NORTH COAST RESOURCE PARTNERSHIP

A. General Project Information

1. **Organization / Project Sponsor Name:**
   Yurok Tribe

2. **Project Name:**
   McKinney Fire Restoration Project

3. **Has the organization implemented similar projects in the past?** ☒ yes ☐ no

4. **If the project sponsor has worked with NCRP in the past, describe the project and outcome.**
   The Yurok Tribe in collaboration with the Watershed Research and Training Center, did planning, design, environmental compliance and implementation of wood loading on the South Fork Trinity resulting in the placement of nearly 300 trees into the river utilizing a helicopter and cable yarding method to restore spring run Chinook habitat. Additional NCRP projects have taken place on the Reservation with other programs in the Fisheries Department.

5. **Please describe the qualifications, experience, and capacity of the project team that will be overseeing project implementation.**

We propose a collaborative, post-wildfire emergency response strategy and restoration implementation through a partnership between the Yurok Tribe, Karuk Tribe, Mid-Klamath Watershed Council, and Watershed Research and Training Center as a local, multi-disciplinary team with a wide range of expertise and experience in design, construction, science and monitoring ecological and river restoration projects that we implement to increase salmon populations through strong and resilient partnerships.

6. **Is this project part of a larger project or program? If so, what effectiveness monitoring is being conducted and what are the results?**

The McKinney Fire Restoration Project is not part of a larger project but occurs within the area that the Karuk Tribe and MKWC have extensive knowledge, fisheries restoration experience, and ongoing monitoring efforts. Regular monitoring of flows, water quality (temperature, dissolved oxygen, turbidity), and fish population is conducted by Karuk Tribe, MKWC, USFS, and USFWS. The Karuk Tribe water quality gaging at Seiad Valley is the most relevant dataset we will integrate into this project.

7. **Project Abstract** [500 characters max.]

The McKinney Fire Restoration Project intends to identify short- and long-term remedial measures to reduce impacts to water quality, salmonid and other aquatic species' habitat, water supply reliability, public safety and infrastructure affected by the fire through a process of data acquisition, assessment of the data to initiate an effective, collaborative restoration strategy, and implementation at a series of sites utilizing numerous restoration techniques within damaged or threatened areas.

8. Project Description [3,000 characters max.]

The McKinney Fire started on July 29, 2022 just west of the town of Yreka in Siskiyou County. Within its first three days, the explosive fire burned over 50,000 acres, and by August 16, 2022, over 60,392 acres were burned with 95% containment. Shortly after its start, precipitation over the burned area on August 2 resulted in flooding and debris flows in Humbug, Little Humbug, and Vesa subbasins. These debris flows damaged infrastructure and subsequently reduced downstream water quality oxygen concentrations to zero for several hours along 50 miles in the Klamath River, killing tens of thousands of fish including suckers, juvenile salmon and trout, and lamprey.

In collaboration with the Karuk Tribe, Mid Klamath Watershed Council, and Watershed Research and Training Center, we propose a post-wildfire watershed condition assessment, response strategy, and restoration implementation using existing and newly collected data to prioritize restoration in areas with heavy erosion risk and stabilization needs in the McKinney Fire footprint. High-resolution aerial imagery throughout the McKinney Fire footprint was collected by the Yurok Tribe between August 19 – 21, 2022 using a fixed-wing manned aircraft system. These data will be processed into orthoimagery, photgrammetric point cloud data, and terrain model products, which will facilitate the identification of areas that have experienced heavy erosion or deposition and those at risk of future heavy erosion. These products will inform a restoration prioritization plan with development of new methods, monitoring, and site specific designs with which we will obtain local, State, and Federal environmental approvals as required. Restoration techniques throughout affected areas will include low-tech process-based restoration in headwater streams, mechanical rehabilitation in larger stream or river segments, bank stabilization with native re-vegetation efforts, and fish passage improvements to damaged infrastructure. On-the-ground implementation will be carried out by work crews provided by project partners and contractors as needed.

Project goals include identification of remedial measures that will protect or mitigate impacts to water quality, salmonid and other aquatic species' habitat, water supply reliability, public safety, and infrastructure. The integrated and collaborative approach to recovery from the McKinney Fire is a bid for securing economic and environmental stability in the region. Furthermore, this can be scaled as a regional level response to discrete local problems; it is an opportunity to model an appropriate post-fire response strategy and understand funding needs to do so. These efforts will integrate existing fire response efforts, watershed assessments, and restoration plans to develop an appropriately restructured prioritization with regard to newly burned conditions and subsequent restoration needs.

9. Specific Project Goals/Objectives

Goal 1: Mitigate water quality impacts to the Klamath River and tributaries affected by McKinney Fire [100 characters max.]
Goal 1 Objective: Acquire data to assess areas with highest risk of impaired water quality [200 characters max.]
Goal 1 Objective: Process data to identify areas with highest threat to water quality
Goal 1 Objective: Implement erosion control measures to improve stability of areas with highest threat to water quality
Goal 1 Objective: Implement sediment control measures to capture sediment and improve water quality of the Klamath River and its tributaries

Goal 2: Mitigate impacts to salmonid and other aquatic species' habitat
Goal 2 Objective: Acquire data to assess areas of damaged or threatened salmonid and aquatic habitat
Goal 2 Objective: Process data to identify areas damaged or threatened salmonid and aquatic habitat
Goal 2 Objective: Implement measures including mechanical rehabilitation with heavy machinery to restore or protect areas of damaged or threatened salmonid and aquatic habitat
Goal 2 Objective: Implement low-tech, process-based restoration features (BDAs, PALs), and apply erosion and sediment control methods in areas of damaged or threatened salmonid and aquatic habitat

Goal 3: Mitigate impacts to water supply reliability
Goal 3 Objective: Acquire data to assess areas posing greatest threat to water supply reliability
Goal 3 Objective: Process data to identify areas posing greatest threat to water supply reliability
Goal 3 Objective: Share data assessment indicating areas threatening water supply reliability with regulatory agencies
Goal 3 Objective: Implement measures to protect areas with threatened water supply reliability that overlap with areas of damaged or threatened salmonid and other aquatic species' habitat

Additional Goals & Objectives (List)
Goal 4: Mitigate impacts to public safety
Goal 4 Objective: Acquire data to assess areas posing geohazard threat to public safety
Goal 4 Objective: Process data to identify areas posing geohazard threat to public safety
Goal 4 Objective: Implement measures including mechanical rehabilitation with heavy machinery to stabilize areas posing geohazard threat
Goal 4 Objective: Implement low-tech, process-based restoration features (BDAs, PALs), and apply erosion and sediment control methods in areas of damaged or threatened salmonid and aquatic habitat

10. **Describe how the project addresses the NCRP Goals and Objectives selected**. [1,000 characters max.]

Project partnership with local Tribes and watershed organizations meet Objectives 1 and 3 in Goal 1. Objectives 4 and 5 in Goal 2 are met because the project addresses stream habitat infrastructure and water quality needs that conserve economic vitality entirely throughout DAC's. Objectives 6 and 7 in Goal 3 are met because this project directly restores watershed and aquatic habitat processes and biological diversity, especially for salmonid populations. Objectives 8 and 9 in Goal 4 are met through the project's water quality improvements for sensitive resources throughout the fire footprint and downstream in the Klamath River. Water infrastructure such as culverts and road crossings will be improved within DAC's to protect not only fisheries but also public health. The project meets Objectives 11 and 13 in Goals 5 and 6 by directly addressing water quality impacts from climate change-induced wildfire and flooding that will improve flood protection and community resiliency.

11. **Describe the physical, biological and/or community need for the project**. [1,000 characters max.]

Isolated precipitation over the east side of the burned area on August 2 resulted in flooding and debris flows in Humbug, Little Humbug, and Vesa Creek subbasins. These events damaged infrastructure and reduced water dissolved oxygen to zero for several hours, killing tens of thousands of fish along 50 miles in the Klamath River. The majority of moderate to high SBS areas occur in the western side of the burned area in Horse, McKinney, and Barkhouse Creek subbasins and have yet to experience precipitation events. These areas were evaluated as having high risk to flooding and debris flow during relatively low rainfall intensities. The need to mitigate water quality throughout high SBS areas of the McKinney Fire is paramount to reduce impacts to fishery resources that have high cultural and economic value. The threat to salmonids who migrate, spawn, and rear during winter and spring is imminent as those rainy seasons approach.

12. **Describe the financial need for the project**. [1,000 characters max.]

Although we will aggressively pursue additional funding sources due to the immediate need to stabilize subwatersheds affected by the fire, financial assistance for restoration efforts in the region is not yet available, nor are other sources as likely to support a unified, comprehensive assessment and strategy to protect or restore water resources and imperiled salmonid habitat throughout the entire McKinney Fire footprint nor provide the high degree of collaboration between local tribes and watershed restoration organizations with the ability to leverage extensive experience and expertise in watershed and river restoration in the mid Klamath watershed.

13. **Describe potential adverse impacts from project implementation and how they will be mitigated.**

1) Brief noise disturbances: mitigated by limited operating hours or hazing. 2) Intermittent flow disturbances to aquatic species from instream habitat restoration work: mitigated by

maintaining passage and reducing prolonged periods of disturbance. 3) Small instream wood structures at risk of becoming overwhelmed by flood events: mitigated by installing instream structures at a higher density in number as they occur on steeper gradients.

14. **Will this project mitigate an existing or potential Cease and Desist Order or other regulatory compliance enforcement action?** ☐ yes ☒ no
    If yes, please describe. [500 characters max.]

15. **Does the project address a contaminant listed in AB 1249 (nitrate, arsenic, perchlorate, or hexavalent chromium)?**
    ☐ yes ☒ no
    If yes, provide a description of how the project helps address the contamination. [500 characters max.]

16. **Describe how the project contributes to regional water self-reliance and addresses climate change.** [1,000 characters max.]

The project will produce an assessment of areas with the greatest risk of post-fire flooding and surface erosion hazards that threaten water resources and corresponding reliability of water supply. Our implementation efforts will focus on restoring or protecting at-risk water resources that threaten the stability of salmonid individuals and populations that will provide collateral benefits to residential and commercial water supplies. The project initiates a response to the aftermath of severe wildfire that is becoming more common with climate change and aims to prepare for erratic future conditions by improving stream morphology and channel-floodplain dynamics, restoring sediment input and retention balance, and improving water quality for aquatic organisms including culturally significant native fish species.

17. **Does the project increase public safety with regards to flood protection, wildfire hazard risk reduction, increasing firefighting capacity, or in other ways contribute to regional emergency resiliency?**
    ☒ yes ☐ no
    Please explain. [500 characters max.]

In addition to infrastructure already identified to be at risk by BAER and WERT assessments, the project will identify infrastructure at greatest risk of future impairment due to geohazards and will propose implementation at sites threatening salmonids and their habitat that will, in many cases, provide collateral benefits to securing transportation accessibility and public safety with measures to protect or restore roads and bridges.

18. Does the project employ new or innovative technologies or practices, including Decision Support Tools that support the integration of multiple jurisdictions, including, but not limited to, water supply, flood control, land use, and sanitation? ☒ yes ☐ no

If yes, please describe. [500 characters max.]

The project employs rapid aerial based data collection that will result in mapping of landscape scale imagery to prioritize restoration needs by identifying sources of sediment and erosion, morphologic change, and hydrologic response in burned areas that pose risk to water quality and fish populations. This can be scaled as a regional level response to discrete local problems in various locations; it intends to model a response strategy with adaptive prioritization in response to changing needs.

19. Describe the population served by this project, including any economically disadvantaged communities or Tribes that will directly benefit.

The project will serve ~25% of the Severely Economically Disadvantaged Community north of Hwy 96 (Census Tract 001300) and ~75% of the Economically Disadvantaged Community south of Hwy 96 within the west side of the project (Census Tract 000600). The entire project is within an Economically Distressed Area and ancestral lands of the Karuk Tribe and is fully focused on mitigating impacts to water resources, particularly to salmonids with significant cultural and subsistence values.

20. Describe local and/or political support for this project. [500 characters max.]

The following agencies and organizations have been contacted and expressed support for the project: Karuk Tribe, Mid Klamath Watershed Council, Watershed Research and Training Center, Caltrans, California Geological Survey, Quartz Valley Indian Reservation, and US Forest Service.

21. List all collaborating partners and agencies and nature of collaboration. [750 characters max.]

This project will be completed with collaboration of the Karuk Tribe, Mid Klamath Watershed Council (MKWC) and the Watershed Research and Training Center (WRTC). The project is within the ancestral lands of the Karuk Tribe who possess critical Traditional Ecological Knowledge and fisheries and fuels management experience within the project area that places them at the core of the project's success. MKWC specializes in restoration efforts in the Middle Klamath subbasin and will provide extensive local insight and coordination. WRTC is a non-profit organization located in Trinity County with the expertise and capacity to process and analyze high-resolution aerial imagery.

22. Is this project part or a phase of a larger project? ☐ yes ☒ no

Are there similar efforts being made by other groups? ☐ yes ☒ no

If yes to either, please describe. [500 characters max.]

B. Project Location

1. **Describe the latitude and longitude of the project site.**
   Latitude: 41.82077 Longitude: -122.8366

2. **Site Address (if relevant):**

3. **Does the applicant have legal access rights, easements, or other access capabilities to the property to implement the project?**
   ☐ yes — If yes, please describe below
   ☒ no — If no, please provide a concise narrative below with a schedule, to obtain necessary access
   ☐ NA — If NA, please describe below why physical access to a property is not needed

   Explanation. [500 characters max.]

The exact location(s) of implementation will be determined pending results of the assessment, which includes site prioritization and restoration treatment type needs. Outreach to establish access will be completed when the knowledge to support our implmentation strategy and methods is completed. There are multiple cooperative partners in support and thus access rights are anticipated to be obtained as needed.

4. **Project Location Notes:**

Implementation will occur as indicated in the budget. We are requesting a total of $xxxfor implementation to be divided between installation of LTPBR features, mechanical rehabilitation, bank stabilization, and fish passage improvements based on per unit estimates for each category of implementation techniques. The comprehensive and collaborative assessment we intend to complete will indicate areas that are most critical to treat immediately and the most appropriate restoration technique for those locations. We anticipate utilizing LTPBR methods in smaller order headwater streams and mechanical rehabilitation methods on larger tributaries or the main stem Klamath River.

C. Benefits To Disadvantaged Communities and/or Tribes

1. **Does the project provide direct water-related benefits to a project area comprised of Disadvantaged Communities or Economically Distressed Communities?** If partially, please estimate percentage of project that benefits disadvantaged communities and list the communities.
   ☐ Entirely

☒ Partially; estimate the percentage of benefits provided directly to DAC: 75%
☐ No

List the Disadvantaged Community(s)

Approximately 75% of the project area is located south of Hwy 96 and will serve the entire geography of the Economically Disadvantaged Communities of Klamath River and Oak Knoll (Block Group 2 of Census Tract 000600, population 994 with 474 households and MHI=$61,636). The entire project is within an Economically Distressed Area and is fully focused on mitigating impacts to water resources, particularly impacts to water quality and salmonids and other aquatic species' habitat by implementing erosion and sediment control measures to mitigate ground surface instability in vulnerable locations.

2. **Does the project provide direct water-related benefits to a project area comprised of Severely Disadvantaged Communities (SDAC)**? If partially, please estimate percentage of project that benefits disadvantaged communities and list the SDACs.
   ☐ Entirely
   ☒ Partially; estimate percentage of benefits provided directly to SDAC: 25%
   ☐ No

   List the Severely Disadvantaged Community(s)

Approximately 25% of the project area is located north of Hwy 96 and will serve about 25% of the geography in the Severely Economically Disadvantaged Communities of Gottsville and Horse Creek (Block Group 4 of Census Tract 001300, population 821, 327 households and Median Household Income (MHI)=$46,635). The project is fully focused on mitigating impacts to water resources, particularly impacts to water quality and salmonids and other aquatic species' habitat by implementing erosion and sediment control measures to mitigate ground surface instability in vulnerable locations.

3. **Does the project provide direct water-related benefits to a Tribe or Tribes**? If partially, please estimate percentage of project that benefits Tribe(s) and list the Tribes.
   ☒ Entirely
   ☐ Partially; estimate percentage of benefits provided directly to Tribe(s):
   ☐ No

   List the Tribal Community(s)

The entire project area is within the ancestral lands of the Karuk Tribe and is intended to mitigate post-fire impacts to water resources, particularly impacts to water quality and salmonids and other aquatic species' habitat by implementing erosion and sediment control measures to mitigate ground surface instability in vulnerable locations.

If yes, please provide a letter of support from each Tribe listed as receiving these benefits.

4. **If the project provides benefits to a DAC, EDA or Tribe, explain the water-related need of the DAC, EDA or Tribe and how the project will address the described need.** [750 characters max.]

The McKinney Fire affected hydrologic and geomorphic processes at a watershed scale likely to initiate widespread dysfunction in stormwater conveyance including a reduction in soil infiltration capacity and an increase in peak flows, soil erodibility, and the quantity of soil subject to erosion (CDFW, 2022). The WERT report identified 44 values-at-risk related to human life-safety and property. CDFW staff conducted a habitat impacts assessment in August, 2022 and confirmed heavy impacts to Humbug, Little Humbug, and Vesa Creeks. Karuk people, DACs and natural resources are in the highly uncertain position of unstable ecological conditions that warrant immediate remedial measures to protect life, property and water resources.

5. **Describe the kind of notification, outreach and collaboration that has been completed with the county(ies) and/or Tribes within the proposed project impact area, including the source and receiving watersheds, if applicable.** [500 characters max.]
   During preparation of this proposal, we communicated via phone or online meeting platforms to develop project goals and objectives with the following agencies or organizations: California Geological Survey, Caltrans, Karuk Tribe, Mid Klamath Watershed Council, Quartz Valley Indian Reservation, US Forest Service, and Watershed Research and Training Center.

D. Project Benefits & Justification

1. **For each of the Potential Benefits that the project claims, complete the following table to describe an estimate of the benefits expected to result from the proposed project. Provide quantitative benefit amounts for at least the primary and secondary benefits. Provide a qualitative narrative description of expected benefits that cannot be quantified.** *See the NCRP Project Application Instructions for more information and a listing of potential benefits.*

PROJECT BENEFITS TABLE

Benefit Description	Units	Quantitative Amount	Qualitative Description
Water Supply			
Honoring Tribal Cultural Priorities			Fishery resources
Water Quality			
Sediment reduction - Streambank stabilized	linear ft	750 - 2250	access dependent

Benefit Description	Units	Quantitative Amount	Qualitative Description
Sediment reduction - Culverts repaired or replaced	# culverts	2	access dependent
Sediment reduction - Total sediment reduced	tons	TBD	eval dependent
Climate Change			
Other Ecosystem Service Benefits			
Habitat Restoration	linear ft	750-2250	improve stream chnl
Fishery improvement	linear ft	750-2250	improve fish habitat
Special status speci	# species	4	
Jobs Created or Maintained			
Jobs created or retained (FTE)	# FTE	20	Partners & support
Job/ workforce training	# trainings	2	LTPBR training
Other Benefits			
Tribal resource-dependent heritage preservation	Chinook Salmon		All life stages
Tribal resource-dependent heritage preservation	Coho Salmon		All life stages
Tribal resource-dependent heritage preservation	Steelhead Trout		All life stages
Tribal resource-dependent	Pacific Lamprey		All life stages

Benefit Description	Units	Quantitative Amount	Qualitative Description
heritage preservation			

2. Does the proposed project provide physical benefits outside of the North Coast Region?
   ☐ yes ☒ no
   If yes, describe the impacts to areas outside the North Coast Region. [500 characters max.]

3. List the impaired water bodies (303d listing) that the project benefits:
   Klamath River HU, Middle HA, Iron Gate Dam to Scott River

4. Describe how the project benefits salmonids, endangered/threatened species and sensitive habitats.
   Endangered Coho Salmon (Oncorhynchus kisutch), fall-run and spring-run Chinook Salmon (O. tshawytscha), winter-run and summer-run Steelhead Trout (O. mykiss), and Pacific lamprey (Entosphenus tridentatus) utilize the mid-Klamath River and its tributaries. Each of those species are experiencing population declines throughout the Klamath-Trinity basins and rely on the suitable habitat that remains from what is largely degraded by logging, dams and diversions, mining, increasing wildfire intensity, and climate change impacts. These fish species are directly threatened by intensified peak flows, increased sediment and debris flows, and poor water quality from post-fire conditions in the McKinney Fire footprint. Our project will mitigate those threats by attenuating flows and sediment inputs in severely burned aquatic habitats that will improve water and habitat quality for spawning, migrating, and rearing fish.

5. Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project?
   ☒ yes ☐ no
   Please explain. [500 characters max.]

As this project includes both assessment and implementation, a project goal is to consider alternative methods for the highest priority outcome.

6. Is the proposed project the lowest cost alternative to achieve the physical benefits?
   ☒ yes ☐ no
   Please explain. [500 characters max.]

The project assessment will result in a decision supporting tool for prioritizing restoration needs based on achieving physical watershed and aquatic habitat benefits. Cost alternatives will weigh into our prioritization framework and support choosing alternatives with the best ratio of cost to benefit.

