RIO GRANDE WATER FUND WILDFIRE RISK ASSESSMENT

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1 PURPOSE OF THE ASSESSMENT

The purpose of the Rio Grande Water Fund Wildfire Risk Assessment (RGWF) is to provide foundational information for evaluating the efficacy of treatments at reducing landscape-scale wildfire risk to highly valued resources and assets across the Rio Grande watershed above Socorro, NM, including all portions of the Cibola, Santa Fe, Carson, San Juan, and Rio Grande National Forests and many tribal reservations. Such information supports fuel management planning decisions, as well as revisions to land and resource management plans. A wildfire risk assessment is a quantitative analysis of assets and resources and how they would be potentially impacted by wildfire. The RGWF analysis considers several different components, each resolved spatially across the project area, including:

- likelihood of a fire burning,
- the intensity of a fire if one should occur,
- the exposure of assets and resources based on their locations, and
- the susceptibility of those assets and resources to wildfire.

To manage wildfires across the watershed, accurate wildfire risk data must be available to inform land and fire management strategies. These risk outputs can be used to aid in the planning, prioritization, and implementation of prevention and mitigation activities. In addition, the risk data can be used to support fire operations in response to wildfire incidents by identifying those assets and resources most susceptible to fire.

1.1 QUANTITATIVE RISK MODELING FRAMEWORK

The basis for a quantitative framework for assessing wildfire risk to highly valued resources and assets (HVRAs) has been established for many years (Finney 2005; Scott 2006). The framework has been implemented across a range of scales, from an individual county (Ager et al. 2017), a portion of a national forest (Thompson et al. 2013), individual states (Buckley et al. 2014), to the entire continental United States (Calkin et al. 2010). In this framework, wildfire risk is a function of two main factors: 1) wildfire hazard and 2) HVRA vulnerability (Figure 1).

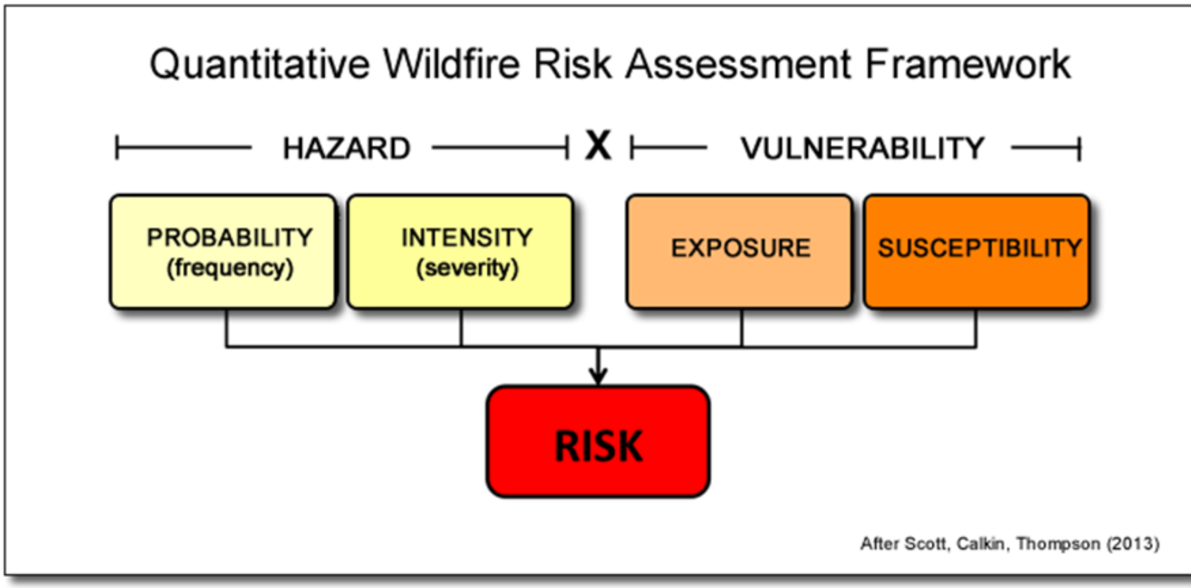

Figure 1. The components of the Quantitative Wildfire Risk Assessment Framework.

Wildfire hazard is a physical situation with the potential for causing damage to vulnerable resources or assets. Quantitatively, wildfire hazard is measured by two main factors: 1) burn probability (or likelihood of burning), and 2) fire intensity (measured as flame length, fireline intensity, or other similar measures).

HVRA vulnerability is also composed of two factors: 1) exposure and 2) susceptibility. Exposure is the placement (or coincidental location) of an HVRA in a hazardous environment—for example, building a home within a flammable landscape. Some HVRAs, like wildlife habitat or vegetation types, are not movable; they are not "placed" in hazardous locations. Still, their exposure to wildfire is the wildfire hazard where the habitat exists. Finally, the susceptibility of an HVRA to wildfire is how easily it is damaged by wildfire of different types and intensities. Some assets are fire-hardened and can withstand very intense fires without damage, whereas others are easily damaged by even low-intensity fire.

2 RISK ANALYSIS OVERVIEW

For any risk assessment, it is imperative to have spatial continuity across all aspects of project development. This ensures data alignment and logically consistent results across data products. The project boundaries used in the Rio Grande Water Fund wildfire risk assessment are described below in sections 2.1.1 – 2.1.3 and are shown in Figure 2.

2.1 LANDSCAPE ZONES

2.1.1 ANALYSIS AREA

The Analysis Area (AA) is the area for which valid burn probability results are produced. The Analysis Area for the Rio Grande Water Fund project was defined as a 10-kilometer buffer on the Rio Grande watershed boundary (Figure 2).

2.1.2 FIRE OCCURRENCE AREAS

To ensure valid Burn Probability (BP) results in the AA and prevent artificial reduction in BP near the AA boundary edge, it is necessary to allow FSim to start fires outside of the AA and burn into it. This larger area where simulated fires are started is called the Fire Occurrence Area (FOA). We established the FOA extent as a 30-km buffer on the AA. The buffer provides sufficient area to ensure all fires that could reach the AA are simulated. The Fire Occurrence Area covers roughly 17.5 million acres and is characterized by diverse topographic and vegetation conditions.

2.1.3 FUELSCAPE EXTENT

The available fuelscape extent was delineated by adding a 30-km buffer to the FOA extent. This buffer allows fires starting within the FOA to grow unhindered by the edge of the fuelscape, which would otherwise truncate fire growth and affect the simulated fire-size distribution, potentially introducing errors in the calibration process. A map of the AA, FOA boundaries, and fuelscape extent are presented in Figure 2.

