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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Initial Version: **NOVEMBER 2004**
Most Recent Revision: **DECEMBER 2016**

## INTRODUCTION

Fire regime condition class (FRCC) is an interagency, standardized tool for determining the degree of ecological departure from historical, or 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).

The FRCC assessment system (Barrett et al. 2010) is used to characterize fire regimes and understand their departure from historical reference conditions.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 2014), provides more information about RV, which is 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 the 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 were instituted for minimum analysis-area sizes that 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 (such as cold forests of the subalpine zone).

This white paper describes how FRCC queries were developed during a watershed analysis for the Potamus watershed on the Umatilla National Forest. Currently, software applications are used to calculate FRCC departures, but none were available when Potamus was analyzed.

[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 the USDA Forest Service.

## DEFINITIONS

The 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 2014, Swanson et al. 1994).

When existing vegetation characteristics (composition, structural classes, stand age, canopy cover, and the spatial or mosaic pattern of vegetation patches) are functioning much as they did historically, then the 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 the existing fire regime is not within its HRV (this description pertains 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 the Potamus analysis area, a large area (almost 100,000 acres) where 92% of the existing condition information was based on interpretation of aerial photography, and the balance (8%) was derived from field-sampled surveys (stand examinations or walk-throughs).

The queries are designed to address the definition provided by Schmidt et al. (2002) (see 2$^{nd}$ paragraph in this section). Composition, structure, and density were used explicitly in the queries (density is used to represent the canopy cover factor in the FRCC definition); the other two vegetation factors mentioned above in the definition (stand age and mosaic pattern) are not addressed explicitly in these queries.

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

## QUERY DEVELOPMENT

When developing the 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 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).

The queries were based on knowing which composition categories in the analysis area were outside of their historical ranges of variability. The advantage of this approach is that it is closely linked to an area's existing situation and how it likely deviates from historical conditions. The disadvantage of this approach is that an analyst would need 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 the Potamus analysis area is summarized in table 1.

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

| Cover Type[1] | **Dry UF PVG[2]** Historical Range (%)[3] | **Dry UF PVG[2]** Current Percent[4] | **Moist UF PVG** Historical Range (%) | **Moist UF PVG** Current Percent | **Cold UF PVG** Historical Range (%) | **Cold UF PVG** 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:* 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 (2004).

[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 (2004).

[3] Historical ranges, derived from Morgan and Parsons (2000), were based on multiple 1200-year simulations representing landscapes in a “dynamic equilibrium” with their disturbance regime.

[4] Current percentages, derived from the Potamus existing vegetation database (Powell 2004), 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.**

The assumptions used for these query statements are:

- Douglas-fir and grand fir cover types are both above HRV for the Dry UF potential vegetation group (see table 1);
- The 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 the native disturbance regime (primarily nonlethal surface fire) was functioning properly;
- Upland forest density would be low for a properly functioning fire regime when surface fire was thinning stands on a 10-25 year interval; and
- The presence of a multi-layered structure (e.g., canopy layers is greater than 1 in the 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.**

The assumptions used for these query statements are:

- The lodgepole pine cover type is above HRV for the Dry UF potential vegetation group (see table above);
- All of the western juniper cover type was assumed to be uncharacteristic on the Dry UF PVG; and
- High forest density for the ponderosa pine cover type is uncharacteristic if the native disturbance regime (primarily nonlethal surface fire) was functioning properly.

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

**2.** Queries for the 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.**

The assumptions used for these query statements are:

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

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

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**e.** Cover Type = ABGR or mix-ABGR and Aspect = South or southwest; OR

**f.** Cover Type = PSME or mix-PSME and 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.**

The assumptions used for these query statements are:

- The grand fir cover type is near the upper limit of HRV for the 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;
- The Douglas-fir cover type is most likely to be uncharacteristic on warm exposures (note that this assumption does not include the density and layering qualifiers used with the FRCC 3 query 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 of the 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.**

The assumptions used for these query statements are:

- Douglas-fir and grand fir cover types are both above HRV for the Cold UF potential vegetation group (see table 1);
- The 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 the 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 of the criteria for FRCC 1 or 2.**

