WATERSHED INVESTMENT TOOL 3.0 UPDATE

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COLORADO FOREST RESTORATION INSTITUTE
COLORADO STATE UNIVERSITY

Peaks to People Water Fund

March 2026 • CFRI-2607

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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 Statement: The Peak to People Water Fund's (PPWF) Watershed Investment Tool (WIT) was originally developed in 2016 through collaboration among PPWF, CFRI, Northern Colorado water providers, The Nature Conservancy, and researchers at Colorado State University. The tool provides a framework to prioritize forest fuels reduction treatments in the Cache la Poudre and Big Thompson watersheds to support strategic investment in wildfire risk reduction for downstream water supplies.

This publication documents the integration of updates into the WIT 3.0 and is intended to provide transparency about the data, assumptions, and collaborative input that informed the updated prioritization framework. The updates were developed through extensive iterative feedback and coordination with partners in the PPWF and the Northern Colorado Fireshed Collaborative.

Acknowledgements: Allison Rhea wrote and developed the figures for this document. Julie Dubin, Sandi Good, and Brett Wolk helped initiate and guide the WIT 3.0 update and provided careful review of this publication. We would like to thank Hannah O'Reilly for document layout and publication. Finally, special thanks to Ben Gannon, as well as Brett Wolk, Heather Schinkel, Sandi Good, Rob Addington, and the many research collaborators, both at Colorado State University and Northern Colorado water utilities, who initially developed the Watershed Investment Tool.

Funding was provided by the Peaks to People Water Fund and by the Colorado Forest Restoration Institute through the Southwest Forest Health and Wildfire Prevention Act.

Publication Date: March 2026

Photo Credit: Peaks to People Water Fund

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Suggested Citation: Rhea, A. (2026). Watershed Investment Tool 3.0 Update. Colorado Forest Restoration Institute. CFRI-2607.

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Purpose

The purpose of this update is to refresh the data products used in the Watershed Investment Tool (WIT) to reflect changing conditions on the landscape. These modifications include:

- Incorporation of updated fire behavior modeling based on the collaboratively developed Northern Colorado Fireshed Collaborative (NCFC) quantitative wildfire risk assessment.
- Integration of updated burn probability with custom FSim model runs from the NCFC quantitative wildfire risk assessment.
- Inclusion of updated fire behavior products based on Alexander Mountain Fire soil burn severity.

We then report on how these updates affect the spatial distribution of wildfire risk to water supplies and influence priorities for treatment across the full Peaks to People planning area and the Big Thompson Initiative (BTI) landscape.

Methods

Updated fire behavior modeling

WIT 2.0 relied on 2016 Landfire fuels data, which had to be manually adjusted to capture the effects of subsequent fuels reduction treatments or wildfires occurring between 2016 and 2020. For fuel treatments, canopy and surface fuels were adjusted by treatment types (Gannon et al., 2020). Wildfire effects were accounted for by adjusting canopy and surface fuels by observed burn severity. Based on these assumptions, most of the area within 2020 fire perimeters was modeled as either unburned or experiencing only surface fire.

WIT 3.0 was based on updated 2020 Landfire canopy and surface fuels data which incorporate fuels reduction treatments and wildfires that occurred between 2016-2020. Thus, we did not rely on assumptions of fuel treatment or wildfire effects. Rather, our base imagery captured the actual effects of those events on surface and canopy fuels. However, 2020 Landfire data was adjusted to increase the intensity of fire behavior in lodgepole pine forests, better aligning model outputs with recent fire behavior observations (Moriarty et al., 2019). First, canopy base height was reduced by 30% and any low load (TL1) or moderate load (TL3) conifer litter fuel models were changed to high load conifer litter (TL5; Scott & Burgan, 2005). Lodgepole pine forests that sustained greater than 25% mountain pine beetle mortality based on Bode et al. (2018) were changed to low load slash blowdown fuel models (SB1) based on conversations with fire managers regarding surface fuels in these areas.

In this baseline model update, we did not manually adjust fuels for any treatments occurring between 2021 and 2023 because 1) the CFRI interagency treatment database only included treatments until 2020, 2) we wanted to maintain as much consistency as possible between the Peaks to People's Watershed Investment Tool and the risk assessment that is a part of the Northern Colorado Fireshed's spatial strategy, and 3) we wanted to iteratively track programmatic progress using the Colorado Forest Tracker database.

We did, however, adjust NCFC fire behavior products to reflect the short-term impacts of the 2024 Alexander Mountain Fire in the Big Thompson Canyon. We used the verified burned area reflectance classification (BARC) map that was published by the United States Forest Service Burned Area Emergency Response team on August 11th, 2024. We resampled and reprojected the burn severity rasters to match the resolution and alignment of the Landfire data products used in the WIT (Figure 1). The USFS burn severity classification includes: 1 – unburned/very low severity, 2 – low severity, 3 – moderate severity, and 4 – high severity. The area burned by severity is presented in Table 1.

Table 1: Spatial extent of each burn severity class within the Alexander Mountain Fire.

Burn Severity	Area (acres)	Percent of Fire (%)
Unburned	703	7.4
Low Severity	4,414	46.2
Moderate Severity	4,182	43.7
High Severity	261	2.7

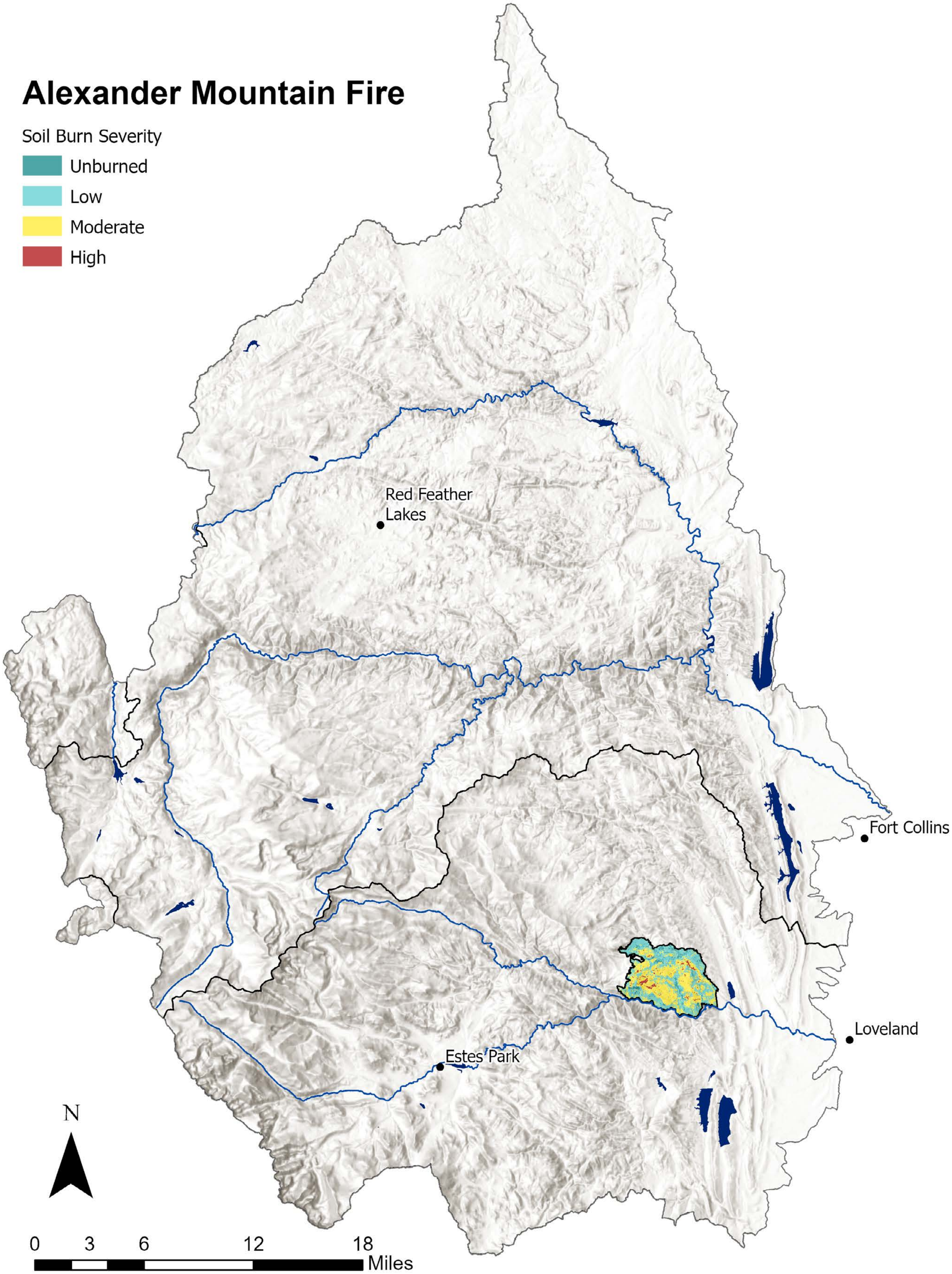

Figure 1: Observed soil burn severity within the 2024 Alexander Mountain Fire in the Big Thompson Canyon.