7. How will the project be monitored to determine whether it is producing the desired benefits?

We will conduct periodic surveys to ensure that implementation efforts are mitigating impacts as designed and to perform any maintenance as needed. We will monitor physical response using aerial-based surveys and ground-based habitat and geomorphic surveys, hydrologic response with existing and newly established streamflow gaging, water quality response with existing Karuk Tribe sensors (dissolved oxygen, temperature, turbidity) on the mainstem Klamath near Seiad Valley, and biological response with riparian (NDVI, aerial imagery) and fish surveys.

8. Provide a narrative for project technical justification. Include any other information that supports the justification for this project, including how the project can achieve the claimed level of benefits listed below. [3,000 characters max.]

- The inter-Tribal partnership led by this project directly incorporates Traditional Ecological Knowledge, Tribal-dependent resource heritage preservation, and honoring of Tribal cultural priorities. The core values of this project are to restore and protect fisheries resource values by mitigating sediment sources, improving water quality, and benefiting native fish populations and their habitat. Water resource achievements will be quantified by continuous long-term monitoring of water conditions such as flow, turbidity, temperature, and dissolved oxygen in select locations throughout the area. Fish habitat achievements will be quantified by monitoring physical habitat changes such as sediment aggradation and sorting from wood structures, changes in physical habitat complexity, linear feet of streambank stabilized, number of fish passage improvements, and linear feet of improved fish passage access to upstream areas. Outreach, collaborative partnerships, and trainings will be documented and utilized for site access and implementation success.

  The California Watershed Emergency Response Team (WERT), the California Department of Fish and Wildlife (CDFW), the US Forest Service Burn Area Emergency Response (BAER) team, and the US Geologic Survey assessed conditions following the McKinney fire for structural and natural resource values at risk from flooding and debris flows. The degree of fire-induced damage to soil is soil burn severity (SBS) and is a primary variable on increased runoff and sediment generation, as well as the occurrence of post-fire watershed hazards. Moderate and high soil burn severity in steeper sloped areas typically create the most impacts. The McKinney Fire has 78 percent of the area burned at moderate (63%) to high (15%) soil burn severity. The WERT, CDFW, BAER, and USGS assessments indicate the fire has significantly increased debris flow, post-fire flooding, and surface erosion hazards—all of which threaten physical, biological, and community stability and thus there is eminent need for rapid intervention.

The USFS BEAR team recommends specific restoration actions throughout defined subbasins of the fire footprint that we will incorporate into our restoration plan, including mulching exposed burned soils, in-channel wood loading, check dams, or other process-based sediment abatement structures. Integrating these recommendations into our efforts will aid in a synergistic approach to addressing post-fire fish habitat restoration with local institutional support for site access, permitting, and implementation. Due to the limited capacity of the USFS to implement all the BAER recommended projects, it may be a good opportunity for this project to integrate efforts and contribute to identified needs.

9. List and include any studies, plans, designs or engineering reports completed for the project as a "Technical & Reference Supporting Materials" into one document that includes a Table of Contents and is limited to approximately **50 pages.** *Please see the instructions for more information about submitting these documents with the final application.*

10. Project Justification & Technical Basis Notes: Please provide any additional information *not included above* that you think is important.

Post-fire fish habitat restoration needs are imperative throughout the McKinney Fire burned area. While we aim to evaluate conditions and devise a restoration plan for the entire burned area, implementation efforts can be scaled based on their priority identfied through our assessment framework. Fisheries values at risk, landowner access, and project cost-benefit will all be major factors in driving implementation efforts and subsequent benefits to water quality, fish populations, and Tribal resource-dependent hertiage preservation.

E. Project Tasks, Budget, And Schedule

1. **Projected Project Start Date:** 7/1/23
   Anticipated Project End Date: 11/30/27

2. **Describe the basis for the costs used to derive the project budget in each budget category.** [500 characters max.]

The estimate for Category A administrative costs is based on percent of total project cost (~8%) determined by prior project experience and anticipated amount of administration needed. Category C Planning/Design/Engineering/Environmental Documentation and Category D Construction/Implementation costs are based on prior experience implementing restoration projects among the four collaborating organizations and anticipated remedial measures needed within the McKinney Fire footprint.

3. **Provide a narrative on cost considerations including alternative project costs.** [500 characters max.]

Project costs will consider alternatives for the greatest cost-benefit based on geographic prioritization of fisheries values at risk and site access. Restoration will use metrics of cost per acre or linear feet that will be site-specific and dependent upon our assessments. The combination of these cost considerations lends itself toward scalability of project costs and identifying the most desired project alternatives.

4. **List the sources of non-state matching funds, amounts and indicate their status**. Proposition 1 requires a minimum cost share of 50% of the total project costs, though a waiver may apply (see Question 6 below).

5. **List the sources and amount of State matching funds.**

6. **Cost Share Waiver Requested (DAC or EDA)?** ☒ yes ☐ no
   Describe what percentage of the proposed project area encompasses a DAC/EDA, how the community meets the definition of a DAC/EDA, and the water-related need of the DAC/EDA that the project addresses. In order to receive a cost share waiver, the applicant must demonstrate that the project will ***directly*** provide benefits that address a water-related need of a DAC/EDA.

The project area encompasses a DAC by 75% and an EDA by 25% (both of which meet annual median household incomes or other hardships to qualify as disadvantaged communities) and will will directly benefit water quality for all communities within the project area.

A cycle of heat, wildfires and drought are negatively impacting biodiversity and the severely disadvantaged communities in the region, both within the ancestral territory of the Shasta Tribe and adjacent to the Karuk ancestral territory. Indigenous people are disproportionately impacted by climate change and are underrepresented due to being low income, communities of color, and ultra-rural. The project encompasses "climate vulnerable communities" as defined by the Governor's OPR resource. These communities "experience heightened risk and increased sensitivity to climate change and have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts."

7. **Is the project budget scalable?** ☒ yes ☐ no

8. **Describe how a scaled budget would impact the overall project,** its expected benefits and state the minimum budget amount that would be viable (see Instructions E.7 for scaled budget examples). [500 characters max.]

Although data was collected of the entire fire footprint, assessment and implementation efforts could be reduced to focus on select geographies (subwatersheds); specific restoration techniques (mechanical restoration with heavy equipment versus low-tech process-based restoration methods with more physical labor); or specific restoration goals (such as sediment removal to protect water quality, wood loading for aquatic habitat enhancement or restoring fish passage).

9. Major Tasks, Schedule and Budget for Project Solicitation
   Please complete MS Excel table available at https://northcoastresourcepartnership.org/ncrp-proposition-1-irwm-round-2-solicitation/see instructions for the information to be included in this document and for how to submit the required excel document with the application materials.

10. Project Tasks, Budget and Schedule Notes:

Over half (62%) of our total budget allocations go toward implementation costs, of which 13% includes technical services to support construction and 87% include physical construction implementation. Administrative costs are estimated at 9% of the total budget, and the remaining 28% goes toward planning, design, engineering, analysis, environmental documentation and reporting. This underscores our priority in fostering change by doing, which is led by science-informed restoration.

11. Project Information Notes. Please provide any information that that has not been specifically requested that you feel is important for the NCRP to know about your project.

Due to the nature of this project encompassing both assessment and implementation, our budget for implementation hinges on our assessment results that will provide detail on site access and specific restoration project needs. While we feel strongly that the assessment costs are captured well, we have provided general cost estimates at the per-acre or per-linear ft unit that will be geographically scalable, with broad categories of treatments such as 1) upslope restoration of sediment and erosion control and 2) instream habitat restoration with large wood sourcing, augmentation, and channel rehabilitation.

Project Name: McKinney Fire Restoration Project
Organization Name: Yurok Tribe

Task #	Major Tasks	Task Description	Major Deliverables	IRWM Task Budget	Non-State Match	Other Match	Total Task Budget	25% Scaled IRWM Budget	50% Scaled IRWM Budget	Current Stage of Completion (%)	Start Date	Completion Date
A	**Category (a): Direct Project Administration**											
1	Project Management	In cooperation with the County of Humboldt sign a sub-grantee agreement for work to be completed on this project. Develop invoices with support documentation. Provide audited financial statements and other deliverables as required	Invoices, audited financial statements and other deliverables as required	$28,711.76	$0.00	$0.00	$19,780.00	$21,533.82	$14,355.88	0%	7/1/23	11/30/27
2	Monitoring	Develop Project Monitoring Plan to include goals and measurable objectives	Project Monitoring Plan	$2,871.18	$0.00	$0.00	$1,960.00	$2,153.38	$1,435.59	0%	7/1/23	12/31/23
3	Reporting	Develop monthly reports describing work completed, challenges, and strategies for reaching remaining project objectives. Develop Final Report	Quarterly and Final Reports	$71,779.40	$0.00	$0.00	$49,450.00	$53,834.55	$35,889.70	0%	7/1/23	11/30/27
B	**Category (b): Land Purchase/Easement**											
1				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0%		
C	**Category (c): Planning/Design/Engineering/Environmental Documentation**											
1	Modeling and Analysis	Process high-resolution aerial imagery collected during McKinney Fire to generate digital terrain models and georeferenced orthoimagery. Combine these products with existing data to assess watershed condition, prioritize restoration needs, and develop restoration strategy	Orthoimagery; digital terrain models; McKinney Fire Recovery Prioritization Assessment	$151,662.78	$0.00	$0.00	$151,662.78	$113,747.09	$75,831.39	0%	7/1/23	4/30/24
2	Final Implementation Plans	Complete land/topographic survey work needed for project design including RTK , totalstation, and UAS photogrammetry surveys. Complete geomorphic and hydrologic investigation and biological reconnaisance to inform project implementation plans. Complete forest inventory and mapping needed for large wood harvest strategy. Develop a set of final implementation plan with specifications as required by regulatory agencies.	Final Implementation Plans informed by project team (construction manager, engineer, environmental compliance specialist, fish biologist and field technician, geomorphologist, geospatial analyst, restoration ecologist)	$101,108.52	$0.00	$0.00	$101,108.52	$75,831.39	$50,554.26	0%	7/1/23	4/30/24
3	Environmental Documentation: CEQA	Complete environmental review pursuant to CEQA. Prepare all necessary environmental documentation.	Environmental Information Form; Notice of Exemption or Notice of Determination; Letter from lead agency stating there were no legal challenges during public review; Approved and adopted CEQA documentation	$26,962.27	$0.00	$0.00	$26,962.27	$20,221.70	$13,481.14	0%	7/1/23	4/30/24
4	Environmental Documentation: NEPA (if required)	Complete environmental review and coordinate with USFS staff to ensure NEPA compliance.	USFS NEPA forms; Letter to the file, PIL, CE, Section 7, etc. Approved and adopted NEPA documentation.	$26,962.27	$0.00	$0.00	$26,962.27	$20,221.70	$13,481.14	0%	7/1/23	4/30/24
5	Permit Development	Obtain required permits/approvals from environmental regulatory agencies.	Final permits/agreements from NCRWQCB, CDFW, ACOE, NOAA, CALFIRE, Caltrans, Siskiyou County	$30,332.56	$0.00	$0.00	$30,332.56	$22,749.42	$15,166.28	0%	7/1/23	4/30/24
D	**Category (d): Construction/Implementation**											
1	Construction Contracting	Complete tasks necessary to contract construction activities: develop bids and contract documents; conduct construction meetings; evaluate contractors; award contracts	Bid Documents; Proof of Advertisement; Award of Contract; Notice to Proceed	$1,960.00	$0.00	$0.00	$1,960.00	$1,470.00	$980.00	0%	5/1/24	10/1/23
2	Construction Management	Complete tasks necessary to manage construction activities: ensure compliance with project schedule, budget, design, and environnmental commitments; conduct construction meetings; procure large wood as salmonid habitat elements; track project progress and compliance; document project completion	Construction Management Logs; Monthly Construction Progress Reports; Construction Inspection Reports; Project Close Out Documents; Photo Monitoring Log; As-Built Drawings; DWR Certificate of Project Completion	$14,700.02	$0.00	$0.00	$14,700.02	$11,025.01	$7,350.01	0%	5/1/24	10/1/27
3	Instream Salmonid Habitat Restoration Implementation	Mobilization and site preparation to complete construction of instream salmonid habitat project components that may include construction of sediment retention basins; removal of sediment and debris; channel reconstruction; culvert repair or replacement; and large wood sourcing and placement to restore water quality, and mitigate impacts to salmonid and other aquatic species' habitat. This task may improve stream morphology, channel-floodplain dynamics, ensure fish passage and restore sediment input and retention balance.	Monthly Construction Progress Reports; Photo Monitoring Log; Construction completed	$448,240.08	$0.00	$0.00	$448,240.08	$336,180.06	$224,120.04	0%	5/1/24	8/1/27
4	Upslope Restoration, Sediment and Erosion Control	Construct Low-Tech Process-Based Restoration techniques in upslope areas; seed, mulch, plant, and develop irrigation to promote site stability with ground cover or revegetation. This task may include construction of beaver dam analogues or other linear features that may attenuate flows and regulate sediment inputs to improve water and habitat quality for spawning, migrating, and rearing fish.	Monthly Construction Progress Reports; Photo Monitoring Log; Construction completed	$313,600.03	$0.00	$0.00	$313,600.03	$235,200.02	$156,800.01	0%	5/1/24	8/1/27
	Total North Coast Resource Partnership IRWM Grant Request			**$1,218,890.87**	**$0.00**	**$0.00**	**$1,186,718.53**	**$914,168.15**	**$609,445.43**			
	Percentage of Total Project Cost			**100%**	**0%**	**0%**	**100%**	**25%**	**50%**			

BUDGET DETAIL

Row (a) Direct Project Administration Costs				
Project Management Type	**Personnel by Discipline**	**Number of Hours**	**Hourly Wage**	**Total Admin Cost**
Project Management	Project Manager, Budget Analyst	400	$59	$23,600
Monitoring	Professional-level Technical Specialists	40	$59	$2,360
Reporting	Professional-level Technical Specialists	1000	$59	$59,000
			Subtotal	$84,960
			Indirect Rate 21.66%	$18,402
			Total	**$103,362**
*** What is the percentage based on (including total amounts)?**		**% based on total project cost**		
*** How was the percentage of cost determined?**		**% determined by prior experience and anticipated amount of administration for project**		

Row (b) Land Purchase/Easement
Not applicable

Row (c) Planning/Design/Engineering & Environmental Documentation				
Personnel (Discipline)	**Major Task Name**	**Number of Hours**	**Hourly Wage**	**Total Cost**
	YUROK TRIBE			
Yurok Tribe Technical Specialist (Professional-level series may include: Project Engineer, Sr. Geomorphologist, Sr. Riparian Ecologist, Technical Field Manager, Fisheries Biologist, Restoration Ecologist, Construction Manager, Environmental Specialist, Survey Manager)	Tasks C1,C2, C3, C4, C5	1000	$59	$59,000
Yurok Tribe Technical Specialist (Technician-level personnel may include Fisheries Technician I or II)	Tasks C1,C2, C3, C4, C5	500	$30	$15,000
			Subtotal	$74,000
			Indirect Rate 21.66%	$16,028
			YUROK TOTAL (Burdened Rate + Indirect Rate)	**$90,028.40**
	KARUK TRIBE			
Karuk Tribe Technical Specialist (Professional-level series may include Lead Fisheries Biologist, Instream Habitat Restoration Project Coordinator)	Tasks C1,C2, C3, C4, C5	1000	$65	$64,500
			KARUK TOTAL (Fully loaded rate)	**$83,500.00**
	MID KLAMATH WATERSHED COUNCIL (MKWC)			
Mid Klamath Watershed Council Technical Specialist (Professional-level series may include Executive Director, Program Director, Project Coordinator, GIS Specialist)	Tasks C1,C2, C3, C4, C5	1000	$56	$56,000
Mid Klamath Watershed Council Technical Specialist (Technician-level personnel may include Senior Field Technician, Geographic Survey Lead, Project Coordinator, Field Technicians)	Tasks C1,C2, C3, C4, C5	500	$35	$17,500
			MKWC TOTAL (Fully loaded rate)	**$73,500**
	WATERSHED RESEARCH & TRAINING CENTER (WRTC)			
Watershed Research and Training Center (Professional-level series may include Regional Technical Services Manager, Geospatial Analyst)	Tasks C1,C2, C3, C4, C5	1500	$50	$75,000
			Indirect Rate 20%	$15,000
			WRTC TOTAL	**$90,000**
			Total	**$337,028**

Row (d) Construction/Implementation				
Personnel (Discipline)	**Work Task and Sub-Task (from Work Task Table)**	**Number of Hours**	**Hourly Wage**	**Total**
	YUROK TRIBE			
Yurok Tribe Technical Specialists during construction may include Professional-level series Project Engineer, Sr. Geomorphologist, Technical Field Manager, Fisheries Biologist, Restoration Ecologist, Construction Manager, Environmental Specialist, Survey Manager	D1, D2, D3, D4	450	$59	$26,550.00

Yurok Tribe Technical Specialists during construction may include technician-level Fisheries Technician I or II	D1, D2, D3, D4	300	$30	$9,000.00
			Subtotal	$35,550.00
			Indirect Rate 21.66%	$7,700.13
			YUROK TOTAL	**$43,250.13**
	KARUK TRIBE			
Karuk Tribe Technical Specialists during construction may include Instream Habitat Restoration Project Coordinator, Fisheries Tech 3, and Cultural Resource Monitor	D1, D2, D3, D4	500	$52	$26,000.00
			KARUK TOTAL	**$26,000.00**
	MID KLAMATH WATERSHED COUNCIL			
Mid Klamath Watershed Council Technical Specialists during construction may include professional-level Executive Director, Program Director, Project Coordinator, GIS Specialist	D1, D2, D3, D4	250	$56	$14,000.00
Mid Klamath Watershed Council Technical Specialists during construction may include Senior Field Technician, Geographic Survey Lead, Project Coordinator, Field Technicians	D1, D2, D3, D4	250	$35	$8,750.00
			MKWC TOTAL	**$22,750.00**
	WATERSHED RESEARCH & TRAINING CENTER			
Watershed Research and Training Center professional-level personnel during construction may include Regional Technical Services Manager, Geospatial Analyst	D1, D2, D3, D4	100	50	$5,000.00
			Subtotal	$5,000.00
			Indirect Rate 20%	$1,000.00
			WRTC TOTAL	**$6,000.00**
			TOTAL TECHNICAL TEAM SUPPORT (YUROK, KARUK, MKWC, AND WRTC) DURING CONSTRUCTION	**$98,000.13**
Materials and Equipment	**Work Task and Sub-Task (from Work Task Table)**	**Number of Units**	**Unit Cost**	**Total**
In-Channel Restoration Treatment - Area Metric (Acres); Cost include: Heavy Equipment, Labor, Materials, Supplies, etc.)	D3 - Area metric example may include sediment and debris removal, construction of sediment retention basins, large wood sourcing and placement to restore water quality, and mitigate impacts to salmonid and other aquatic species' habitat. This task may result in improvement of stream morphology, hydraulic capacity, channel-floodplain dynamics, floodplain connectivity, and restoration of sediment input and retention balance.	90	2350	$211,500.00
In-Channel Restoration Treatment - Linear Metric (Per Foot); Cost include: Heavy Equipment, Labor, Materials, Supplies, etc.)	D3 - Linear metric example may include channel modification or culvert repair or replacement to ensure fish passage.	1400	125	$175,000.00
			Subtotal Task D3 In-Channel Restoration Physical Construction	**$386,500.00**
Up-Slope Restoration Treatment - Area Metric (Acres); Cost include: Equipment, Labor, Materials, Supplies, etc.)	D4 - Area metric example includes seeding, mulching to promote site stability and reduce severe erosion that threatens water quality and fish populations.	200	950	$190,000.00
Up-slope Restoration Treatment - Linear Metric (Per Foot); Cost include: Equipment, Labor, Materials, Supplies, etc.)	D4 - Linear metric example may include construction of beaver dam analogues or other linear features that may attenuate flows and regulate sediment inputs to improve water and habitat quality for spawning, migrating, and rearing fish.	1600	65	$104,000.00
			Subtotal Task D4 Upslope Restoration Physical Construction	**$294,000.00**
			TOTAL IN-CHANNEL AND UPSLOPE PHYSICAL CONSTRUCTION - Portions of restoration will be by acre, portions will be linear feet	**$680,500.00**
			Total	**$1,218,890.87**

ORGANIZATION INFORMATION

1. Project Name:
   McKinney Fire Restoration Project

2. Applicant Organization Name:
   Yurok Tribe

3. Contact Name/Title
   Name: DJ Bandrowski
   Title: Program Manager/Professional Engineer
   Email: djbandrowski@yuroktribe.nsn.us
   Phone Number (include area code): 906-225-9137

4. Organization Address (City, County, State, Zip Code):
   190 Klamath Blvd., Klamath, CA 95548

5. Organization Type
   ☐ Public agency
   ☐ 501(c)(3) Non-profit organization
   ☐ Public utility
   ☒ Federally recognized Indian Tribe
   ☐ California State Indian Tribe listed on the Native American Heritage Commission's California Tribal Consultation List
   ☐ Mutual water company
   ☐ Other:

6. Authorized Representative (if different from the contact's name)
   Name: Leslie Hubbard
   Title: Environmental Sepcialist
   Email: lhubbard@yuroktribe.nsn.us
   Phone Number (include area code): 707-458-5537

7. List all projects the organization is submitting to the NCRP for this Solicitation in order of priority.
   McKinney Fire Restoration Project

8. Organization Information Notes:

The mission of the Yurok Tribe is to exercise the aboriginal and sovereign rights of the Yurok People to continue forever our Tribal traditions of self-governance, cultural and spiritual preservation, stewardship of Yurok lands, waters and other natural endowments, balanced social and economic development, peace and reciprocity, and respect for the dignity and individual rights of all persons living within the jurisdiction of the Yurok Tribe, while honoring our Creator, our ancestors and our descendants. The Yurok Tribe highly values tribal cultural preservation of neighboring tribes through collaborative efforts. Our Fisheries Department has extensive experience and highly qualified personnel in multiple facets of fisheries habitat restoration efforts throughout the Yurok Reservation, the Trinity River watershed, the upper Klamath River, and in some areas of the Sacramento River watershed.

