COLORADO FOREST RESTORATION INSTITUTE 2020 ANNUAL REPORT

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The Colorado Forest Restoration Institute (CFRI) was established in 2005 as an application-oriented, science-based outreach and engagement organization hosted at Colorado State University. Along with centers at Northern Arizona University and New Mexico Highlands University, CFRI is one of three Institutes that make up the Southwest Ecological Restoration Institutes, which were authorized by Congress through the Southwest Forest Health and Wildfire Prevention Act of 2004. We develop, synthesize, and apply locally-relevant, actionable knowledge to inform forest management strategies and achieve wildfire hazard reduction goals in Colorado and the Interior West. We rigorously and objectively integrate the best-available scientific information into decision-making through collaborative partnerships involving researchers, land managers, policy makers, interested and affected stakeholders, and communities. CFRI holds itself to high standards of scientific accuracy and aims to promote transparency in the production and communication of science-based information. Always carefully evaluate sources for appropriateness and rigor before applying in your own work.

CSU Land Acknowledgment: Colorado State University acknowledges, with respect, that the land we are on today is the traditional and ancestral homelands of the Arapaho, Cheyenne, and Ute Nations and peoples. This was also a site of trade, gathering, and healing for numerous other Native tribes. We recognize the Indigenous peoples as original stewards of this land and all the relatives within it. As these words of acknowledgment are spoken and heard, the ties Nations have to their traditional homelands are renewed and reaffirmed. CSU is founded as a land-grant institution, and we accept that our mission must encompass access to education and inclusion. And, significantly, that our founding came at a dire cost to Native Nations and peoples whose land this University was built upon. This acknowledgment is the education and inclusion we must practice in recognizing our institutional history, responsibility, and commitment.

Document Development: The annual report is produced each year in accordance with the fifth (5) duty of the the 2004 Southwest Forest Health and Wildfire Prevention Act (Public Law 108-317). This annual report provides information about accomplishments of the Colorado Forest Restoration Institute at Colorado State University for calendar year 2020 for deliverables approved by the Southwest Ecological Restoration Institutes Executive Team and funded under the Act. Information in this report and the case studies highlight was compiled by Brett Wolk, Tony Cheng, and Hannah Brown. Hannah completed document layout and publishing.

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Cover photo credit: Andrew Slack

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BACKGROUND

The Colorado Forest Restoration Institute (CFRI) at Colorado State University (CSU) strives to address complex forest and fire management values to enhance resilience of increasingly vulnerable forested landscapes and communities. CFRI projects support the development of frameworks to assist communities, managers, and policy makers as they work to increase forest resiliency by combining strategies from ecological restoration and wildfire risk reduction. We also support adaptive management processes by monitoring outcomes of forest treatment and communicating results to stakeholders. The goal is to support fires that can serve their natural role in renewing forests while mitigating social and economic losses and costs. Forest managers, users, and other affected stakeholders must be able to access and apply locally relevant science-based knowledge to communicate and strategically identify where and what kinds of restoration and wildfire risk reduction can provide the most bang for the buck. Federal and university researchers produce scientific information about forest and fire ecology, but their mission is rarely to engage with managers and stakeholders to integrate these findings into local collaborative work, project planning, analyses, design, and monitoring or adapting future plans. Conversely, managers and stakeholders rarely have sufficient time and expertise to access, interpret, and localize scientific findings to inform effective forest restoration. Managers and stakeholders face complex tradeoffs and management decisions as they work towards a future forest that will align with desired conditions and continue to provide ecosystem services. Entities like CFRI that are specifically directed to act as bridges and translators between research and management are crucial, as they can operationalize science to be useful in action.

To address the need for boundary-spanning organizations, the Southwest Forest Health and Wildfire Prevention Act was enacted by Congress in 2004 (Public Law 108-317). The act authorized the establishment and federal funding support for university-based institutes, which have been established in Arizona, Colorado, and New Mexico. As specified by the Act, the duties of each Institute are to:

> (1) Develop, conduct research on, transfer, promote, and monitor restoration-based hazardous fuel reduction treatments to reduce the risk of severe wildfires and improve the health of dry forest and woodland ecosystems in the interior West;
> (2) Synthesize and adapt scientific findings from conventional research to implement restoration-based hazardous fuel reduction treatments on a landscape scale using an adaptive ecosystem management framework;
> (3) Translate for and transfer to affected entities any scientific and interdisciplinary knowledge about restoration-based hazardous fuel reduction treatments;
> (4) Assist affected entities with the design of adaptive management approaches (including monitoring) for the implementation of restoration-based hazardous fuel reduction treatments; and
> (5) Provide peer-reviewed annual reports.

Per the fifth (5) duty of the act, this annual report provides information about accomplishments of the Colorado Forest Restoration Institute (CFRI) at Colorado State University for calendar year 2020 for deliverables approved by the Southwest Ecological Restoration Institutes (SWERI) Executive Team and funded under the Act. In 2020, CFRI had three active agreements under the Act. Deliverable accomplishments for each are included in this report:

- FY18 CFRI annual work plan, active 7/1/2018 through 9/30/2020
- FY19 CFRI annual work plan, active 7/1/2019 through 9/30/2021.
- FY20 CFRI annual work plan, active 7/1/2020 through 9/30/2022.

ORGANIZATION

CFRI is hosted in the Department of Forest and Rangeland Stewardship, one of five academic departments in the Warner College of Natural Resources at Colorado State University. Tony Cheng is Professor in the Forest and Rangeland Stewardship department and serves as the director of CFRI. Dr. Cheng has been director since April 2008. In calendar year 2020, CFRI had fourteen full-time employees (including Dr. Cheng) and approximately twenty-three part-time or seasonal employees. Our seasonal and part time employees included undergraduate students, graduate students, and non-student staff. All CFRI employees report to Dr. Cheng. In turn, Dr. Cheng reports to the head of the Forest and Rangeland Stewardship department. Heads of all departments in the Warner College report to the college's Dean. In addition to staff who hold their primary appointment with CFRI, we leverage other CSU faculty, staff, and graduate students to add their specialized expertise for our projects on an as needed basis.

ACCOMPLISHMENTS

Funding

CFRI funding comes from allocated dollars through the SWERI-approved work plan, agreements with federal and state government and nongovernmental sources, competitive research grants, and charitable gifts. SWERI workplan funding is used to incubate and support innovative new ideas, to augment existing CFRI agreements and projects where significant value can be added, and to support knowledge transfer and application between projects and partners. In this way we create a bridge between research and management, multiplying the impact of applied research and leveraging deep engagement in place-based local monitoring and adaptive management processes to share cumulative broader impacts throughout the Intermountain West. Many of our agreements span multiple years. As a snapshot of our funding, the table below includes all funding sources and agreements signed during calendar year 2020 with CFRI staff as the Principle Investigator. CFRI staff leverage additional funding by participating as co-Principle Investigators and collaborators in additional projects not listed here, which further expands our funding and impact.

Source	Project Title	Agreement Number	Amount
US Forest Service, Grand Mesa-Uncompahgre-Gunnison National Forests	Science-Based Support to Inform Collaborative Adaptive Management on the GMUG	20-CS-11020400-035	$35,000
US Forest Service, Grand Mesa-Uncompahgre-Gunnison NF	Monitoring Ecological, Social, and Economic Effects of the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project, MOD 3	17-CS-11020400-023	$48,000
US Forest Service, Southwest Region	Colorado Forest Restoration Institute, FY20	20-DG-11030000-008	$1,100,000
Forest Stewards Guild (subcontract via DOI-NPS-National Park Service CESU award)	Technical Support for Fuels Treatment Evaluation with the Forest Stewards Guild at Rocky Mountain National Park	008678-00002	$10,000
USDA Forest Service - Washington Office	Assessing the utility and applicability of Wildfire Risk to Communities interactive tools	20-CS-11132543-076	$50,000
US Forest Service, Arapaho-Roosevelt NF/Pawnee NG	Collaborative adaptive management to support wildfire-resilient forests, watersheds, and communities on the Colorado Front Range	20-CS-11021000-036	$631,614
Jefferson County Open Space	Science-Based Support for a Comprehensive Update of the Jefferson County Open Space Forest Management Plan	Sponsor Award ID: PD20-056, CSU award number 009140-00002	$87,168
The Nature Conservancy, Fire Learning Network	Fire Planning and Capacity Building Support		$26,929
US Forest Service, Rocky Mountain Region	Regional PODs strategery	20-CS-11020000-025	$50,000
Peaks to People Water Fund	Peaks to People Water Fund's Watershed Investment Tool and Monitoring Support		$97,437
		TOTAL	**$2,136,148**

In the past five years, CFRI has been successful at leveraging SWERI annual work plan funding to procure additional funds for support of project development, planning, monitoring, and adaptive management on federal (primarily National Forest Systems lands) and non-federal lands. The table below shows these amounts as evidence of the value added by CFRI to the federal SWERI annual workplan funding:

Year	Work Plan Funding ($thousands)	Additional funded projects (federal, state, non-gov't) ($thousands)	State funding ($thousands)	Work Plan Leveraged Funding Ratio ($thousands)
2016	150	590	372	6.4
2017	150	981	423	9.4
2018	450	698	512	2.7
2019	750	890	595	2.0
2020	1,100	1,036	672	1.6
TOTAL	**2,600**	**4,195**	**2,574**	**2.6**

State Support

The State of Colorado, through its support to Colorado State University, provides financial support for CFRI facilities and administration in the form of reduced indirect cost recovery on CFRI federal awards, as well as 9 months of faculty salary to Tony Cheng to serve as Director of CFRI. In 2020, this support totaled approximately $671,756.

2020 Highlights

Case Studies: SWERI Funding Makes Big Ideas Locally Relevant and Informs Fire Planning at Every Stage.

At CFRI, our broad range of collaborative relationships facilitates local problem solving, while our analytical capacity advances the application of science-based tools and solutions. The following graphics illustrate how CFRI leverages SWERI annual workplan funding along with research grants and on-the-ground application projects to multiply our impact. In this way, CFRI bridges science and management for our partners to do the right work, in the right places, to achieve the right outcomes, advancing science informed forest restoration and wildfire hazard reduction across the west.

BIG IDEAS

We synthesize the best available science, make national policy
locally relevant, and deliver usable solutions to our partners.