Wildfire effects on fuels and fire behavior were accounted for by first adjusting canopy and surface fuels by burn severity level and then by modeling crown fire activity (Scott & Reinhardt, 2001) in FlamMap (Finney et al., 2015) from the modified fuels. We used equivalent methods to those used to update fuels to reflect past fuel treatments and to estimate the effects of hypothetical future fuel treatments (Gannon et al., 2020). These revised crown fire activity rasters were restricted to the Alexander Mountain Fire perimeter and then mosaiced with the fire behavior products from the Northern Colorado Fireshed risk assessment for areas outside the fire perimeter.

The canopy adjustment factors are presented in Table 2, alongside the effects of fuel treatments for comparison. The logic for adjusting canopy bulk density and canopy cover stems from the common vegetation burn severity categories based on percent mortality: low – 0 to 30%; moderate – 30 to 80%; and high – 80 to 100%. We assumed that canopy bulk density and canopy cover would be reduced proportionally to mortality, using the midpoint of the vegetation mortality ranges to represent each category; for example, the midpoint of moderate severity is 55% mortality, which converts to a proportional adjustment multiplier of 0.45. Canopy base height and canopy height are assumed to increase with severity.

Fire behavior fuel model transitions by severity level are presented in Table 3. Low and moderate severity levels are assigned the same fuel model changes as prescribed fire, where models are updated to the least extreme option within their respective categories (e.g., grass, timber understory, timber litter). Following Landfire's approach to high severity fire, we assumed that burnable fuels in these areas would transition to an unburnable state in the short term. After initial recovery, we would want to transition fuels in high severity burned areas to the least extreme model in the appropriate fuel category. Once these wildfires are reflected in future Landfire updates, WIT could revert to their logic for representing longer-term recovery.

Table 2: Proportional adjustment factors used to estimate treatment and fire effects on canopy fuels. CBD = canopy bulk density. CBH = canopy base height. CC = canopy cover. CH = canopy height.

Treatment	CBD	CBH	CC	CH
Thin	0.60	1.20	0.70	1.20
Rx Fire	0.92	1.09	0.95	1.13
Complete	0.50	1.20	0.75	1.20
Low Severity Wildfire	0.85	1.10	0.85	1.10
Moderate Severity Wildfire	0.45	1.25	0.45	1.25
High Severity Wildfire	0.10	1.50	0.10	1.50

Table 3: Fire behavior fuel model changes by treatment type and wildfire severity using standard codes from Scott and Burgan (2005).

Code	FBFM40	Manage	Rx Fire	Rearrange	Low Severity Wildfire	Mod. Severity Wildfire	High Severity Wildfire
NB1	91	91	91	91	91	91	91
NB2	92	92	92	92	92	92	92
NB3	93	93	93	93	93	93	93
NB4	94	94	94	94	94	94	94
NB5	95	95	95	95	95	95	95
NB6	96	96	96	96	96	96	96
NB7	97	97	97	97	97	97	97
NB8	98	98	98	98	98	98	98
NB9	99	99	99	99	99	99	99

GR1	101	101	101	**201**	101	101	**99**
GR2	102	102	**101**	**201**	**101**	**101**	**99**
GR3	103	103	**101**	**201**	**101**	**101**	**99**
GR4	104	104	**101**	**201**	**101**	**101**	**99**
GR5	105	105	**101**	**201**	**101**	**101**	**99**
GR6	106	106	**101**	**201**	**101**	**101**	**99**
GR7	107	107	**101**	**201**	**101**	**101**	**99**
GR8	108	108	**101**	**201**	**101**	**101**	**99**
GR9	109	109	**101**	**201**	**101**	**101**	**99**
GS1	121	121	121	**201**	121	121	**99**
GS2	122	122	**121**	**201**	**121**	**121**	**99**
GS3	123	123	**121**	**201**	**121**	**121**	**99**
GS4	124	124	**121**	**201**	**121**	**121**	**99**
SH1	141	141	141	**201**	141	141	**99**
SH2	142	142	**141**	**201**	**141**	**141**	**99**
SH3	143	143	**141**	**201**	**141**	**141**	**99**
SH4	144	144	**141**	**201**	**141**	**141**	**99**
SH5	145	145	**141**	**201**	**141**	**141**	**99**
SH6	146	146	**141**	**201**	**141**	**141**	**99**
SH7	147	147	**141**	**201**	**141**	**141**	**99**
SH8	148	148	**141**	**201**	**141**	**141**	**99**
SH9	149	149	**141**	**201**	**141**	**141**	**99**
TU1	161	161	161	**201**	161	161	**99**
TU2	162	162	**161**	**201**	**161**	**161**	**99**
TU3	163	163	**161**	**201**	**161**	**161**	**99**
TU4	164	164	**161**	**201**	**161**	**161**	**99**
TU5	165	165	**161**	**201**	**161**	**161**	**99**
TL1	181	181	181	**201**	181	181	**99**
TL2	182	182	**181**	**201**	**181**	**181**	**99**
TL3	183	183	**181**	**201**	**181**	**181**	**99**
TL4	184	184	**181**	**201**	**181**	**181**	**99**
TL5	185	185	**181**	**201**	**181**	**181**	**99**
TL6	186	186	**181**	**201**	**181**	**181**	**99**
TL7	187	187	**181**	**201**	**181**	**181**	**99**
TL8	188	188	**181**	**201**	**181**	**181**	**99**
TL9	189	189	**181**	**201**	**181**	**181**	**99**
SB1	201	201	201	201	201	201	**99**
SB2	202	**201**	**201**	**201**	**201**	**201**	**99**
SB3	203	**201**	**201**	**201**	**201**	**201**	**99**
SB4	204	**201**	**201**	**201**	**201**	**201**	**99**

The WIT 3.0 updates generally resulted in increased crown fire activity within the 2020 fire perimeters, but decreased fire behavior across all other areas compared to WIT 2.0 (Figures 2-3).

Under **25th percentile weather** conditions, crown fire activity was similar in WIT 2.0 and 3.0 in areas that had not recently burned (Figure 2). One notable change was that some areas shifted from passive crown fire to surface fire in WIT 3.0. Within the 2020 fire perimeters, WIT 3.0 generally shows higher crown fire activity than WIT 2.0. This is largely due to WIT 2.0 assuming surface fuels were unburnable in areas that burned at high severity in 2020. By contrast, WIT 3.0 incorporates post-fire surface fuels observations, resulting in more predicted surface fire within the 2020 perimeters, reducing both unburned area and passive crown fire area. Active crown fire is still not expected anywhere within the 2020 fire perimeters under 25th percentile weather. The Alexander Mountain Fire perimeter, which was primarily predicted to be passive crown fire in WIT 2.0, shifted to surface fire or unburnable in WIT 3.0 based on the adjustments discussed above.

Under **97th percentile weather** conditions, much of the active crown fire in WIT 2.0 shifted to passive crown fire in WIT 3.0 (Figure 3). Within the 2020 fire perimeters, active crown fire commonly shifted to passive crown fire, and high severity areas previously classified as unburned in WIT 2.0 are now modeled as surface fire in WIT 3.0. Within the Alexander Mountain Fire perimeter, active crown fire modeled in WIT 2.0 largely transitioned to passive crown fire in the NCFC modeling, and was further adjusted to surface fire with small, unburned patches in WIT 3.0 following incorporation of the Alexander Mountain Fire updates.

