Appendix A

The WRENSS Water Yield Model:

Development of Dimensionless Flow-Duration Curve

The WRENSS Water Yield Model & Development of Dimensionless Flow Duration Curve

Objective

Develop dimensionless flow duration curve that integrates estimated change in water yield modeled from the WRENSS analysis, over time. The dimensionless flow duration curve can be used in conjunction with dimensionless sediment transport rating curves to evaluate sediment loading in various sub-drainages to help identify reaches for restoration within the Waldo Canyon Fire perimeter.

Basic Steps:

1) Obtain change in water yield for a given drainage or sub-drainage
2) Create dimensionless flow duration curve representing pre-fire conditions
3) Distribute change in water yield over dimensionless flow duration curve
4) Recalculate dimensionless flow duration curve incorporating change in yield

Methodology

Assumptions:
Goose Creek bankfull discharge - momentary maximum =190 cfs at USGS Gauge #06700500
Goose Creek bankfull discharge - daily mean flow equivalent =151 cfs at USGS Gauge #06700500
Bankfull discharges for Waldo Canyon Fire drainages can be estimated from a regional curve

The regional curve depicting the relationship between bankfull discharge and drainage area was developed from a variety of sources in close proximity to the Waldo Canyon Fire (**Figure A-1**).

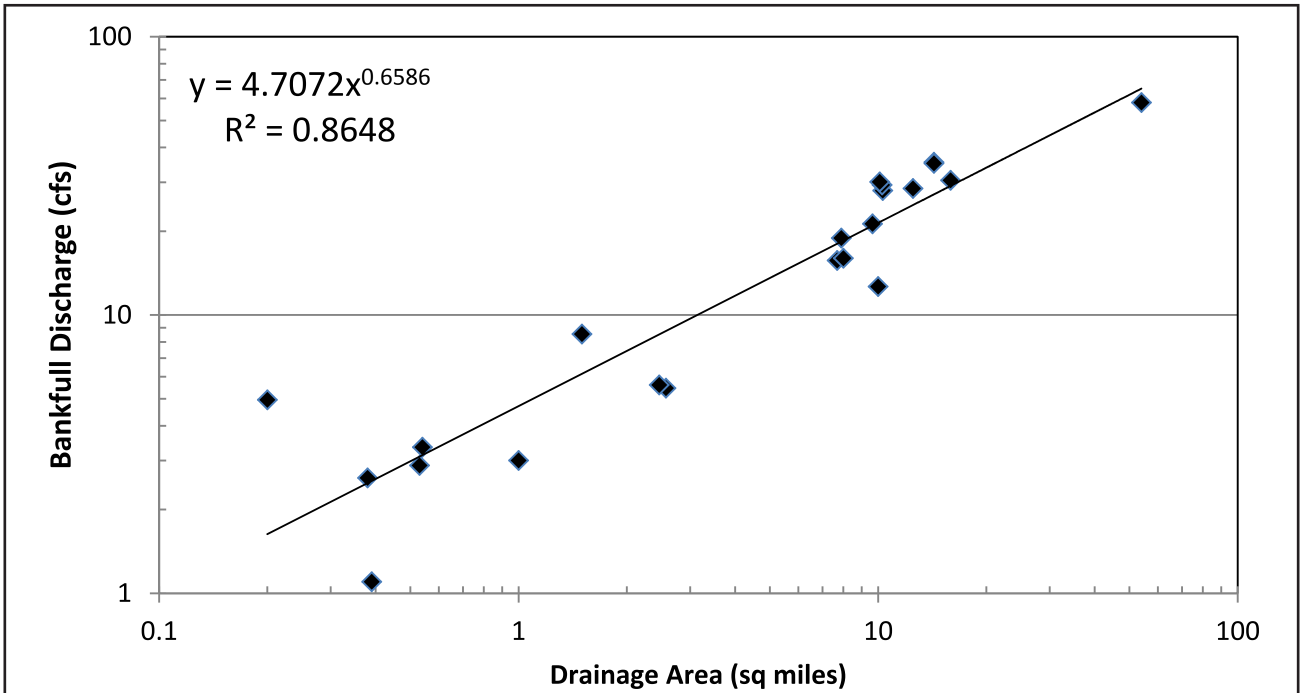


Figure A-1. Bankfull discharge versus drainage area relationship used for the Waldo Canyon Fire area.

Bankfull for each drainage was adjusted by 0.79 (based on the relationship between bankfull discharge and the daily mean flow equivalent at the Goose Creek gauge) to obtain the equivalent daily mean flow of interest for use in the dimensionless flow duration curve.

Estimating Changes in Water Yield for the Waldo Canyon Fire Sub-Basins

The Waldo Canyon Fire perimeter encompassed 24,248 acres and spanned portions of four major drainages: Camp Creek (CC), Douglas Creek (DC), Fountain Creek (FC), and West Monument Creek (MC). The major drainages were divided into 89 sub-drainages and face drainages (non-tributaried inputs to the major drainage) for analysis (**Table A-1**). Douglas Creek values are reported as a composite of the north and south drainages.

Table A-1. Waldo Canyon Fire drainage basin characteristics and sub divisions.

Drainage	Total Watershed Area (acres)	Acres within Fire Perimeter	Percent Watershed Area within the Burn	Average Annual Precipitation in Burn (in)	Sub/Face Drainages
Camp Creek	5,856	5,526	94%	20.4	18/18
Douglas Creek	3303	3,303	100%	18.4	5/4
Fountain Creek	23,936	7163	30%	20.6	10/8
Monument Creek	14,912	8,255	55%	20.8	15/11

Pre-forest fire vegetation conditions were characterized using the USFS vegetation database R2VEG and average monthly precipitation was determined from the OSU Prism Climate Data. Overlaying the R2VEG and PRISM Climate GIS layers over the sub-drainage boundaries and delimiting homogeneous units of vegetation cover type and size, aspect and precipitation yielded 18,625 unique polygons, of which 16,385 polygons contained forest vegetation types (trees) or gambel oak (18,555 acres).

Post-fire vegetation conditions were defined by Ed Biery (Pike San Isabel NF Vegetation and GIS expert) who used high resolution aerial photography (taken July 30, 2012 post fire and supplied by Colorado Springs Utilities) and on-site validation to create a GIS layer identifying percent trees killed over the extent of the fire. Overlaying this burn severity layer over the pre fire dataset provided an accurate estimate of the trees (or shrubs) killed in each of the 16,385 polygons.

Change in water yield as a function of forest cover reduction for each sub-drainage, was determined using the methodologies described by Troendle *et al.*, 2003. Change in water yield for the four major drainages was obtained by area weighting sub-drainage changes (post fire – pre fire) and compositing the difference over the watershed area. **Table A-2** reports the modeled water yield change for the four major drainages relative to the total watershed area and area within the burn perimeter. The data for each sub and face drainage are listed in *Appendix A1*. Distribution of forest vegetation cover type, size and burn status for the major drainages are presented in *Appendix A2*.

Table A-2. Summary of basin characteristics, burn severity and modeled change in water yield.

Basin	Total Watershed		Watershed Area within Burn Perimeter	
	Acres	Δ Water Yield (in)	Acres	Δ Water Yield (in)
Camp Creek	5,856	2.41	5,526	2.55
Douglas Creek	3,303	1.74	3,303	1.74
Fountain Creek	23,936	0.88	7163	2.88
Monument Creek	14,912	0.77	8,255	1.39

A linear regression was developed for each of the four drainages correlating change in water yield as a function of percent reduction in cover (**Figure A-2**). These regressions allow us to reasonably predict changes in water yield for an infinite number of locations within each of the major drainages.

