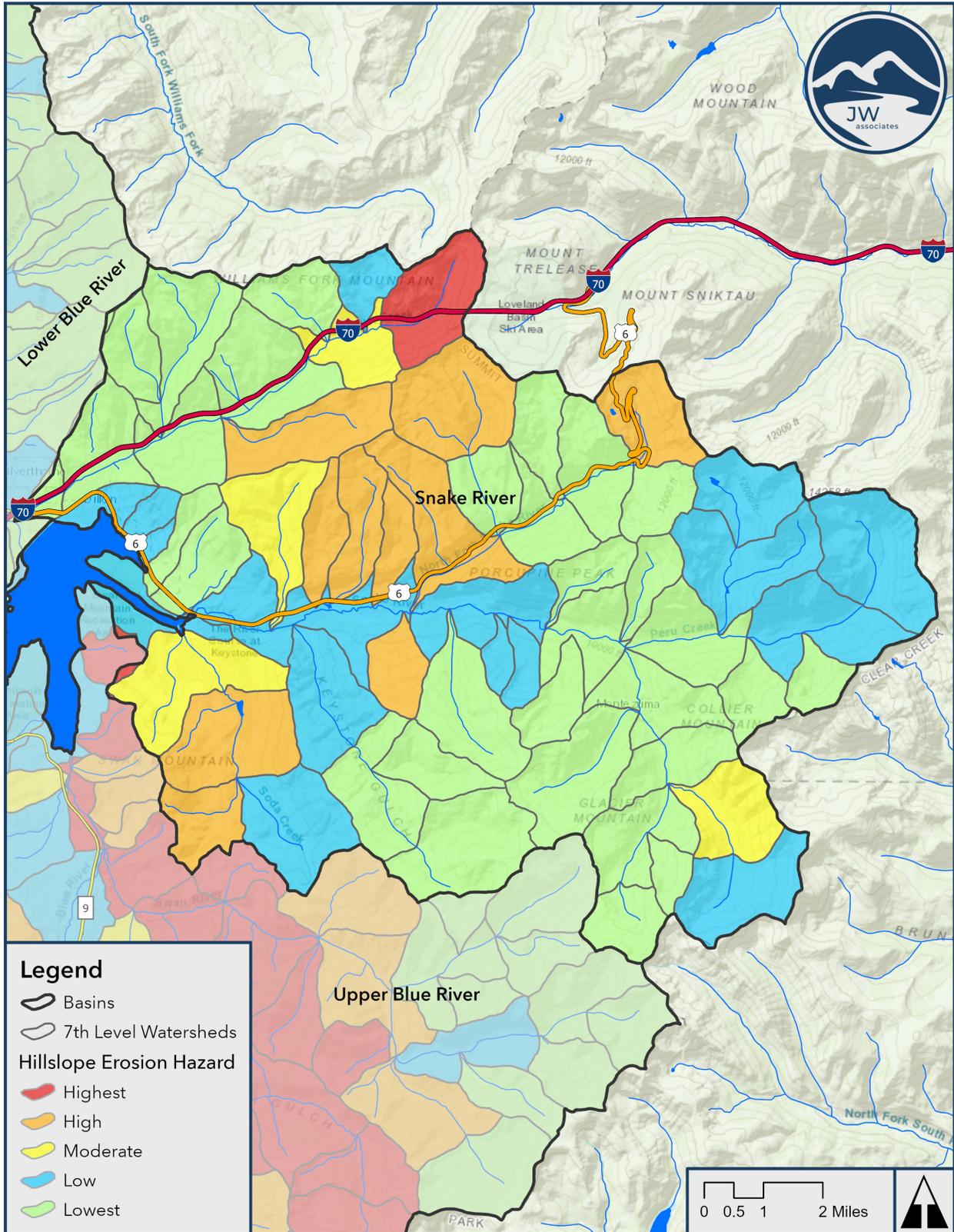
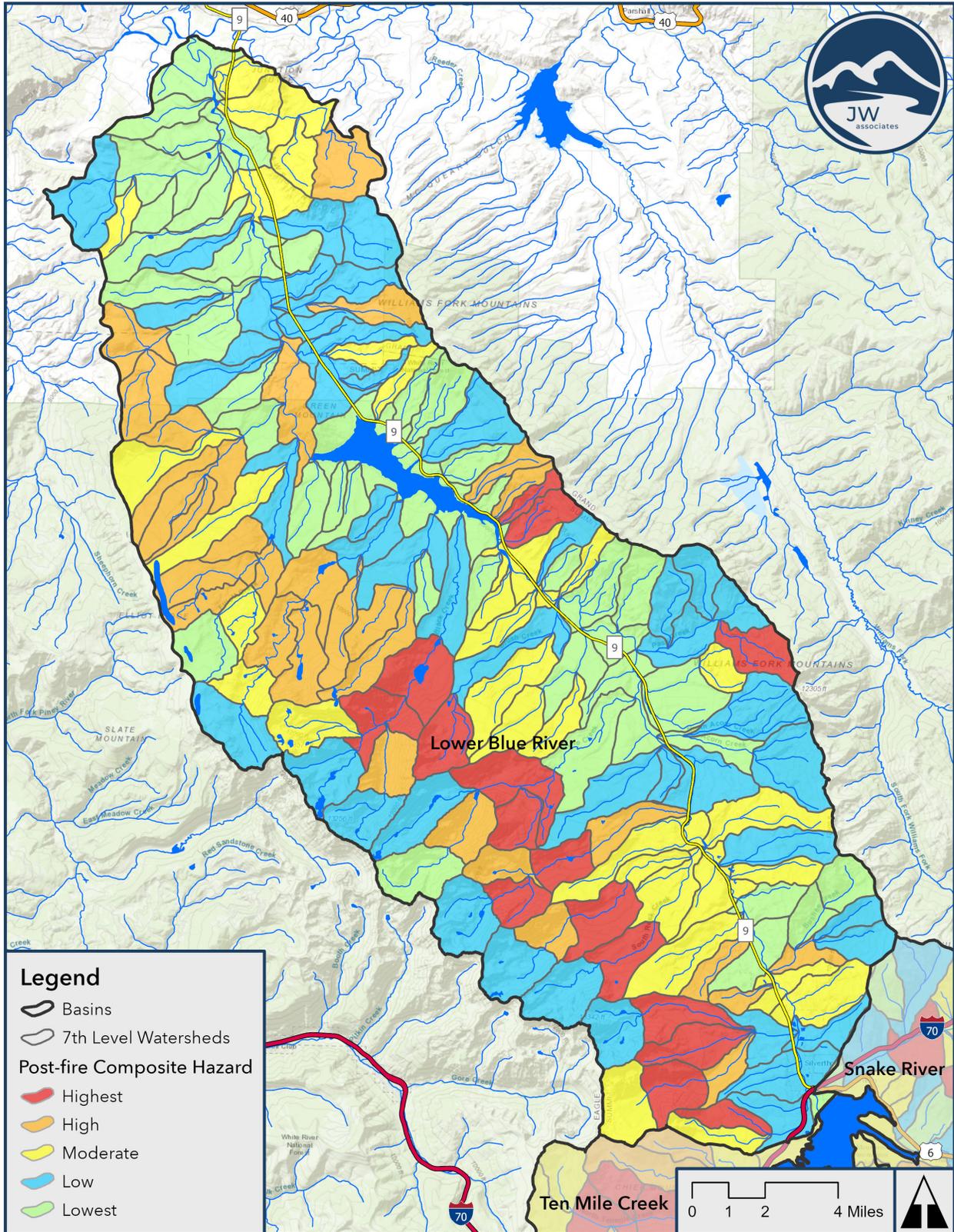
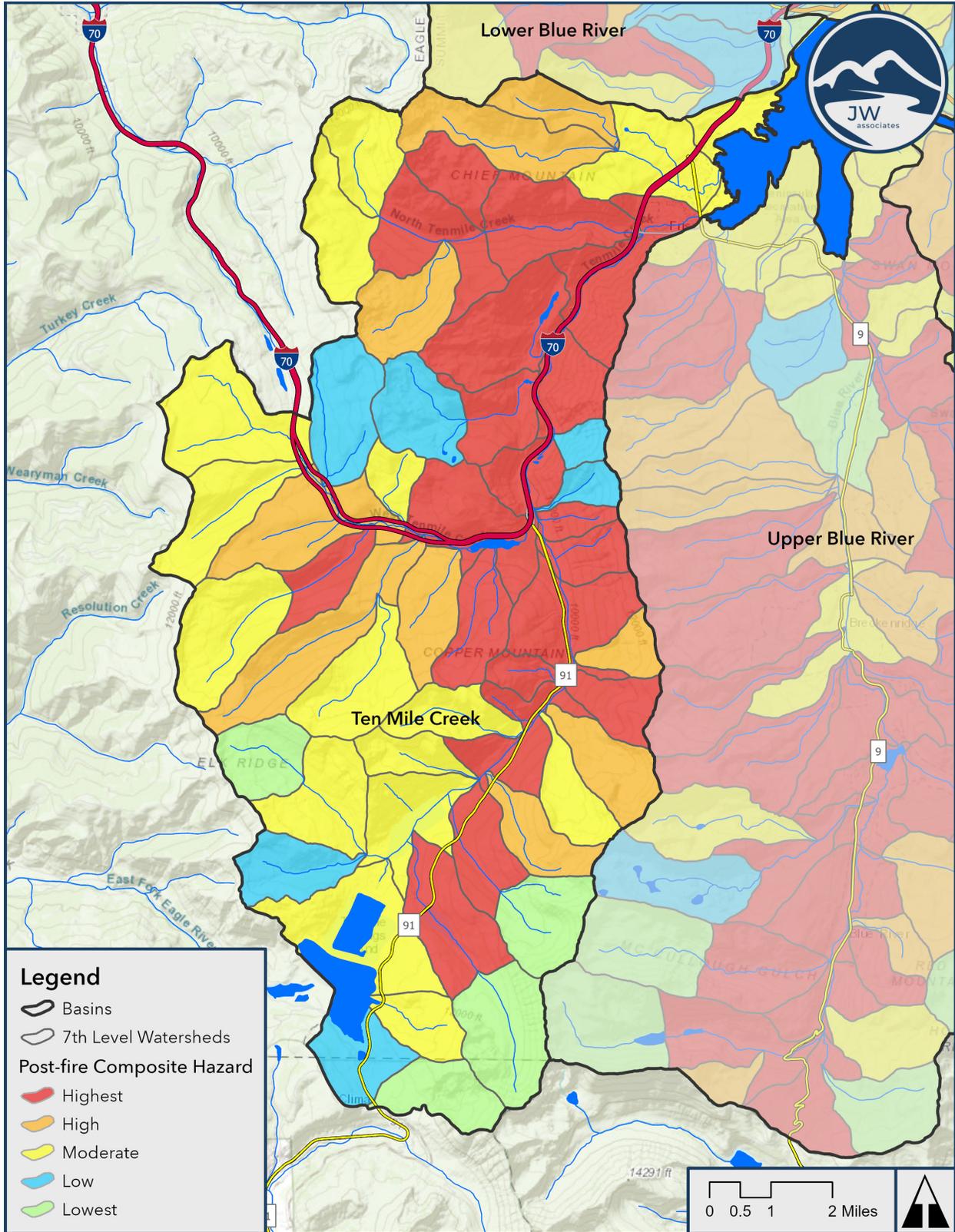


