Assessment Name:

Region 2 – Fuels and Preparedness Budget Allocation

Presented by:

Jim Menakis/Paul Langowski

Scale:

Regional

Management issue:

How to prioritize the allocation of wildland fire funding to high risk areas (Forests) in the Rocky Mountain Region –

> WFHF – Where are the highest priority areas in the region for investing in treatments and how to allocate funds to those areas?
>
> WFPR – How do we apportion increases or decreases in program funding?

Project Management:

WFHF had been allocated to the regions and within R2 to the forests using a risk based approach since 2008 using the HFPAS process. In the fall of 2011 the Region was approached by the WO to see if we would be interested in piloting an approach using a methodology developed by the Cohesive Strategy Science Team to inform our WFHF allocation process. The Regional Fuels Branch Chief briefed Regional leadership on the benefits and costs of undertaking a Regional Risk Assessment using the Fire NVC tool being developed by the RMRS and the intended use of the assessment results and received permission to proceed with the analysis in late Fall 2011. In Early 2012 roles and responsibilities were defined, scope of analysis and tentative completion dates were agreed upon, tentative HVRA's were defined, the process of compiling relevant geospatial data was initiated, workshop dates established and workshop participants contacted. No additional funding was provided to the Region for the analysis.

It was agreed upon that the target for completion of the Risk Analysis was August 2012. This date was selected to ensure that the results would be available to be vetted with leadership and if accepted be available to inform the 2013 initial budget allocation.

Primary participants during this phase were the Branch Chiefs – Fuels, Regional Fire GIS Specialist, Regional Fire Use Specialist and RMRS and Fire Lab personnel.

Workshop 1 – March 2012 – A group of Regional Resource specialists (wildlife biologist, soil scientist, fire use specialist, fuels specialist, hydrologist, silviculturist, botanist, TES program leader) met for a full day session to define the response functions that would support the fire effects analysis. Expert judgment from Regional Office resource specialists and fire behavior specialists was elicited regarding how identified HVRAs may be affected by fire.

Workshop 2 – March 2012 – Half day meeting with Regional Leadership, (Deputy Regional Forester – Resources, Directors of Renewable Resources and Fire and Aviation Management, Regional Budget Officer and the Grand Mesa Uncompahgre, Gunnison and Arapaho Roosevelt and Pawnee National

Grassland Forest Supervisors) established the relative importance across HVRAs. The purpose of this workshop was to establish quantitative weights that differentiate the relative importance of HVRAs. The weights are used for calculation and visualization of weighted risk scores that summarize risks across all HVRAs.

Fuel and fire behavior modeling:

FSIM - Off the shelf National level 2011 FSIM run clipped to R2 (Rocky Mountain Region Boundaries) was utilized for the Regional Risk Assessment to minimize preparation and analysis time.

HVRAs

HVRA's were determined based upon goals of Cohesive strategy, Congressional and Forest Service budget intent, Regional Emphasis Areas (watersheds) and what data we had that was readily available and regionally consistent. Intent was for an essentially off the shelf analysis. There was no new data acquisition but we did do some analysis on existing data to create GIS layers for the analysis.

One of the challenges we faced was linked to our decision to use the National FSIM runs. The Region as many areas of the west was being affected significantly by mountain pine beetle. Without rerunning FSIM we needed to come up with a way to reflect changed fire behavior due to years of MPB activity. After consultation with Matt Thompson at RMRS and Matt Jolly at the Fire Lab we decided on an approach of using a measure of the intensity of Bark Beetle impacts as a modify to the response functions. Working with FHTET (Forest Health Technology Enterprise Team) we utilized 2000-2011 aerial survey data reclassified into 3 levels of activity, Low Moderate, High. This layer was a stumbling block for the analysis as it was more difficult to produce than originally anticipated.

The HVRA's developed for the 2012 analysis from regionally consistent spatial data used for the overall Regional Risk assessment are shown in Table 1.

Table 1: Highly Valued Resources and Assets used in Rocky Mountain Region Wildfire Risk Assessment (2012)

HVRA/Data source	Sub-HVRA
WUI (Residentially Developed Populated Areas) RMRS	low population density (< 28)
	moderate population density (28 - 250)
	high population density (250+ / sq mi)
Watersheds - Surface Drinking Water Importance (Forests to Faucets)	Moderate Importance to surface drinking water
	High importance to surface drinking water
Timber (Regional Forest Plan Management Areas)	Active Timber Program(BH)

HVRA/Data source	Sub-HVRA
	Other Timber Programs
Infrastructure (INFRA and WFDSS)	Transmission lines
	Communication facilities
	Rec residences / admin sites
	Campgrounds, trailheads, etc.
	Ski Areas
Habitat (Regional Data)	Mexican Spotted Owl (MSO)
	Greenback Cutthroat Trout
	Pawnee Montane Skipper
	Preble's Meadow Jumping Mouse
	Grizzly (WBP)
	Sage Grouse

In addition to potential fire behavior two additional variables, Bark Beetle impacts and Erosion Risk were utilized in the development of the response functions (Table 2). Bark Beetle Impacts were considered in the development of response functions for all HVRA's as a modifier of potential fire effects. Erosion Risk was also considered for Surface Drinking Water Importance and Aquatic Habitat for TES

Table 2: Variables used to developed Response Functions in Rocky Mountain Region Wildfire Risk Assessment (2012)

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3
Watersheds		Erosion Risk	Bark Beetle Impacts	Flame Length
WUI			Bark Beetle Impacts	Flame Length

Habitat	Multiple Species	Erosion Risk	Bark Beetle Impacts	Flame Length
Infrastructure	Multiple Sub-Layers		Bark Beetle Impacts	Flame Length
Timber	Activity Level		Bark Beetle Impacts	Flame Length

The Response Functions (RF) developed for the analysis are shown in Table 3.

Table 3: Response Functions utilized in Rocky Mountain Region Wildfire Risk Assessment (2012)

HVRA	**Sub-HVRA**	**Variable 1**	**Variable 2**	**Variable 3**					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
WUI	low (< 28/ sq mi), moderate (28 - 250/ sq mi) and high population density (250+ / sq mi)		none - low	-10	-20	-40	-80	-100	-100
			mod	-20	-40	-80	-100	-100	-100
			high	-20	-40	-80	-100	-100	-100
Water Supply	Moderate and High importance to surface drinking water	none - low	none - low	0	0	-10	-20	-30	-30
			mod	0	0	-10	-20	-30	-30
			high	0	-10	-20	-25	-30	-30
		mod	none - low	0	-10	-20	-30	-40	-50
			mod	0	-10	-30	-40	-50	-60

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
			high	-10	-20	-40	-60	-70	-80
		high	none - low	0	-20	-40	-60	-80	-80
			mod	-10	-30	-70	-80	-90	-90
			high	-20	-40	-80	-90	-100	-100
Infra-Structure	Transmission Lines		none - low	0	0	0	-30	-40	-50
			mod	0	0	-30	-40	-50	-50
			high	0	0	-30	-40	-50	-50
	Communication Facilities		none - low	0	0	0	-30	-40	-50
			mod	0	0	-30	-40	-50	-50
			high	0	0	-30	-40	-50	-50
	Recreation Residences / FS Administrative sites		none - low	-10	-20	-40	-80	-100	-100
			mod	-20	-40	-80	-100	-100	-100
			high	-20	-40	-80	-100	-100	-100
	FS Recreation Infra-Structure (campgrounds, trailheads, etc.)		none - low	0	-10	-10	-20	-50	-70
			mod	-10	-10	-10	-10	-10	-10
			high	-10	-10	-10	-10	-10	-10

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
	Ski Areas		none - low	0	-10	-10	-20	-50	-70
			mod	-10	-20	-30	-40	-60	-70
			high	-20	-30	-40	-50	-70	-80
Timber Values	Active Programs (Black Hills)		none - low	0	0	-10	-20	-30	-30
			mod	0	0	-10	-20	-30	-30
			high	0	-10	-20	-25	-30	-30
	All Others		none - low	0	-10	-20	-30	-40	-50
			mod	0	-10	-30	-40	-50	-60
			high	-10	-20	-40	-60	-70	-80
Habitat (TES and Candidate Species)	Greenback Cutthroat and Rio Grande trout	none - low	none - low	20	20	-20	-40	-50	-60
			mod	20	20	-20	-40	-50	-60
			high	0	0	-40	-60	-70	-80
		mod	none - low	20	20	-30	-50	-60	-70
			mod	20	20	-30	-50	-60	-70
			high	0	0	-50	-70	-80	-90
		high	none - low	20	0	-40	-60	-70	-90
			mod	0	-10	-50	-70	-80	-90

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
			high	-10	-20	-60	-80	-90	-100
	Sage grouse (Greater & Gunnison)			-20	-70	-100	-100	-100	-100
	Preble's Meadow Jumping Mouse			10	10	-20	-60	-80	-80
	Pawnee Montane Skipper			40	60	20	-20	-60	-80
	Southwestern Willow Fly Catcher			10	10	-20	-60	-80	-80
	Mexican Spotted Owl (MSO)			30	15	-20	-60	-80	-100
	White Bark Pine (Grizzly)		none - low	40	60	10	-50	-80	-80
			mod	-20	-40	-60	-80	-90	-90
			high	-20	-40	-60	-80	-90	-90

The relative importance values established and the resulting weights are displayed in Figures 1 and 2 and Table 4.