National: We put the "work" back in workshop

"There is a mismatch between the scale of the risk, and the scale of the work we are actually doing."
~ USDA Forest Service Chief Christiansen

In March 2020, CFRI and the other SWERIs gathered over 150 federal, tribal, state, and local land managers, research partners, and stakeholders. The SWERIs facilitated collaborative small-group discussions in which people shared the barriers they face, and transferred problem-solving knowledge between geographies and "ologies."

Policy: Bennet Western Climate Resilience Roundtable

When CFRI Director Tony Cheng provides input to Colorado Senator Michael Bennet, he makes recommendations about climate change and natural resource policy from an unbiased perpsective based on lessons we've learned as an entire organization. Our science-based monitoring methods and long history of collaborative success provide information developed from the practice of doing—a "pracademics" that positions CFRI to contribute to national discussions.

State: Making statewide priorities locally relevant

When the Colorado State Forest Service (CSFS) was ready to roll out their new Forest Action Plan to staff, they partnered with CFRI to design a virtual workshop. CFRI helped CSFS downscale statewide priorities to frame how the Forest Action Plan would apply to work on their specific forests.

Program: Evaluating the Collaborative Forest Landscape Restoration Program

CFRI worked with the Ecological Restoration Institute and USFS staff to co-develop an analysis of CFLRP projects that documents lessons learned, assesses the factors that enable and restrain collaboration, and identifies features of resilient collaboratives.

Program managers are using this review to improve CFLRP and collaboration within USFS more broadly.

Local: Sharing lessons learned to increase collaborative capacity

As the pace of collaborative forest restoration increases throughout the state, we increase capacity by empowering local groups to monitor and adaptively manage their own projects. At the San Juan Headwaters Forest Health Program Science Symposium (February 2020), we transfered knowledge gained from our other collaborative endeavors and helped groups design protocols that specifically address the social and ecological context of forests, communities, and watersheds of the San Juan.

Project: Prescribed fire monitoring influences on-the-ground decisions

We monitored multiple prescribed burns and mechanical treatments in Northern Colorado to show the outcomes of each treatment type. Our findings show that prescribed fire is more efficient and effective for reducing the risk of catastrophic wildfire. We integrate these findings with local decision making to make each project better than the last.

We use on the ground experience and local expertise
to inform regional and national solutions.

LOCALLY RELEVANT

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CFRI and the 2020 Fire Season

By creating and integrating actionable knowledge across forest and fire management, we helped break down social and ecological barriers to prepare people and landscapes for the 2020 fire season.

Pre-Fire Planning

Fire requires cross-boundary planning, and CFRI works with federal, state, and local organizations in Northern Colorado to support the Northern Colorado Fireshed Collaborative.

- Our landscape prioritization modeling identifies where people can work most effectively towards shared outcomes.

- CFRI collects and analyzes prescribed fire and mechanical treatment effectiveness data with and for our partners to improve outcomes on the ground.

- CFRI's collaborative frameworks leverage our monitoring data to build a shared, science-based understanding of landscape conditions.

Smoke in the Air

Colorado's 2020 fire season had huge social and ecological impacts, and CFRI's relationships with land and fire managers meant that our science-based information and analyses were accessible for fire managers and decision makers to use during fires. We collaborated with teams at the Rocky Mountain Research Station to help fire managers pre-plan fire response activities using Potential Operational Delineations. Products from this collaborative pre-planning, including maps showing suppression difficulty index, and potential control lines, informed fire response that incorporated multiple values.

The Calwood Fire started on October 17 2020, and burned over 10,000 acres in Boulder County. The fire moved quickly and destroyed at least 20 homes.
Photo Credit: William D. Bowman

Post-Fire Recovery

CFRI's expertise is used in post-fire recovery planning:

- CFRI modeling helped prioritize watershed protection by identifying locations and methods for containing post-fire erosion hotspots across the Cameron Peak and East Troublesome Fires, the two largest in Colorado's recent history.

- Before the flames were out, CFRI began working with the Arapaho & Roosevelt National Forests and the Rocky Mountain Research Station to determine areas where reforestation and recovery efforts can be spatially prioritized to give the best bang for the buck with limited resources for re-planting.

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Project deliverables

Following is a report on deliverables under three agreements active during calendar year 2019 that were authorized through the Southwest Ecological Restoration Institutes (SWERI) development and executive team workplan approval process for the Colorado Forest Restoration Institute to carry out the duties described in the Act:

For FY18 agreement number 18-DG-11031600-052, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including July 1st, 2018 through September 30th, 2020:

Deliverable	Status of Deliverables
Project 1: Supporting collaborative monitoring and adaptive management to streamline environmental analysis and decision-making for forest landscape restoration and resilience	
1.1 Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Front Range Collaborative Forest Landscape Restoration Project	Developed a series of technical briefs to support the two GTR-373 field workshops held in September, 2018, in Red Feather Lakes area and Conifer area. Documents covered field based ecological monitoring strategies, and adaptive management processes and lessons learned from the Front Range CFLRP. These briefs included: - Barrett, KJ, Cannon, JB. Front Range CFLRP: Assessing changes in stand-scale forest structure and composition. - Cannon, JB, K Pelz. Ecological restoration in the Colorado Front Range: Research to aid planning and monitoring at multiple scales. - Wolk, BH, Aplet, G, Briggs, J. Adaptive management processes and lessons learned. Produced Association for Fire Ecology Research Highlight: Cannon, JB, Briggs, JS, and Chambers, ME. (2018). Effects of forest restoration treatments and wildfires on tree spatial patterns in the Colorado Front Range. 2017 Fire Congress Research Highlight. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/03/AFE2017_Research-Highlight_Cannon.pdf Produced technical paper: Brown, PM, Gannon, B, Battaglia, MA, Fornwalt, PJ, Huckaby, LS, Cheng, AS, and Baggett, LS. (2019). Identifying Old Trees to Inform Ecological Restoration in Montane Forests of the Central Rocky Mountains, USA. Tree Ring Research 75 (1), 34-48. doi.org/10.3959/1536-1098-75.1.34 https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/04/Brown_et_al_2019_identifying_old_trees.pdf

1.2 Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Uncompahgre Collaborative Forest Landscape Restoration Project.	Developed a series of technical briefs summarizing ecological, economic, social impacts, and the UP CFLR high school internship program. - Chambers, M. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: High School Internship Programs. CFRI-1804. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/UP_CFLRP_High-School-Internship_final_1804.pdf - Chambers, M. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Social Impacts & Contributions. CFRI-1805. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/CFLRP_social_brief_final.pdf - Chambers, M. and Cannon, J. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Ecological Impacts. CFRI-1806. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/UP-CFRLP-Ecological_brief-final_.pdf - Chambers, M. and Speas, C. (2018) Uncompahgre Plateau Collaborative Forest Landscape Restoration Program: Economic Impacts & Contributions. CFRI-1807. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/CFLRP_economic_brief_final_1807.pdf
1.3 Conduct and report on at least two (2) field-based workshops per CFLR project to review and deliberate treatment effects and desired conditions.	August 14-15th, 2018, Brett Wolk and Marin Chambers assisted with organizing a field workshop with the Uncompahgre CFLR project to discuss results with partners and USFS Washington Office staff, attended by ~20 people. August 7th, 2019, Marin Chambers assisted with organizing, leading, and presenting monitoring data and adaptive management for the UP CFLR annual field trip. August 15th, 2019, several CFRI staff assisted with organizing, leading, and presenting monitoring results at the Front Range Roundtable Landscape Restoration Team Field Trip on Pike National Forest. Attended by approximately 20 people from a variety of agencies.
1.4 Document and distribute between 4-6 monitoring methods and results (where applicable) to multi-stakeholder collaborative initiatives focused on forest health	Published written protocols for monitoring impacts of prescribed fire of vegetation and fuel loading: Monitoring Immediate Postburn Vegetation and Fuel Characteristics Protocol. 2018. Colorado Forest Restoration Institute. CFRI-1808. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/ImmediatePostburnProtocol_Mothership_2018.pdf

and wildfire risk mitigation	Updated integrated monitoring approaches and detailed protocols for monitoring changes in forest composition, structure, and fuel loading in Colorado forests. - 2018 Mothership Plot Protocol. Colorado Forest Restoration Institute. CFRI-1810. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/2018-Mothership-Protocol.docx - 2018 Simple Plot Protocol. Colorado Forest Restoration Institute. CFRI-1809. https://cfri.colostate.edu/wp-content/uploads/sites/22/2018/10/2018-Simple-Plot-Protocol.docx CFRI staff Brett Wolk and Marin Chambers visited with San Juan Headwaters Forest Health Partnership on August 29-31st, 2018, to distribute and discuss monitoring approaches for mixed conifer forest ecology and management. September 4th, 2019, CFRI staff Brett Wolk and Kat Morici distributed monitoring methods and results to Washington Department of Natural Resources staff and their contractors, and discussed best practices developing fuel treatment effectiveness monitoring program. Kevin Barrett presented technical poster from Front Range CFLRP monitoring methods and data, and discussed results with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Changes in forest structure in Ponderosa pine-dominated ecosystems following restoration treatments". https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/12/Barrett_AFE_Poster_2019.pdf Marin Chambers presented technical poster from Uncompahgre Plateau CFLRP monitoring methods and data, and discussed results with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Collaborative Forest Landscape Restoration monitoring results following mechanical and prescribed burning treatments on the Uncompahgre National Forest, CO."
Project 2: Translating National Cohesive Wildland Fire Management Strategy principles in practice	
2.1 Produce and disseminate between 2-4 written reports describing linkages between Potential Operational Delineations and fuel treatment effects on landscape-scale fire	Published paper: Thompson, MP, Liu, Z, Wei, Y, & Caggiano, MD. (2018). Analyzing Wildfire Suppression Difficulty in Relation to Protection Demand. In Mihai, FC & Grozavu, A (Eds.), _Environmental Risks._ DOI: 10.5772/intechopen.76937. https://www.intechopen.com/books/environmental-risks/analyzing-wildfire-suppression-difficulty-in-relation-to-protection-demand Published paper: Addington, RN, Tavernia, BG, Caggiano, MD, Thompson, MP, Lawhon, JD, Sanderson, JS. (2019). Identifying opportunities for the

behavior and potential post-fire soil erosion for the purpose of pre-positioning fire response and coordinating future landscape-scale, cross-boundary forest vegetation treatments	use of broadcast prescribed fire on Colorado's Front Range. Forest Ecology and Management 458. https://doi.org/10.1016/j.foreco.2019.117655. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/01/Addington_et_al_opportunities_for_broadcast_prescribed_fire.pdf
2.2 Produce and disseminate between 1-3 written reports describing lessons learned and best practices for cooperative cross-boundary prescribed fire	Produced, printed, and disseminated paper describing collaborative process and best practices for developing Potential Operational Delineations: Caggiano, MD (2019). Collaboratively Engaging Stakeholders to Develop Potential Operational Delineations. CFRI-1908. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/08/PODs-Collaborative-Engagement-Final-Report.pdf
2.3 Conduct and report on between 4-6 field-based workshops to review and deliberate treatment effects and desired conditions with cross-boundary partnerships.	March 26th, 2019, CFRI staff Kat Morici presented fuel treatment effectiveness monitoring results from non-federal lands in Colorado, and led discussion of fuel treatment effectiveness monitoring methods at the Coalition for the Poudre River Watershed quarterly meeting.