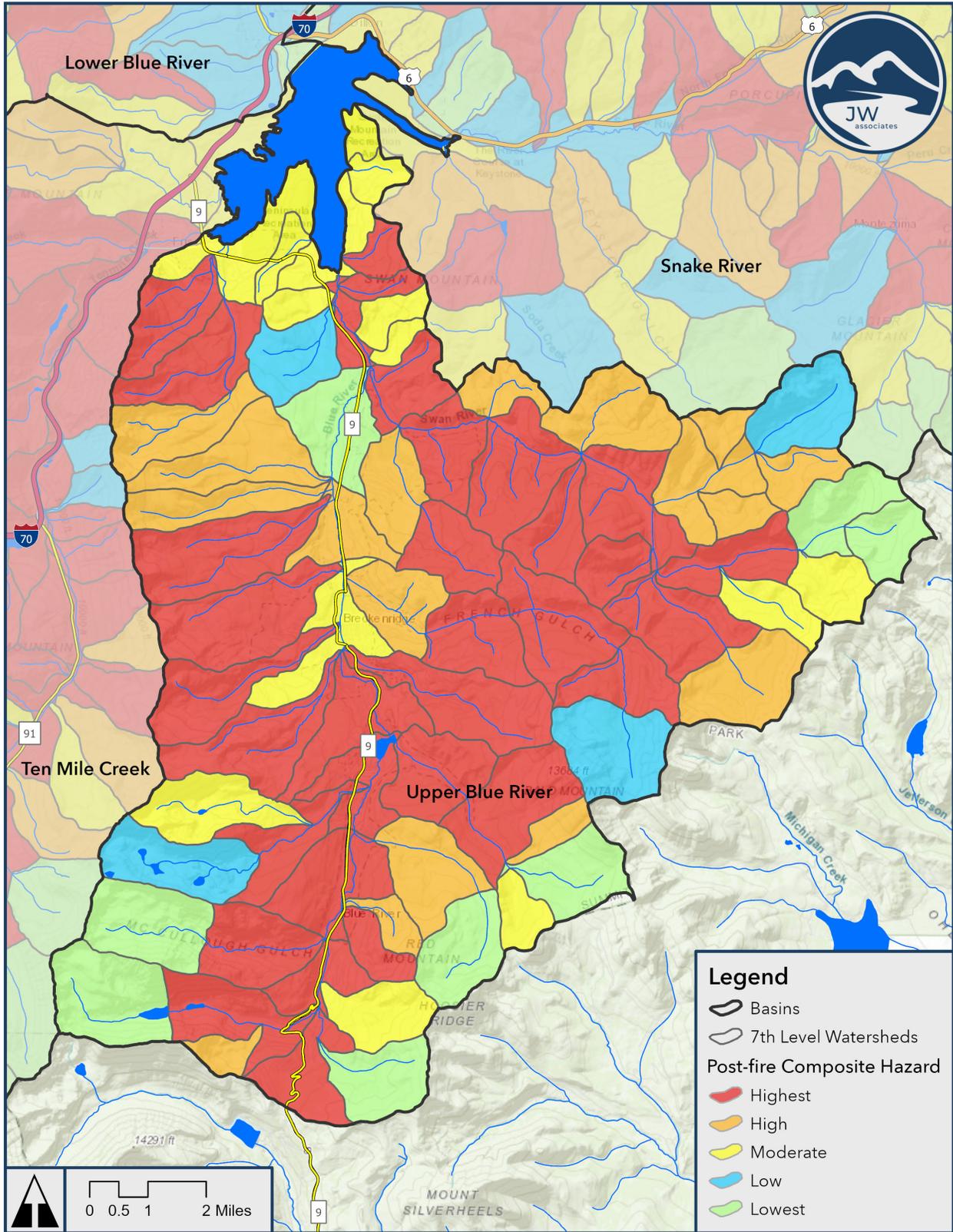
Table 6. Highest Ranked 7th Level Watersheds for Post-fire Composite Hazard

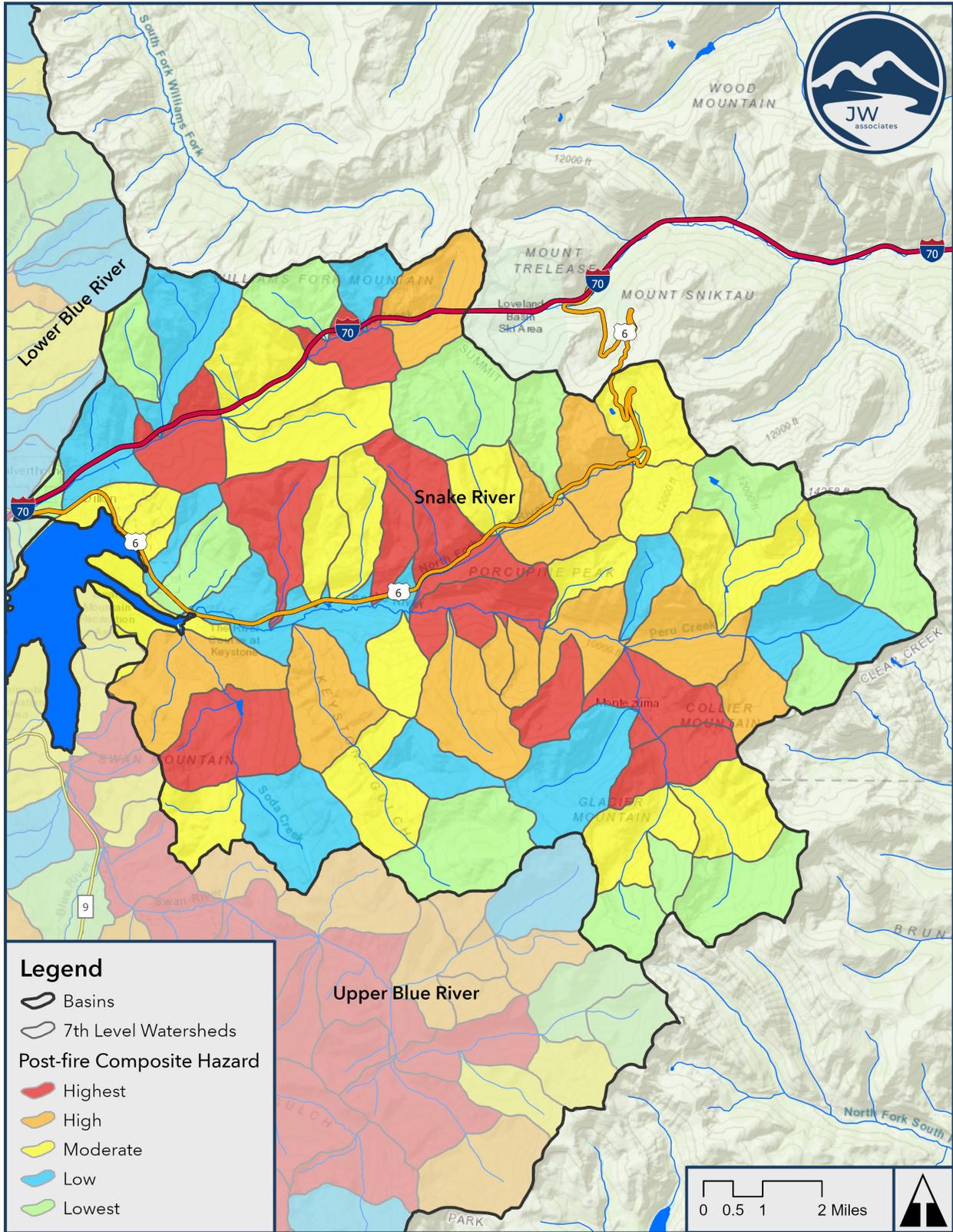
6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME	WILDFIRE HAZARD	DEBRIS FLOW HAZARD	ROADS HAZARD	HILLSLOPE EROSION HAZARD
Coal Creek	Independence Basin	Highest	Moderate	Highest	Highest
	Upper Coal Creek	Highest	Low	Highest	Highest
	Splains Gulch	Highest	Moderate	Lowest	Highest
	Middle Coal Creek	Highest	Highest	Moderate	High
	Wildcat Creek	Highest	High	Low	Highest
	Lower Coal Creek	Highest	Moderate	High	High
	Coon Basin	Highest	High	Highest	Highest
	Gibson Ridge	Highest	Moderate	High	Highest
	Outlet Coal Creek-Crested Butte	High	Low	Highest	Highest
Washington Gulch-Slate River	UT2 to Middle Washington Gulch	Highest	Low	Moderate	Highest
	Middle Washington Gulch	Highest	High	Lowest	Highest
	Halazon Ditch-Crested Butte	High	Lowest	High	Highest
	Lower Baxter Gulch	Highest	Highest	Moderate	Highest
	North Red Mountain	Highest	Low	Moderate	Highest
Ruby Anthracite Creek	Ruby Anthracite Below Lake Irwin	Highest	High	Highest	High