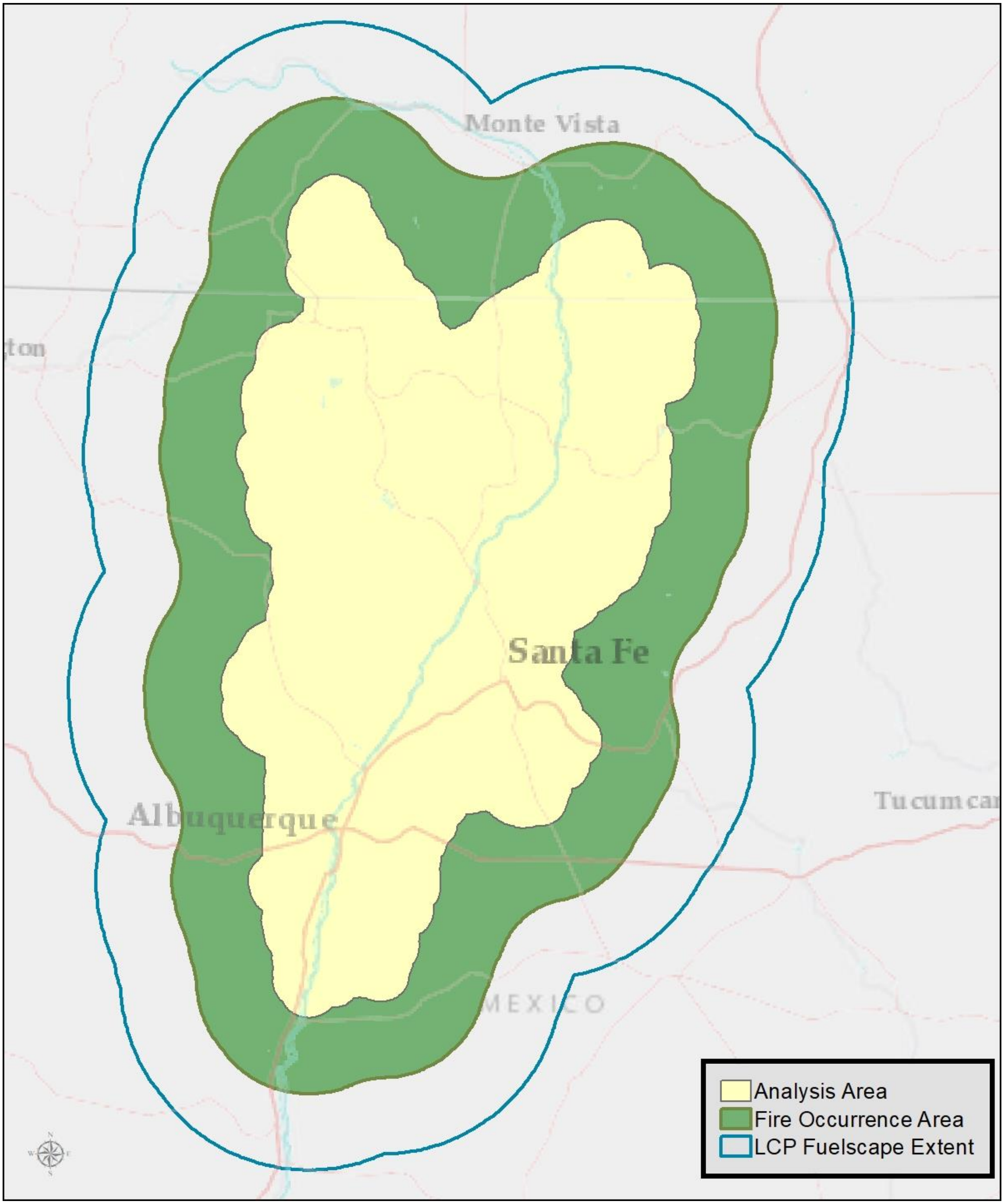

Figure 2. Overview of landscape zones for Rio Grande Water Fund.

3 ANALYSIS INPUTS

Quantifying wildfire risk requires a comprehensive assessment of a focus area's high-value resources and assets, integrated with wildfire hazard (burn probability and fire intensity). A critical component to determining relevant wildfire hazard is an accurate fuelscape. The integrated risk assessment inputs are discussed further in Sections 3.1- 3.1.1.

3.1 RIO GRANDE WATER FUND FUELSCAPES

The foundation of any wildfire hazard assessment is a fuelscape updated for recent disturbances and calibrated to reflect the fire behavior potential realized in recent historical wildfire events. A fuelscape consists of geospatial datasets representing surface fuel model (FM40), canopy cover (CC), canopy height (CH), canopy bulk density (CBD), canopy base height (CBH), and topography characteristics (slope, aspect, elevation).

For this assessment, the Rio Grande Water Fund is seeking to evaluate the efficacy of treatments (from 2012 to 2021) in reducing landscape-scale wildfire risk by comparing the outputs of various wildfire risk measures. Using this analysis, they hope to discern the risk-reduction outcomes of these investments.

To facilitate this comparison, four fuelscapes were developed for which fire modeling can be performed, and therefore enable hazard and risk assessments for the evaluation of treatment efficacy. The four fuelscapes include a 2022 current condition fuelscape, a 2022 fuelscape with no disturbances, and two hypothetical 2022 fuelscapes differentiating between the types of fuel disturbances occurring since 2012. The sections below describe datasets used in the fuelscape process, highlight the differences between these four fuelscapes, and outline the methods used to generate them.

3.1.1 FUELSCAPE DEVELOPMENT

Several data sources were used for generating the fuelscape scenarios, with the primary source being LANDFIRE Remap 2016 (version 2.0.0). These LANDFIRE datasets include vegetation datasets (type, cover, height, biophysical settings), topography datasets (elevation, slope, aspect), and fuel disturbance data (annual disturbance compilations).

LF Remap accounts for disturbances up to and including 2016. To update fuelscapes from 2016 conditions to include disturbances through 2022, Pyrologix also gathered recent fuel disturbances across the fuelscape and assigned appropriate disturbance codes using the same logic developed by LANDFIRE. Fuel disturbances included events such as mechanical treatments, prescribed fire, and wildfires. Datasets were collected from a variety of sources including the USFS Forest Service Activity Tracking System (FACTS), the Department of Interior National Fire Plan Operations & Reporting System (NFPORS), Monitoring Trends in Burn Severity (MTBS), Rapid Assessment of Vegetation Condition after Wildfire (RAVG), Geospatial Multi-Agency Coordination (GeoMAC), and the Wildland Fire Interagency Geospatial Services (WFIGS) Group.

We also received spatial treatment data directly from TNC for 2012-2021 which we were able to incorporate into the fuelscapes to update the fuel mapping.

It should be noted that in generating the fuelscapes, all fuelscapes utilized the same set of fuel rulesets in the LANDFIRE Total Fuel Change Toolbar (LFTFCT). These rulesets initially leveraged the recent Colorado All Lands (COAL) Risk Assessment and Sagebrush Biome calibration efforts and were then updated and reviewed to reflect conditions in the analysis area. Given that the rulesets are the same across all four alternatives, the main data differences between fuelscapes are the types of disturbances included in the datasets listed above. For each fuelscape, both the surface and canopy inputs were updated to reflect the respective set of fuel disturbances.

3.1.2 FUELSCAPE SCENARIOS

3.1.2.1 CURRENT CONDITION FUELSCAPE (2022)

This fuelscape reflects current fuelscape conditions for the year 2022 and includes all historical fuel disturbances from 2012-2021. Surface and canopy inputs were adjusted to reflect any disturbances occurring in 2017-2021 which would not have already been accounted for in the LF Remap data. This "current condition" fuelscape allows hazard and risk to reflect the current fuelscape condition in 2022 and enables the user to compare current conditions to the three hypothetical fuelscapes.

3.1.2.2 INTENTIONAL DISTURBANCE FUELSCAPE (2022)

This fuelscape reflects hypothetical fuelscape conditions for the year 2022 where only intentional historical fuel disturbances such as prescribed fire treatments and mechanical treatments in 2012-2021 are included in the fuelscape.