Figure 1: HVRA Relative Importance (2012)

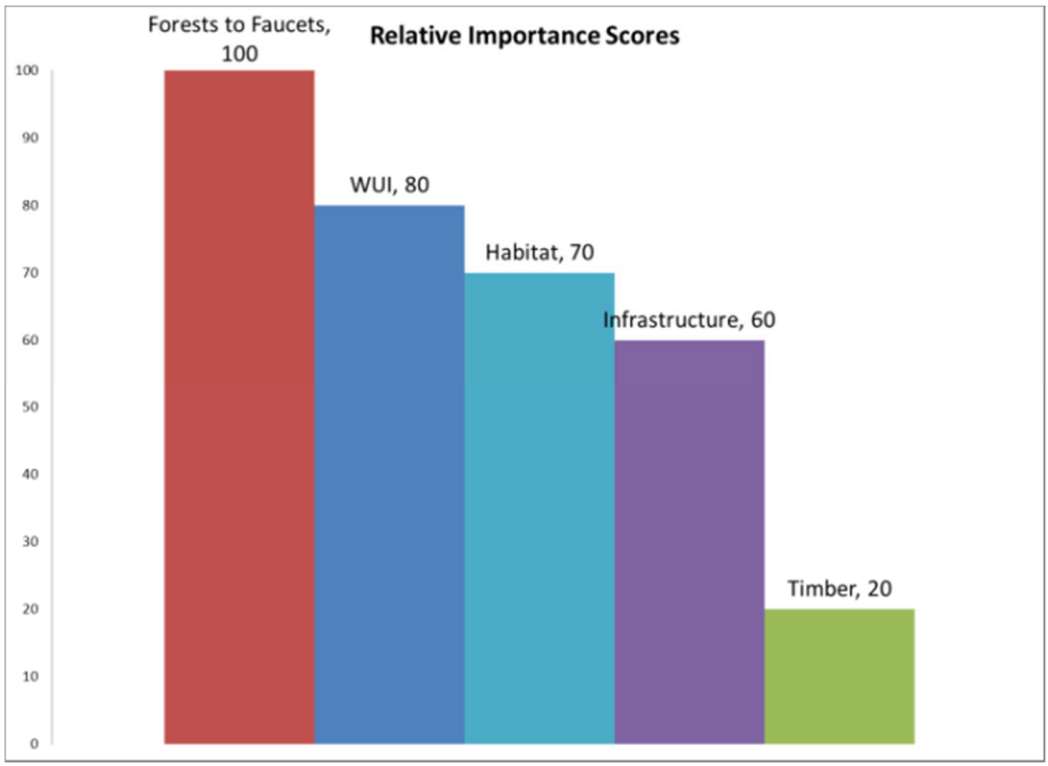


Figure 2: Share of Relative Importance across HVRAs (2012)

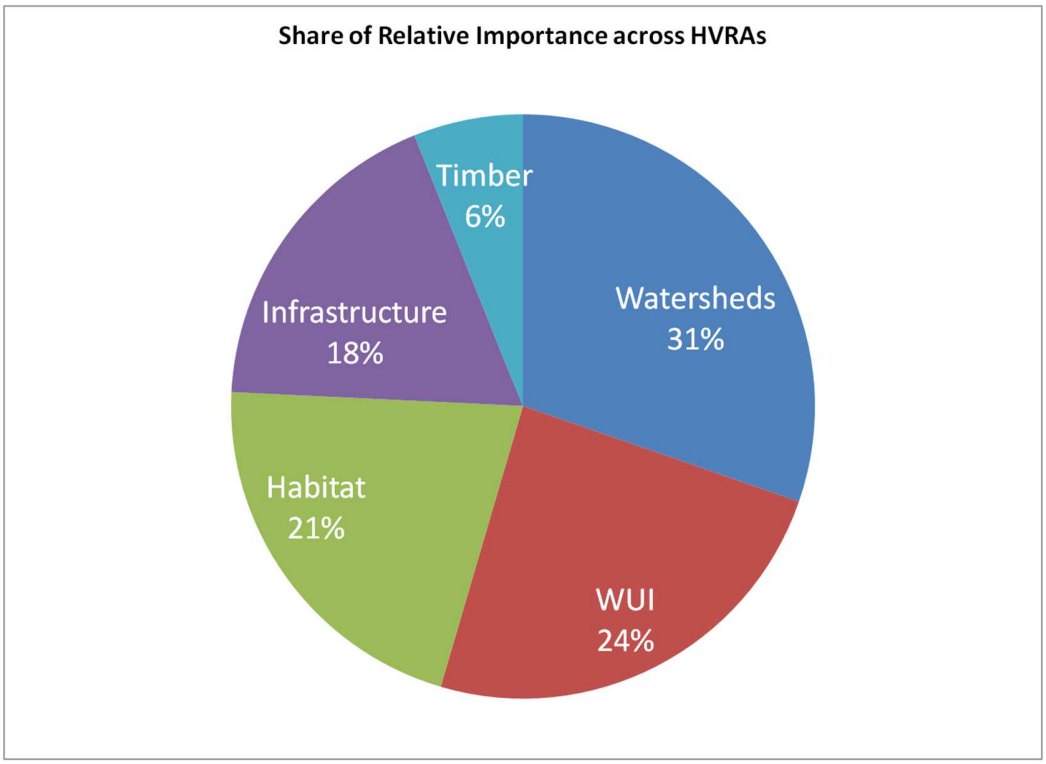


Table 4: Relative Importance Scores and Weights across HVRAs utilized in Rocky Mountain Region Wildfire Risk Assessment (2012)

HVRA	RI	RI %	Sub-HVRA	Sub-RI	Sub-RI %	Overall RI %
WUI	80	24.24%	low population density (< 28)	60	25.00%	6.06%
			moderate population density (28 - 250)	80	33.33%	8.08%
			high population density (250+ / sq mi)	100	41.67%	10.10%
Surface Drinking Water Importance (Forests to Faucets)	100	30.30%	Moderate Importance to surface drinking water	80	44.44%	13.47%
			High importance to surface drinking water	100	55.56%	16.84%
Timber	20	6.06%	Active Timber Program(BH)	100	66.67%	4.04%
			Other Timber Programs	50	33.33%	2.02%
Infrastructure	60	18.18%	Transmission lines	100	37.04%	6.73%
			Communication facilities	70	25.93%	4.71%
			Rec residences / admin sites	25	9.26%	1.68%
			campgrounds, trailheads, etc.	25	9.26%	1.68%
			ski areas	50	18.52%	3.37%
Habitat	70	21.21%	Mexican Spotted Owl (MSO)	80	17.39%	3.69%
			Greenback Cutthroat Trout	80	17.39%	3.69%
			Pawnee Montane Skipper	80	17.39%	3.69%
			Preble's Meadow Jumping Mouse	80	17.39%	3.69%
			Grizzly (WBP)	80	17.39%	3.69%
			Sage Grouse	60	13.04%	2.77%

Following the use of the 2012 analysis results in the 2013 budget allocation the process and results were reviewed and critiqued and changes for the 2014 allocation were proposed. Regional Leadership decided to limit the HVRA's to just those at the core of congressional Intent and Regional Emphasis items and eliminated the Timber program effects and TES from the analysis. It was felt those would be more appropriate for possible use in the integrated program as an investment priority.

The HVRA's used for the overall 2013 Regional Risk assessment are shown in Table 5.

Table 5: Highly Valued Resources and Assets used in Rocky Mountain Region Wildfire Risk Assessment (2013)

HVRA	Sub-HVRA
WUI (Residentially Developed Populated Areas)	low population density (< 28)
	moderate population density (28 - 250)
	high population density (250+ / sq mi)
Watersheds - Surface Drinking Water Importance (Forests to Faucets)	Moderate Importance to surface drinking water
	High importance to surface drinking water
Infrastructure	Transmission lines
	Communication facilities
	Rec residences / admin sites
	Campgrounds, trailheads, etc.
	Ski Areas

AS in the 2012 analysis, in addition to potential fire behavior two additional variables, Bark Beetle impacts and Erosion Risk were utilized in the development of the response functions (Table 6). Bark Beetle Impacts were considered in the development of response functions for all HVRA's as a modifier of potential fire effects. Erosion Risk was also considered for Surface Drinking Water Importance.