Map 23. Ten Mile Creek Basin Post-fire Composite Hazard Ranking

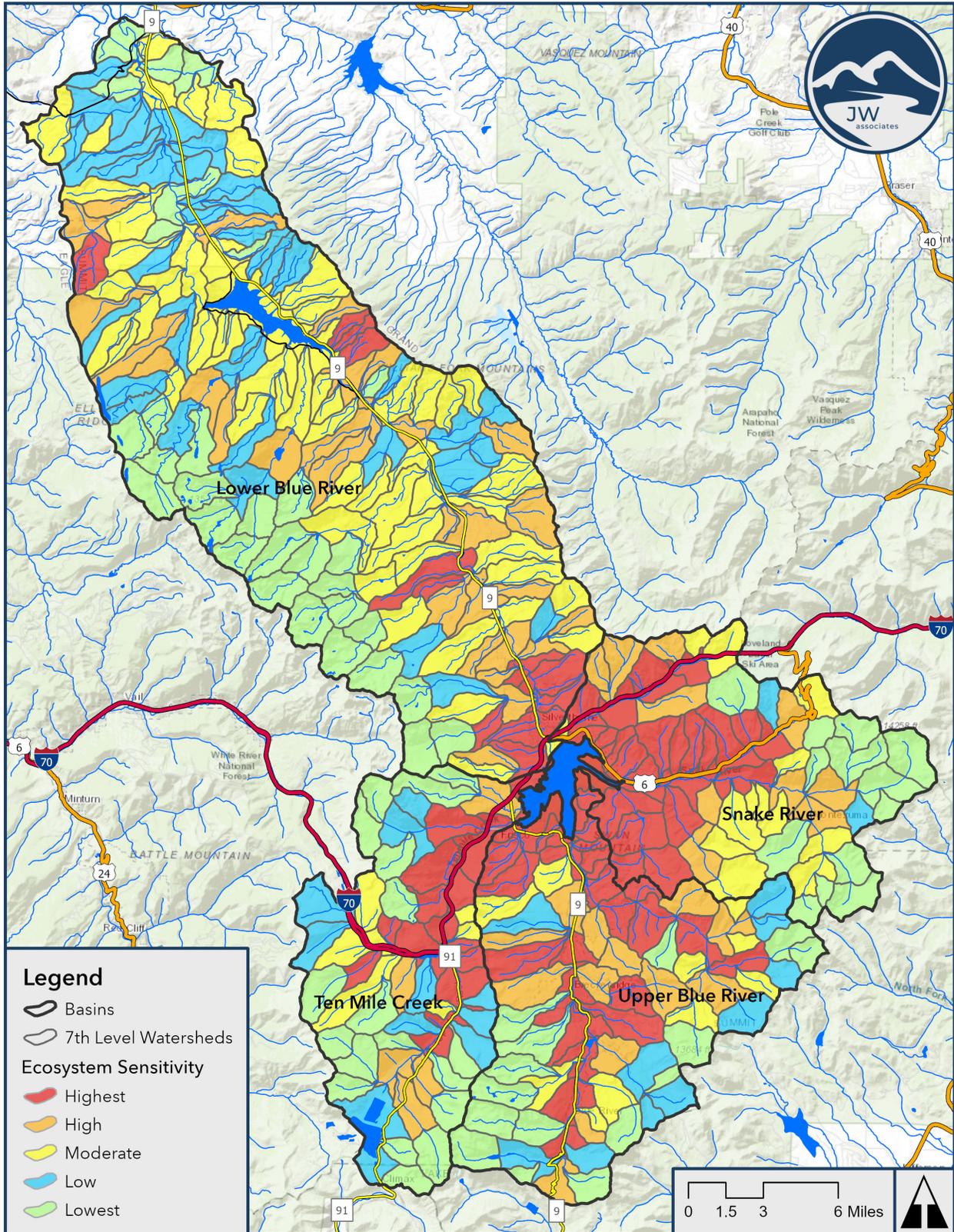




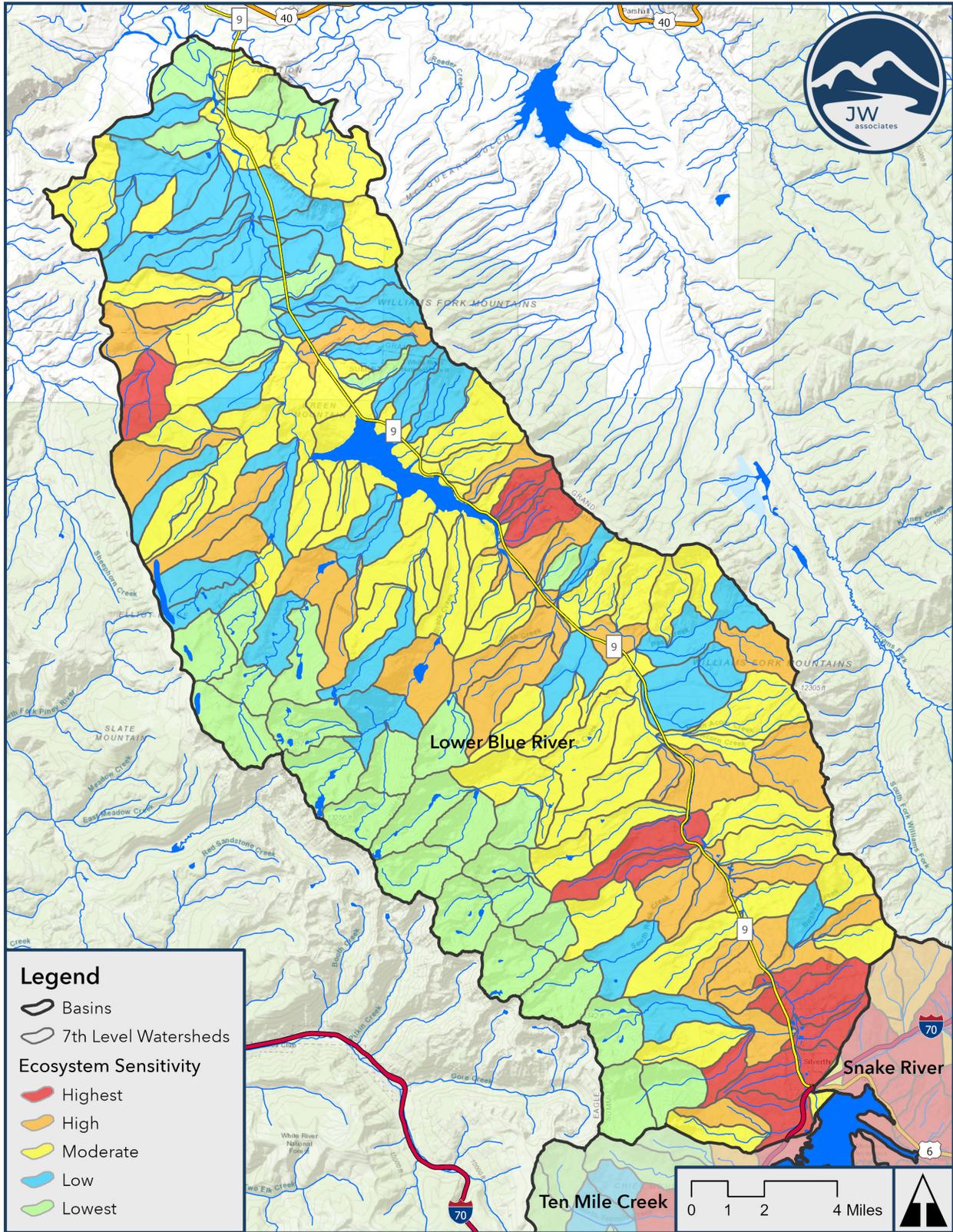
Map 25. Snake River Basin Post-fire Composite Hazard Ranking

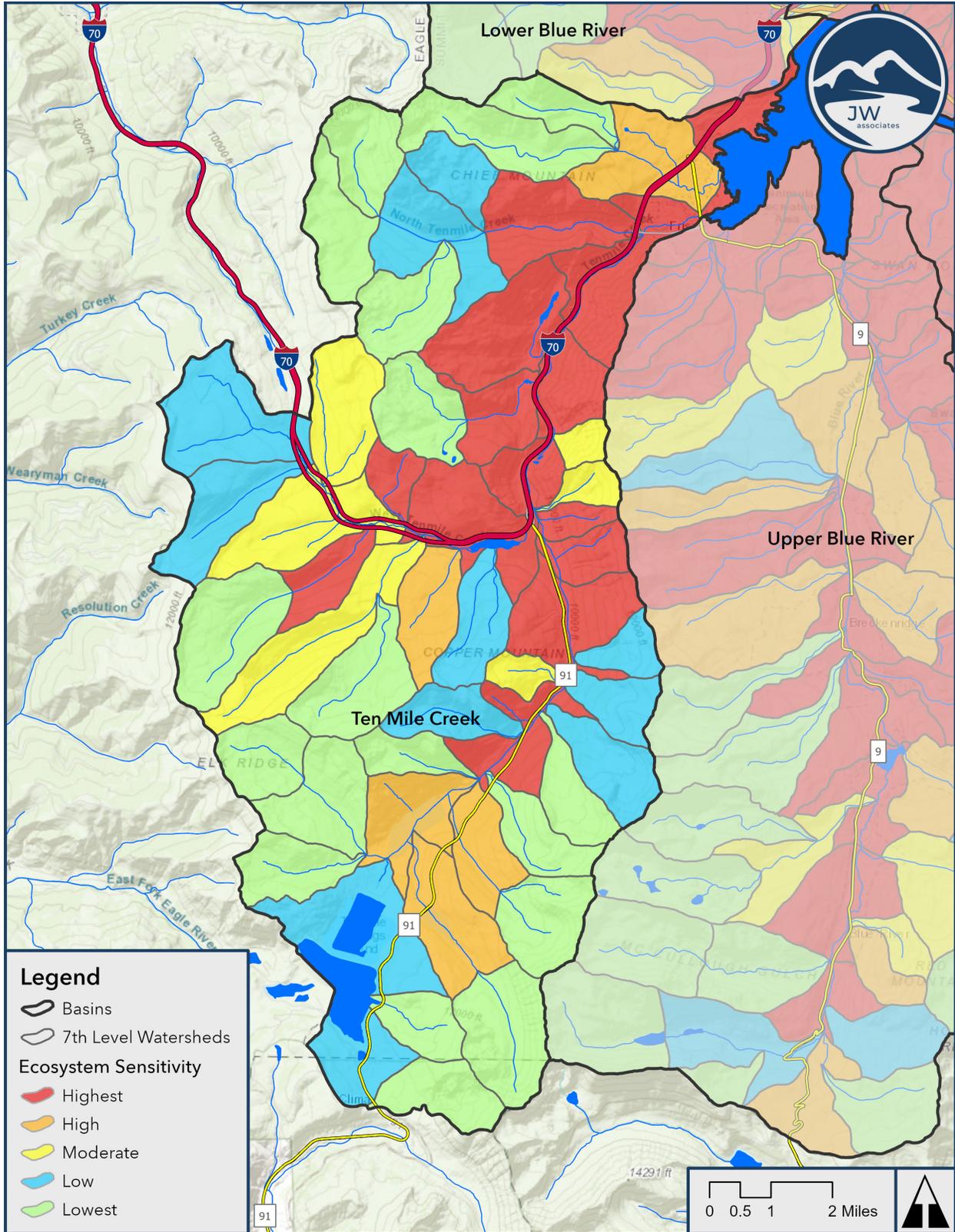
Table 7. Highest Ranked 7th Level Watersheds for Ecosystem Sensitivity Hazard