ELIGIBILITY

1. North Coast Resource Partnership Goals and Objectives

GOAL 1: INTRAREGIONAL COOPERATION & ADAPTIVE MANAGEMENT

☒ Objective 1 - Respect local autonomy and local knowledge in Plan and project development and implementation

☐ Objective 2 - Provide an ongoing framework for inclusive, efficient intraregional cooperation and effective, accountable NCRP project implementation

☒ Objective 3 - Integrate Traditional Ecological Knowledge in collaboration with Tribes to incorporate these practices into North Coast Projects and Plans

GOAL 2: ECONOMIC VITALITY

☒ Objective 4 - Ensure that economically disadvantaged communities are supported and that project implementation enhances the economic vitality of disadvantaged communities by improving built and natural infrastructure systems and promoting adequate housing

☒ Objective 5 - Conserve and improve the economic benefits of North Coast Region working landscapes and natural areas

GOAL 3: ECOSYSTEM CONSERVATION AND ENHANCEMENT

☒ Objective 6 – Conserve, enhance, and restore watersheds and aquatic ecosystems, including functions, habitats, and elements that support biological diversity

☒ Objective 7 - Enhance salmonid populations by conserving, enhancing, and restoring required habitats and watershed processes

GOAL 4: BENEFICIAL USES OF WATER

☒ Objective 8 - Ensure water supply reliability and quality for municipal, domestic, agricultural, Tribal, and recreational uses while minimizing impacts to sensitive resources

☒ Objective 9 - Improve drinking water quality and water related infrastructure to protect public health, with a focus on economically disadvantaged communities

☐ Objective 10 - Protect groundwater resources from over-drafting and contamination

GOAL 5: CLIMATE ADAPTATION & ENERGY INDEPENDENCE

☒ Objective 11 - Address climate change effects, impacts, vulnerabilities, including droughts, fires, floods, and sea level rise. Develop adaptation strategies for local and regional sectors to improve air and water quality and promote public health

☐ Objective 12 - Promote local energy independence, water/ energy use efficiency, GHG emission reduction, and jobs creation

GOAL 6: PUBLIC SAFETY

☒ Objective 13 - Improve flood protection, forest and community resiliency to reduce the public safety impacts associated with floods and wildfires

2. Does the project have a minimum 15-year useful life?
   a) ☒ yes ☐ no
   b) If yes, will the organization be able to provide compliance documentation outlined in the instructions should the project be selected as a Priority Project?
      ☒ yes ☐ no

3. Other Eligibility Requirements and Documentation

CALIFORNIA GROUNDWATER MANAGEMENT SUSTAINABILITY COMPLIANCE

a) Does the project directly affect groundwater levels or quality?
   ☐ yes ☒ no
b) If yes, will the organization be able to provide compliance documentation outlined in the instructions including a Groundwater Sustainability Agency letter of support, to include in the NCRP Regional Project Application should the project be selected as a Priority Project?
   ☐ yes ☐ no

CASGEM COMPLIANCE

a) Does the project overlie a medium or high groundwater basin as prioritized by DWR?
   ☐ yes ☐ no
b) If yes, list the groundwater basin and CASGEM priority:
c) If yes, please specify the name of the organization that is the designated monitoring entity:
d) If yes, please specify whether the local Groundwater Sustainability Agency has endorsed the project:

URBAN WATER MANAGEMENT PLAN

a) Is the organization required to file an Urban Water Management Plan (UWMP)?
   ☐ yes ☒ no
b) If yes, has DWR verified the current 2020 UWMP?
   ☐ yes ☐ no

NORTH COAST RESOURCE PARTNERSHIP

c) If the 2020 UWMP has not been verified by DWR, explain and provide anticipated date for verification:

d) Has DWR verified a water loss audit report in accordance with SB 555 as submitted by the urban water supplier?

☐ yes ☐ no

e) Does the urban water supplier meet the water meter requirements of CWC 525?

☐ yes ☐ no

f) Does the urban water supplier meet the State Water Resources Control Board's Water Conservation and Production Reporting requirement?

☐ yes ☐ no

g) If yes, will the organization be able to provide compliance documentation outlined in the instructions, to include in the NCRP Regional Project Application should the project be selected as a Priority Project?

☐ yes ☐ no

AGRICULTURAL WATER MANAGEMENT PLAN

a) Is the organization – or any organization that will receive funding from the project – required to file an Agricultural Water Management Plan (AWMP)?

☐ yes ☒ no

b) If yes, will the organization be able to provide compliance documentation outlined in the instructions, to include in the NCRP Regional Project Application should the project be selected as a Priority Project?

☐ yes ☐ no

SURFACE WATER DIVERSION REPORTS

a) Is the organization required to file State Water Resources Control Board (SWRCB) annual surface water diversion reports per the requirements in CWC Part 5.1?

☐ yes ☐ no

b) If yes, will the organization be able to provide compliance documentation outlined in the instructions, to include in the NCRP Regional Project Application should the project be selected as a Priority Project?

☐ yes ☐ no

STORM WATER MANAGEMENT PLAN

a) Is the project a stormwater and/or dry weather runoff capture project?

☐ yes ☐ no

b) If yes, does the project benefit a Disadvantaged Community with a population of 20,000 or less?

☐ yes ☐ no

c) If this is a stormwater/dry weather runoff project but does not benefit a small DAC population, please provide documentation that the project has been included in a Stormwater Resource Plan that has been incorporated into the NCRP IRWM Plan:

4. Eligible Project Type under 2022 IRWM Grant Solicitation
   - ☐ Water reuse and recycling for non-potable reuse and direct and indirect potable reuse
   - ☐ Water-use efficiency and water conservation
   - ☐ Local and regional surface and underground water storage, including groundwater aquifer cleanup or recharge projects
   - ☐ Regional water conveyance facilities that improve integration of separate water systems
   - ☒ Watershed protection, restoration, and management projects, including projects that reduce the risk of wildfire or improve water supply reliability
   - ☐ Stormwater resource management projects to reduce, manage, treat, or capture rainwater or stormwater
   - ☒ Stormwater resource management projects that provide multiple benefits such as water quality, water supply, flood control, or open space
   - ☐ Decision support tools that evaluate the benefits and costs of multi-benefit stormwater projects
   - ☐ Stormwater resource management projects to implement a stormwater resource plan
   - ☐ Conjunctive use of surface and groundwater storage facilities
   - ☐ Decision support tools to model regional water management strategies to account for climate change and other changes in regional demand and supply projections
   - ☒ Improvement of water quality, including drinking water treatment and distribution, groundwater and aquifer remediation, matching water quality to water use, wastewater treatment, water pollution prevention, and management of urban and agricultural runoff
   - ☐ Regional projects or programs as defined by the IRWM Planning Act (Water Code §10537)
   - ☐ Other:

5. Describe how the project provides a benefit that meets at least one of the Statewide Priorities as defined in DWR's Final 2022 Guidelines (see page 7) and Tribal priorities as defined by the NCRP?

   This project utilizes natural infrastructure such as forests and floodplains through its instream, floodplain, and riparian habitat restoration actions. It also strengthens parterships with local, federal, and tribal governments through its collaborative inter-tribal and NGO partnership as well as with outreach and external collaborative efforts with the US Forest Service, California State agencies, county-level organizations, and other local stakeholders.

CERTIFICATION OF AUTHORITY

By signing below, the Authorized Representative executing the certificate on behalf of the Project Sponsor affirmatively represents that s/he has the requisite legal authority to do so on behalf of the Project Sponsor. The Authorized Representative executing this proposal on behalf of the project sponsor understands that the NCRP is relying on this representation in receiving and considering this proposal. The person signing below hereby acknowledges that s/he has read the entire NCRP 2022 Project Review and Selection Process Guidelines and the NCRP 2022 Proposition 1 IRWM Round 2 Project Application & Instructions documents and has complied with all requirements listed therein.

Official Authorized to Sign for Proposal

Signature

11/4/22

Date

Organization: Yurok Tribe

Project: McKinney Fire Restoration

Technical & Reference Support

Table of Contents

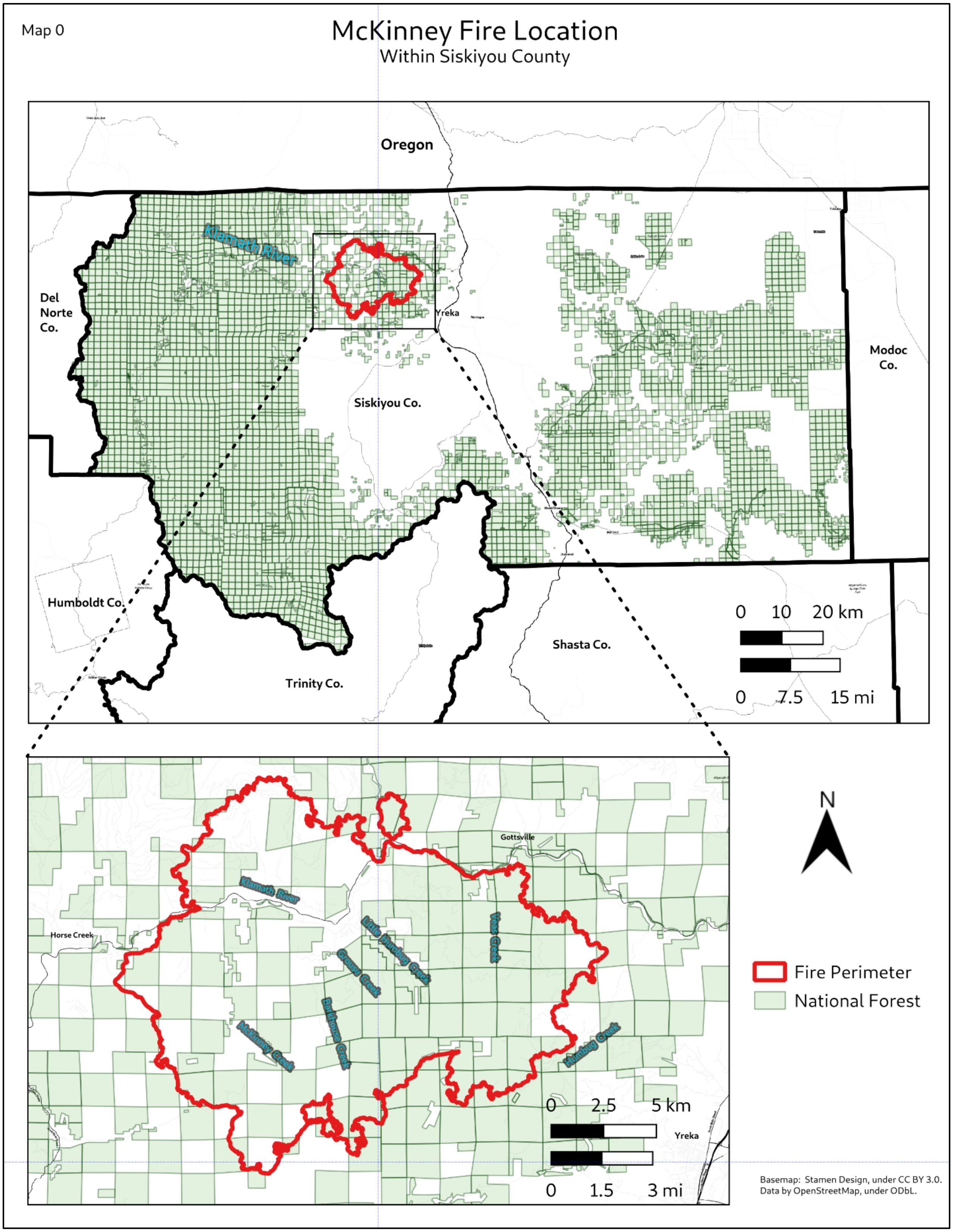


Figure 1. Regional (above) and area (below) maps depicting location of the McKinney Fire and National Forest landownership in Siskiyou County, CA.

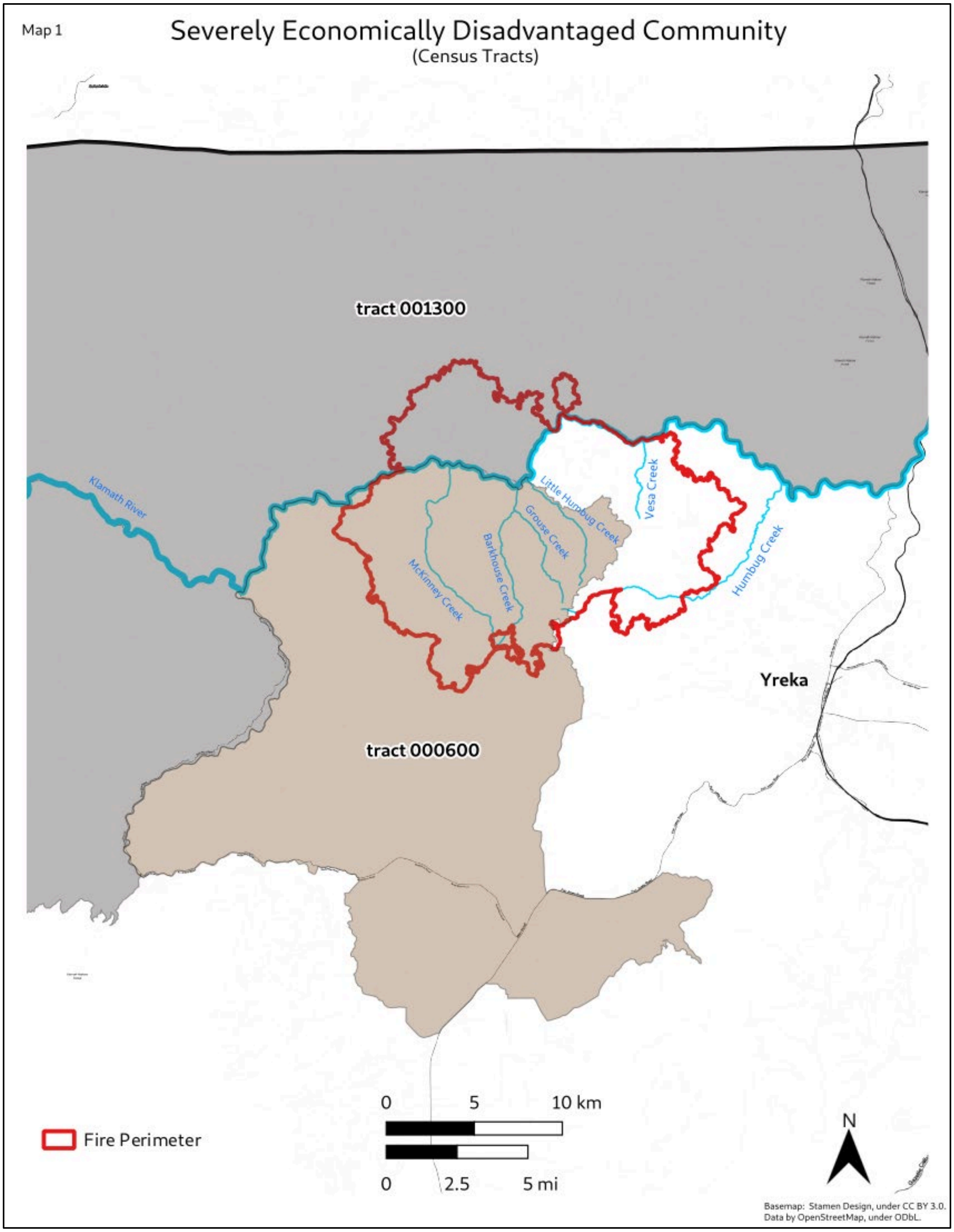
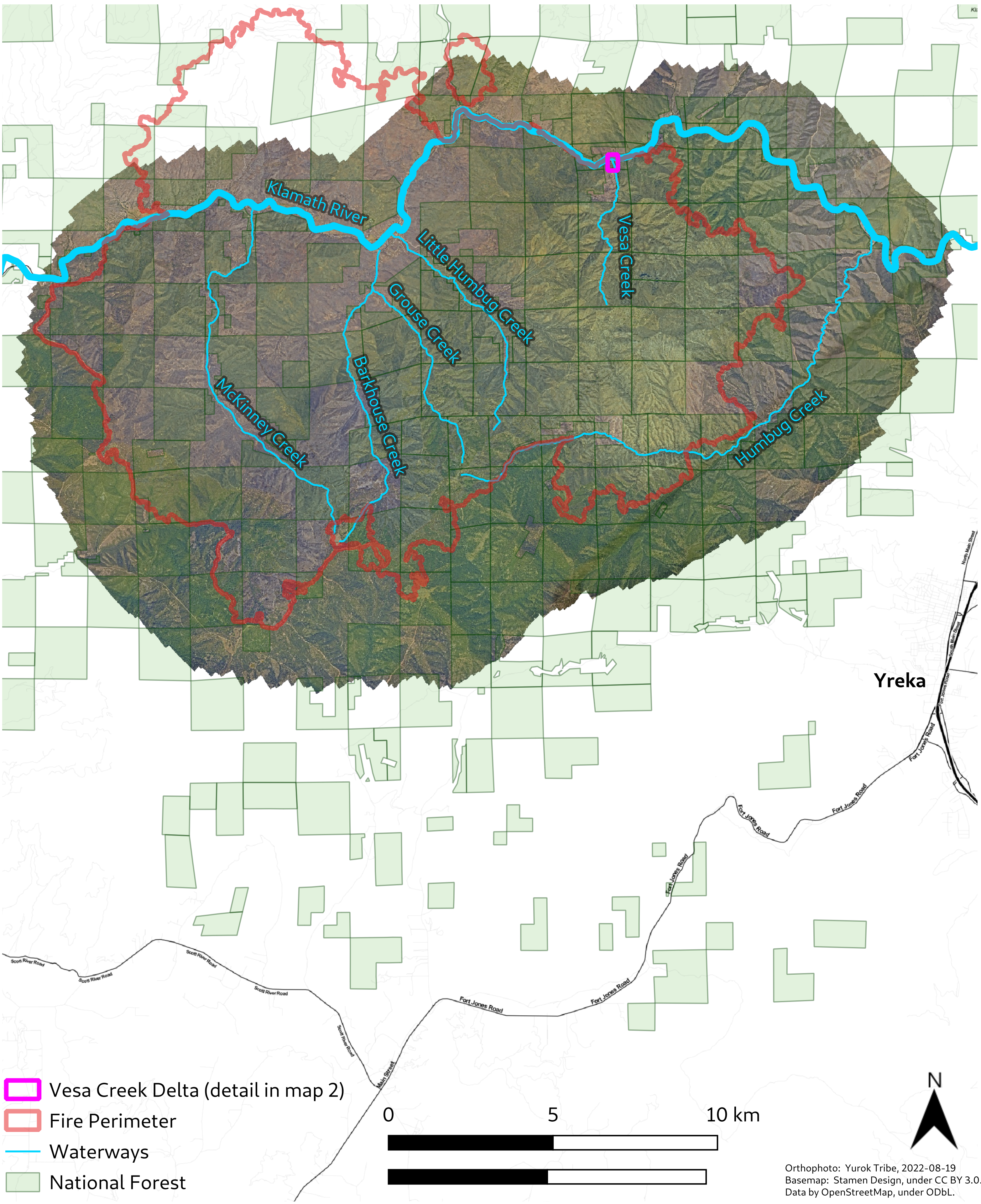


Figure 2. Area map of disadvantaged communities (tract 001300 and tract 00600) that occur in and around the McKinney Fire area of Northern California.

Map 1

McKinney fire Footprint and Orthophoto

With Important Waterways



Orthophoto: Yurok Tribe, 2022-08-19
Basemap: Stamen Design, under CC BY 3.0.
Data by OpenStreetMap, under ODbL.

