

Proposal Body– FSEN NOFO

#23-3-01-1, The Northwest Fire Science Consortium

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I. Key Past Accomplishments, Anticipated Challenges, and Past Successes, Including Lessons Learned

1. Past Accomplishments

The northwestern region of the U.S. is home to diverse social-ecological systems shaped by fire and stewarded by Indigenous people, government managers, and strong partnerships with nonprofit organizations. The Northwest Fire Science Consortium (NWFSC) has served as a regional fire science exchange network since 2012. The NWFSC’s current mission is to: 1) provide a delivery system for the effective dissemination and accelerated user adoption of relevant fire science information, knowledge, tools, and expertise; 2) provide a framework within which a variety of existing institutions and outreach programs focused on fire science delivery and dissemination in the Northwest (NW) can operate more effectively; 3) establish the NWFSC as the preeminent organization in the NW for assessing research needs of fire and fuels managers, delivering fire science, and fostering two-way knowledge exchange; 4) provide a venue to increase researcher understanding of science needs of diverse stakeholders; and 5) conduct on-going evaluation of effectiveness of NWFSC efforts and adapt our approaches and activities to consistently meet the needs of fire science users. For a decade, the NWFSC has successfully embodied this mission and executed a regional fire science exchange guided by JFSP principles. Among past accomplishments, we have led two needs assessments, and products and events including research briefs (24), Fire Facts (24), fire science videos (12), a podcast series (12 episodes), peer-reviewed literature syntheses (5), over 60 webinars; and numerous field tours, workshops, and conference presentations (Table 1). We center the NWFSC on partnership of the Pacific Northwest Research Station (PNW), Oregon State University (OSU), and University of Oregon (UO); diverse collaborators; and commitment to continuous adaptation in the NW’s dynamic social-ecological fire environment. Further details of successes, outcomes, feedback, and lessons learned are specified in Section I(3 and 4).

Table 1. Accomplishments of the NWFSC in last 3 years: FY20—first quarter FY23.

Activity (conducted, hosted, facilitated, sponsored)	# of activities	Total participants	Outcomes/Impacts (FY21-23 logic model)
In-person activities			
Field tour/training sessions	11	48	1,2,3,5,8,13,14,15
Workshops	9	921	1,2,3,5,7,8,9,14,15
Conference/symposia presentation	3	685	1,3,4,5,7,9
Briefings and consultations about NWFSC	14	428	1,4,9,10,17
Requests for information/assistance referrals	76	86	1, 3,9,10,11
Web-based activities			
Webinars	21	11,000+ (attendees/views)	1,3,5,9,11,12,13,14,15
The Fire Story Podcast: Season 1 & 2	12	971 listens	1,4,6,11,12,13
Storymaps	2	3,000+ views	2,3,4,6,7,13
Videos	4	1,761 views	1,5,6,9,12,13,14,15
Electronic newsletter	41	1,806 subscribers	1,2,3,10
Facebook posts	233	1,749 followers	1,2,3,4,9
Tweets	441	3,036 followers	1,2,3,4,9
Printed materials			
Literature syntheses	2	142	1,2,3,6,7,12,13,15,16
Peer reviewed articles	1	33 views	1,2,3,5,6,7,9,13,16
Infographics	2	225	1,2,3,5,6,7,9,13,16
Annotated bibliography	2	142	1,2,3,5,6,7,13,16
Fire Facts	2	Over 2,400 distributed	2,3,4,5,6,7,13
Research briefs	6	2,011	1,3

Table 2. Anticipated accomplishments of the NWFSC in remainder of FY23.

Planned activity	#	Description	Outcomes/Impacts
Conference/symposia support	3	February, April, May events	1,3,4,5,7,9,10
Infographics	1	Indigenous Forest Stewardship in West: Summary	1,2,3,6,7,9
Literature review & Annotated biblio	1	Indigenous Forest Stewardship in Western US	1,2,3,7
Case study	2	OR & WA prescribed burner certification programs	2,3,7,8,9
Research Briefs	2	Topics TBD	1,3
Webinars	2	Topics TBD	1,2,3,5,7,9
Workshop	1	Fire & Fuels Monitoring for NW Tribal Agencies	1,2,3,4,5,7,8,11,16
Virtual brown bags	4-6	Podcast-style conversations with scientists	1,5,6
Website Drupal update & redesign	1	Improved accessibility to science	1,2,3,4,10
Equity series synopsis	1	Series takeaways, key findings, next steps summary	1,3,9,13,15

2. Anticipated Challenges

The NWFSC’s proposed work responds to several interlinked challenges in the NW. One challenge is the diversity of vegetation, fuels, and the fire environment. The NW includes both highly productive and commercially important wetter “westside” (west of the Cascade Crest) forests, characterized by long fire-free intervals; and frequent-fire regimes in drier “eastside” (east of the Cascade Crest) forests like much of the interior west (Agee 1996). This results in different drivers of fire risk and management needs. Furthermore, the NW has faced wildfire events and climate impacts that increase complexity of manager decision-making about mitigation, response, and recovery (Halofsky et al. 2020). These include the wind-driven 2020 Holiday Farm, Beachie Creek, Lionshead, and Archie Creek fires that affected westside OR (e.g., Reilly et al. 2022), burning over 300,000 ha, causing evacuation of nearly 100,000 people, killing five, and resulting in several billion dollars of damage. Over 75% of the population of Oregon and Washington live in westside communities (McEvoy et al. 2021). Major fires on the east side recently included the 2014-2015 Carlton, Okanagan, and Canyon Creek Complexes, and 2021 Bootleg fire (e.g., Prichard et al. 2020). Scientists anticipate that communities with less contemporary experience with fire in westside forests will see more extreme fire events, and that dry forests will continue to experience ongoing drought and forest health issues that increase risk of catastrophic fire.