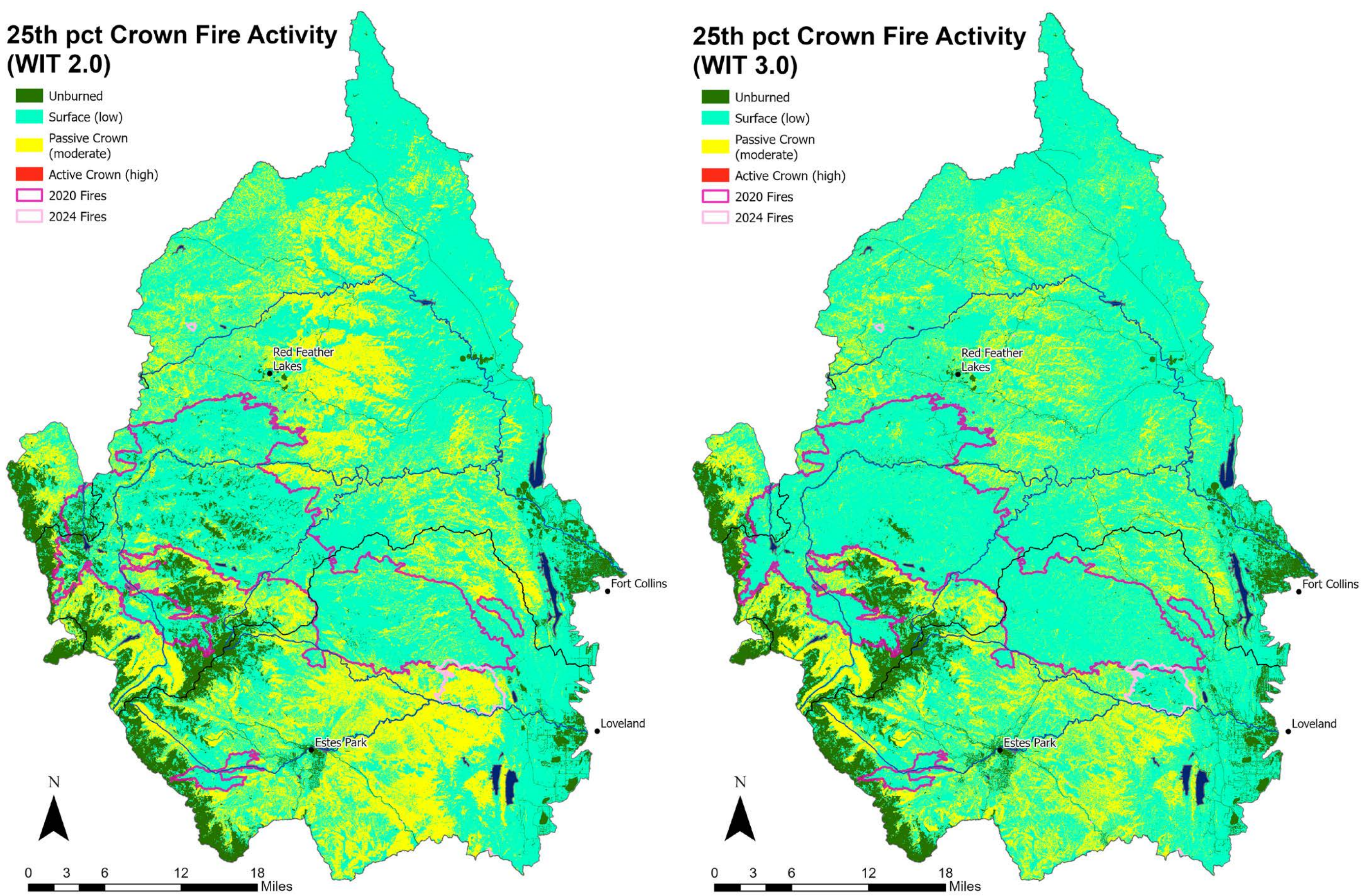

Figure 2: Moderate crown fire activity modeled for the 25th percentile fire weather scenario for WIT 2.0 (LEFT) and WIT 3.0 (RIGHT).

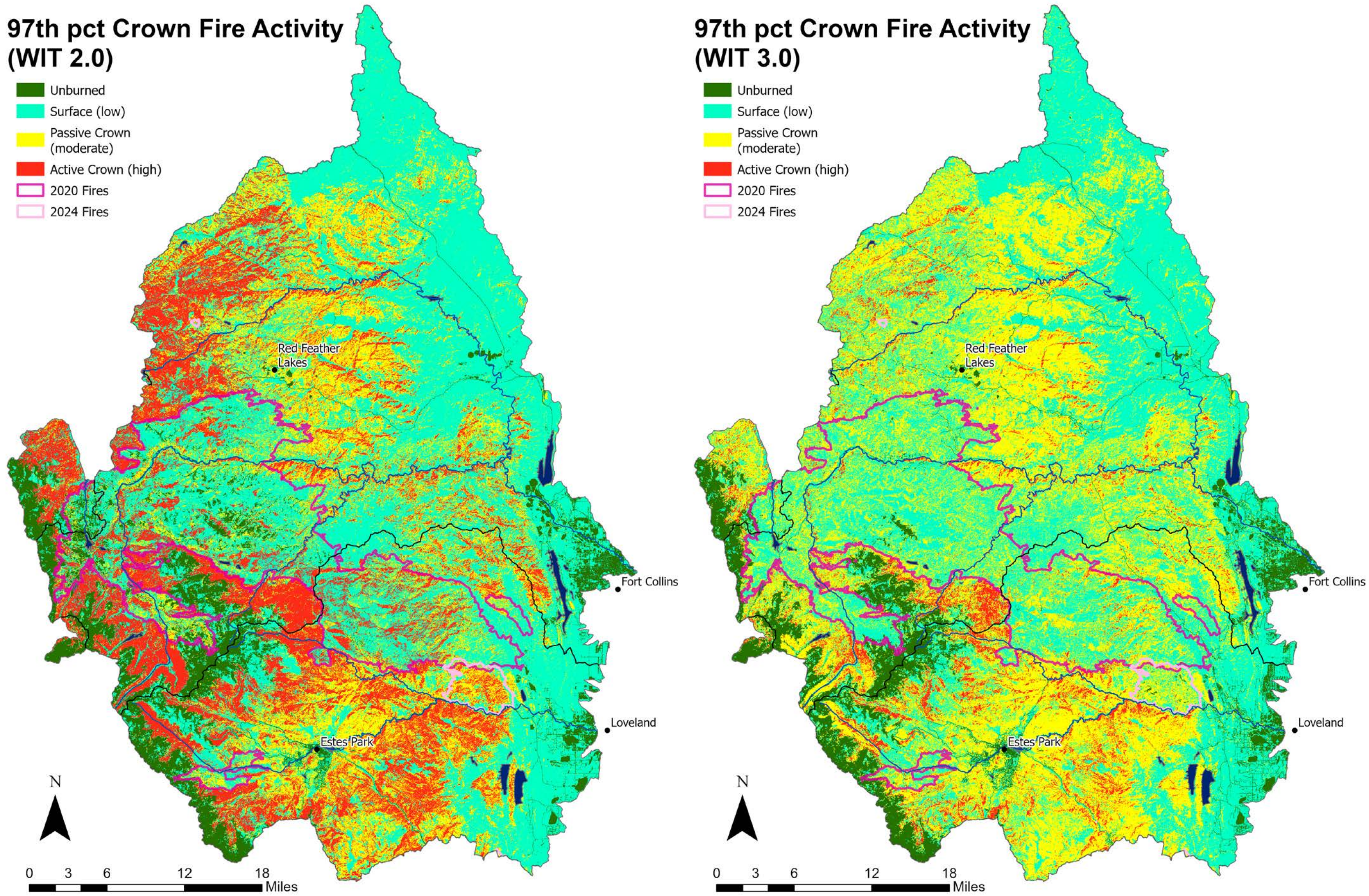

Figure 3: Extreme crown fire activity modeled for the 97th percentile fire weather scenario for WIT 2.0 (LEFT) and WIT 3.0 (RIGHT).

Updated burn probability modeling

WIT 2.0 utilized a national-scale FSim burn probability product that was calibrated to historic fire activity from ~1992-2015 (Short et al., 2020). The scope of WIT 2.0 did not allow for custom FSim modeling and therefore relied on approximate representation of wildfire-driven reductions in burn probability based on a fuel treatment effectiveness study in Oregon that showed an average 36.25% reduction in FSim burn probability after thinning and burning treatments (Thompson et al., 2013). Thus, the National FSim burn probability was uniformly reduced by 36.25% within the 2020 fire extents. This simplifying assumption did not account for the spatial variability in burn severity and extent.

WIT 3.0 benefited from customized FSim burn probability modeling that was conducted for the Northern Colorado Fireshed Collaborative (NCFC).