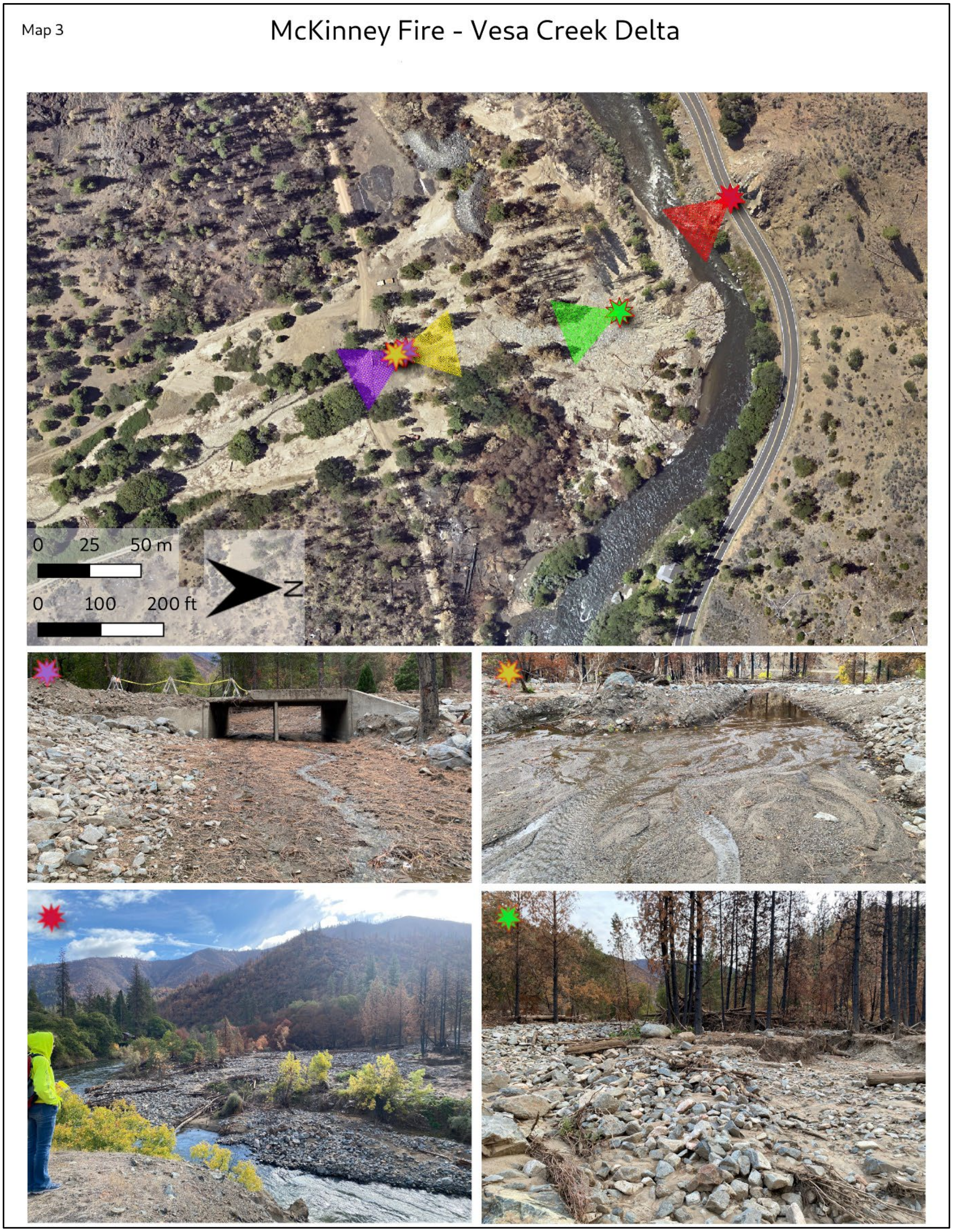


Figure 3. Detail imagery map of the Vesa Creek tributary where it flows into the Klamath River (above), with symbols denoting color coordinated photo locations taken throughout the creek delta (below).

Map 4

Images from Humbug Creek

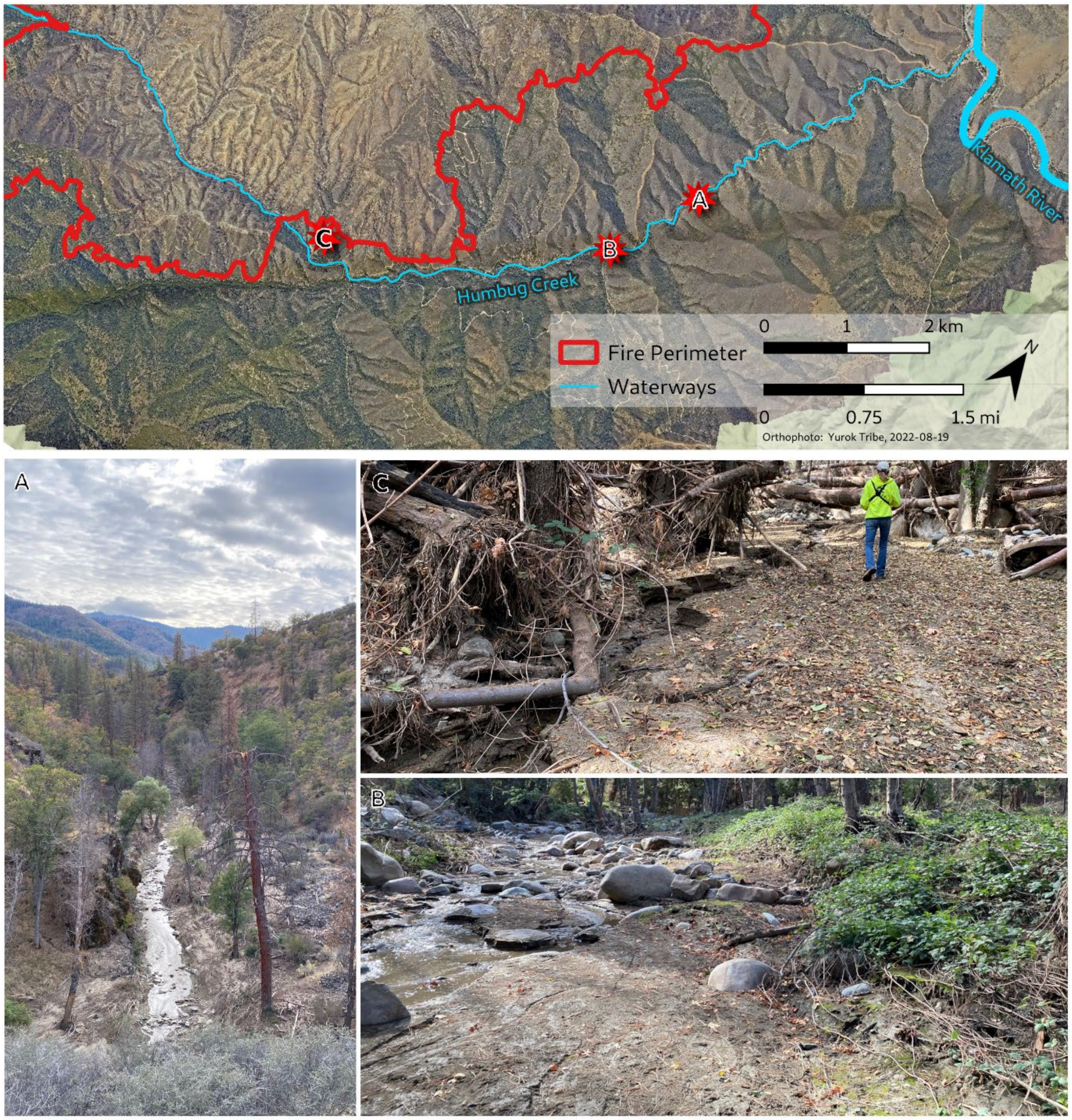


Figure 4. Detail map of Humbug Creek tributary at the southern border of the McKinney Fire footprint with locations symbolizing photo locations of upslope conditions. Photos below coordinate with letter label locations in the map (above).

McKinney Fire Watershed Response Report

July 29th 2022, a fire started on steep slopes above Klamath River fire exploding to 20,000 in 8 hours destroying 122 structures and outbuildings with 4 people perishing. The Fire grew in all directions in the next few days to 60,000 acres. An agency Burned Area Emergency Response (BAER) team was formed by the Klamath National Forests to begin a burned area survey of the McKinney fire that burned on federal, state, and private lands in Siskiyou County.

While many wildfires cause little damage to the land and pose few threats to fish, wildlife, and people downstream, some fires create situations that require special efforts to prevent further catastrophic damage after the fire. Loss of vegetation and exposes soil to erosion; runoff may increase and cause flash flooding; sediments may move downstream and damage houses or fill reservoirs; and put endangered species and community water supplies at risk. It assess wildfire damages to the watershed and threats to values at risk a BAER team is called in to conduct an assessment of risks and to [ropose treatments to reduce these threats.

What is BAER:

BAER is an emergency program aimed at managing imminent unacceptable risks to human life and safety, property, or critical natural and cultural resources from post-wildfire damaging events.

The Burned Area Emergency Response Team is sent to fires to determine the need for and to prescribe and implement EMERGENCY treatments to minimize threats to life or property and to stabilize and prevent unacceptable degradation to natural and cultural resources resulting from the effects of the fire. (Forest Service Manual 2523.02).

BAER teams identify values at risk from the effects of the fire not in response to fire suppression activities (suppression repair covers that). BAER products will include a soil burn severity map, soil erosion map, watershed runoff map, and debris flow map. Along with maps datasets will be provided for detailed analysis. We will assess watersheds with high values at risk for post-fire rain with related impacts such as increased peak flow, debris flow potential, and increased soil erosion. This will be done across the entire fire footprints (private and NFS lands).

Event: Flash Flooding/Debris Flows

On August 2nd, 2022, an upper-level high pressure shifted east of the fire and deep monsoonal moisture surged into the area from the south. Precipitable water values (atmospheric amount of moisture) were the highest ever observed for Medford weather station. Thunderstorms moved into the fire perimeter between 1900-1930 PDT with heavy rain rates for at least the next hour as the storm moved slowly north to the Klamath River. Based only on radar, estimated rainfall rates of 1.5-2"/hr. occurred over the scar on the southeast aspects of Craggy Mountain. Radar also estimated instantaneous rain rates of around 4"/hr at 1930 PDT in this area with Flash floods and debris flow warnings issued for storms in the area with heavy rain beginning at 1916 PDT at the Humbug OHV staging area and a debris flows at Humbug Creek nearby started at 1933 PDT (see Figure 1 Doppler map below).

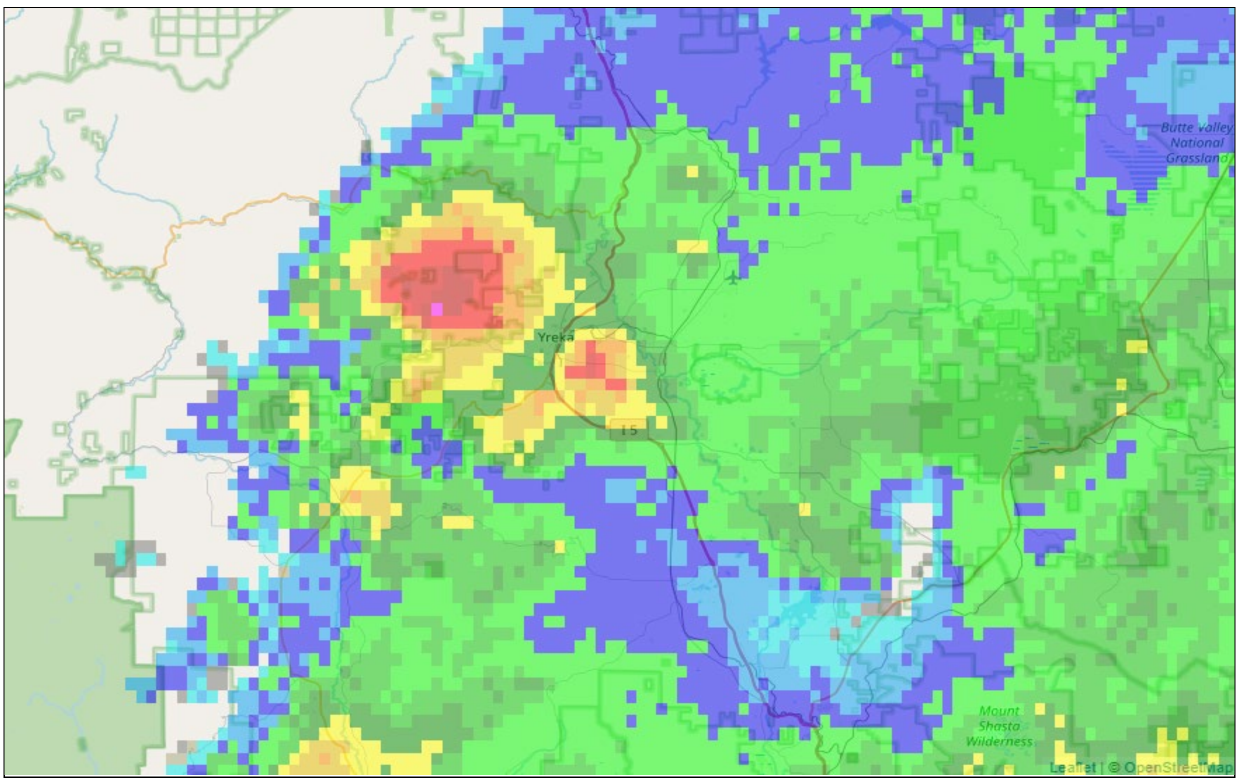


Figure 1: Doppler from Incident IMET Cal Incident Mgt 2

These very heavy thunderstorms on August 2nd, 2022, affected the McKinney Fire in the evening producing 2 to 3 inches of rain in 1 hour over the eastern portion of the Fire (see figure 2 below).

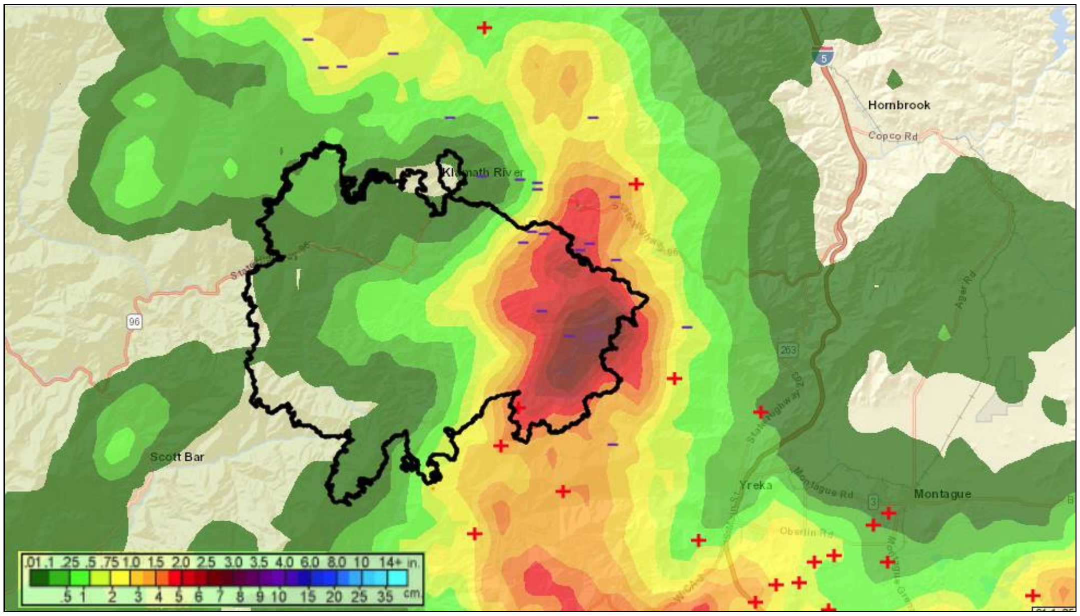


Figure 2: https://mrms.nssl.noaa.gov/qvs/product_viewer/

At 8 pm in the evening of August 2, 2022, flash flooding was reported in Humbug Creek with the bridge crossing being challenged. At the same time Vesa and Little Humbug creeks were flooding and producing debris flows blocking the Walker Road. By 9:15 pm the storm moved off the easter half of the fire and continued east (see pictures below).

Humbug Creek mudflow near OHV park

Little Humbug Creek Walker Road crossing

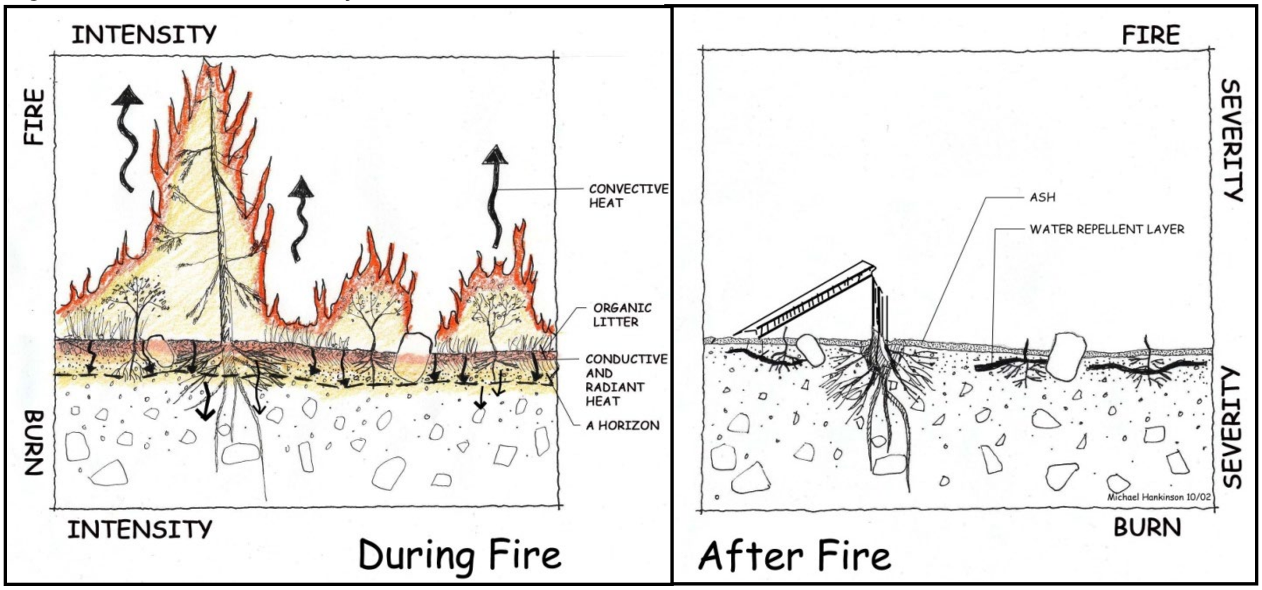
Soil Burn Severity: Fire Intensity vs Soil Burn Severity

It must be understood that **soil burn severity is NOT vegetative burn severity or mortality** as illustrated in Figure 9. Vegetative burn severity is but one component taken into consideration – soil burn severity goes beyond aboveground vegetation impacts to belowground soil heating effects and associated impacts to soil hydrologic function, runoff and erosion potential, and vegetative recovery.

Such additional factors include amount and condition of residual ground cover, viability of native seed banks, condition of residual fine roots, degree of fire-induced water-repellency, soil physical factors (structural stability, porosity, restricted drainage), soil chemical factors (oxidation, altered nutrient status), and topography (slope gradient, length, and profile).

While above-ground burn severity is more related to peak temperatures and fire behavior during the fire, below-ground soil burn severity is related strongly to the length of time the heat is in contact with the soil (residence time).

Figure 3: Soil Burn Severity



Soil Burn Severity Indicators used for the McKinney Fire are detailed in Parsons et al., 2010: Field Guide for Mapping Soil Burn Severity (http://www.fs.fed.us/rm/pubs/rmrs_gtr243.pdf).

Low soil burn severity: Surface organic layers are not completely consumed and are still recognizable. Structural aggregate stability is not changed from its unburned condition, and roots are generally unchanged because the heat pulse below the soil surface was not great enough to consume or char any underlying organics. The ground surface, including any exposed mineral soil, may appear brown or black (lightly charred), and the canopy and understory vegetation will likely appear “green.”

Moderate soil burn severity: Up to 80 percent of the pre-fire ground cover (litter and ground fuels) may be consumed but generally not all of it. Fine roots (~0.1 inch or 0.25 cm diameter) may be scorched but are rarely completely consumed over much of the area. The color of the ash on the surface is generally blackened with possible gray patches. There may be potential for recruitment of effective ground cover from scorched needles or leaves remaining in the canopy that will soon fall to the ground. The prevailing color of the site is often “brown” due to canopy needle and other vegetation scorch. Soil structure is generally unchanged.

High soil burn severity: All or nearly all of the pre-fire ground cover and surface organic matter (litter, duff, and fine roots) is generally consumed, and charring may be visible on larger roots. The prevailing color of the site is often “black” due to extensive charring. Bare soil or ash is exposed and susceptible to erosion, and aggregate structure may be less stable. White or gray ash (up to several centimeters in depth) indicates that considerable ground cover or fuels were consumed. Sometimes very large tree roots (> 3 inches or 8 cm diameter) are entirely burned extending from a charred stump hole. Soil is often gray, orange, or reddish at the ground surface where large fuels were concentrated and consumed.