6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME	LANDSCAPE CONDITION	FOREST RESILIENCE	INSECT & DISEASE
Coal Creek	Independence Basin	Highest	High	Highest
	Upper Coal Creek	Highest	Moderate	Highest
	Splains Gulch	Moderate	High	Highest
	Elk Creek	High	Moderate	Highest
	Middle Coal Creek	Highest	Highest	High
	Lower Coal Creek	Highest	Highest	High
	Coon Basin	Moderate	Highest	Highest
	Gibson Ridge	High	Highest	Highest
	Outlet Coal Creek-Crested Butte	Highest	Highest	Moderate
Washington Gulch-Slate River	UT2 to Middle Washington Gulch	Low	Highest	Highest
	Halazon Ditch-Crested Butte	Highest	Highest	High
	Lower Baxter Gulch	Moderate	Highest	Moderate
	UT3 to Lower Lower Slate River	Moderate	Highest	High
Ruby Anthracite Creek	Ruby Anthracite Creek Below Lake Irwin	Highest	Highest	Highest

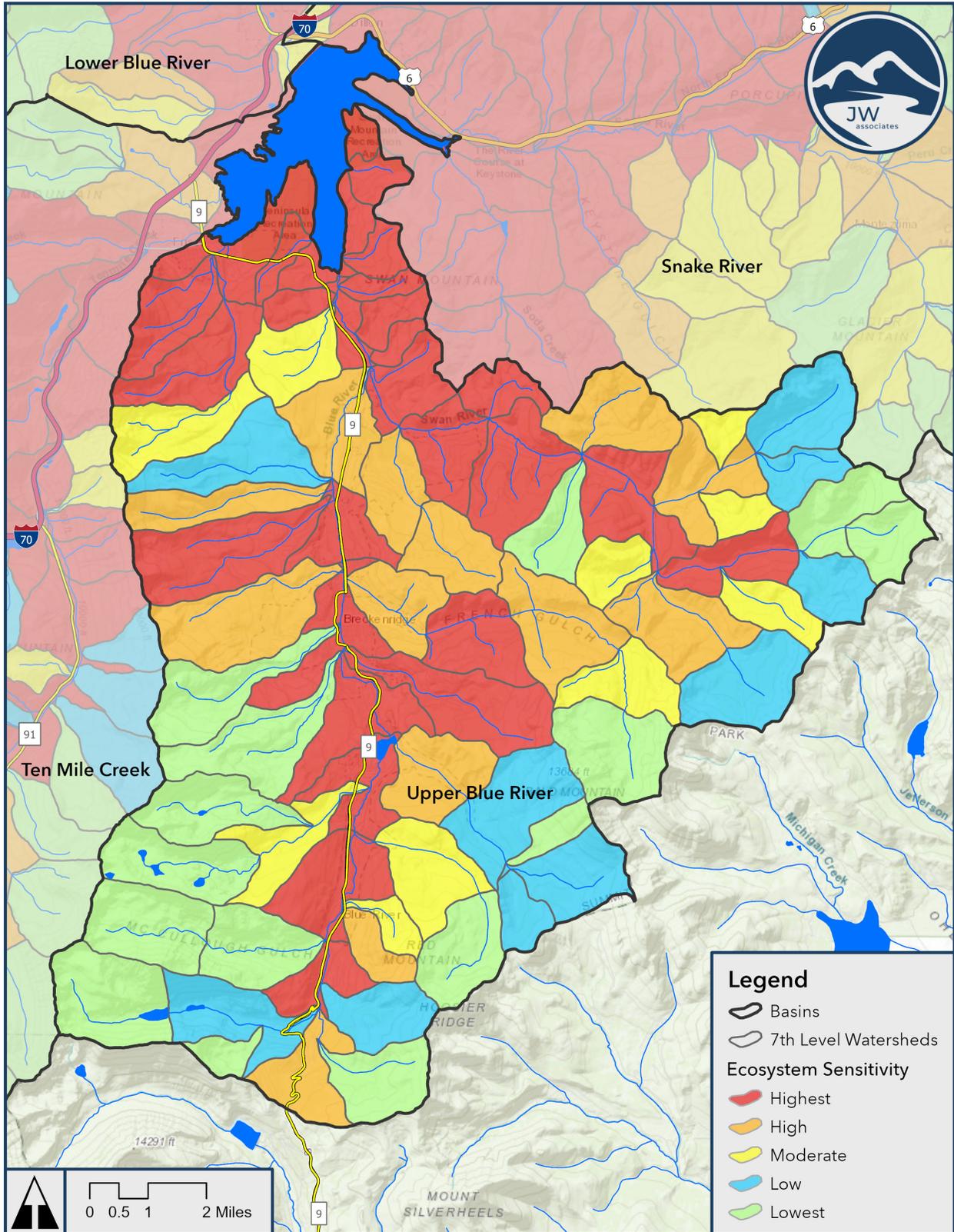


Map 26. Blue River Ecosystem Sensitivity Hazard Ranking





Map 28. Ten Mile Creek Basin Ecosystem Sensitivity Hazard Ranking



Map 29. Upper Blue River Basin Ecosystem Sensitivity Hazard Ranking

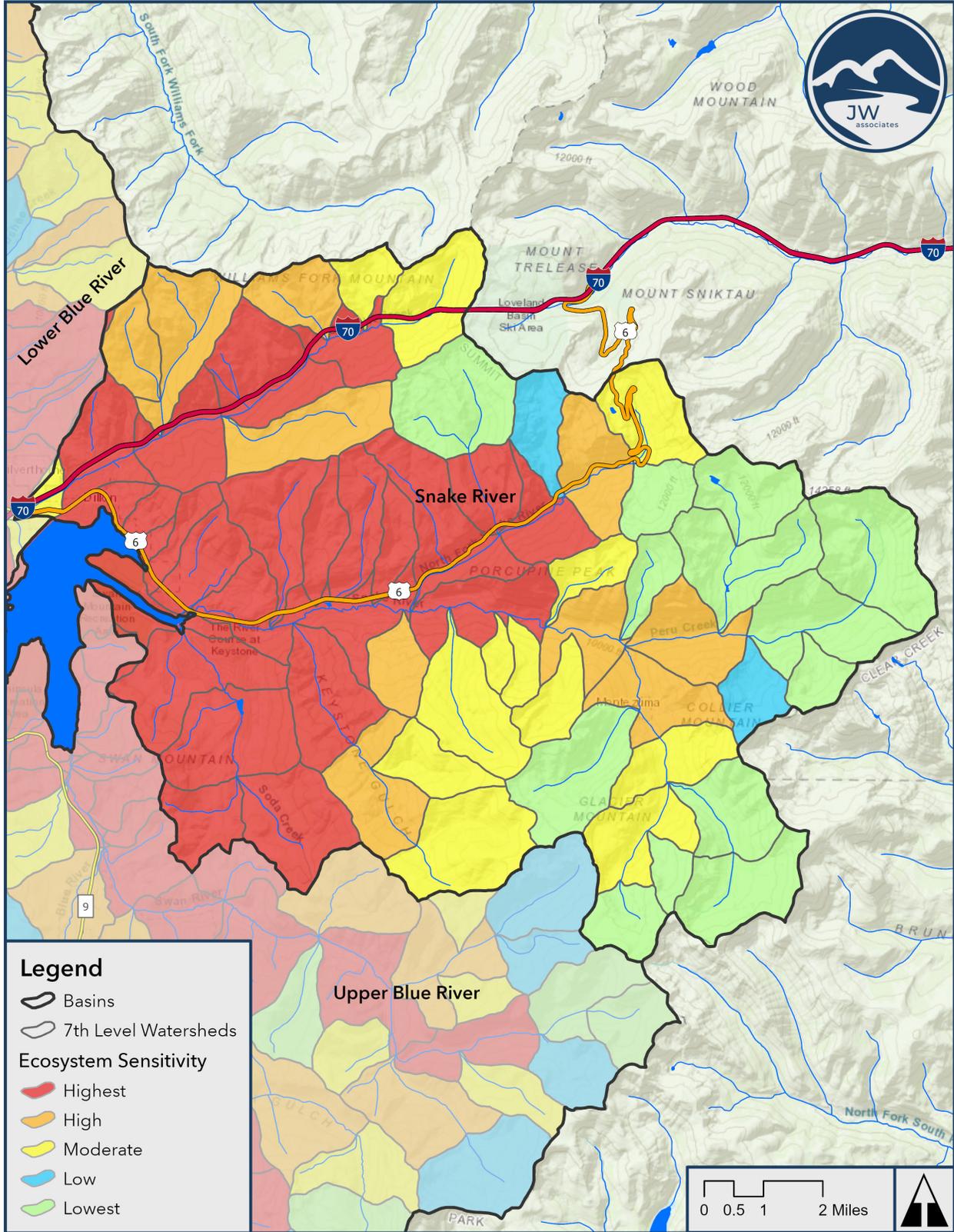
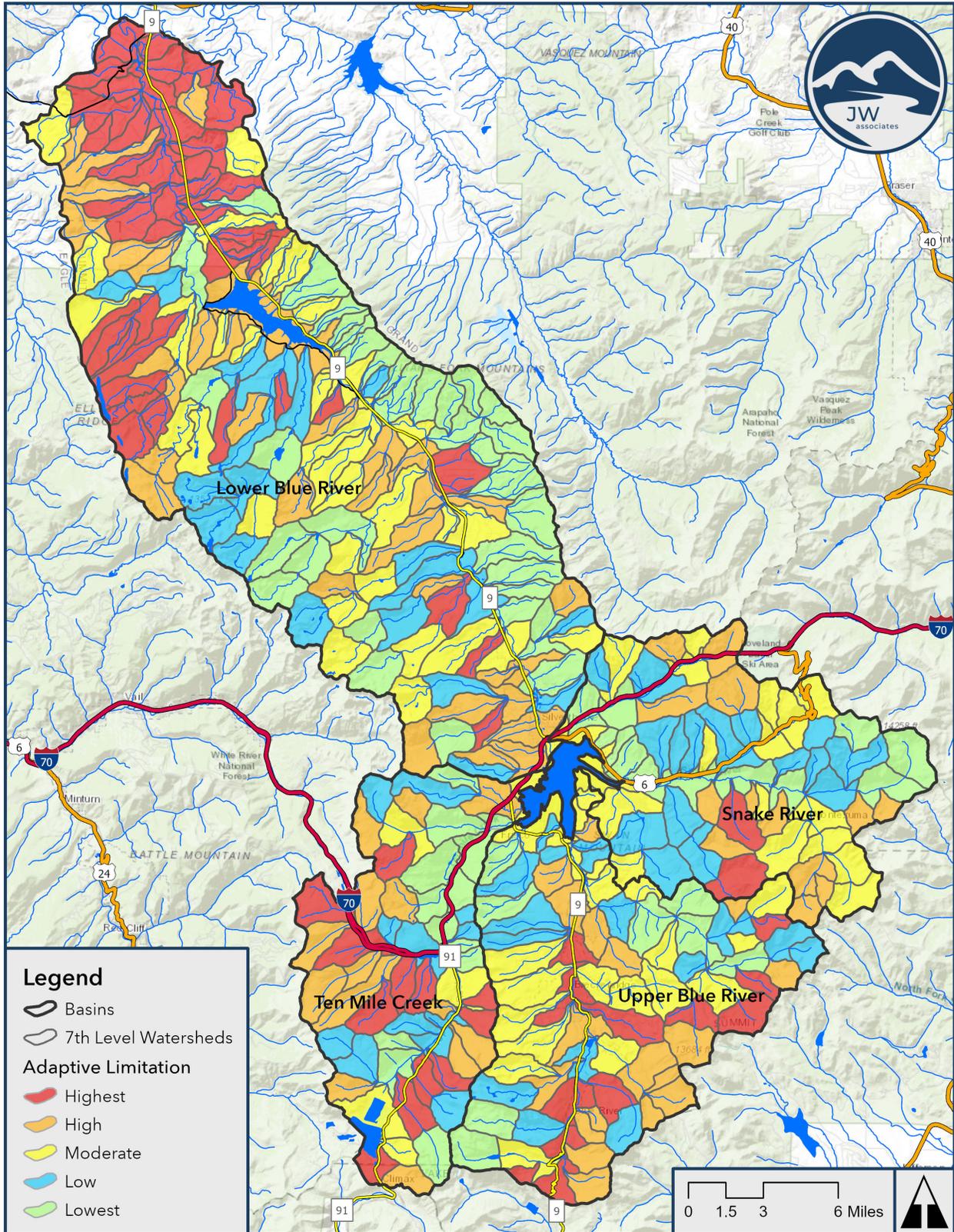
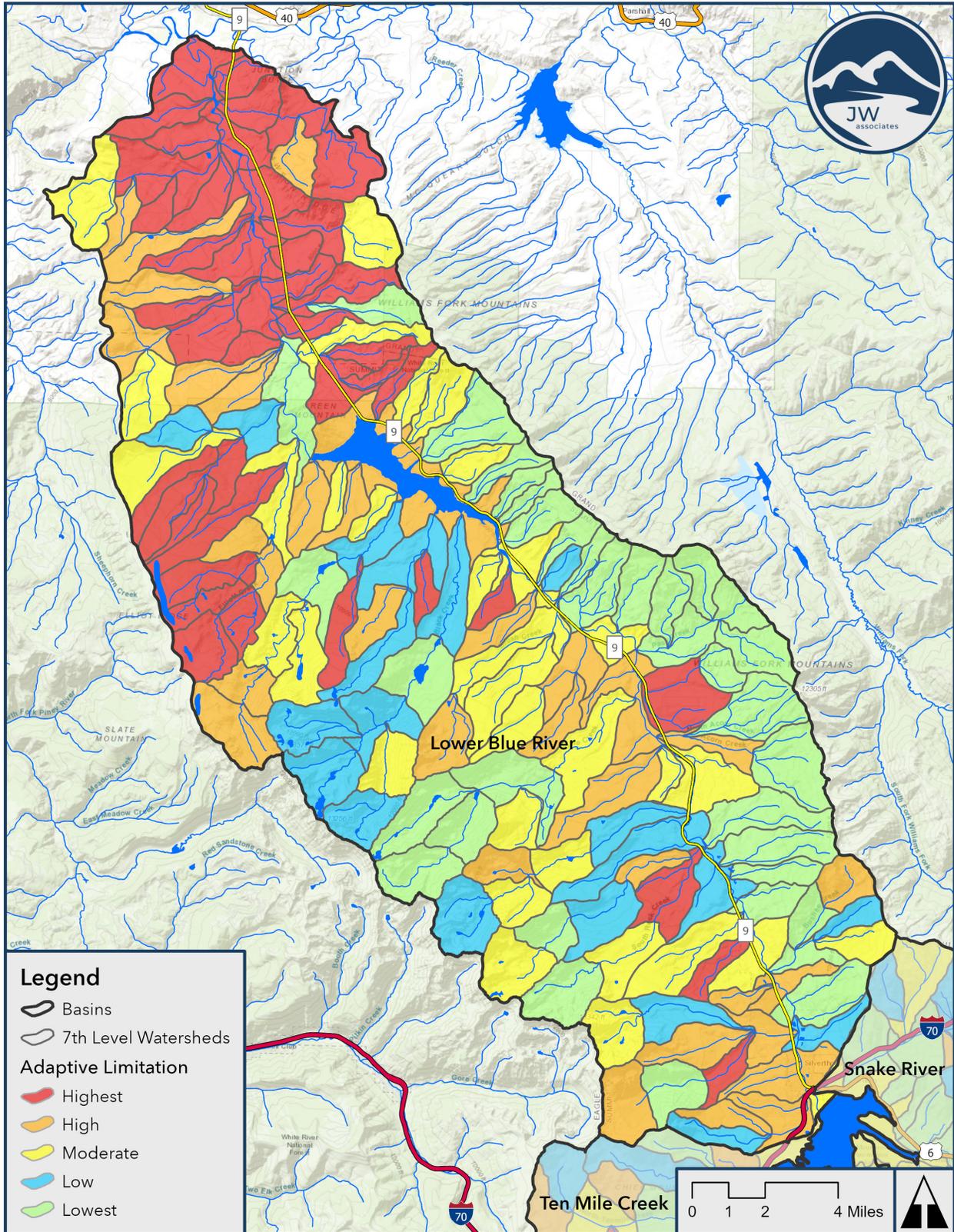


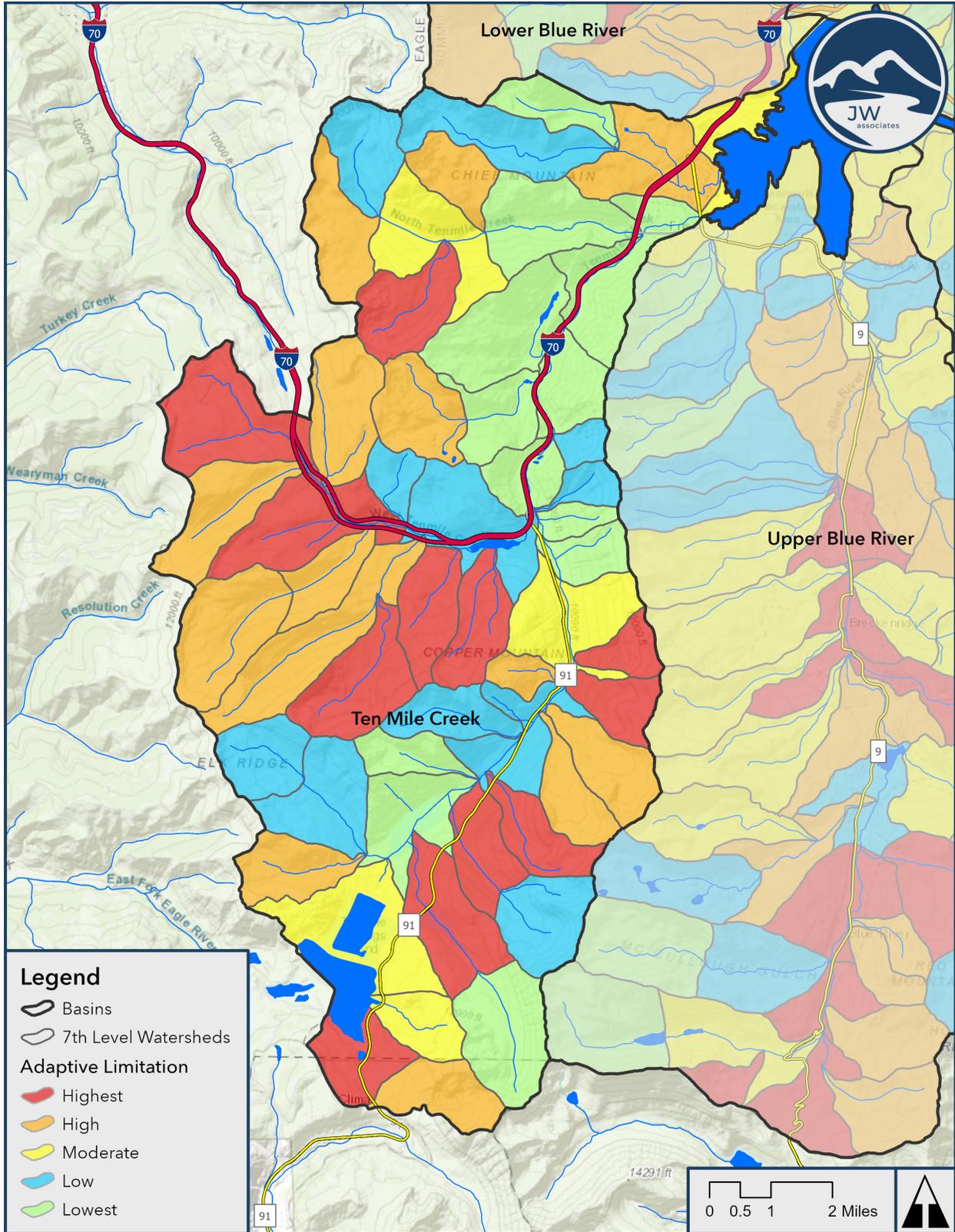
Table 8. Highest Ranked 7th Level Watersheds for Adaptive Limitation Hazard