April 15th, 2019, Mike Caggiano presented information about local PODS spatial fire planning efforts with the Colorado Big Thompson Headwaters Partnership in Estes Park, Colorado. Caggiano led a discussion about opportunities to incorporate POD spatial fire planning with CBT mechanical fuel reduction projects to align fuels and fire management efforts.

CFRI staff Kat Morici presented fuel treatment effectiveness monitoring results and trained others on monitoring protocols at the San Juan Prescribed Fire Training Exchange (TREX) September 10-24th, 2019, in the vicinity of Durango, Colorado.

November 22, 2019, Tony Cheng and Brett Wolk led field based review of fuels treatments, presented monitoring results, and discussed strategic landscape management planning approaches with The Nature Conservancy Restoring America's Forest annual meeting in Estes Park, Colorado.

Kat Morici delivered an oral presentation and discussed methods and results from analysis of fuel treatment effectiveness monitoring on non-federal lands in Colorado with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. |

	"Adaptive Management in Action: Evaluating Fuel Treatment Effectiveness with Field-Based Monitoring and Fire Modeling.
Project 3: Providing Decision Support for Collaborative Landscape-Scale Assessment and Strategic Prioritization	
3.1 Convene and report on the structure and functioning of between 2-4 collaborative landscape analysis teams involving managers, researchers, and stakeholders	**Peaks to People Water Fund:** Published paper with co-authors from The Nature Conservancy and USFS Rocky Mountain Research Station describing functioning and effectiveness of Peaks to People Water Fund. Gannon BM, Wei Y, MacDonald LH, Kampf SK, Jones KW, Cannon JB, Wolk BH, Cheng AS, Addington RN, and Thompson MP. (2019). Prioritising fuels reduction for water supply protection. International Journal of Wildland Fire. DOI: https://doi.org/10.1071/WF18182. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/05/Gannon-et-al-IJWF-2019-Water-Supply-Protection.pdf To increase accessibility of the peer-reviewed publication, CFRI developed a two-page summary and application of the Risk Assessment and Decision Support process used with Peaks to People Water Fund. Gannon BM, Brown, H, Wolk, BH. (2019). The Right Work in the Right Places: Prioritizing Fuels Reduction to Protect Water Supplies. CFRI-1905. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/05/CFRI_wRADS_2Pager_May2019.pdf **Envision Chaffee County** CFRI expand methodologies developed with the Peaks to People Water Fund to lead the Envision Chaffee County interagency collaborative group through a multi-resource wildfire risk assessment. Our assessment methods were published as CFRI technical documents, as well as posters to easily communicate the structure and functioning of the risk assessment to stakeholders, the public, and other planning groups. The final products were included in the updated Chaffee County Community Wildfire Protection Plan, which will inform the allocation of county sales tax dollars that were recently approved by voters to fund fire mitigation work across all land ownerships in the county. *CFRI technical reports:* - Gannon BM. (2019). Chaffee County Wildfire Risk Assessment. CFRI-1913. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_RA_Methods.pdf - Gannon BM. (2019). Chaffee County Fuel Treatment Prioritization. CFRI-1914. https://cfri.colostate.edu/wp-

	content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_FTP_methods-1.pdf *Posters:* - Gannon BM. (2019). Chaffee County Fuel Treatment Prioritization. Poster. CFRI-1911. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_FTP_methods.pdf - Gannon BM. (2019). Chaffee County Wildfire Risk Assessment. Poster. CFRI-1912. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Gannon_2019_Chaffee_RA_methods.pdf
3.2 Convene and report on between 2-4 peer-to-peer learning workshops involving collaborative landscape analysis teams that have utilized the strategic prioritization approach and multi-stakeholder groups interested in applying the approach.	CFRI engaged with the interagency Envision Chaffee County collaborative team to carry out a series of risk assessment and prioritization workshops to inform cross-boundary collaborative development of a county-wide Community Wildfire Protection Plan. The CWPP informs priorities for a county tax passed by residents to support cross-boundary forest management activities. This process involved CFRI staff participating in multiple workshops held in Salida, Colorado, to review treatment effects and desired conditions with the group. The end result was an updated CWPP that relied heavily on CFRI led risk assessment. - February 7th, 2019, Brett Wolk traveled to Salida, Colorado and discussed desired conditions with Envision Chaffee County cross boundary management group to help develop shared goals and desired conditions for an update to their Community Wildfire Protection Plan. - April 15th, 2019, Brett Wolk and Ben Gannon led a discussion via conference call for the Envision Chaffee County collaborative planning group meeting to help stakeholders incorporate local values into advanced wildfire risk assessment and prioritization processes. - June 19th, 2019 Ben Gannon presented initial risk assessment results with the group in Salida, CO, and updated priorities of highly valued resources and assets with the group. - August 5th, 2019, CFRI staff Ben Gannon, Brett Wolk, Tony Cheng, and Marin Chambers attended a meeting in Salida, CO, to refine risk assessment and applications with the community wildfire protection plan. - November 1st, 2019 Ben Gannon and Brett Wolk presented custom fire modeling results to incorporate local knowledge into the fire probability and intensity predictions. These modifications were meant to account for new firefighting tactics and climate change

	impacts on compounding forest disturbances in high elevation forests. Results of this process and our reports are summarized in the final *Community Wildfire Protection Plan*: - Chaffe County Community Wildfire Protection Plan Summary: Envision Chaffee County – A future Built on Common Ground. Published by the Central Colorado Conservancy. 12 p. https://e5778e01-37cb-4a06-a2c6-10384194ae9e.filesusr.com/ugd/afd1f8_c0ead1039f4a496fa49e8485559c3fde.pdf - Chaffee County Next Generation Community Wildfire Protection Plan. 2020. Report compiled and edited by Envision Chaffee County and Central Colorado Conservancy (C. Williams, K. Marquis, T. Flanagan, Z. Tucker) with generous input and guidance from the Envision Forest Health Council. Published by the Central Colorado Conservancy. 206 p. https://csfs.colostate.edu/media/sites/22/2020/02/Chaffee_Co_Next_Gen_CWPP_2-5-20.pdf
3.3 Report on the outputs of strategic prioritization data, methods, and tools for 2-4 projects to Forest, Regional, and Washington Office, water providers, watershed coalitions, and forest collaboratives.	November 15th, 2019: Convened a conference call with USFS Washington office staff Carl Lucero, Luanne Lohr, Erin Connelly, and Kenli Kim; Jen Hayes (RMRS Assistant Station Director), Heidi Huber-Sterns (Ecosystem Workforce Group), CFRI staff, and Ecological Restoration Institute staff to discuss research findings on scenario planning tools and coordinate future strategic investment research projects. CFRI staff Ben Gannon attended the Sustaining Colorado Watersheds Conference, October 7-10, 2019, Avon, Colorado. Ben delivered a presentation on lessons learned from developing and applying strategic prioritization tools that balance fire management and watershed protection, and served on an expert panel titled: Forests, Fires, and Water: Exploring how Colorado Communities can Better Co-exist with Wildfire.
Project 4: Supporting Region 2 forest vegetation program planning	
4.1 Compile currently available data and analytical tools on changes in forest conditions for between 1-3 pilot national forests or areas within a single national forest. These forests or areas will be determined by the collaborative	Jeff Underhill, USFS Region 2 Silviculturist and primary stakeholder for this project, left the USFS during this time. Given Jeff Underhill's departure from USFS, we pursued two avenues to address this project: 1. In coordination with Pike National Forest District Ranger Brian Banks and Biologist Mikele Painter, CFRI staff Brett Wolk helped develop a proposal and participated in a working group to explore applying LiDAR data and other remote sensing methods to update veg condition maps that support forest planning and monitoring on South Platte District of the Pike National Forest. The project was awarded funding to work with the USFS Geospatial Technology

working group convened by CFRI.	and Applications Steering Committee (GeoTASC) on a project titled: Utilizing LiDAR data to assess and plan landscape-scale forest restoration and wildfire mitigation activities in the Upper South Platte watershed of central Colorado. Wolk and CFRI staff Kevin Barrett contributed CFRI field data to validate LiDAR and remote sensing analysis, and guided the group on data applications for fire behavior modeling. CFRI coordinated with RMRS scientists Mike Battaglia and Andy Hudak, as well as CSU Associate Professor Wade Tinkham, to contribute relevant data and participate in the working group. 2. CFRI staff Marin Chambers is co-leading a regional Burn Scar Restoration team to analyze data examining changes in forest conditions and tree regeneration patterns following high severity wildfire. The group consists of several RMRS Scientists based in Fort Collins, CO, and Flagstaff, AZ; USGS Scientist Jens Stevens; staff from New Mexico Highlands university, and The Nature Conservancy Colorado Chapter, among others. Chambers has led an effort to collect and compile data on post fire tree regeneration regional patterns across ponderosa pine ecosystems from South Dakota, Wyoming, Colorado, New Mexico, and Arizona. A peer-reviewed publication is in preparation for submission. The group is collecting and analyzing survival data from USFS tree plantings, meets regularly with forest managers and other stakeholders to develop seed technologies for hand planting and drone reforestation in high severity burn areas, has implemented and monitored first planting trials, and will continue ongoing assessment of data and post fire planting strategies.
4.2 Convene and report on collaborative learning events involving managers, researchers, and stakeholders to assess and validate forest condition changes	Marin Chambers led the planning, coordination, and facilitated a field trip with the Burned Area Learning Network near Colorado Springs, Colorado, May 7-8th, 2019. A group of ~25 people representing diverse agencies toured the Hayman Fire Burned Area, discussed post-disturbance forest management conditions, management options, and data gaps to inform planning future forest restoration. This workshop was part of a larger series that was documented with an ESRI storymap, which Marin Chambers contributed content to. https://foreststewards.maps.arcgis.com/apps/Cascade/index.html?appid=db2481bff458430c8910e0d380db2f05 Marin Chambers helped organize a special session at the North American Forest Ecology Workshop, Flagstaff, AZ, June 23-27, 2019, to validate data and interpretations of post fire forest regeneration. Marin delivered a presentation: Chambers, M.E. Ponderosa pine regeneration following high-severity wildfires is driven by overstory, topo-climatic, and ground layer conditions.