The following soil burn severity map (Figure 4) illustrates the general soil burn severity pattern on the landscape. The soil burn severity was 16% high, 63% moderate, and 22% low. Adding high and moderate soil burn severities shows about 80% of the fire will have a robust storm response in key watersheds. This was abundantly shown in the recent storms where debris flows, and hyper concentrated flows did excessive damage to roads, bridges, and depositing large quantities of ash, sediment, and trash into the Klamath River. Breakdown of soil burn severity by ownership is shown in Table 1 below with 65% federal and 35% private lands.

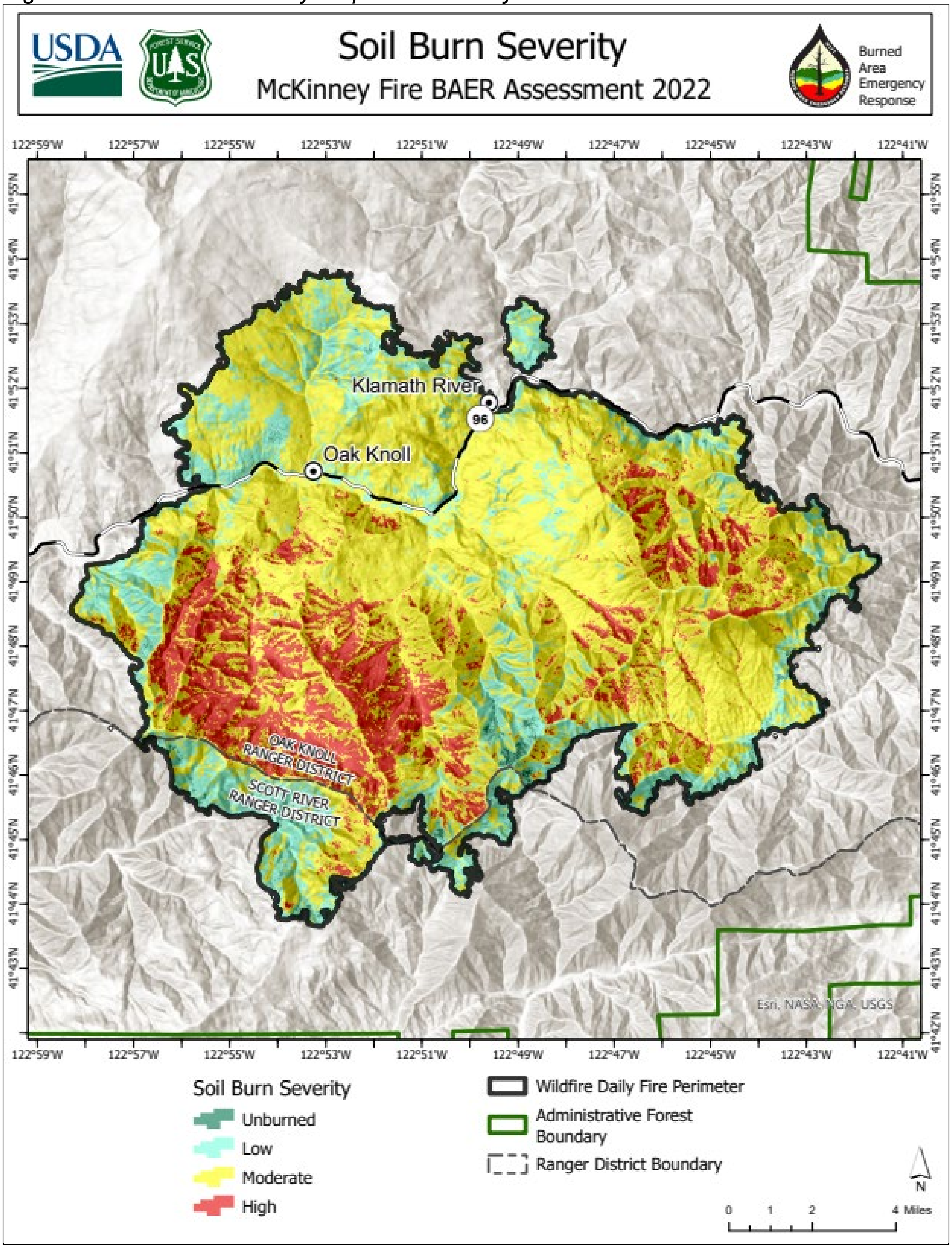
Table 1: Soil Burn Severity per Ownership

Soil Burn Severity	NFS	Other Federal (List Agency)	State	Private	Total	% within the Fire Perimeter
Unburned	**405**	**-**	**-**	**137**	**542**	**1**
Low	**8164**	**-**	**-**	**4386**	**12,550**	**21**
Moderate	**24421**	**-**	**-**	**13441**	**37,862**	**63**
High	**6324**	**-**	**-**	**3046**	**6,324**	**16**
Total	**39316**	**-**	**-**	**21009**	**60,325**	**100**

For purposes of hydrologic and debris flow modelling, Moderate and High SBS are generally treated the same. It is clear this fire burned hot and extensively. *The combined Moderate and High Soil Burn Severity is 78%.* Table 1 summarizes the SBS values. The high areas have obvious evidence of soil heating in the top 1-2 surface inches of soil but have complete lack of cover and widespread and fairly continuous water repellency. The moderate areas are variable, some appear similar to high, with slightly less depth of soil heating (less than 1 inch) but lack surface or canopy cover and will have a watershed response similar to a high SBS. Combined, these areas will produce significantly increased runoff, sediment production, and stream flows. The reason for this is soil cover is the most important soil property to mitigate increased flow and debris flow risk. These areas have long-term soil damage, and natural recovery will be slow particularly at the lower elevation south aspect slopes.

It is common that there are unburned islands within a fire perimeter increasing the unburned percentage. This did not occur within the McKinney Fire; 99% of the fire had enough Soil Burn Severity to increase the risk of erosion, sedimentation, stream flow and debris flows. Only 1% of the fire was mapped as Low Soil Burn Severity

Figure 4 – Soil Burn Severity Map for McKinney Fire



Soils

Erosion Response: Most of the moderate burn severity, and even some of the low burn severity areas contain extremely low ground cover levels, which could contribute to high erosion levels. Some of the factors that allowed the McKinney Fire to burn with such soil burn intensity include:

1) Historically low live fuel moistures – California is in a historic drought with record warm and dry seasons. Any ignition of forest fuels had a high probability of spread (90%). 2) Topography – There is a high density of steep and deep canyons that promote rapid growth and difficulty in fire control. 3) Dense fuel loading – Large tracts of the fire were young, dense stands of plantation trees. There were also thicker stands of old growth forest with high surface fuel loading. The dense conifer regeneration and subsequent fire suppression resulted in very heavy surface fuels which had deep thermal impacts to the soil (High Soil Burn Severity). Both recent and older fire scars are apparent throughout the fire area. The more recent fire scars supported dense shrub stands that result in flashy fire growth. 4) Unstable air – The air was unstable when the fire started. Unstable air allows hot air to rapidly rise resulting in pyro cumulus clouds. Rapid fire growth is often caused by long-range spotting from embers being lofted in the smoke column and depositing away from the main fire.

Most of the fire was moderate and high soil burn severity has either a high or very high erosion hazard rating (Table 2). The ERMiT (Erosion Risk Management Tool) model was used to predict the erosion rates and spatially display erosion source areas (USFS, RMRS-GTR-188, 2007). The spatial distribution of erosion is displayed in Figure 5 and erosion rates for select watersheds are displayed on Table 2 above.

Erosion rates are determined primarily by soil burn severity, topography, soil type and precipitation. All of these factors favor significant erosion on the west side of the fire with the steep canyons, finer-textured soils, rain dominated weather and extensive High and Moderate SBS.

Erosion and the subsequent sedimentation will contribute to bulking hydrologic flow and contribute to debris flow risk. The soil textures in the western part of the fire are finer than the eastern part of the fire resulting in viscous river flow because soils high in silts and clays stay in suspension longer whereas the soils on the east portion of the fire contain a high fraction of sand which tends not to stay in suspension.

As stated earlier, while the fire was still actively burning, a very localized storm centered over Little Humbug, Humbug and Vesa Creeks dumped approximately 3 inches of rain in an hour and, furthermore, winds attaining speeds 60mph roared up the canyons. The result was extreme wind and water erosion in these canyons. Soil samples on the north side of Humbug and Little Humbug Creek revealed erosion of up to 4 inches of soil. Rough calculations suggest that if 4 inches of soil was lost from wind and water erosion, that would translate to 591 cubic yards of soil / acre lost. That would be equivalent to approximately *590 tons / acre of erosion.*

Table 2 - Modelled Hillslope Erosion for post-fire 2, 5, and 10-year runoff events

	ERMiT Erosion Rates (Tons/Acre)			Soil Burn Severity by Pourshed (%)				
POURSHED	**2 Year Event**	**5 Year Event**	**10 Year Event**	**Unburned / Very Low**	**Low**	**Moderate**	**High**	**Moderate +High**
Barkhouse Cty Bridge	1.36	4.74	7.48	3.7	12.7	57.7	26.0	**83.6**
Barkhouse KRR	1.41	4.86	7.61	3.5	12.3	59.5	24.8	**84.2**
Cedar Cove Hwy 96	0.36	2.67	5.91	0.0	8.5	91.5	0.0	**91.5**
Dona KRR	2.45	7.44	11.23	0.0	3.9	53.8	42.3	**96.1**
East of Smith Hwy 96	0.46	2.45	5.25	0.0	14.1	85.3	0.6	**85.8**
Humbug Ck Bridge KRR	0.19	1.02	1.83	60.7	8.3	27.5	3.4	**31.0**
Humbug OHV Park	0.38	2.01	3.61	24.6	12.2	55.8	7.3	**63.1**
Lt Humbug Bridge KRR	1.17	4.51	7.00	0.0	10.0	82.3	7.7	**90.0**
McKinney Xing KRR	1.89	6.22	9.18	0.4	0.8	50.8	47.9	**98.8**
Mill Lower Houses	0.64	2.06	3.17	70.4	16.5	12.0	1.0	**13.0**
Oak Knoll WS West Ck	0.53	2.85	6.10	0.0	5.4	94.6	0.0	**94.6**
Smith Gulch Hwy 96	0.33	2.33	5.22	0.0	5.0	94.8	0.2	**95.0**
Vesa CkBridge KRR	0.56	3.44	6.62	0.0	6.2	66.2	27.6	**93.7**

Figure 5 is a dramatic display of rilling on a hillslope that was located at the center of the storm. Because the soil loses most of its soil cover in Moderate and High SBS, the water runs off the surface unimpeded without organic soil cover. Unfortunately, water repellency was exacerbated by long term drought because the microbial component in the soil that attenuates water repellency was disrupted in dry soil so utilization of the water repellant compounds are outpaced by the deposition. This significantly increases runoff speed which increases stream peak flow and debris flow potential. What may be concerning is that the surface of the soil that burned at Moderate and High Soil Burn

Severity does have an ability to absorb water prior to runoff. With wind and water eroding the unconsolidated material, much of the water repellency is at the surface allowing for immediate runoff.

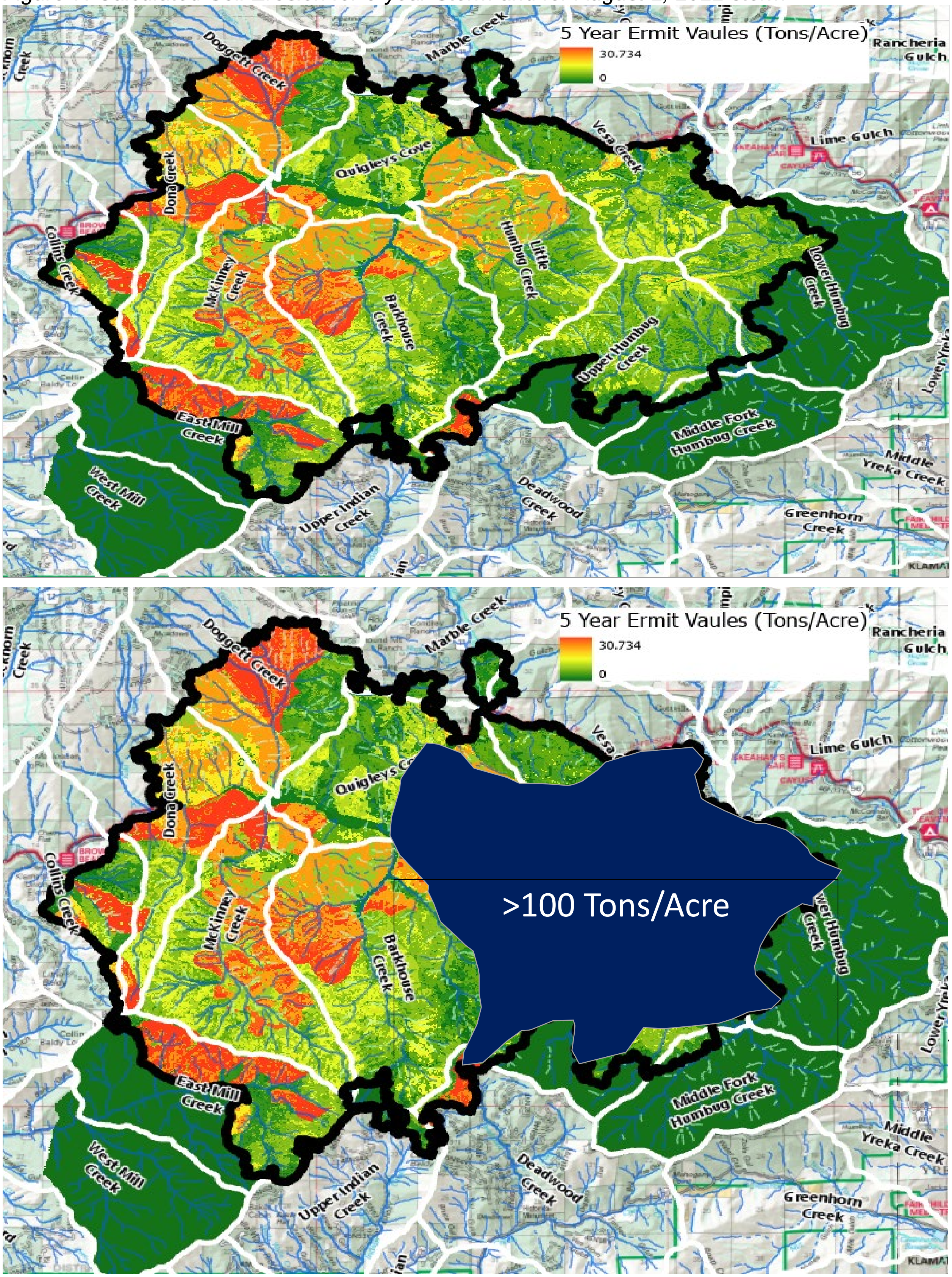
Figure 5. Illustration of extensive rilling patterns within the core of the storm

Figure 6 shows a manzanita stump where the very top is charred. After the erosion event, the unburned part of the stump was exposed.

Figure 6. Manzanita stump unburned portion exposed by extreme erosion

Figure 7 shows the ERMiT soil erosion rates for a 5-year storm and the rate for the area hit by the August 2, storm.

Figure 7. Calculated Soil Erosion for 5-year Storm and for August 2, 2022 storm



Hydrology

The most noticeable effects on water quality will be increases in sediment and ash from the burned area into waterbodies in and downstream of the fire area. Flash flooding and debris flows are natural watershed response for this area. The risk of flash flooding and erosional events will increase because of the fire, creating hazardous conditions within and downstream of the burned area.

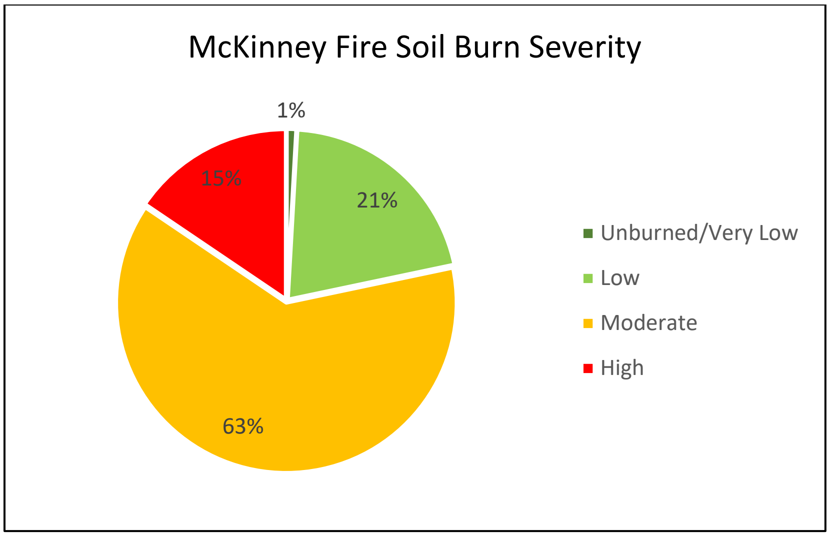


Figure 7. Relative area of different soil burn severities over the entire McKinney Fire footprint.

Watershed resources located within and downstream of the burn area include springs and perennial, intermittent, and ephemeral streams. The fire in the assessment area lies within twenty HUC 14 and nine HUC12 watersheds. HUC 12 watersheds are broken up into smaller contributing drainages designated as HUC14. See Table 2 for acres and percent moderate and high soil burn severity.

Table 3. HUC14 Drainages within the McKinney Fire burn perimeter, acres burned at different soil burn severities, and percent moderate and high SBS.

HUC 14 Name	Total Acres	Acres Burn	Watershed Burned	Unburned	Low SBS	Moderate SBS	High SBS	Moderate & High SBS
Buckhorn Gulch-Beaver Creek (18010206090402)	8,234	644	7.8%	7589 (92.2%)	429 (5.2%)	216 (2.6%)	0 (0%)	2.6%
Clear Creek (18010206080103)	2,781	1,942	69.8%	839 (30.2%	284 (30.2%)	1429 (51.4%)	228 (8.2%)	59.6%
Collins Creek-Klamath River	7,845	2,143	27.3%	5702 (72.7%)	1135 (14.5%)	954 (12.2%)	54 (0.7%)	12.8%

(18010206100502)								
Deadwood Creek (18010208030201)	4,210	550	13.1%	3660 (86.9%)	383 (9.1%)	164 (3.9%)	3 (0.1%)	4%
Doggett Creek (18010206100301)	7,701	4,126	53.6%	3575 (46.4%)	1423 (18.5%)	2699 (35%)	4 (0%)	35.1%
Dona Creek-Klamath River (18010206100303)	4,380	4,215	96.2%	165 (3.8%)	1015 (23.2%)	2399 (54.8%)	801 (18.3%)	73.1%
Grouse Creek (18010206100102)	2,818	2,712	96.2%	106 (3.8%)	872 (30.9%)	1700 (60.3%)	141 (5%)	65.3%
Kohl Creek (18010206100501)	3,537	90	2.6%	3447 (97.4%)	68 (1.9%)	22 (0.6%)	0 (0%)	0.6%
Little Humbug Creek (18010206100201)	6,188	6,185	100%	3 (0%)	615 (9.9%)	5092 (82.3%)	478 (7.7%)	90%
Lower Barkhouse Creek (18010206100103)	2,641	2,641	100%	0 (0%)	35 (1.3%)	2056 (77.8%)	550 (20.8%)	98.7%
Lower Humbug Creek (18010206080104)	7,830	1,034	13.2%	6796 (86.8%)	452 (5.8%)	574 (7.3%)	8 (0.1%)	7.4%
McKinney Creek (18010206100302)	7,275	7,240	99.5%	34 (0.5%)	58 (0.8%)	3695 (50.8%)	3488 (47.9%)	98.7%
Middle Fork Humbug Creek (18010206080102)	4,978	248	5%	4729 (95%)	203 (4.1%)	46 (0.9%)	0 (0%)	0.9%
Miller Gulch-Klamath River (18010206080304)	6,557	2,429	37%	4128 (63%)	657 (10%)	1642 (25%)	130 (2%)	27%
Quigleys Cove-Klamath River	6,162	5,882	95.5%	280 (4.5%)	1060 (17.2%)	4737 (76.9%)	85 (1.4%)	78.3%

(18010206100202)								
Upper Barkhouse Creek (18010206100101)	4,728	4,485	94.9%	243 (5.1%)	339 (7.2%)	2314 (49%)	1832 (38.7%)	87.7%
Upper Humbug Creek (18010206080101)	8,037	6,072	75.6%	1965 (24.4%)	1019 (12.7%)	4474 (55.7%)	579 (7.2%)	62.9%
Upper Indian Creek (18010208050101)	6,121	305	5%	5816 (95%)	240 (3.9%)	65 (1.1%)	0 (0%)	1.1%
Upper Mill Creek (18010208060501)	7,213	3,684	51.1%	3529 (48.9%)	2058 (28.5%)	1500 (20.8%)	126 (1.7%)	22.5%
Vesa Creek (18010206080303)	3,141	3,139	100%	1 (0%)	194 (6.2%)	2080 (66.2%)	865 (27.5%)	93.8%

Changing Climate Effects: The burn area lies within the North Coast climate region. According to a 2015 Forest Service climate change assessment for the Klamath National Forest, several studies show precipitation is falling more as rain versus snow, and the timing of snowmelt is shifting to earlier in the season (Butz et al.). Models also predict a shift to more intense storm events. In general, these changes could influence severity of postfire watershed response. If most precipitation falls as rain rather than snow, with higher intensities, postfire watershed response would be amplified.