To eliminate all unintentional disturbances (namely wildfire) from the fuelscape required a two-step process. For 2012-2016, we removed LANDFIRE wildfire disturbances from the fuelscape in both surface and canopy inputs. Secondly, any recent wildfire disturbances in 2017-2021 were removed from potential additions to this fuelscape.

Recent intentional 2017-2021 treatments were incorporated into the fuelscape, and surface and canopy inputs were further adjusted to reflect these recent intentional disturbances which would not have already been accounted for in the LF Remap data. Older intentional treatments in 2012-2016 would already have been reflected in the LANDFIRE Remap data and no further adjustments were needed for those to be included.

This "intentional disturbances" fuelscape allows the user to assess how variance in hazard and risk might be related to and affected by the efficacy of intentional treatments. This analysis is accomplished through comparisons of the hazard and risk modeling for this fuelscape to the current condition fuelscape, the unintentional disturbances fuelscape, and the no disturbances fuelscape.

3.1.2.3 UNINTENTIONAL DISTURBANCES FUELSCAPE (2022)

This fuelscape reflects hypothetical fuelscape conditions for the year 2022 where only unintentional historical fuel disturbances such as wildfire in 2021-2021 were included in the fuelscape.

To eliminate all intentional disturbances (such as prescribed fire treatments and mechanical treatments) from the fuelscape required a two-step process, similar to the approach mentioned in the section above. For 2012-2016, we removed any non-wildfire LANDFIRE disturbances from the fuelscape in both surface and canopy inputs. Secondly, any recent intentional treatment disturbances (fire or mechanical) in 2017-2021 were removed from potential additions to this fuelscape.

Recent 2017-2021 wildfire disturbances were incorporated into the fuelscape, and surface and canopy inputs were further adjusted to reflect these recent disturbances which would not have already been accounted for in the LF Remap data. Older wildfire disturbances in 2012-2016 would already have been reflected in the LANDFIRE Remap data and no further adjustments were needed for those to be included.

This “unintentional disturbances” fuelscape allows the user to assess how variance in hazard and risk might be related to and affected by unplanned wildfires. This analysis is accomplished through comparisons of the hazard and risk modeling for this fuelscape to the current condition fuelscape, the intentional disturbances fuelscape, and the no disturbances fuelscape.

3.1.2.4 NON-DISTURBED FUELSCAPE (2022)

This fuelscape reflects hypothetical fuelscape conditions for the year 2022 where no disturbances (intentional or unintentional) were included. For 2012-2016, we removed all LANDFIRE disturbances from the fuelscape in both surface and canopy inputs and did not include any recent disturbances.

This "no disturbance" fuelscape allows the user to assess how the variance in hazard and risk might be related to the lack of any disturbances or treatments. This analysis is accomplished through comparisons of the hazard and risk modeling for this fuelscape to the current condition fuelscape, the intentional disturbances fuelscape, and the unintentional disturbances fuelscape.

The varying FM40 dataset scenarios can be seen in Figure 3 in groups of similar fuel types. Each fuelscape scenario's datasets can be combined into a single landscape (LCP) file and used as a fuelscape input in fire modeling programs.

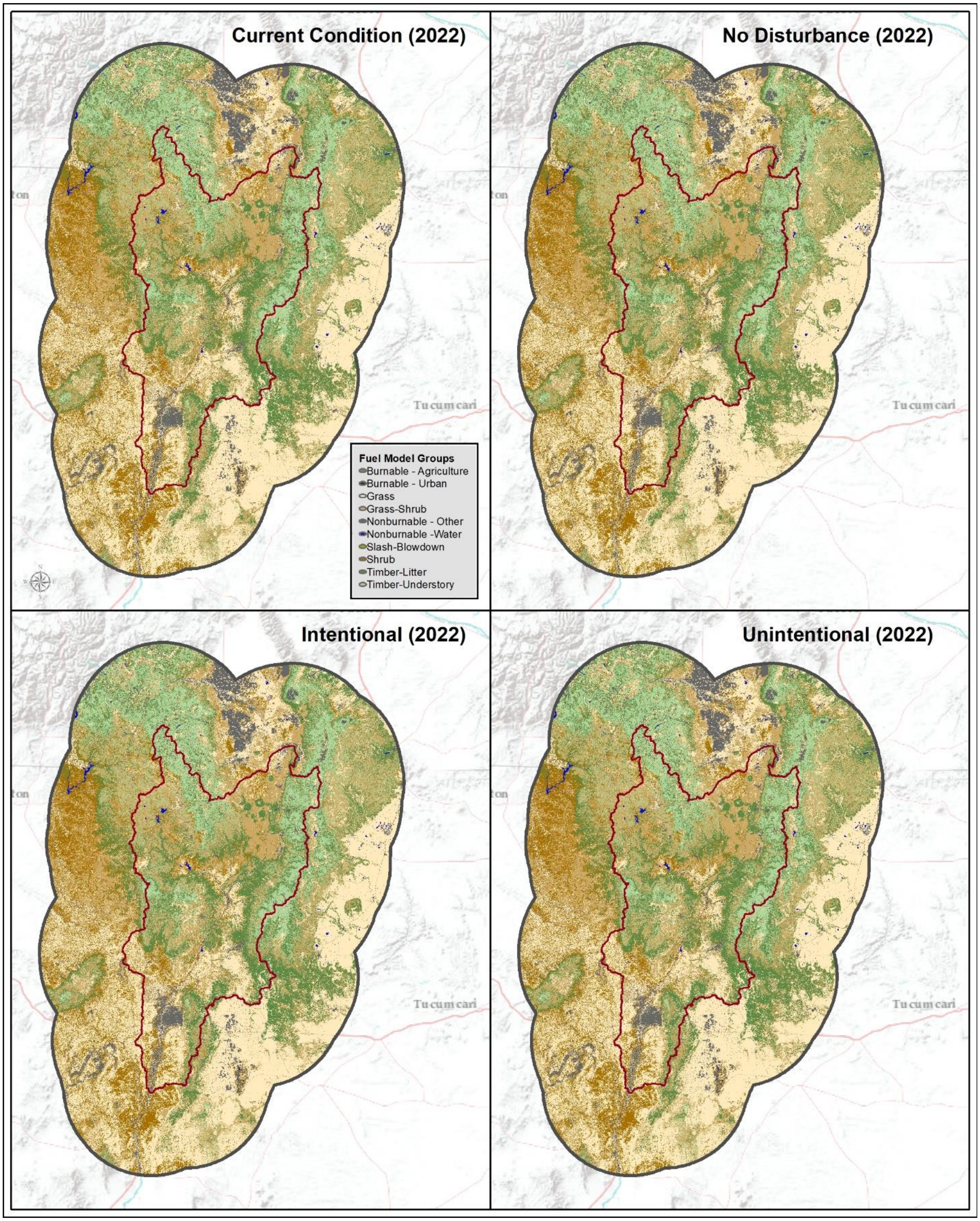

Figure 3. Map of 2022 fuelscape scenario fuel model groups across the Rio Grande Water Fund LCP extent.