FSim estimates pixel-wise annualized burn probability by simulating 1,000s to 10,000s of years of fire to estimate the annual probability that a given pixel will burn. To accomplish this, FSim combines modules for weather, fire ignitions, fire growth, and fire suppression through a stochastic Monte-Carlo simulation approach where fires are ignited and grown independently of one another on a static fuelscape. This simulation accounts for the effects of topology and prevailing wind directions on the rate and direction of fire spread. This captures effects such as lower probabilities of fire on the lee side of large waterbodies, alpine ridgelines, and burn scars. Because fires in FSim do not interact and the fuelscape remains static, the results are only valid for current landscape conditions. As large fires or management actions alter the landscape over time, updated FSim runs are necessary to maintain accuracy.

The FSim simulations for this risk assessment were conducted at 270-meter resolution for 15,000 simulated years of fire activity. Simulation parameters were calibrated to match observed fire characteristics – specifically the annual number of fires, mean fire size, and fire size distribution - between 2000 and 2020 within a 50 km buffer of the analysis area. This buffer size offers two main benefits. First, it increases the sample size of historic fire activity. Secondly, it allows the model to simulate large fire events that originate outside, but spread into the analysis area. This aligns with concerns about potential future fires similar to the 2020 East Troublesome and Cameron Peak fires, which burned through high-elevation forest types and traveled approximately 50-60 km from their ignition points.

Consistent with other large scale FSim modeling efforts (Short et al., 2020), a single representative weather station (Red Feather Remote Automatic Weather Station) was used to generate simulated weather across the analysis area based on daily observations since 2000. The Red Feather station was selected for its long period of record. Fire Family Plus (Bradshaw et al., 2000) was used to generate a fire risk (FRISK) file, summarizing annual percentile weather scenarios and building monthly distributions of wind speed and direction. FSim then uses this FRISK file to generate thousands of years of potential Energy Release Component (ERC) streams and randomly selects wind speeds and directions from the historical monthly distributions. This process ensures that FSim captures both seasonal weather trends and interannual variability.

FSim ignition points are randomly selected for each simulated fire using a historic ignition probability raster, which defines the relative likelihood of ignition across the landscape. This allows the locations of fire ignitions in FSim to match the observed spatial variability of human and natural ignitions across the analysis area. This raster was created by identifying ignition locations of all fires >20 acres in the historical record (Short et al., 2020) within the 50 km buffer of the NCFC analysis area. The Kernel Density tool in ArcGIS Pro was used to convert ignition points into a continuous raster surface.

The final annual burn probability (BP) raster produced by FSim underwent post-processing to address resolution differences between the original simulations (270 m) and the final analysis resolution (30 m). First, all pixels with a BP of zero were set to the 5th percentile BP within the analysis area to avoid assigning zero risk to areas with wildland fuels. Next, a 3 x 3 moving window was applied to smooth BP values. The raster was resampled to 30 m using bilinear interpolation. All 30 m pixels classified as non-burnable based on the 30 m fuelscape used in fire behavior modeling were set to have a BP of zero.

Additional FSim simulations after the 2024 Alexander Mountain Fire were outside the scope of this project. To approximate the fire's effects on burn probability, we again referenced the Thompson et al. (2013) study which found that thinning and burning treatments reduced burn probability by 36.25% within treated areas and 23.37% within a 2-mile buffer. These effects were used as proxies, with the understanding that the Alexander Mountain Fire differed in severity, extent, and spatial configuration from the Oregon treatments referenced in the study. We adjusted custom FSim outputs from the NCFC's risk assessment in two steps. We first uniformly reduced burn probability by 36.25% in pixels that burned in the Alexander Mountain Fire and by 23.37% in all unburned pixels within the fire perimeter and within a 2-mile buffer around it.

The FSim modeling conducted for WIT 3.0 resulted in substantially higher burn probabilities throughout the Cache la Poudre and Big Thompson watersheds (Figure 4). There was a slight increase in BP in the southwestern portion of the Cameron Peak Fire footprint, but the most significant increases occurred in the montane zone, outside of the historic burn perimeters.

Comparing PPWF's WIT to Northern Colorado Fireshed Collaborative's critical water supply modeling

The same crown fire activity rasters were used as a proxy for burn severity in both the WIT 3.0 water supply impact analysis and the Northern Colorado Fireshed Collaborative's (NCFC) critical water supply assessment (Rhea et al., 2022). The primary differences between these two products are the spatial extent of water infrastructure considered and the approach to assigning relative importance weights to water infrastructure.

The NCFC risk assessment encompassed a broader geographic area, so it included additional water infrastructure located outside the Cache la Poudre and Big Thompson watersheds. These data were sourced from the Colorado Division of Public Health & Environment and local water utilities. Due to the large number of infrastructure points and utilities involved, collaborative development of relative importance rankings was not feasible. Instead, infrastructure importance was assigned using Forest to Faucet drinking water importance values (Mack et al., 2022), which were rescaled from 0 (least important) to 1 (most important). These values incorporate population served, distance to population centers, and annual streamflow generation at the HUC 12 scale. These rescaled importance ratings were then applied as weights to reflect the relative impact of sediment delivery to each water supply. During a review of the Forest to Faucet

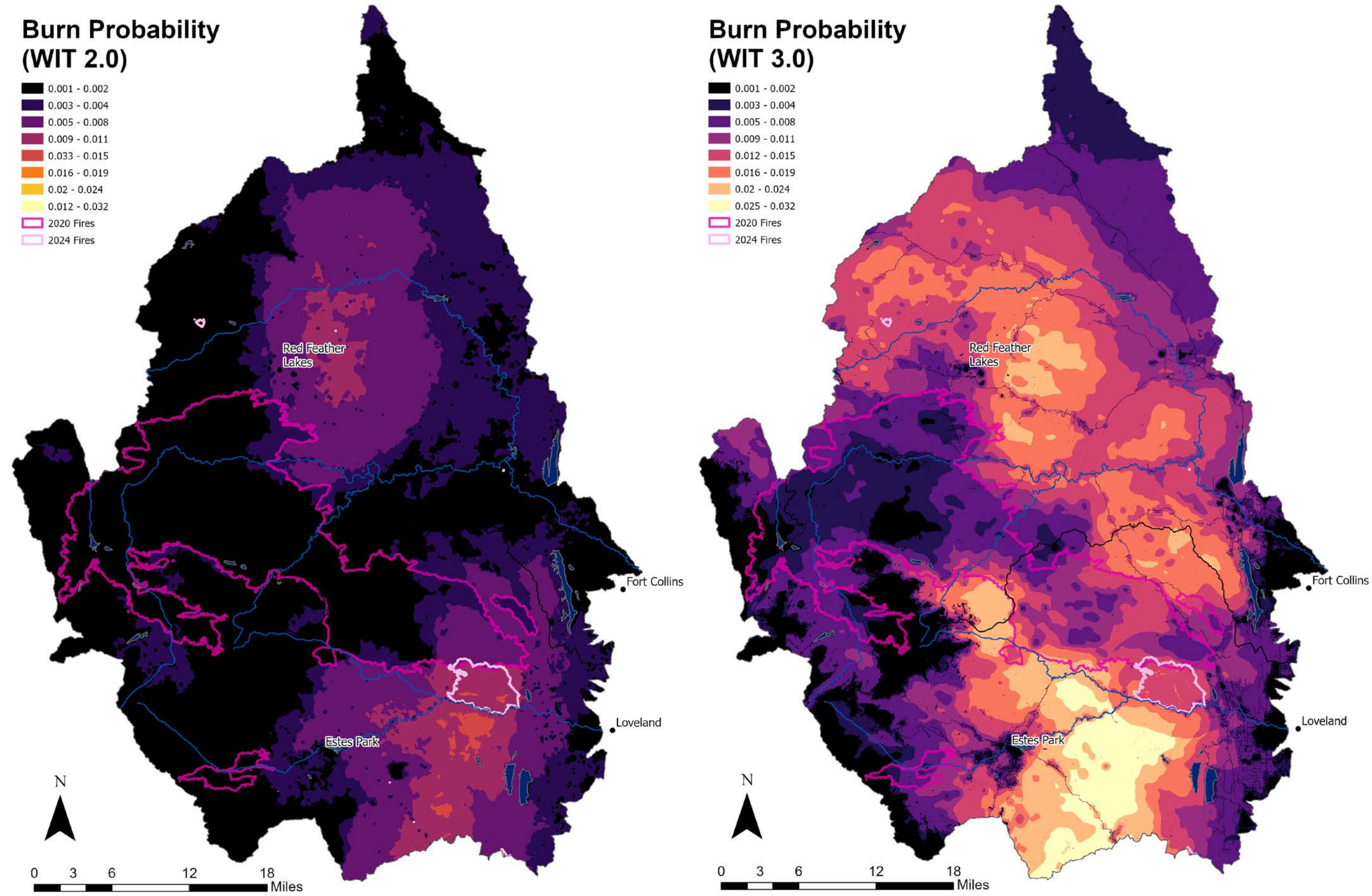

Figure 4: WIT 2.0 burn probability based on an adjusted National FSim product (LEFT) and WIT 3.0 burn probability from a locally-calibrated custom FSim product that accounts for the Alexander Mountain Fire (light pink outline; RIGHT).

ratings with water providers, it was noted that the population served by Colorado-Big Thompson (CBT) water was not accounted for in this rating schema. To address this, we manually increased the relative importance ratings for all water supply infrastructure upstream of Windy Gap, the source area for CBT water.