Table 6: Variables used to developed Response Functions in Rocky Mountain Region Wildfire Risk Assessment (2013)

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3
Watersheds		Erosion Risk	Bark Beetle Impacts	Flame Length
WUI			Bark Beetle Impacts	Flame Length
Infrastructure	Multiple Sub-Layers		Bark Beetle Impacts	Flame Length

The response function for the 2013 analysis were unchanged from the 2012 analysis. The Response Functions (RF) used for the 2013 analysis are shown in Table 7.

Table 7: Response Functions utilized in Rocky Mountain Region Wildfire Risk Assessment (2013)

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
WUI	low (< 28/ sq mi), moderate (28 - 250/ sq mi) and high population density (250+ / sq mi)		none - low	-10	-20	-40	-80	-100	-100
			mod	-20	-40	-80	-100	-100	-100
			high	-20	-40	-80	-100	-100	-100
Water Supply		none - low	none - low	0	0	-10	-20	-30	-30

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
	Moderate and High importance to surface drinking water		mod	0	0	-10	-20	-30	-30
			high	0	-10	-20	-25	-30	-30
		mod	none - low	0	-10	-20	-30	-40	-50
			mod	0	-10	-30	-40	-50	-60
			high	-10	-20	-40	-60	-70	-80
		high	none - low	0	-20	-40	-60	-80	-80
			mod	-10	-30	-70	-80	-90	-90
			high	-20	-40	-80	-90	-100	-100
Infra-Structure	Transmission Lines		none - low	0	0	0	-30	-40	-50
			mod	0	0	-30	-40	-50	-50
			high	0	0	-30	-40	-50	-50
	Communication Facilities		none - low	0	0	0	-30	-40	-50
			mod	0	0	-30	-40	-50	-50
			high	0	0	-30	-40	-50	-50
	Recreation Residences / FS Administrative sites		none - low	-10	-20	-40	-80	-100	-100
			mod	-20	-40	-80	-100	-100	-100

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	Bark Beetle Impacts	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
			high	-20	-40	-80	-100	-100	-100
	FS Recreation Infra-Structure (campgrounds, trailheads, etc.)		none - low	0	-10	-10	-20	-50	-70
			mod	-10	-10	-10	-10	-10	-10
			high	-10	-10	-10	-10	-10	-10
	Ski Areas		none - low	0	-10	-10	-20	-50	-70
			mod	-10	-20	-30	-40	-60	-70
			high	-20	-30	-40	-50	-70	-80
			high	0	0	-50	-70	-80	-90
		high	none - low	20	0	-40	-60	-70	-90
			mod	0	-10	-50	-70	-80	-90
			high	-10	-20	-60	-80	-90	-100

The relative importance scores the Deputy Regional Forester –Resources, Directors of Renewable Resources and Fire and Aviation Management, Regional Budget Officer and the GMUG and ARP Forest Supervisors established in 2012 for FY 2013 budget cycle were utilized in the 2013 analysis except that the relative shares were different as there were two fewer components.

The relative importance values established and the resulting weights used in the 2013 analysis are displayed in Figures 3 and 4 and Table 8.

Figure 3: HVRA Relative Importance (2013)

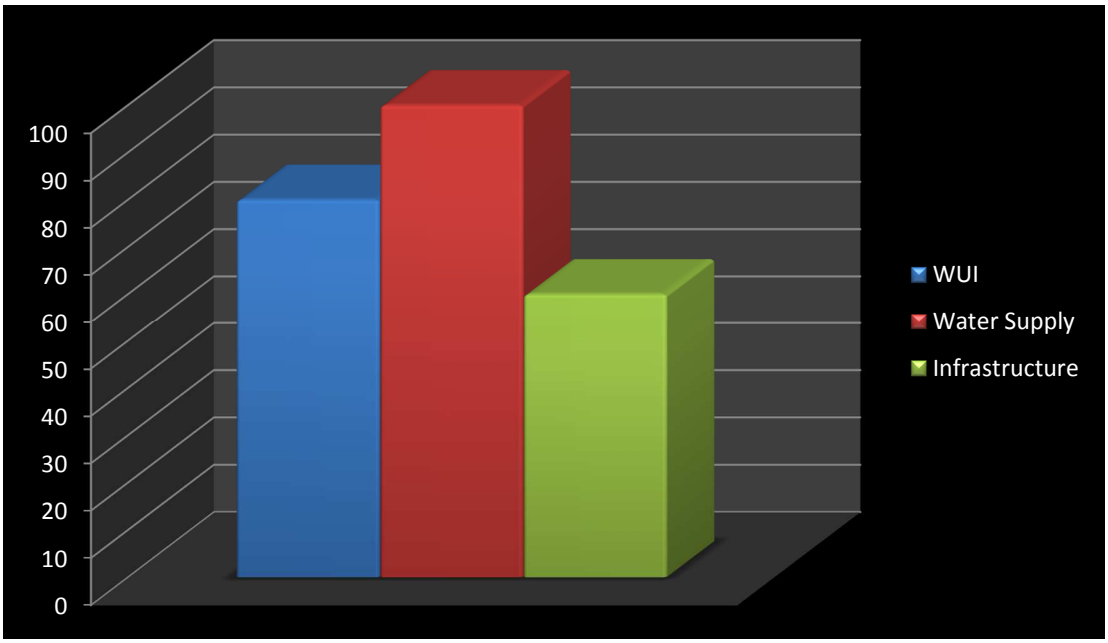


Figure 4: Share of Relative Importance across HVRAs (2013)

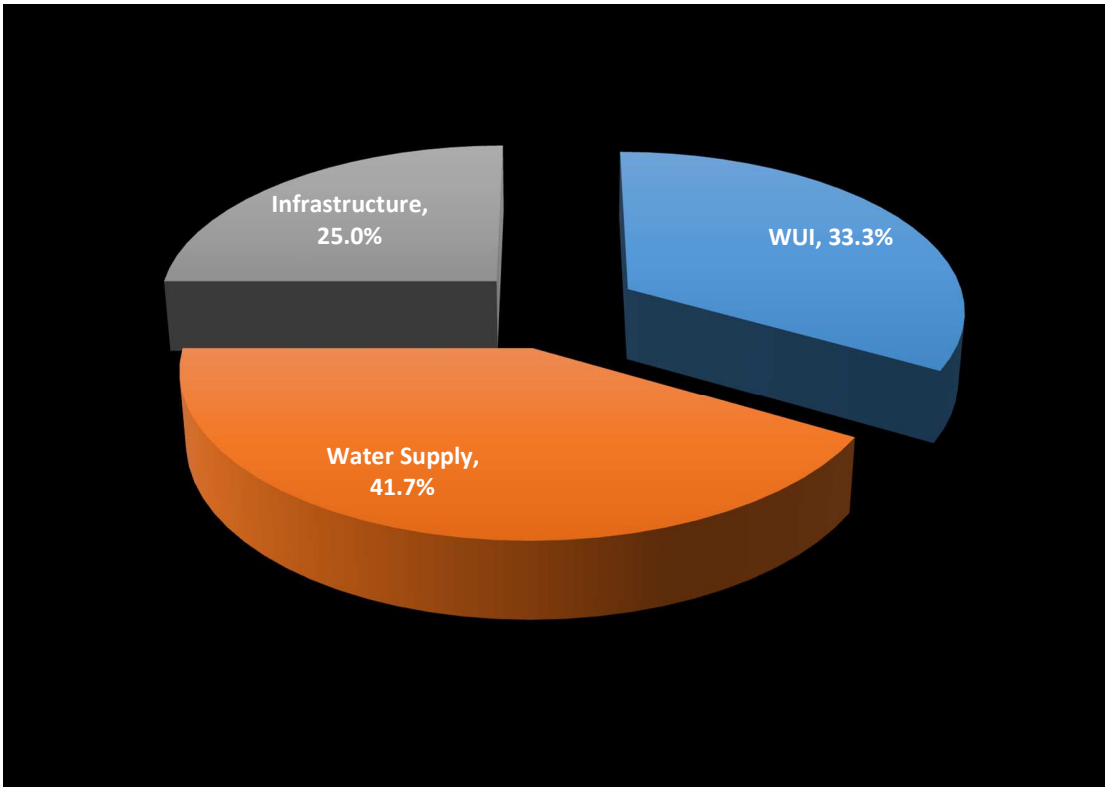


Table 8: Relative Importance Scores and Weights across HVRAs utilized in 2014 Rocky Mountain Region Wildfire Risk Assessment

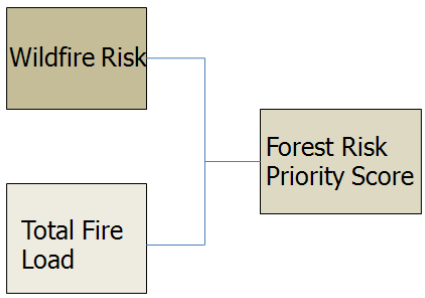
HVRA	RI	RI %	Sub-HVRA	Sub-RI	Sub-RI %	Overall RI %
WUI	80	33.3%	low population density (< 28)	60	25.0%	8.3%
			moderate population density (28 - 250)	80	33.3%	11.1%
			high population density (250+ / sq mi)	100	41.7%	13.9%
Water Supply	100	41.7%	Moderate Importance to surface drinking water	80	44.4%	18.5%
			High importance to surface drinking water	100	55.6%	23.1%
Infrastructure	60	25.0%	Transmission lines	100	37.0%	9.3%
			Communication facilities	70	25.9%	6.5%
			Rec residences / admin sites	25	9.3%	2.3%
			campgrounds, trailheads, etc.	25	9.3%	2.3%
			ski areas	50	18.5%	4.6%

How the results are being used

The results of the Fire Risk Analysis from Fire NVC were used as an input into an allocation model developed by the Region for both WFPR and WHFH funds. The models use similar components but different weighting. However most significantly is that the model changed from the 2013 budget allocation to the 2014 Allocation in how the FireNVC results were used.