3.2 WILDFIRE HAZARD

3.2.1 WILDFIRE SIMULATION (BURN PROBABILITY)

The FSim large-fire simulator was used to quantify wildfire hazard for each of the four fuelscape scenarios at a pixel size of 120 m (3.5 acres per pixel). FSim is a comprehensive fire occurrence, growth, behavior, and suppression simulation system that uses locally relevant fuel, weather, topography, and historical fire occurrence information to make a spatially resolved estimate of the contemporary likelihood and intensity of wildfire across the landscape (Finney et al. 2011). To enable greater resolution on HVRA mapping, we chose to upsample the FSim burn probability (BP) raster from its native resolution of 120 m to 30 m. Further details regarding methods and hazards results are available in the RGWF Wildfire Hazard report.

3.2.2 INTENSITY CALCULATIONS

In addition to estimates of wildfire likelihood, FSim produces measurements of predicted wildfire intensities. Due to the inherent challenges of estimating intensity with a stochastic simulator, estimates of fire intensity were developed for the four fuelscape scenarios using a custom Pyrologix utility called WildEST (Scott et al. 2020). WildEST is a deterministic wildfire modeling tool that integrates spatially continuous weather input variables, weighted based on how they will likely be realized on the landscape. This makes the deterministic intensity values developed with WildEST more robust for use in effects analysis than the stochastic intensity values developed with FSim. This is especially true in low wildfire occurrence areas where predicted intensity values from FSim are reliant on a very small sample size of potential weather variables. The WildEST methodology is further described in Section 3 of the RGWF Wildfire Hazard report.

3.3 HVRA CHARACTERIZATION

Highly Valued Resources and Assets (HVRA) are the resources and assets on the landscape most likely to warrant protection if found to be at risk of wildfire. The key criteria for inclusion in the RGWF assessment is an HVRA must be of greatest importance to the watershed, the spatial data must be readily available, and the spatial extent of the identified HVRA must be complete.

There are three primary components to HVRA characterization: HVRAs must be identified, and their spatial extent mapped, their response to fire (negative, neutral, or positive) must be characterized, and their relative importance to each other must be determined.

3.3.1 HVRA

A set of HVRAs were identified based on readily available spatial datasets and provided by the Rio Grande Water Fund. The complete list of HVRAs and their associated data sources are listed in Table 1. To the greatest degree possible, HVRAs are mapped to the extent of the Rio Grande Water Fund boundary (Figure 2). This is the boundary used to summarize the final risk results.

Table 1. HVRA and sub-HVRA identified for the RGWF Wildfire Risk Assessment and associated data sources.

HVRA & Sub-HVRA	Data Source
Water	
Irrigation	The data set represents benefit-weighted annual average runoff for irrigation.
Public Water	The data set represents benefit-weighted annual average runoff public water systems.
Water for Nature	The data set represents benefit-weighted annual average runoff for nature.
Stream Transmission	The data set represents mitigation of post-fire debris-flow risk transmission to streams and is represented via streams below dams through which water is moved to meet downstream calls.
Habitat	
Terrestrial Habitat	The data set represents terrestrial wildlife habitat and is represented through wildlife-weighted vegetation (used CHAT and other measures of habitat values).
Aquatic Habitat	The data set represents mitigation of post-fire debris-flow risk to aquatic habitat and is represented by streams designated by the New Mexico Environment Department for use by "cold water aquatic life".
Vegetation	
Vegetation	The data set represents vegetation susceptible to fire.
Timber	
Timber	The data set represents timber harvest value or timber-weighted vegetation.
People & Property	
Structures	The data set represents all building assets within the analysis area.
Structure Debris Flow	The data set represents mitigation of post-fire debris-flow risk to buildings and captures areas where if burned are likely to produce post-fire floods that would impact downstream buildings in the flood plain.

3.3.2 RESPONSE FUNCTIONS

Each HVRA selected for the assessment must also have an associated response to wildfire, whether positive, neutral, or negative. Response function assignments were provided by the Rio Grande Water Fund, representing each resource or asset's response to fires of different intensity levels, and characterized the HVRA response using values ranging from -100 to 100. The flame-length values corresponding to the fire intensity levels used in risk calculations are shown in Table 2. The response functions (RFs) used in the risk results are shown in Table 3 below.

Table 2. Flame-length values corresponding to Fire Intensity Levels used in assigning response functions.

Fire Intensity Level (FIL)	**1**	**2**	**3**	**4**	**5**	**6**
Flame Length Range (feet)	0-2	2-4	4-6	6-8	8-12	12+

Table 3. Response Functions used for Rio Grande Water Fund Wildfire Risk Assessment

HVRA	FIL1	FIL2	FIL3	FIL4	FIL5	FIL6
Irrigation	20	10	0	-20	-40	-60
Public Water	20	10	0	-20	-40	-60
Water for Nature	20	10	0	-20	-40	-60
Stream Transmission	0	0	-20	-40	-60	-80
Vegetation	30	10	0	-30	-60	-90
Terrestrial Habitat	30	10	0	-30	-60	-90
Aquatic Habitat	0	0	-20	-40	-60	-80
Timber	30	10	0	-30	-60	-90
Structures	-20	-30	-50	-70	-80	-95
Structure Debris Flow	0	0	-10	-30	-55	-90

3.3.3 RELATIVE IMPORTANCE

Relative importance (RI) assignments are needed to integrate results across all HVRAs. Without this input to prioritize among HVRAs, the default is to assume equal weighting among HVRA – a result that is never a desired outcome. RI assignments were provided by the Rio Grande Water Fund, establishing the importance, and ranking of the primary HVRAs relative to each other. A breakdown of the relative importance of the HVRAs can be seen in Figure 4. These importance percentages reflect the overall importance of the primary HVRAs relative to each other.

Sub-HVRA relative importance was also provided by the Rio Grande Water Fund and determined through the assignment process. Sub-RIs consider both the relative importance per unit area and the mapped extent of the Sub-HVRA layers within the primary HVRA category. These calculations need to account for the relative extent of each HVRA to avoid overemphasizing an HVRA that covers many acres. This was accomplished by normalizing the calculations by the relative extent of each HVRA in the assessment area. Here, relative extent refers to the number of 30-m pixels mapped in each HVRA. By using this method, the relative importance of each HVRA is spread out over the HVRA's entire extent. An HVRA with few pixels can have a high importance per pixel while an HVRA with a great many pixels can have a low importance per pixel. A weighting factor (called Relative Importance Per Pixel [RIPP]) representing both the relative importance per unit area and overall importance was calculated for each HVRA. Table 4 lists each HVRA and its associated relative importance (RIPP).