Table 4. Elevation and Average Annual Precipitation for Select Pour Points.

PP#	**Select Pour Points**	**Max Elevation (ft)**	**Min. Elevation (ft)**	**Average annual precip (in)**	**% above 6,000 ft**
PP1	FS Humbug OHV Park	6,219	2,758	31	0%
PP2	Humbug Creek County Bridge Klamath River Road	6,219	1,950	27	0%
PP3	Vesa Creek County Bridge Klamath River Road	5,529	1,843	31	0%
PP4	Lt Humbug Creek County Bridge Klamath River Road	4,874	1,758	30	0%
PP5	FS Oak Knoll Workstation Drainage	3,457	2,004	26	0%

PP6	McKinney Creek County Crossing Klamath River Road	5,860	1,721	30	0%
PP7	Barkhouse Creek - County Crossing, Klamath River Rd	5,965	1,716	30	0%
PP8	Dona Creek - County Crossing, Klamath River Rd	5,385	1,718	29	0%
PP9	Cedar Cove - Hwy 96	3,839	1,779	27	0%
PP10	"East of Smith" Gulch - Hwy 96	4,222	1,815	29	0%
PP11	Smith Gulch - Hwy 96	4,193	1,785	28	0%
PP12	Mill Ck Above Lower Houses	5,996	2,008	32	0%

Damaging Storms: There are a few types of damaging storms typical for this area. Short-duration, high-intensity storms (such as monsoonal thundershowers) frequently trigger debris flows and could cause localized flooding in small catchments. Precipitation rates can exceed infiltration rates and cause rapid runoff. Thunderstorms and effects tend to be localized and occur in summer and early fall.

Flood potential will decrease as vegetation reestablishes, providing ground cover, increasing surface roughness, and stabilizing and improving the infiltration capacity of soils. Modeling for post-fire flooding was conducted on selected pour points that were associated with specific critical values and/or that might be representative of watershed response in a general area – see Map 2 (end of report). Pour points are points on the landscape through which all water upslope of the point passes.

Because of the lack of gages on unregulated streams and the size of the impacted watersheds, USGS regression equations for Lahontan Region (Region 2) were selected to estimate pre- and post-fire flows (Gotvald et al., 2012). This method is useful for watersheds over 13 square kilometers (~3,200 acres). For small basins, areas less than 13 square kilometers, an alternative modeling method was recommended to better represent post-fire runoff. The WildCat5 model was used to estimate pre- and post-fire flows at five small basins within the northwestern area of the McKinney Fire footprint.

USGS Regression Equations: Regional regression equations were developed to estimate magnitude and frequency of flows in ungauged watersheds based on analysis of discharge at gauged sites and relationship with significant basin characteristics. The Lahontan Region (Region 2) is applicable to the burn area. Lahontan Region regional regression equation (Gotvald et al., 2012) uses inputs of drainage area, elevation, and mean annual precipitation to estimate peak discharge for different return intervals.

Estimates of post-fire flooding are related to the acres of soil burn severity within a pour point watershed. To determine pre-fire discharge using regression equations, no adjustments are made to calculated flows at a given pour point for the selected peak flow (Q2 for this analysis). For estimates of post-fire discharge at the same pour point, percentage of high SBS, moderate SBS, low SBS, and unburned and low severity acres is calculated from the soil burn severity map. The addition of a category for moderate soil burn severity without future needle cast potential was also added. For this analysis, runoff from unburned and very low soil burn severity areas are assumed to be unchanged (Q2); runoff from low soil burn severity areas are assumed to respond similar to a five-year discharge (Q5); runoff from moderate soil burn severity areas are assumed to respond similar to a ten-year discharge (Q10); and runoff from high soil burn severity areas are assumed to respond similar to a twenty-five-year discharge (Q25). Applicable regression equations for Q2, Q5, Q10, and Q25 are applied to each category. The sum of the flows at these various recurrence intervals estimates the response of the newly burned landscape from an event that would typically generate a 2-year peak flow.

Pour point watersheds are delineated using USGS StreamStats web interface and poursheds are imported to ArcMap for further analysis. ArcGIS software is used to analyze data required to run the Wildcat5 program.

The analysis for pre- and post- fire hydrologic response and probability of flows is based on the probability of a 2-year storm occurring in the fire area (assuming a 2-year storm event will produce a 2-year runoff event). The 2-year, 12-hour duration storm for the burn area ranges between 1.5 to 1.9 inches based on NOAA precipitation tables (NOAA website, 2022). The storms expected to occur within the fire burned area that could produce damaging post-fire effects is a short duration, high intensity rainstorm (likely to cause localized effects); a longer duration rainstorm associated with an atmospheric river (causing flooding in large mainstems); or a rain-on-snow event (causing flooding in large mainstems). Intensity within a storm and antecedent soil moisture are both spatially variable. Ultimately, when precipitation intensity exceeds infiltration rates or infiltration capacity, runoff initiates and erosion potential increases. Design storm characteristics are listed in Table 5.

Table 5. Hydrologic Modeling Design Factors

Storm Recurrence Interval	2 years
Design Storm Duration	12 hour
Design Storm Magnitude	1.5 - 1.9 inches

The 2-year design storm has a 50% chance of occurring in any given year, and a 97% chance of occurring in the next five years. Conversely, there is a less than 0.1% chance that the 2-year storm event will not occur in the next 10 years (during the recovery period).

Table 6. Comparison of pre- and post-fire peak flow related to the 2-year return interval (USGS Regional Regression Equations).

				2 yr. RI Peak Flow				
HUC14 Drainage or HUC12 Subwatershed	**PP#**	**Modeled Pour Point**	**% of Mod & High SBS**	**Pre-Fire Q (CFS)**	**Post-Fire Q (CFS)**	**Post-Fire Bulked Q (CFS)**	**Bulked Q Compared to Pre-Fire Q (Time increase)**	**Flood Hazard Rating**
HUC14 Upper Humbug Creek	PP1	FS Humbug OHV Park	63	229	400	500	2.2	HIGH
HUC12 Humbug Creek	PP2	Humbug Creek County Bridge Klamath River Road	31	126	314	392	3.1	HIGH
HUC14 Vesa Creek	PP3	Vesa Creek County Bridge Klamath River Road	94	103	310	387	3.8	HIGH
HUC14 Little Humbug Creek	PP4	Lt Humbug Creek - County Bridge Klamath River Road	90	117	425	532	4.5	HIGH
HUC14 McKinney Creek	PP6	McKinney Creek - County Crossing Klamath River Road	99	67	220	275	4.1	HIGH
HUC12 Barkhouse Creek	PP7	Barkhouse Creek - County Crossing, Klamath River Rd	84	151	474	593	3.9	HIGH
HUC12 Mill Creek	PP12	Mill Ck Above Lower Houses	13	798	1132	1414	1.8	MODERATE

Bulking factor: Post-fire flows will be bulked with sediment and woody debris that increase the volume of runoff, which could negatively impact culverts, constructed channel ways, and other infrastructure designed to pass “normal” flows. Across much of the fire area, particularly in the north-facing watersheds that drain to the Klamath River, observed existing stored sediment will be mobilized in post-fire flows increasing runoff volume. Bulking and increased flows may cause channels to flood, divert, or migrate to areas that do not usually flood. A bulking factor of 1.25 was applied to post-fire estimates (Foltz, et al. 2009).

Modeling Results: Post-fire bulked flows are expected to be 1.8 to 4.5 times that of non-bulked, pre-fire peak flows. Some of these values represent significant increases in runoff, justifying the need for emergency response treatments. Post-fire modeling results are most applicable during the first year of recovery; hydrologic response will decrease in subsequent years.

Hydrologic response displayed as flood hazard rating in Map 8 simplify hydrologic modeling results into one graphic because “low, moderate, high” is easier to relate to than “2x increase in peak flow.” The rating split is as follows: <50% increase is Low; 50% - <100% increase is moderate; >100% increase is high. Our design flow is a little over bankfull (Q2). If twice the bankfull flow would threaten the site, then the flood hazard risk would be high. The graphic simplifies peak flow/flooding estimates; however, actual flood hazard for critical values depends on site characteristics as well as the increase in peak flow. Actual hazard zones would be the low-lying areas, channels, and downstream of the fire, not ridges/uplands/areas outside the fire.

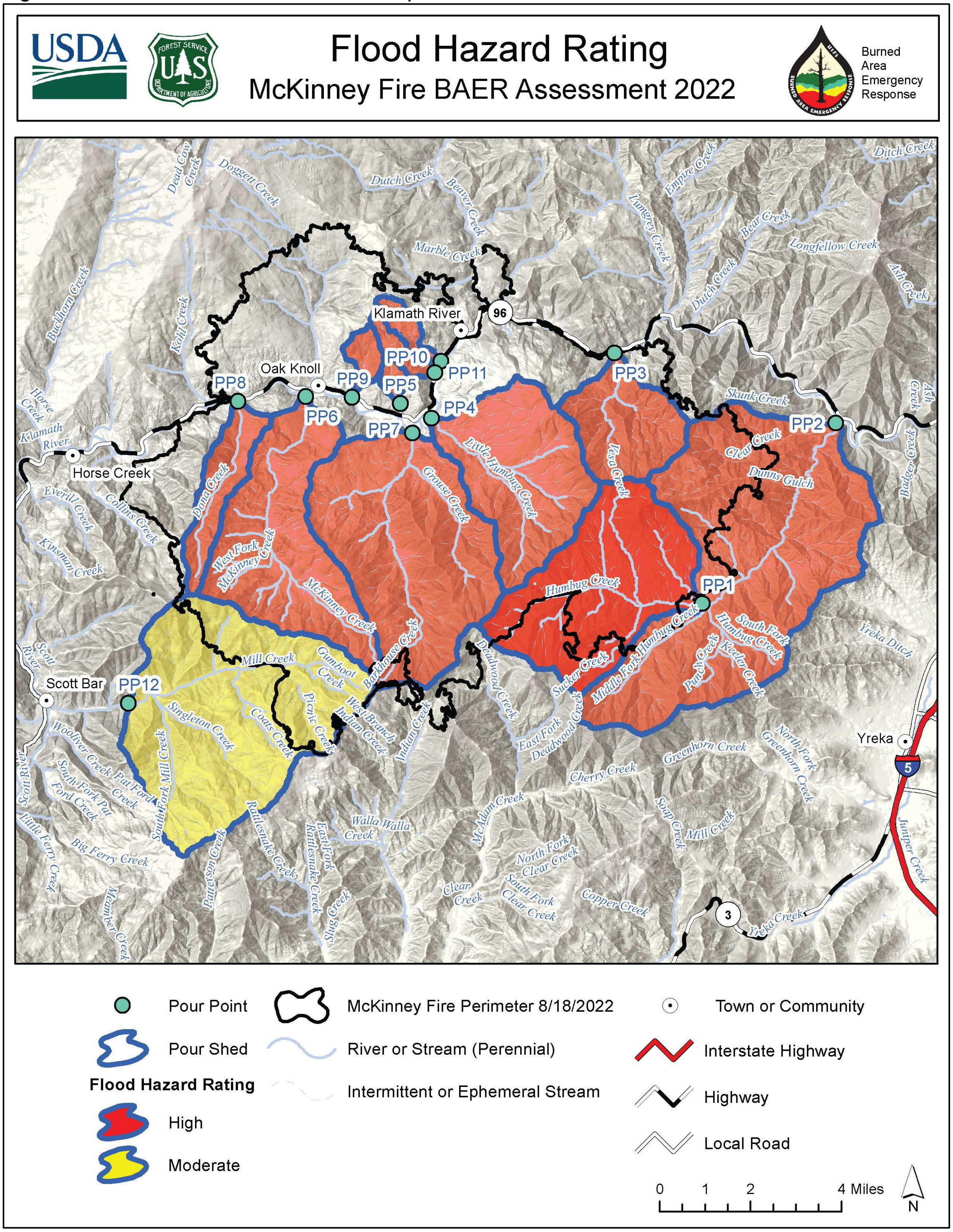
Summary of Post-Fire Threat:

Overall, the primary watershed responses are expected to include: 1) an initial flush of ash, 2) rill, gully, and mass wasting erosion in drainages and on steep slopes within the burned area, and 3) increased peak flows and sediment deposition. Channel crossings, valleys, meadows, and floodplains have an inherent risk of flooding which will be intensified by the fire. Increased runoff and sediment delivery may cause channel migration in flood events. Lateral channel migration can erode cut banks and undercut slopes. Aggradation can increase probability of channel migration and flooding.

Changes in hydrologic processes can also lead to slope instability and result in post-fire debris flows, mudflows, and other mass wasting. Flat areas with diffuse channels will be depositional zones for adjacent steeper slopes. Meadows are depositional areas where flows can spread out in large runoff events, especially with sediment laden flows and woody debris. Dormant channels may be reactivated in post-fire runoff events.

Watershed response in the burn area will pose an intermediate to high risk to life, safety, and infrastructure. The combination of increased flows, sediment loads, and woody debris are likely to cause drainage control structures to fail (culverts, ditches, infrastructure crossing drainages, etc.). It is important to note that downstream areas that experience regular flooding or difficulty controlling drainage during small storms will be likely to experience flooding and/or failure in post-fire storms.

Figure 8 – 2-Year Storm Watershed Response



The increase in peak flows is most applicable during the first year of recovery, as hydrologic response will decrease in subsequent years. Predicted post-fire peak flows show an increase of about one to three times pre-fire values. The peak flow values highlight the post-fire effects on the Fire, with the most increase reflected in watersheds where burn severity is moderate and high and where the greatest susceptible soils are affected. The early precipitation events fill in available slope detention storage and create the rill and gully networks that are necessary to fully induce the expected increase in flood response from rainstorms.

As previously mentioned, the post-fire flows could lead to plugged culverts, flow over road surfaces, rill and gully erosion of cut and fill slopes, erosion and deposition along road surfaces and relief ditches, loss of long-term soil productivity, and threats to human safety. Some sedimentation of the ephemeral channels is likely to occur at an accelerated rate until vegetation establishes itself and provides ground cover.

Geology

Watershed Conditions: From ground surveys and aerial imagery analysis it is evident that pre-fire mass wasting as rock-fall, landslides, and debris flow deposits exists throughout the burned area. In addition, from on-the-ground observations it is apparent that most of the slopes and drainages within the McKinney Fire burned area are loaded with unsorted, unconsolidated materials available to be transported. Depending on the parent material / geological unit, some slopes and drainages are loaded with a thick layer of mostly fine sediments, while other slopes and drainages are loaded with unsorted / unconsolidated materials comprised of rocks of all sizes including boulders, cobbles, gravels, and fine sediments. In addition to the fact that most of these drainages impacted by the fire experienced a moderate to high soil burn severity, most of the slopes at the headwaters of these burned drainages are steep (40-60%) or very steep (60+%) slopes.

Based on a flight recon and field observations, our conclusion is that whether the primary post-fire process is rockfall, debris slides, debris flows or sediment laden flooding, the cumulative risk of various types of slope instability, sediment bulking and channel flushing is high along some steep slopes and creeks in the burn area. Over most of the burned area, no effective treatments exist that will slow or stop the occurrence of landslides and the transport of flood debris. Limited measures can be employed to protect life, property and natural values in the area, largely consisting of implementing timely warning systems of dangerous conditions, and closure of areas where human life is at risk.

Based on our surveys, relatively few values at risk were identified in the burn area on National Forest lands. Critical values at risk that were identified on NF lands include: Potential impacts (Life & Safety threats) to people living, working, traveling, or recreating through and below burned areas, FS roads and facilities, OHV trails, cultural resources and some critical habitat and population of two federally listed aquatic species.

The critical values located off federal lands and/or down-stream of the burn area include: Potential impacts (Life & Safety threats) to people living, working, traveling, or recreating through and below burned areas, State, County and private roads, private properties, pipelines, and other utilities, campgrounds, and other properties.

Depended on the specific location of these Critical Values, some might be impacted by various types of slope failures as landslides and/or rock-fall, while others might be impacted by flooding, hyper-concentrated flows and/or debris flows.

USGS Debris Flow Assessment: To assess the probability and potential volumes of debris flows in the burned area the assistance of the US Geological Survey (USGS) - Landslide Hazards Program was obtained. Their ongoing research has developed empirical models for forecasting the probability and the likely volume of such debris flow events. To run their models, the USGS uses geospatial data related to basin morphometry, burn severity, soil properties, and rainfall characteristics to estimate the probability and volume of debris flows that may occur in response to a design storm (Staley, 2013). Estimates of probability, volume, and combined hazard are based upon a design storm with a peak 15-minute rainfall intensity of 12 – 40 millimeters per hour (mm/h) rate. After receiving the final McKinney Fire burn severity map, the USGS conducted a debris flow assessment of the fire area that presented debris flow hazard classes, probability of occurrence, and volumes of materials occurring for multiple precipitation events. We selected a design storm of a peak 15-minute rainfall intensity of 24 millimeters per hour (0.95 inch/hr.) rate to evaluate debris flow potential and volumes, since based on the NOAA Atlas 14 Point Precipitation Frequency Estimates, this magnitude of storm seems likely to occur in any given year.

Debris flow probability and volume were estimated for each basin in the burned area as well as along the upstream drainage networks, where the contributing area is greater than or equal to 0.02 km^2, with the maximum basin size of 8 km^2. In addition, Watch-streams features were added representing streams that exceed an upslope area of 8 square kilometers and within the analysis extent yet are still susceptible to flood and possibly debris-flow hazards.

Kean et al. (2013) and Staley et al. (2016) have identified that rainfall intensities measured over durations of 60 minutes or less are best correlated with debris-flow initiation. It is important to emphasize that local data (such as debris supply) influence both the probability and volume of debris flows. Unfortunately, local specific data are not presently available at the spatial scale of the post-fire debris-flow hazard assessment done by the

USGS. As such, local conditions that are not constrained by the model may serve to dramatically increase or decrease the probability

Debris Flow Potential:

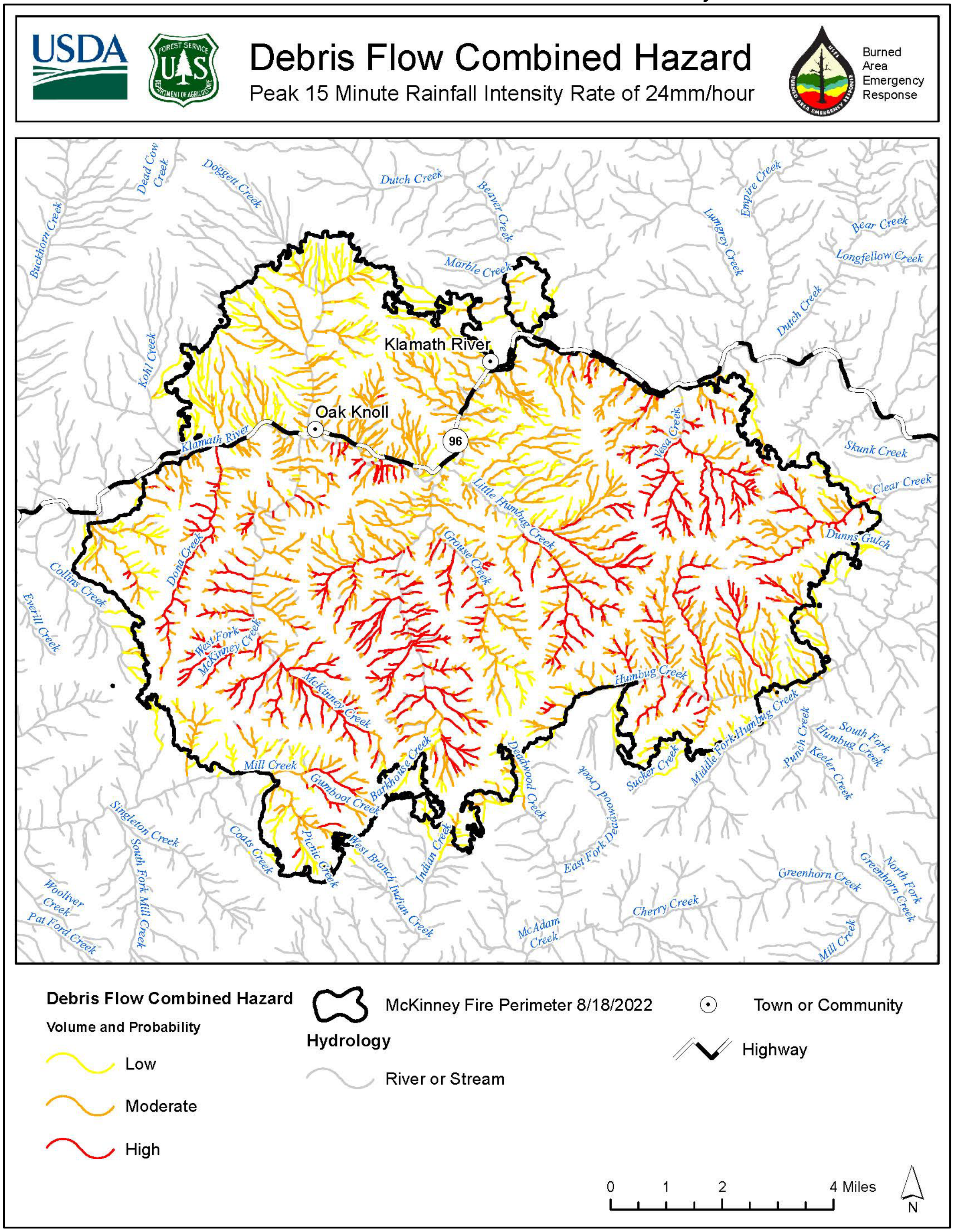
Based on USGS debris flow modeling it appears that under conditions of a peak 15-minute rainfall intensity storm of 24 millimeters per hour (0.95 inches/hour) corresponding to a 1-year storm, most of the drainages in the burn area are predicted to initiate debris flows with high (60-80%) probability or very high (80-100%) probabilities. These drainages include: Vesa Creek, upper reaches of Little Humbug Creek, upper reaches of Barkhouse Creek, upper reaches of McKinney Creek, Dona Creek, upper reaches of Humbug Creek and upper reaches of Clear Creek.

