WHITE PAPER

USDA Forest Service | Pacific Northwest Region | Umatilla National Forest

WHITE PAPER F14-SO-WP-SILV-18

Fire Regime Condition Class Queries[1]

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INTRODUCTION

Fire regime condition class (FRCC) is an interagency, standardized tool for determining degree of ecological departure from historical (reference) vegetation, fuels, and disturbance regimes. Assessing FRCC can help managers establish treatment objectives and set priorities for project work (definition modified from http://www.frames.gov/frcc).

An FRCC assessment system (Barrett et al. 2010) is used to characterize fire regimes and understand their departure from historical reference conditions. FRCC uses many of the same concepts and principles as the range of variation (RV) (white paper F14-SO-WP-SILV-3, *Range of variation recommendations for dry, moist, and cold forests* (Powell 2019), provides more information about RV, also known as the historical range of variability (HRV)).

The FRCC protocol utilizes RV/HRV techniques because it was developed largely in response to this requirement from Healthy Forests Restoration Act: "In carrying out a covered project, the Secretary shall fully maintain, or contribute toward the restoration of the structure and composition of old growth stands according to the pre-fire-suppression old growth conditions" (http://www.gpo.gov/fdsys/pkg/PLAW-108publ148/pdf/PLAW-108publ148.pdf).

FRCC is scale dependent, and guidelines instituted for minimum analysis-area sizes vary by fire regime (FR). Frequent-interval fire regimes (such as dry forests assigned to fire regime I) generally have smaller analysis areas than infrequent-interval fire regimes such as FR IV or V (including cold, subalpine forests).

This white paper describes how FRCC queries were developed during a watershed analysis for Potamus watershed on the Umatilla National Forest. Currently, software applications are used to make FRCC calculations, but they were not available when Potamus was analyzed.

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[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of USDA Forest Service.

DEFINITIONS

A fire regime condition class (FRCC) descriptor was devised to characterize an area's departure from historical fire regimes. Condition class is based on the HRV concept (Morgan et al. 1994, Parsons et al. 1999, Powell 2019, Swanson et al. 1994).

When existing vegetation characteristics (composition, structural classes, stand age, canopy cover, and spatial or mosaic pattern of vegetation patches) are functioning much as they did historically, then an existing fire regime is within its HRV (this is condition class one) (Hann et al. 2004, Schmidt et al. 2002).

When existing vegetation characteristics are departed from their historical situation, often due to ecosystem alterations caused by fire suppression, timber harvest, livestock grazing, and introduction of exotic plants and insects or diseases, then an existing fire regime is not within its HRV (this description relates to condition classes two and three) (Hann et al. 2004, Schmidt et al. 2002).

This document describes how fire regime condition classes were calculated for a Potamus analysis area, a large area (almost 100,000 acres) where 92% of existing condition information was based on interpretation of aerial photography, and the remainder (8%) was derived from field-sampled surveys (stand examinations or walk-throughs).

Queries described below are designed to address a definition provided by Schmidt et al. (2002) (see 2nd paragraph in this section). Composition, structure, and density were used explicitly in the queries (density is used as a proxy for the canopy cover factor in the FRCC definition); the other two vegetation factors mentioned above in the FRCC definition (stand age and mosaic pattern) are not addressed explicitly in these queries.

Queries described here differ from those developed on Umatilla National Forest (NF) in 2001; this is understandable because a firm definition of FRCC (as provided by Schmidt et al. 2002) was not yet available when preliminary queries were developed in 2001.

QUERY DEVELOPMENT

When developing these queries, I used 'potential vegetation group' as a proxy for fire regime because Blue Mountain national forests (Malheur, Umatilla, and Wallowa-Whitman) had not yet agreed on a consistent way to assign fire regimes. Agreement was subsequently reached, and fire regime assignments are now based primarily on plant association groups (PAGs).

