Interim Forest Management Policy for High Conservation Value Forests

HCV: Natural Origin Red Pine

Table 1. Key Statistics	
Total Acreage on DNR-owned land	28,815 ac
Acreage on HCVF (non-STL)	410 ac
Acreage on HCVF (STL)	938 ac

Status: Conservation Status Ranks range from state critically imperiled to secure, common, widespread and abundant (S1 – S5) depending on the native plant community in which it is found.

Location: Most natural origin red pine sites are in Northcentral and Northeastern Minnesota.

Policy for Natural Origin Red Pine (NORP) within High Conservation Value Forests (HCVFs)

Management guidance for natural origin red pine varies depending on the native plant community in which it is found. The following guidance is considered a work in progress, based on the current best available information to manage for natural origin red pine together when diseases like Diplodia are present. The policy should be used when this High Conservation Value (HCV) is encountered on a high conservation value forest (HCVF), and apply to final or regeneration harvests. The management goal of the policy is to maintain red pine presence in a site while maintaining the desirable ecological characteristics of a natural origin red pine site. Current available data suggests that the percent of red pine cones on a site infected with Diplodia could predict varying degrees of future red pine mortality. The DNR will conduct ongoing monitoring to determine if the percentage threshold for Diplodia tolerance is accurate, followed by adaptive management as needed to ensure the continued healthy presence of red pine on the site. Standard forestry regime rotation ages apply.

To determine harvest approach, first determine the site's native plant community. Find full native plant community descriptions here: https://www.dnr.state.mn.us/npc/classification.html.

- For mesic hardwood NPCs containing natural origin red pine, go to Part 2 (page 6).
- For fire dependent forested or woodland NPCs containing natural origin red pine, go to Part 1 (below).

Part 1. Management guidance for fire dependent woodland or forested NPCs containing NORP

Includes (but is not limited to) the following fire dependent NPCs:

- FDc24 - central rich dry pine woodland;
- FDc34 - central dry-mesic pine-hardwood forest
- FDn33 - northern dry-mesic mixed woodland
- FDn43 - northern mesic mixed forest

Harvest

During the start of an initial planning period, identify natural origin red pine sites scheduled for harvest that are located in high conservation value forests. Within those identified sites, Division of Forestry will collect and test cones for presence of Diplodia.

- If, on a site, **less than 10 percent of cones are infected** with Diplodia, proceed to harvest option #1.[1]
    - If the site has less than 10 percent infected cones, but there's a need to increase diversity, consider Option #1 or Option #2.
- If, on a site, **between 10-15% of cones are infected** with Diplodia, use either harvest option #1 or harvest option #2, depending on site conditions.
    - This range of options is provided to allow for variable decisions that will help us better determine Diplodia thresholds in the future. Across HCVF sites falling within this Diplodia infection range, wherever possible, both harvest options should be applied, so that we can learn more about the effectiveness of each harvest option.
- If **more than 15 percent of tested cones are infected** with Diplodia, use harvest option #2.

During the project's monitoring phase, sites should be monitored to understand the impact of Diplodia within these sites and conduct adaptive management as needed.

Harvest Option #1: Use a **seed tree harvest**. When doing so:

- Incorporate biological legacies ("skips") into regeneration harvest prescriptions (individual and clumped red pine trees, snags, retain other tree species, protect large dead logs, protect intact patches of existing regeneration).
- Leave a variety of mature seed trees (average 10 sq ft basal area per acre) and scarify the soil using full-tree skidding during the harvest.
- Seed trees may be aggregated.
- Reserve fire adapted species.
- Reserve advanced regeneration in pockets.

Harvest Option #2: Use a **clear-cut with reserves of 10-15% approach**. When doing so:

- Red Pine reserves should be aggregated as larger skips.
- Reserves of other species may be distributed as aggregated, larger skips, scattered, or both, in a combination best emulating natural disturbance.
- Follow MFRC Forest Management Guidelines with multiple reserve species, forest legacies, and advanced regeneration pockets as appropriate to desired NPC class.

[1] The Diplodia infection thresholds outlined on page 2 are placeholders pending further interdisciplinary vetting of the appropriate percentage. This initial placeholder threshold is based on research outlined in the 2005 Minnesota DNR Forest Health Annual Report by Albers, J., Albers, M., and Gillmore D. On five sites with less than 10 percent of cones infected by Diplodia and over 20 understory red pines present, between 0 and 32 percent of understory red pines had shoot blight.