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

**Condition class 3 = none.**

**a.** Tree Cover ≥ 5% canopy cover.

**Condition class 2 = every polygon meeting this criterion.**

The assumptions used for these query statements are:

- Many nonforest sites have the potential for limited amounts of tree invasion (encroachment) in the absence of periodic wildfire, and 5% tree canopy cover was used as an indicator of sites that might have missed multiple fire cycles;
- It was assumed (within the 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;
- The photo-interpretation surveys do not adequately characterize the presence of noxious weeds or other invasive species that could serve as indicators of impaired ecological function (if that 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 of the criteria for FRCC 1 or 2.**

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

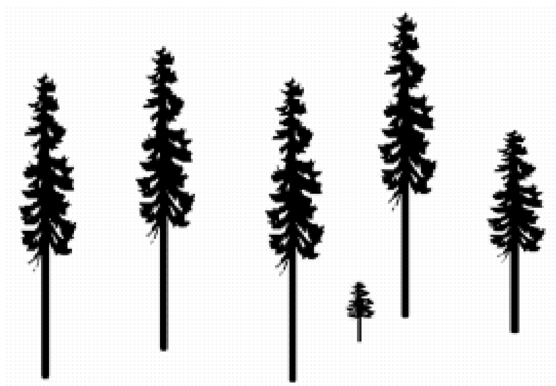
**Table 2.** Existing fire regime condition classes for the Potamus analysis area.

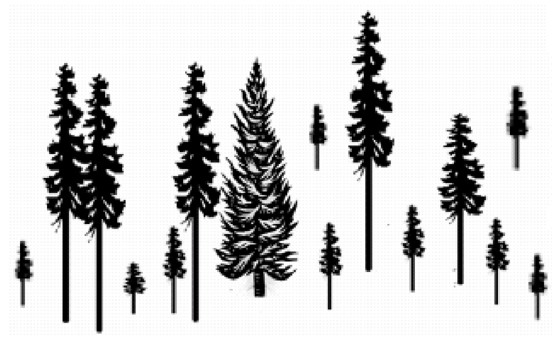
| Fire Regime Condition Class Description | Acres | Percent |
|---|---|---|
| Fire regime condition class 1 | 40,829 | 41.0 |
| Fire regime condition class 2 | 41,486 | 41.7 |
| Fire regime condition class 3 | 17,279 | 17.4 |
| Water (no condition class assigned) | 9 | < 0.1 |

*Sources/Notes*: Summarized from the Potamus existing vegetation database (Powell 2004); acres and percents include National Forest System lands only. Fire regime condition class assignments follow 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 the queries presented in this white paper, and they also describe the basis for 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 the landscape; single-layer canopy structure. | **Composition and structure**: beginning to depart from the historical range; lack of fire allows establishment of fire-sensitive species and a multi-layer canopy structure. | **Composition and structure**: highly altered from the historical range; fire-sensitive species common; open, parklike appearance completely lacking; a multi-layer canopy structure. |
| **Tree density**: stocking levels are within the historical range; density remains consistently below the lower limit of the self-thinning zone. | **Tree density**: stocking levels in upper half of the historical range; density may exceed the lower limit of the self-thinning zone. | **Tree density**: stocking levels exceed the historical range; total tree density may be 3-4 times greater than for condition class 1. |
| **Vigor**[1]: high seasonal energy activity; high capacity to repel or resist disturbance agents such as insects and pathogens. | **Vigor**[1]: moderate to high seasonal energy activity; somewhat decreased capacity to repel or resist insect or pathogen attack. | **Vigor**[1]: little fluctuation in seasonal energy activity; greatly decreased resistance or resilience to insect and pathogen attack. |
| **Fire regime**: maintained within or near the historical range; no departure from historical frequency or severity (nonlethal fire regime). | **Fire regime**: frequency reduced and departing from historical range; severity increased with some mortality of overstory trees. | **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 maintained at historical levels (between 5 and 10 tons per acre). | **Fuel dynamics**[2]: surface and total fuel loads in the upper half of the historical range (10 to 20 tons per acre). | **Fuel dynamics**[2]: surface and total fuel loads outside historical range (> 20 tons per acre); increased fuel continuity at landscape scale. |
| **Resilience and risk**: high capacity to remain fully functional following fire; low risk of losing key ecosystem components after fire. | **Resilience and risk**: fairly high potential to return to condition class 1 using prescribed fire; moderate risk of losing key ecosystem components following wildfire. | **Resilience and risk**: low potential to return to condition class 1 using prescribed fire; mechanical treatments 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: Brown et al. 2003, Barrett et al. 2010, GAO 2004, Schmidt et al. 2002, and Zimmerman 2003.