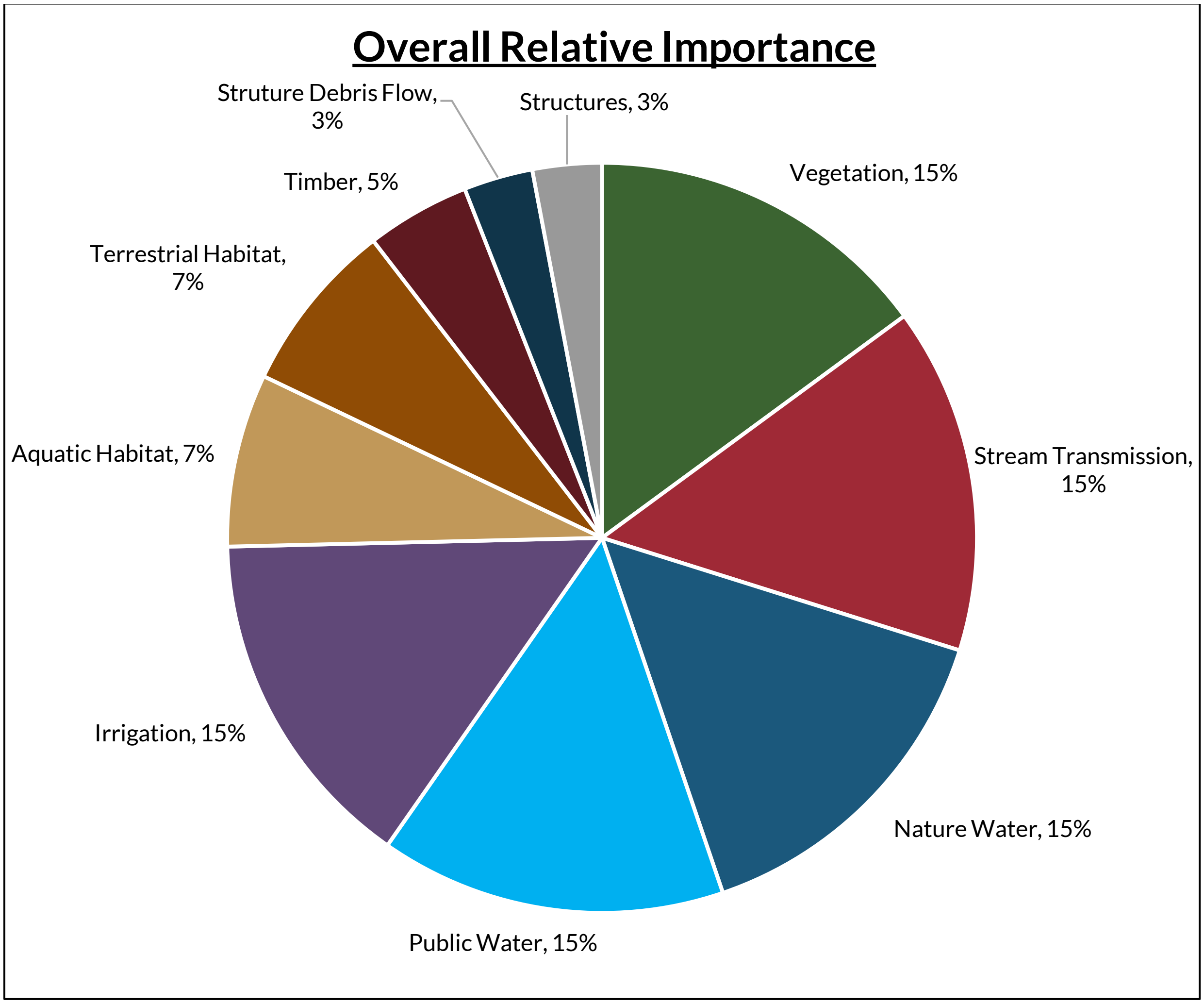

Figure 4. Overall HVRA Relative Importance for the primary HVRA.

Table 4. Relative Importance Per Pixel (RIPP) for all sub-HVRA

HVRA	Sub-HVRA	RIPP
Irrigation	Irrigation Class 1	0.0027
Irrigation	Irrigation Class 2	0.0054
Irrigation	Irrigation Class 4	0.0107
Irrigation	Irrigation Class 8	0.0214
Public Water	Public Water Class 1	0.0147
Public Water	Public Water Class 2	0.0294
Public Water	Public Water Class 4	0.0587
Public Water	Public Water Class 8	0.1175
Public Water	Public Water Class 16	0.2349
Water for Nature	Water for Nature Class 1	0.0033
Water for Nature	Water for Nature Class 2	0.0066
Water for Nature	Water for Nature Class 4	0.0132
Water for Nature	Water for Nature Class 8	0.0265
Stream Transmission	Stream Transmission Class 1	0.0033
Stream Transmission	Stream Transmission Class 2	0.0066
Stream Transmission	Stream Transmission Class 4	0.0132
Stream Transmission	Stream Transmission Class 8	0.0264
Stream Transmission	Stream Transmission Class 16	0.0529
Vegetation	Fire Susceptible Vegetation	0.0119
Terrestrial Habitat	Terrestrial Habitat Class 1	0.0007
Terrestrial Habitat	Terrestrial Habitat Class 2	0.0014
Terrestrial Habitat	Terrestrial Habitat Class 4	0.0029
Terrestrial Habitat	Terrestrial Habitat Class 8	0.0057
Terrestrial Habitat	Terrestrial Habitat Class 12	0.0086
Terrestrial Habitat	Terrestrial Habitat Class 16	0.0115
Aquatic Habitat	Aquatic Habitat Class 1	0.0023
Aquatic Habitat	Aquatic Habitat Class 2	0.0046
Aquatic Habitat	Aquatic Habitat Class 4	0.0092
Aquatic Habitat	Aquatic Habitat Class 8	0.0183
Aquatic Habitat	Aquatic Habitat Class 16	0.0366
Timber	Timber Class 1	0.0006
Timber	Timber Class 2	0.0011
Timber	Timber Class 4	0.0022
Timber	Timber Class 8	0.0044
Structures	Buildings	0.0242
Structure Debris Flow	Structure Debris Flow Class 2	0.0006
Structure Debris Flow	Structure Debris Flow Class 4	0.0013
Structure Debris Flow	Structure Debris Flow Class 8	0.0026
Structure Debris Flow	Structure Debris Flow Class 16	0.0051
Structure Debris Flow	Structure Debris Flow Class 32	0.0103

4 EFFECTS ANALYSIS

An effects analysis quantifies wildfire risk as the expected value of net response (Finney 2005; Scott et al. 2013) also known as expected net value change (eNVC). Effects analysis relies on input from resource specialists to produce response functions for Highly Valued Resources and Assets (HVRA) occurring in the analysis area. A response function is a tabulation of the relative change in the value of an HVRA if it were to burn in each of six WildEST flame-length classes. A positive value in a response function indicates a benefit or increase in value; a negative value indicates a loss or decrease in value.

For the RGWF assessment, the term Highly Valued Resources and Assets (HVRA) is used to describe what has previously been labeled “values at risk.” This change in terminology is important to highlight because resources and assets are not themselves “values” in a way that the term is conventionally defined—they *have* value (importance). For example, assets are human-made features, such as commercial structures, critical facilities, housing, etc., that have specific importance or value. Resources are natural features, such as wildlife habitat, vegetation type, or water with specific importance or value. While such resources and assets may be exposed to wildfire, they are not necessarily “at-risk”—that is the purpose of the assessment.

4.1 CALCULATIONS

Integrating HVRAs with differing units of measure (for example, habitat vs. homes) requires relative importance (RI) values for each HVRA/sub-HVRA. These values were provided by the Rio Grande Water Fund, as discussed in section 3.3.3. The final importance weight used in the risk calculations is a function of overall HVRA importance, sub-HVRA importance, and relative extent (pixel count) of each sub-HVRA. This value is therefore called relative importance per pixel (RIPP).

The RF and RIPP values were combined with estimates of the flame-length probability (FLP) in each of the six flame-length classes to estimate conditional net value change (cNVC) as the sum-product of flame-length probability (FLP) and response function value (RF) over all the six flame-length classes, with a weighting factor adjustment for the relative importance per unit area of each HVRA, as follows:

$$cNVC_j = \sum_{i}^{n} FLP_i * RF_{ij} * RIPP_j$$

where *i* refers to flame length class (n = 6), *j* refers to each HVRA, and RIPP is the weighting factor based on the relative importance and relative extent (number of pixels) of each HVRA. The cNVC calculation shown above places each pixel of each resource or asset on a common scale (relative importance), allowing them to be summed across all resources to produce the total cNVC at a given pixel:

$$cNVC = \sum_{j}^{n} cNVC_j$$

where cNVC is calculated for each pixel in the analysis area.