	Table 2. Harvest approaches for fire dependent woodland or forested NPCs containing NORP
#	**Approach, description and consequences**
1	**Seed Tree.** Use a seed tree approach to incorporate biological legacies (or "skips") into regeneration harvest prescriptions (individual and clumped red pine leave trees, snags, retaining other tree species, protect large dead logs, protect intact patches of existing regeneration). Leave a variety of mature seed trees (aggregated together if shoot blight is an issue in the site) and scarify the soil using full-tree skidding during the harvest. Reserve fire adapted species. Advanced regeneration is reserved in pockets. **Consequences:** • Residual seed trees and coarse woody debris mimic natural disturbance conditions. • Uneven dispersal will encourage variable density regeneration. • A variety of seed trees will encourage the regeneration of a diverse forest which is better able to resist climate change. • This approach may reduce potential economic return.
2	**Clearcut with 10 - 15% clumped reserves.** Follow MFRC forest management guidelines with multiple reserve species, forest legacies, and advanced regeneration pockets as appropriate to desired NPC class. Allow for a higher reserve percentage than described in MFRC guidelines. **Consequences:** Reserves of all NPC site appropriate species will encourage the opportunity for a diversity of natural recruitment. • Red Pine reserves should be aggregated as larger skips. • Reserves of other species may be distributed as aggregated, larger skips or scattered, or both, in a combination best emulating natural disturbance. • The approach creates open light conditions for optimum growth. • Reserves of red pine will come with the risk of shoot-blights into the next generation, but not reserving red pine will not meet the definition of natural origin red pine in the subsequent stand.

Site preparation

- Consider using prescribed fire when cost and site conditions permit.
- Use full tree skidding as much as possible. If inadequate scarification occurs as a result of full tree skidding, follow up with mechanical scarification.
    - Do not use broadcast herbicide for site prep or release. Instead, use lower-intensity scarification, hand release, and in some instances, targeted herbicide treatments to help protect non-competitive ground layer shrubs and herbaceous plants.

	Table 3. Site prep approaches for fire dependent woodland or forested NPCs containing NORP
#	**Approach, description and consequences**
1	**Full Tree Skidding (FTS).** Full tree skidding is completed by the logger during harvest operations. If this approach creates inadequate scarification, follow up with mechanical scarification. **Consequences:** • Preserves parts of the existing ground layer while providing light scarification.

	Table 3. Site prep approaches for fire dependent woodland or forested NPCs containing NORP
#	**Approach, description and consequences**
	• Loosens seed from cones as tops are dragged. • May not sufficiently reduce competition. • Does not enhance fire-dependent plant species. • Exposes the seed bed for additional natural seeding of pioneer species, and ensures adequate mineral soil exposure and competition removal. • Provides the potential ability to focus scarification efforts, including residual skips of the forest floor.
2	**Mechanical.** Mechanical scarification encourages bare mineral soil and reduces future competition. Mechanical methods should be chosen based on soil type and the desired level of scarification. **Consequences:** • May over-disturb the soil, creating rutting, un-natural micro-topography, and erosion. • Allows seed-banked species to take advantage of open conditions, where herbicide may eliminate the initial understory cohort. • Creates additional costs if FTS does not provide adequate seed bed. • Desired equipment may not be available in area. • Effectiveness depends on timing and availability of operators.

Regeneration

- **For FDc24, FDn33 and other <u>woodland</u> NPCs:**
    - Allow for a combination of regeneration including planting, artificial seeding and, as much as possible, natural seeding.
        - Vary planting density from 300-500 trees per acre across the site, with an average of 400 trees per acre. Planting density should not be uniform across the site.
        - Plant mixed tree species based on the NPC type.
        - Where regeneration is occurring after a clearcut treatment, avoid planting red pine within 2 chains (132 feet) of mature (overstory) red pine if there is low tolerance for slower growth and higher mortality. Instead, plant or seed mixed species appropriate for the NPC within 2 chains (132 feet) of mature (overstory) red pine.
        - Conduct artificial seeding the same year as planting.
        - Allow for natural seeding whenever possible.
    - If needed, use a mechanical approach (brush saw) to release trees from competition and/or reduce stocking levels to acceptable tpa and desired species mix.
    - Regeneration checks should occur more than 5 years after initial planting (longer than a typical plantation regeneration check).