In FY 2013 the WFHF allocation model had two components (Figure5)

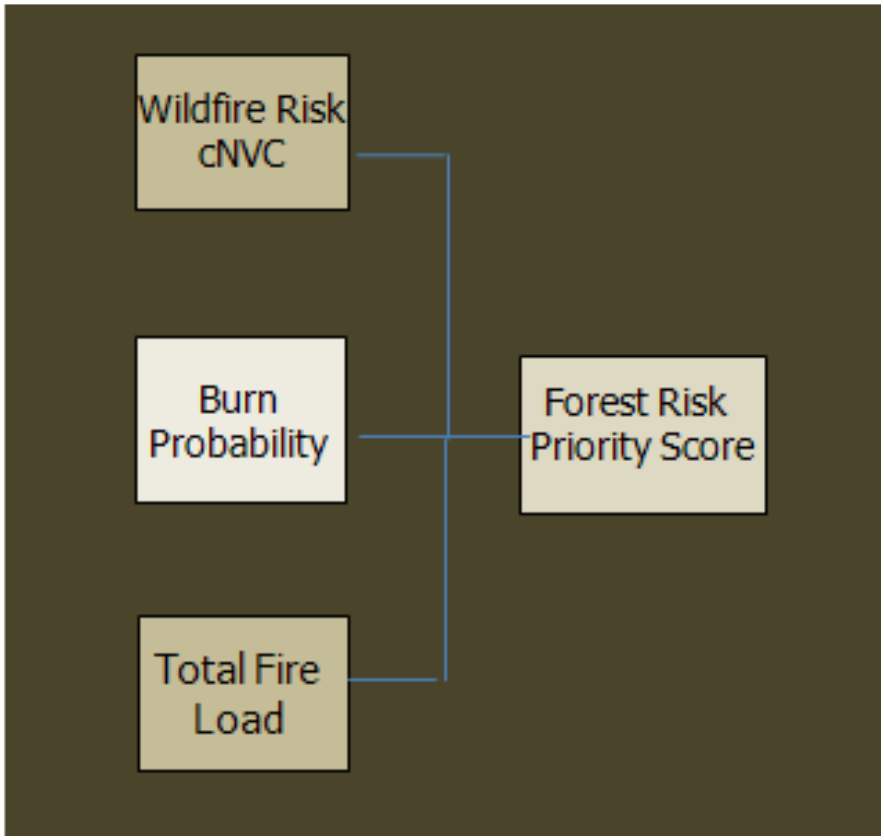
Figure 5: FY 2013 Regional Risk Priority Model



Wildfire Risk assessed the potential impacts of large wildfires as identified by Fire NVC and while the **Total Fire Load** assesses the Forest's risk associated with all ignitions not just large fires. However beginning in the FY2014 budget cycle based upon the critique and discussions of the FY 2013 allocation process and questions leadership had about the risk results and a lack of "faith" in FSIM burn probabilities a modification was proposed to the allocation model that was ultimately adopted by Regional Leadership.

The model used to inform the WFHF FY2014 allocation has three components – **Conditional Wildfire Risk**, **Total Fire Load** and **Burn Probability** which are combined into a **Forest Risk Priority Score** (Figure 6) which is then used in the allocation process. . In FY 2014 the **Burn Probabilities** are separated out after the integrated risk scores (**eNVC**) are calculated and weighted separately in the allocation model**.** The remaining portion of the integrated risk score is now referred to as **Conditional Wildfire Risk (cNVC)** which is also weighted separately in the allocation model.

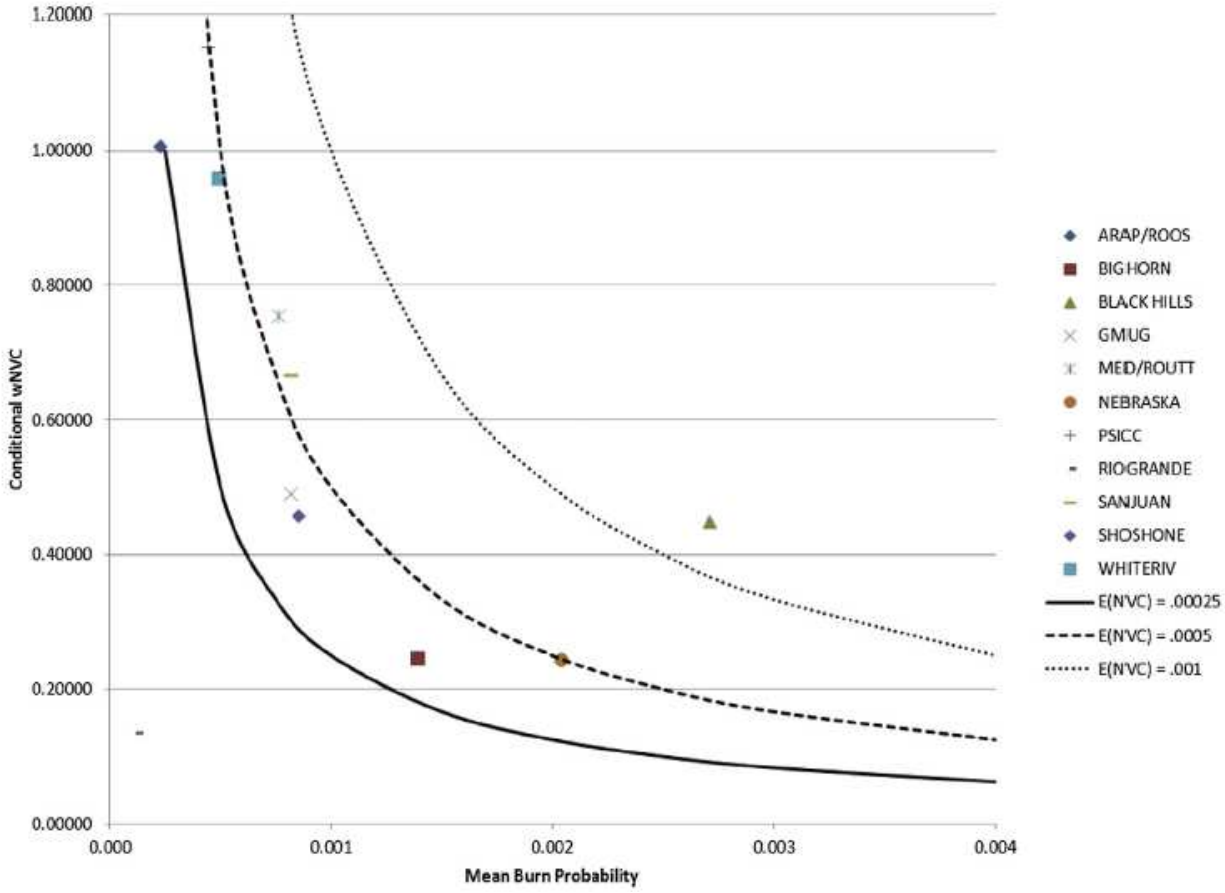
Figure 6: FY 2013 Regional Risk Priority Model



The three model components represent different aspects of wildfire risk.