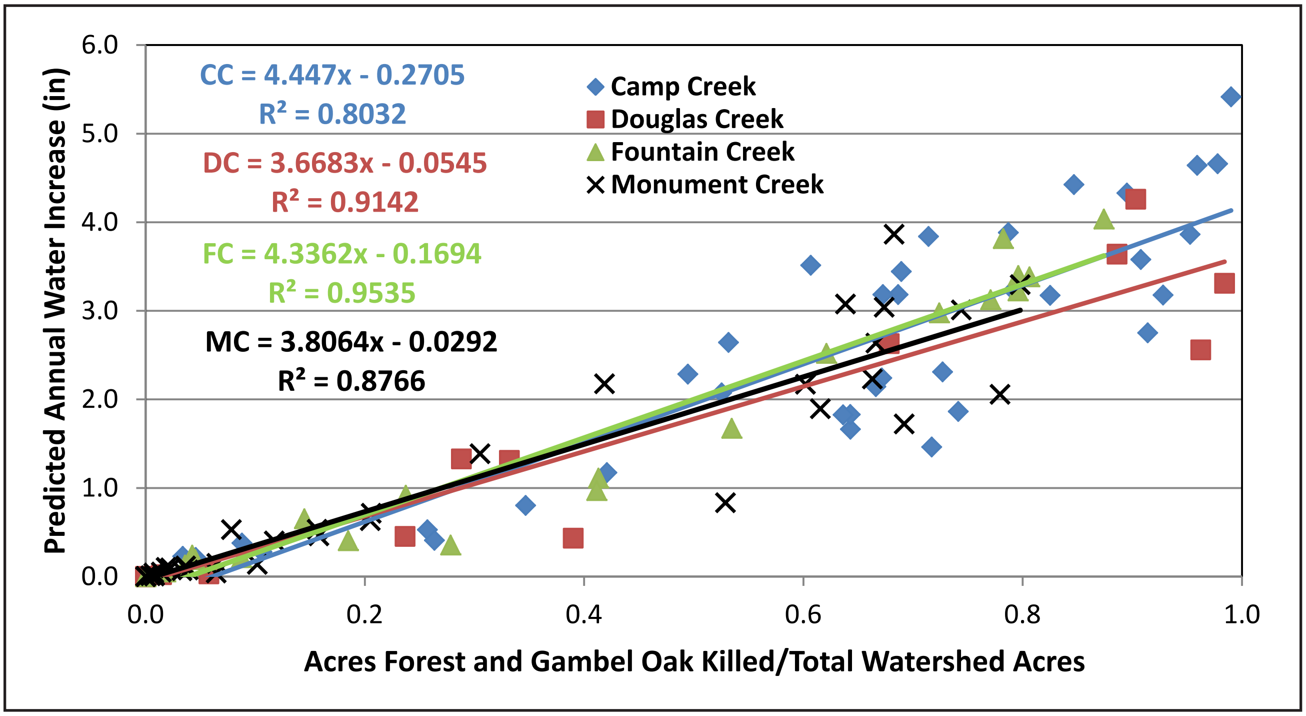


Figure A-2. Predicted water yield increase as a function of percent reduction in cover, by drainage.

Pre-Fire Flow Duration Curve

Develop flow duration curve from the USGS stream gauge at Goose Creek (USGS 06700500 GOOSE CREEK ABOVE CHEESMAN LAKE, CO.) data that represents pre-fire flow conditions. The period of record used for the gauge at Goose Creek ranged from water years 1925 to 1982 and contained only those years with complete annual records (45). Dividing each daily mean flow observation by the estimated bankfull value (151 cfs – the daily mean flow corresponding to the instantaneous bankfull value) creates a dimensionless discharge observation. Sorting all dimensionless observations in descending order and dividing the corresponding rank order by the total number of observations in the period of record provides the percent time a given dimensionless flow value is equaled or exceeded.

Distributing Change in Water Yield

The procedure for distributing the change in water yield over the dimensionless flow duration curve is a modification of the hydrograph approach described in the WRENSS handbook (1980) for the Rocky Mountain/Inland Intermountain hydrologic regions. Averaging the "Open" percentages for the three aspects in tables III.11-III.13, provides a general means to apportion the increased flow over time. WRENSS distributes the water yield increase over one hundred and fourteen days of the hydrograph by 19 increments of increase, 6 days per increment (*Appendix A3*). The percent increases are sorted in descending order and each increment is associated with 270 observations of the Goose Creek flow duration curve (six days per year times forty five years in the period of record of

Goose Creek). In order to make the WRENSS water yield increase distribution compatible with the flow duration time intervals in RIVERMorph, the increments of increase need to be weighted proportionately to the time intervals in RIVERMorph to account for 100% of the flow increase (**Table A-3**).

Table A-3. Template for generating dimensionless flow duration curve for basins of interest using time intervals defined by RIVERMorph.

Percent Time Equaled or Exceeded	Dimensionless Flow Duration Curve Goose Creek (DMF/Bankfull-DMF)	Weighted Percent Increase per Time Interval
0.001%	3.19868	0.1475
0.005%	3.19868	0.1475
0.01%	3.19868	0.1475
0.05%	2.93978	0.1475
0.10%	2.74834	0.1475
0.25%	2.37748	0.1475
0.50%	2.05298	0.1475
0.60%	1.92053	0.1475
0.70%	1.80132	0.1475
0.80%	1.70861	0.1475
0.90%	1.61589	0.1475
1.00%	1.51656	0.1475
1.50%	1.24503	0.1475
2.00%	1.08609	0.1446
3.00%	0.91391	0.1433
4.00%	0.78146	0.1350
5.00%	0.69536	0.1306
10.00%	0.43709	0.0979
20.00%	0.23841	0.0393
30.00%	0.15894	0.0057
40.00%	0.11258	0.0001
50.00%	0.08609	0.0000
60.00%	0.06623	0.0000
70.00%	0.05298	0.0000
80.00%	0.04636	0.0000
90.00%	0.03311	0.0000
100.00%	0.006623	0.0000

Calculate Dimensionless Flow Duration Curve for Basin of Interest

First, convert change in water yield for the basin of interest from inches into cubic feet per second per day (DMF) for each time interval using the equation: (Inches/12)*Basin Area in Acres)/1.9834). Then, multiply DMF by: ((Percent Time Increase/6)/Bankfull for Basin of Interest) to get the dimensionless increase in flow for each time interval. Finally, add the dimensionless increase in flow for each time interval to the Goose Creek dimensionless flow value (baseline) to obtain the dimensionless flow duration curve for the basin of interest. So, in order to calculate a dimensionless flow duration curve for any drainage in the Waldo Canyon Fire area you just need three values specific to that drainage: 1) change in water yield (in) as a function of percent trees/oak killed, 2) watershed area (acres), and 3) bankfull discharge (cfs).

Literature Cited

Troendle, C. A., J. M. Nankervis, and L. S. Porth. 2003. The impact of Forest Service Activities on the stream flow regime in the Platte River. Final report submitted to the U. S. Forest Service by MATCOM Corporation. Fort Collins, CO. 50 p. plus Appendices.

U.S. Environmental Protection Agency. 1980. An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources. U.S. Environmental Protection Agency. August 1980. EPA-600/8-80-012 Athens, GA.

Appendix A1

Summary of Predicted Water Yield Change by Drainage, Sorted in Descending Order of Change in Each Sub-Drainage

and

Summary of Predicted Water Yield Change, Burned Vegetated Acres and Average Annual Precipitation for Each Drainage and Sub-Drainage

Sorted Descending - Water Yield Change by Drainage SubBasin
Water Yield Changes a Function of both Trees and Shrubs (Gambel Oak) Killed

SubShed **CC**	Total acres	Total Area WY change
CC-F07	3.50	5.42
CC-006	73.59	4.66
CC-F04	82.51	4.64
CC-013	243.77	4.43
CC-014	373.28	4.33
CC-015	154.64	3.88
CC-005	102.95	3.86
CC-F09	158.33	3.84
CC-F05	113.89	3.58
CC-F14	58.84	3.51
CC-F19	19.89	3.44
CC-F03	42.07	3.23
CC-F12	113.06	3.18
CC-017	453.14	3.18
CC-008	97.73	3.18
CC-016	77.01	3.18
CC-009	62.66	2.75
CC-004	36.75	2.64
CC-019	440.25	2.31
CC-007	910.26	2.28
CC-020	305.45	2.24
CC-F02	79.80	2.14
CC-F13	1.88	2.07
CC-F16	124.64	1.87
CC-F08	239.40	1.83
CC-F10	36.26	1.83
CC-018	251.33	1.66
CC-F18	56.13	1.46
CC-F17	97.08	1.17
CC-F06	100.11	0.80
CC-003	97.80	0.53
CC-F01	107.94	0.41
CC-012	39.39	0.38
CC-001	316.10	0.28
CC-F20	10.59	0.23
CC-011	44.38	0.22

SubShed **DC**	Total acres	Total Area WY change
DC-006	222.70	3.64
DC-007	822.34	3.15
DC-001	592.46	1.33
DC-004	1007.91	1.31
DC-F02	436.71	0.45
DC-F08	51.85	0.43
DC-F09	43.19	0.03
DC-005	105.35	0.02
DC-F06	20.90	0.00