Since plant association groups are aggregated into potential vegetation groups (PVGs) (Powell et al. 2007), I believe these queries are consistent with a Blue Mountains protocol for assigning fire regimes; however, they are perhaps coarser than what would have been developed explicitly for application with PAGs (appendix 1 shows how PAGs were cross-walked to PVGs, and the analysis methodology described below utilizes PVG as an initial stratification).

Queries rely on knowing which composition categories in an analysis area are outside their historical ranges of variability. An advantage of this approach is that it closely links an area's existing situation to likely deviations from historical conditions. A disadvantage of this approach is that an analyst needs relatively complete data about composition, and its ecological status, before calculating FRCC, and this may not always be possible depending on vegetation data sources and ecological context information.

The composition situation for Potamus analysis area is summarized in table 1.

Table 1. Historical range of variability analysis for existing vegetation composition.

	Dry UF PVG[2]		Moist UF PVG		Cold UF PVG	
Cover Type[1]	Historical Range (%)[3]	Current Percent[4]	Historical Range (%)	Current Percent	Historical Range (%)	Current Percent
Grass-forb	0-5	2	0-5	4	0-5	7
Shrub	0-5	< 1	0-5	3	0-15	2
Western juniper	0-5	< 1				
Ponderosa pine	50-90	21	5-15	9	0-5	1
Douglas-fir	5-15	54	15-30	41	0-15	18
Western larch	0-10	1	10-30	< 1	0-15	2
Broadleaved trees			0-5	< 1		
Lodgepole pine	0-5	7	5-30	12	20-60	19
Western white pine			0-5	0		
Grand fir	1-5	15	5-30	29	0-10	51
Whitebark pine					0-5	0
Spruce-fir			0-15	3	20-40	< 1

Source: Historical ranges adapted from Morgan and Parsons (2000).

[1] Cover types consist of these coding combinations – grass-forb: all grass and forb codes; shrub: all shrub codes; western juniper: JUOC and mix-JUOC codes; ponderosa pine: PIPO and mix-PIPO codes; Douglas-fir: PSME and mix-PSME codes; western larch: LAOC and mix-LAOC codes; broadleaved trees: POTR2, mix-POTR2, POTR5, and mix-POTR5 codes; lodgepole pine: PICO and mix-PICO codes; western white pine: PIMO and mix-PIMO codes; grand fir: ABGR and mix-ABGR codes; whitebark pine: PIAL and mix-PIAL codes; and spruce-fir: ABLA, mix-ABLA, PIEN, and mix-PIEN codes. Cover type codes are described in Powell (2013).

[2] Potential vegetation groups (PVG) are the middle level of a three-level, mid-scale hierarchy for potential vegetation (Powell et al. 2007). PVG codes are described in Powell (2013).

[3] Historical ranges, derived from Morgan and Parsons (2000), were based on multiple 1,200-year simulations representing landscapes in a 'dynamic equilibrium' with their disturbance regime.

[4] Current percentages, derived from Potamus existing vegetation database (Powell 2013), include National Forest System lands only.

1. Queries for the Dry Upland Forest potential vegetation group (code = Dry UF in Potamus database; note that Dry UF is entirely in fire regime 1):

- **a.** Cover Type = PSME, mix-PSME, ABGR, or mix-ABGR; AND
- **b.** Aspect = Level, southeast, south, southwest, or west; AND
- **c.** Density = Moderate or high; AND
- **d.** Tree Layers = 2 or 3.

Condition class 3 = every polygon meeting all four criteria.

Assumptions used for these query statements are:

- Douglas-fir and grand fir cover types are both above HRV for Dry UF potential vegetation group (see table 1);

- Douglas-fir and grand fir cover types are only characteristic for cooler and moister aspects in this PVG (north and east aspects);
- Douglas-fir and grand fir composition on warmer and dryer aspects (south and west) are not characteristic if native disturbance regimes (primarily nonlethal surface fire) were functioning properly;
- Upland forest density would be low for a properly functioning fire regime when surface fire was thinning stands on a 5-20 year interval; and
- Presence of a multi-layered structure (e.g., canopy layers is greater than 1 in database) is indicative of skipped fire cycles, and an uncharacteristic stand structure.