Finally, the expected net value change (eNVC) for each pixel is calculated as the product of cNVC and annual BP:

$$eNVC = cNVC * BP$$

4.2 UPSAMPLING FSIM RESULTS

FSim's stochastic simulation approach can be computationally intensive and time-constraining on large landscapes. The challenge is to determine a resolution sufficiently fine to retain detail in fuel and terrain features while producing calibrated results in a reasonable timeframe. Moreover, HVRA are often mapped at the same resolution as the final BP produced by FSim. To enable greater resolution on HVRA mapping, we chose to upsample the FSim burn probability (BP) rasters to 30-m, consistent with HVRA mapping at 30-m. More information on probability upsampling is available in the RGWF Wildfire Hazard report.

5 RESULTS

5.1 EFFECTS ANALYSIS RESULTS

The cumulative results of the wildfire risk calculations described in section 4.1 are the spatial grids of cNVC and eNVC, representing both the conditional and expected change in value from wildfire disturbance to all HVRAs included in the analysis. Results are limited to those pixels that have at least one HVRA and a non-zero burn probability. Both cNVC and eNVC reflect an HVRA's response to fire and their relative importance within the context of the assessment, while eNVC additionally captures the relative likelihood of wildfire disturbance. Cumulative effects of wildfire across the landscape vary by fuelscape (Figure 5). Results are scaled to mean eNVC values for the No Disturbance fuelscape in the RGWF analysis area. The No Disturbance fuelscape shows the greatest cumulative wildfire losses (eNVC) result followed by Intentional and Unintentional, as the fuelscapes with the greatest cumulative risk.

Figure 6 shows cNVC results for each of the four fuelscape scenarios at a 30-m resolution across the analysis area. The most adverse effects are shown in dark red and are largely concentrated around stream transmission and aquatic habitat HVRA. Adjusting cNVC by fire likelihood (i.e., burn probability) narrows the range of values for negative outcomes and highlights areas more likely to be visited by wildfire as seen in the tiled eNVC map in Figure 8. Figure 7 shows the upsampled BP derived for each fuelscape, as discussed in section 4.2.

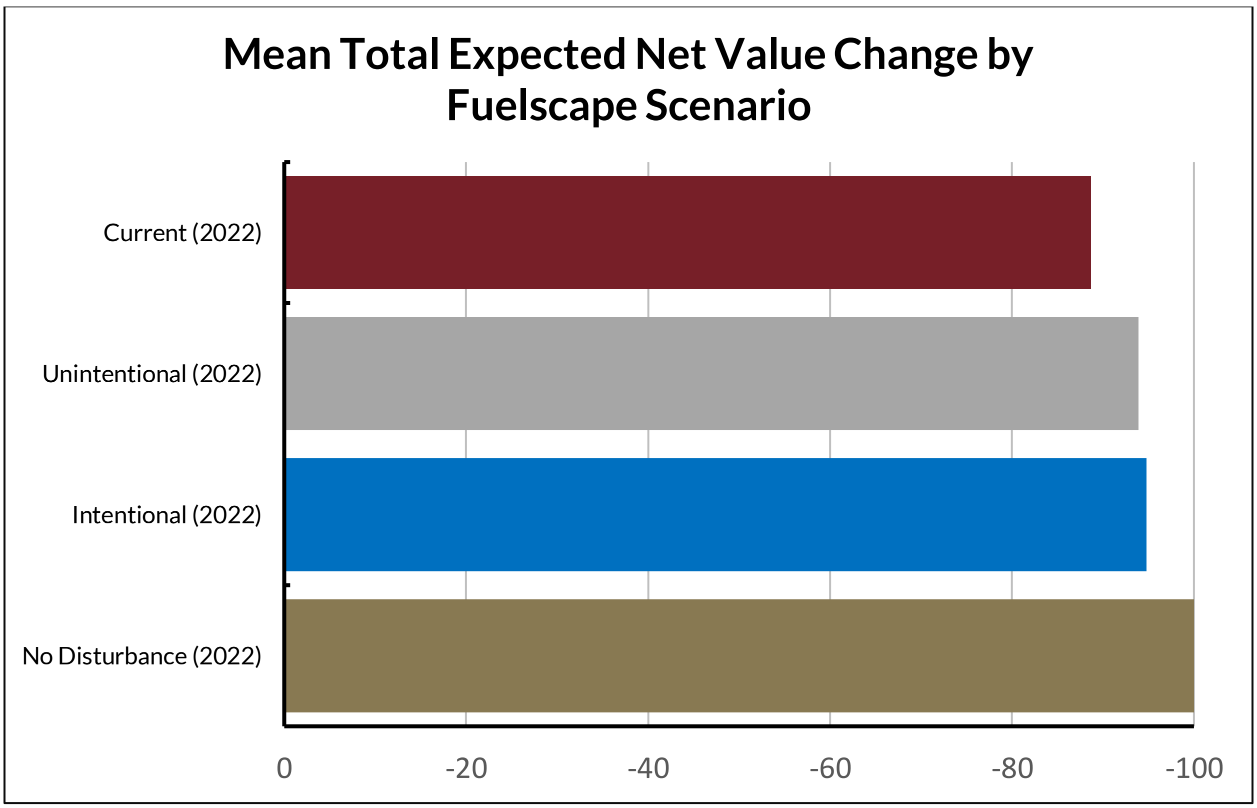

Figure 5. Weighted net response of mean Expected Net Value Change by fuelscape scenario. The results are listed in order of mean overall value change and scaled to eNVC values for the No Disturbance Fuelscape.