SubShed **FC**	Total acres	Total Area WY change
FC-004	1123.23	4.04
FC-007	491.05	3.82
FC-009	239.42	3.40
FC-010	1104.70	3.38
FC-005	335.99	3.22
FC-008	178.61	3.13
FC-002	1720.29	2.98
FC-011	739.81	2.52
FC-006	110.97	1.67
FC-F07	244.15	1.11
FC-F09	118.27	0.97
FC-F04	338.93	0.92
FC-003	100.68	0.65
FC-F05	29.78	0.41
FC-F08	35.95	0.36
FC-F10	80.08	0.24
FC-F06	106.63	0.21
FC-F03	64.73	0.13

SubShed **MC**	Total acres	Total Area WY change
MC-F14	21.58	3.87
MC-010	308.34	3.30
MC-008	709.71	3.08
MC-009	121.30	3.04
MC-018	60.60	3.01
MC-007	729.03	2.64
MC-016	261.83	2.23
MC-F12	70.42	2.18
MC-019	79.18	2.17
MC-017	68.37	2.06
MC-015	961.57	1.89
MC-013	792.38	1.72
MC-F10	16.02	1.39
MC-F06	138.74	0.83
MC-F04	144.64	0.71
MC-F15	21.01	0.63
MC-006	101.56	0.53
MC-F13	27.47	0.53
MC-014	300.18	0.46
MC-001	2215.81	0.40
MC-F03	36.48	0.15
MC-F08	97.03	0.14
MC-F02	67.75	0.12
MC-F11	48.14	0.10
MC-005	270.77	0.07
MC-003	585.42	0.07

Water Yield Change
Color Key
≥ 4.0 in
3.0 ≤ in < 4.0
2.0 ≤ in < 3.0
1.0 ≤ in < 2.0
< 1.0 in

Basin	Oak & Trees Killed (acres)	Acres in Fire Perimeter	Percent Oak & Trees Killed	Water Yield Change (in)	Average Annual Precipitation (in)
Camp Creek	3501	5526	0.63	2.55	20.41
Douglas Creek	1528	3303	0.46	1.74	18.44
Fountain Creek	4891	7163	0.68	2.88	20.56
Monument Creek	3253	8255	0.39	1.39	20.77

SubBasin	Oak Killed (acres)	Trees Killed (acres)	Watershed Area (acres)	Percent Oak & Trees Killed	Water Yield Change (in)	Average Annual Precipitation (in)
CC-001	23.53	9.99	316.10	0.11	0.28	16.76
CC-003	24.10	1.02	97.80	0.26	0.53	17.00
CC-004	6.04	13.50	36.75	0.53	2.64	18.05
CC-005	43.70	54.37	102.95	0.95	3.86	18.50
CC-006	9.61	62.34	73.59	0.98	4.66	18.76
CC-007	32.12	418.08	910.26	0.49	2.28	20.50
CC-008	0.00	90.69	97.73	0.93	3.18	20.04
CC-009	0.00	57.27	62.66	0.91	2.75	20.50
CC-011	0.00	2.02	44.38	0.05	0.22	20.50
CC-012	0.00	3.46	39.39	0.09	0.38	20.50
CC-013	0.00	206.39	243.77	0.85	4.43	20.55
CC-014	0.00	334.06	373.28	0.89	4.33	20.93
CC-015	0.00	121.69	154.64	0.79	3.88	21.16
CC-016	0.00	63.53	77.01	0.82	3.18	20.50
CC-017	0.00	310.98	453.14	0.69	3.18	22.07
CC-018	0.00	161.56	251.33	0.64	1.66	21.94
CC-019	0.00	320.04	440.25	0.73	2.31	22.05
CC-020	0.00	205.09	305.45	0.67	2.24	22.40
CC-F01	12.78	15.65	107.94	0.26	0.41	17.33
CC-F02	23.61	29.54	79.80	0.67	2.14	17.04
CC-F03	0.00	33.29	42.07	0.79	3.23	17.92
CC-F04	6.30	72.84	82.51	0.96	4.64	18.50
CC-F05	15.01	88.37	113.89	0.91	3.58	18.49
CC-F06	0.00	34.69	100.11	0.35	0.80	20.50
CC-F07	0.00	3.47	3.50	0.99	5.42	19.33
CC-F08	22.27	131.59	239.40	0.64	1.83	19.64
CC-F09	0.00	113.05	158.33	0.71	3.84	20.03
CC-F10	0.00	23.07	36.26	0.64	1.83	20.32
CC-F12	0.00	76.03	113.06	0.67	3.18	20.50
CC-F13	0.00	0.99	1.88	0.53	2.07	20.50
CC-F14	0.00	35.69	58.84	0.61	3.51	20.56
CC-F16	0.00	92.38	124.64	0.74	1.87	21.35
CC-F17	0.00	40.84	97.08	0.42	1.17	21.12
CC-F18	0.00	40.25	56.13	0.72	1.46	21.97