In addition, national and regional land and fire management organizations are facing reduced workforce capacity (Westphal et al. 2022) while also implementing new policies, programs, strategies, and funding streams for reducing wildfire risk, restoring landscape resilience, and addressing public health (e.g., USFS 10-year Wildfire Crisis Strategy, OR SB 762, WA 20-Year Forest Health Strategic Plan). They are also responding to the needs of vulnerable populations susceptible to these hazards with limited ability to adapt (Coughlan et al. 2019). These changes increase workloads of public and private land managers and practitioners, and require new capacities and strategies. As a result, agency staff have limited time to engage with fire science and NWFSC activities, yet the need for fire science delivery has never been so critical, particularly to inform ecologically appropriate treatments and to serve underrepresented communities in the region’s diverse settings. Finally, the social environment for fire science knowledge exchange is multifaceted and dynamic. This includes the proliferation of “fire misinformation” (Jones et al. 2022), increased demand on community-based organizations and agencies when responding to fire and smoke events, the importance of trauma-informed approaches for affected communities, and the need to reach audiences across a spectrum of virtual, hybrid, and in-person formats.

Although the NWFSC’s mission and approach are well positioned to address these challenges, these hurdles also demand innovation because they are driving changes in needs, access, and means of engagement. We also recognize difficulties that scientists face in sharing their research. In response, we will expand the NWFSC’s model for bringing the most relevant, current fire science information to federal, state, Tribal, local, and private managers and practitioners by encouraging co-production, inclusivity, and multi-way knowledge exchange. Specifically, we propose the following actions:

- *Adjust the NWFSC governance structure* to 1) increase alignment and inclusivity among core knowledge generating institutions and boundary spanners (see Table 3, p.6); 2) more strategically engage diverse partners in our governance and activities, including underrepresented groups, Tribal managers and scientists; and 3) foster interactive, learner-centered activities (FSEN Objective 1).

- *Conduct expanded needs assessments* using a partner sensing group, roundtables, and systems mapping to provide deeper context of fire science needs, engage networks to increase impact, innovate program delivery, and refine evaluation processes (FSEN Objectives 1, 6).
- *Continue to provide activities and outputs that are impactful, efficient for users, and culturally relevant and appropriate*; informed by our experience, past and future needs assessments, and growing knowledge about science communications and dialogic engagement methods. This includes “science application bundles” that offer multiple, streamlined modes of engagement on focal areas, broadening our ability to reach diverse audiences and be efficient in the face of their workforce capacity challenges (FSEN Objectives 1—5). We will also refine and grow existing platforms including our website, quick reference resource catalog, catalog of new and ongoing research in our focal areas, newsletter, and social media. (FSEN Objectives 1, 2); and share relevant research from JFSP-funded and other fire science projects in the region.
- *Enhance the science application capacity of managers and scientists* by supporting managers’ abilities to evaluate and apply relevant fire science to their contexts; and scientists’ abilities to respond to manager needs. We will update and refine best practices for science exchange activities, and review criteria for written products and learning objectives while relying on key social science literature about effective co-production and science engagement approaches (FSEN Objective 3).

3. Past Successes, Including Lessons Learned

The NWFSC has had many successes since its inception in 2012. We have helped share new knowledge about cutting-edge issues in innovative formats that achieved numerous categories of societal impact and current logic model outcomes (*in italics*). Specific examples from the last three years include:

2022: Equity and Environmental Justice in Wildfire Webinar Series: NWFSC worked with the OSU Extension Fire Program to present a four-part webinar series featuring recent research examining disproportionate hazards to vulnerable populations and access to resources to prepare and recover from fire events. We had considerable interest and many follow-up questions, and recordings of the webinars continue to garner hundreds of views. This had conceptual impact, as it *enhanced awareness and understanding of new research findings, and awareness of the NWFSC*. We plan to create a series synopsis document to summarize key themes, results presented, and further end user science needs.

2021 & 2022: Salvage Science Summits: NWFSC has long worked with other fire science exchanges and particularly the other western Exchanges. In 2020 and 2021, NWFSC partnered with the USDA Forest Service, the Northern Rockies Fire Science Network, and the Southern Rockies Fire Science Network to hold two Salvage Science Summits focused on best management practices for ecosystem health and economic recovery. The videos for the Summit have cumulatively received over 12,000 views. 100% of participants said the subject matter was effectively presented, and 98% said the event *increased communication between researchers and managers*, a connectivity impact.