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e. Cover Type = PIPO or mix-PIPO and Density = Moderate or high; OR

f. Cover Type = PICO or mix-PICO and Density = High; OR

g. Cover Type = JUOC or mix-JUOC.

Condition class 2 = every polygon meeting any of the three criteria.

Assumptions used for these query statements are:

- Lodgepole pine cover type is above HRV for the Dry UF potential vegetation group (see table above);
- For eastern Oregon, areal extent of western juniper has increased substantially from its historical distribution (Gedney et al. 1999). All western juniper cover type on Dry UF PVG was assumed to be uncharacteristic; and
- High forest density for ponderosa pine cover type is uncharacteristic if native disturbance regimes (primarily nonlethal surface fire) were functioning properly.

Condition class 1 = every polygon not meeting any criteria for FRCC 1 or 2.

2. Queries for Moist Upland Forest potential vegetation group (code = Moist UF in database; note that Moist UF is primarily in fire regime 3, but some plant association groups in this PVG occur in fire regime 4):

a. Cover Type = PSME or mix-PSME; AND

b. Aspect = Southeast, south, southwest, or west; AND

c. Density = High; AND

d. Tree Layers = 2 or 3.

Condition class 3 = every polygon meeting all four criteria.

Assumptions used for these query statements are:

- Douglas-fir cover type is above HRV for Moist UF potential vegetation group (see table 1);
- Douglas-fir cover type may be uncharacteristic on warmer and dryer aspects (south and west) because these biophysical environments are likely to have represented the nonlethal portion of a mixed-severity fire regime;

- Characteristic forest density levels for a mixed-severity fire regime were assumed to include both the low and moderate categories (e.g., some proportion of high density category was assumed to represent uncharacteristic conditions);

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e. Cover Type = ABGR or mix-ABGR <u>and</u> Aspect = South or southwest; OR

f. Cover Type = PSME or mix-PSME <u>and</u> Aspect = Southeast, south, southwest, or west; OR

g. Density = Very high ($\geq$ 80% canopy cover).

Condition class 2 = every polygon meeting any of the three criteria.

Assumptions used for these query statements are:

- Grand fir cover type is near upper limit of HRV for Moist UF potential vegetation group (see table 1), and grand fir stands on hot exposures are most likely to be departed from historical conditions due to fire suppression;
- Douglas-fir cover type is most likely to be uncharacteristic on warm exposures (this assumption does not include the density and layering qualifiers used with FRCC 3 query options for moist sites); and
- Very high forest density might be an indicator of less than properly functioning disturbance regimes.

Condition class 1 = every polygon not meeting any criteria for FRCC 1 or 2.

3. Queries for the Cold Upland Forest potential vegetation group (code = Cold UF in database; note that Cold UF is entirely in fire regime 4):

Condition class 3 = none.

a. Cover Type = ABGR, mix-ABGR, PSME, or mix-PSME; AND

b. Aspect = North, east, or northeast; AND

c. Tree Cover $\geq$ 80% canopy cover.

Condition class 2 = every polygon meeting all three criteria.

Assumptions used for these query statements are:

- Douglas-fir and grand fir cover types are both above HRV for Cold UF potential vegetation group (see table 1);
- Douglas-fir and grand fir cover types are only characteristic for warmer and dryer aspects in this PVG, so these types occurring on north and east aspects apparently indicate situations that would be expected to support spruce-fir cover type (and it is currently deficient on cold UF sites in the analysis area);
- Very high forest density might be an indicator of less than properly functioning disturbance regimes.

Condition class 1 = every polygon not meeting any criteria for FRCC 1 or 2.