- **For FDc34 and FDn43 and other <u>forested</u> NPCs:**
    - Allow for a combination of regeneration including planting, artificial seeding and, as much as possible, natural seeding.

- Vary planting density from 400-1,200 trees per acre across the site, with an average of 800 trees per acre. Planting density should not be uniform across the site.
- Plant mixed tree species based on the NPC type.
- Where the harvest treatment was a clearcut, avoid planting red pine within 2 chains (132 feet) of mature (overstory) red pine if there is a low tolerance for slower growth and higher mortality. Instead, plant or seed mixed species appropriate for the NPC within 2 chains (132 feet) of mature (overstory) red pine.
- Allow for natural seeding whenever possible.
- Conduct artificial seeding the same year as planting.

- Regeneration checks should occur more than 5 years after initial planting (longer than a typical plantation regeneration check).

	Table 4. Regeneration approaches for fire dependent woodland or forested NPCs containing NORP
#	**Approach, description and consequences**
1	**Combination: Seeding and Planting.** Use a combination seeding and planting strategy to regenerate the site. Use NPC type to determine planting/seeding density. Conduct variable density planting at 300-500 trees per acre (woodland NPCs including FDc24, FDn33) or 400-1,200 trees per acre (forested NPCs including FDc34, FDn43). Where a clear-cut harvest treatment was used, avoid planting red pine within 2 chains (132 feet) of mature (over story) red pine if there is low tolerance for slower growth and higher mortality. Instead, plant or seed mixed species appropriate for the NPC within 2 chains (132 feet) of mature (overstory) red pine. Allow for natural seeding, and conduct artificial seeding during the same year as planting. Any regeneration check should be longer than plantation- (>5 years). **Consequences** • Planting may include seedlings of multiple acceptable species. • Two chain (132 feet) rule may create desirable pockets of alternative species; alternative species should also be scattered throughout site. • Seeding will contribute to variably dense site, allowing for increased species and structural diversity. • Longer recruitment window ensures adequate seed years may be captured. • Climate change studies suggest that over-stocked sites are more susceptible to climate change stressors. • Lower density encourages open conditions allowing for all plants to flower more abundantly and recruit until canopy closure. • Season of harvest/site prep may affect seeding success. • Low-level planting plus seeding could provide a “fully stocked” site at initiation. • Higher planting costs. • Interplanting would be an additional cost.
2	**Natural Seeding.** Irregular density multi-species seeding. **Consequences:** • Provides seed across the site varying in density, survivability, and species mix. • May not provide the correct conditions for good germination or may get more germination than was expected. • Creates a multi-cohort site, similar to natural disturbance conditions.

	Table 4. Regeneration approaches for fire dependent woodland or forested NPCs containing NORP
#	**Approach, description and consequences**
	• Incurs no cost because of the natural seed source. • May need more time to become fully stocked site. • Risk of failure due to low germination rates and shoot blights.

Part 2. Management guidance for mesic hardwood NPCs containing NORP

Includes (but is not limited to) the following mesic hardwood NPCs:

- MHc26 (central dry-mesic oak-aspen forest)
- MHn44 (northern wet-mesic boreal hardwood-conifer forest)

Harvest

- Use MFRC guidelines reserving advanced regeneration and biological legacies or skips. Tolerate risk of Diplodia.
- Use a shelterwood harvest approach.

	Table 5. Harvest approaches for mesic hardwood NPCs containing NORP
#	**Approach, description and consequences**
1	**Shelterwood.** Follow MFRC forest management guidelines, reserving advanced regeneration, biological legacies. **Consequences:** • Residual canopy may help with initial drought stress. • Second entry may damage established seedlings. • Less initial harvest income is generated from this approach. • Higher risk than seed tree system of failure due to low germination rates and shoot blights. • Increased overhead and administrative costs associated with two entries.

Site preparation

- Consider using prescribed fire when cost and site conditions permit.
- Use full tree skidding as much as possible. If inadequate scarification occurs as a result of full tree skidding, follow up with mechanical scarification.
    - Use of broadcast herbicide is not recommended for site prep or release. Instead, use lower-intensity scarification, hand release, and in some instances, targeted herbicide treatments to help protect non-competitive ground layer shrubs and herbaceous plants.