6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME	VEGETATION TYPE DIVERSITY	TOPO-CLIMATIC VARIABILITY
Coal Creek	Independence Basin	Highest	High
	UT1 to Upper Coal Creek	Highest	Highest
	UT2 to Upper Coal Creek	Highest	Highest
	Upper Coal Creek	Highest	High
	Splains Gulch	Highest	High
	Wildcat Creek	Highest	Moderate
	Gibson Ridge	Highest	Moderate
	Outlet Coal Creek-Crested Butte	Low	Highest
Washington Gulch-Slate River	Upper Lower Slate River	High	Highest
	Upper Baxter Gulch	High	Moderate
	North Red Mountain	Highest	High
Ruby Anthracite Creek	UT to Lake Irwin	Highest	Moderate
	Lake Irwin	Highest	Highest
	Ruby Anthracite Below Lake Irwin	Highest	Moderate

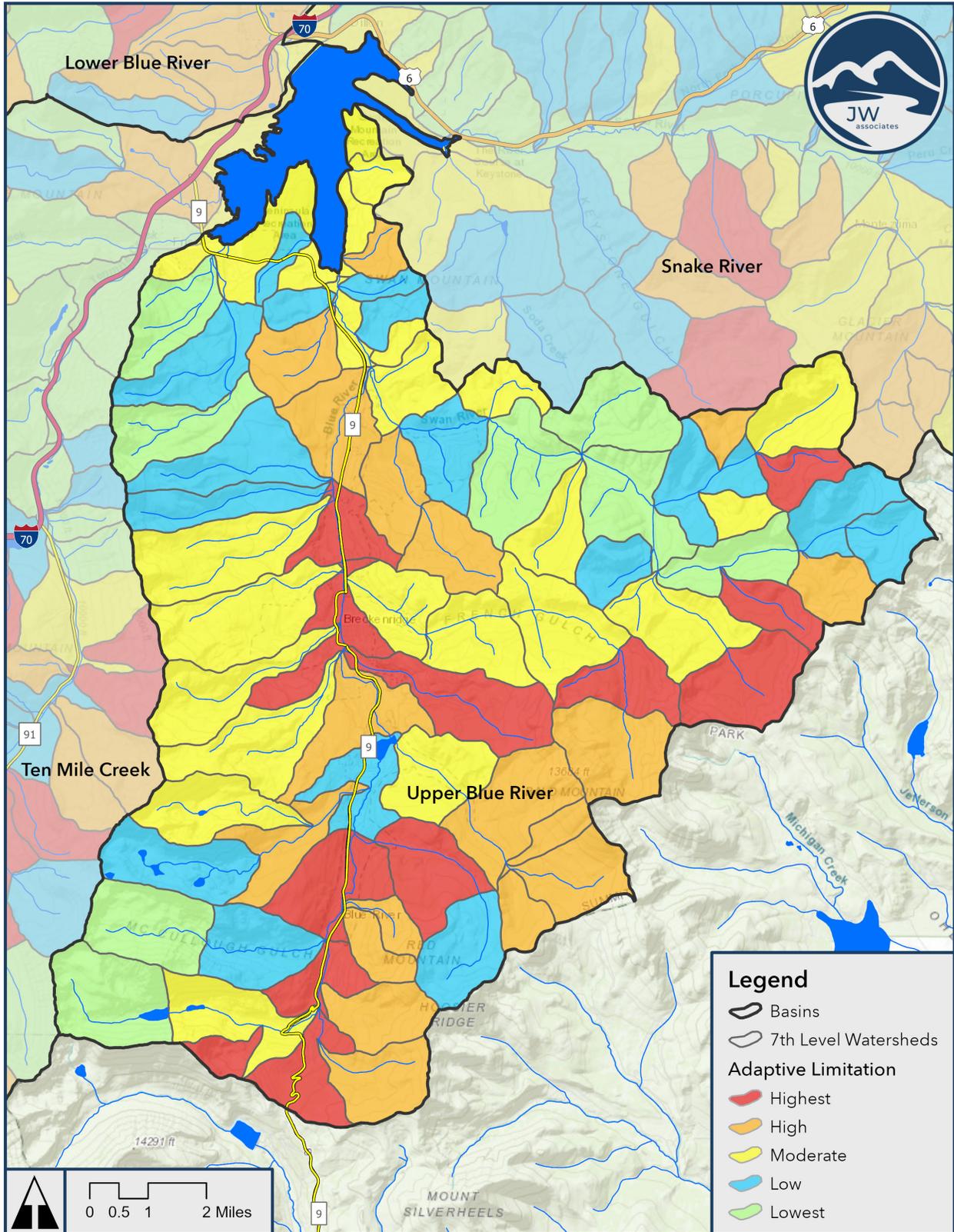


Map 31. Blue River Adaptive Limitation Hazard Ranking

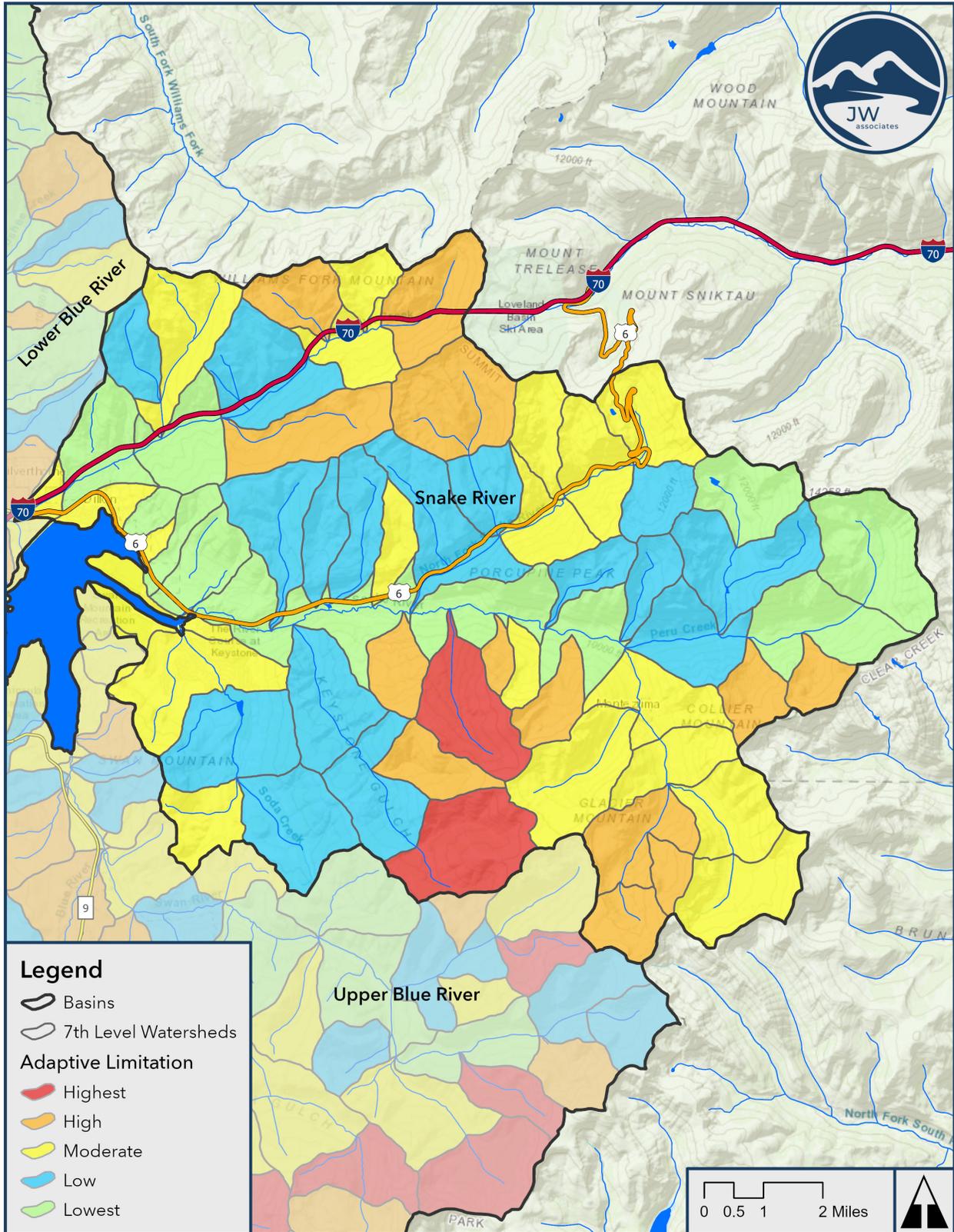




Map 33. Ten Mile Creek Basin Adaptive Limitation Hazard Ranking



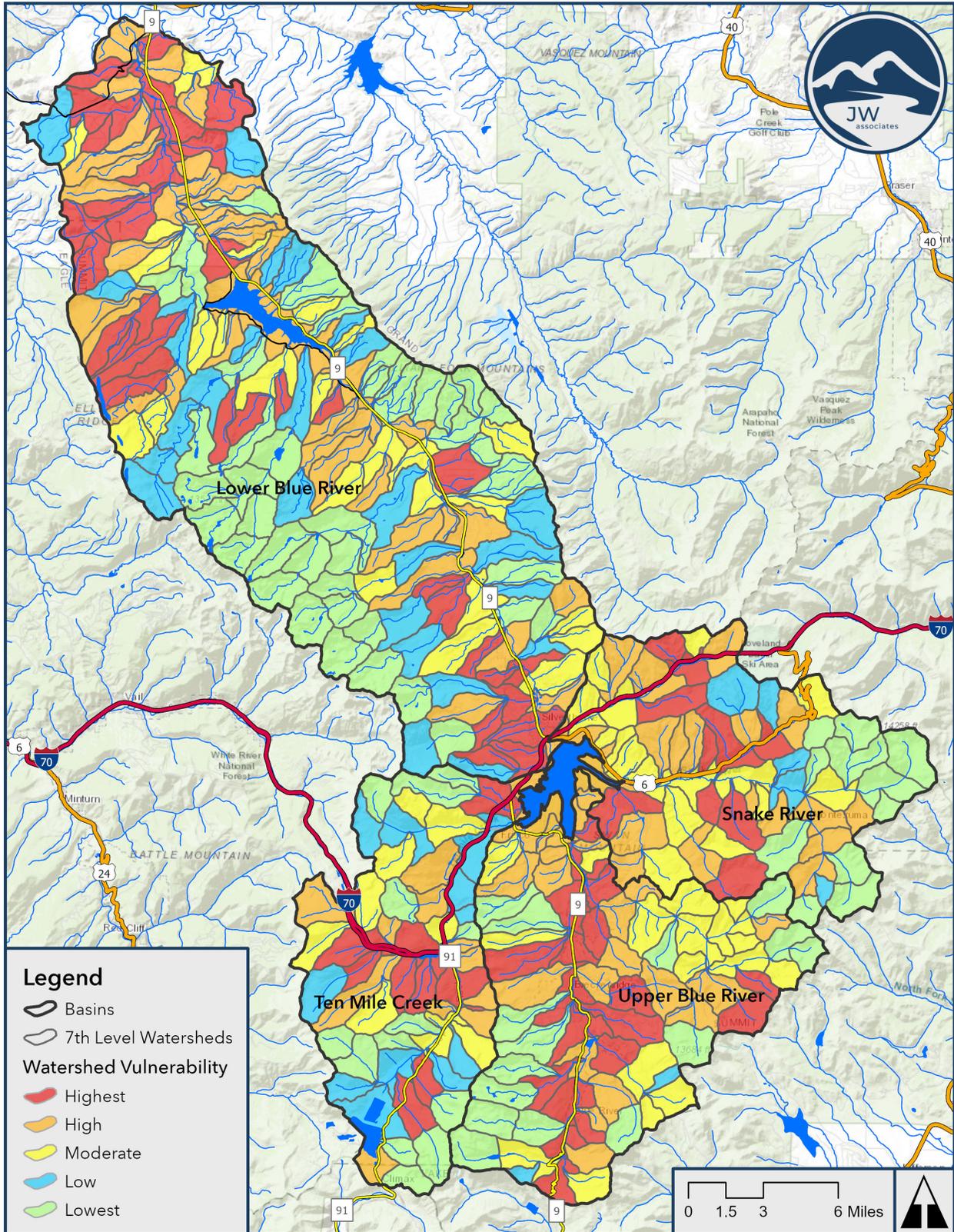
