14720

Central Interior and Appalachian Riparian Systems

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
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Vegetation Type

Mixed Upland and Wetland

Map Zones

53, 54, 57, 59, 60

Geographic Range

This systems group encompasses small stream riparian systems over much of the eastern United States, from southern New England south to Georgia and west to Illinois and eastern Oklahoma (NatureServe 2007).

Occurs near small streams and includes adjoining floodplains, terraces, and lower slopes affected by small stream flooding. This model encompasses the small stream forests of the Piedmont and Southern Appalachian regions. It does not include the broad vegetated floodplains of these and similar large, low-gradient rivers and immediate tributaries, nor the high-gradient, narrow, small streams of the Appalachian Mountains.

NatureServe (2007) describes this as an aggregated system including the following standard ecological systems:

• Central Appalachian Stream and Riparian (CES202.609)

• Cumberland Riverscour (CES202.036)

• Ozark-Ouachita Riparian (CES202.703)

• South-Central Interior Small Stream and Riparian (CES202.706)

• Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Biophysical Site Description

These riverscour-influenced systems occur on moderately to very high-gradient streams over a wide range of elevations. They develop on small floodplains and shores along river channels that lack a broad, flat floodplain due to steeper sideslopes, higher gradient, or both (NatureServe 2007).

The fluvial features (river terraces, oxbows, alluvial flats, point bars, and streamside levees) typical of river floodplains occur less frequently and on a smaller scale along these small streams. Fine-scale alluvial floodplain features are abundant. In pre-European settlement forests, community diversity in these streamside systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young birch/sycamore beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up >95% of the cover that exists today.

These systems have little to no floodplain development (i.e., floodplains, if present, are not differentiated into levees, sloughs, ridges, terraces, and abandoned channel segments) and are typically higher gradient than larger floodplains, experiencing periodic, strong flooding of short duration (NatureServe 2007).

Vegetation Description

Most of the system is forest vegetation. The succession of woody plants (particularly trees) is retarded by the force of "flashy," high-velocity water traveling down the stream channels (NatureServe 2007). The canopy is usually dominated by hardwoods, with pines a small component. Species may include sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), box elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Quercus pagoda*), hackberry (*Celtis occidentalis*), hemlock (*Tsuga canadensis*), or pines (*Pinus* spp.).

Successional areas of map zones (MZs) 54/59 are often dominated by sweetgum (*Liquidambar styraciflua*) or yellow poplar (*Liriodendron tulipifera*) whereas the MZs of 53, 57, 61, and 62 are often dominated by sycamore (*Platanus occidentalis*) or box elder (*Acer negundo*). Pines may be a larger component in the southern part of MZ54.

Sub-canopy species included American holly (*Ilex opaca*), deciduous holly (*Ilex decidua* and *Ilex ambigua*), red mulberry (*Morus rubra*), ironwood (*Carpinus caroliniana*), and hop hornbeam (*Ostrya virginiana*). Shrubs such as spicebush (*Lindera benzoin*), beautyberry (*Callicarpa americana*), and yellowroot (*Xanthorhiza simplicissima*); cane (*Arundenaria gigantea*) and other grasses; and false nettle (*Boehmeria cylindrica*) may be present. Caric sedges may dominate some areas.

NatureServe (2007) also notes the following common shrubs, occurring as forest/woodland understory or as non-forested shrublands: hazel alder (*Alnus serrulata*), common buttonbush (*Cephalanthus occidentalis*), silky dogwood (*Cornus amomum*), coastal plain willow (*Salix caroliniana*), and other *Salix* spp., eastern poison ivy (*Toxicodendron radicans*), and, over parts of the range, mountain witchalder (*Fothergilla major*), Virginia sweetspire (*Itea virginica*), and smooth azalea (*Rhododendron arborescens*). More southern examples may contain oakleaf hydrangea (*Hydrangea quercifolia*), bushy St. John’s wort (*Hypericum densiflorum*), and wax myrtle (*Morella cerifera*). Ozark witchhazel (*Hamamelis vernalis*) is characteristic in the Ozark/ Ouachita region.

Forbs are diverse and variable from occurrence to occurrence. Some characteristic forbs are *Baptisia australis*, *Conoclinium coelestinum* (= *Eupatorium coelestinum*), *Coreopsis pubescens*, *Coreopsis tripteris*, *Elephantopus carolinianus*, *Helenium autumnale*, *Hydrocotyle* spp., *Ludwigia leptocarpa*, *Lycopus* spp., *Orontium aquaticum*, *Osmunda regalis* var. *spectabilis*, *Oxypolis rigidior*, *Phlox carolina*, *Pityopsis graminifolia* var. *latifolia*, *Rudbeckia laciniata*, and *Vernonia gigantean* (NatureServe 2007).