A final difference in the two analyses is units. The NCFC assessment assumed that sediment delivery of ≥ 50 Mg ha^{-1} in the first post-fire year represents a critical impact, based on post-fire hillslope erosion estimates from the 1996 Buffalo Creek Fire (68 Mg ha^{-1}; Moody & Martin, 2001). As a result, pixel-level sediment delivery to water infrastructure estimates were linearly rescaled so that 0 to 50 Mg ha^{-1} of sediment corresponds to 0% to -100% relative value change (i.e., resource loss). In contrast, WIT 3.0 focuses exclusively on the Cache la Poudre and Big Thompson watersheds. It includes fewer water infrastructure points, uses collaboratively developed relative importance weights from local water utilities and outputs raw sediment yield values (Mg ha^{-1}) and monetary impact (USD $acre^{-1}$) rather than rescaled net value change (NVC) metrics.

Big Thompson Initiative progress report

The (BTI) targets the highest risk subset of the Big Thompson watershed for strategic investment. Peaks to People Water Fund began to focus available resources on this landscape in 2020 and wanted to track programmatic progress to date.

We pulled all vegetation management data from the Colorado Forest Tracker (Dannels et al., 2025). The dataset was filtered to include all treatments implemented between 2021 and 2023 within the Big Thompson and Cache la Poudre watersheds. Treatment codes from the Forest Tracker dataset were then reclassified according to WIT-specific categories. For canopy treatments, the following reclassifications were applied: Manual, Mechanical, and Mastication treatments were grouped under Thin, while Broadcast Burn was reclassified as Prescribed Fire. Surface treatments were reclassified as follows: Pile Burn and Removal were grouped under Manage, indicating treatments intended to maintain surface fuel levels; Mastication, Lop and Scatter, and Mulching were grouped under Rearrange, which generally increases surface fuel loads; and Broadcast

Burn was again classified as Rx fire, representing treatments aimed at reducing surface fuels.

When reviewing the Forest Tracker data, Peaks to People Water Fund noted that many partner projects implemented by conservation districts, watershed coalitions, and other local entities were not captured in this statewide database. Therefore, we supplemented Colorado Forest Tracker data with units from the WIT planned treatments database that were known to be completed between 2021-2023 within the BTI landscape, which only includes thin-only treatments.

We manually stamped the above treatments into the fuelscape by treatment type using the same adjustment factors detailed in Tables 2 and 3. We then re-ran the FlamMap fire behavior model and subsequent watershed models to predict wildfire risk to water supplies after treatment. Modeled pre-treatment and post-treatment risk were differenced to estimate potential risk reduction of complete treatments and provide a programmatic progress report.

Results

Wildfire risk to drinking water

Across both the Cache la Poudre and Big Thompson watersheds, estimated wildfire risk to drinking water nearly doubled in WIT 3.0 update compared to WIT 2.0 (Table 4). This increase is primarily driven by changes in burn probability and fire behavior modeling. Key changes in WIT 3.0 update include:

- **Higher burn probability across the landscape**, resulting from locally calibrated FSim models that incorporate the 2020 fire season and simulate behavior within historic fire perimeters (e.g. Cameron Peak). This contrasts with WIT 2.0 which relied on older national FSim products and applied uniform reductions in burn probability (Figure 4).
- **More passive crown fire** within historic fire perimeters and **less active crown fire** everywhere compared to WIT 2.0 (Figures 2-3).
- **Hazard** (cNVC) values, which reflects the response of values and assets to predicted crown fire activity, are generally similar to or lower than WIT 2.0, outside of historic burn perimeters.
- **Risk to drinking water** (eNVC), which is the product of cNVC and burn probability, is approximately twice as high in WIT 3.0 (Figure 5).

The BTI accounts for a disproportionate share of overall wildfire risk to drinking water:

- BTI represents just 12% of the total combined area, yet contributes 42-46% of total risk under both WIT 2.0 and 3.0 (Table 4).
- Within the Big Thompson watershed, BTI comprises 40% of the area and 85-88% of the total risk (Table 4).
- This demonstrates that BTI is a strategic landscape for investment, where targeted mitigation could maximize wildfire risk reduction to drinking water supplies.

Fuel treatment priorities for full planning area

Wildfire risk increased significantly in WIT 3.0 due to revised burn probability estimates, which directly impact fuel treatment prioritization. As a result, we can no longer closely approximate the previously

Table 4: Summary of mean and total watershed risk (USD/acre) by HUC-8 watershed.

Extent	Watershed Risk (USD/acre)				
	WIT 2.0		WIT 3.0		
	Mean	Sum	Mean	Sum	Area (ac)
Cache la Poudre	4.7	15,809,111	13.0	43,336,124	1,209,913
Big Thompson	10.2	18,896,625	21.2	39,378,184	532,750
Big Thompson Initiative	16.7	16,133,034	35.7	34,570,380	215,355
BTI/BT (%)		85		88	40
BTI/CLP+BT (%)		46		42	12