It is important to note that flooding is far more of a concern in drainage basins exceeding 8 square kilometers in contributing area. Streams that exceed an upslope area of 8 square kilometers are still susceptible to flood and possibly debris-flow hazards, are defined as “watch streams”. The few drainages that are predicted to have relatively low probabilities (0-20% or 20-40%) of initiation of debris flows include some side drainages feeding into the lower end of Little Humbug Creek and some drainages flowing into Doggett Creek and just west of Doggett Creek.

Under this same magnitude of storm, predicted volumes in the main channels impacted by the McKinney Fire range for the most case from 10K-100K cubic meters. Most of the side channels feeding into these main channels are predicted to produce volumes ranging from 1K to 10K cubic meters.

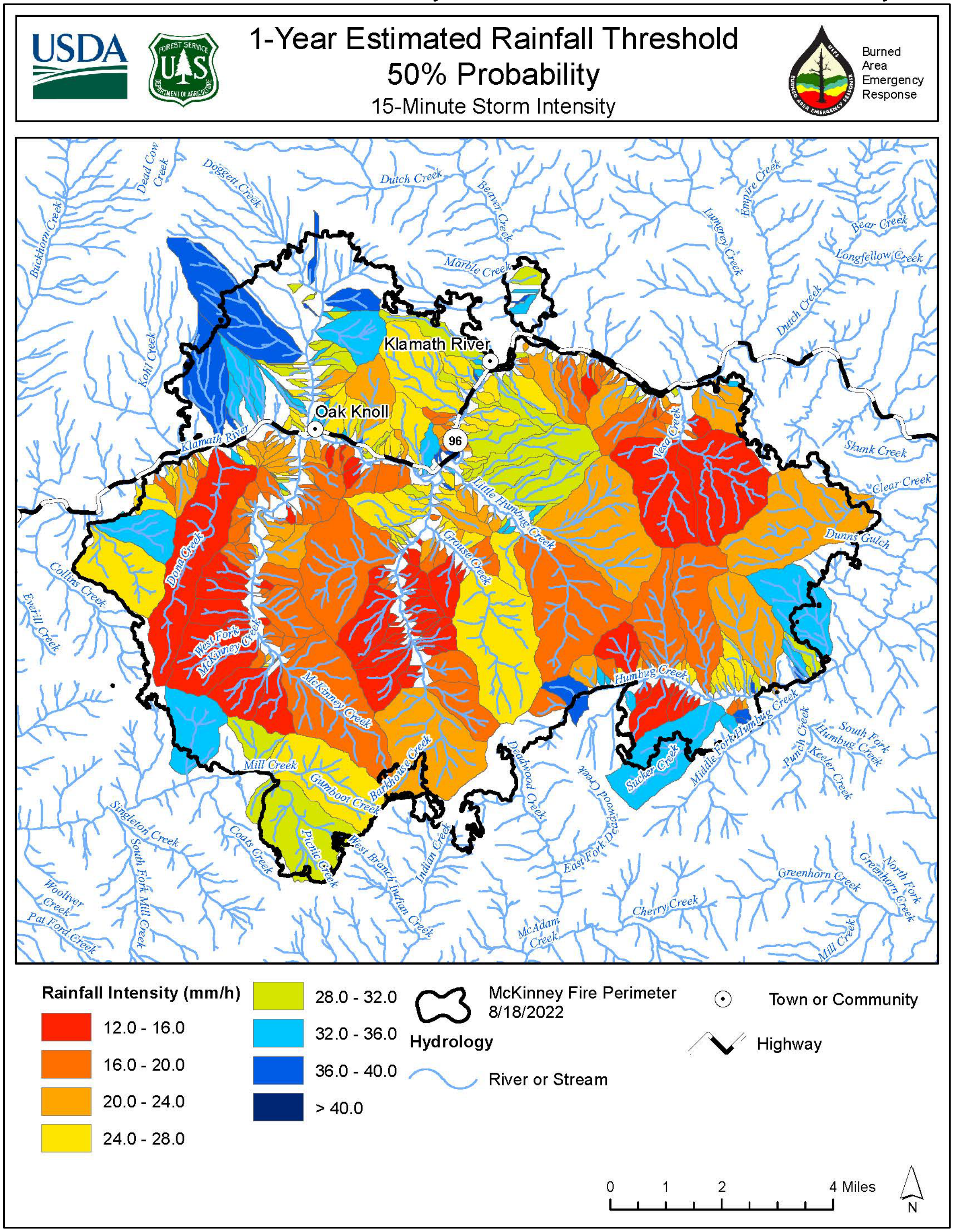
Regarding combined hazard, the USGS debris flow model estimates most of the area burned by the McKinney Fire to be under a moderate to high combined hazard (Figure 8).

Figure 9 – Predicted Debris Flow Combined Hazard for the McKinney Fire



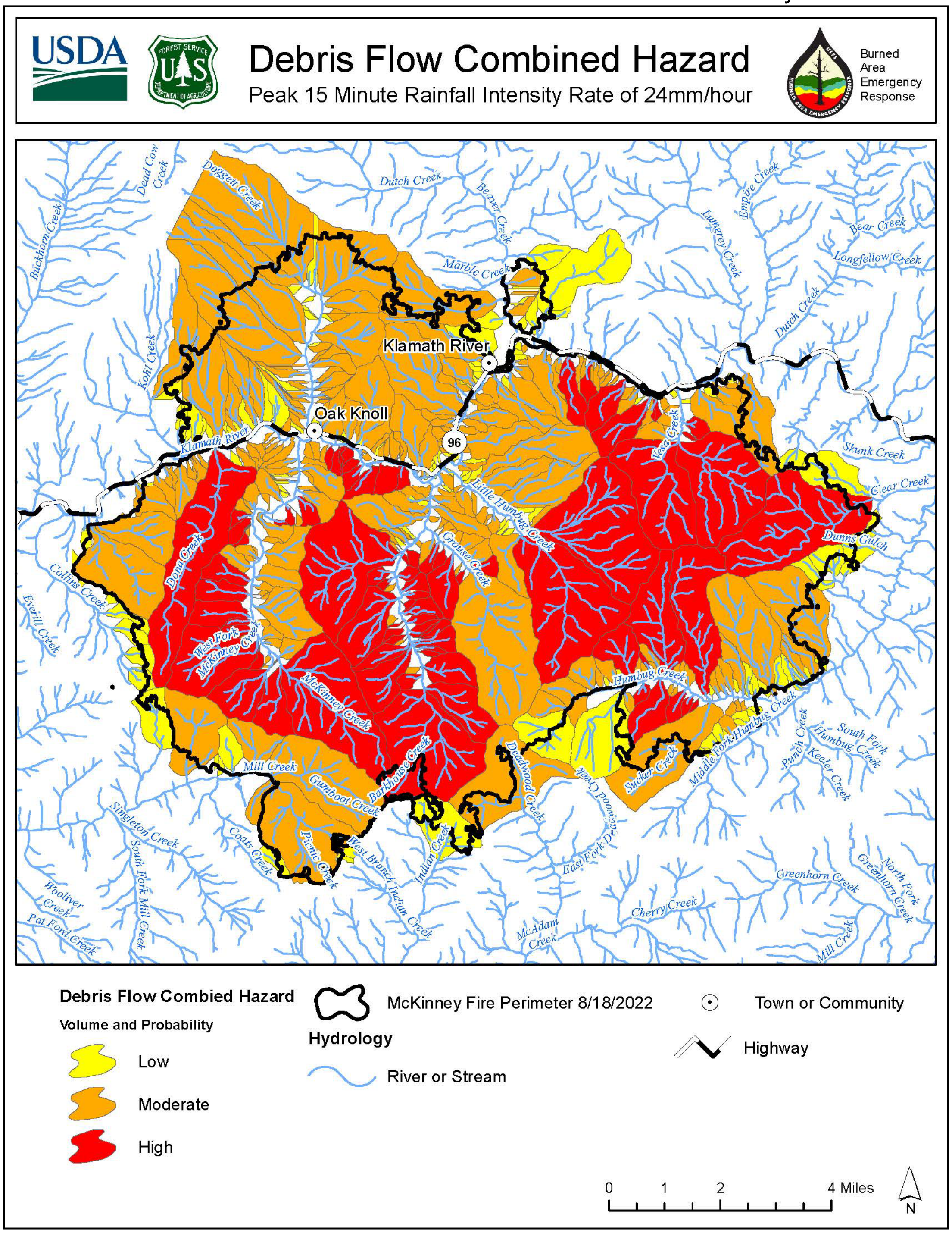
Looking at the 1-year 50% probability estimate thresholds shows which watershed are the most sensitive to a normal winter storm with Donna and Vesa and parts of McKinney being mostly likely to have debris flows. Other areas of concern are Little Humbug and Humbug creeks (Figure 10).

Figure 10 – Predicted 1-Year 50% Probability Estimated Rainfall Threshold McKinney Fire



USGS debris flow combined basin model shows Humbug and Little Humbug, upper Barkhouse and upper McKinney creeks as having high debris flow potentials (Figure 11).

Figure 11 – Predicted Debris Flow Combined Basin Hazard for the McKinney Fire



Based on USGS debris flow modeling, basins in the McKinney fire burned area have a wide range of probability (0-100%) of producing debris flows. Similarly, predicted volumes of debris flows through-out the burned area range from under 1k cubic meters to 100k cubic meters. Even though some creeks are predicted to produce debris flows with high probability and high volumes, based on field observations and the parent rock material not all of these creeks contain the surface rocks to produce those large and destructive debris flows. From analyzing the combined hazard maps, it is clear that even though high hazard debris flows drainages exists through-out the burned areas, the concern areas are focused on the creeks and drainages located directly above existing county and state roads.

The model estimates a high to very high of debris-flow hazard for most of the area burned by the McKinney fire. Many stream reaches and drainage basins have a greater than 60% likelihood of debris-flow occurrence in response to a design storm with a peak 15-minute rainfall intensity of 24 mm/h. A significant number of stream reaches exceed a 80% likelihood of debris flows at the modeled rainfall intensity. These high hazard areas are widespread in the burn area, including most drainage above McKinney, Dona, Barkhouse, Little Humbug, Clear and Vesa creeks. Many other modeled stream segments indicate a high likelihood of debris flows in response to a peak 15-min rainfall intensity of 24 mm/h.

Most of the assessed burn area requires rainfall rates less than 24 mm/h to exceed a 50% likelihood of debris-flow occurrence. High hazard areas require very modest rainfall rates between 12 and 20 mm/h to exceed a 50% likelihood of debris flow occurrence. Most modeled watersheds have the potential to produce sediment volumes between 10,000-100,000 m^3, resulting in a moderate to high combined hazard for most of the assessed area.

The year 1 and 2 model-estimated rainfall thresholds (segment-scale) and corresponding return intervals are as follows:

YEAR 1:
15-minute: 21 mm/h, or 0.20 inches in 15 minutes, RI = 1.1 years
30-minute: 17 mm/h, or 0.35 inches in 30 minutes, RI = 1.7 years
60-minute: 14 mm/h, or 0.60 inches in 60 minutes, RI = 3.1 years

YEAR 2:
15-minute: 28 mm/h, or 0.30 inches in 15 minutes, RI = 2.2 years
30-minute: 22 mm/h, or 0.45 inches in 30 minutes, RI = 3.6 years
60-minute: 19 mm/h, or 0.80 inches in 60 minutes, RI = 8.8 years

Critical Values at Risk

https://usfs.box.com/s/3gzr86r9a59utzk4wn09aman7pyo3agk

Specialist Reports

https://usfs.app.box.com/folder/170681914014

Appendix

References:

1. Incident Management Team 2 IMET Tom Wright, NOAA Doppler Radar Imagery.

2. NOAA **multi-radar multi-sensor (MRMS) composite reflectivity sensor:** Op Product Viewer (noaa.gov)

3. McKinney USFS BAER Team – BAER Team Leader Brad Rust, Forest Soil Scientist, Shasta-Trinity National Forest.

4. Debris flow analysis: USGS ftp://ftpext.usgs.gov/pub/cr/co/golden/Kostelnik/McKinney/CA_2022_McKinney_mkn2022_20220817_1814.zip

Location of McKinney BAER geospatial data, maps, values at risk, and pictures:

5. McKinney External Cooperators BOX - https://usfs.box.com/s/3gzr86r9a59utzk4wn09aman7pyo3agk

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Selected pictures and power-point summaries:

https://usfs.box.com/s/iomj6cyjsyb9n423aw5zafmut254qwhd

Watershed Emergency Response Team (WERT)
2022 McKINNEY FIRE

CA-KNF-006177

October 6, 2022

California Department of Forestry & Fire Protection
CAL FIRE
SINCE 1885

California
Department of Conservation
California Geological Survey

Contents

McKinney Fire – WERT REPORT EXECUTIVE SUMMARY

CA-KNF-006177 - WERT Evaluation

Mission Statement: The California Watershed Emergency Response Team (WERT) helps communities prepare after wildfire by rapidly documenting and communicating post-fire risks to life, property, and infrastructure posed by debris flow, flood, and rockfall hazards.

It should be noted that the findings included in this report are not intended to be fully comprehensive or conclusive, but rather to serve as a preliminary tool to assist Siskiyou County Office of Emergency Services, CAL FIRE Siskiyou Unit, local first responders, Siskiyou County Public Works, California Department of Transportation (Caltrans), the California Governor's Office of Emergency Services, the United States Department of Agriculture Natural Resources Conservation Service, utility companies, and other responsible agencies and entities in the development of more detailed post-fire emergency response plans. It is intended that the agencies identified above will use the information presented in this report as a preliminary guide to complete their own more detailed evaluations, and to develop detailed emergency response plans and mitigations. This report should also be made available to local districts, residents, businesses, and property managers so that they may understand their proximity to hazard areas, and to guide their planning for precautionary measures as recommended and detailed in this document.

The McKinney Fire started on July 29, 2022 near McKinney Creek Road and State Route 96, along the Klamath River in Siskiyou County. The relatively large size of the fire (i.e., 94 mi^2), the predominance of moderate and high soil burn severity, and the steep slopes means that the McKinney Fire area will be subject to post-fire hazards such as sediment laden flooding, debris flows, rockfall, and greatly increased erosion. This was confirmed by the August 2, 2022 storm event, when an intense convective storm cell triggered extensive high magnitude erosion, sediment deposition, and flooding.

Due to this storm event and subsequent response, its proximity to residential areas and critical infrastructure, the burn area was evaluated by an interagency WERT. The WERT rapidly evaluated post-fire watershed conditions, identified potential **Values-at-Risk (VARs)** related to human life-safety and property, and evaluated the potential for increased post-fire flooding, debris flows, and rockfall. The team also recommended potential emergency protection measures to help reduce the risks to those values.

Summary of the Key WERT Findings

- The degree of fire-induced damage to soil is called "soil burn severity" and is a primary influence on increased runoff and sediment generation, and the occurrence of post-fire watershed hazards (e.g., debris flows and flooding). Moderate and high soil burn severity typically create the most impacts.
- The McKinney Fire has 78 percent of the area burned at moderate (63%) to high (15%) soil burn severity, respectively.

- There are 44 VARs identified within and downslope/downstream of the fire. Eight (8) VARs are shown as polygons which encompass multiple individual sites. The remaining 36 VARs are points, which are associated with discrete VARs.
- Seven (7) of the VARs are exigent for life-safety risk and require immediate attention to reduce potential risk.
- The county road network will likely be subject to extensive storm damage for the next 2 to 5 years. Specific crossing structures that provide access and egress were addressed as VARs.
- State Route 96 has several crossing structures subject to potential blockage and overtopping. Rockfall hazard also exists along the highway corridor.
- Twelve (12) VARs are associated with burned structures and associated house pads. Further evaluation of these sites are needed before residents should erect or occupy temporary housing (e.g. trailers) on these sites.
- Modeling results are presented for debris flow hazard, post-fire flooding, and surface erosion, the model results show the fire has significantly increased these hazards.
- The ERMiT post-fire surface erosion model predicts elevated surface erosion across the burn area due to the preponderance of moderate average erosion rates for the 2-year and 10-year storm event, ranging from 1.5 to 6.6 tons per acre for the fire area.
- To trigger the National Weather Service early warning system, WERT recommends a firewide rainfall threshold of 0.3 inches for 15-minutes, 0.5 inches for 30-minutes, and 0.6 inches for 60-minutes.
- Five VARs will require a lower threshold for triggering response due to their susceptibility to rapidly moving debris flow hazards. The thresholds for these VARs are 0.2 inches for 15-minutes, 0.35 for 30-minutes, and 0.6 inches for 60-minutes.
- Close coordination between Siskiyou County Office of Emergency Services, the National Weather Service, and local first responders will be necessary to effectively implement a response plan that will minimize risk.
- Residents potentially subject to post-fire hazards will need to have a clear understanding of these hazards, and mitigation strategies (e.g. evacuation, etc.), to effectively reduce risk to life and safety.
- General recommendations are contained herein to help further reduce risk from dispersed hazards throughout the burned area.

State of California
Department of Fish and Wildlife

M e m o r a n d u m

Date: 9/15/2022

To: **Tina Bartlett**
Regional Manager, Northern Region
Department of Fish and Wildlife

From: **Colin R. Hughes**, PG, CEG
DocuSigned by:
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51388089BC09415...
Senior Engineering Geologist
Department of Fish and Wildlife

Subject: **Preliminary Reconnaissance Habitat Impacts Assessment and Remedial Recommendations, McKinney Fire, Siskiyou County, California**

This memorandum summarizes the initial reconnaissance effort by California Department of Fish and Wildlife (Department) staff to assess instream habitat conditions along salmonid bearing tributaries to Klamath River affected by post-fire debris flows (PFDFs) and resulting recommended short- and long-term remedial measures to reduce additional impacts to fall run Chinook salmon and Coho salmon.

Background

The McKinney Fire initiated on July 29, 2022, in the Scott Bar Mountains region of Siskiyou County, California. According to the U.S. Forest Service (USFS) Burned Area Emergency Response (BAER) team's rapid assessment, the McKinney Fire burned approximately 60,325 acres of forestland draining primarily to the Klamath River and tributary watercourses upstream of the Scott River (Attachment A). Approximately 39,300 acres of Klamath National Forest land and 21,000 acres of privately owned land was burned by the wildfire. Sixty-three (63%) percent of the burn area was identified as having moderate soil burn severity and 16% as having high soil burn severity by the BAER team.

On August 2, while the McKinney Fire was still burning and emergency response personnel were actively engaged in fire suppression, intense precipitation from thunderstorms impacted localized basins within the burn area. Decibel relative to Z (dBZ) values correlating to 2-8 inches/hour were documented by National Weather Service radar over the Humbug Creek, Little Humbug Creek, and Vesa Creek subbasins (Attachment B). The intense precipitation triggered numerous PFDFs sourced from steep recently burned terrain which have affected several creeks within the burn area and resulted in extreme sedimentation, impacts to water quality, and a fish kill within the Klamath River.

Debris flows are one of the most devastating natural phenomena affecting mountainous areas in California and around the world. Debris flows are extremely rapid flow-like landslides composed of a mixture of both fine and coarse earth materials and a variable ratio of water. Where debris flow failures from steep source areas can be confined and channelized by stream valleys, they may bulk in size by scouring channel bed and bank materials and travel long distances by fluidization of the debris mass, ultimately depositing in unconfined low gradient areas. Short-duration, high-intensity rainfall during the first two post-fire winters is a key factor for producing PFDFs and flooding from burned areas (Lancaster et al., 2021; Moody, 2012; Staley et al., 2016). Steep slopes within high and moderate burn severity areas have the greatest potential to fail as debris flows and deliver large volumes of sediment to the stream system, negatively affecting macroinvertebrate populations, physical channel habitat characteristics (pools, riffles, substrate gradation), and water quality characteristics (e.g., pH, temperature, turbidity, dissolved nutrients).