	Table 6. Site prep approaches for mesic hardwood NPCs containing NORP
#	**Approach, description and consequences**
1	**Full Tree Skidding (FTS).** Full tree skidding is completed by the logger during harvest operations. If this approach creates inadequate scarification, follow up with mechanical scarification. **Consequences:** • Preserves parts of the existing ground layer while providing light scarification. • Loosens seed from cones as tops are dragged. • May not sufficiently reduce competition. • Does not enhance fire-dependent plant species. • Exposes the seed bed for additional natural seeding of pioneer species, and ensures adequate mineral soil exposure and competition removal. • Provides the potential ability to focus scarification efforts, including residual skips of the forest floor.
2	**Mechanical.** Mechanical scarification encourages bare mineral soil and reduces future competition. Mechanical methods should be chosen based on soil type and the desired level of scarification. **Consequences:** • May over-disturb the soil, creating rutting, un-natural micro-topography, and erosion. • Allows seed-banked species to take advantage of open conditions, where herbicide may eliminate the initial understory cohort. • Creates additional costs if FTS does not provide adequate seed bed. • Desired equipment may not be available in area. • Effectiveness depends on timing and availability of operators.

Regeneration

- Allow for a desirable combination of species, including red pine. Rely on natural seeding for regeneration as much as possible.
    - Regeneration checks should occur more than 5 years after initial planting (longer than a typical plantation regeneration check).

	Table 7. Regeneration approaches for mesic hardwood NPCs containing NORP
#	**Approach, description and consequences**
1	**Combination: Seeding and Planting.** Use a combination seeding and planting strategy to regenerate the site. Use NPC type to determine planting/seeding density. Conduct variable density planting at 300-500 trees per acre (woodland NPCs including FDc24, FDn33) or 400-1,200 trees per acre (forested NPCs including FDc34, FDn43). Where a clear-cut harvest treatment was used, avoid planting red pine within 2 chains (132 feet) of mature (over story) red pine. Allow for natural seeding, and conduct artificial seeding during the same year as planting. Any regeneration check should be longer than plantation- (>5 years). **Consequences:** • Planting may include seedlings of multiple acceptable species.

	Table 7. Regeneration approaches for mesic hardwood NPCs containing NORP
#	**Approach, description and consequences**
	• 2 chain (132 feet) rule may create desirable pockets of alternative species; alternative species should also be scattered throughout site. • Seeding will contribute to variably dense site, allowing for increased species and structural diversity. • Longer recruitment window ensures adequate seed years may be captured. • Climate change studies suggest that over-stocked sites are more susceptible to climate change stressors. • Lower density encourages open conditions allowing for all plants to flower more abundantly and recruit until canopy closure. • Season of harvest/site prep may affect seeding success. • Low-level planting plus seeding could provide a "fully stocked" site at initiation. • Higher planning costs. • Interplanting would be an additional cost.
2	**Natural Seeding.** Irregular density multi-species seeding. **Consequences:** • Provides seed across the site varying in density, survivability, and species mix. • May not provide the correct conditions for good germination or may get more germination than was expected. • Creates a multi-cohort site, similar to natural disturbance conditions. • Incurs no cost because of the natural seed source. • May need more time to become fully stocked site. • Risk of failure due to low germination rates and shoot blights.
	Release strategy. If needed, use a mechanical approach (brush saw) to release trees from competition and/or reduce stocking levels to acceptable tpa and desired species mix.

Natural Origin Red Pine Description

MN DNR identifies sites of natural origin red pine (NORP) during forest inventory sampling where the primary cover type is red pine and stand origin is determined to be from natural processes (where there is no evidence of artificial regeneration). The intent of a separate designation is to allow natural origin red pine sites to develop a more natural age class distribution, followed by a regeneration strategy that mimics the creation of a natural origin site.

The natural origin red pine resource on state-managed lands occurs on sites with a variety of physical conditions and native plant community classifications. The five most common NPC classes in which NORP occurs are: Central Dry-Mesic Pine-Hardwood Forest, Northern Dry-Mesic Mixed Woodland, Northern Mesic Mixed Forest, Central Dry-Mesic Oak-Aspen Forest, and Central Rich Dry Pine Woodland. NORP comprises 27% of the red pine resource on state-managed lands, 32.5% of the red pine cover-type located on school trust lands, and 29% of the red pine cover-type in high value conservation forests.