Periodically reworked gravel bars may be dominated by young black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), or infrequently, river birch (*Betula nigra*), or they may have sparse vegetation of a wide variety of annual and perennial herbs of weedy habits.

Canebrakes occurred in particular locations that had easy access for fire (i.e., bottomlands bordered by upland flats as opposed to steep slopes) and where the uplands experienced frequent fire as the result of a combination of lightning and Native American ignitions.

Natural levee forests form on ridges of silt and sand deposited on stream margins during flood conditions. A levee's width is related to the abundance of ground vegetation present to reenforce sediment in future deposition events. They receive more light and may be dominated by stream margin specialists such as sycamore (*Platanus occidentalis*), willows (*Salix nigra*), river birch (*Betula nigra*), box elder (*Acer negundo*), and eastern cottonwood (*Populus deltoides*). Streamside levees support a diverse flora of other bottomland graminoids and forbs.

Open, flood-scoured rivershore prairies feature *Andropogon gerardii*, *Sorghastrum nutans*, *Schizachyrium scoparium*, *Chasmanthium latifolium*, *Tripsacum dactyloides*, and/or *Panicum virgatum*. *Carex torta* is typical of wetter areas near the channel (NatureServe 2007).

Distinctive shoals with *Hymenocallis coronaria* and/or *Justicia americana* may be present as well. Small seeps and fens can often be found within these habitats, especially at the headwaters and terraces of streams. These areas are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis* (NatureServe 2007).

Creighton also suggests silver maple (*Acer saccharinum*), common hackberry (*Celtis occidentalis*), spicebush (*Lindera*), and eastern hemlock (*Tsuga canadensis*) as dominant indicator species for MZs 53, 57, 61, and 62.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PLOC | *Platanus occidentalis* | American sycamore |
| BENI | *Betula nigra* | River birch |
| ACNE2 | *Acer negundo* | Boxelder |
| ACRU | *Acer rubrum* | Red maple |
| CELA | *Celtis laevigata* | Sugarberry |
| LIQUI | *Liquidambar* | Sweetgum |
| FRPE | *Fraxinus pennsylvanica* | Green ash |
| LIRIO | *Liriodendron* | Tuliptree |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Flooding -- Flooding is the major process affecting the vegetation, with the substrate more rapidly drained than in flat floodplain areas. The distinctive dynamics of stream flooding and protected topographic position dominate the forming of the distinctive vegetation of this system. Not all of the factors are well known. Gradients of most of these rivers limit floods to fairly short duration. Flooding is most common in the winter but may occur in other seasons particularly in association with hurricanes, tornados, or microbursts from thunderstorms. The sorting of plant communities by depositional landforms of different height suggests that wetness or depth of flood waters has significance. Flood waters have significant energy. Scouring and reworking of sediment make up an important factor in bar and bank communities. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds. Most floods do not lead to canopy tree mortality. Flooding can act as a replacement disturbance in areas where beavers impounded a channel or in rare years with severe prolonged flood events. The most significant disturbance along small streams was wind. Two types of floods were modeled: 1) occasional catastrophic floods due to beaver activity or other severe, prolonged floods and 2) more frequent repeated minor flooding (i.e., several minor floods within a 10yr period).

Winds affect streamside forests because of wet soils, less dense soil, and trees that are shallow-rooted. Canopy tree mortality from more common windstorms would have resulted in tree-by-tree or small-group replacement. Windthrow formed the primary cause of mortality in bottomlands. Major storms or even hurricanes occurring at ~20yr intervals would have impacted whole stands. Tornado tracks can be found passing across uplands and bottomlands (see one such indicated on a map of Umstead State Park, Raleigh, NC), leaving narrow swaths of felled trees. The majority of windthrow in MZs 54/59 seems to have been the result of hurricanes and hurricane-spawned tornadoes. Following Hurricane Fran in 1996, even though the Piedmont is removed from the coast by 25 to >100 miles, extensive windthrow occurred in middle-aged and old-growth trees in Piedmont bottomlands. Bottomland oaks, even though seemingly more sheltered, were much more heavily affected than hardwoods on adjacent uplands. Gaps as large as 1ha were seen intermixed in areas with extensive single-tree windthrow. Windthrow may also occur because of thunderstorm microbursts or tornados.