Map 34. Upper Blue River Basin Adaptive Limitation Hazard Ranking



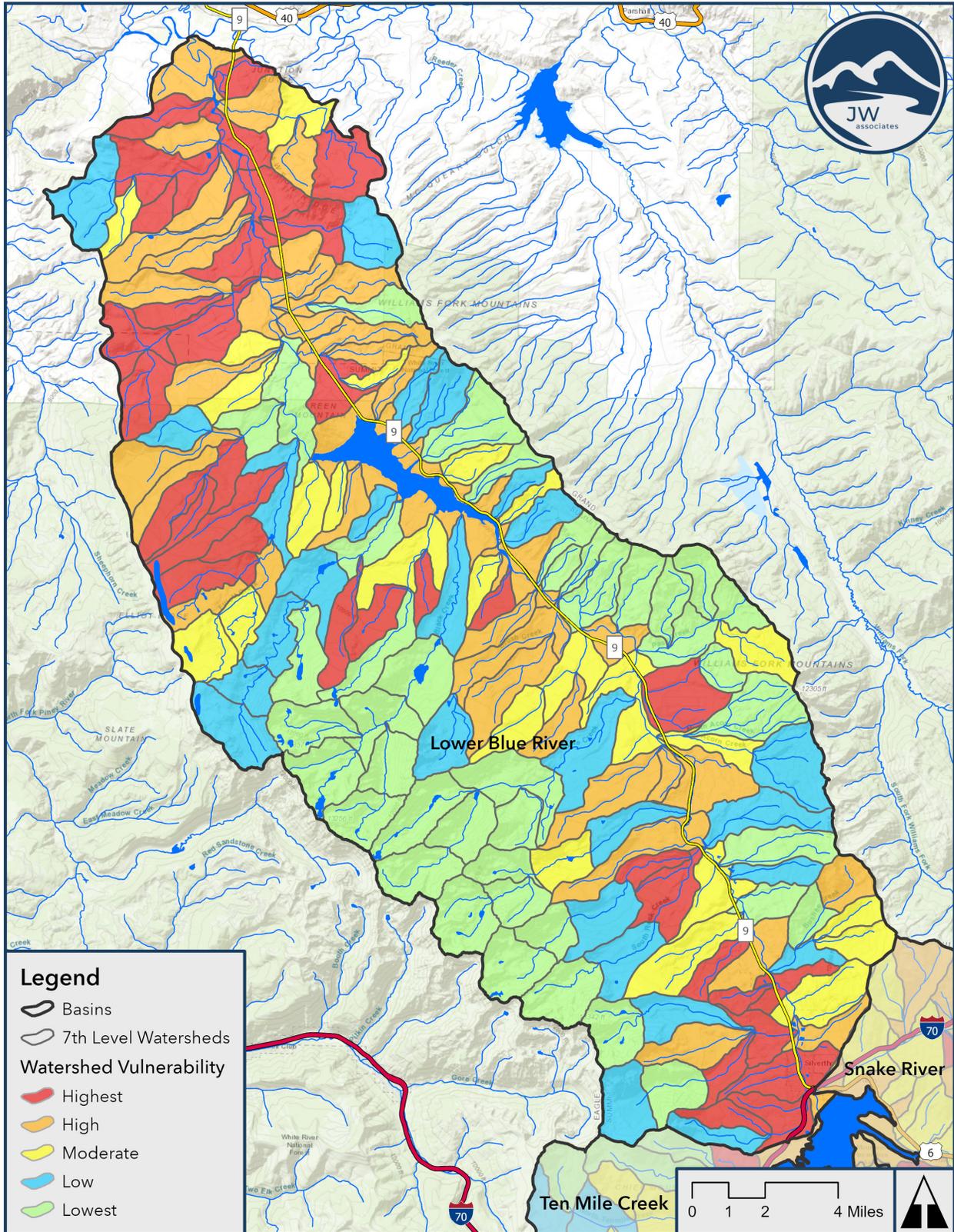
Map 35. Snake River Basin Adaptive Limitation Hazard Ranking

Table 9. Highest Ranked 7th Level Watersheds for Watershed Vulnerability

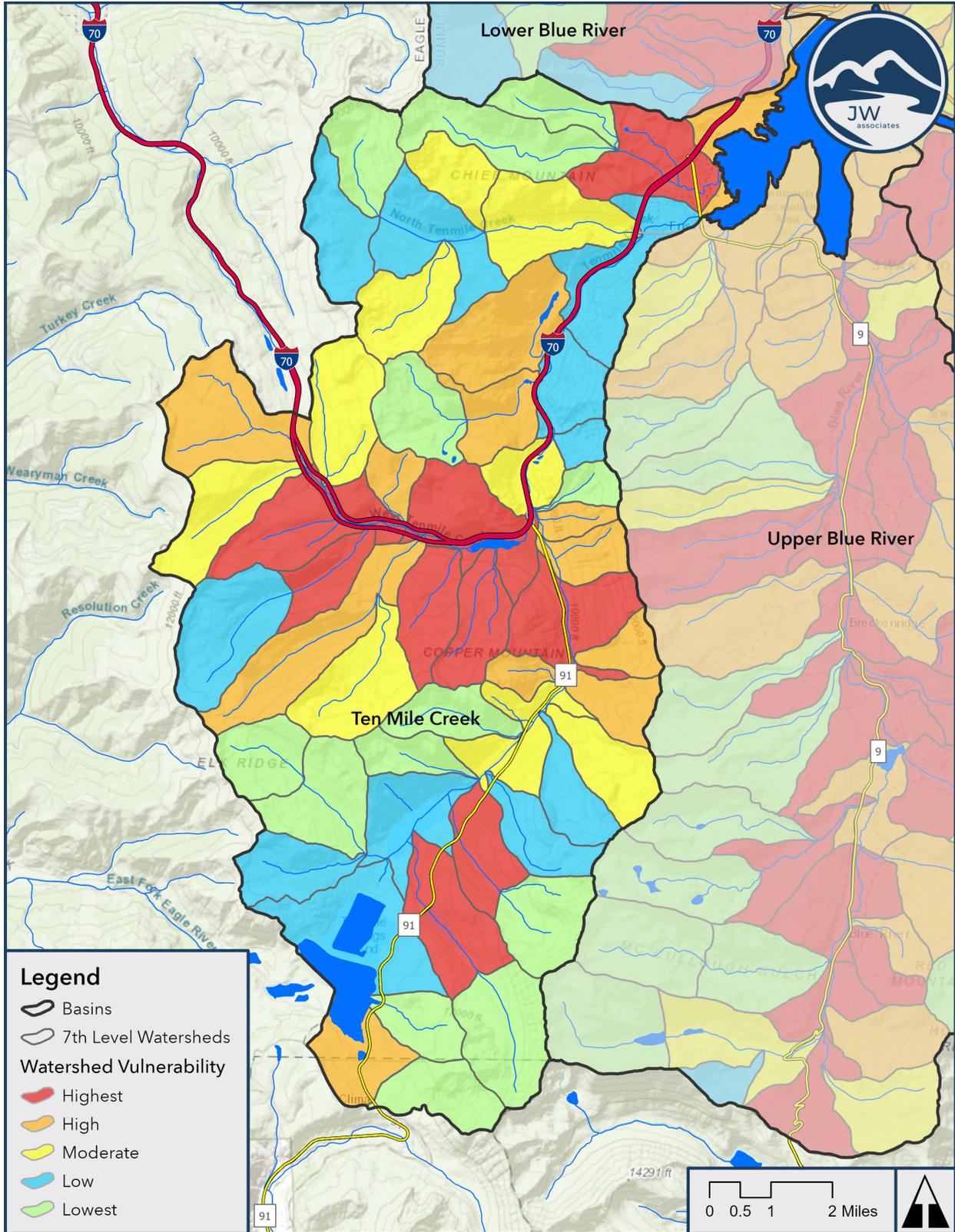
6 TH LEVEL WATERSHED NAME	7 TH LEVEL WATERSHED NAME	ECOSYSTEM SENSITIVITY	ADAPTIVE LIMITATION
Coal Creek	Independence Basin	Highest	Highest
	UT2 to Upper Coal Creek	High	Highest
	Upper Coal Creek	Highest	Highest
	Splains Gulch	Highest	Highest
	Elk Creek	Highest	High
	Wildcat Creek	High	Highest
	Lower Coal Creek	Highest	Moderate
	Coon Basin	Highest	Moderate
	Gibson Ridge	Highest	Highest
	Outlet Coal Creek-Crested Butte	Highest	Highest
Washington Gulch-Slate Creek	UT2 to Middle Washington Gulch	Highest	High
	Halazon Ditch-Crested Butte	Highest	High
	North Red Mountain	High	Highest
Ruby Anthracite Creek	Lake Irwin	Moderate	Highest
	Ruby Anthracite Below Lake Irwin	Highest	Highest