Because red pine occurs in many different native plant communities dependent upon different ecological conditions, the specific characteristics of NORP are highly variable. The potential for red pine to become the dominant cover type is not necessarily inherent in each of these NPC's; factors such as soils, moisture availability, disturbance, and seedbed conditions determine whether initial red pine establishment occurs as pure sites or as minor components in early successional communities. In addition, as a long-lived species, the dominance of red pine within a site frequently increases over time as the site develops (Almendinger, Silviculture Interpretations, 2018).

Natural origin red pine forest features that are often missing in pine plantations include the presence of dead and decadent standing trees, super-canopy legacy trees, large diameter coarse woody debris, variable diameter trees, greater species diversity, and canopy complexity. These features provide shelter and food opportunities that otherwise may be lacking in a homogenous forest. Natural origin red pine sites can have greater spatial and temporal complexity as they are typically initiated over a longer period of time. These sites would often be characterized as two or three cohort, mixed species sites.

Management considerations that informed policy development

The primary conservation concern when managing natural origin red pine sites relates to maintaining the characteristics that differentiate these sites from traditional, planted origin red pine sites:

- Natural origin red pine sites, like other native plant communities, should provide a range of ecological functions (which cannot as easily be maintained in non-natural systems).
- A natural origin red pine site should reflect outcomes created by natural disturbances over the course of site development. When assessing a site, evaluate for native biodiversity, structure, soil and water ecosystem processes, natural (or mimicked) disturbance processes, and capacity to withstand environmental stress. Management objectives should emphasize maintaining or enhancing these processes.
- These sites should encourage higher species diversity, greater spatial and structural complexity, high-quality NPC characteristics, saw-timber or other high-value forest products, and more legacy features compared to plantation style management.
- For more specifics look to the DNR Silvicultural Interpretations by NPC, and consult with ECS Program staff, Forest Wildlife Coordinators and Regional Ecologists about questions.
- Final harvest, site initiation, and intermediate treatment strategies must promote the maintenance or enhancement of the natural ecological processes found within natural origin sites (2016, MNDNR FAQ).
- Utilize local NPC information when developing silviculture prescriptions to include careful consideration of the inherent characteristics of the local native plant community. In some cases, this could require restoration of characteristics removed by previous management activities. Others will require prescription adjustments to align disturbance and regeneration with NPC natural history.
- Retain biological legacies (skips) through site development. Legacies include structural, compositional, and spatial patterns. Retain snags, decadent trees, and large diameter logs and debris. Special consideration should be given to current and potential cavity, mast, and nest trees. Coarse woody debris should be of varying sizes, including stem wood. Keep healthy live trees, super canopy trees, and advanced regeneration. Legacy patterns include patches of undisturbed vegetation, forest floor, and soils. Incorporate residual biological legacies based on the character of the local NPC and site objectives.
- Consider all methods of site preparation or competition control to determine the best opportunity to obtain a desired outcome. Intensity of forest floor disturbance should be appropriate to the regeneration strategy. Mechanical methods are highly preferable to broadcast herbicide site preparation. Fire should always be considered; it provides benefits that are difficult to impossible to mimic using traditional management methods. When using herbicide, employ localized spot spraying instead of broadcast application.
- Mimic a natural origin red pine site relevant to the local NPC in all entries throughout the site trajectory (e.g. thinning activities, release methods). Retain site complexity and species diversity. Employ variable density thinning to encourage stem and canopy complexity. Use prescribed fire to manage underbrush. Use longer recovery periods between entries. Expand the recruitment window to encourage a range of ages and sizes.
- The presence of shoot blights will be a limiting factor in management options. Consider alternative species rotation within the trajectory of the local NPC. Utilize management options for retaining legacy red pine (aka the 2 chain/132 feet rule).
- Stocking rates may be highly variable and may be dependent on native plant community. Natural origin red pine often recruited into sites over a long period of time. The Revised Manager's Handbook for red pine in the North Central Region identifies 400 – 800 trees per acre as suitable densities to achieve both

ecological and economic goals. A combination of variable low density planting (400 tpa) and seeding (natural or artificial) may reduce deer browse risk and provide sufficient stocking levels overtime.
- Climate change has implications for natural origin red pine. A reduction of tree population densities, independent of site age, reduces vulnerability to drought. Diverse structure and composition may enhance resistance or resilience to disturbances like introduced pests and climate change.

Next steps and additional needs

- Raise awareness of desired natural origin conditions through interdisciplinary field tours and case studies to showcase the desired future forest condition.
- Develop consistent methodology for tracking natural origin red pine in the forest inventory module of FORIST.

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