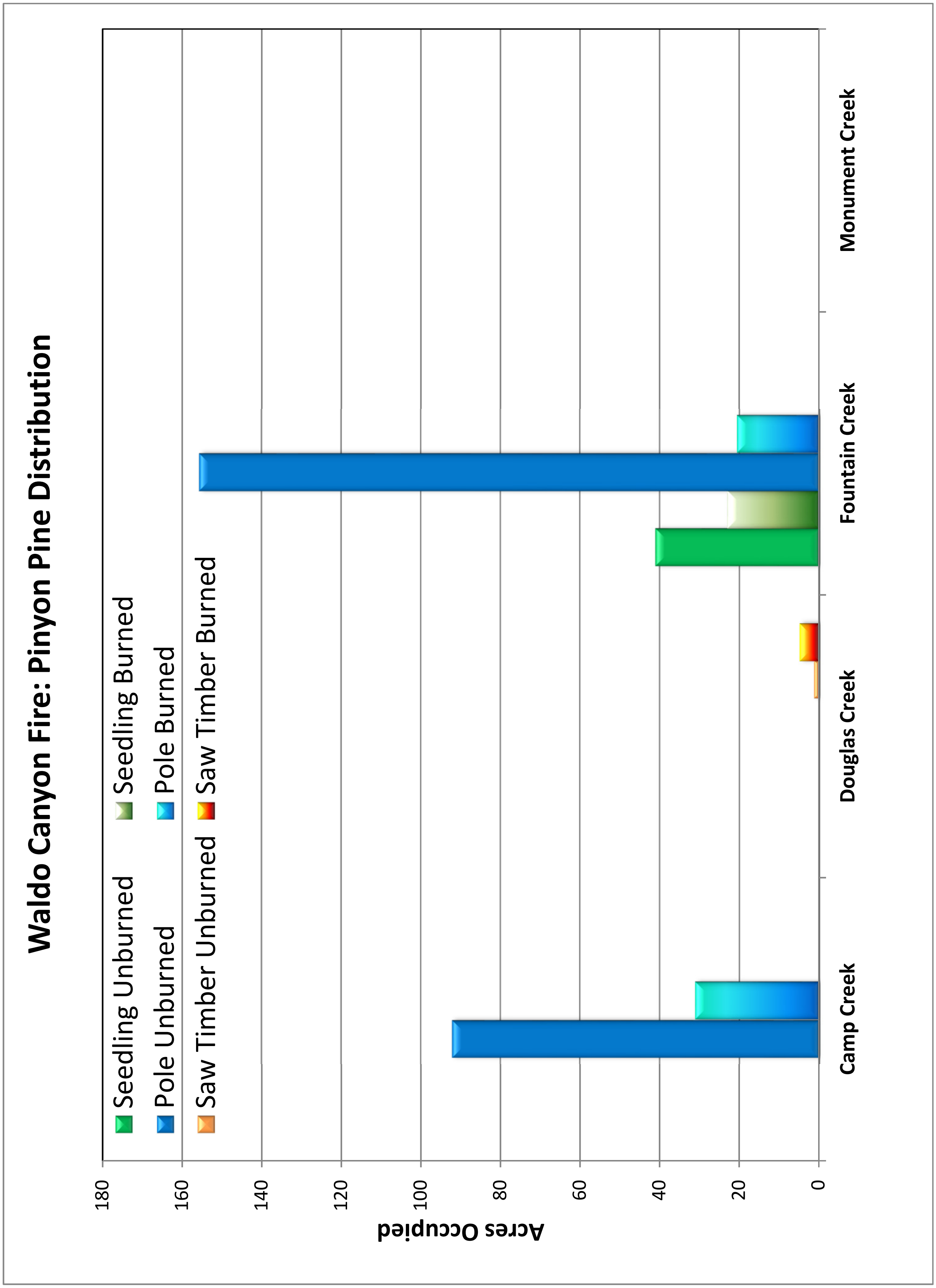
SubBasin	Oak Killed (acres)	Trees Killed (acres)	Watershed Area (acres)	Percent Oak & Trees Killed	Water Yield Change (in)	Average Annual Precipitation (in)
CC-F19	0.00	13.71	19.89	0.69	3.44	22.00
CC-F20	0.00	0.36	10.59	0.03	0.23	22.00
DC-001	29.61	140.98	592.46	0.29	1.33	17.47
DC-004	161.61	172.78	1007.91	0.33	1.31	18.42
DC-005	0.27	1.25	105.35	0.01	0.02	17.67
DC-006	44.00	153.31	222.70	0.89	3.64	19.29
DC-007	0.00	698.33	822.34	0.98	3.15	19.89
DC-F02	68.23	35.07	436.71	0.24	0.45	17.12
DC-F06	0.00	0.00	20.90	0.00	0.00	16.91
DC-F08	6.33	13.88	51.85	0.39	0.43	17.65
DC-F09	0.00	2.49	43.19	0.06	0.03	17.36
FC-002	523.21	721.90	1720.29	0.72	2.98	19.42
FC-003	14.36	0.21	100.68	0.14	0.65	18.09
FC-004	290.69	691.00	1123.23	0.87	4.04	20.09
FC-005	95.77	171.53	335.99	0.80	3.22	20.50
FC-006	47.56	11.77	110.97	0.53	1.67	20.54
FC-007	110.95	273.15	491.05	0.78	3.82	21.16
FC-008	33.84	103.81	178.61	0.77	3.13	21.58
FC-009	33.21	157.34	239.42	0.80	3.40	21.52
FC-010	88.31	802.30	1104.70	0.81	3.38	21.85
FC-011	47.69	411.66	739.81	0.62	2.52	21.59
FC-F03	2.28	0.05	64.73	0.04	0.13	18.00
FC-F04	7.24	73.20	338.93	0.24	0.92	20.22
FC-F05	5.49	0.01	29.78	0.18	0.41	20.50
FC-F06	8.84	0.49	106.63	0.09	0.21	20.52
FC-F07	67.08	33.73	244.15	0.41	1.11	21.00
FC-F08	9.99	0.00	35.95	0.28	0.36	21.00
FC-F09	36.05	12.60	118.27	0.41	0.97	20.95
FC-F10	0.00	3.40	80.08	0.04	0.24	20.67
MC-001	99.58	160.29	2215.81	0.12	0.40	17.80
MC-003	11.20	8.17	585.42	0.03	0.07	18.73
MC-005	0.00	10.52	270.77	0.04	0.07	20.18
MC-006	0.00	15.89	101.56	0.16	0.53	20.74
MC-007	0.00	485.54	729.03	0.67	2.64	21.26
MC-008	0.00	452.96	709.71	0.64	3.08	22.02
MC-009	0.00	81.71	121.30	0.67	3.04	22.50
MC-010	0.00	245.93	308.34	0.80	3.30	22.28
MC-013	0.00	548.23	792.38	0.69	1.72	22.45
MC-014	0.00	47.43	300.18	0.16	0.46	22.96
MC-015	0.00	591.81	961.57	0.62	1.89	22.73
MC-016	0.00	173.56	261.83	0.66	2.23	22.99
MC-017	0.00	53.28	68.37	0.78	2.06	22.98
MC-018	0.00	45.08	60.60	0.74	3.01	22.96

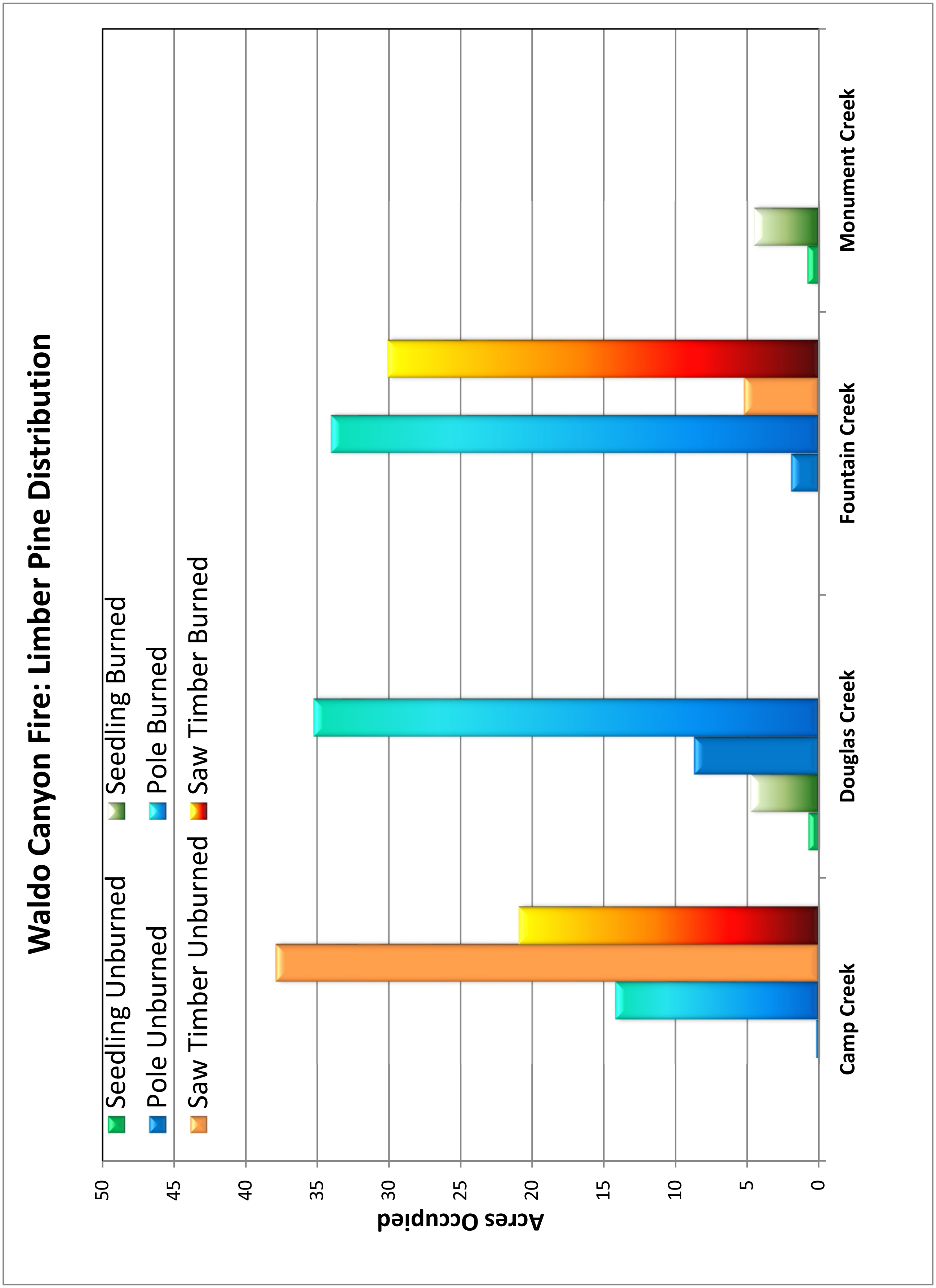
SubBasin	Oak Killed (acres)	Trees Killed (acres)	Watershed Area (acres)	Percent Oak & Trees Killed	Water Yield Change (in)	Average Annual Precipitation (in)
MC-019	0.00	47.65	79.18	0.60	2.17	23.00
MC-F02	0.00	2.47	67.75	0.04	0.12	21.14
MC-F03	0.00	2.37	36.48	0.06	0.15	21.74
MC-F04	0.00	29.77	144.64	0.21	0.71	22.19
MC-F06	0.00	73.36	138.74	0.53	0.83	22.50
MC-F08	0.00	9.88	97.03	0.10	0.14	22.77
MC-F10	0.00	4.89	16.02	0.30	1.39	22.60
MC-F11	0.00	1.09	48.14	0.02	0.10	23.00
MC-F12	0.00	29.47	70.42	0.42	2.18	22.61
MC-F13	0.00	2.15	27.47	0.08	0.53	23.00
MC-F14	0.00	14.73	21.58	0.68	3.87	22.50
MC-F15	0.00	4.30	21.01	0.20	0.63	22.98