5.1.1 CONSEQUENCE – CONDITIONAL NET VALUE CHANGE (CNVC)

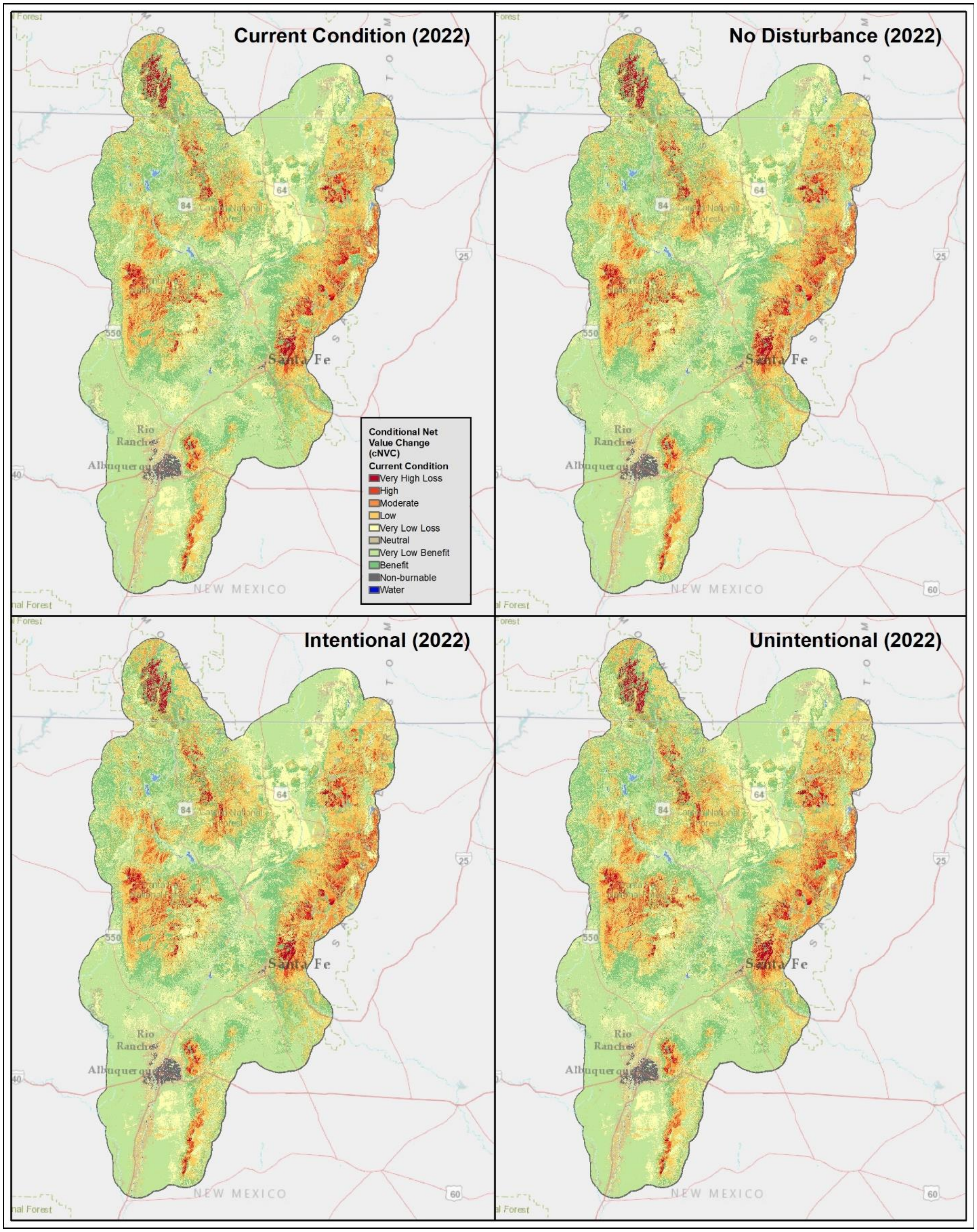

Figure 6. Map of Conditional Net Value Change (cNVC) for all fuelscapes at the analysis area (30-m resolution).

5.1.2 LIKELIHOOD – ANNUAL BURN PROBABILITY (BP)

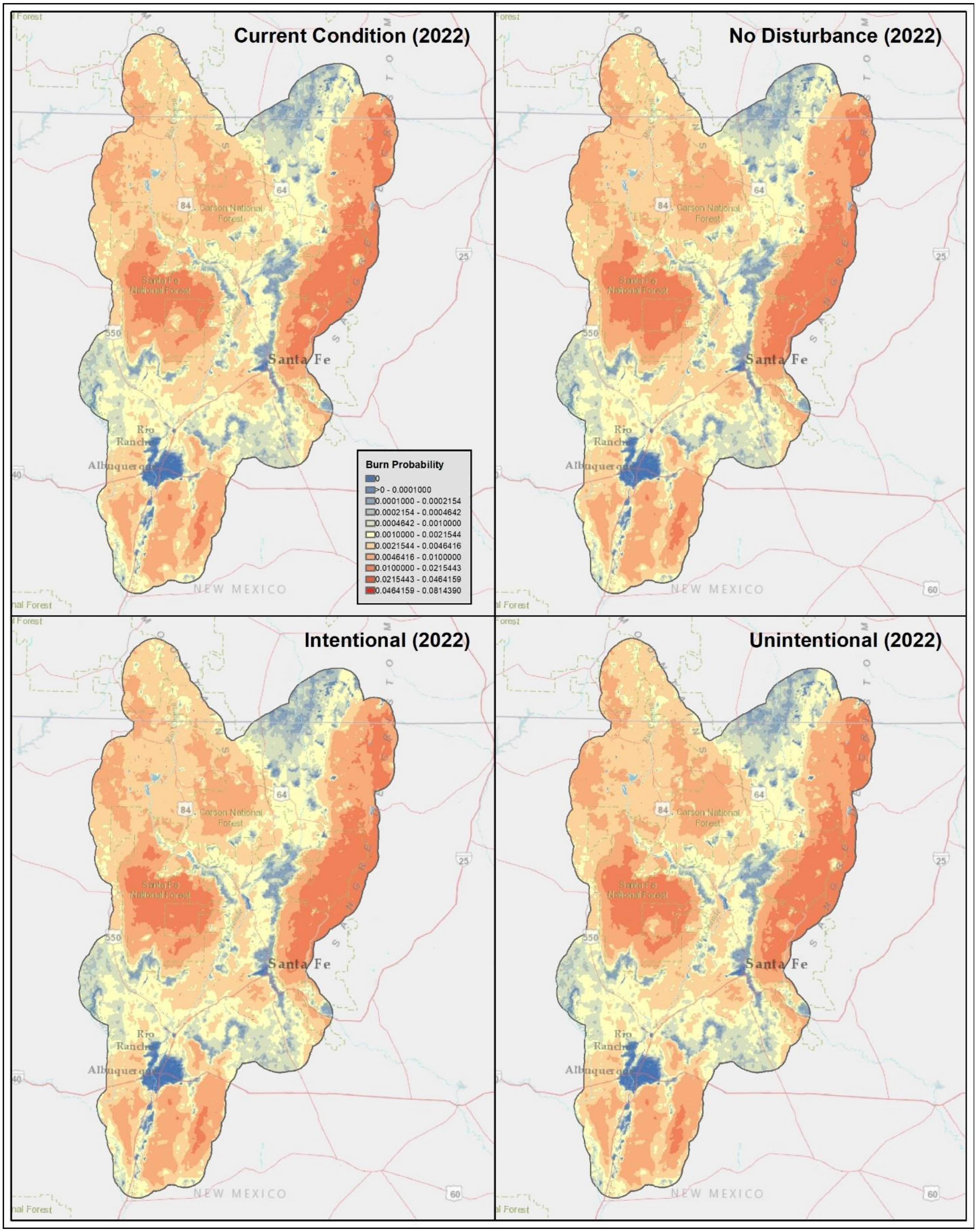

Figure 7. Map of integrated FSim burn probability results for all fuelscapes at the analysis area (30-m resolution).