4.3 Convene and report on between 1-3 peer-learning workshops to facilitate knowledge exchange between managers and stakeholders engaged in this project with managers and stakeholders interested in replicating the process on their national forest or geographic area.	CFRI staff Marin Chambers provided forest ecology technical expertise, science delivery guidance, and participated in planning events as part of a series titled "Preparing Today's Boulder Forests for Tomorrow's Wildfires". Marin attended and presented forest ecology information related to post fire tree regeneration at 1 fieldtrip and the classroom workshop. The series was convened by the University of Colorado Center for Sustainable Landscape and Communities, and altogether 100 people participated in these activities. Other experts providing insights included: 10 land managers, ecologists, and fire specialists from Boulder City and County; research scientists from CU and CSU, and 2 managers from the Arapaho-Roosevelt National Forest. https://cslc.colorado.edu/events-blog/preparing-todays-boulder-forests-for-tomorrows-wildfires-events - Field trip September 22nd, 2018 - Field trip September 29th, 2018 - Classroom workshop September 26th, 2018
Project 5: Supporting Collaborative Capacity-Building and Peer-Learning	
5.1 Conduct, convene, organize, and report on between 4-6 site visits or workshops that bring together research scientists from RMRS, other federal agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for collaborative assessment, monitoring, and adaptive management.	Organized, facilitated, and delivered meeting 2019 Prescribed Fire Download in Fort Collins, CO, February 28th, 2019, to discuss the 2018 prescribed fire season: successes, challenges, lessons learned, prescribed fire research and monitoring, and upcoming plans. Approximately 30 people attended the event, and presentations were made by USFS Arapaho-Roosevelt NF fire staff, The Nature Conservancy, Forest Stewards Guild, CFRI staff Mike Caggiano and Emma Williams, and others. CFRI sponsored and helped organize 3 special sessions on forest and fire restoration science at the High Altitude Restoration Science and Practice Conference, March 12-14th, 2019, in Fort Collins, Colorado. The conference was attended by ~225 people representing research, management, policy, and private industry fields. CFRI invited and sponsored Keynote speaker Dr. Don Falk's participation to provide expertise in forest ecology and management in light of changing climates to support collaborative capacity building and peer learning with forest restoration stakeholders. The session was moderated by CFRI staff Brett Wolk, Don's presentation was followed by a presentation from RMRS Research Scientist Paula Fornwalt, and several others. Other CFRI staff presentations during the conference: - Kevin Barrett: "Effects of collaborative restoration and adaptive management on forest structure and composition in the Colorado Front Range." - Jeffery Cannon: "Modeling the effects of heterogeneous restoration treatments on understory light environments in a mixed-conifer forest."

	Conference program available at: https://sites.warnercnr.colostate.edu/restoration-conference/
	Organized a CFRI FireLab meeting March 27th, 2019, in Fort Collins Colorado, including 20+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. Laurie Huckaby (RMRS Scientist) delivered a presentation titled: "Historical forest type conversions along an elevational gradient in Colorado Front Range Forests".
	Brett Wolk delivered a presentation and participated in a panel discussion to discuss forward looking forest restoration strategies during a special session at the North American Forest Ecology Workshop, Flagstaff, AZ, June 23-27, 2019. Brett delivered a presentation titled: Restoring Colorado front range forests: knowledge co-production and tools for shared stewardship.
	Hannah Brown delivered oral presentation and discussed best practices for science communication with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Science, management, and implementation of forest restoration concepts: What works?"
	Katarina Warnick delivered a poster presentation and discussed methods and results from analysis of spatial distribution of forest restoration treatments with stakeholders at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. "Changes in forest structure in Ponderosa pine-dominated ecosystems following restoration treatments". https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/12/Warnick_AFE_Poster_2019.pdf
	Andrew Slack participated in a special session on forest resilience to fire at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. Andrew delivered a presentation titled: "Contingent resistance in longleaf pine (Pinus palustris) growth and defense 10 years following smoldering fires".

For FY19 agreement number 19-DG-11031600-062, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including July 1st, 2019 through December 31st, 2020:

Deliverable	Status of Deliverables
Project 1. Supporting strategic prioritization, monitoring, and adaptive management of cross boundary wildfire risk co-management strategies to operationalize the Shared Stewardship approach.	
1.1) Document and report on 2-4 successful examples of science based Shared Stewardship implementation in forests of the intermountain West.	With Rocky Mountain Research Station, co-developed and co-published Connected Science briefs • *When the Fire Starts: A Science-Based Framework for Risk-Based Incident Response.* https://www.fs.usda.gov/rmrs/documents-and-media/when-fire-starts-science-based-framework-risk-based-incident-response • *Looking into the Past: How reconstructing historical forest conditions can help future restoration efforts.* https://www.fs.usda.gov/rmrs/documents-and-media/looking-past-how-reconstructing-historical-forest-conditions-can-help-future-0 CFRI staff Mike Caggiano and Ben Gannon helped develop content, provided data, as well as provided feedback on overall directions for a storymap produced in partnership with the RMRS Wildfire Risk Management Science Team, titled: *Strategic, Cross-Boundary Wildfire Response Planning Enhancing preparedness, communication, and safety.* https://arcg.is/04nPGb CFRI personnel Tony Cheng and Brett Wolk co-authored study on social understanding and support for cross-boundary forest wildfire risk reduction: Roberts, R., K.W. Jones, E. Duke, X. Shinbrot, E.E. Harper, E. Fons, A.S. Cheng, and B.H. Wolk. 2019. Stakeholder perceptions and scientific evidence linking wildfire mitigations to societal outcomes. *Journal of Environmental Management* 248:109286 (online). https://doi.org/10.1016/j.jenvman.2019.109286 CFRI Director co-authored case study of cross-boundary forest watershed governance: Huber-Stearns, H.R., C.A. Schultz, and A.S. Cheng. 2019. A multiple streams analysis of institutional innovation in forest watershed governance. *Review of Policy Research* 36(6):781-804. DOI: 10.1111/ropr.12359
1.2) Assist in the identification and facilitation of partnership engagement in a	On December 5, 2019, CFRI staff (Cheng, Wolk, Caggiano, Gannon, Beeton) organized and hosted a Colorado All-lands Risk Assessment meeting with USFS Region 2 fire staff Brian Keating and Sarah Synowiec, USFS Washington Office staff Jim Menakis and Rick Stratton, Pyrologics, and Colorado State Forest Service Jeff Underhill, Kristin Garrison, and Amanda

Colorado all-lands wildfire risk assessment process led by USFS Region 2. This includes working with targeted partners to identify the High Values, Resources, and Assets (HVRA's) that will help frame the risk assessment outputs.	Fordham. The goals of the meeting were to: 1) Discuss and develop a strategy for the partnership engagement aspect of the HVRA component of the risk assessment process; and 2) Discuss the role of CFRI to serve as a "non-agency" partner who can help all agencies both identify and engage with the appropriate level of partnership involvement we need to be successful. CFRI staff Mike Caggiano has led continued engagement with USFS Rocky Mountain Region fire planning staff to develop risk assessment processes and frameworks. This has resulted in co-development of a regional fire management strategy and process for deploying risk assessments and Potential Operational Delineations (PODs) to all national forests and adjacent landscapes across all states in Region 2.
1.3) Advise the Colorado State Forest Service with applying and interpreting prioritization tools to inform their Statewide Forest Action Plan revision.	In spring of 2020, multiple CFRI staff reviewed a Forest Action Plan draft and provided written and oral feedback to improve the final plan. At the request of CSFS leadership and in coordination with CSU Department of Forest and Rangeland Stewardship, CFRI co-developed and co-lead a 3 part virtual workshop for all CSFS staff November 12th, 13th, and 19th, 2020. The goal of the workshops were to introduce CSFS staff to the new FAP planning framework, and facilitate their ability to interpret and apply the FAP within various job duties across the agency. The workshop included breakout groups that involved over 14 CFRI staff serving as facilitators and note takers to empower CSFS staff to use the FAP framework in their project and activity planning. CFRI developed and conducted a post-workshop survey to assess continued training and resource needs for CSFS staff and their partners to successfully implement the FAP, and has developed a working group with CSFS and FRS staff to coordinate follow up activities in 2021. A summary of the process and CFRI engagement is found here: https://warnercnr.source.colostate.edu/newly-published-csfs-forest-action-plan-takes-immediate-action/
1.4) Working with RMRS, support development, implementation, and integration of cross boundary landscape planning and prioritization tools in 2-4 new landscapes, with a focus on linking spatial fire planning (PODS) with prioritization of forest and fuels management objectives (e.g. RADS, RESTSIM, etc.) across	CFRI supported the development, implementation, and integration of spatial fire management strategies in close partnership with the RMRS Wildfire Risk Management Science Team, and coordinated with USFS Region II fire staff and the USFS Washington Office on strategies for POD workshop facilitation and implementation. Many of these efforts were co-developed and co-funded with RMRS partners. CFRI Staff facilitated the initiation and/or continued development and application of PODs across several landscapes: • Carson and Santa Fe National Forests in New Mexico and adjacent non-USFS landscapes. • Medicine Bow-Routt National Forest in Colorado and Wyoming and adjacent non-USFS landscapes. • Rio Grande National Forest in Colorado and adjacent non-USFS landscapes. • San Juan National Forest in Colorado and adjacent non-USFS landscapes.