2021-22: Barriers to Building Resilient Forest Landscapes in the Presence of Weeds:
Working group and deliverables: The spread of invasive weeds from forest and rangeland management activities is a challenge for managers on Northwest grasslands and national forests, who must balance resource objectives with preventing invasive plant spread. In April 2021, the NWFSC, PNW Research Station, USFS Region 6, and the Great Basin Fire Science Exchange (GBFSE) began convening to discuss key issues and develop useful tools to guide communication and implementation efforts. This led to: 1) A webpage for the JFSP project (#16-1-01-21): *Ecosystem Change in the Blue Mountains Ecoregion: Exotic Invaders, Shifts in Fuel Structure, and Management Implications* that provides key results, publications, news, and resources (404 visits in 2022); 2) a deep-dive webinar with project PI Dr. Becky Kerns and collaborating scientists to present and synthesize project results (306 attendees/views); and 3) an infographic conceptualized with the GBFSE, which has been shared widely on social media, in emails, via newsletters, and through downloads from our website. This has had capacity-building and socio-environmental impact by *equipping managers to address this issue in local and regional contexts*.

2021: Communicating with the public about wildland fire preparation, response, and recovery. The NWFSC conducted a literature review to synthesize empirical research about wildland fire communication, providing land managers, public health and safety officials, and community groups with evidence-based recommendations. Products included a science synthesis summarizing scholarly literature

on the topic with detailed methodology and categorization of all articles reviewed, an infographic that summarized key takeaways in a visual format shared with managers and collaboratives including the Smoke Ready Communities working group, and a journal article (Santo et al. 2022). The multiple deliverables allowed the NWFSC to reach diverse audiences while establishing credibility on this topic across platforms and content levels, and supported connectivity and capacity building impacts by providing knowledge about creating *new communication strategies*.

FY 2020-21: Prescribed Fire Activities. In 2020, the NWFSC partnered with OSU Forestry & Natural Resources Extension on a Learn & Burn workshop for forest landowners. 20 participants that collectively owned and managed over 8,700 acres learned about fire ecology and management and participated in a pile burning activity. 100% of participants said they would use this knowledge when burning their own piles and 86% expressed an interest in learning about broadcast burning at a future workshop. In 2021, the NWFSC partnered with USFS Region 6 and the GBFSE to hold a Fire Science Symposium in conjunction with an Advanced Burn Boss Workshop. This was a virtual and interactive event using graphic facilitation to bridge research and practice around the Cohesive Strategy's three pillars; 126 people registered. These events supported instrumental, capacity building, and conceptual impacts including *acceptance of prescribed fire, landowners/managers' adoption of new methods, and increased requests for NWFSC assistance and expertise*.

FY 2020-2022: Videos, podcasts, and storymaps. The NWFSC has long partnered with the UO School of Journalism and Communication to create innovative audio and visual products. Our most-watched video has over 7,600 views. When COVID-19 limited the ability to interview scientists and managers, we adapted our deliverables. In FY 2020—22, we produced: 1) A longer video about returning fire to western landscapes in the context of wildfire history (902 views); 2) Three “Fire Facts” videos: [Fire Weather](#), [Smoke](#), [The Fire Triangle](#) (859 views); 3) two seasons/12 episodes of [The Fire Story Podcast](#) with accompanying resource guides (971 listens); and 4) a Fire Facts [Story Map](#) that can be used as an educational tool when working with communities, collaboratives, and the public (3,000 + views). These efforts had instrumental and connectivity impacts by *enhancing awareness and understanding of new research findings, acceptance of prescribed fire, and new communication strategies*.

Through these successful efforts, we have identified several crucial lessons learned. One lesson is the value of multiple resources and modes of outreach (e.g., publishing a full-scale literature synthesis, creating an infographic on key results, and hosting a webinar to summarize). This approach has allowed us to accommodate different learning approaches and improve reach to diverse audiences. It has also proven necessary to offer varied formats and flexible options given the COVID-19 pandemic. Specific to formats used, we have learned that although audio, visual, and storymap products can reach diverse learners, they require substantial resources to execute effectively and be disseminated in ways that achieve intended outcomes.

Other key lessons are related to our governance. Given the complexity of wildland fire science needs, producers, and users in the region, we identified that a full-time coordinator has allowed for more consistent communication across governance tiers and outreach levels in NWFSC's work. We also learned that our past model of funding more institutions with smaller contracts introduced inefficiencies and administrative obstacles. We reduced the number of core partner institutions receiving funds to increase capacity to accomplish deliverables and expand new partnerships. We have also recognized the need to diversify our advisory group representation and create more interactive engagement opportunities. Lastly, a major lesson learned is the continued importance of regular needs assessments. While many previously identified needs remain relevant, the regional environment for fire science application has changed considerably and rapidly in recent years due to major wildfire events, new policies, accelerated investments in fuels reduction, the COVID-19 pandemic, and shifts in workforce capacity. Efforts to respond to these shifts and further assess needs are described in our program of work, below.

4. Feedback on Past Work

The feedback below was selected to represent a wide range of our offerings over the last three years.

Feedback from webinar attendees:

“I REALLY appreciate this [environmental justice] series existing...as a person who is considered coming from a "historically disadvantaged" community & now working in natural resource management,

its affirming to know there is research being done to include the communities I am a part of.”
“Excellent--I will integrate this info into my job as a volunteer wildfire risk assessor... I see a real need to make home hardening activities accessible to low-income people and older and disabled people.”
“This style of webinar-panel is really good format for interaction & idea sharing.”