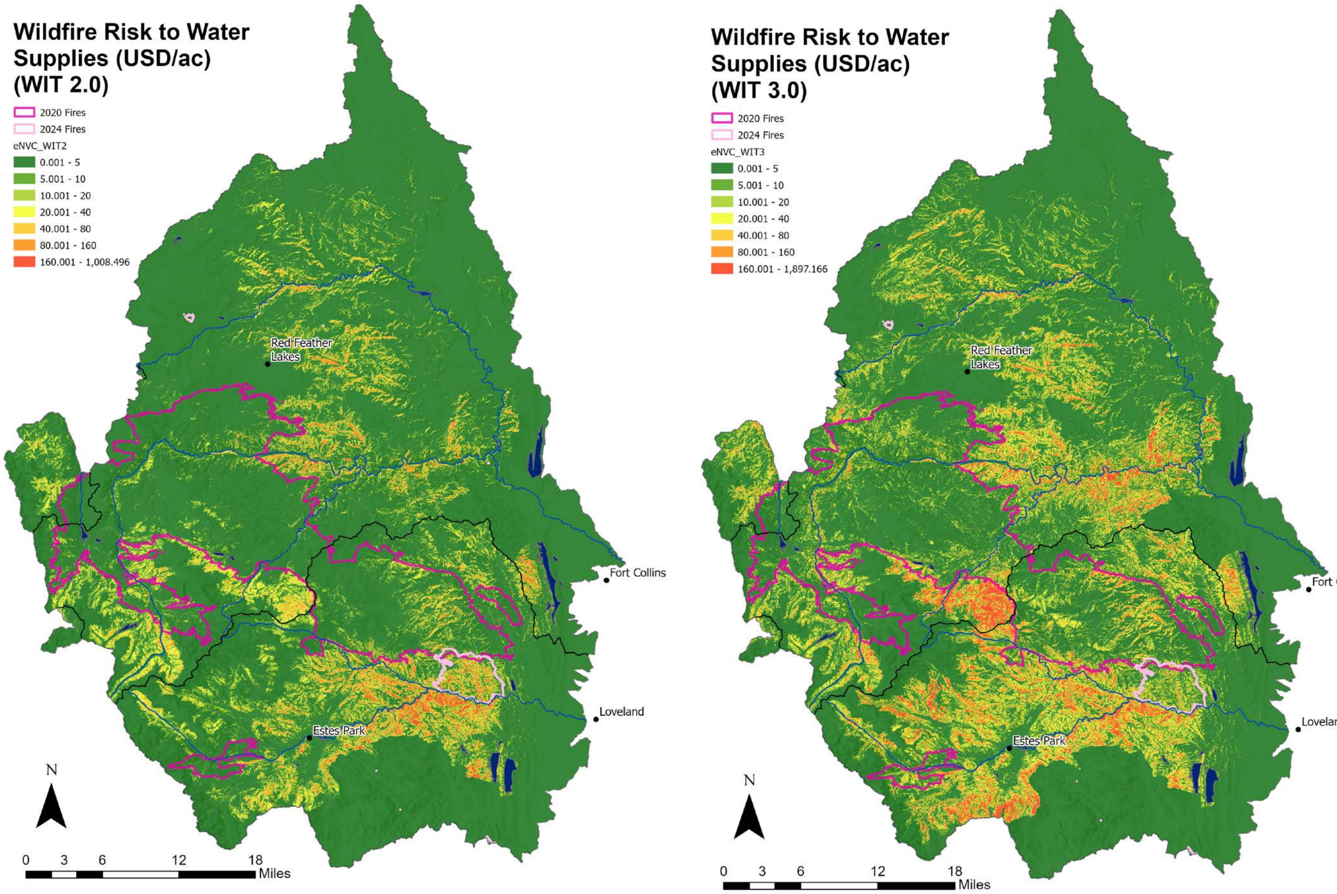

Figure 5: Wildfire risk to water supplies (USD/acre) from WIT 2.0 (LEFT) and WIT 3.0 (RIGHT).

modeled 10%, 25%, and 50% total risk reduction goals. This limitation stems from two main factors. First, the baseline risk has nearly doubled so achieving the same relative risk reductions now requires significantly greater investment. Second, the maximum total risk reduction under WIT 3.0 is only 35% due to changes in fire behavior modeling (Figure 6).

Given these constraints, we shifted the analysis to evaluate fuel treatment optimizations under fixed budget scenarios: $10M, $50M, $100M, and $200M (Table 5). We evaluated two treatment prioritization strategies:

1) **All treatment types**: This scenario is allowed to choose from three treatment types - thinning, prescribed fire, or complete (i.e. thinning followed by prescribed fire). This approach enables the model to identify the most cost-effective treatment for each planning unit. Since prescribed fire is generally the most effective and least expensive option, it comprises a large share of total treated acres in this scenario, ranging from 44% to 82% across budget levels (Figure 6).

2) **Thin only**: The second scenario is limited to thinning only to reflect local treatment history and operational constraints. This approach was informed by 2021-2023 treatment data from the Colorado Forest Tracker (Dannels et al., 2025), the WIT planned treatments database, and input from the Peaks to People Water Fund. Notably, during the first three years of the BTI, no prescribed fire treatments (referring to broadcast burns, not pile burns) were implemented in the Big Thompson watershed. To reflect this reality, we included this second scenario where thinning is the only allowable treatment type.

To compare expected treatment outcomes, we report two key metrics. **Total risk reduction** is calculated as the reduction in risk achieved through hypothetical treatments divided by the total wildfire risk to drinking water in the Big Thompson and Cache la Poudre watersheds. **Feasible risk reduction** is calculated as the reduction in risk achieved through hypothetical

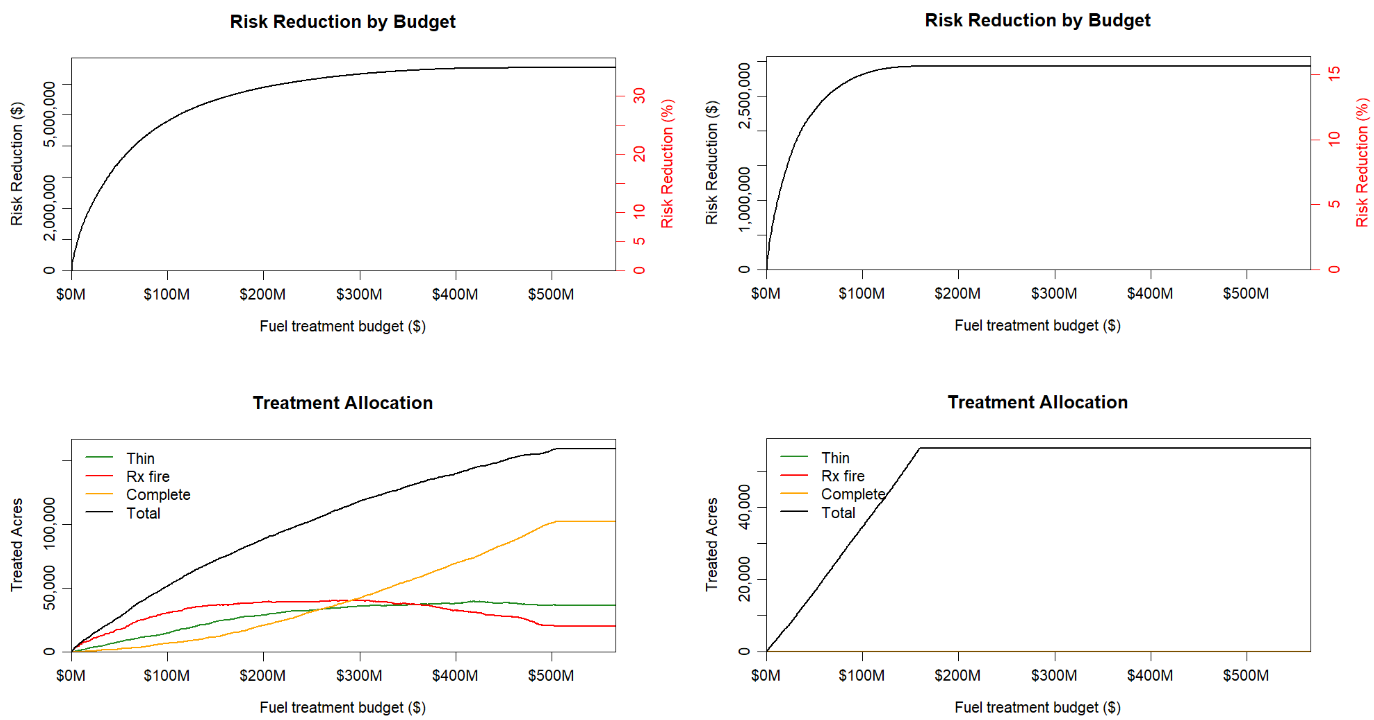

Figure 6: Return on investment curves for all treatment types (upper left) and thin only (upper right) that demonstrate decreasing risk reduction with increasing budgets. The thin only scenario has much lower risk reduction values than the all treatments scenario. The lower plots are treatment allocation curves that demonstrate the total acres allocated to each treatment type across a range of budgets. Total acres (black) is the same as thin acres (green) in the thin only lower right plot.

treatments divided by the maximum possible reduction if all feasible areas were treated. Because thinning is both more expensive per acre and less effective than prescribed fire, fewer acres can be treated under a fixed budget, and total risk reduction is lower in the thin-only scenario (i.e., smaller numerator in total risk reduction formula; Table 5). However, because the total feasible treatment area is smaller and thinning is less effective overall, the feasible risk reduction is higher in the thin only scenario (i.e., smaller denominator in feasible risk reduction formula; Table 5). Both risk reduction formulas are presented below:

$$total\ risk\ reduction = \frac{risk\ reduction\ from\ hypothetical\ treatment}{total\ risk}$$

$$feasible\ risk\ reduction = \frac{risk\ reduction\ from\ hypothetical\ treatment}{risk\ reduction\ if\ all\ feasible\ areas\ were\ treated}$$

Table 5: Summary of treated acres, percent of treated acres as prescribed fire, total risk reduction, and feasible risk reduction across both scenarios and budget levels.

All Treatment Types				Thin Only			
Budget ($)	Treated Acres	Total Risk Red. (%)	Feasible Risk Red. (%)	Budget ($)	Treated Acres	Total Risk Red. (%)	Feasible Risk Red. (%)
10,000,000	7,398	7	20	10,000,000	3,263	5	30
50,000,000	27,141	19	54	50,000,000	16,503	12	79
100,000,000	51,390	26	74	100,000,000	34,524	15	96
200,000,000	88,093	31	90	200,000,000	56,202	16	100

Priority treatment locations remained geographically similar across the all-treatment and thin-only prioritization scenarios (Figure 7). The most notable difference is the reduced number of priority treatment units in the highest priority categories (red and orange) under the thin only scenario (Figure 7). Despite these differences, several areas consistently emerge as high priorities across both scenarios: Fish Creek south of Estes Park, the Waltonia area south of Highway 34, Pennock Creek, the West side of Horsetooth Reservoir, and the High Park burn scar.