multiple scales of planning and implementation.	In response to the large wildfires across Colorado in 2020, CFRI staff Ben Gannon provided custom risk modeling for the USFS RMRS Risk Management Assistance team assigned to Cameron Peak and Williams Fork fires in Aug/Sept 2020 via Dale Deiter and Rick Stratton. In partnership and co-funded with RMRS and CSU colleagues, we published applied research papers supporting the development of cross boundary landscape planning tools and new research linking fire management strategies with integrated natural resource planning methods: Gannon, BM, Thompson, MP, Deming, KZ, Bayham, J, Wei, Y, O'Connor, CD (2020). A Geospatial Framework to Assess Fireline Effectiveness for Large Wildfires in the Western USA. Fire 3, 43. https://www.mdpi.com/2571-6255/3/3/43 Gannon, BM, Wei, Y, & Thompson, MP (2020). Mitigating Source Water Risks with Improved Wildfire Containment. Fire 3 (3), 45. doi.org/10.3390/fire3030045 https://www.mdpi.com/2571-6255/3/3/45 Kampf, Stephanie K, Gannon, Benjamin M, Wilson, C, Saavedra, F, Miller, ME, Heldmyer, A, Livneh, B, Nelson, P, MacDonald, L. PEMIP: Post-fire erosion model inter-comparison project. Journal of Environmental Management 268. https://doi.org/10.1016/j.jenvman.2020.110704
1.5) Complete 2 written summaries documenting case study examples describing the application of prioritization methodologies, approaches, and planning processes being used to enhance co-management of fire risk. Focus on lessons learned that provide guidance for diverse stakeholders to assess what risk assessment and prioritization tools are appropriate for different planning and evaluation purposes. The case studies will be coordinated with ERI to augment their West-	Completed CFRI publication summarizing process and lessons learned collaboratively integrating multiple prioritization models in a single landscape: Caggiano, MD (2019). Northern Colorado Fireshed Model Prioritization and Project Planning Workshop. CFRI-1915. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/03/Caggiano_NoCo_Fireshed_Model_Comparison_Report.3.11.20.pdf In Progress, CFRI staff have conducted follow up interviews with participants and are writing up case study and lessons learned from CFRI's engagement leading risk assessment and prioritization process with Envision Chaffee County collaborative group. A summary of the outcome of outcomes from the planning process is available on the Envision Chaffee County website: https://mk0envisionchafrnvlf.kinstacdn.com/wp-content/uploads/2020/04/SummaryBooklet.for-Email-copy.pdf

wide inventory to determine if and how these tools are being used more broadly to inform restoration and all-lands management planning and implementation.	
1.6) Deliver 2-4 presentations, meetings, peer to peer learning events, etc. to report on the range of methodologies, approaches, and planning processes being used to enhance co-management of wildfire risk in the western US to Forest, Regional, and Washington Office units, water providers, watershed coalitions, forest collaboratives, or other affected entities.	September 25th, 2019, CFRI staff Brett Wolk, Ben Gannon, and Andrew Slack met with Jefferson County Open Space staff in Golden, Colorado, to discuss landscape planning and prioritization tools, and collaborative processes for implementing them. (Contact: Drew Rayburn). December 11th, 2019, CFRI staff Brett Wolk, Tony Cheng, and Kat Morici met with Colorado Department of Natural Resources assistant director Tim Mauck, and staff Amy Moyer and Angela Boag to discuss fuel treatment effectiveness and operationalizing a Shared Stewardship strategy with the state of Colorado. December 17th, 2019, CFRI staff Mike Caggiano delivered a presentation and discussion at the New Mexico Collaborative Forest Restoration Program annual meeting sharing lessons learned from his work on cross-boundary burning efforts. Over 100 diverse stakeholders were in attendance. Presentation titled: "Supporting cooperative burning in New Mexico: The Collaborative Forest Restoration Program". CFRI staff Mike Caggiano has participated in development of New Mexico Shared Stewardship planning efforts and advised New Mexico state forestry about approaches for integrating PODs into fire management plans and the New Mexico shared stewardship agreement. CFRI staff Mike Caggiano delivered a presentation on WUI home loss & PODs on June 12, 2020, at the virtual monthly meeting of the West Region Wildfire Council speaker series to an audience of 25+ people. CFRI Director Tony Cheng co-authored study of Colorado's Wildfire Risk Reduction Grant Program's effects on enhancing co-management of wildfire risk on non-federal lands: Cheng, A.S., and L.A. Dale. 2020. Achieving adaptive governance of forest wildfire risk using competitive grants?: Insights from the Colorado Wildfire Risk Reduction Grant Program. Review of Policy Research 37(5):657-686. https://doi.org/10.1111/ropr.12379
1.7) Produce 3-5 training resources (technical briefs, blog posts, videos, etc.) to facilitate the broader application of	Caggiano, MD, Brown H (2020). Using PODs on Your Forest. CFRI-2005. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/10/Using-PODs-on-Your-Forest.pdf Caggiano, MD, O'Connor, CD, & Sack, RB (2020). Potential Operational Delineations and Northern New Mexico's 2019 Fire Season. CFRI-2002.

analytical tools and collaborative planning processes that support strategic investments in cross boundary forest and fire management.	https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Caggiano_PODs-New-Mexico-Case-Study-2.14.20.pdf Published science brief: Brown, H. We need to Reintroduce Fire in Fire Adapted Ecosystems. CFRI-SB-1903. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/01/Reintroducing-fire-in-fire-adapted-ecosystems.pdf
Project 2. Supporting knowledge transfer of monitoring, adaptive management strategies, and outcomes for collaborative forest landscape restoration and resilience	
2.1) Produce and disseminate between 1-3 technical documents regarding multi-party monitoring strategies and results for the Front Range Collaborative Forest Landscape Restoration Project.	Completed publication and distributed printed copies to stakeholders describing monitoring and implementation strategies for mulching in Colorado Front Range: Wolk, BH, Stevens-Rumann, CS, Battaglia, MA, Wennogle, C, Dennis, C, Feinstein, JA, Garrison, K, and Edwards, G (2020). Mulching: A knowledge summary and guidelines for best practices on Colorado's Front Range. CFRI-2001. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/FRRT-Mulching-Knowledge-Summary-and-Implementation-Guidelines-1.16.20.pdf. CFRI staff Brett Wolk lead a discussion of the findings at the February 2020 Front Range Roundtable meeting and disseminated printed copies of the report to meeting attendees.
2.2) Produce and disseminate 1-3 technical documents regarding multi-party monitoring strategies and results for the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project.	Completed report: 2019 Uncompahgre Plateau Collaborative Forest Landscape Restoration Project: Forestry Internship Program (FIP) Progress Summary. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/10/FIP-Progress-Summary.pdf
2.3) Conduct and report on at least one field-based workshop per Colorado CFLR project (2) to review and deliberate treatment effects and desired conditions.	Field based workshops did not occur during 2020 due to the COVID-19 Pandemic. Additional effort was put towards enhancing the Front Range CFLRP Monitoring JAM Session with recorded videos of monitoring data for collaborative members to view at their convenience.
2.4) Convene stakeholders, compile and analyze monitoring data, and support reporting for 10 year accomplishments with Front Range and	Uncompahgre Plateau CFLR: CFRI staff have cleaned data for analysis, and are in communication with GMUG CFLRP coordinator Todd Gardner. CFRI attempted to convene stakeholders, but have determined along with Todd Gardner that there is little interest amongst stakeholders to have annual meeting and participate in reporting. Front Range CFLR: Continue coordinating with Jim Gerleman and Kevin McLaughlin (Front Range CFLRP coordinators) to organize data and contribute to reporting as needed. In lieu of 10 year reporting, effort of

Uncompahgre Plateau CFLR projects.	multiple CFRI staff was put towards co-leading the convening of stakeholders, data analysis, and writing of an application for the new round of CFLRP funding. The application was selected for 3rd tier funding status.
2.5) In collaboration with the other SWERI institutes, convene a workshop with land managers, researchers, and their stakeholders to develop strategies that facilitate the application of lessons learned from collaborative forest landscape management planning, implementation, monitoring, and adaptive management in the intermountain west and southwest.	The workshop was held March 2-4th, 2020 in Albuquerque, New Mexico, and attended by more than 150 land management representatives from 55 federal and state agencies, non-profits, environmental groups, universities, and community collaboratives. Participants discussed lessons learned, shared success stories, learned about science-based tools, and networked over three days in Albuquerque. CFRI co-lead the workshop planning, organizing, facilitation, and post workshop wrap-up with the other SWERI institutes, National Forest Foundation, and Forest Stewards Guild staff. Workshop website: https://sweri.eri.nau.edu/cross-boundary-workshop-wrap-up/ Workshop outcomes and summary document: Southwest Ecological Restoration Institutes (SWERI) (2020). 2020 Cross-Boundary Restoration Workshop Summary: Advancing all-lands restoration in New Mexico, Arizona, Colorado, and surrounding states. ERI Workshop Report. https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/1066/rec/4
2.6) Working with the Rocky Mountain Research Station, document, produce, and disseminate 1-3 applied scientific publications that leverage data and adaptive management process from collaborative forest landscape management projects.	In Collaboration with local and national Natural Resource Conservation Service (NRCS) staff, published paper that leveraged concepts and monitoring data from Front Range collaborative adaptive management processes: Cannon, JB, Gannon, BM, Feinstein, JA, Padley, EA, Metz, LJ (2020). Simulating spatial complexity in dry conifer forest restoration: implications for conservation prioritization and scenario evaluation. Landscape Ecology 35, 2301–2319 (2020). https://doi.org/10.1007/s10980-020-01111-8 Leveraged data from the state of Colorado Wildfire Risk Reduction Grant program and published paper: Cheng, AS & Dale, L (2020). Achieving Adaptive Governance of Forest Wildfire Risk Using Competitive Grants: Insights From the Colorado Wildfire Risk Reduction Grant Program. Review of Policy Research. https://doi.org/10.1111/ropr.12379 https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/08/ropr.12379.pdf
2.7) Convene and report on between 3-5 webinars or peer to peer learning events documenting and	November 21, 2019, CFRI staff Brett Wolk and Tyler Beeton presented lessons learned and best practices for collaborative forest landscape restoration on the USDA Forest Service CFLR all hands webinar.

distributing monitoring methods, results, and adaptive management processes to multi-stakeholder forest landscape management initiatives focused on forest health, wildfire risk mitigation, or watershed protection.	April 15th, 2020, CFRI staff Tyler Beeton and Tony Cheng virtually attended, co-authored presentation, and facilitated breakout group meeting on best practices and lessons learned to sustain collaborative resilience at the Idaho forest restoration partnership workshop entitled, evolving forest collaboration: expanding shared stewardship of Idaho's Forests.
	