Conditional Wildfire Risk (cNVC) – This component of the model assesses Forest's risk associated with the potential effects to highly valued resources and assets (HVRAs) if a fire were to start. Three main pieces of information were utilized to generate wildfire risk outputs: potential fire intensity generated from wildfire simulations (wildfire hazard as modeled in the 2011 National FSIM analysis), spatially identified highly valued resources and assets (HVRAs), and response functions that describe the effects of fire to each HVRA

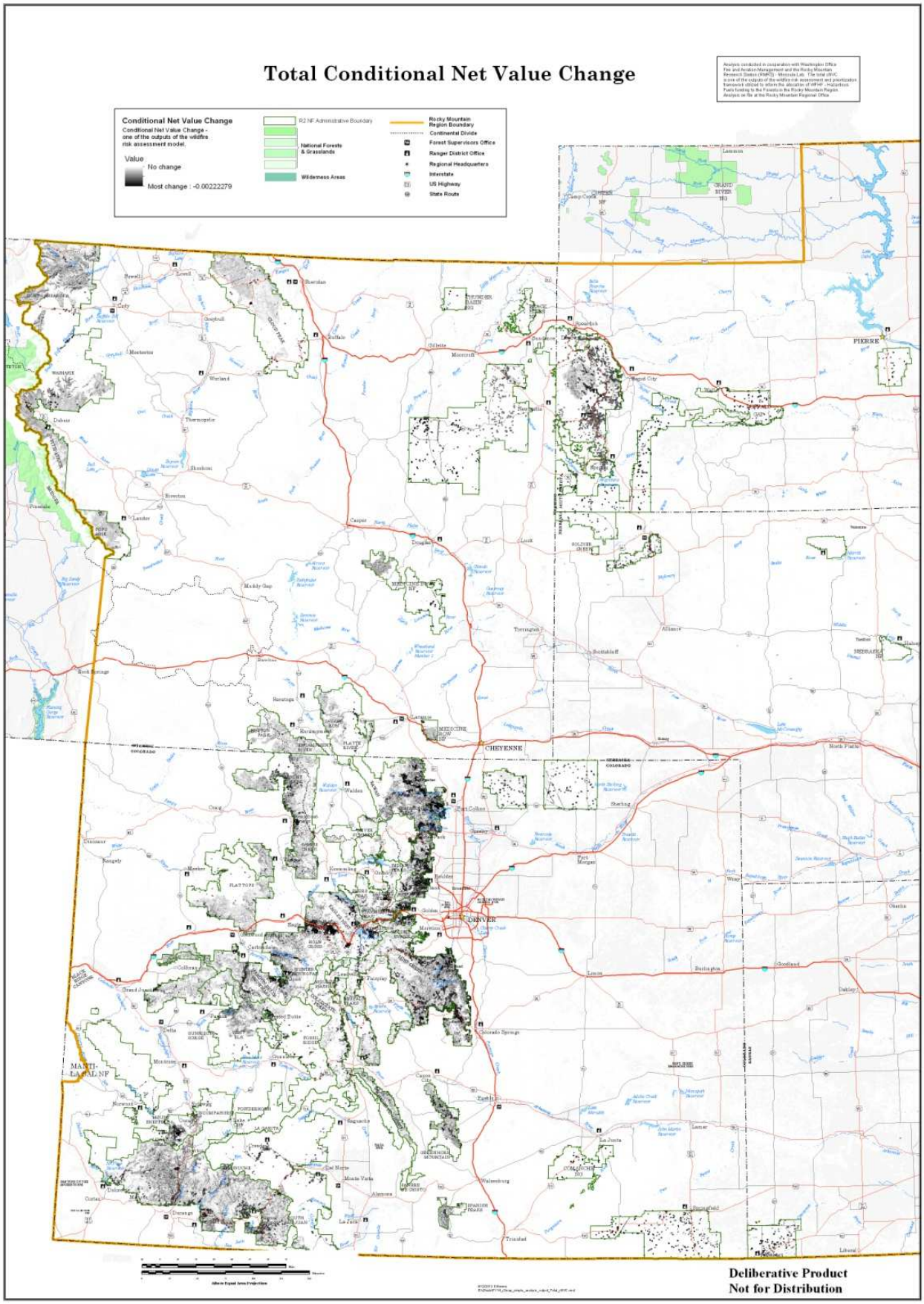
Figure 7: Scatterplot diagram of mean conditional weighted net value change (cNVC) scores (y-axis) and mean burn probability (x-axis), for all National Forests and Grasslands in the Rocky Mountain Region. The three lines in black represent contours of equal expected net value change.



Consistent with the above figure (Figure 7) it is apparent that each forest has its own risk profile. There is significant variation in the potential for loss that drives cNVC ratings and similarly there is significant variation in the probability of experience large wildfires. This variability in burn probability along with leaderships concerns with the FSIM burn probabilities led to the split of eNVC and split and separate weighting of cNVC and Burn probabilities.

Figure 8 displays a plot of cNVC spatially across the Region.

Figure 8: Conditional Net Value Change (cNVC)



Total Fire Load –This component of the model assesses Forest's risk associated with all ignitions not just large fires. It is based on the Forests' fire occurrence history for the period of 1992-2010 as recorded in FIRESTAT (Figure 9). This is the same base period used for the 2011 National FSIM analysis for FPA, which was the source for wildfire hazard and burn probability used elsewhere in the analysis. The acreage of National Forest Systems lands from the 2012 Land Areas of the National Forest System Report (http://www.fs.fed.us/land/staff/lar/). The analysis is summarized in Table 9.

Figure 9: Fire Occurrence (1992-2010)

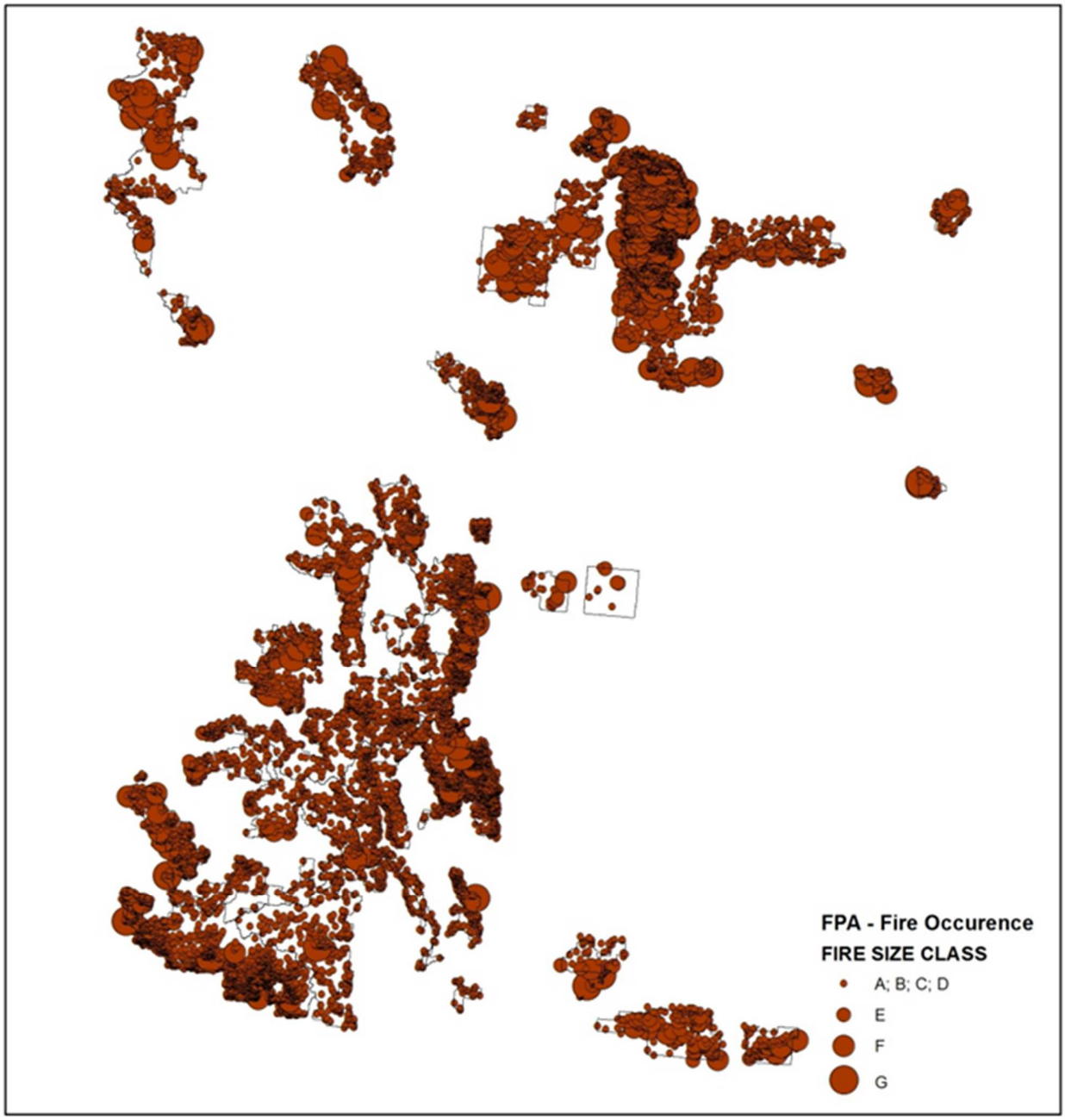
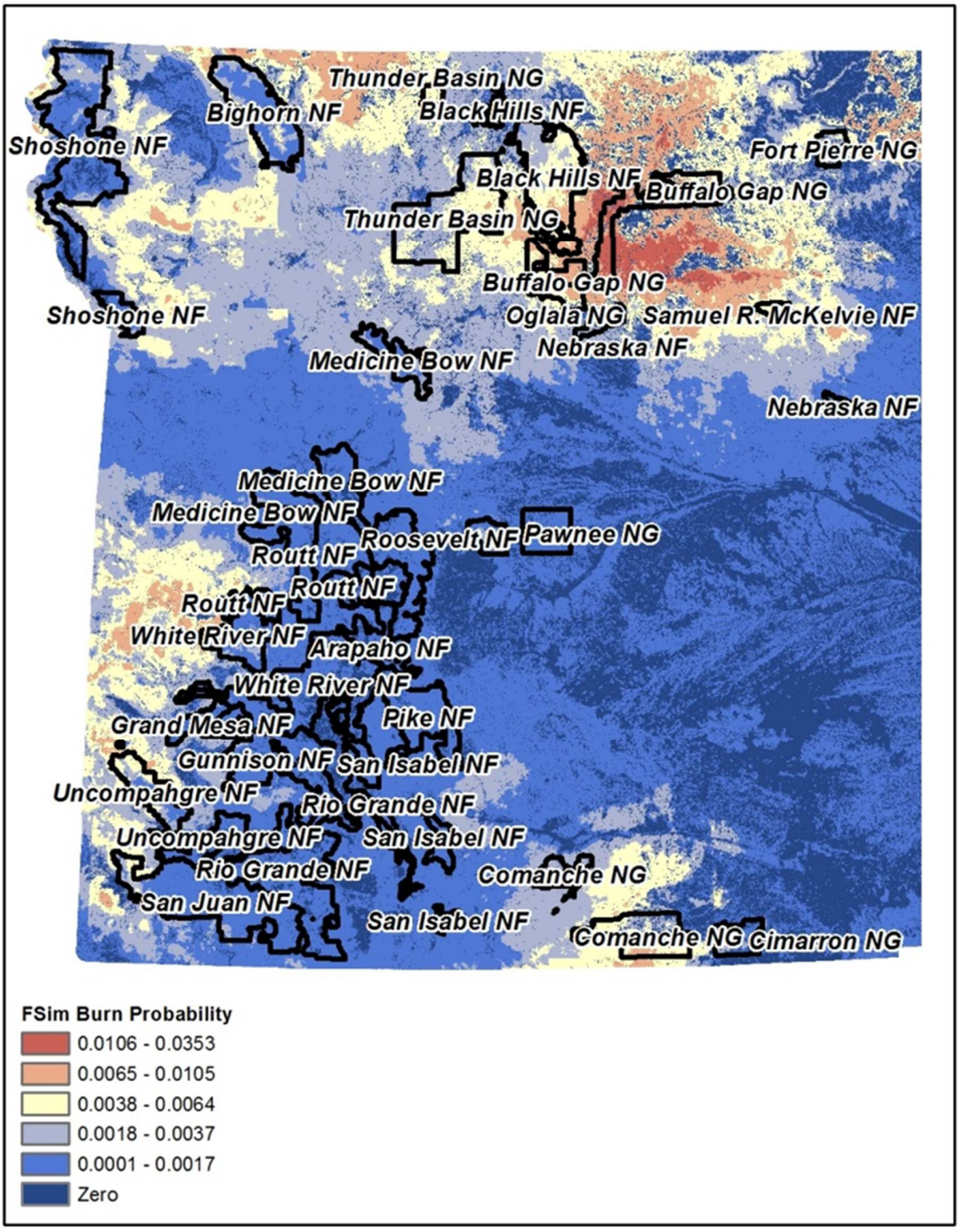