Feedback from workshop participants:

“I was looking for ideas about how forests are likely to change and how to incorporate that info into adaptation planning. I will incorporate what I learned. Many good insights and ideas.”
“The workshop did great at fitting a bunch of content into a relatively short amount of time while still providing time to talk in small groups... facilitation using illustrations worked well for me.”
“All the topics were very pertinent and helpful as well as informative. The presenters did an excellent job and utilizing the virtual concept via ZOOM worked very well and was coordinated very, very well. An excellent day of learning and I really appreciate the level of instruction.”
“LOVE this format. It was helpful to be able to watch the presentations ahead of time and be able to rewind when I didn’t understand something. Also, form my questions ahead of time...I would love to see fire studies from the west side of the Cascades b/c it so different from drier forests/Rocky Mountains.”

Other feedback:

“This video is helpful in showing the importance of processes involved in maintaining habitat complexity. We will be interested in seeing how this translates into specific agency action and coordination among the agencies charged with addressing fire "management" and those charged with protecting habitat and processes that allow complexity to develop over time.”-*YouTube comment on a fire science video*
“We really like this NWFSC storymap. It provides basic wildfire information, background, terminology, & resources to increase knowledge & understanding of wildland fire.”-*Twitter share, Fire Facts Storymap*
“Check out this beautiful infographic...! We couldn’t have said it better: Weeds are fuel. Weed management is part of building resilient forest landscapes.”-*CA Invasive Plant Council, Facebook share*

The [2021 USGS Assessment of the Fire Science Exchange Network](#) also provided insight on areas of effectiveness and for improvement. This showed that the NWFSC audience extends far beyond its geographical boundaries. The NWFSC had the third highest number of participants and was one of just two that respondents from every region reporting participating in. The NWFSC was deemed a “go-to” exchange: “*Northwest and Northern Rockies additionally stood out as go-to exchanges for information because there were higher percentages of respondents that went to these exchanges for information on average compared to the other exchanges... for postfire recovery and management Northwest was the go-to exchange for respondents from other locations to gather information from*” (Collins et al. 2022, pp. 97-98). Further, the assessment of importance and performance for fire science topics placed the NWFSC as “good work” for 14 of 16 topics; including one of three exchanges with “good work” on social science and human dimensions. Like most exchanges, the NWFSC was evaluated as having a gap in addressing economic impacts and Indigenous knowledge.

II. Project Outcomes

The NWFSC pursues 20 outcomes under three NW exchange-specific objectives, described in our logic model (p.12). Our short-term outcomes focus on improving information access, accuracy, awareness, and delivery; our medium-term outcomes on increasing inclusion, multi-way engagement, and co-production between research and the field; and long-term outcomes on promoting collaboration and co-learning that addresses inequities and sustains and conserves resilient social and ecological systems. Through pursuing these outcomes, our work will advance application of new science about historical, current, and future fire regimes; reducing impacts of catastrophic wildfire through active management, postfire ecological dynamics; fire and carbon-oriented management strategies; smoke mitigation and management; strategies for prioritizing effective fuels treatments to create landscape resiliency and conserve landscapes; and equity and environmental justice in mitigation and recovery. These outcomes directly address anticipated challenges described in Section I(2), are aligned with the USDA/USDOJ Secretarial priorities, and will foster a range of social and ecological benefits. Managers, decisionmakers, and policymakers

will share knowledge to support sustainable active management aligned with the pillars of the Cohesive Strategy and aimed at reducing negative effects of wildfire, as well as supporting strategic decisions about conservation priorities and actions. Further, our emphasis on centering equity and environmental justice will support managers in expanding inclusion of diverse perspectives in decision making, increasing access to mitigation resources, and reducing disproportionate impacts of wildfires. These outcomes address categories of social impact as described in Section IV.

III. Governance

1. Proposed Fire Science Exchange Structure

Our new proposed governance structure is based on new leadership and past experience and designed to meet the needs of the region’s diverse and dynamic fire science audiences. We propose locating the responsibilities of principal investigator to the director of the Extension Fire Program at OSU. This program was created in 2020 and has eight funded faculty dedicated to wildfire education, partnerships, and science application covering Oregon. This leadership arrangement brings new capacity to the NWFSC, will enhance impacts of both programs, and streamlines our internal function and supervision as the core NWFSC administration and coordinator position have historically been at OSU.

Further, we have retained and will expand essential core partnerships with the USDA Forest Service’s Pacific Northwest Research Station (PNW) and the Ecosystem Workforce Program (EWP) at UO. The PNW has served as a foundational partner and provided leadership for the NWFSC to date. We will broaden the partnership to include PNW Tribal Relations and the Communications and Applications Program, elevating the application and impact of PNW-led research produced through partner-focused initiatives on fire, carbon, water, and rural communities. PNW also houses the director of the Northwest Climate Hub to support decision-making informed by climate science. The PNW will contribute time of six personnel and resources of its involved programs. Maintaining a core partner role, the EWP will continue to expand the NWFSC’s network and capacity for science syntheses, science communication, and wildfire smoke research and application. We will add core institutional leadership from Washington State University (WSU) Extension for more consistent representation of WA end user needs, increased partnership between WSU and OSU’s Extension programs, and stronger NWFSC reach with private landowners, forest industry, and managers serving those communities. We will add the USGS Northwest Climate Adaptation Science Center (NW CASC) to our management committee, growing connections to USGS and scientists at the University of Washington. Together, our institutions and partnerships also connect us to scientists and other knowledge generators of new fire and fuels science in the Northwest. To coordinate these partnerships and connections with end users, we will use three tiers: 1) an operations team, 2) a management committee, and 3) a partner sensing group (Table 3).