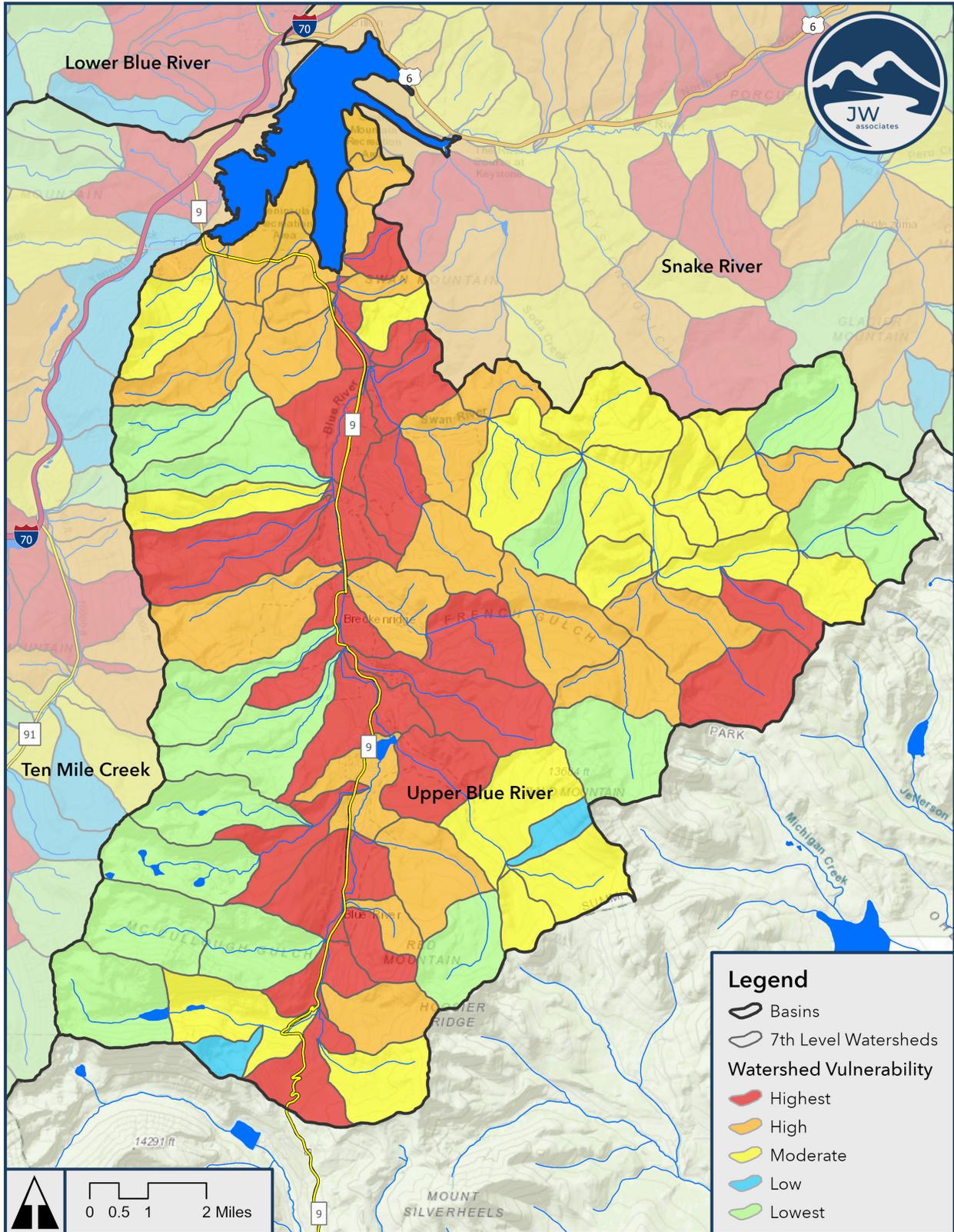
Map 36. Blue River Watershed Vulnerability Ranking



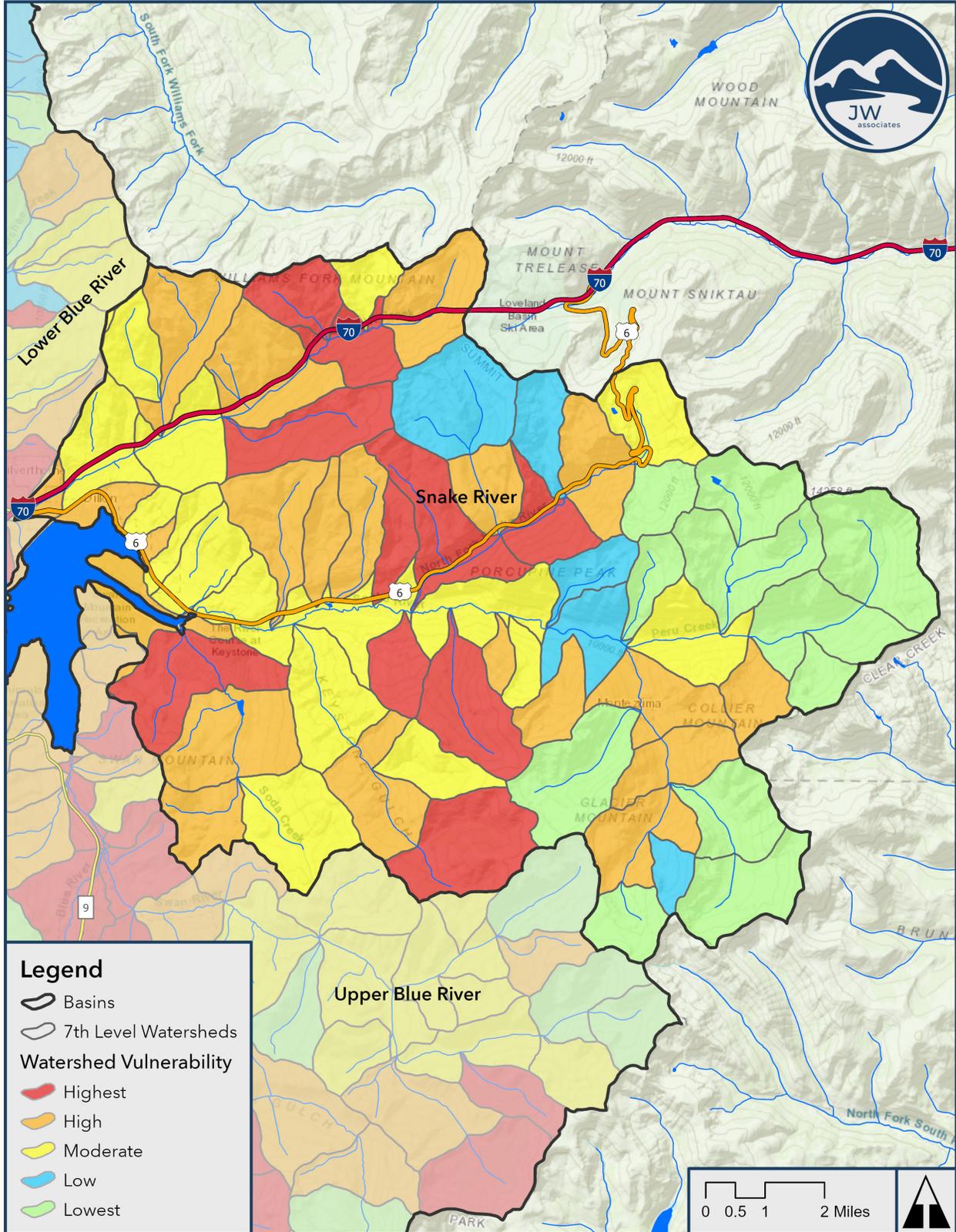
Map 37. Lower Blue River Basin Watershed Vulnerability Ranking



Map 38. Ten Mile Creek Basin Watershed Vulnerability Ranking



Map 39. Upper Blue River Basin Watershed Vulnerability Ranking



Map 40. Snake River Basin Watershed Vulnerability Ranking