Table 9: Total Fire Load

	Avg. Annual Fire Occurrence 1992-2010	NFS Acreage	Occurrence Per Acre	Total Fire Load Score
0202 – Bighorn	7	1,107,571	0.000005892	0.01721
0203 – Black Hills	138	1,253,308	0.000110361	0.32242
0204 – Grand Mesa, Uncompaghre and Gunnison NFs	47	2,974,474	0.000015766	0.04606
0206 – Medicine Bow, Routt NFs & Thunder Basin NGL	65	2,769,812	0.000023581	0.06889
0207 – Nebraska, Samuel R. McKelvie NFs, Oglala, Buffalo Gap & Fort Pierre NGL	28	1,064,068	0.000026710	0.07803
0209 - Rio Grande	16	1,823,403	0.000008746	0.02555
0210 - Arapaho & Roosevelt & Pawnee NGL	55	1,731,404	0.000031827	0.09298
0212 - Pike, San Isabel NFs, Cimarron & Comanche NGL	122	2,782,183	0.000043775	0.12789
0213 - San Juan	88	1,878,793	0.000046642	0.13627
0214 – Shoshone	23	2,437,731	0.000009608	0.02807
0215 – White River	44	2,286,249	0.000019384	0.05663

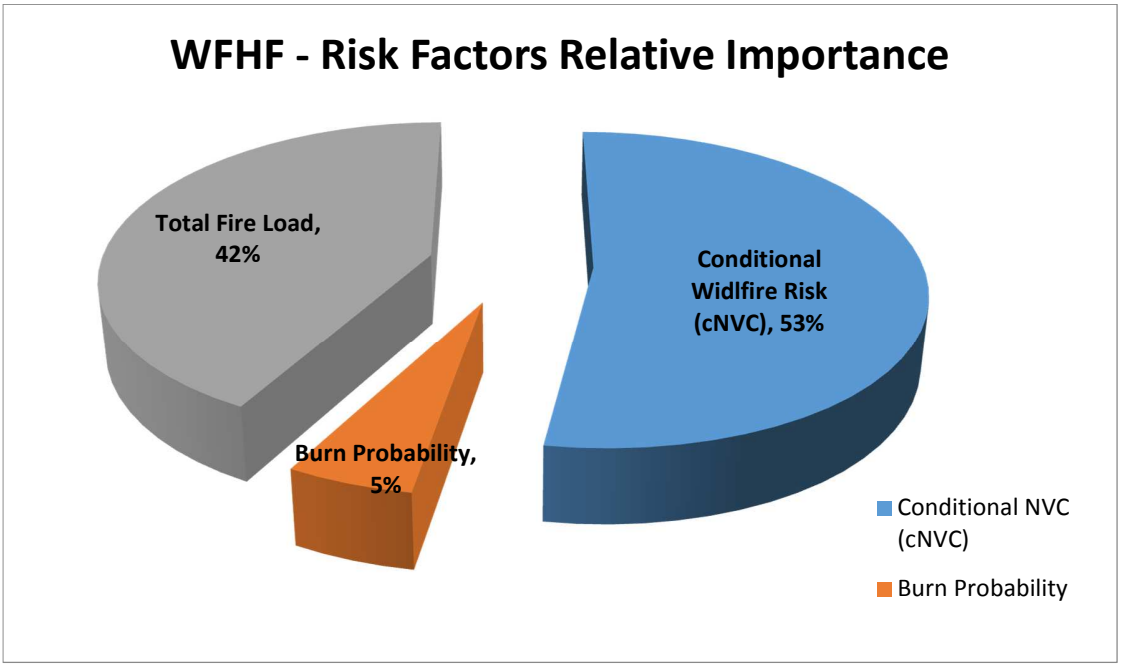
Burn Probability – This component of the model assesses Forest's risk associated with the potential for a fire to spread and affect HVRAs if a fire were to start. One piece of information was utilized: burn probabilities generated from the 2011 National FSIM analysis for FPA. Figure 10 displays a plot of the 2011 FSIM Burn Probability spatially across the Region.

Figure 10: 2011 FSIM Burn Probabilities



The weights for the three components were established using a multi-criteria decision analysis technique known as the Simple Multi-Attribute Rating Technique, or SMART. The overall approach is based on leadership input, group consensus, and iterative refinement of relative importance scores. The relative weights for the three components are depicted in Figure 11 below.

Figure 11: FY 2013 WFHF Regional Risk Priority Model Component Weights



Forest Risk Priority Scores – Regional Leadership (DRF – Resources, the Directors for SPF-TR, FAM and RR and the RBO) established the weights (Figure 11) for each of the components of the 2014 WFHF and WFPR allocation models through iterative refinement (input, dialog, and development of group consensus) of the relative importance scores using a multi-criteria decision analysis technique known as the Simple Multi-Attribute Rating Technique, or SMART. The results of the analysis are shown in Table 10.