Ice damage is an infrequent but potentially catastrophic disturbance, especially in MZs 57 and 61 and the lower-elevation portions of MZ59.

Fire -- Fire Regime Group III (conspicuous and most frequent in stands with canebrake). Fire return interval varied highly. Except in canebrake, most fires were very light surface fires, creeping in hardwood or pine litter with some thin, patchy cover of bottomland grasses. Flame lengths were mostly 6-12in. Even so, fire-scarred trees can be found in most small stream sites except in the wettest microsites. Stand-replacement fires are almost unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands. Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from ~3-8yrs in streamside canebrake, streamside hardwood/canebrake, or pine to 25yrs or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by back swamps and oxbows were virtually fire-free. Fire effects were largely limited to topkill of shrubs and tree saplings <2in diameter and formation of hollow trees.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 985 | 17 | 200 | 1000 |
| Moderate (Mixed) |  |  | 150 | 500 |
| Low (Surface) | 199 | 83 | 50 | 250 |
| All Fires | 166 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Considerations

Narrow bands or isolated pockets occur along small streams. Width depends strongly on topography.

Adjacency or Identification Concerns

This Biophysical Setting (BpS) does not include the broad vegetated floodplains of these and similar large, low-gradient rivers and immediate tributaries nor the high-gradient, narrow, small streams of the Appalachian Mountains. This BpS is likely to grade into 1471 (Central Interior and Appalachian Floodplain Systems).

NatureServe (2007) lists this as an aggregated system that includes the following standard ecological systems:

• Central Appalachian Stream and Riparian (CES202.609)

• Cumberland Riverscour (CES202.036)

• Ozark-Ouachita Riparian (CES202.703)

• South-Central Interior Small Stream and Riparian (CES202.706)

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Issues or Problems

The widespread introduction of Chinese privet (*Ligustrum sinense*) and other invasives has dramatically reduced native diversity in the understory. Most occurrences of this system in North Carolina were cleared within the past century.

Widespread placement of dams has extensively altered flood frequency and duration in some areas.

Modelers are uncertain of the role of ice and the prevalence of pine in this system in Alabama and Georgia.

Current Conditions

Comments

Barker, Reese, and Ryan created this model based on BpS model 4614740 -- Gulf and Atlantic Coastal Plain Small Stream Riparian Systems, with substantial changes to the disturbance pathways. The modelers were most familiar with piedmont North Carolina and suggest review is needed for other areas, especially with respect to the Alabama and Georgia portions of MZ54. Literature listed is carried over from the previous model (BpS 4614740).

Subsequently, during the workshop for MZs 53, 57, 61, and 62, Jerre Creighton (jerre.creighton@dof.virginia.gov) reviewed the Barker et al. model and had some species composition changes, but Creighton’s model descriptions, class descriptions, class parameters (VDDT parameters) closely matched Barker et al. with slight changes to wind/weather/stress and Options 1 and 2 frequencies. Barker et al. always gave wind/weather/stress a frequency of 0.005 (200yrs) and Options 1 and 2 frequencies of 0.003 (333yrs) and 0.01 (100yrs), respectively. Creighton changed the frequency of the wind/weather/stress events from class to class, and Options 1 and 2 were given frequencies of 0.005 (200yrs) and 0.002 (500yrs).

However, the differences between the Creighton and Barker et al. models don’t affect class percent outcome or fire frequency values. Both models are identical with an overall fire frequency of 169yrs.

Therefore, the BpS model descriptions provided were those of Barker et al.’s work with Creighton noted as a reviewer.

One reviewer would suggest, however, that this model as combined by C. Szell be used for all MZs listed.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | A | A | A | A | A | A | A | A |
| Tree | 5-10 | A | A | A | A | A | A | A | A | A | A |
| Tree | 10-25 | C | C | C | C | C | C | C | B | B | B |
| Tree | 25-50 | D | D | D | D | D | D | D | E | E | E |
| Tree | >50 | D | D | D | D | D | D | D | E | E | E |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 17 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ACRU | Acer rubrum | Red maple | All |
| LIST2 | Liquidambar styraciflua | Sweetgum | All |
| FRPE | Fraxinus pennsylvanica | Green ash | All |
| LIRIO | Liriodendron | Tuliptree | All |

Description

Tree fall gaps with saplings and small trees up to 30cm DBH. Potential canopy species are typically mixed with sub-canopy species and herbs and an occasionally short-lived early successional species such as willow (*Salix nigra*) or river birch (*Betula nigra*). This can include areas disturbed by flooding from drained wetlands when beaver dams fail. Also included are other disturbed areas such as windthrow and effects of tornados, hurricanes, thunderstorm microbursts, or ice events. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event. Repeated minor flooding (Optional 2) that would open up the midstory would occur. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur. Light, creeping surface fire is likely. Replacement fire is likely only in extremely dry years.