Appendix A2

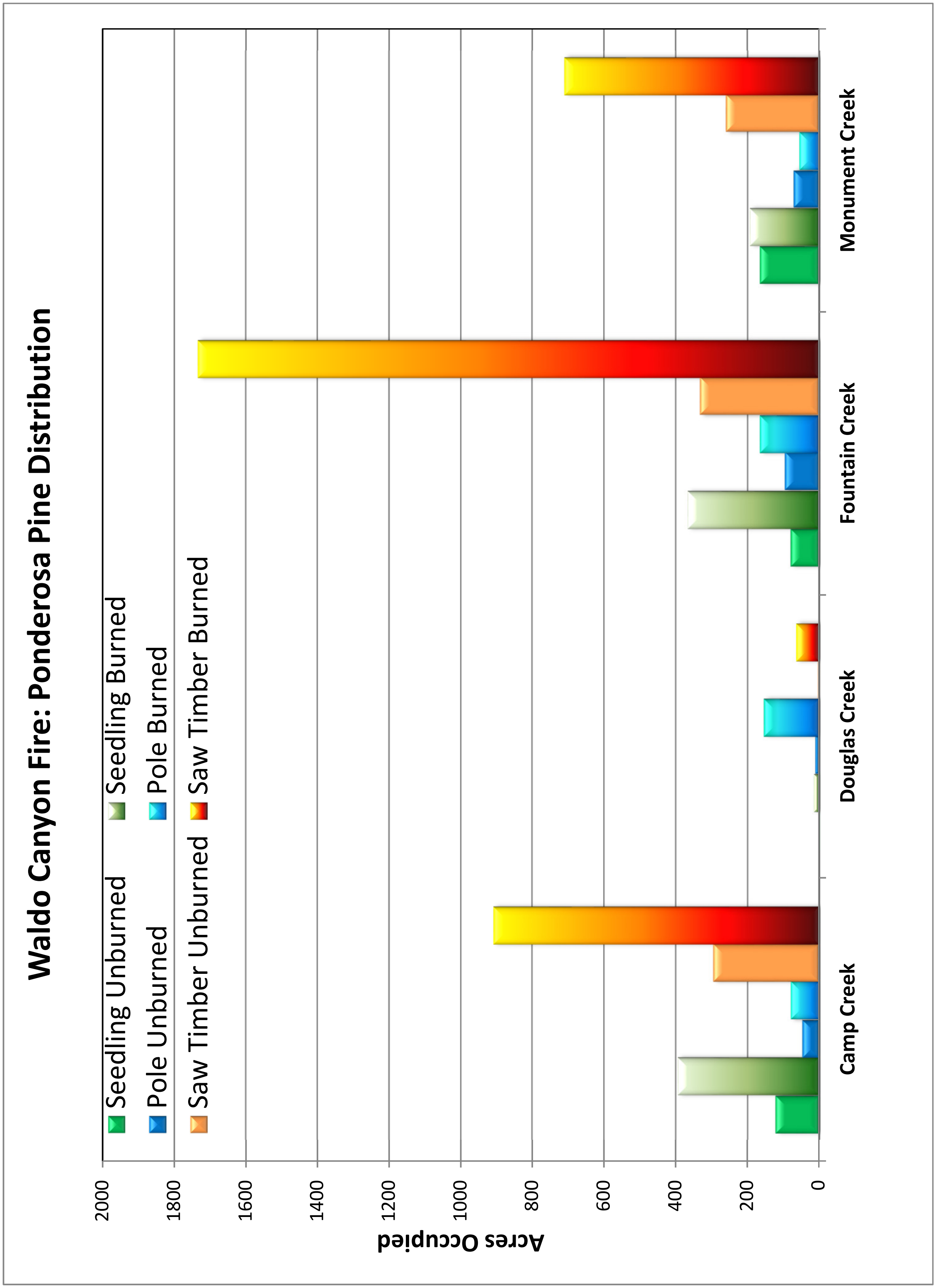
Summary and Graphs of Vegetation Cover Type, Size and Status by Drainage

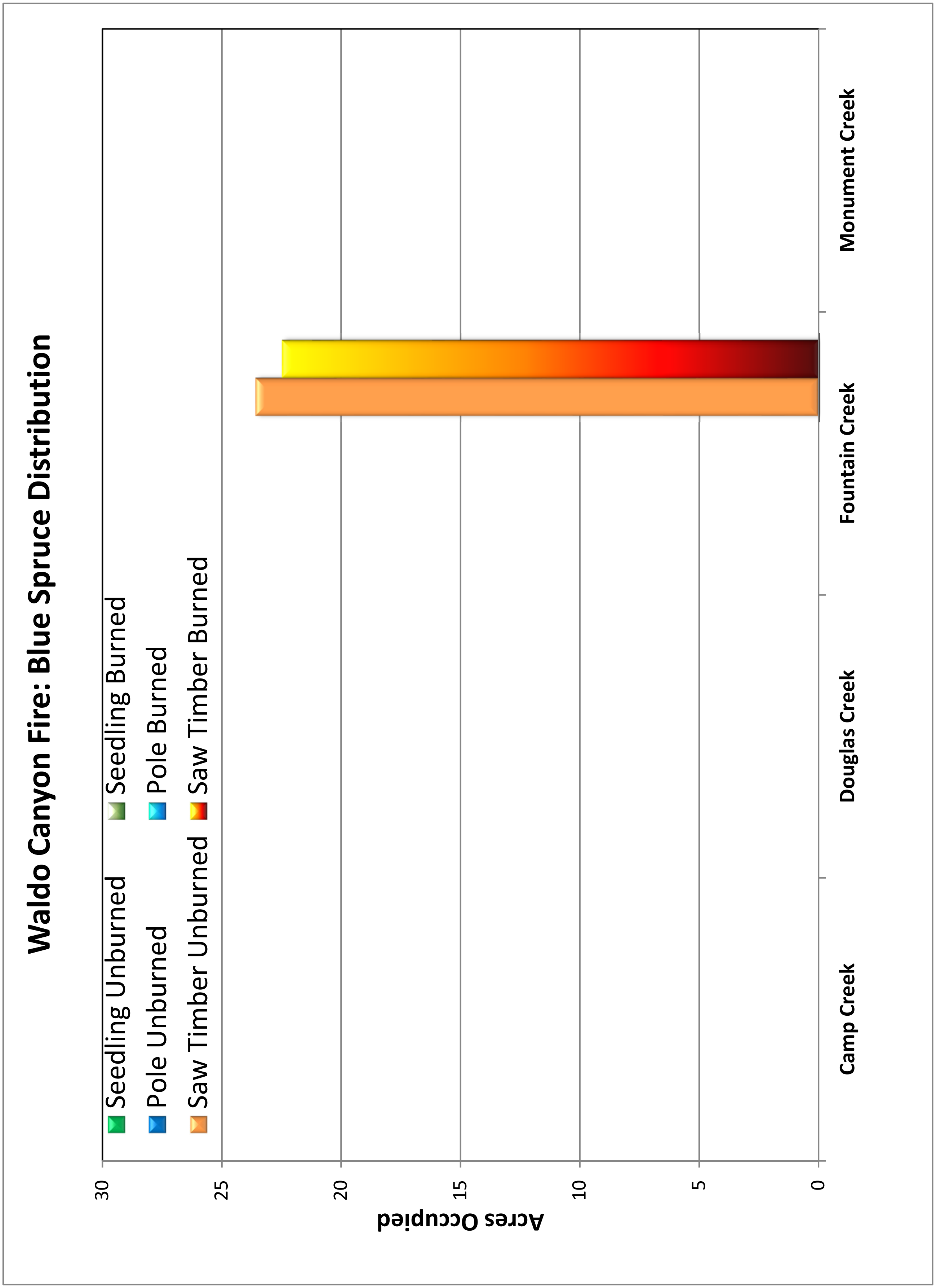
Cover Type	Cover Size	Status	Acres by Drainage: Camp Creek	Douglas Creek	Fountain Creek	Monument Creek
Pinyon Pine	Seedling	Unburned			41	
		Burned			23	
	Pole	Unburned	92		156	
		Burned	31		21	
	Saw Timber	Unburned		1		
		Burned		5		
Limber Pine	Seedling	Unburned		1		1
		Burned		5		5
	Pole	Unburned	0	9	2	
		Burned	14	35	34	
	Saw Timber	Unburned	38		5	
		Burned	21		30	
Ponderosa Pine	Seedling	Unburned	122	0	79	165
		Burned	394	15	366	193
	Pole	Unburned	47	11	95	71
		Burned	79	154	166	55
	Saw Timber	Unburned	295	4	332	259
		Burned	909	64	1734	710
Blue Spruce	Seedling	Unburned				
		Burned				
	Pole	Unburned				
		Burned				
	Saw Timber	Unburned			24	
		Burned			22	
Cottonwood	Seedling	Unburned				
		Burned				
	Pole	Unburned				
		Burned				
	Saw Timber	Unburned			29	
		Burned				
Aspen	Seedling	Unburned	93	1	34	318
		Burned	207	36	70	592
	Pole	Unburned	17	0	35	49
		Burned	42	8	71	57
	Saw Timber	Unburned	42		5	192
		Burned	58		5	193
Douglas Fir	Seedling	Unburned	227	38	30	417
		Burned	394	399	148	542
	Pole	Unburned	139	18	30	347
		Burned	423	328	133	288
	Saw Timber	Unburned	192	5	95	590
		Burned	710	160	646	509
Gambel Oak	HT ≤ 3 FT	Unburned	9	0	28	21
		Burned	83	5	300	7
	3 < HT ≤ 6 FT	Unburned	43	64	121	101
		Burned	114	172	662	62
	HT > 6 FT	Unburned	2	30	112	57
		Burned	22	142	460	41
NonForested		UnBurned	333	1148	634	2222
		Burned	334	445	386	192