Table 10: Individual WFHF Forest Priority and Tier Scores

FOREST	Conditional NVC Relative Score	Burn Probability Relative Score	Total Fire Load Relative Score	Unit Priority Score
0202 – Bighorn	0.03738	0.1304	0.01721	0.0338
0203 – Black Hills	0.06843	0.2535	0.32242	0.1851
0204 – Grand Mesa, Uncompaghre and Gunnison NFs	0.07461	0.0767	0.04606	0.0627
0206 – Medicine Bow, Routt NFs & Thunder Basin NGL	0.11504	0.0714	0.06889	0.0933
0207 – Nebraska, Samuel R. McKelvie NFs, Oglala, Buffalo Gap & Fort Pierre NGL	0.03718	0.1909	0.07803	0.0625
0209 - Rio Grande	0.02061	0.0110	0.02555	0.0222
0210 - Arapaho & Roosevelt & Pawnee NGL	0.15340	0.0216	0.09298	0.1210
0212 - Pike, San Isabel NFs, Cimarron & Comanche NGL	0.17589	0.0417	0.12789	0.1486
0213 - San Juan	0.10163	0.0766	0.13627	0.1149
0214 – Shoshone	0.06963	0.0798	0.02807	0.0527
0215 – White River	0.14620	0.0463	0.05663	0.1032

The individual Forest Risk Scores were evaluated and combined into three tiers (Table 11) - low, moderate and high risk to display risk in a manner similar to the widely used three tiered GAR (Green, Amber, Red) model. The 33rd and 66th percentiles of the Forest Risk Priority Scores were used to have consistent class breaks following feedback from the Forests in 2013. The tier approach is used to minimize large fluctuations in annual allocations. The tier scores were then used in the budget allocation.

Table 11: Tiered WFHF Priority Scores

WFHF	Forest Priority Score	By Tier
0203 – Black Hills	0.1851	
0212 - Pike, San Isabel NFs, Cimarron & Comanche NGL	0.1486	
0213 - San Juan	0.1149	0.1424
0210 - Arapaho & Roosevelt & Pawnee NGL	0.1210	
0215 – White River	0.1032	
0206 – Medicine Bow, Routt NFs & Thunder Basin NGL	0.0933	0.0864
0204 – Grand Mesa, Uncompaghre and Gunnison NFs	0.0627	
0207 – Nebraska, Samuel R. McKelvie NFs, Oglala, Buffalo Gap & Fort Pierre NGL	0.0625	
0214 – Shoshone	0.0527	
0202 – Bighorn	0.0338	0.0428
0209 - Rio Grande	0.0222	

2013 to 2014 Comparison of Risk Scores – Figures 12 and 13 compare the individual Forest Risk Priority scores and the Tier Scores (low (<33rd percentile) Moderate (34th – 66th percentile) and high (>66th percentile)).

Figure 12: Comparison of FY2013 and FY 2014 WFHF Forest Risk Priority Scores

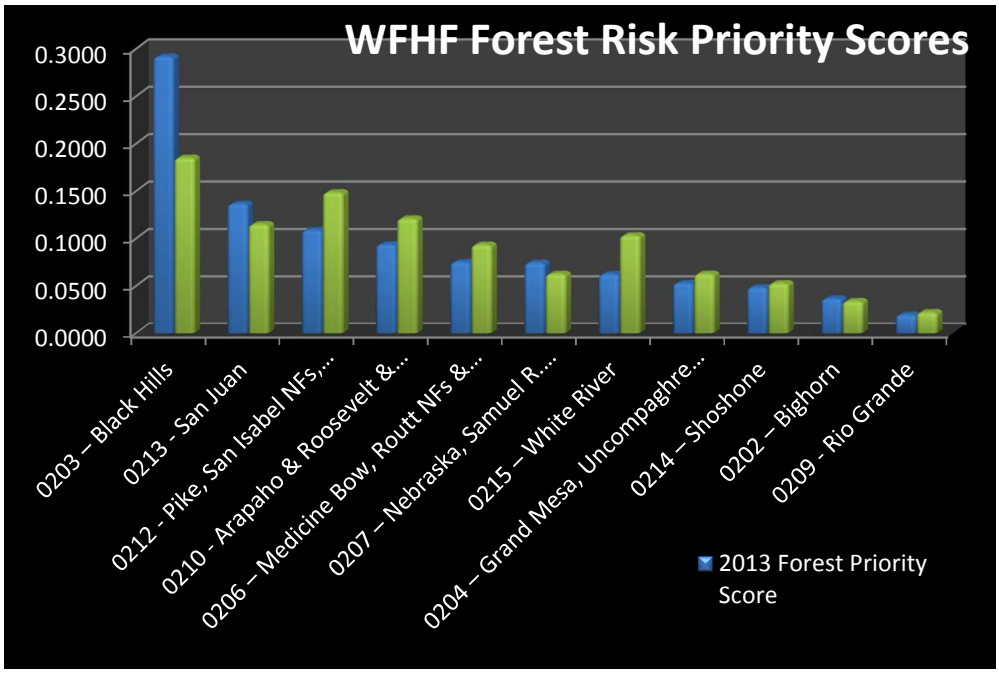
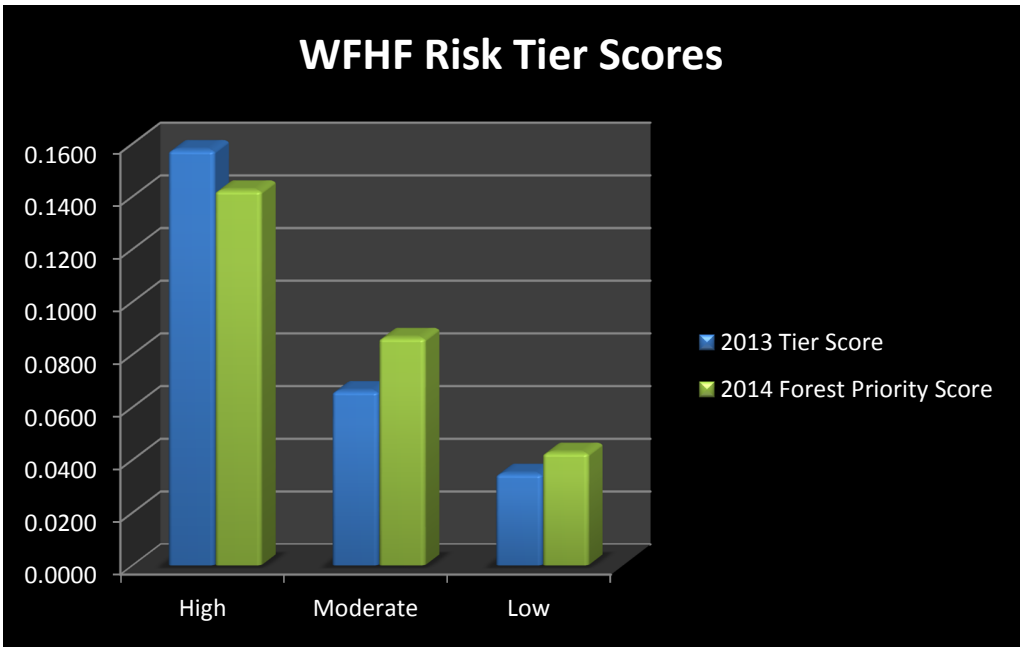


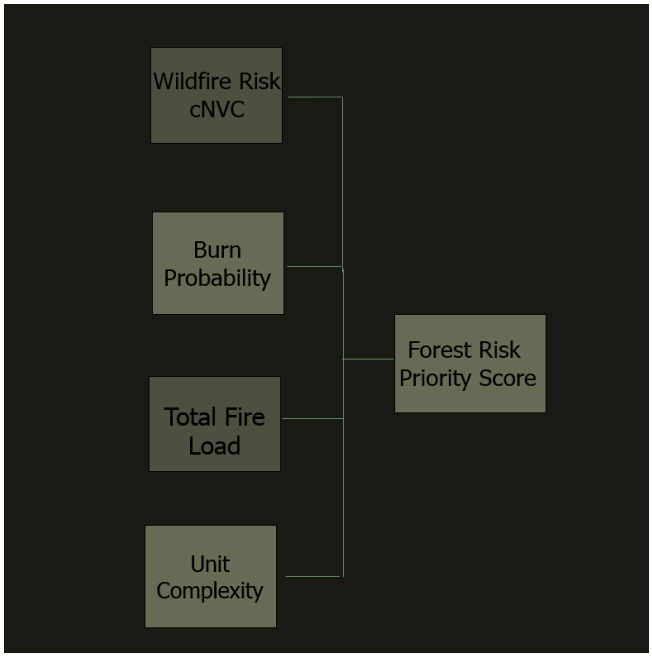
Figure 13: Comparison of FY2013 and FY 2014 WFHF Risk Tier Scores



In the FY2014 Initial allocation, each unit's initial funding was calculated at 75% of the unadjusted 2013 allocation. The remaining available balance was then spread to the units based upon their relative importance as calculated by the % of their Regional Risk Priority Tier Score.