4. Queries for upland, nonforest potential vegetation groups (e.g., site potential is nonforest as assigned by using an ecoclass code; these potential vegetation groups occur in fire regimes 2-5):

Condition class 3 = none.

a. Tree Cover $\geq$ 5% canopy cover.

Condition class 2 = every polygon meeting this criterion.

Assumptions used for these query statements are:

- Many nonforest sites have potential for limited amounts of tree invasion (encroachment) when periodic wildfire is absent, and 5% tree canopy cover was used as an indicator of sites that may have missed multiple fire cycles;
- It was assumed (within information constraints associated with photo-interpretation surveys) that tree invasion at levels less than 5% canopy cover might indicate that disturbance regimes are functioning within their historical ranges;
- Photo-interpretation surveys do not adequately characterize presence of noxious weeds or other invasive species that could serve as indicators of impaired ecological function (if invasives information had been available, it would definitely have been used to help determine FRCC for nonforest sites).

Condition class 1 = every polygon not meeting any criteria for FRCC 1 or 2.

5. Here are results from an FRCC query exercise for Potamus watershed (table 2):

Table 2. Existing fire regime condition classes for Potamus analysis area.

Fire Regime Condition Class Description	Acres	Percent
Fire regime condition class 1	40,829	41.0
Fire regime condition class 2	41,486	41.7
Fire regime condition class 3	17,279	17.4
Water (no condition class assigned)	9	< 0.1

Sources/Notes: Summarized from Potamus existing vegetation database (Powell 2013); acres and percent include National Forest System lands only. Fire regime condition class assignments follow concepts and principles from Schmidt et al. (2002).

Table 3 describes and illustrates fire regime condition classes for dry upland forests. Table 4 describes and illustrates forest structural stages and FRCC succession classes for dry upland forests. These tables provide context for queries presented in this white paper, and they also describe and illustrate some concepts and principles relating to assumption statements associated with each query section.

Table 3: Fire regime condition classes for dry upland forests (Fire Regime I).

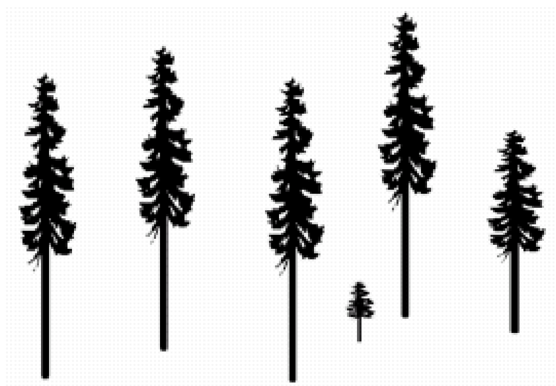
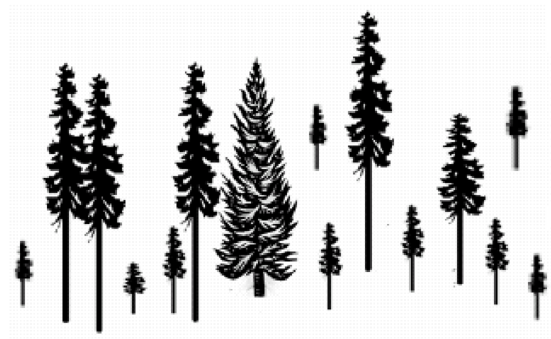
		