Table 3. Governance structure of the NWFSC and key leaders/advisors.

	Operations team	Management committee	Partner sensing group
<i>Purpose</i>	Support task accomplishment and address routine issues and needs. Engage other levels through updates and participatory processes	Discuss progress and advise on implementation of deliverables Support needs assessment and program evaluation with additional perspectives beyond the core operations team.	Review accomplishments, outcomes, lessons learned, and workplans. Help design and engage end users in needs assessments, particularly for diverse representation and inclusion of underrepresented groups. Network and share NWFSC activities and outputs within their organizations and partnerships.
<i>Meeting approach</i>	Meet monthly	Meet every three months	Meet annually for review, feedback, and work planning; twice annually for needs roundtables
<i>Key leaders/advisors</i>	Coordinator and lead PI from each institution: <i>OSU:</i> Autumn Ellison, EJ Davis <i>UO:</i> Heidi Huber-Stearns <i>WSU:</i> Andy Perleberg <i>PNW:</i> Vita Wright	Inclusive of operations team plus co-PIs and collaborators. <i>OSU:</i> Holly Ober, Carrie Berger; <i>UO:</i> Michael Coughlan, Hollie Smith; <i>WSU:</i> Patrick Shults; <i>PNW:</i> Becky Kerns, Aurora Lehr, Adam Watts; <i>USFS R6:</i> Tom DeMeeo; <i>USGS NW CASC:</i> Nicole DeCrappeo	<i>BLM:</i> James Dickinson; <i>BIA:</i> Kim Kelly; <i>WA DNR:</i> Jen Watkins; <i>WA DOE:</i> Sean Hopkins; <i>ODF:</i> Ryan Gordon; <i>OSU Forestry Tribal Initiatives:</i> Cristina Eisenberg; <i>PNW:</i> Liz Dent; <i>NPS:</i> Karen Kopper; <i>R6:</i> Dana Skelly; <i>TNC:</i> Ryan Haugo; <i>USDA Climate Hub:</i> Jessica Halofsky

2. Past Experience with Governance

The NWFSC's [operating guidelines and charter](#) articulate our current governance structure. Direction has been provided by a principal investigator from the PNW Research Station and an administrative director and coordinator at Oregon State University. Most notably, restructuring in the FY22-FY23 funding cycle enabled us to fill a full-time coordinator position, increasing our capacity to accomplish deliverables and expand partnerships. Additional leadership and end user input has been provided through a two-level structure consisting of a management committee and advisory board. The management committee consists of personnel from entities directly involved in implementing NWFSC activities and deliverables, and meets monthly to help set priorities and make decisions. The advisory board has approximately ten representatives from state, federal, Tribal, and nonprofit end user entities and has convened annually for an in-person workshop and field tour. The past experiences and lessons learned in Section I(3) have demonstrated the importance of designing options for engagement that are best suited to each entity's relationship to specific exchange activities and outputs. It has also demonstrated the need for new modes of involvement with advisory representatives to diversify perspectives, reduce the time burden on individuals, and advance more frequent and interactive engagement opportunities. Further, the 2020 wildfire season required us to be dynamic and shift to address emerging needs including a focus on westside communities and postfire impacts. Our proposed future three-level structure, with emphasis on ongoing dialogue and needs assessment through a partner sensing group, reflects these lessons learned, and is responsive to anticipated challenges in Section I(2).

IV. Logic Model and Program of Work

1. Customer Expectations

The primary end user communities that the NWFSC serves include federal, state, and Tribal land and fire management agencies; nonprofit and community-based organizations; Extension personnel; local partnerships and collaborative groups; and practitioners such as forestry consultants. From these users, we continue to hear diverse content needs and format preferences, but common and enduring themes are:

- Fire science is frequently used (57% of respondents surveyed in last assessment reported using research publications in their job at least once a week); there is an ongoing need for a regional fire science exchange to facilitate this level of use.
- A majority of managers find research briefs, science syntheses, and project summaries to be the most useful products offered by the NWFSC and turn to us for these materials.
- The NWFSC resource library and newsletter are key places where managers expect to receive information about new research and learning opportunities.
- Priority research topics that managers expect the NWFSC to address are: public communication about fire impacts and fire risk, social considerations for science application, public perceptions of fire risk, and climate change effects on local forest conditions and local fire regimes.

As wildfire impacts increase for ecosystems and communities, managers are working to accelerate the pace and scale of wildfire risk reduction, protect public health, and restore landscape resilience. They require fire science that supports strategic planning while factoring in future climate change scenarios. Many managers also face growing and urgent needs for action alongside accelerated investments in their work. They therefore expect partners like the NWFSC to target their needs and use engagement approaches that make best use of their limited time. The NWFSC will continue to adapt to this situation by regularly assessing shifting expectations, wants, and priorities through the expanded needs assessment and partner sensing group as described below.