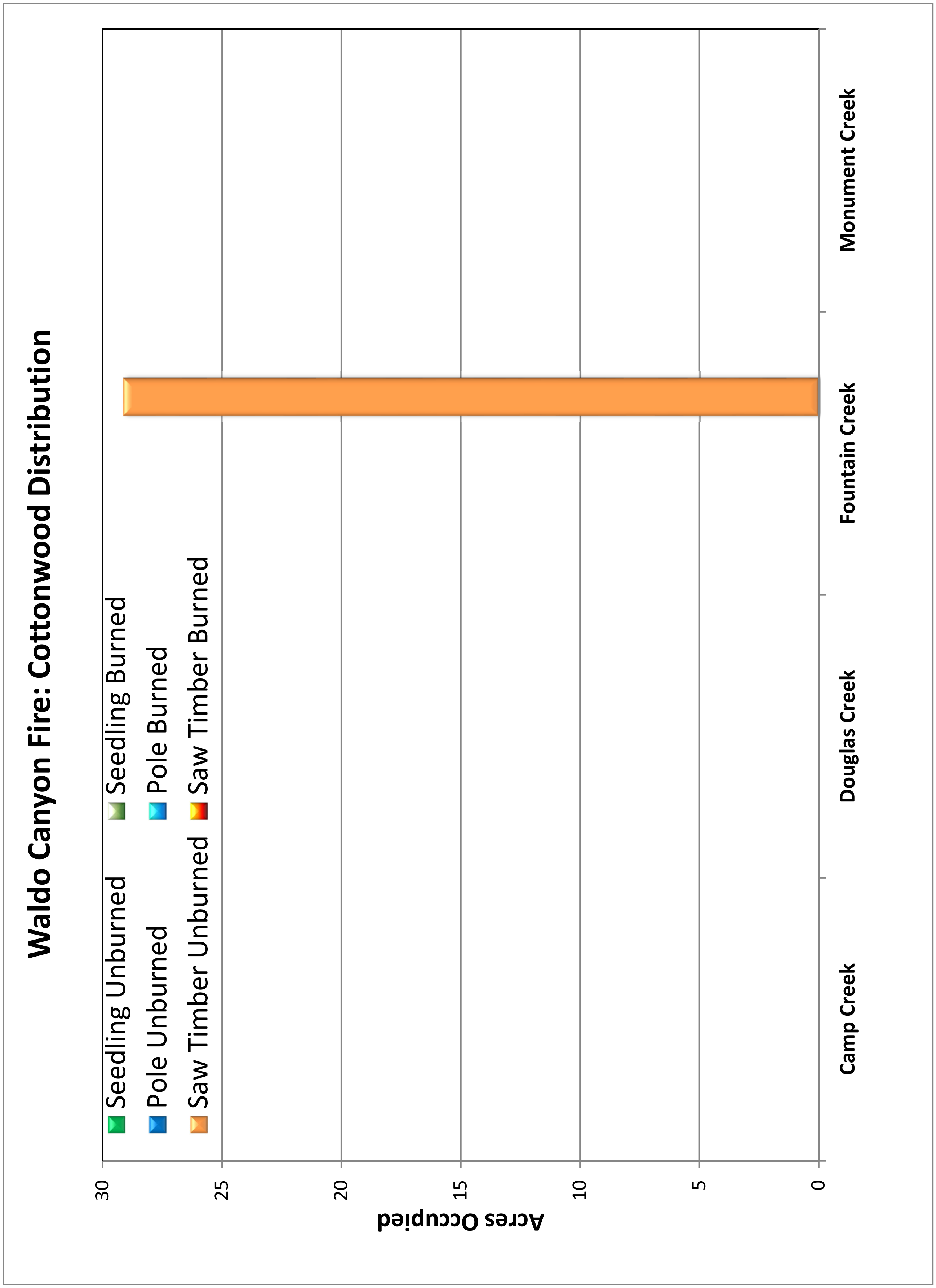

Waldo Canyon Fire: Pinyon Pine Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
0
20
40
60
80
100
120
140
160
180
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek

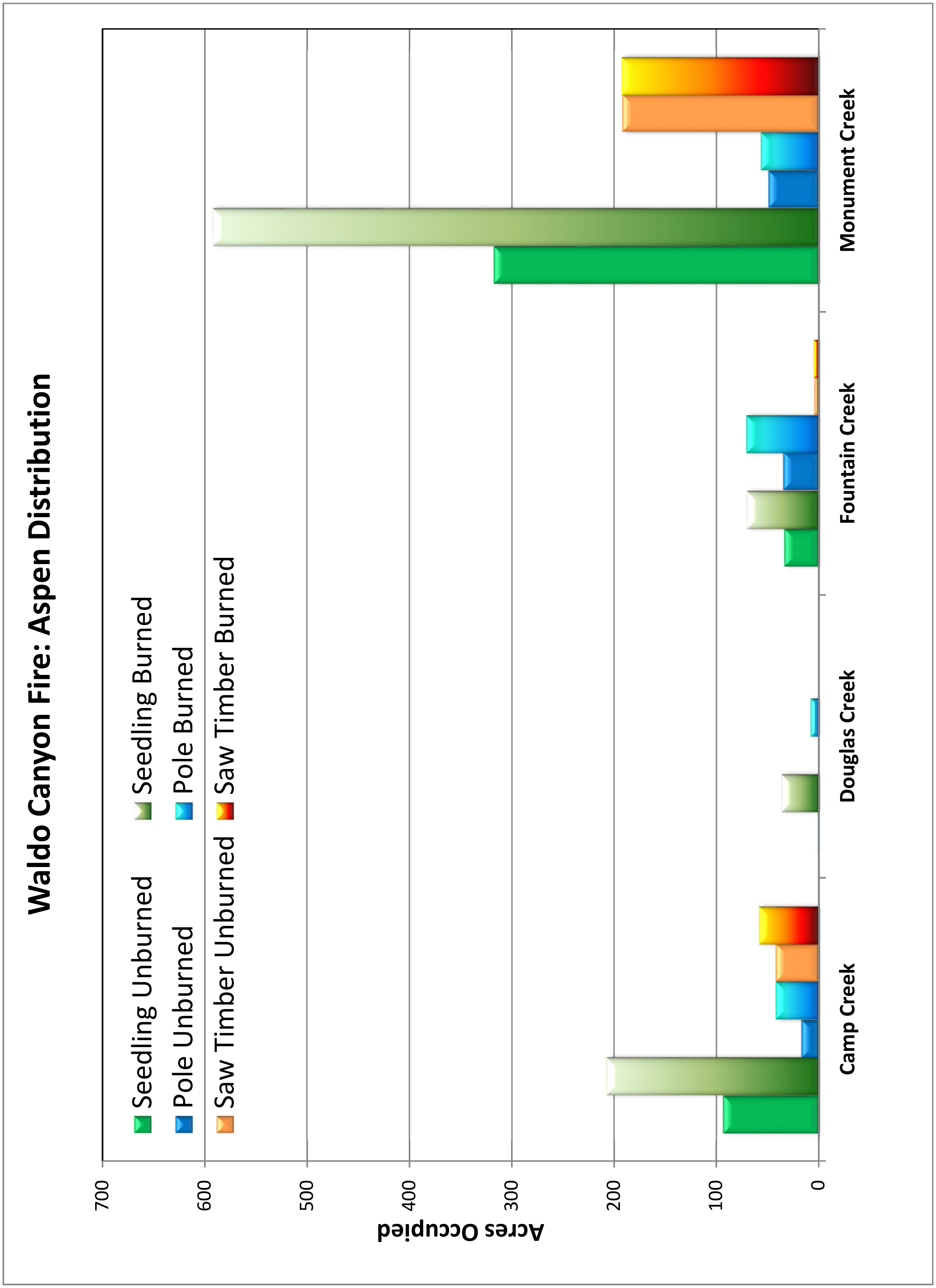


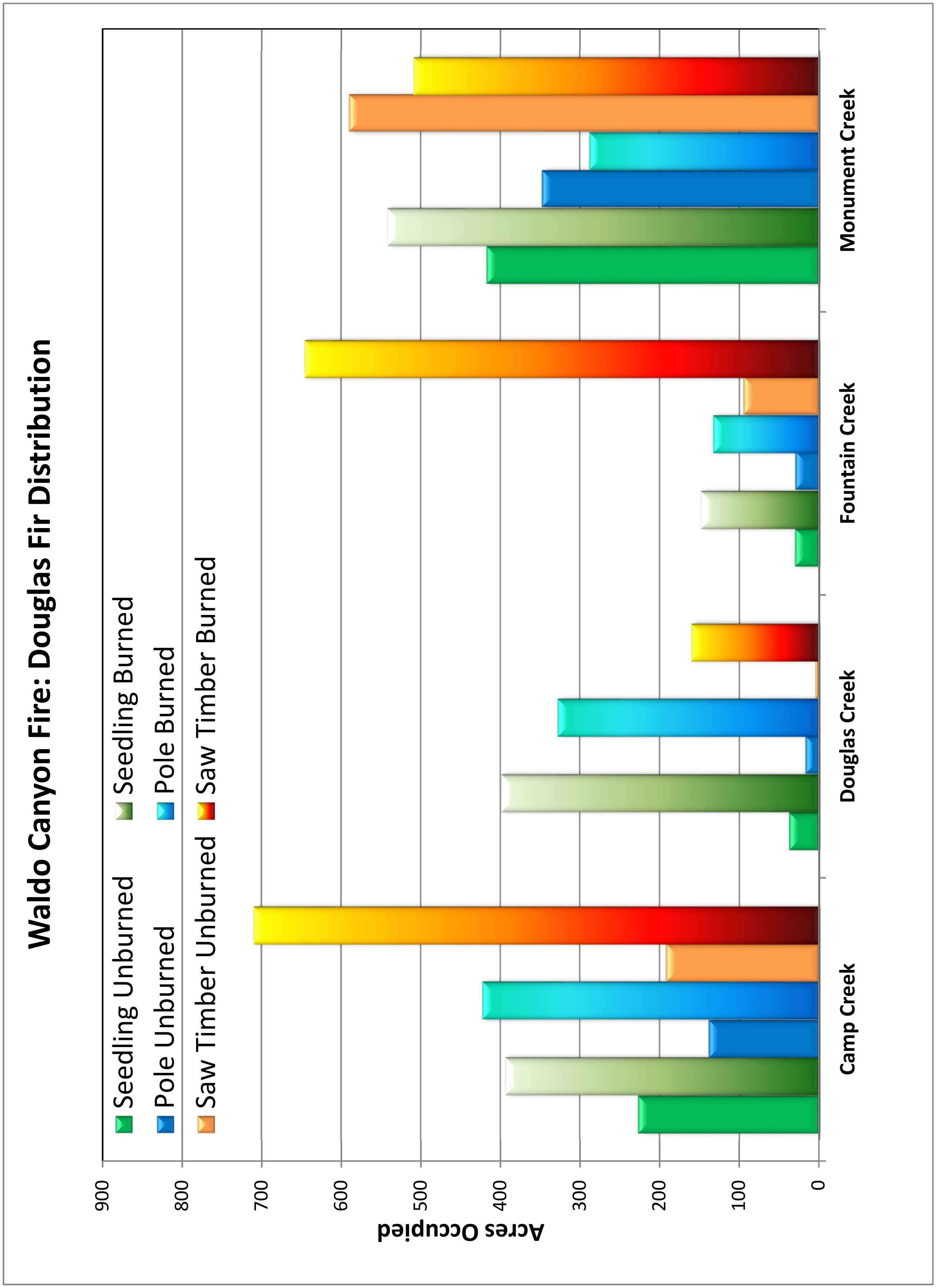
Waldo Canyon Fire: Limber Pine Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
0
5
10
15
20
25
30
35
40
45
50
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek


Waldo Canyon Fire: Ponderosa Pine Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek

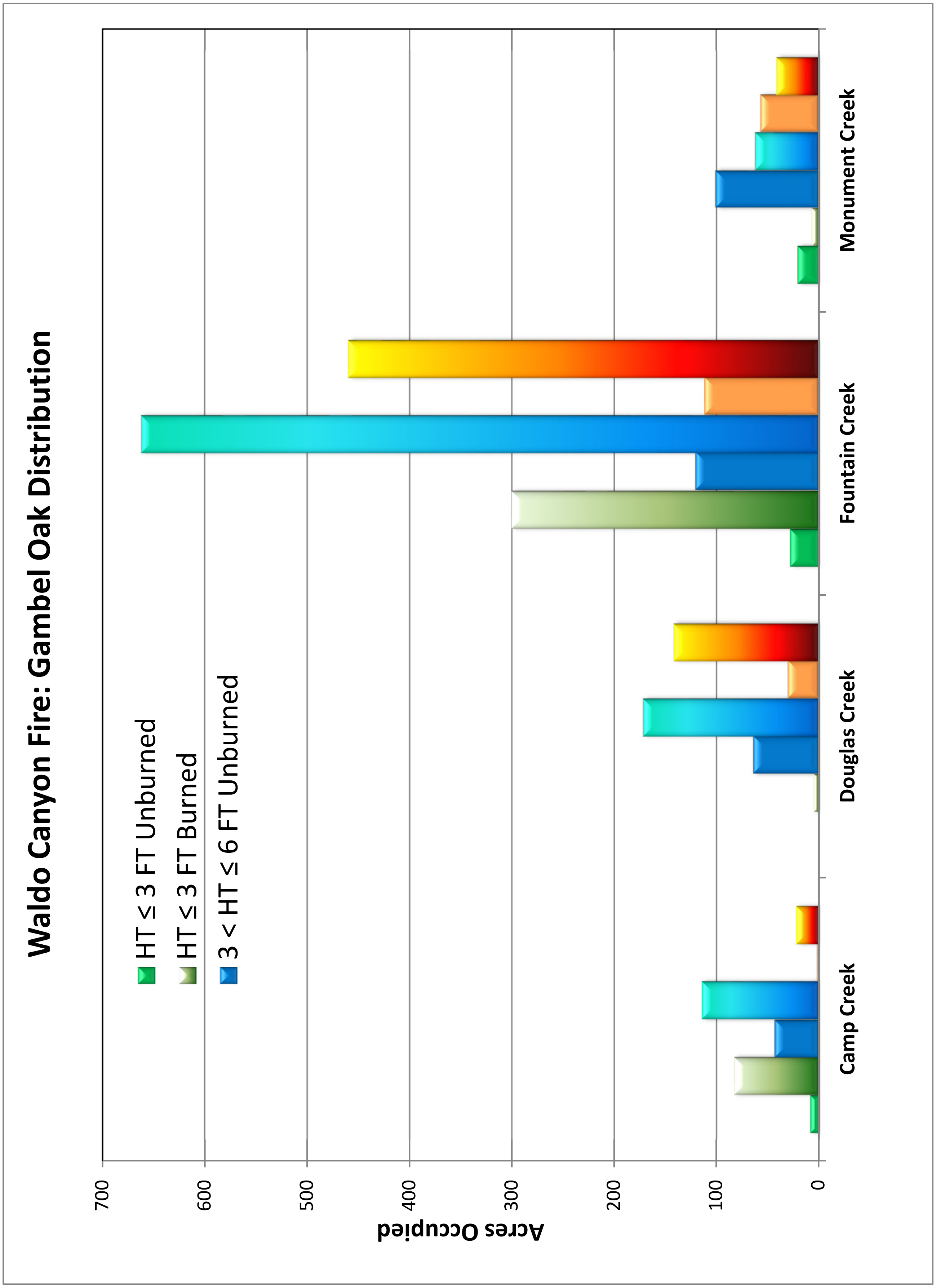

Waldo Canyon Fire: Blue Spruce Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
0
5
10
15
20
25
30
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek

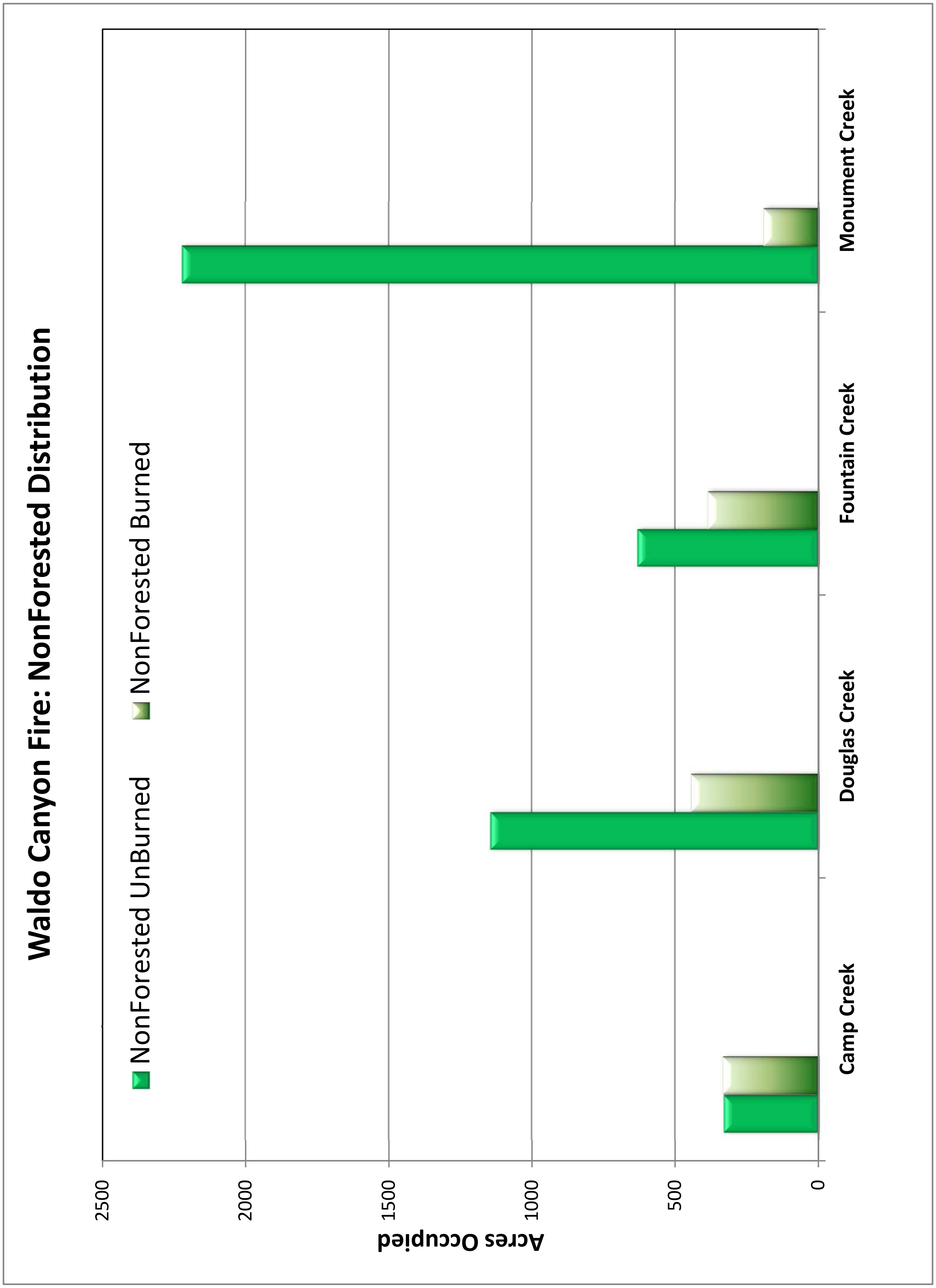

Waldo Canyon Fire: Cottonwood Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
0
5
10
15
20
25
30
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek


Waldo Canyon Fire: Aspen Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
700
600
500
400
300
200
100
0
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek



Waldo Canyon Fire: Douglas Fir Distribution
Seedling Unburned
Seedling Burned
Pole Unburned
Pole Burned
Saw Timber Unburned
Saw Timber Burned
Acres Occupied
0
100
200
300
400
500
600
700
800
900
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek


Waldo Canyon Fire: Gambel Oak Distribution
HT ≤ 3 FT Unburned
HT ≤ 3 FT Burned
3 < HT ≤ 6 FT Unburned
Acres Occupied
700
600
500
400
300
200
100
0
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek


Waldo Canyon Fire: NonForested Distribution
NonForested UnBurned
NonForested Burned
Acres Occupied
2500
2000
1500
1000
500
0
Camp Creek
Douglas Creek
Fountain Creek
Monument Creek

Appendix A3

Summary of Percent Increase in Water Yield per Time Interval

and

Weighted Percent in Water Yield Increase per RiverMorph Time Intervals for Reference Flow Duration Curve

Increase in water yield apportioned over 114 days of the reference hydrograph
There are a total of 19 - 6 day increments of increase per WRENSS (1980).

Increment	Cumulative Days Of Increase	Percent Time Equaled/Exceeded	Percent Increase per Increment
1	6	1.64%	0.1475
2	12	3.29%	0.1433
3	18	4.93%	0.1317
4	24	6.58%	0.1158
5	30	8.22%	0.0983
6	36	9.86%	0.0825
7	42	11.51%	0.0717
8	48	13.15%	0.0525
9	54	14.79%	0.0400
10	60	16.44%	0.0367
11	66	18.08%	0.0217
12	72	19.73%	0.0208
13	78	21.37%	0.0125
14	84	23.01%	0.0108
15	90	24.66%	0.0067
16	96	26.30%	0.0033
17	102	27.95%	0.0025
18	108	29.59%	0.0008
19	114	31.23%	0.0008

Goose Creek USGS Gauge # 06700500 - Reference Flow Regime
RiverMorph Percent Time Categories for Flow Duration Curve

Daily Mean Flow (cfs)	Dimensionless Discharge (DMF/151)	Percent Time Equaled/Exceeded	Weighted Percent Increase
483	3.199	0.001%	0.1475
483	3.199	0.005%	0.1475
483	3.199	0.01%	0.1475
444	2.940	0.05%	0.1475
415	2.748	0.10%	0.1475
359	2.377	0.25%	0.1475
310	2.053	0.50%	0.1475
290	1.921	0.60%	0.1475
272	1.801	0.70%	0.1475
258	1.709	0.80%	0.1475
244	1.616	0.90%	0.1475
229	1.517	1.00%	0.1475
188	1.245	1.50%	0.1475
164	1.086	2.00%	0.14455
138	0.914	3.00%	0.14333
118	0.781	4.00%	0.13501
105	0.695	5.00%	0.13060
66	0.437	10.00%	0.09788
36	0.238	20.00%	0.03932
24	0.159	30.00%	0.00570
17	0.113	40.00%	0.00010
13	0.086	50.00%	0
10	0.066	60.00%	0
8	0.053	70.00%	0
7	0.046	80.00%	0
5	0.033	90.00%	0
1	0.007	100.00%	0