CONDITION CLASS 1 (ECOSYSTEM MAINTENANCE STAGE) (LOW DEPARTURE)	**CONDITION CLASS 2** (ECOSYSTEM ALTERATION STAGE) (MODERATE DEPARTURE)	**CONDITION CLASS 3** (ECOSYSTEM DEGRADATION STAGE) (HIGH DEPARTURE)
Composition and structure: open, parklike, ponderosa pine stands; even-aged clumps occurring in an uneven-aged structure across a landscape; single-layer canopy structure. **Tree density**: stocking levels are within historical range; density remains consistently below lower limit of self-thinning zone. **Vigor**[1]: high seasonal energy activity; high capacity to repel or resist disturbance agents, including insects and pathogens. **Fire regime**: maintained within or near historical range; no departure from historical frequency or severity (nonlethal fire regime). **Fuel dynamics**[2]: surface and total fuel loads maintained at historical levels (between 5 and 10 tons per acre). **Resilience and risk**: high capacity to remain fully functional following fire; low risk of losing key ecosystem components after fire.	**Composition and structure**: beginning to depart from historical range; lack of fire allows establishment of fire-sensitive species and a multi-layer canopy structure. **Tree density**: stocking levels in upper half of historical range; density may exceed lower limit of self-thinning zone. **Vigor**[1]: moderate to high seasonal energy activity; somewhat decreased capacity to repel or resist insect or pathogen attack. **Fire regime**: frequency reduced and departing from historical range; increased severity with some mortality of overstory trees. **Fuel dynamics**[2]: surface and total fuel loads in upper half of historical range (10 to 20 tons per acre). **Resilience and risk**: relatively high potential to return to condition class 1 by using prescribed fire; moderate risk of losing key ecosystem components following wildfire.	**Composition and structure**: highly altered from historical range; fire-sensitive species common; open, parklike appearance completely lacking; a multi-layer canopy structure. **Tree density**: stocking levels exceed historical range; total tree density may be 3 to 4 times greater than for condition class 1. **Vigor**[1]: little fluctuation in seasonal energy activity; greatly decreased resistance or resilience to insect and pathogen attack. **Fire regime**: dramatic departure from historical frequency and severity; many fire return intervals missed; increased mean fire (patch) size. **Fuel dynamics**[2]: surface and total fuel loads outside historical range (> 20 tons per acre); increased fuel continuity at landscape scale. **Resilience and risk**: low potential to return to condition class 1 by using prescribed fire; mechanical treatments are needed before reintroducing fire; high risk of losing key ecosystem components to stand-replacing wildfire.

Table 3 Notes and Sources: Table compiled by David C. Powell as a handout for Blue Mountains FRCC training. Literature sources are Barrett et al. 2010, Brown et al. 2003, GAO 2004, Schmidt et al. 2002, and Zimmerman 2003 (literature citations provided below).

[1] Vigor ratings are based on Zimmerman (2003). Vigor and stress indicators for dry-forest sites might include items such as these (adapted from Fiedler and Harrington 2004):

LOW VIGOR INDICATORS	HIGH VIGOR INDICATORS
Thin, sparse tree crowns	Trees: high sap flow
Short, compressed tree crowns	Trees: high foliar nitrogen content
Dull, chlorotic tree foliage	Increased tree foliage production
Reduced tree seed production	Increased tree radial growth
Treetop die-back (some dead tops)	Good tree seedling height growth
Increased dwarf mistletoe severity	Improved herbaceous undergrowth

[2] Fuel loadings, expressed as a historical range of variability (in tons per acre), were taken from Brown et al. 2003.

Barrett, S.; Havlina, D.; Jones, J.; Hann, W.; Frame, C.; Hamilton, D.; Schon, K.; Demeo, T.; Hutter, L.; and Menakis, J. 2010. Interagency Fire Regime Condition Class Guidebook. Version 3.0 [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service, US Department of the Interior, and The Nature Conservancy]. [Online]. Available: www.frcc.gov**.**

Brown, J.K.; Reinhardt, E.D.; Kramer, K.A. 2003. Coarse woody debris: managing benefits and fire hazard in the recovering forest. Gen. Tech. Rep. RMRS-GTR-105. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 16 p. http://www.treesearch.fs.fed.us/pubs/5585