2. Program of Work Drivers

The NWFSC program of work for FY24-25 and beyond is driven by a multi-step process incorporating input from Secretarial and JFSP priorities, JFSP guiding principles, needs assessments and evaluations, partner sensing conducted during proposal development, and research produced or pending from key fire science organizations in the region. First, we have consistently operated the NWFSC to focus on Secretarial and JFSP priorities, and designed the current charter to embody guiding principles for FSEs. This proposal remains responsive to these priorities while further refining how we meet needs across the

Northwest's biophysically and socio-economically diverse region. To assess end user priorities, we have utilized formal NWFSC-led needs assessments (Davis et al. 2013, Ellison et al. 2019), FSEN evaluations (Maletsky et al. 2018, Collins et al. 2022), assessments of regional forest health and landowner needs (e.g., DNR 2019, Cooke et al. 2020), assessments of Indigenous research priorities (e.g., Hoagland 2017, Dockry et al. 2017), the Northwest Climate Adaptation Science Center's 2018-2023 Science Agenda (NW CASC 2017), evaluation of NWFSC events, feedback gathered through the networks of the NWFSC management committee, and systems mapping conducted through the OSU Extension Fire Program.

After identifying priorities through the aforementioned sources, we further refined plans for the program of work through targeted partner sensing with leaders of Tribal initiatives and regional fire scientists, iterative discussions among the core NWFSC partners, and management committee input. We considered variables including our partner institutions' assets and capacities, new and pending fire science generated by our institutions and others, identified challenges and opportunities (Section I[2]); and the specific policies, plans, and strategies developed by federal, state, and Tribal managers in the region in recent years. In summary, we identified several drivers:

- Increasing recognition of Indigenous knowledge and the practice of fire stewardship (e.g., Long et al. 2021); the need to bridge diverse knowledges in applying fire science to management and the deficiency of available resources, relationships, and capacities to do so (Collins et al. 2022).
- Multiple efforts to strategically manage fuels and reduce the risk of catastrophic wildfire through cross-boundary landscape resiliency strategies and new related state agency and Extension program capacities (DNR 2019, OSU 2022).
- New knowledge emerging about fire history, fire ecology, and fuels treatment effectiveness in sub-regions such as the western Cascades, east slope Cascades, and Blue Mountains (e.g., Reilly et al. 2021, 2022; Laughlin et al. 2023, Meigs et al. 2022, Merschel et al. 2021, Johnston et al. 2021); and postfire recovery and management options spurred by the 2020 wildfire season. This necessitates a proactive science exchange role for the NWFSC in these places and specialization of planned activities for west- and east-side audiences in the region.
- Ongoing needs for research about public and community engagement and inclusivity in fire preparedness and response (Santo et al. 2022, Van Deventer et al. 2021, Palsa et al. 2022).
- The proliferation of existing and planned research-manager collaborations including our institutions' portfolios, and increasing demands on managers and reduced workforce capacity. This requires a more deliberate approach to boundary spanning (Colavito et al. 2019), aligning planned work with existing efforts, and enhancing use of networks.

The proposed Program of Work responds to these drivers by focusing on content (focal topics and science application bundles) and exchange formats (activities and outputs) that align with this current context of priorities, needs, and capacities. We are also investing in foundational improvements to refine our governance structure, diversify partnerships, and provide learner-centered and engaging knowledge exchange activities that build manager and scientist capacity to engage with one another.

3. Planned Activities

a. Adapting NWFSC foundations

With this proposal, we are adapting the NWFSC to a new fire science and management environment, which requires adjusting our governance and core platforms. Prior to FY24, we will have completed partner sensing to inform a new proposed governance structure, updated website, strategic packaging of science synthesis with multiple modes, additional formats for webinar feedback, and webinar preparation guidelines for scientists to most effectively communicate research in virtual settings. If funded, we will continue these efforts in FY24 to further enhance our ability to share information and build relationships (FSEN objective 1). We will update our charter to reflect our new governance structure and partnership approach through inclusive opportunities for new operations team and management committee participants to provide input on our mission, decision processes, and operational frameworks.

We will also continue to improve our processes for delivering activities and outputs to support the science application capacity of managers and scientists. Specifically, we will continue to assess best practices for facilitating field tours, meetings, and other events where managers and scientists interact. We will base practices on our own lessons learned and draw on research about effective science

communication and engagement through dialogue and storytelling rather than lecture (e.g., Dahlstrom 2014). We will ensure that activities are structured by specific learning objectives, and maximize participants' ability to ask questions, explore ideas and assumptions, and assess how new knowledge fits their contexts. For written outputs, we will create new criteria to review products for accuracy, applicability of research to fire science needs of the Northwest, and efficacy in communicating key messages for diverse audience (FSEN Objective 3). We will also refresh our approach to gathering participant feedback on activities and products by complementing quantitative needs assessments and event evaluations with qualitative approaches to gather more in-depth input that adds context to responses. We will also continue to consult with other exchanges and boundary spanning science organizations to share insights around needs assessment and evaluations; and identify and discuss collective needs and strengths that transcend regions through peer learning during FSEN monthly calls, annual gatherings, and national events where multiple exchanges are present.