	June 12th, 2020, CFRI staff Tyler Beeton presented at 10 Years of CFLRP Lessons Learned Peer Learning Webinar on findings from Collaborative Resilience White Paper.
	
	CFRI staff contributed to the national CFLRP program 10 year synthesis project of Results and Lessons Learned Summary Series, regularly participating in meetings and doing the work of small subteams to compile and present information, leveraging our expertise and knowledge from engagement in several CFLRP projects across the West.
	  - CFRI staff were active participants in CFLRP working groups and meetings to develop metrics around monitoring outcomes, collaborative governance, and other national work groups.
	  - Staff participated in a core team to develop, compile, and write the CFLRP Results and Lessons Learned Summary Series in collaboration with USFS partners.

Project 3. Translating ecologically-based forestry principles into practice	
3.1) In coordination with the Rocky Mountain Research Station, develop, produce, and deliver 2-4 workshops supporting applications of forest restoration principles.	A workshop to apply concepts for tree marking and project layout is in the planning stages, but has been delayed due to COVID-19 restrictions on in-person workshops and events. In collaboration with Rocky Mountain Research Station Wildfire Risk Management Science Team, multiple CFRI staff are actively participating in the planning and coordination for an online workshop on Potential Operational Delineations titled: PODs: Collaborative Fire Planning Workshop, scheduled for February 24-25, 2021. The workshop is expected to attract 500 participants from across the country to engage in discussion and training to better integrate principles of forest restoration and natural resource planning with fire management strategies.
3.2) Convene, deliver, and report on 4-6 peer to peer learning exchanges or presentations to deliver localized forest restoration science to place based restoration organizations, planners, or leadership and high level decisionmakers.	CFRI staff Marin Chambers, Tony Cheng and Brett Wolk co-organized and delivered the presentation, "Collaborative Adaptive Management case studies", at the San Juan Headwaters Forest Health Partnership's Science Forum, February 21, 2020. Marin Chambers, Tony Cheng, and Brett Wolk presented on multiple collaborative monitoring and adaptive management projects, and facilitated discussion with Science Forum participants about opportunities and constraints to implement collaborative adaptive management for San Juan Headwaters Forest Health Partnership projects. CFRI Director was invited by Colorado US Senator Cory Gardner to present to USDA Secretary Sonny Perdue and Sen. Gardner on June 19, 2020, Empire, Colorado, about the Northern Colorado Fireshed Collaborative about localizing forest restoration and wildfire risk management science to increase

	pace and scale of treatments to mitigate the behavior and effects of large severe wildfire. CFRI staff Hannah Brown collaborated with CSU Forest and Rangeland Stewardship Department communications staff to write an article for the CSU Source that reported back to Colorado State University and Warner College community about the peer-to-peer learning exchange that took place at the 2020 SWERI Cross-Boundary Restoration Workshop. https://warnercnr.source.colostate.edu/csu-institute-workshop-brings-western-land-managers-together/ CFRI staff Kat Morici delivered the presentation "Prescribed Fire Monitoring on the Front Range" at the virtual Landscape Restoration Team JAM session on October 15th, 2020.
3.3) Develop, produce, and distribute 3-5 science briefs, and create multimedia resources such as videos, ESRI story-maps, etc., that facilitate application of science based strategic cross-boundary forest restoration principles in Colorado frequent fire forests.	Published science brief: Brown, H. Cutting Down Trees isn't Always a Bad Thing. CFRI-SB-1901. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/06/Cutting-Down-Trees-Isnt-Always-a-Bad-Thing.pdf Published science brief: Brown, H. The Complexity of Forest Science and Management. CFRI-SB-1902. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/10/Complexity-of-Forest-Science-and-Management.pdf Published briefing paper on incorporating traditional science with different perspective into planning processes: Brown, H. "It's about the people": A Reflection and Reading List. CFRI-SB-1904. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/02/Its-about-the-people-reflection-and-reading-list.pdf CFRI staff Marin Chambers development content and appeared in an 8 minute video produced by Local Motives titled: What do the wildfires of today mean for the forests of tomorrow? Video link: https://www.youtube.com/watch?v=i7BZq6APVeQ
3.4) Collaborating with Rocky Mountain Research Station and partners, facilitate improving existing websites and/or building a new website to host information that facilitates application of forest restoration principles in Colorado frequent fire forests.	Major upgrades and regular content updates to the CFRI website https://cfri.colostate.edu/ have been added, including: - A Geospatial Portal was developed and added to the CFRI website to host internal and publicly available spatially-explicit data and tools that provide relevant information for planning, assessment, monitoring, and adaptive management. https://cfri.colostate.edu/cfri-geospatial-database/cfri-planning-links/ - Regular posting of CFRI publications to facilitate sharing and application of forest restoration principles by partners. https://cfri.colostate.edu/publications/ - Many of our "collaborations" pages were updated and expanded to better describe CFRI's engagement with collaborative groups around

	the region, and how we work to incorporate science with local knowledge to move cross boundary shared stewardship forest restoration principles forward. https://cfri.colostate.edu/projects/
3.5) Working with the Rocky Mountain Research Station, co-produce and disseminate 1-3 applied scientific publications to inform collaborative planning, implementation, monitoring, and/or adaptive management of restoration principles for ponderosa pine forest types in Colorado.	Working with Mike Battaglia, RMRS research silviculturist, published study describing implications of restored forest structures on tree regeneration growing environments. The study was conducted within the Colorado Front Range CFLRP Upper Monument Creek project. Cannon, JB, Tinkham, WT, DeAngelis, RK, Hill, EM, and Battaglia, MA. (2019) Variability in Mixed Conifer Spatial Structure Changes Understory Light Environments. Forests 10 (11) doi:10.3390/f10111015. https://cfri.colostate.edu/wp-content/uploads/sites/22/2019/11/Cannon_et_al_Variability.pdf
3.6) Complete 1-3 written reports that document the application of forest restoration principles for forest types other than ponderosa pine and dry mixed conifer forests, such as Gambel oak, wet mixed conifer, or subalpine forests.	Published briefing paper with original artwork depicting fire and restoration in different forest types: Brown, H, Chambers, ME, Stevens-Rumann, CS, Edwards, G (2020). Fire behaves differently in different forest types. CFRI-2007. https://cfri.colostate.edu/wp-content/uploads/sites/22/2021/01/FireEd-Infographic-Web_Print-1.pdf In progress, continue working with partners in Southwest Colorado on a literature review to document application of forest restoration principles in upper-montane mixed conifer forests.
Project 4. Supporting planning, monitoring, and adaptive management to improve fuel treatment effectiveness and forest resilience under changing precipitation and rising temperatures.	
4.1) Document and report on 2-4 monitoring methods, and collect monitoring data that facilitates leveraging existing monitoring networks to enhance fuel treatment effectiveness and maximize fuel treatment longevity.	CFRI developed remote sensing monitoring methods to quantify ecological changes in both forest canopy openings and forest tree group sizes and arrangement before and after management activities. Methods reported in: Slack, AW, Wolk, BH, Stevens-Rumann, CS, Brown, HLC, Barrett, KJ, Mueller, SE, Hunter, TM, Morici, KE, & Warnick, KJ (2021). *Upper South Platte Watershed Monitoring Report: Learning from forest restoration projects to advance landscape resilience and collaboration.* CFRI 2103. https://cfri.colostate.edu/wp-content/uploads/sites/22/2021/04/Upper-South-Platte-Monitoring-Report-2021_Web.pdf Improved "mothership" and "simple plot" field based ecological effectiveness monitoring methods to better capture tree regeneration and saplings in order to quantify changes in ladder fuels and better measure fuel treatment longevity.

	CFRI leveraged SWERI funding to collect ecological effectiveness monitoring data at Pole Hill management sites in northern Colorado in partnership with the Peaks to People Water Fund and the Big Thompson Conservation District. CFRI staff worked with Big Thompson foresters to integrate project inventory data with ecological effectiveness monitoring to leveraging resources, improving project planning, and enhance forester understanding of effective treatment methods.
4.2) Develop, document, apply, and report on prescribed fire monitoring methods for Colorado forests.	CFRI staff Mike Caggiano and Kat Morici attended the Colorado Prescribed Fire Council meeting in Durango, Colorado, September 2019, and shared CFRI monitoring methods and results with stakeholders. Caggiano continued to engage with the Prescribed Fire Council throughout 2020. Prescribed fire monitoring methods were developed and applied at the Elk Fire in Northern Colorado during fall 2019. Results were shared by CFRI staff Kat Morici with stakeholders via zoom August 6th, 2020, during a workshop titled: Learning from Burning: Science and Monitoring Outcomes from the Elkhorn Unit 4 Prescribed Fire. Video recording of workshop: https://www.youtube.com/watch?v=vwVWkOErfBQ A written report of results and methods are forthcoming. Developed and published ESRI storymap on CFRI website describing cross boundary prescribed fire monitoring and implementation efforts in Northern Colorado: *Prescribed Fire in Northern Colorado and The Colorado Forest Restoration Institute.* Benjamin Markle, Nov 25, 2020. https://storymaps.arcgis.com/stories/1d03a9c78dfe4f6681ab4eef4240356d
4.3) Complete 1-3 reports summarizing fuel treatment effectiveness and treatment longevity in forest types in Colorado and the intermountain west.	Published paper analyzing post fire tree regeneration patterns across the Southwest and longevity of fire footprints as fuel treatments: Rodman, KC, Veblen, TT, Battaglia, MA, Chambers, ME, Fornwalt, PJ, Holden, ZA, Kolb, TE, Ouzts, JR, Rother, MT (2020). A changing climate is snuffing out post-fire recovery in montane forests. Global Ecol Biogeogr. 2020;00: 1–13. https://doi.org/10.1111/geb.13174
4.4) Provide technical assistance and training in monitoring data collection, analysis, and/or application of results for assessing monitoring data trends for the Colorado State Forest Service and 2-4 additional organizations or forest, fire, or watershed collaborative groups.	Ongoing conversation with CSFS staff Wilf Previant and Zach Mellema to coordinate monitoring sampling methods and analysis technique, including tablet data collection and processing. Communicated with Program Manager Diana Selby to provide feedback for the Forest Restoration and Wildfire Risk Reduction Grant advisory committee on fuel treatment effectiveness and allocation of resources for effective grant program outcomes. CFRI staff Brett Wolk and Kat Morici discussed monitoring findings with the full FRWRM program advisory committee January 9th, 2020, to help inform effective allocation of program funds. Provided Daniel Bowker (Coalition for the Poudre River Watershed) with a basic summary and interpretation of results of CFRI monitoring plots that burned in the Red Feather unit 28 RX. This information was presented at a public field tour of prescribed fires in the Red Feather area. CFRI has