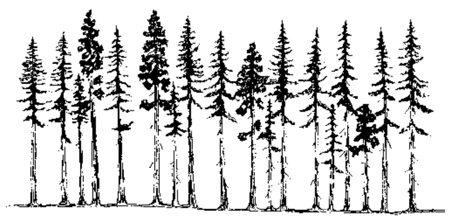
Fiedler, C.E.; Harrington, M.G. 2004. Restoring vigor and reducing hazard in an old-growth western larch stand (Montana). Ecological Restoration. 22(2): 133-134. doi:10.3368/er.22.2.131

General Accounting Office (GAO). 2004. Wildland fires: Forest Service and BLM need better information and a systematic approach for assessing the risks of environmental effects. GAO-04-705. Washington, DC: U.S. General Accounting Office. 88 p. https://www.gao.gov/products/GAO-04-705

Schmidt, K.M.; Menakis, J.P.; Hardy, C.C.; Hann, W.J.; Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 p. (+CD). http://www.treesearch.fs.fed.us/pubs/4590

Zimmerman, G.T. 2003. Fuels and fire behavior. In: Friederici, P., ed. Ecological restoration of southwestern ponderosa pine forests. Washington, DC: Island Press: 126-143. isbn:1-55963-653-X

Table 4: Structural stages and FRCC succession classes for dry upland forests.[1]

Structural Stage Example[2]	Structural Stage Name[3]	Historical Ranges (Percent)[4]	Crosswalk to Succession Class[5]	RC for PPIN1:[6] Ponderosa Pine PNW/Great Basin	RC for PPDF1:[6] Ponderosa Pine-Douglas-fir (Int NW)
	**Stand Initiation**	**15-25**	**Early (Class A)**	**10**	**15**
	**Understory Reinitiation**	**5-10**	**Mid (Class B)**	**5 (Closed)**	**10 (Closed)**
	**Stem Exclusion**	**10-20**	**Mid (Class C)**	**20 (Open)**	**25 (Open)**
	**Old Forest Single Story**	**40-60**	**Late (Class D)**	**55 (Open)**	**40 (Open)**
	Old Forest Multi-Story	**5-15**	**Late (Class E)**	**10 (Closed)**	**10 (Closed)**

[1] Table prepared by David C. Powell as a handout for an FRCC training held in Pendleton, OR in June 2011.

[2] Structural stage examples are taken from Powell (2000).

[3] Structural stage names are taken from Martin (2010).

[4] Historical ranges for Dry Upland Forest potential vegetation group are taken from Martin (2010). Potential vegetation groups are described in Powell et al. (2007).

[5] Cross-walk shows suggested assignment of structural stages to FRCC succession classes (Barrett et al. 2010, Schmidt et al. 2002).

[6] RC or 'reference conditions' refers to published FRCC reference conditions for two biophysical settings (see: www.frcc.gov).

Table 4 Notes and Sources: Literature citations and sources are:

Barrett, S.; Havlina, D.; Jones, J.; Hann, W.; Frame, C.; Hamilton, D.; Schon, K.; Demeo, T.; Hutter, L.; and Menakis, J. 2010. Interagency Fire Regime Condition Class Guidebook. Version 3.0 [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service, US Department of the Interior, and The Nature Conservancy]. [Online], Available: www.frcc.gov**.**

Martin, K. 2010 (October 5). Range of variation direction for forest vegetation project planning; file designation 1920-2-1 memorandum to S.O. Staff and District Rangers. Pendleton, OR: USDA Forest Service, Umatilla National Forest, Supervisor's Office. 6 p.