5.1.3 RISK – EXPECTED NET VALUE CHANGE (ENVC) - TOTAL

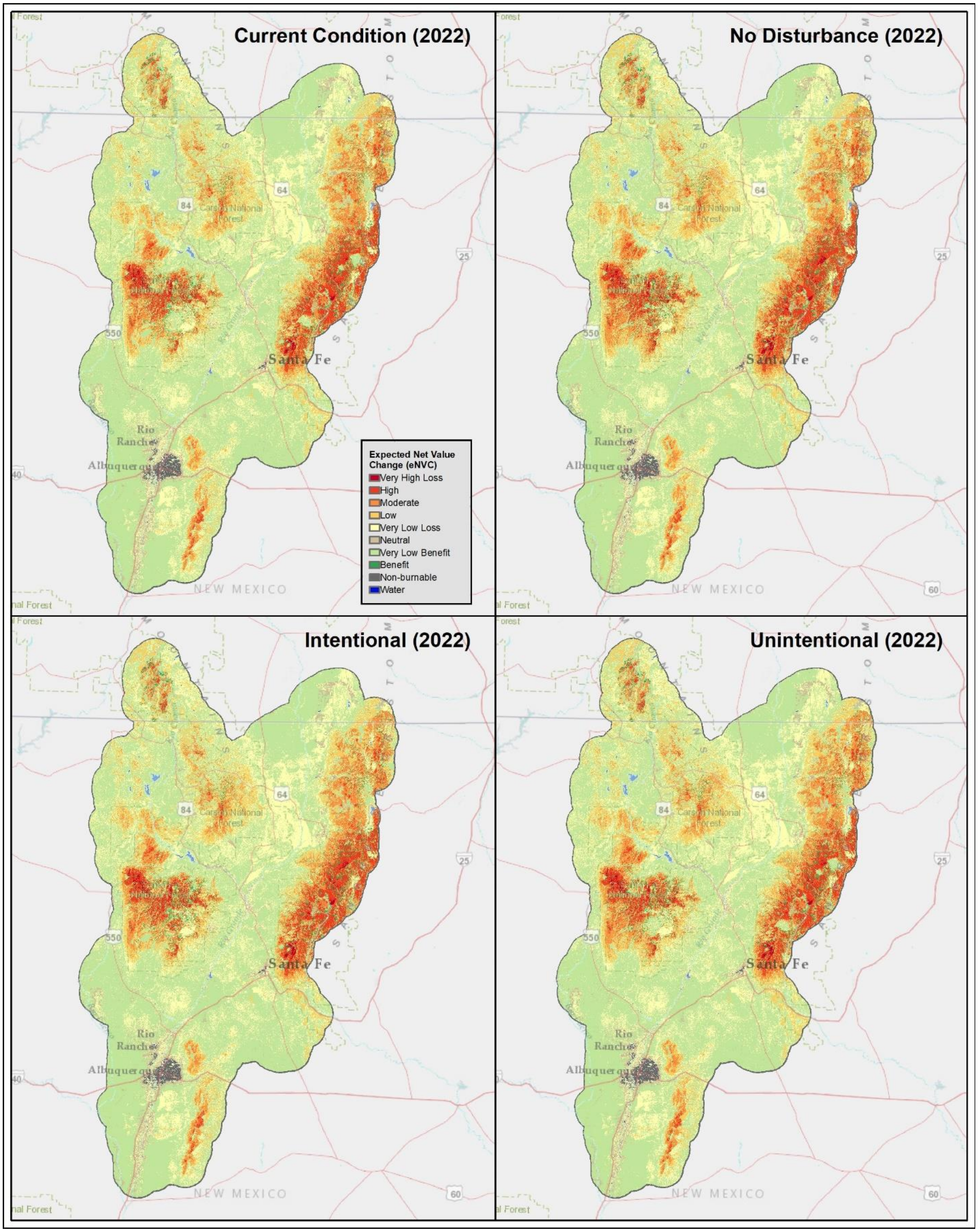

Figure 8. Map of Expected Net Value Change (eNVC) for all fuelscapes at the analysis area (30-m resolution).

6 ANALYSIS SUMMARY

The RGWF Wildfire Risk Assessment provides foundational information about wildfire hazard and risk across the watershed. The results represent the best available science across a range of disciplines. While this report was generated by Pyrologix LLC, the overall analysis was developed as a collaborative effort with the Rio Grande Water Fund. This analysis can provide great utility in a range of applications including resource planning, prioritization and implementation of prevention and mitigation activities, and wildfire incident response planning. Lastly, this analysis should be viewed as a living document. While the effort to parameterize and calibrate model inputs should remain static, the landscape file should be periodically revisited and updated to account for future forest disturbances.

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8 DATA PRODUCTS

The Rio Grande Water Fund Wildfire Risk Assessment required the development of a wide range of data products. The section below outlines those datasets, with a brief description, based on provided data deliverables. More detailed descriptions of data product background and development procedures can be found in the metadata of each data product.

Deliverable Folder	Data Product	Description
	HVRA Characterization	
3.1	Table of response functions and relative importance values for each HVRA	This subfolder contains an Excel file (*RGWF_RF-RI_2022_FULL_20220610.xlsx*) containing a table of response functions and relative importance values for each assessed HVRA.
3.2	Spatial data representing the assessed HVRA	This subfolder contains an ESRI ArcGIS geodatabase containing HVRA rasters used as inputs for the risk calculation.

Deliverable Folder	Data Product	Description
	Effects Analysis	
4.1(B)	**Baseline (2012)** Wildfire Risk (eNVC) and Consequence (cNVC) by HVRA and in total	The subfolder contains two ESRI ArcMap geodatabases that contain rasters representing **Baseline (2012)** conditional and expected NVC results for all assessed HVRA individually (irrigation, public water, water for nature, stream transmission, terrestrial habitat, aquatic habitat, vegetation, timber, structures, structure debris flow), and in total.

4.1(C)	**Current Condition (2022)** Wildfire Risk (eNVC) and Consequence (cNVC) by HVRA and in total for	The subfolder contains two ESRI ArcMap geodatabases that contain rasters representing **Current Condition (2022)** conditional and expected NVC results for all assessed HVRA individually (irrigation, public water, water for nature, stream transmission, terrestrial habitat, aquatic habitat, vegetation, timber, structures, structure debris flow), and in total.
4.1(I)	**Intentional (2022)** Wildfire Risk (eNVC) and Consequence (cNVC) by HVRA and in total	The subfolder contains two ESRI ArcMap geodatabases that contain rasters representing **Intentional (2022)** conditional and expected NVC results for all assessed HVRA individually (irrigation, public water, water for nature, stream transmission, terrestrial habitat, aquatic habitat, vegetation, timber, structures, structure debris flow), and in total.
4.1(N)	**No Disturbance (2022)** Wildfire Risk (eNVC) and Consequence (cNVC) by HVRA and in total	The subfolder contains two ESRI ArcMap geodatabases that contain rasters representing **No Disturbance (2022)** conditional and expected NVC results for all assessed HVRA individually (irrigation, public water, water for nature, stream transmission, terrestrial habitat, aquatic habitat, vegetation, timber, structures, structure debris flow), and in total.
4.1(U)	**Unintentional (2022)** Wildfire Risk (eNVC) and Consequence (cNVC) by HVRA and in total	The subfolder contains two ESRI ArcMap geodatabases that contain rasters representing **Unintentional (2022)** conditional and expected NVC results for all assessed HVRA individually (irrigation, public water, water for nature, stream transmission, terrestrial habitat, aquatic habitat, vegetation, timber, structures, structure debris flow), and in total.

9 CHANGE LOG

The change log documents changes made to this document after the initial submission.

Date	Location of Change	Author	Description of Change
6/28/2022	-	-	Initial submission

THANK YOU

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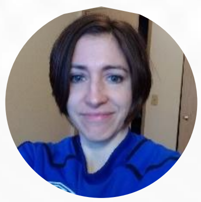

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The Rio Grande Water Fund wildfire risk assessment was conducted by Pyrologix, a wildfire hazard and risk assessment research firm based in Missoula, Montana.

For More Information Please Visit:

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