Finally, we will focus on establishing relationships and mutual understanding with managers from the Northwest's federally recognized Tribes and rights-holder organizations, and Indigenous scientists. This will occur through introductions, site visits, presentations at meetings, and other forms of interaction facilitated by the BIA NW Regional Fire Ecologist, PNW Tribal Relations Specialist, OSU College of Forestry's Associate Dean for Inclusive Excellence and Director of Tribal Initiatives, and Tribal Liaisons with the USGS NW CASC. This ongoing process will require time, attention to cross-cultural learning, and a dedicated focus on being responsive to the engagement needs of new partners.

b. Needs assessment

To stay abreast of the diverse needs across the NW, an updated understanding of the most current management issues, knowledge, and manager priorities is necessary. A new needs assessment will inform direction and provide opportunities for dialogue and learning among diverse audiences. Specifically, we will undertake a full assessment employing a survey, Tribal manager sensing, and systems mapping in FY24; and twice-annual roundtables in both years. Contingent on future funding, we will conduct another needs assessment in FY26. We will collaborate with the USGS NW CASC for alignment and reduced duplication with their processes for assessing climate science needs and developing science agendas; and with our partner sensing group to design the assessment process and validate results.

For the full assessment, we will further explore how audiences learn and use knowledge based on adult learning theories and recent research on wildfire and smoke information access in order to develop more specialized activities and outputs that are culturally competent for a diversity of learning styles. We will survey knowledge needs and priorities related to our three focal areas of westside fire, smoke, and landscape resiliency strategies (described below in "e") to identify new research and synthesis needs (FSEN Objective 6). We will also ask about strengths, opportunities, frequency, and purpose of connections, and how managers obtain and share knowledge to inform asset-based systems mapping (e.g., Freitag et al. 2014) that can broaden and specialize NWFSC reach within and across each state. We will include a culturally suitable and practical process to sense needs of fire and natural resource managers from Tribes, considering their capacity and protocols for access, and engaging through management committee and partner sensing group relationships. We will ask questions specific to environmental justice and fire management of ecocultural resources, while respecting Tribal data sovereignty and safekeeping of Indigenous knowledge. We will highlight the identified future research and synthesis needs from the needs assessment in a summary and webinar for fire scientists, and submit to the JFSP Research Needs database. Roundtables will be coordinated twice per year with the partner sensing group for dialogue and engagement about science applications and evolving manager needs. In FY24, roundtables will focus on needs and priorities to inform planning of a westside fire knowledge summit (see "c" below). In FY25, roundtable topics will align with activities in the Program of Work to refine content and format needs for "science application bundles" (described below in "e"), and future activities contingent on funding. Roundtable input will be documented and disseminated in summary documents.

c. NW fire knowledge summit

Face-to-face convenings in the region have been limited in recent years, but remain important for managers and scientists to build relationships. The NWFSC-sponsored annual Central Oregon Fire Science Symposium was well-attended and helped build connections and disseminate new knowledge. We will convene an in-person fire knowledge summit focused on the westside of our region (late FY24 or early FY25), and another for the eastside (FY 26) pending future renewal (FSEN Objective 1). The

purpose will be interactive exchange of current and emerging knowledge about fire's ecological effects, how managers and partners are adapting in response to climate change, and social science to inform public and community engagement. We will draw on our partner sensing group and needs assessment to design summits to be inclusive and focused on salient needs. Inclusivity emphasizes diverse forms of knowledge and observation about fire and climate change across cultures and scales (Cote and Nightingale 2012); and meaningful involvement of a diversity of partners as planners and presenters, including underrepresented groups. We have allocated participant stipends for this inclusion. We seek to strategically build on existing research collaborations and bodies of work, such as the PNW Station's Westside Fire Initiative. The summits will be in-person, with recorded presentations available on a resource page. We will use post-meeting evaluation to assess how well the sub-regional focus served our audiences' needs and to determine desired formats for future summits pending funding past FY25.

d. Multi-exchange virtual workshop on equity and environmental justice related to wildfire

Wildfires and smoke events within and beyond Oregon and Washington have disproportionate impacts on socially vulnerable populations. Equity and environmental justice are recognized by USDA and USDOJ's 2022 Equity Action Plans in response to Executive Order 13985 (Advancing Racial Equity and Support to Underserved Communities). In the NW, WA's SB 5141 (Healthy Environment for All) requires the Department of Natural Resources and other state agencies to integrate environmental justice into strategic plans and decision-making; and OR's SB762 identifies vulnerable communities for defensible space and air quality protection resources. There is increasing emphasis on incorporating human health and environmental justice in forest restoration planning (e.g., D'Evelyn et al. 2022), but this is a new arena for many natural resource agencies, with uncertainty about applicable social science frameworks and tools. The NWFSC has led a science synthesis (Coughlan et al. 2019) and offered a webinar series (2022) to share recent studies on these topics, but the volume of interest across the U.S. West warrants cross-exchange learning. We will partner with the Northern Rockies FSE (NRFSE) to execute a multi-exchange virtual workshop that serves fire science users in understanding and applying current knowledge about equity and environmental justice (FY25), and build and promote a new resource page (FSEN objective 2) in coordination with the NRFSE, who will prepare a "Hot Topic" page on their website. We will refine geographic scope and additional FSE and community-based partnerships within the West as we plan.

e. "Science application bundles" on key focal topics

Through experience, we have learned the value of multiple forms of engagement and science communication on a given topic instead of one-off outputs. This improves reach of knowledge to more diverse audiences by offering formats specialized for specific groups, and increases likelihood that knowledge is digested and applied by repeating key messages. The drivers of the Program of Work (Section IV[2]) led us to identify three broad future focal areas: westside fire, smoke, and landscape resiliency strategies. Within each focal area, we will address priority topics identified in prior needs assessments and sensing: fuels treatments effectiveness, climate change impacts on forest conditions and fire regimes, postfire management, workforce skills and capacity, prescribed fire, and community/public engagement; as well as other priorities that emerge through the FY24 needs assessment.