Powell, D.C. 2000. Potential vegetation, disturbance, plant succession, and other aspects of forest ecology. Tech. Pub. F14-SO-TP-09-00. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 88 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5358579.pdf

Powell, D.C.; Johnson, C.G., Jr.; Crowe, E.A.; Wells, A.; Swanson, D.K. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 87 p. http://www.treesearch.fs.fed.us/pubs/27598

Schmidt, K.M.; Menakis, J.P.; Hardy, C.C.; Hann, W.J.; Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 p. (+CD). http://www.treesearch.fs.fed.us/pubs/4590

LITERATURE CITED

Franklin, J.F.; Agee, J.K. 2003. Forging a science-based national forest fire policy. Issues in Science and Technology. 20(1): 59-66. https://issues.org/franklin/

Gedney, D.R.; Azuma, D.L.; Bolsinger, C.L.; McKay, N. 1999. Western juniper in eastern Oregon. Gen. Tech. Rep. PNW-GTR-464. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 53 p. http://www.treesearch.fs.fed.us/pubs/3250

Hann, W.; Havlina, D.; Shlisky, A. [et al.]. 2004. Interagency fire regime condition class guidebook, version 1.0.5. http://www.frcc.gov (August 20, 2004)

Morgan, P.; Aplet, G.H.; Haufler, J.B.; Humphries, H.C.; Moore, M.M.; Wilson, W.D. 1994. Historical range of variability: a useful tool for evaluating ecosystem change. Journal of Sustainable Forestry. 2(1/2): 87-111. doi:10.1300/J091v02n01_04

Morgan, P.; Bunting, S.C.; Black, A.E.; Merrill, T.; Barrett, S. 1996. Fire regimes in the interior Columbia River basin: past and present. Final report for contract RJVA-INT-94913: coarse-scale classification and mapping of disturbance regimes in the Columbia River basin. Portland, OR: USDA Forest Service, Pacific Northwest Research Station, Interior Columbia Basin Ecosystem Management Project. 37 p. https://www.fs.fed.us/r6/icbemp/science/morgan.pdf

Morgan, P.; Parsons, R. 2001. Historical range of variability for the Idaho southern batholith ecosystem. Unpub. Rep. Moscow, ID: University of Idaho, Department of Forest Resources. 34 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev7_015498.pdf

Parsons, D.J.; Swetnam, T.W.; Christensen, N.L. 1999. Uses and limitations of historical variability concepts in managing ecosystems. Ecological Applications. 9(4): 1177-1178. doi:10.1890/1051-0761(1999)009[1177:ualohv]2.0.co;2

Powell, D.C. 2013. Description of composite vegetation database. White Paper F14-SO-WP-Silv-2. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 39 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5326218.pdf

Powell, D.C. 2019. Range of variation recommendations for dry, moist, and cold forests. White Paper F14-SO-WP-Silv-3. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 79 p. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5326219.pdf

Powell, D.C.; Johnson, C.G., Jr.; Crowe, E.A.; Wells, A.; Swanson, D.K. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. http://www.treesearch.fs.fed.us/pubs/27598

Schmidt, K.M.; Menakis, J.P.; Hardy, C.C.; Hann, W.J.; Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 p (plus CD). http://www.treesearch.fs.fed.us/pubs/4590

Swanson, F.J.; Jones, J.A.; Wallin, D.O.; Cissel, J.H. 1994. Natural variability – implications for ecosystem management. In: Jensen, M.E.; Bourgeron, P.S., eds. Volume II: Ecosystem management: principles and applications. Gen. Tech. Rep. PNW-GTR-318. Portland, OR: USDA Forest Service, Pacific Northwest Research Station: 80-94. https://www.fs.usda.gov/treesearch/pubs/6223