[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.

**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.

**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.

**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).

**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.

**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] This table was 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 the 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.

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**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.

**Morgan, P.; Parsons, R. 2000.** Historical range of variability for the Idaho southern batholith ecosystem. Unpub. Rep. Moscow, ID: University of Idaho, Department of Forest Resources. 42 p. On file with: Boise Cascade Corporation, One Jefferson Square, Boise, ID 83728.

**Parsons, D.J.; Swetnam, T.W.; Christensen, N.L. 1999.** Invited feature: uses and limitations of historical variability concepts in managing ecosystems. Ecological Applications. 9(4): 1177-1277.

**Powell, D.C. 2004.** Description of composite vegetation database. White Paper F14-SO-WP-SILV-9. Pendleton, OR: USDA Forest Service, Umatilla National Forest. 37 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5326218.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.fs.fed.us/rm/pubs/rmrs_gtr087.html

**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.

## 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 the lowest level of the mid-scale portion of the 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 the historical fire frequency and severity under which plant communities evolved (Franklin and Agee 2003, Morgan et al. 1996). Fire regimes are classified using five categories (Schmidt et al. 2002) and each plant association group was assigned to one, and only one, of the fire regime categories.

## 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 dry forests in the Blue Mountains: silvicultural considerations |
| 5 | Site productivity estimates for upland forest plant associations of the Blue and Ochoco Mountains |
| 6 | Fire regimes of the Blue Mountains |
| 7 | Active management of moist forests in the Blue Mountains: silvicultural considerations |
| 8 | Keys for identifying forest series and plant associations of the 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 the 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 the Blue and Wallowa Mountains |
| 21 | Historical fires in the headwaters portion of the 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 insects and diseases of the Blue Mountains |
| 26 | Is this stand overstocked? An environmental education activity |
| 27 | Mechanized timber harvest: some ecosystem management considerations |
| 28 | Common plants of the south-central Blue Mountains (Malheur National Forest) |
| 29 | Potential natural vegetation of the Umatilla National Forest |
| 30 | Potential vegetation mapping chronology |
| 31 | Probability of tree mortality as related to fire-caused crown scorch |
| 32 | Review of the "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 the Pomeroy and Walla Walla ranger districts |
| 36 | Tree density protocol for mid-scale assessments |
| 37 | Tree 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 the Blue Mountains variant of the Forest Vegetation Simulator |
| 40 | Competing vegetation analysis for the southern portion of the Tower Fire area |
| 41 | Using General Land Office survey notes to characterize historical vegetation conditions for the Umatilla National Forest |
| 42 | Life history traits for common conifer trees of the Blue Mountains |
| 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 | The Knutson-Vandenberg (K-V) program |
| 47 | Active management of quaking aspen plant communities in the northern Blue Mountains: regeneration ecology and silvicultural considerations |
| 48 | The 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 the Umatilla National Forest: a range of variation analysis |
| 51 | Restoration opportunities for upland forest environments of the 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 | The state of vegetation databases on the Malheur, Umatilla, and Wallowa-Whitman national forests |
| 58 | Seral status for tree species of the Blue and Ochoco Mountains |

## REVISION HISTORY

**December 2016**: The first version of this white paper was prepared in November 2004 during an ecosystem analysis at the watershed scale (e.g., watershed analysis) for the Potamus drainage on the Heppner and North Fork John Day ranger districts of the Umatilla National Forest. Minor formatting and editing changes were made, including adding a white-paper header and assigning a white-paper number. An appendix was added describing the white paper system, including a list of available white papers. A short Introduction section was also added.