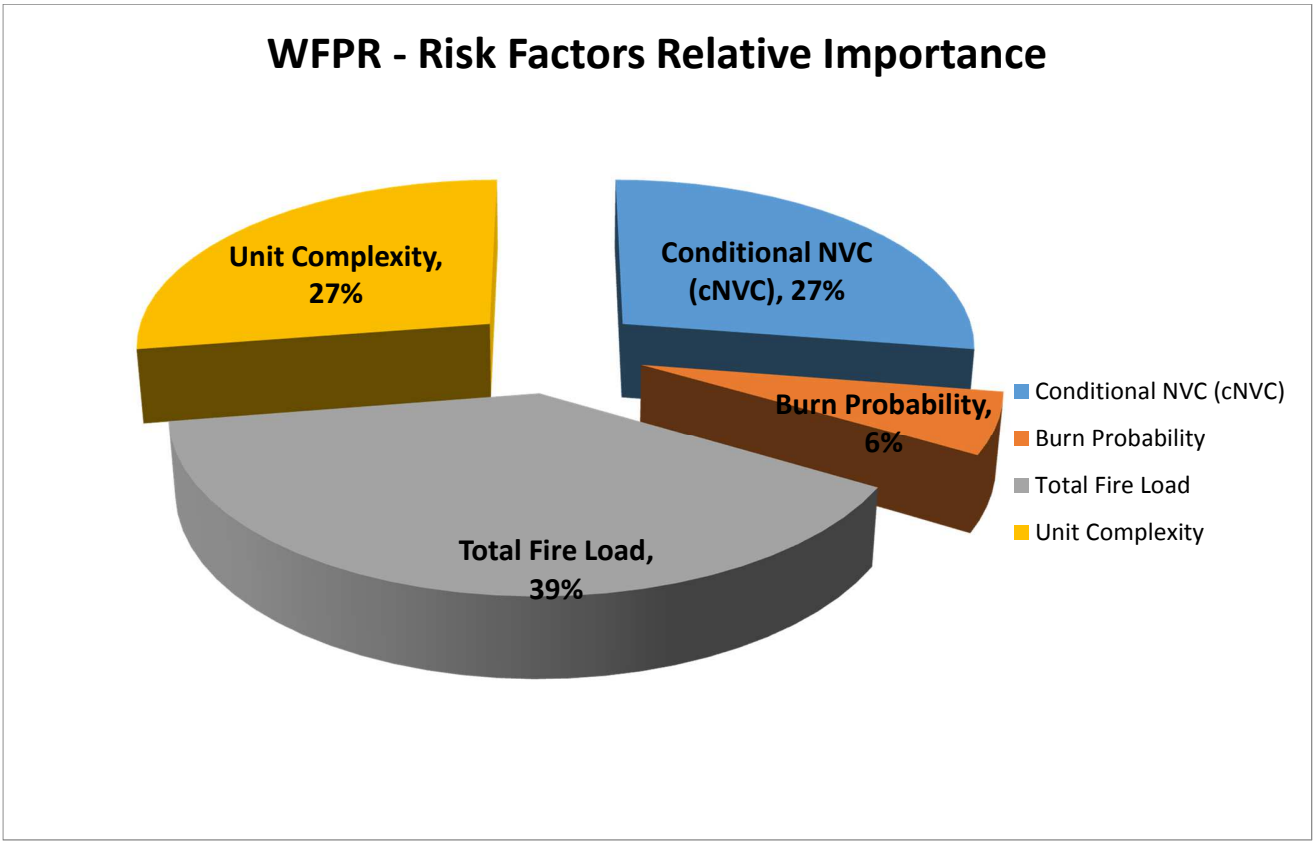
For WFPR the allocation model (Figure12) and process is similar except with the addition of another model component and different weighting of the relative importance) of the model components.

Figure 12: WFPR Regional Risk Priority Model



Unit Organizational Complexity assesses components of the Forest's IFPM complexity rating as they relate to current organizations. The weights for the four components were established using a multi-criteria decision analysis technique known as the Simple Multi-Attribute Rating Technique, or SMART. The overall approach is based on leadership input, group consensus, and iterative refinement of relative importance scores. The relative weights for the three components are depicted below. (Figure13)

Figure 13: FY 2013 WFPR Regional Risk Priority Model Component Weights



The results of the analysis are shown in Table 12.

Table 12: Individual WFPR Forest Priority and Tier Scores

FOREST	Conditional NVC Relative Score	Burn Probability Relative Score	Total Fire Load (Density Index) Relative Score	Organizational Structure and Program Complexity Relative Score	Unit Priority Score
0202 – Bighorn	0.03738	0.1304	0.01721	0.0725	0.0446
0203 – Black Hills	0.06843	0.2535	0.32242	0.1157	0.1919
0204 – Grand Mesa, Uncompaghre and Gunnison NFs	0.07461	0.0767	0.04606	0.0764	0.0640
0206 – Medicine Bow, Routt NFs & Thunder Basin NGL	0.11504	0.0714	0.06889	0.0871	0.0867
0207 – Nebraska, Samuel R. McKelvie NFs, Oglala, Buffalo Gap & Fort Pierre NGL	0.03718	0.1909	0.07803	0.0760	0.0729
0209 - Rio Grande	0.02061	0.0110	0.02555	0.0623	0.0334
0210 - Arapaho & Roosevelt & Pawnee NGL	0.15340	0.0216	0.09298	0.1144	0.1112

0212 - Pike, San Isabel NFs, Cimarron & Comanche NGL	0.17589	0.0417	0.12789	0.1164	0.1328
0213 - San Juan	0.10163	0.0766	0.13627	0.1069	0.1152
0214 – Shoshone	0.06963	0.0798	0.02807	0.0928	0.0603
0215 – White River	0.14620	0.0463	0.05663	0.0795	0.0869

The individual Forest Risk Scores were evaluated and combined into three tiers (Table 13) - low, moderate and high risk to display risk in a manner similar to the widely used three tiered GAR (Green, Amber, Red) model. The 33rd and 66th percentiles of the Forest Risk Priority Scores were used to have consistent class breaks following feedback from the Forests in 2013. The tier approach is used to minimize large fluctuations in annual allocations. The tier scores are then used in the budget allocation.

One additional difference between the WFPR and WFHF allocation process is that for WFPR the allocation model scores are used to apportion increases or decreases in program funding. Therefore tier scores were also calculated for a decreasing program. The scores can then be applied to both increases and decreases in funding from the baseline used.

Table 13: Tiered WFPR Priority Scores

WFPR	Forest Priority Score	By Tier	Increasing Program (% of Increase applied to baseline)	Decreasing Program (% of reduction applied to baseline)	Percentage of Increase Tier Receives	Percentage of decrease absorbed by Tier
0203 – Black Hills	0.1919		13.8%	5.0%		
0212 - Pike, San Isabel NFs, Cimarron & Comanche NGL	0.1328		13.8%	5.0%		
0213 - San Juan	0.1152	0.1378	13.8%	5.0%		
0210 - Arapaho & Roosevelt & Pawnee NGL	0.1112		13.8%	5.0%	**55.1%**	20.1%
0206 – Medicine Bow, Routt NFs & Thunder Basin NGL	0.0867		8.2%	8.4%		
0215 – White River	0.0869	0.0822	8.2%	8.4%		
0207 – Nebraska, Samuel R. McKelvie NFs, Oglala, Buffalo Gap & Fort Pierre NGL	0.0729		8.2%	8.4%	**24.6%**	25.2%
0204 – Grand Mesa, Uncompaghre and Gunnison NFs	0.0640		5.1%	13.7%		
0214 – Shoshone	0.0603		5.1%	13.7%		
0202 – Bighorn	0.0446	0.0506	5.1%	13.7%		
0209 - Rio Grande	0.0334		5.1%	13.7%	**20.2%**	54.7%

Highlights and lessons learned

- Data Acquisition and preparation was more time consuming and lengthy than we anticipated even with utilizing an “off the shelf” approach”
- **Broader scale analysis (State, Region, National) will most likely be more limited by data availability than finer scale local level analysis DATA Consistency is ESSENTIAL.**
- For Forest Risk ratings to dramatically shift would require major changes in response functions, a major reordering of priorities and/or significant and widespread changes in modeled burn

probabilities. (the analysis does not need to be updated every year unless significant changes are made to one of the components)

- Engagement of leadership from the beginning was key for acceptance and use of results. Don't work in a vacuum and spring it on folks.
- GIS specialists assigned to project is essential to pull data together and prep for analysis. By being engaged with the process from the beginning full understanding of process and requirements
- Adaptive Learning. From the initial work in 2012 to the 2014 allocation we learned a lot about process and analysis by continuous review and discussion. Between the Region and RMRS and WO, Within the Region with Leaderships and the Forests. We reviewed how things worked, consulted with Leadership and RMRS and made adjustments to the process based upon what was learned both with the regional analysis and other step down analysis in the Region (Forest Level on the Black Hills and Project level on the Upper Monument Creek on the PSICC)
- Winners and Losers - Risk based allocations shift funds towards units with higher risk

For Additional information on FireNVC and the Region 2 analysis see:

Development and application of a geospatial wildfire exposure and risk calculation tool. Environmental Modeling and Software 63 2015. P 61-72.

(http://dx.doi.org/10.1016/j.envsoft.2014.09.018)

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