APPENDIX 1: BASING FIRE REGIMES ON PLANT ASSOCIATION GROUPS

Plant Association Group[1]	Fire Regime[2]
Cold Dry UF	4
Cold Dry UH	5
Cold High SM RF	4
Cold High SM RH	4
Cold High SM RS	4
Cold Low SM RF	4
Cold Moderate SM RF	4
Cold Moist UF	4
Cold Moist UH	4
Cold Moist US	4
Cold Very Moist US	5
Cool Dry UF	4
Cool Dry UH	4
Cool Dry US	3
Cool Moist UF	3
Cool Moist UH	2
Cool Moist US	4
Cool Very Moist UF	4
Cool Wet UF	4
Hot Dry UF	1
Hot Dry UH	2
Hot Dry US	2
Hot Dry UW	3
Hot High SM RH	4
Hot Low SM RF	1
Hot Low SM RS	1
Hot Moderate SM RF	1
Hot Moderate SM RH	3
Hot Moderate SM RS	3
Hot Moist UF	1
Hot Moist US	3
Hot Moist UW	3
Hot Very Moist UH	2
Hot Very Moist US	2
Warm Dry UF	1
Warm Dry UH	2
Warm High SM RF	4
Warm High SM RH	4
Warm High SM RS	4
Warm Low SM RF	1
Warm Low SM RH	2
Warm Low SM RS	4
Warm Moderate SM RF	4
Warm Moderate SM RH	4

Plant Association Group[1]	Fire Regime[2]
Warm Moderate SM RS	4
Warm Moist UF	3
Warm Moist UH	2
Warm Moist US	2
Warm Very Moist UF	3
Warm Very Moist UH	2

[1] Plant association group is lowest level of mid-scale portion of a potential vegetation hierarchy (Powell et al. 2007). UF is upland forestland, UH is upland herbland, US is upland shrubland, UW is upland woodland, RF is riparian forestland, RH is riparian herbland, and RS is riparian shrubland.
[2] Fire regimes characterize historical fire frequency and severity under which plant communities evolved (Franklin and Agee 2003, Morgan et al. 1996). Fire regimes are classified by using five categories, 1 (I) to 5 (V) (Schmidt et al. 2002), and each plant association group was assigned to one, and only one, fire regime category.

APPENDIX 2: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).
(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.
(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]
(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.
(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.
(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.
(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a

description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	**Title**
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of Blue Mountains dry forests: Silvicultural considerations
5	Site productivity estimates for upland forest plant associations of Blue and Ochoco Mountains
6	Blue Mountains fire regimes
7	Active management of Blue Mountains moist forests: Silvicultural considerations
8	Keys for identifying forest series and plant associations of Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking, and reforestation standards from Umatilla National Forest Land and Resource Management Plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: A process paper
16	Douglas-fir tussock moth: A briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of Blue and Wallowa Mountains
21	Historical fires in headwaters portion of Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important Blue Mountains insects and diseases
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: Some ecosystem management considerations
28	Common plants of south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of Umatilla National Forest
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – Forest vegetation
33	Silviculture facts
34	Silvicultural activities: Description and terminology

Paper #	Title
35	Site potential tree height estimates for Pomeroy and Walla Walla Ranger Districts
36	Stand density protocol for mid-scale assessments
37	Stand density thresholds as related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: Forestry direction
39	Updates of maximum stand density index and site index for Blue Mountains variant of Forest Vegetation Simulator
40	Competing vegetation analysis for southern portion of Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for Umatilla National Forest
42	Life history traits for common Blue Mountains conifer trees
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: Vegetation management considerations
46	Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in northern Blue Mountains: Regeneration ecology and silvicultural considerations
48	Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for Umatilla National Forest: A range of variation analysis
51	Restoration opportunities for upland forest environments of Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: An environmental education activity
55	Silviculture certification: Tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman National Forests
57	State of vegetation databases for Malheur, Umatilla, and Wallowa-Whitman National Forests
58	Seral status for tree species of Blue and Ochoco Mountains

REVISION HISTORY

December 2016: First version of this white paper was prepared in November 2004 during an ecosystem analysis at the watershed scale (e.g., watershed analysis) for Potamus drainage on Heppner and North Fork John Day Ranger Districts of Umatilla National Forest.

During this revision, minor formatting and editing changes were made, including adding a white-paper header and assigning a white-paper number. An appendix was added describing a white paper system, including a list of available white papers. A short Introduction section was also added.