- *Westside fire*: The unique biophysical and human dimensions of fire in NW westside forests are being examined through research collaborations including the PNW's West-Side Fire and Climate Adaptation Research Initiative. New knowledge is emerging about historical, current, and future fire regimes (Reilly et al. 2022); fire and carbon-oriented management strategies; and postfire ecological dynamics and management options. We will engage westside managers and practitioners in understanding new knowledge and its applications to encourage rapid adoption.
- *Smoke*: Growing smoke impacts in the NW are driving investments and innovations in research and mitigation resources. Smoke management for prescribed fire remains a key issue for managers and regulatory agencies, and smoke from catastrophic wildfires affects many communities including Tribes and those who are socially vulnerable. We will catalogue lessons learned from major NW smoke events, continue to synthesize and share emerging smoke research, and foster connection between land/fire management and public health agencies and organizations; and partner with entities including the proposed Center for Wildfire Smoke Research and Practice at UO, the multi-organizational Smoke Ready Communities working group, and the PNW AirFire modeling team.
- *Landscape resiliency strategies*: WA DNR, ODF, federal agencies, Tribes, and others are applying or building science-based strategies for prioritizing landscapes at highest fire risk and determining

effective forest restoration and fuels reduction treatments. The science and practice of these strategic approaches is evolving (Hessburg et al. 2021) through several monitoring programs and adaptive management processes. We will support managers and partners in learning from these processes, particularly across state lines, and engage Extension programs to apply new science in local contexts. We propose to develop “bundles” for each topic with several modes of engagement and address FSEN Objectives 1-5. We will use roundtables as described above to refine specific priorities within each topic, clarify target audiences, and identify specific sub-regions and science partnerships where current management-relevant research is underway in the NW. A subset of the management committee most connected to each topic will help develop a workplan for each bundle, to include a combination of: 1) a science synthesis publication, 2) research briefs or infographics, 3) webinar(s), 4) field-based working sessions for research demonstration and discussion of applications; 5) a social media and networking plan with key messages and content; and 6) a new dedicated page on our website with links to relevant resource catalog topics. All written products will undergo content and science communication review.

f. Outputs and Outcomes

The NWFSC’s short-term outcomes focus on improving information access, accuracy, awareness, and delivery; our medium-term outcomes on increasing inclusion, multi-way engagement, and co-production between research and the field; and long-term outcomes center on promoting collaboration and co-learning that addresses inequities and sustains and conserves resilient social and ecological systems. The planned activities and outputs link to these outcomes and to NWFSC-specific objectives in multiple ways as specified in our updated logic model (p.12). Through NWFSC objectives, we will address FSEN Objectives 1-5 by sharing synthesized information, creating venues for scientist-manager interaction, hosting field-based research demonstrations, supporting new science adoption and adaptive management, and helping managers evaluate relevancy of science for their geographic and resource settings. Each science application bundle will also address USDA/USDOJ Secretarial goals of reducing occurrence and impacts of wildfire by helping directly apply science to support active management, implement effective fuels treatments, and mitigate fire and smoke impacts to communities. Contingent on future funding, we will plan topics and specific outputs for FY26 and beyond. Additionally, we will meet Objective 6 by regularly sensing fire science and synthesis needs in novel ways that engage diverse partners, build relationships, and increase involvement of underrepresented groups including Tribal managers and scientists; and continue to expand and adapt the core platforms that NW fire science audiences rely on for timely and effective access to the most relevant knowledge (FSEN Objectives 1 and 2).

g. Describe how intended outcomes align with categories of societal impact

By following an updated logic model (p.12), the NWFSC will achieve outcomes that result in all categories of societal impact. We will draw on inputs including regional fire science and knowledge, our institutions, numerous partnerships, and prior and future needs assessments to produce a diversity of engaging activities and outputs that foster manager-scientist relationships, mutual learning and co-production, and on-the-ground adoption of the most relevant fire science. Conceptual impacts will be derived from short-term outcomes such as enhanced awareness and understanding of frameworks and tools for supporting equity and environmental justice, and new research findings for prioritizing management to reduce risk and occurrence of catastrophic wildfire. Capacity for co-production among managers and scientists and connectivity of their relationships will be built through interactive, inclusive needs assessments and best practices for science delivery that lead to medium-term outcomes including increased scientist ability to communicate science, manager ability to apply science, collaboration and co-production, and engagement among Tribal managers and scientists. Increased inclusion of underrepresented communities in NWFSC activities will further foster collective capacity to apply new fire science and meet a diversity of needs. Instrumental impacts will occur through medium-term outcomes such as application of new methods and communications strategies; and increase the diversity of collaboration and inclusive public participation in management decision making, the use of cross-boundary partnerships, and mutual inclusion and respect for Indigenous knowledge and rights in research and management efforts. Socio- environmental impacts resulting from long-term outcomes will include landscape resilience to disturbance, and improved safety, health, and resilience of NW communities.