	provided Bowker with monitoring protocols, datasheets, and advised on analysis of data using Forest Vegetation Simulator analysis programs. CFRI staff shared protocols and data collection templates, and provided training on protocol development, data collection, and analysis techniques with the Boulder Valley and Longmont Conservation Districts and local Colorado State Forest Service staff with the goal to build monitoring capacity of other agencies and enhance forest inventory protocols for developing improved forest management plans on private lands. Inventory monitoring protocols were modified to include collection of adequate data to estimate changes in fire risk using Forest Vegetation Simulator fire behavior modeling.
4.5) Work with 1-2 forest collaborative groups to develop and document forest management strategies that balance fire risk reduction and forest resilience under changing precipitation patterns and rising temperatures.	CFRI staff Marin Chambers attended and contributed to a Colorado State Forest Service Forest Action Plan Climate Adaptation Workshop and provided a review of Forest Action Plan drafts to help integrate climate adaptation strategies into the FAP. Chambers and CFRI Staff Camille Stevens-Rumann have continued engagement with CSFS on climate adaptation strategies, including multiple workshops and ongoing communication to facilitate developing an Assisted Silviculture for Climate Change field learning site at the State Forest State Park in partnership with RMRS and CSU Department of Forest and Rangeland Stewardship.
Project 5: Supporting Collaborative Capacity-Building and Peer-Learning	
5.1) Conduct, convene, organize, and report on between 7-9 site visits, peer to peer learning events, webinars, or workshops that bring together research scientists from RMRS, other federal agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for collaborative assessment, monitoring, and adaptive management.	Organized a FireLab meeting October 10th, 2019, in Fort Collins Colorado, including 40+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. Mike Caggiano (CFRI Research Associate), Katie Donahue (USFS), and James White (USFS) delivered a presentation about Potential Operational Delineations (PODS) and their development for the Arapaho-Roosevelt National Forest. Organized a FireLab meeting December 17th, 2019, in Fort Collins Colorado, including 40+ people from academic institutions, federal and non-federal agencies, and non-governmental place based collaborative group leaders. CFRI staff Ben Gannon delivered a presentation discussing wildfire risk reduction strategies to protect drinking water supplies. Presentation title: "Murky waters: adding rigor to wildfire-water supply risk assessment". CFRI staff Stephanie Mueller participated in a special session on forest resilience to fire and climate at the Association for Fire Ecology 8th International Fire Congress, November 18-22, 2019, Tucson, AZ. Stephanie delivered a presentation titled: "Climate relationships with increasing wildfire in the southwestern US from 1984 to 2015".

	CFRI staff Katarina Warnick organized and facilitated CFRI Science Friday peer to peer learning events to make forest science accessible to diverse audiences and connect research scientists and university students/young professionals. The series included a mix of in-person and web-based meetings.

- January 2020: How to build your CV, presented by Marin Chambers, Katarina Warnick, and Hannah Brown.
- February 2020: Evaluating Information and Improving Scientific Literacy, presented by Hannah Brown.
- September 2020: Examining the impact of two prescribed fires on forest structure, fuel arrangement, and predicted wildfire behavior at Ben Delatour Scout Ranch using field data collected by CFRI field monitoring crews, presented by Kat Morici.
- October 2020: How CFRI monitoring data goes from numbers collected in the field to a resource for managers and a tool to advance Adaptive Management in the Upper South Platte region of Colorado. Presented by Tori Hunter and Andrew Slack.
- November 2020: Shifting plant communities in response to disturbances: both human and natural. Presented by Camille Stevens-Rumann.

Camille Stevens-Rumann (CFRI) was featured in a podcast for the Association for Fire Ecology on January 5, 2020 titled "Tree Regeneration in the Western US," available here: https://fireecology.org/feco-podcast/7

Camille Stevens-Rumann delivered presentation, "Forest changes following wildfires and climate change" at Yale University Spring Seminar, Yale School of Forestry. February 2020, New Haven, CT.

CFRI staff Tyler Beeton and Tony Cheng delivered presentation entitled, "Evolving and sustaining local collaboratives: cultivating collaborative resilience" at the Idaho Forest Restoration Partnership Annual Conference (virtual), April 14-15, 2020.

Camille Stevens-Rumann delivered the presentation "Managing for resilience?" at SWCASS Ecosystem Resilience, University of Arizona, Tucson AZ, in May of 2020.

Camille Stevens-Rumann contributed to the June 2020 "Deep Dive" event held virtually by the Northwest Climate Adaptation Science Center, with 80+ participants.

CFRI staff Tyler Beeton and Tony Cheng delivered presentation entitled, "Cultivating collaborative resilience in the face of change" at the First 10 Years of the Collaborative Forest Landscape Restoration Program Peer-Learning Webinar, June 12, 2020.

For agreement number 20-DG-11030000-008, CFRI reports the following cumulative accomplishments toward each project deliverables in the work plan for dates while the agreement was active, including June 1st, 2020 through December 31st, 2020:

Deliverable	Status of Deliverables
Project 1: Supporting strategic prioritization, monitoring, and adaptive management of cross boundary wildfire risk co-management strategies to operationalize the Shared Stewardship approach.	
1.1 Continue to assist in the identification and facilitation of partnership engagement in a Colorado all-lands wildfire risk assessment process led by USFS Region 2. This includes working with targeted partners to identify the High Values, Resources, and Assets (HVRA's) that will help frame the risk assessment outputs.	CFRI staff Mike Caggiano has led continued engagement with USFS Rocky Mountain Region fire planning staff (Contact: Brian Keating) to develop risk assessment processes and frameworks. The all lands Colorado wildfire risk assessment has been delayed due to contractor data processing timelines and focused efforts towards other existing risk assessment and prioritizations. With delays in the USFS R2 risk assessment, efforts have been re-directed to participating in a Colorado Shared Stewardship working group, advising on best practices to gather information about HVRA's and priorities of forest and watershed collaborative groups around the state and framing the assessment process for the group.
1.2 In coordination with the Colorado State Forest Service, support cross boundary application of the updated Statewide Forest Action Plan.	In Progress. Following the November, 2020, 3 day Forest Action Plan introduction workshop for CSFS staff that was co-organized and co-lead by CFRI staff, CFRI is creating a regular working group with CSFS staff and CSU Forest and Rangeland Stewardship staff to continue assessing FAP implementation and future training needs to support Forest Action Plan implementation.
1.3 Participate in the Colorado Natural Resources Conservation Service Forest Advisory Committee to develop priorities and advise on strategic prioritization of NRCS forestry conservation practices across the state.	CFRI remains in regular communication with NRCS leadership. No meeting of the advisory committee currently scheduled.

1.4 Working with RMRS, continue to support development, implementation, and integration of cross boundary landscape planning and prioritization tools in 2-4 landscapes, with a focus on linking spatial fire planning (PODS) with prioritization of forest and fuels management objectives (e.g. RADS, etc.) across multiple scales of planning and implementation.	CFRI supported the development, implementation, and integration of spatial fire management strategies in close partnership with the RMRS Wildfire Risk Management Science Team, and coordinated with USFS Region II fire staff and the USFS Washington Office on strategies for POD workshop facilitation and implementation. Many of these efforts were co-developed and co-funded with RMRS partners. CFRI Staff facilitated the initiation and/or continued development and application of PODs across several landscapes: • Carson and Santa Fe National Forests in New Mexico and adjacent non-USFS landscapes. • Medicine Bow-Routt National Forest in Colorado and Wyoming and adjacent non-USFS landscapes. • Rio Grande National Forest in Colorado and adjacent non-USFS landscapes. • San Juan National Forest in Colorado and adjacent non-USFS landscapes. • Ashley National Forest in Utah and adjacent non-USFS landscapes. CFRI staff Ben Gannon worked with Envision Chaffee County Recreation and Balance committee to develop and implement Wildlife Decision Support Tools for Recreation. This involved a series of meetings and custom decision support modeling that integrates strategies to maximize recreation opportunities while minimizing impacts, enhance wildlife habitat characteristics, and integrate wildfire risk reduction planning in the upper Arkansas valley. Results are summarized in Chaffee County Recreation in Balance Progress Report, by Benjamin Gannon, and will be integrated into the Envision Chaffee County Wildlife Decision Support Tools for Recreation final report. Results will be available at Envision Chaffee County website Recreation Management section https://envisionchaffeecounty.org/our-tools/ CFRI staff Brett Wolk and Stephanie Mueller are building capacity of partners in southwest Colorado to implement Risk Assessment and Decision Support tools on the San Juan National Forest to support the Southwest Environmental Impact Fund, in an effort to better link spatial fire planning with prioritization of forest and fuels management strategies. Published papers supporting the development of cross-boundary landscape planning tools: Caggiano, MD, Hawbaker, TJ, Gannon, BM, & Hoffman, CM (2020). Building Loss in WUI Disasters: Evaluating the Core Components of the Wildland–Urban Interface Definition. Fire, 3, 73. https://cfri.colostate.edu/wp-