The McKinney Fire burn area is underlain by multiple bedrock units of the Eastern Hayfork terrane, Rattlesnake Creek terrane, and the post-tectonic amalgamation Vesa Bluffs pluton (Irwin, 1994). Rocks of the Vesa Bluffs pluton are granitic and gabbroic and outcrop in the headwaters of Vesa Creek and Little Humbug Creek, and northern subbasins of Humbug Creek. Granitic bedrock aggressively weathers to granular gravel, sand, and silt sized particles, forming easily erodible soils. Granitic rocks and soils of the Shasta Bally Batholith were the source materials for the 1997 Paige Boulder debris flow in Whiskeytown National Recreation Area which delivered massive quantities of debris flow deposit to critical salmonid habitat in lower Clear Creek.

<u>Habitat Impacts Assessment</u>

On August 22 and 23, 2022, under the direction of Cary Japp (Senior Environmental Scientist Supervisor), a team of Department staff including Colin Hughes (CEG; Regional Engineering Geologist), Richard Klug (Senior Environmental Scientist Supervisor), Mark Elfgen (Fish Habitat Specialist), and Domenic Guidice (Environmental Scientist) conducted a reconnaissance assessment of existing habitat conditions along the reaches of Humbug Creek, Barkhouse Creek, and McKinney Creek supporting anadromous Chinook and Coho salmon. Observations of channel and riparian conditions were made where stream channels were observable from access roads, at stream crossings, or within short hiking distance from access roads.

Reconnaissance assessment of upslope watershed conditions in the Humbug Creek, Barkhouse Creek, and McKinney Creek watersheds was conducted to identify factors and hazards which may contribute to post-fire erosion, sediment delivery, and controllable impacts to downstream salmonid habitat.

In preparation for field assessment of existing wildfire and PFDF impacts to anadromous salmonid habitat, background resources and literature were compiled and reviewed, including the following resources:

- Recent and historic aerial imagery and ground photos
- Geologic mapping and unit descriptions
- GIS data identifying records of historic salmonid presence, road networks, historic fire extent, bare earth hillshade modeling, hillslope topography
- 2006 Collins Road Inventory – Road Sediment Source Inventory and Risk Assessment

A provisional field dataform for GPS location data, photographic data, and site characterization data was developed using the ESRI Field Maps application for GPS enabled tablets. Field data regarding existing conditions, PFDF and wildfire habitat impacts, structures at risk, and emergency post-fire activities were collected using the Field Maps application and associated digital dataform.

Observations and Findings

Humbug Creek

Approximately 42% of the Humbug Creek subwatershed was burned in the McKinney Fire. The South Fork Humbug Creek subbasin and eastern hillslopes draining to Humbug Creek are unburned. The riparian corridor along the entire length (approximately 4.8 miles [mi]) of mainstem Humbug Creek from Middle Fork Humbug Creek to the Klamath River is unburned and intact (Map 1). However, mainstem Humbug Creek has been highly impacted by PFDFs emanating from the steep slopes of Craggy Mountain draining to the Kennebec Gulch subbasin and accelerated post-fire surface erosion from the Rider Gulch subbasin (Photo 1, Map 1). Earth materials deposited along the Humbug Creek channel were observed to consist primarily of noncohesive medium to very coarse sands with minor gravel.

The Klamath River Road bridge across Humbug Creek is located approximately 500 ft upstream Humbug Creek from the confluence at the Klamath River (Map 1). Piles of woody debris adjacent to the bridge and a damaged steel cargo container are evidence that debris was cleared from the upstream side of the bridge during emergency post-debris flow efforts. Humbug Creek in the vicinity of the bridge crossing is an alluvial stream with a valley width of approximately 350 ft. PFDF deposits visible from the crossing appear to be 2 ft or less in average thickness. Riparian trees and brush remain on the banks of Humbug Creek and within the bed of the stream. No surface flow was present during the period of assessment.

Photo 1. Mainstem Humbug Creek at the intersection with Hawkinsville Humbug Road. Debris flow sand and gravel deposits have filled the streambed and streamflow is forced to the surface through confined valley reaches.

The Kennebec Gulch subbasin drains to Humbug Creek approximately 6 mi upstream from the Klamath River and is identified as the primary source basin for recent PFDFs which have affected salmonid habitat in Humbug Creek. Approximately 1.2 mi of Kennebec Gulch was directly observed by the assessment team to contain a significant volume of PFDF deposit consisting of subangular to subrounded granitic boulders, gravel, and sand.

Photo 2. Kennebec Gulch above Humbug Creek Road looking upstream.

The Humbug Creek Road stream crossing at Kennebec Gulch was observed to have been recently replaced or reinstalled with a previously used pipe-arch culvert. The preexisting crossing structure is interpreted to have plugged or washed out by the PFDF and have been replaced during emergency response efforts. The newly installed culvert appeared to have been installed directly on porous granitic or gabbroic sand materials and no clay-rich bed or collar material was observed. Culvert installations on porous and noncohesive bed materials are more likely to develop soil piping and subsurface flows beneath the stream crossing culvert and fills which may lead to future failure of the crossing.

The culvert inlet at the Yreka Walker Road stream crossing on Middle Fork Humbug Creek was observed to have been recently unplugged by removal of accumulated woody debris. Woody debris was removed from the immediate culvert inlet area; however, a large accumulation of woody debris completely fills the stream channel for approximately 60 ft upstream of the culvert inlet (Photo 3). If the woody debris accumulation above the crossing is not completely removed prior to 2022-23 stormflows, the culverted crossing will be at extremely high risk of plugging, road prism failure, and delivery of eroded crossing material to the downstream channel.

Photo 3. Woody debris deposited upstream of the culvert inlet at the Yreka Walker Road crossing on Middle Fork Humbug Creek.

Barkhouse Creek and McKinney Creek

High elevation slopes within Barkhouse and McKinney Creek watersheds showed evidence of high soil burn severity while streamside slopes within both watersheds showed evidence of only moderate soil burn severity. All riparian vegetation was observed to have been completely burned along the salmonid bearing segments of Barkhouse Creek and McKinney Creek. All streamside slopes, streambanks, and riparian areas were observed to be covered by unconsolidated ash.

Conspicuously, no signs of post-fire sediment transport were observed in the Barkhouse Creek or McKinney Creek mainstem channels or along the inboard ditches of streamside or upslope roads within these watersheds (Photo 4). Anecdotal accounts of post-fire thunderstorm precipitation provided by residents state that intense precipitation within the burn area was isolated to the Humbug Creek, Little Humbug Creek, and Vesa Creek watersheds and little precipitation occurred within the Barkhouse and McKinney Creek watersheds. The observed focused concentration of intense rainfall is corroborated by historic radar data (Attachment B) and the observed lack of evidence of surface erosion and sediment mobilization within the McKinney Creek and Barkhouse Creek watersheds. Klamath River Road stream crossing structures at Barkhouse Creek and McKinney Creek did not appear to have been affected by PFDFs or post-fire flooding. No evidence of significant emergency maintenance was observed.

Photo 4. View of McKinney Creek looking upstream from Klamath River road. Evidence of accelerated sediment transport or sedimentation from August thunderstorm precipitation in the McKinney subbasin is not apparent in the mainstem channel.

Other Tributary Streams

The lower reaches of Vesa Creek and Little Humbug Creek in the vicinity of Klamath River Road were observed to be significantly affected by PFDFs. Large volumes of PFDF deposits currently fill the bankfull channels of both streams and emergency post-fire heavy equipment work was conducted to unplug the Siskiyou County bridges at both crossings on Klamath River Road.

Within the floodplain of the Klamath River and downstream of Klamath River Road, PFDFs in sourced in the Vesa Creek watershed have deposited in a large debris flow fan delivering to the Klamath River (Photo 5). The PFDF fan deposit, estimated as approximately 3 acres in area, is composed of a chaotic assemblage of granitic and gabbroic boulders ranging from 1.5 – 3 ft in diameter, sands, few fines, and woody debris ranging in size from small branches to whole trees. Given the large component of coarse boulder material and large woody debris, the debris flow fan shown in Photo 4 is interpreted as surge-front deposit. Sediment and ash delivery from the PFDFs sourced in Vesa Creek is believed to be a major factor in water quality impacts resulting in the post-McKinney Fire fish kill in the Klamath River downstream of the burn area.

No well-defined channel has yet developed across the debris flow fan deposit. Vesa Creek stormflows from the upcoming rainy season will undoubtedly reestablish at least one channel, if not several, through the fan deposit, delivering eroded PFDF deposit material directly to the Klamath River.

Photo 5. Distal end of post-fire debris flow fan at the Vesa Creek and Klamath River confluence. Photo provided by Alex Corum, Karuk Tribe Fisheries.

Lower Little Humbug Creek was also observed to have been severely impacted by PFDFs both upstream and downstream of Klamath River Road (Photo 6). Significant deposition of boulders and sand has filled the bankfull channel and spread to overbank areas. Post-fire emergency work has cleared the PFDF surge deposit from the bridge at Klamath River Road and constructed a large levee from coarse deposit materials along the right (east) side of the historic channel location. Streamflow currently flows onto and through PFDF deposit above the elevation of the widening stream valley as Little Humbug Creek flows onto the Klamath River floodplain. While the channel bed and banks of Little Humbug Creek downstream of

Klamath River Road have been exhumed from the PFDF deposit using heavy equipment, generally reestablishing the recent historic channel morphology, the upstream channel remains choked by PFDF deposit. PFDF materials used in emergency construction of the levee are highly porous and eventual failure of the levee due to soil piping and erosion and evacuation of sand size particles is anticipated if no further work is performed.

Photo 6. Photo of graded PFDF deposit in Little Humbug Creek looking upstream. A levee composed of porous PFDF deposit materials has been constructed to constrain surface streamflow and direct streamflow to the bridge crossing at Klamath River Road.

Reconnaissance Upslope Hazard Assessment

The Department assessment team conducted a reconnaissance hazard assessment of upslope areas within the Humbug Creek, Barkhouse Creek, and McKinney Creek watersheds. Select roads were identified in consideration of hillslope position, slope steepness, mapped underlying geology, and data from the 2006 Collins Road Sediment Inventory and Hazard Assessment and inspected to identify obvious initiation points for road or infrastructure related future PFDFs. Road alignments and stream crossings significantly alter hillslope hydrology, are not generally designed to withstand post-fire storm conditions, and are recognized as contributing factors for potential PFDF initiation.

USFS roads reviewed by the Department assessment team were observed to generally be outsloped, moderate to well-drained, and have stream crossings with culvert drainage structures where stream channels transport significant streamflow. Roads within the Barkhouse Creek and McKinney Creek watersheds were drained by rolling dip drainage structures. No significant stream diversions, failing stream crossings, or severely plugged culverts were observed along the road alignments surveyed. Although only a small sample of prioritized roads were reviewed, road drainage design measures including drainage breaks and road shaping was observed to be functioning and uniform in application, and no locations at very high risk for PFDF generation were observed.

Discussion

Both NOAA and CDFW Coho salmon recovery plans identify Humbug Creek as a key watershed for restoring Coho salmon populations. In 2002, 235 juvenile Coho salmon were observed to be rearing in Humbug Creek by USFS staff. Observations of steelhead spawning and rearing in Middle Fork Humbug Creek and South Fork Humbug Creek are also reported. Pacific lamprey is also known to inhabit Humbug Creek. Prior to the McKinney Fire and associated PFDF impacts, the Humbug Creek streambed was predominantly comprised of boulder and coarse gravel. Department survey reports dating back to 1967 repeatedly identify the lack of spawning gravels and excessive flow velocities as limiting factors for salmonid, and presumably, Pacific lamprey habitation in Humbug Creek. Coarse boulders transported in PFDF surge flows affecting the Humbug Creek watershed were observed to have primarily deposited in Kennebec Gulch and were not observed to have traveled to and deposited in lower reaches of Humbug Creek which provide spawning and refugia habitat to listed salmonid species. Future stormflows in Humbug Creek will mobilize and route sands deposited by the PFDFs, however, the combination of sand and small to medium gravel contributed to the channel by PFDFs will likely function to improve channel substrate conditions relative to salmonid spawning and Pacific lamprey habitation.

Impacts to instream habitat conditions post-fire result from the effects of wildfire on hydrologic and geomorphic processes at the watershed scale. Moderate to high severity wildfires can result in significant reduction in rainfall interception, reduction in soil infiltration capacity, increase in soil erodibility, increase in the quantity of soil subject to erosion processes, and lead to greatly elevated rates of runoff and likelihood for generation of PFDFs. Elevated surface erosion, sediment delivery, and likelihood for PFDF generation is typically greatest within the first one to two years post-fire and decrease over time as soil and vegetation recover (McGuire et al., 2001). Efforts to mitigate post-fire surface erosion, sediment delivery, and increased hillslope runoff using aerial seeding or mulch application have been documented as being largely ineffective or cost prohibitive in large-scale application (Cafferata, Coe, and Short, 2021). Currently, PFDF mitigation measures with demonstrated effectiveness consist of engineered debris barriers and basins, requiring thorough planning and engineering design. Debris flow barriers and basins are typically utilized in areas recognized as perpetual debris flow producing basins and are a long-term approach to hazard mitigation.

All salmonid habitat restoration and rehabilitation actions should be planned and performed in recognition of and consideration of these acknowledged impacts to watershed hydrology and geomorphic processes and anticipated watershed response over the next several years. Localized instream channel restoration projects conducted in the immediate years post-fire will be subject to the effects and hazards of wildfire-altered watershed dynamics.

Recommendations

1) The Department should review all BEAR and/or Watershed Emergency Response Team (WERT) findings regarding the McKinney Fire and post-fire impacts. These interagency teams conduct extensive assessment and analyses relevant to burn intensity, PFDF probability, flood and debris prone area identification, and risks to critical natural resources which is an invaluable tool to guide both short-term triage response and long-term recovery and restoration.

2) The Department should work to obtain access from private landowners at the confluence of Humbug Creek and Klamath River to assess post-fire salmonid habitat and passage conditions. The assessment should develop remedial plan recommendations to restore salmonid habitat and passage conditions in accordance with assessment findings.

3) Department staff should work with USFS and Siskiyou County to evaluate the planning and implementation of stream crossing culvert replacement and woody debris clearing activities on Humbug Creek Road (at Kennebec Gulch) and Yreka Walker Road (Middle Fork Humbug Creek). Coordinate with USFS to remove a significant quantity of channel-stored PFDF deposit from Kennebec Gulch to reduce future erosion and sediment delivery to salmonid-bearing Humbug Creek and reduce the potential for plugging and subsequent failure of the Kennebec Gulch stream crossing.

4) The Department should coordinate with Siskiyou County to review plans for emergency stream crossing maintenance and long-term restoration of channel morphology at Vesa Creek and Little Humbug Creek in vicinity of Klamath River Road to reduce future erosion and delivery of channel-stored debris flow deposit material and restore stream function. Excavation of channel-stored PFDF deposits and full reestablishment of the historic channel morphology upstream and downstream of Klamath River Road will minimize future erosion and sediment delivery by providing hydraulic capacity, providing additional capacity for potential future PFDF deposits, and creating stable banks capable of revegetation in the event that the subsequent few years provide mild precipitation and erosion and sedimentation processes in the low-slope alluvial reaches of these channels is minimal.

5) The Department should encourage the design and incorporation of short-term debris basin structures in Vesa Creek and Little Humbug Creek restoration plans to reduce sediment delivery to tributary refugia habitat and the Klamath River. Debris basin structures likely will not be able to completely mitigate the impacts from additional PFDFs or watershed scale sediment transport and deposition, however, installation and maintenance of retention basins over the next few years post-fire could function to

minimize additional impacts to downstream habitat and water quality.

6) Additional instream habitat condition assessments should be conducted, and recommended habitat restoration and enhancement projects should be implemented after at least two rain seasons have passed and the likelihood for large-scale impacts from PFDFs and accelerated sedimentation is significantly diminished. Large-scale post-fire habitat condition assessments should be conducted at Humbug Creek, McKinney Creek, and Barkhouse Creek, and evaluate the potential for implementation of physical habitat restoration projects to reconnect floodplains and off-channel habitat, provide low velocity habitat for rearing and improve spawning conditions. Assessments should consider the potential for use of low-tech, bioengineering, large wood augmentation, and riparian restoration techniques to restore and enhance salmonid habitat conditions within anadromous waters. A Technical Advisory Committee (TAC) consisting of agencies, tribal groups, and conservation groups should be formed and utilized to develop and implement prioritized restoration and habitat enhancement projects.

7) The installation of low-cost wood habitat structures, constructed by hand or with small equipment where access permits, should be considered for the repurposing of woody debris and vegetation materials deposited by PFDFs to provide channel roughness, streamflow retention, and immediate salmonid habitat in the short-term.

I trust this summary of assessment findings and remedial treatment recommendations provides you with information necessary to further respond to the impacts of the McKinney Fire and protect these important affected salmonid habitats. If you need additional information, please call me by telephone at (707) 499-9978 or email colin.hughes@wildlife.ca.gov.

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Maps

Map 1. Location and Geographic Map for the Preliminary Reconnaissance Habitat Impacts Assessment and Remediation Recommendations, McKinney Fire, Siskiyou County, California

Attachments

A. Soil Burn Severity Map, McKinney Fire BAER Assessment 2022
B. National Weather Service Radar, August 2, 2022

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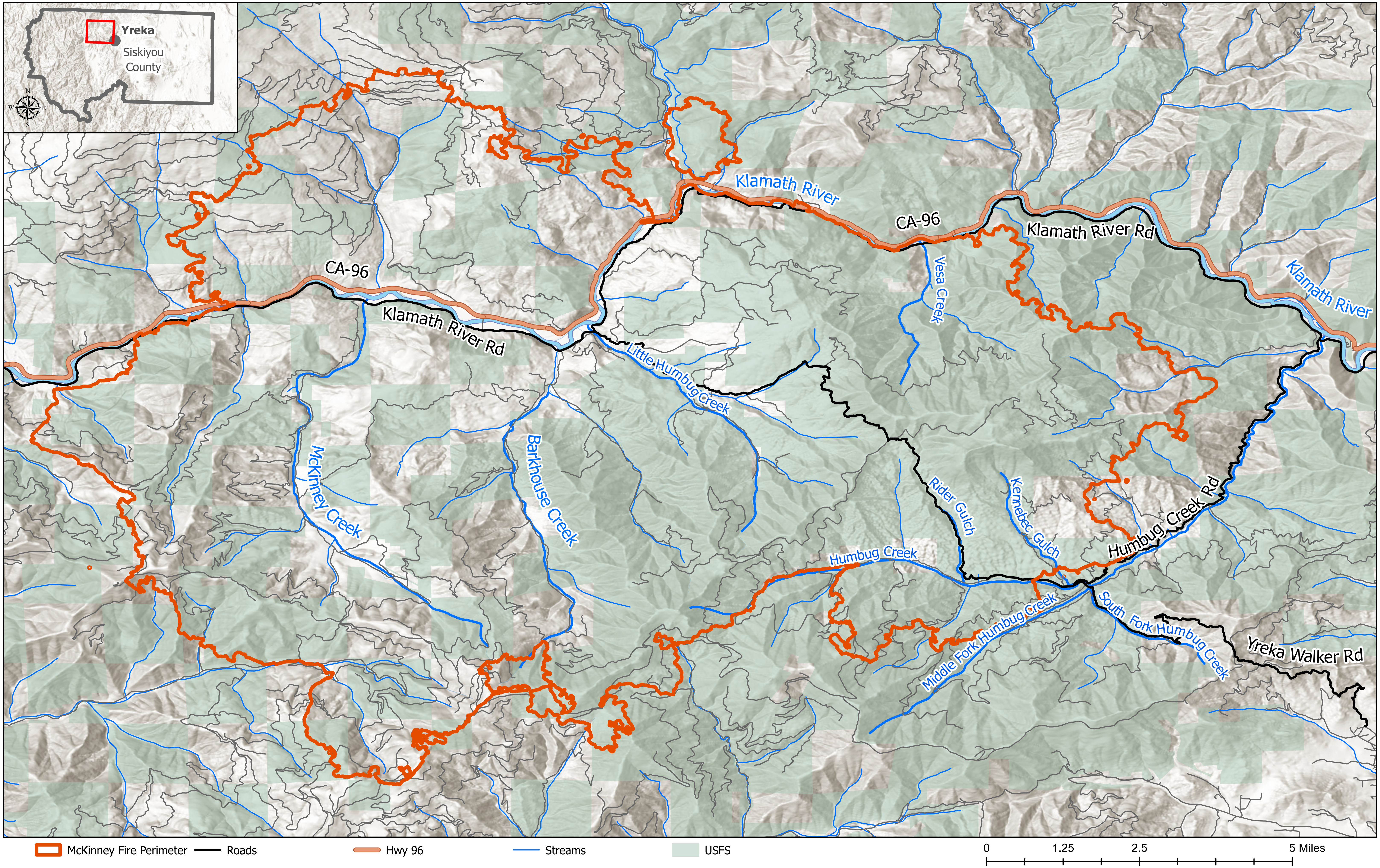

McKinney Fire Perimeter | Roads | Hwy 96 | Streams | USFS