Fuel treatment priorities for Big Thompson Initiative

Within the BTI landscape, we identified four budgets that correspond to discrete slope breaks in incremental risk reduction. For any given budget, treated acres and total risk reduction are lower in the thin-only scenario, while feasible risk reduction is higher because thinning is both more expensive and less effective at reducing wildfire risk than prescribed fire, which dominates the all-treatments scenario (Table 6). Treating all 32,050 feasible acres with thinning, prescribed fire, or complete treatments would require an estimated $82 million and would reduce 38% of total risk and 99% of feasible risk in the BTI. In contrast, under the thin-only scenario, only 11,594 acres are feasible for treatment which would cost $35 million and reduce 18% of total risk and 100% feasible thin-only risk.

Again, there are fewer priority treatment acres in the thin only scenario (Figure 8B), resulting in the loss of some priority units compared to the all treatments scenario (Figure 8A). However, several areas consistently emerge as high-priority across both scenarios. If thinning is the only realistic management action and source water protection remains the primary management objective, we recommend focusing efforts in the Fish Creek watershed South of Estes Park, the Waltonia area, and Lory State Park (Figure 8B).

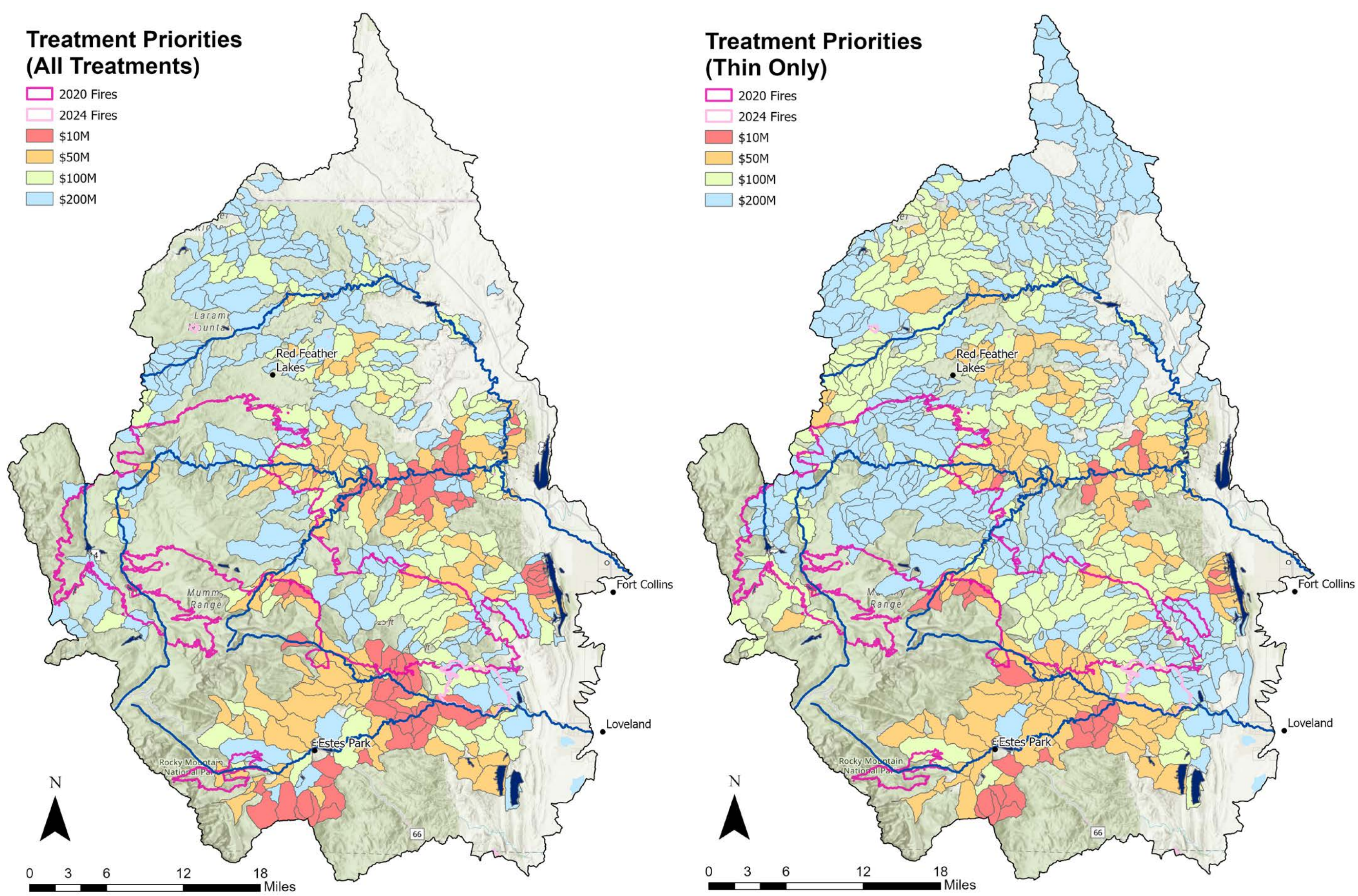

Figure 7: Treatment priorities for the full Peaks to People planning area when running treatment optimizations with all three treatment types (LEFT) and the thin only scenario (RIGHT). The $10M budget (red) represents the highest priority treatment units and the $200M budget (blue) the lower priority treatment units.

Table 6: Summary of treated acres, total risk reduction, and feasible risk reduction by budget for just the Big Thompson Initiative landscape for both the all treatment types and thin only scenarios. Note: the treatment scenarios include different budgets based on slope breaks in incremental risk reduction.

All Treatment Types				Thin Only			
Budget ($)	Treated Acres	Total Risk Red. (%)	Feasible Risk Red. (%)	Budget ($)	Treated Acres	Total Risk Red. (%)	Feasible Risk Red. (%)
4,000,000	3,216	7	19	3,000,000	1,009	4	23
9,000,000	6,583	13	34	8,000,000	2,648	8	46
30,000,000	15,605	27	71	14,000,000	4,528	12	67
82,000,000	32,050	38	99	35,000,000	11,594	18	100

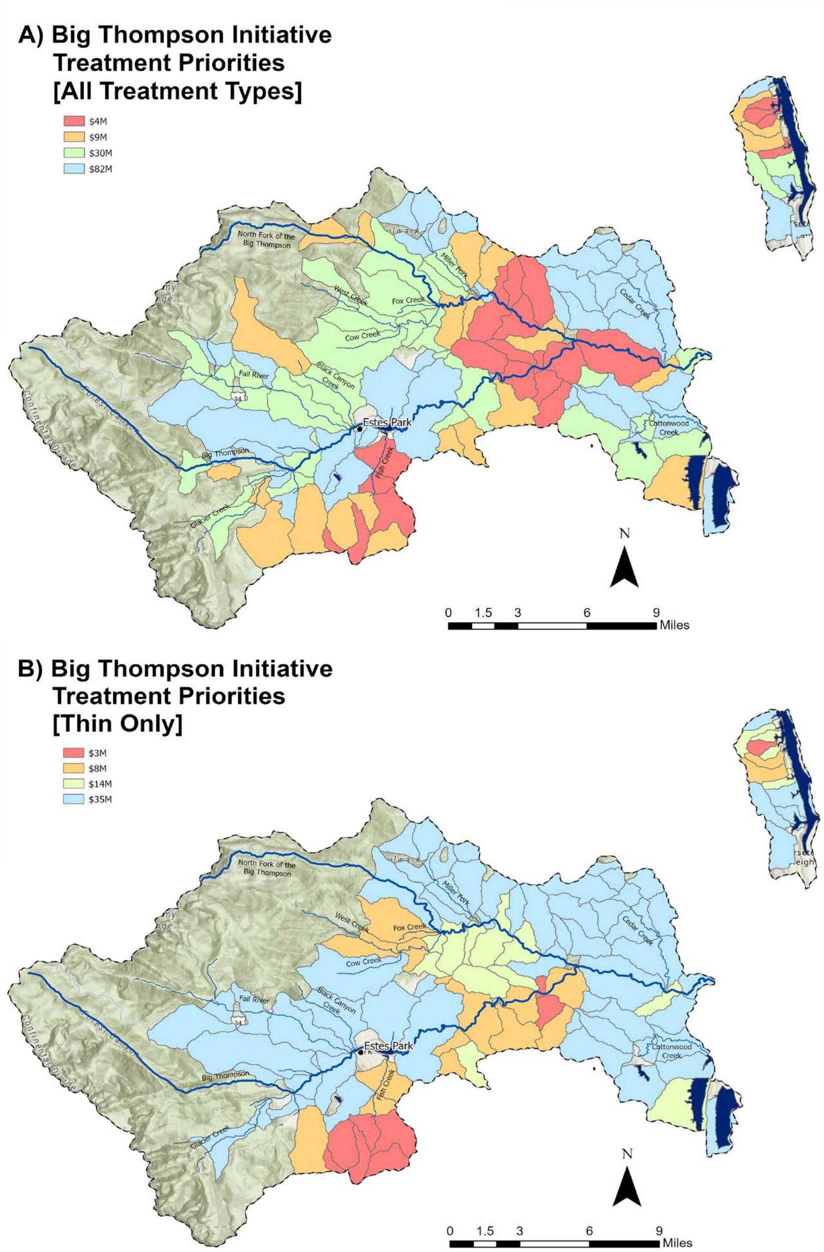

Figure 8: Treatment priorities for the Big Thompson Initiative planning area A) when considering all treatment types and B) when limiting treatments to thin only. The $3M budget (red) represents the highest priority treatment units and $35 million (light blue) represents lower priorities.