Creighton suggests the following indicator species for MZs 53, 57, and 61: silver maple (*Acer saccharinum*), box elder (*Acer negundo*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*).

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class B 23 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ACRU | Acer rubrum | Red maple | Upper |
| LIST2 | Liquidambar styraciflua | Sweetgum | Upper |
| BENI | Betula nigra | River birch | Upper |
| CELA | Celtis laevigata | Sugarberry | Upper |

Description

Old tree fall gaps and other disturbed areas ranging from 30-70cm DBH. Shade-tolerant species in the understory. Occasionally with a pine-dominated overstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event. Repeated minor flooding (Optional 2) that would open up the midstory would occur. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur. Light, creeping surface fire is likely. Replacement fire is likely only in extremely dry years.

Creighton suggests the following indicator species for MZs 53, 57, and 61: silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*).

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class C 13 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PLOC | Platanus occidentalis | American sycamore | Upper |
| CELA | Celtis laevigata | Sugarberry | Upper |
| FAGR | Fagus grandifolia | American beech | Upper |
| BENI | Betula nigra | River birch | Upper |

Description

Similar overstory as B but without well-developed midstory or understory. Grasses will also be present. Occasionally with a pine-dominated overstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event. Repeated minor flooding (Optional 2) that would open up the midstory would occur. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur. Light, creeping surface fire is likely. Replacement fire is likely only in extremely dry years.

Creighton suggests the following indicator species for MZs 53, 57, and 61: silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*).

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class D 38 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PLOC | Platanus occidentalis | American sycamore | Upper |
| CELA | Celtis laevigata | Sugarberry | Upper |
| FAGR | Fagus grandifolia | American beech | Upper |
| BENI | Betula nigra | River birch | Upper |

Description

More of a closed canopy then C with trees and minimal midstory and understory shrubs and grasses. More shrubs and less grass than C. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event. Repeated minor flooding (Optional 2) that would open up the midstory would occur. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur. Light, creeping surface fire is likely. Replacement fire is likely only in extremely dry years.

Creighton suggests the following indicator species for MZs 53, 57, and 61: silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*).

*Maximum Tree Size Class*  
Large 21-33" DBH

Class E 9 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PLOC | Platanus occidentalis | American sycamore | Upper |
| CELA | Celtis laevigata | Sugarberry | Upper |
| FAGR | Fagus grandifolia | American beech | Upper |
| BENI | Betula nigra | River birch | Upper |

Description

Closed hardwood canopy. Extensive shade-tolerant shrub understory and midstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event. Repeated minor flooding (Optional 2) that would open up the midstory would occur. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur. Light, creeping surface fire is likely. Replacement fire is likely only in extremely dry years.

Creighton suggests the following indicator species for MZs 53, 57, and 61: silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*).

*Maximum Tree Size Class*  
Large 21-33" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 19 |
| Mid1:OPN | 20 | Late1:OPN | 69 |
| Mid1:CLS | 20 | Late1:CLS | 69 |
| Late1:OPN | 70 | Late1:OPN | 999 |
| Late1:CLS | 70 | Late1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Optional 1 | Early1:ALL | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Surface Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | No | 0 |
| Optional 2 | Early1:ALL | Early1:ALL | 0.01 | 100 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Optional 1 | Mid1:OPN | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 2 | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Optional 1 | Mid1:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Surface Fire | Mid1:CLS | Mid1:OPN | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 2 | Mid1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Optional 1 | Late1:OPN | Early1:ALL | 0.003 | 333 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.005 | 200 | No | 0 |
| Wind or Weather or Stress | Late1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 2 | Late1:OPN | Late1:OPN | 0.01 | 100 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Optional 1 | Late1:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:OPN | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 2 | Late1:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |

Optional Disturbances

Optional 1: Major stand replacing floods

Optional 2: repeated minor flooding

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