	content/uploads/sites/22/2021/01/Caggiano-et-al-building-loss.pdf Gannon BM, Thompson MP, Wei Y (2020). An Operationally Relevant Framework for Mapping Spot Fire Transmission Potential. Environmental Sciences Proceedings 3(1):13. https://doi.org/10.3390/IECF2020-08001
1.5 Develop tools to streamline collaborative spatial fire planning analytical processes that facilitate updating and maintaining existing mapping and prioritization efforts. Implement data and analytical updates on 2-4 landscapes where PODS or other prioritization methods have already been developed and implemented.	CFRI staff Ben Gannon developed POD summary geodatabase and POD atlas products in collaboration with the RMRS Wildfire Risk Management Science Team. The POD Atlas was applied with the Carson and Santa Fe National Forests in their POD workshops to help consolidate information and update spatial fire planning strategies with the latest data. Published paper on PODs atlas methods: Thompson, MP, Gannon, BM, Caggiano, MD, O'Connor, CD, Brough, A, Gilbertson-Day, JW & Scott, JH (2020). Prototyping a Geospatial Atlas for Wildfire Planning and Management. Forests 11, 909. https://www.mdpi.com/1999-4907/11/9/909
1.6 Deliver 2-4 presentations, meetings, peer to peer learning events, etc. to report on the range of methodologies, approaches, and planning processes being used to enhance co-management of wildfire risk in the western US to USFS Forest, Regional, and Washington Office units, Colorado Department of Natural Resources, water providers, watershed coalitions, forest collaboratives, Congressional members and staffs, or other affected entities.	Along with colleagues from Bureau of Land Management and USFS national fire planner, CFRI staff Mike Caggiano and Ben Gannon organized and led a Cross Boundary Wildfire Planning workshop at the 2020 New Mexico Wildland Urban Fire Summit, October 2020. CFRI staff Mike Caggiano co-delivered a webinar presentation with RMRS colleague Kit O'Connor and Carson National Forest AFMO Jamie Long for Southwest Fire Science Consortium. The webinar was titled: Potential Operational Delineations: On the Ground Experiences and Future Directions. November 19, 2020. Video recording here: https://www.youtube.com/watch?v=aVpBq6wWC9g Delivered presentation: An operationally relevant framework for mapping spot fire transmission potential. Ben Gannon,1st International Electronic Conference on Forests – Virtual (November 2020).
1.7 Produce 4-6 training resources (technical briefs, blog posts, webinars, etc.) to facilitate the broader understanding and	In Progress.

application of analytical tools and collaborative planning processes that support strategic investments in cross boundary forest and fire management. Focus on documenting lessons learned that provide guidance for diverse stakeholders to assess what risk assessment and prioritization tools are appropriate for different planning and evaluation purposes.	
Project 2: Supporting knowledge transfer of monitoring, adaptive management strategies, and outcomes for collaborative forest landscape restoration and resilience	
2.1) Produce and disseminate between 2-4 technical documents regarding multi-party monitoring strategies and results from collaborative forest landscape management projects.	In progress – final stages of publishing results from Colorado Front Range CFLRP projects: Barrett, K.J., J.B. Cannon, A.M. Schuetter, and A.S. Cheng. Submitted. Effects of collaborative monitoring and adaptive management on restoration outcomes in dry conifer forests. *Forest Ecology and Management*
2.2) Conduct and report on at least one field-based workshop per Colorado CFLR project to review and deliberate treatment effects and desired conditions.	In progress.
2.3) In coordination with CFLRP Program Administrators and other SWERI Institutes, produce 2-4 reports or briefing papers documenting forward looking lessons learned from the CFLRP program in order to facilitate knowledge transfer to newly awarded CFLRP projects.	In collaboration with USFS staff and national leads for the CFLR program, published paper: Beeton, TA, Cheng, AS, & Colavito, MM (2020). Developing and sustaining collaborative resilience in the face of change: A review of the Collaborative Forest Landscape Restoration Program projects. CFRI-2003. https://cfri.colostate.edu/wp-content/uploads/sites/22/2020/08/CFLRP-Developing-and-sustaining-collaborative-resilience.pdf
2.4) In collaboration with the other SWERI institutes, USFS, and other partners, convene a regional Cross-Boundary Landscape Restoration	In progress – planning underway for March 2022 workshop

workshop, or series of smaller workshops, with land managers, researchers, and their stakeholders to develop strategies that facilitate the application of lessons learned from collaborative forest landscape management planning, implementation, monitoring, and adaptive management in the intermountain west and southwest.	
2.5) Working with the Rocky Mountain Research Station, document, produce, and disseminate 2-4 applied scientific publications that leverage data and adaptive management process from collaborative forest landscape management projects and wildfire risk co-management strategies.	Submitted for publication consideration: Beeton, T.A., A.S. Cheng, and M. Colavito (In review). Cultivating collaborative resilience to social and ecological change: An assessment of adaptive capacity, actions, and barriers among collaborative forest restoration groups in the United States. *Journal of Forestry*
2.6) Convene and report on between 4-6 webinars, presentations, or peer to peer learning events documenting and distributing monitoring methods, results, and adaptive management processes to research colleagues or multi-stakeholder forest landscape management initiatives focused on forest health, wildfire risk mitigation, or watershed protection	CFRI staff member Kat Morici met with staff of the Big Thompson Watershed Coalition on September 3, 2020, to discuss how to use field monitoring data in the Forest and Fuels Extension to the Forest Vegetation Simulator.
Project 3. Translating ecologically-based forestry principles into practice	
3.1) Working with the Rocky Mountain Research Station, co-produce and disseminate 1-3 applied scientific publications to inform collaborative planning, implementation, monitoring, and/or adaptive	In Progress.

management of restoration principles for ponderosa pine forest types in Colorado.	
3.2) Complete 1-3 written reports that document the translation and application of forest restoration principles for forest types other than ponderosa pine and dry mixed conifer forests, such as Gambel oak, Aspen, wet mixed conifer, or subalpine forests.	In Progress.
3.3) Develop a technical brief, and report to USFS Rocky Mountain Regional Office staff demonstrating how GTR-373 planning frameworks and ecological concepts can streamline planning for large landscapes (1 million+ acre planning areas) to improve forest restoration and fuels treatment programs.	In Progress.
3.4) In coordination with the USFS Rocky Mountain Region and Rocky Mountain Research Station, convene a working group and report on opportunities to translate climate vulnerability assessments into actionable climate adaptation strategies that are accessible for use in treatment unit or USFS District level prescriptions or adaptive planning processes.	In Progress.

3.5) Collaborating with Rocky Mountain Research Station and partners, improve existing websites and/or build a new website to host information that facilitates application of forest restoration principles in Colorado frequent fire forests.	In Progress.
3.6) In coordination with the Rocky Mountain Research Station, develop, produce, and deliver 1-3 workshops or trainings to support applications of forest restoration principles into practice.	In Progress.
3.7) Develop, produce, and distribute 2-4 technical briefs or multimedia resources such as videos, ESRI story-maps, etc., that facilitate application of science based strategic forest restoration principles in Colorado frequent fire forests.	In progress.
Project 4. Supporting planning, monitoring, and adaptive management to improve fuel treatment effectiveness and forest resilience under changing precipitation and rising temperatures.	
4.1) Support the collection, data management, analysis, and reporting for monitoring data at 1-3 forestry projects, focusing on building prescribed fire monitoring knowledge and capacity within Colorado, conducting project scale remote sensing analysis, and/or leveraging existing monitoring networks to collect longer term data that enhances knowledge of fuel treatment effectiveness and maximize fuel treatment longevity.	In progress.

4.2) Document and report on 2-4 monitoring methods to make monitoring protocols more accessible and transparent for other organizations to apply and understand. This includes plot based field monitoring, remote sensing techniques, and/or data management strategies.	In progress.
4.3) Complete 1-3 technical reports summarizing fuel treatment effectiveness and treatment longevity in forest types in Colorado and the intermountain west.	In progress.
4.4) Conduct a pilot analysis and application of methods to assess value of different treatments relative to costs with USFS Regional and Washington Office planning and timber program staff.	In progress.
4.5) Provide technical assistance and training to build capacity for monitoring data collection, analysis, and/or application of results for assessing monitoring data trends for the Colorado State Forest Service and 1-3 additional organizations or forest, fire, or watershed collaborative groups.	In progress.
4.6) Conduct a needs assessment for post fire reforestation that examines the capacities, constraints, and desired conditions for re-planting high severity burn scars in frequent fire forests of the Southwest under anticipated changing future climatic conditions.	In Progress.

Project 5: Supporting Collaborative Capacity-Building and Peer-Learning	
5.1) Conduct, convene, organize, and report on between 8-10 site visits, peer to peer learning events, webinars, or workshops that bring together research scientists from RMRS, other federal agencies, and universities with participants of place-based forest collaboratives to transfer knowledge about, and assist in the development of, science-based methods for collaborative planning, assessment, monitoring, and adaptive management.	Camille Stevens-Rumann (CFRI) co-delivered online webinar with non-CFRI colleagues J. Coop and S. Parks titled "Forest type conversions: how are our landscapes changing" for the NACCB, July 2020. CFRI staff helped co-organize the semi-annual Colorado Forest Collaboratives Summit, August 5, 2020 (virtual conference). CFRI Director Tony Cheng delivered presentation, "Statewide network and capacity resources for forest collaboratives: Oregon example" to seed discussion and follow-up actions for Colorado's forest collaboratives. CFRI staff Ben Gannon delivered presentation and lead discussion with Long's Peak Society of American Forester's Meeting: Wildfire risk to water supplies and prioritizing forest management – (August 20, 2020) Delivered presentation: Creating inclusive and actionable community wildfire protection plans. Ben Gannon (CFRI) and Megan Matonis (Forest Stewards Guild), Colorado Wildland Fire Conference – Virtual (September 2020) Delivered presentation: Spotting Index: a spatial framework to assess spot fire transmission potential. Ben Gannon, Colorado Wildland Fire Conference – Virtual (September 2020). Camille Stevens-Rumann delivered online podcast, "Awareness of the Spread, Fire Ecology," as part of Warner College of Natural Resource Podcast series, Season 3 Episode 1 (Fall 2020), available here: https://warnercnr.colostate.edu/tune-into-nature-a-warner-college-podcast/season-3/ In November of 2020, Camille Stevens-Rumann (CFRI) delivered a presentation titled "Post-fire tree regeneration in a changing world" for a virtual graduate seminar at Northern Arizona University School of Forestry, and another presentation titled "Looking back to plan for a changing world of fire" at a virtual Western Colorado University seminar. CFRI Assistant Director Brett Wolk participated as an expert panelist with USFS Regional Office staff, Colorado State Forest Service, and Denver Water, November 18th, 2020, on a virtual tour discussing how forest management activities are used improve watershed resilience at the Water in the West symposium. The audience included journalists, K-12 educators, corporate

	executives, and restoration practitioners. Video link: https://www.youtube.com/watch?v=gwk8LTLvLMU CFRI personnel Marin Chambers, Tony Cheng and Brett Wolk participated in a peer-learning exchange with forest collaboratives in Arizona and New Mexico December 10, 2020 and delivered presentation, "Adaptive management case studies".

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