Big Thompson Initiative Progress Report

Since the launch of the BTI, we updated fire modeling to reflect 2020 baseline conditions (i.e. surface and canopy fuels) and custom burn probability products that were locally calibrated with recent fire history, including the 2020 wildfires. While the fire behavior modeling approach remains consistent with earlier efforts, it now reflects updated 2020 fuels data (previously based on 2016). Treatment planning scenarios were also revised to include only thinning treatments to reflect the reality that there has been no reported prescribed fire in the BTI in this progress reporting period (2021-2024). Because of these updates, the spatial distribution of priority treatment areas and the underlying risk values have changed, and the original BTI goal to treat 84% of the feasible wildfire risk over 10 years is no longer directly applicable. The results that follow therefore reflect progress relative to the updated WIT 3.0 prioritization, which provides the most current and accurate framework for assessing wildfire risk reduction to drinking water.

From 2021 to 2023, Peaks to People Water Fund supported 1,139 acres of treatments within the BTI footprint. An additional 6,412 have been treated in the BTI footprint according to the polygons uploaded into the Forest Tracker, largely representing work led by federal agencies. In total, 7,551 acres of the BTI were treated in the first 3 years of the Initiative. These only include thinning treatments, as there have not been any recent prescribed fires in the BTI footprint. An additional 7,725 acres of the BTI landscape were impacted by wildfire with the 2024 Alexander Mountain Fire accounting for 98% of that and the smaller 2021 Kruger Mountain and 2022 Soul Shine fires accounting for the remaining 2%.

Although more acres have been treated in the last three years than in the hypothetical $14 million budget thin-only scenario, estimated risk reduction remains relatively modest (Table 7). This is largely due to the location of many treatments – particularly those led by federal agencies – falling outside of the highest-priority areas for wildfire risk to water supplies (Figure 9). These treatments likely supported other important resource or land management objectives. 406 acres of these completed projects fall within the highest priority treatment units based on the $3 million thin only scenario using WIT 3.0. 5,991 acres, or 79%, of these projects fell within any priority treatment unit identified in the $35 million thin only scenario. For context, 4,508 acres, or 60%, of those completed projects fell within the high priority treatment units identified using WIT 3.0. To enhance BTI's return on investment (i.e. risk reduction per dollar spent or acre treated) for drinking water, future efforts would benefit from aligning treatments more closely with high-priority zones identified in Figure 8.

Table 7: Acres treated and risk reduction estimates for the Big Thompson Initiative landscape. The top four rows present the four budget scenarios from the thin-only treatment prioritization. The bottom three rows represent progress reports based on the Watershed Investment Tool's database of treatments from local entities, based on the Forest Tracker's complete treatments database which is focused on Federal agencies, and the combination of the two.

Scenario	Total Risk Reduction (%)	Feasible Risk Reduction (%)	Area Treated (acres)	Area Treated (% of BTI)
$3M	4	23	1,009	0.5
$8M	8	46	2,648	1.2
$14M	12	67	4,528	2.1
$35M	18	100	11,594	5.4
Watershed Investment Tool	0.2	1	1,139	0.5
Forest Tracker	0.4	2	6,412	2.9
Sum WIT + FT	0.6	3	7,551	3.4

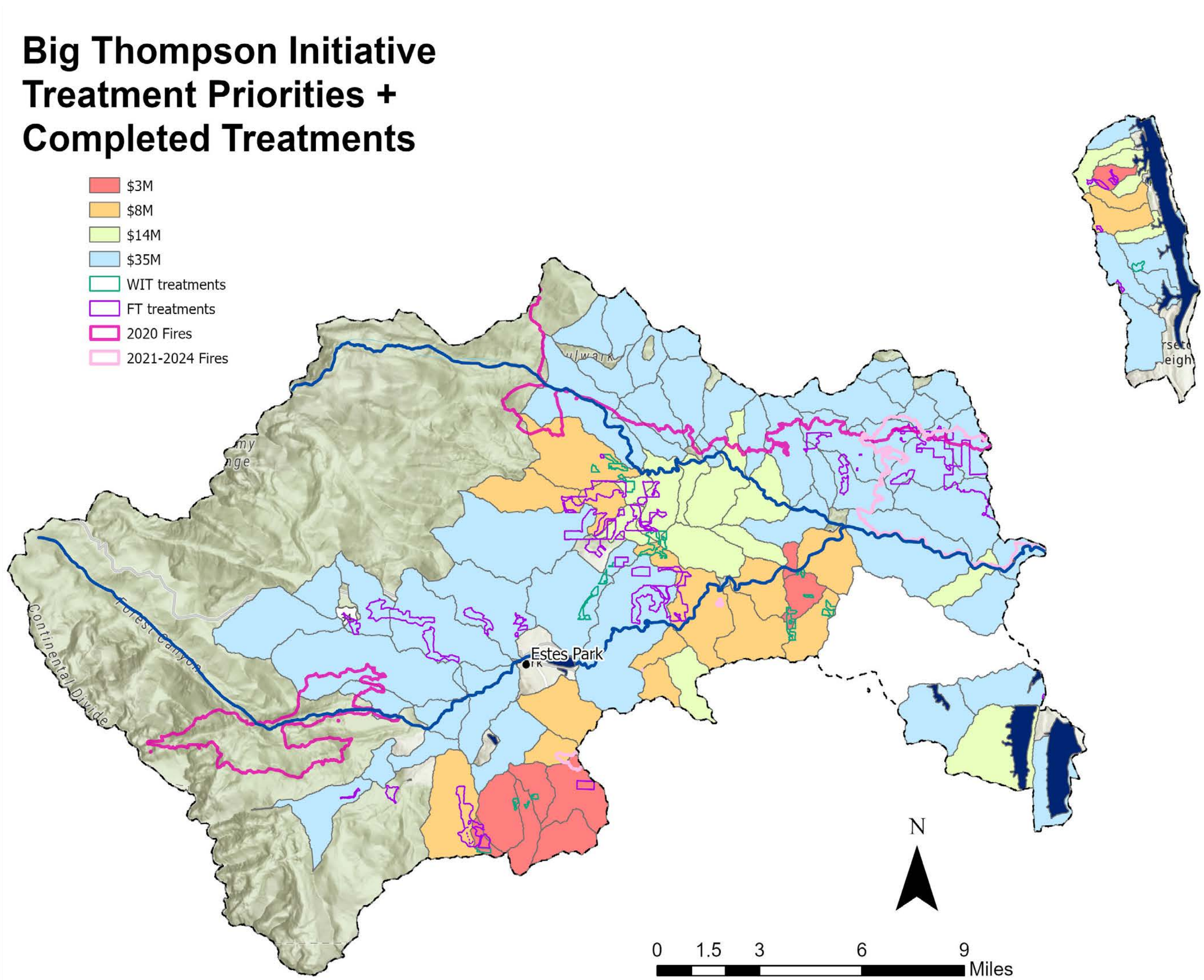

Figure 9: Thin-only treatment priorities for the Big Thompson Initiative planning area where the $3M budget (red) represents the highest priority treatment units and $35 million budget (light blue) is a lower priority. Wildfires (pink) and completed forest management treatments from the Watershed Investment Tool (teal) and Forest Tracker (purple) databases are overlain for reference.

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